FACETS
a multidisciplinary open access science journal

RESEARCH ARTICLE

Undermining environmental assessment laws: post-assessment amendments for mines in British Columbia, Canada, and potential impacts on water resources

Ben R. Collison[a]*, Patrick A. Reid[a], Hannah Dvorski[a], Mauricio J. Lopez[a], Alana R. Westwood[a], and Nikki Skuce[b]

[a]School for Resource and Environmental Studies, Dalhousie University, Halifax, NS B3H 4R2, Canada; [b]Northern Confluence Initiative, Smithers, BC V0J 2N0, Canada

*b.collison@dal.ca

OPEN ACCESS

Citation: Collison BR, Reid PA, Dvorski H, Lopez MJ, Westwood AR, and Skuce N. 2022. Undermining environmental assessment laws: post-assessment amendments for mines in British Columbia, Canada, and potential impacts on water resources. FACETS 7: 611–638. doi:10.1139/facets-2021-0106

Handling Editor: Brett Favaro

Received: July 25, 2021

Accepted: February 7, 2022

Published: April 28, 2022

Published by: Canadian Science Publishing

Abstract

In British Columbia (BC), Canada, there is increased attention on mines and their impacts on water resources. In BC, many proposed mines undergo provincial environmental assessment (EA), which predicts a mine's risks and involves government oversight and public engagement. After approval, mines can apply for amendments that alter the project's undertakings, including in ways that may harm water resources. We examined all amendment documents for mines undergoing provincial EA in BC from 2002 to 2020. Of the 23 approved mines, 15 (65%) requested a total of 49 amendments, of which 98% were approved. Most mines applied for their first amendment within 3 years of approval. We deemed 20 of the approved amendments (associated with 10 projects) likely to have negative impacts on water resources, including changes to effluent discharge, increased volume of water extraction, or degradation of fish habitat. Amendment applications and approval documents lacked specific, quantitative information to reinforce claims or decisions. We present the first known summary of EA amendments in any jurisdiction. Given that most mines in BC receive amendments, and many are related to water, we express concern that amendment processes increase risk to water resources without meeting standards of evidence and public scrutiny required by the regular EA process.

Key words: environmental assessment, environmental impact assessment, project amendment, mining, water resources, British Columbia

Introduction

The mineral mining industry has a long history in British Columbia (BC), contributing to the current employment of almost 40 000 people and 2% of the province's workers (Statistics Canada 2021). BC is the third-ranking jurisdiction in Canada for mineral production value, with an estimated economic contribution of $9.7 billion CAD in 2018 (Natural Resources Canada 2019). The province asserts that economic prosperity relies on strong environmental regulations, as evidenced by government enactment and enforcement of environmental policies for the mining sector (Province of British Columbia 2017; Bennett 2021). However, environmental impacts still occur and, on occasion, are brought into focus by disasters like the Mount Polley tailings dam failure (Byrne et al. 2015). For

many in BC, including government and members of the public, adherence to environmental laws is seen as important protection of environmental resources such as freshwater (Schoenberger 2016; Pollon 2019; University of Victoria Environmental Law Centre 2019). Environmental assessment (EA) laws are one tool used to prevent, monitor, and manage impacts of mines on water resources. In Canada, these laws require proponents of mines to go through a public, highly transparent process of predicting the impacts of their projects on a suite of environmental, social, economic, and health values that includes freshwater (Beanlands and Duinker 1984; Impact Assessment Agency of Canada (IAAC) 2021). However, in some jurisdictions (including BC), after the assessment is completed, a proponent can apply for an amendment to their EA certificate. Amendments are extremely common and typically happen with little public scrutiny relative to the EA process. It is unknown if amendments to mining projects in BC may impact freshwater resources, with what frequency they occur, with what rigour they are analyzed by the regulator, and how often they are approved.

The province has an abundance of freshwater, supporting species such as salmon that are not only economically and ecologically important, but also of immense spiritual and cultural importance to Indigenous Peoples (Atlas et al. 2017; Atlas et al. 2020; Wood 2021a). Although access to clean water is required for the protection of the several treaties in BC that reference title rights related to drinking water issues (FNFC 2018), several First Nations reserves are still under long-term boiled water advisories (Ball 2018; Mike and Cheung 2019). There are also numerous recent cases in the news regarding impacts on water systems and aquatic species from mineral extraction in BC, especially pertaining to rampant selenium pollution (Linnitt 2018; Environment and Climate Change Canada (ECCC 2021); Weber 2021); approved permits for increased effluent discharge into fish-bearing rivers (Hosgood 2021; Lavoie 2021; Penner 2021); and decommissioned mines leaching wastewater into salmon watersheds with copper concentrations 250 times higher than the "safe for salmon" threshold (MiningWatch Canada 2021; Simmons 2021). The mining industry has contributed to declines of fish populations (Affandi and Ishak 2019; Cope 2020) with 62 out of 82 (76%) of Canadian mines assessed by ECCC (2017) indicating adverse effects on fish and fish habitat. Downstream risks have been noted across international boundaries, with communities in southeastern Alaska that are dependent on healthy salmon populations calling for stricter regulations, supervision, and enforcement of mining operations in Canada (Murkowski et al. 2019; Sexton et al. 2020). Furthermore, acid mine drainage is caused by mines exposing sulfite waste rock, which oxidizes with water and oxygen, forming sulfuric acid and dissolving heavy metals such as selenium, copper, and arsenic (Rezaie and Anderson 2020). These toxic mixtures can contaminate hydrologic systems and cause long-lasting environmental effects with adverse effects on aquatic life (Michalski 2011; Rambabu et al. 2020). While the impacts of acid rock drainage are often not felt immediately, the process can continue for hundreds to thousands of years until the sulphide minerals are fully consumed (Egiebor and Oni 2007; Olías and Nieto 2015; Earthworks 2019).

The relationship between mines and water resources was brought into public focus through what was termed by the media as the "Mount Polley Mine Disaster" (Meissner 2019; Hoekstra 2020; Simmons 2020). In August 2014, the tailings impoundment failure at the Mount Polley Gold and Copper Mine released approximately 25 million m^3 of water and slurry waste into nearby waterbodies over the course of three days (Byrne et al. 2015). The sheer volume of tailings released caused one creek channel to expand from 2 m to over 25 m, and increased water levels by 1.7 m (Byrne et al. 2015). The effects of this disaster were felt through the deterioration of freshwater systems, loss of wildlife habitat, and damage to culturally significant areas (Petticrew et al. 2015; Shandro et al. 2017; First Nations Health Authority (FNHA) 2016; Hamilton et al. 2020). The full extent of repercussions from the breach are still not fully realized but are expected to be felt for at least decades, if not centuries (Byrne et al. 2015; FNHA 2016).

The Mount Polley Mine, like other mineral extraction operations in BC, was subject to a legislated EA process. However, after investigation by the Auditor General of British Columbia, it was found that the Ministry of Energy and Mines did not ensure that the tailings dams were designed or operated in accordance with the approved initial plan, nor with its approved amendments to the original project certificate (Auditor General of British Columbia (AGBC) 2016). It is not known in this case whether the amendments to the project certificate played a significant role in the failure of the tailings dam. However, the identification of an amendment as a potential contributing factor by the Auditor General suggests that this amendment, and others like it, warrant further investigation. The purpose of most EA processes is to anticipate the impacts of proposed works on the environment (Beanlands and Duinker 1984; IAAC 2021), but if many projects are being amended after the EA process has concluded, the overall credibility of EA processes becomes threatened. Therefore, we assessed the frequency in which mining project EAs have been amended in BC under provincial EA law in relation to direct or indirect impacts on water resources.

The amendment process for environmental assessments in British Columbia

BC's first environmental assessment law, the *Environmental Assessment Act* RSBC 1996 c. 119 (henceforth EAA (1996)), came into force in 1996 and was substituted in 2002 with the *Environmental Assessment Act* SBC 2002 c. 43 (henceforth EAA (2002)). This law was subject to criticism for its lack of stringency, lack of clarity on post-certificate monitoring, and insufficient opportunities for public or Indigenous engagement, among other elements (Haddock 2010; Booth and Skelton 2011; Murray et al. 2018; Smith et al. 2018). It was replaced in 2018 by the *Environmental Assessment Act* SBC 2018 c. 51 (henceforth EAA (2018)), enacted in December of 2019 with new objectives for advancing reconciliation with First Nations, enhancing public confidence, and emphasizing sustainable project approvals (Province of British Columbia 2021a).

Under the EAA (2002), once a project completed the EA process and was approved, it received an EA certificate ("approval certificate") from the BC Environmental Assessment Office (BCEAO), allowing the proponent to commence project activities. However, after the EA process was completed, a certificate holder (e.g., the proponent) was eligible to apply for amendments requesting an addition or removal of conditions to or from the certificate. In these situations, an amendment application was prepared by the certificate holder stating the reasons for amending the certificate. The application was then sent to the BCEAO along with a prescribed fee which varied based on amendment type: simple ($2,000), typical ($10,000), or complex ($50,000) (BCEAO 2016a).

The degree of review for each type of amendment differed, where simple amendments such as name changes or certificate transfers did not involve engagement of the public, working groups, or Indigenous Peoples (BCEAO 2016a). A typical amendment was defined as a "material but limited change to the project", in which guidelines stated that public consultation may be required (BCEAO 2016a). A complex amendment was categorized as a "material change to the processes and outputs of a facility with potential for significant adverse effects", in which Indigenous and (or) public consultation was required (BCEAO 2016a). Once the amendment was submitted to the BCEAO, the executive director of the BCEAO and relevant Minister had three options: (1) amend the environmental assessment certificate, adding or removing certificate conditions; (2) refuse to amend the certificate and request further information for the amendment application to be resubmitted; or (3) refuse to amend the certificate entirely (BCEAO 2016a).

The proponent-requested amendment process remains the same under the EAA (2018), except with added conditions under ss. 32(7) and 32(8), where the chief EA officer must be satisfied that the certificate holder sought to achieve consensus with participating Indigenous nations prior to granting an

amendment. Additionally, ss. 32(5) gives the chief EA officer authority to independently make amendments if required following a mining project audit, mitigation effectiveness report, 5-year anniversary of the issued certificate, or other criteria (BCEAO 2020a). The fees payable to the BCEAO for requesting simple, typical, and complex amendments increased to $5,000, $25 000, and $100 000 respectively (BCEAO 2020a). The EAA (2002) and EAA (2018) do not specifically mandate public consultation periods or offer step-by-step guidance for the BCEAO to follow during the amendment assessment process.

Although the general EA process in BC is explained through public-facing websites, presentations, and videos (Ministry of Environment and Climate Change Strategy (MECCS) 2021; Province of British Columbia 2021b), and calls for public consultation for projects are clearly posted on the project registry (BCEAO 2021a), there are fewer public-facing explanations or details about the amendment process. It is unclear if amendments are subject to equivalent public, scientific, and legal scrutiny as the main EA process precedes the awarding of a certificate. There is no limit to the number of post-assessment amendments a proponent can apply for under either statute.

Concerns regarding a lack of transparency and controversial decision-making by the BCEAO have been raised for the BC EA process in the past (Cox 2018; Yaylaci et al. 2020) and because of the gap of public-facing information about certificate amendments, these concerns apply to the amendment process. To date, there has not been any study on the amendments to mining project certificates in BC. We ask, of the mines awarded a certificate between 2002 and 2020 under the EAA (1996), EAA (2002), or EAA (2018), (1) how many applied for amendments?; (2) how many of these were issued amendments, and how does the volume of issued amendments vary based on the time elapsed from mining project certificate approval or the political party in power?; (3) do granted amendments relate to water resources, and do they pose risks of harm?; (4) does the categorization of amendments as simple, typical, or complex by BCEAO actually correspond to the complexity of project changes proposed in the text of the amendment?

Methods

We consulted the BCEAO Project Information Centre (EPIC) website (BCEAO 2021a) for information about mines approved under the BC *EAA* in the last two decades. Within EPIC is a registry listing all projects reviewed under the BC EAA (2002) and EAA (2018) and their associated documentation. To determine the number of mines approved under these laws, we selected "Mines" from the "Project Type" filter from within the EPIC web interface. From the "EA Decision" filter, we selected "Certificate Issued (2002)" and "Certificate Issued (2018)". Our search returned mining projects which received their approval certificate between 1 January 2002 and 31 December 2020. All amendment applications that were submitted to the BCEAO prior to 31 December 2020 were included in the analysis, and the status of amendments with pending decisions at that time were updated in May of 2021.

Collection of quantitative and qualitative data

For each mining project that met this filter criteria, we visited the individual project's EPIC registry page and recorded information for our variables of interest (**Table 1**) in a Microsoft Excel spreadsheet.

For projects where presence of information about potential direct or indirect impacts of project amendments on water resources was identified, we recorded the date of the project's awarded EA certificate, the date on which an amendment application related to water resources was submitted, and the amendment's approval date (if approved). For each amendment deemed likely to impact water

Table 1. Variables of interest for determining the frequency of amendments to mining project certificates and their description.

Variable	Description
Project name	Title of mining project
Proponent	Institution, company, individual, or government applying for a certificate to develop the mining project
Amendment	Presence or absence of a record of an application for (or approval of) an amendment
Amendment category	Presence or absence of a BC Environmental Assessment Office categorization of the amendment type (simple, typical, complex, etc.) in accordance with the 'guidance for certificate holders' document (BCEAO 2016a)
Direct effects on water	Presence or absence of information suggesting water resources may potentially be directly impacted by adjustments to the project as specified in the amendment
Indirect effects on water	Presence or absence of information suggesting water resources may potentially be indirectly impacted by adjustments to the project as specified in the amendment
Date of issue	Date on which approval certificate was issued

resources we qualitatively categorized the potential effects. To ensure we identified valued components for water resources that conformed with existing BC regulations, we used key words and definitions from the BCEAO's 2020 Effects Assessment Policy (BCEAO 2020b):

- **Direct effect:** results of a cause-and-effect relationship between the project and a component of the biophysical or human environment.
- **Indirect effect:** a result from a change that a project may cause that is often one step removed (secondary) from a project's activities due to complex relationships among components.
- **Negative effect:** a result that is identified as undesirable by participants in the EA including Indigenous nations, government agencies, the technical advisory committee, any community advisory committee, the public, or the proponent involved in an EA process. Also referred to as an adverse effect.
- **Positive effect:** a result that is considered desirable or beneficial by participants in the EA including Indigenous nations, government agencies, the technical advisory committee, any community advisory committee, the public, or the proponent.

For the purposes and scope of this research paper, "components of the biophysical environment" in relation to studied direct or indirect effects was limited to water resources. Potential impacts to water resources were broken down into three categories: (1) surface water quality (e.g., effluent discharge, sedimentation), (2) surface water quantity (e.g., diversion, extraction, retainment), and (3) valued components (e.g., groundwater extraction, acid rock precipitation, fish and fish habitat) (Table 2).

One member of the research team read the full text of each amendment request and its related approval documents and recorded activities that included any physical act during construction, operation, and (or) decommissioning of the mine that may classify as a water use purpose under s. 2 of BC's Water Sustainability Act SBC 2014 c. 15. For each amendment, the authors consulted and summarized the long-form text describing activities that may have a potential impact on water. Some examples of activities impacting water that we encountered during examination of amendment documents included the following (refer to Table 3 for an exhaustive, project-specific list):

Table 2. Variable categories and descriptions for analysis of potential impacts to water resources by mining project amendments.

Variable	Description
Surface water quality	
Effluent discharge	The release of a substance into water that injures or is capable of injuring any life form, and/or damages or is capable of damaging the environment (Environmental Management Act SBC 2003 c. 53, ss. 1(1)).
Sedimentation	The release of total suspended solids into receiving waters at a higher-than-natural erosion rate (Clark et al. 2012).
Surface water quantity	
Diversion	To cause water to leave a stream channel, including, without limitation, a lake, pond, river, creek, spring, ravine, gulch, wetland or glacier, whether or not usually containing water, including ice, but does not include an aquifer, to flow into another stream channel, natural or human-made (Water Sustainability Act SBC 2014 c. 15, ss. 1(1)).
Extraction	To remove water from a stream, including, without limitation, a lake, pond, river, creek, spring, ravine, gulch, wetland or glacier, whether or not usually containing water, including ice, but does not include an aquifer (Water Sustainability Act SBC 2014 c. 15, ss. 1(1)).
Retainment	To impound or store water from a stream, including, without limitation, a lake, pond, river, creek, spring, ravine, gulch, wetland or glacier, whether or not usually containing water, including ice, but does not include an aquifer (Water Sustainability Act SBC 2014 c. 15, ss. 1(1)).
Valued components	
Groundwater extraction	To remove water from an aquifer or any other water source that naturally occurs below the surface of the ground (Water Sustainability Act SBC 2014 c. 15, ss. 1(1)).
Acid rock precipitation	The leaching of metals and generation of acid from mined rock materials that are exposed to the weathering effects of oxygen and water (Egiebor and Oni 2007).
Fish and fish habitat	Fish includes any part of fish, shellfish, crustaceans, marine mammals, and; the eggs, sperm, spawn, larvae, spat and juvenile stages of fish shellfish, crustaceans and marine animals. Fish habitat refers to any body of water frequented by fish and any area on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas (Fisheries Act RSC 1985 c. 14, ss. 2(1)).

- Diversion of or transfer between watercourses or aquifers (e.g., reroute of creeks)
- Disturbance to fish life, fish habitat, or vegetation (e.g., destruction of wetlands)
- Discharge of mining effluent into a waterbody, watercourse, or groundwater aquifer
- Extraction or storage of surface, groundwater, or snowmelt for mining or domestic purposes
- Surface stockpiling or sub-aqueous storing of acid-generating waste rock

We completed a qualitative assessment of the ease of the clarity of amendments that were deemed likely to affect water resources directly or indirectly. For each amendment document, one reviewer specifically looked for the inclusion of numerical information and specific predictions to reinforce claims or decisions made by proponents or the BCEAO. Where claims or decisions appeared to be made without robust justification (meaning one or more of the following: did not cite any completed scientific studies, did not include quantitative data or predictions, or lacked sufficient clarity to

Table 3. Application and approval dates for amendments with potential to impact water resources and their descriptions

Project name	Amendment number	Application date	Approval date	Description
Brucejack Gold Mine	1	30 December 2015	10 March 2016	Requesting for longer surface storage of acid waste rock due to previous storage dump failure.
	4	5 April 2016	31 March 2017	Requesting to extend above ground storage of acid waste rock by 2 years.
	5	11 April 2018	15 November 2018	Requesting to increase allowable effluent discharge concentrations of antimony, ammonia, and arsenic into Brucejack Creek, as they were being exceeded. Also requesting to allow for melting of snow and withdrawing of water from Bruce Jack Lake to support ore processing.
	7	8 September 2020	15 April 2021	Requesting adjustments to the road alignment and for access to quarry materials along the Brucejack Access Road. Predicted impacts on groundwater quantity and quality, surface water quality, fish and fish habitat.
Brule Mine	1	12 November 2008	24 August 2009	Requesting temporary hauling road for raw coal. Concerns raised by First Nations that it could affect sediment loading into the nearby watercourses.
Fording River Operations Swift	2	26 April 2016	24 August 2017	Requesting to allow acid waste rock spoils from Teck's Greenhills Operations to be deposited within the project boundary.
	3	6 June 2018	1 August 2018	Requesting to reroute a section of the 138 kV Britt Creek Spur transmission line along the Fording River and Fish Pond Creek; extend the certified project description boundary by 7 ha.
Kootenay West Mine	1	31 May 2018	15 October 2019	Requesting to divert a forest service road for transportation of gypsum, which could affect the water quality of the adjacent Kootenay River (risk of spilling of contaminants).
	2	3 April 2020	9 April 2020	Requesting the installation of three new culvert crossings along the Kootenay Forest Service Road.
Line Creek Operations Phase II	1	30 June 2014	15 December 2014	Requesting to expand mining production by adding a third open pit to the existing mining infrastructure.
Mt. Milligan Copper-Gold	3	5 December 2017	22 January 2018	Requesting emergency use of Esker and Phillips Lakes to meet water needs for project development.
	4	28 June 2018	31 August 2018	Requesting continued surface water extraction from sources with additional tailings storage facility groundwater extraction and well water use.
	5	18 October 2018	23 January 2019	Requesting in-water works for Meadows Creek road crossing to improve fish passage.
	6	24 January 2019	26 February 2019	Requesting further surface water extraction, water transportation infrastructure, and long-term groundwater withdrawals from nearby wells.
Murray River Coal	1	12 December 2017	23 March 2018	Requesting the relocation of M19A Creek Crossing, additional unsuitable material stockpiles, and realignment of water discharge pipeline.
Red Chris Porphyry Copper-Gold Mine	1	4 February 2012	28 February 2012	Requesting permission to build a power transmission line extension from Tatogga to Bob Quinn. Predicted impacts to aquatic life associated with water quantity, quality, and flow in Trail Creek.
	2	27 May 2016	19 August 2016	Requesting design changes in water management around the Tailings Impoundment Area and the South Dam.

(*continued*)

Table 3. (*concluded*)

Project name	Amendment number	Application date	Approval date	Description
Tulsequah Chief Mine	5	2 March 2012	19 October 2012	Requesting to alter the access road route. Predicted impacts to waterflow with the removal of water quality monitoring and removal of water sampling for sedimentation along river crossings.
Wolverine Coal Mine	1	3 June 2005	7 April 2006	Requesting to expand mining activities to increase overall production by 50%. Predicted changes to water quality and aquatic life due to an increased exposure rate of coal and overburden, and subsequent potential for increased metal leaching, particularly selenium, and acid rock drainage.
	7	7 January 2020	12 February 2021	Requesting to incorporate a third pit, ancillary infrastructure, coal hauling, and processing of Hermann coal at the Wolverine processing plant. Predicted changes in surface water quality due to release of parameters of potential concern from waste rock dumps, coal storage areas, and from the storage of tailings.

Note: Amendment descriptions have been significantly condensed into plain language for ease of readability. Please note that only project changes with potential impacts on water resources have been summarized and many amendments included other requested project changes not listed here. The full documents for proponent amendment applications and BC Environmental Assessment Office (BCEAO) assessments can be accessed on the BCEAO Project Information Centre website (BCEAO 2021a).

understand the claim), the reviewer recorded the appropriate document title, page number, and section of text. Then the reviewer brought forth these identified sections of text to the remainder of the data collection team which consisted of four individuals with post-secondary education, academic training in environmental impact assessment, and partial completion of a Master's degree. The team came to consensus as to whether each claim lacked robust justification and on what grounds. Each amendment application and assessment can be tens to hundreds of pages long, thus this analysis was only completed for amendments deemed to have potential to impact water resources and not all amendments.

All data analysis was conducted in Microsoft Excel for Microsoft 365 MSO. For each of the quantitative variables collected, we calculated descriptive statistics (frequency, range, maximum, minimum, mean, and median) for projects whose amendments indicated a potential direct or indirect impact on water quality or quantity. For each amendment deemed likely to impact water resources, we calculated the years elapsed between the amendment application, amendment approval, and the issue of its original EA certificate.

We also compared proposal and approval years for amendments to the political party in power at the time. BC's New Democratic Party (NDP) presents itself as a progressive left-leaning political party, whereas the BC Liberal party presents itself as more moderate on the political spectrum (The Canadian Encyclopedia 2017). Such variations in political agendas can result in diverse decision-making processes that may favour or disfavour resource extraction corporations (Plourde et al. 2017; Duval 2018). Historically in BC, the Liberal Party had a clear commitment to mining development (e.g., in 2011 the Liberal premier promised eight new mines and nine upgrades to existing mining operations within 4 years (CBC 2015)). The NDP–Green Party coalition also made several promises to the mining sector, including permanent tax credits, an easier *Mines Act* permitting process, and a mining jobs task force (Horgan 2017). Since both of these parties were in power over the time period, we plotted the number of amendments and their approval against the tenure of the majority party to visually examine for trends as they may have been more or less favourable to approving amendments based on political leaning. We also compared whether the duration of time

between application and approval differed based on which political party was in leadership in the provincial legislature.

Results

Mining project amendments potentially impact water resources

We found a total of 23 mines approved by the BCEAO, with each mine receiving an EA certificate (full list in Appendix A). Twenty-two of the 23 mines were approved under the EAA (2002), with only one mine being approved under the EAA (1996) and none issued a certificate under the EAA (2018). Of the 23 approved mines, 15 proponents applied for amendments to alter their original certificate (65%). Of these 15 projects, 14 received approval for one or more amendments. Ten projects received approvals for amendments we deemed likely to directly or indirectly impact water resources (**Fig. 1**).

The total number of amendment applications submitted by the 15 mining project proponents (including multiple applications for the same project) was 49. Amendment applications included certificate ownership transfers, certificate language or statement changes, and major or minor physical changes to the project itself. Of the 49 amendment applications filed, 48 were subsequently approved by the BCEAO, with 20 of those amendments resulting in project changes we deemed likely to have direct or indirect effects on water resources. Potential impacts to water resources varied across projects and were categorized based on likely negative effects to or from water-related variables by project (**Fig. 2**) with a brief description of each amendment (**Table 3**).

Temporal trends of amendment approvals

Of the 49 amendment applications submitted, all but one amendment was approved by the BCEAO. There were no amendments approved between 2002 and 2005, a varied level of amendment approval for mining projects between 2006 and 2015, and a spike in amendment approvals beginning in 2016 (**Fig. 3**).

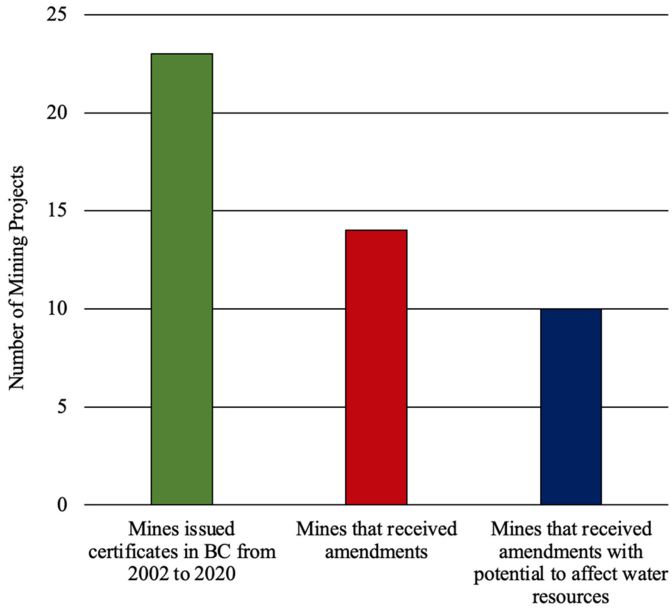

Fig. 1. Amendment analysis for approved mines in BC from 2002 to 2020.

Mining Project Name	Surface Water Quality		Surface Water Quantity			Valued Components		
	Effluent Discharge	Sedimentation	Diversion	Extraction	Retainment	Groundwater Extraction	Acid Rock Precipitation	Fish and Fish Habitat
Brucejack Gold Mine	●	○	●	●		●	●	●
Brule Mine		○	○					○
Fording River Operations Swift		●					●	○
Kootenay West Mine		○	○			●		○
Line Creek Operations Phase II							●	○
Mt. Milligan Copper-Gold			●	●	●	●		○
Murray River Coal Mine		○	○					○
Red Chris Porphyry Copper-Gold Mine	○	●	●	●		○		○
Tulsequah Chief Mine		●	○					●
Wolverine Coal Mine	●	○	◍	◍		●	●	○

● = Direct impact ○ = Indirect impact ◍ = Both direct and indirect impact

Fig. 2. Potential impacts on water quality, quantity, or valued components related to water associated with approved amendments to mining project certificates.

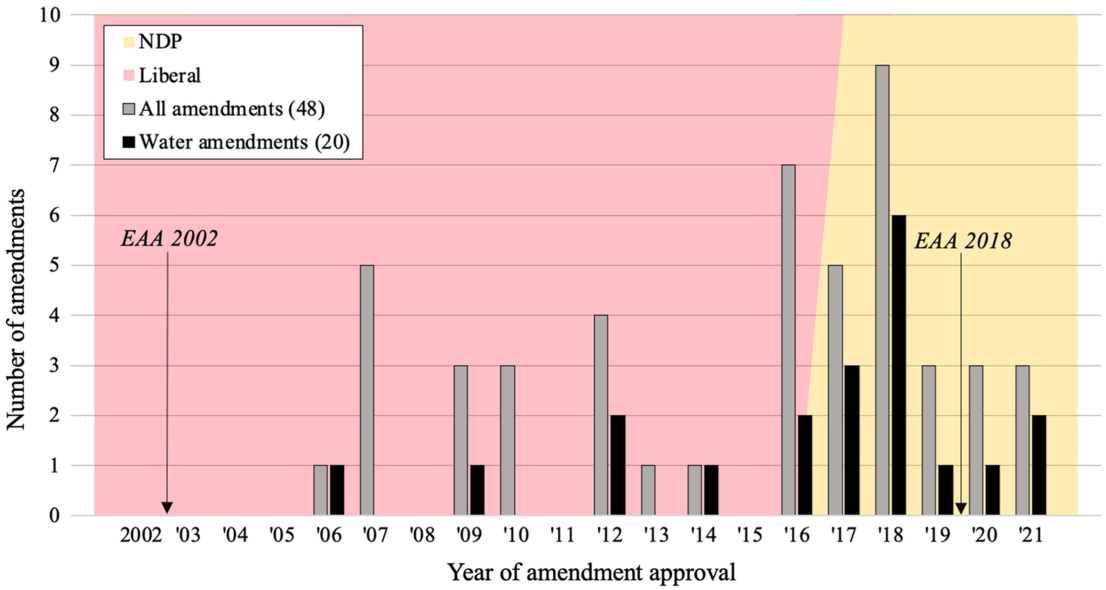

Fig. 3. Number of approved amendments for certificates issued for mines, by year and governing political party (Liberal or NDP).

Both the Liberal and NDP provincial political parties were in power over the course of our study period. The Liberal government was elected in 2001 and mandated decisions under the BCEAO under two different premiers until 2017, at which time the NDP once again gained control (The Canadian Encyclopedia 2017). During these shifts in power, the Liberals held power for roughly 16 years while the NDP held power for approximately 3 years. Over their tenures in office, 19 of the 23 mining

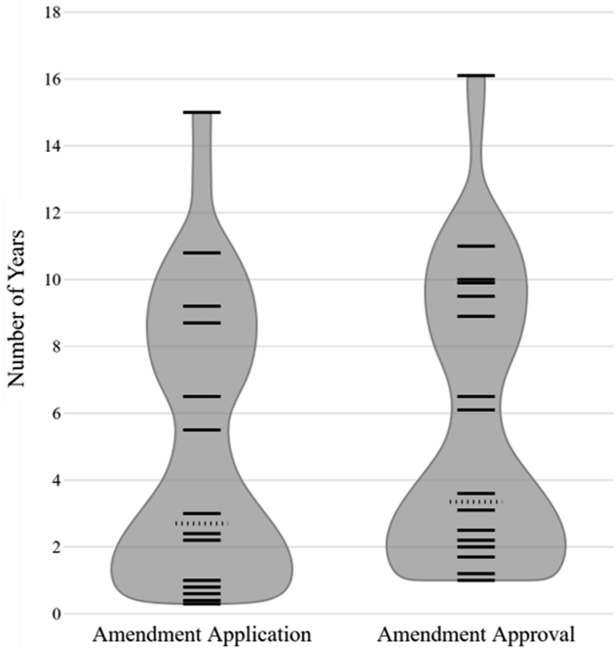

Fig. 4. Years elapsed between the date of a mine's EA certificate approval and each of its corresponding amendment applications (left) and amendment approvals (right). The chart area shows distribution of amendments compared to years since certificate approval, with each black line representing an individual amendment. The dotted line indicates median.

project certificates were approved under a Liberal government, whereas the remaining four were approved by the NDP. Twenty-five individual amendments were approved during the Liberal's 15-year governing tenure, whereas 23 amendments were approved during the NDP's 4-year governing tenure up to 2021. The BCEAO approved 42 amendments while the EAA (2002) was active, and 6 amendments after the enactment of the EAA (2018).

There were 10 mining projects that requested amendments with potential to impact water resources directly or indirectly, for a total of 20 unique amendments. Five (50%) of the mining projects applied for their first water-related amendment less than one year after being granted an EA certificate, with 50% of all water-related amendments being requested within three years of certificate approvals (median of 2.9 years; **Fig. 4**). The time between application and approval for each individual water-related amendment ranged from 6 to 502 days with a mean of 188 days. The number of water-related amendments per project varied from one to four (**Table 3**).

Levels of detail, use of language, and categorization of amendment documents

The use of language in project amendment documents was generally inconsistent, vague, and non-quantitative in nature. This trend was noted in both amendment applications from proponents and the subsequent BCEAO assessment reports of these applications. Both types of documents provided broad overviews of the criteria that were added, removed, or amended to the project certificates. Despite many of these documents being lengthy, there was a lack in numerical information or publicly accessible data used to reinforce claims and decisions made by proponents or the BCEAO (**Table 4**).

Table 4. Examples of level of detail or omission of quantitative information in amendment documents.

Variable	Exemplar	Source
Acid rock precipitation	"Ministry of Environment (ENV) confirmed that *despite the information lacking in the amendment application pertaining to short term incremental changes in water quality in the near field receiving environment* and proportional waste rock increases in the Swift/Cataract drainage, ENV agrees that the proposed amendment is *unlikely to negatively affect the receiving environment beyond what has already been assessed* … ENV noted that this comment is contingent on: the waste rock proposed to be deposited in the Swift Project already being accounted for in the Elk Valley Water Quality Plan modelling as indicated by Teck; the Fording River Operation South Active Water Treatment Facility being *operational on schedule*; and *water quality predictions not declining as a result of the model update*."	BCEAO (2017, p. 4)
Effluent discharge	"ENV is of the opinion that the *proposed increases in concentrations of antimony, ammonia and arsenic* will not negatively affect the aquatic resources in Brucejack Creek and the environment downstream."	BCEAO (2018a, p. 6)
Diversion	"ENV noted that there is *considerable uncertainty in the hydrologic analysis as no measured data are currently available to characterize flow* in the hillslope tributaries or in lower Trail Creek. [The proponent] *will finalize the specific design features of the east diversion* during the EMA permit amendment process and any residual concerns of ENV will be addressed at that time."	BCEAO (2016b, p. 6)
Fish and fish habitat	"The outcomes of the permitting process cannot be known at this time, and there is *residual uncertainty* around the ability to protect Lake Whitefish eggs given *information limitations*…"	BCEAO (2018b, p. 6)
Effluent discharge & Fish and fish habitat	"Impacts to fish and fish habitat may occur via changes in *loading of deleterious materials (i.e., dissolved metals, ions)* that effect aquatic productivity or fish survival. Toxic effects to aquatic biota that result from changes to surface and groundwater quality consider both *potential effects from mining* as well as haul truck accidents along the Kootenay FSR that lead to accidental spills of *contaminants*."	Vast Resource Solutions (2020, p. 3)
Effluent discharge	"While no exceedances of water quality guidelines are predicted for Beece Creek, a *number of elements are predicted to exceed guidelines* for the non-fish bearing Wasp Lake in the absence of mitigation. Continued pumping of water from the south embankment seepage collection pond to the tailings storage facility in closure *could be conducted if required* to avoid impacts on water quality in Wasp Lake."	Taseko Mines Limited (2017, p. 17)

Note: Specific phrases within the quoted text are italicized to emphasize sections that demonstrate a low level of detail or lack of quantitative information.

The categorization of amendments as simple, typical, or complex varied significantly in the process used by the BCEAO to assess each type of amendment, and their requirements for proponent applications of each type. A surprising finding was the use of "nonmaterial" in amendment categorization, an amendment type not explained in the amendment process guide (BCEAO 2016a) or defined in the EAA (2002) and EAA (2018). For example, amendment #1 for the Murray River Coal project was classified as a "nonmaterial amendment", yet there were six physical project changes that were amended to the certificate conditions including the addition of new stockpiles for unsuitable materials, the realignment of a water discharge pipeline, and the relocation of a creek crossing (BCEAO 2018c). Some of the reasons given to justify that this amendment was nonmaterial in nature were that the changes were "largely within the assessment footprint area", "no concerns [were] raised by First Nations groups regarding the proposed changes", and "potential adverse effects" were addressed in the original EA certificate approval (BCEAO 2018c). The word nonmaterial is defined as "not of a physical nature" (Merriam-Webster n.d.); therefore, it is unclear why this term would be used in amendment assessment documents that outlines physical changes to mining projects. The 48 approved amendments across 14 mining projects were classified by the BCEAO as: seven nonmaterial, 18 simple, 20 typical, one complex, and two unspecified (**Fig. 5**).

Mining Project Name	Amendment Category (BCEAO, 2016a)				
	Non-material	Simple	Typical	Complex	Un-specified
Brucejack Gold Mine	💧💧💧✓✓✓		💧		
Brule Mine		✓✓✓	💧		
Fording River Operations Swift			💧💧✓		
Kootenay West Mine		✓	💧💧		
Line Creek Operations Phase II			💧		
Mt. Milligan Copper-Gold		✓✓	💧💧💧💧✓		
Murray River Coal Mine	💧				
Red Chris Porphyry Copper-Gold Mine		✓✓	💧💧		
Tulsequah Chief Mine		✓✓	✓✓		💧
Wolverine Coal Mine		✓✓✓✓	✓	💧	💧
Galore Creek Copper-Gold-Silver		✓✓	✓		
Kemess Underground			✓		
Kitsault Mine		✓			
KSM Mine		✓			
Total	**7**	**18**	**20**	**1**	**2**

💧 = amendments with potential to impact water resources ✓ = non-water related amendments

Fig. 5. BCEAO categorization of all 48 approved amendments for mining projects issued certificates between 2002 and 2020, split by amendments with potential to impact water resources and non-water related amendments.

Discussion

We found that over 60% of mining projects issued certificates by the BCEAO between 2002 and 2020 subsequently received some form of amendment to their certificate after the conclusion of the EA process as per the relevant EAA statute. Of the mines that received amendments, 71% of them received amendments we expect would directly or indirectly affect water through physical changes to the project. The distribution of time elapsed between EA certificate and amendment application was similar to the distribution of time elapsed for amendment approval (Fig. 4). Although half of amendments with potential impacts on water resources took >250 days for approval, thus potentially allowing for a sufficient period for public comment or intervention, many were completed much more quickly (e.g., 6 days for approval of installation of three new culverts for Kootenay West; 28 days for Red Chris Gold-Copper to obtain permission to build a transmission line extension; 48 days for Mt. Milligan Copper to request additional use of water from Esker and Phillips Lakes to meet water needs for project development). Although public participation is a hallmark of the main EA processes, timelines are not prescribed for post-approval amendments, and it is unclear if they are sufficient to ensure public and expert input. Although the elapsed length of time between application and approval for amendments did not change based on which political party was in power, the NDP government approved more amendments than its Liberal predecessor. We also found that the amendment documents themselves lacked quantitative justification, used nonstandardized language between projects,

and commonly did not include enough scientific detail to sufficiently assess potential impacts on water resources.

It is the responsibility of the BCEAO to ensure that mines constructed within the province are designed, built, operated, and reclaimed to an acceptable standard (AGBC 2016). However, with over 60% of projects receiving amendments in the past 20 years, it may be difficult to ensure that the same environmental considerations are given in the amendment process as the initial project certificate assessment. These concerns may also translate to economic costs: while industry is responsible for the construction and maintenance of the sites indefinitely, if a project proponent becomes insolvent during a mine's operating life, taxpayers will bear the entire cost of the site's cleanup (Canada's Ecofiscal Commission (CEC) 2018; Berchtold et al. 2021). From 2010 to 2019, BC taxpayers were liable for more than $1.2 billion in environmental reclamation costs (Union of BC Indian Chiefs 2016), while total liability estimates grew to about $2.8 billion (Chief Inspector of Mines 2019). These costs are likely to continue, as the Auditor General of British Columbia (2016) predicted that 10% of all major mines in the province will require water treatment facilities in the future, with taxpayers faced with the brunt of the expenses.

The amendment that was not approved

The only amendment application that was not approved by the BCEAO within our research timeline was submitted over 10 years ago by the proponent, Taseko Mines Ltd. (BCEAO 2021b). The proposed Prosperity Gold-Copper Mine was a highly controversial project from the beginning (Lavoie 2019; Smith 2021). In 2007, the federal and provincial governments planned a joint EA review of the Prosperity project (Haddock 2012). However, after Taseko Mines' proposed Kemess North Gold-Copper project was rejected by a joint assessment in 2008, Taseko objected to another joint review panel (Haddock 2012). The BCEAO then proposed two separate EA reviews of the Prosperity Mine (Mehdic et al. 2020) and granted a project certificate to the Prosperity Mine in early 2010, signifying project approval. The BCEAO's approval has been accused of underestimating negative irreversible environmental impacts on water systems (Levy 2009; MacDonald et al. 2013; Selbie et al. 2013) and ignoring the strong opposition from the Tsilhqot'in Nation (Haddock 2012; Bhattacharyya 2013; Hamelin 2019; Lavoie 2019) whose "Aboriginal rights and title" (*Constitution Act, 1982*, s. 35) were affirmed in a 2014 landmark Supreme Court of Canada decision (Tsilhqot'in Nation *v*. British Columbia 2014 SCC 44, (2014) 2 S.C.R. 256).

Later in the same year, the Canadian Minister of the Environment rejected the project under federal EA law, stating that "the significant adverse environmental effects cannot be justified in the circumstances" (Canadian Environmental Assessment Registry Office 2010). Taseko Mines tried again three months later in 2011, and the project was federally rejected once again in 2014 due to potential for significant adverse effects (Aglukkaq 2014). Despite two federal environmental impact assessment rejections, the BCEAO continued to provide certificate extensions to this project over the course of 12 years until they allowed the certificate to finally expire on 14 January 2022, unofficially signifying the project's demise. (BCEAO 2021b; Smith 2021; Heyman 2022). To continue to extend the certificate, the province had to specifically add an regulation to the EAA (2018) (Exemption Regulation No. 2), as the EAA (2002) (ss. 18(4a)) and EAA (2018) (ss. 31(4a)) both state that certificates can only be extended once for a maximum of five years. Given that the only unapproved mining project amendment (of 49) is due to federal legal blockades (and that the province specifically introduced legal tools to allow it to potentially approve this amendment in future; Smith 2021), this brings into question whether or not rejection of amendments is a real option that would be utilized by BCEAO.

Mining project amendments potentially impact water resources

The sheer number of mining project amendments being approved undermines the stringency of the issued certificate as well as the amendment application and review process. As stated in both the EAA 2002 (ss. 37(3)) and EAA 2018 (ss. 56(3)), "any amendment made or condition attached to an environmental assessment certificate is conclusively deemed to be part of the certificate, whether contained in or attached to it or contained in a separate document". This living document characteristic to the certificate raises concerns that an original EA certificate can evolve throughout a project's lifespan, while carrying the risk of drifting away from the conditions initially set out in the certificate. We posit that if mining project proponents believe with certainty that any post-certificate amendment they put forth will be approved (as the evidence suggests), it may be rational for them to plan to enter the EA process with one project description and then submit substantial alterations to the project as amendments after the fact. If it is not the intention of proponents to put forward an initial EA certificate application with a simultaneous objective of making future amendments, the high rate of amendments still brings into question proponents' abilities to accurately predict uncertainties and project conditions.

Of the 48 total amendments across 14 mines, 42% showed potential for direct or indirect negative impacts on water. One example is at the Wolverine Coal Mine, where an amendment request (#1) sought permission to expand mining activities to increase overall production by 50% (Western Canadian Coal, 2005). Changes to water quality and aquatic life were predicted for the amendment request due to increased potential for metal leaching, particularly selenium, and acid rock drainage from increased overburden (Western Canadian Coal 2005). Permission was given at the same mine almost 15 years later through amendment #7, to incorporate an additional pit with predicted changes in surface water quality due to release of parameters of potential concern from waste rock dumps, coal storage areas, and from the storage of tailings (Conuma Coal Resources Limited 2019).

Another example, in the case of the Mt. Milligan Copper-Gold project certificate, the proponent held the following four water-use permits to operate their milling facility: surface water usage from King Richard Creek, use of direct precipitation onto the project area, water extraction from Meadows Creek water supply pond, and recycled tailings water from the tailings storage facility (TSF) (Stantec Consulting Ltd. 2020). Following a bathymetric survey of the TSF, the proponent determined that water volumes were critically low, forcing a shutdown of the milling facility. To address the issue, the proponent put forward their third amendment application to allow surface water withdrawals from the surrounding Phillip Lake and the Meadows Creek freshet. A year later in 2019, the project continued to experience water volume shortages, leading to further applications of amendments #4 through #6 to allow surface and ground water withdrawal for milling operations (Stantec Consulting Ltd. 2020). The proponent is currently conducting studies and investigations to find other viable water supply sources for the duration of the project. Clearly, the proponent did not accurately predict water shortage possibilities during the original EA certificate application, leading to multiple amendments requiring water extraction from the immediate environment. However, the use of high-quality science and monitoring in the EA process will be increasingly important with climate change impacts on water resources, which is already making future water supply data more difficult for engineers, hydrologists, and managers to predict (Milly et al. 2008).

Potential impacts of changes in government and legislation on approvals

Proponents have had the ability to request certificate amendments for the entire history of environmental assessment in BC (EAA 1996 (s. 12 and 13), EAA 2002 (s. 19), and EAA 2018 (s. 32)). However, it is unknown whether any explanation of the amendment process was publicly accessible prior to 2016, when the "Guidance for Certificate Holders" document was released (BCEAO 2016a). This document clearly stated the "EAO has considerable flexibility about the structure and design of the application review process", most often for typical amendments (BCEAO 2016a). Furthermore, the BCEAO did not usually provide the explicit categorization (simple, typical, complex, etc.) in amendment assessments that were completed prior to 2016. The authors relied on published fee orders ($2,000, $10,000, or $50,000) for proponents corresponding to each amendment as a way to categorize amendments. Two amendments (approved in 2005 and 2012) were not categorized by the BCEAO, did not have published fee orders, and did not have enough relevant information in the amendment application or assessment for to assign a category, thus were left as "unspecified" in the analysis (**Fig. 5**). Both of these amendments were deemed to have potential impacts on water resources and once again, demonstrated that particularly prior to 2016, the BCEAO did not have a transparent, repeatable process to follow for project amendments, resulting in considerable inconsistencies in assessment methodology. A more detailed guidance document was released in 2020 to incorporate the new conditions for amending a project certificate under the EAA 2018 (BCEAO 2020a).

Given that the BCEAO is a provincial government agency, it is important to consider the implications of exchanges in power between political parties. As the decision-maker responsible for assessing the social, environmental, and economic impacts of proposed projects prior to their development, it is possible that direction given to the agency will change based on the mandate of the government in power. We found a record for number of amendment approvals in 2018, with 9 approved amendments. Although there was an influx of requests (and subsequent approvals) during the tenure of the NDP–Green coalition government, this may not be due to political environment. As mentioned previously, the EAA (2018), which received assent on 27 November 2018 and was enacted on 16 December 2019 (Government of British Columbia 2020) introduced higher fees (i.e., $5,000, $25,000, or $100,000) and additional steps to the amendment process (ss. 32(7) and ss. 32(8)). Despite this increase, these administrative fees pale in comparison to the multi-billion-dollar annual revenue for many mining corporations (Johnston 2021). However, the new legislation required that the BCEAO must "be satisfied that the applicable person, board, tribunal or agency referred to in that subsection sought to achieve, with respect to the amendment, consensus with participating Indigenous nations" (BCEAO 2020a). This additional step may cost extra funds and time as well as engender political complexities. While the added legal conditions and increase in amendment fees are not conclusive evidence, they likely contributed towards an explanation for the spike in amendments applied for and approved between 2016 and 2018, directly before the EAA (2018) was enacted.

Levels of detail, use of language, and categorization of amendment documents

Some level of public participation is a hallmark of EA processes, with experts in EA calling for modern laws to include robust provisions for public participation as well as open data (Sinclair and Fitzpatrick 2002; Gibson et al. 2016; Westwood et al. 2019), and better public engagement has been a focus for Canada's recent revision of federal EA law (Expert Panel for the Review of Environmental Assessment Processes 2018; Government of Canada 2021).

Not only do amendments receive a less thorough and publicized review as EAs under BC's process for mining projects, but we also found that the dialogue in most amendment documents was generally vague and nonquantitative in nature. For example, an amendment was approved to allow greater above ground stockpiling of acid-generating waste rock at the Fording River – Swift Project, in which the Ministry of Environment offered a response that stated the "proposed amendment is unlikely to negatively affect the receiving environment beyond what has already been assessed [for the certificate]" (BCEAO 2017). However, the department cited that this statement was conditional on a water treatment facility being installed at the site "on schedule" and water quality predictions not declining as a result of this installation (BCEAO 2017). The specific information regarding when the water treatment plant was supposed to be installed was not provided in the amendment, and penalties associated with failure to abide by this condition were also not listed. Without all the relevant information in one place, it is difficult for even the informed reader to evaluate whether proposed mitigation measures will be sufficient to prevent serious environmental harm. This is especially true in a context of declining trust where mining companies have recently received serious fines for polluting the environment and harming species at risk and fish habitat, (Allen 2019; Environment and Climate Change Canada 2021; Hosgood 2021; Wood 2021b) while not complying with the conditions outlined in approved project amendments. Teck Resources' amendment application for the Swift Project was approved in 2017 with conditions that the water treatment facility be operational by 2018 (Teck Resources 2015); no facility was in operation as of May of 2021 (Teck Resources 2020).

A related concern is the inconsistency as to how amendment assessments were categorized as simple, typical, or complex. There were situations where amendments that caused relatively substantial physical changes to the project were categorized as "typical" instead of complex. For example, amendment #6 of the Wolverine Coal Mine was approved by the BCEAO (2020a), allowing the proponent to conduct "early works" such as land clearing, soil removal, and soil overburden storage in 34.6 ha of area outside of the original project area stated in the certificate. Amendment #6 was approved "in order to efficiently sequence future construction activities *in the event* that the Wolverine Mine amendment #7 is approved", (BCEAO 2020c) which was approved several months later (BCEAO 2021c). The approval of amendment #7 allowed the Wolverine Mine to expand, opening another pit for ore extraction, and install subsequent infrastructure with likely direct and indirect effects on water resources (BCEAO 2021c). Despite the BCEAO stating in the review that amendment #6's "early works" area would lie outside of the Wolverine project footprint and has the potential to result in adverse effects, it was categorized as a typical amendment instead of a complex amendment (BCEAO 2020c). For reference, a typical amendment is categorized by the BCEAO as a "material but limited change to the project" (BCEAO 2016a). Although working group sessions were held by BCEAO members and Indigenous participants, there was no public comment period held prior to the approval of amendment #6, which subsequently led to a significant mine expansion. It is particularly concerning that 13/20 (65%) of typical amendments with "material but limited" project changes, and 4/7 (57%) of nonmaterial (not of a physical nature) amendments, resulted in potential direct or indirect impacts on water resources. Most amendments potentially capable of harming public water resources were classified as "typical" by the BCEAO, in which public consultation only may be required, and there is "considerable flexibility" with how these are reviewed (BCEAO, 2016a). Furthermore, classifying only one amendment among 20 deemed likely to impact water as being "complex" may demonstrate leniency towards mining proponents and a lack of clear guidelines for amendment review processes with considerable variability for how amendments are categorized and subsequently assessed.

Limitations and recommendations for further research

Overall, our findings that the majority of mining projects granted a certificate by the BCEAO were later approved for amendments, and that many of these are deemed likely to have negative effects on water resources, are worrisome. We express concern that post-certificate amendments may have been used by proponents to bypass the regular EA process, whether intentionally or unintentionally, to add or change project elements in a way that receives less public or scientific scrutiny. Amendments for mining projects in BC may present a case of "path dependency" in environment decision-making where an initial certificate decision sets precedent for mines to expand.

In terms of immediate recommendations, we encourage the BC government to ensure that all documentation related to amendments is written in clear and enforceable language and that proponents are required to give detailed quantitative descriptions and predictions of proposed changes or activities in amendment applications. We also recommend that the BCEAO develop, publish, and enforce standardized definitions of amendment complexity. We echo the recommendation of the Auditor General of BC (2016) that calls for regulatory language that includes measurable criteria, such as thresholds and timing, to be implemented in all future mining permits and amendments. These elements would allow the public to more easily identify amendments with which they seek to intervene or request additional information.

Our scope was limited to evaluating the potential impacts of mining project amendments to water resources in BC. However, mines and other natural resource extraction projects can impact social, economic, health, and all other biophysical valued components. Our study should be repeated for other types of projects, other valued components, and in other jurisdictions to evaluate if this trend of frequent post-certificate amendments is specific to mining projects in BC or part of a larger pattern in EA laws in Canada and worldwide.

Conclusion

The EA process in BC, like many worldwide, is designed to mitigate environmental risk of resource developments, including mines. However, changes to project design and implementation occurring during post-certificate amendments pose additional threats to water resources that are not captured by the initial EA process. We found that most mines approved for construction in BC have received post-certificate amendments, and many of these were deemed to be potentially harmful to water resources. As 98% of amendments were approved, we express concern that the amendment process is being used by proponents (whether intentionally or unintentionally) as a "loophole" to evade the rigour and scrutiny of the regular EA process. At minimum, the high rate of amendment approvals points to a failure of accurate prediction of anticipated works during the EA process.

BC has recently enacted new EAA legislation, and its impact on the use of amendments for these purposes should be evaluated in the future. However, it is possible that the use of amendments to change project designs with reduced scrutiny is a trend that can influence other jurisdictions or project types and, more generally, it potentially threatens the integrity of EA laws. We have presented the first known case of the high prevalence of amendments in an EA as related to mining projects and impacts on water, but urge researchers to examine for evidence for a similar pattern in other project types and jurisdictions.

Land acknowledgement

The bulk of this work was done in relationship to Dalhousie University, which sits on unceded Mi'kmaq Territory. We, the authors, acknowledge the Peace and Friendship Treaties on these lands of Mi'kma'ki. We are all Treaty People.

Competing interests

The authors have declared that no competing interests exist.

Acknowledgements

We would like to sincerely thank the Wilburforce Foundation for supporting and funding the publication of this work. We also thank Chris Sergeant for a detailed review of an early draft, and Avelyn Taing for assistance in the creation of Fig. 4. We acknowledge the editorial team and our two anonymous peer reviewers for their contributions to improve this article.

Author contributions

BRC, PAR, HD, MJL, ARW, and NS conceived and designed the study. BRC, PAR, HD, and MJL performed the experiments/collected the data. BRC, PAR, HD, MJL, and ARW analyzed and interpreted the data. ARW and NS contributed resources. BRC, PAR, HD, and ARW drafted or revised the manuscript.

Data availability statement

All relevant data are within the paper.

References

Affandi FA, and Ishak MY. 2019. Impacts of suspended sediment and metal pollution from mining activities on riverine fish population—a review. Environmental Science and Pollution Research, 26(17): 16939–16951. PMID: 31028621 DOI: 10.1007/s11356-019-05137-7

Aglukkaq L. 2014. Decision statement issued under section 54 of the Canadian Environmental Assessment Act, 2012 [online]: Available from ceaa-acee.gc.ca/050/evaluations/document/98468.

Allen M. 2019. Court assesses $15,000 penalty in Banks Island Mine case, The Northern View [online]: Available from thenorthernview.com/news/court-assesses-15000-penalty-in-banks-island-mine-case/.

Atlas WI, Ban NC, Moore JW, Tuohy AM, Greening S, Reid AJ et al. 2020. Indigenous systems of management for culturally and ecologically resilient pacific salmon (*Oncorhynchus* spp.) fisheries. BioScience, 71(2): 186–204. PMID: 33613129 DOI: 10.1093/biosci/biaa144

Atlas WI, Housty WG, Béliveau A, DeRoy B, Callegari G, Reid M et al. 2017. Ancient fish weir technology for modern stewardship: lessons from community-based salmon monitoring. Ecosystem Health and Sustainability, 3(6): 1341284. DOI: 10.1080/20964129.2017.1341284

Auditor General of British Columbia [AGBC]. 2016. An audit of compliance and enforcement of the mining sector [online]: Available from bcauditor.com/pubs/2016/audit-compliance-and-enforcement-mining-sector.

Ball D. 2018. A B.C. reserve has been 17 years without safe drinking water. Many don't even have tap water. Toronto Star [online]: Available from thestar.com/vancouver/2018/08/09/a-bc-reserve-has-been-17-years-without-safe-drinking-water-many-dont-even-have-tap-water.html.

BCEAO. 2016b. Assessment of amendment application #2 for Red Chris Porphyry Copper-Gold Mine Project [online]: Available from projects.eao.gov.bc.ca/api/public/document/5886b3d5a4acd4014b81ff36/download/.

BCEAO. 2017. Assessment of amendment application #2 for Fording River operations – Swift Project [online]: Available from projects.eao.gov.bc.ca/api/public/document/599f5f6363560800193 83dbf/download/.

BCEAO. 2018a. Assessment of amendment application #5 for Brucejack Gold Mine [online]: Available from projects.eao.gov.bc.ca/api/public/document/5bedec677edef80024aa7c71/download/Brucejack_Amendment5_Assessment_Report_Final.pdf

BCEAO. 2018b. Assessment of amendment application #4 for Mt. Milligan Copper-Gold Project [online]: Available from projects.eao.gov.bc.ca/api/public/document/5b89a8853965330024d5469b/download/.

BCEAO. 2018c. Assessment of a request for non-material amendment #1 – Murray River Coal Project [online]: Available from projects.eao.gov.bc.ca/api/public/document/5ab572615741ad002458853a/download/.

BCEAO. 2020a. Environmental assessment certificate and exemption order amendment policy [online]: Available from www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/guidance-documents/2018-act/certificate_and_exemption_orders_amendment_policy_15dec2020_final.pdf.

BCEAO. 2020b. Effects assessment policy [online]: Available from www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/guidance-documents/2018-act/effects_assessment_policy_v1_-_april_2020.pdf.

BCEAO. 2020c. Assessment of amendment application #6 for Wolverine Coal Project [online]: Available from projects.eao.gov.bc.ca/api/public/document/5eb333035035f3001a198943/download/FINAL.

BCEAO. 2021a. Environmental Assessment Office Project Information Centre [online]: Available from projects.eao.gov.bc.ca/.

BCEAO. 2021b. The EAO's report on the review of an application for extension of an environmental assessment certificate – Prosperity Gold-Copper Project [online]: Available from projects.eao.gov.bc.ca/api/public/document/5fff5fded2876600219b0ed6/download/.

BCEAO. 2021c. EAO's assessment of an application for certificate amendment #7 – Wolverine-Hermann amendment [online]: Available from projects.eao.gov.bc.ca/api/public/document/60271e23df65a400201dcbbd/download/Wolverine_ARWithFig_Final_20210212.pdf.

Beanlands GE, and Duinker PN. 1984. Ecological framework for environmental impact assessment [online]: Available from researchgate.net/publication/236399538_An_Ecological_Framework_for_Environmental_Impact_Assessment_in_Canada.

Bennett N. 2021. British Columbia introduces mining innovation roadmap. Mining [online]: Available from mining.com/british-columbia-launches-mining-innovation-roadmap/.

Berchtold A, Skuce N, and Knox G. 2021. Dirty dozen 2021: B.C.'s top polluting and risky mines [online]: Available from reformbcmining.ca/wp-content/uploads/2021/05/BCMLR-Dirty-Dozen-2021-report-web.pdf.

Bhattacharyya J. 2013. Cultural and social-ecological significance of the region surrounding Teztan Biny (Fish Lake) to the Xeni Gwet'in and other Tsilhqot'in Nations [online]: Available from iaac-aeic.gc.ca/050/documents/p63928/91955E.pdf.

Booth AL, and Skelton NW. 2011. Improving First Nations' participation in environmental assessment processes: recommendations from the field. Impact Assessment and Project Appraisal, 29(1): 49–58. DOI: 10.3152/146155111X12913679730395

British Columbia Environmental Assessment Office [BCEAO]. 2016a. Seeking an amendment to an environmental assessment certificate – guidance for certificate holders [online]: Available from www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/guidance-documents/eao-guidance-certificate-holder-amendments.pdf.

Byrne P, Hudson-Edwards K, Macklin M, Brewer P, Bird G, and Williams R. 2015. The long-term environmental impacts of the Mount Polley mine tailings spill, British Columbia, Canada. EGU General Assembly Conference Abstracts: 6241. DOI: 10.1130/abs/2016AM-278498

Canada's Ecofiscal Commission [CEC]. 2018. Responsible risk: how putting a price on environmental risk makes disasters less likely [online]: Available from ecofiscal.ca/wp-content/uploads/2018/06/Ecofiscal-Commission-Risk-Pricing-Report-Responsible-Risk-July-11-2018.pdf.

Canadian Environmental Assessment Registry Office. 2010. Panel review decision of the Prosperity Gold-Copper Mine Project [online]: Available from ceaa-acee.gc.ca/050/evaluations/document/91222.

CBC. 2015. Mining and mineral exploration permits to get $6M boost from B.C. Premier Christy Clark. CBC News [online]: Available from cbc.ca/news/canada/british-columbia/mining-and-mineral-exploration-permits-to-get-6m-boost-from-b-c-premier-christy-clark-1.2932099.

Chief Inspector of Mines. 2019. Chief inspector of mines 2019 annual report [online]: Available from www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/health-and-safety/ci-annual-reports/112869_2019_ci_annual_rpt.pdf.

Clark J, Gibson A, Rex J, Moody A, and Orban J. 2012. Developing a mine erosion and sedimentation control plan guidance document for exploration, construction, operation and closure. British Columbia Mine Reclamation Symposium. DOI: 10.14288/1.0042618

Conuma Coal Resources Limited. 2019. Wolverine Coal Project environmental assessment certificate amendment application (EAC #M04-01). BCEAO EPIC [online]: Available from projects.eao.gov.bc.ca/api/public/document/5e17b4355f6fe400218f83ad/download/Woverine%20Amendment%206%20Application-%20Combined.pdf

Cope S. 2020. Upper Fording River westslope cutthroat trout population monitoring project report 2019. Report Prepared for Teck Coal Limited, Sparwood, BC. Westslope Fisheries Ltd., Cranbrook, BC. 48 p. teck.com/media/UFR_WCT_Monitor_Final_Report_April_9_2020.pdf.

Cox S. 2018. B.C. environmental assessment overhaul marred by deficiencies, scientists say. The Narwhal [online]: Available from thenarwhal.ca/b-c-environmental-assessment-overhaul-marred-by-deficiencies-scientists-say/.

Duval D. 2018. What's in store for BC miners with a new NDP government. Canadian Mining Journal [online]: Available from canadianminingjournal.com/features/store-bc-miners-new-ndp-government/.

Earthworks. 2019. Acid mine drainage [online]: Available from earthworks.org/issues/acid_mine_drainage/.

ECCC. 2021. Teck Coal Limited to pay $60 million under the Fisheries Act and must comply with a direction requiring pollution reduction measures [online]: Available from canada.ca/en/environment-climate-change/news/2021/03/teck-coal-limited-to-pay-60-million-under-the-fisheries-act-and-must-comply-with-a-direction-requiring-pollution-reduction-measures.html.

Egiebor NO, and Oni B. 2007. Acid rock drainage formation and treatment: a review. Asia-Pacific Journal of Chemical Engineering, 2(1): 47–62. DOI: 10.1002/apj.57

Environment and Climate Change Canada [ECCC]. 2017. Third national assessment of environmental effects monitoring data from metal mines [online]: Available from canada.ca/en/environment-climate-change/services/managing-pollution/publications/third-national-assessment-monitoring-data/chapter-6.html.

Environmental Assessment Act (EAA), RSBC 1996, c. 119. [online]: Available from bclaws.gov.bc.ca/civix/document/id/rs/rs/96119_01.

Environmental Assessment Act [EAA], SBC 2002, c. 43. [online]: Available from bclaws.gov.bc.ca/civix/document/id/consol14/consol14/00_02043_01.

Environmental Assessment Act [EAA], SBC 2018, c. 51. [online]: Available from bclaws.gov.bc.ca/civix/document/id/complete/statreg/18051.

Environmental Management Act, SBC 2003, c. 53. [online]: Available from bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_01.

Expert Panel for the Review of Environmental Assessment Processes. 2018. Building common ground: A new vision for impact assessment in Canada [online]: Available from canada.ca/en/services/environment/conservation/assessments/environmental-reviews/environmental-assessment-processes/building-common-ground.html#_Toc001.

First Nation Fisheries Council [FNFC]. 2018. Protecting water our way – First Nations fresh water governance in British Columbia [online]: Available from fnfisheriescouncil.ca/wp-content/uploads/2018/05/FNFC-Protecting-Water-Our-Way-Report_May-2018_FINAL-1.pdf.

First Nations Health Authority [FNHA]. 2016. Health impact assessment of the 2014 Mount Polley Mine tailings dam breach: Screening and scoping phase report [online]: Available from fnha.ca/Documents/FNHA-Mount-Polley-Mine-HIA-SSP-Report.pdf.

Fisheries Act, RSC, 1985, c. F-14. [online]: Available from laws-lois.justice.gc.ca/eng/acts/f-14/FullText.html.

Gibson RB, Doelle M, and Sinclair AJ. 2016. Fulfilling the promise: basic components of next generation environmental assessment. Journal of Environmental Law and Practice, 29: 257–283. ssrn.com/abstract=2670009.

Government of British Columbia. 2020. Source drinking water quality guidelines – British Columbia [online]: Available from www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/drinking-water-and-recreation/source_drinking_water_quality_guidelines_bcenv.pdf.

Government of Canada. 2021. Public participation in impact assessment [online]: Available from canada.ca/en/impact-assessment-agency/services/policy-guidance/public-participation-impact-assessment-fact-sheet.html.

Haddock M. 2012. Comparison of the British Columbia and federal environmental assessments for the Prosperity mine. [online]: Available from stopajaxmine.ca/files/documents/NWI_EAreport_July2011.pdf

Haddock M. 2010. Environmental assessment in British Columbia. Environmental Law Centre, University of Victoria. 84pp. [online]: Available from elc.uvic.ca/wordpress/wp-content/uploads/2014/08/ELC_EA-IN-BC_Nov2010.pdf.

Hamelin L. 2019. Tsilhqot'in Nation accuses the B.C. government of acting illegally, back in court to protect land. Aboriginal Peoples Television Network National News [online]: Available from aptnnews.ca/national-news/tsilhqotin-nation-accuses-the-b-c-government-of-acting-illegally-back-in-court-to-protect-land/.

Hamilton A, Laval B, Petticrew E, Albers S, Allchin M, Baldwin S, et al. 2020. Seasonal turbidity linked to physical dynamics in a deep lake following the catastrophic 2014 Mount Polley mine tailings spill. Water Resources Research, 56(8): e2019WR025790. DOI: 10.1029/2019WR025790

Heyman G. 2022. Letter to Taseko Mines Limited regarding joint request for extension to certificate for Prosperity Copper-Gold Project. [online]: Available from projects.eao.gov.bc.ca/api/public/document/61c2562343e3850023229bb2/download/385247%20-%20McDonald%20%26%20Dickson%20-%20SIGNED%20FINAL.pdf.

Hoekstra G. 2020. No environmental charges as 6th anniversary of Mt. Polley mine dam collapse looms. Prince George Citizen [online]: Available from princegeorgecitizen.com/local-news/no-environmental-charges-as-6th-anniversary-of-mt-polley-mine-dam-collapse-looms-3741058.

Horgan J. 2017. Mandate letter to Honourable Michelle Mungall. Province of British Columbia [online]: Available from: www2.gov.bc.ca/assets/gov/government/ministries-organizations/premier-cabinet-mlas/minister-letter/mungall-mandate.pdf.

Hosgood AF. 2021. Tŝilhqot'in launch challenge to Gibraltar Mine's effluent dumping in Fraser River. The Tyee [online]: Available from thetyee.ca/News/2021/03/15/Tsilhqotin-Launch-Challenge-Gibraltar-Mine/.

Impact Assessment Agency of Canada [IAAC]. 2021. Basics of environmental assessment under CEAA 2012 [online]: Available from canada.ca/en/impact-assessment-agency/services/environmental-assessments/basics-environmental-assessment.html.

Johnston M. 2021. 10 biggest Canadian mining companies. Investopedia [online]: Available from investopedia.com/articles/markets/082015/5-biggest-canadian-mining-companies.asp.

Lavoie J. 2019. This is not Canada': inside the Tsilhqot'in Nation's battle against Taseko Mines. The Narwhal [online]: Available from thenarwhal.ca/this-is-not-canada-inside-the-tsilhqotin-nations-battle-against-taseko-mines/.

Lavoie J. 2021. Tsilhqot'in Nation fights B.C.'s approval of Gibraltar mine's waste discharge into Fraser River. The Narwhal [online]: Available from thenarwhal.ca/tsilhqotin-gibraltar-mine-discharge-fraser-river/.

Levy D. 2009. Review of the prosperity mine aquatic impact assessment. MiningWatch Canada. 24 pp. [online]: Available from davidlevy.ca/LevyReviewOfProsperityAquaticImpactAssessment.pdf.

Linnitt C. 2018. For decades B.C. failed to address selenium pollution in the Elk Valley. Now no one knows how to stop it. The Narwhal [online]: Available from thenarwhal.ca/for-decades-b-c-failed-to-address-selenium-pollution-in-the-elk-valley-now-no-one-knows-how-to-stop-it/.

MacDonald DD, Schein A, Sinclair JA, and Stockner J. 2013. A review of the adequacy of baseline water quality data and mitigation of mining impacts in the vicinity of the New Prosperity Gold-Copper Mine Project, British Columbia. [online]: Available from iaac-aeic.gc.ca/050/documents/p63928/91297E.pdf.

Mehdic A, Gunton T, and Rutherford M. 2020. Assessing the role of subjective judgment and science in environmental impact assessment: implications and options for reform. Journal of Environmental Planning and Management, 63(10): 1771–1790. DOI: 10.1080/09640568.2019.1688650

Meissner D. 2019. Mount Polley mine disaster 5 years later; emotions, accountability unresolved. CBC News [online]: Available from cbc.ca/news/canada/british-columbia/mount-polley-mine-disaster-5-years-later-emotions-accountability-unresolved-1.5236160.

Merriam-Webster. n.d. Nonmaterial. Merriam-Webster dictionary [online]: Available from merriam-webster.com/dictionary/nonmaterial.

Michalski S. 2011. Coal-mining techniques and coal fires. Coal and Peat Fires: A Global Perspective, 1: 29–46. DOI: 10.1016/B978-0-444-52858-2.00002-5

Mike J, and Cheung C. 2019. The water crisis in First Nations communities: an election explainer. The Tyee [online]: Available from thetyee.ca/News/2019/10/17/First-Nations-Water-Crises-Explained/.

Milly PCD, Betancourt J, Falkenmark M, Hirsch RM, Kundzewicz ZW, Lettenmaier DP, and Stouffer RJ. 2008. Stationarity is dead: whither water management? Science, 319(5863): 573–574. PMID: 18239110 DOI: 10.1126/science.1151915

MiningWatch Canada. 2021. New map shows dozens of mine pollution threats in BC [online]: Available from miningwatch.ca/news/2021/1/19/new-map-shows-dozens-mine-pollution-threats-bc?

Ministry of Environment and Climate Change Strategy [MECCS]. 2021. 2018 Act – Environmental Assessment Process [online]: Available from www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/environmental-assessments/the-environmental-assessment-process/2018-act-environmental-assessment-process.

Murkowski L, Sullivan D, Crapo M, Risch J, Tester J, Danies S, et al. 2019. Multistate delegation letter to British Columbia Premier Horgan. [online]: Available from murkowski.senate.gov/download/multistate-delegation-letter-to-premier-horgan.

Murray CC, Wong J, Singh GG, Mach M, Lerner J, Ranieri B, et al. 2018. The insignificance of thresholds in environmental impact assessment: an illustrative case study in Canada. Environmental Management, 61(6): 1062–1071. PMID: 29556722 DOI: 10.1007/s00267-018-1025-6

Natural Resources Canada. 2019. Canadian mineral production [online]: Available from nrcan.gc.ca/science-data/science-research/earth-sciences/earth-sciences-resources/earth-sciences-federal-programs/canadian-mineral-production/17722.

Olías M, and Nieto JM. 2015. Background conditions and mining pollution throughout history in the Río Tinto (SW Spain). Environments, 2(4): 295–316. DOI: 10.3390/environments2030295

Penner D. 2021. Tsilhqot'in First Nation fights water discharge permit for Gibraltar mine. Vancouver Sun [online]: Available from vancouversun.com/news/local-news/tsilhqotin-first-nation-fights-water-discharge-permit-for-gibraltar-mine.

Petticrew EL, Albers SJ, Baldwin SA, Carmack EC, Déry SJ, Gantner N, et al. 2015. The impact of a catastrophic mine tailings impoundment spill into one of North America's largest fjord lakes: Quesnel Lake, British Columbia, Canada. Geophysical Research Letters, 42(9): 3347–3355. DOI: 10.1002/2015GL063345

Plourde F, Carman T, and Zeidler M. 2017. Millions in political donations prompt call for review of B.C. mining regulations. CBC News [online]: Available from cbc.ca/news/canada/british-columbia/millions-in-political-donations-prompt-call-for-review-of-b-c-mining-regulations-1.4058998.

Pollon C. 2019. 5B.C.'s 'archaic' mining laws urgently need update: 30 groups. The Narwhal [online]: Available from thenarwhal.ca/b-c-s-archaic-mining-laws-urgently-need-update-30-groups/.

Province of British Columbia. 2017. BC mining compliance and enforcement strategic plan. 8 pp. [online]: Available from www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/compliance-and-enforcement/bc_mines_compliance_and_enforcement_strategy_web.pdf.

Province of British Columbia. 2021a. Environmental assessment revitalization intentions paper. [online]: Available from www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/environmental-assessment-revitalization/documents/ea_revitalization_intentions_paper.pdf.

Province of British Columbia. 2021b. Environmental Assessments in British Columbia [Video]. YouTube [online]: Available from youtube.com/watch?v=NyWbf8XdP-s.

Rambabu K, Banat F, Pham QM, Ho SH, Ren NQ, and Show PL. 2020. Biological remediation of acid mine drainage: review of past trends and current outlook. Environmental Science and Ecotechnology, 2: 100024. DOI: 10.1016/j.ese.2020.100024

Rezaie B, and Anderson A. 2020. Sustainable resolutions for environmental threat of the acid mine drainage. Science of The Total Environment, 717: 137211. DOI: 10.1016/j.scitotenv.2020.137211

Schoenberger E. 2016. Environmentally sustainable mining: the case of tailings storage facilities. Resources Policy, 49: 119–128. DOI: 10.1016/j.resourpol.2016.04.009

Selbie DT, Bradford M, McIsaac E, and Joyce M. 2013. Sufficiency review of the draft lake productivity information submitted in relation to the new prosperity gold-copper mine project. Fisheries and Oceans Canada – Canadian Science Advisory Secretariat Science Response 2012/039 [online]: Available from waves-vagues.dfo-mpo.gc.ca/Library/40610238.pdf.

Sexton EK, Sergeant C, Moore J, Westwood A, Chambers D, McPhee M, et al. 2020. Canada's mines pose transboundary risks. Science, 368(6489): 376–377. PMID: 32327591 DOI: 10.1126/science.abb8819

Shandro J, Jokinen L, Stockwell A, Mazzei F, and Winkler MS. 2017. Risks and impacts to First Nation health and the Mount Polley mine tailings dam failure. International Journal of Indigenous Health, 12(2): 84–102. DOI: 10.18357/ijih122201717786

Simmons M. 2020. Six years after Mount Polley disaster, expert recommendations not fully implemented: report. The Narwhal [online]: Available from thenarwhal.ca/mount-polley-mine-expert-recommendations-not-implemented-report/.

Simmons M. 2021. B.C.'s 'dirty secret': more than 100 contaminated mine sites threaten water, wildlife and communities. The Narwhal [online]: Available from thenarwhal.ca/bc-mines-skeenawild-report/.

Sinclair AJ, and Fitzpatrick P. 2002. Provisions for more meaningful public participation still elusive in proposed Canadian EA bill. Impact Assessment and Project Appraisal, 20(3): 161–176. DOI: 10.3152/147154602781766636

Smith G. 2021. Update on Taseko's New Prosperity Proj . . . wait, that's still a thing?? [online]: Available from wcel.org/blog/update-tasekos-new-prosperity-proj-wait-thats-still-thing?utm_source=LEB.

Smith G, Johnston A, and Askew H. 2018. Why it's time to reform environmental assessment in British Columbia. West Coast Environmental Law Association. 24 pp. [online]: Available from wcel.org/publication/why-its-time-reform-environmental-assessment-in-british-columbia.

Stantec Consulting Ltd. 2020. Mt. Milligan Copper-Gold Project – amendment assessment for environmental assessment certificate #M09-01 [online]: Available from projects.eao.gov.bc.ca/api/public/document/5fc57d14701a99002145874d/download/rpt_milligan_EACamappl_medtermext_Master_20201127.pdf.

Statistics Canada. 2021. Labour statistics consistent with the System of National Accounts (SNA), by job category and industry [online]: Available from www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610048901&pickMembers%5B0%5D=1.11&pickMembers%5B1%5D=2.1&cubeTimeFrame.startYear=2018&cubeTimeFrame.endYear=2018&referencePeriods=20180101%2C20180101.

Taseko Mines Limited. 2017. Certified amendment description for an environmental assessment certificate amendment #1 of New Prosperity Gold-Copper Project [online]: Available from projects.eao.gov.bc.ca/api/public/document/5ba5481eaa05240024e-1844b/download/IR-EAO-014%20Certified%20Amendment%20Description.pdf.

Teck Resources. 2015. Elk Valley water quality plan [online]: Available from projects.eao.gov.bc.ca/api/public/document/58868f50e036fb01057680a2/download/.

Teck Resources. 2020. Water quality in the Elk Valley [online]: Available from teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/.

The Canadian Encyclopedia. 2017. Premiers of British Columbia [online]: Available from thecanadianencyclopedia.ca/en/article/premiers-of-british-columbia.

Union of B.C. Indian Chiefs. 2016. BC encouraging environmentally risky mining and creating massive taxpayer liability [online]: Available from ubcic.bc.ca/bc_riskymining.

University of Victoria Environmental Law Centre. 2019. A plan of action for change – Summary recommendations [online]: Available from reformbcmining.ca/wp-content/uploads/2019/05/BCMLR-Summary-Recommendations.pdf.

Vast Resource Solutions. 2020. Amendment request for Kootenay West Mine environmental assessment certificate M18-01 [online]: Available from projects.eao.gov.bc.ca/api/public/document/5e8cc52a665dfc0025012ed9/download/00KWM_CPD_Amendment2_Application_3April2020_FINAL.pdf.

Water Sustainability Act, SBC 2014, c. 15. [online]: Available from bclaws.gov.bc.ca/civix/document/id/complete/statreg/14015.

Weber B. 2021. Coal company Teck fined $60M for contaminating rivers in southeastern B.C.. The Canadian Press [online]: Available from cbc.ca/news/canada/british-columbia/teck-fined-60m-contaminating-bc-rivers-1.5965646.

Western Canadian Coal. 2005. Wolverine Coal Project: Wolverine EA certificate and mine permit amendments – 2.4 Mtpa, May 2005. BCEAO EPIC [online]: Available from projects.eao.gov.bc.ca/api/public/document/5886e221eed3c0016f856eaa/download/Text%20only%20of%20the%20Wolverine%20Application%20Amendment%20%20to%20EA%20Certificate%20M04-01.pdf

Westwood AR, Olszynski M, Fox CH, Ford AT, Jacob AL, Moore JW, and Palen WJ. 2019. The role of science in contemporary Canadian environmental decision-making: the example of environmental assessment. UBC Law Review, 52(1): 243–284.

Wood S. 2021a. Want to save B.C. salmon? Bring back Indigenous fishing systems, study says. The Narwhal [online]: Available from thenarwhal.ca/bc-salmon-fishing-indigenous-systems-report/.

Wood S. 2021b. B.C.'s Copper Mountain mine proposes major tailings pond expansion, sparking cross-border concern. The Narwhal [online]: Available from thenarwhal.ca/bc-copper-mountain-mine-tailings-pond/.

Yaylaci ED, Forner J, and Cohen J. 2020. Accountable mining: A risk assessment of the environmental assessment process, Canada national report. 85 pp. [online]: Available from static1.squarespace.com/static/5df7c3de2e4d3d3fce16c185/t/6026fce13e1e8-10766dbb34e/1613167849106/AccountableMining-CanadaNationalReport.pdf.

Appendix A

Table A1. BC mining projects with certificates issued between 2002 and 2020.

Project name	Proponent	Certificate issued date	EAA Legislation	Amendment (Y/N)	Amendment impacts water resources	
					Directly (Y/N)	Indirectly (Y/N)
Brucejack Gold Mine	Pretium Resources Inc.	26 March 2015	EAA (2002)	Y	Y	Y
Brule Mine	Conuma Coal Resources Ltd.	4 July 2006	EAA (2002)	Y	N	Y
Fording River Operations Swift	Teck Coal Ltd.	10 September 2015	EAA (2002)	Y	Y	Y
Galore Creek Copper-Gold-Silver	Galore Creek Mining Corp.	16 February 2007	EAA (2002)	Y	N	N
Kemess Underground	AuRico Metals Incorporated	13 March 2017	EAA (2002)	Y	N	N
Kitsault Mine	Avanti Kitsault Mine Ltd.	18 March 2013	EAA (2002)	Y	N	N
Kootenay West Mine	CertainTeed Mining Corp.	25 January 2018	EAA (2002)	Y	Y	Y
KSM	KSM Mining ULC	29 July 2014	EAA (2002)	Y	N	N
Line Creek Operations Phase II	Teck Coal Ltd.	25 September 2013	EAA (2002)	Y	Y	Y
Mt. Milligan Copper-Gold	Thompson Creek Metals Company	16 March 2009	EAA (2002)	Y	Y	Y
Murray River Coal	HD Mining International Ltd.	1 October 2015	EAA (2002)	Y	N	Y
Red Chris Porphyry Copper-Gold Mine	Newcrest Red Chris Mining Ltd.	24 August 2005	EAA (2002)	Y	N	Y
Tulsequah Chief Mine	Chieftain Metal Ltd.	12 December 2002	EAA (1996)	Y	Y	Y
Wolverine Coal Mine	Conuma Coal Resources Ltd.	14 January 2005	EAA (2002)	Y	Y	Y
Baldy Ridge Extension	Teck Coal Ltd.	19 September 2016	EAA (2002)	N	N	N
Blackwater Gold	BW Gold Inc.	21 June 2019	EAA (2002)	N	N	N
Burnco Aggregate	Burnco Rock Products Ltd.	18 March 2018	EAA (2002)	N	N	N
Giscome Quarry and Lime Plant	Graymont Western Canada Inc.	14 December 2016	EAA (2002)	N	N	N
Orca Sand and Gravel	Orca Sand and Gravel Ltd.	14 July 2005	EAA (2002)	N	N	N
Prosperity Gold-Copper	Taseko Mines Ltd.	14 January 2010	EAA (2002)	N	N	N
Red Mountain Underground Gold	IDM Mining Ltd.	5 October 2018	EAA (2002)	N	N	N
Roman Coal Mine	Peace River Coal Inc.	14 December 2012	EAA (2002)	N	N	N
Swamp Point Aggregate Mine	Ascot Resources Ltd.	21 June 2006	EAA (2002)	N	N	N

Note: EAA, Environmental Assessment Act; Y, yes; N, no.