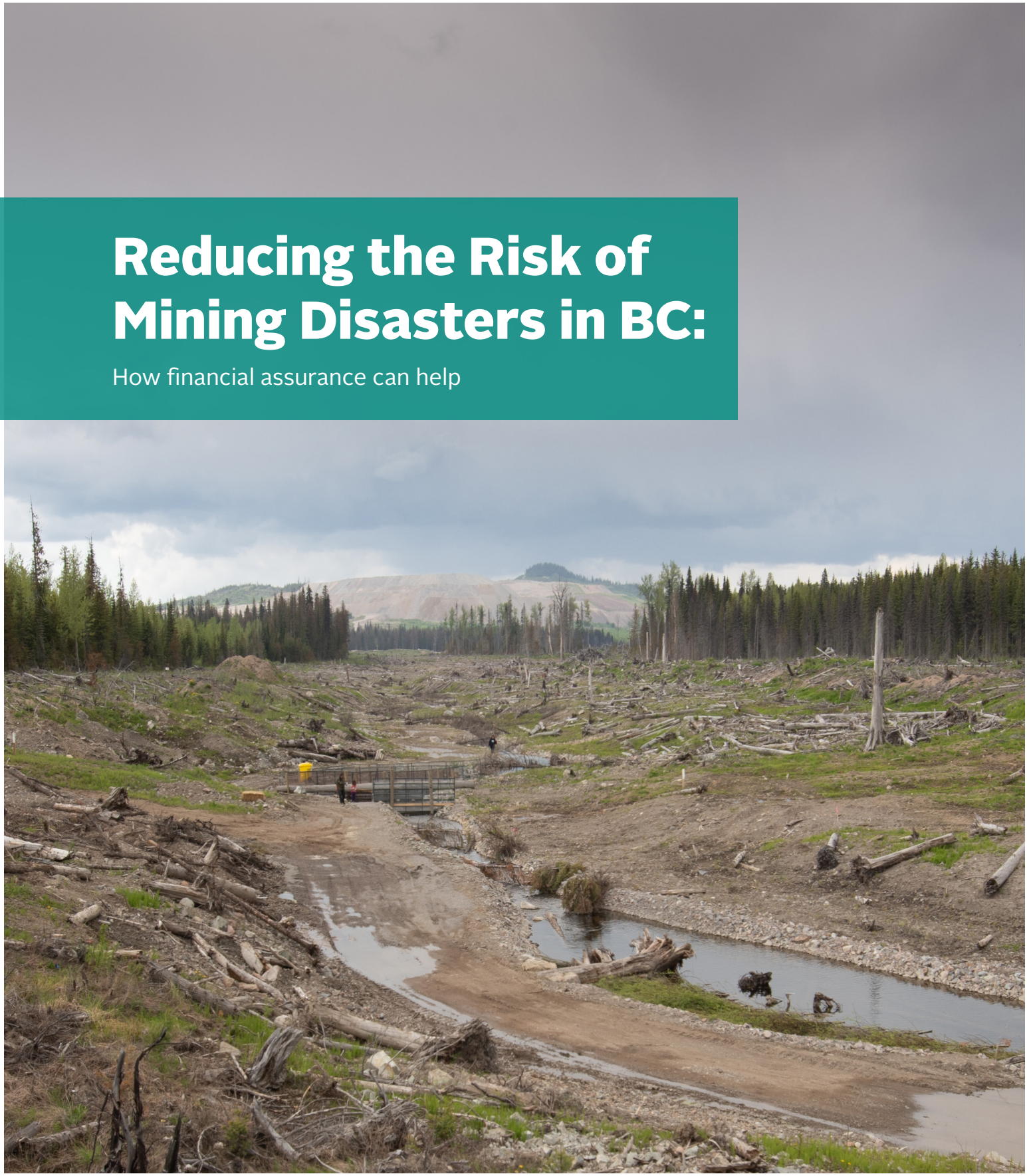
Reducing the Risk of Mining Disasters in BC:

How financial assurance can help



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BC First Nations Energy and Mining Council

Tailings spill at the Mount Polley copper and gold mine in British Columbia

First Nations Energy and Mining Council
1959 Marine Drive, North Vancouver,
B.C. V7P 3G1

For more information please contact us:
604.924.3844
info@fnemc.ca

Special thank you to author Jason Dion

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Summary

Mining has important economic benefits for British Columbia, but it also comes with environmental risks. This paper shows how smart policy and legal changes can reduce the risk of a future mining disaster in the province.

The risk of another mining disaster in British Columbia is real

- On August 4, 2014, a tailings dam ruptured at the Mount Polley copper and gold mine in Northern British Columbia, spilling its content into nearby lakes and rivers. It was one of the largest environmental disasters in British Columbia's history.
- While disasters like these are rare, they can and do happen. The Mount Polley expert review panel found that, absent policy change, British Columbia can expect two more tailings spills per decade going forward.
- There is no guarantee that the polluter would pay the costs of a future mining disaster in British Columbia. If the disaster bankrupted the responsible company, significant costs would fall to taxpayers.
- The risks and costs of mining disasters particularly affect British Columbia's Indigenous communities, who are often on the front line of dealing with a disaster, and experience the most significant impacts to their culture and way of life. First Nations are increasingly calling for change and even beginning to implement mining policies of their own.

Requiring "financial assurance" from mining companies can reduce the risk of disaster

- Legislated financial assurance requirements require companies to commit funds against their environmental risks. Instruments can include bonds, insurance, or industry funds.
- Financial assurance ensures that funds are available to pay for clean-up regardless of whether a company goes bankrupt. They give companies a direct economic incentive to reduce their operations' risk of disaster. And they keep costs to companies low by leveraging market forces.
- No financial assurance is required against the risk of mining disasters in British Columbia. While this is not uncommon across Canadian provinces, it is very uncommon in other sectors that pose a risk of environmental disaster, such as offshore drilling, nuclear energy, and pipelines.

RECOMMENDATIONS FOR BRITISH COLUMBIA

Strong legislated financial assurance requirements can help British Columbia reduce the risk of mining disasters while still ensuring a thriving mining sector in the province.

Main recommendation

British Columbia should require hard financial assurance against the risk of mining disasters. Current policy does not adequately protect communities and taxpayers from costs and exacerbates the risk of another mining disaster. British Columbia should close its current policy gap through legislative and regulatory change.

Supporting Recommendations

- British Columbia should implement a "tiered" financial assurance scheme. Tiered schemes combine different financial assurance instruments under a system of successive coverage tiers. In lower tiers, company-level requirements provide a direct incentive to reduce disaster risk. In higher tiers, risk-pooling instruments protect the public from costs while keeping costs to the sector manageable.

- British Columbia should broaden the risk pool in a tiered system's higher tiers. Pooling risk with other sectors that pose a risk of disaster can both better protect the public and reduce costs to companies. Alternatively, the province can pursue pooling mining disaster risk with other Canadian provinces. To uphold British Columbia's commitment to the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), the governance body for this risk pooling instrument should include representation from Indigenous communities.

Contents

1 Introduction

In August 2014, Imperial Metals' Mount Polley copper and gold mine was the site of one of the largest environmental disasters in British Columbia's history. The tailings dam at the mine ruptured, sending 24 million cubic meters of tailings into Polley Lake, Hazeltine Creek, Quesnel Lake, and the Cariboo River. The spill had a significant impact on the region's physical landscape, depositing sediment layers as thick as 10 metres in Quesnel Lake, altering river flows, and destroying habitat. The tailings contained arsenic, selenium and heavy metals which damaged local ecosystems and affected nearby communities' water supplies (Byrne et al., 2015; Kennedy et al., 2016; Nikl et al., 2016).

Mining disasters like the Mount Polley tailings spill are uncommon. But they can and do happen. Brazil has since suffered two major mine tailings spills. In November 2015, the Fundão tailings dam collapsed at the Samarco iron mine, killing 19 (do Carmo et al., 2017). And just this January, a tailings dam failure at the Córrego do Feijão iron ore mine killed 240 in what has been called Brazil's worst-ever environmental disaster. There is significant risk that mine tailings will spill again in British Columbia (Bowker & Chambers, 2017). The Mount Polley expert review panel found that absent change, British Columbia can expect to suffer two tailings spill per decade going forward (Independent Expert Engineering Investigation and Review Panel, 2016).

These kinds of risks affect all British Columbians. But they particularly affect the province's Indigenous peoples on whose lands and territories these projects are often built (Hipwell et al., 2002; Docherty et al., 2010). Indigenous communities rely on healthy ecosystems for sustenance and cultural uses. And they have deep spiritual connections to the land, water and wildlife that mining disasters can damage. Their exercise of rights and title includes access to land and resources for food, social a nd ceremonial purposes; therefore, it is important that mining occur with the consent of the province's Indigenous communities—consistent with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (United Nations, 2007).

Figure 1:
Tailings spill at the Mount Polley copper and gold mine in B.C.

Indigenous communities in British Columbia want to see mining's environmental risks managed responsibly and are increasingly calling for policy change.
In many cases, they are starting to institute mining policies of their own (Zimmerling, 2016). The Taku River Tlingit First Nation's mining policy provides a notable example of a nation with a comprehensive mining policy framework which lays out the conditions under which it will and will not consent to mining projects on its lands (Taku River Tlingit First Nation, 2007). [1] These types of policies are especially relevant given the legal advances that have been established as a result of court cases (many out of BC, such as the Supreme Court of Canada's 2014 Tsilhqot'in Nation ruling) that give nations title over their traditional land. Both court decisions confirming the requirement of good faith engagement with Indigenous peoples and British Columbia's commitment to UNDRIP mean that Indigenous calls for mining law change in the province must be addressed in a manner that is consistent with advancing reconciliation and that recognizes Indigenous governance and values.[2]

[1] The Northern Secwepemc te Qelmucw's Mining Policy provides another example (Northern Secwepemc te Qelmucw Leadership Council, 2014).
[2] In its 2019 throne speech, the British Columbia said that it will implement UNDRIP through legislation and bring provincial laws and policies into harmony with it (Curpen et al., 2019).

In this report, we focus on the role "financial assurance" can play in managing the risk of mining disasters. Financial assurance policies require companies to commit funds against the risk of a disaster such as a tailings spill. Financial assurance is a powerful tool for policy-makers: it protects communities and taxpayers by ensuring that funds are available for cleanup and compensation; it makes disasters less likely by giving mining companies a direct economic incentive to reduce their environmental risk; and it does so cost-effectively by harnessing market forces (Ben-Shahar & Logue, 2012; Mackie, 2014; Faure, 2016).

This report is organized as follows. Section 2 outlines the risk of environmental disaster in the mining sector and the role financial assurance can play. Section 3 describes British Columbia's financial assurance policy regime. Section 4 presents the concept of "tiered" financial assurance schemes. Section 5 discusses how a tiered scheme could be extended beyond the mining sector, and why it might make sense to do so. Finally, Section 6 offers conclusions and recommendations.

2 Using financial assurance to manage the risk of mining disasters

Mining pollution occurs when the by-products from mining or mineral processing flow offsite. It is a regular occurrence that is often anticipated and permitted. In contrast, a mining disaster is an unauthorized, unanticipated event which leads to severe, even catastrophic environmental consequences. In some cases, disasters may be the result of sudden, one-time events, as was the case with the Mount Polley tailings spill. Or they may occur more gradually. Leaching and groundwater contamination, for example, can lead to environmental damage that accumulates slowly over time (Gorton et al., 2010; Kossoff et al., 2014; Akcil & Koldas, 2006; UNEP, 2017).

A substance called acid mine drainage (AMD) is of particular concern. When mining wastes that contain sulfur come into contact with both water and air, they can oxidize and turn highly acidic, creating AMD. If water contaminated with AMD flows offsite, it can cause significant environmental damage. Once AMD forms at a mine, it becomes a perpetual risk to the surrounding environment, so avoiding it through proper site management is essential (Hoffert, 1947; Akcil & Koldas, 2006).

Tailings—a type of mining waste—also present significant disaster risk. Tailings are a mix of waste rock, soil, water, and other materials such as heavy metals. Different types of mine produce different types of tailings, so their composition and toxicity can vary widely (Fourie, 2009). A single mine can generate millions of tonnes of tailings over its lifetime. Because treating or transporting them tends to be difficult or costly, they are often stored onsite indefinitely in ponds or dams. **Contamination from mine tailings can lead to severe environmental consequences.** Proper management and monitoring of tailings storage facilities is essential to avoiding accidental releases (Kossoff et al, 2014; UNEP, 2017).

In this report, we focus on unauthorized releases of tailings or AMD that lead to severe environmental damage. Controlled, authorized releases of mine wastes are not the subject of this report; nor are historical disasters that have already occurred.[3]

Figure 2: Acid Mine Drainage

[3] We also focus only on disasters that occur during a mine's operating life, rather than those that occur after a mine site has been relinquished. For an examination of environmental risks related to mine remediation and relinquishment in British Columbia and how financial assurance can deal with them, see Dion (2019).

Broadly speaking, governments have three different tools they can use to address the risk of mining disasters:

- ***Regulations***: They can craft rules and requirements that firms adopt particular technologies or practices (or bar them), as well as issue fines or penalties to ensure regulatory compliance.
- ***Liability rules:*** They can enact legislation that clearly establishes firms' legal liability for a mining disaster and its economic and environmental consequences.
- ***Financial assurance:*** They can require firms to commit funds against the risk of a disaster.

Each of these tools has a role to play—they act as complements to each other, rather than as substitutes. When they are applied in a coordinated way, they can help manage risk more effectively and at lower cost than approaches that rely on only a subset of them. However, in this report, we focus on the role that financial assurance can play.

Figure 3: Lac Megantic train derailment in 2013

2.1 Financial assurance's role as a policy tool

Financial assurance backstops a jurisdiction's liability rules. It ensures that when a company causes a mining disaster, funds are available to cover the costs that it is liable for—even if the company goes bankrupt. [4]

This was not the case with the Mount Polley disaster—the owner of the mine, Imperial Metals, is still in business. [5] Following the disaster, the government had a company it could recover clean-up costs from and issue cleanup orders to. [6] But this was not guaranteed. Had Imperial Metals been bankrupted by the spill, it would not necessarily have borne the costs of cleanup. Instead, it would only have borne costs to the extent its remaining assets were sufficient to cover them. Any costs over and above this would have been borne by British Columbia's taxpayers.

An environmental disaster resulting in company bankruptcy and costs to taxpayers is not a hypothetical scenario. The Lac-Megantic train derailment provides an important example. In July 2013, a train carrying crude oil derailed in Lac-Megantic, Quebec. The resulting explosion killed 47 and much of the oil spilled into local waterways and soil. The disaster bankrupted the train's operator, the Montreal, Maine and Atlantic Railway company. While the company held $25 million in liability insurance, the disaster's total costs have been estimated at over $1 billion. A settlement fund created by a number of other companies implicated in the disaster has helped cover some of these costs, but only those relating to personal injury and property damage. The majority of the derailment's environmental costs are being borne by Quebec citizens. This underscores the risks that a future mining disaster could pose to British Columbia's taxpayers (de Santiago-Martín et al., 2015; Bernstein Shur, 2015).

[4] In this sense, it is only as powerful as a jurisdiction's liability rules. This is a key reason financial assurance acts as a complement to liability rules, rather than a substitute for them.

[5] There are, however, questions about whether it will remain solvent (Wilt, 2018).

[6] Critically, the fact that Imperial Metals has undertaken remediation work does not mean that the area has been fully reclaimed or that there are no remaining environmental risks. It also does not mean that it has borne the full costs of the disaster. Some environmental damage is likely to be irreversible, and some affected communities have likely suffered costs which they have not been compensated for. There are currently three civil cases before British Columbia courts asserting uncompensated damages, all of them brought forward by First Nations: Members of the Tl'esqox (Toosey Indian Band) v Amec Foster Wheeler Americas Limited – Amec Foster Wheeler Ameriques Limited; St'at'imc Chiefs Council on Behalf of the St'at'imc v Mount Polley Mining Corporation; and Louie, Chief v Mount Polley Mining Corporation.

The possibility of a firm going bankrupt following an environmental disaster does not only present financial risks—it also exacerbates the risk of disaster occurring in the first place. When a company knows that it may not bear the cost of damage arising from its actions, it has less incentive to reduce the likelihood or severity of that damage. Economists call this problem "moral hazard." [7] In the context of the mining sector, if a company knows it would be bankrupted by a potential disaster and therefore not bear its costs, the cost-benefit calculus of investments that would reduce the risk of that disaster get distorted. Because the benefits of these investments would end up shared by society and the company, companies have less incentive to invest in them. In this way, the moral hazard that the possibility of bankruptcy creates can make mining disasters more likely. [8]

Financial assurance policies address moral hazard by plugging the liability gap that bankruptcy creates. Requiring mining companies to allocate funds against the risk of a disaster occurring ensures that they will be the one to bear its costs. When strong financial assurance is in place, mining companies will manage their operations in a way that reflects a potential disaster's total costs—rather than only the portion of costs that would end up falling to them. In this way, financial assurance strengthens companies' economic incentive to avoid disaster (Strand, 1994; Mackie, 2014; Faure, 2016). [9] **Requiring financial assurance against the risk of a mining disaster can both protect British Columbians and make disaster less likely.**

Importantly, requiring financial assurance can reduce the risk of disaster from both existing and future projects. For existing projects, companies that can find ways to demonstrably reduce the risk of disaster—for example, by storing tailings dry instead of wet, or building less-steep embankments around their tailings dams (see Figure 6 for other risk-mitigation actions)—can face less-stringent financial assurance requirements. This gives them a strong economic incentive to find ways of reducing their risk of disaster. On the other hand, financial assurance reduces the risk of future projects by providing a screening function. Because operations that pose a higher degree of risk face more-stringent financial assurance requirements, some kinds of high-risk proposed projects will become uneconomical. Though this may lead to fewer total mining projects, it represents an economically efficient outcome, since projects whose returns cannot justify their environmental risks do not present a net benefit to society, and should not proceed. The fact that financial assurance leverages market forces to weed out excessively risky projects makes it a powerful type of screening tool. [10]

Figure 5: Red Chris Mine. Tailings Pond. Northwest B.C.
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[7] In plain language, moral hazard essentially refers to the phenomenon of a person or company not worrying as much about risk when they know that, should things go wrong, someone else will pay the cost.
[8] It can also increase the scale of a potential disaster: If a mining company knows that a disaster above a certain size would bankrupt it, it has less incentive to take steps that would reduce the disaster's costs over and above that threshold.
[9] Of course, companies already have incentives to avoid disasters, since they pose risks to their reputation and bottom line. But in the context of possible bankruptcy, these incentives may not be enough.
[10] While financial assurance can act as a useful screening tool, it cannot objectively determine whether or not a project presents an "acceptable" level of risk. Policy-makers must make subjective determinations of how stringent their financial assurance requirements should be, and—by extension—the economic returns necessary to justify a given level of risk. Similarly, financial assurance cannot substitute for environmental assessments that determine whether a given project should proceed despite their environmental risks, since these assessments consider much broader issues such as local benefit agreements, social and cultural impacts, and implications for GHG emissions. Rather, financial assurance can help manage the risks that society, via environmental assessment processes, decides it is comfortable taking, as well as provide a screening function that precedes environmental assessments.

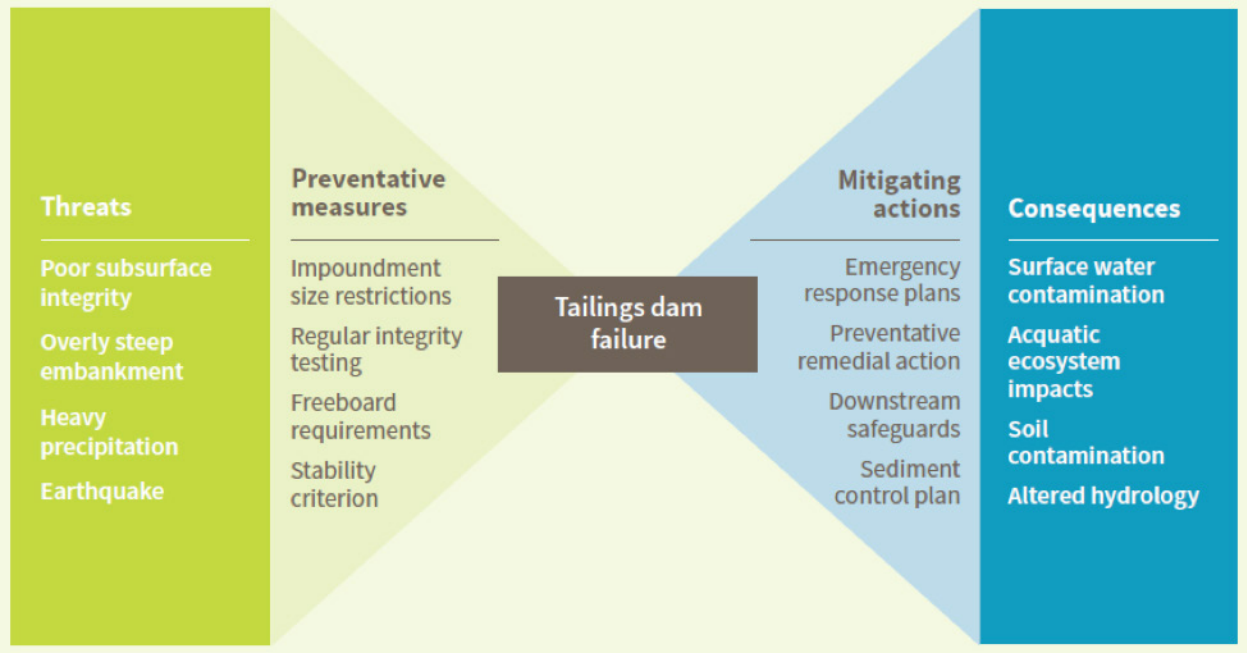

Figure 6: Tailings dam failure risks and risk-mitigation actions represented in a "bowtie" model

2.2 Financial assurance and policy-makers' goals

Financial assurance policy is often complex to put into practice because policy-makers have three different policy goals that they must balance:

1. ***Deterrence:*** Policy-makers want to provide firms with an incentive to reduce risk to the environment, either by increasing the likelihood of environmental damage, its potential severity, or both.

2. ***Compensation:*** Policy-makers want to ensure that if harm occurs, the responsible firm or an engaged third party bears the costs—rather than society.

3. ***Economic activity:*** Policy-makers want to facilitate production and investment, so that society can benefit from the income and jobs that it creates.

The challenge is that these goals can be in conflict with one another. For example, requiring every mining company to post financial assurance against the full costs of an estimated worst-case disaster scenario—as, for example, Maine in the United States does—can ensure full compensation and provide strong deterrence. But worst-case scenarios are extremely costly; most mining companies would not have the capacity to post financial security in line with one. As a result, this kind of financial assurance policy would support deterrence and compensation but significantly undermine economic activity—potentially even making mining altogether unviable.

On the other hand, lax financial assurance requirements can lead to the situation that occurred following the Lac Megantic train derailment, where the financial assurance held by government following a disaster proves to be woefully insufficient. Such an approach would support economic activity by keeping costs to operators low, but it would also provide weak deterrence and inadequate compensation.

[11] Of course, these are not the only goals that policy-makers might have. For example, in British Columbia, the government would also have respect for UNDRIP and free, prior and informed consent (FPIC) as one of its goals. We use the three-goal framework in this report because it illustrates the tradeoffs inherent to different financial assurance policy choices. In practice, policy-makers will have to balance both these and other goals.

There is no "right" balance across these policy goals because tolerance for environmental risk is subjective. At one extreme, some voices will want to see environmental risk reduced to zero. However, many forms of economic activity carry at least some degree of risk to the environment. Fully eliminating risk may require shutting down the underlying activity that creates it. While this will be acceptable to some, others will contend that the costs of doing so exceed the benefits. At the extreme, these voices may be indifferent to environmental risk—content to trust in the existing (if incomplete) incentives that firms have to avoid disasters.

In practice, most perspectives will fall somewhere in the middle. They will accept that some amount of environmental risk is probably unavoidable, but want to manage and limit it. However, they will also likely differ in their definitions of what an "acceptable" level of risk is. And they may also differ in the weight they assign to compensation (as well as the scope of harms they include in it).

It falls to policy-makers to reconcile stakeholders' and First Nations' differing perspectives on risk. They must define and pursue a balance across policy goals that they believe makes the most sense for their jurisdiction. In Section 3, we consider the balance that British Columbia is aiming to strike—and whether its approach to mining sector financial assurance is achieving it.

2.3 Financial assurance types and their effects on goals

A wide range of financial assurance instruments exist. Asset collateral, cash deposits, bonds, insurance and industry funds are just a few examples. Financial assurance instruments can be broken down into five broad categories. Each category has different implications for the three policy goals of deterrence, compensation and economic activity. We discuss the categories in turn below. [12]

1. "Hard" assurance from firms

Financial assurance is considered "hard" when firms put up assets that cannot fluctuate in value or suddenly become unavailable. Common types of hard assurance are cash deposits, securities and trusts. Hard assurance is typically held by government or in trust by a third party, and is used when a qualifying liability arises and the firm does not bear the cost. If no liability arises or if the firms bears the costs of its liability, the assurance is returned to the firm (Gerard, 2000; Boyd, 2001; Miller, 2009; Sassoon, 2009). Box 1 provides a discussion of qualifying liabilities and compensation.

Hard assurance generally supports deterrence and compensation, but its high up-front cost to individual firms can reduce economic activity relative to other instruments.

Figure 7 : Tailings spill at the Mount Polley copper and gold mine in B.C.

[12] The effects on policy goals that we highlight are ceteris parabus—all else being equal.

Box 1: The scope of compensation

Environmental damage can result in both market and non-market costs. Market environmental costs are measurable in dollar terms using observable data on market prices and quantities, while non-market ones are not. For example, a tailings spill risks contaminating local water bodies. This can reduce tourism and affect commercial fishing incomes (market environmental costs). At the same time, it can also affect recreational use of the water body, local biodiversity, and the food, social and ceremonial uses that are part of Indigenous communities' cultural connection to lands and waters (non-market costs). While non-market environmental costs are not visible in the same way that market costs are, they nevertheless represent a real — and important — dimension of a harm's total costs (Hallegatte & Pryzluski, 2010).

In the context of environmental risks from mining, the potential exists for significant non-market environmental, social, and cultural losses, especially given the possibility of irreversible ecosystem damage (e.g., species extinction) and irreversible impacts to an Indigenous nation's culture and way of life. Therefore, the scope of compensation mechanisms' coverage is a critical factor in mining sector financial assurance policy. However, in practice, the scope of covered harms tends to be fairly narrow.

In civil litigation, non-market environmental, social and cultural costs are often excluded from firms' liability because they are difficult to identify, measure, or value monetarily, and because the results of their valuation can be contentious (Monti, 2002). Compensation under financial assurance systems tends to define liability similarly, focusing on directly attributable market costs (and in many cases, only those that fall to governments). However, financial assurance does not have to be constrained by the way firm liability is defined in civil courts. Indeed, a critical feature of financial assurance is that it can bypass the need for costly civil litigation (Shavell, 1986; Faure, 2014; Faure, 2016; Arnold, 2017).

Governments can set up compensation mechanisms that work in parallel to civil courts. These mechanisms can define the types of harms that are covered, and governments can make both financial assurance and participation in a given compensation mechanism a condition of mine licensing. In the event of harm, redress would be pursued through the compensation mechanism. Compensation would come directly from the responsible company in cases where it was still solvent or from the financial assurance held by government in cases where it was not.

Having an accessible, fair, and transparent and binding compensation mechanism helps financial assurance systems work better. First, a strong compensation mechanism helps ensure that a harm's total costs (i.e., whether market or non-market; environmental, social or cultural) are compensated. Second, it helps improve deterrence, since companies undertake more significant risk mitigation when the financial assurance they provide better reflects the full scope of costs that may arise (for this to hold, however, the scope of financial assurance requirements must be set in line with the scope of the harms covered by the compensation mechanism). Third, by providing clarity on companies' potential liability for environmental harm (outcomes in civil litigation can, in contrast, be much more uncertain), a strong compensation mechanism helps companies make more informed investment decisions, which supports economic activity.

2. "Soft" assurance from firms

Financial assurance is considered "soft" when its ultimate value is to some degree uncertain. Common types of soft assurance are "self-assurance" (essentially, a pledge to bear the cost of future liabilities), parent company guarantees, and pledges of assets. Under soft assurance requirements, firms usually remain in possession of their capital or assets (Boyd, 2001; Sassoon, 2009; Gorton et al., 2010; Guzman, 2017).

By accepting soft assurance, governments are essentially accepting the strong financial standing, favourable reputation, or general good faith of a company in lieu of more concrete types of security. As such, a given company's financial situation will have important implications for the reliability of its soft assurance. It is therefore common for governments to monitor the financial health of companies that provide soft assurance.

Compared to hard assurance, soft assurance puts less constraints on firms' capital, which helps support economic activity. However, since the assurance's value can fluctuate, it also tends to pose a greater financial risk to the public. It also provides significantly weaker incentives for risk-reduction.

3. Third-party assurance

Third-party instruments involve the use of intermediaries; for example, a bank, an insurer, or a capital provider. In the event of a qualifying environmental harm, the third party bears its cost. [13] In exchange for this coverage, the firm pays the third party a regular premium. Common types of third-party assurance include environmental insurance, surety bonds, and letters of credit. By *pooling* risk, third parties can help firms avoid firms incurring the larger, up-front costs of providing hard assurance.

Third-party coverage can have a disciplining effect on firms (e.g., when insurers require certain risk-mitigation measures as a condition of coverage). This is particularly the case where premiums are "risk-differentiated" (see Box 2 for more information). However, the use of third parties can also create moral hazard, since firms no longer directly bear the cost of their environmental damage. In addition, non-quantifiable or uncertain risks may make third party coverage unavailable (Boyd, 2001; Monti, 2002; UNEP, 2003; Munchmeyer et al., 2009; Gorton et al., 2010; Ben-Shahar & Logue, 2012; Gorey et al., 2014; Boomhower, 2014; Arnold, 2017).

Third-party coverage can help support policy-makers' compensation goals, especially when third parties are large and well-capitalized. And it can also support economic activity by keeping firm costs low. However, the moral hazard that it creates can lead to lesser deterrence than hard, firm-level requirements.

[13] The definition of a qualifying environmental harm and the scope of damages that are compensated for in the event of one are critical design components of any financial assurance mechanism. However, they can be particularly critical in third-party assurance, since third parties have a strong economic incentive to reduce the risk and extent of their potential liability.

Box 2: Risk differentiation - Making financial assurance work better by making it fair

Premiums collected from firms are 'risk-differentiated' when they reflect the actual level of risk posed by an operation: Operations that pose a high level of risk pay more, while low-risk operations pay less. Risk-differentiated premiums ideally reflect *all* relevant risks—whether environmental, financial, or technological.

Risk-differentiation supports deterrence. Projects with lower risk end up with a financial advantage. This creates a powerful economic incentive for firms to not only select lower-risk projects, but also to innovate and find *new* ways of reducing proposed projects' environmental risk. These incentives also extend to existing projects, since when firms can demonstrably reduce risk, they will stand to reduce their expenditure on financial assurance.

Importantly, risk-differentiation is also fair to companies. Collecting premiums equally or based on production levels effectively asks low-risk operations to subsidize high-risk ones, which is unfair to low-risk operators. **Collecting premiums based on risk is fair because it ensures that firms bear the cost of environmental damage in proportion to how much they contribute to the risk of it.**

Administrators need to effectively *monitor* risk for risk-differentiation to be effective. Operational-level risk information may in some cases be costly to collect, so administrators need to be careful to ensure that the benefits of risk-differentiation outweigh the cost. Where the cost of collecting this information (or keeping it up-to-date) is too high, administrators can instead use *proxies* for risk; for example, collecting higher premiums when companies plan to use risky production technologies or tailings storage methods, fail to adhere to a voluntary safety standard, or have a record of non-compliance.

4. Sector-level assurance

Under sector-level assurance, firms in a sector collectively assure against their environmental risks. Common types of sector-level assurance are industry funds or mutual insurance. These instruments typically operate similarly to third-party assurance, collecting regular premiums in exchange for coverage. They leverage the sector's expertise in its own risks, and can in some cases provide coverage where third-party coverage is not available, or only available at a high cost (Freeman & Kunreuther, 1997; Bennett, 1999; Faure, 2002; Smith, 2012; Dana & Wiseman, 2015).

Third-party assurance schemes share many of the features of third-party coverage in terms of their impact on policy goals. Pooling risk supports compensation and economic activity. But due to the effect of moral hazard, it does so at the expense of stronger deterrence (and thereby, causes greater risk to communities and the environment).

5. Public assurance

Public assurance operates similarly to third-party and sector-level assurance schemes, with regular premiums collected in exchange for coverage. The key distinction is that under public assurance, the scheme is government-run. In addition, public instruments might pool risk not only across firms in a particular sector, but across entire sectors. Public assurance schemes tend to play a role in cases where neither third parties nor the sector as a whole is able to provide cost-effective coverage, usually due to non-quantifiable risks or the potential for catastrophic costs (Freeman & Kunreuther, 1997; Katzman, 1998; Nguyen, 2013).

Like third-party and sector-level assurance, public assurance instruments collect risk-weighted contributions from firms in exchange for coverage, so their effect on policy goals tends to be similar.

Summarizing instruments' effect on policy goals

Table 1 provides an overview of the five categories of financial assurance instruments and their effect on the three policy goals. As seen in the figure, each instrument strikes a different balance across policy goals, with none able to deliver strong outcomes across all three.

Table 1: The five types of financial assurance and their effect on policy goals

Table 1: Summary of financial assurance instruments

Category	Description	Instruments	Effect on policy goals		
			Reducing risk (deterrence)	Paying for damages (compensation)	Minimizing costs (economic activity)
Hard financial assurance from firms	Firms provide assurance that cannot fluctuate in value and is readily available. The assurance is held in trust until the risk subsides.	• Cash • Securities • Sinking funds • Trusts	Strong	Strong	Weak
Soft financial assurance from firms	Firms agree to cover the cost of a potential harm but retain possession of their assets.	• Self-assurance • Parent guarantees • Pledges of assets	Weak	Weak	Strong
Third-party assurance	In the event of a qualifying environmental harm, a third party like a bank or insurer covers the cost. In exchange for this coverage, the firm pays a regular premium.	• Bonds • Insurance • Letters of credit	Limited	Moderate	Moderate
Sector-level assurance	All firms in a sector collectively provide coverage. Individual firms pay a regular premium in exchange.	• Industry funds • Mutual insurance	Limited	Moderate	Moderate
Public assurance	A publicly-administered instrument provides firms with coverage in exchange for a regular premium.	• Public funds • Public insurance	Limited	Moderate	Moderate

Source: Canada's Ecofiscal Commission, 2018

3 Mining sector financial assurance policy in British Columbia

In British Columbia, financial assurance is used strictly to protect against the risk of mine non-remediation (that is, mines not getting cleaned up by their owner at the end of their useful lives). [14] Financial assurance is not applied against the risk of mining disasters in British Columbia—a significant policy gap that exacerbates the risk of another Mount Polley.

While it is not uncommon across Canadian provinces for mining disasters to be exempted from financial assurance requirements, it is very unusual across other sectors that pose a risk of environmental disaster. Table 2 provides an overview of sectors where companies must provide financial assurance against the risk of disaster in Canada.

British Columbia's exemption of mining disasters from financial assurance requirements is notable in that it is at odds with the province's stated "polluter-pay" policy. Under the province's Environmental Management Act (EMA), the Minister of Environment can levy charges in the event of an unauthorized tailings release or other environmental harm, and recover any related costs the government may incur. The policy allows for full cost recovery after an environmental disaster, and is the only one of its kind in Canada (Government of British Columbia, 2017a; Government of British Columbia, 2017b).

But while the province's implementation of a polluter-pay policy provides an important legal foundation for recovering costs, it has a significant gap. According to the province, the EMA ensures that "those that pollute are held responsible under a polluter pay principle, so the taxpayer does not have to assume (the) cleanup costs" (Government of British Columbia, 2016). But if a mining company goes bankrupt, it might not pay the costs of a disaster it is liable for.

Like other jurisdictions, British Columbia is pursuing a balance across its policy goals. It has stated aims both to make the polluter pay and to encourage mining activity and investment. However, when it comes to mining disasters, the province's financial assurance policy is tilted heavily toward economic activity, to the significant expense of deterrence and compensation. **There is effectively no guarantee that the polluter would pay the costs of a mining disaster in British Columbia—indeed, if a financially precarious mining company caused a disaster, the vast majority of its costs would likely fall to the public.**

A better balance is possible. In particular, a "tiered" financial assurance scheme could offer British Columbia a way of improving deterrence and compensation outcomes while at the same time supporting continued production and investment in the sector.

[14] There are important shortcomings in British Columbia's current approach to financial assurance for mine remediation, as detailed in AGBC (2016), Canada's Ecofiscal Commission (2018), and Dion (2019).

Table 2: Canadian financial assurance policies for sectors that pose a risk of environmental disaster

Sector	Environmental disaster risks	Financial assurance requirements
Tanker traffic	Some goods that are transported by rail in Canada pose serious environmental risks, such as oil, toxic chemicals, and industrial wastes. If trains derail or otherwise spill the contents of railcars carrying these types of goods, the environmental consequences can be severe. Derailments can also have tragic human costs, as the 2013 Lac Megantic disaster demonstrated (Lacoursière et al., 2015; de Santiago-Martín et al., 2015)	Since 2016, the Canadian Transport Agency requires rail operators and owners to carry a minimum of $25 million in liability insurance, and requirements can be as high as $1 billion for particularly dangerous goods. In addition, the Safe and Accountable Rail Act (2015) (brought in in response to the Lac-Megantic disaster) requires that rail companies transporting oil pay into an industry fund. The fund is intended to cover any costs of a potential disaster that exceed operators' insurance coverage and ability to pay (Government of Canada, 2015a).
Offshore drilling and extraction	Environmental risks from offshore oil production are similar to those of tanker traffic. A key difference is that if a leak or blowout occurs below the ocean's surface, some oil can remain underwater. Such spills can be difficult to locate and can persist for years before they are observed, and be impossible to fully clean up. The 2010 Deepwater Horizon blowout provides a powerful example of the risks of offshore drilling (Kingston, 2002; Peterson et al., 2003; Spier et al., 2013).	Firms undertaking offshore drilling or extraction in Canada must prove they have financial resources to cover up to $100 million in damages. Alternatively, they can participate in a $250 million pooled fund with other offshore operators (Baines & Syer, 2016; Government of Canada, 2016; Government of Canada, 2018).
Nuclear energy	Catastrophic nuclear disasters such as Chernobyl and Fukushima are the most obvious disaster risk in the nuclear sector. However, the unique design of Canada's nuclear reactors makes them less prone to catastrophic meltdown than other reactor types. Nevertheless, accidental releases of radioactive material can still occur (Hamilton & McLean, 2009; CBC News, 2011; NRCan, 2018).	Nuclear operators in Canada are required to participate in an insurance pool, where they pay regular premiums in exchange for coverage. The pool provides coverage against the costs of a nuclear disaster up to operators' $1 billion liability cap for damages. Canadian insurers in the pool share the risks of insuring nuclear operators so that no single insurer is unable to settle claims or is made insolvent by them. (CNSC, 2017; CNSC, 2018)
Rail transport	Some goods that are transported by rail in Canada pose serious environmental risks, such as oil, toxic chemicals, and industrial wastes. If trains derail or otherwise spill the contents of railcars carrying these types of goods, the environmental consequences can be severe. Derailments can also have tragic human costs, as the 2013 Lac Megantic disaster demonstrated (Lacoursière et al., 2015; de Santiago-Martín et al., 2015)	Since 2016, the Canadian Transport Agency requires rail operators and owners to carry a minimum of $25 million in liability insurance, and requirements can be as high as $1 billion for particularly dangerous goods. In addition, the Safe and Accountable Rail Act (2015) (brought in in response to the Lac-Megantic disaster) requires that rail companies transporting oil pay into an industry fund. The fund is intended to cover any costs of a potential disaster that exceed operators' insurance coverage and ability to pay (Government of Canada, 2015a).
Pipelines	Oil spills from pipeline rupture are the main environmental risk from pipelines. Spills can lead to soil, surface, and groundwater contamination, as well as habitat and biodiversity loss. The damage can be especially large if a spill occurs in an ecologically sensitive or populated area. A recent example of a pipeline rupture is the 2016 Husky-Maidstone rupture, which spilled approximately 225,000 litres of oil into the North Saskatchewan River (Dziubiński et al., 2006; Warick, 2017).	Pipeline operators in Canada must provide financial assurance against the risk of an oil spill. Their assurance requirements are based on a pipeline's assessed "risk value," which is based on its diameter, operating pressure, and daily transport capacity. Any operations with capacity exceeding 250,000 barrels per day are required to provide $1 billion in financial assurance—their maximum legal liability for damage (Government of Canada, 2015b; NRCan, 2017e).

4 Tiered financial assurance as a policy solution

Environmental disasters are by definition low-probability, high-cost events. This makes it challenging to develop financial assurance policy for them.

When the costs of damage can be severe or even catastrophic, the shortcomings of individual financial assurance instruments that we presented in Section 2.3 get amplified, and the balance they strike across policy goals begins to tend toward extremes. If, for example, legislators and policy-makers use firm-level bonding to secure against the costs of a potential disaster, it can have a very powerful deterrence effect. But as we noted above, requiring companies to post security against the full costs of a potential disaster would be prohibitively expensive. It would likely make continued production in the mining sector economically unviable.

On the other hand, relying on insurance markets to assure against the risk of disasters would also pose problems. The infrequency of mining disasters as well as their uniqueness makes it difficult for insurers to reliably estimate—and thereby, price—their risk. When this uncertainty is combined with the potential for extremely high costs, insurers may be reluctant to provide coverage high enough to assure against the full cost of a potential disaster. Or, where they are willing to provide coverage, they are likely to set premiums quite high, in order protect themselves against large (and uncertain) losses. While requiring firms to purchase this coverage would ensure full compensation, its cost might to be too large for many firms to bear.

As an alternative approach, pooling firms' risk under a sector-level scheme or a public instrument can spread the costs of assurance more broadly, so that the costs to individual firms become more manageable. It can also support compensation. However, when costs are spread thinly in this way, firms have less of a direct financial stake in avoiding a disaster, which creates moral hazard. This can lead to weak deterrence outcomes.

Policy-makers looking to implement a disaster-focused financial assurance scheme that balances their policy goals can do so by combining different instruments in a "tiered" scheme. Tiered schemes can help policy-makers realize the different strengths that individual financial instruments offer, while at the same time avoiding the extreme trade-offs across policy goals that come from relying on only one type of instrument.

Figure 8: Brumadinho dam collapse, Brazil 01/19

4.1 Understanding "tiered" financial assurance schemes

Under a tiered assurance scheme, firm-level or third-party assurance instruments provide coverage up to a certain point. If the costs of a disaster exceed this coverage, sector-level financial assurance or public instruments then kick in.

Mixing instruments in this way helps to leverage both the deterrence that hard firm-level assurance provides and the lower costs that risk pooling instruments provide. It also supports compensation by combining their coverage together under a system of successive tiers. **Tiered schemes offer a way of reducing both the risk of mining disasters and the risk of society bearing the costs of them, while at the same time ensuring that mining remains economically viable.** Tiered schemes give legislators and policy-makers a way to make financial assurance viable where it would otherwise lead to costs too high for individual firms to bear (Radetzki & Radetzki, 2000; Monti, 2002; Faure, 2014).

Tiered financial assurance schemes are common in other sectors that pose a risk of environmental disaster. As we detail in Table 2, financial assurance requirements for both oil tanker operators and rail operators that transport dangerous goods combine firm-level insurance requirements with sector-level industry funds. Employing a variety of integrated tools is achievable and can be an effective approach.

Any number of tiers is possible in a tiered scheme. The most comprehensive would have hard, firm-level assurance backstopped by insurance, then sector-level assurance, then a public fund that pooled risk across different sectors (we discuss cross-sectoral risk pooling in Section 5). Less complex schemes can also be effective, and will often have lower administrative costs. At the same time though, by omitting certain types of financial assurance instruments, they may fail to realize their strengths. For example, the financial assurance systems for tanker traffic and rail transport have weaker deterrence as a result of their not requiring at least some amount of firm-level bonding.

The thresholds at which higher tiers kick in is a key design feature in a tiered assurance scheme. It has important implications for the balance that the scheme will strike across policy goals. Ideally, lower, deterrence-focused tiers should have requirements that are stringent enough that firms take notice. They should also apply risk-differentiation, so that there is a worthwhile return on firms investing in measures that demonstrably reduce the risk of disaster (see Box 2). Higher tiers, on the other hand, should offer high enough coverage that the risk of taxpayers having to absorb costs is low.

The total coverage that a tiered assurance scheme provides is a critical design feature. Having a reliable estimate of the distribution of potential costs as well as how high a worst-case scenario's costs could prove to be is crucial to calibrating a tiered scheme's coverage limits. If the system's total coverage is set significantly higher than it needs to be, it will unnecessarily constrain economic activity in the sector. If the threshold is set too low, taxpayers will remain exposed to significant financial risk. As an example, companies engaged in offshore oil extraction in Canada must either provide $100 million in firm-level assurance or participate in a pooled scheme with $250 million in coverage. While this is a significant amount of coverage, it is notable that the Deepwater Horizon blowout in the Gulf of Mexico is expected to cost BP $60 billion (Bishop et al., 2017). In Box 3, we discuss methods for estimating the costs of a credible worst-case scenario, as well as the implications of governments choosing to set coverage limits below this level.

[15] We exclude soft firm-level assurance because of its weak effects on deterrence and compensation.

Box 3: Worst-case scenarios and public-private risk-sharing

The development of a credible worst-case scenario is critical to calibrating the total level of coverage that a tiered financial assurance scheme should provide. But estimating the costs of a worst-case scenario is not always straightforward. In many cases, a disaster of such scale may be unprecedented, at least in the specific physical environment where it may occur. And it may involve a range of environmental and social harms that are difficult to quantify, or to value in monetary terms. These kinds of uncertainty can make it difficult to reliably estimate a worst-case scenario's costs.

When assigning financial assurance requirements for the decommissioning of nuclear facilities, the Canadian Nuclear Safety Commission uses specific provisions that adjust its cost estimates for uncertainty. First, in cases where cost estimates can be reliably developed, it applies a 10 to 30% contingency to protect against the possibility of costs being under-estimated. Second, where estimating the cost of decommissioning is complex or where the results might be deficient, it brings a diversity of views and perspectives to bear by defining a worst-case scenario and estimating its costs under a multi-stakeholder collaborative process.

These kinds of provisions and processes can help policy-makers determine how high a tiered scheme's coverage should extend. However, in some cases, policy-makers may opt to set coverage limits below a worst-case cost level—to deliberately have society share in the private actor's financial risk. Doing so can help facilitate economic activity in cases where it might not otherwise proceed, and may be appropriate in specific circumstances, such as when the resource being developed is publicly owned. Still, governments must be careful to ensure that the economic benefits that these kinds of risk-sharing arrangements deliver do not lead to a level of increased disaster risk and reduced compensation that is ultimately not in the interest of communities and society.

Finally, it should be noted that even tiered schemes with high levels of coverage will not always be able to guarantee full compensation in contexts where truly catastrophic costs are possible. Tiered schemes cannot have infinite coverage; at some point, a system's highest tier—whether a sector-level assurance instrument or some kind of public assurance instrument—will be exhausted. [16] Jurisdictions that adopt a tiered scheme to address the risk of an extremely costly disaster must recognize that such a system can never fully eliminate the possibility of at least some costs falling to taxpayers.

[16] There is a key difference between insurance-based instruments and fund-based instruments in this regard. While the total capitalization of an insurance-like scheme determines its capacity, funds can continue to be built up over time, potentially to the point that they are able to absorb the full costs of even a severely catastrophic event. However, the drawback of funds is that they are less able to absorb costs while they are being built up.

5 Broadening the risk pool

In this section, we discuss how legislators and policy-makers can lower the costs of coverage under a tiered scheme's higher tiers by broadening the kinds of risks that they pool.

Risk-pooling instruments leverage the "law of large numbers," which holds that as a sample size grows, its outcomes start to approach the theoretical average (Hsu & Robbins, 1947). The likelihood of a mining disaster can be more easily estimated across a portfolio of mines (i.e., as the Mount Polley expert panel did in estimating that, absent change, two more tailings dam ruptures can be expected per decade in British Columbia going forward). However, the smaller the sample size, the more difficult this kind of estimation becomes, since individual mines' disaster risks vary and since chance starts to play a larger factor.

All else being equal, the broader a risk pool, the lower its premiums have to be. When a risk pool has a larger number of firms in it, it becomes easier for administrators to calibrate what size of premiums are needed to cover the pool's expected costs, since the law of large numbers gives them greater confidence in the reliability of their estimates. In this way, **broader risk pooling can both improve compensation and, by reducing costs, facilitate economic activity.**

In this section, we discuss two possible ways of broadening a disaster risk pool: pooling risk across sectors and pooling risk across provinces. We discuss each in turn.

5.1 Pooling risk across sectors

The logic of risk pooling does not only apply within a sector. When other sectors also pose a risk of disaster, including them in a risk pool can both help reduce the costs of coverage and better support compensation. This kind of risk diversification is common practice for large insurers, who may have lines of business that focus on, for example, commercial liability, auto, property and health.

Pooling risk across sectors helps avoid "correlated" risks. For example, heavy precipitation can exacerbate the risk of tailings dam failure—it affects the risk of disaster at all tailings dams. But when a risk pool includes disaster risks that are less affected by increased precipitation (for example, the risk of a pipeline rupturing) or which are not affected at all, there is less chance that a particularly heavy rain season that causes multiple tailings dam failures will exhaust the capacity of the pool.[17] Cross-sectoral risk pooling avoids correlated risk and supports compensation by *diversifying* risk.

Public assurance instruments are particularly suited to pooling risk across sectors. The administrators of sector-level schemes will typically be reluctant to pool together with sectors whose risk profiles they do not understand, and therefore unlikely to do so voluntarily. Public instruments, on the other hand, are government-run. Through regulation or legislation, they can *require* sectors that pose a risk of disaster to participate. A well-known example of a public assurance scheme that pools risk across sectors is the Superfund in the United States. We discuss the Superfund in Box 4.

[17] Notably, the risk of this kind of precipitation season will likely grow as the effects of climate change become more pronounced.

Box 4: An example of cross-sectoral risk pooling – Superfund in the United States

The U.S. Environmental Protection Agency's (EPA) Superfund is a well-known example of a public fund that deals with environmental risk across a range of sectors. Founded in 1980, the Superfund provides the EPA with funds it can use to quickly clean up emergency spills and deal with potential releases, to address orphaned or abandoned sites, or to accelerate cleanup where responsible parties are failing to adequately do so (Judy & Probst, 2009).

The Superfund started as an industry-funded risk pool, but has since moved to being more of a publicly-funded backstop. Initially, 87 percent of the Superfund's revenues came from new excise taxes on the petroleum and chemical industries, with smaller amounts from income taxes, interest payments, and cost recovery. The federal government initially conceived of it as a self-sustaining model. However, remediation costs in the Superfund's early years far exceeded its revenues, and the excise taxes that were intended to fund it in perpetuity expired in 1995. Superfund actions and interventions are now largely paid for with general revenues in cases where costs cannot be recovered from the responsible party (Hird, 1994; Anderson, 2017; USEPA, 2017).

The Superfund offers a useful example of a cross-sectoral pool; however, its funding model makes it more like a liability rule than a financial assurance scheme. Companies are forced to reimburse the Superfund for its costs (often plus penalties) *after-the-fact*. Unlike in the scheme's early days, companies do not have to commit any funds or make any contributions that would cover the risk of possible future disasters. In the event that a responsible party cannot be held accountable because it is bankrupt, the public instead pays the costs, via taxes.

This design limits the risk-reduction effect the Superfund can have. It has a deterrence effect in that companies will seek to limit environmental damage and undertake responsible cleanup in order to avoid the costs of reimbursements and penalties. But it does little to remedy the problem of moral hazard. As a result, the Superfund provides less deterrence and less compensation than a scheme funded by industry via risk-differentiated premiums would provide.

While cross-sectoral risk-pooling can offer important advantages, careful design and implementation are necessary to realize them. Different sectors pose altogether different disaster risks; for example, the risk of a pipeline spill and the risk of a tailings dam rupture have different risk factors, likelihoods of occurrence, and cost distributions. If policy-makers are not careful about *how* they pool sectors' disaster risks together, one sector can end up making contributions entirely out of step with the claims it is likely to make. This can create a situation where one sector is effectively cross-subsidizing risks in another. Not only is this unfair to the sector doing the subsidizing, it can also exacerbate the risk of a disaster by creating moral hazard.

To avoid creating these kinds of cross-subsidies, policy-makers looking to pool sectors' risks under a single scheme should make sure that their contributions are *risk-differentiated* (see Box 2). When sectors' contributions to a risk pool are in proportion to the magnitude of risk they pose, the cost burden is distributed more fairly and overall deterrence is strengthened.

Another area that requires caution from policy-makers is how cross-sector risk pools interact with existing policies. As we outline in Table 2, sectors that pose a risk of disaster are commonly required to provide financial assurance. When policy-makers extend a risk pool to include sectors that are already subject to financial assurance, they must first decide whether these new requirements would complement the sector's existing ones or replace them. Second, they must ensure that the new policy represents a net improvement. Does it provide better coverage or deterrence effects? Does it reduce the cost of premiums? What are its administrative costs? Are the associated governance challenges worthwhile?

The most logical place for policy-makers to start when extending the sectoral coverage of a risk pool is in sectors that pose a risk of disaster but are not yet subject to financial assurance. [18] Hydraulic fracturing (or "fracking") is a notable example here. [19] While fracking's environmental impacts remain controversial and highly studied, disaster risks in the sector include regional impacts to water and air quality, earthquakes, and potential long-term impacts from the chemicals used during injection (Adgate et al., 2014; Gagnon et al., 2015; Rogers et al., 2015; Atkinson et al., 2016; Holding et al., 2017). However, despite these risks, the sector—like mining—is not subject to financial assurance outside of the requirements it faces for the risk of non-remediation (BCOGC, 2015).

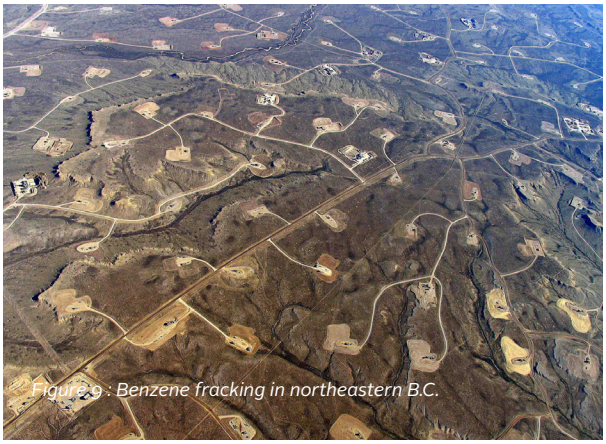

Figure 2.9 : Benzene fracking in northeastern B.C.

5.2 Pooling risk across provinces

In the same way that pooling different sectors' disaster risks can provide greater coverage and reduce the cost of premiums, so too can pooling together different provinces' mining disaster risks.

While cross-provincial pooling could provide administrative synergies, it is also likely to present significant implementation challenges. A cross-provincial pool for mining disaster risk would be simpler to underwrite than a cross-sectoral pool, since member companies' disaster risk profiles tend to be more similar when they are from the same sector. [20] But because mining is provincially regulated in Canada, provinces would need to voluntarily come together to pool their mining sector risks. While the federal government might be able to provide a convening and administrative role, it does not have the same constitutional authority to intervene in financial assurance policy for the mining sector that it has in the sectors we outline in Table 1.[21]

Ironically, the fact tha t mining is under provincial jurisdiction in Canada both increases the challenge of implementing a cross-provincial risk pool in the sector and the advantages of doing so. Provinces and their mining sectors will tend to be reluctant to voluntarily risk pool with other jurisdictions when they perceive them to have a higher risk profile. Risk-differentiation of premiums can help with this, but only up to a point. To facilitate significant cross-provincial risk pooling, greater harmonization of regulations and safety standards may be needed. But while this presents its own challenges, it also presents its own benefits. Having an incentive for standard harmonization would limit the scope for Canadian provinces to compete for investment with each other on the basis of their regulatory regimes. This could help avoid a "race to the bottom" in mining regulatory standards in Canada — an important additional benefit.

[18] Provincially-regulated sectors are another obvious place to start. We discuss provincially- versus federally-regulated sectors in Section 6.2.

[19] Hydraulic fracturing (or "fracking") is an increasingly widespread form of fossil fuel extraction where a mix of water, sand, and chemicals are injected underground and used to extract oil or gas from rock formations. It is a provincially-regulated sector.

[20] Underwriting is the process that an insurance company or risk pool administrator uses to assess risk and to set corresponding coverage limits, premiums and (where applicable) deductibles.

[21] The sectors and activities we present in Table 2 are federally regulated when they involve infrastructure that crosses provincial borders or when they occur on federal territory.

6 Recommendations

Based on the analysis presented in this report, we make one overarching recommendation to British Columbia policy-makers and two supporting ones.

6.1 Main recommendation

Require hard financial assurance against the risk of mining disasters in British Columbia

As we discuss in Section 3, British Columbia does not require financial assurance against the risk of a mining disaster. This means that if another Mount Polley-like disaster were to occur in the province and the responsible company was bankrupted, significant costs would fall to the province's taxpayers. This policy gap exacerbates the risk of another mining disaster.

Although British Columbia's lack of financial assurance policy for mining disasters is not uncommon across Canada, it is an outlier in other sectors that pose a risk of environmental disaster. It is also at odds with the province's stated polluter-pay policy.

To better protect the public from costs and reduce the risk of another Mount Polley, British Columbia should require financial assurance against the risk of mining disasters. As we discuss in Section 2.3, each type of financial assurance instrument has its own strengths and weaknesses. Some are better at providing deterrence, others compensation, and others at facilitating economic activity. From a policy perspective, **applying *any* type of hard financial assurance instrument that guarantees funds will be available in the event of a mining disaster would be an improvement over the status quo.** [22] Critically, coverage must be set high enough that it can provide adequate compensation following a disaster (to ensure *full* compensation would likely require a "tiered" solution, as we discuss in our next recommendation).

Regardless of which financial assurance instrument (or instruments) British Columbia policy-makers choose to apply, they should ensure that it treats operations based on their unique level of risk. Not only do one-size-fits-all financial assurance requirements reduce the incentives that firms have to reduce risk, they are also unfair to lower-risk operators. Any category of financial assurance instrument can incorporate risk-differentiation: for risk-pooling instruments such as industry funds, it can involve weighting companies' premiums for their unique risk of disaster; for firm-level bonding, it can be as simple as having different classes of bonding requirements.

Where assessing the unique disaster risk that individual operations pose proves to be too costly or complex, policy-makers can use proxies for risk. The Mining Association of Canada's *Tailings Management Protocol* (TMP) provides just such a proxy. The TMP is a series of performance indicators, policies, and controls that mining companies can use to ensure that they are managing their tailings storage facilities in a safe and environmentally responsible manner (MAC, 2018). Use of the TMP is mandatory for Mining Association of Canada members. Operations that meet the TMP standard receive different classifications depending on how well they are managing their risks: A, AA or AAA. It is rated as one of the most comprehensive tailings management frameworks available internationally and is considered a useful proxy for compliance with good practice (Golder Associates, 2016). Both overall adherence to the TMP standard and the classifications within it provide a ready-made basis for policy-makers to differentiate mines according to their risk of a tailings disaster.

[22] "Notably, "soft" types of firm-level financial assurance such as self-assurance and pledge of assets cannot provide this type of guarantee, since they can fluctuate in value or suddenly become unavailable.

6.2 Supporting recommendations

1. ***Pursue a "tiered" financial assurance scheme for mining disaster risk in British Columbia***

To deliver a financial assurance approach for mining disasters that creates a balance across policy goals, British Columbia should pursue a *"tiered"* scheme. Tiered schemes combine different financial assurance instruments into successive levels of coverage. Lower tiers leverage the greater risk-reduction incentives that direct, firm-level requirements provide, while higher tiers *pool* risk to provide greater coverage than firms would be able to provide on their own, helping keep costs to individual companies manageable.

A key advantage of tiered financial assurance schemes is that they can be built one instrument at a time. Following our main recommendation, **British Columbia should implement firm-level bonding requirements, insurance requirements or an industry fund, then later combine this assurance with coverage from an additional instrument**, or integrate both into a larger system. Policy-makers do not need to have a tiered system fully planned out in advance in order to work toward one.

Figure 10.:
Tailings spill at the Mount Polley copper and gold mine in B.C.

There are several design features that policy-makers will need to consider as they work toward a tiered financial assurance scheme:

- *Types of financial assurance instrument.* Instruments like bonds, insurance, industry funds and public assurance each have their own strengths and weaknesses. Policy-makers must decide which instruments will be part of their tiered system, and why.

- *System complexity and the number of tiers.* Policy-makers must weigh the benefits of additional tiers against their administrative costs. While a well-integrated system can have a significant number of tiers and still function cost-effectively, policy-makers may find that they can meet their policy goals and keep administrative costs lower with a smaller number.

- *Tiers' thresholds.* The levels of coverage provided by each tier have important implications for the balance a scheme creates across policy goals.

- *The total coverage limit.* The level at which a tiered system's total coverage caps out is a critical design element. It defines the maximum compensation that taxpayers can expect from a bankrupt company that has caused a disaster.

Where feasible, policy-makers should design their tiered scheme to facilitate third party involvement. Measures that facilitate private-sector involvement in financial assurance can reduce administrative burdens and help keep costs low, since third parties may be able to offer capacity and expertise that can help reduce costs. For example, insurance companies have underwriting expertise that they can offer to a sector-run industry fund or mutual insurance scheme. [23]

[23] Private actors may even be able to manage some tiers entirely. For example, insurers or other capital providers may be willing to take on a risk pool that covers higher-tiered risks—something reinsurers already do in the context of natural disasters. Where they are reluctant to do this for mining disaster risks (or only willing to do so at high cost), policy-makers can design their systems such that they are open to the possibility of their later entry. For example, a government running a public assurance scheme as its highest coverage tier can encourage private actors to enter by pricing premiums above their actuarially fair level—effectively trying to price itself out of the market (Pollner, 2001; Bougen, 2003; Kunreuther 2015; Faure, 2016).

2. Broaden pooled risks in a tiered scheme's highest tier

Policy-makers should aim to broaden pooled risks in a tiered system's highest coverage tiers. They face a choice in terms of how they broaden these risks—they can pool risk across other sectors that pose a risk of environmental disaster, or they can pool the mining disaster risk across other provinces. [24] Either kind of risk-pool broadening can be valuable; each has its own strengths and weaknesses. In practice, policy-makers are likely to be guided by which option they believe has a greater chance of successful implementation.

Whether policy-makers prioritize pooling risk across sectors or across provinces, they should use a public assurance instrument to do so. The benefits of broader pooling—in particular, the improved compensation it provides—accrue not only to the pool's participants but to society in general. As a result, privately-run instruments may have weaker incentives to broaden their risk pool than publicly-run ones.

In order to support deterrence and keep their financial assurance requirements fair, policy-makers should ensure that their public instruments risk-differentiate individual firms' contributions as much as possible. While the U.S. Superfund offers an interesting general template for cross-sectoral risk-pooling, British Columbia policy-makers should learn from its shortcomings by insisting that coverage comes from risk-differentiated contributions that are paid by industry.

Critically, policy-makers must take care to ensure that risk pool broadening offers a net benefit. Where a risk pool is broadened such that standards get set to a lowest-common denominator level, the changes may not be in society's interest. Grappling with these possibilities requires effective governance. When cross-provincial pooling is being pursued, governance bodies should include technical expertise in each jurisdiction's policy and practices; where cross-sectoral risk is being pursued, they should include expertise in different sector's unique environmental risks. And critically, **governance bodies for publicly-run risk pools should leverage the knowledge and expertise of First Nations by including Indigenous representation.** Indigenous communities should also participate in the design and implementation of these instruments as much as possible, in order to uphold British Columbia's commitment to the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). [25]

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[24] While they could technically pursue both, the implementation challenges of doing both at once would be much larger than the (already considerable) challenges of pursuing either in isolation.

[25] The notion that Indigenous peoples rights are to be respected in legal and policy mechanisms such as financial assurance is derived from provisions in UNDRIP: that recognize the right to self-determination (Article 3); that Indigenous peoples have the right to maintain and strengthen their spiritual relationship to land and waters owned or occupied by them (Article 25); that Indigenous peoples have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used (Article 26.1, 26.2); and in particular, that states are to consult in good faith and obtain the free, prior and informed consent before adopting and implementing legislative and administrative measures that may affect Indigenous Peoples (Article 19) (United Nations, 2007).

As the Mount Polley disaster underscored, the risk of mining disasters affects all British Columbians. Implementing financial assurance policy for mining disasters can help reduce the risk of another mining disaster in the province. And it can also ensure that, should one occur, the responsible company—rather than taxpayers and communities—pays the cost.

Implementing financial assurance for disasters and ensuring that Indigenous communities participate in its design would also help British Columbia act on its commitment to UNDRIP. In particular, it can support UNDRIP provisions related to the rights Indigenous peoples have over the lands, territories and resources that they have traditionally owned, occupied and used. Using financial assurance requirements to increase mining companies' responsibility and accountability for mining disasters will be a critical part of gaining First Nations' free, prior and informed consent to mining projects in British Columbia. And it will also reduce the need for First Nations to develop and implement financial assurance requirements of their own.

British Columbia can enjoy more of the benefits of mining and less of the risks by implementing smart financial assurance policy for mining disasters.

Figure 11 : Tailings spill at the Mount Polley copper and gold mine in B.C.

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