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A MULTIPLE ACCOUNT BENEFIT-COST ANALYSIS OF COAL MINING IN ALBERTA†

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SUMMARY

Alberta's history with coal development goes back to 1874, but 21st century social, economic and environmental factors demonstrate that it's not in the public interest to pursue coal mining on the Eastern Slopes of the Rocky Mountains.

This paper uses a multiple account benefit-cost analysis to compare the positives and negatives of a hypothetical coal mine in the eastern foothills of the Rockies. We provide estimates of the economic, social and environmental impacts, and evaluate how coal mining affects different stakeholders.

The economic benefits — $440 million in undiscounted incremental tax revenues and $35 million in undiscounted incremental employment earnings — are overshadowed by the costs arising from the displacement of ranching, tourism and the negative environmental effects on water, vegetation, air and wildlife. Compounding these effects is the non-zero probability that the Alberta government will pick up the tab for reclamation costs, and the adverse social impacts on local communities and on Indigenous Peoples' rights and interests. Therefore, any new coal mine development is unlikely to provide the province with a net benefit.

Following on the heels of the federal government's rejection of the Grassy Mountain coal project in southwestern Alberta, the provincial government should consider banning coal mining in the Eastern Slopes. Any future coal

† An earlier version of this paper was submitted to the Alberta Coal Policy Committee.

development policy should include a public-interest test that examines both monetary and non-monetary impacts.

This paper finds an estimated undiscounted profit before taxes and royalties of $511 million to the mine developer. Discounting that value by a rate of eight per cent, which would approximate the opportunity cost of investors' capital, shows coal mines are at best a break-even proposition from a private perspective. Only under optimistic price and activity assumptions does the mine earn a net profit.

Tax revenues would be marginal and additional labour income would accrue to only a few individuals. These benefits would be vastly outweighed by the adverse effects on a much greater population, including Indigenous Peoples.

Further, the Eastern Slopes already suffer the effects of current forestry, oil and gas, ranching, road development and recreational activities. Water quality and habitat for such wildlife as the Westslope cutthroat trout would be significantly compromised. With coal markets in a long-term decline due to coal's impact on climate change and the focus on transitioning to alternative energy sources, new coal mine projects in Alberta would be counter-productive in many ways.

The comparatively small economic benefits derived from a new coal mine could not possibly justify the large and possibly irreversible damage done to the environment, local communities and to the rights and interests of Indigenous Peoples.

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1. INTRODUCTION

Alberta has a long history with coal development; the first commercial mine was developed in 1874 and the province has over 2,000 legacy mine sites (Alberta Culture and Tourism n.d.; Alberta Energy Regulator n.d.c). Most recently, the Government of Canada determined a proposed mine would not be in the public interest, calling into question the future of coal mining in Alberta. This, combined with policy change in Alberta — revocation and then subsequent reinstatement of the policy governing coal exploration, development and mining activity — along with several proposals for new coal mines, has prompted vociferous public debate about the future and value of coal mining in the province. In response to public interest and concern, the province initiated a public engagement process led by an expert panel to inform a modernized coal policy. With this paper, we aim to provide an objective analysis of the benefits and costs of coal development in Alberta.

The current coal policy, implemented in 1976, states that "no coal development will be permitted to proceed unless in its overall economic and social impact it is clearly beneficial to Alberta" (Government of Alberta 1976, 12); the statement applies to all coal development, not just specific land categories or areas. The policy outlines that evaluating the benefit to Alberta requires benefit-cost, social impact, and environmental impact analyses. Importantly, the policy explicitly states "[c]onsideration will be given … to those costs and benefits which are measurable in dollars" and "to the more subjective, social costs and benefits" (Government of Alberta 1976, 12).

In keeping with the principles of the 1976 Coal Policy, we examine the positive and negative effects of coal mining in Alberta from a social perspective — that of the province of Alberta rather than the project proponent — using benefit-cost analysis. We provide estimates of the economic, social and environmental impacts (benefits and costs associated with the development, construction, operation and reclamation) of an illustrative coal mine in the Eastern Foothills of Alberta's Rocky Mountains. Our analysis is meant to inform the public and government on the potential trade-offs associated with additional coal development, and support and inform Alberta's current coal policy review.

Our analytical framework relies on the method of multiple account benefit-cost analysis. Multiple account benefit-cost analysis (MABCA) retains many of the strengths of traditional benefit-cost analysis (BCA), but recognizes that not all consequences can be monetized and the assessment of public interest cannot in general be reduced to a single monetary value. Instead of working toward a monetized measure of overall net benefits, MABCA uses a set of accounts (e.g., environmental, social, taxpayer) to evaluate how a project affects different stakeholders and the distributional consequences of policy choices.

Less lucrative than oil and gas, coal royalties are a small contribution to provincial coffers ($170 million in fiscal 2018/19).[1] Coal mining is a small contributor to economic

[1] Coal royalties are small and have slightly increased over time. In fiscal 2020/21, they accounted for $12.4 million, or 0.4 per cent of natural resource revenues (Government of Alberta 2021c). This compares to fiscal 2008/09 and earlier, where coal royalty revenue accounted for 0.1 per cent or less of natural resource revenues.

activity in communities near the mines, and to Alberta's overall economic activity.[2] As of July 2021, there are eight coal mines in Alberta (six active, two suspended), and 12 proposed. Of the 12 proposed, only two have entered the regulatory process. The economic benefits of coal mining are easily measured and well understood; negative environmental and social impacts are often more difficult to quantify.

We find small economic benefits of a new coal mine, in the form of incremental tax revenues ($440 million, undiscounted dollars) and employment earnings by mine workers ($35 million, undiscounted dollars). Given any individual mine's small size relative to Alberta's overall economy, there is unlikely to be any material increase in economic activity relative to the absence of mine development. In contrast, costs to Alberta are likely to be significant. These costs come from displacing other economic activity (primarily ranching and tourism); significant and adverse environmental impacts on water, wildlife, vegetation and air; a non-zero probability the province will be responsible for reclamation liabilities; negative social impacts on nearby communities; and interference with Indigenous Peoples' interests and rights. Overall, we conclude that coal mine development is not likely to be a net benefit to Alberta, and the costs are likely to outweigh the benefits.

Our work fits in a large literature on the environmental and social effects of coal mining. Qualitatively, it is most similar to work collating and summarizing the impacts of coal mining, such as Epstein et al. (2011) and Jenner and Lamadrid (2013). Our work is also similar to assessments through regulatory review processes, though with a few key differences. We assess an illustrative project rather than a specific project, rely solely on publicly available information, and do not have the rigour and depth of a full regulatory review. Nevertheless, our analysis is relevant and useful as it gives guidance on whether coal development in general has benefits that justify the substantial and long-term costs.

The paper proceeds as follows. In the next section, we describe the current policy context, the history of Alberta's coal policies, and coal development in Alberta. We then discuss our methodology and specific assumptions in detail. Section 4 describes our results, contextualizing them by also discussing interactions with other potential uses. We discuss and conclude in section 5.

2. POLICY HISTORY AND CONTEXT

In this section, we review the current state of coal policy, including the events leading to the Government of Alberta's coal policy engagement process. We also describe the responsible decision-making authorities and their guiding mandates under legislation and regulation, as these principles inform our own assessment of coal mining. We then present the history of coal policy and detail the specifics of the 1976 Coal Policy,[3]

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2 Coal mining accounts for 0.2 per cent of Alberta's GDP in current dollars between 1997 and 2017 (Statistics Canada 2021b).

3 For an extensive overview of the 1976 Coal Policy and the legal implications of the changes, see Bankes (2021a; 2021b; 2021c; 2021d; 2021e), Kwasniak (2021), Yewchuck (2021), and Yewchuck and Bankes (2021).

followed by a discussion of land use management. We conclude the section with a brief history of coal development in Alberta up to present activities.

2.1. CURRENT POLICY CONTEXT

Oversight and policy direction regarding coal comes from Alberta Energy, the government ministry responsible for stewarding "Alberta's energy and mineral resources on behalf of all Albertans" (Government of Alberta 2021c). First implemented in 1976, Alberta's policy for coal development remained largely unchanged while it was in force, albeit within a milieu of other policies and plans active over this period. When Alberta revoked its 1976 Coal Policy[4] in its entirety in May 2020, this came as a surprise to many. As rationale, the government noted "[t]he only mechanism left in effect from the Coal Policy before rescission was the land use classification system" and "[o]ther mechanisms, such as provisions pertaining to royalties, labor requirements, environmental protection, and Crown equity participation, were superseded or not enforced" (Alberta Energy 2020). New leasing rules for Crown coal rights, which opened for lease previously restricted lands, accompanied the policy change.[5] The government argued the 1976 policy — including its land-use restrictions — was outdated, and the changes would modernize the regulatory framework and land-use planning for metallurgical coal (Government of Alberta 2020b). Inherent in the government's recent policy actions is a desire to create a regulatory environment to support coal export growth (Government of Alberta 2020b).

Over the course of the next few months, Alberta Energy took several steps to move forward with its new coal policy, culminating in a lease sale in December 2020 (Figure 1). The policy change was subject to considerable public backlash and opposition (CBC News 2021; The Canadian Press 2021; Trembath 2021; Weber 2021a), and on January 20, 2021 Alberta Energy temporarily suspended lease offerings for Category 2 lands[6] and cancelled 11 recently granted leases (Government of Alberta 2021a; Rieger 2021). On February 8, 2021, the government reinstated the 1976 Coal Policy in full and subsequently announced a public engagement and policy consultation process led by an expert panel to inform future coal policy development (Government of Alberta 2021b).

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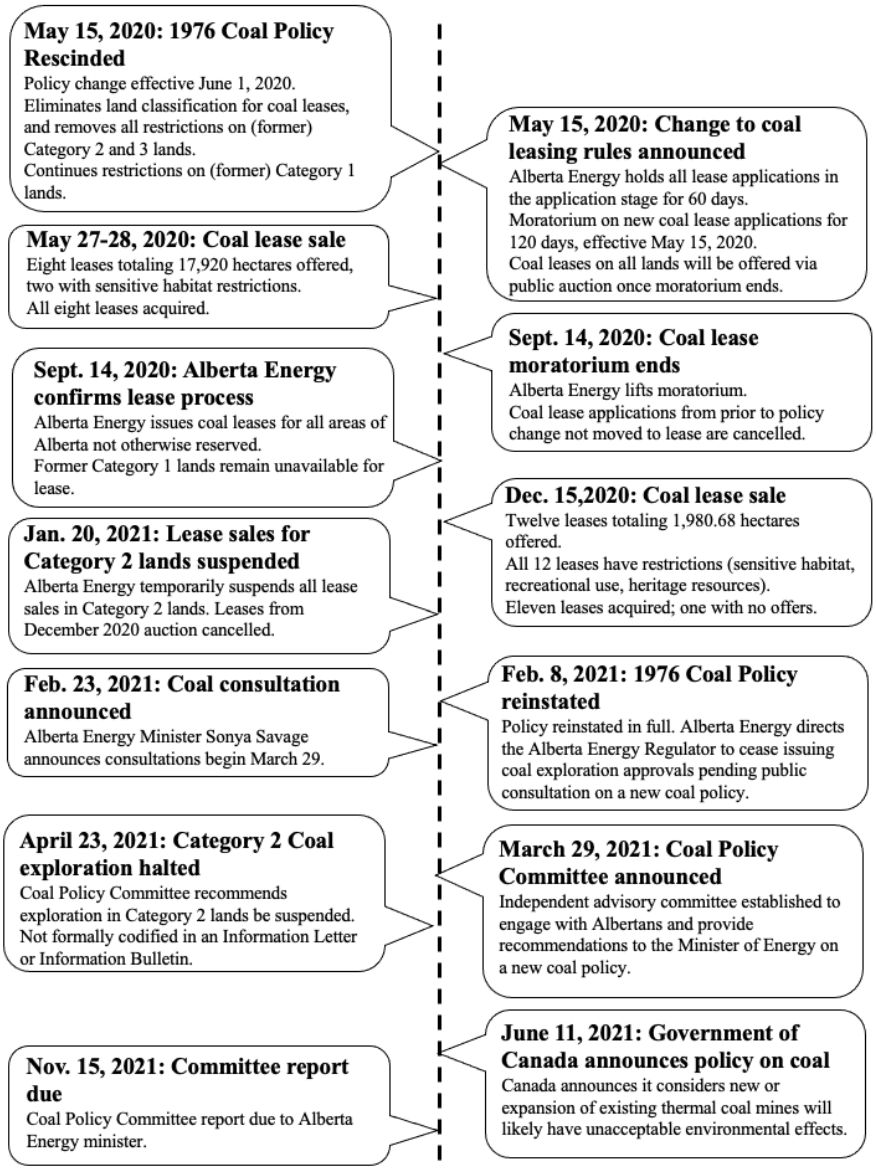
4 Formally, A Coal Development Policy for Alberta.

5 Restrictions continued for national parks, provincial parks (including proposed) and recreation areas, wilderness areas, and wildlife sanctuaries.

6 The 1976 Coal Policy defines Category 2 lands as restricted to development, though coal mining is permissible under certain circumstances. We describe further below.

Figure 1: Timeline of Coal Policy Changes, May 2020 to July 2021



2.1.1. Responsible Authorities

Coal development in Alberta is not solely under provincial jurisdiction. The decision-maker approving a coal mine is one or both of the Government of Alberta and the Government of Canada; the latter is involved if a project triggers a federal environmental assessment. The triggers for a federal assessment are defined in the Physical Activities Regulations under the *Impact Assessment Act*. For coal, this includes (1) a new mine with production capacity of 5,000 tonnes per day or more; or (2) an expansion that increases the operational mining area by 50 per cent or more and results in production capacity of 5,000 tonnes per day or greater after expansion.[7]

[7] The mine capacity triggering federal review in the Regulations Designating Physical Activities under the *Canadian Environmental Assessment Act, 2012* was 3,000 tonnes per day or more for both new and operating mines.

Federal impact assessment may or may not result in a federal-provincial joint review. Regardless of the nature of federal-provincial integration of review processes, triggering a federal impact assessment means the Government of Canada makes the final public interest determination.

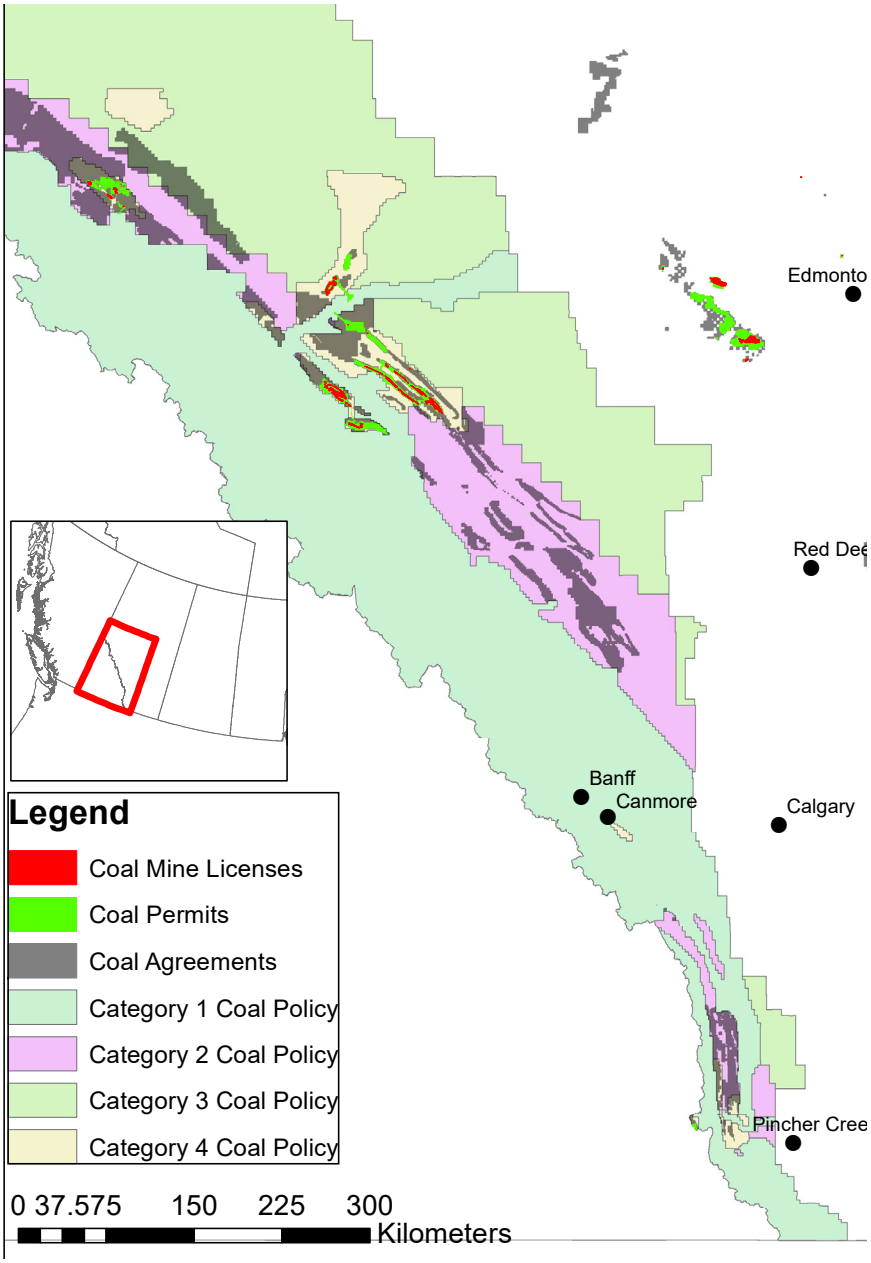
The main regulator of coal mining in Alberta is the Alberta Energy Regulator (AER), which oversees the four phases of coal mine life-cycles: application, "exploration, construction and operation, and closure" (Alberta Energy Regulator n.d.a). The AER is also responsible for overseeing environmental assessments of coal projects (Government of Alberta n.d.e). Six pieces of legislation guide the AER's decision-making on coal development: the *Responsible Energy Development Act*, the *Coal Conservation Act*, the *Environmental Protection and Enhancement Act*, the *Mines and Minerals Act*, the *Public Lands Act*, and the *Water Act*. The *Responsible Energy Development Act* describes the AER's mandate, which includes "efficient, safe, orderly and environmentally responsible development of energy resources in Alberta" and "protection of the environment" (Alberta 2013, s. 2). Among other things, the *Coal Conservation Act* "ensure[s] orderly, efficient and economic development of Alberta's coal resources in the public interest" and "control[s] pollution and ensure[s] environmental conservation" (Alberta 2000, s. 4).

Also relevant here is the public interest guidance in the *Environmental Protection and Enhancement Act*, which calls for environmentally responsible economic growth. In particular, the act's guiding purpose introduces "the principle of sustainable development, which ensures that the use of resources and the environment today does not impair prospects for their use by future generations" (Alberta 2021, s. 2(c)). The act also requires cumulative effects assessment in any environmental impact assessment, covering environmental, social, health, economic and cultural effects.

2.2. ALBERTA'S 1976 COAL POLICY AND PRINCIPLES OF COAL DEVELOPMENT

In 1976, the Government of Alberta under Premier Peter Lougheed introduced *A Coal Development Policy for Alberta*, which separated Alberta lands into four "categories" (Figure 2). The policy recognized coal as an important economic and energy resource for Alberta. More importantly, the policy also recognized the importance of other land uses and stated development would not be permitted "unless the Government is satisfied that it may proceed without irreparable harm to the environment and with satisfactory reclamation of any disturbed land" (Government of Alberta 1976, 3), and disallowed exploration and development in designated lands. As Bankes (2021a) notes, the policy was "an early and relatively crude form of landscape-level planning with respect to a single resource: coal." The four categories allow for increasing levels of coal activity.

Figure 2: Land Classification under the 1976 Coal Policy and Coal Development



Source: Alberta Energy Regulator (2015; n.d.b), United States Census Bureau (2018), Natural Resources Canada (2020), Statistics Canada (n.d.).

Category 1 covers national parks, provincial parks, and other areas of high environmental sensitivity[8] and does not allow coal exploration or development; land uses other than coal development "have a higher priority" (Government of Alberta 1976, 14). Category 1 is almost 4.2 million hectares in area (Table 1).

8 This includes proposed provincial parks, wilderness and natural areas, wildlife sanctuaries, heritage sites, and major bodies of water.

Table 1: Coal Land Categories' Total Area, Area Leased and Developed Area (hectares)

Category	Total Area	Area Leased (Per cent)	Area Developed (Per cent)
Category 1	4,155,506	*No leasing or development allowed*	
Category 2	1,458,400	25.7	0.6
Category 3	3,327,630	4.7	0.01
Category 4	533,236	14.1	1.83

Source: Alberta Energy (n.d.).

Category 2 covers lands in the Rocky Mountains and Foothills. The policy allows for limited exploration and development in this area, stating the preferred land use was not yet determined and, at the time, the area did not have much of the needed infrastructure to support coal development. Category 2 also "contains local areas of high environmental sensitivity," and coal development "may be permitted under strict control but in which commercial development by surface mining will not normally be considered" (Government of Alberta 1976, 14).

Category 3 includes the Northern Forested Region and eastern portions of the Eastern Slopes of the Rocky Mountains, as well as agricultural lands. Under the policy, "exploration is desirable," and development is allowable, "subject to proper assurances respecting protection of the environment and reclamation of disturbed lands" and the infrastructure associated with development is in the public interest (Government of Alberta 1976, 15–16). Interestingly, the policy includes a requirement that any surface mining on agricultural lands must involve reclamation to a level greater than or equal to productivity prior to mining activities.

Finally, Category 4 (lands not covered in the other three categories) has the least restrictions, with exploration subject to regulation and, like Category 3, development is allowable "subject to proper assurances respecting protection of the environment and reclamation of disturbed lands" (Government of Alberta 1976, 16).

The 1976 Coal Policy was clear that coal development should take place responsibly, "to bring and maintain maximum benefits, now and in the future, to the people of Alberta" (Government of Alberta 1976, 3). The policy stressed the need for proponents to conduct benefit-cost analyses, social impact analyses, and environmental impact assessments, and to develop reclamation plans. Embedded in the policy was a principle of balance between land uses, and between "resource development and environmental protection in order to maintain a desirable quality of life for future Albertans" (Government of Alberta 1976, 5).

Importantly for our purposes, and for the current policy discussion in Alberta, is the emphasis on both the public interest and the consequences of changing land uses:

> The Government recognizes the importance of Alberta's land resources for agriculture, recreation, forest products and wildlife, and is determined that proper attention be given to these alternative uses in the consideration of coal development projects… Only where the temporary withdrawal of the land from agricultural, recreational or other use for coal development is judged to be in

> the public interest, and where full reclamation is assured, will the Government authorize developments which would cause land disturbance. (Government of Alberta 1976, 6)

At the time of the policy's publication, resource development policies for the Eastern Slopes were under review, eliminating the area from consideration for coal leases. Category 2 development was restricted to underground only, as was Category 3. The policy gave additional direction that the province would only grant new leases in areas with a "reasonable likelihood" of permitting commercial mining operations, essentially eliminating Category 2 and Category 3 lands from extensive development (Bankes 2021a).

While not legally binding, the 1976 Coal Policy presided over coal development from the time of its introduction until 2020. It had an "*internal* legal effect" (emphasis in original) on Alberta Energy actions and planning (Bankes 2021a). It subsequently acquired enhanced legal status through implementation of Alberta's 2008 Land-Use Framework, the South Saskatchewan Regional Plan and the Livingstone-Porcupine Hills Land Footprint Management Plan (Bankes 2021a). The latter two documents explicitly suggest the Coal Policy categories be reviewed and potentially adjusted, but no changes were made until the 2020 rescission. We now turn to a discussion of land-use management.

2.3. LAND-USE MANAGEMENT

Due to its importance as wildlife habitat, as source water for much of the prairies, and as landscapes valued for their aesthetics and recreational opportunities, it is not surprising that from the late 19th century through today governments have emphasized conserving the Eastern Slopes. The Alberta and federal governments have undertaken a number of management actions focused on environmental protection, designation of numerous national and provincial parks and protected areas, and regional land-use plans.

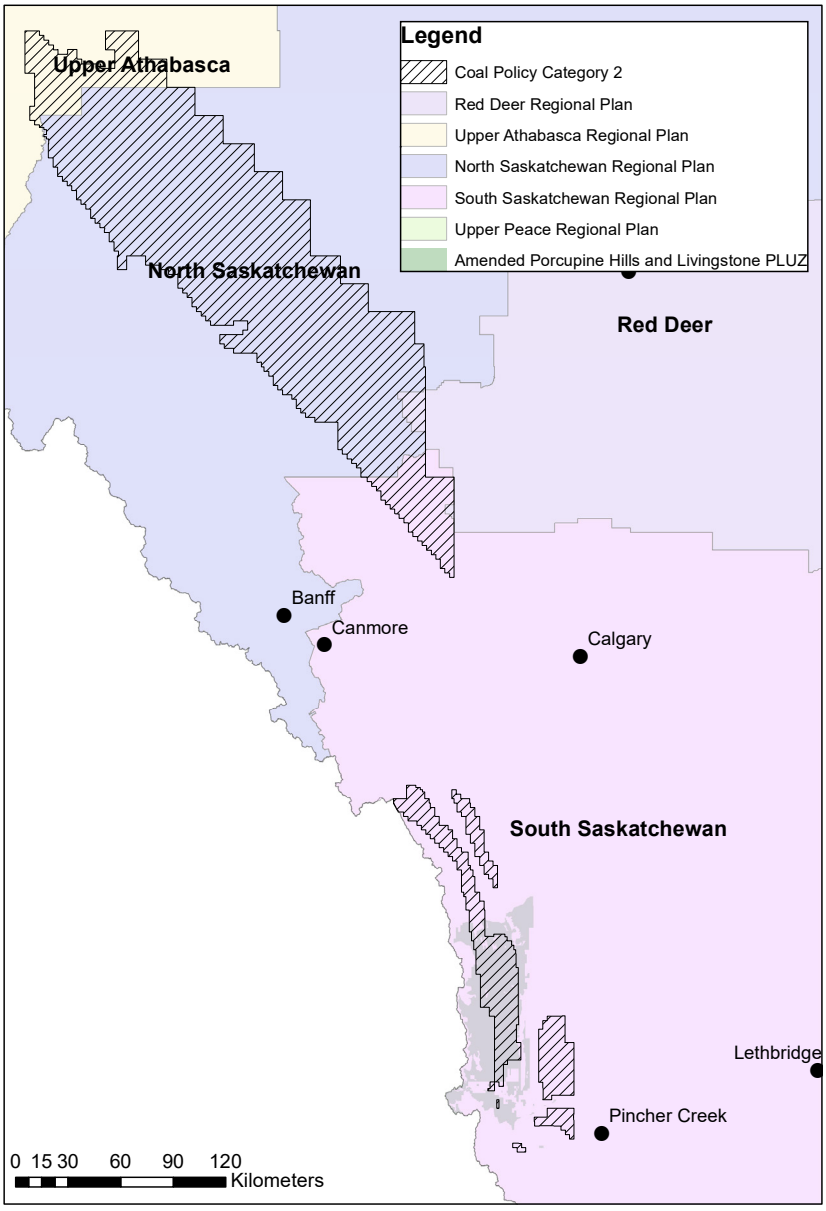
The Eastern Slopes have been the focus of a number of planning efforts. Beyond the 1976 Coal Policy, the 1977 Eastern Slopes Policy (revised in 1984) describes the government's management intentions for the Eastern Slopes, including protection, resource management and development (Government of Alberta 1984). The policy lists watershed management as the highest priority and recognizes recreation, tourism, renewable resources, and other values (Government of Alberta 1984; 2018, 4). The Eastern Slopes Policy introduced two environmental protection designations: (1) the prime protection zone, focused on high elevation lands with high aesthetic and ecological value; and (2) the critical wildlife zone, focused on wildlife protection but compatible with appropriate recreation and resource development (Government of Alberta 1984). This policy guided land and resource use on the Eastern Slopes until new land-use planning processes were initiated in the mid-2000s.

In 2008, the Government of Alberta initiated its Land-use Framework to manage cumulative effects, promote conservation and stewardship, promote efficient use of human activities, improve the knowledge base for management, and better include Indigenous Peoples in land-use planning (Government of Alberta 2008). The Framework identified seven regions for developing new regional land-use plans.

Four regions overlap the Eastern Slopes: the Upper Peace, Upper Athabasca, North Saskatchewan, and South Saskatchewan (Figure 3).

The regional plans are intended to balance economic development, environmental conservation and social impacts, as well as direct regulatory decision-making — such as where, when, and how coal development occurs (Government of Alberta 2008). The Framework lists three desired outcomes: a healthy economy supported by land and natural resources; healthy ecosystems and environment; and people-friendly communities with ample recreational and cultural opportunities (Government of Alberta 2008). As of August 2021, of the four regions relevant to the Eastern Slopes, only one land-use plan is approved (South Saskatchewan) and another started (North Saskatchewan).

Figure 3. Land-Use Plans on the Eastern Slopes



Source: Natural Resources Canada (2020), Alberta Environment and Parks (n.d.), Statistics Canada (n.d.).

The South Saskatchewan Regional Plan (SSRP) was finalized in 2014 and amended in 2017 and 2018 (Government of Alberta 2018). The plan is strategic in that it provides direction and a long-term vision to guide more geographically- and sector-focused plans and on-the-ground decision-making. The SSRP covers the southern portion of the province, from the B.C. to U.S. to Saskatchewan borders and slightly beyond Calgary to the north. The plan seeks to balance economic, environmental, cultural, and social values now and for future generations. Eight outcomes are sought (Government of Alberta 2018):

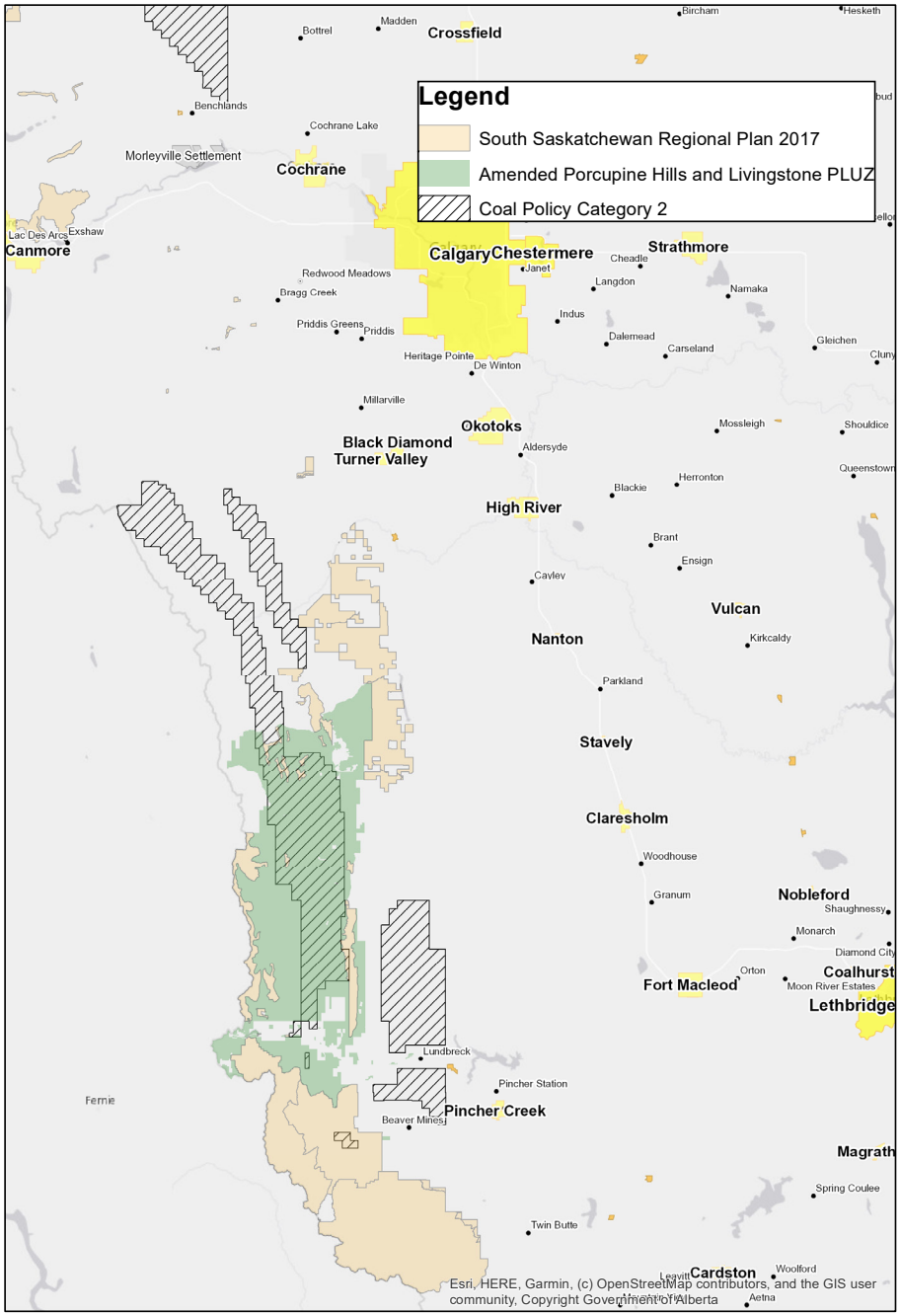
1. The region's economy is growing and diversified.
2. Air quality is managed to support healthy ecosystems and human needs through shared stewardship.
3. Biodiversity and ecosystem function are sustained through shared stewardship.
4. Watersheds are managed to support healthy ecosystems and human needs through shared stewardship.
5. Land is used efficiently to reduce the amount of area taken up by permanent or long-term developments associated with the built environment.
6. The quality of life of residents is enhanced through increased opportunities for outdoor recreation and the preservation and promotion of the region's unique cultural and natural heritage.
7. Aboriginal peoples are included in land-use planning.
8. Community development needs are anticipated and accommodated.

The SSRP provides an implementation plan to achieve these eight outcomes, and is a legislative instrument under the *Alberta Land Stewardship Act*.

Importantly, the SSRP is a means to build upon past planning efforts and underpin further planning. The SSRP "incorporates the principles and directions of the Eastern Slopes Policy" and supersedes it in the South Saskatchewan Region (Government of Alberta 2018, 4), and is intended to incorporate and replace other plans and policies. The status of this consolidation is unclear, as the most recent progress report on regional plans is from 2015.

Further planning has taken place, though, for the Livingstone and Porcupine Hills sub-regions. Building on the 1987 Livingstone-Porcupine Hills Sub-Regional Integrated Resource Plan, the 2017 Livingstone-Porcupine Hills Recreation Management Plan responds to the recreation values recognized in the SSRP for these sub-regions (Alberta Environment and Parks 2018b). The vision for recreation management in the sub-regions concerns maintenance of recreation alongside scenery, wildlife, and Indigenous cultural values. Likewise, the 2018 Livingstone-Porcupine Land Footprint Management Plan seeks to manage the cumulative effects of human activity on the sub-regions' natural assets and ecosystems (Alberta Environment and Parks 2018a). The plan sets legally backed zones, management thresholds, and other tools to manage impacts.

Figure 4. South Saskatchewan Regional Plan and Public Land-Use Zones



Source: Alberta Environment and Parks (2018b), Statistics Canada (n.d.).

2.4. COAL DEVELOPMENT IN ALBERTA

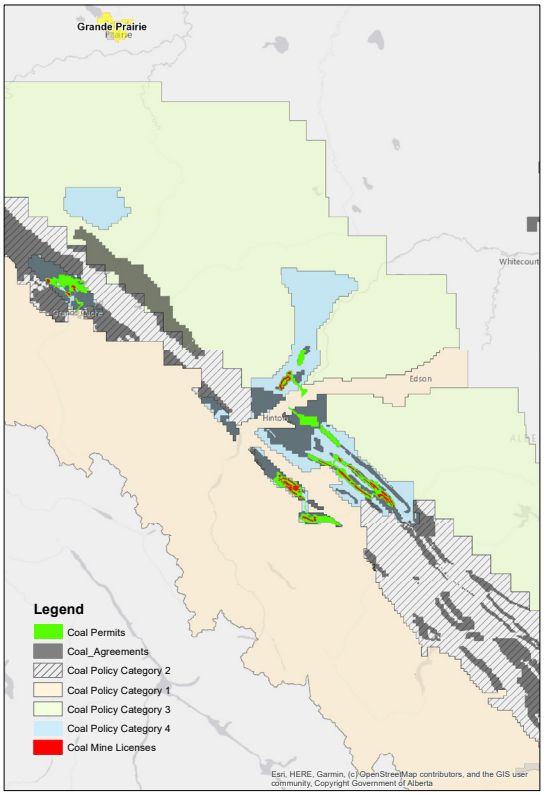
Coal underlies almost half of Alberta (Government of Alberta n.d.a), with reserves in 2020 of 33.1 billion tonnes (Alberta Energy Regulator 2021c). Since Alberta's first commercial mine in 1882, more than 2,300 small- and large-scale mines have operated in the province (Alberta Energy Regulator n.d.c). In 2016 (the latest data available), 830.8 million tonnes of reserves were under active development (Alberta Energy Regulator 2021d).

Geologically, two broad bands of coal run in a north-south orientation (Figure 5). Bituminous coal, generally a type of metallurgical coal used for steelmaking — and the focus of our study — is the western-most band, underlying the Rocky Mountains in the west and extending eastward onto the Eastern Slopes (Alberta Energy Regulator 2000; Government of Alberta 2020c). The total area of land in the Eastern Slopes with coal seams is about 4,900 km^2.[9] Substantial metallurgical coal deposits lie west of Alberta, most notably in B.C.'s Elk Valley (adjacent to the Crowsnest Pass) as well as northeastern B.C. (west of Grande Prairie).

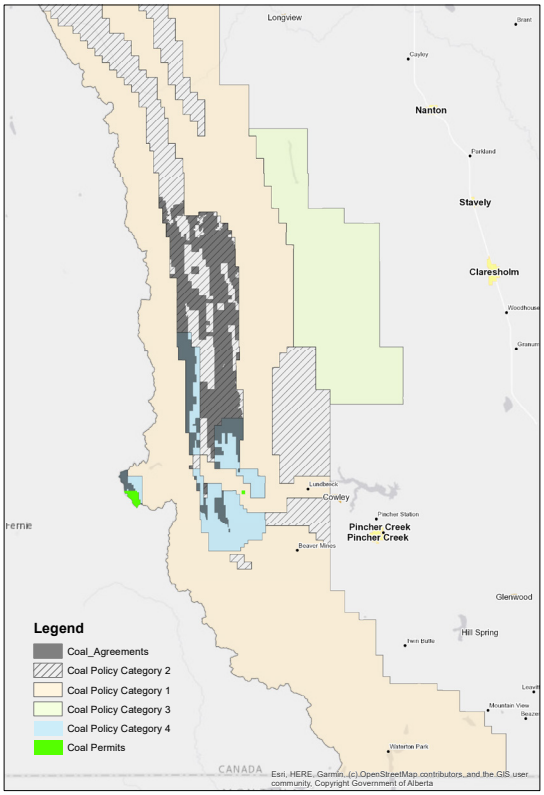
Between 2006 and 2020, Alberta let 175 coal leases, totalling 230,545 hectares. Currently, there are five coal mines in operation, three in suspension and one in closure (Table 2), with total annual output averaging 25 million tonnes over the last decade (Alberta Energy Regulator n.d.c). Alberta's coal production has trended downwards, due mostly to the shift away from coal-fired electricity generation and associated thermal coal mining (Figure 6). In 2020, Alberta produced 14.3 Mt of coal, 1 Mt of metallurgical bituminous for export and the rest sub-bituminous and thermal bituminous for power generation (Government of Alberta 2020c; Alberta Energy Regulator 2021b).

Figure 5: Alberta Coal Development

Panel A: North



Panel B: South

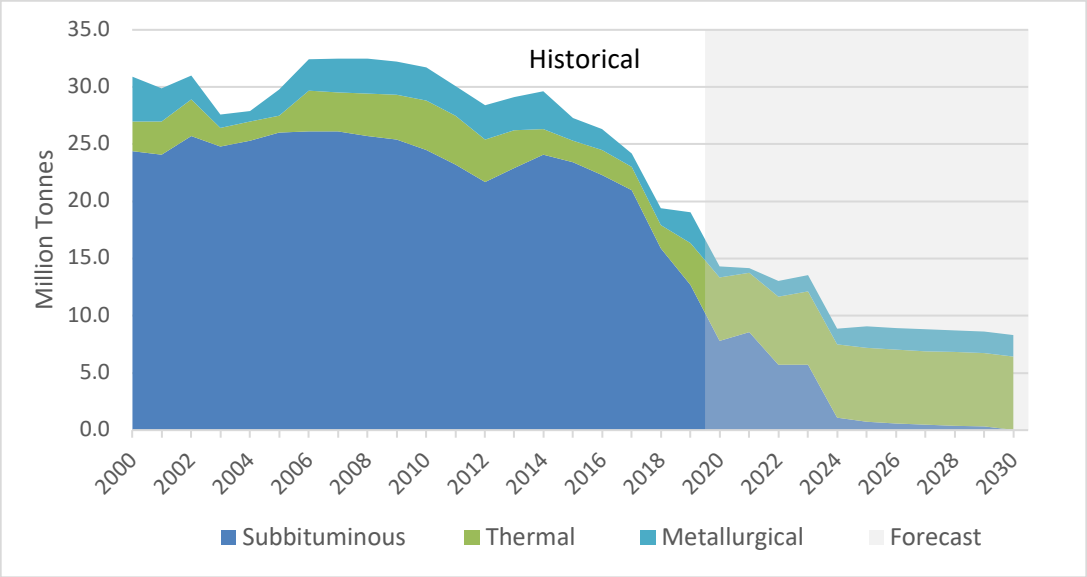


Source: Alberta Energy Regulator (2015; n.d.b); Statistics Canada (n.d.).

9 The AER distinguishes between coal resources above and below the 760m depth boundary (Alberta Energy Regulator 2000), presumably based upon underground mining technology at the time.

The Alberta Energy Regulator (AER) currently forecasts a continued decline in coal production in Alberta, from 14.3 Mt of marketable coal[10] in 2020 to 8.3 Mt by 2030, due to the phase-out of coal-fired electricity generation in the province (Alberta Energy Regulator 2021b). The AER anticipates metallurgical and thermal coal production, both for export, to grow over the coming decade and offset some of the decline in coal production for domestic consumption (Alberta Energy Regulator 2021b).

Figure 6: Alberta Marketable Coal Production



Source: Alberta Energy Regulator (2021e).

At present, there are at least 12 coal mine projects in various stages of development, representing over 25 million tonnes of production capacity per year. Many are proposed for Category 2 lands (Table 1). Of the new mine projects identified as in development, only a small subset are substantially advanced, and only a subset of mine projects that are proposed can be expected to ever make it to construction due to market, resource quality, or other factors. Notably, on June 17 the Joint Review Panel reviewing the Grassy Mountain application denied the project's approval, though its proponent has said it is "reviewing its options" and other proponents of proposed mine projects are continuing to advance their projects (Fletcher 2021a). International companies back many of the proposed projects (Table 3).

Before the Government of Alberta's pause of coal exploration activities, a variety of exploration activities took place on Category 2 lands, some as early as 2017 (Alberta Energy Regulator 2017a; 2017b; 2018a; 2018b; 2018c; 2018d; 2019a; 2019b; 2019c; 2019d; 2020a; 2020b; 2020c; 2020d; 2020e; 2020f).[11] Alberta's new coal policy could

10 Marketable coal is processed (washed) coal ready for sale.

11 According to Moroskat (2021b), Alberta Energy does not track the extent of exploration across coal leases, but proponents do not need to hold coal leases in order to obtain a coal exploration program approval. Furthermore, Alberta Energy has no data on the spatial extent of exploration that has occurred to date on Category 2 lands.

result in additional lands being developed beyond projects already proposed for Category 2. However, as discussed above, Alberta is not the final decision-maker, and the Government of Canada's denial of Grassy Mountain may signal limits on future development. Moreover, the fact that exploration is underway in Category 2 lands does not confirm viable reserves.

Table 2. Existing Coal Mines in Operation and in Suspension.

Mine	Mine No.	Proponent	Coal Rank	2020 Output (million tonnes)	Location and 1976 Coal Policy Land Category	Main Product	Status
Cheviot (Cardinal River)	1808	Teck Resources (Canada)	Bituminous	0.6	Hinton Category 4	Export: metallurgical	Closure (2020)
Coal Valley	1778	Westmoreland (USA)	Bituminous	0.7	Hinton Category 4	Export: thermal	In suspension (COVID). Expected restart late 2021.
Dodds	0215	Dodds Coal Mining (Canada)	Sub-bituminous	0.1	Ryley Outside the Categories	Small-scale sales	Operating
Genesee	1788	Westmoreland (USA)	Sub-bituminous	4.2	Warburg Outside the Categories	Electricity generation in Alberta	Operating
Grande Cache	1810	CST Coal (Canada)	Bituminous	0.4	Grande Cache Category 4	Export: metallurgical	In suspension (COVID)
Highvale	1769	SunHills Mining (Canada)	Sub-bituminous	2.4	Wabamun Outside the Categories	Electricity generation in Alberta	Operating
Paintearth/ Vesta	1781	Westmoreland (USA)	Sub-bituminous	0.1	Forestburg Outside the Categories	Electricity generation in Alberta	Operating
Sheerness/ Montgomery	1809	Westmoreland (USA)	Sub-bituminous	1.1	Hanna Outside the Categories	Electricity generation in Alberta	Operating
Vista	1815	Coalspur Mines (Operations) Ltd. (USA)	Bituminous	4.8	Hinton Category 4	Export: thermal	In suspension. Proponent in creditor's protection.

Sources: Government of Alberta (2020c); Alberta Energy Regulator (2021b; 2021e; 2021f); Rolfe (2021); Westmoreland Mining LLC (2021; n.d.a; n.d.b); CST Coal (n.d.); Teck Resources Limited (n.d.).

Table 3. Coal Mines in Development in Alberta.

Mine	Proponent	Coal Rank	Output (million tonnes per year)	Location and 1976 Coal Policy Land Category	Main Output	Status
Vista (expansion)	Coalspur/Vista Energy Holdings (USA)	Bituminous	Proposed expansion of 4.2	Hinton; Category for expansion unclear	Export: thermal	Expansion in development (early)
Aries	Ram River Coal (Canada)	Bituminous	4	Rocky Mountain House; Category 2	Export: metallurgical	In development (early)
Blackstone	Valory Resources (Australia)	Bituminous	Unknown	Rocky Mountain House; Category 2	Export: metallurgical	In development (early)
Cabin Ridge	Warburton (Australia)	Bituminous	Unknown	Crowsnest Pass; Category 2	Export: metallurgical	In development (early)
Chinook	Montem (Australia)	Bituminous	Unknown	Crowsnest Pass; Category 4	Export: metallurgical	In development (early)
Elan	Elan Coal Ltd./ Atrum (Australia)	Bituminous	6	Crowsnest Pass; Category 2	Export: metallurgical	In development (early)
Grassy Mountain	Benga/Riversdale Resources (Australia)	Bituminous	4.5	Crowsnest Pass; Category 4	Export: metallurgical	In development. Approval application denied June 2021
Moberly Creek	Noir Resources (Canada)	Bituminous	Unknown	Grande Cache; Category 2	Export: metallurgical	In development (early)
Palisades	Noir Resources (Canada) & JOGMEC (Japan)	Bituminous	Unknown	Hinton; Categories 2 and 4	Export: metallurgical	In development (early)
Summit Coal	Maxim (Canada)	Bituminous	1.3	Grande Cache; Category 4	Export: metallurgical	Permitted but no development.
Targa	Noir Resources (Canada)	Bituminous	3.6	Grande Cache; Category 2	Export: metallurgical	In development (early)
Tent Mountain	Montem (Australia)	Bituminous	1.2	Crowsnest Pass; Category 4	Export: metallurgical	In development (seeking regulatory approval)

Sources: Cassell (2014); Valory Resources Inc. (2019); Atrum Coal Ltd. (2020); Government of Alberta (2020c). Alberta Energy Regulator (2021b); Cabin Ridge Project (2021; n.d.); Montem Resources (2021; n.d.a; n.d.b); Noir Resources Ltd. (n.d.a; n.d.b); Maxim Power Corp. (n.d.); Ram River Coal Corp. (n.d.);

2.4.1. Economic Impacts

There are limited data on employment in coal mining in Alberta, but what is available gives a sense of the scale of the economic impact of coal mining in the province. In 2020, there were 7,791 people employed in coal mining across Canada, which was 0.0005 per cent of total Canadian employment; in Alberta, the number of people employed in coal mining is suppressed for confidentiality reasons (Statistics Canada 2021c). According to Urquhart (2021a) in an Alberta Wilderness Association newsletter, there were 1,600 Albertans employed in coal mining in 2019, and according to Jeyakumar (2016) there were about 2,500 jobs in "coal mining and processing" in the province. As with other mining jobs, coal mining tends to pay well: an average of between $75,000 in July 2021 (Payscale n.d.a; n.d.b) and $104,000 in 2020 (Statistics Canada 2021d), or almost double the average industrial wage in Canada.

In 2020, coal mining was responsible for $2.6 billion in gross domestic product (GDP), or about 0.1 per cent of Canada's total GDP ($1.9 trillion), down from an average of $3.5 billion over the 2010 to 2020 period (Statistics Canada 2021a). Coal mining in Alberta accounted for $215 million in 2020 (chained 2012 dollars), or 0.07 per cent of Alberta's GDP (Statistics Canada 2021b).

Coal mining activities pay taxes and royalties to the provincial government, as well as local governments and the federal government. Over much of the past decade, the province has collected between $5 million and $12 million in royalties on bituminous coal, and between $5 million and $9 million from sub-bituminous coal (Government of Alberta 2020c). The value of all coal lease sales between 2006 and 2020 is just over $4 million (nominal dollars). Over the 2019-20 fiscal period, coal royalties were 0.2 per cent, or about $12 million, of a non-renewable resource revenue total of $5.9 billion (Government of Alberta 2020a). In comparison, bitumen and conventional oil generated $4.1 billion and $1.2 billion, respectively, over the same period (Government of Alberta 2020a). No data are available on tax payments by the Alberta coal industry (Moroskat 2021b).

3. METHODOLOGY

3.1. ASSESSING THE PUBLIC INTEREST OF COAL DEVELOPMENT

The goal of this report is to assess whether coal development in the eastern Foothills of Alberta's Rocky Mountains is of public interest. Exactly what is meant by the "public interest" and how it should be assessed, however, is not well defined.

Hierlmeier (2008) notes the "public interest" is defined in many different and often contradictory ways. This can include the notions of common interest (an interest that is common to all members of society); majority interest; balance of interests (requiring a process of negotiation or compromise among competing interests); and economic interests (with economic goals taking priority over social and/or environmental ones), to name a few.

The Canada Energy Regulator uses the working definition of the public interest as "inclusive of all Canadians and refers to a balance of economic, environmental, and social interests that change as society's values and preferences evolve over time" to assess the public interest of projects (Canada Energy Regulator 2020b, 3). In a recent report, *Public Interest Determination for Infrastructure Development*, Goodday, Winter and Westwood (2020) similarly conclude the determination of whether a project is in the public interest requires some weighing or balancing of its different positive and negative economic, environmental, and social consequences. The question of public interest is thus centred around which consequences should be taken into account, a determination of what is incremental, and how various trade-offs among different consequences should be weighted.

In economics, traditional **benefit-cost analysis (BCA)** weighs the positive and negative consequences of a project based on the values people place on their effects, i.e.,

what people are willing to pay for the positive, or must be compensated to offset the negative effects. The public interest question BCA addresses is whether the total amount people are willing to pay for all of the outputs and positive consequences of a project exceeds what they would have to be compensated to offset the costs of the inputs and negative consequences. BCA is an important and widely used methodology, but it has some key limitations. Not all consequences can reliably be captured in dollar measures of willingness-to-pay or compensation demanded. Moreover, assessment of the public interest cannot generally be reduced to a single monetary value. The nature and distribution of benefits and costs are important considerations that require additional analyses.

An alternative to BCA is **multi-criteria analysis (MCA)**, also known as **multiple account analysis (MAA)**. Rather than trying to convert impacts into dollar values, MCA establishes a set of evaluation criteria and performance indicators in order to assess the public interest (Shaw et al. 2001; Robertson and Shaw 2004; 2006; Shaffer 2010).[12] For example, criteria could be local job creation or particular environmental thresholds, such as emissions limits. MCA avoids the monetization problems of BCA but has its own limitations. Unlike BCA, MCA does not ensure all of a project's effects are taken into account — only pre-defined criteria and performance indicators are used in scoring a project. The subjective weights assigned to each criterion, as well as their subjective inclusion or exclusion, can result in project "scores" that are misaligned with what one might consider a project's truly incremental societal value.

Multiple account benefit-cost analysis (MABCA) was developed, unlike MCA, to retain many of the strengths of traditional BCA while recognizing that not all consequences can be monetized and that the assessment of public interest cannot in general be reduced to a single monetary value.[13] Instead of working toward a monetized measure of overall net benefits, MABCA uses a set of accounts to evaluate how a project affects different stakeholders. Dollar measures of value are calculated where that can be done in a meaningful and reliable way; otherwise, physical measures or descriptions of the magnitude and significance of impacts are used. Because there is no need to calculate an overall bottom line, the significance of different consequences does not have to be measured in common dollar terms.

Most projects — and coal development is no different — result in winners and losers among affected stakeholders. Rather than trying to weight these trade-offs to determine a single net benefit, MABCA presents the distribution of costs and benefits, allowing the public and policy-makers to transparently determine if the trade-offs are in the public interest. This transparent focus on the distribution of costs and benefits is a core strength of the MABCA methodology.

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12 The Government of Canada requires the use of MAA in assessing alternatives for mine waste disposal (Environment and Climate Change Canada 2012).

13 See Shaffer (2010) for a comprehensive explanation of MABCA and its application.

3.2. APPLYING MULTIPLE ACCOUNT BENEFIT-COST ANALYSIS

The best way to understand the application of MABCA is by way of a thought experiment. Imagine two potential worlds. Both are identical in all aspects except one decides to develop a particular project, in our example a metallurgical coal mine, while the other does not. The subsequent *difference in outcomes* between these two worlds — in terms of effects on employment, on the environment, on recreation, etc. — is what MABCA is meant to identify and assess. This focus on *incrementality,* or difference in outcomes, is critical to properly attributing truly incremental costs and benefits to the project.

Implicit in this analysis is a baseline, or no-development scenario. In other words, what would the local ecosystem and economy more generally (employment, environment, etc.) look like in the absence of developing this project? It is not sufficient, for example, to measure employment benefits as the number of jobs or person-hours to build and operate the project. The true economic benefit is relative to the employment situation that would otherwise have occurred absent the project. In times of extreme weakness in labour demand and high unemployment, such a gross measure may fairly approach the real employment benefit. The jobs in that scenario may properly be considered incremental benefits of the project; however, more typically, employment for one project simply represents a *shift* in jobs between and across sectors and locations. The economic benefit in that situation is the extent to which real wages increase because of the project's labour demand.

In addition to constructing a baseline, the other preliminary decision is determining the appropriate *reference jurisdiction*. For example, if the Government of Alberta is assessing the merits of developing coal mines in southeast Alberta, it may want to exclude any employment gains (or losses) in British Columbia from its MABCA analysis; a similar analysis by the Government of Canada would likely include such extra-provincial impacts (but they might exclude many gains and losses occurring outside Canada). Determining the stakeholders with standing in the analysis, and thus the reference jurisdiction, is a required explicit first step in the analysis. For the purposes of this analysis, we consider the reference jurisdiction to be Alberta (though we acknowledge global impacts of any greenhouse gas emissions).

3.3. THE MABCA ACCOUNTS

The purpose of creating "accounts" in the MABCA methodology, and its key difference from traditional benefit-cost analysis, is to illustrate the distribution of winners and losers among a variety of affected groups (or stakeholders). Each account represents the real and incremental consequences of the project relative to the baseline, or no-development, scenario.

While we list a set of accounts commonly used in MABCA, there is no rigid requirement for which accounts to include. The structure and choice of accounts is intended as a useful tool to better understand the distribution of impacts of a project on relevant groups. Importantly, the MABCA approach is a social (or public interest) benefit-cost analysis, investigating the distribution of benefits and costs to society as a whole.

3.3.1 Market Valuation Account

A typical MABCA analysis starts with the **market valuation account**. This account captures the net revenues (i.e., gross revenues less all costs) for the project itself. With a privately developed project, this account is the discounted cash flow analysis to determine a project's profitability. With a publicly funded project, the market valuation account is often large and negative. Consider, for example, the construction of a bridge, school or hospital. With the exception of bridge tolls or private schools, the revenues will be low or non-existent in these projects but costs will be large. In this case, the negative value of the market valuation account simply represents the real costs of the project; the benefits would typically accrue in a **user account** where use value is high and costs are low or zero.

With coal development, the market valuation account represents the expected private profit from development (rather than the social net benefits, which are constructed from the different accounts). While we calculate this value in Section 4.2, for our purpose of determining overall public interest it is sufficient to assume this account passes a threshold of being non-negative in order to proceed. That is, given the presence of one or several project proponents willing to invest in a project like a coal mine — with more detailed information about expected costs and revenues — we can assume the net benefit to the proponent is positive, and therefore the market valuation account is as well.

3.3.2. Taxpayer Account

A key argument in support of coal development in the Rockies has been the incremental taxes and royalties that would be collected by the activity. While taxes and royalties are costs to the private proponent, they are transfers that result in benefits to taxpayers. The key to the taxpayer account is assessing whether and to what extent such revenues are incremental to the no-development scenario. Coal royalties, for example, can reasonably be considered incremental to the no-development scenario.

The taxpayer account also recognizes any costs from government services that are provided free or at rates that do not reflect their full costs, i.e., subsidies. Examples could be if development requires public construction of roads or local schools or hospitals to manage increased activity and population.

3.3.3. Economic Activity Account

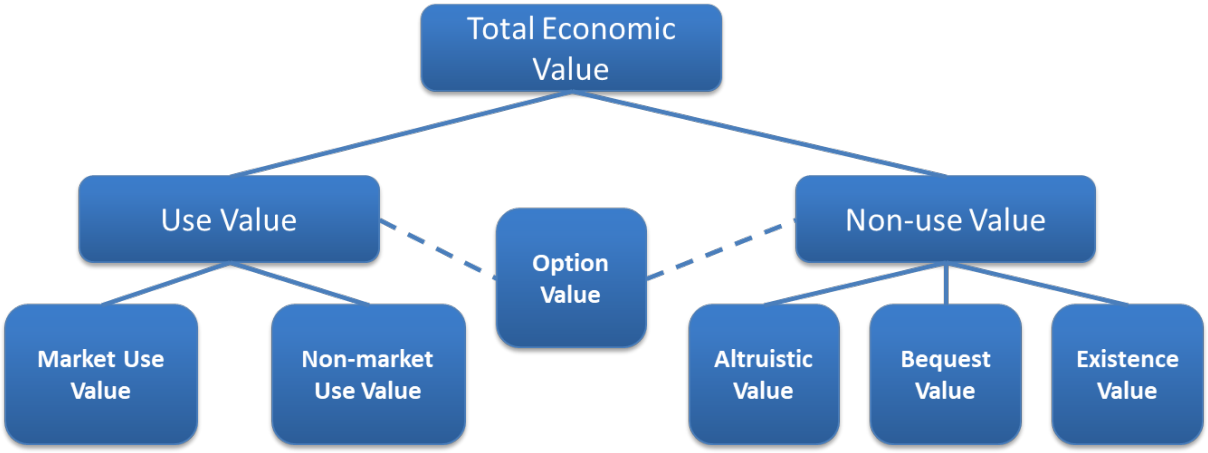
This account captures the net benefits that workers and business receive because of economic activity due to the project. As per the taxpayer account, many of the benefits in this account (e.g., labour income) are costs in the market valuation account. The purpose of disaggregating is twofold. First, it allows for a clearer picture of the distribution of costs and benefits from the project. Second, it allows for a careful assessment of which costs and benefits should be considered incremental, i.e., relative to what would have been in the no-development scenario. To the extent that workers are simply shifting from one job or another location in the province, to coal mining, the benefit is any incremental increase in real wages, not the gross amount.

3.3.4. Environmental Account

The environmental account captures the nature, magnitude and significance of environmental impacts of coal mining relative to the no-development scenario. This account includes impacts to both use and non-use environmental values (Figure 7). For example, harm to parks, Crown land and recreation areas impairs the use of such areas, reducing their use value. These are often non-market values, but elements can have market values from tourism and recreation activities. Whereas harm to the natural environment can affect non-use values, from the existence value of pristine wilderness — value society ascribes to the existence of such an environmental state — to bequest values due to the loss of the ability to pass on an undisturbed area of land from one generation to the next.

In the context of this analysis, the environmental account will be key to facilitating a clear understanding of the trade-offs between environmental costs and the results from other accounts. The purpose of the environmental account is to provide perspective on the magnitude and significance of expected environmental damages.

Figure 7. Total Economic Value and its Components.



3.3.5. Other Accounts

Several other accounts can be used to disaggregate the benefits and costs of the project to better understand impacts on certain stakeholders. Other accounts we consider in this analysis are Indigenous Peoples, as an affected group with different rights than the broader public, and a social account, which measures benefits and costs to the community. For example, these could be benefits such as increased services available to the community, or they could also be costs due to an influx of workers and population leading to higher crime rates.

4. MABCA RESULTS

This section focuses on incremental impacts of a coal mine on Category 2 lands in Alberta between 2021 and 2068. We start with key assumptions, then proceed to discuss each of the MABCA accounts in turn.

4.1. KEY ASSUMPTIONS FOR COAL MABCA

This analysis examines the impacts of incremental coal development separate from development already allowed under the 1976 Coal Policy. We use the word "incremental," as we compare the estimated impacts to a likely no-development scenario under the 1976 Coal Policy. Therefore, this analysis examines the potential impacts of coal development in what are currently Category 2 lands. We evaluate the effects from the perspective of the province of Alberta. We compare two scenarios:

1. No coal development in Category 2 lands (i.e., the no-development scenario), and
2. Coal development in Category 2 lands (i.e., the development scenario).

A caveat of our analysis is that we focus on Category 2 lands alone, and so our assessment does not include implications of coal development on the Eastern Slopes in their entirety. However, we do consider the cumulative effects of such development within our assessment, i.e., we interpret the potential effects of coal development on Category 2 lands within the context of impacts occurring on Category 3 and 4 lands.

4.1.1. No-development Scenario

In the no-development scenario, we assume that all coal development activities in Category 2 lands cease as of spring 2021: the Government of Alberta's April 2021 moratorium continues indefinitely, beyond the terminal year of this analysis.

4.1.2. Development Scenario

The development scenario entails continued coal exploration in Category 2 lands and eventually, one greenfield surface mine is built. This mine produces bituminous, metallurgical coal for export, consistent with the coal resource within (or underneath) Category 2 lands. We assume that within the roughly 1.5 million hectares classified as Category 2, exploration activities including road development, drilling, and small-scale coal extraction for testing occur. These activities are concentrated in five areas of roughly 5,000 hectares[14] each that receive attention between 2017 and 2026 (i.e., a 10-year period from when exploration in Category 2 lands began). We further assume that one of these exploration sites leads to a developed surface mine.[15]

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14 The Grassy Mountain project site is about 3,000 hectares, but it is a brownfield development (Riversdale Resources 2015).

15 It is common for only a subset of exploration programs to lead to mine pre-feasibility and feasibility studies, and only a subset of these to make it to environmental assessment applications and approvals, and only a subset of these to make it to positive final investment decisions and finally to construction.

We present our base assumptions below. To account for uncertainty, we adjust costs, prices and production by 10 per cent up and down to reflect pessimistic and optimistic scenarios (from the point of view of coal development). The pessimistic scenario therefore has a 10 per cent decrease in per-tonne profits, a 10 per cent increase in other costs (excluding exploration) and a 10 per cent decrease in production. The optimistic scenario has a corresponding 10 per cent increase in per-tonne profits, a 10 per cent decrease in other costs (excluding exploration), and a 10 per cent increase in production. These bounds are not definitive and we present additional sensitivity analysis where appropriate.

Physical Characteristics

This single mine is situated on Category 2 lands north of the Crowsnest Pass area at a distance from communities in the area. The lease area is 5,000 hectares and the disturbed area from mine activities is 1,500 hectares.

The mine will have a nominal production capacity of three million tonnes per year of marketable (clean[16]) coal and a 20-year lifespan. This production capacity and lifespan is comparable to the proposed Grassy Mountain mine and other recently proposed projects.[17]

The surface mine includes surface pits, waste rock disposal areas, a coal handling and processing plant and water management structures (e.g., berms, end-pit lakes). An overland conveyor belt transports cleaned coal to a rail load-out facility along the Canadian Pacific Railway line in Crowsnest Pass, where it is then loaded onto rail cars and transported to the Port of Vancouver for export to Asia.

Timing Assumptions

The mine proceeds through the prefeasibility, feasibility and environmental assessment regulatory processes by the end of 2026, and is constructed over a two-year period by the end of 2028.[18]

We assume production takes two years to ramp up to three million tonnes per year. After 16 years of full production, production ramps down for two years. We apply a production factor of 75 per cent to this production schedule — i.e., production is reduced from the maximum capacity amount — to reflect technical, market, or other challenges, including temporary shutdowns, which are common with coal mines in Alberta, B.C. and elsewhere (Allan et al. 2020). This production factor is adjusted 10 per cent up and down to reflect optimistic and pessimistic scenarios, respectively.

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16 In contrast to run-of-mine coal, clean coal has been sized, separated from soil and other contaminants, dewatered and otherwise prepared for sale.

17 Grassy was anticipated to have an average annual production of 4.5 million tonnes of clean coal and a production lifespan of 23 to 25 years (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021; Riversdale Resources Limited n.d.).

18 This is consistent with the two-year construction phase that was anticipated for Grassy Mountain (Nichols Applied Management 2016).

We assume that progressive reclamation will begin while operations are still underway, and that 20 additional years of reclamation occur post-operation. Reclamation occurs between 2049 and 2068.

Discounting

We discount all monetized values using two alternative rates: (1) an eight per cent rate consistent with the Treasury Board of Canada Secretariat's default recommendation, and (2) a rate of three per cent consistent with the Treasury Board of Canada Secretariat's recommendation when addressing impacts on private consumption or environmental goods and services, and consistent with other studies of sustainability matters (Treasury Board of Canada Secretariat 2007; 2018). For non-monetized impacts, we approach discounting in qualitative terms.

Labour Requirements

Based upon employment projections from proposed coal mines, we assume the mine requires 750 person-years of labour during construction — or about 375 workers for two years — and about 300 full-time jobs over the 20-year operations phase. Grassy Mountain was anticipated to have an annual production capacity of four million tonnes and require 1,000 person-years during construction, or 250 construction workers per million tonnes of annual capacity, and 385 workers during operations, or 86 operational jobs per million tonnes of capacity (Nichols Applied Management 2016). The Tent Mountain project is anticipated to require 158 operational workers per million tonnes of capacity and the Vista project about 55 operational workers per million tonnes of capacity (Government of Alberta 2020c; Montem Resources n.d.b). The average operational worker requirements of the Grassy Mountain, Tent Mountain, and Vista projects are about 100 workers per million tonnes of capacity. For the mine in our development scenario — an assumed annual production capacity of three million tonnes — means 300 jobs.

However, with our assumption that market conditions and other factors will lead to only a 75 per cent production factor, the effective number of operations jobs is 225. We err on the conservative side of potential employment income and use a figure of $75,000 per year for these jobs.

Costs

We make a variety of assumptions with respect to the cost of coal development in Category 2 lands.

Exploration

We assume at each of the five exploration sites an average of 7,500 metres of drilling occurs at a cost of $500 per metre.[19]

[19] According to Farmer (2021) of Telkwa Coal, drilling tends to be between 5,000 to 10,000m per site, and drilling costs average about $500 per metre.

Capital Costs

We assume $800 million in capital costs, based on other recently proposed projects. Grassy Mountain's proponent states capital costs are $730 million while the Alberta government states $800 million (Government of Alberta n.d.g). Another comparable project proposed for the same region of the province — the Atrum Elan project — has an estimated capital cost of $773 million (Nichols Applied Management 2016; Atrum Coal Ltd. 2020). Given the tendency of project costs to rise over the course of a project's development, we assume a capital cost of $800 million.

Study Costs

We assume pre-feasibility, feasibility, baseline and environmental assessment studies and processes; we assume $40 million in total costs. One source suggested at least $15 million, but another source suggested five per cent of capital costs (Baldwin 2021; Farmer 2021). We assume total study costs of $40 million (2021 CAD) incurred in $8 million amounts over a five-year period from 2022 to 2026, based on five per cent of an assumed $800 million capital cost. This cost is $32 and $22 million in present value terms at discount rates of three per cent and eight per cent, respectively.

Operating Costs

We assume operational costs of $90 CAD per tonne of actual production, incurred over the project's 20-year production life (2029 to 2048). These costs are based upon the Grassy Mountain project's estimated operational costs of $89 per tonne (Riversdale Resources Limited 2019).

Reclamation and Remediation

We assume a lease area of 5,000 hectares and a disturbed area of 1,500 hectares. The reclamation cost is $250 million (undiscounted), or $85 and $17 million in present value terms at discount rates of three per cent and eight per cent, respectively. The costs are incurred over the latter 10 years of operations (i.e., progressive reclamation) and the 20 ensuing years of the mine's reclamation phase.

Benga assumed a reclamation cost of $131 million for the Grassy Mountain project (Riversdale Resources Limited 2019). However, the Joint Review Panel denied Benga approval for its proposed project in part due to mitigation deficiencies (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). Another proponent, Teck Resources, has spent significant amounts trying to address water and other reclamation issues at its coal mines. In 2020, Teck was ordered to examine methods to improve water quality outcomes, at an estimated cost of up to $400 million on top of an estimated $600 million between 2015 and 2020 to address water quality impacts alone (McCormack 2020). Another estimate puts the cost of mine reclamation at $175,000 per hectare for challenging topographic sites, which we assume will be the case with a mine site on the Eastern Slopes (Stelfox and Donahue 2021).

Using a figure of $175,000 per hectare for the assumed disturbed area of 1,500 hectares gives a reclamation cost of $263 million; we assume a cost of $250 million

given uncertainty in the actual amount. This amount is much larger than what the Grassy Mountain proponent estimated but is in line with expert opinion of actual costs, consistent with Teck's costs in the Elk Valley, and consistent with the Grassy Mountain review panel's conclusions (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021).

Coal Prices

Our base case long-term average coal price is $130 CAD (2021 dollars) per tonne (or $108 USD per tonne) over the mine's life. The optimistic and pessimistic scenarios raise and lower this price by 10 per cent, respectively. Coal prices are historically volatile; between 2010 and 2020 for example, U.S. metallurgical coal prices reached a high of $183 USD/t, a low of $62 USD/t, and averaged $114 USD/t (U.S. Energy Information Administration n.d.).[20] We adopt an average price to reflect anticipated highs and lows over the mine's life.

Numerous energy information authorities assume declining demand for metallurgical coal due to global climate policy actions and a shift away from coal-based steelmaking (Canada Energy Regulator 2020a; International Energy Agency 2020; 2021). The Grassy Mountain review panel echoed this concern, noting that the market for metallurgical coal may change due to climate policy, including through a possible shift to greener steelmaking technology (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021; Thomson Reuters 2021). The net effect on price is uncertain, given uncertainties about global supply in the face of potentially declining demand. Finally, available information on the metallurgical coal in the Eastern Slopes (inclusive of the Crowsnest Pass) suggests it is relatively low quality, creating a quality discount (Kolijn 2021a; 2021b).

Considering all these factors, our base case is an average price of $130 per tonne (2021 CAD) or $108 per tonne (2021 USD) over the mine's life. Our high price for the optimistic scenario is an average price of $143/t (2021 CAD) or $114/t (2021 USD), and our low price for the pessimistic scenario is an average price of $117/t (2021 CAD) or $94/t (2021 USD).

Our base case average price is more conservative than Benga's assumed benchmark price of $163 CAD/t ($135 USD/t) and less conservative than Benga's low price case of $121 CAD/t ($100 USD/t). Our pessimistic scenario price is slightly more conservative than the Benga low-price case. Importantly, as indicated in the Grassy Mountain hearings, Benga's assumed benchmark price of $135 USD/t is an index price and Benga would receive a lower price than this due to location, quality, or other discount factors (Riversdale Resources Limited 2019).

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20 These historical prices are within +/-10 per cent of the average price ($114/t) for 29 per cent of the data. Increasing the price adjustment to +/-15 per cent increases the share of prices within the range to 40 per cent, and with +/-20 per cent the share within the range increases to 51 per cent. We keep the range at +/-10 per cent for ease of analysis (so the changes to costs, production and prices with the optimistic and pessimistic scenarios are symmetric), and to be conservative with the range around the base price. We present additional sensitivity analysis below.

Taxes and Royalties

We assume that several types of payments are incremental and discuss the assumptions for each. Corporate income tax payments are incremental, given no assurance of alternative capital investment in the no-development scenario. Rental fees, property tax and royalties are incremental, given no alternative prospects for development of the relevant lands and coal resources. Carbon tax payments are incremental, given no assurance of alternative capital investment involving GHG emissions in the no-development scenario. Finally, we include only those personal income tax payments associated with incremental employment benefits.

Corporate Income Taxes

As of 2020, Alberta charges an eight per cent rate on corporate income (Government of Alberta n.d.b). Federally, the rate is currently 15 per cent (Government of Canada n.d.). We assume both rates will hold over the life of the mine.

Royalties and Rental Fees

Alberta charges one per cent of mine mouth revenue before mine payout, and one per cent of mine mouth revenue plus 13 per cent of net revenue after payout (Government of Alberta n.d.d). We estimate royalties for the coal mine in the development scenario based on the method presented in the Alberta government's coal royalty guidelines (Alberta Energy 1993).

Alberta's coal-lease rental fee is $3.50 per hectare, though coal leases are not necessary to conduct coal exploration (Moroskat 2021a; Government of Alberta n.d.c). The annual lease cost per 5,000-hectare exploration site is $17,500. Given this relatively minor expense, and the short time frame of each exploration program, we ignore rental fees except in the case of the mine site. We assume that the developer acquires the coal lease after five years of exploration for the 5,000-hectare area.

Property Taxes

We assume that the new mine will occur solely within the Municipal District of Ranchland No. 66 and the municipality receives all property taxes. We assume the annual property tax payment is $1.5 million, from beginning of construction through to the end of the scheduled reclamation period, consistent with recent estimates for the Grassy Mountain project (Nichols Applied Management 2016, 2).

Carbon Taxes

Alberta's current Technology Innovation and Emissions Reduction (TIER) Regulation imposes a cost on facilities emitting 100,000 tonnes of CO_2e or more per year, or facilities with emissions above 10,000 tonnes of CO_2e that are designated as emissions-intensive and trade-exposed (Government of Alberta n.d.i). Coal mines are included in this designation. It is not assured that there would be some alternative facility subject to TIER in the no-development scenario, and therefore we assume that carbon tax revenue in the development scenario is incremental.

Other Taxes

Given current and anticipated labour market conditions, most personal income tax would otherwise be earned in the no-development scenario. We discuss this further in our results. Similarly, we assume that the development scenario will have no particular effect on the economic output of fuels and other goods and services, and therefore fuel tax revenue associated with coal development is not incremental.

4.2. MARKET VALUATION ACCOUNT

The market valuation account represents the net revenue of the coal proponent. It estimates the revenue earned from coal sales less all the costs involved in coal development and production, including the costs to the proponent associated with tax payments.

4.2.1. Costs of Coal Development

There are five costs to coal developers: exploration, studies including regulatory review, construction, operations, and reclamation. In general, exploration can take five to 10 years, regulatory review up to five years, construction about two years, operations 10 to 30 years, and reclamation 10 or more years (Allan 2016; Farmer 2021). We consider these costs incremental, as in the non-development scenario they would not otherwise be spent in Alberta.

We estimate for a single representative mine, coal development proponents incur about $19 million in undiscounted exploration costs, or $16 million and $13 million in present value terms at discount rates of three per cent and eight per cent. This includes both capital and labour costs.

Study costs for the developer, covering pre-feasibility, feasibility, baseline and environmental assessment studies and processes, amount to $40 million (undiscounted) over a five-year period, or $32 million and $22 million in present value terms at discount rates of three per cent and eight per cent.

Undiscounted construction costs will be a total of $800 million incurred over a two-year period, or $570 and $330 million in present value terms at discount rates of three per cent and eight per cent, respectively.

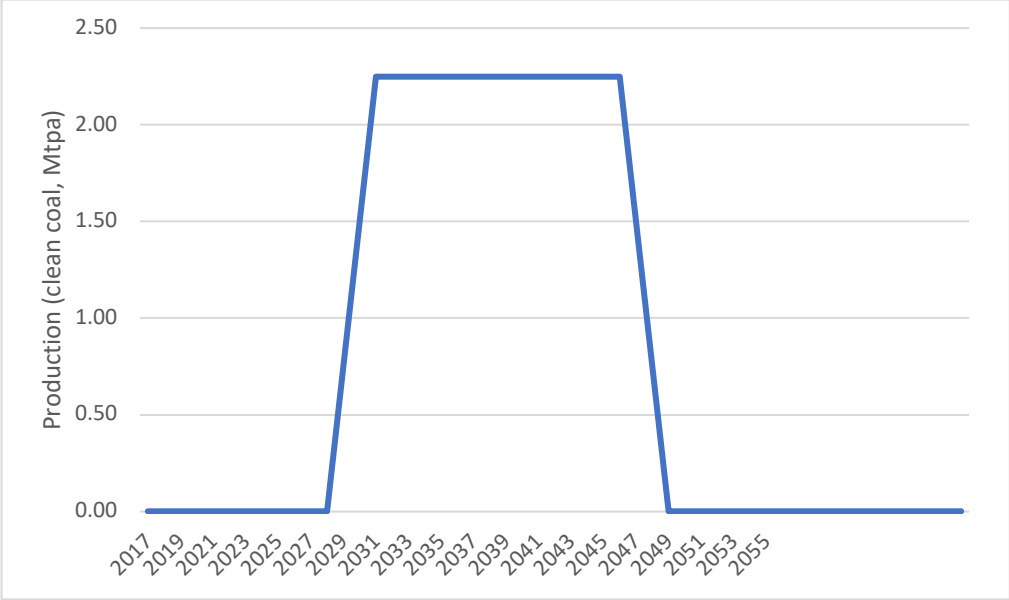
Operational costs are $90 per tonne of actual production, incurred over the production life of the project, a 20-year period beginning in 2029 and ending in 2048. These costs add up to $3.6 billion undiscounted, or $1.9 and $0.7 billion in present value terms at discount rates of three per cent and eight per cent.

With a lease area of 5,000 hectares, and a disturbed area of 1,500 hectares, reclamation costs are $250 million undiscounted, or $85 million and $17 million in present value terms at discount rates of three per cent and eight per cent. This amount reflects what the proponent may actually pay for reclamation, but not necessarily the full costs of reclamation.

4.2.2. Production and Mine Revenues

The case study mine will have a planned production capacity of three million tonnes per annum (Mtpa) of marketable coal. However, between ramp up and ramp down in the early and latter years of the mine's production life, and after accounting for temporary shut-downs and other challenges, only about 41 million tonnes of marketable coal are produced over the mine's life (Figure 8).

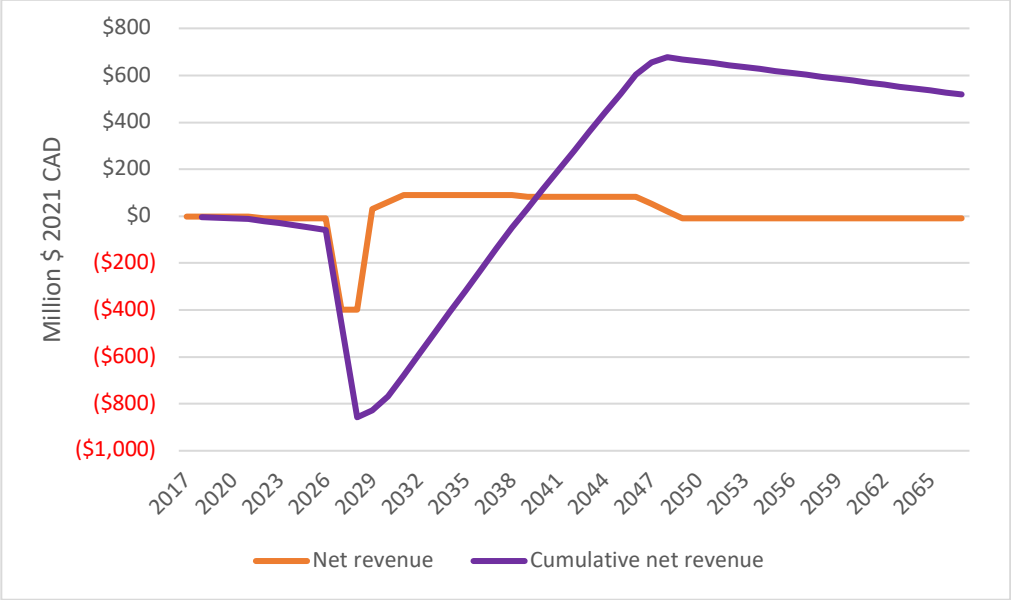
Figure 8. Production From New Coal Mine on Category 2 Lands (Development Scenario)



Note: Production of three million tonnes per year nominal mine with ramp up and ramp down as well as 75 per cent production factor reflecting temporary shut-downs or other challenges affecting production.

Accordingly, we estimate that the gross revenues of the mine will ramp up to almost $300 million per year, totalling $5.3 billion (undiscounted) over the assumed life of the project, or $2.7 and $1 billion in present value terms at discount rates of three per cent and eight per cent, respectively. On a net revenue basis, i.e., gross revenues minus development costs but excluding taxes and royalties, the mine is anticipated to peak at $90 million per year (Figure 3). On a cumulative net revenue basis, excluding taxes and royalties, the mine is not expected to break even until around 2039. Including taxes and royalties (detailed below), we estimate that only under the optimistic scenario does the mine developer earn a positive return on investment in present value terms (Table 5).

Figure 9. Undiscounted Net and Cumulative Net Revenues of the New Mine, Excluding Taxes and Royalties



Note: Presents net and cumulative net revenues for the baseline development scenario.

4.2.3. Taxes and Royalties

Coal development companies pay a variety of taxes and royalties to municipal, Alberta and federal governments.

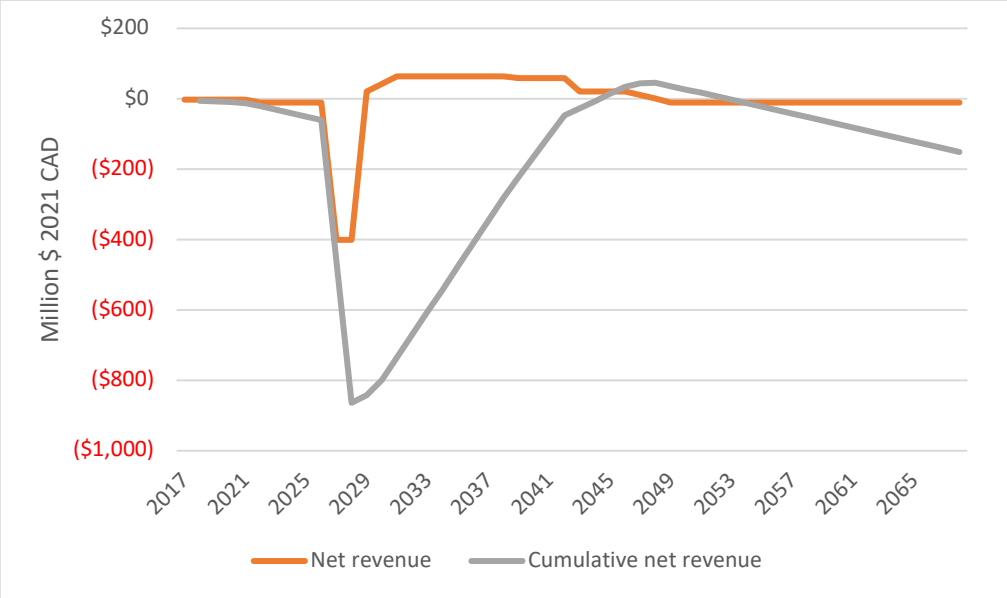
The mine proponent is responsible for annual rental fees of $3.50 per hectare for leased land, payable to the Alberta government. We estimate annual rental payments of about $20,000 for the 5,000-hectare site that is eventually turned into a mine, and therefore cumulatively we estimate this developer will pay a total of about $0.8 million (undiscounted) in rentals over the site's lifetime, or $0.4 and $0.1 million in present value at discount rates of three per cent and eight per cent.

The annual property tax payment is $1.5 million a year, from beginning of construction through to the end of the scheduled reclamation period, summing to an undiscounted cumulative total of $65 million, or $28 million and $9 million in present value at discount rates of three per cent and eight per cent.

The developer pays royalties on marketable coal produced from the mine. We estimate royalties totalling $243 million undiscounted over the life of the mine, or $108 million and $31 million in present value at discount rates of three per cent and eight per cent.

We estimate undiscounted corporate income tax payments to Alberta will total $123 million, or about $64 million and $24 million in present value at discount rates of three per cent and eight per cent. Federal corporate income tax payments total $230 million undiscounted, or about $121 million and $45 million in present value at discount rates of three per cent and eight per cent.

Figure 10. Undiscounted net and cumulative net revenues of the new mine, including taxes and royalties



Note: Presents net and cumulative net revenues for the baseline development scenario.

Governments sometimes provide subsidies through tax breaks or other mechanisms to support natural resource development, offsetting firms' costs. The B.C. government, for example, subsidized coal mines in northeastern B.C. (Knight 1990; Gunton 2003; Allan et al. 2020). However, at this point in our analysis, any subsidy from local, Alberta or federal governments is speculative and so we do not include an estimate in this account.

Last, the mine is subject to Alberta's GHG emissions regulation. We have not tried to estimate the carbon tax payments, given that these payments would only occur about 2031 (when we estimate the 100,000-tonne CO_2e threshold will be surpassed) and our expectation that emissions policy will evolve materially over this time.

4.2.4. Summary of Market Valuation Account

The costs and benefits in the market valuation account are summed to provide a partial accounting of the net benefits of the development scenario (Table 4). Excluding any payments to government of taxes and royalties, and under base case cost and price assumptions, we estimate that the undiscounted net revenues of the development scenario to coal developers are $511 million, $140 million at a discount rate of three per cent, or a net cost of $72 million at a discount rate of eight per cent. Under optimistic cost and price assumptions, we estimate net gross revenues before taxes and royalties to be nearly $1.8 billion undiscounted, and $806 million and $186 million at discount rates of three per cent and eight per cent, respectively. Under pessimistic cost and price assumptions, we estimate undiscounted net gross revenues of -$566 million, or -$433 million and -$296 million at three per cent and eight per cent discount rates.

Table 4. Benefits, Costs and Net Benefits Excluding Taxes and Royalties in the Market Valuation Account.

Scenario	Impact	Undiscounted Net Benefits (million C$)	Net Present Value, 3% Discount Rate (million C$ 2021)	Net Present Value, 8% Discount Rate (million C$ 2021)
Base Case	Exploration Costs	$19	$16	$13
	Study Costs	$40	$32	$22
	Construction Costs	$800	$570	$330
	Operations Costs	$3,645	$1,897	$699
	Reclamation Costs	$250	$85	$17
	Gross Revenue	$5,264	$2,740	$1,010
	Net Benefits before Taxes	***$511***	***$140***	**-$72**
Optimistic Scenario	Exploration Costs	$19	$16	$13
	Study Costs	$32	$26	$18
	Construction Costs	$720	$513	$297
	Operations Costs	$3,608	$1,878	$692
	Reclamation Costs	$225	$77	$16
	Gross Revenue	$6,370	$3,315	$1,222
	Net Benefits before Taxes	***$1,766***	***$806***	***$186***
Pessimistic Scenario	Exploration Costs	$19	$16	$13
	Study Costs	$48	$38	$26
	Construction Costs	$880	$626	$363
	Operations Costs	$3,608	$1,878	$692
	Reclamation Costs	$275	$94	$19
	Gross Revenue	$4,264	$2,219	$818
	Net Benefits before Taxes	**-$566**	**-$433**	**-$296**

From the perspective of the mine developer, the financial numbers that matter are the net revenues of the mine after taxes and royalties. As shown in Table 5, only one of the scenarios we examine leads to a positive return on investment in present value terms: the optimistic scenario with a three per cent discount rate. The internal rate of return (the discount rate at which the project breaks even) under the optimistic scenario is six per cent. Adjusting only the price, under our baseline assumptions the mine breaks even with a coal price of $151 CAD per tonne (2021 dollars) at a three per cent discount rate, and a price of $175 per tonne at an eight per cent discount rate. In the pessimistic scenario, a price of $160 is required to break even without discounting, $172 is required to break even at a three per cent discount rate, and $201 is required to break even at an eight per cent discount rate. In the optimistic scenario, a price of $151 is required to break even at an eight per cent discount rate.

Many uncertainties go into the market valuation account, and we do not pretend to have better information on costs and selling prices than a private proponent does. It is possible our cost and revenue estimates are overly pessimistic, given that the number of proposed mines in Alberta signals substantial investment interest. While we believe our assumptions are reasonable, given the large investment value involved in a coal mine it is possible proponents have better information underpinning their decisions.

Alternatively, market conditions could have shifted significantly enough to affect the viability of coal mining in Alberta.[21]

What we can say is that by separating this account, we lay bare the private benefits from the public interest costs and benefits in other accounts. From a public-interest benefit-cost analysis perspective, since the market valuation account captures the private net profit to the project proponent, it is sufficient for us to assume the proponent believes the private net benefit will be positive (or at least non-negative) and therefore the market valuation account is non-negative, and proceed with the estimates for the other accounts.

Table 5. Market Valuation Net Benefits After Taxes and Royalties

Scenario	Impact	Undiscounted Net Benefits (million $ CAD)	Net Present Value, 3% Discount Rate (million $ 2021 CAD)	Net Present Value, 8% Discount Rate (million $ 2021 CAD)
Base Case	Net Revenues before taxes and royalties	$511	$140	-$72
	Quantified taxes and royalties	$661	$321	$109
	Net Benefits for Account	***-$150***	***-$181***	***-$181***
Optimistic Scenario	Net Revenues before taxes and royalties	$1,766	$806	$186
	Quantified taxes and royalties	$1,299	$645	$221
	Net Benefits for Account	***$467***	***$161***	***-$35***
Pessimistic Scenario	Net Revenues before taxes and royalties	-$566	-$433	-$296
	Quantified taxes and royalties	$238	$119	$44
	Net Benefits for Account	***-$804***	***-$553***	***-$340***

Note: Taxes and royalties include payment of federal corporate income tax, and exclude payment of personal income tax.

4.3. TAXPAYER ACCOUNT

The taxpayer account covers incremental tax and royalty revenue flowing to governments, but also incremental costs incurred by governments, thus providing a sense of the net benefits of the development scenario to taxpayers in Alberta.

Our estimate of the mine's revenues are used to assess the benefits of the development scenario. As the mine's development is incremental — the economic activity would not otherwise occur in Alberta — the majority of tax revenues are a benefit in this account. However, they are also a transfer from taxpayers (project proponent and workers) to the government. Note we also exclude federal tax payments from this account, in contrast to the values in Table 5, as we are evaluating the mine from the perspective of the province of Alberta.

[21] For example, Montem has recently changed its plans for the Tent Mountain site (Fletcher 2021b), suggesting weaker current economics than when the mine was originally proposed.

4.3.1. Taxes and Royalties

The majority of benefits in this account accrue from tax payments by the mine developer. We focus on our base-case scenario, though also report values for the optimistic and pessimistic scenarios in Table 6.

The rental fee revenue — about $0.8 million in undiscounted rentals over the site's lifetime, or $0.4 million and $0.1 million in present value terms at discount rates of three per cent and eight per cent — is an incremental benefit of the development scenario, but from a distributional perspective a transfer from the developer to the Alberta government.

Property tax, payable to the Municipal District of Ranchland No. 66, is a benefit of $1.5 million a year. This yields an undiscounted cumulative total of $65 million, or about $28 million and $9 million in present value terms at discount rates of three per cent and eight per cent. This revenue is an incremental benefit of the development scenario, but from a distributional perspective a transfer from the developer to the local government.

The Alberta government receives royalties on coal produced from the mine. We estimate royalties totalling $243 million (undiscounted) over the life of the mine, or about $108 million and $31 million in present value terms at discount rates of three per cent and eight per cent. We note the Grassy Mountain review panel expressed substantial concern about tax and royalty revenues that would in theory flow to government and taxpayers. The panel noted that faltering demand for metallurgical coal, as well as potential quality decline of the coal produced at the mine — given that high-quality ores tend to be produced first — could lead to lower revenues flowing to government (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). Our analysis from the market valuation account suggests the mine would not break even exclusive of payments to government until 2039, and so any market challenges or high-grading of ore could result in substantial royalty payments only occurring in the 2040s or beyond.

The Alberta government would also receive corporate income tax payments. We estimate Alberta tax to total $123 million undiscounted, or about $64 million and $24 million in present value at discount rates of three per cent and eight per cent. All else equal, corporate taxes are generally not incremental, as the capital invested in the coal mine would likely be invested elsewhere in Alberta (Shaffer 2010). If the capital investment comes from outside Alberta, and would be invested outside of Alberta in the mine's absence, then the provincial corporate tax revenue is a benefit. While much proponent interest in Category 2 lands in Alberta comes from foreign companies, we nonetheless make this qualification.

As explained in more detail in the economic activity account below (section 4.4), we estimate that only about 25 per cent of employment will be incremental in the development scenario, and then only for the mine's initial years. Under these conditions, we estimate an incremental employment income tax benefit of $9 million undiscounted, or $6 million and $3 million in present value at discount rates of three per cent and eight per cent.

Last, the mine would be subject to Alberta's *Technology Innovation and Emissions Reduction Regulation*, which involves payment for emissions above a threshold. While a transfer from the mine developer to government and taxpayers, this is an incremental benefit to taxpayers as this revenue flow cannot be expected in the no-development scenario, albeit offset by GHG damage costs as discussed in s.4.4.1 below. We have not tried to estimate carbon tax revenues in the development scenario given that emissions are unlikely to be material until the mine comes online in 2029, and our expectation that emission policy will evolve materially over this time.

4.3.2. Incremental Financial Burdens on Government and Taxpayers

New development can pose incremental costs for government and taxpayers. We do not anticipate the exploration activities will create any particular incremental costs to government, but mine development will result in incremental costs.

The mine will be near the Crowsnest Pass area, and we expect the developer would rely on existing infrastructure to build and operate the mine, including getting product to market on the B.C. coast. Accordingly, there is no incremental government investment in roads or railway infrastructure. We also do not expect any particular incremental burden associated with provincial environmental monitoring; the new activity would be relatively small in the context of provincial activities.

An incremental burden that may occur is in terms of subsidies through tax breaks or other mechanisms to support the mine through challenging times. Such subsidies are common and may include flow-through share programs, mining tax credits, grants, loans, subsidized costs of electricity, or direct investments in infrastructure like roads, rail lines, ports, or the mines themselves. We have no particular information indicating that the Alberta or other government plans to subsidize new coal development in Category 2 lands, and we do not try to predict such subsidies. If it did occur, however, it would reduce the benefits in the taxpayer account but also increase the net benefits of the market valuation account.

Reclamation Liability

An important incremental burden on government and taxpayers that we do anticipate is with respect to environmental reclamation. Any discussion of resource development, especially any sort of development with substantial alterations to landscape such as mining, has to acknowledge reclamation liability. Reclamation of exploration sites is relatively straightforward — road removal, re-vegetation, etc. — but reclamation of open-pit mine sites is not. Coal mining results in substantial changes to topography, soils, vegetation, and water courses, and can leave behind pit lakes, waste rock dumps, and sources of water quality contamination that have proven challenging to remediate.[22] The coal-mine proponent's reclamation expenditure of $250 million over the final 10 operational years (reclamation of areas no longer mined would occur during operation) and the ensuing 20 years post-operations may not fully cover the costs of

[22] As an example, Teck Resources has continuing challenges in B.C.'s Elk Valley addressing water quality impacts from its coal mine (Weber 2021d).

addressing reclamation liabilities at the mine site. In other words, there is a risk of a non-zero probability of an additional cost to society from a new mine.

Despite various laws and policy to ensure coal development sites' reclamation, numerous sites are not yet reclaimed or only partially reclaimed in the province. These sites pose a liability for the provincial government and Alberta's citizens. A 2019 audit by Alberta's auditor general noted that while the Alberta Energy Regulator (AER) had improved its process of managing mine reclamation liability, the AER held but five per cent of the estimated financial security required by end of June 2018 for the 18 coal and 10 oil sands mines in the province at the time. The auditor general noted that "[i]f a mine operator cannot or does not fulfill its reclamation obligations, Albertans may have to pay the costs to complete conservation and reclamation work" (Auditor General of Alberta 2019, 1). Whatever the liability amount is, this economic and environmental risk is an important contextual factor when considering the economics of new coal development in Alberta.

These potential costs may be incurred over a long time; as Alberta already faces a substantial reclamation liability from existing and past mines, this backlog of liabilities means that any new liabilities may not be addressed for a very long time. Submissions to the coal policy engagement committee and opinion pieces have similarly warned of reclamation liabilities shifting to the government in the event of coal mine bankruptcy, especially if the owner is foreign (Trafford 2020; Kolijn 2021a). New mine development means the public takes on risk with a financial magnitude equal to the potential costs of partially or fully completing reclamation of the mine site, if the mining company goes out of business prior to the land being certified as fully reclaimed to "equivalent land capability."

Alberta's Mine Financial Security Program, established in the Conservation and Reclamation Regulation, is intended to address this risk. The mining company posts a bond to government as security in case it fails to properly reclaim the site. These payments by the mining company to the Alberta government as part of a liability program are transfers: they are returned if reclamation is successful, or used to address an outstanding liability if reclamation is unsuccessful. However, the program relies on an assets-to-liability approach whereby Alberta's security is in part held in the form of the resource being developed. While the program has mechanisms to address changes in commodity prices, there is still some risk that a decline in coal prices could lead to an asset that is worth less than the reclamation liabilities, a scenario discussed by the Auditor General of Alberta in a 2015 report (Auditor General of Alberta 2015; Alberta Energy Regulator 2021a; Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). Likewise, as the Grassy Mountain review panel noted, mines typically extract the highest quality ore first, reinforcing the concern about reliance on remaining assets to cover reclamation liabilities (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). Gaps in reclamation science also pose a substantial challenge to achieving equivalent land capability. As repeatedly noted by the Grassy Mountain review panel, often in reference to the B.C. Elk Valley experience with selenium contamination of water, there is substantial uncertainty about when or even if a coal mine site at high elevation in the southern Eastern Slopes could ever

be reclaimed properly (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021).

Accordingly, the mechanics of the Mine Financial Security Program and the knowledge gaps that exist mean there is a risk to the project of an amount equal to the probability of the mining company defaulting on its obligation and the difference between the future value of unmined coal assets and the reclamation liability. We do not try to predict the amount of this government and taxpayer burden but expect that the risk is real, i.e., the probability of a burden is greater than zero, and the cost of the burden is not trivial, leading to an incremental reclamation costs incurred by government and taxpayers.

4.3.3. Summary of Taxpayer Account

Conceptually, the costs and benefits in the taxpayer account can be summed to provide a partial accounting of the net benefits of the development scenario (Table 6). We estimate that incremental benefits to taxpayers are $440 million undiscounted, roughly $108 million at a discount rate of three per cent and $67 million at a rate of eight per cent.[23]

[23] Including federal income tax, these values are $671 million undiscounted, roughly $228 million at a discount rate of three per cent, and roughly $112 million at a rate of eight per cent.

Table 6. Benefits, Costs and Net Benefits in the Taxpayer Account

Scenario	Impact	Undiscounted Net Benefits, (million $ CAD)	Net Present Value, 3% Discount Rate (million $ 2021CAD)	Net Present Value, 8% Discount Rate (million $ 2021CAD)
Base Case	Personal Income Tax	$9	$6	$3
	Rentals	$0.8	$0.4	$0.1
	Property Tax	$65	$28	$9
	Royalties	$243	$108	$31
	Alberta Corporate Income Tax	$123	$64	$24
	Carbon Tax	Benefit (not estimated)		
	Environmental Reclamation Liability	Costs (not estimated)		
	Subsidies	Potential costs (not estimated)		
	Net Benefits for Account	***Not possible to estimate***		
Optimistic Scenario	Personal Income Tax	$10	$7	$4
	Rentals	$0.8	$0.4	$0.1
	Property Tax	$65	$28	$9
	Royalties	$616	$294	$92
	Alberta Corporate Income Tax	$215	$112	$42
	Carbon Tax	Benefit (not estimated)		
	Environmental Reclamation Liability	Costs (not estimated)		
	Subsidies	Potential costs (not estimated)		
	Net Benefits for Account	***Not possible to estimate***		
Pessimistic Scenario	Personal Income Tax	$9	$6	$3
	Rentals	$0.8	$0.4	$0.1
	Property Tax	$65	$28	$9
	Royalties	$43	$22	$8
	Alberta Corporate Income Tax	$45	$24	$9
	Carbon Tax	Benefit (not estimated)		
	Environmental Reclamation Liability	Costs (not estimated)		
	Subsidies	Potential costs (not estimated)		
	Net Benefits for Account	***Not possible to estimate***		

4.4. ECONOMIC ACTIVITY ACCOUNT

The economic activity account covers incremental benefits and costs accruing to workers and other businesses and thus provides a sense of the net benefits of the mine's development on other economic actors in Alberta. The incrementality of any economic impacts of the mine is a function of the Albertan and Canadian economies.

Generally, given that these economies function well (i.e., labour is generally full employed), we do not expect any incremental economic impacts on Alberta's

economy. For example, while the mine's operator will undoubtedly purchase goods and services, and mine workers will buy groceries and consumer electronics with their wages, these purchases would still occur in the mine's absence.

However, from a regional perspective, there may be a boost in economic activity linked to the project. Communities near a new mine — such as High River, Nanton, Claresholm or the communities of the Crowsnest Pass — might experience some increase in economic activity. For example, Benga estimated that 0.5 per cent of construction expenditures and 11 per cent of operations expenditures of the Grassy Mountain mine would occur within the local region (Nichols Applied Management 2016, 15–16). If this additional economic activity is just a shift from elsewhere in Alberta, then there is no overall gain from a provincial perspective, but we do recognize that host communities may value such a boost in economic activity and benefit substantially from it.

4.4.1. Impacts on Workers

There are several types of coal development jobs and we discuss the potential incrementality of each on their own below. The most important consideration for our discussion is whether individuals who would otherwise earn less obtain higher paying employment, or whether unemployed individuals become employed as a result of the mine.

An incremental employment effect entails comparing the employment opportunities associated with coal exploration and mine development with workers' social opportunity cost of labour (SOCL), or the value of their next-best alternative. If the workers would otherwise be employed and be paid the same, then the SOCL is a cost equal to their pay — meaning no incremental employment benefits. In contrast, if some earn less or are unemployed then their SOCL is lower than their pay, meaning the mine creates incremental employment benefit. Considering Alberta's current economic environment, it seems reasonable to consider the possibility that coal development in Category 2 lands might lead to some incremental employment.

Exploration requires workers skilled in road development, well pad development, drilling, data interpretation and reclamation. Given the relatively small number of jobs involved, and that these skill sets cross over into many other sectors (e.g., forestry, oil and gas), we expect there be substantial demand for these workers. Therefore, we do not include exploration jobs as incremental economic activity.

Similarly, the study phase of the mine requires a small number of workers with engineering, geology, financial, and environmental assessment skillsets, all of which experience demand for similar work across the province, country and continent, and so we ignore this potential job impact.

The job impacts of mine construction and operations will be more substantial, though, and may lead to incremental employment benefits. Construction requires a variety of skillsets: heavy equipment operators, welders, millwrights, pipefitters, ironworkers, and electricians, and fabricators and engineers off-site. During operations, jobs include heavy equipment operators, millwrights, process operators, administrators,

management, mechanics, and maintenance workers (Nichols Applied Management 2016). We expect that the mine in our development scenario would require about 750 person-years of labour during construction — or about 375 workers for two years — and 225 full-time jobs during operations over the 20-year operations phase.

As noted in the Government of Alberta's August 2021 budget and economic outlook, the province's economy is in the midst of one of the worst downturns in its history due to the combined effects of low oil prices and COVID-19 (Government of Alberta 2021d). The outlook is cautious about the economy's future, noting uncertainties in COVID-19 mitigation and future oil prices, but does predict gradual improvement in economic conditions, with unemployment rates anticipated to decline from around 10 per cent in 2021 to 6.3 per cent by 2024 and some modest improvement in oil prices over the same period (Alberta Treasury Board and Finance 2021). We likewise expect the impact of COVID-19 on the Alberta economy to lessen and even disappear over the next few years, but due to the Alberta economy's substantial reliance on fossil fuel production, we expect further headwinds.

Alberta's unemployment rate has generally been below the Canadian trend unemployment rate (typically five to seven per cent)[24] in line with the pace of oil sands and other development in the province. However, the unemployment rate has been increasing to higher levels over the last decade (Government of Alberta 2021f). Notwithstanding uncertainties due to COVID-19, Alberta's labour market is recovering from recent declines due to the pandemic and low oil prices (Government of Alberta 2021e). Oil and natural gas prices affect demand for labour with natural resource development skills, and further dampening of demand associated with global GHG emission reduction efforts may make this labour more freely available. Some of this labour has shifted from oil and gas to other forms of resource development or other sectors (e.g., general construction); with further dampening of oil and gas markets, more of this labour will likely reallocate to new resource development such as coal.

Current construction labour market forecasts are anticipating moderate recovery in the near-term from the impacts of COVID-19 and the slump in the oil and gas markets, followed by resumed demand for labour later in this decade tied to an expectation of improved market conditions for oil and gas development and spinoff economic impacts (BuildForce Canada 2021a; 2021b). Given the substantial overlap between skillsets in coal mine construction and operations, construction labour market forecasts are also informative with respect to labour demand during the mine's operations phase. Accordingly, if the forecasts' anticipated conditions transpire, we expect very little or no incremental employment from the coal development scenario. However, if oil and gas investment does not ramp up as anticipated then some incremental employment benefits from coal development might be expected.

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24 Unemployment rates between five and seven per cent generally indicate a balanced labour market, with rates above seven per cent indicating an excess of labour relative to job opportunities, and rates below five per cent indicating a shortage of labour. The five to seven per cent range reflects the fact that there are always people in between jobs or unwilling to work at the time.

There are numerous methods to calculate the incrementality of new employment, relying on data on wages, unemployment, individuals' opportunity costs, and labour force participation (Bartik 2011; 2012). These methods give ranges of incremental wages between zero and over 100 per cent of market wages (Del Bo, Fiorio, and Florio 2011; Bartik 2012). While we expect very little incremental employment, we assume that 25 per cent of the employment benefits of the construction and first five years of operations of the mine in the development scenario will be incremental. That is, the SOCL is 75 per cent of wages for these jobs. After this period, we assume that the labour market will be in equilibrium, i.e., there will be no supply excess in the Alberta major project labour market. This is a deliberately aggressive assumption that likely overemphasizes the benefits.[25]

Under these labour conditions, only a portion of the employment impacts of the construction and first five years of operations of the mine in the development scenario will be incremental. Accordingly, we estimate that 188 person-years of construction employment and 56 operations jobs during the first five years of operations will be incremental economic benefits of the development scenario. Given that coal mining jobs tend to pay about $75,000 per year (Payscale n.d.a; n.d.b), we estimate that the development scenario will provide about $35 million (undiscounted) in incremental direct labour income, or $23 million and $12 million in present value terms at discount rates of three per cent and eight per cent.[26]

4.4.2. Effect on Other Commercial Interests

There are numerous other commercial activities along the Eastern Slopes that coal development will affect. These include forestry, oil and gas development, ranching, agriculture and recreational activities (Figure 11). We discuss each in turn.

Forestry

Forestry is active throughout the Eastern Slopes in the Rocky Mountain Forests. Species are deciduous and mixed-wood species at lower elevations and coniferous at higher elevations (Bliss et al. 2015; Alberta Wilderness Association n.d.). Forestry activity along the Eastern Slopes is governed by higher-level plans such as the Eastern Slopes Policy and the South Saskatchewan Regional Plan, and on the ground with forest management plans and forest management agreements with forest companies.

We expect that there would be negligible impact on forestry on the Eastern Slopes from coal development on Category 2 lands. Exploration would have little impact on timber yield from forest tenures given the relative footprint of coal exploration versus logging operations. Any licensees impacted by the mine would log the mine site prior to

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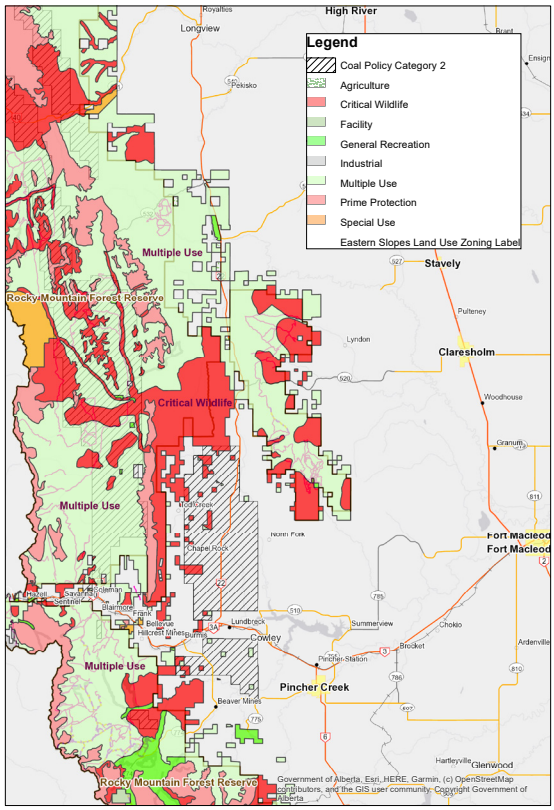
25 For example, Shaffer (2013) examining Manitoba Hydro's resource development plans, assumes the net benefits of employment to be 15 per cent of gross wages, and 50 per cent for northern Indigenous workers. Joseph (2018), reviewing economic benefits of Teck's Frontier Mine (a bitumen mine north of Fort McMurray, AB), assumes SOCL to equal wages because of the tight labour market at the time, and 10 per cent in sensitivity analysis.

26 This assumes the SOCL is 75 per cent of the wages for these jobs in the first five years, and is equal to wages thereafter.

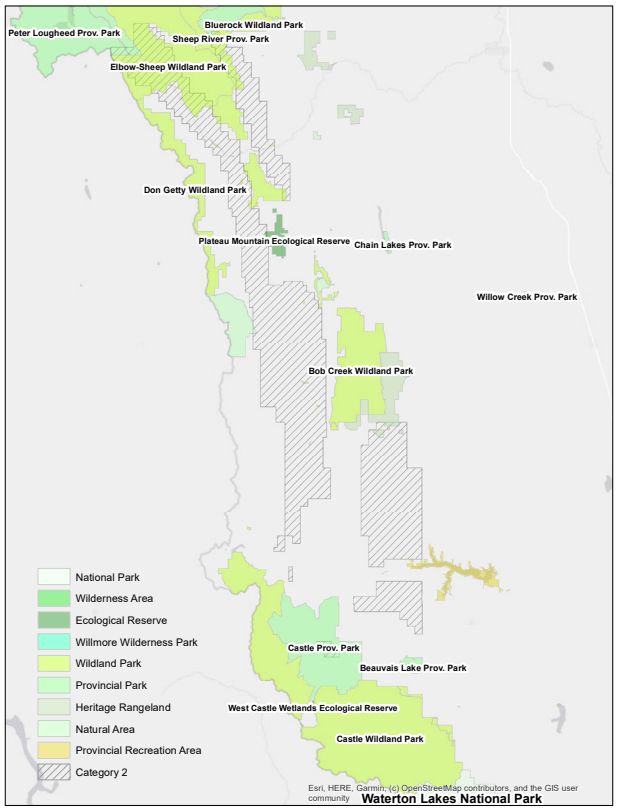
development or be compensated financially for the loss in timber.[27] The Grassy Mountain assessment likewise concluded that effects on commercial forestry would be minor (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 327).

Figure 11. Eastern Slopes Land Uses and Protected Areas

Panel A: Land Uses



Panel B: Protected Areas



Sources: Alberta Environment and Parks (2015; 2017; n.d.).

Oil and Gas Development

Oil and gas development entails exploration through seismic testing, and development of well pads for drilling and extraction. Oil and gas development is subject to higher-level plans like the Eastern Slopes Policy, site-specific integrated resource plans, and policy and requirements of the AER.

We assess that oil and gas activities would not be affected by coal exploration or mining, as the relative depths of activity are quite different. Furthermore, oil and gas drilling and extraction could be done from near the mine boundaries using directional drilling.

27 A similar arrangement for Grassy Mountain is discussed in Alberta Energy Regulator and Impact Assessment Agency of Canada (2021).

Ranching

Ranching has been taking place on the Eastern Slopes since the late 1800s, though only officially from 1914 (Weerstra 1986). Grazing areas are generally along valley bottoms and grass-covered hillsides, but can overlap with other uses such as forestry, oil and gas and certain types of recreation lands. Beyond benefits to the beef industry, grazing can have ecological importance via maintaining grassland and soil health, helping to manage wildfire among economically important timberlands, and maintaining the headwaters of river systems that provide water to the Alberta prairie and into Manitoba (Weerstra 1986; Government of Alberta n.d.h).

Ranching would be impacted both by coal exploration and mine development. Impacts on water quantity and quality would extend to ranchers given their dependence on water resources, creating higher costs of production or even limiting it altogether (Stelfox and Donahue 2021, 45). Secondly, any rancher(s) whose grazing leases overlap with the mine would lose access to these lands. We have not been able to quantify these costs.

Agriculture

Agriculture on the prairies east and below the Eastern Slopes may be affected through coal exploration and development's effects on water quantity and quality. As discussed in more detail in s.4.4.3 below, exploration in Category 2 lands will contribute to the cumulative sedimentation effects of human activities on water quality of Eastern Slopes streams. More importantly, the mine would consume water as well as contribute to selenium and other contamination downstream. Water quality and quantity is critical to agriculture; irrigation agriculture consumes over 80 per cent of total water in the Oldman River Basin (Stelfox and Donahue 2021, 31), the same basin that would be affected by the new mine in our development scenario. The contribution of the incremental coal development in Category 2 lands to sedimentation may be small relative to forestry and other human activities, but the demands of the new mine on water supplies over the 2029 to 2048 period and the contribution of this new mine to water selenium and other contamination would be substantial. A new mine would, especially in drought years that are expected to occur increasingly as climate change progresses, lead to higher costs of clean water supplies for agricultural and other users downstream. We have not been able to quantify these costs, but we expect them to be non-negligible.

Recreation and Tourism

The Eastern Slopes are a major recreation destination for Albertans and visitors from elsewhere in Canada and the world (Canadian Parks and Wilderness Society et al. 2018). The area is host to excellent skiing, hiking, mountaineering, camping, wildlife viewing and sport fishing and is recognized as such (Alberta Environment and Parks 2018b; Alberta Southwest 2020; Green Destinations 2021). Many recreation attractions lie within the numerous protected areas up and down the Eastern Slopes, including national parks (Banff, Jasper, Waterton) and provincial parks (e.g., Willmore Wilderness Park, Peter Lougheed Provincial Park). Other attractions are outside of protected areas,

such as trails for off-highway vehicles. Some of the parks on the Eastern Slopes are part of management activities intended to protect recreation, water, wildlife and resource development like forestry and ranching (Weerstra 1986).

The Eastern Slopes are a global tourism destination for sightseeing and other recreational activity (Canada Guide n.d.). Tourism generates more than $8 billion in annual spending in the province — most of which is in the Eastern Slopes — and 7.1 million tourists visited the Banff, Jasper and Waterton national parks in 2019 (Invest Alberta n.d.). Tourism and outdoor recreation are an important contextual factor for potential coal mining, a point recognized by the Joint Review Panel for the Grassy Mountain coal mine proposal (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021).

Coal exploration activities in Category 2 lands are unlikely to affect tourism, particularly outdoor recreation. However, the mine can be expected to cause substantial impacts. Impacts on water resources would affect sport fishing substantially as coal mining has in B.C.'s Elk Valley (Linnitt 2020). Mountaintop removal mining will affect all tourism activity via its effects on aesthetics — especially hiking and other tourism activities where participants are at high elevation or using other viewpoints — within the viewshed of the coal development, an impact discussed in the assessment of the Grassy Mountain proposal. The consequence of water quality, aesthetics and other environmental impacts is decreased desirability to visit and spend money in the area by tourists. We have not been able to quantify these costs but expect them to be non-negligible.

4.4.3. Summary of Economic Activity Account

There are two major effects in the economic activity account (Table 7). We estimate a relatively small benefit for workers in the development scenario amounting to about $35 million in undiscounted incremental direct labour income, or $23 and $12 million in present value at discount rates of three per cent and eight per cent, respectively. This is partially offset by incremental personal income tax payments of $9 million undiscounted, or $6 and $3 million in present value at discount rates of three per cent and eight per cent, respectively. Adverse effects on agriculture, ranching and tourism offset the net labour income benefit by an unquantified extent.

Table 7. Benefits, Costs, and Net Benefits in the Economic Activity Account

Scenario	Impact	Undiscounted Net Benefits (million C$)	Net Present Value, 3% Discount Rate (million C$ 2021)	Net Present Value, 8% Discount Rate (million C$ 2021)
Base Case	Incremental Employment	$35	$23	$12
	Incremental Personal Income Tax Payments	-$9	-$6	-$3
	Effects on Other Commercial Activities		Unquantified adverse effects	
	Net Benefits for Account	***<$26***	***<$17***	***<$9***
Optimistic Scenario	Incremental Employment	$37	$25	$13
	Incremental Personal Income Tax Payments	-$10	-$7	-$4
	Effects on Other Commercial Activities		Unquantified adverse effects	
	Net Benefits for Account	***<$27***	***<$18***	***<$9***
Pessimistic Scenario	Incremental Employment	*$33*	*$22*	*$12*
	Incremental Personal Income Tax Payments	-$9	-$6	-$3
	Effects on Other Commercial Activities		Unquantified adverse effects	
	Net Benefits for Account	***<$24***	***<$16***	***<$9***

4.5. ENVIRONMENT ACCOUNT

Alberta has designated the majority of the Eastern Slopes as environmentally significant at provincial, national or international levels, and the federal Department of Fisheries and Oceans has designated the Eastern Slopes as a priority area for conservation of fish species at risk (Fiera Biological Consulting Ltd. 2014; Fisheries and Oceans Canada 2020). Exploration and development of a coal mine would lead to adverse impacts on the Alberta environment from air pollution and greenhouse gases (GHGs), noise and the visual environment, water, vegetation, fish and wildlife, reclamation liabilities and non-use values. We describe each of these impacts in turn in the sub-sections below.

Important for our discussion is the temporal nature of any impacts, during exploration, over the course of mine operations, and during reclamation and remediation. Alberta will certify a mine site as reclaimed once a site achieves equivalent land capability, "the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical" (Province of Alberta 1993, s. 1(e)). In our discussion below, we discuss impacts as well as the likelihood of return to equivalent land capability.

4.5.1. Air Pollution and Greenhouse Gases

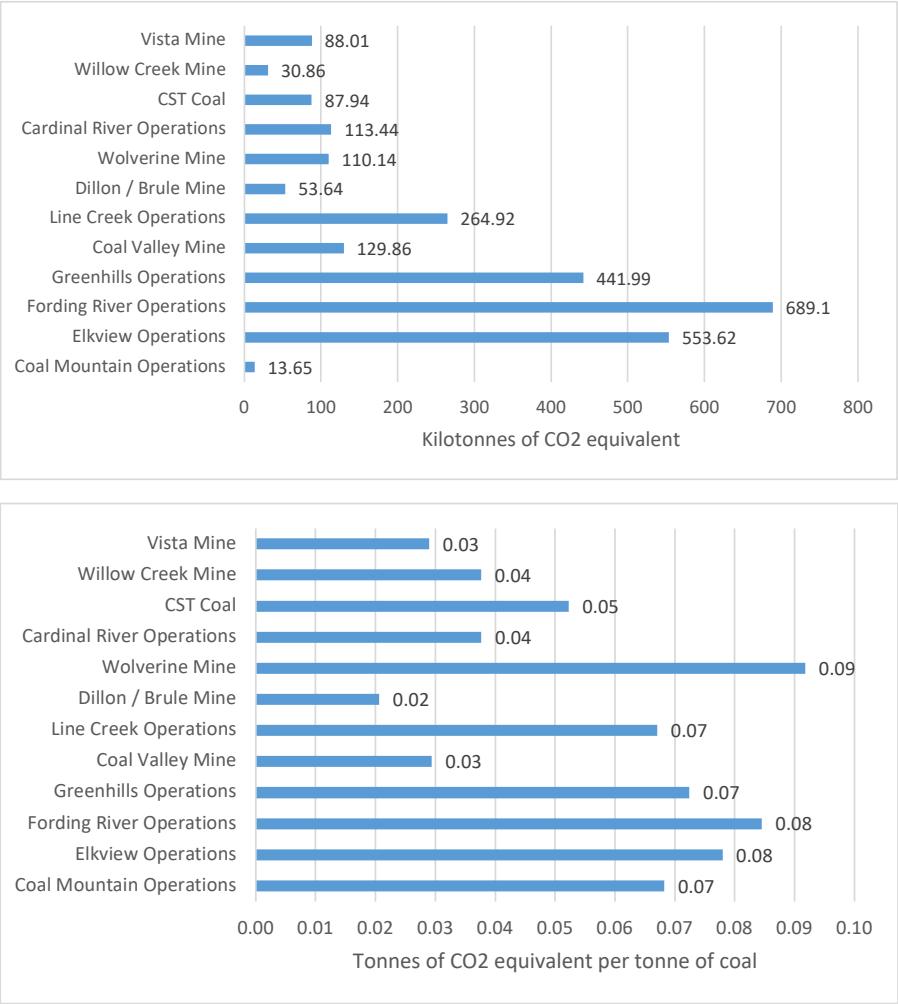
Coal exploration causes air pollutants (e.g., nitrous oxides and GHGs) from combustion of gasoline and diesel by trucks and machinery, but we exclude them from our analysis. Any criteria air contaminants (CACs) and GHGs from exploration are unlikely to be incremental, as we expect that much of this equipment would be used for other resource

development activities elsewhere in Alberta. Second, while exploration contributes cumulatively to global GHG emissions, the emissions are very small quantitatively.

Mine construction and operation have six major sources of emissions. First, heavy machinery running on diesel, during both construction and operations, emits CACs and GHGs. Second, there are dust emissions during blasting and mining and movement of materials around the mine. Third, coal mine faces emit methane. Fourth, diesel consumption by trains carrying the coal to export ports leads to emissions. Fifth, there is coal dust from the trains en route to export. Sixth, there are emissions associated with fossil-based electricity consumed at the mine. Total mine emissions are uncertain, given the substantial variation in mine emissions from existing mines (Figure 12).

Consistent with our assumption that coal development would not lead to any change in use of refined petroleum products in Alberta, we exclude combustion-related CAC or GHG emissions from our analysis as non-incremental.

Figure 12. 2019 Annual GHG Emissions and Emissions per Tonne of Coal at Canadian Bituminous Mines.



Note: Government of Canada (2021) reports the Vista mine as sub-bituminous coal whereas Alberta Energy Regulator (2019e) lists production as bituminous.

Source: Alberta Energy Regulator (2019e); Ministry of Energy, Mines and Petroleum Resources (n.d.); Government of Canada (2021).

The Grassy Mountain project assessment concluded that most CAC and dust pollution would be restricted geographically to the mine site, especially given watering of coal along the rail route, and thus we expect little if any impact of these emissions on people in the region (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021).

However, the mine face emissions of methane (a potent greenhouse gas) is incremental, as these specific emissions would not occur absent the mine's development. According to Grassy Mountain GHG estimates, mine face emissions would be about 16 per cent of total mine emissions. Based on 2019 emissions from bituminous mines, this could range between 7,500 and 33,000 tonnes CO_2-equivalent per year in the baseline scenario, between 8,200 and 36,600 in the optimistic scenario and between 6,700 and 30,000 in the pessimistic scenario.[28]

These emissions are meaningful, despite their apparent small volume quantitatively in a provincial or larger sense, as the mine's GHG emissions contribute to the cumulative effects of climate change (Joseph 2020). These GHG emissions can be monetized using the social cost of carbon (SCC), a monetary measure of the incremental global damages from an additional tonne of CO_2 (Environment and Climate Change Canada 2016). As the SCC measures global damages, it may overstate the damages to Alberta.[29] In the absence of Alberta-specific estimates of damages, and in keeping with Treasury Board Secretariat guidelines (Treasury Board of Canada Secretariat 2018), we use Canadian SCC estimates.[30] With these assumptions, cumulative damages from mine face emissions during production range from $92.1 million to $414.5 million in the baseline scenario (2020 dollars). In the optimistic scenario damages range from $101.3 million to 456 million (2020 dollars) and in the pessimistic scenario, damages range from $82.9 million to $373.1 million (2020 dollars). This is likely an underestimate, as we do not include mine face emissions after production ceases.

We note from a benefit-cost analysis perspective, carbon tax revenues or payments under Alberta's *Technology Innovation and Emissions Reduction Regulation* offset some of the damages. However, given the uncertainty in climate policy, and lacking good information on the quantitative amount of mine face emissions subject to any climate policy, we are not able to estimate any offsetting revenue from emissions pricing.

4.5.2. Water Quantity and Quality

The Eastern Slopes play a key role as a clean water source (Weerstra 1986; Stelfox and Donahue 2021; Alberta Wilderness Association n.d.). Four of Canada's major rivers

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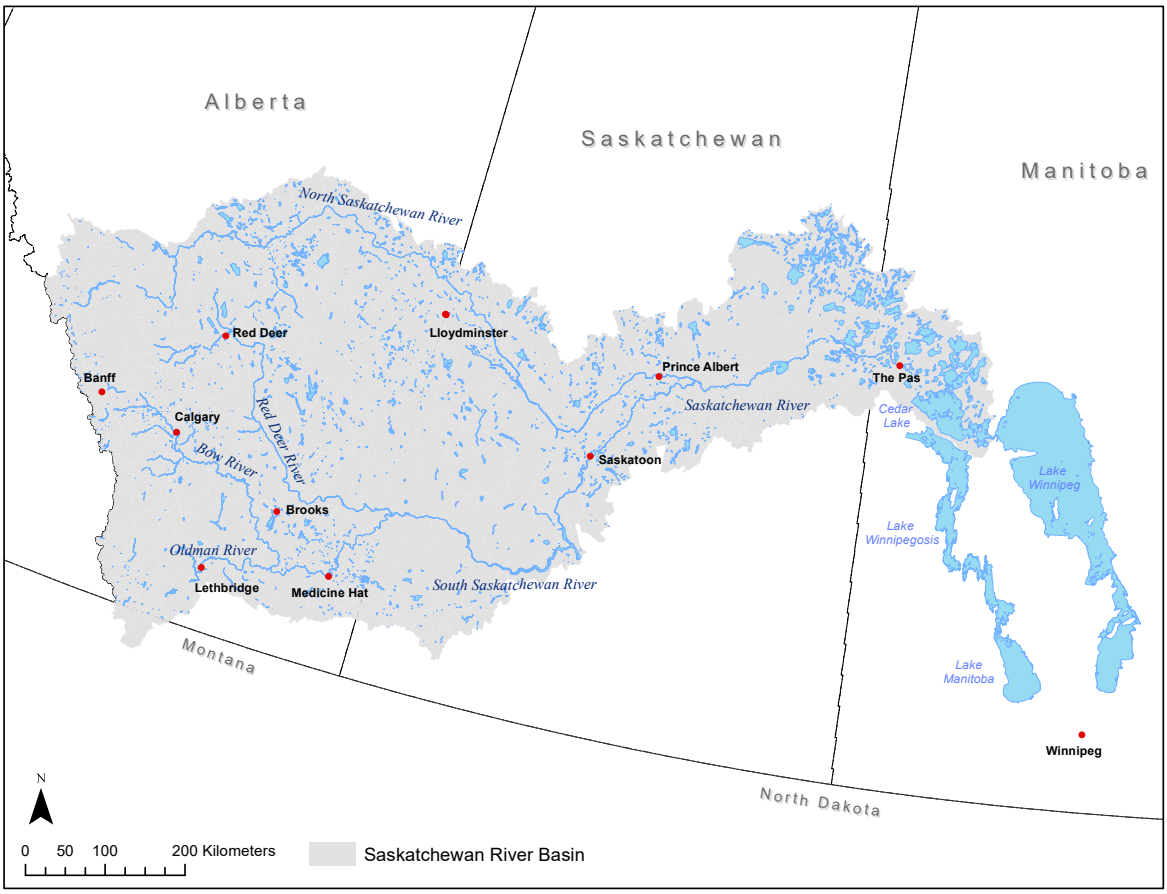
28 We calculate this based on tonnes of emissions per tonne of production ranges from the mines in Figure 12, assuming three million tonnes per year of production adjusted by the production factors for the baseline, optimistic and pessimistic scenarios.

29 In 2018, the U.S. Environmental Protection Agency estimated the SCC associated with "the direct impacts of climate change that are anticipated to occur within the contiguous 48 states" (U.S. EPA 2018, ES-10), which substantially lowered the estimates relative to when global damages are used (Plumer 2018).

30 This use is not compliant with our assumption of considering only costs and benefits within Alberta, but it is consistent with the Treasury Board Secretariat guidance to use Environment and Climate Change Canada's SCC in estimating costs of emissions.

originate on the Eastern Slopes of the Rocky Mountains — the Peace, Athabasca, North Saskatchewan and South Saskatchewan — and accordingly the Eastern Slopes are the source for much of the water used on the Canadian prairies (Figure 13). The prairies, of course, are home to millions of people and are a major centre for global agriculture. A 2003 study put the value of water in the South Saskatchewan watershed at just under $1 billion a year (Haxby and Prather, 2003, "The Value of Water to the Alberta Economy," as cited in Alberta Wilderness Association (2010, 12)). The 1984 Eastern Slopes Policy recognized this value of water and made water management its key foci, as did the 1969 Master Agreement on Apportionment between Alberta, Saskatchewan, Manitoba, and Canada (Prairie Provinces Water Board n.d.).

Figure 13. Eastern Slopes Watershed and South Saskatchewan River Basin.



Source: Agriculture and Agri Food Canada (2013); United States Census Bureau (2018); Government of Canada (2020); Natural Resources Canada (2020); Statistics Canada (n.d.).

Water contamination on the Eastern Slopes by past and proposed development, including coal mining, is a major concern (Stelfox and Donahue 2021; Weber 2021c). Surface mining entails denudation of land to get at coal deposits and waste-rock piling; both are associated with contamination of local streams with selenium and other contaminants poisonous to fish and people alike. Data from the Alberta government demonstrating substantial contamination downstream of the Luscar, Gregg River, and Cheviot mines near Hinton, as well as the experience of water contamination in B.C.'s Elk Valley, are testament to negative environmental impacts (Stelfox and Donahue

2021). Selenium is a key concern, but other contaminants are also associated with coal mining in Eastern Slopes headwaters. Water quality is also threatened by the sedimentation of watercourses that occurs with road building for forestry and oil and gas development, and by OHV use (Canadian Parks and Wilderness Society et al. 2018).

The potential impacts of coal development on the Eastern Slopes are a major concern for many people and interests in Alberta. There are water impacts from past coal mines in Alberta (e.g., the Obed mine in 2013 (Cooke et al. 2016)). B.C.'s Elk Valley exemplifies this issue, where serious water contamination issues are unresolved, despite many years and hundreds of millions of dollars of investment in water treatment by Teck, and the largest fine in the history of the federal *Fisheries Act* (Cooke et al. 2016; Teck Resources Limited 2020; Weber 2021d).

There are four types of water impacts possible by coal development — impacts on groundwater quantity, groundwater quality, surface water quantity, and surface water quality — and due to the interaction of groundwater with surface water, these four impacts blend into one another. These impacts affect fish and wildlife, people, communities and commercial interests downstream of the Eastern Slopes. Exploration, particularly road-building and road use, can contribute to stream sedimentation, whereas coal mining consumes water, creates contaminated water, and exposes water resources to various contaminants, most notably selenium.

Groundwater

Assessing impacts on groundwater is challenging because of the complex geology and topography of the Eastern Slopes. Studies of coal mining and water in Alberta and in B.C.'s Elk Valley strongly suggest that a new mine on the southern Eastern Slopes would negatively affect groundwater quantity and quality (SNC-Lavalin 2014; Alberta Energy Regulator and Impact Assessment Agency of Canada 2021; Stelfox and Donahue 2021). The Grassy Mountain assessment concluded that impacts on groundwater were likely to occur and that they would be "irreversible or only reversible in over decades or centuries" (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 177). The review panel noted that the developer itself estimated "extended" leaching of selenium and other contaminants from waste rock after closure and a long-term care and custody cost of $22 million. While the review panel concluded that groundwater impacts would have little effect on municipal and agricultural ground wells at a distance from the mine, the panel noted that climate change would compound the mine's impacts on groundwater (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021).

Given the expected location of the hypothetical mine from human consumption points, the issue of water contamination is more tied to cumulative effects on fish and wildlife, and downstream water quality. This Grassy Mountain evidence suggests that any remediation activities effectively preventing water contamination would be prohibitively expensive.

Surface Water

The volume of water that a coal mine requires is non-trivial. For example, in 2017 Benga applied for 150 acre-feet of water per year to support its mine (Alberta Energy Regulator 2017c). With the already high level of allocation of water resources in southern Alberta (Bankes and Bradley 2020; Alberta Environment 2006), security of supply to existing users, including fish and other wildlife, would likely be detrimentally affected by an additional coal mine. A recent study of Alberta coal mining and water characterized the situation as follows:

> [t]he network of downstream land uses are completely reliant on the water supplies…of the headwaters, which in turn owe their existence to the climate and landscape integrity in the headwater basins. (Stelfox and Donahue 2021, 38)

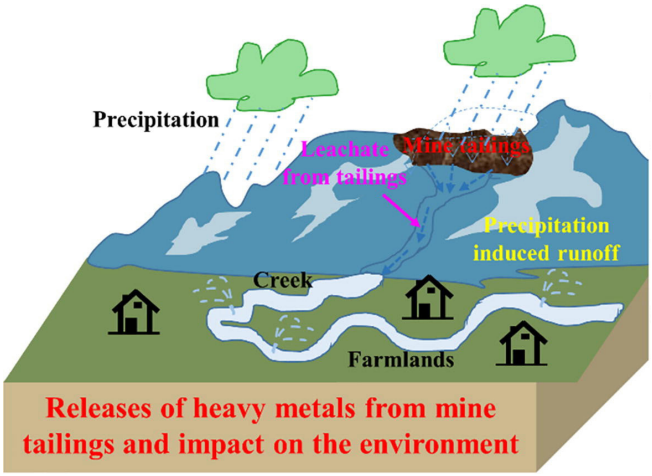
The Grassy Mountain review panel concluded that there would be adverse but "not significant" impacts on surface water quantity, with most impacts occurring in the upper parts of the Eastern Slopes watershed (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 191). Stelfox and Donahue (2021) concurred, finding that the greatest impact of coal mine water consumption will be felt upstream, and noting that with climate change this consumption will be most impactful on fish and downstream water rights-holders in summer through fall.

We expect the mine considered in our development scenario would similarly affect surface water quantity. Assessing the mine's precise water quantity impacts is beyond our scope, but we do discuss these impacts further in the context of other commercial interests and fish and wildlife below.

Coal mines affect surface water quality via leaching of selenium, metal and acid into fish-bearing streams and eventually into water sources used by communities and commercial interests downstream (Djuric 2021).

In B.C.'s Elk Valley, where mining has been underway for decades in similar geology and with similar water values (i.e., fish, community water needs, transboundary water demands, etc.), the impact of mining on water quality is an issue front and centre. Figure 14 illustrates a key vector for the contamination of water resources by selenium and other pollutants: rock exposed by mining contaminates rainfall runoff which then enters streams and eventually larger water bodies. Teck, the owner of the Elk Valley mines, is in the midst of executing a water-quality treatment plan that it expects to cost upwards of $400 million, and the plan's success is unknown based upon Teck's experience to date.

Figure 14. Illustration of Water Pollution from Contaminant Leaching from Mine Waste Rock into Surface and Groundwater.



Source: Wang et al. (2019).

Alberta government data indicate that water continues to be substantially polluted downstream of mines in west-central Alberta (Luscar, Gregg River) that were closed in the early 2000s, with effects on aquatic ecosystems, and bighorn sheep are heavily contaminated by selenium from coal mines (Stelfox and Donahue 2021; Weber 2021b; 2021f). Several academic studies also catalogue elevated contaminant levels in insects, birds and fish associated with coal mining (Wayland and Crosley 2006; Wayland, Casey, and Woodsworth 2007; Miller et al. 2013).

The Grassy Mountain review panel noted the limited success of Teck in the Elk Valley at preventing water quality exceedances in far-downstream Lake Koocanusa[31], and the importance of preventing water contamination before it occurs (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 194–95, 247–51). The panel noted that Benga predicted greater selenium and sulphate loads than Elk Valley mines and the mitigation plan, including a $20 million long-term water treatment system, was unlikely to work and might end up being massively underfunded and pose a long-term liability for Albertan taxpayers (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 199, 244–45). Overall, the review panel concluded that the mine posed a high-magnitude, significant adverse impact on water quality with potentially irreversible effects (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 257). Given current evidence from Alberta and B.C., we are also skeptical about a coal mining company's ability to mitigate water pollution.

With all of this in mind, we expect that a new coal mine in Category 2 lands on the southern Eastern Slopes would cause substantial surface water contamination regardless of attempts at mitigation. Contamination problems and costs are most substantial for those upstream (ranchers, communities, sport fishers and others near the Eastern Slopes). These negative effects would extend along the length of the

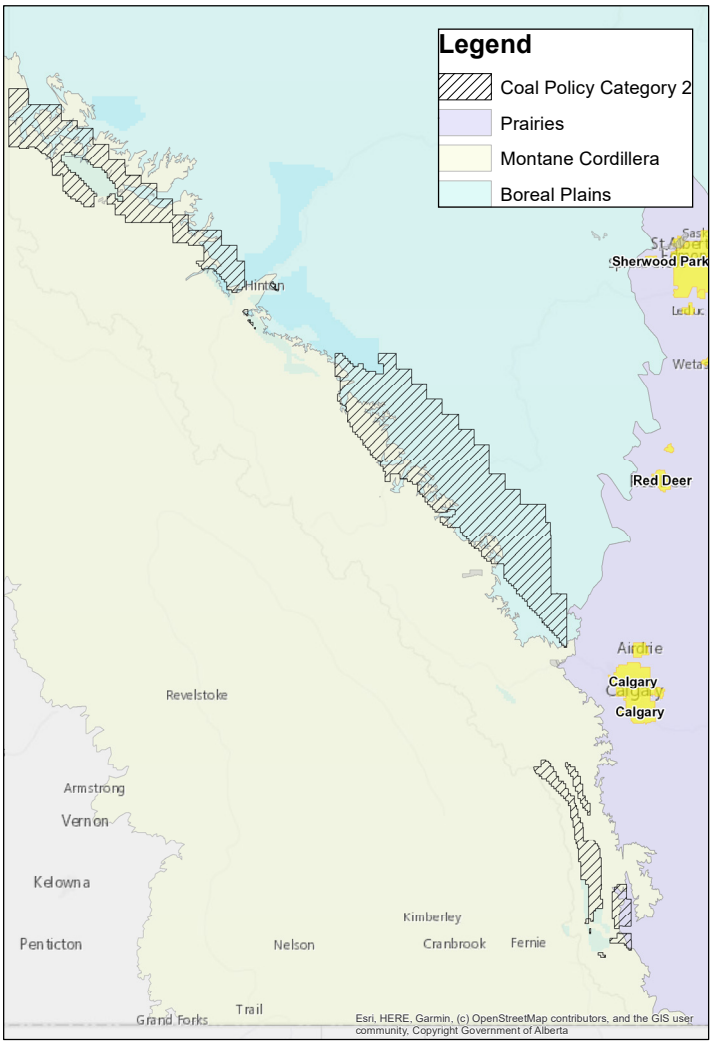
31 Lake Koocanusa is a dammed lake, with controlled water levels that become low in the summer, so it may not be representative of expected effects on natural lakes. However, it is illustrative of the potential harm to downstream water bodies.

riverine systems all the way through the Canadian prairies. We have not attempted to quantify the cost of impacts on water supplies and quality beyond reclamation costs and the potential reclamation liability discussed, but we expect these additional costs would be material and persistent.

4.5.3. Vegetation

Category 2 lands are largely composed of sub-alpine, montane, foothills parkland and foothills fescue ecosystems (Figure 15), containing everything from lands supportive of commercial forestry and ranching to rare plants, including species-at-risk like whitebark and limber pine. Exploration will lead to fragmentation of plant communities, contributing to the cumulative effects of other human activities on vegetation across the Eastern Slopes. Mining will take this habitat removal to a higher level with complete removal of vegetation across its footprint. Reclamation would take place, but the evidence suggests that reclamation of the mine site, at least, will take a very long time and may never return vegetation to its former state.

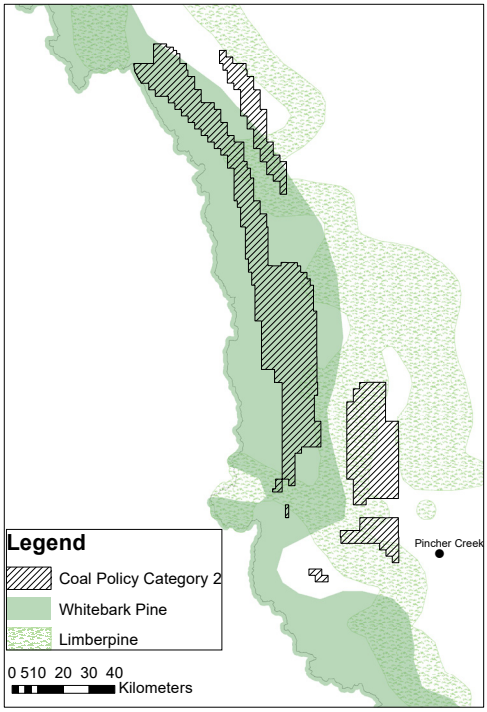
Figure 15. Eastern Slopes Ecosystems.



Source: Canadian Council on Ecological Areas (2014); Alberta Energy (n.d.); Statistics Canada (n.d.).

The Grassy Mountain assessment concluded that the project would have "significant" adverse impacts on whitebark pine, rough fescue grasslands and the biodiversity of vegetation species and communities (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). "Non-significant" adverse impacts were expected to occur with respect to a variety of other vegetation sub-components, including but not limited to old-growth, rare plants and communities, species important to Indigenous people, wetlands, and landscape biodiversity (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). The review panel stressed that there was insufficient information to make any conclusions about potential effects on the endangered limber pine, or cumulative effects on rangeland vegetation, old-growth forests, and vegetation valued for traditional purposes (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 324, 338, 342–44). The proponent anticipated that reclamation would begin to show success in "65 years or more" (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 312). The panel concluded at least 100 years would pass before any success in returning to equivalent land capability (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 100, 312, 359, 362).[32] This is due to reclamation science gaps, the harsh growing conditions of the affected habitat, impacts on mutualistic species like Clark's nutcracker, soil and topography changes at the mine site through the reclamation process, and climate change (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 312–13, 322, 331).

Figure 16. Endangered Plant Species and Category 2 Lands



Source: Alberta Energy Regulator (2015); Government of Alberta (2016); Natural Resources Canada (2020); Alberta Energy (n.d.); Statistics Canada (n.d.).

32 Equivalent land capability is "the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical" (Province of Alberta 1993, S. 1(e)).

Given that the hypothetical mine's footprint would occupy similar lands and vegetation ecosystems as the proposed Grassy Mountain project, we expect similar outcomes on vegetation values. Therefore, we expect substantial impacts on vegetation species-at-risk, the biodiversity of vegetation species and communities, old-growth, rare plants and plant communities, species of value for traditional purposes, wetlands, and landscape biodiversity. We expect that the mine will contribute to cumulative landscape disturbance and habitat fragmentation of the southern Eastern Slopes. We have not attempted to quantify these impacts other to note that they are significant and long-lasting.

4.5.4. Fish and Wildlife

The Eastern Slopes are home to many iconic species like caribou, grizzly bear and bighorn sheep, as well as fish prized by anglers like Westslope cutthroat trout and bull trout. Table 8 shows many of these species are threatened with extinction (Alberta Environment and Parks 2018b; Canadian Parks and Wilderness Society et al. 2018; Stelfox and Donahue 2021; Urquhart 2021b). The Eastern Slopes, and the Rockies more broadly, provide key habitat for these and other species, many of which formerly occupied the foothills and prairies but have been pushed into the mountains by agriculture and other human activity (Weerstra 1986).

Table 8. Species at Risk along the Eastern Slopes

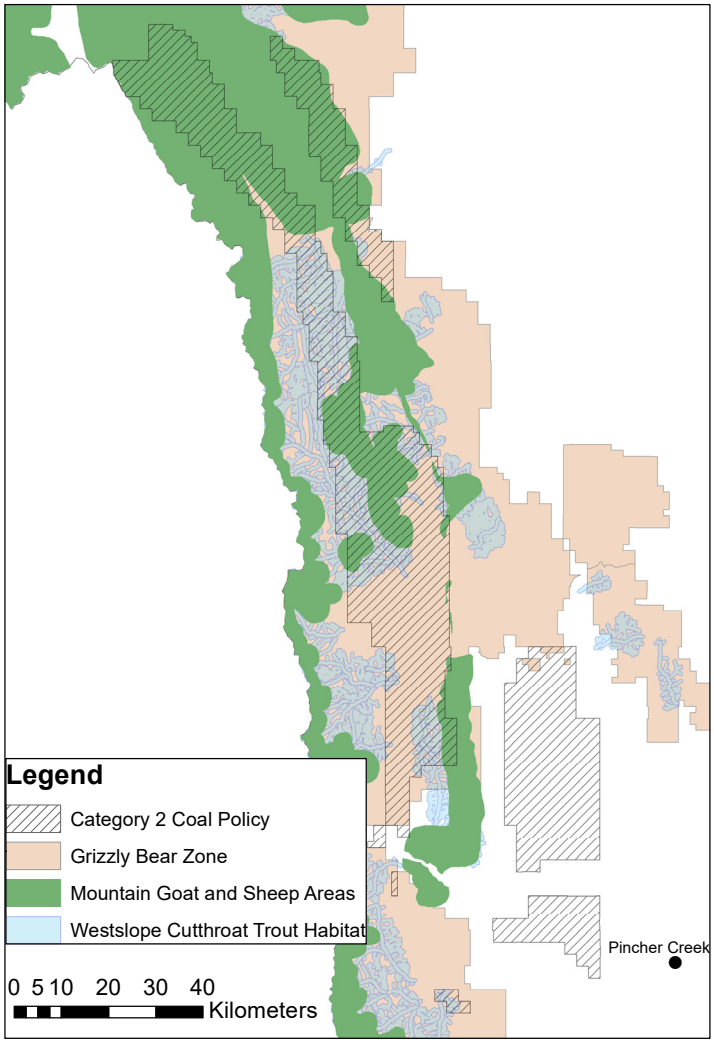
Species	Status
Athabasca rainbow trout	Endangered
Barred owl	Special concern
Bull trout	Threatened
Grizzly bear	Threatened
Harlequin duck	Special Concern
Limber Pine	Endangered
Long-toed salamander	Special Concern
Peregrine falcon	Threatened
Westslope cutthroat trout	Threatened
Whitebark pine	Endangered
Woodland caribou	Threatened

Note: This is not a complete list.

Source: Government of Alberta (2015; n.d.f).

Exploration will lead to habitat fragmentation, road development, stream sedimentation and noise impacts, which will add to the cumulative effects of other human activities and climate change on fish and wildlife. Again, the mine will have the most substantial impacts on fish and wildlife.

Figure 17. Wildlife Habitat and Category 2 Lands



Source: Alberta Energy Regulator (2015); Natural Resources Canada (2020); Alberta Energy (n.d.); Government of Alberta (n.d.k); Statistics Canada (n.d.).

The mine footprint will grow as the mine progresses, ultimately covering 1,500 hectares. The footprint will change over time as reclamation begins on parts of the footprint while other parts remain or become active. One estimate is that about a third of a southern Eastern Slopes coal mine's total footprint would be riparian (and aquatic) habitat, which works out to about 500 hectares of damaged or totally destroyed riparian habitat (Stelfox and Donahue 2021).

With respect to fish, the Grassy Mountain assessment focused on Westslope cutthroat trout (WSCT) due to the species' at-risk status and the spatial overlap between coal deposits in the southern Eastern Slopes and WSCT habitat (Department of Fisheries and Oceans 2019; Government of Alberta n.d.j). As noted in the federal recovery plan for WSCT, habitat is key:

> [A]ll areas currently occupied by naturally-occurring pure-strain populations within the original Westslope Cutthroat Trout distribution, including the areas on which Westslope Cutthroat Trout depend indirectly (e.g. riparian areas) in order

> to carry out their life processes and areas where genetically pure populations of the species formerly occurred and has the potential to be reintroduced. … The areas currently identified as critical habitat in this plan is insufficient to fully achieve the population and distribution objectives. As information is collected and analyzed, additional critical habitat and recovery areas will be added in order to fully achieve the population and distribution objectives. (Department of Fisheries and Oceans 2019)

In this context, the review panel concluded that the project would cause a direct loss in critical habitat for WSCT due to changes in water flow and calcite deposition, increases in contaminants that interfere with fish viability such as selenium and sulphates, and changes in sediment loads and food supply, and that mitigation (both reclamation of fish habitat and addressing water pollution) was either ineffective or unproven (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). The panel inferred similar impacts on bull trout and other aquatic life. Overall, the panel concluded that the project posed unacceptably high risks to WSCT and other aquatic life; they concluded that project and cumulative effects would be high in magnitude, provincial in geographic extent, irreversible, and "significant."

Stelfix and Donahue (2021) also noted a strong link between coal mining and low ecosystem productivity (i.e., biodiversity and abundance) in streams downstream from coal mines in Alberta's McLeod River watershed, as well as in B.C.'s Elk Valley and U.S. waters downstream of coal mining.

Given the overlap between WSCT critical habitat and Category 2 lands, the effects of coal mining on fish and fish habitat, and the challenges that coal mines seem to have at mitigating their impacts on fish and fish habitat downstream, we can only conclude that the mine would have substantial impacts on WSCT and other aquatic life. Accordingly, from a benefit-cost analysis perspective, the impacts of the development scenario on fish and fish habitat are a cost. However, given that WSCT and bull trout are species-at-risk, this impact is less appropriately an economic cost as a moral issue with the development scenario.

Serious impacts on terrestrial wildlife are also expected. Exploration will contribute to further fragmentation of wildlife habitat, but the mine will have a much greater effect on wildlife and its habitat. The best information available on the impacts of a new coal mine on the Eastern Slopes is again the decision statement from the Grassy Mountain project. The review panel concluded that the project would contribute to adverse effects on wildlife, including species-at-risk, migratory birds and amphibians, and would cause "significant" cumulative effects on at least little brown bats and grizzly bears (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, s. 17, s. 18, viii, xv, xvi, 370). Effects identified ranged from loss of habitat, habitat fragmentation, loss of habitat connectivity (for example, by building mine roads and the coal conveyor), direct mortality, and morbidity due to exposure to pollution. The review panel made clear that the cumulative effects context for further pressures from new coal development was tenuous (i.e., vulnerable) due to the habitat impacts of forestry but also impacts of roads (i.e., mortality from collisions with automobiles), hunting,

climate change and other stresses (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 37, 41, 355, 358).

Importantly, the panel was skeptical about the ability of a coal mining company to successfully reclaim a mine site in the southern Eastern Slopes; the panel noted that habitat could easily take 100 years or more to return to a viable state for wildlife (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 362). Allan et al. (2020) make similar observations on the impacts of coal mining on wildlife, studying the economic benefits of B.C. coal mining in the context of caribou decline. We expect that the Grassy Mountain panel conclusions are broadly reflective of what would happen to wildlife in our development scenario. We do not attempt to quantify this cost.

4.5.5. Loss of Ecosystem Goods and Services

Even if reclaimed to equivalent site capability, the ecosystem goods and services (EGS) provided by the mine site post-reclamation may be less or lower in quality than pre-mining. The definition of equivalent land capability does not ensure that all of the EGS previously provided by the site — such as maintenance of the water cycle and spiritual value — are provided afterwards.

For a benefit-cost analysis, the potential loss in EGS can be conceptualized as the product of a non-zero probability of this reclamation liability and its annual costs. The latter is the difference between the value of the EGS provided by the mine site pre-disturbance and the value of the EGS provided by the site post-mining. The Grassy Mountain review panel often referred to timelines of 100 years or more, and so these costs are potentially substantial on a cumulative basis (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 95, 100). We do not attempt to quantify these costs.

4.5.6. Cumulative Effects

Despite the large number of protected areas along the Eastern Slopes, its ecosystems are detrimentally affected by a wide range of industrial and commercial activities like forestry, oil and gas, ranching and associated road development; recreational activities like off-highway vehicle (OHV) and human-powered activities (e.g., hiking); and climate change (Canadian Parks and Wilderness Society 2014; 2017; Alberta Environment and Parks 2018a; 2018b; Canadian Parks and Wilderness Society et al. 2018). Forest cutblocks and other clearings, as well as roads and seismic lines, dramatically alter habitat, create edges and fragment contiguous habitat, to the detriment of species that thrive only in natural, uninterrupted spaces. OHV users often create new trails that branch off industrial linear development, adding to the linear density in habitat. Caribou are particularly affected by seismic lines and roads because it gives wolves greater ability to hunt them (Government of Alberta 2017), and grizzly bears' persistence is threatened by the greater access linear development offers people who, intentionally or not, are a source of bear mortality (Government of Alberta 2020d).

4.5.7. Non-use Values

Our analysis thus far has considered market values (e.g., value of coal) and various other use values (e.g., recreation) but has not thus far considered the full range of values within the total economic value framework, such as option or non-use values. Assessing non-use values is outside our scope.[33] Nonetheless, we expect that a mine would adversely affect the following types of non-use values:

- option value, i.e., the value that some people may hold for being able to possibly use something in the future;
- altruistic value, i.e., the value that some people may hold for knowing that others can benefit from something;
- bequest value, i.e., the value that some people may hold for knowing that others in the future can benefit from something; and
- existence value, i.e., the value that some people may hold for knowing that something simply exists.

The widespread public outcry at the Government of Alberta's rescinding of the 1976 Coal Policy is indicative of concern over use values (e.g., a nice view while hiking in the Livingstone Range) and non-use values (e.g., the option to be able to hike in the mine site area, or the comfort of knowing that iconic wildlife species in the region persist even if one doesn't expect to see or interact with the species). Estimating the magnitude, in monetary terms, of non-use values is challenging and outside our scope. This does not mean that these values do not exist or are insubstantial.

4.5.8. Summary of Environmental Account

Coal development would have substantial impacts on the environment, mostly associated with the mine. While there would be emissions of dust and various pollutants associated with diesel combustion, these would mostly be confined to the mine site out and away from communities and thus of negligible effect. On the other hand, the mine's construction and operations would contribute to the cumulative effects of climate change via its GHG emissions. Ground and surface water quantity and quality would be substantially affected. Strong evidence exists on the serious impacts that coal mining has on water resources from Alberta, B.C., and the U.S., and this evidence figured strongly in the Grassy Mountain project denial.

Mine development will also have substantial direct and cumulative impacts on vegetation species-at-risk, species and community biodiversity, old-growth, rare plants and plant communities, species of value for traditional purposes, wetlands, and landscape biodiversity. The mine will alter and destroy about 1,500 hectares of habitat, some of it likely to be critical habitat for species-at-risk, and reclamation limitations mean that habitat restoration will take at least decades if not a century or more.

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33 This would entail engagement with Indigenous peoples with a history of use of Category 2 lands as well as other people with a connection to these lands to identify and describe how these groups value the existence of the Eastern Slopes.

Species-at-risk such as Westslope cutthroat trout will be severely affected, as will other aquatic and terrestrial wildlife, including some of Alberta's most iconic species. There is also a risk of loss of environmental goods and services due to the limited extent of reclamation required under Alberta law. Last, the mine would impose losses with respect to non-use values including option, altruistic, bequest, and existence values.

Table 9 summarizes these important costs of the development scenario on the environment. We did not attempt to quantify most of the environmental impacts of the development scenario, but the evidence gathered — especially the denial of the Grassy Mountain project based on environmental impact — indicates the weight of this cost from the public interest perspective.

Table 9. Benefits, Costs and Net Benefits in the Environment Account.

Scenario	Impact	Description
All scenarios	Mine-face GHGs during operation	Baseline Scenario: $92.1 to $414.5 million (2020 dollars) Optimistic Scenario: $101.3 to $456 million (2020 dollars) Pessimistic Scenario: $82.9 to $373.1 million (2020 dollars)
	Water Quantity and Quality	Costs associated with serious, long-lasting and geographically widespread impacts on both water quantity and quality
	Vegetation	Costs associated with serious, long-lasting impacts on vegetation species, biodiversity, old growth, rare and highly valued plants and species-at-risk
	Fish and Wildlife	Costs associated with serious impacts on aquatic and terrestrial species-at-risk (e.g., Westslope cutthroat trout) and iconic species of Alberta (e.g., grizzly bear)
	Loss of Ecosystem Goods and Services	Costs imposed on Albertans associated with the loss of ecosystem goods and services due to limited reclamation required by law
	Non-use Values	Costs associated with adverse effects on non-use values including impacts on option, altruistic, bequest and existence values
	Net Benefits for Account	Unable to sum, but evidence of a substantial net cost

Note: Due to the mostly qualitative nature of the analysis of potential environmental impacts of the development scenario, no sensitivity analysis was undertaken.

4.6. SOCIAL ACCOUNT

The development scenario would have several community and health impacts, some positive and some negative. Lessons on the economic, social, and associated health and other effects of coal mining booms and busts can be drawn from studies of communities where such effects have taken place.

Community Impacts

The community, or social, impacts of coal mine development are an important piece of the broader implications of opening up of Category 2 lands to coal development. A variety of impacts can be expected with the development scenario.

One source of community impacts is a change to a host community's population and demographics. Major project development often entails immigration of temporary, non-local construction workers due to the need for specialized skills and the need for increased numbers of labourers. The Grassy Mountain assessment, for example,

predicted that most mining jobs during construction and operations would go to domestic immigrants from outside of local communities (Nichols Applied Management 2016). Temporary workers might fly in and out, or if the host community is relatively close to population centres, drive in and out. While this influx of workers can be an economic boon for local businesses, it can also negatively affect local cost of living: pressure on rental and ownership housing markets is a common issue because of the tight housing markets that tend to exist in small communities and the high pay of major-project workers (Lawrie, Tonts, and Plummer 2011; Ryser and Halseth 2011; Ennis, Finlayson, and Speering 2013). The small city of Williston, North Dakota became the most expensive city in the U.S. to rent in following the Bakken oil boom, due to the influx of highly paid oil workers (Upton 2014). In Fort McMurray, AB, the increase in population that occurred alongside the province's oil boom resulted in a significant increase in homelessness (Echenberg and Jensen 2009). Increased household income resulting from resource development cannot be reliably expected to offset rapid increases in housing costs (Okkola and Brunelle 2018).

The influx of new, temporary and/or itinerant resource workers can exert other pressures on host communities through an increased incidence of social delinquency, particularly in the form of violence and crime associated with substance abuse (Ruddell 2011; Aalhus, Oke, and Fumerton 2018). Police, emergency services, health care and social services can become stressed during such times, with spillover effects on locals otherwise needing these services. High levels of substance abuse within host communities are also associated with resource development (Parkins and Angell 2011). Additionally, reports of increases in gendered violence have been reported in resource communities (Stockwell 2015); Indigenous women and girls are particularly vulnerable to this increased risk of violence, which is correlated with the predominantly young and male demographic of resource workers (Amnesty International 2016). Many of the impacts of resource development on associated communities, including increased substance abuse and addiction issues, gendered violence and demographic instability are documented during both boom and bust periods (Galley 2011).

The pulse of new and/or temporary workers associated with resource development can mean other types of pressure on local service infrastructure, including increased demand on health-care services (Ryser and Halseth 2011; Shandro et al. 2014; Aalhus, Oke, and Fumerton 2018). Major projects in cities often have negligible effects on community services and infrastructure, but if situated in rural regions where only small communities exist, new major projects' — or often their workers' — pressures on community services and infrastructure can be substantial (Aalhus, Oke, and Fumerton 2018). Immigration of significant numbers of outsiders into a resource community is also associated with negative impacts on social connectedness in the host community (Aalhus, Oke, and Fumerton 2018).

Another common problem with major project development in host communities is economic leakage, where temporary construction workers spend their income in their home communities on their days off while increasing pressure on host communities' services and infrastructure (Storey 2010). This can carry over to operations: in Elkford and Sparwood, B.C. (the host communities for much of Teck's Elk Valley coal mining),

operations workers tend to spend their money in Fernie, Calgary, and elsewhere, hollowing out the host communities' retail sectors (Storey 2010).

These economic impacts of natural resource development are often discussed in terms of boom-and-bust phenomena that tend to plague host communities that are economically reliant on natural resource development. Boom-and-bust refers to the economic upswing that occurs in resource-dependent communities when the price of the associated resource being exploited (in our case, coal) is high, and the corresponding downswing that occurs when commodity prices fall and development pauses or ends altogether. While this phenomenon is strongly associated with natural resource-dependent communities[34], it has been observed in larger, more economically dynamic communities — such as Calgary, Edmonton, and Saskatoon — as well (Okkola and Brunelle 2018). This suggests that the development of a dependency relationship may not be necessary for communities associated with new coal development in Category 2 lands to experience the effects of the boom-bust commodity cycle.

The extent to which our development scenario would induce any of the above conditions and phenomena is difficult to assess, but we would expect to see them all manifest to some degree. The exploration stage would likely have only minor impacts, given the smaller number of people involved and minimal need to bring in workers to any particular community to undertake this work, in contrast to mine development and operational stages. The extent of the community impacts of a new mine, though, would depend on several key factors, including its location relative to communities in the surrounding area and the socioeconomic conditions in potentially impacted communities prior to mine development. Communities that have previously experienced the impacts of resource development and the associated boom-bust phenomena may already be in disadvantaged circumstances with regards to local socioeconomic conditions, magnifying any potential impacts of renewed development (Parkes et al. 2019).

Noise and Visual Environment

Here we cover the effects of noise and the visual environment on human activities. Exploration is a relatively minor source of noise and visual impacts given its temporary nature and location away from human habitation.

Mining, on the other hand, will have substantial impacts on both noise levels and visual aesthetics. During mine construction, we expect noise impacts to be minor given that the mine is not located near any communities and the noise of construction (heavy equipment, blasting, etc.) will be temporary in nature. Similarly, operational noise will have no effect given the mine site distance from any communities.

Coal transportation (loading onto rail cars and train transit near communities) will likely cause noise impacts as the loading facility will be near the rail line which transits

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34 Also referred to as resource-based communities, resource-dependent communities are characterized not only by their economic dependence on the exploitation or processing of a single type of natural resource (forestry, mining, oil and gas, etc.) but by a set of unique social and cultural characteristics which can undermine community resilience, adaptability, and non-resource-based development (Tsenkova and Youssef 2014).

directly through Crowsnest Pass communities. The Grassy Mountain review panel concluded that noise impacts of one train loading every day at the rail load-out facility would not be negligible but at the same time not significant (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 140). We do not quantify this impact.

The mine will have visual impacts in a landscape treasured for its wild, mountain aesthetic (Alberta Environment and Parks 2018b). The mine site will be visible from various outdoor recreation sites in the southern Eastern Slopes (e.g., hiking trails, OHV trails, ski areas), and the rail load-out facility will change the aesthetics of the Crowsnest Pass area, potentially affecting property values. Many people value the visual aesthetics of the region, and the mine would add substantially to the cumulative visual effects of other development. In the Grassy Mountain project assessment, ranchers stated that they highly value "the privilege of living in a beautiful, scenic location in a rural setting" (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 144). At the end of the mine's life, the mine site might only partially be reclaimed, visually. While re-vegetation and land sculpting have the potential to bring back a natural-looking vista in the latter half of the century, the Grassy Mountain assessment concluded that some mine features would remain distinguishable from natural features for longer (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 145, 305). The review panel concluded that

> the visual impacts of the project during mining operations and after closure may negatively affect enjoyment of the natural landscape by local residents and visitors participating in tourism and recreational activities in the area

and that

> there is a risk that both the recreational and tourism sectors could experience a reduction of activities…affect[ing] the socioeconomic conditions of the region. (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, 145)

The above passage from the review panel discusses impacts on other commercial interests, but the point holds: the mine's visual impacts are material. We do not quantify the economic cost of the visual impacts but expect them to be non-negligible.

Health Impacts

If a coal mine is developed according to our scenario, a mix of potential health impacts might be expected.

First, nitrogen oxides (NO_x) and other criteria air contaminants known to cause substantial health effects are generally only a concern when emitted near population centres; as exploration would occur away from communities, we only discuss these emissions as they pertain to the mine's operations stage.

There are a number of direct physical and mental health impacts associated with coal development. Certain respiratory diseases, including pneumoconiosis, silicosis, dust-related diffuse fibrosis and chronic obstructive pulmonary disease are associated with workplace exposure to airborne pollutants and have been observed in elevated rates

among coal mine workers; these diseases are collectively known as coal mine dust lung disease (Laney and Weissman 2014; Hendryx 2015).

Research from the U.S. and around the world shows a strong link between coal mining and associated air and water pollution, and disease among people living near coal-processing facilities and transportation routes. This includes respiratory disease, cardiovascular disease, kidney disease, dental disease, cancer, birth defects, low birthweight, depression, and self-reported low quality of life (Hendryx and Innes-Wimsatt 2013; Hendryx 2015; Hendryx, Zullig, and Luo 2020). These health outcomes occur after controlling for variables such as levels of obesity and smoking, though those in more challenging socioeconomic conditions are disproportionately affected. A dose-response effect is also present: the greater the exposure to coal mining — whether due to residential proximity to coal operations, rate of coal extraction, or otherwise — the worse the health outcomes (Hendryx and Innes-Wimsatt 2013; Hendryx 2015; Hendryx, Zullig, and Luo 2020).

A second set of indirect impacts involves changes to social and economic conditions affecting physical and mental health outcomes. Income, employment status, access to health and social services, and social networks are all determinants of health and are among those conditions likely to be affected in a development scenario.[35] Some of these potential effects are already discussed under *Community Impacts*, including demographic changes, decreased affordability of housing, and increased incidences of substance abuse, crime and gendered violence which have been correlated with resource development and associated boom-bust cycles.

Changes to local income and employment in communities proximate to coal mine development are likely in our development scenario, with mixed impacts on the health of local residents. Increased incomes associated with high resource sector wages could have a positive effect on both household buying power and financial stability; this would also be the case in households currently experiencing unemployment. Even temporary employment opportunities can support the development of transferable skills and increase future employability for workers (Shandro et al. 2014).

However, evidence from northeastern British Columbia, home of extensive natural resource development projects, suggests that higher incomes and lower unemployment are not necessarily associated with positive health outcomes. Increased income inequality, the predominantly male demographic of new resource jobs, persistent rates of high unemployment among women and low job security due to the limited profitable lifetime of resource development projects all have negative implications for the health and well-being of communities associated with those projects (Aalhus, Oke, and Fumerton 2018). Additionally, the boom-bust cycles associated with natural resource development have been associated with increased family instability and child neglect, as well as high levels of stress, anxiety, depression,

35 Determinants of health also include such factors as individual behaviour, education and genetics; however, our considerations here are confined primarily to social and economic determinants as they encompass those conditions more likely to be impacted in a development scenario. Environmental factors are also determinants of health; we discuss these factors elsewhere.

and cardiovascular disease (Shandro et al. 2011). Aalhus et al. (2018) attribute this to, among other factors, the negative impact of resource development on feelings of control and self-determination among residents of resource-dependent communities, which can result in feelings of powerlessness, depression and social upheaval.

For those living near or with a close connection to the mine site, one specific type of mental health impact deserves mention. The type of development being considered here — surface mining in a mountain environment, potentially involving the removal of mountain tops and wholesale change to the landscape in the mine boundary — is associated with a set of mental health conditions variously called ecological grief, solastalgia, and eco-anxiety (Albrecht 2011; Cordial, Riding-Malon, and Lips 2012; Hendryx and Innes-Wimsatt 2013). These mental health conditions concern the grief, pain, sadness, and suffering people feel due to the loss or anticipated loss of beloved ecosystems, landscapes, seascapes, species, or places. Those most connected to the mine site's natural state are most vulnerable to this type of mental health impact. The resulting behaviours and health outcomes of ecological grief — such as substance misuse and depression — may compound other health issues.

Changes to individuals' economic situations may be one of the most important impacts of major project development. However, as we noted in section 4.4, the effect on household incomes from incremental employment with a new mine is likely to be relatively minor. Social and health impacts of resource development are cumulative, suggesting that communities associated with mine development may still be experiencing the effects of previous resource development cycles; pre-existing local issues could magnify even the relatively minor influence of new development (Parkes et al. 2019).

Proximity to current and potential development and mining operations is an important factor in considering impact. For example, those living near coal infrastructure in southwestern Alberta and along the rail line and who do not currently live near any coal development or operations, would likely be exposed to elevated levels of air pollutants because these people would not otherwise be exposed to these pollutants. Similarly, those living downstream and with water from private wells or community water sources in the foothills and prairies of the South Saskatchewan watershed could be exposed to contaminants in their water that would not otherwise be there. These changes to environmental quality could mean higher rates of physical disease and mental health challenges among residents of southern Alberta, given the correlation between negative environmental impacts and health outcomes. Given that only ancillary coal infrastructure is expected be close to communities in our scenario, we can expect that health impacts associated with air pollution will be muted, though water pollution associated with new mine development would likely have a wider impact.

Additionally, the evidence suggests that the combination of adverse environmental impacts, especially water, fish, and reclamation liability impacts, will be substantial (section 4.5). It is not clear if the social impacts of the development scenario would be substantial or not. Overall, it would seem that the development scenario will be net negative on health outcomes, but much further analysis would be required to establish confidence in this conclusion.

Summary of Social Account

A variety of community and health impacts are expected with the development scenario (Table 10). A determining factor is the exact location of the new mine relative to host communities; if nearer to larger centres like Calgary, then adverse effects can be expected to be reduced. For example, noise impacts will be minor at the mine site but appreciable at the rail load-out facility in or near Crowsnest Pass communities. The evidence gathered suggests that overall there would be a net negative impact of the development scenario on communities and health, but due to the complex nature of these effects and the limits of what we have been able to do within the confines of this study, this conclusion is tentative.

Table 10. Benefits, Costs, and Net Benefits in the Social Account.

Scenario	Impact	Description
All Scenarios	Population and Demographic Change	Potential adverse effect on community membership, depending on exact location of new mine and host communities. Potential adverse effect on host communities with respect to substance abuse, crime, violence and pressure on emergency services. Potentially substantial adverse effect on community infrastructure and services, including housing.
	Boom and Bust Phenomena	Potential adverse effect on community retail sector and community feel associated with leakage of worker earnings out of host communities. Potential net adverse effects of booms and busts on host communities' economic and social fabrics.
	Health Outcomes	Potential net adverse health effects; adverse effects on the environment and community would outweigh the relatively minimal improvements to household income and government revenue.
	Noise and Visual Environment	Costs associated with substantial noise impacts at rail load-out facility in or near communities, and substantial and long-lasting visual impacts across region
	Net Benefits for Account	***Uncertain, but evidence suggests a net cost.***

Note: Due to the mostly qualitative nature of the analysis of potential environmental impacts of the development scenario, no sensitivity analysis was undertaken.

4.7. IMPACTS ON INDIGENOUS PEOPLES

It is critical to understand how potential coal mining may affect Indigenous Peoples, in keeping with the principles and spirit of reconciliation. These impacts are also important given Indigenous Peoples' distinct rights under section 95 of the *Constitution Act* and subsequent jurisprudence on Indigenous rights and title. This section thus provides important context adding to the results from the six accounts discussed above.

The Eastern Slopes overlaps with the traditional territories, and in some cases the reserve lands, of a number of First Nations and Indigenous groups (Figure 18 and Figure 19), including the Aseniwuche Winewak, the three nations comprising the Blackfoot Confederacy (Kainai First Nation (or Blood Tribe), Piikani Nation, and Siksika First Nation), and the Metis Nation of Alberta. Three treaties with the Government of Canada overlap the Eastern Slopes: Treaties 6, 7, and 8. It is likely the mine would also affect Indigenous communities and Nations in B.C., given overlap of traditional territories (Native Land 2019).

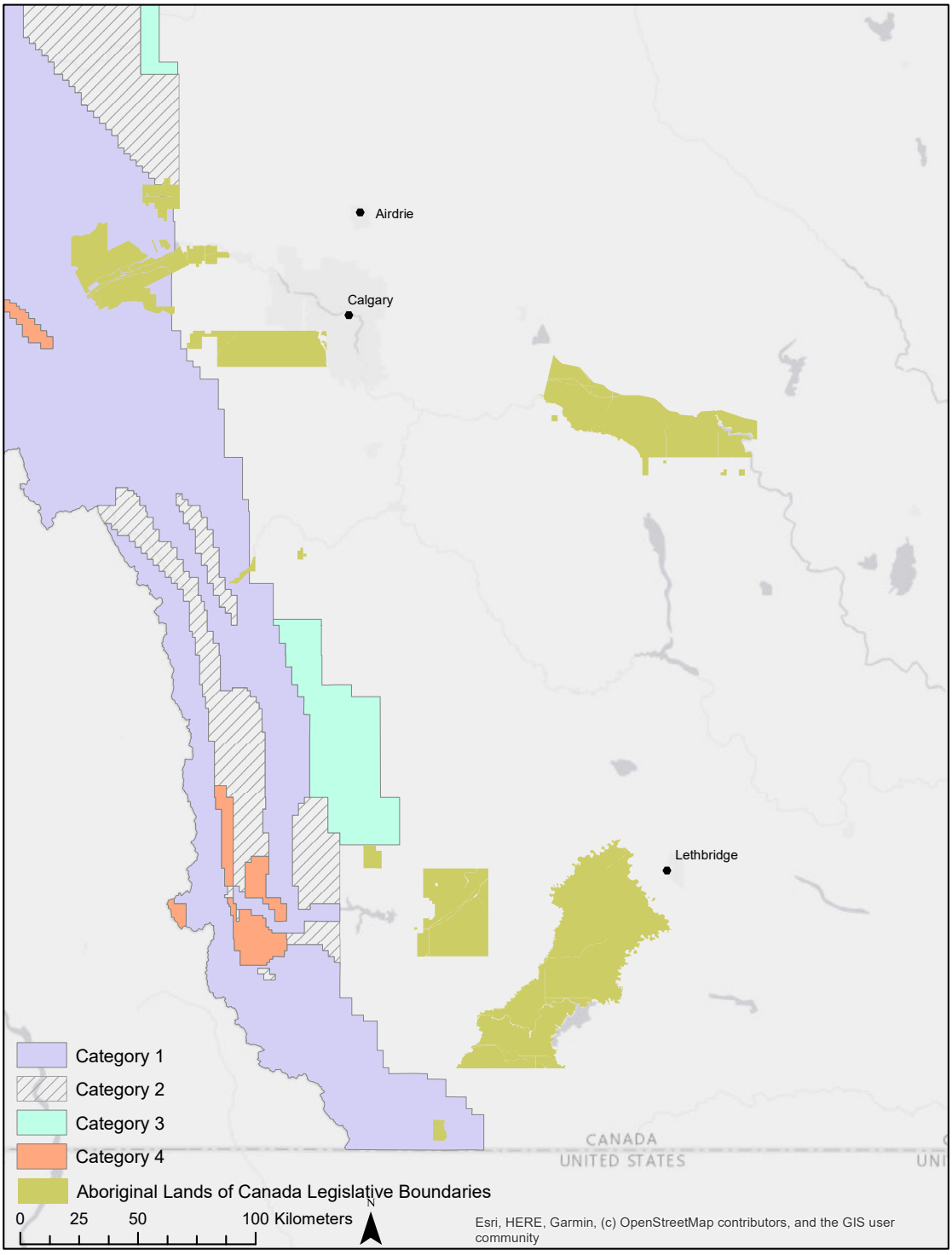
Figure 18. Numbered Treaties and Year of Signing

Source: Yug (2011).

The debate about coal mining on the Eastern Slopes, and the place of Indigenous Peoples within this debate, is taking place within the larger process of reconciliation underway in Canada.[36] Among these efforts are changes to how resource development, such as coal mining on the Eastern Slopes, is planned (Impact Assessment Agency of Canada 2021). Impacts on the Eastern Slopes therefore need to consider the broad variety of ways in which Indigenous Peoples may be affected, and the intersectionality of the many stresses that Indigenous Peoples face.

36 Spurred on in recent years in particular by the Truth and Reconciliation Commission's work over the past decade, reconciliation is a process of raising awareness about colonization's past and current effects on Indigenous peoples and undertaking efforts to address these effects (Crown-Indigenous Relations and Northern Affairs Canada n.d.).

Figure 19. 1976 Coal Policy Categories and Indigenous Reserves



Source: Alberta Energy Regulator (2015); United States Census Bureau (2018); Natural Resources Canada (2020; 2021); Alberta Energy (n.d.); Statistics Canada (n.d.).

The Eastern Slopes are important to each of these Indigenous groups for a multiplicity of reasons, including traditional land use such as ceremonial activities or collecting medicinal plants (Alberta Environment and Parks 2018b). Changes to the Eastern Slopes, more so for Indigenous Peoples than non-Indigenous, are therefore impactful

for many reasons, most importantly the negative effect on traditional land use and Indigenous Peoples' ability to exercise their rights (Parlee 2015).

Conversion of a natural place to a mine site for at least a century (based on the reclamation reality as concluded in the Grassy Mountain assessment) would detrimentally interfere with traditional territorial activities. The Canadian constitution and case law recognize the special significance of such impacts. Indigenous peoples and their ways of life enjoy certain protections under Canadian law, and so impacts on traditional territories and rights to practise cultural activities require accommodation (i.e., a type of mitigation specified in law). In other words, some of the impacts of the development scenario would have legal significance.

For some, such as those Indigenous peoples focused on economic development opportunities, the economic benefits that might come from an impact-benefit agreement signed with a project proponent — such as training and hiring provisions, as well as financial compensation and agreement on certain environmental protections — might be worth the trade-offs. A number of nations signed agreements with Benga with respect to the Grassy Mountain mine (Pimental 2021), while others expressed concerns about coal mining (Condon 2021; Pimental 2021; Weber 2021e), suggesting that for many, the adverse impacts might not be worth the benefits at all.

The experience of the proposed Grassy Mountain project demonstrates both perspectives are present in Indigenous communities facing major project development within their territories. The Grassy Mountain review panel noted that all Treaty 7 First Nations and Métis Region 3 signed agreements with the project's proponent. Two First Nations' legal challenges to the review panel's rejection of the project suggests support for the project, but members of numerous Indigenous communities have spoken out against the proposed project and their own communities' leadership (Opinko 2020; Alberta Energy Regulator and Impact Assessment Agency of Canada 2021; Weber 2021g).

Evidence regarding the benefits of resource development for Indigenous communities is mixed; benefits are unclear and baseline data are lacking. For example, resource development is associated with short-term employment opportunities but Indigenous Peoples are disadvantaged due to lower educational attainment (North Slave Metis Alliance 1999; Gibson and Klinck 2005; Angell and Parkins 2011; Amnesty International 2016). Any economic benefits would be limited by a project's financial challenges (as might occur, for example, with a bust in global coal prices), challenges facing Indigenous community members in obtaining and keeping project jobs, and other limitations built into impact-benefit agreements with proponents, all of which are common in the history of such agreements (Sosa and Keenan 2001; O'Faircheallaigh 2016; C. Gunton and Markey 2021). Moreover, project employment can displace traditional cultural activities and social structures (Booth and Skelton 2011; Nightingale et al. 2017).

Social impacts of development would likely affect Indigenous Peoples more than non-Indigenous people, given the former's typically higher reliance on health and social services and typically lower levels of income (National Collaborating Centre for Aboriginal Health 2013). The negative health and social impacts discussed above may

also be exacerbated by pre-existing challenges in Indigenous communities (Angell and Parkins 2011; Parlee 2015; Manning et al. 2018). Amnesty International (2016), studying the impacts of gas development in B.C.'s northeast region, highlights the social effects: loss of access to lands, gendered violence, increased competition for land use with non-Indigenous recreational users and social strain from an influx of non-residents.

As the Grassy Mountain Joint Review Panel found, any mine development will undoubtedly alter lands and waters important for Indigenous harvesting and cultural activities and affect asserted or established Aboriginal or treaty rights (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). The panel concluded that the project would have a "non-significant" adverse effect on current use of lands and resources for traditional purposes and a "significant" adverse effect on physical and cultural heritage, all contributing to existing "significant" adverse cumulative effects on affected Indigenous peoples. The panel did not conclude that the project would affect Indigenous health conditions, and that it would have modest positive economic effects and a mix of positive and negative social impacts. The panel concluded that the project was likely to impact Aboriginal or treaty rights of several First Nations as well as Métis Region 3.

However, Borrows (2016) points out that there is weak policy or legislative support for Indigenous economic self-determination or control over Indigenous-driven economic and natural resource development outside of government- or business-initiated projects and programs. This often leaves Indigenous communities with little actual power to drive decisions about development. Additionally, Palmater (2020) identifies that having legal standing does not necessarily translate into practical change, citing recent disputes over Mi'kmaq fishing rights in Nova Scotia — despite having the right to fish in their traditional territories, agents of the Canadian state have failed to protect said rights. Given past experiences with natural resource development,[37] the ability of Canadian governments to appropriately mitigate impacts on Indigenous Peoples is questionable.

In sum, given the results discussed above in the environment account and the social account, any benefits to Indigenous communities and groups are likely to be small and negative effects large and significant.

4.8. SUMMARY OF RESULTS AND DISTRIBUTION OF IMPACTS

Table 11 presents the various impacts assessed in the MABCA of coal development on Category 2 lands.

[37] Such as the oil sands, the Site C dam, the Trans Mountain pipeline, and various mining projects.

Table 11. Summary of Results Across Accounts

Account	Results		
	Baseline	Optimistic	Pessimistic
Market Valuation	Net revenues of -$150/-$181/-$181 million	Net revenues of $467/$161/-$35 million	Net revenues of -$804/-$553/-$340 million
Taxpayer	Government revenues of $440/$207/$67 million	Government revenues of $906/$441/$147 million	Government revenues of $205/$102/$38 million
	• Unestimated carbon tax revenue • Unestimated environmental reclamation liabilities • Unestimated subsidies (costs)		
Economic Activity	$29/$17/$9 million in net incremental labour income	$27/$18/$9 million in net incremental labour income	$24/$16/$9 million in net incremental labour income
	• Unestimated adverse effects on other commercial interests		
Environment	$92.1 to $414.5 million (2020 dollars) GHG emissions with global damage costs	$101.3 to $456 million (2020 dollars) GHG emissions with global damage costs	$82.9 to $373.1 million (2020 dollars) GHG emissions with global damage costs
	• Costs associated with substantial noise impacts at rail load-out facility in or near communities, and substantial and long-lasting visual impacts across region • Costs associated with serious, long-lasting and geographically widespread impacts on both water quantity and quality • Costs associated with serious, long-lasting impacts on vegetation species, biodiversity, old growth, rare and highly valued plants and species-at-risk • Costs associated with serious impacts on aquatic and terrestrial species-at-risk (e.g., Westslope cutthroat trout) and iconic species of Alberta (e.g., grizzly bear) • Costs imposed on Albertans associated with the loss of ecosystem goods and services due to limited reclamation required by law • Costs associated with adverse effects on non-use values including impacts on option, altruistic, bequest and existence values		
Social	• Potential adverse effect on community membership, depending on exact location of new mine and host communities • Potential adverse effect on host communities with respect to substance abuse, crime, violence and pressure on emergency services • Potentially substantial adverse effect on community infrastructure and services, including housing • Potential adverse effect on community retail sector and community feel associated with leakage of worker earnings out of host communities • Potential net adverse effects of booms and busts on host communities' economic and social fabrics • Potential net adverse health effects; adverse effects on the environment and community may outweigh the relatively minimal improvements to household income and government revenue		
Impacts on Indigenous Peoples	• Cultural significance of environmental impacts • Potential impact-benefit agreements • Impacts outlined in social account may be exacerbated by existing inequalities		

Note: Monetary figures are presented in the order of undiscounted dollars, discounted at three per cent and discounted at eight per cent. Government revenues exclude federal corporate income tax payments.

A limitation of traditional benefit-cost analysis is that it ignores the distribution of benefits and costs; a project may have a net benefit or a net cost to society, but particular groups in society may be disproportionately affected (adversely or positively). Examining the distribution of impacts is therefore a key component of good analysis.

Key groups of concern with respect to the opening up of Category 2 lands to coal development include:

- coal mining companies involved in development;
- labour;
- local, Alberta and federal governments;

- Indigenous nations and groups whose traditional territories overlap with Category 2 lands;
- private land owners and businesses with property and commercial interests that may be affected materially by coal development;
- people living in host communities or those who would interact with coal development and/or coal workers in their day-to-day lives (e.g., renting households in host communities, recreationists, etc.).

This list is not exclusive; we have tried to identify the key groups for which the benefits and costs of coal development can reasonably be expected to be substantially affected (positively or negatively or both). Impacts by key group are summarized in Table 10, and a column for impacts affecting the general public is included.

Table 12. Impacts across Key Groups (base case scenario)

Account	Coal Developers	Labour	Government	Indigenous Groups	Property and Commercial Interests	Host Community Members	General Public
Market Valuation	-$150/-$181/ -$181 million	--	Revenues of $431/$201/$64 million plus carbon tax payments	--	--	--	--
Taxpayer	Payments to government of $431/$201/$64 million plus carbon tax payments	Payments to government of $9/$6/$3 million in incremental income tax	Revenues of $440/$207/$67 million plus carbon tax payments minus unestimated environmental reclamation liabilities and subsidies	---	--	--	Benefits flowing to public corresponding with government revenues from development.
Economic Activity	--	Incremental income of $36/$23/$12 million	Payments to government of $9/$6/$3 million in incremental income tax	--	Unquantified adverse effects	Potential economic benefits in host communities	--
Environment	--	--	--	Water impacts on region Visual impacts on region Vegetation impacts Fish and wildlife impacts Loss of ecosystem goods and services Cultural significance of environmental impacts			Global greenhouse gas emission damage costs ($92.1 to $414.5 million (2020 dollars))
Social	--	Economic effects associated with local economic booms and busts	Effects of booms and busts on government resources	Effects on health outcomes	Economic effects associated with local economic booms and busts	Economic, health and social effects associated with population and demographic change, local economic booms and busts Noise at rail load-out facility in host community	--

Note: Monetary figures are presented in the order of undiscounted dollars, discounted at three per cent and discounted at eight per cent.

5. SUMMARY AND CONCLUSION

Our analysis suggests there are more costs than benefits to the development scenario, defined as coal exploration in various locations in Category 2 lands and the development of a single mine in the southwestern portion of Alberta. We estimate gross profits to the coal mine developer — i.e., excluding payment of royalties and taxes — of $511 million undiscounted and $140 million if discounted at a rate of three per cent. At a discount rate of eight per cent, which is much closer to the opportunity cost of capital for investors, the mine would not earn even a gross profit, at -$72 million. We estimate a net loss to the coal mine operator after payments of royalties and taxes to government. As we note above, however, mine proponents likely have better information on expected revenues and costs, and so for our purposes of a public-interest evaluation, it is sufficient to assume the private benefit to the project proponent is non-zero.

While we would expect some incremental labour income given the state of oil and gas markets and the Alberta economy's focus on such, we expect a wide range of other economic, environmental, and social impacts that would by and large be adverse. Importantly, the distribution of benefits and costs are unequal. The private benefits are concentrated in the project proponent; any increases in tax revenue are marginal given the size of Alberta's economy, and any incremental labour income is captured by a few individuals employed by the hypothetical mine. In contrast, the negative environmental and social impacts would affect a much broader population, including Indigenous Peoples. While some parties may benefit from development, overall the opening up of Category 2 lands does not appear to be in the public interest of Alberta.

Despite the large number of protected areas along the Eastern Slopes, its ecosystems are detrimentally affected by a wide range of industrial and commercial activities like forestry, oil and gas, ranching, and associated road development, and recreational activities. Protected areas in the central and northern portions of the Eastern Slopes enjoy substantial protection in parks, but the southern portion around the Crowsnest Pass does not have any substantial protected areas to maintain contiguity of habitat. The cumulative effects of human activities are also concerning from the effect on water quality and availability.

Our results mirror the findings of the Grassy Mountain environmental assessment. The joint review panel concluded that

> the project's significant adverse environmental effects on surface water quality and westslope cutthroat trout and habitat outweigh the low to moderate positive economic impacts of the project. Therefore, we find that the project is not in the public interest…even if the positive economic impacts are as great as predicted by Benga, the character and severity of the environmental effects are such that we must reach the conclusion that approval of the Coal Conservation Act applications is not in the public interest. (Alberta Energy Regulator and Impact Assessment Agency of Canada 2021, xix)

We relied on the Grassy Mountain assessment for much of our own analysis, given the recency of this assessment, the detailed information provided and its relevance to any other coal mine pursued in the region. Therefore, the similar results are not surprising.

As stressed by analysts examining coal development in northeast B.C. and noted by the Grassy Mountain review panel, the actual economic benefits that can realistically be expected from coal development are much smaller than the potential benefits presented by coal proponents (Allan et al. 2020; Alberta Energy Regulator and Impact Assessment Agency of Canada 2021). The evidence strongly suggests that coal markets are on the long-term decline, and with so many environmental liabilities of coal mining development in a location so valued for its environmental and other qualities, it is hard to see the case for new coal development.

Limitations to our analysis include our focus on local effects. Given that we restricted our scope to Alberta, it is possible there are benefits and costs to other jurisdictions (e.g., B.C. and Canada) that we did not include in our analysis. We also were only able to qualitatively assess — based on available evidence and research — environmental and social impacts and potential effects on Indigenous Peoples. Nevertheless, the qualitative evidence is sufficient to conclude that adverse effects are likely to be large and negative. Overall, we conclude the minor economic benefits are insufficient to justify large and potentially irreversible harms.

REFERENCES

Aalhus, Melissa, Barb Oke, and Raina Fumerton. 2018. "The Social Determinants of Health Impacts of Resource Extraction and Development in Rural and Northern Communities: A Summary of Impacts and Promising Practices for Assessment and Monitoring." Northern Health. https://www.northernhealth.ca/sites/northern_health/files/services/office-health-resource-development/documents/impacts-promising-practices-assessment-monitoring.pdf.

Agriculture and Agri Food Canada. 2013. "AAFC Incremental Gross Drainage Areas." AAFC Watersheds Project - 2013. Canadian Watersheds Information Network. https://doi.org/10.5203/Z8NP-CX60.

Alberta. 2000. *Coal Conservation Act*. *RSA 2000*. https://open.alberta.ca/publications/c17.

———. 2013. *Responsible Energy Development Act*. *RSA 2000*. https://open.alberta.ca/publications/r17p3.

———. 2021. *Environmental Protection and Enhancement Act*. *RSA 2000*.

Alberta Culture and Tourism. n.d. "Nicholas Sheran (1841-1882)." Coal. Accessed August 29, 2021. http://history.alberta.ca/energyheritage/coal/the-early-development-of-the-coal-industry-1874-1914/the-spirit-of-entrepreneuralism/nicholas-sheran.aspx.

Alberta Energy. 1993. "Coal Royalty Guidelines." Government of Alberta. https://training.energy.gov.ab.ca/Guides/1993CoalRoyaltyGuidelines.pdf.

———. 2020. "Information Letter 2020-23: Rescission of A Coal Development Policy for Alberta and New Leasing Rules for Crown Coal Leases." Government of Alberta.

———. n.d. "Geoview - Coal." GeoView. Accessed October 28, 2021. https://gis.energy.gov.ab.ca/Geoview/Coal.

Alberta Energy Regulator. 2000. "ST31: Reserves of Coal, Province of Alberta." Alberta Energy and Utilities Board. https://www.aer.ca/providing-information/data-and-reports/statistical-reports/st31.

———. 2015. "Map-87: Coal in Alberta." Products and Services Catalogue. August 2015. http://www1.aer.ca/ProductCatalogue/184.html.

———. 2017a. "Publication of Decision - Application A10053557." June 1, 2017. https://webapps.aer.ca/pod/details?decisionnumber=A10053557.

———. 2017b. "Publication of Decision - Application A10059310." October 13, 2017. https://webapps.aer.ca/pod/details?decisionnumber=A10059310.

———. 2017c. "Notice of Application - Grassy Mountain Coal Project." Alberta Energy Regulator. https://open.alberta.ca/dataset/12ab5b0c-c74d-4936-8fe7-2d550a2fa69e/resource/0873def0-d2f2-4673-9c8c-a555d79bead7/download/benga-publicnotice-oct31-2017.pdf.

———. 2018a. “Publication of Decision - Application A10061952.” March 8, 2018. https://webapps.aer.ca/pod/details?decisionnumber=A10061952.

———. 2018b. “Publication of Decision - Application A10059741.” March 19, 2018. https://webapps.aer.ca/pod/details?decisionnumber=A10059741.

———. 2018c. “Publication of Decision - Application A10075673.” August 3, 2018. https://webapps.aer.ca/pod/details?decisionnumber=A10075673.

———. 2018d. “Publication of Decision - Application A10032675.” November 7, 2018. https://webapps.aer.ca/pod/details?decisionnumber=A10032675.

———. 2019a. “Publication of Decision - Application A10089948.” May 29, 2019. https://webapps.aer.ca/pod/details?decisionnumber=A10089948.

———. 2019b. “Publication of Decision - Application A10092686.” July 8, 2019. https://webapps.aer.ca/pod/details?decisionnumber=A10092686.

———. 2019c. “Publication of Decision - Application A10095553.” July 23, 2019. https://webapps.aer.ca/pod/details?decisionnumber=A10095553.

———. 2019d. “Publication of Decision - Application A10090497.” October 8, 2019. https://webapps.aer.ca/pod/details?decisionnumber=A10090497.

———. 2019e. “ST26: Alberta Coal Industry Monthly Statistics.” Statistical Series 26: Alberta Coal Industry Monthly Statistics. Calgary, Alberta: Alberta Energy Regulator. https://static.aer.ca/prd/documents/sts/st26/ST26_2019-12.pdf.

———. 2020a. “Publication of Decision - Application A10101333.” February 26, 2020. https://webapps.aer.ca/pod/details?decisionnumber=A10101333.

———. 2020b. “Publication of Decision - Application A10090503.” May 28, 2020. https://webapps.aer.ca/pod/details?decisionnumber=A10090503.

———. 2020c. “Publication of Decision - Application A10099788.” June 2, 2020. https://webapps.aer.ca/pod/details?decisionnumber=A10099788.

———. 2020d. “Publication of Decision - Application A10103910.” July 9, 2020. https://webapps.aer.ca/pod/details?decisionnumber=A10103910.

———. 2020e. “Publication of Decision - Application A10104623.” September 10, 2020. https://webapps.aer.ca/pod/details?decisionnumber=A10104623.

———. 2020f. “Publication of Decision - Application A10104523.” September 25, 2020. https://webapps.aer.ca/pod/details?decisionnumber=A10104523.

———. 2021a. “Guide to the Mine Financial Security Program.” Alberta Energy Regulator. https://static.aer.ca/prd/documents/liability/MFSP_Guide.pdf.

———. 2021b. “Coal Production: ST98.” Alberta Energy Regulator. https://www.aer.ca/providing-information/data-and-reports/statistical-reports/st98/coal/production.

———. 2021c. “Executive Summary: ST98.” Alberta Energy Regulator. https://www.aer.ca/providing-information/data-and-reports/statistical-reports/st98/executive-summary.

———. 2021d. “Reserves: ST98.” Alberta Energy Regulator. https://www.aer.ca/providing-information/data-and-reports/statistical-reports/st98/reserves.

———. 2021e. “ST98: Alberta Energy Outlook.” Alberta Energy Regulator. https://www.aer.ca/providing-information/data-and-reports/statistical-reports/st98.

———. 2021f. “ST26: Alberta Coal Industries Monthly Statistics.” Statistical Series 26: Alberta Coal Industry Monthly Statistics. Calgary, Alberta: Alberta Energy Regulator. https://static.aer.ca/prd/documents/sts/st26/ST26_Current.pdf.

———. n.d.a. “Coal.” Alberta Energy Regulator. n.d.a. https://www.aer.ca/providing-information/by-topic/coal.

———. n.d.b. “Coal Mines in Alberta Shapefile.” Maps, Map Viewers, and Shapefiles. n.d.b. https://www.aer.ca/providing-information/data-and-reports/maps-mapviewers-and-shapefiles.

———. n.d.c. “ST45: Operating and Abandoned Coal Mines in Alberta.” Alberta Energy Regulator. n.d.c. https://www.aer.ca/providing-information/data-and-reports/statistical-reports/st45.

Alberta Energy Regulator and Impact Assessment Agency of Canada. 2021. *Report of the Joint Review Panel: Benga Mining Limited Grassy Mountain Coal Project: Crowsnest Pass.* https://epe.lac-bac.gc.ca/100/201/301/weekly_acquisitions_list-ef/2021/21-31/publications.gc.ca/collections/collection_2021/aeic-iaac/En106-239-2021-eng.pdf.

Alberta Environment. 2006. “Approved Water Management Plan for the South Saskatchewan River Basin (Alberta).” Alberta Environment. https://open.alberta.ca/dataset/7541cb1e-b511-4a98-8b76-af33d7418fa1/resource/483eb9b0-29fd-41d4-9f81-264d53682b9a/download/2006-ssrb-approvedwatermanagementplan-2006.pdf.

Alberta Environment and Parks. 2015. “Parks and Protected Areas in Alberta.” Government of Alberta. https://geodiscover.alberta.ca/geoportal/rest/metadata/item/0d1ac1474eba42fe9444a42a23a4ea1b/html.

———. 2017. “Eastern Slopes Land Use Zoning.” Government of Alberta. https://geodiscover.alberta.ca/geoportal/rest/metadata/item/ae158308d4ac4a03bedd6b15b63dd741/html.

———. 2018a. “Livingstone-Porcupine Hills Land Footprint Management Plan.” Government of Alberta. https://open.alberta.ca/publications/9781460139660.

———. 2018b. “Livingstone-Porcupine Hills Recreation Management Plan.” Government of Alberta. https://open.alberta.ca/publications/9781460139684.

———. n.d. “Land-Use Planning Maps.” Maps and Shapefiles. n.d. https://landuse.alberta.ca/ResultsResources/Pages/MapsandShapefiles.aspx.

Alberta Southwest. 2020. “Alberta Southwest Crown of the Continent Wins 3rd Place in ‘Best of the Americas’ Category at the Sustainable Top 100 Destination Awards.” Alberta SouthWest Regional Economic Development Alliance. March 4, 2020. https://www.albertasouthwest.com/about/our-projects/current-projects/sustainable-top-100-destination/.

Alberta Treasury Board and Finance. 2021. “Budget 2021: Fiscal Plan.” Government of Alberta. https://open.alberta.ca/dataset/6f47f49d-d79e-4298-9450-08a61a6c57b2/resource/ec1d42ee-ecca-48a9-b450-6b18352b58d3/download/budget-2021-fiscal-plan-2021-24.pdf.

Alberta Wilderness Association. 2010. “The Forests of Alberta’s Eastern Slopes: Forests or Forestry? August 2010 Update.” Alberta Wilderness Association. https://albertawilderness.ca/wp-content/uploads/20100816_rp_awa_forests_or_forestry.pdf.

———. n.d. “Rocky Mountain and Foothills Natural Regions.” Issues. Accessed October 26, 2021. https://albertawilderness.ca/issues/wildlands/forests/rocky-mountain-and-foothills-forests/.

Albrecht, Glenn. 2011. “Chronic Environmental Change: Emerging ‘Psychoterratic’ Syndromes.” In *Climate Change and Human Well-Being: Global Challenges and Opportunities*, edited by Inka Weissbecker, 43–56. New York, NY: Springer New York. https://doi.org/10.1007/978-1-4419-9742-5_3.

Allan, Robyn. 2016. “Toward Financial Responsibility in British Columbia’s Mining Industry.” Union of British Columbia Indian Chiefs. https://miningwatch.ca/sites/default/files/toward_financial_responsibilty.pdf.

Allan, Robyn, Peter Bode, Rosemary Collard, and Jessica Dempsey. 2020. “Who Benefits from Caribou Decline?” Canadian Centre for Policy Alternatives. https://www.policyalternatives.ca/publications/reports/who-benefits-caribou-decline.

Amnesty International. 2016. “Canada: Out of Sight, out of Mind: Gender, Indigenous Rights and Energy Development in Northeast British Columbia.” AMR 20/4872/2016. Amnesty International. https://www.amnesty.org/en/documents/amr20/4872/2016/en/.

Angell, Angela C., and John R. Parkins. 2011. “Resource Development and Aboriginal Culture in the Canadian North.” *Polar Record* 47 (1): 67–79. https://doi.org/10.1017/S0032247410000124.

Atrum Coal Ltd. 2020. “Elan Project Updated Scoping Study.” Atrum Coal Ltd. https://www.atrumcoal.com/wp-content/uploads/2020/12/ATU_ELAN_PROJECT_UPDATED_SCOPING_STUDY.pdf.

Auditor General of Alberta. 2015. “Systems to Ensure Sufficient Financial Security for Land Disturbances from Mining.” Report of the Auditor General. https://www.oag.ab.ca/reports/oag-aep-and-aer-sufficient-financial-security-land-disturbances-mining-july-2015/.

———. 2019. “AER: Systems to Ensure Sufficient Financial Security for Land Disturbances from Mining Followup - Nov 2019.” Report of the Auditor General. https://www.oag.ab.ca/reports/aer-sufficient-financial-security-mining-followup-nov-2019/.

Baldwin, M. (SNC-Lavalin). 2021. Personal communication with C. Joseph, June 2021.

Bankes, Nigel. 2021a. “Coal Law and Policy in Alberta, Part One: The Coal Policy and Its Legal Status.” *ABlawg* (blog). February 8, 2021. https://ablawg.ca/2021/02/08/coal-law-and-policy-in-alberta-part-one-the-coal-policy-and-its-legal-status/.

———. 2021b. “What Are the Implications of Reinstating the 1976 Coal Development Policy?” *ABlawg* (blog). February 9, 2021. https://ablawg.ca/2021/02/09/what-are-the-implications-of-reinstating-the-1976-coal-development-policy/.

———. 2021c. “Coal Law and Policy in Alberta, Part Two: The Rules for Acquiring Coal Rights and the Royalty Regime.” *ABlawg* (blog). February 11, 2021. https://ablawg.ca/2021/02/11/coal-law-and-policy-in-alberta-part-2-the-rules-for-acquiring-coal-rights-and-the-royalty-regime/.

———. 2021d. “Coal Law and Policy in Alberta, Part Three: Was the Public Rationale for Rescinding the Coal Policy Ever Convincing?” *ABlawg* (blog). February 15, 2021. https://ablawg.ca/2021/02/15/coal-law-and-policy-in-alberta-part-three-was-the-public-rationale-for-rescinding-the-coal-policy-ever-convincing/.

———. 2021e. “Coal Law and Policy Part Six: Coal Consultation Terms of Reference.” *ABlawg* (blog). April 21, 2021. https://ablawg.ca/2021/04/21/coal-law-and-policy-part-six-coal-consultation-terms-of-reference/.

Bankes, Nigel, and Cheryl Bradley. 2020. “Water for Coal Developments: Where Will It Come From?” *ABlawg* (blog). December 4, 2020. https://ablawg.ca/2020/12/04/water-for-coal-developments-where-will-it-come-from/.

Bartik, Timothy J. 2011. “Including Jobs in Benefit-Cost Analysis.” 11–178. Upjohn Institute Working Papers. W.E. Upjohn Institute. https://doi.org/10.17848/wp11-178.

———. 2012. “Including Jobs in Benefit-Cost Analysis.” *Annual Review of Resource Economics* 4 (August): 55–73. https://doi.org/10.1146/annurev-resource-110811-114520.

Bliss, L. C., W. I. Strong, Roy L. Taylor, D. Meidinger, Robert T. Coupland, Paul F. Maycock, Peter J. Scott, and C. J. Bird. 2015. “Vegetation Regions.” In *The Canadian Encyclopedia*. Historica Canada. https://www.thecanadianencyclopedia.ca/en/article/vegetation-regions.

Booth, Annie L., and Norman W. Skelton. 2011. “‘There’s a Conflict Right There’: Integrating Indigenous Community Values into Commercial Forestry in the Tl’azt’en First Nation.” *Society & Natural Resources* 24 (4): 368–83. https://doi.org/10.1080/08941920902755390.

Borrows, John. 2016. *Freedom and Indigenous Constitutionalism*. Toronto: University of Toronto Press.

BuildForce Canada. 2021a. "Alberta Highlights 2021-2030." Construction and Maintenance Looking Forward. Ottawa: BuildForce Canada. https://www.buildforce.ca/en/lmi/forecast-summary-reports.

———. 2021b. "National Summary Highlights 2021-2030." Construction and Maintenance Looking Forward. Ottawa: BuildForce Canada. https://www.buildforce.ca/en/lmi/forecast-summary-reports.

Cabin Ridge Project. 2021. "Responsible Metallurgical Coal Development in Alberta: Presentation to the Coal Policy Consultation Committee." June 16. https://s3.ap-southeast-2.amazonaws.com/assets.cabinridgecoal/app/uploads/2021/08/05005256/Cabin-Ridge-Presentation-to-Coal-Policy-Consultation-Committee-June-16-2021.pdf.

———. n.d. "Our Project." Cabin Ridge Project. Accessed October 29, 2021. https://www.cabinridgecoal.com/our-project/.

Canada Energy Regulator. 2020a. "Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050." Canada Energy Regulator. https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2020/index.html.

———. 2020b. "Canada Energy Regulator Report NOVA Gas Transmission Ltd. GH-003-2018." Canada Energy Regulator. https://www.cer-rec.gc.ca/en/applications-hearings/view-applications-projects/2021-ngtl-system-expansion/key-information.html.

Canada Guide. n.d. "Alberta Tourism Information." The Canada Guide. Accessed October 26, 2021. https://thecanadaguide.com/places/canadian-tourism/alberta-tourism/.

Canadian Council on Ecological Areas. 2014. "Ecozones." 2014. https://ccea-ccae.org/ecozones-downloads/.

Canadian Parks and Wilderness Society. 2014. "Summary Paper: Understanding Forest Management of Alberta's Southern Eastern Slopes." Canadian Parks and Wilderness Society. https://cpaws-southernalberta.org/wp-content/uploads/2018/06/Understanding_Forest_Management_Summary.pdf.

———. 2017. "Envisioning A Better Way Forward For Alberta." Canadian Parks and Wilderness Society. https://cpaws-southernalberta.org/wp-content/uploads/2018/06/EnvisioningABetterWayForwardForAlberta.pdf.

Canadian Parks and Wilderness Society, Miistakis Institute, Southern Alberta Land Trust Society, and Yellowstone to Yukon Conservation Initiative. 2018. "Southern Eastern Slopes Conservation Strategy." Southern East Slopes Conservation Strategy. http://www.southerneasternslopes.ca/wp-content/uploads/2018/07/SESCC_Report_SinglePages.pdf.

Cassell, Barry. 2014. "MAXIM Advances Milner Gas Project; Mulls Sale of Alberta Coal Projects | Transmission Intelligence Service." *Transmission Hub*, March 19, 2014. https://www.transmissionhub.com/articles/2014/03/maxim-advances-milner-gas-project-mulls-sale-of-alberta-coal-projects.html.

CBC News. 2021. "'I Feel the Government Is Trying to Trick Albertans': Former Civil Servant on Sudden Coal Lease Cancellations | CBC News." *CBC News*, January 19, 2021. https://www.cbc.ca/news/canada/calgary/alberta-coal-leases-cancelled-david-luff-eyeopener-1.5879123.

Condon, Olivia. 2021. "First Nations Launch Legal Challenge to Coal Mining on Alberta's Eastern Slopes." *Calgary Herald*, February 3, 2021. https://calgaryherald.com/news/local-news/first-nations-launch-legal-challenge-to-coal-mining-on-albertas-eastern-slopes.

Cooke, Colin A., Colin Schwindt, Martin Davies, William F. Donahue, and Ekram Azim. 2016. "Initial Environmental Impacts of the Obed Mountain Coal Mine Process Water Spill into the Athabasca River (Alberta, Canada)." *Science of The Total Environment* 557–558: 502–9. https://doi.org/10.1016/j.scitotenv.2016.03.058.

Cordial, Paige, Ruth Riding-Malon, and Hilary Lips. 2012. "The Effects of Mountaintop Removal Coal Mining on Mental Health, Well-Being, and Community Health in Central Appalachia." *Ecopsychology* 4 (3): 201–8. https://doi.org/10.1089/eco.2012.0032.

Crown-Indigenous Relations and Northern Affairs Canada. n.d. "Truth and Reconciliation Commission of Canada." Administrative page. Government of Canada. Accessed October 27, 2021. https://www.rcaanc-cirnac.gc.ca/eng/1450124405592/1529106060525.

CST Canada Coal Limited. n.d. "Welcome to CST Canada Coal Limited." CST Canada Coal Limited. Accessed October 29, 2021. https://cstcoal.ca/.

Del Bo, Chiara, Carlo Fiorio, and Massimo Florio. 2011. "Shadow Wages for the EU Regions*." *Fiscal Studies* 32 (1): 109–43. https://doi.org/10.1111/j.1475-5890.2011.00129.x.

Department of Fisheries and Oceans. 2019. "Recovery Strategy and Action Plan for the Alberta Populations of Westslope Cutthroat Trout (Oncorhynchus Clarkii Lewisi) in Canada 2019 [Proposed]." Government of Canada. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery/westslope-cutthroat-trout-2019-proposed.html.

Djuric, Mickey. 2021. "'An Abomination': Sask. Water Expert Warns of Contamination Following Alberta's Coal Policy Changes." *CBC News*, February 5, 2021. https://www.cbc.ca/news/canada/saskatchewan/alberta-coal-policy-possible-contamination-saskatchewan-water-1.5902681.

Echenberg, Havi, and Hilary Jensen. 2009. "Risk Factors for Homelessness." PRB 08-51-E. Background Paper. Ottawa, Canada: Library of Parliament. https://publications.gc.ca/site/eng/9.828931/publication.html.

Ennis, Gretchen, Mary Finlayson, and Glen Speering. 2013. "Expecting a Boomtown? Exploring Potential Housing – Related Impacts of Large Scale Resource Developments in Darwin." *Human Geographies - Journal of Studies and Research in Human Geography* 7 (1): 33–42. http://dx.doi.org/10.5719/hgeo.2013.71.33.

Environment and Climate Change Canada. 2012. "Guidelines for the Assessment of Alternatives for Mine Waste Disposal." Government of Canada. https://www.canada.ca/en/environment-climate-change/services/managing-pollution/publications/guidelines-alternatives-mine-waste-disposal.html.

———. 2016. "Technical Update to Environment Canada's Social Cost of Carbon Estimates." Government of Canada. http://wayback.archive-it.org/7084/20170506183554/http:/ec.gc.ca/cc/default.asp?lang=En&n=BE705779-1.

Epstein, Paul R., Jonathan J. Buonocore, Kevin Eckerle, Michael Hendryx, Benjamin M. Stout III, Richard Heinberg, Richard W. Clapp, et al. 2011. "Full Cost Accounting for the Life Cycle of Coal." *Annals of the New York Academy of Sciences* 1219 (1): 73–98. https://doi.org/10.1111/j.1749-6632.2010.05890.x.

Farmer, D. (Telkwa Coal). 2021. Personal communication with C. Joseph, June 14, 2021.

Fiera Biological Consulting Ltd. 2014. "Environmentally Significant Areas Report: 2014 Update." Report prepared for the Government of Alberta Fiera Biological Consulting Report Number 1305. Edmonton, Alberta: Government of Alberta. https://albertaparks.ca/albertaparksca/library/environmentally-significant-areas-report/.

Fisheries and Oceans Canada. 2020. "Rocky Mountains' Eastern Slopes Priority Areas Profile." Canada.ca. Government of Canada. August 31, 2020. https://www.dfo-mpo.gc.ca/species-especes/sara-lep/cnfasar-fnceap/priority-priorite/profiles/rocky-rocheuses-eng.html.

Fletcher, Robson. 2021a. "Australian Coal Companies Not Giving up on Southern Alberta Mines in Wake of Grassy Mountain Rejection." *CBC News*, June 22, 2021. https://www.cbc.ca/news/canada/calgary/australian-mining-companies-continue-despite-grassy-mountain-rejection-1.6075391.

———. 2021b. "Instead of a Coal Mine, This Alberta Mountain May Now Become a 'Green Energy Complex.'" *CBC News*, October 20, 2021. https://www.cbc.ca/news/canada/calgary/montem-tent-mountain-green-energy-complex-1.6218293.

Galley, Emily. 2011. "Remaking a Forestry Town: The Multifaceted Challenges of Transition in Port Alberni, BC." Master's thesis, London, Ontario: University of Western Ontario.

Gibson, Ginger, and Jason Klinck. 2005. "Canada's Resilient North: The Impact of Mining on Aboriginal Communities." *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 3 (1): 26.

Goodday, Victoria, Jennifer Winter, and Alana Westwood. 2020. "Public Interest Determination for Infrastructure Development: A Review of Guidance and Practice in Canada." Knowledge Synthesis Report submitted to the Social Sciences and Humanities Research Council. https://jenniferwinter.github.io/website/GWW_PublicInterest_KS_Report.pdf.

Government of Alberta. 1976. “A Coal Development Policy for Alberta.” Government of Alberta. https://open.alberta.ca/dataset/cc40f8f5-a3f7-42ce-ad53-7521ef360b99.

———. 1984. “A Policy for Resource Management of the Eastern Slopes. Revised 1984.” Alberta Energy and Natural Resources. https://open.alberta.ca/publications/0864990677#summary.

———. 2008. “Land-Use Framework.” Alberta Environment and Parks. https://landuse.alberta.ca/LandUse%20Documents/Land-use%20Framework%20-%202008-12.pdf.

———. 2015. “Species at Risk - Alberta : A Guide to Endangered and Threatened Species, and Species of Special Concern in Alberta (Version 2).” Environment and Sustainable Resource Development. https://open.alberta.ca/publications/9781460116616.

———. 2016. “Wildlife Sensitivity - Plants.” Information and Data Provisioning Services, Informatics Branch, Corporate Services Division, Alberta Environment and Parks, Government of Alberta. https://maps.alberta.ca/genesis/rest/services/Wildlife_Sensitivity_Plants/Latest/MapServer.

———. 2017. “Draft Provincial Woodland Caribou Range Plan.” Alberta Environment and Parks. https://open.alberta.ca/publications/9781460137055.

———. 2018. “South Saskatchewan Regional Plan 2014-2024.” Alberta Environment and Parks.

———. 2020a. “Alberta Energy Annual Report 2019-2020.” Government of Alberta. https://open.alberta.ca/publications/1703-4582.

———. 2020b. “Updated Coal Rules Keep Protection, Strengthen Certainty.” Government News. May 15, 2020. https://www.alberta.ca/release.cfm?xID=71360F8EBFAD6-F329-868E-8D338CE2C2A0A01F.

———. 2020c. “Coal and Mineral Development in Alberta 2019 Year in Review.” Alberta Energy. https://open.alberta.ca/publications/2291-1553.

———. 2020d. “Alberta Grizzly Bear Recovery Plan.” 37. Alberta Species at Risk Recovery Plan. Edmonton, Alberta: Alberta Environment and Parks. https://open.alberta.ca/publications/9781460147917.

———. 2021a. “Coal Leases: Minister Savage.” Government News. January 18, 2021. https://www.alberta.ca/release.cfm?xID=76086EB3F6EAA-0249-3A70-A8C209C9AD72C097.

———. 2021b. “Engaging with Albertans on a Modern Coal Policy.” Government News. March 29, 2021. https://www.alberta.ca/release.cfm?xID=77832FC8888D0-CED3-59AD-A6561C1C843FD14A.

———. 2021c. “Alberta Energy Annual Report 2020-2021.” Government of Alberta. https://open.alberta.ca/publications/1703-4582.

———. 2021d. “Budget 2021: Economic Outlook.” Budget. August 2021. https://www.alberta.ca/economic-outlook.aspx.

———. 2021e. “2021-22 First Quarter Fiscal Update and Economic Statement.” Alberta Treasury Board and Finance. https://open.alberta.ca/dataset/9c81a5a7-cdf1-49ad-a923-d1ecb42944e4/resource/bd9378f4-895d-4f7b-8bf5-7629396761b5/download/2021-22-first-quarter-fiscal-update-and-economic-statement.pdf.

———. 2021f. “Unemployment Rate.” Economic Dashboard. October 8, 2021. https://economicdashboard.alberta.ca/Unemployment.

———. n.d.a. “About Coal - Overview.” n.d.a. https://www.alberta.ca/about-coal-overview.aspx.

———. n.d.b. “Alberta Tax Overview.” Taxes. n.d.b. https://www.alberta.ca/taxes-levies-overview.aspx.

———. n.d.c. “Coal Leasing and Maintenance.” n.d.c. https://www.alberta.ca/coal-leasing-and-maintenance.aspx.

———. n.d.d. “Coal Royalties and Reporting.” Coal. n.d.d. https://www.alberta.ca/coal-royalties-and-reporting.aspx.

———. n.d.e. “Environmental Assessment Process.” Environmental Impact Assessments. n.d.e. https://www.alberta.ca/environmental-assessment-process.aspx.

———. n.d.f. “Fish Species at Risk.” Resources. n.d.f. https://www.alberta.ca/fish-species-at-risk.aspx.

———. n.d.g. “Grassy Mountain Coal Project.” n.d.g. https://majorprojects.alberta.ca/details/Grassy-Mountain-Coal-Project/3031.

———. n.d.h. “Grazing and Range Management – Overview.” Grazing and Range Management. n.d.h. https://www.alberta.ca/grazing-and-range-management-overview.aspx.

———. n.d.i. “Technology Innovation and Emissions Reduction Regulation.” n.d.i. https://www.alberta.ca/technology-innovation-and-emissions-reduction-regulation.aspx.

———. n.d.j. “Westslope Cutthroat Trout FSI.” Fish Sustainability Index. n.d.j. https://www.alberta.ca/westslope-cutthroat-trout-fsi.aspx.

———. n.d.k. “Wildlife Sensitivity Maps.” n.d.k. https://www.alberta.ca/wildlife-sensitivity-maps.aspx.

Government of Canada. 2020. “National Hydro Network - NHN - GeoBase Series.” Open Government Portal. December 9, 2020. https://open.canada.ca/data/en/dataset/a4b190fe-e090-4e6d-881e-b87956c07977.

———. 2021. “Greenhouse Gas Reporting Program (GHGRP) - Facility Greenhouse Gas (GHG) Data.” Open Government Portal - Greenhouse Gas Reporting Program. April 12, 2021. https://open.canada.ca/data/en/dataset/a8ba14b7-7f23-462a-bdbb-83b0ef629823.

———. n.d. “Corporation Tax Rates.” Taxes. Accessed October 25, 2021. https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/corporations/corporation-tax-rates.html.

Green Destinations. 2021. “2021 Top 100 Destination Sustainability Stories.” Green Destinations Top 100. 2021. https://greendestinations.org/programs-and-services/top-100-destinations/.

Gunton, Cameron, and Sean Markey. 2021. “The Role of Community Benefit Agreements in Natural Resource Governance and Community Development: Issues and Prospects.” *Resources Policy* 73 (October): 102152. https://doi.org/10.1016/j.resourpol.2021.102152.

Gunton, Thomas. 2003. “Megaprojects and Regional Development: Pathologies in Project Planning.” *Regional Studies* 37 (5): 505–19. https://doi.org/10.1080/0034340032000089068.

Hendryx, Michael. 2015. “The Public Health Impacts of Surface Coal Mining.” *The Extractive Industries and Society* 2 (4): 820–26. https://doi.org/10.1016/j.exis.2015.08.006.

Hendryx, Michael, and Kestrel A. Innes-Wimsatt. 2013. “Increased Risk of Depression for People Living in Coal Mining Areas of Central Appalachia.” *Ecopsychology* 5 (3): 179–87. https://doi.org/10.1089/eco.2013.0029.

Hendryx, Michael, Keith J. Zullig, and Juhua Luo. 2020. “Impacts of Coal Use on Health.” *Annual Review of Public Health* 41 (1): 397–415. https://doi.org/10.1146/annurev-publhealth-040119-094104.

Hierlmeier, Jodie L. 2008. “‘The Public Interest’: Can It Provide Guidance for the ERCB and NRCB?” *Journal of Environmental Law and Practice* 18 (3): 279–311.

Impact Assessment Agency of Canada. 2021. “Policy Context: Indigenous Participation in Impact Assessment.” Government of Canada. https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act/policy-indigenous-participation-ia.html.

International Energy Agency. 2020. “World Energy Outlook 2020.” International Energy Agency. https://www.iea.org/reports/world-energy-outlook-2020.

———. 2021. “Net Zero by 2050.” International Energy Agency. https://www.iea.org/reports/net-zero-by-2050.

Invest Alberta. n.d. “Tourism.” Key Sectors. Accessed October 26, 2021. https://investalberta.ca/key-sectors/tourism/.

Jenner, Steffen, and Alberto J. Lamadrid. 2013. “Shale Gas vs. Coal: Policy Implications from Environmental Impact Comparisons of Shale Gas, Conventional Gas, and Coal on Air, Water, and Land in the United States.” *Energy Policy* 53 (February): 442–53. https://doi.org/10.1016/j.enpol.2012.11.010.

Jeyakumar, Binnu. 2016. “Job Growth in Clean Energy: Employment in Alberta’s Emerging Renewables and Energy Efficiency Sectors.” The Pembina Institute. https://www.pembina.org/reports/job-growth-in-clean-energy.pdf.

Joseph, Chris. 2018. “Teck Frontier Mine: Review of Economic Benef Its and Cost Benefit Analysis.” Swift Creek Consulting.

———. 2020. “Problems and Resolutions in GHG Impact Assessment.” *Impact Assessment and Project Appraisal* 38 (1): 83–86. https://doi.org/10.1080/14615517.2019.1625253.

Knight, Nancy. 1990. “Mega-Project Planning and Economic Welfare : A Case Study of British Columbia’s North East Coal Project.” University of British Columbia. https://doi.org/10.14288/1.0100391.

Kolijn, Cornelius. 2021a. “Montem Assessment CJK FOR Excerpt for AWA (06Jan21).”

———. 2021b. “Crowsnest Coal Reserves: Mistaken Value of AB’s Eastern Slopes Coal Reserves.” Presented at the Presentation to The Coal Policy Consultation Committee, May 25.

Kwasniak, Arlene. 2021. “Coal Development Consultation Terms of Reference Revisited.” *ABlawg* (blog). May 3, 2021. https://ablawg.ca/2021/05/03/coal-development-consultation-terms-of-reference-revisited/.

Laney, A. Scott, and David N. Weissman. 2014. “Respiratory Diseases Caused by Coal Mine Dust.” *Journal of Occupational and Environmental Medicine* 56 Suppl 10 (October): S18-22. https://doi.org/10.1097/JOM.0000000000000260.

Lawrie, Misty, Matthew Tonts, and Paul Plummer. 2011. “Boomtowns, Resource Dependence and Socio-Economic Well-Being.” *Australian Geographer* 42 (2): 139–64. https://doi.org/10.1080/00049182.2011.569985.

Linnitt, Carol. 2020. “Unique B.C. Trout Population Suffers 93 per Cent Crash Downstream of Teck’s Elk Valley Coal Mines.” *The Narwhal*, April 16, 2020, sec. In-Depth. https://thenarwhal.ca/teck-resources-elk-valley-mines-bc-fish/.

Manning, Susan, Patricia Nash, Lash Levac, Deborah Stienstra, and Jane Stinson. 2018. “Strengthening Impact Assessments for Indigenous Women.” Canadian Research Institute for the Advancement of Women. https://www.criaw-icref.ca/publications/strengthening-impact-assessments-for-indigenous-women/.

Maxim Power Corp. n.d. “Summit Coal.” Accessed October 29, 2021. https://maximpowercorp.com/summit-coal/.

McCormack, Ryley. 2020. “Teck Put under New Elk Valley Water Quality Measures.” *My East Kootenay Now*, October 30, 2020. https://www.myeastkootenaynow.com/12515/teck-put-under-new-elk-valley-water-quality-measures/.

Miller, L. L., J. B. Rasmussen, V. P. Palace, G. Sterling, and A. Hontela. 2013. “Selenium Bioaccumulation in Stocked Fish as an Indicator of Fishery Potential in Pit Lakes on Reclaimed Coal Mines in Alberta, Canada.” *Environmental Management* 52 (1): 72–84. https://doi.org/10.1007/s00267-013-0038-4.

Ministry of Energy, Mines and Petroleum Resources. n.d. “British Columbia Coal Industry Overview, 2019.” Information Circular 2020–02. British Columbia Geological Survey.

Montem Resources. 2021. “Montem Resources Alberta Operations Ltd Tent Mountain Project.” https://montem-resources.com/wp-content/uploads/2021/02/Project-Summary-Final-11-Feb2021.pdf45.pdf.

———. n.d.a. “Chinook Project.” n.d.a. https://montem-resources.com/projects/chinook-project/.

———. n.d.b. “Tent Mountain Mine.” n.d.b. https://montem-resources.com/projects/tent-mountain/.

Moroskat, M. (Alberta Energy). 2021a. Personal communication with C. Joseph, June 9, 2021.

———. 2021b. Personal communication with C. Joseph, June 16, 2021.

National Collaborating Centre for Aboriginal Health. 2013. “An Overview of Aboriginal Health in Canada.” National Collaborating Centre for Aboriginal Health.

Native Land. 2019. “The Land You Live On: An Education Guide.” Native Land. https://native-land.ca/wp-content/uploads/2019/03/teacher_guide_2019_final.pdf.

Natural Resources Canada. 2020. “Download Geographical Names Data – Alberta.” Geographical Names in Canada. Natural Resources Canada. November 26, 2020. https://www.nrcan.gc.ca/earth-sciences/geography/download-geographical-names-data/9245.

———. 2021. “Aboriginal Lands of Canada Legislative Boundaries.” Government of Canada. https://open.canada.ca/data/en/dataset/522b07b9-78e2-4819-b736-ad9208eb1067.

Nichols Applied Management. 2016. “Benga Mining Ltd. Grassy Mountain Coal Project Socio-Economic Impact Assessment.” Benga Mining Ltd.

Nightingale, Elana, Karina Czyzewski, Frank Tester, and Nadia Aaruaq. 2017. “The Effects of Resource Extraction on Inuit Women and Their Families: Evidence from Canada.” *Gender & Development* 25 (3): 367–85. https://doi.org/10.1080/13552074.2017.1379778.

Noir Resources Ltd. n.d.a. “Projects.” Noir Resources Ltd. n.d.a. https://www.noirresources.ca/noirprojects.

———. n.d.b. “The Targa Project.” Noir Resources Ltd. n.d.b. https://www.noirresources.ca/targa.

North Slave Metis Alliance. 1999. “Can’t Live Without Work: North Slave Metis Alliance Environmental, Social, Economic and Cultural Concerns: A Companion to the Comprehensive Study Report on the Diavik Diamonds Project;”

O'Faircheallaigh, Ciaran. 2016. *Negotiations in the Indigenous World: Aboriginal Peoples and the Extra*. Indigenous Peoples and Politics. New York, USA: Routledge. https://www.routledge.com/Negotiations-in-the-Indigenous-World-Aboriginal-Peoples-and-the-Extractive/OFaircheallaigh/p/book/9780815370444.

Okkola, Sinikka, and Cédric Brunelle. 2018. "Has the Oil Boom Generated New Problems of Housing Affordability in Resource-Driven Agglomerations in Canada? A Case Study of St. John's, Saskatoon, Calgary, Edmonton, and Fort McMurray, 1991–2011." *Urban Geography* 39 (2): 299–327. https://doi.org/10.1080/02723638.2017.1314174.

Opinko, David. 2020. "Blood Tribe Residents Not Consulted on Proposed Coal Mine despite Thumbs up from Officials." *Lethbridge News Now*, November 23, 2020. https://lethbridgenewsnow.com/2020/11/23/blood-tribe-residents-not-consulted-on-proposed-coal-mine-despite-thumbs-up-from-officials/.

Palmater, Pam. 2020. "Mi'kmaw Treaty Rights, Reconciliation and the 'Rule of Law.'" *Canadian Dimension*, September 22, 2020. https://canadiandimension.com/articles/view/mikmaw-treaty-rights-reconciliation-and-the-rule-of-law.

Parkes, Margot W., Sandra Allison, Henry G. Harder, Dawn Hoogeveen, Diana Kutzner, Melissa Aalhus, Evan Adams, et al. 2019. "Addressing the Environmental, Community, and Health Impacts of Resource Development: Challenges across Scales, Sectors, and Sites." *Challenges* 10 (1): 22. https://doi.org/10.3390/challe10010022.

Parkins, John R., and Angela C. Angell. 2011. "Linking Social Structure, Fragmentation, and Substance Abuse in a Resource-Based Community." *Community, Work & Family* 14 (1): 39–55. https://doi.org/10.1080/13668803.2010.506030.

Parlee, Brenda L. 2015. "Avoiding the Resource Curse: Indigenous Communities and Canada's Oil Sands." *World Development* 74 (October): 425–36. https://doi.org/10.1016/j.worlddev.2015.03.004.

Payscale. n.d.a. "Salary for Industry: Coal Mining." n.d.a. https://www.payscale.com/research/CA/Industry=Coal_Mining/Salary.

———. n.d.b. "Salary for Industry: Oil and Gas Pipeline or Related Structure Construction." n.d.b. https://www.payscale.com/research/CA/Industry=Oil_and_Gas_Pipeline_or_Related_Structure_Construction/Salary.

Pimental, Tamara. 2021. "Blackfoot in Alberta Look to Educate Community Members on Proposed Coal Mine." *APTN News*, February 3, 2021. https://www.aptnnews.ca/national-news/grassy-mountain-piikani-first-nation-kainai/.

Plumer, Brad. 2018. "Trump Put a Low Cost on Carbon Emissions. Here's Why It Matters." *The New York Times*, August 23, 2018, sec. Climate. https://www.nytimes.com/2018/08/23/climate/social-cost-carbon.html.

Prairie Provinces Water Board. n.d. "1969 Master Agreement on Apportionment." Prairie Provinces Water Board. Accessed October 26, 2021. https://www.ppwb.ca/about-us/what-we-do/1969-master-agreement-on-apportionment.

Province of Alberta. 1993. *Environmental Protection and Enhancement Act: Conservation and Reclamation Regulation. AR 115/1993*. https://www.qp.alberta.ca/documents/Regs/1993_115.pdf.

Ram River Coal Corp. n.d. "The Aries Project." Accessed September 4, 2021. http://www.ramcoal.com/aries-project.

Rieger, Sarah. 2021. "Alberta Pauses Future Coal Lease Sales in Rocky Mountains, Cancels 11 Recent Leases." *CBC News*, January 19, 2021. https://www.cbc.ca/news/canada/calgary/alberta-coal-lease-pause-1.5878364.

Riversdale Resources. 2015. "Grassy Mountain Coal Project Project Description." Millennium EMS Solutions Ltd. https://www.ceaa-acee.gc.ca/050/documents/p80101/101323E.pdf.

Riversdale Resources Limited. 2019. "Target's Statement." Riversdale Resources Limited. http://www.rivresources.com/site/PDF/64aaf8c8-e338-4acc-95ad-db71ddcf66c7/RiversdaleResourcesTargetsStatement28March2019.

———. n.d. "Projects." Accessed October 25, 2021. http://www.rivresources.com/site/Projects/grassy-mountain-project2/overview3.

Robertson, Andy, and Shannon Shaw. 2004. "Use of the Multiple-Accounts-Analysis Process for Sustainability Optimization." In , 8. Denver, Colorado. https://rgc.ca/files/publications/MAA_SME_2004.pdf.

———. 2006. "Use of the Multiple-Accounts-Analysis Process for Sustainability Optimization." *Mining Engineering* 58 (8): 33–33.

Rolfe, Kelsey. 2021. "Coalspur: The Canary in Canada's Thermal Coal Mines as Ottawa Sets High Bar for New Projects." *Financial Post*, June 23, 2021. https://financialpost.com/commodities/energy/vista-mine-owner-preparing-to-restart-operations-while-working-through-ccaa-proceedings.

Ruddell, Rick. 2011. "Boomtown Policing: Responding to the Dark Side of Resource Development." *Policing: A Journal of Policy and Practice* 5 (4): 328–42. https://doi.org/10.1093/police/par034.

Ryser, Laura, and Greg Halseth. 2011. "Housing Costs in an Oil and Gas Boom Town: Issues for Low-Income Senior Women Living Alone." *Journal of Housing For the Elderly* 25 (3): 306–25. https://doi.org/10.1080/02763893.2011.595618.

Shaffer, Marvin. 2010. *Multiple Account Benefit-Cost Analysis: A Practical Guide for the Systematic Evaluation of Project and Policy Alternatives*. Illustrated edition. Toronto: University of Toronto Press.

———. 2013. "Needs For and Alternatives To Chapter 13 – Integrated Comparisons of Development Plans – Multiple Account Analysis." Manitoba Hydro.

Shandro, Janis, Laura Jokinen, Kandace Kerr, Ann Marie Sam, Malcolm Scoble, and Aleck Ostry. 2014. "Community Health and Safety in the Nak'al Bun/Stuart Lake Region During the Construction Phase of the Mount Milligan Mine." http://www.piplinks.org/system/files/Nak'al+Bun-Stuart+Lake+Mount+Milligan+Construction+Phase+Report+December+2014.pdf.

Shandro, Janis, Marcello M. Veiga, Jean Shoveller, Malcolm Scoble, and Mieke Koehoorn. 2011. "Perspectives on Community Health Issues and the Mining Boom–Bust Cycle." *Resources Policy* 36 (2): 178–86. https://doi.org/10.1016/j.resourpol.2011.01.004.

Shaw, S. C., A. Robertson, W. C. Maehl, J. Kuipers, and S. Haight. 2001. "Review of the Multiple Accounts Analysis Alternatives Evaluation Process Completed for the Reclamation of the Zortman and Landusky Mines Sites." In *Proceedings of the 2001 National Association of Abandoned Mine Lands Annual Conference*. Athens, Ohio. https://bc-mlard.ca/images/uploads/B.17b.pdf.

SNC-Lavalin. 2014. "Elk Valley Water Quality Plan Annex L.2: Drinking Water Evaluation, Preliminary Conceptual Hydrogeological Model and Groundwater Protection Strategy." Prepared for Teck Coal Ltd. https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/area-based-man-plan/annexes/l2_elk_valley_groundwater_summ_report.pdf.

Sosa, Irene, and Karyn Keenan. 2001. "Impact Benefit Agreements Between Aboriginal Communities and Mining Companies: Their Use in Canada." Canadian Environmental Law Association, Environmental Mining Council of British Columbia, CooperAcción. https://cela.ca/impact-benefit-agreements-between-aboriginal-communities-and-mining-companies-their-use/.

Statistics Canada. 2021a. "Table 36-10-0434-06 Gross Domestic Product (GDP) at Basic Prices, by Industry, Annual Average, Industry Detail (x 1,000,000)." January 1, 2021. https://doi.org/10.25318/3610043401-eng.

———. 2021b. "Table 36-10-0402-01 Gross Domestic Product (GDP) at Basic Prices, by Industry, Provinces and Territories." May 3, 2021. https://doi.org/10.25318/3610040201-eng.

———. 2021c. "Table 14-10-0202-01 Employment by Industry, Annual." July 29, 2021. https://doi.org/10.25318/1410020201-eng.

———. 2021d. "Table 14-10-0203-01 Average Weekly Earnings by Industry, Monthly, Unadjusted for Seasonality." September 28, 2021. https://doi.org/10.25318/1410020301-eng.

———. n.d. "2016 Census Boundary Files." Census Program. Accessed October 22, 2021. https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2016-eng.cfm.

Stelfox, J. B., and W. F. Donahue. 2021. "Assessing Watershed-Scale Consequences of Coal Surface Mines in the Headwaters of the Oldman River Watershed (ORW)." Prepared for the Livingstone Landowners Group (LLG). https://your.alberta.ca/22184/widgets/91480/documents/66912.

Stockwell, Alison Marie. 2015. "Capturing Vulnerability : Towards a Method for Assessing, Mitigating, and Monitoring Gendered Violence in Mining Communities in British Columbia." Vancouver: University of British Columbia. https://doi.org/10.14288/1.0223120.

Storey, Keith. 2010. "Fly-in/Fly-out: Implications for Community Sustainability." *Sustainability* 2 (5): 1161–81. https://doi.org/10.3390/su2051161.

Teck Resources Limited. 2020. "New Water Quality Measures in the Elk Valley." News Release. Teck. October 29, 2020. https://www.teck.com/news/news-releases/2020/new-water-quality-measures-in-the-elk-valley.

———. n.d. "Cardinal River." Teck. Accessed October 29, 2021. https://www.teck.com/operations/canada/legacy/cardinal-river.

The Canadian Press. 2021. "Alberta Musician Corb Lund Comes out against Proposed Coal Mines in Rocky Mountains | CBC News." *CBC News*, January 13, 2021. https://www.cbc.ca/news/canada/calgary/corb-lund-coal-mine-opposition-alberta-1.5871428.

Thomson Reuters. 2021. "Steel Made without Fossil Fuels Delivered for 1st Time." *CBC News*, August 19, 2021. https://www.cbc.ca/news/science/fossil-free-steel-1.6146061.

Trafford, Bill. 2020. "Opinion: Coal Mining in Alberta Must Be Carefully Assessed before Allowing Expansion." *Calgary Herald*, September 11, 2020, sec. Opinion. https://calgaryherald.com/opinion/columnists/opinion-coal-mining-in-alberta-must-be-carefully-assessed-before-allowing-expansion.

Treasury Board of Canada Secretariat. 2007. "Canadian Cost-Benefit Analysis Guide: Regulatory Proposals." President of the Treasury Board. https://www.tbs-sct.gc.ca/rtrap-parfa/analys/analys-eng.pdf.

———. 2018. "Policy on Cost-Benefit Analysis." https://www.canada.ca/en/government/system/laws/developing-improving-federal-regulations/requirements-developing-managing-reviewing-regulations/guidelines-tools/policy-cost-benefit-analysis.html.

Trembath, Terri. 2021. "Couple Says Alberta's New Direction on Coal Threatens Livelihood of Third-Generation Ranch | CBC News." *CBC News*, January 16, 2021. https://www.cbc.ca/news/canada/calgary/alberta-john-smith-nanton-laura-laing-coal-mine-corb-lund-1.5876036.

Tsenkova, Sasha, and Karim Youssef. 2014. "Resource-Based Communities." In *Encyclopedia of Quality of Life and Well-Being Research*, edited by Alex C. Michalos, 5531–34. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-007-0753-5_2500.

United States Census Bureau. 2018. "Cartographic Boundary Files - Shapefile." Census.Gov. 2018. https://www.census.gov/geographies/mapping-files/time-series/geo/carto-boundary-file.html.

Upton, John. 2014. “Rents in This North Dakota Oil Town Are Now Higher than in NYC or San Francisco.” *Grist*, February 18, 2014, sec. Climate + Culture. https://grist.org/climate-energy/rents-in-north-dakota-oil-town-now-higher-than-in-nyc-or-san-francisco/.

Urquhart, Ian. 2021a. “Coal: A May 2020 to February 2021 Retrospective.” *Wildlands Advocate*, April 2021.

———. 2021b. “Updates: Federal Critial Habitat Order for Alberta Bull Trout.” *Wildlands Advocate*, April 2021.

U.S. Energy Information Administration. n.d. “Coal Data Browser.” Database. Accessed September 5, 2021. https://www.eia.gov/coal/data/browser/.

U.S. EPA. 2018. “Regulatory Impact Analysis for the Proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program.” EPA-452/R-18-006. United States Environmental Protection Agency.

User: Yug. 2011. *Map of Numbered Treaties of Canada*. Canada location map.svg. https://commons.wikimedia.org/wiki/File:Numbered-Treaties-Map.svg.

Valory Resources Inc. 2019. “Valory Resources Inc. Investor Presentation.” October. https://www.miningnewsfeed.com/reports/annual/Valory_Resources_Inc_Investor_Presentation_102019.pdf.

Wang, Ping, Zehang Sun, Yuanan Hu, and Hefa Cheng. 2019. “Leaching of Heavy Metals from Abandoned Mine Tailings Brought by Precipitation and the Associated Environmental Impact.” *Science of The Total Environment* 695: 133893. https://doi.org/10.1016/j.scitotenv.2019.133893.

Wayland, Mark, Richard Casey, and Eric Woodsworth. 2007. “A Dietary Assessment of Selenium Risk to Aquatic Birds on a Coal Mine Affected Stream in Alberta, Canada.” *Human and Ecological Risk Assessment: An International Journal* 13 (4): 823–42. https://doi.org/10.1080/10807030701456734.

Wayland, Mark, and Robert Crosley. 2006. “Selenium and Other Trace Elements in Aquatic Insects in Coal Mine–Affected Streams in the Rocky Mountains of Alberta, Canada.” *Archives of Environmental Contamination and Toxicology* 50 (4): 511–22. https://doi.org/10.1007/s00244-005-0114-8.

Weber, Bob. 2021a. “‘Morally and Ethically Wrong:’ Court to Hear Challenge to Alberta Coal Policy Removal | CBC News.” *CBC News*, January 17, 2021. https://www.cbc.ca/news/canada/calgary/court-coal-peter-lougheed-sonya-savage-david-luff-1.5876772.

———. 2021b. “Contaminant from Coal Mines Already High in Some Alberta Rivers: Unreported Data.” *CBC News*, January 25, 2021. https://www.cbc.ca/news/canada/edmonton/selenium-alberta-coal-mines-contamination-1.5886293.

———. 2021c. "'Stories the Numbers Tell': Critics Ask Why Alberta Sat on Coal Contamination Data." *Global News*, January 26, 2021. https://globalnews.ca/news/7599705/critics-alberta-sat-on-coal-contamination-data/.

———. 2021d. "Coal Company Teck Fined $60M for Contaminating Rivers in Southeastern B.C." *CBC News*, March 26, 2021. https://www.cbc.ca/news/canada/british-columbia/teck-fined-60m-contaminating-bc-rivers-1.5965646.

———. 2021e. "First Nations, Coal Companies Asking Alberta Government for Better Consultation on Mines." *Global News*, April 27, 2021. https://globalnews.ca/news/7814660/first-nations-business-alberta-coal-consultations/.

———. 2021f. "Alberta Government Knew Bighorn Sheep Contaminated with Coal-Mine Selenium: Scientist." *CBC News*, May 11, 2021. https://www.cbc.ca/news/canada/edmonton/alberta-government-knew-bighorn-sheep-contaminated-with-coal-mine-selenium-scientist-1.6022966.

———. 2021g. "Two Alberta First Nations Want to Appeal Decision against Grassy Mountain Coal Mine." *CBC News*, July 22, 2021. https://www.cbc.ca/news/canada/calgary/first-nation-appeal-coal-mine-1.6113693.

Weerstra, B. G. 1986. "Rocky Mountains Forest Reserve: Livestock Grazing History and Festuca Scabrella Torr. Range Recovery." Unpublished master's thesis, Calgary: University of Calgary. http://dx.doi.org/10.11575/PRISM/20139.

Westmoreland Mining LLC. 2021. "Coal Valley Restart Press Release." August 10, 2021. https://westmoreland.com/2021/08/coal-valley-restart-press-release/.

———. n.d.a. "Coal Valley Mine - Alberta." Westmoreland Mining. n.d.a. https://web.archive.org/web/20210305140052/https://westmoreland.com/location/coal-valley-mine-alberta/.

———. n.d.b. "Genesee Mine - Alberta." Westmoreland Mining. n.d.b. https://web.archive.org/web/20210305123008/https://westmoreland.com/location/genesee-mine-alberta/.

Yewchuk, Drew. 2021. "Coal Law and Policy Part Five: What Is the Role of the Federal Government in Relation to Alberta Coal Mines?" *ABlawg* (blog). March 24, 2021. https://ablawg.ca/2021/03/24/coal-law-and-policy-part-five-what-is-the-role-of-the-federal-government-in-relation-to-alberta-coal-mines/.

Yewchuk, Drew, and Nigel Bankes. 2021. "Coal Law and Policy, Part Four: The Regulation of Coal Exploration." *ABlawg* (blog). March 9, 2021. https://ablawg.ca/2021/03/09/coal-law-and-policy-part-four-the-regulation-of-coal-exploration/.

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