Review of the Economic Value of the Proposed KGHM Ajax Mine Project

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Executive Summary

This report examines the proposed KGHM Ajax mine project as described in the proponent's environmental assessment application and feasibility study. This report is intended to support the SSN's understanding, decision-making, and negotiations regarding the project. This report provides a critique of the proponent's environmental assessment application and feasibility study from the perspective of understanding the economic value of the project to the SSN and society as a whole, and presents an assessment of the project's economic value to the SSN and society.

The main critiques I have of the EA application and feasibility study are:

- the presentation of a decline of new benefits as an adverse effect;
- the misconstruing of impacts as net benefits;
- multiple-counting of benefit information;
- lack of synthesis of impact information; and
- incomplete and insufficiently documented sensitivity analysis.

The economic value of a project is the sum of the value of its impacts. In my study I used multiple account cost-benefit analysis to examine the project's many impacts. This method is designed to examine net benefits and not solely look at gross benefits as was examined in the proponent's economic impact assessment. My analysis examined the components of value shown in Table ES-1 below.

Table ES-1. Accounts and associated benefits and costs examined in the MA-CBA.

Account	Topics
Proponent	• Private Net Benefits
Government and Taxpayers	• Incremental Tax Revenue • Incremental Government Expenditures • Subsidies
Economic Activity	• Employment, Wages, and Training • Other Business and Local Government
SSN and Aboriginal	• Lands, Resources, and Activities within SSN Traditional Territory • Negotiated Benefits and Mitigation Measures
Social and Community	• Property Values • Infrastructure and Services • Archaeology and Heritage
Environment	• Greenhouse Gas Emissions • Local Air Pollution • Water • Fish and Wildlife
Other	• Non-use and option values

The results of my study indicate that it is not clear that there is an overall net benefit from the project to the SSN or Canada. Looking at the monetized values alone I estimate the project's net benefits to range from negative $650 million net present value to positive $101 million NPV, though these numbers are contingent on assumptions about the extent to which the project burdens government-provided infrastructure and services as well as other assumptions such as whether or not foreign investment is incremental, and the outcomes of any impact-benefit agreement signed between the SSN and the proponent. The many non-monetized impacts must also be considered, such as how one values the project's impacts on archeology and heritage values, and the environment.

The SSN can expect benefits in terms of employment, property value appreciation, whatever is negotiated in an impact-benefit agreement with the proponent, and to the extent that its citizens gain from incremental tax revenues flowing to local, provincial, and federal governments. The SSN can expect costs in terms of infringement on traditional territory and activities, damage to archaeological and heritage sites, and the many ways that all citizens in the area are affected by incremental government expenditures and effects on the environment.

It is now up to the SSN to decide the relative worth of the project given the additional information provided in this study on the net benefits of the project. Many of the impacts examined in this study are not objectively factual but are inherently subjective, and the SSN must now decide itself whether the benefits of the project outweigh the costs to them.

Statement of Limitations

This document was prepared by Swift Creek Consulting for the exclusive use and benefit of the Stk'emlupsemc te Secwepemc Nation ("Client"). This document represents the best professional judgment of Swift Creek Consulting based on the information available at the time of its completion and as appropriate for the scope of work. Services were performed according to normal professional standards in a similar context and for a similar scope of work.

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Contents

Acronyms

AIR/EISG	Application Information Requirements/Environmental Impact Statement Guidelines
BC EAO	BC Environmental Assessment Office
CBA	cost-benefit analysis
CDN	Canadian dollars
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
EA	environmental assessment
EAA	BC *Environmental Assessment Act*
EconIA	economic impact analysis
GHGs	greenhouse gas emissions
IBA	impact-benefit agreement
IRR	internal rate of return
MW	Megawatts
NPV	net present value
NO_x	oxides of nitrogen
PM	particulate matter
PY	person-year
SO_2	sulphur dioxide
SSN	Stk'emlupsemc te Secwepemc Nation
t CO_2eq	tonnes carbon dioxide equivalent
USD	US dollars

1 Introduction

This report examines the proposed KGHM Ajax mine project as described in the proponent's environmental assessment (EA) application (ERM 2015) and feasibility study (KGHM and M3 2016). This report is intended to support the Stk'emlupsemc te Secwepemc Nation (SSN) in their internal deliberations and decision-making with respect to the project and any discussions and negotiations the SSN may have with the proponent, the BC and federal governments, or other parties. Accordingly, this report (1) provides a critique of the proponent's EA application and feasibility study from the perspective of understanding the economic value of the project to the SSN and society as a whole, and (2) presents an assessment of the project's economic value to the SSN and society.

In this report, economic value is conceived of as all the consequences of the project that people value positively or negatively, including both those that have market prices (e.g., the cost of labour) and those which don't have prices (e.g., many environmental impacts). In technical jargon, economic value is the *total economic value* of the project.

In the following section (s.2) I present several critiques that relate to understanding the economic value of the project. The next section (s.3) presents my assessment of the various components of economic value of the project and a summary of the project's value.

2 Critique

2.1 Critique of Ajax EA Application

From a broad perspective, the intent of the EA process is to help inform provincial and federal decision-makers about the overall value of the project. In the language of the provincial *Environmental Assessment Act* (*EAA*), the issue is whether the project will have any "significant adverse effects" and whether in consideration of the project's benefits and adverse effects the project is in the "public interest". In the language of the federal *Canadian Environmental Assessment Act*, the issue is whether any "significant adverse effects" can be "justified in the circumstances" by any positive effects of the project. In concert with this thinking, the final Application Information Requirements/ Environmental Impact Statement Guidelines (AIR/EISG) for the Ajax project (BC EAO and CEA Agency 2015) requires the proponent to explain the benefits of the project (s.2.7 of the AIR/EISG) and whether the project is needed (s.17.3 of the AIR/EISG).

To fulfill the above requirements the Ajax EA application therefore needs to provide information on three topics:

1. the anticipated residual adverse effects of the project, i.e., adverse effects after mitigation is accounted for;
2. the anticipated benefits of the project; and
3. the overall significance of the project' effects.

The EA application has strengths and weaknesses in each respect. The following sub-sections present what I see to be the most significant limitations with respect to each of these topic.

3.1.1 Critiques Regarding Adverse Effects of the Project

Consistent with the focus of EA on whether or not a project will cause significant adverse effects, much of the Ajax EA application is concerned with whether the project will cause significant adverse effects on the environmental values (s.6), economic values (s.7), social values (s.8), heritage values (s.9), or health values (s.10). The scope of my review is to examine issues pertaining to economic impacts and economic value, and as the SSN has other consultants examining environmental, social, heritage, and health values specifically I restrict my critique to economic issues.

Critique #1: A decline of new benefits is not an adverse effect.

The proponent argues throughout s.7 of the application that a decline in economic benefits of the project at project closure is an adverse effect of the project. For example, on p7.1-23, the proponent argues

> *[a]lthough Project's contributions to economic activity during Project Construction and Operation are considered as a beneficial effect, the decrease in economic activity as the Project enters the Decommissioning and Closure Phase, given the long term nature of the Project, is considered as an adverse effect.*

The logic of considering loss of benefit flows as an adverse effect of the project is embedded in the proponent's assessment of four of the economic VCs: Economic Growth; Labour Force, Employment and Training; Income; and Business.

This decline in benefits is not an adverse effect that should factor into decisions about whether the project should be approved or not. A decrease in economic benefit flows from project development could certainly be disruptive to a community, but this decrease in benefit flows is simply the reduction in benefits flows that requires proper transition planning. The reference point for judging effects as positive or negative is the no-development scenario, i.e., a scenario in which Ajax does not go ahead. Therefore, development of Ajax may create economic benefits beyond what would occur anyway, and the decline and eventual cessation of these potential benefit flows merely withdraws the benefit flows. One doesn't abstain from undertaking a project for fear of

benefits subsiding; one undertakes a project for the new benefits that will be gained from development.

3.1.2 Critiques Regarding Benefits of the Project

Critique #2: Misconstruing of impacts and net benefits.

The intent of EA is to assess the difference between a future with and without the project, and yet the methods used by the proponent to assess the economic impacts of the project are not capable of assessing this difference in scenarios. Economic impact analysis (EconIA) methods such as input-output modeling and multipliers provide perspective on the *gross* economic benefits of development but not *net* benefits, and yet these methods are commonly used in EA and their results are commonly presented as measures of net effects.

EconIA begins with identifying a project's expected capital and operating costs and labour needs. These data are then used to estimate the project's direct, indirect, and induced economic effects on indicators such as GDP, employment, labour income, and government revenue. Direct effects are the initial inputs, e.g., the cost of project capital, operating costs, and the labour directly employed on the project. Indirect and induced effects are estimated using multipliers derived from input-output modelling or other techniques and reflect the economic activity supported by the project's purchases of supplies and services (indirect effects) and the economic activity supported by the purchases of project employees in their home communities (induced effects). In EconIA, the sum of these direct, indirect, and induced effects are often incorrectly referred to as a project's 'economic benefits'.

From a net benefit perspective – that which EA is interested in – these so-called economic benefits are merely expressions of gross effects because opportunity costs and other project costs are ignored. Opportunity costs are what labour and investment capital would earn if they were not employed in the project being assessed. In a well-functioning economy like Canada's, most labour and capital generally has alternative employment opportunities. Under this condition, the labour and capital used by a project such as Ajax has an opportunity cost: the labour and capital employed on the Ajax project is not free but a real cost to the economy since if used on the Ajax project it cannot be employed elsewhere. In contrast, in EconIA opportunity costs are ignored, and as such project costs are treated as benefits generated by the project. An illogical consequence of ignoring opportunity costs is that EconIA indicates that a project is more 'beneficial' if the project costs more per unit of output compared to a project that costs less – higher costs are interpreted in EconIA as inherently beneficial. A second shortcoming of EconIA is that it ignores many project costs such as environmental costs and costs to government. For example, environmental impacts, such as the public health

costs of air pollution, are omitted, and gross tax revenue to government is estimated without deducting government expenditures that may result from a project such as investment in infrastructure or services. This omission of various types of impacts in EconIA means that EconIA is incapable of examining the net benefits a project may generate.

The explanation for why EconIA treats gross costs as net benefits is that EconIA is designed to examine the local economic impacts of development. At a local scale, with investment coming in from outside, EconIA can be used to provide information on the local incremental economic impacts of development – investment in the local area is not assured, and thus there may not be any opportunity costs locally. When EconIA is applied to larger geographic scales, though, this assumption of no opportunity costs is usually inappropriate.

The Ajax EA application is indicative of the error of interpreting economic impacts as assessed through EconIA as net benefits of the project. In the words of the proponent, "the Project is expected to make a positive contribution to… economic conditions" and the project will create "economic… benefits" (p2-26), and further indicating the misapplication of methods, the proponent writes that the "key methodological tool… is the Statistics Canada input-output model, which uses Project expenditure information to predict overall economic benefits" (p2-27). The assessment of benefits provided in the application does not temper forecasts of economic benefits through consideration opportunity costs of capital or labour, benefit flows to government do not reconcile potential increases in burdens on government-provided infrastructure and services, and environmental, health, and other adverse effects of the project are not factored in. Therefore, the proponent's estimates of the economic benefits of the project as presented in s.2.7 of the application as well as in numerous places of s.7 of the application do not in fact indicate the incremental, or net, economic benefits of the project.

Critique #3: Multiple-counting of benefit information.

Decision-makers and stakeholders in EA processes are best served when EA information is presented clearly and orderly and where there is no duplication or double-counting of effects. To the detriment of clear comprehension of the effects of the Ajax project, the Ajax application presents project benefit information repetitively in numerous locations and in the process doesn't just double count benefits but 'multiple'-counts them.

Section 2.7 of the application presents the proponent's estimates of the project's economic benefits. It is standard to present the potential benefits of a project early in an EA application and in a section dedicated to benefits.

Section 7 of the application concerns potential effects of the project on six valued components (VCs) – Economic Growth; Labour Force, Employment, and Training; Income; Business; Property Values; and Economic Diversification. In the assessment of all of these VCs except Property Values the proponent presents their estimates of the economic benefits of the project alongside potential adverse effects of the project and as a consequence expresses multiple times over the benefits of the project.

While the final AIR/EISG for the project indicated that this inter-mixing of positive and negative effects would occur, doing such is counter to standard practice in EA which is to present anticipated benefits early in the application (as was done in s.2.7 of the Ajax application) and then separately and specifically to examine anticipated adverse effects of the project so that readers can get a clear idea of the individual adverse effects of the project. Further, the repetition of the same benefit information runs counter to BC Environmental Assessment Office (BC EAO) guidelines for VC selection which is to ensure no duplication and has the effect of not just double-counting but 'multiple'-counting of project benefits. As a consequence, decision-makers and stakeholders may misunderstand the magnitude and nature of the project's benefits.

3.1.3 Critiques Regarding Overall Significance of Project Effects

Critique #4: Lack of synthesis of impact information.

The economic benefits of the project are reviewed in s.2.7 of the application and much of s.7 of the application, and other benefits are indicated by the many mitigation measures proposed to address the project's adverse effects. The application reviews the many anticipated adverse effects of the project throughout ss. 6, 7, 8, 9, 10, and 11. Consistent with the impact assessment methodology explained in ss. 4 and 5 of the application and outlined in the final AIR/EISG for the project, the proponent considers each effect separately in terms of whether or not a significant adverse effect is anticipated. This is standard practice in EA in Canada today, but it is not as helpful as it could be in terms of synthesizing all of this impact information and making clear to decision-makers and stakeholders the overall significance, or value, of the project's many effects.

Understanding the overall significance of a project's many benefits and adverse effects is very challenging when there are so many individual effects. How are decision-makers and stakeholders to know if the positives outweigh the negatives? It may be that the benefits outweigh the costs of development to society as a whole, or to only particular groups (as almost always benefits and costs accrue to different parties differentially). But how is one to know without some structuring of impact information?

The most tested and theoretically developed method for structuring the many impacts of major project development is cost-benefit analysis (CBA). While the proponent

conducted a discounted cash flow analysis (akin to a private CBA) as part of their 2012 and 2016 feasibility studies, these studies looked only at benefits and costs to the proponent and so omitted the majority of impacts covered in the EA.

The proponent has not brought together and synthesized the many dimensions of impact information that they have amassed in their EA application. Decision-makers and stakeholders are as a consequence left to sum up the many impacts in their own way, however sound or faulty they do this themselves.

2.2 Critique of Ajax Feasibility Study

Critique #5: Incomplete and insufficiently documented sensitivity analysis.

It is not uncommon in Canada and around the world for major projects to be developed when there is poor economic rationale. Sometimes projects are developed and then run at a loss, other times they are closed in the hopes of better financial conditions, and yet other times they are abandoned. For the communities that host major projects, and the people and businesses that get involved through employment, service contracts, or as investors, major project failure can have serious adverse consequences. Major project failure can also be serious for governments that invest in them, and for the environment and those that depend on the environment project failures can mean that the benefits that have been promised don't materialize while the costs get incurred. For these reasons it's critical that sound financial studies are conducted to minimize the likelihood of project failure.

To prevent financial failure it is key that financial models incorporate risk. At a basic level, a mine project like Ajax depends on a sufficiently high enough price for the output, i.e., sufficient demand, over the expected life of the mine, and sufficiently low capital and operating costs. These and related parameters in financial models should be based on sound data and sound forecasts about their future values, and these parameters then should be tested in terms of how variations in their values affect the financial viability of the project.

The 2012 and 2016 financial viability studies for Ajax (Wardrop 2012; KGHM and M3 2016) addressed risk in two ways.

First, contingency costs (e.g., higher capital costs, some higher operating costs, etc.) were built into the model to account for cost inflation. The use of contingency costs makes sense given, as the feasibility study indicates (p277 in 2016 feasibility study), there is a history of cost inflation.

Second, sensitivity analyses were conducted to examine the effect of changes in key parameters on the project's estimated net present value (NPV). Key parameters examined in sensitivity analysis included the prices of copper, gold, and silver,

development and sustaining capital costs, operating costs, the Canada-US exchange rate, and contingency costs. Each parameter tested in sensitivity analysis was varied +/- 20%, and as shown in Figure 22-3 on p291 in the 2016 feasibility study, the NPV of the project can vary from a pre-tax value of $429 million US dollars (USD) under base case assumptions to as low as a near $200 million USD loss with a copper price 20% lower than base case.[1] The feasibility study estimates that there will only be a net private loss under one of three conditions:

- copper prices 15% or lower from the base case assumption;
- operating costs ~18% higher than base case assumptions; or
- the Canada-US exchange rate being ~15% poorer.

According to the sensitivity analysis shown in the feasibility study, the project will produce a positive NPV under most conditions.

The sensitivity analysis is helpful, but there are limitations and deficiencies in the sensitivity analysis, including:

- there is no discussion of the appropriateness of the range of values used, specifically whether the +/- 20% range is appropriate;
- there is no discussion of other mines and how they have fared financially and with respect to key parameters (i.e., reference class forecasting) beyond contingency costing;
- there is no discussion about associations and correlations between parameters and thus a situation in which multiple parameters trend towards unfavourable values and compound on top of one another; and
- it is unclear how likely it is that parameters might vary – the sensitivity analysis examines the NPV consequences of variations in parameter values, but we are provided little information on the likelihood that these parameters may vary so.

The above issues may have been considered by the analysts who conducted the feasibility study, but the thinking underlying the subjective choices leading to the chosen parameter values is not explained. Decision-makers – whether they are public or private – need to understand the underlying thinking and assumptions that go into financial studies in order to act appropriately with the results. Further, it is not uncommon for experts themselves to make errors due to their own cognitive bias or otherwise misjudge conditions and make errors. Therefore, it is critical that those that conducted the analysis expose their assumptions and thinking to broader scrutiny such that any errors are more likely to be caught prior to major decisions being made.

[1] All monetary figures in this report in current Canadian dollars (CDN) unless otherwise specified.

The broader consequence of the incomplete and insufficiently documented sensitivity analysis presented in the feasibility study is that we must be cautious of the results presented.

3 Economic Value of the Ajax Mine Project

3.1 Introduction

My assessment of the project's economic value relies upon the method of multiple account cost-benefit analysis (MA-CBA). MA-CBA is a method for synthesizing the many and diverse range of impacts of major project development and providing perspective to decision-makers and stakeholders on the overall value of a project to society. MA-CBA provides a means to consider the benefits of the Ajax mine alongside its costs, many of which have been identified in the Ajax EA application as adverse effects.

MA-CBA is a variant of the method of CBA, and much of MA-CBA's theoretical underpinning and logic is grounded in CBA. CBA is based upon welfare economics and stems from simple comparisons of pros and cons of alternative courses of action. The method is widely believed to have first come into practical use in the 1930s in the US to address water resource management issues and by the 1950s much of the method's theoretical and practical foundation had been developed. Today, CBA is considered among many policy scientists, economists, and planners to be the principal method available to examine the net impacts and value of projects to society.

CBA revolves around the notion that the welfare of society is equal to the sum of the welfare of all individuals. The objective of CBA is then to identify how a project will affect people's welfare and to aggregate all of these effects to indicate whether a project creates a net gain or loss in social welfare. In doing so, CBA evaluates the net impacts accruing to society as a whole instead of gross benefits or gross costs that might occur to any one individual party.

In CBA, all impacts are translated into monetary terms such that one can sum up a project's benefits and costs and get a final, single financial number signifying the net benefits of the project (or net cost) to society. In contrast, in MA-CBA only those impacts that lend themselves to monetization are monetized; other impacts are simply quantified or described qualitatively and then compared with monetized impacts.

Critical to CBA (and MA-CBA) are assumptions about what would happen otherwise. Just like in EA, one can only assess the value of a project by comparing what happens with the project to what can reasonably be expected to occur otherwise.

Standard CBA has limitations, and this is why I use MA-CBA. One commonly cited limitation of CBA is its ability to properly value changes to things that are not normally

traded in markets, such as damages to wetlands. With MA-CBA, such impacts can be considered in non-monetary ways and the technical challenges and controversies can be avoided. In general, it is important to see MA-CBA results as further perspective on a project's impacts to be used and considered by decision-makers and stakeholders alongside other information inputs.

Further to this point, it's important to distinguish CBA (and MA-CBA) with standard practice in EA with respect to how significance is conceived and tracked. As with the Ajax EA, EA is typically focused with determining if impacts are 'significant' or not, and significance is determined subjectively by impact assessors in reference to criteria such as impact magnitude and duration. This approach differs markedly from CBA where the relative significance of impacts is indicated by the monetary value (or implied monetary value if one or more impacts aren't actually monetized) of each, and the significance of the project as a whole is indicated by the net present value (NPV) of all the impacts in aggregate. In other words, in typical EA, an impact is either significant or not in a binary sense, whereas in CBA all impacts have varying levels of significance. These different conceptualizations are not a problem with using CBA in EA contexts and should not be taken to mean that CBA's way of looking at significance should supplant typical EA practice; the differences between the two methods simply provide different perspectives on a project's impacts and combined allow decision-makers and stakeholders to be more informed.

The main question to be answered in the present report through MA-CBA is what is the value of the project to the SSN but also to Canada as a whole. The value of the Ajax mine is the sum of components of value, and by value I specifically mean what people would be willing to trade-off for benefits, and what people would require as compensation for costs (i.e., adverse effects). For this study, based upon the interests of the SSN and the types of impacts that the Ajax mine is anticipated to cause, I focus the valuation on six categories (or accounts) of benefits and costs (Table 1). The topics reflect the typical concerns of major project development; overlaps in topics are addressed in the assessment.

Table 1. Accounts and associated benefits and costs examined in the MA-CBA.

Account	Topics
Proponent	• Private Net Benefits
Government and Taxpayers	• Incremental Tax Revenue • Incremental Government Expenditures • Subsidies
Economic Activity	• Employment, Wages, and Training • Other Business and Local Government
SSN and Aboriginal	• Lands, Resources, and Activities within SSN Traditional Territory • Negotiated Benefits and Mitigation Measures
Social and Community	• Property Values • Infrastructure and Services • Archaeology and Heritage
Environment	• Greenhouse Gas Emissions • Local Air Pollution • Water • Fish and Wildlife
Other	• Non-use and option values

Lastly, to address uncertainty in parameters I carry out my analysis using two scenarios: a pessimistic scenario, and an optimistic scenario, from the perspective of the economic value of the project. In the pessimistic scenario I adopt assumptions that contribute to lower economic value, and this constitutes the pessimistic sensitivity analysis. In the optimistic scenario I adopt assumptions that are favourable to higher economic value, and this constitutes the optimistic sensitivity analysis. This level of treatment of uncertainty reflects the limited scope of this study; more in-depth consideration of uncertainty could be undertaken in a more in-depth study of the economic value of the Ajax project. Further, I put the onus on the proponent to demonstrate, with reasonable consideration of uncertainty, the value of the project.

3.2 Proponent

3.2.1 Private Net Benefits

Investors backing the proponent undertake development to earn a positive financial return from their investment. If such a return is earned then this is a benefit to society of the project. There are two complicating factors, though, affecting the analysis: (1) what level of profits are required to attract investment capital, and (2) the effect of foreign investment.

With respect to the first issue, investors are attracted to the prospect of earning a return from their investment, but how much return is needed to attract this capital? In

economic jargon, normal profits are those minimum profits that investors require to invest, and above-normal profits – also called rent – are profits beyond this minimal level. The proponent's feasibility study (KGHM and M3 2016) estimates after-tax returns of the project of $288 million CDN NPV at a discount rate of 8% (Table 2).[2] The question is whether this estimated return is all normal profits or some combination of normal and above-normal. Under the assumption that investors would've required all of this return to invest in the project – i.e., that the entire return is normal profit – then there is no private benefit of the project. This is the pessimistic scenario. Alternatively, under the optimistic scenario in which we assume that investors would not have required all of this return to invest in the project, i.e., they would only require normal profits to invest, and thus some portion of this estimated return would be above-normal profit, then the private benefit of the project is some value up to $288 million NPV. This benefit would be even higher if we used a discount rate lower than 8% as is typical of analyses looking at the impacts of projects on society as a whole.

Table 2. Results of proponent's 2016 feasibility study.

Metric	2016 Feasibility Study Result
NPV pre-tax at 8% discount rate	$429 million USD ($573 million CDN)
IRR pre-tax	13.4%
Payback period pre-tax	6.48 years
NPV after-tax at 8% discount rate	$216 million USD ($288 million CDN)
IRR after-tax	11.1%
Payback period after-tax	6.72 years

Source: KGHM and M3 (2016).

The second issue of foreign investment pertains to whether or not there is an opportunity cost to this foreign investment, and to what extent profit is leaked from the country. The EA application indicates that the proponent is a joint venture between KGHM Polska Miedź S.A. based in Poland, and Abacus Mining and Exploration Corporation of Canada, implying that a portion of the investment money will be coming from out of country, and thus a portion of the profit will be leaked from Canada. The first question here is whether or not foreign investment in Canada is assured or not – if it is then the foreign investment has an opportunity cost just as the Canadian portion of the investment, but if the foreign investment is not assured then some or all of this investment is a benefit to Canada. Statistics Canada data on foreign investment in the mining industry in Canada suggests that about 50% of capital is foreign-sourced.[3]

[2] The discount rate is used to factor in time to the analysis. Future benefits and costs are worth less than those that occur in the present for two reasons: (1) people's preference for benefits sooner and costs later, and (2) the fact that benefits realized sooner can be invested and earn a return.

[3] STC (2015) data for 2013 (the latest available) indicate that 33.1%, 58.6%, and 56% of assets, operating revenues, and operating profits, respectively were foreign-controlled.

Therefore, under the pessimistic assumption that foreign investment is assured the $1.1 billion CDN coming from foreigners has an opportunity cost and is thus just portion of the costs of the project.[4] Alternatively, under the optimistic assumption that foreign investment is not assured some portion of the $1.1 billion is a benefit to Canada. Yet even under this more optimistic case we can expect that much if not all of this investment will be leaked from Canada over the long-term given that investors invest to earn a return. Therefore, even if this foreign investment has no opportunity cost this benefit will be negated through leakage of all of this money plus the profit earned on this investment. In this case, what is leaked is the investment monies but also about half – $144 million NPV at a discount rate of 8% – of the after-tax profits minus any taxes on this profit (see s.3.3.1 below). With this leakage, only the portion that stays in Canada – about $144 million NPV – is a benefit of the project.

Therefore, considering all of the above, the private benefit of the project ranges from nothing to as much as $144 million NPV. This figure is exclusive of any incremental taxes earned on the investment as discussed below in s.3.3.1.

3.3 Government and Taxpayers

The proponent estimates $354 million undiscounted in tax revenue during construction and $84 million undiscounted annually during operations (p7.1-16, 7.1-17), or about $1.1 billion total NPV at an 8% discount rate. The implication in the application is that all of these taxes paid in the course of the project are a benefit of the project. From a net valuation perspective, though, only a portion of this revenue be incremental and thus only a portion of the proponent's estimated tax impacts are a net benefit of the project. Tax revenues generated by a project are only net benefits to society if they would not otherwise be realized and if they are not offset by increased demands that the project places on government infrastructure and services or subsidies offered to the project.

3.3.1 Incremental Tax Revenue

The project has the potential to offer incremental taxes of the following types:

- sales tax on purchases of goods and services during construction and operations;
- income tax on project labour;
- corporate income tax on project net revenues;
- mineral tax on rents earned through mining extraction;
- withholding tax on foreign profits; and
- property taxes.

[4] Total initial and sustaining capital costs (undiscounted) of 1.7 billion USD (KGHM and M3 2016, 276) which translates roughly to $2.2 billion CDN.

Sales taxes are only incremental if can expect an increase in production and sales in Canada caused by the project that wouldn't otherwise occur. As discussed in s.3.2.1 above, it seems reasonable to expect the Canadian portion of the investment to occur anyway, and so any sales tax revenue associated with this cannot be expected to be incremental. In contrast, foreign investment represents the possibility that investment, and thus economic activity, occurs in Canada that wouldn't otherwise occur. Under a pessimistic scenario that assumes that foreign investment would not be incremental, sales tax would not be incremental. Alternatively, under an optimistic scenario in which foreign investment is believed to be incremental then sales tax on the non-labour purchases associated with this investment is incremental. For the capital costs portion of the project, this amounts to about $100 million NPV at a discount rate of 8%.[5] Under the argument that half of operational expenditures would be incremental under the assumption that foreign investment is not assured and therefore this operational activity would not otherwise occur, then there would be further incremental sales tax revenue. It's unclear from the application what portion of operational costs are non-labour, but if we assume that 25% of operational costs are non-labour, then the total incremental sales tax revenue would add up to about $210 million NPV at a discount rate of 8%.

Income taxes are only incremental if unemployed people are put to work, or higher wages are earned, as a result of the project. As I discuss in some detail below in s.3.4.1, it seems reasonable to expect only a relatively small amount of incremental employment and only marginal changes in earnings of those who come to work at the project. Consequently I don't try to estimate this relatively small amount of incremental income tax revenue.

Corporate income tax is only incremental if the net returns earned on the project wouldn't otherwise be earned. As I assume that the Canadian portion of the investment would otherwise occur, it follows that the net return earned off this investment (i.e., the $144 million NPV discussed in s.3.2.1) would otherwise be earned and thus isn't incremental. With respect to the corporate income tax earned off of foreign investment, under the pessimistic scenario in foreign investment would otherwise occur, this tax revenue would otherwise be earned and therefore wouldn't be incremental. Alternatively, under the optimistic scenario in foreign investment is not assumed to occur, the associated corporate income tax wouldn't otherwise be earned and is incremental. This revenue is the applicable rate (22.5%) times the foreign portion of before-tax profits and amounts to about $64 million NPV.[6]

[5] Total capital costs of project of $1.7 billion CDN. The foreign investment portion is $868 million. The non-labour portion 21% (pp. 2-29 and 2-30)) equaling $688 million. Multiply by sales tax rate of sum of BC PST (7%) and federal GST (5%) to get sales tax associated with foreign investment. Note most capital costs incurred in early years but some in later years and so actual value would be lower than the estimated $106 million due to discounting.

[6] The corporate income tax rate of 22.5% was what was assumed by the proponent (Appendix 7.1B p5).

BC mineral tax is incremental if mining wouldn't otherwise occur. Investment in new development in Canada goes into many different industries, and so one cannot assume that if Ajax didn't proceed another mine would be developed in Canada, never mind in BC. If we did take the pessimistic case and assume that mining would otherwise occur, then any mineral tax revenue earned by Ajax would not be incremental. However, if we assumed that mining wouldn't necessarily occur then this revenue would be incremental. Under this latter scenario, incremental mineral tax revenue would amount to about $63 million NPV flowing to the BC government based on as assumed blended rate of 11% on net returns.[7]

Withholding tax is a tax on foreign profits and is incremental if it wouldn't otherwise be earned. Under the pessimistic scenario in which foreign investment and thus leakage would otherwise occur, this tax revenue would not be incremental. Alternatively, if we assume that foreign investment is not assured, then withholding tax revenue would be incremental. Assuming a rate of 5% on net returns gives revenue of about $14 million NPV flowing to the federal government.[8]

Property tax is only incremental if we wouldn't otherwise expect this property to be occupied and paying these taxes. There is a history of mining on the project site, but it is also conceivable that the site sits vacant and unused if Ajax doesn't proceed. Under the pessimistic assumption that the site would be used for a similar purpose anyway there would not be any incremental property taxes. Alternatively, if we assumed that no other activity would proceed if Ajax doesn't, then the property tax revenues would be incremental. The application indicates that the assessed annual property taxes are $6.9 million which over the life of the project would amount to $81 million NPV flowing to the City of Kamloops.[9]

Additionally, under the assumption that foreign investment is incremental we can expect that there would be some incremental taxes associated with indirect economic activity spurred on by this incremental investment, i.e., taxes earned through sales to those providing goods and services to the project. Tax revenue associated with induced activity would not be incremental because this activity can be assumed to already occur given that the Canadian labour market is well-employed (see s.3.4.1 below) and so the goods and services bought by labour would otherwise be purchased and so the taxes associated with this economic activity would otherwise be paid. Taxes associated with

[7] BC charges two different taxes on mineral production – a 2% net current proceeds tax, and a 13% net revenue tax (KPMG 2011). For simplicity, given the former can be used to offset the latter, I assume a blended rate of 11%.

[8] Withholding tax rate assumed to be 5% consistent with KPMG (2011) even though standard rate is 25% if no treaty between Canada and country repatriating profits.

[9] The EA application does not clearly specify the amount of property tax revenue to be paid by the project but I assume that the only local tax during operations is property tax, and therefore I assume that the local tax amount during operations presented in Table 7.1-4 of the application of $6.9 million is the annual property tax revenue.

indirect and induced economic activity spurred on by the Canadian investment would not be incremental because it would already occur.

Altogether, depending upon the assumptions one makes, we can expect the following range of incremental tax:

- $0 up to $240 million NPV sales tax revenue;
- only marginal amounts of income tax revenue;
- $0 to $64 million NPV corporate income tax revenue;
- $0 to $63 million NPV mineral tax revenue;
- $0 to $14 million NPV withholding tax revenue;
- $0 to 81 million NPV property tax revenue; and
- indirect taxes earned from economic activity spurred by foreign investment if that investment assumed to be incremental.

This all amounts to a potential total of $462 million NPV if all optimistic assumptions hold true. Note, though, that sales, income, and associated indirect tax revenue would be lessened to the extent that physical capital purchased by the proponent to build the project is sourced outside of Canada. It is not clear how much physical capital will be sourced from the USA, Asia, or elsewhere (KGHM and M3 2016, 300), but to the extent that this occurs the incremental tax revenue flowing to governments in Canada will diminish.

3.3.2 Incremental Government Expenditures

Economic activity places a burden on government-provided infrastructure and services. The application notes that the project will place demands on roads, landfills, and emergency services (pp. 8.1-20, 8.1-21, and 8.1-51) but presumably also on health services, recreation infrastructure, schools, employment services, and perhaps otherwise due to in-migration of labour and their families and the physical activities of the project. The proponent's planned mitigation measures will help address project stresses on government-provided infrastructure and services; the costs of these measures are already accounted for in the project's capital costs (s.3.5.1 of my report). In contrast, the financial costs associated with the incremental burdens on roads, landfills, emergency services, etc. are not explicitly accounted for in the application.

The application does highlight tax revenues paid to local, provincial, and national governments, though, as discussed in s.3.3.1 above. Sales, income, and other taxes are generally used by governments to pay for infrastructure and services. The question for valuation is therefore to what extent are there incremental burdens on government-provided infrastructure and services, and to what extent will these offset incremental tax revenues.

Incremental burdens to Canada are associated with any economic activity that wouldn't otherwise occur. As discussed above, Canadian investment is assumed to otherwise occur, though perhaps in areas of Canada other than Kamloops. Regardless from a Canadian perspective the associated burdens on infrastructure and services would already occur. From a Kamloops perspective this activity may not have otherwise occurred, but between property tax revenue and senior levels of government spending revenue from other taxes where activity is occurring in the country it seems reasonable to assume that any tax revenue from Canadian investment and property taxes will be offset by incremental burdens on government.

As for foreign investment, the incremental economic activity and taxes generated is associated with incremental burdens on public infrastructure and services such as incremental burdens on regulating authorities, administration, roads, etc. The new economic activity generates new burdens. From this perspective, the incremental sales tax, income tax, corporate income tax revenue, tax revenue associated with indirect economic activity, and property taxes will be offset at least partially or perhaps even fully.

However, withholding and mineral taxes are not typically instituted as means to cover the costs of everyday public infrastructure and services but instead exist as special sources of revenue used to finance atypical needs. From this perspective, the withholding ($14 million) and mineral taxes ($63 million) estimated in s.3.3.1 are not offset and instead are benefits flowing to governments and taxpayers.

3.3.3 Subsidies

If the government, and thus taxpayers, provide inputs to the project at below what it costs to provide them, then the project is being subsidized and is exacting a cost on society. One common way in which such a subsidy occurs in the industrial sector is with respect to electricity because new major projects demand substantial additions to the provincial power supply and because the regulated rate is significantly less than what it costs BC Hydro to add new supply.

The application indicates on p3-74 that average annual power demand during operations will be 90 megawatts (MW), and the feasibility study (KGHM and M3 2016) assumes a price of $0.069 CDN/kWh, or $69/MWh. This rate is substantially lower than recent BC Hydro power calls and signifies a subsidy. BC Hydro's most recent estimate of the cost of new supply from February 2016 was $85/MWh [Marvin reference]. If we assume that the latter is the cost of new supply, then the project imposes a cost on BC ratepayers of about $12 million a year or $99 million NPV. For sensitivity analysis I consider less recent costs of new supply: the cost of Site C has been estimated at $110/MWh (BC Hydro 2013), and in BC Hydro's 2010 power call BC Hydro was willing to

pay $125/MWh [reference needed]. Using the Site C cost, the subsidy amounts to about $32 million a year on taxpayers, or $257 million NPV.

3.4 Economic Activity

3.4.1 Employment, Wages, and Training

Employment benefits can be of three types: new jobs, higher wages, and new training. I deal here in this section with employment benefits at the project specifically; I deal with effects on labour working elsewhere in s.3.4.2 below.

According to p2-33 of the application, the project will provide 3,873 person-years (PY) of employment over the three year construction period, with a peak demand of 1,800 jobs in year two.[10] The skills demanded during construction will be mostly in trades. During operations, the proponent expects to require 468 staff per year, again with skills mostly in the trades and having at least a grade 12 diploma or equivalent. The proponent estimates that 47-80% of construction jobs (i.e., 433 to 1,152 construction jobs in a given year) will be filled by pre-existing locals depending on the construction year (pp 2-36, 7.2-24), and that 58-74% of operations jobs (i.e., 271 to 347 jobs) will likewise be filled by locals (pp 2-37, 7.2-26).

The application does not present the wages that it expects to pay construction employees but notes that in 2010 in BC, engineering construction jobs (the type that the proponent expects 96% of construction jobs to be) paid an average annual salary of $83,600 (p7.3-18) and that the application notes that the average operations salary will be $117,000 (p7.3-20). These levels of wages are high in comparison to many other jobs in the province, as the application notes, but are of a level that is typical of mining and other similar jobs relative to other labour sectors (BC Statistics Undated-a).

As for training, the application is not clear as to what new training they will provide that wouldn't already occur or be provided by other parties:

- on-the-job training is implied or noted as something that the proponent may provide (pp 7.1-23, 7.2-25, 7.2-32, and 7.4-29);
- material on p7.1-24 implies that the proponent will develop training programs with local training institutions;
- the proponent indicates that federal and provincial training will be relied on (pp 7.1-24, 7.2-26, 7.2-32, and 7.2-33);
- the proponent indicates that it will possibly support training at project closure (p7.3-24);

[10] One PY is one person working for a year. It is important, though, not to confuse PY with jobs. For example, 99 PY can be 99 jobs for one year, or 33 jobs for three years, or some other combination.

- the proponent indicates that it will possibly implement programs to increase local supply of labour in occupations required for the project (p7.2-21);
- the proponent expects that other employers competing for labour will provide training to fill their positions (p7.4-24); and
- the proponent notes that training could help alleviate labour competition (p7.4-24).

Employment, wages, and training can be important benefits of major project development, but these benefits will only be incremental under certain conditions. The reason that employment is not necessarily a benefit of a project is that in well-functioning economies like that in BC and Canada, many workers would already be working at comparable wages. Incremental benefits stem from the employment of people who wouldn't otherwise be employed, employment at higher wages than would otherwise be earned, but also from training that wouldn't otherwise be received.

With respect to the employment of people who wouldn't otherwise be employed, census data on unemployment rates presented on p7.2-8 of the application and BC Statistics data (Table 3) indicate low levels of unemployment in the province and thus few people in the province who wouldn't otherwise be employed. The exception is local Aboriginal (including SSN) labour who have unemployment rates that are well above natural rates of unemployment (5-7%).[11] Census data from 2011 indicate that unemployment rates for SSN people were 16% to 23.6% (pp 12-49 and 12-58). These rates suggest that it is possible that the Ajax project will create employment benefits for the local Aboriginal population. Other Aboriginal groups in the region have similarly high unemployment rates (s.12 of the application).

Table 3. Unemployment rates in BC, 2014.

Statistic	Unemployment Rate
BC – all industries	6.1%
BC – goods-producing sector	5.8%
BC – forestry, fishing, mining, oil and gas	7.1%
BC – mining and oil and gas extraction	5.3%
BC – construction	6.4%
BC – service-producing sector	3.2%

Sources: BC Statistics (Undated-b).

For SSN and other Aboriginal labour, the question is then whether there are the skills and inclination to work at the Ajax project. As the application itself notes (pp 2-35, 7.2-23), a key factor in local hiring is the availability of workers with appropriate skillsets. The application indicates that about 31% and about 40% of Tk'emlúps te Secwépemc on-

[11] There is almost always some unemployment due to the fact that at any given time a certain number of people are in between jobs and not able to find employment that they are willing to undertake. A typical rate of 'natural' unemployment is on the order of 5-7%.

reserve members and Skeetchestn Indian Band on-reserve members, respectively, have no degree, certificate, or diploma (pp 12-48 and 12-58). SSN staff involved in careers and training also note several barriers for SSN members with respect to Ajax employment:

- only a portion of the SSN labour force is supportive of the project, and only about 50 members have expressed interest in the jobs on the project;
- many members have little to no experience, and it is difficult to get jobs with only 'brand new certificates';
- many members don't have drivers licenses, Grade 12 diplomas, or the appropriate skillsets;
- many members don't have transportation to the project; and
- racial, cultural, historical, and social obstacles impede employment uptake and retaining of jobs.[12, 13]

Further, the application notes that little can likely be done by the proponent to address local skills gaps in the short-term to address construction labour needs (p7.2-25), and few people in the region work in mining at present and have the relevant skills (p7.2-9).

It would therefore appear that there is reason to believe that only a relatively small number of project jobs will be attained by SSN members or other Aboriginals in the region. It is difficult to quantify this employment benefit but we can get a sense of what the order-of-magnitude of this number. If we assume:

- that 50 SSN members or other Aboriginal people are interested in Ajax jobs,
- all of these people would otherwise earn $25,000 per year (the average total income in 2011 for SSN members (pp 12-50 and 12-59),
- only operational jobs would be attained, and
- 75% of these people have or pass through the necessary training to get these Ajax operational jobs, then

the approximate employment benefit for SSN members and other Aboriginal people in the region is $3.5 million per year of operations, or $28 million NPV. This estimate assumes no employment benefits during the project's construction phase given the barriers to such employment noted above. If we assumed 100 Aboriginal people are interested and 100% have or pass the necessary training, benefits would rise to $9.2 million per year, or $74 million NPV.

For those already employed (both Aboriginal and non-), the question is whether these workers would shift jobs, and if they did would they earn a higher wage than otherwise.

[12] Personal communication February 5, 2016 with Jordann Hazelwood (SSN Career Coach) and Sharon Gottfriedson (SSN Pathways to Success Instructor).

[13] Beyond offering cross-cultural training to employees (p7.1-24), the proponent doesn't appear to have any mitigation measures in place to address barriers and obstacles to Aboriginals attaining project employment.

According to the application, several key people interviewed by the proponent noted that the regional population of appropriately skilled and interested individuals were largely already engaged in similar jobs at existing mines or related places of employment (Appendix 7.1 2-8). This – combined with the proponent's expectation of labour and associated wage competition (e.g., pp 7.4-18), low unemployment rates (Table 3), and average wages across sectors of the economy in BC (BC Statistics Undated-a) which further highlight labour competition – strongly suggest that employed labour with the relevant skillsets are already earning comparable wages and thus there would be little if any incentive to switch jobs. For the Ajax project to find employees, KGHM would need to offer competitive compensation, but given it is a profit-driven entity I would expect KGHM to offer little more than minimal over competing employers, translating to only marginal employment benefits in the form of wage premiums for whoever switched jobs.

In summary, few employment benefits can be expected from the Ajax project. An order-of-magnitude estimate of employment benefits flowing to the SSN and other Aboriginals in the region suggests about $3.5 million a year during operations. Only marginal benefits would flow to the rest of the labour market due to pre-existing conditions of labour competition. As for training, the application doesn't make clear that the project will offer anything new that wouldn't otherwise be provided by other parties.

3.4.2 Other Business and Local Government

The application identifies potential impacts to other business and local government in terms of (a) increased business activity, (b) wage inflation from competition for labour, (c) a drop-off in purchases from businesses associated with project decommissioning and closure, and (d) the effects of aesthetic and environmental changes on tourism, recreational, or agricultural businesses in the area. Each of these effects are relevant for SSN businesses like the contractor Stk'emlupsemc Enterprises, and I deal with each in turn below.

With regard to the first issue of business activity, the application notes (ss. 2.7 and 7) that other businesses in the area may benefit from the project through indirect and induced economic effects, i.e., increased sales directly to the project or to employees of the project. With new money injected into the local economy via the project, other businesses in the area can gain a benefit if they can charge higher prices or achieve lower costs per unit. Importantly, increased sales revenue is not a benefit as greater throughput entails greater input cost and effort on behalf of the business, but if there are profits earned on that increased throughput then these profits can be tabulated as benefits. But would there be profits on increased throughput? Not under the assumption of a competitive economy, but economies are rarely if ever perfectly competitive and so some profits might be gained. It is not possible to quantify or put

bounds around these potential benefits to other businesses because of all of the complexities involved in doing so.

However, these profits may be offset in part or even fully countered by increased costs posed by wage inflation. The application argues that due to relatively low rates of unemployment, skills shortages, and the relatively high wages to be paid at the mine, other employers including other businesses in the Kamloops area and beyond as well as local government will likely have to pay more to retain or replace their employees or expand, particularly during the onset of project operations (pp 7.4-22, 7.4-24). The application argues that the adverse effects of labour competition will be reduced because businesses can tap into the unutilized portion of the Kamloops labour market as well as support and provide training, and further that competing businesses "will have mechanisms in place to accommodate or alleviate competitive pressures as required" (p7.4-24). The proponent concludes that the adverse effects of wage inflation will be non-significant and minor, in part because of the proponent's planned mitigation measures which include potentially joining with other businesses in recruitment, training, and education. It's not clear exactly how these adaptive and mitigative strategies would work, nor what they would cost other businesses to implement. From a valuation perspective, these are impacts would be offset anyway by gains to the people in these jobs.

The third effect noted in the application – of adverse economic effects on other business associated with a drop-off in project economic activity – is not an adverse effect but a decline in a positive effect. See Critique #1 in s.3.1.1 above.

The fourth potential effect of the project on other business and local government of costs imposed by project environmental effects may or may not be substantial. Several businesses in the area depend upon a clean environment including those involved in agriculture and tourism, and the City of Kamloops itself arguably attracts residents, businesses, and conference and sporting events due in part to a perception of a clean and aesthetically pleasing environment. So as not to double-count I refer to the reader to a broader discussion of environmental effects in s.3.7 below.

3.5 SSN and Aboriginal

3.5.1 Lands, Resources, and Activities within SSN Traditional Territory, and Negotiated Benefits

With respect to SSN lands, the natural resources on those lands, and SSN activities involving their lands and resources, there are three main issues of concern:

1. the extent to which the project takes-up of traditional territory, i.e., project footprint,

2. cumulative biophysical effects on traditional territory and the physical resources within it, and
3. the extent to which the project interferes with the SSN's ability to practice traditional activities on its traditional territory.

The three issues are interrelated: when traditional territory is taken-up, physical resources upon which traditional activities depend are destroyed, damaged, or altered, and these impacts compound the impacts of other past, present, and potential future activities and stresses.

As indicated on p13-44 of the application, the entire project footprint is within the traditional territory of the SSN, and the project footprint of 1,705 hectares is only 0.14% of the SSN's traditional territory. However, this simple measure doesn't get at the relative importance of this loss of traditional territory, nor how this loss contributes to the cumulative effects of a history of impact on SSN traditional territory, activities, and culture. As noted in the application, the project footprint will completely or partially affect several important landscape features and areas used for fishing and other activities including Jacko Lake (Pípsell) and Peterson Creek (pp 12-27, and 13-45 to 13-56). There will also be effects outside the project footprint affecting SSN traditional lands, resources, and activities such as impacts on water quality, wildlife, air quality, and noise as covered in ss. 6 and 13 of the application (s.3.7 of this present report)

From a valuation perspective, the question is: what minimum monetary or other compensation would the SSN require to make these project effects acceptable, if at all? The application notes that the BC government expects that the SSN has a strong claim to their territory, that the SSN feels that their rights and title will be infringed by the project, and that the SSN expects compensation if such infringement occurs (pp 13-54 and 13-55). The monetary value of such a loss may be inferred from past infringements and associated compensation, but the importance of the losses associated with the Ajax project may be unique and thus past transactions may not provide an accurate assessment of the compensation demanded. To the SSN the cumulative infringement may matter, and thus even if the lands lost from Ajax are similar to past losses this new loss may be more impactful and thus may demand proportionately greater compensation.

An outside analyst cannot place a value on the SSN's loss; only the SSN can value this loss and have been doing so as exhibited by the degree to which they have become involved in the EA and related regulatory processes for the project and as the SSN will negotiate with the proponent in an impact-benefit agreement (IBA).

To account for infringements on Aboriginal rights and title, as well as impacts upon First Nations' territory, resources, and activities, but also to account for other adverse effects

on First Nations' interests and to gain social license from affected First Nations, major project proponents commonly negotiate IBAs with affected First Nations. Typical IBAs include direct monetary payments (both up front lump sums as well as payments over time), contracting and employment arrangements, training, monitoring programs, and other activities and investments. The value embodied in IBAs thus provide compensation for harms but also additional benefits.

As IBAs are private agreements between affected First Nations and proponents, their value is confidential. For the SSN, the value of any IBA it negotiates with KGHM can be added to the tally of costs and benefits estimated in this study.

3.6 Social and Community

3.6.1 Property Values

Changes in property values as a result of project development can have both negative effects (e.g., increased noise, degraded view) and positive effects (e.g., increased demand for commercial property).

Negative effects on properties adjacent, downwind, otherwise near the Ajax project or even not near the project could be affected by way of project impacts on visual quality, noise and vibration, air quality, the placement of project infrastructure such as transmission lines, the utilization by the project of easements and rights-of-way across properties, or simply due to perceptual effects on the impact of the project on the property. Generally, these negative effects manifest themselves in terms of lower resale values and rental prices and thus are a nuisance cost – or externality – of the project.

The application concludes that adverse effects on the values of residential and agricultural properties near the project these effects will not be significant (p7.5-47). The application argues that while there might be some short-term losses in property value there will be a market correction "after the real effects of the Project are shown — through environmental monitoring and disclosure of results — to be minimal" (p7.5-48). In coming to this conclusion the proponent contemplated using the method of hedonic pricing – a statistical method to determine how factors such as adjacency to industrial sites affects property values – but ultimately decided that the method does not produce conclusive results (p7.5-24). To complement their analysis the proponent then used analogues from past EAs to infer how the Ajax mine might affect property values in Kamloops (p7.5-25).

My own review of the hedonic pricing literature on the effects of industrial sites on property values likewise didn't identify conclusive results, but this large body of literature does identify some common patterns that are relevant to understanding how the Ajax project might adversely affect residential properties in the Kamloops area.

Residential property values reflect numerous things including building and lot characteristics, proximity to services and employment, neighbourhood characteristics, and environmental quality. In general, the closer a property is to industrial sites, the larger the industrial site, the more noxious or dreaded a site, and the more urban the properties in question, the greater the effect on property values (Thayer et al. 1992; Jackson 2001; Damigos 2006; de Vor and de Groot 2011). The extent of effects on property values tends to be from several thousand dollars to tens of thousands of dollars but can also manifest themselves in owners' inabilities to get financing or refinancing and delayed sales (Farber 1998; Damigos 2006; Simons and Saginor 2006). However, numerous studies noted that negative effects can sometimes rebound partially and are often localized, and the effects can even be moderated or even offset by employment opportunities at the site itself (though this employment benefit tends to be spread wider geographically on a community's property values than the negative effects on values) (Farber 1998; Jackson 2001). There are limitations to hedonic pricing studies but there is a now a long history of use of this method in environmental valuation but also real estate communities, and overall the methods and results experience substantial trust.

The proponent's use of analogues to infer the Ajax project's effect on property values is helpful but only to a limited extent. Analogues can be a useful means to infer impacts of a project, but to be effective there must be similarity between the analogues and the project under study and the effects in question (or differences must be controlled for), and the information must be trustworthy. The proponent's choice of analogues included three recent EAs, two of which were linear developments (the Keystone XL pipeline in the US, and the Northwest Transmission Line in northern BC), and the third a deep geologic repository in Ontario. As described in the Ajax application, these analogues pose some utility as they are from recent EAs, but the different physical nature of the projects compared to the Ajax mine, and as they noted that in the case of linear developments landowners often negotiate settlements with proponents outside of the EA process, it is questionable how useful these analogues are to the present study. Further, EA applications are not necessarily accurate renditions of actual effects without post-development monitoring and ground-truthing of impact predictions.

Given the information gathered and the inability within the scope of this study to conduct a detailed statistical analysis of the potential effect of the Ajax mine on Kamloops properties, we can assume a negative effect on the value of residential properties most close to the mine (particularly Aberdeen and Knutsford neighbourhoods) on the order of a few thousand to as high as over $10,000 per residential property based upon studies elsewhere.

However, housing prices across the Kamloops area may rise with the development of the Ajax project, as noted in the EA application (p7.5-27) due to increased demand from in-migration. If the proponent's estimates of local hires is correct (pp 2-34, 2-37) then about 123 to 197 employees would be in-migrating to the Kamloops area alongside family members. If we assume that each in-migrating employee brings with them an average of 1.5 dependents then between 300 and 500 people total may move to the Kamloops area requiring 123 to 197 new housing units. With a population in Kamloops of around 90,000 people, this will only be about a 0.5% increase in the local population. If fewer locals are hired the order-of-magnitude increase in the Kamloops population would still only be a few percent. In terms of housing units, even 197 units (what would be demanded by the non-local hires and their families) is only 0.5% of the total non-rental housing stock in the City of Kamloops and less if regional housing stock is considered and about 6% of the total rental housing stock (p8.1-7). Thus if all or many of the in-migrants sought to rent as opposed to buy there might be some upward pressure on rental prices to the benefit of landlords and detriment of new and existing renters. The net of these effects would be offset but distributionally local and wealthier people would benefit (being the ones who would tend to already own property and/or be landlords) and non-local and/or less well-off people would lose. The latter distributional effect is important given that SSN people fall disproportionately in the latter category due to lower average incomes (pp 7.3-4, 12-50, and 12-59).

There may also be some increases in prices for commercial and industrial properties if the project will increase demand for them. This effect is important to the SSN given the SSN's ownership of the Mt. Paul Industrial Park.

The application explains that between 25% and 35% of project expenditures will be made from Kamloops businesses, or between $75 and $105 million annually (p7.4-12). This business activity may lead to expansion of local businesses that serve project needs, and if so may increase demand for commercial and/or industrial property such as that held by the SSN. Presumably the value of such property will relate to its zoning, its size, and its proximity to the project and transportation corridors. It seems reasonable to therefore expect some positive effects of the project on commercial and industrial property values to the benefit of these property holders, concurrent with the conclusions of the proponent in their application.

3.6.2 Infrastructure and Services

Section 8.1 of the application reviews how the project may affect infrastructure, public facilities, and services. The application considers how population growth stimulated by the project's employment demand and additional traffic may affect housing and accommodations and cause increased stress on community infrastructure and services, how project activities may affect community infrastructure and services including roads,

and how competition for labour may affect municipal works. I agree that each of these types of effects are likely to occur and have covered all of these topics above.

In ss. 3.3.1 and 3.3.2 I review how the project will lead to incremental government expenditures to cover this additional pressure on infrastructure and services, but that incremental tax revenues should cover much of these costs. In s.3.6.1 I review how we can expect the project to drive rental and non-rental housing prices up to the detriment of renters and buyers but to the benefit of landlords. And in ss. 3.4.1 and 3.4.2 I review how project demand for labour will add to existing shortages of labour and how there is already high wages in these types of jobs yet little substantial gain should flow to labour except Aboriginal labour given their high unemployment levels. This latter topic of labour competition deserves further exploration, though, given that I have not yet examined how municipal public works may be affected.

Municipal public works such as road development and sewer repair depend on funds to pay for equipment and materials but also to cover the costs of municipal in-house and contracted labour. If the costs of public works projects rise substantially, then logically we can expect that some will get pushed back to later dates or avoided altogether. Building from arguments I make above in s.3.4, there is already competition for skilled labour and other 'public works'-related skills, though the project will raise the level of competition. While the labour market is already tight, there is no evidence to suggest that the proponent is going to pay anything beyond a marginal premium to attract labour, and therefore we shouldn't expect labour to experience much of a benefit. Further, presumably municipal public works jobs have certain advantages like proximity over some competing places of employment, such as forestry and mines in the region. While Ajax might compete with the municipality on the matter of proximity, the municipality presumably will be able to continue to compete favourably with other employers other than Ajax, offsetting the municipality's need to offer wage premiums. For these reasons, I would expect only minor wage competition for the municipality. By extension, I expect little effect on public works via cost escalation.

3.6.3 Archaeology and Heritage

Section 9 of the application reviews how the project may affect important archaeological and heritage resources. As stated on p9.1-31,

> *heritage resources are non-renewable, can be very susceptible to disturbance, and are finite in number. They are considered to be important resources that are protected and/or managed for their historical, cultural, scientific, and educational value to the general public, local communities, and Aboriginal groups.*

The application makes the following conclusions with respect to expected impacts on archaeological resources:

- 28 archaeological sites are in or within 50m of the project footprint and may be directly affected, 18 other sites may be "indirectly" affected by project activities (p9.1-8), and possibly other as-of-yet unknown sites; and
- known affected sites include lithic scatters (stones shaped by earlier peoples), a hunting blind with great significance to the SSN, and a former church and cemetery site.

The proponent anticipates that these effects, however, will be "not significant" with the exception of the impact on site EdRc-25 (the hunting blind). The proponent indicated in the application that they will continue to work with the SSN to reduce the effects of the project on the hunting blind site.

As for heritage sites, the application notes that it may affect a single paleontological site but also as many as 64 Aboriginal burial sites, historical and current hunting, fishing, and gathering sites, as well as several non-Aboriginal historical campfire and trail features. The proponent has concluded that after planned mitigation measures there should be minor non-significant effects at worst.

From a MA-CBA perspective, it is not appropriate to try to value these residual impacts monetarily but it is appropriate to recognize any residual effects that occur. The residual impacts estimated by the proponent are recorded in the summary table in s.3.8.

3.7 Environment

3.7.1 Greenhouse Gas Emissions

Greenhouse gas emissions (GHGs) cause global and by extension local climate change effects. In SSN territory climate change may affect such things as forest fire hazard, insect infestation rates, fish habitat, and fish and wildlife population resilience. The SSN has raised concerns regarding the effects of climate change on Jacko Creek, Jacko Lake, Peterson Creek, and the rest of the ecology within their traditional territory (p6.1-2).

The application presents the expected GHG emissions of project for peak construction and operational years. During construction about 230,000 tonnes of carbon dioxide equivalent (t CO_2eq) will be emitted.[14] Over the course of the 18 year operational life the

[14] The proponent estimates 82,010 t CO_2eq scope 1, 2, 3 and land use change emissions will be emitted in the first of the three construction years but that construction years two and three should emit less. Scope 1 emissions are directly emitted from the project; scope 2 emissions are those associated with purchased electricity; scope 3 emissions are those associated with sources owned or controlled by others, such as commuting employees and business travel; land use change emissions are associated with clearing and altering the project footprint. Under the assumption that scope 3 emissions (1,820 t CO_2eq) would occur anyway, and given that construction years two and three will emit less than year one, I have assumed 80,190 t CO_2eq emissions in construction year one and an average of 75,000 t CO_2eq emissions for construction years two and three.

mine will emit almost 2 million t CO_2eq.[15] The application notes on p6.1-43 that mitigation measures "will further reduce the project's potential adverse effects" but it would appear that the effect of these measures are already incorporated into their estimates of GHG emissions and therefore I have not adjusted GHG emission projections.

Globally, in general, GHG emissions are externalities of human activity, i.e., costs imposed on global society not borne by the party that causes it. However, in BC with our carbon tax, consumers of fossil fuels (the combustion of which leads to GHG emissions) are forced to internalize a portion of these externalities with benefits flowing to the BC government and BC citizens. The carbon tax regime is therefore intended to reflect upon consumers of fossil fuels the 'true' cost of fossil fuels, thereby incenting reduced consumption, and to help address climate change through investments funded by the tax.

From the perspective of CBA, the valuation question is therefore: what are the damage costs associated with the project's emissions after offset investments funded by the BC carbon tax or otherwise are taken into account?

Damage costs can be estimated by multiplying annual GHG emissions by the monetary value of a volume of GHGs emitted into the atmosphere. Carbon damage costing is not without controversy due to challenges estimating the effects of climate change and judgments and assumptions that must be made to do so, but there is a sizeable research literature providing a range of estimates that can be used to estimate GHG damage costs. To capture the range of estimates I use two values: $50 per t CO_2eq based upon a recent US study (US GAO 2014) and $100 per t CO_2eq to capture higher range estimates. I assume that GHG emissions during decommissioning are identical to those during operations. Under the lower value the project imposes a cost of about $60 million NPV; under the higher value I estimate damage costs of $119 million NPV.

The proponent does not present an estimate of BC carbon tax payments in their application or feasibility study but this tax revenue can be estimated by tabulating fuel consumption and multiplying this by the BC carbon tax rate for the fuel. According to the air quality study conducted by Stantec for the Ajax project (described in Appendix 10.1 of the application), the only fossil fuel consumed by the project is diesel. Table 4 presents diesel consumption by project year and phase consistent with emission assumptions outlined above in this sub-section. At a constant diesel carbon tax rate of

[15] The proponent estimates 123,028 t CO_2eq scope 1, 2, 3, and land use change emissions for operational year "4/8" which is meant to represent the combination of factors leading to a peak emissions operational year. Under the assumption that scope 3 emissions (5,065 t CO_2eq in operational year 4/8) would occur anyway, and that typical operational years emit less than the peak 4/8 year, I have assumed an average of 110,000 t CO_2eq scope 1, 2, and land use change emissions for each of the project's 18 operational years.

$0.0767 per litre, about $2 million in carbon taxes would be paid annually to the BC government per year throughout the project's lifespan amounting to an estimate of $24.4 million NPV. Should the BC carbon tax rate rise or otherwise change over the project's lifespan the carbon tax revenue would change accordingly.

Table 4. Diesel consumption and GHG emission estimates by project phase and year.

Project Phase and Year	Diesel Consumption	GHG Emissions
Construction year 1	24,363,837 litres	80,190 t CO_2eq
Construction year 2 and 3	22,786,978 litres	75,000 t CO_2eq
Operations (annual)	28,497,397 litres	110,000 t CO_2eq

3.7.2 Local Air Pollution

As with GHG emissions, the emissions of local air pollutants such as particulate matter (PM, particularly of 10 and 2.5 microns in size – PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), and oxides of nitrogen (NO_x) are externalities of development and cause damages. Damages include such things as health impacts to people exposed to the pollution (e.g., respiratory disease), damage to agricultural crops, and aesthetic impacts.

Unlike with GHG emissions, damage costing of local air pollution must take into consideration not just how much pollution is emitted into the atmosphere and the value of the damages that stem from the pollution but also dispersion characteristics of pollutants, how many people and other receptors are physically exposed to pollutants, and the doses that exposed people and other receptors receive. Damage costing of local air pollution is therefore not a straight forward activity, and while the proponent's consultants have done some of the necessary analysis on dispersion and exposure the process is still very complex and it is not possible within the scope of the present study to try to monetize these impacts. Instead I review the proponent's finding and literature examining such questions to provide a sense of the scale and nature of the air pollution impacts of the Ajax project.

The application presents the results of a study of air quality impacts with and without the project. The pollutants examined included dustfall, total suspended particulates, PM_{10} and $PM_{2.5}$, SO_2, NO_2, and carbon monoxide. The proponent's study of local weather patterns found that summer winds are predominantly from the northwest, and winter winds predominantly from the south-south-east (p10-1.9), and thus given that the Ajax project is sited for south of Kamloops the main concern is air pollution exposure during the winter, particularly in the Pineview Valley and Aberdeen neighbourhoods. In the baseline scenario without the project, the proponent concluded that levels of particulate matter ($PM_{2.5}$ and PM_{10}) and dust already occasionally exceed government air quality standards (pp 10.1-18 and 10.1-32). With the project the proponent anticipates exceedances in these same pollutants in areas of Kamloops near

the project boundary but also in north Kamloops and downtown, but notes that the exceedances in north Kamloops and downtown would not be due to the Ajax project but other pollutant sources (pp 10.1-45 to 10.1-48). This latter argument made by the proponent is problematic given that what matters are the cumulative effects of all sources of air pollution, including the Ajax project.

While damage costs from air pollution are very specific to the local context (Rabl and Spadaro 2000), we can still get a sense of the scale nature of damages of the Ajax project by looking at air pollution damage costing studies around the world. Key lessons from these studies are that $PM_{2.5}$ and SO_2 tend to be the most harmful, human health is the most important component of damages (i.e., relative to damage to agricultural crops, buildings, etc.), and local air pollution in an urban setting is much more damaging than in rural settings due to the greater number of people exposed (Rabl and Spadaro 2000; Muller and Mendelsohn 2007). A study of the damage costs of 10,000 sources of air pollution across the US gives a sense of damage costs per tonne of emissions (Table 5).

Table 5. Average damage costs of air pollution in urban and rural settings in the US.

Source Location	$PM_{2.5}$	PM_{10}	NO_x	SO_2
urban ($ USD /tonne/year)	$3,300	$500	$300	$1,500
rural ($ USD /tonne/year)	$1,100	$200	$300	$900

Source: Muller and Mendelsohn (2007).

Using these numbers from the US and the air pollution estimates provided in the application (Appendix E to Appendix 10.1-A) for $PM_{2.5}$, the most hazardous pollutant, it would appear that the Ajax mine will cause minor damages relative to other items being considered here in this present study. The application indicates that about 60 tonnes of $PM_{2.5}$ will be released each year both from ore and other sources, and if we use the average of the urban and rural damage cost multipliers in Table 5 there would only be a about $132,000 USD in damages per year.[16] I refrain from using this number in my summary table in s.3.8 due to the complexities inherent in transferring damage costs between study areas and the many complexities in air pollution damage costing.

3.7.3 Water

The application notes that the project has the potential to affect surface and groundwater quality and quantity (ss. 6.3, 6.4, 6.5, and 6.6). These impacts are important to the SSN as water resources are integral to SSN territory and as other components of

[16] This estimate ignores inflation.

this territory, such as fish and wildlife, depend on this water. I focus on surface water for the purposes of this MA-CBA.

The Ajax EA examined how the project might affect surface water quality from deposition of dustfall onto surface water bodies and from seepage and runoff from the project site into nearby surface water bodies (p6.3-133). Two water bodies were examined in detail: Humphrey Creek, and Peterson Creek. The proponent concluded that minor to moderate non-significant effects are expected associated with changes in sulphate, copper, molybdenum, selenium, and chloride concentrations (p6.3-135).

With respect to surface water quantity effects, the application concluded that annual streamflows in Peterson Creek (Lower) will be reduced roughly 17% during operations rebounding to 6% lower following project decommissioning (p6.4-61). The proponent concluded that these effects would be moderate and non-significant (p6.4-61).

Monetary valuations of impacts on water resources have been conducted around the world, but like most environmental valuation studies the results are highly site- and context-specific. As such, there is little benefit from transferring monetary valuations to the Ajax case. Regardless, the impacts of the project on surface water is not without consequence and is therefore recognized in the summary table in s.3.8 of this report. Note that these impacts are separate from non-use and options values discussed in s.3.7.5 of this report.

3.7.4 Fish, Wildlife, and Plants

The application reviews numerous types of effects of the project on fish, wildlife, and plants in s.6. Table 6 summarizes the conclusions of the application regarding these effects.

Table 6. Summary of project effects on fish, wildlife, and plants.

Valued Component	Effects	Proponent Conclusion
Fish populations and fish habitat	• habitat loss • fish mortality • sub-lethal effects	not significant (minor)
Rare plants	• habitat loss	not significant (moderate)
Rare and sensitive ecological communities	• habitat loss	not significant (minor)
Grasslands	• habitat loss	not significant (minor)
Terrestrial invertebrates	• n/a	no residual effects
Amphibians	• habitat loss • direct mortality • chemical hazards	not significant (minor)
Reptiles	• n/a	no residual effects

Valued Component	Effects	Proponent Conclusion
Migratory birds	• habitat loss • chemical hazards	not significant (minor)
Raptors	• habitat loss • sensory disturbance	not significant (minor)
Non-migratory gamebirds	• habitat loss • decreased lek usage, or abandonment of nests due to sensory disturbance	not significant (minor)
Mammals	• habitat loss • sensory disturbance • disruption of movement • chemical hazards	not significant (moderate to minor)

Source: Section 6 of the application.

Considering the value of many if not all of these ecological components to the SSN and others, it is important to recognize residual effects. From a valuation standpoint, the key question is what level of compensation would the SSN and others demand for these impacts. The diversity and complexity of these impacts are great and so I make no attempt in this present study to monetize or even synthesize the impacts into summary quantitative measures, but these impacts are captured in the summary table in s.3.8. Note that these impacts are separate from non-use and options values discussed in s.3.7.5 next in this report.

3.7.5 Non-use and Option Values

Total economic value is composed of use, non-use, and option values, and the latter two types of value capture the values that many people attach to having the option to enjoy benefits from something and knowing that others in the present or future will be able to enjoy benefits. As many studies in environmental economics have found, and as legitimized by the courts in such cases as that of the *Exxon Valdez* oil spill, these types of values can be sizeable and therefore they should be considered in CBA and impact assessment generally.

The most well-known studies of the value of damages to the ability of natural environments to provide non-use and option values are those by Carson et al. (Carson and Hanemann 1992; Carson et al. 2003; Carson et al. 2004) regarding the impacts of the *Exxon Valdez* oil spill. These studies determined that US residents would be willing to pay between $4.9 and $7.2 billion (1991 USD) to prevent another oil spill similar to the *Exxon Valdez* accident. These studies were sophisticated and withstood the scrutiny of the US courts and independent experts.

The Ajax project is arguably different in many ways from oil spills along the Alaska coastline – in terms of scale, the nature of the damage, what would be damaged, and who would be affected – but it remains that the Ajax project would have an impact on the ability of the affected landscape to provide for non-use and option values, at least until the project is decommissioned.

The Ajax application does not explicitly examine option and non-use values, yet several types of option and non-use values are relevant such as bequest values (e.g., the SSN's desire to pass on their territory and what exists within it (wildlife, culturally-significant locations, etc.) to future SSN generations), and existence and altruistic values held by people living in the region (e.g., the value associated with knowing that others in the region can benefit from wildlife). The project's environmental impacts within and near the project area are associated with in some cases complete losses and/or alteration.

No specific quantitative nor monetary values of the costs of the impacts of the Ajax project on non-use or option values are derived for the present study, but we can be confident that the project will cause such impacts. These impacts compliment other environmental impacts noted in prior sections of this present study including ss. 3.7.3 and 3.7.4.

3.8 Summary of Values

Table 7 presents a summary of the numerous effects of the Ajax project examined in this study. The effects on value are contingent upon numerous assumptions, such as whether or not foreign investment is incremental or not. Looking at the monetized values alone the range is -$650 million NPV to $101 million NPV, though these numbers are contingent themselves on the extent of incremental government expenditures. The many non-monetized impacts must also be considered; the question can be asked about whether all the negatives combined outweigh the sum of the positives.

The table also highlights how different parties will be affected. The SSN can expect benefits in terms of employment, property value appreciation, whatever is negotiated in an IBA with the proponent, and to the extent that all citizens gain from incremental tax revenues. The SSN can expect costs, though, in terms of infringement on traditional territory and activities, damage to archaeological and heritage sites, and the many ways that all citizens in the area are affected by incremental government expenditures and effects on the environment.

Table 7. Summary of effects of the Ajax project.

Account	Item	Effect on Value	Affected Party
Proponent	Private profit	• $0 to $144 million NPV	Private investors
Government and Taxpayers	Incremental tax revenue	• $0 to $462 million NPV • plus indirect taxes associated with foreign investment if this investment judged incremental • diminished to the extent that physical capital sourced from outside of Canada	Local, provincial, and national governments and taxpayers
	Incremental government expenditures	• ≤ -$385 million NPV	Local, provincial, and national governments and taxpayers
	Subsidies	• -$257 million NPV to -$99 million NPV	Provincial government and BC Hydro ratepayers
Economic Activity	Employment benefits	• $28 million NPV to $74 million NPV for Aboriginal employment • marginal wage premium benefits for rest of labour market associated with job switching and labour competition	SSN and other Aboriginal labour
	Other business and local government	• potential incremental profits flowing to local businesses associated with project purchases of local goods and services • increased costs to business from wage inflation, but offset gain to employees	Kamloops and area businesses, local government, and their employees

Account	Item	Effect on Value	Affected Party
		• adverse effect on relatively small number of local businesses that depend on clean environment and aesthetics	
SSN and Aboriginal	Land, resources, and activities, and negotiated benefits	• loss of territory, damage to biophysical components within the territory, and impediments to SSN's ability to practice cultural activities • benefits specified in private agreement with proponent	SSN
Social and Community	Property values	• financial losses to residential property owners near mine site (e.g., Aberdeen and Knutsford) • financial gains to commercial and industrial property owners due to increased demand spurred on by project	Property owners in the Kamloops area including SSN
	Infrastructure and services	• see above re incremental tax revenues, incremental government expenditures, and employment benefits • little to no effects on public works	Local, provincial, and federal governments
	Archaeology and heritage	• destruction of SSN hunting blind site • proponent conclusion of non-significant adverse residual effects on other archaeological and heritage sites	SSN and public
Environment	GHG emissions – damage costs	• -$60 million NPV to -$119 million NPV	Global society

Account	Item	Effect on Value	Affected Party
	GHG emissions – BC carbon tax revenue	• $24 million NPV	BC government and taxpayers
	Local air pollution	• health impacts due to $PM_{2.5}$, SO_2, and other emissions, primarily affecting nearby neighbourhoods • damages to agricultural crops, and negative effects on local businesses and City of Kamloops associated with air quality degradation	Kamloops area citizens
	Water	• some chemical contamination of Humphrey and Peterson Creeks • some reduction in water flows in Peterson Creek (Lower) during operations and persisting following decommissioning of project	Kamloops area citizens
	Fish, wildlife, and plants	• variety of residual effects on fish, wildlife, and plants including habitat loss, direct mortality, sub-lethal injury, sensory disturbance, and disruption of movement	Kamloops area citizens
	Non-use and option values	• environmental damages affecting people's ability to pass on benefits to others and affecting people's ability to exercise the option of using damaged environmental goods and services	regional citizens

Notes: 1. Values in red signify negative values.

4 Enhancing Benefits

The proponent has made substantial effort at identifying ways to mitigate the adverse effects of their project on what people in the Kamloops area care about, and the proponent has also identified ways to enhance benefits of the project. In Table 8 I present ways in which the project might be made more beneficial to the SSN and others.

Table 8. Means to enhance benefits of the Ajax project.

Issue	Proponent Actions to Enhance Benefits
Burdens on government expenditures	• Engage with City of Kamloops, BC, and federal governments on burdens that the project will place on government-provided infrastructure and services and explore ways to offset or cover these costs, such as through an impact-benefit agreement with the City to address burdens on municipal infrastructure and services
Employment and training	• Engage with SSN about specific barriers and challenges affecting job uptake and retaining of jobs, and commit to working with the SSN to address these barriers and challenges • Invest in training programs specifically designed for SSN and other Aboriginal people in the region • Contribute financially and/or in-kind to existing training programs
Other businesses	• Commit to buying Canadian-made physical capital as opposed to sourcing internationally
Property value	• Invest in nearby residential neighbourhoods to offset project's effects on these properties' values
Archaeology and heritage	• Invest in a museum, preservation efforts, or other activities focused on local archaeology and heritage values. Plan this investment with the SSN.
GHGs	• Invest in additional carbon mitigation efforts on- or off-site to further mitigate the project's GHG emissions.
Other environment	• Invest in additional mitigation efforts such as additional on-site air emission reduction, or off-site such as the purchase of lands for conservation, investments through the Nature Conservancy, or other. Plan these efforts with the SSN.

5 Conclusion

This report examines the proposed KGHM Ajax mine project as described in the proponent's environmental assessment application and feasibility study.

The main critiques I have of the EA application and feasibility study are:

- the presentation of a decline of new benefits as an adverse effect;
- the misconstruing of impacts as net benefits;
- multiple-counting of benefit information;
- lack of synthesis of impact information; and
- incomplete and insufficiently documented sensitivity analysis.

The results of my study indicate that it is not clear that there is an overall net benefit from the project to the SSN or Canada. Looking at the monetized values alone I estimate the project's net benefits to range from negative $650 million net present value to positive $101 million NPV, though these numbers are contingent on several assumptions and are contingent upon the outcomes of any impact-benefit agreement signed between the SSN and the proponent. In addition, the project's many impacts on on archeology and heritage values, and the environment must be considered as I have not monetized most of these impacts. Further, the SSN can expect a variety of benefits such as employment and property value appreciation, but also costs such as infringement on traditional territory and activities.

It is now up to the SSN to decide the relative worth of the project given the additional information provided in this study on the net benefits of the project. Many of the impacts examined in this study are not objectively factual but are inherently subjective, and the SSN must now decide itself, in its judgment, whether the benefits of the project outweigh the costs.

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