Appendix 7.1-B

Technical Memorandum on the Statistics Canada Input-Output Model

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1.0 INTRODUCTION

InterGroup Consultants Ltd. (InterGroup) was retained by KAM to undertake the assessment of potential effects of the Ajax Project (the Project) on economic and social valued components (VCs) as outlined in the Project Application Information Requirements (AIR). As part of the analysis, InterGroup was assigned with coordinating an input-output analysis of the Project's potential economic impacts. The results of the analysis will inform the assessment of Project effects on a range of VCs, including Labour Force, Employment and Training, Income, Economic Growth and Economic Diversification. InterGroup contracted Statistics Canada to run the Input-Output Model analysis.

2.0 APPROACH

Development and completion of the input-output model consisted of the following key steps:

i. Data collection and clarification
ii. Modelling
iii. Calculation of taxes
iv. Review and finalization
v. Summary results

2.1 DATA COLLECTION AND CLARIFICATION

InterGroup developed data collection tables in order to provide a sufficient level of Project detail for Statistics Canada to run the input-output model. A sample of the expenditure categories used is provided below. Rows were allocated for all key expenditure categories, in addition to other information as required (e.g., full-time equivalents). One table was developed for each of construction and operations phases.

A. Detailed Employment
    - Wages and salaries
    - Employee benefits (assumed to be 35% in addition to wages/salaries)
    - Employment (full-time equivalents – 2,000 hours/year)
B. Manufactured products
    - Mining and mineral products (refined petroleum and coal products – gasoline, etc.)
    - Other manufactured products (motor vehicles; other transportation equipment; chemicals, pharmaceuticals and chemical products; other manufactured products (e.g., related to mill crushing, grinding, labour supplies, etc.)
C. Utilities
    - Electricity
D. Purchased services

- Transportation and storage
- Communication services (postage, telephone, etc.)
- Financial services (banking, insurance, etc.)
- Other purchased services (architect, engineering and scientific, repairs and maintenance, etc.)

E. Catch-all categories

- Operating (assaying and umpire, marketing and logistics, inland freight, port costs, ocean freight, etc.)

F. Government Payments and Subsidies

- Indirect taxes (GST, PST, property taxes)
- Mining royalties

The tables were populated with expenditure information for each of construction and operations phases, and where feasible, comments were included to describe the extent to which the purchases (or hires) were expected to be locally sourced (i.e., Kamloops). Any other relevant assumptions regarding the data were gathered as well (e.g., currency and effective year). Expense categories were included separately if they represented more than 5% of total expenditures. Expense categories representing less than 5% of total expenditures were consolidated into a single category.

The Statistics Canada input-output model does not include personal and corporate income taxes in its standard outputs. For this reason, a separate set of calculations were prepared to provide supplementary estimates of these values. An appropriate methodology was reviewed and agreed upon with Statistics Canada staff.

Following initial assembly of the tables, InterGroup and KAM held a teleconference to review the data, assumptions, and steps going forward.

2.2 MODELLING

Upon approval of construction and operations expenditure data, the tables were circulated to Statistics Canada for review and incorporation into the Statistics Canada input-output model.

2.2.1 Statistics Canada Input-Output Model Background

Input-output modelling represents a quantitative technique used in economics to describe potential effects across an economy (national or otherwise) as a result of introducing some form of change (e.g., a development project). Through use of statistical information about the flow of goods and services between various economic sectors, the analysis can provide a description of the provincial and national economies for a given year.

To simplify within the context of the Project, expenditures and employment associated with the Project will have effects throughout the local, provincial, and national economies as they flow through different sectors. Purchase of one type of good or service will have flow-through effects in terms of employment

and expenditures associated with other parts of the economy. By applying a 'shock' to the model in the form of Project expenditures and employment, it is possible to determine how much additional production or economic activity might be generated by that change in output.

Outputs from the model are divided into direct, indirect, and induced effects. Direct impacts represent the initial purchase of goods and services, as well as the direct Project-related employment (including direct and contractor employment). The initial purchase of goods and services places increased demand on the suppliers of goods and services and the entire supply chain. These indirect effects arise from the increased demand for goods and services. Induced effects arise from the increased household income received by employees involved in both direct and indirect activities, who use their additional income on the typical range of household expenditures, creating another cascade of effects among all of the suppliers of household goods and services.

2.2.2 Cautions and Limitations

The following cautions and limitations are important when considering the results of the input-output model:

- **The model is linear** – The model assumes that a change in the demand for a commodity or the outputs of a given industry will translate into a proportional change in production.
- **Timelines not considered** – The model does not take into account the amount of time required for a change to happen. Changes to the economy resulting from the Project (i.e., a shock) are assumed to take place immediately.
- **No capacity constraints** – It is assumed that there are no capacity constraints with respect to labour or any other input. If an increase in the demand for labour is introduced into the model there will be a resulting increase in employment that will not be hampered by a potential lack of workers.
- **Spending of personal income** – The model assumes a consistent ratio of consumer personal income spending on goods and services versus what would be consumed by taxes or allocated into savings.
- **Snapshot** – The Statistics Canada model represents a snapshot of Canada's economy in one particular year. It is necessary to assume that the relationships between industries or sectors are stable over time so that the structure of the economy can be effectively applied to current circumstances.
- **Scope of analysis** – The Statistics Canada model, like most other input-output models, does not describe regional or local effects. The scope of the analysis is provincial and national only.

2.2.3 Currency Standardization

The data sets provided by KAM were in several different currencies (and years). In order for all reported results to be consistent and directly comparable to each other, all currency values have been

standardized to 2015 Canadian dollars ($Cdn) based on the average value of the dollar from January to mid-April). This was accomplished through the following steps:

- US dollars were converted to Canadian dollars using average daily exchange rates for 2012 (the valid date for most operational expenditures) or 2014 (the valid date for most construction expenditures). The Canadian and US dollars had the same value in 2012 while the US dollar was worth $1.105 (Cdn$) in 2014.
- Canadian dollar values for 2012 or 2014 are converted to 2015 Canadian dollar values using the most appropriate cost index for different types of expenditures. These include:
    - Average weekly construction wages in BC (up 0.8% from 2014 to 2015).
    - Average weekly wages in the resource sector in BC (including forestry, fishing, mining, and oil & gas). Note that average weekly wages in this broad sector have declined slightly since 2012, so mining wage costs for the Project area were assumed to be constant since that time.
    - Petroleum product prices, which according to the Statistics Canada price index have declined since both 2012 and 2014, are assumed to be unchanged as a contingency against future price volatility.
    - The total industrial product price index for Canada (excluding energy and petroleum products) was used as a proxy for price changes in other industrial goods and supplies (prices up 5.6% from 2012 to 2015 and 2.6% from 2014 to 2015).
    - Statistics Canada's implicit price deflator, which is the broadest possible measure of the general level of prices in the economy, was used as a proxy for the prices of all other inputs (up 3.1% from 2012 to 2015 and up 0.3% from 2014 to 2015).
    - No change was assumed in recent estimates of electricity and natural gas prices.

2.2.4 Shock Value Development

Model inputs or 'shocks' were developed with Statistics Canada using the information provided by KAM as outlined in Section 2.2.1 – Data Collection and Clarification (following standardization to 2015 Canadian dollars). For the operations shock values, the production function for *copper, nickel, lead and zinc ore mining industry* was used as a starting point and then adjusted based on the specific pattern of expenditures estimated for the Project. Each expenditure type was allocated to one or more input-output commodity classification (IOCC) codes. A weighting procedure was undertaken in cases where figures had to be allocated to more than one code.

For the construction shock values, two shocks were consolidated. The first shock was the results from a shock on intermediate inputs (i.e., goods and services used in construction) using the production function for *other engineering construction industry*. The second shock was a shock on gross fixed capital formation (i.e., to account for the purchase of machinery and equipment) using the commodity pattern for investment related to the *mining and quarrying industry*.

3.0 CALCULATION OF TAXES

The model does not provide estimates of personal or corporate income taxes. An approach to calculating this data was developed through consultation with Statistics Canada. Key steps in the process were as follows:

- Total personal income was based on estimates from the Input-Output Model of wages and salaries and labour income of the unincorporated sector. These estimates are provided for British Columbia and all other provinces and territories (based on the income earned through indirect and induced activities).
- Average federal and provincial tax revenues as a percentage of personal income are reported by Canada Revenue Agency based on actual tax returns. Effective tax rates for BC were 10.9% for federal tax and 4.6% for provincial tax, with slight variations across jurisdictions within Canada. Note that while effective tax rates varied by income level, the average incomes for this Project were broadly consistent with overall average incomes across all industries so it is reasonable to use the overall average tax rates.
- Personal income taxes for both federal and provincial governments were calculated by applying the average tax rates in each province or territory to the estimated personal income in those jurisdictions.
- Corporate income tax as a share of operating surplus for Canadian corporates averaged 22.5% over the 2012 to 2014 period, as reported in corporate accounts data from Statistics Canada. An estimated 60% of corporate income taxes were federal, based on average tax rates across Canada (rates varied somewhat by province and company size as a result of substantially lower small business corporate tax rates).
- The input-output model provided an estimate of the gross operating surplus for the Project.
- Corporate income taxes for both the federal and provincial governments were estimated by applying the average level of corporate taxation to the mine's gross operating surplus.

4.0 REVIEW AND FINALIZATION OF RESULTS

InterGroup, KAM, and Statistics Canada worked cooperatively to ensure an efficient and informed approach to the modelling. Data, assumptions, and results were cross-checked at key times via conference call and email to produce high quality, replicable outcomes.

5.0 SUMMARY RESULTS

Impacts were calculated over the duration of each of the construction and operation Project phases, meaning that construction impacts were calculated in totality for the approximate three-year construction period (from commencement to plant commissioning) and operating impacts were calculated in totality

for the estimated 23-year operating life of the mine[1]. These total estimates can be converted to simple average annual impacts by dividing by the number of years in each phase.

All impacts were estimated for British Columbia and for the rest of Canada. These geographic impacts were based on the expected location of project suppliers, as well as the assumed characteristics of their supply chains stretching across the country and around the world.

The calculated economic impacts include:

- **Output** - This is the total dollar increase in expenditures in the economy, including the direct, indirect, and induced impacts. Note that output also includes the purchase of intermediate inputs that are used to produce final goods and services.
- **GDP (Gross Domestic Product)** - This is the total "value-added" generated in the economy, meaning that the value of intermediate inputs is excluded. It is consequently smaller than Output but is a better measure of the true dollar impact on the economy.
- **Employment** - Expressed as person-years of full-time-equivalent (FTE) employment. One person-year represents the amount of work that one person could do within a year-long period (assumed to be 2,000 hours). It includes direct employment on the Project (including contractors), as well as indirect and induced employment related to goods and services. Estimates for construction were provided for the entire phase. For operations, the reported employment impacts were divided by the number of years to show the estimated annual employment impact.
- **Tax Revenue** - Tax revenue was estimated for all three levels of government (federal, provincial, and local) and incorporated the full range of taxes, including income taxes, excise taxes, sales taxes, and any other special levies. Note that local tax estimates were estimated for all municipalities in BC or Canada, not just Kamloops.

5.1 CONSTRUCTION PHASE IMPACTS

The total cost of the Project construction phase is estimated at $1.54 billion ($Cdn). This is a combination of all wages and benefits paid to mine staff; all purchases of machinery and equipment; all payments to construction companies and other service providers; and all other spending on goods and services, utilities, and taxes. These estimates have been prepared for the purpose of the environmental assessment to forecast the distribution of Project construction and operations expenditures within British Columbia and the rest of Canada.

[1] The Project construction phase is defined as a two-year period for the purposes of the environmental assessment; however, the total period between the start of construction activities and plant commissioning is approximately three years (see Section 2.2.4). The construction and operations phases overlap. Since the magnitude of construction activities in the third year is much smaller than in the previous two years, the overlap does not influence the conclusions of many of the effects assessments. For the effects assessments on the Economic Growth; Labour Force, Employment, and Training; Income; Business; and Economic Diversification VCs the three-year construction phase is more relevant as these assessments are particularly influenced by Project construction workforce and expenditures. Therefore, these VCs will refer to the three-year construction phase instead of to the two-year phase.

Approximately two-thirds of all direct expenditures in the construction phase are expected to be made within BC and one-third imported from elsewhere in Canada and internationally. The majority of expenditures, estimated at slightly more than $1 billion, will be made in the Kamloops area and elsewhere in British Columbia. Some expenditures, such as specialized mining machinery and equipment, are only available from outside the province. Based on information provided by KAM, as well as industry averages reflected in Statistics Canada's Interprovincial Input-Output Model, an estimated $522 million of the direct mine construction expenditure will be for items imported from outside BC, including $323 million of international imports and $199 million of imports from the rest of Canada.

The input-output model calculates direct, indirect, and induced economic impacts. **Direct impacts** are factors associated with the initial purchases of goods and services along with direct employment on the Project, including all employees of KAM, as well as the direct employment in construction contractors, manufacturers, and various service providers that receive part of the initial $1.54 billion in expenditures.

Indirect impacts are generated among the suppliers to the directly impacted industries described earlier. There is a chain reaction as each industry that received direct spending has to increase its production (and employment), causing them to increase spending on their inputs, which increases spending on the inputs to those inputs, and so on down the production stream.

Employment generated through the direct and indirect impacts creates additional household income among the affected workers and company owners. This additional income generates **induced impacts** as the extra income is spent on a wide variety of household expenditures, supporting additional employment in household-serving industries and additional demand for all of the inputs to those industries. Retail trade (e.g., grocery and clothing stores), food services (e.g., restaurants), and personal services (e.g., hair stylists) are good examples.

The **total impacts** of the Project are the sum of the direct, indirect, and induced impacts as summarized in the table below. In addition to employment, the input-output model also provided estimates of total industry output (analogous to total revenue for all companies in the supply chain), GDP (the value-added component of the additional revenue), and tax revenue for all three levels of government. Note that even though the Project is located in British Columbia, the additional demand created for goods and services elsewhere in Canada leads to additional provincial and local taxes as companies increase sales, expand their buildings, and hire more workers in those other provinces.

The total employment impact in the Project's construction phase is 9,725 person-years of employment within BC and a further 3,715 person-years of employment in the rest of Canada. This includes 1,700 person-years in Ontario, 1,000 person-years in Alberta, 600 person-years in Quebec and about 400 person-years scattered among the other provinces.

Please note that the tax revenue figures include tax revenue estimates from the input-output model, as well as personal and corporate income tax estimates generated separately through a methodology described in Section 2.2.1.5.

Table 1: Total Economic Impacts for Project Construction Phase (Direct, Indirect and Induced Impacts; 2015 Cdn$)

Impact	Total Construction Phase	
	British Columbia	Rest of Canada
Estimated Construction Expenditure	$1.0 billion	$522 million
Total Output[1]	$1.8 billion	$820 million
Gross Domestic Product (GDP)[2]	$873 million	$409 million
Full Time Equivalent Employment (FTE)[3]	9,725	3,715
Government Tax Revenue[4]	$354 million (all taxes, Canada-wide)	
- Federal Taxes	$162 million (Canada-wide)	
- Provincial Taxes	$115 million	$40 million
- Local Taxes	$25 million	$12 million

Source: Statistics Canada Input-Output Model.

Notes:

(1) Total Output: The total dollar increase in expenditures in the economy, including the direct, indirect and induced impacts, including the purchase of intermediate inputs used to produce final goods and services.

(2) Gross Domestic Product: The total "value-added" generated in the economy after the value of intermediate inputs are removed from Total Output. It is consequently smaller than Total Output, but is a better measure of the true dollar impact on the economy.

(3) FTE (Full Time Equivalent) Employment: Expressed as person-years of full time equivalent (FTE) employment (assuming 2,000 per year). Includes direct employment (including contractors) as well as indirect and induced employment related to goods and services. Estimates for construction are provided for the entire phase.

(4) Total government tax revenues include tax revenue estimates from the input-output model as well as personal and corporate income tax estimates generated separately by InterGroup Consultants. See Section 3.0 for description of calculation methodology.

5.2 OPERATING PHASE IMPACTS

The operating life of the Project is currently estimated at 23 years. The projected average level of operating expenditures each year is $299 million, yielding total direct operating expenditures over the projected mine life of $6.9 billion.

Direct employment at the mine is projected at an average of 453 full-time equivalent positions (based on 2,000 hours per year)[2]. Total direct wages plus benefits will be nearly $62 million per year.

Total impacts, including all direct, indirect, and induced impacts, are summarized in Table 2 below. Total employment supported by the Project is estimated at 1,450 FTE positions in BC per year and an additional 540 FTE positions in the rest of Canada. The cumulative increase in BC provincial GDP is estimated at $5.1 billion over the life of the mine (average of $222 million per year), plus a total of $1.5 billion in the

[2] The economic input-output model has assumed on average 453 FTE positions are required during the operations phase of the project. For the economic modelling and assessment of economy VCs, 453 was considered conservative for the purposes of assessing estimated Project benefits. For social VCs, where projections were made on population and the assessment focused on potential adverse effects, an average annual workforce of 468 FTE positions was used. This figure was based on current workforce estimates and remains conservative. Total workforce levels may fluctuate over the 23-year period and could be as high as 500 positions.

rest of Canada (average of $67 million per year). Total tax revenue to all levels of government is estimated at $1.9 billion over the life of the mine (average of $84 million per year).

Table 2: Total Economic Impacts for Project Operational Phase (Direct, Indirect and Induced Impacts; 2015 Cdn$)

Impact	Total Operating Phase (23 years)		Annual Average	
	British Columbia	Rest of Canada	British Columbia	Rest of Canada
Total Estimated Expenditures	$6.9 billion		$299 million	
Total Output[1]	$11.4 billion	$3.3 billion	$495 million	$143 million
Gross Domestic Product (GDP)[2]	$5.1 billion	$1.5 billion	$222 million	$67 million
Full Time Equivalent Employment (FTE)[3]	33,400	12,400	1,450	540
Government Tax Revenue[4]	$1.9 billion (all taxes, Canada-wide)		$84 million (all taxes, Canada-wide)	
- Federal Taxes	$858 million		$37 million	
- Provincial Taxes	$710 million	$152 million	$31 million	$6.6 million
- Local Taxes	$160 million	$41 million	$6.9 million	$1.8 million

Source: Statistics Canada Input-Output Model.

Notes:

(1) Total Output: The total dollar increase in expenditures in the economy, including the direct, indirect and induced impacts, including the purchase of intermediate inputs used to produce final goods and services.

(2) Gross Domestic Product: The total "value-added" generated in the economy after the value of intermediate inputs are removed from Total Output. It is consequently smaller than Total Output, but is a better measure of the true dollar impact on the economy.

(3) FTE (Full Time Equivalent) Employment: Expressed as person-years of full time equivalent (FTE) employment (assuming 2,000 hours per year per position). Includes direct employment (including contractors) as well as indirect and induced employment related to goods and services. Total estimated employment impacts have been divided by the number of years to generate average annual employment estimates.

(4) Total government tax revenues include tax revenue estimates from the input-output model as well as personal and corporate income tax estimates generated separately by InterGroup Consultants. See Section 3.0 for description of calculation methodology.