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5.2.3 Climate Change

5.2.3.1 Introduction

This subsection will describe the approach and applicable regulatory framework for the assessment of the Climate Change Valued Component (VC).

5.2.3.1.1 Regulatory Framework

The *BC Greenhouse Gas Reduction Targets Act* of 2007 sets broad province-wide targets for the reductions of greenhouse gas (GHG) emission in British Columbia (BC). There are also a number of specific requirements for public sector agencies which are not applicable to the proposed Blackwater Gold Project (the Project). In 2008 several other pieces of legislation were passed that have requirements more specifically applicable to project activities. The *Carbon Tax Act* of 2008 imposes taxes on GHG emitting fuels used in BC. This will be applicable to fuel used for Project activities, although it has no direct effect on GHG emissions. The *Greenhouse Gas Reduction (Cap and Trade) Act* was also passed in 2008 and it is the authorizing Act for the *Reporting Regulation* enacted in 2009. The Reporting Regulation requires reporting of GHG emission from a wide-range of industrial activities, however primary mining is not one of those activities. Production of aluminum, copper, nickel, magnesium and lead are reporting activities, but production of gold and silver is not. Therefore is does not appear that the Project will have GHG reporting requirements under BC legislation.

Environment Canada (EC) requires GHG reporting under the National Pollutant Release Inventory (NPRI). The estimated emission of GHGs described further in this section suggests that the Project will emit more GHGs that the NPRI reporting threshold.

There are no legislative requirements in BC or federally in Canada that require mandatory GHG emission reductions.

5.2.3.1.2 Approach and Methods

The approach used for the assessment considers well-developed methodologies for estimating GHG emissions. These methods rely on equipment and operations information, which was provided by the Project design team. The number and type of equipment was obtained from the Preliminary Economic Analysis (AMEC, 2012), Fuel consumption and hours of use were provided by the AMEC engineering project team.

The equipment information for mine fleet is calculated according to BC GHG methodology (BC Ministry of Environment (BC MOE), 2013) and based on the fuel consumption information provided by the engineering project team.

The GHG from on-road vehicles are based on the emission factors (EFs) from the US EPA (United States Environmental Protection Agency) motor vehicle emission simulator model (US EPA, 2010).

GHG emission from aviation is based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2010) according to the Landing and Take Off emission factors.

GHG emissions from waste incinerators were based on the US EPA AP-42 Section 2.1 Refuse Combustion (US EPA, 2000).

5.2.3.2 Valued Component Baseline

Climate change effects are global in nature, and emissions at any one location do not necessarily have effects at that location. Therefore, a Project-specific climate change baseline was not assessed.

A comprehensive list of past, present and future project and activities located within the regional study areas for all selected VCs is presented in **Appendix 4C** and is summarized in **Table 4.3-11**. The project and activities with the potential to affect the climate change include existing forestry and transportation activities that are currently being executed in the Regional Study Area (RSA). The contribution to GHG generation by other activities present in BC and Canada is captured in the GHG emission inventories used of the assessment of potential effects presented in **Section 5.2.3.4**.

Climate change is considered a VC because of the concern for long-term effects due to increased concentrations of GHGs in the atmosphere. This concern was considered among others in the determination of climate change as a selected valued component, as described in **Section 5.2.1**. The effects of GHG emissions are world-wide, although the magnitude of these effects may vary spatially. Therefore the location of the GHG emissions doesn't influence the global effect. So it may be considered that all GHG emitting projects world-wide past, present and future, including natural emissions, interact with GHG emission from the Project. As it is not possible to assess the effects of this scope of activities, a comparison of project emissions with provincial and national emission inventories is the approach used to assess the potential impact of GHG emission from the Project on Climate Change.

No traditional or community knowledge has been considered in the assessment of potential effects on climate change, which relies largely on public information, particularly the provincial, Canadian and global GHG emission inventories.

5.2.3.3 Assessment Boundaries

5.2.3.3.1 Spatial Boundaries

The effects on climate change of greenhouse gases emitted at any point are global in nature. Therefore there is not any local or regional study area for the Climate Change VC.

5.2.3.3.2 Administrative Boundaries

There are no administrative boundaries for the Climate Change VC.

5.2.3.3.3 Technical Boundaries

The methodologies for estimating greenhouse gas emission from the project are reasonably well defined. The variability in project activities between phases and years reduces the accuracy of the estimate. However this uncertainty is ameliorated as most important greenhouse gases are long-lived in the atmosphere. The concentration of greenhouses gases due to the project is effectively a time-weighted average over many years so the effect of this technical boundary is not significant.

5.2.3.3.4 Temporal Boundaries

The temporal boundaries for the assessment are aligned with the construction, operations, closure, and post-closure phases of the Project. For the climate change assessment the emission of each phase were estimated and the emission level used for the assessment is the estimated maximum GHG emissions for the peak operating year. The emissions during construction are similar to operating emissions. The estimated GHG emission during closure and post-closure are trivial relative to operating emissions and are neglected for the purpose of this assessment.

5.2.3.4 Potential Effects of the Proposed Project and Proposed Mitigation

Moderate interactions between project components and activities and the Climate Change VC during the construction and operations phases are presented in **Table 4.3-2** (Project Component and Activity Interaction Matrix) in **Section 4**. The interactions consist on GHG emissions generated by machinery used for the construction of mine facilities and off-site infrastructure. During the operation phase the emissions will be generated largely by equipment within the mine site (hauling equipment needed for transportation of ore and waste rock), and vehicles that will mobilize personnel and transport materials along the Kluskus Forest Service Road (FSR). As described in the previous section, the Climate Change assessment uses the mine operation phase only as the assessment case as this phase has the highest GHG emissions. It is assumed that the entire construction and operation phases have GHG emissions as described below and the closure and post-closure phases have zero emissions. As can be seen in **Table 5.2.3-1** to **Table 5.2.3-4**, GHG emissions are estimated for all major project activities. Minor activities such as routine maintenance are not included as they are very small relative to construction & operation and their contribution falls within the uncertainty bound of the emission estimation methodology.

The past, present and future project and activities with the potential to affect the climate change include existing forestry and transportation activities that are currently being executed in the RSA, which utilize machinery that generate GHG emissions. Removal of trees also contributes to climate change because forests act as CO_2 sinks.

The Project will produce GHG emissions from the combustion of fossil fuels that produce carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The GHG emissions from the Project were estimated and compared to total GHG emissions for BC and Canada. GHG emissions are expressed in carbon dioxide equivalents (CO_2E). Factors for global warming potential used in

generating GHG estimates are 1 for CO_2, 21 for CH_4, and 310 for N_2O emissions (World Meteorological Organization (WMO), 2007).

The estimated GHG emissions from the Project depend on the operating parameters in place and the production level. **Table 5.2.3-5** to **Table 5.2.3-6** outline the emission factors and calculations used in the estimates. **Table 5.2.3-5** provides a summary of the maximum estimated GHG emissions from the Project. At full production, the total emissions from the Project are estimated to be 0.47 kt CO_2E/d, which is equivalent to 171.5 kt CO_2E/y. **Table 5.2.3-6** compares the Project GHG emissions estimate with the total BC, Canadian and global emission estimates. The Project operations are estimated to add 0.28% to the 2010 provincial total, 0.02% to the 2011 national total (BC MOE, 2012b; EC, 2013), and 0.0005 % to the global total (CO_2Now, 2014). **Table 5.2.3-5** provides the impact ratings for GHG emission changes due to the Project.

Table 5.2.3-1: GHG Emissions from On-Road Vehicles

	Distance Travelled (km/d)	Emission Factors (g/km)[1]			Total Emissions (t/d)				Total CO2e (kt/y)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e	
FSR									
Buses	102	759	0.02	0.00122	0.08	0.000	0.000	0.08	0.03
Light Duty Trucks	510	372	0.01	0.00095	0.19	0.000	0.000	0.19	0.07
Light Duty Vehicles	340	168	0.00629	0.00024	0.06	0.000	0.000	0.06	0.02
Mine Access Road									
Buses	102	759	0.02	0.00122	0.08	0.000	0.000	0.08	0.03
Heavy Duty Vehicles	510	1094	0.02	0.00112	0.56	0.000	0.000	0.56	0.20
Light Duty Vehicles	340	168	0.00629	0.00024	0.06	0.000	0.000	0.06	0.02
Airport Access Road									
Light Duty Vehicles	12	168	0.00629	0.00024	0.00	0.000	0.000	0.00	0.00
Total					**1.02**	**0.00**	**0.00**	**1.02**	**0.37**

Note: [1] US EPA Motor Vehicle Emissions Simulator (MOVES)

Table 5.2.3-2: GHG Emissions from the Mine Fleet

	Fuel Consumption (L/h)	Emission Factors (g/L) [1]			Total Emissions (t/d)				Total CO2e (kt/y)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e	
Major Equipment	5887	2556	0.15	1.1	361.13	0.021	0.155	409.76	149.56
Construction Equipment	623	2556	0.15	1.1	38.22	0.002	0.016	43.36	15.83
Total					**399.35**	**0.023**	**0.172**	**453.12**	**165.39**

Note: [1] BC MOE (2013)

Table 5.2.3-3: GHG Emissions from Aviation

	Cycles (LTO/d)	Emission Factors (kg/LTO) [1]			Total Emissions (t/d)				Total CO2e (kt/y)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e	
727-200	5887	4610	0.81	0.1	9.22	0.000	0.000	9.32	3.40
Total					**9.22**	**0.00**	**0.00**	**9.32**	**3.40**

Note: [1] IPCC (2006)

Table 5.2.3-4: GHG Emissions from the Incinerators

	Mass Incinerated (t/h)	Emission Factors (kg/tonne) [1]			Total Emissions (t/d)				Total CO2e (kt/y)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e	
Incinerators (3)	0.27	985	0.000	0.046	6.38	0.000	0.000	6.48	2.36
Total					**6.38**	**0.000**	**0.000**	**6.48**	**2.36**

Note: [1] US EPA (1995)

Table 5.2.3-5: GHG Emissions from the Project

Source	Total CO_2E Emissions (kt/y)
On-Road Vehicles	0.4
Mine Fleet	165.4
Aviation	3.4
Waste Incinerators	2.4
Total	**171.5**

Note: kt/y = thousand tonnes per year

Table 5.2.3-6: Comparison of Project GHG Emissions

Project GHG Emissions Comparison	Total GHG Emissions (kt CO_2E/y)
BC GHG Emissions (2010)	61,500
Canada GHG Emissions (2011)	702,000
Global GHG Emissions (2013)	36,700,000
Project Estimated GHG Emissions	171
Project GHG Emissions as a Percentage	**Percentage of Total GHG Emissions (%)**
Percentage of BC Total	0.28
Percentage of Canadian Total	0.02
Percentage of Global Total	0.0005

Note: CO_2E = carbon dioxide equivalent units, which convert non-CO_2 species (CH_4 and N_2O) using global warming potentials; GHG = greenhouse gas; kt/y = thousand tonnes per year
Source: BC total is from BC MOE, 2012; Canadian total is from EC, 2013; Global Total is from CO_2Now, 2014

5.2.3.4.1 Mitigation

The Project has been designed to minimize GHG emissions on-site by connecting to the BC Hydro energy grid rather than having on-site diesel generators. Buses are used to transport workers to the site, minimizing use of large numbers of personal vehicles. Federal legislation specifying GHG emission levels for vehicles is in place and Project vehicles will comply with the new federal GHG emission requirements for vehicles.

Table 5.2.3-7 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on climate change during mine site development.

Table 5.2.3-7: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Climate Change during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Climate Change	Construction	The Project has been designed to minimize GHG emissions on-site by connecting to the BC Hydro energy grid rather than having on-site diesel generators	High
	Construction, Operations, Closure, Post-Closure	Buses are used to transport workers to the site, minimizing use of large numbers of personal vehicles	High
		Federal legislation specifying GHG emission levels for vehicles is in place and Project vehicles will comply with the new federal GHG emission requirements for vehicles	High

Note: GHG = greenhouse gas

In summary, a low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective. The effectiveness of mitigation measures was rated to be high, because the proposed mitigation measures have been proven effective in other mining projects.

5.2.3.5 Residual Effects and their Significance

The determination of significance of residual project effects on Climate Change is presented in **Table 5.2.3-8**. The amount of GHG emissions relative to provincial emission is non-trivial, but the potential for distinguishable effects when compared to national or global emissions is negligible. Effects of the Project on the air quality regional study area are anticipated to be indistinguishable from the natural range of variability. Therefore the residual effects of GHG emissions on climate change are determined to be not significant (negligible). Because the assessment considered the operations phase which is the worst case scenario for GHG emissions the residual effects for all other project phases are also determined to be not significant (negligible).

Table 5.2.3-8: Determination of Significance of Residual Project Effects on Climate Change

Category	Rating	Rationale
Context	Low	There is uncertainty in climate change effects and policy, and this VC is unlikely to be sensitive to effects of the Project.
Magnitude	Negligible	Emissions generated by the Project are of a negligible scale compared to global emissions.
Extent	Global	GHG emissions are a potential global issue due to the likelihood of accelerated climate change.
Duration	Chronic	Climate changes are will extend beyond the post-closure phase of the Project
Frequency	Continuous	Project GHG emissions are continuous for the life of the Project, post-closure emissions are negligible.
Reversibility	Irreversible	The reversibility of climate change is uncertain therefore it is conservatively assumed to be non-irreversible.
Likelihood	Moderate	Differences of opinion exist regarding the magnitude of the global temperature change and associated climate implications.
Confidence in Likelihood Determination	Moderate	It is not anticipated to be possible to determine climate change effects directly caused by the Project.
Significance Determination	Non-Significant (negligible)	Indistinguishable from the natural range of variability.
Confidence in Significance Determination	Moderate	Climate change science is highly uncertain. There is no existing methodology for providing climate change effect predictions over small geographic areas and short timeframes.

Note: GHG = greenhouse gas

5.2.3.6 Cumulative Effects

A Cumulative Effects Assessment (CEA) for climate change has not been considered, as adverse residual effects of the Project are determined to be Non-Significant (negligible).

5.2.3.7 Limitations

The science of predicting global climate change is highly uncertain and therefore any attempt to ascribe effects of any activity or project within that framework is even less certain. The methodology of estimating GHG emission is relatively robust, but assuming peak emissions for most of the project duration is highly conservative. Regardless, this methodology is commonly used to ensure the conservativeness of the assessment and minimize the potential for false-negative conclusions.

5.2.3.8 Conclusion

The conclusion reached is that the effect of the Project on the Climate Change VC is Not Significant negligible. There is no proposed monitoring or follow-up for climate change, other than the required reporting of GHG emissions under federal legislation.