6 Environmental Assessment Methodology

6.1 Regulatory Context

The impact assessment methodology addresses the requirements of the *Yukon Environmental Assessment Act* (YEAA) and is consistent with the Environmental Assessment (EA) Report Guidelines for the proposed Wolverine Project (Yukon Executive Council Office [ECO] 2005). As outlined in the Guidelines and as per future regulatory requirements under *Yukon Environmental and Socio-Economic Assessment Act* (YESAA), it also takes into account socio-economic effects of the project, alternatives to the project, and alternative ways of undertaking the project, and it identifies follow-up programs.

It is based on a systematic scoping of the Wolverine Project and its environmental, social, economic and cultural effects, based on consultation with community members, affected First Nations and government regulators, as well as scientific research and technical analyses. The assessment identifies all potential effects, but focuses in particular on representative valued ecosystem and cultural components (VECCs) that serve as sensitive indicators of project effects on the ecological, socio-economic and cultural environment. The general sequence and approach of the effects assessment are described in the following sections.

6.2 Define the Scope of the Assessment and Select VECCs

Guidance on the scope of the assessment was provided in EA Report Guidelines prepared by the responsible authorities (RAs) identified for the project. The Yukon departments of Energy, Mines and Resources and the Executive Council Office have identified themselves as RAs. These Guidelines were based on the Wolverine Project Description Report (Expatriate 2004) and public and government review comments on the Project Description. The EA Report Guidelines were also subject to public and regulatory review and they reflect the comments received.

The scope of the assessment was further refined through correspondence and meetings with regulators, planning and resource management agencies, and community members in the project area (Section 5). Environmental, socio-economic and cultural information for the project area (i.e., existing data and results of field surveys) was thoroughly reviewed and evaluated to define the scope of the assessment (Sections 7.1 through 7.15). Workplans for biophysical assessments were submitted to the project Technical Committee for review and approval (Yukon Zinc Corporation [YZC] 2005a, 2005b). The Ross River Traditional Knowledge Oversight Committee provided review and input to ensure the integrated traditional knowledge (Section 5 and Section 7.12).

Project elements to be included in the assessment are listed in detail in Section 2.2 of the EA Report Guidelines. This assessment examines all project components and phases listed at the feasibility stage level of design. Alternative designs and facility site locations are described along with the technical, economic and environmental rationale for selection of preferred alternatives (e.g., infrastructure and access route locations).

The EA Report Guidelines provided a list of environmental components and parameters which guided the selection of VECCs for detailed analysis in this report. Based on the

consultation process, traditional knowledge, technical information and the baseline studies, the list of VECCs was refined based on one or more of the following criteria:

- sensitive to project effects
- important to local communities and resource users
- important nationally or internationally (e.g., designated for specific management or protection measures by recognized national or international authorities)
- indicators of effects on related resources and broader systems (e.g., ecological, economic, social, cultural)
- key linkages in pathways between the project and effects on VECCs (e.g., sediment quality, benthic and periphyton communities)

Where possible, evaluation of project effects on VECCs is based on predicted changes in measurable parameters, and strives to characterize the effects of those changes on the long-term sustainability of the VECC.

The VECCs selected for assessment of the project are:

- Climate – temperature, precipitation, snowpack, wind, humidity, solar radiation
- Ambient air quality - particulate matter, SO_2, NO_X , CO, greenhouse gases
- Terrain, surficial geology and soils – key terrain features, surficial materials, permafrost, soils with high erosions potential, terrain hazards, sensitive soil types
- Surface water hydrology – runoff, flood flows, low flows, evaporation, snowmelt
- Surface water quality – total suspended solids, pH, conductivity, alkalinity, sulphate, metals, nitrogen compounds
- Sediments – metals
- Groundwater – quality (pH, conductivity, alkalinity, sulphate, metals, nitrogen compounds) and flows
- Periphyton – abundance (chlorophyll a), species composition
- Benthic invertebrates – abundance, species composition
- Fish – fish habitat, metals in fish tissue
- Vegetation – rare plants, uncommon vegetation communities, mature and old forest, wetland and riparian vegetation, alpine vegetation, productive berry producing areas (traditional use), productive forest, metals levels in vegetation
- Wildlife – woodland caribou, moose, thinhorn sheep, grizzly bear, lynx/hare predator/prey relationship, marten, trumpeter swan, beaver, song bird community
- Land use – settlement and transportation infrastructure, mineral and oil and gas activity, forestry and agriculture, non-traditional fishing and hunting, trapping, tourism and non-consumptive recreation, guide-outfitting, protected areas
- Heritage resources – historical, archaeological and palaeontological sites
- Socio-economic conditions – employment opportunities, contract and business opportunities, community health, traffic interruption/safety, maintenance of traditional way of life

6.3 Establish Spatial and Temporal Boundaries of the Assessment

Temporal and spatial boundaries for the effects assessment are defined by the characteristics of the project and the VECC being assessed. These boundaries encompass time periods and areas during and within which the VECCs are likely to interact with or be influenced by the project. Spatial boundaries vary according to the nature of the VECC (e.g., air quality versus fish) but generally are defined in terms of:

- a local study area (LSA), where project effects can be predicted with a reasonable degree of accuracy and confidence and impacts are likely to be most concentrated
- a regional study area (RSA) where, depending on conditions (e.g., seasonal conditions, habitat use, more intermittent and dispersed project activities), project effects may be more wide reaching. The definition of the RSA may take into consideration factors such as:
    - habitat for sensitive life stages
    - wildlife migration routes and ranges
    - areas of potential effects from dispersed, intermittent project activities, such as, air transport, road haul
    - areas within which there is potential for cumulative effects with other projects

Temporal boundaries for project-related effects are defined in terms of the project phases:

- baseline – covers ecological, physical and human-related characteristics of the environment, as characterized in 2005, prior to initiation of the construction phase
- construction – includes all activities associated with project construction and before commencement of ore processing (mill start-up) such as:
    - access road construction
    - mobilization of equipment and supplies to the site by air and road
    - construction of mine site facilities, including camp, infrastructure, ore stockpile, mill, temporary waste rock storage area, tailings impoundment, water treatment plant, water management facilities (diversions, settling ponds, seepage collectors etc.) and mining activities up to commencement of ore processing
    - camp operations and personnel transport during construction
- operations – includes ongoing mining and processing of ore to produce concentrate, tailings disposal, water treatment plant operations and effluent disposal, operation of water management facilities, camp operations, transport of concentrate, transport of supplies and personnel
- decommissioning – includes all activities to decommission minesite facilities and remove equipment and materials from the site, recontour the site and restore drainage patterns to stable long term conditions, stabilize the mine and wastes (tailings and waste rock) for safe long term maintenance, and implement the final site reclamation procedures to prevent erosion and restore vegetation cover where feasible
- closure – refers to conditions that will exist on the site after the site is abandoned and revegetation is complete

Temporal boundaries are also defined for the cumulative effects assessment, spanning baseline to a point in the future, within which project effects on VECCs are predicted to overlap with effects of other projects or activities. Spatial and temporal boundaries for each VECC are detailed in respective report sections.

6.4 Evaluate and Characterize Residual Project Effects

Potential project impacts on each environmental component are identified for each project phase, as relevant. Mitigation measures to avoid or minimize impacts of these interactions are also identified. These measures may include:

- project design standards
- generic environmental protection measures and protocols
- site-specific measures (i.e., timing of activities in relation to local conditions, site-specific impact mitigation procedures)
- contingency measures to address the possibility of unexpected or accidental events that could affect the environment

Residual project effects on the environment; that is, effects that are predicted to persist even with the prescribed mitigation measures, are identified. These residual effects are characterized as fully as possible, for each project phase, based on:

- direction of effect, that is, positive, adverse, or neutral
- magnitude of the effect, that is, the amount or proportion of a value, resource or species affected, quantified where possible in the context of the status or resilience of the VECC in the RSA
- geographic extent of the effect, quantified where possible, to reflect the influence of geographic extent of the effect on sustainability of the VECC in the RSA
- duration and frequency of the effect on the VECC, characterized where possible to reflect the influence of effect duration on sustainability of the VECC in the RSA
- reversibility of the effect or the ability of the VECC to recover to pre-disturbance conditions during or following project activities
- likelihood of occurrence, which is a characterization of the investigators confidence that the effect on the VECC will manifest as predicted, based on the status of scientific or statistical information, experience and/or professional judgment of the author
- the ecological and social context of the effect, that is, a discussion of the ecological or social consequences of the predicted effect (e.g., Is a critical life stage of a species affected, or an important link in the food chain? Is there an effect on traditional activities?)

Where possible, documented quantitative thresholds describing levels of impact on VECCs (e.g., magnitude/extent/duration of disturbance that will displace animals from habitats or affect productive capacity; capacity of physical and social infrastructure of settlements affected by development) are used to assess the relative levels of effects. Section 7 describes the assessment of effects of project facilities and routine activities on

each VECC. Section 8: Accidents and Malfunctions describes assessment of the effects of potential accidents and malfunctions.

6.5 Define the Scope of the Cumulative Effects Assessment

Scoping of the cumulative effects assessment involves identification of other projects, activities or disturbance features in the vicinity of the project, including past, present and future projects, which may have effects that could combine with the residual project effects to increase the level of effect on VECCs. Past and present projects are identified from:

- historical records of activities
- spatial information identifying existing disturbance features (clearing, ground disturbance, facilities sites, roads and other linear disturbance features, etc.)
- traditional knowledge
- current land tenures
- knowledge of ongoing activities (access development, exploration activities)

Foreseeable future projects include existing activities known to be ongoing in future years (permanent roads, existing mines), or new projects that have embarked on a formal approval process (e.g., documentation or applications for permits or regulatory approvals have been submitted or a project description has been formally released).

Study areas for cumulative effects assessments are specific to each VECC and typically correspond to the RSA defined for each VECC. In some instances (e.g., wide ranging wildlife VECCs), additional areas may be considered to address potential cumulative effects on VECCs (e.g., wildlife migration routes).

A list of existing tenures and activities in the southeastern Yukon that could potentially contribute to cumulative effects is provided in the Wolverine Project Inclusion List (Table 6.1-1). Locations tenures are shown on maps in the land use and land tenure section (Section 7.11; Figures 7.11-3 through 7.11-7). The scope and rationale for cumulative effects assessment for each VECC are described in Section 7. Projects in Table 6.1-1 are referenced as appropriate to individual assessments.

6.6 Evaluate and Characterize Cumulative Environmental Effects

The main question the cumulative effects assessment seeks to address is “will the project contributions to regional cumulative environmental effects have the potential to measurably change the health or sustainability of the resource in question?” (Hegmann et al. 2002).

To provide some sense of scale regarding the project contributions to cumulative effects, the assessment compares:

- the additive effect of the project on VECCs in relation to the cumulative effects of development to date
- the additive effect of the project in relation to the effects of development to date in combination with the effects of foreseeable future development

Specific methods for assessment of cumulative effects on each VECC are provided in Section 7. Mitigation measures specific to management of cumulative effects, typically government led or jointly coordinated mitigation approaches applied at a regional level, are identified where appropriate.

6.7 Determine Significance of Residual Project and Cumulative Effects

The significance of the residual project effects and contributions to the cumulative effects on VECCs and their sustainability over time is characterized as fully as possible building on the characterization of effects direction, magnitude, extent, frequency, reversibility, likelihood of occurrence, and ecological and social context. Where possible, quantitative thresholds describing levels of impact on VECCs are used to evaluate the significance of predicted effects (e.g., receiving water quality guidelines, documented average values and variability for environmental parameters, documented thresholds for core security habitat, road density affecting habitat suitability, design capacity of existing physical or social infrastructure, national averages for socio-economic indicators, etc.). Effects also are characterized in terms of compatibility with resource management objectives and priorities for the area. In addition, the professional judgment and experience of assessors is used to characterize the level of impact and effect on the sustainability of the affected component. Residual project effects and contributions to cumulative effects are described in terms of their influence in moving a VECC towards or past a sustainability threshold. The rationale and criteria for characterization of significance of impacts on each VECC are fully documented in the subsequent sections.

6.8 Identify Monitoring and Follow-up Programs

Based on the findings of the assessments, the requirements for follow-up work to improve predictive capabilities or understanding of baseline conditions are identified. Monitoring programs to be implemented throughout the life of the project, to evaluate the effectiveness of mitigation measures and guide subsequent management actions, are also identified.

Table 6.8-1 Wolverine Project Inclusion List

Activity	Tenure Holder or User(s)	Location	Status	Notes
INDUSTRIAL – Mines				
Past/Present Producer- tungsten	North American Tungsten Corporation Ltd.	Cantung Mine: 300 kilometres NE of Watson Lake on NWT/Yukon border	Closed 1986; Reopening August 2005	Reopening of mine expected in August 2005 with first shipment anticipated in September 2005. A total of ~170 employees will be working on two rotating work crews. Camp consists of a 3-level 80-man bunkhouse. Annual concentrate production capacity of 400,000 metric tonne units. Two new Caterpillar power generators are now on site.
Past/Present Producer- coal	Cash Minerals Ltd.	Whitehorse Coal Mine; 30 km SW of Whitehorse	Re-licensed in 2004	1986-88: produced 4606 tonnes. 2004: re-licensed.
Past Producer - coal		Whiskey Lake Mine; Ross River	Inactive	1986-89: produced 87,000 t and 1992: produced 14,000 t.
Past Producer - coal	Archer, Cathro and Associates (1981) Ltd.	Tantalus Mine; Carmacks	Inactive	Underground operation closed 1978
Past Producer- lead/zinc		Sa Dena Hes Mine	Inactive	Closed 1992
Past Producer- gold		Ketza River Mine	Inactive	Closed 1990
Past Producer- lead/zinc		Faro Mine	Inactive	Closed 1992
Past Producer- lead/zinc		Grum Mine	Inactive	Closed 1996
Past Producer- lead/zinc		Vangorda Mine	Inactive	Closed 1993
Past Producer- gold		Mount Nansen Mine	Inactive	Closed 2000
Past Producer- gold	Tagish Lake Gold Corp.	Mt. Skukum Mine	Mine closed; current exploration	Resources of 109,000 tonnes indicated during past mining operation. Closed 1988.
Past Producer- gold		Venus Mine	Inactive	Closed 1971
Mineral Exploration – copper, cobalt, gold	Pacific Ridge Exploration Ltd.	Fyre Lake Property; 160 km northwest of Watson Lake; 30 km southeast of Wolverine	On hold - seeking joint venture	169 claims covering 85 km^2; preliminary scoping and metallurgical testwork have been completed

Table 6.8-1 Wolverine Project Inclusion List (cont'd)

Activity	Tenure Holder or User(s)	Location	Status	Notes
INDUSTRIAL – Mineral Exploration				
Mineral Exploration – copper, minor gold, silver, cobalt	Yukon Zinc Corp.	Ice Property; 60 km east of Ross River	Inactive	1105 claims covering 22,000 ha; estimated mineral resource of 4,561,863 tonnes
Mineral Exploration – zinc, lead, silver	Atna Resources Ltd.	Wolf Property; 90 km southeast of Ross River; 65 km from Wolverine Project	On hold	33 mineral claims covering 689 haDiscovery of East Slope Zone 1200 m east of the Wolf deposit has enhanced potential of property
Mineral Exploration – zinc, lead, copper, gold	Teck Cominco Ltd.	Kudz Ze Kayah Project; 35 km west of Wolverine	Planning/Evaluation ?	Indicated resource of 11,300,000 tonnes of mineral resources
Mineral Exploration – silver, lead, zinc	Tintina Silver Mines Ltd.	Tintina Property; 160 km northwest of Watson Lake		
Mineral Exploration-tungsten	North American Tungsten Corporation Ltd.	Three ACE claim group; approximately 35 km southwest of the CanTung mine.	Active exploration	Work on the property will include line cutting, soil sampling and geophysical surveys
Mineral Exploration - gold	Ross River Minerals Inc.	Tay-LP Property; 50 km SSW of Ross River	Active exploration	Property is 413 contiguous mineral claims covering ~8,600 ha. Exploration has occurred from 1984. In 2004, 9 drill holes were completed, totaling 1,001m. More drilling is planned for 2005.
Mineral Exploration - gold	ASC Industries/Regent Ventures	Red Mountain	Active exploration	Commenced: 5000 feet of drilling, completed; 5 holes were drilled for a total of 2,115 feet; 43 claims. The area being explored is equal to approximately 7,500 hectares. Upgrades to the road were completed, allowing for the installation of heavy drill equipment and establishment of a permanent base camp
Mineral Exploration - gold, silver	Tagish Lake Gold Corp.	Skukum Creek (Mt. Reid)	Active exploration	High grade gold and silver prospect preparing to drill winter 2005

Table 6.8-1 Wolverine Project Inclusion List (cont'd)

Activity	Tenure Holder or User(s)	Location	Status	Notes
Mineral Exploration - gold, silver	Freegold Resources	Grew Creek; 40 km west of Faro	Active exploration	Several drill holes completed in 2004. Additional drill testing, bulk sampling and geophysics have been recommended for 2005. A diamond drill program is now in progress
Mineral Exploration - gold	Stratagold Corp./Northgate Minerals Corp.	Hyland Gold; 72 km NE of Watson Lake	Active exploration	2005 field work will consist of four or five drill holes to test geochemical and geophysical targets south and east of the currently known gold mineralization.
Mineral Exploration - coal	Cash Minerals Ltd.	Division Mountain; 90 km NW of Whitehorse	Advanced exploration	Indicated resource deposit of 52.9 million tonnes of coal. Feasibility studies planned for 2005.
Mineral Exploration - tungsten	North American Tungsten Corporation Ltd.	MacTung Property; located in MacMillan Pass on the Yukon/Northwest Territories border, ~ 100 miles north of CanTung Mine	Active exploration	20-hole 6,000m drilling program being conducted
INDUSTRIAL – Major Mineral Deposits				
Deposit - zinc, lead		Matt Berry Property		
Deposit- lead/zinc		MacMillan		
Deposit- lead/zinc		Mel Group; 80 km ENE of Watson Lake		
Deposit- tungsten		Logtung		
Deposit- silver		Silvertip		
Deposit- silver		Hart		
Deposit- lead/zinc		Logan; 108 km NW of Watson Lake		
Deposit- lead/zinc		Howard's Pass		
Deposit- tungsten		Bailey		
Deposit- tungsten		Risby		
Deposit- silver		Groundhog		
Deposit- other		Stormy		
Deposit- tungsten		JC		
Deposit- silver		Logjam		
Deposit- lead/zinc		Grizzly		

Table 6.8-1 Wolverine Project Inclusion List (cont'd)

Activity	Tenure Holder or User(s)	Location	Status	Notes
Deposit- lead/Zinc		Swim		
Deposit – coal		South Tantalus; Carmacks		Past exploration inferred 780 633 t
Deposit - coal	Almaden Minerals Ltd.	Sulpetro	Inactive; re-licensed 2004	
Deposit- gold		Brown McDade		
Deposit- other		Marlin		
Deposit- gold, silver	Tagish Lake Gold Corp.	Goddell Gully		2004 drilling program indicated resources of 178,000 oz. gold accessible by adit
Deposit - zinc, lead	Breakwater Resources Ltd. and Hunter Dickinson Inc.	GP4F Property		1,500,000 in mineral reserves
Deposit - zinc, lead		Matt Berry Property		
Deposit – jade		King Arctic	Inactive	
INDUSTRIAL – Oil and Gas				
Pipeline – gas	Alaska North Slope producers	Alaska Highway Pipeline Project (AHPP) runs from Prudhoe Bay, Alaska along the Alaska Highway, through northeast BC to the Alberta border.	Proposed – in the planning/approval stages: estimated that the AHPP will be on stream in 2012-2015	TransCanada filed an application under the Alaska Stranded Gas Development Act. The company will now proceed with processing its application with the State of Alaska for a right-of-way across State lands.
PROTECTED AREAS				
Territorial Park	Yukon Department of Environment	Coal River Springs Territorial Park: located east of Watson Lake	Existing	This park is a 16 square kilometre area that encompassing the springs. It was established to an ecological reserve to protect its fragile tufa formations.
National Park - proposed	Parks Canada	Wolf Lake (Gooch Aa) – this area is outside the Land Use RSA	Proposed - under Yukon Protected Area Strategy	If support by the communities reached, a feasibility study will be conducted
First Nations Interim Protected Areas	Yukon First Nations	Various areas throughout the Land Use RSA, including the southeast side of Wolverine Lake, Little Wolverine Lake and Little Jimmy Lake	Temporarily Protected	These lands are protected for future First Nations Settlements.

Table 6.8-1 Wolverine Project Inclusion List (cont'd)

Activity	Tenure Holder or User(s)	Location	Status	Notes
HUNTING, OUTFITTING, TRAPPING				
Game Management Zone (GMZ)	Yukon Department of Environment	GMZ 1 (subzone 1116, 1117, 1121 and 1122) and GMZ10) (subzone1007, 1008, 1009)	Existing	These areas are used to regulate hunting in the territory and for the management of wildlife species.
Outfitter Concessions (OCs)	Ken Reeder of Teslin Outfitters Ltd	OC#20	Existing	These are legal boundaries that define an area where the holder of the concession has the exclusive right to outfit non-residents for the purpose of hunting big game animals and game birds.
Registered Trapping Concession (RTC)	Ross River Dena Council	Group trapline (RTC 249-25252, 255, 259 and 405)	Existing	A RTC is a parcel of land on which the holder is given exclusive rights to harvest furbearing animals.
RECREATION AREAS				
Campgrounds	Yukon Government	Frances Lake Government Campground; west side of Frances Lake adjacent to the Robert Campbell Highway	Existing	24 campsites
Other Campgrounds	Various	Simpson Lake, Watson Lake, Lapie Canyon and Faro	Existing	
Lodges	Andrea and Christoph Altherr	Frances Lake Wilderness Lodge; south end of Frances Lake	Existing	Consists of a main log cabin (with a kitchen, dining room, library and living room) and five log guest cabins
Other Lodges	Anita LaFave	Inconnu Lodge; McEvoy Lake	Existing	
Trails		TransCanada Trail and Canol Heritage Trail	Existing	Hiking and snowmobiling
COMMUNITIES				
Ross River		Junction of Canol Road and	Unincorporated community	Population 327
Watson Lake		Junction of Alaska Highway and Robert Campbell highways	Incorporated as a town in 1984	Population 1553
Faro		70 km west of Ross River, and 120 km east of Carmacks	Town (incorporated?)	Population 360
Whitehorse			City	Population of 22,673; Capital of Yukon Territories