ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

EXECUTIVE SUMMARY

SUBMITTED TO
TENKE FUNGURUME MINING S.A.R.L. (TFM)
DEMOCRATIC REPUBLIC OF THE CONGO

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INTRODUCTION

This executive summary provides an overview of the environmental and social impact assessment (ESIA) for the Tenke Fungurume Mining S.A.R.L. (TFM) copper-cobalt mining project in the Democratic Republic of the Congo (DRC). It summarizes the five ESIA volumes, which include the Introduction and Project Description (Volume A), Baseline (Volume B), Impacts and Cumulative Effects Assessments (Volume C), Environmental and Social Management System (Volume D) and Appendices (Volume E). An ESIA and a feasibility study have been prepared to determine whether it is environmentally, socially, technically and economically feasible to complete the project.

Project Introduction

TFM, a company incorporated under the laws of the DRC was formed for the purpose of developing the deposits of copper, cobalt and associated minerals under mining concession nº 198[1] and mining concession nº 199[2] granted to TFM in 1996 at Tenke and Fungurume in Katanga Province. Currently, TFM's shareholders are the state-owned Congolese company, La Générale des Carrières et des Mines ("Gécamines"), which owns 17.5 percent of TFM, and Lundin Holdings Ltd. (LHL), a Bermuda company, which owns 82.5 percent of TFM. Phelps Dodge Corporation (PD) indirectly holds a 70 percent interest in LHL and is accordingly the majority shareholder in TFM.

The concession is located approximately 180 kilometers northwest of the provincial capital of Lubumbashi and includes the towns of Tenke and Fungurume. The Tenke Fungurume copper and cobalt deposits are part of the Central African Copperbelt. The ore comes to the surface in a series of hills within the concession. TFM proposes to mine the Kwatebala, Goma and Kavifwafwaulu (Fwaulu) ore bodies over more than an initial 20 year period, and to process ore for more than 40 years, during which up to 115,000 tonnes of copper cathode and 8,000 tonnes of cobalt cathode/cobalt hydroxide (with some flexibility to produce an additional 2,000 tonnes of cobalt hydroxide) will be produced each year. The ore has an average grade of over 2 percent copper and near 0.3 percent cobalt. There is a strong possibility that the project will expand at a future date to mine other mineralized areas on the concession, including the Fungurume ore bodies. Expansion could achieve a copper production rate of 400,000 tonnes or more per year.

PD is one of the world's leading producers of copper and operates on five continents. It has a strong safety and environmental record. Many of its operations are certified under the International Organization for Standardization (ISO) 14001 Standard for Environmental Management Systems. PD is also known for ensuring that local communities benefit from its projects.

[1] Renumbered nº 123 by the Cadastre Minier Certificat d'Exploitation nº CAMI/CE/940/2004 dated November 3, 2004; pending division, renewal, and renumbering by the Ministère des Mines.

[2] Renumbered nº 159 by the Cadastre Minier Certificat d'Exploitation nº CAMI/CE/941/2004 dated November 3, 2004; subsequently divided and renumbered nº 159, nº 4728, and nº 4729 by the Ministère des Mines through Ministerial Decree dated July 7, 2006.

Project History

Mining activity has occurred in the Tenke Fungurume region for thousands of years. Archaeological evidence indicates that mining occurred over 200,000 years ago and that smelting of copper was practiced on the concession several thousand years before present. During the Iron Age, between 500 and 2,000 years ago, much mining and smelting activity took place in the Katanga Province.

Modern drilling first took place in 1918 by the Union Minière de Haut Katanga, but no mining took place. In 1970, the Société Minière de Tenke Fungurume (SMTF) and Gécamines were awarded the concessions and began to study the feasibility of constructing a mine. A fair amount of infrastructure including access roads was constructed. This effort, however, was abandoned because of economic and political issues.

TFM initiated a feasibility study and impact assessment in the late 1990s but had to postpone activities in 1999 due to civil war. Studies resumed in 2004 and the work accelerated after the signing of the Amended and Restated Mining Convention (ARMC) with the DRC government in September 2005.

Artisanal3 mining has occurred on the concession for many years. This activity increased substantially in recent years due to the rise in copper and cobalt prices. As many as 3,000 workers mined the Kwatebala, Goma, Fungurume and other hills for heterogenite ore containing cobalt, as well as malachite ore containing copper. All digging was done by pick and shovel, employing potentially unsafe work practices and little evident regard for the environmental impact. TFM discouraged artisanal mining on the concessions in October 2005, following signing of the ARMC. This was done through control of entry and exit from the concession. Currently, very little if any artisanal mining is being conducted in the concession.

Legal and Policy Framework

Laws of the DRC as well as World Bank Group policies and guidelines will apply to the construction, operation and closure of the TFM project. The World Bank Group policies and guidelines are internationally accepted environmental and social standards for major mining projects as outlined in the Equator Principles. The DRC civil code applies to the project as limited by the Amended and Restated Mining Convention (ARMC), issued on September 28, 2005. Additionally, the Mining Law of 1981 continues to apply to the project rather than the New Mining Code of 2002 (NMC).

[3] The term 'artisanal' is widely used to distinguish between non-mechanized and mechanized production techniques. In the economic development literature 'artisanal' has most often been applied to the fisheries and mining sectors. All artisanal mining conducted in the Tenke Fungurume concession area is unauthorized and illegal.

Under the ARMC, TFM has committed to undertake its activities in compliance with environmental standards internationally accepted as good mining practice as far as these may be applied in the DRC. TFM also commits to design, build and operate the facilities aligned with a Quest for Zero philosophy, to obtain all necessary permits and authorization to proceed with the project and to comply with applicable international treaties and agreements that the DRC is signatory to. The latter include treaties that protect biodiversity, endangered species, various ecosystems and monitoring of greenhouse gas emissions. Quest for Zero is a philosophy embraced by Phelps Dodge Corporation, embodying the goals of designing and operating its facilities with the goal of having zero safety/environmental incidents or illnesses.

The project will be planned and conducted in accordance with the Equator Principles. These principles represent a formal agreement among a number of commercial banks to use the International Finance Corporation's (IFC) Performance Standards. These standards include the following eight categories:

- Social and environmental assessment and management systems.
- Labor and working conditions.
- Pollution prevention and abatement.
- Community health, safety and security.
- Land acquisition and involuntary resettlement.
- Conservation of biodiversity and sustainable natural resources.
- Indigenous peoples and natural resource dependent communities.
- Cultural heritage.

The ESIA includes a table of conformance that indicates where each requirement under the IFC standards is addressed in the report.

TFM has its own mining policies, which include:

- Safety, health and the environment.
- Employment policies.

Where TFM does not have specific policies of its own it will adopt those of PD. PD is a leader in world mining and manufacturing and maintains world-class environmental, social, and health and safety policies.

A community development plan is being developed by TFM to ensure that social development occurs in a sustainable manner that reflects the needs and desires of the local population. A "road map" for the plan has been developed as part of the ESIA. The strategy behind the road map is to make the communities in the Fungurume and Tenke region independent from the mining operations within a 20-year time frame. In order to reach this level of economic sustainability, the strategy will focus on:

- Basic needs of the communities.
- Income generation and livelihoods.
- Social and community infrastructures.
- Good governance.

Environmental and Social Impact Assessment Approach

An ESIA is to be finalized prior to mining. This assessment follows the Terms of Reference (ToR) issued in May 2006 as well as the requirements of the Equator Principles.

Work on the ESIA started in October 2004, and benefited from studies from 1997 to 1998 conducted by TFM.

The preparation of the ESIA also involved collaboration within the TFM project's ESIA team, which was comprised of TFM and PD staff, international consultants and many specialists based in Africa. The assessment considered baseline conditions, construction, operation and closure phases for the project. As required by the ToR, the ESIA process included the following steps:

Identify the environmental and socio-economic resources potentially affected by the project.

- Predict positive and negative effects and the extent to which positive effects can be enhanced and negative effects mitigated.
- Quantify and assess the significance of effects where possible.
- Consider the need to compensate for any significant residual negative effects.
- Identify methods to mitigate and monitor resources that may be affected by the project.

The above steps suggest a linear flow of activities. However, in many instances results of initial impact analyses were provided to the engineering design team so that negative impacts could be minimized through improved design. The ESIA provides the basis for the development of an environmental and social management system for construction, operation and closure.

Further details on the structure of the ESIA report are provided at the end of this summary.

Sustainability

An important component of the assessment is its vision to move the project towards sustainability. TFM recognizes the needs of society and the value of economic prosperity, national security and a healthy environment. TFM is committed to integrating social, environmental and economic principles in its mining operations and in facilities associated with preparing products for further use.

TFM aims to be a catalyst in development beyond its own operations. It works to ensure that the project will operate in such a way that does not deter other development and that will contribute to a net positive impact to the host communities where it operates. This net impact embraces social, economic and environmental conditions and builds capacities necessary to provide for the needs of current and future generations.

The ESIA addresses many disciplines in each of the physical, biological and social realms. The ESIA is structured to assess two aspects for each discipline:

- How can the project be designed to reduce or eliminate negative effects?
- How can the project have a positive effect that will last beyond the life of the mine? This is the main goal of a sustainability approach.

Within each discipline, both “actions” and “indicators” are used. Actions outline specific steps to be taken to reduce negative effects and to enhance positive benefits. Indicators are selected and used to monitor the success of actions in achieving the desired goals.

Public Participation

As required by international guidelines, ongoing consultation has been and continues to be an important part of the ESIA process. More than 175 disclosure and consultation meetings took place from November 2005 to June 2006 with a variety of stakeholders, including:

- Individual members of the general public.
- Non-governmental organizations (NGOs).
- Special interest groups.
- Regional government representatives.
- National government representatives.

Some meetings were large and involved many stakeholder groups at once. Other meetings were small, such as meetings with village members living near the project. Along with professional expertise, consultation with stakeholders provided a solid basis for focusing mitigation planning and impact analyses on issues of concern.

Stakeholder consultation has included:

- Announcement of opportunity to comment, through meetings held by the socio-economic baseline team, meetings held by TFM, distribution of letters of invitation and a background information document, radio announcements, newspaper advertisements, websites and distribution of sets of posters. Over 4,000 copies of the background information document were distributed
- Distribution of an Issues and Response Report providing an ongoing record of all stakeholder issues raised and TFM's comments.
- Distribution of a draft Scoping Report that described the proposed TFM project and defined the proposed scope of the ESIA.
- Open houses to enable comment on the draft scoping report.

Many issues were raised during consultation and these have been discussed throughout the ESIA. Some key issues include:

- The need to optimize employment and economic benefits for Congolese people.
- Concern over the loss of farmland and residences and the need to resettle people.
- Concern over possible health and safety effects on people, including HIV/AIDS linked to migrant workers.
- Concern that changes to water quantity and quality downstream of the mine and tailings storage facility could damage the environment and affect people and agriculture.
- Concern over the level of impact the mine will have on biodiversity of flora.

Stakeholder consultation will continue during the construction and operation phases.

PROJECT DESCRIPTION

The ore bodies within the TFM concession are rich in copper and cobalt. The project is expected to bring significant benefits to the local population, the Katanga Province, the DRC and TFM shareholders. The processing operation is projected to last over 40 years.

Significant investment will be made in local and regional infrastructure to include power generation and transmission systems, major improvement to national and regional roads, improved border-crossings, clinics, schools and agricultural programs. Associated sustainable development projects include small business initiatives in brick and fence manufacturing, aggregate quarries, waste management and bed and breakfast facilities.

Direct benefits of the project to the DRC are expected to contribute to alleviating local poverty and large-scale unemployment during operation and include provincial and municipality royalty shares, workforce earnings, local procurement, corporate income tax, withholding tax, export and import duties, transportation and a local agriculture and social investment fund. These items average over 100 million dollars of the United States of America (USD) per year during the first ten years. Over 60% of the direct cash distribution of the project goes to the account of the DRC and its people.

It can also be reasonably expected that the project will have secondary and tertiary development effects from increased activity in the area. During construction, the project will employ approximately 2,000 people, the majority of which are anticipated to be for local people recruited in the Katanga area. During plant operation, TFM expects to employ approximately 1,100 people, the majority of which are expected to come from local communities, with the number increasing over time as the local workforce increases its capacity. Each direct job should create four to six indirect DRC jobs, significantly increasing local employment opportunities. As well as these regional financial benefits, the project will be focused on improving transport infrastructure and will be committed to investment in training its employees. At the national level, TFM is expected to pay taxes, duties, a royalty and dividends to the DRC and Gécamines in the amounts set forth in the ARMC

Future expansion of the mine would include mining of the Fungurume and other deposits, with a possible eventual production of 400,000 tonnes or more per year of copper.

The Kwatebala, Goma and Fwaulu hills will be mined using an open pit method. Following a planned construction period in 2007 and 2008, mining will begin at Kwatebala as early as late 2008 and last approximately 20 years. The Goma ore body is expected to be developed beginning in 2017 and the Fwaulu ore body in 2020. The project will mine ore until at least 2027. Thereafter, processing of stockpiled low grade ore will occur for about 20 additional years.

Waste rock will be blasted with explosives so that it can be broken up and removed. Rock overlying the ore will be excavated by mechanized equipment and transported by truck to waste rock facility areas.

A surface miner, which is a track-mounted machine with a large rotating drum and hardened steel picks that break the rock in situ, will be used to mine ore at Kwatebala, Goma and Fwaulu. The ore, which is located in relatively thin seams, will be mined in very thin cuts (0.6 meters) to minimize ore dilution and loss. Surface miners are being used successfully throughout the world and in this application will provide significant capital and operating cost savings by eliminating the need to drill, blast and primary crush the ore. The ore will be broken to minus 150 millimeters in size and will be loaded into 45-tonne haul trucks with front-end loaders. High-grade ore will be delivered to stockpiles near the mill feed chute where a loader will be used to produce an ore blend from these stockpiles that maximizes plant production. The lower-grade ore, totaling approximately 57 million tonnes by Year 20, will be dumped on stockpiles near the waste stockpiles to the north and northwest of the plant site and southeast of the Goma pit.

The processing plant, located near the Kwatebala pit, will be designed using modern equipment and technologies and will meet or exceed the applicable environmental standards (see Figure 1).

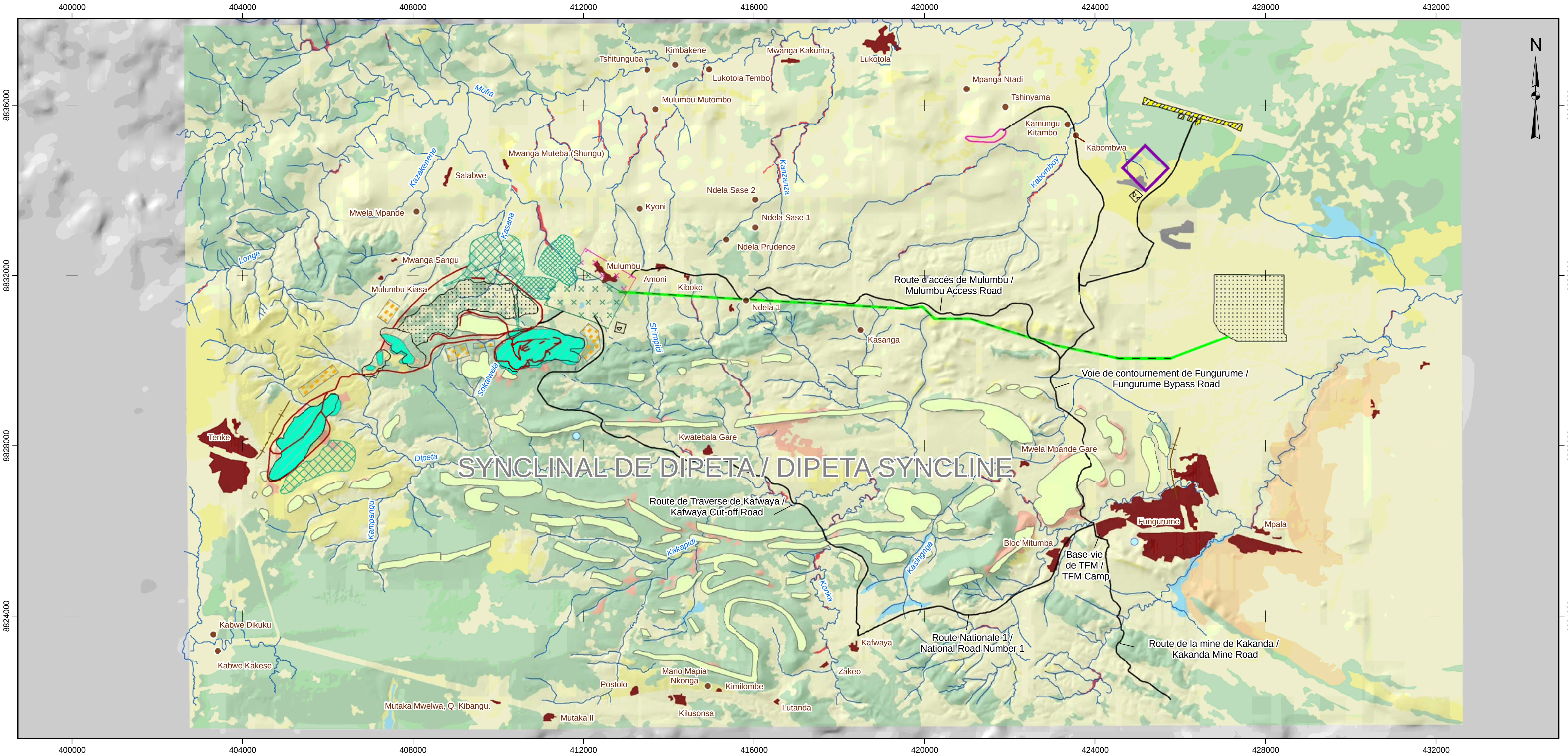
Following milling, the ore will be leached using acid in large tanks. This is a simple, well-proven technology. The solids will be separated from the liquids by counter-current decantation thickeners. Next, solution extraction and electrowinning methods will be used to produce copper cathode. This technology is also very well understood and carried out extensively in the copper belt in neighboring Zambia.

A sulfuric acid plant will be built for the generation of sulfuric acid and sulfur dioxide (SO_2). The sulfuric acid is used to leach copper and maintain spent electrolyte acid concentration for the solution extraction stripping section. SO_2 is used in the leaching circuit for the recovery of cobalt. SO_2 is also diluted with air and used to precipitate manganese dioxide (MnO_2) in the manganese removal tanks. Waste heat from the acid plant is used to produce steam for various operations throughout the plant.

The processing plant will use water, electricity and other raw materials such as lime, magnesium hydroxide and limestone to extract the copper and cobalt from the ore and to produce the final products. Power will be supplied by the state-owned utility. The main wastes and emissions from the processing plant will be tailings and air emissions. Most water used in the processing plant will be recycled.

Tailings from the processing plant will be deposited in a lined tailings storage facility. This facility will be formed by damming a small valley north of the Kwatebala pit and depositing tailings in it. A water reservoir also will be constructed to store excess water during portions of the year. The dam wall will be fortified by placing waste rock on the downslope side. This will prevent any accidental breaching or failure of the dam. If required, a second tailings storage facility will be constructed north of Fungurume.

Project: I:\CLIENTS\PHELPS_DODGE\05-1334-035\mapping\mxd\Tenke_ESIA\Exec_Summary\Figure1_Geological_deposits_11x17.mxd - Plot: I:\CLIENTS\PHELPS_DODGE\05-1334-035\pdf\Tenke_ESIA\Exec_Summary\Figure1_Geological_deposits_11x17.pdf



LÉGENDE / LEGEND

- VILLAGE
- RIVIÈRE / RIVER
- RIVIÈRE INTERMITTENTE / SEASONAL RIVER
- ÉTABLISSEMENT HUMAIN / SETTLEMENT
- ZONE À ÊTRE EXPLOITÉE PAR UNE MINE / ZONE TO BE MINED
- ZONE MINÉRALISÉE / MINERALIZED ZONE

COMPOSANTS DE PROJET / PROJECT COMPONENTS

- BANC D'EMPRUNT / BORROW PIT
- CHEMINS DE ROULAGE/ HAUL ROAD
- LIGNE DE TRANSPORT D'ÉNERGIE / POWER LINE
- ROUTE / ROAD
- VOIE D'ÉVITEMENT / RAILWAY SIDING
- PIPELINE / PIPELINE
- AÉROPORT / AIRFIELD
- CARRIÈRE / QUARRY
- CLÔTURE / FENCE
- FOSSE / MINE PIT
- LIMITES DE L'IMPLANTATION FUTURE / FUTURE EXPANSION BOUNDARY
- LIMITES DE L'USINE (ÉTAPE DE CONCEPTION) / PLANT DESIGN BOUNDARY
- PARC À RÉSIDUS / TAILINGS STORAGE FACILITY
- PILE DE STOCKAGE - SOL / STOCK PILE - SOIL
- SITE D'ENFOUISSEMENT / LANDFILL
- STÉRILES / WASTE ROCK
- MINERAI À FAIBLE TENEUR SUR STÉRILES / LOW GRADE ORE ON WASTE ROCK
- VILLAGE PERMANENT / PERMANENT VILLAGE

COUVERTURE VÉGÉTALE / UTILISATION DU TERRAIN / LANDCOVER

- AFFLEUREMENT ROCHEUX DE MINERAI CUIVRE-COBALT - COMPLEXE EXPLOITÉ PAR L'ACTIVITÉ MINIÈRE ARTISANALE / COPPER-COBALT ROCK OUTCROP - ARTISANAL MINING COMPLEX
- STEPPE-SAVANE SUR SUBSTRAT CUPRO-COBALTIFÈRE / COPPER-COBALT STEPPE-SAVANNA
- FORÊT DE MIOMBO / MIOMBO WOODLAND
- FORÊT DE MIOMBO DÉGRADÉE / MIOMBO WOODLAND DEGRADED
- FORÊT GALERIE / GALLERY FOREST
- TERRAIN MARÉCAGEUX / WETLAND
- MOSAÏQUE AGRICOLE / AGRICULTURAL MOSAIC
- ANCIENNE JACHÈRE / OLD FALLOW FIELD
- AÉROPORT / AIRFIELD
- PERTURBATION / DISTURBANCE
- ÉTABLISSEMENT HUMAIN / SETTLEMENT

RÉFÉRENCE / REFERENCE

Projection : Mercator transverse. Système géodésique : WGS 84 Système de coordonnées : UTM Zone 35S / Projection: Transverse Mercator Datum: WGS 84 Coordinate System: UTM Zone 35S

PRÉLIMINAIRE / DRAFT

3 0 3

ÉCHELLE 1:90,000 KILOMÈTRES

SCALE 1:90,000 KILOMETERS

PROJET / PROJECT

tfm

PROJET MINIER TENKE FUNGURUME
TENKE FUNGURUME PROJECT
TENKE FUNGURUME MINING SARL

TITRE / TITLE

GISEMENTS, EMPREINTE DU PROJET PROPOSÉ ET INFRASTRUCTURE DE LA MINE / ORE BODIES, PROPOSED PROJECT FOOTPRINT AND MINE INFRASTRUCTURE

Golder Associates
Calgary, Alberta

N° PROJET / PROJECT NO. 05-1334-035		ÉCHELLE TELLE QU'INDIQUÉE / SCALE AS SHOWN	REV. 0
DESSIN / DESIGN	RT	10 Jul. 2006	
GIS / SIG	RLP	19 Oct. 2006	
VÉRIFIÉ / CHECK	MR	19 Oct. 2006	
APPROUVÉ / REVIEW	MR	19 Oct. 2006	

FIGURE: 1

During construction, some temporary housing will be required to house the construction workers. During mine operations workers will need housing in the local area. TFM will build a construction village north of Fungurume that will later be converted to a permanent village for operation staff.

It is also expected that the mine operations may attract others to move into the local area. TFM will provide assistance to local authorities specifically to plan for this additional population. TFM will also help provide some of the basic infrastructure, such as water and power, needed. Growth centers will be built near both Tenke and Fungurume to allow for controlled growth of support services, such as market gardens and small businesses.

Other infrastructure that will be constructed include deep water wells, power line links from the DRC electrical grid to the mine and plant, a sewage treatment plant, access roads from the mine to the plant and from the existing limestone quarry north of Fungurume to the mine and plant, storm water controls, fencing and access control facilities.

ANALYSIS OF ALTERNATIVES

An analysis of different options or alternatives was conducted for the major project components of the TFM project. For mining projects, economic factors (e.g., cost of hauling waste rock) and local conditions (e.g., topography) dictate or constrain the project as options are often limited. Also, the selection of one alternative may then restrict options for other components. For example, the decision to mine the Kwatebala area first means that other major components, including the tailings storage facility and processing plant site, must be located nearby.

The selection of the preferred processing plant site required an analysis of the risks and costs associated with resettlement of villages that were likely to be impacted. Ultimately, the selection of the preferred processing plant site led to the decision to relocate the villages of Mulumbu, Amoni and Kiboko. This was based on results of air quality and noise modeling. This modeling indicated that, while a 115,000 tonnes per year processing plant could likely be situated such that air and noise impacts to these villages would meet applicable air and noise standards, future expansion of the plant would result in unacceptable impacts. Also, having the villages located close to the mine and plant sites was considered to be a potential safety hazard. The decision to relocate the villages was made for these reasons.

Alternatives were evaluated for the mine operation configuration, tailings storage facility location, waste rock facilities location, processing plant location, process type, final copper and cobalt products, construction camp/permanent village location, growth center location, main access road location within the concession, water source, power source and transport of raw materials and product. The "no project" alternative was also considered.

Methods for most of the analyses followed the internationally accepted "K-T analysis" approach (Kepner and Tregoe 1997). Environmental, social, technical and sustainability criteria were considered in the analysis. Criteria evaluated for each alternatives analysis were weighted relative to each other. Each alternative was then scored for each criteria relative to the other alternatives.

The first major decision made concerning the TFM project dealt with the overall project layout, i.e., where the ore will initially be mined and in what general area the plant site would be located. Since the mine start up requires a large and reliable source of ore the analysis was restricted to consideration of the Kwatebala and Fungurume ore bodies, the two largest known deposits on the concession. Three combinations of ore body location and processing plant locations were considered. The preferred alternative is mining the Kwatebala ore body and having the processing plant site situated in the Kwatebala area. This alternative would disturb the least amount of agricultural land, has a short haul route for ore and waste rock and has the lowest cost.

Once the decision was made as to which ore body to mine, the next step in the analysis of alternatives was to evaluate sites for the major facilities. The facilities had to be located so that they were not built on mineable ore. While facilities such as roads could be moved at a later date to mine ore beneath them, the cost of moving the processing plant site, tailings storage facility or waste rock facilities would likely be too high.

A K-T analysis was not conducted for the tailings storage facility because of the limited location options available and the design decisions that were made. Five possible tailings storage sites were initially identified outside of the mineable ore areas. The preferred site just north of Kwatebala Hill was selected due to its larger natural storage capacity, slightly longer distance from local villages and better reclamation potential when compared to the other alternatives.

Several air quality and noise models were run for a variety of processing plant site locations. The analysis of alternatives determined that the communities of Mulumbu, Amoni and Kiboko would need to be resettled. This factor then had to be taken into account in reviewing the options for the waste rock facility locations. Three alternatives were analyzed in depth. The preferred option is located immediately north of the tailings storage facility. Waste rock will be used to build the tailing dam embankments and will also buttress the downstream faces of these embankments. The waste rock facilities will be designed to be up to 85 meters high in order to reduce the amount of land that will be disturbed.

Three options for a processing plant site were compared. Locations were restricted by the need for level ground. A site to the northeast of Kwatebala Hill was selected as the preferred alternative. This site is close to the proposed open pit and the tailings storage facility, is on level ground and is not located on mineable ore.

The next facility considered was the location of the construction camp and permanent village for up to 2,500 workers. Five sites were compared: Kiboko, a site in or near Fungurume, a site in or near Tenke, a site north of Fungurume and a camp co-sited with the plant. None of these sites have a high probability of mineable ore beneath them. The analysis indicated that the preferred alternative for the construction camp site is the site north of Fungurume for environmental, social and technical criteria.

Growth centers are an identified strategy for the project, to deal with the expected influx of people into the concession area. The exact locations will be decided upon in consultation with government and community leaders. Growth centers will be managed as part of the larger community development program. Four options for the locations of a growth center were considered: Kiboko, Fungurume, Tenke and both Fungurume and Tenke. The analysis indicated that the preferred alternative includes growth centers at both Fungurume and Tenke. The selection was based largely on social and sustainability factors, since growth centers are intended to support many thousands more people than the construction village and meet long-term housing needs.

Three access road alternatives were considered: southern, central and northern routes. These would be used for transport of construction and raw materials to the site transport of product and waste materials from the site, and to transport workers to and from the construction village to the site. All three route options originate from the road that approaches the TFM camp from the Kakanda Mine to the south in order to avoid Fungurume. The northern route was clearly the preferred alternative, largely related to the decision to relocate the villages of Mulumbu, Amoni and Kiboko. This route is the shortest, crosses fewest watercourses, crosses the least amount of sensitive vegetation types and would be less prone to flooding. It was decided that an option to also develop the southern route should be retained, to provide an alternate route to the plant site over a less populated route. As with the northern route, much of this route already exists as a poorly developed road.

Water supply for the construction village will be from existing wells near Fungurume. A new pipeline will be constructed, from which water will flow under gravity. Water for construction of facilities and for pre-stripping mine operations will come from new groundwater wells. It is estimated that two to three wells will be required to produce the volume of water needed.

Electrical power will be provided by a new 17-kilometer 220-kilovolt overhead power line fed from the existing Fungurume substation. Existing switchboards and transformers at this substation will be replaced, as necessary, to provide a reliable power supply to the TFM infrastructure. Both overhead and direct buried cables will be used. An emergency diesel generator facility will be established at the plant site. Power will also be supplied to the permanent village from the Fungurume substation via a separate 15-kilovolt overhead line.

Routes for the transport of raw materials into, and products out of, the concession were also considered. Import and export of materials will require a coastal port. Supplies and product will be transported between the mine and the port by a combination of rail and road. The size of the shipments makes it preferable for rail to be used for the transport of major bulk reagents. Road transport may be used for minor reagents where special security is warranted or where rail systems are nonexistent or not dependable. Air transport is not an economically viable option other than for personnel. Three main alternative routes were considered from the DRC to ports in: Dar es Salaam, Tanzania; Richards Bay or Durban, South Africa; and Walvis Bay, Namibia. While the Dar es Salaam route scored highest in the analysis, transport routes are likely to remain flexible based on local conditions and availability of locomotives and railcars.

Finally, the “no project” alternative was compared to the project alternative. The objective was to determine if the overall benefits of the project outweigh the overall negatives. The project alternative scored highest for social, technical and sustainability criteria, with lower scores for environmental criteria as compared with the “no project” alternative. Expected benefits as a result of the project include significant social and economic benefits from the local to the national level (e.g., increased employment opportunities, job training, education in work practices, infrastructure improvements and increased revenues), improved transportation routes through the country and beyond, improved border crossings and the introduction of better mining and mitigation methods. There will also be increased potential for small business development. Most of the environmental impacts can be mitigated. Overall, the potential beneficial effects of the TFM project far outweigh the adverse effects.

BASELINE CONDITIONS

Most baseline data was collected from late 2005 to May 2006, although groundwater drilling is still ongoing. Water flow and climate monitoring are also ongoing. This data supplements that collected by TFM in 1997 and 1998. Baseline conditions are discussed below for the physical, biological and social realms. Local and regional baseline study areas (LSA and RSA) were used for each discipline of study.

Physical Context

The baseline physical aspects that were assessed included topography and geomorphology, geology, geochemistry, soils, visual aesthetics, major hazards, climate, air quality, noise and vibration, ground water, surface water flow, water and sediment quality and traffic. A general description of the physical baseline conditions is provided in the following section.

Regionally, the topography is dominated by the north and south limbs of the Dipeta syncline, forming a long valley, extending between the towns of Tenke and Fungurume. The local topography is characterized by a series of steep-sided prominent hills and ridges rising to an elevation of 1,500 meters above sea level and up to 170 meters above adjacent valleys. The Dipeta River flows through the valley from west to east.

The landscape in the area of the TFM project includes a mixture of existing human-modified areas such as villages, agricultural lands, fallow lands, roads and power line rights-of-way, and natural habitats such as copper-cobalt hills and miombo woodland.

The landscape types with the highest visual value were considered to be the copper-cobalt hills and areas of miombo woodland. The copper-cobalt hills are the most distinctive elements of the landscape of the LSA. They are the areas of greatest elevation in the landscape and are places from which visibility is further enhanced by the absence of miombo woodland. The miombo woodland is not as unique a visual feature but is inherently varied and aesthetically distinctive.

The project region is part of the Lufilian Arc, a geologic formation with extensive high-grade copper-cobalt mineralization extending about 500 kilometers through central Africa. Locally, the dominant rock types are sedimentary in origin, including dolomites, limestones and shales. The major copper mineral is malachite.

The geochemistry studies built upon studies conducted in 1998 and characterized the waste rock, ore and tailings for the Kwatebala ore body. The upper ore materials are composed predominantly of oxide minerals, grading to sulfide mineralization at depth. Only oxide materials are proposed to be mined in the proposed project scope and none of these are acid-generating. In addition to the copper and cobalt mineralization, quartz and muscovite are the primary components of the ore. The metals leaching potential for oxide waste rock is enhanced for copper, cobalt, lead, magnesium, manganese and other elements. The leaching potential for arsenic is low. There is also a potential for copper, cobalt, aluminum, molybdenum, manganese and other elements to leach from the tailings and ore.

Soils in the project region are typical of highly weathered, tropical soils. Soils are generally low in nutrients due to high rainfall which promotes leaching of minerals through the soil profile. Warm soil temperatures and high moisture conditions promote high levels of biological activity capable of rapidly degrading organic matter.

Nine preliminary soil units were mapped for the LSA. Three were determined to be moderately to highly suitable for agriculture, two were found to be moderately suitable and the remainder not suitable. Among the not suitable units is a unique copper-cobalt soil type found on the mineralized outcrops of the concession.

Baseline conditions were developed for major potential hazards, including extreme climatic (i.e., rainfall, flooding and wind) events, geotechnical events (e.g., landslides and seismic events). Key results are as follows:

- Baseline risks of slides and other earth movements are low, although these risks have been increased by artisanal mining.
- The maximum 50-year return period rainfall for 24 hours is 150 millimeters, for three days it is 199 millimeters and for seven days it is 266 millimeters.
- In the past, intense rainfall has been known to trigger flash flooding in tributaries to the Dipeta River and sometimes the main river itself.
- Annual average wind speed is near six kilometers per hour in the LSA. The maximum wind speed is frequently above 36 kilometers per hour.
- The project is in a seismically stable area.

A few extreme events, including floods, earthquakes and lightning storms, are known to have occurred locally.

The climate is typical of tropical Africa locations, existing at relatively high altitude near the equator. Five distinct seasons can be readily distinguished, namely:

- Cool dry season – May to July.
- Hot dry season – August to September.
- Early rainy season – October to November.
- Full rainy season – December to February.
- Late rainy season – March to April.

The first rains fall, on average, around the first two weeks of October and the rainy season lasts, on average, 195 days. Average annual rainfall is

1,183 millimeters, with a range over a 40-year period of 800 to 1,400 millimeters. Average temperature varies little from month to month (near 20 degrees Celsius), however the daily temperature extremes are greater during the dry season. Relative humidity is high throughout the year. The prevailing wind directions in the concession are from the southwest and northeast. The most common wind speeds in the concession are between one and two meters per second.

Air quality varies with the season, reflecting variations in atmospheric stability, ambient air temperatures and rainfall. The main emission sources in the study area include domestic fuel burning (mainly firewood and charcoal), bush fires, burning of stubble, vehicle emissions (tailpipe exhaust gas and fugitive dust), agricultural activities (tilling, plowing, etc.) and wind erosion of exposed areas. Volumes of motorized traffic along local roadways are very low. Bicycle and pedestrian traffic remain the primary modes of transportation and account for most road traffic. The general condition of local roads is poor. No significant industry occurs within the immediate vicinity of the project. The nearest active mine is 21 kilometers to the southeast.

Noise within the project area is typical for a rural African setting. Daytime noise levels near villages ranged from 42 to 53 decibels. Nighttime noise levels ranged from 39 to 52 decibels. There may be some existing ground vibrations near the local roads and rail lines due to vehicles passing by.

Groundwater in the RSA is associated with moderately to highly permeable limestone and dolomite aquifers. These aquifers have formed as a result of the dissolution of limestone and/or dolomite along fractures by infiltrating rainwater. This results in a highly transmissive aquifer capable of supplying large well yields. The total aquifer thickness is about 600 meters.

The dolomitic aquifers tend to be separated into compartments by geological structures including folding and associated faulting. Folding and faulting brings less permeable formations to the surface, which appear to act as barriers to groundwater flow. The largest single aquifer identified locally is within the Dipeta syncline. Numerous springs and seeps identified during the baseline study occur close to geological structures and lithologies (rock formations) that appear to behave as groundwater flow barriers. These barriers are of lower permeability than the dolomitic aquifers and force groundwater to discharge at the ground surface because of a decrease in permeability along the groundwater flow path.

The groundwater system is recharged by the infiltration of precipitation (rainfall) over the surface outcrop area of the aquifers and from river leakage/infiltration where the water table is below the elevation of the river bed. The general groundwater flow direction south of the Kwatebala ridge is from north to south toward the Dipeta River. From the Dipeta River, groundwater flow is predominately in an easterly direction. To the north of the Kawatebala ridge, groundwater flow is to the north and the Mofia River. The groundwater system and the surface water system are closely interconnected along the Dipeta valley.

Two main surface water systems exist in the region: the Mofia River catchment to the north of Kwatebala Hill and the Dipeta River catchment to the south. The proposed mine and plant sites straddle the hydrologic divide between these two surface water systems, with surface waters from the mine area flowing toward the Dipeta River and surface waters from the areas of the plant site, tailings area, and waste rock piles flowing toward the Mofia River. The limestone quarry, airstrip and construction camp/permanent village will be located in the Kabomboy River catchment, which flows into the Mofia River. The catchments are dominated by deep well-drained soils. Infiltration into these soils is high and, as a result, very little surface runoff exists in the catchment headwaters.

Water quality sampling indicated that both *E. coli* and total coliform bacteria were high throughout the region in both groundwater and surface water. Metals concentrations were very high in some of the samples. High concentrations of nitrate and ammonia were also observed in some of the samples.

Historical data indicate that metal and nutrient concentrations were highly variable at all sites in both seasons. The Mofia River catchment and tributaries to the Dipeta River tended to have lower dissolved solids, suspended solids and hardness than the Dipeta River. The headwaters to the Dipeta River, where the Goma deposits are located, had very soft water.

Sediment generally had low metals concentrations except for one site on the Sokalwela River downstream of the Kwatebala deposits that had elevated concentrations of cobalt, beryllium and copper relative to other locations. Uranium and thorium concentrations were low, indicating that the likelihood of finding radioactivity in the area is also low. Organic parameters were not detected in the sediment samples.

Biological Context

The baseline biological aspects that were assessed included flora, fauna, fish and aquatic habitat, natural habitats and biodiversity, and protected areas. A general description of the biological baseline conditions is provided in the following section.

The TFM project is located in the DRC, a country rich in biodiversity. The DRC supports over 11,000 known higher plants, over 1,300 known mammals, birds, reptiles and amphibians and over 100 fish. The DRC is a signatory to the Convention on Biodiversity and has established national- and provincial-level plans for the conservation of biodiversity. Numerous protected areas exist in the DRC, to facilitate preservation of important biological habitats and species. There are no formal protected areas or Ramsar sites (internationally important wetland areas) within the mining concessions. However, there are five protected areas within 100 kilometers of the TFM project. These include the Upemba National Park, the Kundelungu National Park, the Lubudi-Samppa Hunting Reserve the Tshangalele Hunting Reserve, and the Lufira Biosphere Reserve.

The project region is within the miombo woodland belt of central Africa. Regionally, 634 species have been firmly identified, including 475 higher plants, 144 terrestrial vertebrates and 15 fish. Based on the literature, many more species have the potential to exist in the region. However, the local area is relatively fragmented and modified by man, reducing the numbers of species that presently exist.

The local habitat types ranked from most to least in terms of total species level biodiversity follow:

- Gallery forest.
- Intact miombo woodland.
- Copper-cobalt steppe-savanna.
- Copper-cobalt rock outcrop.
- Degraded miombo woodland.
- Wetland.
- Agricultural mosaic (not a "natural habitat").

All habitat types support numerous species of flora and fauna and are of some value regardless of the state of disturbance. However, it is notable that two of the most biologically valuable habitat types (gallery forest and the copper-cobalt habitats) are rare and already under threat in baseline conditions.

Of all vegetation types, the miombo woodland has the greatest flora species diversity. Miombo woodland is under pressure from human activities. Clearing for agricultural purposes, charcoal and fuelwood collection, urbanization, infrastructure and industrial development are all reducing the size of the miombo woodland community. The copper-cobalt habitat types also have high flora species diversity. Many of the species have a restricted distribution. In the past, artisanal mining impacted these habitat types.

Shifting agricultural practices are common and result in abandoning of sections of the land, likely due to the soil becoming too impoverished or perhaps because weed infestation was too high. Natural revegetation is generally reestablishing in these highly disturbed areas.

The fauna in the study area is diverse but densities are low. Hunting and habitat loss are realities in the area and have had a significant influence on the local fauna.

A field survey during the wet season (2006) found 14 frog species, nine reptile species, 109 bird species and 12 mammal species in the LSA.

From relevant literature, the miombo woodland foot-slope habitat alone would have been expected to contain 310 species, followed by riparian (streamside) areas with 264 species and miombo corridors (strips of forest between larger forest patches) with 262 species.

Twenty large game species occurred in this area historically, but none of these remain having been hunted to local extinction. Three endemic fauna species (one frog and two birds) are expected to occur locally, but were not found during the studies. Four Red-listed bird species are expected to occur locally, according to the World Conservation Union (IUCN), but were not observed during the study. The short-eared trident bat (Vulnerable) of the woodlands and the otter shrew (Endangered) of the riparian environment are the only possible Red-listed mammals that could occur in the study area. Neither were observed during the field survey.

The rivers in both the Mofia and Dipeta catchments are generally regarded as degraded. This is mainly due to the extent of deforestation in the catchments as well as poor cropping activities into riparian zones. Both of these activities cause extensive sedimentation in the rivers. The effect of the sedimentation is evident in the generally low diversities collected for both macro invertebrates as well as fish for all the sites on the Dipeta

River. However, a few riverine reaches (Shimpidi, upper Kazakenene) still exist where the riparian forests are intact.

No Red-listed fish species were collected during the surveys. Given the degraded nature of the surveyed rivers it is unlikely that such species may persist in these catchments. However, the relatively higher integrity of the streams and gallery forests of the Shimpidi subcatchment supports a population of a fish species (the sand catlet *Ziareichthys brevis*) that is highly sensitive to environmental quality. The presence of this species is therefore indicative of a higher quality aquatic environment in the Shimpidi subcatchment.

Elevated contaminant levels, specifically arsenic, measured from collected fish tissues is of concern since these values may pose a current health risk for subsistence consumption.

Social and Cultural Context

The baseline social and cultural aspects that were assessed included socio-economics and cultural heritage. A general description of the social and cultural baseline conditions is provided in the following section.

The mine site is located in a hilly region within the Kolwezi District, between the urban centers of Fungurume and Tenke. At least 41 rural villages also fall within the TFM project's LSA, including Mpala, Mitumbu, Mulumbu, Kiboko, Amoni, Mwela Mpande Gare, Kwatebala Gare and Lukotola. With a combined population of over 52,000, Tenke and Fungurume each serve as a primary transportation center and marketplace for the region. Between the urban centers of Tenke and Fungurume is a patchwork of farm fields, villages, forests and mineralized lands which have undergone significant artisanal mining activities in the recent past.

The population of the region is young, with 54 percent under 15 years of age. Households in the rural villages tend to be small, averaging less than five persons per household. A striking characteristic of the villages in the region is the very small number of people (10 percent) residing in the same village where they were born. Thirty percent of the population has lived in the same village for less than five years. Recent years of conflict and resulting economic challenges throughout the DRC have contributed to a complex pattern of population movement. Most of the villages in the region are very recently settled. The latest population growth in the Kolwezi District is perceived to be the result of the return of war-displaced peoples to the region and the movement of miners and their families displaced by mine closures elsewhere.

Such recent social and economic change is reflected in the cultural diversity of the area. The majority of the region's residents belong to the Sanga ethnic group, the largest in the project area, along with the Luba, Ruund, Tshokwe, Bemba and Boyo peoples of the region. A local dialect of Swahili is the most common language spoken in the area. French is spoken and understood by only a small minority.

Agriculture is the main economic activity for both rural and urban populations. Virtually all rural households engage in agriculture, as do more than 80 percent of the urban population. Rural livelihoods are based largely on a mix of subsistence and commercial agriculture, predominantly maize (corn) and beans. Secondary crops such as cassava, peanuts and soybeans are also produced. People rely on additional economic activities such as government jobs, occasional wage labor, beer brewing (a key source of income for women) and charcoal making (traditionally a male activity) to supplement farming incomes. Overall, the regional economy is characterized by multiple cash income and subsistence sources, of which agriculture is the chief component. Agriculture, however, accounts for less than 50 percent of household incomes.

Approximately 10 percent of the population has a salaried job, though not necessarily with regular pay. Employment typically consists of jobs in the civil service, education and health care systems. Almost 53 percent of people in rural villages and the urban centers of Tenke and Fungurume have never held a job. As a result, there are many job seekers in the area. Even those currently employed have expressed interest in working for TFM and consider themselves in search of work. While recent government reforms aimed at diversifying the agricultural and economic base of the country are underway, options for diversifying livelihoods remain limited.

An important component of the socio-economic context of the region is the practice of artisanal mining. Over the four-year period from 2002 to 2005 there was a boom of artisanal mining activity in Katanga Province. A significant amount of this activity occurred illegally on the TFM concession area. A final ban in the area was established in October 2005. This had an important effect on the local economy. Local villagers no longer sold produce and drinks to the miners. Women lost an important source of income as they no longer sorted, washed and bagged ore produced by the miners.

Many goods were no longer available in the markets on a daily basis. The negative effects of artisanal mining were also recognized by local communities and were perceived as the source of an increase in social problems. Stakeholder consultations indicate villagers accepted that unauthorized artisanal mining needed to be stopped. Villages also expressed optimism for greater economic benefits from a large commercial mine.

TFM on average has directly or indirectly employed approximately 1,000 people since February of 2006.

Infrastructure issues have taken on particular importance in the DRC. Years of conflict have seriously degraded the quality of and access to basic infrastructure and services. Water is sourced mainly from rivers, streams and other unprotected sources raising associated health risks. Health services are available in the urban areas of Fungurume, Tenke and Lukotola. Despite differing levels of access to health services both urban and rural dwellers face similar health challenges. Medicine is normally in short supply and facilities are in generally poor repair. Malaria, a preventable illness, accounts for 54 percent of all health center visits. Health authorities indicate that HIV/AIDS is not yet a pressing problem. However, no HIV/AIDS testing is currently taking place and high-risk behavior was observed during the artisanal mining period. There is concern within the region that with development, such as the TFM project, HIV/AIDS will become a greater problem in the future.

Education levels in the region are generally low. During the artisanal mining period, boys were leaving school to mine. Although current enrolment suggests no gender bias, adult education levels indicate that men typically complete more grades than women. Almost 19 percent of women in rural villages have never attended school.

In general, the rural population lacks many basic necessities. There is a general lack of education, poor housing, absence of household and farm equipment, poor access to health care, and almost no regular income. In urban centers the situation is somewhat improved. Better housing, higher educational achievement, slightly more regular income and better access to health care are characteristic of urban centers. Many more families in towns have access to protein foods in the form of dried fish. Annual median income among rural households was estimated to be 79,000 Fc (Congolese francs) (175 USD [US dollars]) and 115,000 Fc (255 USD) among urban households. The lingering effects of conflict and the slow pace of economic and infrastructure revitalization continue to present significant social and economic challenges for the region and throughout the DRC.

Archaeological and ethnographic techniques were used to locate and interpret several cultural heritage sites. These include two Palaeolithic (Stone Age) archaeological sites, at least one Iron Age site, three cemeteries, three cult sites (known as Kipanda) and five traditional sacred sites. The table below lists the main types of cultural sites that were recorded within the concession area:

Table 1 Cultural Sites within the Concession Area

Site Category	Examples	Cultural Significance
sacred sites	Katumba	a sacred pool which is now used for fishing, boating or bathing
	Mpungulume Hill	once considered sacred and inhabited by spirits, now deconsecrated
	Muta cave	traditionally home to spirits, now considered deconsecrated
	Kabakishi River	considered a sacred river where fishing is prohibited
cult sites	known as Kipanda	are often temporary and destroyed after use or when vacating a village
cemeteries	Moama cemetery is one of the oldest and most respected places in Lutanda territory	often associated with the burial of chiefs or notable citizens
archaeological sites	include Lower and Upper Palaeolithic (Stone Age) sites and Iron Age sites	site in the Dipeta Valley contains evidence of the Acheulian tradition, which is known in only one other region of the DRC

No sacred sites are located within the actual proposed facility footprint. Sacred sites and cemeteries continue to be used by groups and villages in the area. Several of the archaeological sites were judged to be sufficiently important that they were recommended for further investigation, including systematic excavation. Overall, there is an expected variety, though not an overabundance, of cultural sites in the mine area.

KEY MITIGATION AND IMPACTS

The ESIA evaluates residual impacts, or those that remain after various mitigation measures are implemented. In the context of this assessment, mitigation includes the following hierarchy:

- Avoidance.
- Minimization.
- Rehabilitation or repair.
- Compensation.

Key mitigation measures to protect and enhance the physical, biological and social resources of the project area, as well as residual impacts, are described below. Results of the sustainability assessment and the assessment of the potential cumulative effects of the expanded project are provided later in this summary.

Protecting and Enhancing Physical Resources

Topography and Geomorphology

The TFM project will result in changes to existing topographic features such as hilltops and hillside slopes. The project will create new topographic features such as the tailings storage facility and waste rock facilities. Indicators for such changes are slopes, heights of features, and variability of terrain. The topography of the mine areas will be most affected. Mining of the ore bodies will affect Kwatebala, Goma and Fwaulu hills, ultimately removing most or all of these prominent topographic features. Internal mine slopes (highwalls up to 155 meters high will have slopes of about 39 degrees) will be increased due to mining activities. Waste rock facilities will be created next to mining areas. At Kwatebala Hill, the maximum height of the main waste rock facility will be about 85 meters, with a side slope ratio of 1:1.5 (33.7 degrees). The waste rock facility east of the Goma hills is expected to be about 75 meters high with a side slope ration of 33.7 degrees. These slopes have been designed to take earthquakes, extreme climate and slope failures into account. These two waste rock facilities (stockpiles) will represent locally prominent topographic features.

Stakeholder consultations regarding appropriate land uses at closure will help ensure the reclaimed landscape is appropriate for future land use activities.

Geochemistry

Geochemistry of potential mine wastes has to be understood so that predictions can be made regarding water quality of mine facility runoff, seepage and effluent. The geochemistry program characterized mine waste and ore, including:

- Waste rock.
- Ore.
- Tailings.

This information was then used to predict water quality for:

- Waste rock storage facility runoff and seepage.
- Ore stockpile facility runoff and seepage.
- Tailings storage facility supernatant water as well as seepage (for any potential seepage passing through the liner).
- Open pit lake at closure.

These results were used to determine appropriate water and waste management techniques, including use of a liner for the tailings storage facility and recycling of low-grade ore stockpile runoff, waste rock runoff and tailings supernatant.

Radioactivity was also investigated as it was raised as a concern during stakeholder consultations. Radioactivity testing indicated only a slight potential for low levels of radioactivity in the tailings. Radioactivity levels in process effluents are not likely to exceed reference guidelines.

Soils

The TFM project has the potential to affect soil productivity and to impact unique or unusual soils.

The project will impact approximately 2,400 hectares of soils over the mine project's life. During operation and at closure about 1,300 hectares will be fully or partially reclaimed. The reclaimed processing plant area will be able to support land uses similar to those that existed before disturbance. The open pit will not be reclaimed and the tailings storage and waste rock facilities will not be reclaimed to an agricultural end land use.

Mitigation for soil impacts includes the use of best management practices during construction and operation phases and a reclamation plan for restoring soils at closure. Topsoil salvage, management, placement and reconstruction of soil materials will be performed. The length of time topsoil will be stockpiled will be minimized. Separate stockpiling of different soil types and soil horizons will prevent mixing of soils. Organic matter in the topsoil will be increased through mulching and green manuring. Measures will also be used to prevent soil compaction and to prevent and clean up spills to avoid soil contamination.

Visual Aesthetics

The introduction of a major industrial facility into this setting will contrast with the existing patterns of land use and the natural habitats. It will contribute to a reduction in the visual aesthetics of the local area. The mine, tailings storage facility, processing plant site and other project infrastructure will be visible from nearby populated areas. Visual intrusion will also be caused by the ongoing operation of the mine, the movement of heavy vehicles and the generation of dust on unpaved roads around the mining area, between the mine and the waste rock facilities and on the tailings dam.

The hilly terrain in which the project is situated results in fragmented viewsheds which do not extend uninterrupted over long distances. Regionally, even the top of Kwatebala Hill, which is the highest point in the area, is not visible over extensive areas. Only smaller villages such as Salabwe, Mwanga Muteba, Mwanga Sangu and Mulumbu Kiasa will have views of the processing plant and waste rock facilities. Visual impacts will be minimized through the use of vegetation screens, dust control, using appropriate colors at the processing plant site and the use of lights with fixtures that direct light downward.

The limestone quarry will cause alteration of landscape characteristics over a small area. The visual quality of the existing landscape is moderate to high. Building the quarry will contrast with the existing patterns of land use and natural habitats.

The power line will be linear intrusions across the same landscape, contrasting with existing patterns of land use and natural habitats and causing localized changes in visual quality.

Major Hazards

Major hazards include natural and man-made hazards. A natural hazard is a naturally occurring event that could lead to potential failure of project facilities that would impact the public or the environment. The principal natural hazards are from earthquakes and extreme climate and geotechnical (e.g., slope failure) events. Man-made hazards include accidents or malfunctions in the processing plant or other facilities, including rail or road transportation accidents (e.g., spills or collisions with people).

During construction and operation impacts from major hazards will be managed through risk mitigation. Risk analyses will be completed within an ongoing management program. Risk mitigation measures will be implemented for all potential major hazard scenarios. Designs for the processing plant, mine site and tailings storage facility will be developed using international standards to minimize risks to within acceptable levels for the public and environment. The transportation program will incorporate mitigation measures to minimize risks from accidental spills and collisions.

In addition, specific mitigation measures will be implemented at each of the project sites to minimize risks. For example:

- There will be geotechnical testing of tailings, fill waste overburden and foundation materials. Outer slopes, containing tailing or fill materials, will be designed to withstand the predicted maximum earthquake (peak horizontal ground acceleration of 0.12 gravity units) for the area without a major failure. Additionally, buffer zones around the waste rock stockpiles will be maintained to protect the public from incidental rock falling or sliding during operations.
- The TSF containment will be designed for an extreme storm and wet year water cycle.

- At the processing plant, tanks and vessels will be designed for anticipated wind loads; buildings and dams will be designed to withstand the design earthquake ground motions and deformations.
- There will be regular monitoring for the stability of slopes and fill materials.

The tailings storage facility walls will be buttressed with waste rock so that the chance of a dam failure will not exist. The likelihood of an embankment overtopping due to a severe storm event is less than one in 100,000.

After mitigation, residual impacts are expected to be in the low-to moderate-risk rating as defined in a project risk matrix. Such levels are within international standards for mining operations to minimize risk to the public and to environmental resources.

Air Quality

Construction activities that will affect air quality include dust (particulates) caused by traffic and site clearing and tailpipe emissions (exhaust) from vehicles. During operation, dust and tailpipe emissions will continue and processing plant emissions may cause additional effects. Dust generation and vehicle exhaust will continue during reclamation and closure activities, including earthworks and facility demolition. Wind erosion from exposed surfaces will occur during all of the project phases unless surfaces are revegetated or kept moist. Changes to air quality can affect nearby residents, agricultural crops and natural flora. Greenhouse gas emissions, although minimized through the use of hydroelectric power, can contribute to global warming.

TFM proposes to mitigate the effects of dust through all phases of the project using effective and proven techniques. These include the use of water on roads, treating the surfaces of portions of the road network, use of speed limits for drivers and covering loads. Revegetation of selected exposed areas will also be used when feasible and the tailings storage facility will be kept wet to limit wind erosion. Water sprays will be used in high traffic areas and on the waste and ore stockpiles, as necessary, to control dust generation. Transport of the ore to the processing plant will be by a combination of mining equipment up to a stockpile and from there through a covered conveyor. Modeling of predicted dust levels without mitigation indicated that particulates could be spread over large areas. However, dust levels will be kept to within applicable standards through use of the above actions.

Tailpipe exhaust will be kept low during all project phases through use of adequate exhaust control systems on vehicles that will be kept in good repair. Emissions from the processing plant and acid plant will be controlled by means of scrubbers. Air quality modeling predicted that emissions of sulfur dioxide, nitrogen dioxide and carbon monoxide will be within applicable and reference guidelines at the nearest communities during operation.

Greenhouse gas emissions will be reduced through the use of hydropower that will provide electricity to the processing plant and other facilities.

Noise and Vibration

The TFM project will contribute to local noise and vibration levels through vehicle traffic on the access roads, blasting and haulage of waste rock and limestone and processing of the ore. As a surface miner will be used (a machine with a rotating drum with steel spikes that grinds ore at the active pit face) blasting for ore and a crusher at the processing plant site may not be necessary, leading to reduced noise and vibration levels.

Mitigation measures for noise include outfitting all vehicles with standard silencers that will be kept in good repair. Waste rock facilities, ore stockpiles and buildings will act as barriers to noise generated by the mine and the processing plant. No mitigation of vibration is recommended.

Noise and vibration modeling was performed, based on the proposed mining at Kwatebala. Results from the modeling indicated that none of the nearest communities will experience noise or vibration above applicable guidelines as a result of the project. As a result, no harmful effects are predicted. This conclusion assumes that the three closest communities of Mulumbu, Amoni and Kiboko will be relocated. Prior to mining of Goma and/or Fwaulu, noise and vibration modeling will be performed and appropriate mitigation actions taken to minimize impact to nearby communities.

Groundwater

Groundwater will be pumped from wells to supply the processing plant, construction camp and other mine facilities with water. Rainfall will also be captured on the tailings storage facility, waste rock storage facilities, ore stockpiles and portions of the processing plant site and used for process water and other uses. Beginning in year 8, when the pit will be mined below the water table, groundwater flowing to the Kwatebala pit will be intercepted by dewatering wells to prevent the pit from filling with water. All of these actions have the potential to lower the local water table and reduce the discharge of groundwater to springs and surface water. Such changes in groundwater levels have the potential to affect local wells and springs, surface water hydrology and quality, fish and fish habitat, flora and fauna.

TFM has designed the project to minimize the effects on groundwater levels. A design feature related to groundwater levels and flows includes allowing all water that does not come into contact with exposed waste rock or ore (“non-contact” water) to infiltrate into the ground to recharge groundwater levels. The construction of the tailings storage facility will be staged so that the amount of water that becomes “contact” water only increases as more tailings storage is needed. Groundwater will only be pumped from aquifers that are shown to have adequate long-term supply for the mine. Pit dewatering will be kept to the minimum necessary to keep the pit floor dry and conditions safe for workers.

The environmental assessment concluded that some effects to groundwater levels within the local aquifer where most of the mine facilities are located are likely. While more studies are underway to confirm the nature and extent of the impact, TFM is committed to supplying any adversely affected communities with potable (drinking) groundwater during the operation of the mine. Groundwater quality has the potential to be affected by water infiltrating through waste rock facilities and ore stockpiles, stormwater control dams, accidental spills, and to a lesser degree by lined facilities such as the tailing storage facility and the decant return pond. The post-mining pit lake may also affect the long-term groundwater system. Secondary containment will be used at all surface tanks and fuel/chemical storage areas containing potential contaminants to prevent groundwater contamination.

These measures will ensure that effects on groundwater quality are minimized. Despite these measures, some effects may occur due to seepage from the waste rock storage facilities and the ore stockpiles. Geochemical modeling has shown that the predicted impact is likely to be low, due to the fact that the ore and waste rock has a low potential for acid generation. However, further testing work is being completed to better characterize the potential nature of these effects.

Surface Water Flow

Surface water flows will be disrupted at the mine site by diversion of non-contact water around the facilities and by capture of all contact water for use in the processing plant. Clearing of land will lead to increased runoff until the land can be reclaimed and revegetated. Changes in groundwater levels, described above, will likely result in a lower rate of groundwater discharge to the headwaters of three local rivers: the Kasana, Sokalwela and Shimpidi rivers. Release of treated sewage effluent to the Kabomboy River will result in increased flows. Changes in flows may affect downstream water users as well as the morphology of the streams, fish and fish habitat, flora and fauna.

Mitigation measures to reduce the effects to surface water hydrology will include:

- Staged development of the tailings storage facility so that the amount of water sent to the processing plant is minimized.
- Return of disturbed areas to natural runoff conditions as soon as possible.
- Provision of potable groundwater to downstream residents if dry season flows where people withdraw water are appreciably reduced.

A water-flow model was prepared for the mine site and used to predict effects. The environmental assessment determined that both wet and dry season flows would be reduced in the three rivers. A reduction in the wet season flows was not considered to affect local users, flora or fish due to the large amounts of water that flow during that season. However, a reduction in dry season flows could affect surface water availability to users immediately downgradient, as well as ecosystems such as gallery forests on the Kasana River and aquatic habitat on the Shimpidi River. This impact is most likely to occur as a result of aquifer dewatering activities necessary to mine below the current water table at Kwatebala. It is predicted that the mining operation will reach the current water table in about the 8th year of mining. If required, a portion of the groundwater removed for pit dewatering will be used to mitigate the dry season baseflows to the extent necessary to preserve the affected ecosystem.

An increase in flows in the Kabomboy River will not have any harmful effects. Changes to channel geomorphology in all rivers are expected to be negligible.

Water Quality

Water quality in local springs and watercourses may be affected by site clearing and disruption of natural drainage patterns, disposal and stockpiling of waste rock and ore, ore processing, sewage treatment effluent, accidental releases and spills and site reclamation and closure activities. Water from mine pit dewatering wells may be released to local rivers and have an influence on water quality.

Best management practices (BMPs) will be used during site clearing and construction to minimize erosion and sedimentation. These practices will include diversion of runoff water away from roads and disturbed areas and the use of sedimentation ponds and silt fences.

The TFM project will be designed using a “zero discharge” concept, where water release will be kept to the minimum and will meet applicable water quality guidelines. Key mitigation measures for water quality include lining the tailings storage facility and return water dams and recycling of all contact water in the processing plant. Sewage treatment plants will be installed at the plant site and at the permanent village. Sewage will be treated so that all effluent meets discharge criteria. Solids will be composted and used as a soil amendment or disposed of in a landfill. Secondary containment will be used at all surface tanks and storage areas containing potential contaminants. BMPs will be employed during reclamation and closure. The closure landscape will be designed with sustainable drainage and vegetation cover so that erosion and sedimentation is reduced and so contact of runoff water with mine or waste material is minimized.

Results from the groundwater and surface water resources assessments were used in the evaluation of potential surface water quality effects. A groundwater attenuation model was also used to determine water quality of springs and watercourses. Little or no effects were predicted for erosion and sedimentation effects, sewage effluents, mine pit dewatering or spills. Total dissolved solids concentrations in springs and watercourses near the proposed facility may increase above the background concentrations and reference guidelines due to seepage from the waste rock storage facilities and ore stockpiles. This would only occur when flows are low (low flows that occur only five percent of the time were used in the assessment). The community of Mwanga Muteba would potentially be affected by changes in water quality. This village takes its water supply from the Kasana River. Should monitoring indicate that drinking water standards are not being maintained, TFM is committed to supplying the community with potable (drinking) groundwater during the operation of the mine. No other community is located downstream of Mwanga Muteba on the Kasana River. Once this river enters the Mofia River dilution parameters will likely reduce the dissolved constituents to acceptable levels with the possible exception of nitrate. All parameters will be at acceptable levels at the next downstream village on the Mofia River.

No impacts from radioactivity are expected due to low levels of uranium, thorium and alpha and beta radiation in ore and waste rock samples.

No change in sediment quality is predicted from the mine. The Kwatebala pit will partially fill with water to form a lake at closure. As this lake will not drain to surface waters, no impact to natural surface water is predicted. Water quality in the lake may not support aquatic life. Further geochemical modeling is being undertaken to investigate this.

Traffic

During the construction phase, traffic access will be along the road from Likasi to Fungurume, using the Kambove to Kakanda mine road and cutoff to the TFM camp through the concession. Access will continue on the Fungurume bypass road and intersect with the Mulumbu access road to reach the Kwatebala processing plant site. This northern access route will convey all traffic to and from the site (including the movement of supplies, reagents, product and personnel) during construction and initial years of production. A southern access route (partly an upgrade of an existing road and partly a new road) along National Road Number 1 to the Kafwaya cutoff road may serve as the primary route for the transport of product and reagents for the remainder of the life of the project (years 5 to 20).

Given the low numbers of motorized vehicles currently on the roadways, changes in traffic represent a considerable increase in traffic volumes particularly along the access roads. Overall, motorized vehicle traffic along the northern access route will increase by approximately 276 percent during construction, and by approximately 442 percent during the initial years of operation.

The TFM project is expected to bring about overall improvements in transportation infrastructure. Increases in traffic volumes along the northern and southern access routes will be minimized by the upgrading and maintenance of the Mulumbu access road, Kafwaya cut off road and the Fungurume bypass road. Increases in traffic volumes along the northern access route will have the greatest potential impact in relation to bicycle and pedestrian traffic. To minimize this, TFM will delineate and mark a pedestrian lane on main access roads, including the use of marker stakes implanted in the road surface. Common crossing points will be identified by signs and crosswalks.

Measures that are to be built into the project design include the construction of new roadways and upgrading existing roads. A number of safety measures will also be implemented including speed limits, drivers' education, public education, vehicle scheduling, and vehicle maintenance. These measures will reduce the potential for accidents along roadways within the concession.

Waste Management

Management of wastes will include dedicated facilities for tailings, waste rock, iron/aluminum/manganese (FAM) water treatment residue, and domestic, industrial and hazardous waste.

Objectives for waste management will be for (1) waste reduction, recycling, re-use and composting, and on-site treatment, as applicable, and (2) safe storage of any wastes produced. Storage of wastes will be conducted such that effects to the environment (air, surface water, groundwater) will be minimized. Monitoring of waste facilities will be conducted so that remedial action can be taken if any effects are found to occur.

The tailings facility will be lined with an impermeable liner and all tailings water will be recycled to the processing plant. Enhanced evaporation (water sprays) will be used as necessary to balance process water inventories, thereby minimizing the likelihood of process waters being discharged as a waste to the environment. Waste rock (and low grade ore and plant site) runoff also will be collected and recycled in the processing plant. FAM residue will be placed in a lined storage facility that eventually will be capped with a low permeability cover.

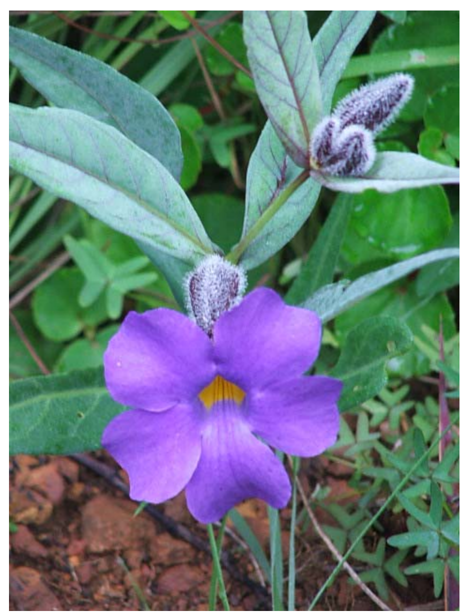
Solid wastes will be classified and sorted according to their characteristics (recyclable, suitable for clean landfill, compostable or hazardous). Non-hazardous and hazardous waste management landfills will be constructed for the project. The proposed lining for both landfills will consist of double lining systems with a leachate collection system above the primary liner and a leakage collection system between the primary and secondary liner system. The leachate will be collected in a detention pond, then transported or pumped to the sewage treatment works or recycled to the processing plant, if possible.

A comprehensive monitoring program will be implemented to track waste volumes and types, assess surface and groundwater conditions up and down slope of each major facility; and assess the integrity of leachate collection systems, diversion berms and monitoring systems.

Protecting and Enhancing Biological Resources

Flora

The TFM project will disturb floral communities on the ore outcrops that will be mined and in the areas where the mine and its associated facilities will be constructed. Other potential effects to flora include those from airborne dust, emissions from the mine fleet and the processing plant, changes in surface water hydrology and the introduction of non-native plants. Also of concern are effects related to the likely in-migration of people to the area. This may lead to increased clearing of forests for charcoal and agricultural production.



An important issue affecting flora is the removal of rare copper-cobalt floral communities on the Kwatebala, Goma and Fwaulu hills as these hills are mined. These hills support unique floral communities of copper-cobalt flora and some species are only known to occur in the region. One species is known to only occur on Kwatebala Hill. The removal or alteration of gallery (streamside) forest and intact miombo woodland is also of concern.

TFM will employ a multi-faceted approach to keep impacts to flora to an acceptable level. This will include avoiding copper-cobalt plants as much as is practical and the creation of copper-cobalt plant micro-reserves (PMRs) in areas adjacent to the development site. These reserves will be identified and protected from accidental disturbance. Further inventory of copper-cobalt plants on the main ore bodies of the concession will be undertaken in November 2006. This will help determine the relative value of each ore body with respect to setting aside one or more as conservation areas. TFM will also set aside areas to experiment with ecosystem reconstruction and plant propagation activities. Such activities will add to the current knowledge base for copper-cobalt flora conservation and will aid in the future planning for possible mine expansion. It is expected that no species loss will occur as a result of the TFM project.

A small area (five hectares) of gallery forest will be lost. An equivalent amount of this vegetation type will be restored within the concession. Some gallery forest is also located downstream from the project site on the Kasana River. Should dry season flows to the river be reduced sufficiently to affect the health of this forest flows will be augmented by use of groundwater. At closure miombo woodland will be replanted over portions of the plant site and other areas as feasible, unless local land users have preferred land use options.

Fauna

Impacts to fauna will include habitat loss due to site clearing and possibly habitat change as a result of changes in dust or air emission, changes in stream flow, noise, and fencing or other obstructions impeding movement. Animals may also be affected by mine infrastructure such as ponds, power lines and stacks. Animals may be killed or injured by vehicles. Increased hunting of fauna as the human population of the area grows is also an issue.

The project is being designed to minimize its disturbance area. For example, the waste rock facilities are being designed to be high so that their footprints can be smaller. In addition, best management practices will keep erosion and sedimentation under control.

Any areas that are abandoned will be promptly reclaimed, as will all sites (except open pits) at closure. Most site clearing will occur in miombo woodland and agricultural habitats. These habitats are not limited in the region. Site clearing will also affect copper cobalt habitats. However, no Red-listed species are known to be restricted to these areas.

Effects related to noise and air quality are expected to be negligible to low. This is based on the mitigation and impacts outlined in the noise and air quality assessments. Similarly, changes to water flows and quality are predicted to have a low impact on fauna.

Wildlife movements may be affected by fencing, new roads and loss of habitat. However, buffers of viable habitat will be left around the facilities to encourage faunal movement. Progressive reclamation will restore movement habitats as land is made available for reclamation. Few large species currently exist within the LSA, so fencing will not deter wildlife movement.

Wildlife death due to the project will be minimized by appropriate project design, prohibition of hunting by staff or contractors and establishing of speed limits. Increased local harvesting due to in-migration of people to the concession area is an issue that is difficult to mitigate. However, no species is expected to become extinct due to the project.

Fish and Aquatic Habitat

Fish and aquatic habitat may be affected by the TFM project due to loss or disturbance of habitat including changes in surface water flows, sedimentation and water quality. Increased fishing pressure due to an influx of newcomers into the area is also a concern.

Mitigation measures for fish and aquatic habitat are primarily related to those described above for water flows, sedimentation and water quality. Best management practices will be used to minimize erosion and sediment loading to streams. Watercourse crossing guidelines will be implemented to protect aquatic habitats. Flows in the upper catchments around the mine site will be augmented, when available, with pit dewatering water (intercepted by wells) to maintain aquatic habitats if monitoring indicates that habitat quality is being compromised following the initiation of pit dewatering. As a result, impacts to fish and aquatic habitat are predicted to be low.

Fish abundance is primarily related to

aquatic habitat. Changes in fish abundance are expected to be low to moderate. Subsistence fisheries in the concession will be similarly affected. It will be difficult to control informal fisheries and this activity is likely to increase as more people move into the area.

Natural Habitats and Biodiversity

Effects to natural habitats and biodiversity will be related to changes in flora, fauna and fish and aquatic habitat as discussed above. Key issues are to do with habitat loss or alteration, direct or indirect mortality (death) of locally endemic (native), threatened or endangered species and fragmentation of natural habitats.

Mitigation measures include those aspects discussed previously, including minimizing the project footprint, translocation of rare plant species to ecosystem reconstruction sites, conservation of plant micro-reserves and larger areas, and reclamation.

Gallery forest habitat will be directly affected by site clearing but an equivalent area of forest will be replanted during operation and closure. Monitoring of changes in stream flow near the mine will be undertaken and flow augmentation undertaken if gallery forests are shown to be affected. Copper-cobalt habitats will be impacted as most of the ore bodies to be mined are covered by this vegetation. Mitigation measures as described under flora above will limit but not eliminate these impacts. Miombo woodland habitat will also be affected during site clearing and operation, but reclamation of miombo woodland is more feasible than for copper-cobalt flora. As a result, residual effects are expected to be much less.

At the landscape level, the project will increase natural habitat fragmentation (i.e., natural habitats will decline in total area and patch size and the amount of edge will increase). Effects are expected to be low for miombo woodland and gallery forest habitats, but moderate for copper-cobalt habitats.

Protected Areas

No protected areas will be directly affected by the project. The nearest protected area is 75 kilometers away. It is predicted that there will be little, if any, effects from air or water quality or increases in the local population that may put pressure on protected areas.

Protecting and Enhancing Social and Cultural Resources

Socio-economics

Stakeholder consultation results indicate that socio-economic opportunities created by the mine are a main concern. This includes individuals who expect to directly benefit, but also those people (particularly rural villagers and women) who view employment as less of a project benefit. For these people assistance with agriculture, education, health services, water, electricity and housing are the expected benefits of project development.

There is considerable complexity in assessing the socio-economic impacts of a project. Impacts, mitigation measures and even benefits can result in many interacting effects, both positive and negative. Managing socio-economic impacts, more so than other disciplines, involves minimizing negative effects and enhancing positive benefits.

Land Use

Impacts related to land use include impacts to livelihoods and residences. The loss of agricultural land due to occupation by the project may result in the loss of agricultural income and livelihoods, increased pressure on other farm lands or land-related conflicts. Depending on the land and livelihood resources that are affected by the TFM project, preferable alternatives for compensation will be identified for affected peoples. This could include replacing that portion of the land or livelihood resource affected, or other restoration measures.

Where access to otherwise unaffected land may become difficult for users, consultations will identify preferred alternatives for addressing impacts. This can range from the provision of footpaths or other means of access to the eligibility of stranded or 'orphaned' parcels of land for compensation or replacement. The intent is to ensure that peoples' social and economic well-being are not harmed by project impacts.

Where permanent residences fall within the project footprint, residents will be physically displaced. People whose lands are required for the project will be resettled according to the Resettlement Action Plan (RAP). The village of Mulumbu will be impacted and all of the approximately 1,300 individuals in the village will be resettled. This impact will also apply to the villages of Amoni and Kiboko, which have 224 and 134 residents respectively. Criteria that have guided TFM resettlement planning are derived from the policies and guidelines of the Equator Principles, which would address the following issues:

- Both economic (e.g., farm fields) and physical (e.g., homes) displacement will be addressed if resettlement planning is needed.

- If the source of any individual's livelihood is affected by more than 10 percent (more than 10 percent of their farm fields), the replacement of that livelihood and not simple cash compensation will be required.
- Affected people will be left no worse off and preferably better off by the project.
- Losses will be compensated at full replacement cost and informal occupation rights will be taken into consideration.
- Resettlement will be carried out in a consultative manner, particularly when it comes to the selection of resettlement sites, with the affected people, the host communities and local authorities. The objective is to reach broad community consensus.
- The RAP is tied to the ESIA process and provisions will be made for long-term monitoring of affected people and their livelihood.

Workforce and Population Change

Impacts to the local population are expected to begin during the construction phase as a large workforce will be brought in from outside the project area. Large numbers of job seekers and migrants can also be attracted to the project area. These often rapid changes in local demographics can result in a number of undesirable pressures and consequences, including:

- Pressures on housing and existing minimal infrastructure.
- Development of spontaneous settlements around the project site, often associated with poor sanitation conditions, inappropriate rent taking and unmanaged agriculture.
- Disruptions to local cultures.
- Increased incidences of sexually transmitted diseases (STDs) and HIV/AIDS associated with worker and migrant in-flux.

Measures to manage potential effects will be put in place through a combination of public consultations, policies and planning. These measures will include:

- A hiring policy giving priority to local residents.
- A procurement policy that gives preference to locally produced goods and services.
- Accommodation of non-local workers in a dedicated construction camp with independent water and waste treatment facilities.
- Control of spontaneous settlements in the project vicinity.
- Busing construction workers from Tenke and Fungurume.
- Establishing project-sponsored commercial area near the construction site.

- A code of conduct for project workers that establishes rules for interaction between the project, its workers and the local community.
- Developing a workforce HIV/AIDS management and awareness program.
- Voluntary and free-of-charge HIV testing and counseling for project workers.

The project itself will make few demands on existing services and infrastructure as the non-local construction workforce will be housed at dedicated camps where all their service requirements will be met. As well, project construction will require infrastructure upgrades in the power, road, and water supply sectors. These upgrades will remain after the end of construction and will be beneficial to local communities and beyond. Improvements to transportation infrastructure associated with the project will improve roadway safety and access for local residents.

Training

It is the project's policy to provide training to employees. A positive impact of local workforce recruitment is the improved employability of those hired. Local recruitment and training will improve skills needed for better job performance and promotion, broaden the skill base of employees and prepare them for new opportunities in the future. Temporarily hired local workers will obtain on-the-job training in aspects such as safety and other technical topics. This training will enhance the capacity of temporary workers to secure better jobs in the future.

Employment and Labor

Perhaps the most significant benefit for local communities will be through direct employment and job creation. The number of direct project hires is anticipated to be 2,000 construction workers at peak of the construction phase and approximately 1,100 workers during operation at the mine. The direct and indirect economic contribution of the project sustains a multiplier process within the country, resulting in an increase in incomes and employment that exceeds the original contribution of the project. This economic rippling effect continues as portions of wages and profits are spent by businesses and workers within the local economy, supporting other jobs and businesses. It has been estimated that during operations, from four to six indirect livelihoods could be created for each direct job provided by TFM. Therefore 4,400 to 6,600 individuals within the DRC could rely on the TFM project for their main source of livelihood during operations, in addition to the 1,100 direct jobs provided by the company during that phase.

Salaries for locally hired residents will benefit both household and local economies through increases in purchasing power and by directing economies away from barter exchanges. As local people gain skills and experience through work and training, they will also improve their access to more skilled jobs.

Experience from elsewhere in Africa indicates that labor conflicts are difficult to avoid at the end of construction when numerous work contracts are terminated. Poor human relations policies and the failure to adequately manage labor agreements and worker expectations can potentially damage community relations or even create local or regional unrest. The TFM project will reduce the potential negative impacts of labor through compliance with national and international labor standards, and through on-going consultations and monitoring. The project will also enhance the benefits of increased employment at the household, local and regional levels.

Economic Impacts

It is estimated that a total of 650 million dollars of the United States of America (USD) will be spent during the construction of the project. Of this, at least USD 75 million will be spent in the DRC. The estimated spending during operations will be significant, of which approximately 40% will be spent in the DRC. Taxation over the life of the project will also be significant and will be allocated to local, regional and national governments. Because anticipated project expenditures are expected to be large relative to the size of the local and national economy the benefit is considered to be of high consequence.

The scale of the TFM project is expected to bring large economic benefits to the local area through creation of employment, demand for businesses and improvements in infrastructure. The overall goal of managing socioeconomic impacts is to minimize negative effects and to contribute to economic and social development through employment, business opportunities and training as well as through support of planned urban growth.

Community Safety

It was clear during stakeholder consultations that there is a strong desire for improved roads within the project area. Access to agricultural markets, health and educational services would all be enhanced by road improvements and would significantly assist in addressing fundamental socio-economic constraints. Communities also expressed concerns about the deterioration of roads as a result of increased traffic and rated community safety concerns regarding potential accidents. Increases in traffic volumes will be minimized by the construction, upgrading and maintenance of access roads and by the construction of a bypass road around Fungurume. The implementation of safety measures such as speed limits, drivers' education, public education and scheduled maintenance of vehicles will reduce potential impacts to community safety.

Health and Well-Being

The potential for adverse effects to human health during operations and post-closure were considered low to negligible. Potential impacts on aquatic life and agricultural resources were also considered negligible. The risks of increasing incidences of STDs and HIV/AIDS are of special concern and will be addressed through vigorous prevention, awareness and monitoring programs. Safeguarding human health is of critical importance. Sound and sustainable project development is built around regard for the social well-being of locally affected communities. The fabric of community life can be affected by a project through increases in many unwanted social pathologies, such as crime and other social ailments, or social disruptions caused by the unequal distribution of income and employment. Several measures and policies will be employed to reduce potential negative impacts on community well-being, including:

- Implementation of a workers' code of conduct.
- Accommodation of non-local workers in a dedicated construction camp.
- Establishment of a fair compensation mechanism.
- Transparent and publicly-disclosed employability and hiring policies.

Community development investments supported by the TFM project are expected to bring significant benefits to the local community. This program has already been launched with the building of three primary schools and installation of 10 village wells during the project ESIA and Feasibility Study phase. TFM is working closely with local communities and NGOs to identify and implement additional such projects during the construction phase of the project in 2007.

Cultural

Avoiding sites of cultural and historical significance is always the preferred mitigation option for sound and sustainable project development. Fortunately, most of these sites recorded in the project area can be safely avoided. Archaeological sites within the project's buffer zone (at the western boundary of the project area) can be avoided. The proposed project footprint avoids all of the cemeteries recorded. Some sites will be impacted by the project. Protecting or enhancing the cultural and historical resources of the area relies not only on best practices for appropriate identification, protection and mitigation, but also on consultation with local communities to assist in understanding the meaning and importance attached to particular locations and resources.

The cultural significance of certain sites and resources in the region is dynamic, and is the result of previous and ongoing use and access. Specific cultural-historic contexts are also important to cultural significance. While several Kipanda sites were identified within chiefs' land holdings in the project area, none were considered to be of cultural significance by the chiefs. The significance of certain sacred sites is also open to modification of use and cultural meaning. Sites such as the Kabakishi River and the Maoma cemetery and adjacent gallery forest continue to have important cultural significance within the region.

Where sites are impacted by the TFM project, practices such as the deconsecration or relocation of existing sites or cemeteries will assist in preserving the region's cultural resources.

SUSTAINABILITY ASSESSMENT

Impact analysis methodology is centered on a process to minimize negative impacts and to optimize benefits. This process focuses on direct and indirect effects that arise during all phases of the project life cycle. However, two additional areas will be considered for the TFM project:

- Development of project-supported actions over and above impact-related mitigation measures that would benefit people and the environment (social and environmental investment) beyond closure of the mine.
- Prediction of the ecological or social consequences of predicted positive effects.

This ESIA has attempted to address both these areas.

Actions that TFM could take to encourage positive, long-term effects were identified through a combination of stakeholder consultations and a series of workshops and discussions among the ESIA specialists, project design teams and management personnel.

Once the actions were identified and the impact criteria were rated for each action, the overall effect of these actions on people and the environment and on sustainability could be assessed in a semi-quantitative explicit manner.

Considering sustainability goals is in line with several recent industry initiatives, including the Global Reporting Initiative and the International Federation of Consulting Engineers. Results of sustainability analyses for this ESIA are found in each discipline's assessment section, as well as in the environmental and social action plans.

The main potential project sustainability ideas (actions) are summarized and listed in tables under physical, biological and social headings. Actions are generally not repeated between sections and multiple benefits are sometimes predicted to come from a single action. Except as noted, actions that represent mitigation measures for predicted project impacts are not included under sustainability and are not summarized here. This includes the many reclamation and closure activities that will help rehabilitate the area once the project closes.

The following tables provide examples of the kinds of sustainability-related ideas that TFM is willing to support. It must be noted that these ideas, and any others that might be considered, depend on stakeholder review, support and involvement as a condition of implementation. Development of a final sustainable development plan will only be finalized with the input and support of the many communities near the project. A Sustainability Forum will be created, comprised of local community members, local government, NGOs and TFM. This forum will be involved in selecting and monitoring the progress of sustainability actions.

Enhancing Positive Physical Effects

Similar to an impact analysis of physical disciplines, sustainability actions to improve the physical environment are usually proposed with people or the biological environment as the actual ultimate end points of benefit. Table 2 summarizes actions and predicted benefits to the physical environment according to the main proposed sustainability activities:

Enhancing Positive Biological Effects

Many mitigation measures are proposed for construction, operation and closure to minimize negative effects of the project on biodiversity. These have been detailed in the flora, fauna, fish and aquatic habitat, biodiversity and protected area sections of the ESIA. They will in general not be summarized here. Listed below are mainly those project actions which will enhance positive biological effects and which are over and above mitigation measures for specific project impacts.

Table 2 Potential Sustainability Actions to Enhance Positive Physical Effects

Sustainability Issue	Actions	Main Benefits
Assistance with agricultural initiatives to enhance soil productivity.	• Provide assistance in the areas of agricultural credit (i.e., possible "seed money"), draft animals, agro-forestry, soil mulching and green manuring linked to other local or regional initiatives.	• To both improve existing soil conditions and to offset potential additional negative effects on soils that may arise off-site owing to in-migration. • Local communities would realize socio-economic benefits from better agriculture linked to improved soils.
Geomorphology conservation.	• As part of a land use management plan, TFM will minimize disturbances to lands not required for mining operations. The areas required for mining operations will be minimized as much as possible. • Geomorphology conservation will be combined with the programs for the protection of rare plant species and watersheds (see below).	• To conserve significant landscape features, where possible.
Sustainable groundwater supply	• These initiatives are in partial response to predicted project impacts, as well as being part of a more general social investment. • Construction of wells completed with a rudimentary (mechanical) hand-pump system. These systems will be installed by village-based mobilization committees who will have long term responsibility for their maintenance and will provide a long-term sustainable groundwater supply for local villages.	• To provide a sustainable groundwater supply for the local population who rely on springs and shallow wells that are often contaminated with fecal matter.

Table 2 Potential Sustainability Actions to Enhance Positive Physical Effects (continued)

Sustainability Issue	Actions	Main Benefits
	• Similarly, training local people and transferring the existing water supply infrastructure to Fungurume could ensure the long-term sustainability of the groundwater supply for Fungurume. If approved by DRC stakeholders the wellfield used to supply the permanent village would be handed over to the community with the establishment of a local water utility following provision of water system operator training. The wellfield could provide a long-term sustainable groundwater supply for the community. • Educate the local population on the use of water from springs and dug wells would help improve public health.	• Improve public health.
	• A diversion structure will be constructed as part of a river diversion at Goma, before mining of the Goma Hills starts. This diversion structure could merely channel water around Goma or it could be designed to attenuate flows to reduce flood peaks. If the diversion structure merely attenuates flood peaks and stores no water in the long term it would be of little benefit for water supply. If the diversion structure is designed to store water it may benefit water storage needs. This diversion structure would come with environmental consequences such as reduced flow, increased mosquito breeding area and aquatic habitat temperature changes. These aspects will need to be considered in more detail prior to construction of that diversion structure.	• Water storage for dry season use, if constructed with retention capacity.

Table 2 Potential Sustainability Actions to Enhance Positive Physical Effects (continued)

Sustainability Issue	Actions	Main Benefits
Sustainable water supply	• Assistance to the local government with regional watershed planning.	• Decreased sedimentation and improved water quality.
	• Surface water quality benefits would develop from the various initiatives which concern soil conservation (see above).	
Air quality	• Equipment design and other mitigation measures will be in place to minimize air quality impacts to the environment and people. Although initiatives have been identified to improve exterior air quality, a sustainability program is proposed to assist with indoor air pollution in people's homes.	• Improved health. • Reduced demand for wood and charcoal.
	• Assistance could be given to community groups and NGOs to set up small businesses to locally make energy-efficient stoves with chimneys to reduce exposure to indoor smoke with possible benefits for people's health.	• Improved health.
	• Establish a private electrical distribution utility that could provide electricity, first to the growth centers and the permanent village and later to the public as the people become more affluent. This utility would continue beyond the life of the mine.	• Lights for evening use. • Reduced demand for wood and charcoal.

Table 3 Potential Sustainability Actions to Enhance Positive Biological Effects

Sustainability Issue	Actions	Main Benefits
Management of copper-cobalt flora.	• Off-site copper-cobalt plant community managed areas will be created as will plant micro-reserves.	• To protect remnant examples of this rare community type.
	• By retaining local residents and institutions to assist with the maintenance and protection of these areas, the TFM project can strive to preserve threatened species during the project and help develop a framework for their preservation long after the project is complete.	• To allow for rare species seed collection and population monitoring.
	• Conservation of this rare vegetation type will also benefit visual aesthetics during operation and closure	• Community education and acceptance.
Agro-forestry.	• Educate local communities on the benefits of agro-forestry.	• To counter current regional deforestation trends. • Biological and social goals can both be realized through development of agro-forestry.
Land use watershed planning.	• Assist local NGO or government agency with preparing a land use/watershed plan for the Dipeta and Mofia catchments.	• To protect riparian (streamside) areas and upper watersheds. • To focus development on previously disturbed areas or areas close to major centers.
Sustainable use of non-timber forest products (NTFP).	• Promote the commercial extraction of NTFP by purchasing products for use in the camp. This conservation strategy is based on the argument that forest conservation must be able to offer economic incentives to local rural people in order to counter the threat from destructive land use practices.	• To counter current regional deforestation trends. • To provide alternative livelihoods.
Promotion of sustainable aquatic resources management.	• Assist in the development of multi-user aquatic objectives through technical assistance and aquatic resource management training.	• Sustainable harvest of fish populations.

Table 3 Potential Sustainability Actions to Enhance Positive Biological Effects (continued)

Sustainability Issue	Actions	Main Benefits
Conservation education.	• A key to the sustainability of flora and fauna relates to local people understanding the value of biodiversity; interactive education, research and conservation programs in the RSA that include local people, local schools and the University of Lubumbashi (among others) are proposed; awareness of ecological issues may also assist local communities to better manage natural resources in a sustainable way. • Educational programs will include reference to aquatic systems to identify the potential value of conserving riparian habitats for protection of fish and fauna and for the provision of safe food sources.	• Better educated communities that recognize the value of conservation and ecology. • Continued conservation practices after mine closure. • Better educated communities help ensure safe food sources.

Enhancing Positive Social and Cultural Effects

The socio-economic impact analysis, more so than other disciplines, is by nature a mixture of minimizing negative impacts and optimizing positive benefits. There is also much complexity in social assessment, since mitigation measures and even benefits can have many interacting effects, both positive and negative. Overall, sustainability principles are the foundation for socio-economic impact assessments. For this sustainability summary mainly those proposed social investment measures not directly linked to mitigation are highlighted. These are described more in the community development plan roadmap. Additional details of positive project impacts not listed here can be found in the social action plan.

Specific proposed actions are summarized below. All proposed action must be confirmed by community and other stakeholder input before implementation.

Table 4 Potential Sustainability Actions to Enhance Positive Social and Cultural Effects

Sustainability Issues	Actions	Main Benefits
Community mobilization.	• Facilitate the formation of a functional government advisory structure for the project; this body will help integrate input from community and NGO stakeholders to set development policies and priorities.	• Advisory group that speaks for the communities
	• Work with government and NGOs to form the future TFM Foundation, which would be a cornerstone for managing and financing social development initiatives supported by the permanent social development fund.	• Framework for decision-making.
	• TFM and NGO partners will mobilize 41 communities to develop participatory three-year development plans and priorities; ongoing projects related to provision of oxen for ploughing fields, the construction of three or more schools and a potential water initiative will be supported.	• Community-specific initiatives.
Create alternative livelihoods.	• Creating farmers' associations in all 41 communities.	• Improved agricultural production.
	• Work with farmers to improve agricultural production through improved inputs.	• Give farmers a voice.
	• Assist farmers to establish seed-multiplication centers and community silos.	
	• Provide distribution and training in the use of improved seed varieties.	
	• Provide oxen, implements and training in ploughing techniques.	
	• Work with women in the areas of micro-savings, literacy, micro-enterprise and leadership development.	• Gender equality.
	• Organize, equip and provide ongoing support for 25 small-scale enterprises that will produce materials of immediate need for the TFM construction program.[4]	• Creation/promotion of small business that will continue post-closure.

4 Note: At the time of ESIA preparation 24 such enterprises had already been established for the production of bricks and chain-link fencing material.

Table 4 Potential Sustainability Actions to Enhance Positive Social and Cultural Effects (continued)

Sustainability Issues	Actions	Main Benefits
	• Establish a demonstration farm/market garden that could supply the project with fresh vegetables and be expanded to sell products outside of the areas.	• Establishment of farms and market gardens.
NGO capacity building.	• Assess current status of NGOs to receive support from the TFM Foundation or other sources.	• Develop network of capable NGOSs that can assist.
Leverage additional resources.	• TFM is evaluating participation in the Extractive Industries Alliance (USAID and DFID).	• Could double the resources available for social development and good governance.
Health	• Construction of village wells to reduce the incidence of waterborne disease. This could be tied to the groundwater initiative outlined in the physical resources table. • Education in proper sanitation, causes of illnesses and how to prevent them. • A region-wide HIV/AIDS initiative will be funded, linked also to anti-malaria work.	• Improved health. • Minimize spread of HIV/AIDs and other sexually transmitted diseases.
Acquiring and dispersing additional cultural resource information.	• Project-acquired cultural heritage data will augment the regional data base; excavation, when needed, of some of the existing archaeological sites in the concession area will contribute to our understanding of the region's prehistory; in the case of the Lower Palaeolithic site in the Dipeta Valley, it will contribute to our shared understanding of human prehistory. • Local experts hired by the project for mitigative excavations can also assist with use of found materials in education (schools, University of Lubumbashi) and display (museum).	• Increased knowledge of prehistory. • Greater appreciation of prehistory by local residents.

CUMULATIVE EFFECTS ASSESSMENT

A cumulative effects assessment was conducted for each physical, biological and social discipline. A cumulative effects assessment should consider the proposed project in addition to all other existing, planned or reasonably foreseeable projects in the regional study area. The nearest industrial project to the TFM concession is the Kakanda Mine, located some 21 kilometers to the southeast. It was considered to be outside any zone of possible interaction with the TFM project. Also, no other planned or reasonably foreseeable projects are known for the region other than TFM's own potential expansion plans. The cumulative effects assessment investigated the effects of the current proposed project with the effects of an expanded project.

Expansion of the project to a production rate of 400,000 tonnes per year of copper was considered for the cumulative effects assessment. Because of the conceptual nature of the expanded project at this time, the following assumptions were made:

- Mining of oxide ore at Fungurume, Goma, Fwaulu and Kwatebala.
- Expansion of the proposed Kwatebala processing plant to a production of 200,000 tonnes per year of copper.
- Construction of a second processing plant north of Fungurume with a production of 200,000 tonnes per year of copper.
- Construction of a second tailings storage facility north of Fungurume.
- Deposition of waste rock near the Goma, Fwaulu, Kwatebala and Fungurume pits.
- Expansion of the construction camp and ancillary facilities as required.

Predictions of effects are made with a low level of confidence given that the eventual form of the expanded project may be different from that considered in the analysis. Given the conceptual nature of the expanded project scenario, the description of cumulative effects is similarly broad and conceptual in nature. More specific and detailed assessments of potential impacts would be required prior to any expansion of the project.

Physical Effects

Cumulative effects to topography are expected to be high as approximately four times more land will be mined out or otherwise used, compared to the current project. Effects to soils are expected to be similar to, but larger than, those for the current project. Some 2,700 ha of soils are predicted to be lost due to the current and expanded projects combined. Visual aesthetics are expected to be highly altered during operations, but the impact will be reduced to moderate levels following reclamation and closure. Hazards are expected to be similar to those discussed for the current project, but the chance of hazards occurring (e.g., interaction of people with traffic) will be higher. Cumulative effects to air and noise quality were not assessed quantitatively for this assessment. However, impacts are expected to be greater due to the increased size of the project, and spread out over a larger area. Separation of emission sources, such as through construction of a second plant or mining of widely separated pits, will help to lessen cumulative effects. Groundwater is expected to be affected due to an increase in groundwater demand. Water quality effects have the potential to be greater due to mining and processing of sulfide ores. Mining of sulfide materials may require that mitigations to control acid rock drainage be put in place.

Biological Effects

The cumulative effects for the biological disciplines are all expected to be larger in magnitude, but similar in type, to effects predicted for the current project. The only exception is for protected areas, where few if any effects are expected for either the current or expanded project cases. The most important terrestrial effect is predicted to be the loss of rare copper-cobalt plant communities, as these occur where most mining is expected to take place. Mitigation techniques developed over the course of the current project, including translocation of rare species, ecosystem reconstruction and conservation of small management areas, will aid for future mitigation for the expanded project. However, the expanded project will result in larger areas of tailings and open pits that will not be possible to restore to the conditions that exist at these sites today. In-migration of people to the region as a result of an expanded project, and their effect on the local ecology through deforestation, increased fishing pressure, and other impacts, will also be an important cumulative effect.

Social and Cultural Effects

Social

Extension of the current project's life through expansion will have a positive effect on the local and regional economies through continued and increased employment, acquisition of skills, taxation and payments to the local development fund. The expanded project will therefore aid in the sustainable development of the region. More land, however, will be required to achieve these benefits and some additional communities may have to be relocated. Planning has already been initiated during the current project in order to minimize population influx to mineralized areas in order that future relocations can be kept to a minimum. Other negative social effects will be as described for the current project. These include effects related to in-migration of people with a resultant strain on local infrastructure and social fabric and increased likelihood of alcoholism, prostitution, drug-use and sexually-transmitted diseases. Effective means to address these concerns, developed over the course of the current project, will be used to lessen these potential effects of the expanded project.

Cultural

The cumulative effects of an expansion of the project could considerably increase the geographic extent of impacts on cultural heritage resources. Project development would occur across much of the study area, including additional ore-bearing hills such as the Fungurume hills. However, with additional consideration of the cultural and heritage resources of the area including surveying, on going consultation with local communities and best practices for the preservation, enhancement and mitigation of heritage resources, the social consequence of cumulative impacts is likely to be negligible.

ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM

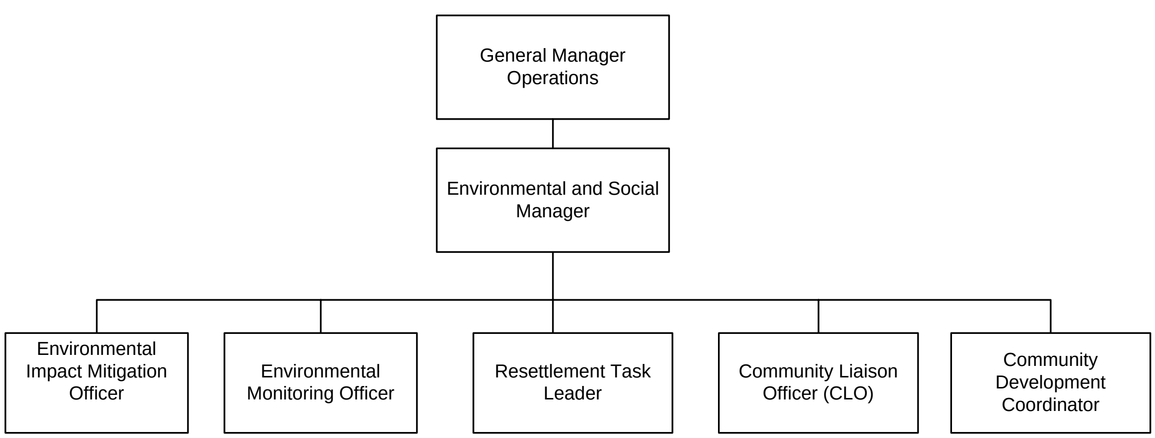
An environmental and social management system (ESMS) has been designed to implement the measures required to mitigate and manage the environmental and social impacts of the proposed project.

In accordance with best international practice, TFM will put in place specific actions to appropriately prevent, mitigate, manage and monitor the environmental and social impacts of the project from construction until post-closure.

The ESMS considers the important design aspects that are necessary to prevent the occurrence of environmental and social impacts as well as specific actions required to mitigate impacts that can not be prevented. Furthermore, the ESMS considers preventive measures to address potential environmental risks associated with the project as well as responsive measures that would need to be implemented under the occurrence of an emergency.

The implementation of the ESMS will fall under the responsibility of the Environmental and Social Department, which will be comprised of two main sub-departments: environmental and social. The manager of the Environmental and Social Department will interact with government institutions and with third party organizations throughout the implementation of the different action plans that constitute the Environmental and Social Department.

Figure 2 ESMS Conceptual Preliminary Organizational Structure



The ESMS comprises five main action plans or sets of plans:

- Environmental action plans.
- Social action plans.
- Reclamation and closure plan.
- Occupational health and safety plan.
- Emergency response plan.

The environmental action plans include 15 separate plans for pertinent environmental disciplines (e.g., air quality, surface water, flora, etc.) assessed in the ESIA and important waste streams (e.g., mine waste, domestic and industrial waste) as well as materials management.

The social action plans consider four key aspects relating to social mitigation, management and monitoring, including:

- Though not mitigation-driven, a community development plan (CDP) will be implemented to provide a framework for effective local development.
- Social management plan to address the key socio-economic issues raised in the ESIA.
- Cultural heritage plan to minimize impacts to archaeological, historical and cultural resources.
- Resettlement action plan (RAP) to ensure that any required resettlement is carried out to best international standards (see below).

The reclamation and closure plan describes the actions that will be taken for the closure of project facilities. The main objectives of the reclamation and closure plan are to ensure the long-term physical and chemical stability of the project, wherever possible restore the project site conditions that would allow post-closure beneficial use and to protect humans and wildlife from any hazards. This plan will also present necessary post-closure treatment, maintenance and monitoring measures that would be required following completion of closure measures.

The occupational health and safety plan describes the actions that will be taken to protect the health and safety of the employees involved in the construction and operation of the project.

The emergency response plan describes the actions that will be taken to respond to situations out of the scope of normal operations such as medical emergencies, fires, non-schedule explosions, vehicle accidents, hazardous materials spills/releases and natural disasters.

RESETTLEMENT ACTION PLAN

The management of social risk is a high priority for the TFM project. Achieving minimal involuntary displacement impacts is key not only to the project's social risk management strategy, but was central to decisions on where to site project facilities. TFM has committed to applying the Equator Principles and applicable DRC legislation in the design, construction, operation and closure of its mining project.

Based on air quality and noise modeling, as well as considerations regarding safety, TFM has concluded that resettlement of the three closest villages to the mine site, Mulumbu, Kiboko and Amoni, with a combined population of approximately 1,600 individuals, represents the lowest overall risk to both the residents of these communities as well as to the future viability of the TFM mining operation.

In following internationally-recognized standards for addressing involuntary settlement impacts, the quality of life for residents in these three villages will be arguably better if resettled appropriately than it would be if they were left in their current location, to be eventually surrounded by industrial development.

TFM has committed to the following key principles for guiding the implementation of the resettlement and compensation programs:

- Resettlement and compensation of Project-Affected People will be carried out in compliance with DRC legislation and IFC Performance Standard 5, which is part of the Equator Principles.
- As the vast majority of Project-Affected People derive their livelihood from agriculture, they will accordingly be offered a resettlement option that includes the provision of agricultural land of equivalent potential to that which they have lost.
- Both Physically-Displaced People and Economically-Displaced People will be compensated for their losses of livelihood.
- TFM will assist in restoring affected livelihoods, and will provide assistance as necessary during the transition period until livelihoods are restored to their previous level.
- The RAP implementation and outcomes will be monitored and evaluated as part of a process that is transparent to all stakeholders.
- Vulnerable parties within the project affected populations will be identified, and their needs addressed during the displacement and resettlement process.
- A grievance mechanism will be established and dedicated TFM staff will be responsible for recording and following up on resettlement-related grievance actions.

The Mulumbu village will be totally affected by the project, including the whole residential area and a significant part of agricultural land used by both Mulumbu residents and “transhumant” farmers from Tenke and Fungurume towns. The residential area of Amoni would be totally affected by the project, due to noise levels and to the likely concentrations of sulfur dioxide in the ambient air that might not meet World Bank Group and DRC requirements. However, the area is not to be physically occupied by mine facilities, and as a result Amoni residents’ fields near the residential area would not be affected. The impacts for Kiboko village are the same as in Amoni.

Consultation on resettlement sites is already well underway. Discussions will target both the affected communities and the host communities where applicable. This early consultation program will more finely address a number of potential concerns about the resettlement site location, including:

- Resettlement sites should be located at a reasonable distance from existing locations.
- Resettlement sites should be located in an area where the traditional powers of the Chief can be re-established.
- Factors such as groundwater availability, soil fertility, potential significance of deforestation impacts and potential impacts to existing residents will be determined.

Livelihood restoration is a cornerstone element of resettlement planning under IFC guidelines. Project-affected households are eligible to one of the three livelihood restoration packages:

- An Agriculture Enhancement Package, which provides increased surface of agricultural land above one to one replacement, training on improved agricultural techniques, and support for the purchase of agricultural equipment, fertilizers and improved seeds.
- An Employment Package, characterized as full-time employment of at least five years duration for one member of a project-affected household (or provision of one of the other livelihood restoration packages for the balance of the 5-year period), along with training appropriate to the position.
- An Income Generation-Enterprise Development Package, which is intended to help affected households identify non-farming income-generating activities, provides technical and management training and financial support for the purchase of equipment.

A number of other compensation measures form important components of the resettlement plan. These include cash compensation (both currency and in-kind payments) for replacement of residences, non-residential structures, and standing crops, and both cash and in-kind compensation for the restoration of livelihoods during the transition period.

While careful planning, ongoing consultation, adherence to internationally-recognized standards, and a range of compensation measures all support best practices, some grievances and disputes are likely during the implementation of a resettlement program. Many grievances derive from misunderstandings of the project policy, or result from neighbor conflicts, which can usually be solved through adequate mediation using customary rules. The Project will put in place an extra-judicial mechanism for managing grievances and disputes arising from the resettlement process, based on mediation by third parties. Access to this mechanism will be available without compromising access to judicial resolution that may be due. Complaints that cannot be closed to the complainant's satisfaction will be handed over to a mediation committee.

Finally, social and economic monitoring will provide a follow-up on the status of resettled people, and the implementation of program elements. TFM will provide for qualified external social audits to carry out reviews that will assess compliance with social commitments contained in DRC legislation, the Equator Principles, and the specific elements of the RAP and Social Management Plan for the Project.

CONCLUSIONS

The following table outlines the main issues, mitigation and residual impacts for the TFM project.

Table 4 Potential Impacts and Mitigation for the TFM Project

Discipline Category	Potential Impacts	Mitigation	Residual Impacts
Physical	**Topography and Soils** • Changes in the landscape and underlying geomorphology.	• Erosion control and water management as described below. • Reclamation planning to restore sustainable biological communities or agriculture as feasible.	• Moderate change in topography due to removal of hills and creation of waste rock stockpiles and tailings facility.
	• Changes in soil quality/productivity.	• Salvage of topsoils that may be useful for reclamation. • Avoidance of large-scale soil compaction. • Control of soil erosion with vegetative ground cover and other temporary measures. • Adherence to an erosion and sediment control plan. • Spill containment and clean-up practices. • Soil restoration as needed through mulching and fertilization. • Reclamation and monitoring of reclaimed land to ensure acceptable productivity.	• Moderate effects to soil productivity with losses to areas of soil at mine pits, water reservoir, some roads and some parts of the tailings facility.
	• Effect on unique copper-cobalt soils.	• Use of minimum feasible mine impact area. • Unique soil types to be stored in separate stockpiles. • Strive for the reclamation of 13 hectares of copper-cobalt soils as much as feasible.	• High effect due to net loss of areas of unique copper-cobalt soils (main impact is on flora, discussed below).
	Water • Surface and groundwater volume changes due to changes in flow regimes, catchments, groundwater drawdown.	• Minimize project footprint and diversion of streams; develop tailings facility in stages. • Maximize recycling of process water. • Establishment of a sustainable reclamation drainage plan with drainage paths to natural receiving water bodies. • Dry season flows in the Kasana and Shimpidi rivers will be augmented if necessary following monitoring.	• Moderate impact on far north and north aquifers due to groundwater drawdown. • Limited dry season surface flow declines predicted at year 15 for Mofia (-6%) and Dipeta (-7 to -16%) assessment nodes. • Maintenance of base flows at Kasana (10% at year 15), Sokalwela (15%) and Shimpidi (13%) assessment nodes.

Table 4 Potential Impacts and Mitigation for the TFM Project (continued)

Discipline Category	Potential Impacts	Mitigation	Residual Impacts
Physical (continued)	• Surface and groundwater quality changes due to metal leaching and transport, releases from containment ponds, seepage from tailings, effluent releases, treated sewage releases or accidental spills.	• Implementation of runoff and sediment control procedures during site clearing and preparation to minimize the migration of sediments to water bodies. • Use of runoff from waste rock and ore storage facilities in the processing plant. • Treatment of storm water runoff from the plant and other facilities prior to release.	• Low to moderate impact on groundwater quality at far north and north aquifers. • Moderate impact on surface water quality due to groundwater flow from waste rock and ore stockpiles resulting in possible surface water guideline exceedances of major ions such as chloride and sulfate.
		• Lined tailings facility and return water dam. • Secondary containment around surface tanks and storage areas containing potential contaminants. • Treatment of effluent, if needed. • Comprehensive environmental action plan to include hazardous materials handling requirements and spill response capability. • Emergency measures for prevention or cleanup of containment pond releases. • Restoration, as much as possible, of native plant communities at closure to control erosion. • Removal of potential contaminants and contaminated infrastructure at closure.	
	• Reduction on water supplies used by people.	• The groundwater process supply / pit dewatering system will be designed to minimize drawdown impacts on local wells / springs. • Basic groundwater supply systems will be provided to villages where spring water sources are affected.	• Negligible impact after mitigation.

Table 4 Potential Impacts and Mitigation for the TFM Project (continued)

Discipline Category	Potential Impacts	Mitigation	Residual Impacts
Physical (continued)	**Air, Noise, Traffic, Natural Risks** • Increase in dust, sulfur dioxide and nitrous oxide levels due to mine fleet exhaust, emissions from facilities and fugitive dust.	• Dust control measures including wet suppression, wind breaks, treatment of surface roads and prompt revegetation of selected exposed areas. • Maintenance of air quality levels within applicable guidelines at receptor locations.	• Impacts due to dust and vehicle emissions are low in magnitude in construction and closure phases. • In operation phase, low increases in sulfur dioxide and nitrogen dioxide; high increases in dust.
	• Increase in greenhouse gas emissions.	• Energy/fuel efficiency and use of hydroelectric power.	• Moderate increase in greenhouse gas emissions.
	• Increase in noise and vibration at the site and along access routes.	• Use of vehicles equipped with appropriate noise limiting devices. • Use of continuous miner in place of ripper, truck, shovel and crusher combination. • Maintenance of noise and vibration levels within applicable guidelines at receptor locations.	• Negligible impacts on receptors.
	• Increase in traffic congestion and traffic accident rate.	• Roads will be upgraded and widened to accommodate traffic – separate pathways constructed along some roads for pedestrian and bicycle traffic. • A bypass road will be constructed around Fungurume. • Speed limits, driver education, public education, vehicle scheduling and vehicle maintenance.	• Large increases in traffic will occur on local roads that are being upgraded. • Small proportional increases will occur on other existing roads farther from the project. • Potential increases in accident rates; low impact to community safety.

Table 4 Potential Impacts and Mitigation for the TFM Project (continued)

Discipline Category	Potential Impacts	Mitigation	Residual Impacts
Physical (continued)	• Increased risk of extreme natural events on the project, including seismic activity, exceedance of water containment capacity or slope failures; and resulting effects on the public and environment.	• Assessment of natural risks. • Project design based on international standards to manage and protect against extreme events. • Build in precautionary design features in tailings facility including adequate capacity; emergency planning to mitigate effects if a failure occurs. • Implement risk management program including aspects such as spill clean-up and protection of the general public. • Dewatering and consolidation of tailings to reduce long-term hazards.	• Residual natural risks and hazards from the processing plant, tailings facility, mine and transportation activities are expected to be in the low to moderate risk rating defined by the project risk matrix.
	Visual Aesthetics • Decline in visual aesthetics due to construction of the mines, plant and associated infrastructure on visual aesthetics.	• Use of vegetation screening, dust management, color management, and limiting light pollution. • Reclamation for establishment of native vegetation cover.	• Low to moderate impacts of most facilities on visual aesthetics. High impact of Goma mine on visual aesthetics during operation.
Biological	**Biodiversity, Flora, Fauna, Fish** • Direct loss of biodiversity including rare habitats and local endemic species, especially in copper-cobalt vegetation communities.	• Modification/minimization of footprint. • Establishment of off-site natural areas to compensate for disturbed copper–cobalt flora communities. • Establishment of plant micro-reserves. • Reconstruction of copper-cobalt communities in at least two conservation areas as feasible.	• Construction and operation: high negative impacts on copper-cobalt rock outcrop and copper-cobalt steppe-savanna habitats. Moderate negative impacts on miombo woodland habitat. Low negative impacts on gallery forest and wetland habitats.

Table 4 Potential Impacts and Mitigation for the TFM Project (continued)

Discipline Category	Potential Impacts	Mitigation	Residual Impacts
Biological (continued)		• Direct translocation of rare plants to off-site areas. • Restoration of gallery forest and some miombo forest. • Transfer of fauna microhabitat features from disturbed areas to areas unaffected by clearing. • Diversion channel (Goma pit area) for no net loss of aquatic habitat. • Reclamation of terrestrial and aquatic habitats, as much as possible.	• Reclamation will provide for moderate positive impacts for miombo woodland and low positive impacts for copper-cobalt steppe-savanna and gallery forest. • Direct faunal mortality during construction represents a moderate impact. • Direct impact on aquatic habitat will be low to moderate. • Impact on aquatic health will be low.
	• Indirect loss of habitat quality due to dust, air quality, and human population change • Improved access to rare habitats and local endemic species, resulting in increased hunting, fishing and trapping.	• Dust control measures as described above. • Agroforestry program for local residents to reduce dependence on natural habitats. • Employees and subcontractors not permitted to hunt, fish or trap on project sites.	• Negligible to moderate indirect impacts on vegetation due to dust and sulfur dioxide. • High indirect effects on fauna due to hunting/ collecting of larger local human population.
	• Reduction in on connectivity of habitat affecting movements of wildlife species.	• Compact project design to reduce edge. • Use of existing disturbed areas for temporary accommodation areas to avoid new fragmentation. • Reclamation to connect fragmented habitats.	• Moderate impact on fragmentation of habitats for fauna. For overall landscape biodiversity, low impact on miombo woodland and gallery forest; moderate impact on copper-cobalt habitats.
	• Introduction of exotic species (terrestrial and aquatic).	• Monitoring and control of exotic species. • Use of native species for reclamation.	• Increase in some weedy species (mainly plants) representing a low impact after mitigation.
	• Changes in water flows or quality from the development during operations may affect adjacent plant communities.	• Minimize water-related effects to vegetation through maintenance of flows in the dry season, if needed, and treatment of effluent.	• Negligible impact after mitigation.
	• Risk of destruction of natural habitats in downstream areas (terrestrial and aquatic) in the case of a dam failure.	• Build in precautionary design features in tailings dam (proper safety factors). • Emergency planning to mitigate effects if a failure occurs. • Major hazards mitigation as above.	• Residual natural risks for the environment from the tailings dam are expected to be in the low to moderate risk rating defined by the project risk matrix.

Table 4 Potential Impacts and Mitigation for the TFM Project (continued)

Discipline Category	Potential Impacts	Mitigation	Residual Impacts
Biological (continued)	• Water quality and volume changes in streams and wetlands, affecting fish and aquatic fauna.	• Mitigate effects through site design and water management plan (see water, above). • Mitigation as needed to address water quality issues, including lining of tailings storage facility and recycling of all waste rock, ore stockpile and plant site runoff (see water above). • Minimum dry season baseflows to be maintained for kasana, sokalwela and shimpidi catchments.	• Low to moderate impacts due to changes in downstream water flow • Low impacts due to water quality changes, mainly associated with instream works, spills or releases from containment ponds and groundwater affected by mine materials.
	• Fish habitat degradation as a result of riparian deforestation.	• Water quality protection through runoff and sediment control. • Prompt revegetation of areas disturbed along watercourses.	• Low impacts with water sediment changes, due to erosion during surface water runoff.
	• Degradation of protected areas.	• Location of project away from protected areas	• Negligible negative effects and potential positive effects.
Social	**Public Health and Safety** • Risk of increase in transmission of HIV/AIDS and other transmissible diseases. • Increased public safety risks due to the presence of large imported workforces.	• HIV/AIDS and transmissible disease programming, including public education. • Workforce codes of conduct and training.	• Medium impact due to influx of workers with associated risks of sexually transmitted diseases. • Low impact due to increase in crime caused by influx of job-seekers.

Table 4 Potential Impacts and Mitigation for the TFM Project (continued)

Discipline Category	Potential Impacts	Mitigation	Residual Impacts
Social (continued)	**Livelihoods** • Loss or reduced access to natural resources. • Higher density of people using the same agricultural and grazing resources. • Resettlement and loss of agricultural land, fruit trees and perennial crops. • Disruption to subsistence livelihood as people leave their land and try to re-establish themselves on new land.	• Co-operative forest management program. • Compensation and resettlement planning as appropriate. • Comprehensive resettlement, if appropriate, and compensation program, following detailed consultation with local communities; assistance to develop agriculture in host areas. • Provision of a combination of compensation, replacement land, title, payment of all moving costs, and temporary income during the re-establishment phase.	• Moderate impact due to loss of agricultural land. • Low impact due to loss of access to lands.
	Community Infrastructure • Loss of immovable assets and community infrastructure. • Increased pressure on existing social and physical infrastructure. • Loss/alteration of historic resources and places of cultural importance. • Disruption of social networks and support systems. • Migration (temporary workers and infrastructure needs).	• Replacement of community infrastructure, especially around areas of direct impact and in host communities. • Cooperative community development and infrastructure planning. • Avoidance, excavation and preservation of historic resources. • Resettlement planning, if appropriate, to keep extended families and sub-communities together. • Planning for temporary workforce.	• High impact due to physical displacement and resettlement of Mulumbu, Kiboko and Amoni. • Medium impact due to strain on local infrastructure with corresponding positive impact with long-lasting improvements to some local infrastructure. • Low impact due to developments of spontaneous settlements in the vicinity of project facilities. • Positive impact with increase in fiscal resources to government.

Table 4 Potential Impacts and Mitigation for the TFM Project (continued)

Discipline Category	Potential Impacts	Mitigation	Residual Impacts
Social (continued)	**Economic/Income Effects** • Increase in inflation • Increase in income effects (increased inequality, competition for jobs, increased demands on disposable income). • Loss of incomes at closure.	• Enhance community support systems/development. • Economic and social programming; proactive local employment and procurement; opportunities for training and employment with the project and assistance with business development. • Cooperative efforts with stakeholders during operation to plan for closure; reclamation planning designed to meet the needs of local stakeholders.	• Low negative impact of inflation, potentially detrimental to poorest in the community. • Medium negative impact due to loss of artisanal mining activity. • Positive impact of training for workforce with long term improvement of local population employability. • Positive impact in local household income and corresponding medium negative impact at end of construction and operation “booms”.
	Cultural and Social Change • Loss of traditional rights to the land, which are intimately related to history on the land. • Social conflict in host communities. • Cultural change (dissimilarity in age, gender, or ethnic composition).	• Compensation for land and resource use; return to title holder at closure. • Dispute resolution mechanisms; community policing. • Comprehensive workforce management program; cultural awareness program for expatriate staff; community initiatives.	• Low impact due to cultural conflict between local residents and job-seekers moving from outside the area. • Low impact due to increasing gap between “haves” (people with jobs or other benefits) and “have-nots” (people without jobs or other benefits).
	Cultural Resources • Loss of cultural heritage sites.	• Sites of importance that will be impacted by the project will be re-located with proper protocols. • Indirect impacts may be mitigated through educating non-locals of the local cultural practices.	• Low impact on cultural heritage sites in the project operations phase.