E-Tech International

231 Las Mañanitas • Santa Fe • NM • 87501 • USA • 505.983.4642

Executive Summary **August 11, 2010**

The primary purpose of this study is to evaluate the Environmental and Social Impact Study (EIA&S; Estudio de Evaluación de Impacto Ambiental y Social) and the extent to which predictions made about water quality before mining began comport with actual conditions at the mine.

The Marlin Mine is located in the highlands of western Guatemala in the San Marcos Department and produces gold and silver by open pit and underground mining. The mine is now owned by Montana Explorada de Guatemala, S.A., a 100% subsidiary of Goldcorp. The mine was partially owned by the International Finance Corporation (IFC) of the World Bank until 2006, when the loan was repaid. The Marlin Mine has been in commercial production since December 2005. The mine includes two open pits, an underground mine and associated workings, a vat leach cyanide operation, tailings facility, and two waste rock dumps.

Relationships between the mine and local communities have been tense since the exploration phase began, and a number of complaints have been lodged and protests taken place against the mine. The backdrop of political instability and violence, poverty, and natural disasters in the country and in the immediate Marlin Mine area has heightened tensions between the mine and the local indigenous communities. The 1997 mining law encouraged metal mine development and offered little protection of local land ownership. The Marlin Mine was the first mine to open under the new law and the first to receive IFC funding after their extractive industry review in 2003.

According to the EIA&S, the Marlin project was designed to conform to North American standards and would employ the best environmental management practices to minimize environmental impacts and comply with Guatemalan regulations, international guidelines for environmental management, and company environmental policies. The major shortcomings of the EIA&S are:

- The EIA&S provided limited information on the baseline environmental setting in and around the Marlin Mine. The baseline water quality monitoring period was too short (only 8 to 9 months) to evaluate seasonal and inter-annual changes in water quality before mining began. For groundwater quality, only two springs were sampled; deeper groundwater was not sampled at all during the short EIA&S period. A rapid biological assessment was conducted at a limited number of surface water locations. More monitoring locations and a longer period of baseline analysis should have been conducted for water quality, water quantity and levels, and the abundance and health of aquatic biota.
- There was not enough information on groundwater levels to know the degree of hydrologic connection among aquifers, the extent of hydrologic connection

between aquifers and surface water, or the directions of groundwater flow. Without information on groundwater flow directions, it is impossible to know the potential for the migration of contaminants from mine sources to receptors. Groundwater flow directions must be established before a reliable monitoring network can be established for the Marlin Mine.

- Essentially no information on geochemical testing was included in the main body of the EIA&S. The EIA&S predicted that the acid generation and contaminant leaching potential of the rocks would be low, but no supporting tables or figures were provided. More extensive geochemical testing should have been conducted before mining began, and a comprehensive summary of the results should have been included in the main body of EIA&S. This type of information is crucial for developing effective waste rock and tailings management plans.
- A tailings water balance model was conducted for EIA&S. However, infiltration through the impoundment was not considered in the model. The model predicted that direct discharge to the environment would be required by 2007, yet it has not yet been needed at the writing of this report (mid 2010). The causes of the discrepancy between the modeled water balance and actual conditions should be investigated.
- The EIA&S identified a number of moderately or strongly *positive* impacts related to water bodies, most of which were associated with revegetation after operations. None of these positive impacts should have been identified as such, because impacts should be evaluated relative to baseline (pre-mining) conditions rather than conditions resulting from mining operations.

To evaluate the predicted vs. actual environmental conditions, we compared predictions in the EIA&S and early annual monitoring reports with operational water resource information. Following the approach in Kuipers et al. (2006), we distinguished between "potential" impacts – those predicted to occur without mitigation measures – and "predicted" impacts – those predicted to occur after mitigation measures are in place. In the United States, permits are granted on the basis of "predicted" rather than "potential" impacts. However, Kuipers et al. (2006) found that "potential" impact predictions were more accurate and that mitigation measures often fail. For operational water quality information we examined results from Goldcorp/Montana Resources, Asociación de Monitoreo Ambiental Comunitario (AMAC), Comisión Pastoral Paz y Ecología (COPAE), the Ministry of the Environment and Natural Resources (MARN), and the Ministry of Energy and Mines (MEM). Where possible, we compared operational water quality to pre-mining conditions to determine if any observed changes in water quality or quantity resulted from mining operations. Baseline conditions not caused by mining at the Marlin Mine were also taken into account, for example, the effects of sand and gravel operations on downstream water quality.

The EIA&S identified potential and predicted impacts (positive and negative) and mitigation measures. No strongly negative effects were identified in the EIA&S. After mitigation measures are installed, the EIA&S predicted that no moderately negative impacts to water resources or aquatic life would occur. However, our findings suggest

that adverse effects to the environment may have already begun as a result of mining operations at the Marlin Mine.

The key findings of the report include:

- *The mine wastes have a moderate to high potential to generate acid and leach contaminants to the environment*. The EIS&A predicted that contaminant leaching and acid generation potential would be low. However, based on waste rock characterization information available in the Goldcorp AMRs, nearly half of the waste rock is potentially acid generating, and an additional 25 to 35% has uncertain acid-generation potential. Wastes with higher acid generation potential will release higher concentrations of metals and pose a greater risk to water resources.
- *Although more information is needed, the existing data suggest that tailings seepage may be migrating to the drainage downstream of the tailings dam.* The EIA&S did not address this issue, but our analysis of limited water quality data from Goldcorp, AMAC, and COPAE suggests that tailings seepage may be leaking into the Quebrada Seca tributary downstream of the tailings dam. A hydrologic and water quality study is needed to fully assess potential leakage from the tailings impoundment.
- *Water in the tailings impoundment does not meet IFC effluent guidelines*. The EIA&S predicted that tailings water would meet IFC guidelines during operation. However, water stored in the tailings impoundment exceeds IFC effluent guidelines for pH, cyanide, copper, and mercury. Maximum concentrations of cyanide, copper, and mercury measured in 2006 were over three, ten, and 20 times IFC guidelines, respectively. Treatment is planned for tailings water discharged to the environment, but treatment will not address leakage of contaminants to groundwater.
- *Groundwater flow directions and seepage pathways from contaminant sources to groundwater and surface water are poorly understood.* The potential for impacts to water resources cannot be adequately evaluated before groundwater flow directions are known. Arsenic and sulfate concentrations in one of the wells have been increasing over time, and because groundwater flow directions are unknown and the monitoring network is so sparse, neither the source nor the potential downgradient receptors are known. A study of water use and transport pathways should be undertaken to evaluate the potential for mine contaminants to reach water resources.

Based on our review, the key technical and policy recommendations include:

- Technical recommendations
    - <u>Monitoring</u>: The groundwater, surface water, and discharge monitoring systems should be expanded. More groundwater wells are needed to establish groundwater flow directions. More surface water monitoring points are needed upstream and more immediately downstream of mine facilities, including upstream of mining activity on Rio Quivichil. All monitoring data should be publicly available in electronic format. Analytical detection limits (the lowest concentration detectable) should be three to five times lower than

the most protective water quality standards. Future sampling efforts should incorporate quality control elements to ensure data quality, especially at a site as contentious as the Marlin Mine.

- Adaptive Management: An adaptive management plan with citizen involvement and annual meetings should be created. Monitoring results from the previous year should be reviewed, and changes in mine operations should be recommended and carried out.
- Studies needed: The potential influence of the mine on groundwater and surface water quality and aquatic life should be evaluated. A hydrogeologic study of groundwater flow directions, transport pathways (including via faults), and the extent of hydrologic connection between mine facilities and water resources and downgradient water resources should be conducted in the near future.

- Policy Recommendations
  - Water quality standards: MARN should develop water quality standards for protection of all possible uses in surface water and groundwater.
  - Bonding requirements: The Ministry of Energy and Mine should develop mechanisms for bonding of hard rock mines in Guatemala. A bond is an amount of money held in reserve to cover unforeseen expenses associated with environmental impacts that occur after closure. Actual costs of reclamation, closure, and post-closure should be incorporated into bonding, which has been as high as $250 million in the United States.
  - Independent monitoring: A well funded, independent, transparent, and scientifically rigorous monitoring system is needed with participation from all stakeholders.