Proposed Cerro Blanco Mining Project
Preliminary Comments On the Environmental Impact Analysis

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1.0 SUMMARY

The proposed Cerro Blanco mining project is located nearAsunción Mita, Jutiapa, Guatemala. Entre Mares de Guatemala, S.A., owns the mining site. Entre Mares is a subsidiary of Goldcorp, Inc. a transnational corporation headquartered in Vancouver, British Columbia, Canada.

Entre Mares submitted an environmental impact analysis (EIA 329-07) (June 2007) in support of their application for a mine exploitation license. This report partially reviews the EIA including those portions that cover the physical environment and the mining plans. The review does not include the biotic environment and the socioeconomic circumstances. Another excellent review of the EIA is given by Dr. Dina L. López[1], Professor of Geochemistry and Hydrogeology, Ohio University.

The proposed Cerro Blanco mine is an exceptionally high-risk project.

Firstly, there is the presence of very toxic arsenic in the soil, rock,surface water, and groundwater. Mining will likely increase the toxic concentrations of arsenic.

Secondly, the EIA is seriously lacking in information, planning, and reclamation guarantees.Shortcomings in the EIA provide no confidence that the owners know how to mine in a manner that protects public health and the environment.

Given the toxic arsenic (plus other toxic metals) and the inadequate EIA, the proposed Cerro Blanco mine should not be granted an exploitation license. In addition, government agencies should be most diligent in protecting public health

[1]López, D.L., 2010. *Análisis del Estudio de Impacto Ambiental para el Proyecto Minero Cerro Blanco, Asunción Mita, Jutiapa, Guatemala*, Department of Geological Sciences, Ohio University, Athens, OH, USA.

and the environment from a new toxic dischargethat comes from a tunnel mined by Entre Mares to access the Cerro Blanco ore deposit[2].

The Cerro Blanco mine is expected to be very profitable and most of the profits probably will be exported as the owner, Goldcorp, is a transnational corporation. The risks to public health and the environment should be carefully considered against the relatively little economic gain for Guatemala.

The following discussion provides justification for the preceding conclusions and recommendations.

2.0 ARSENIC RISKS

Arsenic is ubiquitous in the Cerro Blanco project area in concentrations exceeding health standards. Soils in the project area range up to 50 micrograms per gram, see EIA Table 8-21.Compare that local soil concentration with the crustal abundance of arsenic at 1-3 micrograms per gram, and the US Environmental Protection Agency arsenic soil criteria for residential areas at 0.39 micrograms per gram. A tunnel driven into the Cerro Blanco ore body by Entre Mares discharges water with arsenic concentration of 0.495 milligrams per liter (MEM 2011), which is 50 times the safe drinking water concentration permitted by the COGUANOR.Springs in the area and exploration drill holes also show very high arsenic concentrations, see EIA Section 8.5.3.5 Evaluation of Quality of Surface Water, Thermal Sources and Groundwater.

The EIASection 5.7.1 Water Supply states that Entre Mares plans to spray water from the water treatment lagoon on area roads to control dust. This practice will add to the high levels of background arsenic in the surface soil and groundwater. (Originally, Entre Mares also planned to infiltrate contaminated water from the mine into the ground in unlined ditches. *In 2011, the Initial Environmental Evaluation for the water discharge system (EAI 101-11) indicated that the channels would be lined with concrete. This will limit infiltration of the arsenic-contaminated water.*).

There could be additional effluent arsenic contamination from the waste rock dumps and tailings landfill, as the EIAgeochemistry, leach testing, and tailings landfill design are incomplete and could be inadequate. (See below for additional discussion of the preceding issues.) Most importantly, the EIAomits an analysis ofhuman health risks of arsenic transfer downslope from the project area to the agricultural fields below and then into food crops.

[2]Ministerio de Energía y Minas, 2011. *Informe Técnico Inicio de Descarga de Agua en el Proyecto Minero Cerro Blanco*, DGM-UGSA-INF-MA-35-2011.

Human health effects of arsenic at high levels are death and increased cancer risk, and at lower levels arsenic causes nausea, vomiting, and damage to skin and blood vessels.

3.0 EIA SHORTCOMINGS

3.1 Baseline Information

The physical information collected by Entre Mares to characterize the mine site has serious shortcomings. There is vital missing information regarding the mine site in the areas of geology, geochemistry, geotechnical characterization, and groundwater, as described in the following subsections.

3.1.1 Geology

In regard to Cerro Blanco structural geology, the EIASection 8.1.1 Regional Geology, Section 8.1.2 Local Geology, and Section 8.1.4 Structural Analysis and Evaluation only haveinformation on large-scale faults in the area of the ore deposit. There is no information on the smaller rock fractures. Probably, it is the rock fractures that contain the deeper groundwater, as the volcanic rock in the area is impermeable.The fractures and faults may be pathways for toxic effluentsleaching out of the mine and surrounding rock. There may be several sets of fractures of varying age and orientation, varying groundwater transmissivity, and varying amounts of gouge and infilling with varying chemical composition.The EIA Section 8.1.3 Geochemical Characterization states the ore deposit contains acid-neutralizing minerals that will neutralize acid-generatingminerals also present in the ore deposit. However, it is possible that the rock will break along particular fractures when blasted and crushed, and this will exposeprimarily acid-generating minerals but not any acid-neutralizing minerals.

The possible environmental impacts of the mining cannot be determined without a thorough examination of any fractures.

3.1.2 Geochemistry

The EIA Section 8.1.3 Geochemical Analysis reports high levels of arsenic and other toxic metals in the ore body, and reports that the toxins are likely to leach out of the hostrock unless there are appropriate mitigation measures.However, this section has no information on the spatial distribution and in-situ location of the toxic and inert rock, dimensions of the various geochemical rock type zones, and what proportion of the newly exposed rock is represented by the various geochemical results.In other words, the EIA does not indicate whatmine openings, how much of the mined rock, and how much of the ore are in the various categories of toxic and inert rock types.

The EIA makes a seemingly statistical analysis of the potential for toxic discharges by simply comparing the number of samples that areacid generatingand acid neutralizing. Because there are relatively few acid-generating samples, 40 percent, the EIA concludes that there is adequate acid neutralizing rock to mitigate the possibility of toxic discharges. However, given the lack of information in the EIA, there is no way to evaluate whether the samples are surface and/or volume representative of the rock exposed by mining and ore processing. For example, it could be that the 40 percent of acid generating samples actually represents most of the mine openings and mined rock. If so, there is a much higher risk of toxic discharge than implied by the EIA.

Other shortcomings of the EIA geochemistry section include the following:

- Table 8.2 lists results of acid-base accounting tests. However, no pH is listed for many of the samples. This measurement is exceptionally simple and an important characteristic of the leachates. Its omission indicates a possible sub-standard sampling and analysis program.
- Two of the four tables in Section 8.1.3 have no sample identification and none have location data. Sample identification is important for assuring that data is accurately transcribed from source of the data to analytical use of the data.Location data is important for determining the scale and pathwaysof the possible environmental impacts from mining and ore processing.
- The leaching extraction tests, Section 8.1.3.2, were performed over a very short time period, 96 hours, which does not adequately mimic weathering impacts on mined rock that is landfilled on the surface. These tests should be performed over several years.
- Section 8.1.3.2 makes the statement that the leaching extraction tests "provide a more conservative indicator of the potential [leachates] during operation of the mine." This statement is not true of leachates seeping out of rock faces exposed by mining. Such seeps may be on preferential pathways with concentrated toxins, and/or pathways with little or no neutralizing agents.
- Section 8.1.3.2 makes the statement, "Five of the samples had a value of acid potential with a slightly low pH…" The samples referred to in Table 8.3 have pH in the range of 2.91 to 4.79, which are exceptionally low pH indicating high acidity.
- The mineralogical analysis, Section 8.1.3.4, reports higher sulfur concentrations (approximately half of the pyrite concentration) than the results of the geochemical analysis, Table 8-2. No explanation is given for this discrepancy.

Additional shortcomings of the geochemical analysis are given by Dr. Lopez including the omission of sampling for lithium and radon that are generally present in geothermal areas; the possible safety impact on miners of toxic gases,

and hot gases and steamthat might be released explosively in the mine; the lack of adequate kinetic testing for the acid-generating potential of the mined rock; and inadequate post-closure mitigation planning in the event of toxic discharges from the project site.

3.1.3 GeotechnicalCharacterization

The EIA Section 8.1.5Geotechnical Characterization has two important omissions. First, there is no geotechnical characterization and stability analysis of the tailings, the tailings landfill site, and the tailings confinement structure. Some of the missing information includes the following.

- Geology, surface and groundwater characterization at the landfill site.
- Ashort interval contour map of the landfill site.
- Soil description and strength of the landfill base, and what measures may be necessary to strengthen and drain the base.
- Physical and structural characterization of the tailings.
- Hydrology of tailings particularly for the long term.
- Evaluation of alternative landfill sites.

Second, this section has no rock mechanics analysis of the underground mine openings. Rock mechanics are critical to the safety of mine workers.

3.1.4 Hydrogeology

The EIA Section 8.5 Hydrology does not describe the rock openings through which the groundwater passes; does not describe the boundaries of the local aquifers; does not provide the method, calculations, and graphical interpretation for estimating hydrologic parameters (permeability, conductivity, storage) (López, 2010). In addition, the EIA has no information on the possible pathways and transport properties of toxins in the rock surrounding the mine.

The EIA does not predict the quantitative impacts of the underground openings, mine waste dumps, tailings landfill, and water treatment, particularly after the mine closes. (EIA Section 8.5.7 is only a qualitative and partial analysis.) Quantitative analysis requires developing a model of each of the preceding units, characterizing hydrogeologic and chemical conditions, determining mass fluxes into the unit, determining water quality kinetics within the unit, determining mass fluxes out of the unit, evaluating migration to environmental receptors, and evaluating impact of any mitigation.

3.2 Environmental Impacts

3.2.1 Mine

The EIASection 5.7.1 Water Supply states that groundwater will be diverted away from the mine workings with wells placed on the periphery of the mine, and the mine also will be equipped with pumps to remove any groundwater that flows into the mine. Water pumped from monitoring wells and the existing tunnel has exceptionally high levels of arsenic, and there are other toxic metals. This contaminated discharge from the mine will continue during exploitation of the ore deposit, and the water will require treatment. See water treatment discussion below.

Mining will start in a shallow fresh water aquifer, break through an aquitard (geologic formation retarding water flow), and continue down into a geothermal water aquifer. It is this geothermal aquifer that has the contaminated water. When mining ends, the pumps will be removed from the diversion wells and mine, and the water table will return to its original levels. This return will occur through fractures in the rock, and any pathways in the mine that are not sealed. Because mining will create new groundwater pathways andbreak through the aquitard, it is possible that the geothermal water could contaminate the shallow fresh water aquifer, continue to the surface, and contaminate surface water.

The EIA states that there will be no impact of the mine on groundwater as the mine will be backfilled with a paste made of tailings, waste rock, and cement. Certainly, this backfill will reduce the risk of toxic discharge. However, this backfill is unlikely to seal the mine completely. Mining, particularly blastingwill break through and fracture the aquitard. Most likely not all mine openings will be backfilled,those that are backfilled probably will not be sealed tightly, nor will the blasting fractures around the mine openings be sealed.

3.2.2 Water Treatment

The EIASection 5.7.1 Water Supply states that contaminated mine water will be treated in lagoons with the addition of lime. This process is expected to precipitate the arsenic and other toxic metals from the water into sludge at the bottom of the lagoon. However, in practice this process is not perfect. Typically, some of the arsenic precipitates onto colloids that remain suspended in the water when it is discharged. Even though the discharge meets water quality standards, the colloids with arsenic accumulate downstream in the stream sediments where the arsenic enters the biotic environment through benthic organisms or the arsenic is released from the sediments as conditions change in the river.

In addition, the EIA does not have a monitoring plan to insure there are no lagoon leaks and toxic effluents escaping to the environment.

Entre Mares also plans to spray water from the treatment lagoons on-site to control dust. Even though this water may have low concentrations of arsenic, this practice could accumulate additional arsenic in the on-site soils, and over the

life of the mine result in higher levels of arsenic in soils that already are a health risk.

3.2.3 Waste Rock Dumps

The EIA Section 5.9.2.1 Solid, Liquid and Gas Wastesstates that acid generating waste rock will be encapsulated within neutralizing rock when placed in the waste rock dump. As the filling continues, the dump will be covered with soil and vegetation,and perimeter ditches will divert surface water around the dump. These measures are intended to limit exposure of the acid generating rock to weathering and surface water that could leach toxic chemicals and discharge the effluents into the environment. Such dumps are prone to failure, particularly over the long term, as follows:

1. Mixing and encapsulation of the acid generating rock must be carefully managed. However, there is little incentive for the mining company to do so. Supervisors typically are not rewarded for paying any attention to waste disposal. Proper waste disposal adds to costs and lessens company profits. Government agencies generally do not have the resources to perform daily inspection of waste disposal operations. To insure proper waste disposal, third parties should perform monitoring and inspection of waste disposal,and report results directly to government authorities.
2. Soil covers can be effective at limiting penetration of water into a rock dump. However, they require engineering design, and they are susceptible to erosion and storm events. No soil cover design is given in the EIA, and the EIA has no long-term monitoring and maintenance plans.
3. The EIA may seriously understate the possible risks of acid-generating rock. See above geochemistry discussion.

It may take many years after mining concludes for toxic dischargeto become evident from the waste rock dumps. Water penetration througha dump can be a slow process.

3.2.4 Tailings Landfill

Tailings landfills are one of the highest risk parts of a mining project. They lie on the land forever. The structure and toxic chemicals within are exposed to the weather and extreme events such as hurricanes and earthquakes.

The EIA provides noinformation on the tailings landfill. Some of the missing information includes chemistry, mineralogy, size distribution, water content, annual and total amounts of the tailings; site location and contour map; soil characterization and geology of the site; surface and groundwater characterization; engineering design and plans including tailings fill, cover, liner, and surface and groundwater diversion; stability analysis of landfill including

erosion and structure particularly under extreme events; landfill operations; monitoring and maintenance including post-closure period; analysis of alternatives; and more.

3.3 Planning

3.3.1 Project Plans

In addition to the tailings landfill, engineering design and plans are generally missing or deficient for those units of the project important to evaluating environmental impacts of the proposed mine. The EIAAppendix 17.1.1 has the project plans. This appendix has no shortinterval contour maps adequate for engineering;no map showing a plan view of project facilities and spill prevention structures; no surface disturbance map, no engineering plans for topsoil storage; no engineering plans for fresh and process water; no engineering plans and map of site drainage, erosion control, and sediment collection structures;no engineering design and plans for water treatment;no post-closure maps showing site reclamation. The only engineering plansare for one waste rock dump, layout of the industrial waste landfill, and mine water discharge cooling and treatment system, see the related initial environmental evaluations EIA 298-08 and EIA 101-11. None of the plansare stamped and signed by a professional engineer. The waste rock dump plan has no surface water diversion and liner details, and the industrial waste landfill planis only a general layout diagram, and has no profiles and details of the facilities.

3.3.2 Project Alternatives

The EIA Section 11 Selection of Alternatives is limited. The analysis does not evaluate process alternatives that do not involve cyanide, alternative methods for disposal of tailings and location of the tailings landfill. Most importantly, the analysis also does not evaluate the no-action alternative, that is, whether the nation, region, local area, public health, and environment would be better served if the mining did not proceed.

3.3.3 Post-Closure

There are two issues in regard to closing the mine in addition to the above discussion of risks to public health and the environment. These issues are the length of the post closure period, and the assurance of adequate final reclamation and closure. The EIA proposes a two-year post mining reclamation period followed by two more years to monitor success of the reclamation and perform any required repairs and modification. This monitoring and maintenance period is much too short. Generally, it requires 15 to 25 years to demonstrate successful stability of site drainage, landfills, lagoons, erosion and sedimentation, and revegetation. In addition, the risks of toxic mine drainage and failure of rock dumps and tailings landfillmust be considered in setting the post-reclamation

performance period. These risks must be modeled by experienced professionals to determine the time it might take for toxic drainage to occur, and the time it might take to test stability of site reclamation subject to extreme events such as hurricanes and earthquakes.

Throughout the life of the mine, it is most advisable to have in place a surety bond posted by Entre Mares to guarantee the full cost of reclamation. Mining companies commonly abandon their mining projects without reclamation if the company goes bankrupt, the ore runs out, metal prices drop, mining costs go up, or any other event occurs that results in little profit. The surety bond provides the funds to complete reclamation if the company abandons the site or improperly completes reclamation. The bond is returned to the company when the performance period ends, if reclamation is successful.

The EIA Table 7-4 Inversión Contemplada Para el Cierre Técnico estimates mine reclamation at US$8,350,000; This estimate is low as it is insufficient to include indefinite water treatment of any post-mining toxic discharge, and repair or relocation of any landfill. Further, the EIA has no details of the cost estimate, and the estimate should be confirmed by an independent and qualified costing engineer. Most distressing, MARN in their Dictamen y Resoluciónapproving the EIA has set the bond amount at only Q3000000 (US$375,000), less than five percent of the reclamation cost estimated by Entre Mares. There is no need for such a concession to Entre Mares. Full cost surety bonds are a standard for doing business in countries with a mature mining industry, and the company owners, Goldcorp, have accommodated to the requirement elsewhere.

4.0 DISTRIBUTION OF MINED WEALTH

The EIS Section 12.3 Evaluación de Impacto Social does not include a discussion of how much wealth will be exported from Guatemala in relation to the wealth retained in country. This is an important discussion, as the people of Guatemala should have full disclosure of the project economics in order to weigh whether the environmental risks and social impacts are worth the monetary gains. The project economics are summarized in the following tables and notes.

TOTAL PROJECT REVENUE

Project Resource	Current Metal Prices Au $1600/oz, Ag $27/oz	2007 Metal Prices Au $700/oz, Ag $12/oz
Gold 1,579,959 ounces	Q19,844,285,040	Q8,681,874,705
Silver 4,486,632 ounces	950,941,652	422,640,734
Total Revenue	Q20,795,226,692	Q9,104,515,439

TOTAL PROJECT COSTS AND PROFIT

Cost Items	Current Metal Prices		2007 Metal Prices	
	Cost	Percent of Revenue	Cost	Percent of Revenue
Investment & Operating	Q4,788,691,346	23.6%	Q4,788,691,346	54.0%
Labor	242,323,500	1.2%	242,323,500	2.7%
VAT	30,872,000	0.2%	30,872,000	0.3%
Income Tax	21,077,272	0.1%	9,228,000	0.1%
Royalty	207,952,267	1.0%	91,045,154	1.0%
Total Costs	Q5,412,833,539		Q5,162,160,000	
Company Profit	Q15,382,393,153	74.0%	Q3,942,355,439	43%

Notes:

1. Currency conversion Q7.85 = US$1.00.
2. Metal produced EIATable 5-7.
3. Investment and operating cost from total cost EIA Section 7 less labor, taxes, and royalties.
4. Labor cost EIA Table 12-24.
5. For 2007, VAT and income tax EIA Table 12-26. For current metal prices, VAT remains same, and income tax pro-rated based on increase in revenue.
6. Royalty calculated as 1% of revenue. (Royalties given in EIATable 12-26 have comma and decimal errors, and were not used.)

The Cerro Blanco ore deposit is an extraordinary resource. The mine could produce Q21.8 billion in revenue in the expected 15-year life, if the current gold (US$1600 per ounce) and silver ($US27 per ounce) prices continue. Even at the lower prices (gold US$700 per ounce and silver US$12 per ounce) as of the 2007 EIS date, the project would produce Q9.1 billion.

The investment, operating, and labor costs and VAT are the same for both cases as these items are not a function of revenue. Income tax for the 2007 metal price case was given in the EIS as noted. Income tax for the current metal price case was simply scaled up from the 2007 income tax based on the ratio of the revenue increase. Royalties are one percent of revenue. The mine is a very low cost

operation at Q5.4 billion for the current metal price and slightly less at Q5.2 billion for the 2007 metal price case.

After subtracting costs from the revenue,Entre Maresmakes a profit of Q15.4 billion or 74 percent of the resource value in the case of current metal prices and Q3.9 billion or 43 percent of the resource value in the case of 2007 metal prices. Goldcorp, a transnational company, owns Entre Mares, and the vast majority of the profit probably will be exported out of Guatemala. In addition, much of the investment cost probably will be spent outside Guatemala as little mining and processing equipment is manufactured within the country. The economic gain for Guatemala is some portion of the investment and operating costs and the 2.5 to 4.1 percent paid by the mine in labor costs, VAT and income taxes, and royalty. At the most Guatemala will retain from 15 to 30 percent of the total mined wealth of the Cerro Blanco mine. Particularly striking is the minimal amount earned by labor and retained by the central and municipal governments.

The social impact of this extraordinary export of wealth is the lost opportunity for economic development in Guatemala, a relatively poor country. Making matters worse, the public health and environmental risks discussed above could occur, leaving Guatemala even more impoverished.

5.0 CONCLUSIONS

Arsenic already exceeds typical backgroundconditions in the soil, and surface and groundwaterin the area of the proposed Cerro Blanco mine. There is a risk that mining could make matters worse and seriously impact public health and the environment. However, the project EIA submitted by the mining company, Entre Mares, is deficient in baseline information and planning for the prevention and mitigation of the possible toxic impacts.

- Some missing baseline information includes fracture geology and hydrology, water sample analytes, long-term kinetic testing for toxic effluents, modeling of possible toxic discharges, and geotechnical characterization of dumps and landfills.
- Engineering plans and drawings are generally absent.
- Entre Mares proposes self-monitoring of its operations. This plan could be disastrous, particularly for any construction where errors are not visible after the work is complete, for example, sealing the mine openings, and constructing the dumps and landfills. Self-monitoring is an inappropriate trust given the possible impacts on public health and the environment.
- The post-closure period at four years is seriously inadequate. Some environmental impacts may not appear for many years after mine closure, for example toxic discharge from the mine, dumps, and landfills. In addition, many years may pass before a major storm and seismic event validates the stability of reclamation.

- The proposed surety bond is inadequate to assure that Entre Mares will persist with the site until reclamation is clearly demonstrated.

The high arsenic risks and inadequate EIA seem little incentive to approve a mine that leaves little economic gain for Guatemala.