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A social and environmental impact assessment of the Crucitas gold mining project in Costa Rica

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ABSTRACT

In 2008 Costa Rica was facing a critical time in its history. A five year mining moratorium had just ended and mining companies were interested in exploring untapped resources in the country. The country was facing important decisions with which development path to take. The Crucitas Mining Project (CMP) was an issue that the whole country had an opinion on; in fact the Constitutional Court of Costa Rica (SALA IV) was debating what to do with the CMP. The purpose of this study was to assist decision makers by providing a well-rounded assessment of the impacts the CMP would have. The goal of this study was to evaluate whether it would be better for Costa Rica to let the mining operation continue or shut it down permanently.

This study is a social and environmental impact assessment of the CMP. The conceptual framework for integrating social and environmental impacts developed by Slootweg *et al*. (2001) was used to guide the discussion. Multiple data sources were used to get a well-rounded understanding of the issues surrounding the CMP. These data sources include literary sources, mining documents, participant observation and interviews with a wide variety of stakeholders impacted by the project. Interviewees include government officials, university professors, mine personnel and local community members.

After evaluating the social, environmental and economic impacts of the CMP it became evident that even though there would be benefits from allowing the CMP to continue, the risks simply outweighed the potential rewards. The location of the CMP, in the humid tropics, coupled with its close proximity to Nicaragua made the CMP very risky. This study concluded that the precautionary principle should be applied and the CMP should be permanently closed.

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Abbreviations

AIDA	Interamerican Association for Environmental Defense
ARD	Acid Rock Drainage
AMD	Acid Mine Drainage
CMP	Crucitas Mine Project
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EsIA	Environmental Impact Study
FECON	Northern Front in opposition to mining and Conservation Federation of Costa Rica
IISA	Industrias Infinito S.A
MINAET	Ministry of the Environment, Energy and Telecommunications in Costa Rica
PES	Payment for Environmental Services
SALA IV	The constitutional Court of Costa Rica
SEAT	Socio-Economic Assessment Toolbox
SENARA	The National Groundwater, Irrigation and Drainage Service
SETENA	Costa Rican National Environmental Technical Secretariat
SMARA	The Surface Mining and Reclamation Act of the California State Mining and Geology Board U.S.A
WAVES	Wealth Accounting and the Valuation of Ecosystem Services
WHO	World Health organization
WSFP	Waste storage facility pond

1. **INTRODUCTION**

There is a growing concern about the environmental and social consequences of development efforts. The developed world potentially faces enormous costs because of the need to restore and to protect the environment to safeguard natural resources for future generations. There is great pressure on governments of developing countries like Costa Rica to improve the living standards and quality of life of its citizens. However, "developing countries must consider how their social and economic development can be combined with protection of the environment and preservation of their natural resources. This should be regarded, not as a luxury, but as a necessity for sustainable development" (Slootweg *et al*., 2003, p.56).

This thesis is a social and environmental impact assessment of the Crucitas Mining Project (CMP). The aim of this report will be to assess whether the detrimental impacts of the mine will outweigh the potential positive impacts that could result from this mining activity in Crucitas. This is a very real and timely issue that the constitutional court of Costa Rica (SALA IV) is grappling with. The CMP had just received permission from the Costa Rican government to start clearing the mine site when an injunction was filed against the CMP, halting operations. Environmental groups had filed an objection stating the CMP is not constitutional. It is up to SALA IV to decide what to do with the CMP, should the mining operation be allowed to continue or be halted permanently. This thesis will aim to shed light on the issue by answering the following research questions.

The main research question is: should the CMP be allowed to continue or be shut down? Sub questions include, what are the environmental and biophysical impacts of the CMP? What are the social impacts and social change processes the result from the CMP? Do the benefits from the CMP outweigh the negative impacts?

This is a critical time; Costa Rica is at a crossroads in its history. A five year mining moratorium has just ended and the nation was exploring which development path it should follow. On the one hand eco-friendly development, with environmental protection is the path the country has been going towards until recently when mining was reintroduced into the development agenda. Which development path will the country follow? Decisions regarding the CMP could have far reaching impacts shaping the country's future. Therefore, this evaluation comes at a crucial time in Costa Rica's history.

This is a difficult task and thus a detailed examination of the social, environmental, economic as well as other factors will be undertaken. These factors will be discussed using the conceptual framework developed by Slootweg *et al*. (2001) for integrating Social and Environmental impacts to guide this discussion.

The environmental issues discussed will focus on the impact of the mine on biodiversity in the area and the biological corridor in which it is located. Also the potential for impacts on surface and ground water and factors related to arsenic, ARD (Acid rock drainage) and heavy metals will be explored. There are certain risks associated with mining in the humid tropics; these will be covered as well as specific circumstances that make mining risky in the Crucitas area.

The social impacts will look at how the mine is impacting the communities that are located close to it. There are 7 communities in close proximity to the mine; Coopevega, Moravia, Chamorro, El Roble, Las Crucitas de Cutris, Jocote and Llano Verde de Pocosol. Of these Crucitas is the closest. Here the positive impacts of initiatives undertaken by IISA will be explored as well as possible negative impacts the mine has had on these communities. Some interesting social impacts the CMP has had at the national level will be discussed. These include the Costa Rican government's ability to monitor and control such a project and the impact of the CMP on Costa Rica's national identity and sustainable image.

Economically the benefits for the communities around the mine, the municipality of San Carlos and the country of Costa Rica as a whole will be examined. The direct and indirect economic impacts will also be evaluated.

There are several larger issues that have been discovered over the course of this research that need to be discussed as they have significant impact on this assessment. These are due to the location of the CMP, in a biodiversity hot spot. Also the mines close proximity to Nicaragua raises some legal issues that need to be addressed. These will be opened up and discussed.

This thesis will show that there are both positive and negative impacts associated with the CMP. It will also highlight the great risks associated with establishing a mine at this particular location. The thesis will argue that the risks are not worth the reward and in this case the precautionary principle should be applied and other alternative forms of development should be perused in this area.

1.1 Location of Crucitas and the CMP

The CMP is an advanced exploration project consisting of 10 mining concessions covering an area of 176 square kilometers in north-central Costa Rica, 105 km north of San Jose and 16 km northeast of the small town of Coopevega, in the province of Alajuela. The San Juan River that forms the border with Nicaragua is located 5km north of the Cerro Crucitas site.

Crucitas is located in the North Central part of Costa Rica in the Province of Alajuela. This region has a small population in a remote area. Logging and cattle farming are the main activities in the region.

Figure 1: Map of towns near CMP (www.infinitogold.com)

Figure 2: map of Costa Rica showing the location of Crucitas (Lafleur, J.P., 2006 p.26)

Figure 3: Regional map showing the Crucitas village and project location (Lafleur, J.P., 2006 p.29)

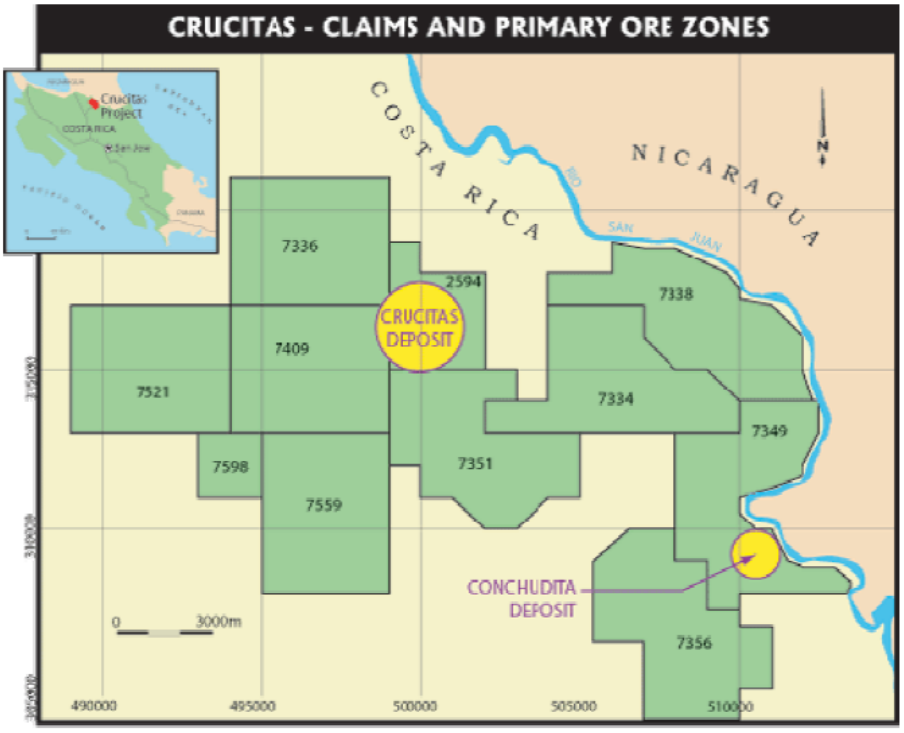

Figure 4: IISA Claims and Primary ore Zones (Lafleur, J.P., 2006 p.11)

1.2 Short socio-economic description of the Crucitas area

In considering the background of the social setting in Crucitas and the surrounding area, according the John Thomas this is the "forgotten corner of Costa Rica" (University for Peace, Roundtable discussion, November 2008). He claimed that until a few years ago when they started fixing the roads, it was very difficult to get to from Coopevega to Chamorro. This 15 km stretch of road would be almost impassable in the rainy season. There are high illiteracy rates in the communities around the mine; it can be as high as 35%. According to their estimates 43% live in extreme poverty and 38.6% live below the poverty line. Only 18% live above the poverty line. It is quite clear that this area is in dire need of development. The schools are falling to pieces, the roads need work, there is no electricity, and the people have a very hard life. It is the stated aim of IISA to promote sustainable development in the area.

José Francisco Castro, Minister of the Environment, Energy and Telecommunications in Costa Rica (MINAET) and Director of Geology and Mines commented that the communities affected by the project are located in the northern border area that is characterized by a marked condition of marginalization, poverty, high unemployment, poor infrastructure, and poor soil quality. For the most part there has been a lack of public development policies for that region. The sources of employment in the area are: Sawmills, dairy farms, livestock and agriculture, reforestation, and trade.

The area has a small population and is sparsely populated; on average the area has a density of 10 to 25 persons per square kilometer (Lafleur, 2006).

1.3 Environmental Impact Assessment in Costa Rica Law

Costa Rica has had laws pertaining to EIA since 1995. These laws can be found in the Environmental Impact chapter (Articles 18-24) of the Organic Environmental Law, Law No. 7554 of October 4th, 1995. Simply stated the law stipulates that human activities that alter or destroy elements of the environment or generate waste, toxic or hazardous materials will require environmental impact assessment by SETENA. For a complete list of these laws see Appendix 1.

Costa Rica has a classification system for determining what kind of EIA a given project will require (Guide to obtain the Environmental Feasibility, 2012). SETENA is the legal entity that regulates this process. The first step is to complete the Environmental Evaluation form (D-1 or D-2) and submit the form to SETENA. Once they evaluate the information contained in the evaluation form the project will be placed in one of the following categories:

- Category A: High Potential Environmental Impact
- Category B: Moderate Potential Environmental Impact. This category is subdivided into two subcategories:
    - B1: Moderate - High Potential Environmental Impact
    - B2: Moderate - Low Environmental Impact Potential
- Category C: Low Environmental Impact Potential

If the evaluation reveals that the project classification is a B2 or lower, the procedure will end when the applicant submits a sworn statement or affidavit to SETENA that they will wholly and entirely comply with the terms and conditions stipulated in the guidelines derived from the Environmental Impact Assessment process (Guide to obtain the Environmental Feasibility, 2012).

If the project evaluation is a B1 then the applicant will have to submit a more extensive Environmental Management Plan (Plan de Gestion Ambiental, PGA) which would set out the environmental protection measures, potential costs, time frames, those responsible for the actions to prevent, mitigate and or compensate for any environmental damages which may occur.

If SETENA determines that the project falls into the A category such as the CMP, then a full Environmental Impact Study must be conducted. These studies can only be carried out by an Environmental Consultant that has been approved by SETENA. More information on this can be obtained by consulting the General Regulations on Environmental Impact Assessment (EIA) procedures (Nº 31849-MINAE-S-MOPT-MAG-MEIC).

When projects can potentially impact on biodiversity an EIA is also required. Article 92 of [Costa Rica's] Biodiversity Law 7788 (1998), states than ‘at the discretion of the Technical Office of the Commission (SETENA), an environmental impact assessment of proposed projects shall be requested when there is a possibility that the project could affect biodiversity’.

1.4 A Brief Project Description and History

The mine project has been in progress and under development since 1992 when exploration started. Between 1992 and 1994 Placer Dome conducted extensive soil sampling, geological mapping and ground geophysical programs. A 251 diamond drill hole and 90 auger drill hole program was completed between 1994 - 1996 to identify and evaluate the Fortuna, Fuentes and Botija deposits all located on the Crucitas mining concession no. 2594. In 1999, Lyon Lake Mines became the new owner and completed a 100 auger drill hole program and commissioned a feasibility study by Cambior Project and Construction Group. Vannessa Ventures signed an agreement with Lyon Lake Mines Ltd. in May 2000 to acquire a 100% interest in the project, and is operating in Costa Rica through its fully owned subsidiary IISA (Industrias Infinito S.A). Therefore, Vanessa ventures and IISA will be used interchangeably in this report. To date over US$34 million has been spent on the property.

Since acquiring Crucitas, Vannessa Ventures has subcontracted a number of engineering reviews, filed and secured an exploitation permit in January 2002, and submitted an Environmental Impact Assessment Mining Plan in March 2002. After this the process was slow but when a public meeting was held in July 2004 in Copevega (18km from project site) 1300 people attended, a very large turnout, there seemed to be support for the mining project. In December 2005 the EIS was approved by SETENA (Costa Rican National Environmental Technical Secretariat). After this IISA took a deep look at the project and discovered it could be modified and improved in many ways. The total surface area of the mine was reduced from 126.4 hectares to 50 hectares, but the depth of the mine was increased significantly form 15 meters to 60 meters. Now they would be mining both saprolite and hard rock material, See diagram below. There was a change in effluent treatment method amongst other changes.

In February 2008 IISA received approval from the Ministry of the Environment for the modified Environmental Impact Study dealing with all technical social and environmental aspects associated with the current mine development plan. In this approved study IISA presented detailed reclamation plans which included commitments to return to native forest additional lands owned by IISA around the mining area currently used for pasture and plantation forestry. IISA will plant fifty trees on these lands for every one that was to be removed from the mine and tailings area. The mining and tailings area is a mixture of pasture and forest which had already been partially harvested in the past before it was under IISA's control.

Construction was started on June 1st but there had been some road construction before that. The project was decreed to be in the national interest of the country by president Arias on October 13, 2008. This authorized the issuance of a Change in Land Use Permit by the regional authorities in San Carlos, Costa Rica allowing for the clearing of land (the cutting of trees, including species that are forbidden) for the open pits and tailings impoundment of the CMP and the development of infrastructure in protected areas. The permit was received and clearing activities commenced on Friday, October 17, 2008 and continued up until Monday October 20, 2008, when IISA was served with a court order from the Constitutional Court, or SALA IV, requiring that tree cutting operations be suspended. This suspension was due to a challenge from an individual in Costa Rica under provisions which entitle every citizen to apply directly to the SALA IV for decisions on constitutional

issues, in this case the environmental protection provision in Costa Rica's constitution. Prior to the suspension IISA cleared the land required for the initial Botijas pit and for the area required for the tailings dam but clearing in the Fortuna pit area and the tailings impoundment area was not completed.

It was at this stage of the CMP when this research began. IISA was in the middle of solving this issue with SALA IV. SALA IV was making a very important decision, whether to allow the CMP to continue or terminate operations permanently. This was a critical time in the history of Costa Rica. The goal of this research was to aid SALA IV in the decision with regard to the CMP. Would it truly be in the national interest to allow the CMP to continue and operate as previously intended or would Costa Rica be better off without ever trying to develop this mine?

This thesis will look at the situation in Crucitas, social factors in that region and in the country as a whole. It will evaluate the environmental consequences of having a mining operation in this area and what kind of environmental impacts it will have if allowed to continue. What kind of economic impacts will this mine have for this region and for the country as a whole? Will the benefits outweigh the negatives?

1.4.1 Tailings Dam

The basic dam design incorporates a homogeneous saprolite fill section with internal chimney, finger and toe drains to intercept seepage and control pore pressures. The main dam crests will ultimately be constructed typically to an elevation 80 m and will be some 18 m wide. The upstream slopes are provided with a 1 m thick blanket of waste rock for erosion protection. The downstream slopes are provided with rock fill and a robust geo-textile for erosion protection (Ward, I.R *et al*., 2008).

At the end of mining operations, the pond water will continue to be completely contained within the basin and excess pond water will continue to be treated prior to release to the environment until such time as the water quality has improved and treatment is no longer required. Once the basin pond water meets applicable water quality standards, the tailings will be flooded with a minimum 1.0 m water cover and all runoff from the facility will discharge through the permanent spillway. Discharges from the facility on closure will ultimately flow into the Rio Infiernillo, which in turn discharges some 10 km downstream to the Rio San Juan, along the border of Costa Rica and Nicaragua (Ward, I.R *et al*., 2008).

1.4.2 About the Gold deposit

Ward, I.R *et al*., (2008) in the NI 43-101 Technical Report Summary of the Bankable Feasibility Study and Addendum Report for the Las Crucitas Gold Project have aptly described the gold deposit. The following section is based on information from there.

The CMP deposit comprises a gold-bearing saprolite (weather-oxidized soil) and gold-bearing hard-rock resource. The most recent independent estimate of the entire deposit was completed in May 1999 by Independent Mining Consultants Inc., which calculated a total measured and indicated gold resource of 44,789 kilograms (kg) (1.44 million troy ounces)

that consisted of 29.6 million metric tons (Mt) of ore at average grades of 1.51 grams per metric ton (g/t) gold and 3.41 g/t silver based on an 0.8 g/t gold cut-off grade. Inferred resources are 10.1 Mt of ore at average grades of 1.56 g/t gold and 2.93 g/t silver.

The mining will be conducted on 5 metre benches, with a pre-strip totalling 440,000 cubic metres, planned to gain barren saprolite waste to be used in construction of the tailings dam. After ramping up to plant capacity, a nominal plant feed consisting of a blend of 75% saprolite and 25% hard rock, is planned to continue until the completion of the saprolite reserves. The plant capacity is designed for 7,500 ore tonnes per day (2.50 Mtpa) within saprolite, whereas within hard rock the plant capacity is 5,000 tonnes per day (1.82 Mtpa). Therefore an initial ore production rate from the mine of 6,875 tonnes per day was scheduled in order to provide the nominal feed of 75% saprolite and 25% hard rock. On completion of the saprolite reserves the plant feed rate will be reduced and so the ore production rate is dropped to 5,000 tonnes per day. (Ward, I.R *et al*., 2007, p.7)

There is capacity for the stockpiling of 50,000 tonnes of hard rock ore, which can be stored on a pad adjacent to the plant. The planned strip ratio during mine production was 1.35, and is maintained as closely as possible throughout the mine life. At the earliest date possible, waste is planned to be back-filled into completed sections of the mine.

The production schedule is planned around a work regime of 350 days per annum and 20 hours per day. In order to minimise dilution and mining losses, ore excavations are scheduled for the day shifts.

The Crucitas mining project would last for 12 years. Below you can see a breakdown of ore production per year.

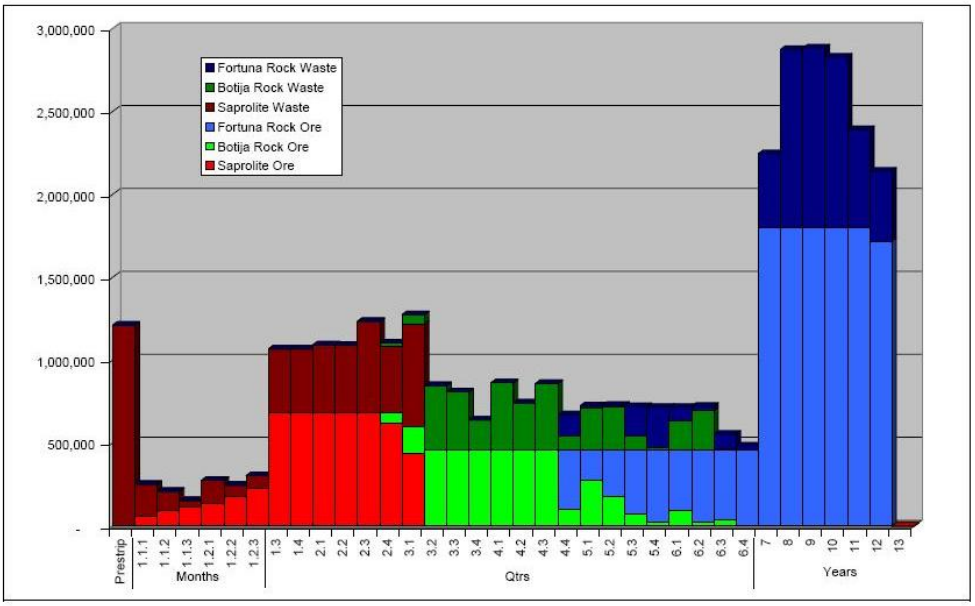

Figure 5: Graph of ore production (Ward, I.R *et al*., 2008)

The project construction period is expected to be 16 months. During construction the labour force on-site is expected to peak at 270 workers. The Crucitas project proposes two

open pit mines in North Central Costa Rica composing an area of 50 hectares in total with a tailings dam of 143 hectares. There will only be trace amounts of gold in the soil. It is estimated that there will be 1.2 ounces of gold per ton of earth. Therefore, this will require massive amounts of earth to be moved.

1.4.3 How the plant works and how the ore is processed

The process for extracting the gold from the ore is as follows:

1. The ore is crushed
2. Ground into fine grain
3. Gold is leached in cyanide
4. The gold is absorbed on coconut shell charcoal
5. Produce alloy of gold and silver
6. Exported to Canada where refined and sold

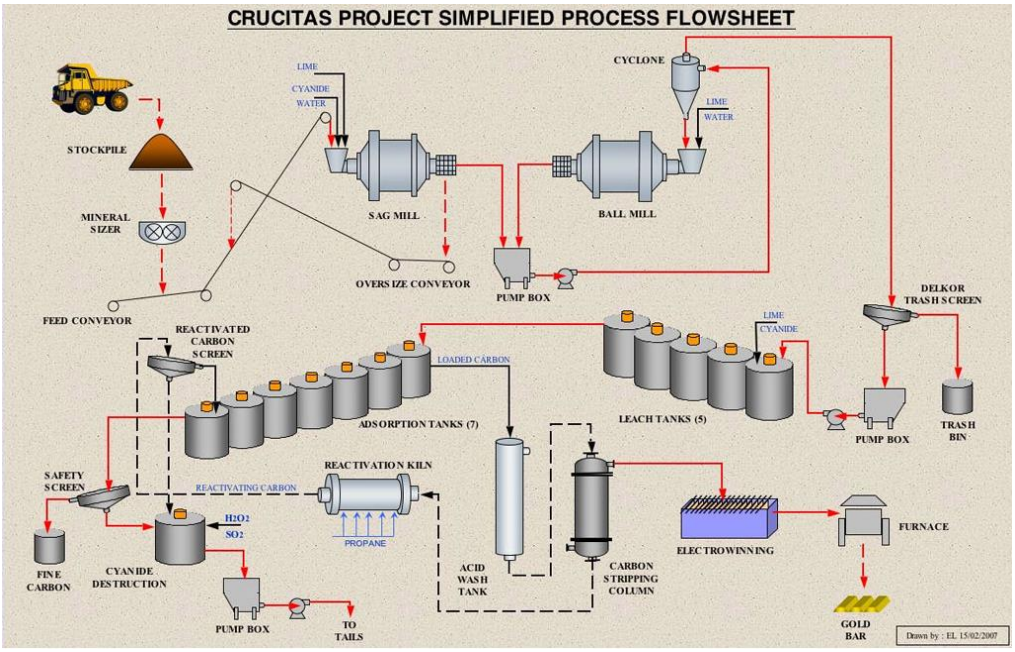

Figure 6: CMP simplified process flow sheet (http://www.infinitogold.com)

The plant is quite small 200m by 100m and all the solutions are contained steel tanks, with concrete retaining walls, all leaks and spills should be contained if there are any. Cyanide will be used to separate the gold and silver from the ore. Cyanide is a simple monticule made up of carbon and nitrogen. It is highly toxic and able to dissolve gold and silver. However, cyanide is very unstable, it is readily broken down into smaller components through an oxidation reaction into carbon and nitrogen. The CYplus process used is state of the art and is fully automated, it continually destroys cyanide and leaves an effluent that is water and ground rock and this is what goes into the tailings pond. There is no cyanide in the tailings pond, it is only in the plant where it is well protected.

1.5 Crucitas Mining Project life cycle

Aerial photograph of the mining site and the locations and of the different areas.

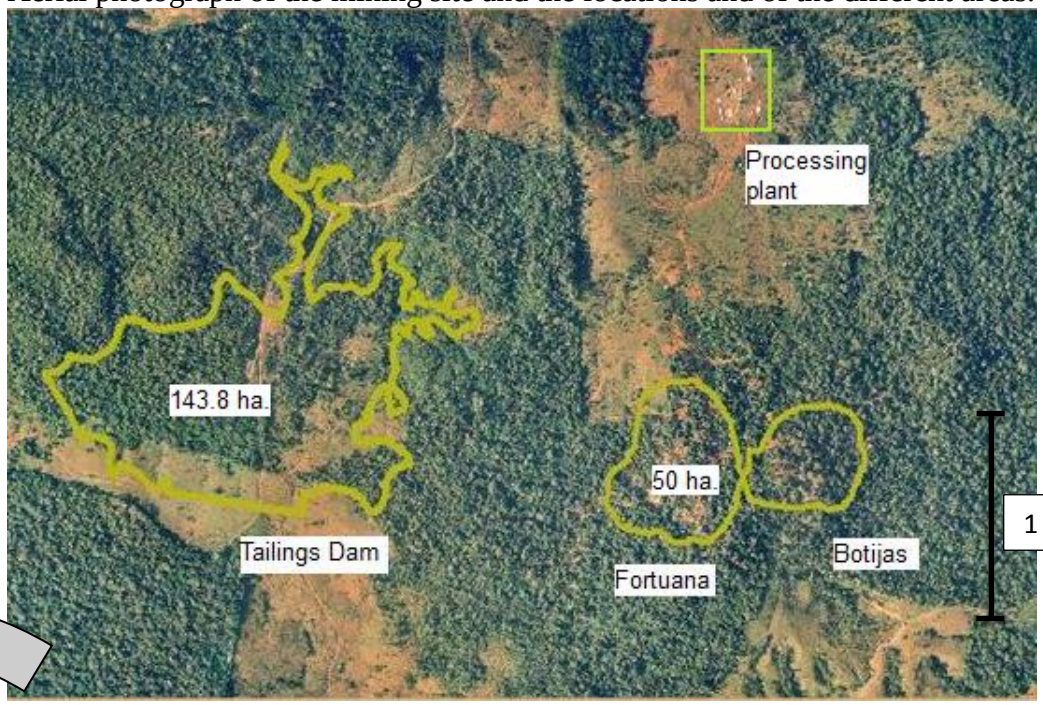

Figure 7: Aerial photograph of the mine site and the proposed layout (DGM, 2008)

The mine after 3 years

After 6 years

At the end of the project

50 years after the project

1.6 Background to Mining Moratorium in Costa Rica

In May 2002 in response to lobbying from the country's environmentalists and other foreign non-governmental organizations, the Costa Rican President, Abel Pacheco in his inaugural address, declared Costa Rica to be a country free of oil exploration and exploitation and free of open pit mining (Bruch, 2002). President Pacheco stressed that Costa Rica's future was better secured in harmony with nature, which represented the countries true and lasting treasure. His program includes constitutional and legal reforms centered towards securing reforestation, the protection of watersheds, waters, wetlands and wildlife. His declaration read, "Before we declared peace within us and declared peace with all peoples; now we must make peace with nature" (Bruch, 2002, p.238). The role of civil society organizations in supporting the newly elected president's platform and now implementing his reform program provides interesting opportunities for public participation.

If this moratorium delays open pit mining and cyanide processing, then the gold-mining industry would be directly and severely affected. Although this moratorium officially applied only to new projects, not to existing projects that had already been approved prior to May 2002, or those that were already in the process of approval, such as the CMP. The decree was still indicative of a more-restrictive legal environment for mining in Costa Rica. Failure to comply strictly with applicable laws, regulations, and local practices that related to mineral rights applications and tenure could result in loss, reduction, or expropriation of entitlements (Velasco, 2003).

This mining moratorium ended in April 2008. Many of the government officials had changed and the new government was much more open to developing the country using mineral and oil exploitation. The country is going through an interesting time in its history; seldom does the tension between environmental protection and industrial development come to the fore as it does in this case. There is an inherent tension between Costa Rica's "Peace with Nature" and mining. Which of these will shape the future of the country? There is a sense that the decisions that will be made with regard to the Crucitas mining project will shape the future direction of the country. Will it follow the path of ecological sustainability or industrial development? This is a critical time in Costa Rica's history.

2. METHODOLOGY

The methodology for this thesis is a case study approach. The case study research approach was the most appropriate since the Crucitas mining project, deals with contemporary events and results and outcome are outside the boundaries of the researcher's control. The case study approach is also relevant as the focus of this thesis is to answer how and why questions with regard to the CMP.

With these kinds of situations triangulation of data is also important to verify validity of the data obtained (Baxter and Jack, 2008). Therefore, during this research interviews were conducted with as many different stakeholders or interest groups associated with this mining project as possible. Information gathered was compared to different literary sources

such as News Paper articles and mining documents. The goal being to get a well rounded perspective of what has happened and what will be the true impacts of this mine.

Let's look more specifically at what is the definition of a case study as a research approach? According to Schramm (1971) "the essence of a case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result." This thesis will be dealing with similar questions, particularly which decision should be made by SALA IV (The Costa Rican Constitutional Court) with regard to the Crucitas mining project and why that particular decisions should be made.

According to Yin (2003) a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and contest are not clearly evident. Also rigorous qualitative case studies afford researchers opportunities to explore or describe a phenomenon in context using a variety of data sources. In this particular research area, multiple data sources will be used to get a holistic picture of the Crucitas mining project. These data sources include various semi-structured interviews with different stakeholders in the project. Semi-structured interviews were deemed to be the most appropriate method for gathering relevant data. This allowed for a greater level of detail to be obtained during the course of this research. Interviewees include: the minister of MINAET (Ministry of the Environment, Energy and Telecommunications) to obtain the official government policy and stance toward mining in Costa Rica; IISA personnel to hear about their strategies of Corporate Social responsibility and accountability to local communities around the mine and Costa Rica as a whole. Also to discuss the safety of using cyanide as an agent for extracting gold from the ore deposit.

Other interviews include University professors specializing in the environment and international law. To explore their views on the impacts of mining on the area as well as potential conflicts arising over the close proximity of the Crucitas mining project to Nicaragua and the potential trans-boundary water pollution due to this close proximity. The mine is located in the San Juan River basin and all water will drain into the San Juan river which is entirely within Nicaraguan territory. Therefore, if any pollution or contamination were to take place this would immediately become an international issue.

Interviewees also include several local community members that are living in the seven communities in close proximity to the mine. The main purpose was to ascertain what impacts the mine had had on the area and those communities. What benefits did it bring with it and what detrimental impacts did it have on the area. These are the people that will be most directly impacted by the mine therefore, I felt it was of vital importance to hear what they had to say and get them to express their views on the mining project, and how the mine had directly or indirectly impacted their communities.

Survey questionnaires were also distributed to community members around the mine but they were less well received. Too few were returned to have statistical significance.

Participant observation was also a method used for gathering data. This was recorded when visiting the area and by keeping a journal of what I saw and discovered while I was there.

The information gathered was triangulated with news paper articles and other literature, as environmental impact studies, feasibility studies and journal articles written in regard to the Crucitas mining project. This was done to verify accuracy and consistency of the data gathered.

3. THEORETICAL FRAMEWORK

This section will explore the theoretical discourses behind social and environmental impact assessment and then will elaborate on the conceptual framework that will be used in this thesis to integrate and evaluate the social and environmental impacts of the Crucitas mining project.

Historically Environmental impact assessment (EIA) and Social impact assessment (SIA) have operated in separate spheres. EIA being very scientific based in measurable quantitative data and assessment of the natural environment. It was conducted by the experts; they determined the best way to proceed that would mitigate negative environmental impacts. This is all relatively clear cut and simple, go out gather data, analyze it and make decisions on what has been discovered. SIA on the other hand is a much messier process. When people are involved it is never as clear or simple. People bring in different opinions and values and ideas, the assessment moves away from simply gathering facts to communicating with people making collective decisions and it is based on participatory methods. It is these two separate spheres that this thesis will aim to combine, not only looking at the Environmental impacts that this mining operation is having but also looking at the social impacts it has had on communities in the vicinity of the mining operation. Since this mining operation was still in the beginning phases of operation some of these results will be predictive of future impacts and others will have already occurred. This thesis is most concerned with finding out if the positive impacts outweigh the negatives. Some recommendations will be made based on the results discovered. This is a very relevant topic. Governments and the resource industries have long been criticized for failing to take seriously the social and environmental impacts of mining activities and the rights of those affected to participate in the assessment and decision making.

Slootweg *et al*., (2003, p, 56) surmise that when applied in the earliest stages of the decision making process, environmental impact assessment (EIA) and social impact assessment (SIA) can become important project planning instruments. They provide information on the consequences of specific development activities in a way that allows these consequences to be taken into account and used in the process leading to a final decision and in designing mitigation measures. Proper application of EIA and SIA can significantly improve the quality of project proposals and will eventually lead to important savings on project implementation because of reduced negative impacts and better acceptance of the project objectives.

It is important to define what social impact assessment means in the context of this thesis. At the very core and in the simplest sense SIA is analyzing, monitoring and managing the social consequences of development (Vanclay, 2003b). Arguably the origins of SIA and

EIA stem from the 1969 National Environmental Policy Act of the USA (NEPA) (Vanclay, 2002).

Frank Vanclay (2003a, p.1) one of the leading experts on SIA has described its objective as ensuring that developments (or planned interventions) that do occur maximize the benefits and minimize the costs of those developments, especially those costs borne by the community. By identifying impacts in advance, better decisions can be made about which interventions should proceed and how they should proceed. Mitigation measures can be implemented, and redesign can occur, to minimize the harm and maximize the benefits. By promoting participatory processes, better consideration can be given to what appropriate development for a community may be.

Based on this purpose Vanclay (2003a, p.6) defines SIA as including , "the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment." Mahmoudi *et al*. (2013, p.3) describe Social impact assessment as referring to "certain or expected outcomes", and that it includes "all social and cultural consequences relating to the activity or event".

It is this definition that will be used to guide the discussion in this thesis. One of the goals is to integrate social and environmental assessment into a coherent conceptual framework. Slootweg *et al*. (2001) have developed such a framework. Their framework is based on the so called 'function evaluation' of nature. The starting point in this approach is that "society utilizes products and services that are provided by the biophysical environment" (Slootweg *et al*, 2003, p.57). This framework presents a useful way of thinking about the integration of social and environmental impacts, and for conceptualizing the full range of social impacts that are likely to occur from a given intervention. By following impact pathways, or causal chains, and specifically by thinking about the iterations that are likely to be caused the full range of impacts can be identified. This makes the model a useful scoping mechanism and a heuristic aid (Van Schooten *et al*., 2003, p.79-80).

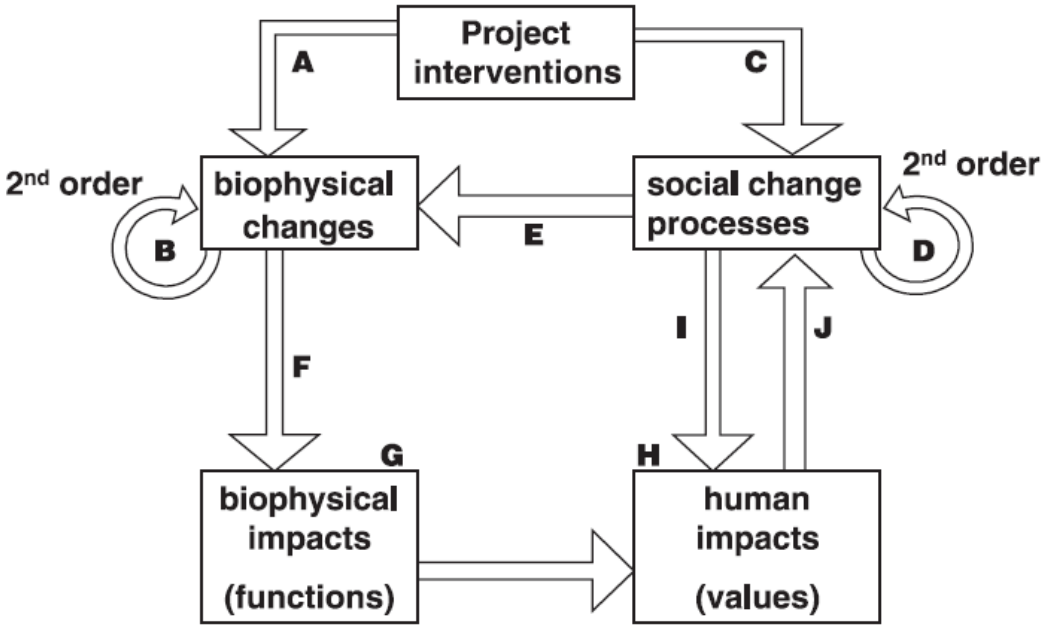

Figure 8: Conceptual Framework (Slootweg *et al*. 2001 p. 26)

A new term, 'human impacts', is introduced which can be defined as, "the effect resulting from social change processes or bio-physical impacts, as experienced (felt) by an individual, family or household, community or society, whether in corporeal (physical) or perceptual (psychological) terms". Biophysical and social impacts are framed and thought of in regard to their impact on humans, and thus the final recipient of impacts is the same only the pathway is different.

This is another way to structure social and biophysical knowledge in impact assessment. It shows that the social setting can be influenced by interventions through two pathways: indirect and direct. Indirect human impacts result from changes in the natural resource base and derived functions, that is, from biophysical impacts. Direct human impacts originate directly from (social) interventions (via the social change processes) and either are especially designed to influence the social setting (objectives) or are an unintended consequence of the intervention (Slootweg *et al*., 2003, p. 67-68).

Social change processes that result directly from the intervention, the so-called 'first order changes', can lead to (several) other social change processes, the second, and higher order change processes. In addition, the social experience of change (that is, the human impacts) can also prompt people to undertake other behaviour or further social change processes. Social change processes can also provoke biophysical changes. It is these social and bio-physical change processes that lead to bio-physical and social impacts, that can either be direct or indirect human impacts. These are the cause-effect pathways that will be utilized in this thesis to identify what kind of human impacts the Crucitas mining project has already had and potentially could have.

Through this process the worlds of environmental impact assessment and social impact assessment that have historically operated in their separate realms be unified in a conceptual framework. The goal is to use this framework to provide insight and understanding of, complex cause-effect chains that may lead to desired or undesired effects

as well as assist in the identification of potential environmental and social and economic impacts of this planned intervention.

To open up this conceptual framework even further, Slootweg and Kolhoff, (2003, p. 660-661) have provided short descriptions that coincide with the letters in the diagram to explain each link more clearly. This list can be found in Appendix 2.

Slootweg *et al*. (2001) have stressed that this is "not a procedural framework for impact assessment and that it is not a predictive model. Rather, it is a way of thinking." This is the way it will be utilized in this thesis. This conceptual framework will be used to guide the discussion of the impacts of the CMP.

To make the assessment of impacts easier and clearer first the biophysical impacts of the CMP (indirect human impacts) will be discussed, followed by the discussion of the social impacts (the direct human impacts).

4. RESULTS

4.1 Biophysical changes and impacts

The discussion of the biophysical changes and impacts will be limited to the most significant changes and impacts. The purpose of this thesis is to aid decision makers, therefore, a broader overview of biophysical impacts will be undertaken. An extremely technical description would defeat this purpose.

The CMP will have certain interventions that will directly result in bio-physical changes. These biophysical changes will then result in various bio-physical impacts that will have impacts on values for society. The following steps will be used in determining the impacts resulting from bio-physical changes.

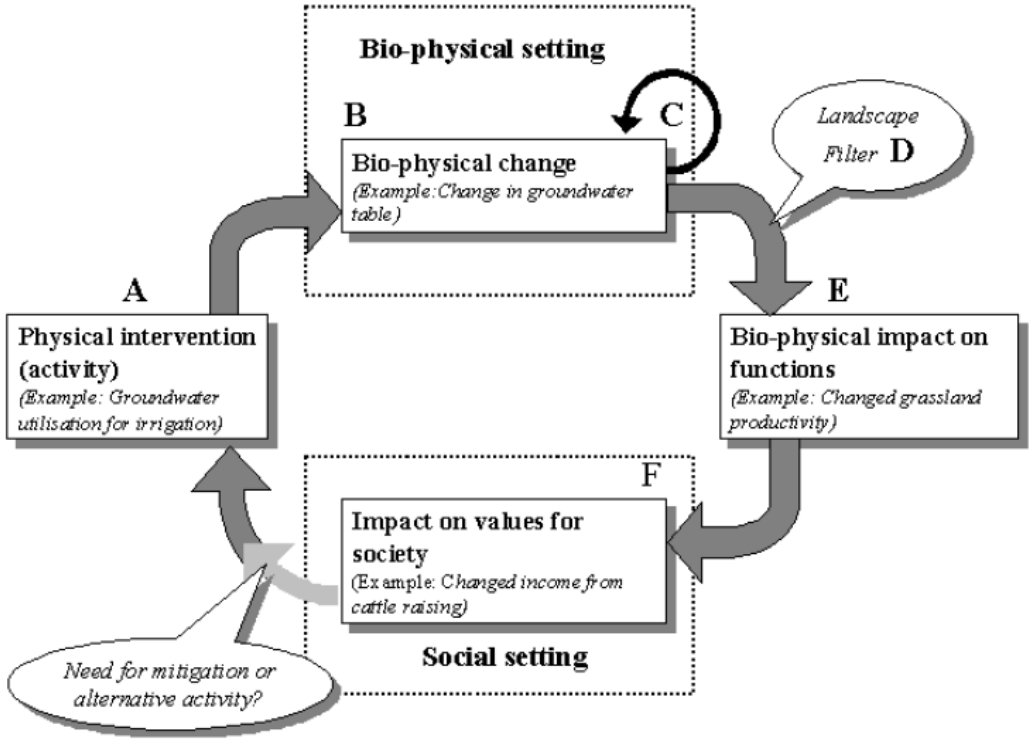

Figure 9: Steps in determining impacts (Slootweg *et al*., 2003 p. 64)

The figure shows that physical interventions (A) create changes to the characteristics of the natural resources in the biophysical setting (B). The biophysical change that directly results from an intervention is a first order change. This change may in turn cause second- and higher –order biophysical changes (C).The figure shows that changes in the physical and biological properties of natural resources will change the functions of the natural environment (E); the goods and services provided by nature. These changes are called the biophysical impacts. Biophysical impacts can be expressed in terms of changes in the products and services provided by the environment and will consequently have impacts on the values of these functions for human society (F). Changes in the functions of nature will lead to changes in the values assigned to nature.

The primary interventions in the CMP are designed to have direct influences in the bio-physical setting. However, there are also interventions undertaken by the IISA to influence the social setting and offset some of the negative impacts caused in the bio-physical setting.

Slootweg *et al*. (2001) identify several key questions that need to be asked in impact assessment.

1. How are social and biophysical impacts interlinked?
2. What are the chains of events that lead from a proposed intervention to expected impacts?
3. Can second- and higher-order effects be identified?
4. Can off-site impacts (away from the site of the intervention) be identified?

These questions will be used as a guide in the evaluation of biophysical impacts. Of all the biophysical impacts that the CMP will have they can be categorized under three major first order biophysical changes. (1) Changes in forest cover due to clear cutting open pit areas and the tailings area. (2) The CMP will result in various impacts on water sources; firstly impacts to surface water will be discussed. (3) Followed by an examination of the impacts on groundwater. These three first order changes will be used to start and structure the discussion on biophysical changes and impacts. From these three broad divisions the most pertinent higher tier impacts will be expanded upon.

The CMP would entail the clear cutting of 192 ha of forests, to clear the area for the two open pits and the tailings pond. This deforestation will result in a variety of biophysical changes and impacts. This study will also focus on these impacts with regard to the biodiversity of the area.

4.1.1 Deforestation

This section will discuss how deforestation leads to changes in forest cover and composition, including issues regarding the cutting of the Mountain Almendro tree (*Dipteryx panamensis*) and how this impacts on conservation efforts of the Great Green Macaw (*Ara ambiguous*). Change in forest cover and land use also results in the fragmentation of the forest within the San Juan-La Selva biological corridor, which is where the CMP is located. This section will also highlight issues regarding how effective the closure plans of IISA in regard to reforestation of the area may or may not be.

One of the major issues of debate surrounding the mining operations and actually the reason why an injunction was filed against the CMP ceasing operations in 2008 is that with in the area that needs to be cleared for the two open pit mines and tailings pond there are 196 Almendro trees. These trees are of great significance as by law, it is prohibited to cut down these trees. The government needs to issue a special permit to cut any of these trees. On the project site there are over 700 individual Mountain Almendro trees, however only 196 are in areas that need to be cleared (University for Peace, Roundtable discussion, November 2008). The reason the Almendro tree is protected by the constitution is that it is a feeding and nesting ground for the endangered Great Green Macaw. The Great Green Macaw has been on the IUCN Red list as an endangered species since 2005 due to extensive habitat destruction and capture for the cage bird trade (BirdLife International 2012). The impact of the CMP on the Great green macaw will be explored in more detail.

Olivier Chassot, the Research Director at the Tropical Science Center and the coordinator of Research and Conservation of the Great Green Macaw has provided some very interesting insight into the impacts of the Crucitas mining project. One of the first things that needs to be emphasised is the location of the CMP. It is located in the San Juan-La Selva biological corridor and the area of influence of the mining project is also part of the buffer zone of the Rio San Juan Wildlife Refuge and the Indio-Maiz Biological Reserve, which belongs to the Rio San Juan Biosphere Reserve. This is an area of great ecological importance; it is the only remaining ecological connection of moist broadleaf forest between Nicaragua and Costa Rica. In the Corridor area there are more than 500 species of birds, over 120 species of mammals, 60 species of fish and over 700 species of trees

(Chassot and Monge, 2009). Many of these species are on the endangered species list of the International Union for the Conservation of Nature.

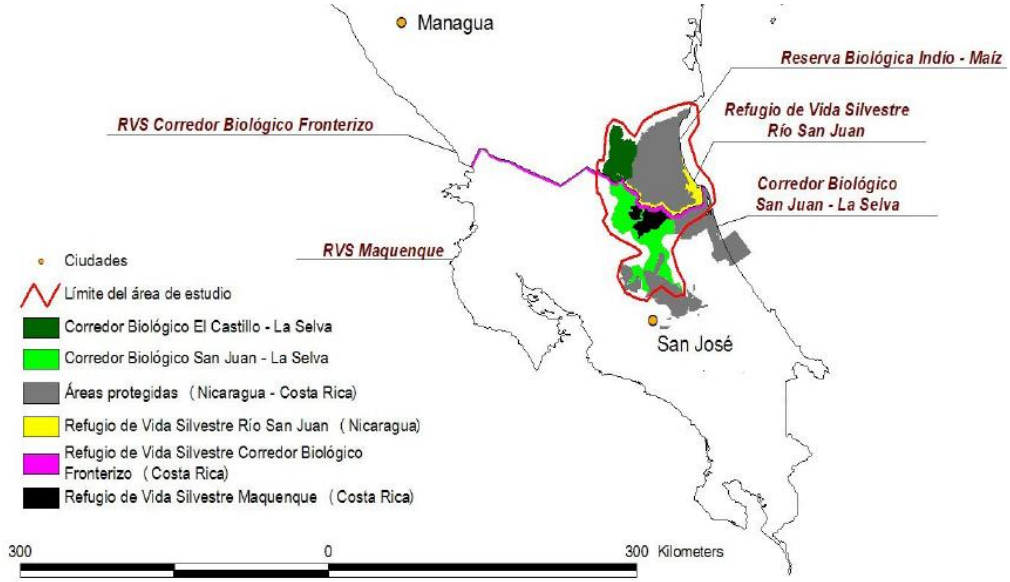

Figure 10: Map of bi-national reserve (Chassot and Monge, 2012)

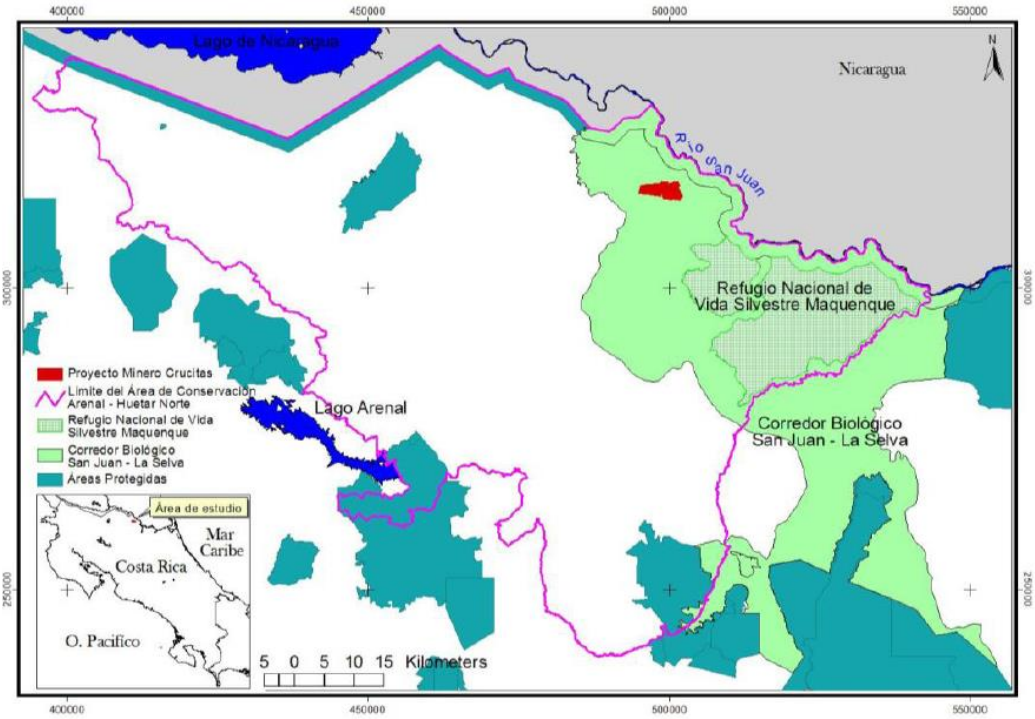

Figure 11: The location of the CMP in the Biological Corridor (Chassot and Monge, 2009)

The Great Green Macaw is also a topic that has spurred much debate with regard to the mine. It has a limited distribution in the Atlantic wet lowlands of Central America, from eastern Honduras to northern Colombia. The total global population is estimated to be about 7,000 individuals (Monge *et al.*, 2009). In Costa Rica, this species is currently limited to 600 km2 of tropical very wet forest in the northern part of the country on the

border with Nicaragua. There were estimated to be 1,530 individuals in the southern Nicaragua - northern Costa Rica population in 2009 (BirdLife International, 2013).

The Macaw depends on the Mountain Almendro tree, both for feeding (85% of all food during breeding season, December to June) and nesting (90% of nests are located in this tree species) (Monge *et al.*, 2003). This magnificent bird has been in serious danger of disappearing from Costa Rica, although recently its population has increased due to improved policy, governance and to the implementation of a connectivity conservation initiative and a biological corridor (Chassot *et al*., 2010).

Jorge Lobo, a biologist and professor at the University of Costa Rica has done some research of the impact of the CMP on the Almendro trees. He has argued that if the CMP is allowed to continue as planned, "In reality the Crucitas site will never be the same as it was, especially where one of the species in question has a slow growth rate as the Almendro tree" (Lobo *et al*., 2009, p.6). The Almendro tree, according to several studies on growth rates in plantations in the northern and Atlantic regions of Costa Rica, the Almendro initially grows quite fast on average 1.4 to 2 centimeters in diameter per year (varying a bit depending on the conditions at the site), but after a few years the tree growth reduced drastically resulting in Almendro's taking a long time to reach maturity. Petit and Montagnini (2006) classified the Almendro as slower growth. Other species, such as the Black Manwood (*Minquartia guianensis*) and *Lecythis ampla*, are also within the area affected by the CMP. These are also slower growing hardwoods and require a long time to grow. The slower growth rates of these species will impact on the success of the reforestation and regeneration efforts after the closure of the CMP.

The management plan of IISA includes reforesting the area after the mining operation is finished including up to 5000 Almendro trees. Lobo has noted that this sounds good on paper but what kind of benefit will it actually have. As already noted the young Almendro trees provide food for the Green Macaw and the old trees provide nesting opportunities. The green macaw will only nest in trees that have a trunk that is over 30 meters tall. Therefore, nesting sites are one of the most important constraints to the growth of the population of the Macaw, because large trees are becoming increasingly scarce. The slow growth rate of the trees means that it will be many years before the newly planted trees will be of benefit to the Macaw. It will be tens and hundreds of years before the true benefit of the reforestation effort will be realized. Lobo recognizes that undoubtedly, these time commitments far exceed what IISA have established in their environmental impact study (which only speaks of 18 months after the end of the project). Who will monitor the growth of the young trees that have been planted after IISA leaves to ensure they reach maturity? This is one of the aspects that has not been accounted for.

Lobo *et al*., (2009, p.6) not only discuss the Almendro tree but other trees found on the Crucitas mining site. The Almendro is an emblematic tree protected by the constitution, but the reality is that there are many other species in danger of extinction, and/or with very small populations, and whose reproduction is pretty limited or completely unknown. Lobo feels quite strongly "That for Crucitas, the regeneration process will be difficult and slow, because of the vast deforested area, the landscape surrounding the exploited area is already very deforested and has highly fragmented forests, and very importantly the soil would be transformed and lose fertility and become degraded after intense erosion and potential chemical pollution, and so on". Due to the environmental degradation it will be difficult for

seedlings to take root and grow. There are other facts that will increase the difficulties of indigenous slow growth tree species. Lobo *et al*., (2009, p.7) also notes that the, "Fragmentation of forests and human intervention also introduced the problem of the growth of invasive species: plants and animals that quickly colonize disturbed areas eliminating the chance for other species, often it is precisely those most at risk of extinction". IISA has committed to reforesting the area with indigenous species. Indigenous species to this area that are already engendered are slow growing, thus giving faster growing invasive species a chance to colonize the area. This will undoubtedly be one of the challenges for preserving the biodiversity in this area.

There are arguments that suggest that the CMP will not have a direct impact on the Great Green Macaw. Evidence compiled by Chassot suggests that the population of the Great Green Macaw is not dependent on Crucitas area for food. The Great Green Macaw does not nest in any Crucitas area, the closest nest is located 8.7 km from Las Crucitas. Also according to M. Jorge Hernandez Benavides, Programme coordinator of Wildlife Conservation Area, Central Volcanic Range, of the 196 trees cut by the Crucitas project there were no Macaw nests and none of the baseline studies reported nests at the site of Las Crucitas. It appears that the CMP would not directly impact the current populations of the Great Green Macaw. However, what about the indirect impacts?

Chassot goes on to discuss the indirect or not so obvious impact that the Crucitas mine will have on the effort to protect the Great Green Macaw. He states that "even though Crucitas is not part of the nesting area of the Macaw, it is important to note that the mine is inside the Maquenque National Wildlife Refuge. The Crucitas mining activity may not have direct harmful consequences on the population of the green macaw, but it certainly will have an impact on conservation efforts that have focused on this magnificent species" (Chassot and Monge, 2009, p.5). The constitutional court has suspended clear cutting of the Almendro tree to help protect the species. Therefore, how can the state deny a permit to farmers from cutting an Almendro tree when it has authorized the felling of hundreds of them to a foreign company? These higher tier impacts of this action could be quite extensive and this is a difficult question to answer. The impacts could be quite significant if we look a little farther back through Costa Rica's history.

Costa Rica has had a significant problem with deforestation in the past. In the 1950s, a full 50 per cent of Costa Rica's territory was covered in forest (Evans, 1999). The chainsaw and the growth of the fast food industry provided the means and the desire to expand the agricultural frontier much more quickly than before (Evans, 1999). By the 1980 Costa Rica boasted the highest deforestation rate in the Western hemisphere. It was so rapid that by 1990 the percentage of land under forest cover had diminished to 25 per cent total (Evans, 1999). It was through concerted political and private sectors will that these alarming deforestation rates were halted and reversed. Programmes such as payment for environmental services (PES) were instrumental in this turnaround (see Pagiola, 2008; Daniels *et al*., 2010). The most recent assessments suggest that as a result of this and other efforts Costa Rica's forests have now recovered to 1950s levels, encompassing 52.38 per cent of the country (Fletcher, n.d.). The transition in Costa Rica has been quite remarkable, and it has been no easy task to achieve these results. Therefore it is important to consistently enforce the rules and regulations with regard to deforestation. Chossot presents a prudent question, with no easy answer.

It is the location of the CMP that exacerbates many of the impacts it will have. According to Chassot and Monge (2009), The Crucitas project is within a geographic area of paramount local, regional, national and bi-national importance. For these features, the site itself must be subject to outstanding efforts of conservation and sustainable development. The removal of forest cover whether primary or secondary, decreases the chances of maintaining the structural connectivity along the San Juan-La Selva Biological Corridor. This corridor is subject to a continuous process of fragmentation, so it is of paramount importance to maximize opportunities to strengthen connectivity through activities designed to prohibit land use change. The increased fragmentation of the biological corridor makes it more difficult for species to survive. Again this will have direct and indirect impacts on biodiversity in the region.

The current project may seem relatively small and the amount of deforestation rather insignificant. After all, 192 ha seems rather small in an area that is 600 sq.km. However, this rather small project may lead to some much larger impacts. What is worrisome in regard to forest fragmentation and biodiversity is that the IISA is not just looking to limit itself to Crucitas; they have plans on expanding and exploiting other resources in the region.

In an interview with Gold investment News, John Morgan, President, CEO and director of IISA stated that, "We're excited not only in the Crucitas project, but it's the potential we have in the land surrounding it for incremental discovery" (Alper and Cueni-Cohen, 2008).

Costa Rica recently lifted the moratorium on open mining in April 2008. The moratorium had no effect on Crucitas, but Morgan acknowledged that this will add value and interest to future projects in the area. In fact IISA has submitted requests for exploration permits to a number of different sites. See figure below.

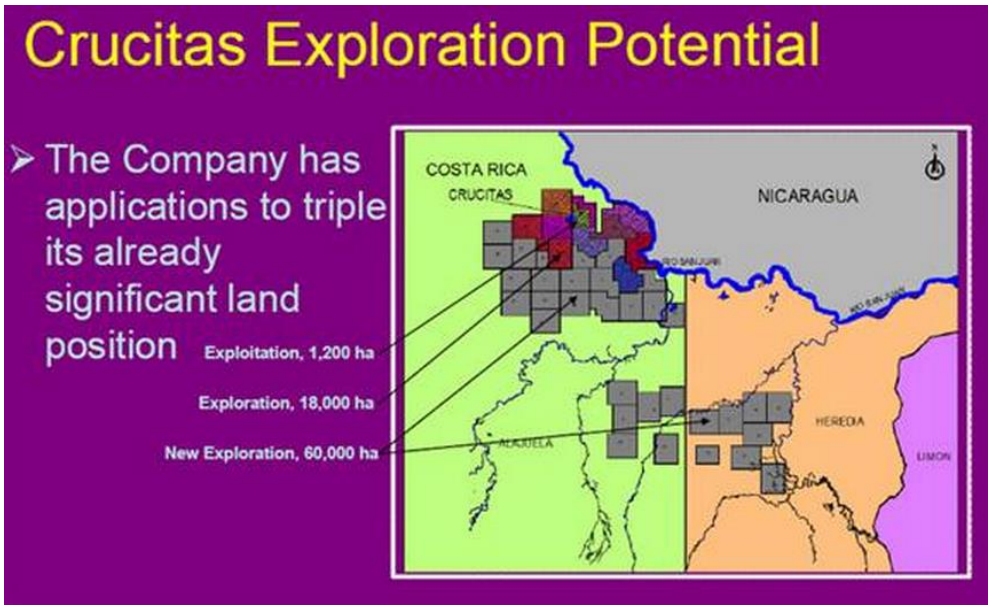

Figure 12: CMP exploration potential (Alper and Cueni-Cohen, 2008).

The second and higher order impacts of allowing the CMP to continue could be very significant. Several years into the future, the landscape of Northern Costa Rica could be quite different. The higher level impacts of the CMP could be very difficult to quantify but

this kind of fragmentation of the biological corridor will have great impact on the many species that live in this area and it will have a great impact on the biodiversity in this area.

It is important to note that once mining has a foot hold in the area it will be much harder to uproot. Once mining begins it will be easier to let it continue. Costa Rica could quite quickly lose its sustainability image. The impact of Crucitas mine could be much larger than what would be expected at this time. Therefore, this is quite a critical time in the history of Costa Rica and decisions made in regard to this mine could shape the future of the country and what path it will take. There is something much larger at stake than a relatively small gold mine, in a poor region of Costa Rica. The impacts of this decision could be far reaching for the country.

If Costa Rica allows the CMP to continue then why wouldn't it allow further exploration into other sites? Once the "Pandora's Box" is opened it is difficult to shut. Exploring these pathways into future indirect impacts would be a useful exercise, but outside the scope of this study.

4.1.2 Water

This section will explore the potential and perceived impacts that CMP could have on water sources. The discussion will be divided, firstly by looking at impacts on surface water followed by the impacts the CMP will have on ground water. There are local conditions that increase the risk of contamination; these include high precipitation and seismic activity. High precipitation leads to high surface runoff. Also the impacts of the use of cyanide in gold extraction, issues related to ARD and bio accumulation of heavy metals and the presence of arsenic in the water supply will be discussed.

Perhaps the most significant impact of a mining project is its effects on water quality and availability of water resources within the project area. Key questions are whether surface and groundwater supplies will remain fit for human consumption, and whether the quality of surface waters in the project area will remain adequate to support native aquatic life and terrestrial wildlife ("Guidebook for Evaluating Mining Project EIA's", 2010, p.8).

One of the other major biophysical changes associated with the CMP and other mining projects is their impact on water sources. As Environment Australia explains, Water is integral to virtually all mining activities and typically the prime medium, besides air, that can carry pollutants into the wider environment. Consequently, sound water management and practice are fundamental for most mining operations to achieve environmental best practice (Environment Australia, 2002).

Below is a very useful diagram that effectively shows how water is a prime medium for carrying pollutants and how its management can be challenging. The diagram outlines the potential contamination sources, the pathways pollutants spread and the receptors or places where the pollution will eventually end up. This diagram will help to better conceptualize the different change processes and impacts specifically in regard to water.

Since this thesis is focusing on the impacts the CMP will have on water sources, the "receptors" column in the diagram is the most pertinent. The CMP will have direct impacts

on the surface and ground water. Higher order impacts include terrestrial and wild life, off site or downstream impacts, impacts on vegetation and lastly impacts on humans. In the larger conceptual framework these will be considered indirect human impacts.

The source and pathways are key in discovering and exploring what impacts the CMP will have on the receptors. Many of the pathways will be brought up in the discussion.

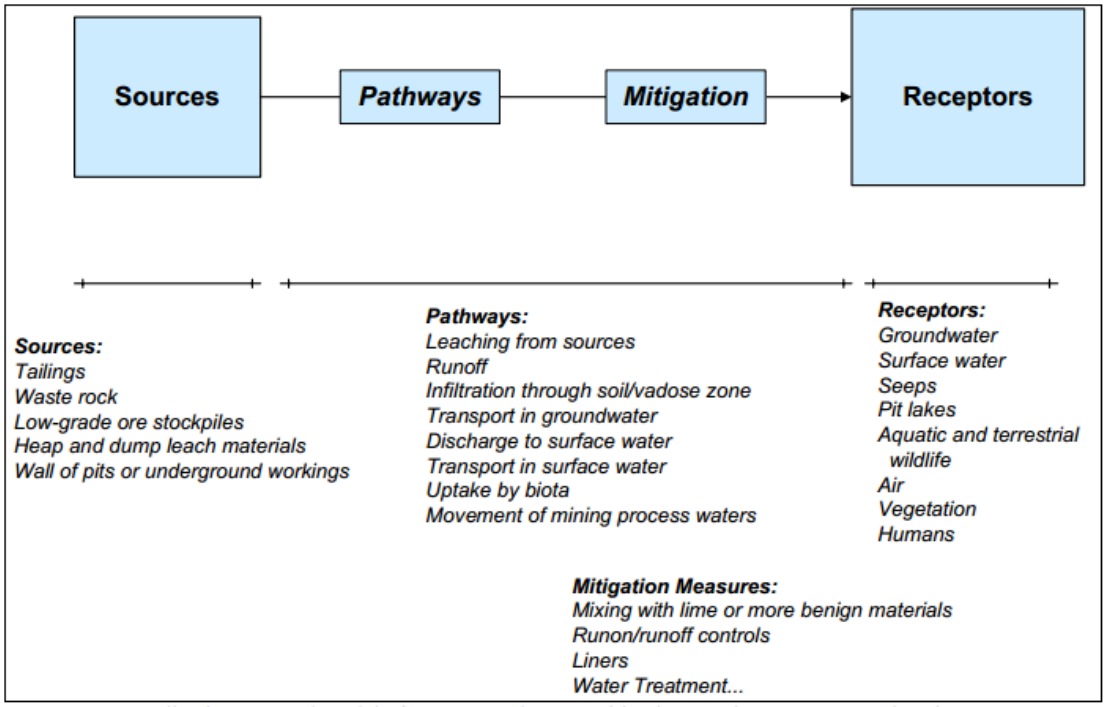

Figure 13: Conceptualization of water contamination (Maest, A.S. *et al*., 2005, p.5)

4.1.2.1 Surface water impacts

The CMP is located in the humid tropics; therefore, water needs to be managed exceptionally well. This area has very high levels of precipitation and this provides a great resource for the mining operation but is also a potential risk. The level of precipitation is around 3000 mm annually. An evaluation of extreme rainfall events indicated a Probable Maximum Precipitation (PMP) daily event over a 24-hour duration of 425 mm (Ward, I.R *et al*., 2008). In this area tremendous amounts of rain can fall in a short time. The high rainfall generates large quantities of runoff. Mining projects in many tropical areas are fraught with environmental risk. These projects not only threaten pristine ecosystems, but high rainfall and heavy storms overwhelm mining facilities and mitigation measures for preventing environmental disasters. An especially rainy climate can, by itself, deem a proposed mining project environmentally unacceptable ("Guidebook for Evaluating Mining Project EIA's", 2010).

Due to the heavy amount of precipitation in the Crucitas area, the potential of soil and sediment eroding into and degrading surface water quality can pose serious problems. According to a study commissioned by the European Union, "Because of the large area of

land disturbed by mining operations and the large quantities of earthen materials exposed at sites, erosion can be a major concern at hard rock mining sites". The study goes on to explain that "Sediment-laden surface runoff typically originates as sheet flow and collects in rills, natural channels or gullies, or artificial conveyances. The ultimate deposition of the sediment may occur in surface waters or it may be deposited within the floodplains of a stream valley. Erosion and sedimentation processes can cause the build-up of thick layers of mineral fines and sediment within regional flood plains and the alteration of aquatic habitat and the loss of storage capacity within surface waters" (MINEO Consortium, 2000, P.12). However most importantly, "The types of impacts associated with erosion and sedimentation are numerous, typically producing both short-term and long-term impacts. In surface waters, elevated concentrations of particulate matter in the water column can produce both chronic and acute toxic effects in fish" (MINEO Consortium, 2000, P.13).

The mines location in the San Juan river basin and the close proximity to Nicaragua makes proper control of surface runoff and erosion very important from the beginning of operations through completion of reclamation. This will be to avoid adverse impacts from sediments being deposited in surface waters, ground water, and terrestrial ecosystems.

The potential of high rainfall and poor management of erosion to wreak havoc on mining operations has already been seen in Costa Rica. The Bellavista mine in Miramar de Puntarenas, Costa Rica, is an example of high rainfall causing a land slide that damaged the geo-membrane under the tailings pond that contained highly toxic substances that could contaminate soil and ground water. This disaster caused the eventual shutting down of the mine. This happened only a few years ago in 2005. Building a mine in an area with high precipitation only increases the risks. Are the risks too great with regard to the CMP?

The Costa Rican government runs a great risk by playing a scenario like Miramar in the San Juan River basin, which can lead to irreversible environmental damage, violation of the right to a healthy and ecologically balanced environment and the consequences of international liability for pollution of shared resources.

The most pertinent issue here is that any contamination that does occur will have an impact on the Rio San Juan. The Rio San is also rich in bio diversity, it is an area known for the presence of now very rare Bull Sharks (*Carcharhinus leucas*) and the Largetooth Sawfish (*Pristis pristis)*. Both species are nowadays protected. In the IUCN Red list the Largetooth Sawfish is listed as critically endangered (Kyne *et al.*, 2013) and Bull shark as near threatened (Simpfendorfer, C. & Burgess, G.H., 2009). Any contamination of the Rio San Juan would have a detrimental impact on these species.

It is not only on these species but on all the species that rely on the Rio San Juan. There are also many people that rely on the Rio San Juan for their livelihoods; either they rely on the fish in the river for food or through income generated through sport fishing. Many avid fishermen travel to Nicaragua to fish the tarpon in the river. Any contamination will have a great impact on these people. The consequences of an accident related to the CMP will have far reaching impacts. Therefore, if the CMP is allowed to continue it must adhere to exemplary standards, to minimize any damage, or at the very least the Costa Rican government must have an airtight agreement with IISA that will ensure that the company will commit to clean up any pollution. Let's see if these hold true.

Some concerns with regard to the impacts of the CMP on water sources have been raised by Yamileth Astorga, a biologist specializing in environmental sanitation. She is the coordinator of the Comprehensive Environmental Management Program at the University of Costa Rica. In an interview with her, she expressed concern and was very afraid of this kind of project, and she was almost positive that a project like this located in the humid tropics would produce much greater detrimental impacts than benefits. She felt there was a higher risk of contaminating surface water. The Crucitas mining activities could directly impact the quality of the water bodies and of aquatic ecosystems. The impact on these ecosystems would mainly be in the form of sediment and debris or accidental spills of chemicals and the dangers associated with Acid Rock Drainage (ARD).

4.1.2.1.1 ARD

ARD is produced by the oxidation of sulfide minerals, chiefly iron pyrite or iron disulfide (FeS2). This is a natural chemical reaction which can proceed when minerals are exposed to air and water (Jennings *et al*., 2008). The potential for the generation of ARD at any mine site is a key question. ARD and contaminant leaching is the most important source of water quality impacts related to metallic ore mining (USDA Forest Service, 1993, p.12). The CMP testing results indicate that the "saprolite is non-acid generating while the hard rock from below the saprolite has been characterized as potentially acid generating" (Ward, I.R *et al*., 2007 p.12). Existing geochemical data suggests that "acid rock drainage and metal leaching will occur within the pit walls, and geochemical modeling suggests that water in the pit sumps will significantly impact the water quality of the waste storage facility pond (WSFP) and because the water in the open pit will likely be characterized by low-pH, sulphate-and metal-rich water, water collected in the open pit sump may need to be treated before being discharged into the WSFP" (Ward, I.R *et al*., 2007 p.12). The source of ARD will be in the pit walls, waste rock and tailings. It can follow different pathways for contamination.

ARD could be a real problem with this mining operation, Earth works outlines how ARD is particularly harmful because it can continue indefinitely causing damage long after mining has ended. Due to the severity of water quality impacts from ARD, many hard rock mines across the west require water treatment in perpetuity. Even with existing technology, ARD is virtually impossible to stop once the reactions begin. They argue that "to permit an acid generating mine means that future generations will take responsibility for a mine that must be managed for possibly hundreds of years" (Earthworks Fact Sheet p.2).

There are cases where ARD has cause enormous amounts of damage and clean up and reclamation efforts can be very long and costly. For example, government officials have determined that ARD at the Golden Sunlight mine will continue for thousands of years ("Montana Department of Environmental Quality", 1997). Acid runoff from the Summitville Mine in Colorado killed all biological life in a 17-mile stretch of the Alamosa River. The site was designated a federal Superfund site, and the EPA is spending $30,000 a day to treat mine drainage, it will cost an estimated $170 mission dollars to clean up. Remediation of the half million abandoned mines in 32 states may cost up to $35 billion or more (U.S. EPA, 2000, p.10). In South Dakota, Dakota Mining Co. abandoned the Brohm mine in 1998, leaving South Dakota with $40 million in reclamation costs, largely due to acid mine drainage (McClure, 2001).

If ARD is allowed to occur at the CMP or it is not managed correctly it can cause a huge burden for Costa Rica, contamination can spread into Nicaragua, and then this becomes an international issue. The potential for disaster is great. The examples above are from the USA, where regulations are much stricter than in Costa Rica. If they can happen there, then there is certainly a risk that they could occur in Costa Rica.

Another point that has been raised by Earthworks, is that Acid mine drainage also dissolves toxic metals, such as copper, aluminum, cadmium, arsenic, lead and mercury, from the surrounding rock. Even in very small amounts, metals can be toxic to humans and wildlife. Carried in water, the metals can travel far, contaminating streams and groundwater for great distances. The impacts to aquatic life may range from immediate fish kills to sub-lethal, impacts affecting growth, behavior or the ability to reproduce. These metals are particularly problematic because, "they do not break down in the environment. They settle to the bottom and persist in the stream for long periods of time, providing a long-term source of contamination to the aquatic insects that live there, and the fish that feed on them" (Earthworks fact sheet p.1). Many metals bio-accumulate in humid environments and in the wildlife of this area. This will not only impact the health of fish but also of the receivers higher up the food chain, larger predators and humans. The consumption of contaminated fish can be harmful (Kitula, 2006, p.410). There are many receptors for the pollution generated by ARD.

If IISA takes the proper precautions adverse causes associated with ARD could be minimized. However, if IISA does not manage this threat well there is great potential for long term impacts.

4.1.2.1.2 Quality of the tailings

Another source for potential contamination and pollution is the tailings. There are other water quality issues that need to be addressed with regard to this.

Due to the abundance of water the CMP has planned to implement a wet tailings area, in this case a tailings pond. The entire tailings pond will be 143.8 ha. The tailings pond will have a catchment area of 310 ha. The site of the proposed tailings facility is located in the watershed of the Rio Infiernillo which drains into the Rio San Juan. Cofferdams will be required during the initial stage of construction to block the flow of the creeks across the basin (Ward, I.R *et al*., 2007, p.12).

The tailings dam and pond will have a number of impacts. They will have an effect on the river hydrology downstream. There will be less water flowing into the river since part of the catchment area no longer feeds in the river san-Juan. The tailings pond could also affect the quality of water in the river.

Results of model simulations by Ward, I.R *et al*. (2008, p.13) indicate that several elements may potentially exceed Costa Rican drinking water guidelines within the WSFP, including Al, As, Cu, Mn, Ni and SO4. Concentrations of Al, As, CN and Cu also exceed Costa Rican industrial effluent guidelines. Because elevated concentrations of sulphate and metals are expected to occur in the WSFP and will likely impact downstream receivers if

discharged to the environment, a treatment system is required, and as a minimum will need to achieve concentrations of metals that comply with Costa Rican industrial guidelines. Ward I.R, *et al.* (2008) suggest that offsite downstream receivers will need to be taken into consideration. This is a very important point as the downstream receiver in this case is the Rio San Juan in Nicaragua as mentioned above. This was not properly taken into consideration and addressed by IISA. This will be discussed more in Section 4.4.1.

The peak rainfall can be very high in this area, it could be possible that during periods of heavy rain, more water may enter a tailings impoundment than it has the capacity to contain, necessitating the release of tailings impoundment effluent. Since this effluent will contain toxic substances mentioned above, the release of this effluent can degrade water quality of surrounding rivers and streams. The impact of which could be very large.

4.1.2.1.3 The tailings Dam

Also related to the tailings pond is the structural integrity of the tailings dam. Dam breaks pose potential threats. Dozens of dam breaks at wet tailings impoundments have created some of the worst environmental consequences of all industrial accidents. When wet tailings impoundments fail, they release large quantities of toxic waters that can kill aquatic life and poison drinking water supplies for many miles downstream of the impoundment.

The risks of such an accident occurring are greater with the CMP than other mining sites. Firstly, the heavy rainfall can overwhelm a tailings facility and seismic activity can compromise the integrity of the dam.

Costa Rica is part of the Pacific "Rim of Fire" and has seven of the isthmus's 42 active volcanoes plus dozens of dormant or extinct cones. Earth tremors and small quakes shake the country from time to time. The last major quake hit on April 22, 1991. Centered on the Caribbean side southeast of San Jose, it measured 7.4 on the Richter scale (Lafleur J.P, 2006, p.35). Earth quakes are unpredictable and are a potential risk to this kind of mining operation. Having lived in Costa Rica for nine months I felt several fairly large earthquakes during the time I was there. One of them registered 5.4 on the Richter scale. Earthquakes are a common occurrence and you never know when or where the next one will be. The earth dam's final elevation will be 80 m and the storage capacity of the tailings pond is 17 Mm^3 of tailings and 8 Mm^3 of waste rock (Ward I.R, *et al.* 2008). This is an enormous amount of wet tailings and waste rock. If an earthquake was to strike in the area and the tailings dam was to fail, it would cause an enormous amount of damage to the catchment area and the Rio San Juan. John Thomas noted that the dam will be designed by a very professional company that is responsible for most of the dams in Costa Rica. Therefore, this will minimize some of the risk but it cannot be eliminated all together.

4.1.2.1.4 Cyanide

One major concern that I came across at the local and national level was the use of cyanide to extract the gold and silver from the ore. There were concerns that if the cyanide was released into the tailings pond then it could find its way into the environment. However,

after a review of the situation it appears that contamination through cyanide would be rather unlikely.

The vice president of IISA, John Thomas, was of the opinion the cyanide has gotten a lot of undue bad press. In his opinion the risk of contamination of cyanide was very little, due to their state of the art processing plant. The plant is quite small, 200m by 100m and all the solutions are contained in steel tanks with concrete retaining walls. If there are leaks or spills they will not get past the retaining walls. The CYplus process is completely automated and continually destroys the cyanide and all that leaves the plant is an effluent made up of water and ground rock. This goes into the tailings pond so there should be no cyanide in the tailings pond, it is only in the plant where it is well protected. In addition even if some were to get out of the plant, mining and regulatory documents often state that cyanide in water rapidly breaks down in the presence of sunlight into largely harmless substances, such as carbon dioxide and nitrate or ammonia. However, cyanide also tends to react readily with many other chemical elements, and is known to form, at a minimum, hundreds of different compounds (Morgan, 1998). Cyanide readily combines with most major and trace metals it also tends to react readily with many other chemical elements, producing a wide variety of toxic, cyanide-related compounds. And because cyanide is carbon based, an organic compound, it reacts readily with other carbon-based matter, including living organisms (Morgan, 1998). This can pose significant threats especially to aquatic but also to terrestrial organisms.

4.1.2.1.5 Arsenic

At the local level in particular it was noted that water quality and quantity had also decreased since exploration started in 1993. There have been reports that arsenic has been present in the water and has caused some cattle deaths. When interviewing one farmer in close proximity to the mine, he complained that his cattle had been drinking from the river that flows through Crucitas mine site and had subsequently died. He didn't have any hard evidence to indicate that it was the water that had caused the death, but in his mind it was the obvious conclusion.

It is important to note that not all of the water quality issues may be a result of the CMP. AIDA (Interamerican Association for Environmental Defense) has reviewed the water quality in the region for some time. They noted that the area has already had water quality problems. The Laboratory Services Unit Industry School of Chemistry at the University of Costa Rica, found that there are high levels of arsenic in water that supplies the population. While the allowed parameter of milligrams of arsenic per liter (mg / l), approved by the World Health Organization (WHO) for drinking water is 0.01 mg / l (WHO, 2006, p.306), the results of the six tests sites at Crucitas indicate 2.3 mg / l 4.18 mg / l 2.64 mg / l to 10.93 mg / l. These tests were taken in different parts of the river and other rivers in the area. The new Crucitas mining project could further increase these levels. ("Descripción del Proyecto Minero Crucitas", p.13-14)

Although it has been argued that these levels of arsenic were caused by mining activities, it is true that high levels of arsenic in water can also be a "normal" condition, a result of the geology of the area, considering that the tributaries with high gold content often also have high levels of arsenic. Without going into this debate, these are factors that need to be

taken into consideration when deciding whether to allow the Crucitas mining project to continue. Will the mining project exacerbate already poor water quality levels? It would be important to evaluate the potential cumulative impacts on the quality and quantity of water available for people and ecosystems before a project of this type is approved.

4.1.2.2 Impacts on Ground Water

Ground water impacts due to mining are not as widespread as surface water impacts because of the much slower velocity of ground water movement, the more limited extent of many affected aquifers, and the lack of available oxygen to continue the oxidation process. Nevertheless, the fact that ground water contamination is extremely difficult to remedy once it occurs makes it a serious concern (MINEO Consortium, 2000, p.14).

The CMP can affect ground water quality in several ways. The first method and most obvious is that since the open pits extend below the water table, this provides a direct conduit to aquifers. Critics of the CMP have raised concerns that impacts on groundwater were not adequately addressed in the EIA. For example, Nicolas Boeglin questioned why The National Groundwater, Irrigation and Drainage Service (SENARA - *Servicio Nacional de Aguas Subterráneas, Riego y Avenamientos*), was not consulted by IISA with regard to the CMP. SENARA conducts research on the preservation of aquifers so that optimal and efficient water resource management practices are maintained. They could have offered a lot of insight to determine the impact the CMP would have on the aquifers in the region. This is important information that would need to be included before such a project like this would be allowed to continue.

The description of the project in 2002 is completely different from the CMP to be implemented in 2008. The original plan was to dig an area of 124.6 hectares to a depth of 15 meters. However, the new plan is to excavate an area of 50 hectares to a depth of 60 meters.

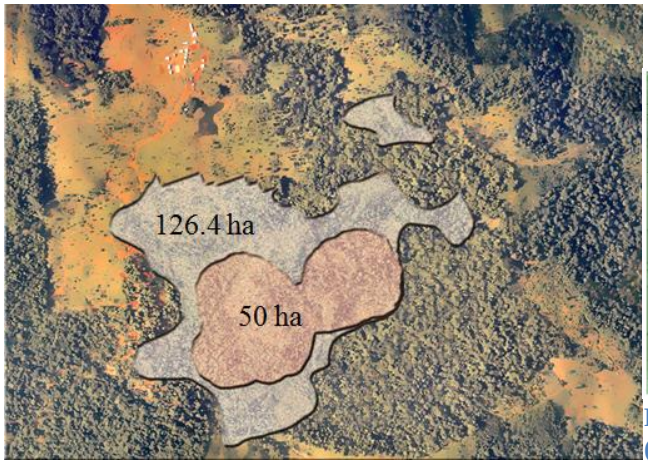

Figure 14: Overlay of old and new mine plan (DGM, 2008)

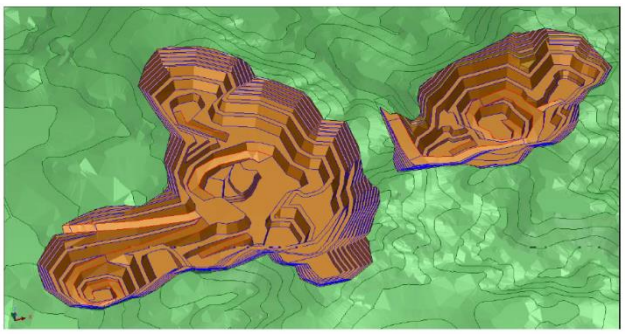

Figure 15: 3D Isometric view, final open pit design, (Ward, I.R *et al*., 2008)

IISA claims the new project will have a smaller impact because the surface area horizontally is smaller but in actual fact the amount of earth removed will be larger since

they are digging much deeper. There will be many differences in the environmental impact due to this increased depth, in particular impacts on groundwater.

Ground water quality is also affected when water infiltrates through surface materials (including overlying waste or other material) into ground water. This can also happen in the open pits or through the tailings pond. Allan Astorga, a geologist, and a professor at the University of Costa Rica, notes that the volcanic and sedimentary rocks that are the predominant rock type in the region, is full of interstratifications of gaps and fissures which allow for high permeability and infiltration. These rock features coupled with high rainfall have created underground aquifers, and many of them are of great strategic and practical importance, since they provide safe water for communities. However, these same rock features make the aquifers highly vulnerable to human contamination.

According to Yamilth Astorga there are two aquifers in the Northern Region of Costa Rica. A local aquifer that will be completely destroyed by the mine and a regional aquifer, that is much larger and deeper. It is at approximately 70 to 80 meters below the ground; therefore, the mine should not directly affect it. However, if there is generation of ARD in the pit walls and it seeps down through the highly permeable sedimentary rocks into the regional aquifer it can have far reaching regional impacts. It is a substantial risk not only for people in Crucitas but everyone who relies on this water.

4.1.2.2.1 Impacts of mine dewatering

As shown the CMP may have direct consequences and impacts on the quality of water in Crucitas and the region but it may also have impacts on the quantity in the area. When an open pit mine intersects the water table, groundwater flows into the open pit. For mining to proceed, mining companies must pump and discharge this water to another location. Pumping and discharging mine water causes a unique set of environmental impacts that are well described in a study commissioned by the European Union (MINEO Consortium, 2000). The continual removal of water can create a cone of depression in the ground water table. This can also be referred to as Groundwater drawdown. Impacts from groundwater drawdown may include the reduction or elimination of surface water flows; degradation of surface water quality and beneficial uses; degradation of habitat (not only riparian zones, springs, and other wetland habitats, but also upland habitats as ground water levels decline below the deep root zone). It can also result in the decreased production of domestic wells. At the end of the mining operation when dewatering ceases the cones of depression may take many decades to recharge and may continue to reduce surface flows.

The extent to which dewatering will affect the Crucitas area is still unclear. When interviewing a local farmer he had already noticed a decrease in water supply. Was this an actual decrease or perceived decrease, and was it a result of the CMP or simply a change in climatic conditions? These are not known. However, if some changes in water quantity had occurred from the impacts of the exploration phase of the CMP how much more would they be when the actual mining operation begins. Due to the volcanic and sedimentary rock in the Crucitas area, the recharge of ground water may not take as long as described in the EU study.

4.1.3 Climate change considerations

These are some higher tier considerations that are worth briefly mentioning. There will not be a great deal of impact on climate change; however, there will be some lost CO2 uptake by forests and vegetation due to deforestation. The CMP is in a relatively heavily forested tropical region. These tropical forests are critical for absorbing atmospheric carbon dioxide (CO2) and maintaining a healthy balance between CO2 emissions and CO2 uptake.

In addition CO2 will also be emitted by the machines (e.g., diesel powered heavy vehicles) involved in extracting and transporting ore. As well as in the processing of turning the ore into metal. Therefore, there will be increased emissions due to the CMP as well as reduced CO2 uptake due to clearing of vegetation.

IISA has committed to planting lots of trees in the reclamation plan, over 600,000 in total. In the long term these will help reduce the impact of CO2 in the atmosphere. However, this would be a long way into the future.

4.1.4 Evaluation of IISA closure and contingency plan

One of the factors that is of great importance is the closure and contingency plan of the CMP. The previous two mining operations in Costa Rica resulted in disastrous results; something must be done to ensure that this does not happen again. There are three specific areas this section will focus on, firstly the management of water, in the form of the quarry lake and tailings pond. Secondly the time allocated for mine closure, and thirdly ensuring adequate funding for reclamation and closure. However, before exploring these three aspects, let's briefly look at what IISA has committed to with regard to mine closure.

The IISA reclamation plan includes reforestation and re-vegetation of the impacted area. Currently the total project area consists of 1474 hectares. It is made up of 478 hectares pasture land and 996 hectares of secondary forest. IISA will cut a total of 192 hectares of secondary forest to build the tailings dam and open pit mines. IISA is committed to re-generate and reforest all pasture and secondary forest after closure. Therefore, at the end of the project there will be 1274 hectares of forest and 200 hectares of lakes (one pit lake and the tailings pond). They have claimed that there will be greater biodiversity than there is now. The reforestation will result in natural forests with native species (estimated around 1500 trees per hectare, for a total of 611,200 trees, 5000 will be almendro trees.) IISA predicts that the planting of more than 5000 almendro trees will help to improve the effective population size of the Great Green Macaw in the very short term. IISA has indicated that the closure plan is scheduled to take place over 18 months after active mining ends. How effective will these plans be?

Environment Australia explains that best practice demands that the land should be returned to some beneficial use for the community after mine closure. Landform design is critical to achieving this objective (Environment Australia, 2002). They also warned that traditional mining activity either left the land with no shaping, or left any shaping until the end when the size of the problem and low cash flows generally resulted in a minimalist program of landscaping works. IISA had already started a tree nursery before the mining activity had

begun (see photo in Appendix 3) and had concrete plans to return the land to beneficial use, which is very positive.

However, the water bodies on site could be managed better. The Surface Mining and Reclamation Act (SMARA) of the California State Mining and Geology Board U.S. states that "Open pits should normally be backfilled, re-contoured, and re-vegetated to create a final surface that is consistent with the original topography of the area". IISA planned to do this procedure for one of the open pits, but the other they planned to leave as a quarry lake. This is not in line with best practice as quarry lakes can more easily result in contamination.

However, in SMARA there is a provision that states,

> "the requirement to backfill an open pit excavation to the surface pursuant to this section using materials mined on site shall not apply if there remains on the mined lands at the conclusion of mining activities, in the form of overburden piles, waste rock piles, and processed or leached ore piles, an insufficient volume of materials to completely backfill the open pit excavation to the surface, and where, in addition, none of the mined materials has been removed from the mined lands in violation of the approved reclamation plan. In such case, the open pit excavation shall be backfilled in accordance with subsections (b) and (d) to an elevation that utilizes all of the available material remaining as overburden, waste rock, and processed or leached ore." (SMARA p.62)

Therefore, leaving the quarry lake would be an acceptable solution. I am aware that SMARA is in no way binding in Costa Rica, but it is a useful point of reference in my opinion.

The second point of interest is the treatment of the tailings pond in the closure plan. In a presentation given by John Thomas, VP of IISA, he explained that, "the tailings pond is where the ground ore will be pumped, the solids will settle to the bottom and there should always a layer of water on top. The bed will be treated ground ore, there is a small amount of sulphite (pyrite) in the ore, if left in contact with air and water may oxidize and form sulfuric acid, but they will be at the bottom of the tailings pond, there is spillway to ensure that water cover will be there till the end of time".

There is some debate as to which is the most appropriate method for decommissioning of a tailings impoundment at mine closure. The 'collect and treat' (long-term treatment phase) vs. the 'water cover' (closure phase) option. In general, while 'no long-term treatment' objective is preferred, the fact is that in general a tailings dam supporting water cover will be more hazardous in the very long-term as compared with a dam where the tailings pond is partially or fully drained.

According to Szymanski & Davies (2004) there has been some confusion in this regard. Some mine owners and regulators were under the impression that providing a permanent water cover supported by one or more dams would relieve the owner and, potentially, the public from the obligation to treat the tailings impoundment runoff in the long-term. Besides significant technical and economic problems with flooding of some tailings deposits, this judgment was flawed since an implicit assumption was made that a flooded tailings impoundment would essentially be 'care and maintenance' free as long as an

adequate spillway is provided. This certainly is not the case. While a water cover can indeed create a low oxygen diffusive environment, from a geotechnical perspective a flooded impoundment is certainly of higher risk with regard to essentially every nature of possible physical failure mode and needs to be considered as such for impoundments with a flooding plan for the closure condition. An allowance for long-term inspections, monitoring and maintenance must be made wherever a dam is left to support a water cover. In general, such an allowance will be less for dams where the tailings pond is partially or fully drained (and the residual risk of dam failure will be less as well). Szymanski & Davies (2004) go on to state that the closure phase that is assumed to last 1000 years or more, this is a lot longer than any mining company will commit to, IISA has allotted 18 months for the closure phase of the CMP.

There have been concerns raised whether 18 months for the closure phase is not enough time. Yamileth Astorga raised questions as to who would monitor the pH and other pollutants in the tailings dam and quarry lake after the 18 months and the level of water in the tailings dam and the structural integrity of the earth fill tailings dam, especially since the area is prone to seismic activity. The potential for ARD has already been discussed, who will continue to ensure that this continues to be controlled 20, 50 or a 100 years down the road?

Yamileth also noted the striking difference in Costa Rican law with regard to closure times of landfills and potentially dangerous sites. Landfills require 15 years of monitoring after they have been closed and gold mines only require 18 months. She felt that dry landfills posed less of a threat than gold mines. She felt 18 months was too short a time.

Re-vegetation is an essential and oft-promised element of mine Reclamation and Closure Plans. Actual re-vegetation is easy to describe on paper, but very difficult to accomplish in practice. As Conservation International (2000) explains, it requires attention to details such as maintenance of topsoil stockpiles, selection of native species, and preparation of soil for the growth of planted species. Companies need to be careful about possible changes that mining operations may have caused in the soil. Lobo has also commented on the difficulties of reforesting the area. He recognized that many of the trees that were to be planted are slow growing; 18 months may not be enough time to ensure that they are large enough to survive. Who will make sure that they grow to full capacity and are not over run by invasive species?

Thirdly, what kind of financial assurance is present for reclamation and closure? According to the Guidebook for Evaluating Mining Project EIA's (2010) one of the most important questions an EIA for a proposed mining project must address is, who will pay to reclaim the mine site and/or cleanup a mess if things go wrong?

Unless a responsible government has made steadfast, prior provisions for the mining company to pay, it will risk having to pay for the cleanup itself or then do nothing and leaving the environment and local citizens much worse off than they were. This is usually done by the mining company paying a guarantee or bond, to cover clean-up expenses.

Reclamation bonding is meant to serve as an "insurance policy" against pollution problems. It is a cache of money that mining companies are required to put down before

beginning work, and which can be used for clean-up down the road, if needed" (National Wildlife Federation, 2000).

According to the International Institute for Sustainable Development (January 2002), "It seems that it is a good idea to demand a financial guarantee for newly permitted mines. The financial guarantee should consist of enough money to assure reclamation of the site at an agreed upon 'worst case scenario'. This encourages better mine operation and closure planning since generally mine planning becomes more efficient when money is involved." IISA has paid the government a guarantee in the amount of 600 000 USD. How far will this amount go in covering actual expenses if something goes wrong? Will it cover a worst case scenario?

As a point of reference, In Western Australia, tailings facilities are bonded at a minimum rate of A$12,000 per hectare, and waste rock piles are bonded at a rate of A$10,000 per hectare (Western Australia Department of Industry and Resources, December 2006). If only the tailings of the CMP were to be bonded at this minimum rate, the amount would be A$1725600, which comes to approximately 1.5 million USD. To properly bond the entire mine site would be substantially more. This guarantee is clearly not enough if the above mentioned recommendations are followed. Therefore, this leaves the Costa Rican government at risk and they may be left with the choice of paying staggering reclamation and cleanup costs or leaving citizens to suffer.

The above mentioned method is not the only way to calculate costs associated with the CMP. Ecosystem service valuation is an evaluation method that is becoming much more popular in assessing the true costs of any given intervention or action. The idea is that ecosystems provide many beneficial services to mankind and when these ecosystems are changed, disturbed or destroyed, these services are lost. This evaluation method aims to put dollar values on the services that ecosystems provide and to frame these services in terms that the free market economy can understand.

After the injunction was filed against IISA and suspended operations at the CMP Earth economics has performed such a study on the impacts the CMP had had up until that point. Earth Economics evaluated the total cost of environmental damage the Crucitas Mining project had caused, in terms of changes in ecosystem service flows together with the costs of restoration of the affected area. According to their calculations the cost of damage incurred, coupled with restoration costs would be a total of $ 4,625,547.03. It is important to bear in mind that this figure is for the environmental damage caused before the mine was fully operational. Clear cutting of small sections of forest had only begun. If the mine had been operating for the full 9 year life cycle the figure would be many times higher.

4.2 Social Impacts

Slootweg *et al*. (2001) and Vanclay (2002) make a useful distinction between social change processes and social/human impacts. They argue that a distinction between social change processes and human impacts should be identified. Policies or project interventions cause social change processes. Under certain conditions, depending on the characteristics of the existing community and the nature of mitigation measures, these social processes

may cause impacts. There is, therefore, a distinction to be made between social change process and human impacts. Conceptually too, it is obvious that an 'impact' has to be experienced or felt in a corporeal (physical) or cognitive (perceptual) sense, whether at the level of individual, household, or society/community. Slootweg *et al*., (2001, p, 67) give an useful example to explain the difference, "an increase in population, or the presence of strangers, is not the experienced impact, the experienced impact is likely to be changed perception about the nature of the community ('communityness', community cohesion), changed perception about personal attachment to the community, and possibly annoyance and upset as a result of the project". The rigid division between change processes (being tangible, objectively verifiable and measurable processes) and impacts (as subjective, context-dependent final variables of impact studies) provides considerable analytical assistance in the early identification of potential impacts. It adds something new to both EIA and SIA. (Slootweg *et al*., 2001, p, 70)

It is this distinction that will aim to be utilized in the analysis of social impacts of the CMP. Initial social change processes will be indentified and then the impacts that these processes have had in families, communities and at a national level in Costa Rica. There are social change processes and social impacts that have already happened as a result of the Crucitas mining project, even though it is not fully operational. Slootweg *et al*. (2003, p. 66) aptly note that in contrast to biophysical impacts, "human impacts can occur as soon as there are changes in social conditions, even from the time when a project is anticipated. People do not simply experience social changes; they react to them and are able to anticipate them. This makes prediction of social changes and human impacts difficult and situation specific". This report will identify these social process and impacts that are already occurring and then will predict some of the future impacts that will occur if the mining project is allowed to continue.

In the theoretical framework the definition for "social impact assessment" was identified. However, before going any farther, it is important to clarify how "social impacts" will be identified in this section. Social impacts have been discussed in a variety of ways. Burdge and Vanclay (1995, p. 32) consider that social impacts are "all social and cultural consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs, and generally cope as members of society", including "changes to the norms, values, and beliefs of individuals that guide and rationalize their cognition of themselves and their society." Slootweg *et al*. (2001, p. 25) consider that "an 'impact' has to be experienced or felt in a corporeal (physical) or cognitive (perceptual) sense, whether at the level of individual, household, or society/community." In the field of SIA, social impacts include anticipated as well as unanticipated impacts, positive as well as negative (Esteves *et al*., 2012; Vanclay, 2003b).

Among SIA practitioners, there is general agreement that social impacts relate to

> "all social and cultural consequences to human populations of any public or private actions that alter the ways in which people live, work, play relate to one another, organise to meet their needs, and generally cope as members of society." (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment, 1994, p. 107)

Finsterbusch (1977) quoted by Mahmoudi *et al*., (2013, p.2) identified the two main goals of SIA as being: 1) assisting decision making by determining the full range of costs and benefits of a proposed action; and 2) improving the design and administration of policies in order to mitigate disadvantages and increase benefits. The main object is to help policy makers make good decisions that will maximize benefits and minimize negative impacts. This is precisely the goal of this assessment. Mahmoudi *et al*. (2013) go on to say that SIA applies to both the ex-ante and ex-post assessments of planned interventions and it is important to assess both positive and negative impacts, as well as intended and unintended impacts, equally.

Van Schooten *et al*. (2003) outline some social change processes that are important in social impact assessment. It is their list of social change processes and social impacts that will loosely form the basis for this evaluation of the social impacts of the Crucitas mining project. Initially the social change processes and impacts that have already been experienced (ex-post) will be explored/assessed, followed by an examination of the likely social change processes and impact that will be experienced if the Crucitas mining project is allowed to continue (ex-ante). The positive, negative, intended and unintended impacts will be assessed exploring the pathways by which social impacts may result from the Crucitas mining project.

Similarly to the biophysical impacts not all the social impacts will be identified and discussed. That is probably not even possible. Most social impact specialists stress that "it is impossible to detail all dimensions of social impact; social change has a way of creating other changes" (van Schooten *et al*. 2003, p.74). The most pertinent and crucial social change process and social impacts that have been identified through the course of this research will be discussed in this section.

4.2.1 Social Change processes and impacts ex-post (already experienced)

In this section the social change processes that the CMP has triggered will be identified and then any cause-effect pathways will be followed to the direct human impacts. Any second and higher order impacts will also try to be identified.

As a result of the CMP there has been a conversion and diversification of economic activities in the Crucitas area. This has resulted in a certain degree of Capacity building which in this case entails a change in the nature of economic activities from one type of production to other types of production.

When interviewing IISA representatives they pointed out that they did not wait until production started to begin their social programmes, but started them significantly earlier. From 2003 to 2008 a great deal of work was carried out by IISA to lay the groundwork for on-going socioeconomic development of the region. This was done through various training programs that include organic farming, cheese production, sewing and clothing manufacture as well as computer technology. These programmes are already being run by IISA. Further courses are planned, some to prepare local people for work in the mine, others to prepare them for other economic activities. A dedicated training centre has been built by IISA in Coopevega for on-going training. As a result of the sewing trainings some

of the ladies have established a small company that manufactures and sells clothes. A photo of this computer laboratory can be seen in Appendix 3.

Some infrastructure projects have also been undertaken by IISA. A school has been re-built in Crucitas (see photo in Appendix 3) and IISA is heavily investing in forestry regeneration. They are looking into trainings and courses that increase the efficiency of agriculture. According to assessments of economic activities this is one of the only other viable activities for the area other than mining.

There are several other social change processes and impacts associated with the procurement of land by IISA. Has this resulted in the displacement of local farmers or has it increased revenue to the area due to income from land sales? Both sides have been argued and have some merit. IISA views this as a positive change and investment into the area. Possibly some farmers could have benefited from selling their land. However, the contrary is also true and became evident after interviewing local community members. In an interview with Mr. Guillermo Herrerra, one of the wealthier land owners and cattle ranchers in the area, it became apparent that some of the people that sold their land were now working for other farmers in the area. They had lost their source of income and livelihood so now they had to work for others. It is unclear what they had done with the income from selling their land. One of the farmers interviewed who lived right next to the CMP compound said his brother had sold 280 acres of land to IISA mining Company. According to him it was well below market rate and he was paid under 50,000 USD for the land. Is this adequate compensation for their land? This amount of money will support someone for a little while but will not last very long. It could results in out-migration as these people leave the area after they have sold their land, in search of a better life, or in search of jobs and livelihoods elsewhere. However, the money could be quickly spent in larger centers and then the farmers are back in Crucitas looking for work from other farmers.

Heidy Murillo Quesada, one of the leaders of the Northern Front in opposition to mining and Conservation Federation of Costa Rica (FECON) believes that farmers sold their land at a very low price, questions what they are supposed to do now. They have lost access to productive lands and because IISA has procured large tracts of land there is less land available for farmers and cattle ranchers. There are lots of concerns over what famers will do after they have sold their lands and are left with no source of income. The lack of access to productive land could also lead to deforestation of new land to increase farming and cattle ranching opportunities. It becomes a threat as local community members look for alternative livelihoods. Figure 3 shows the lands that have been procured by IISA.

4.2.1.1 Improved infrastructure

One of the first and most visible projects that IISA undertook was to improve the road network and infrastructure which enhanced transport and rural accessibility. This is one of the benefits that is often cited by IISA that they have brought to the area. In the environmental operating permit it is clearly stated that “the Coopevega road will be the main access to the Crucitas project and the upgrading of this road is one of the responsibilities of the company” (Ward I.R *et al*., 2008, p.98).

IISA has already committed to investing in upgrading several stretches of road. These stretches are as follows:

- 8.3 km of roads in the Crucitas (1 bridge and 16 culverts for water) at a cost of $350,000 total
- 11.8km of roads from Crucitas-Moravia (3 bridges and 34 culverts with culverts) at a cost of $1,350,000
- 7.5 Km to Llano Verde Crucitas (3 bridges and 11 culverts with culverts) at a cost of $1,052,000

IISA has invested significant amounts of resources into the road network infrastructure to improve access to these areas (See Appendix 3 for pictures). Many critics of IISA questioned the motivation behind building these roads and have pointed out that they are improving the road network because they need it for their own use, to truck in supplies and ship out the gold. Many of the local people are skeptical of IISA. They don't know if they are there to actually help the people or if they just want to come and take as much as they can and leave the people in these communities with nothing. These kinds of sentiments came up many times when interviewing local community members. Interestingly the new road that was constructed to Crucitas runs farther away from the mine than the original road. Some local people view this as IISA trying to hide something and that they have built the road so people cannot see what they are doing. There is a lot of distrust of IISA and the CMP.

However, it should be mentioned that regardless of IISA's motivation for improving the road infrastructure, it should be of benefit to the local communities. It will significantly improve access to larger centers in the region and also to the rest of the country. This will help facilitate trade and possibly increase public and private investment into the area and hopefully eventually decrease the marginalization of the area. In a presentation by John Thomas he mentioned "the road from Coopevega to Crucitas was virtually impassable during the rainy season". Now access to Crucitas was possible year round, even though a 4 wheel drive would most likely be needed.

With the construction of the mine and auxiliary structures, the traffic through the area has significantly increased. Therefore, this will also have some social impacts on the area. The dust that is created by the traffic can increase the prevalence of respiratory problems and eye infections, as well as other health impacts. Also increased traffic increases potential for accidents, as well as people and livestock being run over. Also the noise from heavy trucks could disturb the peace in these towns.

The improved road infrastructure has mixed impacts on the communities. Another improvement to the infrastructure that IISA had undertaken was to bring electricity to Crucitas. The 14 kV mono-phase power line ended some 7 km from Crucitas. This line was extended to the small settlement of Crucitas and for IISA it will be useful as a power source during construction of the mine and auxiliary buildings. This was extended at a cost of 80,000 dollars (See Appendix 3 for photos).

IISA determined that the normally used supply voltage of 25 kV will not be adequate for the load for when the mine was fully operation (estimated at 5.4 MW) and therefore, plans to build a new 69 kV line from the Muelle substation to Crucitas, a distance of approximately 80 km. The first 30 km would follow the paved highway (number 35) then

from Buenos Aires to Crucitas it would follow the present road via Coopevega (Ward I.R *et al*., 2008).

An agreement was negotiated with Coopelesca which will require that IISA supplies all the materials for the line (poles, insulators, cable, hardware) and Coopelesca will be responsible for arranging the right-of-way and the installation of the line. The feeder line from the main substation at Penas Blancas (15 km away) will be the responsibility of Coopelesca.

These improvements to the power grid as with the road network can be viewed as something IISA has developed to benefit themselves. Especially the improved 69kV line will not benefit anyone else except IISA. Since 15km of this power line will be financed by the principality of Coopelesca, it will be additional investment in infrastructure that will only benefit the CMP. The resources used here could also be invested somewhere else that would be of greater benefit to local communities. Also it can be questioned as to how much the 14kV mono-phase power line that was extended to Crucitas really benefits the local community members. IISA certainly did not supply all the homes with electricity. These poor farmers would not have the means to pay for feeder lines from the main line to their homes. Therefore, does it really change the quality of life of the local farmers and cattle ranchers? It could be that some local shop owners would have received electricity but this information was not verified.

However, even though this new infrastructure may not bring too much benefit to the area currently, maybe at some point in the future it could be of greater benefit. These future benefits cannot be known at this time.

The increased electricity that would be purchased by IISA would also bring indirect financial benefits to the region. However, the Costa Rican power grid was already strained to meet the current demand. When living there, from time to time there would be power outages since the supply of electricity would not meet the demand. Would this additional demand that IISA would create, lower the supply of electricity to other consumers? Would it mean that other people would be left without electricity? It is something that needs to be taken into consideration.

The impacts of the improved infrastructure that IISA is committed to implement will have both positive and negative impacts. The benefits that IISA has claimed to be bringing to local communities may not actually be of that much benefit to them. At least those community members interviewed for this research had not received very much benefit.

4.2.1.2 Community cohesion

Having been in the communities and talking to and interviewing residents, one of the main concerns that kept coming up time and time again was that the CMP was dividing their communities. The process of segregation and cultural differentiation had resulted in breakdown of social networks as well as increased tension in the social interaction of household members with other members in the community. They had experienced a decrease in community cohesion. Many told me that communities which had once been homogenous, with similar views and values were now on opposing sides, some were

supporting the CMP and others were not. When the topic of the mining project came up, very quickly people indicated whether they were in support or against the mine. This seemed to be a new way in which community members identified themselves as being for or against the mine, a very interesting sociological phenomenon.

What was very concerning was that this division went right down the family level, some families had been divided over this issue, some to such a great extent that they would no longer talk with one another. Many people were saddened by this impact that the mine had on their families and communities.

However, there were also instances of increased solidarity as a result of the CMP. This was seen when IISA wanted to replace the roof on one of the community centers in one of the towns. The leaders in the community refused to take their money, they felt that if the community themselves banded together and raised resources and did it themselves then it would be their community center and not a foreign company's. This community solidarity was a counter reaction to the segregation and decrease in community harmony and cohesion that was being experienced as a result of the CMP. It was an interesting social phenomenon.

This was one of the major social impacts that had already resulted from the Crucitas mining project. This impact was not just felt at the local level but also nationally in the country. There were some groups that were very strongly opposed to the mining operation and formed demonstrations and rallies in opposition to the mine (see Appendix 3 for photos). It became a national issue that gained a lot of attention from the public. Police intervened and obstructed people from coming to these demonstrations. This resulted in allegations of loss of free speech and thus in human rights violations. The criminalization of these demonstrations definitely had a negative social impact, and thus further decreased the popularity of the CMP in public perception.

4.2.1.3 Perceived health impacts

One of the other impacts the CMP has had is on the perceived health of the community members living close to the mine. I use the term perceived, since I was not able to ascertain if their health had actually deteriorated. There have been reports of respiratory and skin diseases as well as cattle deaths for unexplained reasons. These may or may not be linked to the mining operation. One possible explanation for this could be the arsenic in the water supply that was mentioned above in the biophysical impacts. It would be important to evaluate the potential cumulative impacts on the quality and quantity of water available for people and the ecosystems before a project of this type is approved. Contaminated water is the cause of many adverse health impacts, and thus it is very important to know the potential consequences of this action.

4.2.1.4 Distrust and disillusionment with IISA.

Instances of cattle deaths and the very restricted access to the CMP area as well as the new road being farther away, has created a lot of suspicion and distrust of IISA in the communities around the mine.

Figure 16: Photo from CMP property boarder (No hunting, fishing or removal of plants)

Some of the promises made by the company to provide jobs have not materialized, only a few people have been hired for a short time and they were paid the minimum wage by law. This has resulted in disillusionment with IISA, that there is a lot of talk of development but little has actually been done. Since the CMP is not yet even operational, therefore, the development efforts would still be in the preliminary stages and have not been properly started.

Many community members feel that IISA will take what they need and then move on, and leave the communities with nothing. Sentiment to the effect that the company is "based on lies" has been shared by some of the community members interviewed.

However, there are also community members that are neutral, neither for or against the mine. One lady that was a shop keeper felt that the more people that work at the mine, the more business she could get. She felt that IISA was passing through and she would try to get all that she could.

The way in which the CMP was given permission to start clearing trees before the injunction and work stop order was filed, was because it was declared in the national interest of the country by the president. Therefore a land change permit was issued, and the mining operation could start. Many have questioned the government as to the legality of issuing such a decree for a mining project. Alvaro Saggot being one of them, he is a specialist in environmental law, and a professor at the National University and the University of Costa Rica. He argues that in this case the declaration of being "in national interest" has been given to a project that does not classify as such because the Forest Act, Article 19 states that the change of land use of forests is not allowed unless there are private or state infrastructure projects that bring benefits to Costa Rica. In his opinion it is clear that this refers to infrastructure like dams, airports, roads and ports etc., but never, unless through an "abusive interpretation" can it be used for mining. He felt there is no national interest in a project that provides short-term benefits to a foreign company, and a result of this declaration should be overturned by the constitutional court.

These kinds of instances have shaken the integrity and credibility of the government. Doubts have been voiced whether or not the government can handle and monitor a project like this.

4.2.1.5 The government's inability to monitor the CMP

On a national scale there has been quite a lot of debate as to whether mining should be undertaken in Costa Rica as an economic activity. There has been even greater debate as to the functioning and integrity of government agencies in Costa Rica. In particular the capacity of the formal institutions to handle the additional workload as well as the competence and technical expertise required to monitor mining projects to ensure that no contamination will occur. Is Costa Rica ready for mining operations such as this?

When looking at the track record of the mining industry in Costa Rica it is not very good to say the least. There have been two open pit mines in the history of Costa Rica, the Macacona mine and the Bellavista mine in Miramar de Puntarenas. Both of these mining operations caused substantial environmental damage. In the case of the Macacona mine, it was operated by an American company that simply abandoned the country, leaving a contaminated site and leaving Costa Rica with no procedure to force the company to come and restore the terrain. It also left the workers abandoned. In the case of the Bellavista mine, a significant portion of the mine collapsed. The head quarters were buried in a land slide and to this day the amount of pollution generated by that disaster is unknown. All existing reports were supervised by the company and neither the public nor the government had access to them. These examples are cited as reasons why many Costa Ricans feel their government simply lacks the ability to control this kind of activity.

The potential impacts of surface mining have already been seen firsthand in Costa Rica. Therefore, even if the environmental feasibility studies are acceptable, it is not unfounded to fear that the Costa Rican government does not have the ability to prevent and manage the damage that the CMP could cause. Any contamination this time would include a large portion of the Rio San Juan river basin. AIDA warned that if the government were to approve the CMP without first improving their technical capacity to control mining projects, there is a great risk of repeating past mistakes ("Descripción del Proyecto Minero Crucitas", 2008, p. 16).

Chassot and Monge (2009, p.5) went to the extent to say that, "Perhaps this company adopts the highest environmental standards in the industry; they may be providing services to the surrounding communities for many years that the state could not offer. However, there is no doubt that Costa Rica is not ready for this type of project, and this was demonstrated during previous mining projects." Many other professors at the University of Costa Rica share their sentiments.

These sentiments are not new, and there have been allegations of the inefficacy of the government to manage, control and monitor a project of this type and scale. In fact, this was one of the main reasons that the mining moratorium was declared in 2002. The then government felt this moratorium should be kept in place until Costa Rica is capable of handling such a mining operation. According to Carlos Manuel Rodríguez, the former Minister of Environment and Energy and a specialist in environmental law, the administration of Abel Pacheco declared a moratorium on open pit metal mining in 2002 for three reasons, and he felt as long as these reasons or conditions have not changed, mining should not be promoted in order to safeguard the interests of the nation. Those reasons were, (1) economic benefits established by the mining legislation are minimal for the country, (2) the capacities of the Directorate of Geology and Mines for verification,

monitoring and evaluation are extremely limited, and (3) the experience of mineral industries to develop projects in tropical environments and ecosystems are insufficient and bad. It is the opinion of Carlos Manuel Rodríguez as well as many others that these reasons have not changed to date.

Jose Francisco Castro Munzo, the current Director General de la Direccion de Geología y Minas at MINAET presented 8 safeguards that they have recently developed to help them monitor mining more successfully. Lets briefly look at what each of these safe guards are and if they meet the conditions outlined by Abel Pacheco.

1. Submit listings to municipalities reporting on the country's mining concessions in their jurisdiction. This information will be updated every two months. This information will be used for:
    a. Collection of taxes from mining and patents.
    b. Ensure up to date information about land use in each county.

2. At random DGM (direccion de Geologia y minas), can appoint a certified laboratory to take samples of material, especially material sources of construction aggregates. The cost of the analysis will be covered by the mining company.
    a. Practical use: Establish a quality control of construction materials from the pits to the public's knowledge at the time of buying the same quality

3. Order it in every mining lease duly executed, will keep a copy of the resolution granting and placed a sign on the entry of the same indicating the file number of mining and SETENA.
    a. This information will be used to: That different authorities and the general public aware of the existence of a concession granted by law and can identify illegal. Municipalities also provide operating locate sites in their areas, facilitating applicable checks

4. In cases of metal mining, the DGM may request audit services from external geological-mining for a cross-check of the controls carried out by officials of the DGM. The cost of the audit shall be borne by the concessionaire.
    a. This information will be used to: To exercise more efficient controls the activity

5. Coordinate with the Conservation Areas control for this activity will be provided with a list of active leases in the region. Geologists also coordinators in each area, coordinated with those areas concerning mining information.
    a. Practical use: Exercise more efficient control of mining

6. Coordinate with the Public Ministry extraction process complaints of illegal materials.
    a. Due to the structure of the judiciary, when a cause is raised to judgment, it is necessary to have the best evidence of the crime. Coordination ensures a high percentage of convictions quality due to testing.

7. Train law enforcement in regard to illegal mining, in order to weaken the illegal practice in the country.

   a. Illegal mining is executed in remote areas where there are offices MINAE and especially of the DGM, as well as non-working days (Saturdays, Sundays, holidays). Having the support of the security forces is essential to attack the crime of illegal mining.

8. Strengthen coordination with SETENA and Environmental Administrative Tribunal with a view to strengthening and weakening phase control of illegal mining.
   a. By law DGM officials cannot make the confiscation of machinery and other equipment used in the mining crime.

These 8 safeguards are a step in the right direction. There is an attempt to more efficiently and effectively monitor the mining concessions. However, there are still significant short comings. With regard to the first condition, the laws have been improved. The royalty is only 2% however; IISA is also paying 30% income tax to Costa Rica. The 30% could be higher, for example in Chile it is 40%, but it is not nearly as bad as it used to be.

As for the second requirement, the DGM themselves will not have qualified personnel to monitor mining activities. They are still reliant on external experts. The fact that the mining company is the one that will end up paying the external auditors that check quality controls, can result in biases in their results and findings. Therefore, the second condition has not been adequately met in my opinion. The DGM would significantly have to invest in equipment and personnel to ensure that mining activities are carried out up to standard.

As for the third condition/requirement, mineral mining industries still have a dismal track record when it comes to sustainable mining projects especially in the humid tropics. One will be hard pressed to find a success story. The two previous mines in Costa Rica were a complete disaster. This condition certainly has not been met.

Therefore, reviewing these actions that have been undertaken at least the Abel Pacheco administration would not allow this mining concession to continue.

Nicolas Boeglin at a round table discussion at UPeace university felt quite strongly that "Something must be wrong in Costa Rica", for there are serious inconsistencies between discourse and action. The public stance of the Costa Rican government is peace with nature, the carbon neutral initiative, protection of the tropical forests for which Costa Rica is known for internationally. They have projected this green image outside but what is happening inside Costa Rica is completely different. Costa Rica is rapidly changing, SETENA is going through some big changes, from April 2008 to November 2008 the National Secretary and 5 high level members have changed. Now the Tico-verde pineapple company was allowed to produce pineapple even though the three previous times their requests to SETENA were refused. In fact pineapple plantations are expanding and are increasing by 40%. The Guanacaste beaches are under pressure do to vast tourist development. In April 2008 the mining moratorium ended and now mining is being added to industries that are being developed, namely the CMP. Costa Rica is rapidly changing from a green environmentally friendly country to something else. Some of these activities especially mining are in opposition to Costa Rica's green image. This is what we will look at more closely next.

4.2.1.6 Costa Rica's sustainable image

One of the most interesting social impacts was at the national level, how many Costa Ricans felt that the Crucitas mining project did not fit into their national identity.

Some went as far to say that it was an affront to their culture and completely in contradiction to their national identity. Many felt that allowing the CMP to continue would be a violation of cultural mores that have been established over the past decades, principles of sustainability, being environmentally friendly, with vast protected areas. Mining doesn't fit into this paradigm.

In an interview with Yamileth Asotorga she talked about how Costa Rican's view their country and some of the transitions that have taken place in Costa Rica. She explained that "earlier there was a lot of exportation of bananas and coffee and then later on we decided to have a lot of protected lands inviting the world to come and see what we have and now a project like this is completely the opposite to that". She also feels that, "it is very risky to have this kind of activity, it is not compatible. Costa Rica is a small country and doesn't have room for both mining and conservation". She made reference to the "goose that produced the golden egg, we may destroy it." She felt in Costa Rica the golden goose is their rich biodiversity and nature.

Chassot and Monge (2009) go on to argue that this mining project goes much deeper than just protecting the endangered green macaw or the Almendro tree, or providing development for the poor community that seems to have been abandoned by the government. Nor is it about implementing an exemplary mining project that IISA claims they will do. In the end it comes down to a decision that the country will have to make: do we want to promote a potentially harmful activity that contradicts the way that Costa Rica had been drawn up since the decree that saw the first protected areas and began receiving an increasing number of tourists? Costa Rica now stands out internationally as a model of sustainable development and conservation of natural resources.

The latest initiative to cement Costa Rica's long-standing reputation as a global leader in progressive environmental protection occurred on 7 June 2007, when president Arias made international headlines by announcing Costa Rica's intention to become the world's first carbon neutral country by 2021, the nation's bicentennial. As a result of this Costa Rica was heralded as a "role model" for the world and to be among "the vanguard" of climate change action (Hermwille 2011, p. 10). By accepting such a demanding challenge the nation has advanced "to the forefront of climate protection and set an example for developing and developed countries alike" (Hermwille 2011, p. 10).

This praise for Costa Rica's initiatives in environmental protection was quite fitting. After all, the carbon neutrality initiative represented merely an intensification of Costa Rica's long-standing effort for environmental protection (Fletcher, n.d). The "Peace with Nature" initiative (Paz con la Naturaleza, or PCN), has been an ongoing skilful and self-conscious effort to capitalize on the two attributes for which Costa Rica is most known in the international arena: its non-violent nature (represented, foremost, by the abolition of its formal military in 1948); and its aggressive environmental protection (symbolized, by its extensive system of protected areas) (Fletcher, n.d, p.158). Through its extensive environmental protection initiatives Costa Rica has gained the global reputation as the so

called “ecotourism’s poster child” (Honey 2008, p. 160). The good reputation that Costa Rica has can be tangibly felt in the international arena. For example, Mr. Roberto Dobles, the Costa Rican Minister of Environment and Energy was named President of the Governing Council/Global Ministerial Environment Forum of the United Nations. This is the first time that a Costa Rican has occupied such a prestigious position.

However, as alluded to by Boeglin, rhetoric and practice don’t always add up. Fletcher (n.d, p.167) notes that “it is apparent that the Costa Rican government has taken few tangible steps thus far actually to implement its carbon neutrality proposal”. In fact “the civil society group co2neutral2012 claims that since the plan’s introduction the country’s emissions have risen substantially”. Also Chassot's analysis of the situation is in agreement with Boeglins that, over time this administration has shown an almost systematic separation between discourse and practice, and even many foreign media are amazed at this time of environmental policy that our government has decided to go against and the interests of Costa Ricans.

In Costa Rica, tourism is the biggest industry, bringing an estimated 2 billion dollars a year into the country. A lot of these tourists are eco-tourists that come and enjoy Costa Rica’s pristine environment, landscapes and wild life. Many feared that if mining operations are allowed to continue the image of Costa Rica can slowly start to change. An image that has been created over many decades of being sustainable and eco-friendly can be quickly lost if the mining industry gets a foot hold in Costa Rica and pineapple plantations are allowed to expand as well as other initiatives that are not environmentally friendly. If Costa Rica is no longer viewed as a natural paradise then this could have larger national and international consequences and have a serious impact on the tourism industry. All the impacts and their magnitude are difficult to predict at this time. However, we can be quite sure that there will be impacts.

Carlos Manuel Rodríguez, eloquently makes an analogy of the Crucitas mining project to the national theater, Costa Rica’s greatest national treasure. Would we be willing to destroy it if there was a billion dollar treasure below it? He feels now, the country's national treasures are worth keeping; their value is not measured in dollars and cents. He accounts the ecological services of the tropical rainforest as Costa Rica’s national treasures also, and they should be saved. He has said, “Aunque quedan algunos que 500 años después de la conquista siguen cambiando el oro de la nación por espejitos y cuentas de vidrio” (Rodríguez, 2009). This loosely translated means “Although there are some who 500 years after the conquistadors, continue to exchange the nation's gold for mirrors and glass beads.” The nation's real gold lies in its nature, fauna and flora, and this is worth more than the gold underneath.

These were the social change processes and social impacts that had already been experienced with regard to the CMP. Some of these impacts included worry with regard to future impacts. Let’s see what those impacts may be.

4.2.2 Social impact processes and impacts ex-ante (future impacts)

One of the purposes of SIA is to not only to assess impacts that have already occurred but also assess potential future impacts. Becker duly notes that, “SIA falls within the

overarching field of Impact Assessment, defined simply as the process of identifying the future consequences of a current or proposed action" (Becker, 1997, p. 2). This following section will deal with social impacts and social change processes that have not yet occurred but could likely occur in the future.

4.2.2.1 Waged Labour

If the project is allowed to continue, one of the definite changes will be an increase in the amount of waged labour. In the construction phase IISA has committed to hiring 300 people and then 260 people for the entire life cycle of the mine. The social change process of increased waged labour will result in increased income. These increases in income should lead to increased standards of living and at least the local communities hope for increased economic prosperity and resilience.

John Thomas the VP of IISA feels that the jobs the CMP will provide will be one of the best services that IISA can and will be providing Costa Rica. The 260 fulltime jobs will be a big stimulus for the region. He claims that 12 years of solid salaries will significantly increase the level of awareness and level of education of the local people. IISA is committed to ensuring that at least 75% of the work force be local people. He estimated that most of the workers would have 10-20 hectares of their own land and with a constant source of income and the help of IISA; it would enable them to develop their economy to a much higher level. In his words "this would be the greatest advantage that they can give to Costa Rica".

The scale of the impact that John Thomas feels the CMP will have is questioned by Yamileth Astorga. She agreed that the rural areas have not received very much support from government. Therefore, when the locals hear of a "big project" that can bring some resources, they view it as an opportunity for them to have a better job and better quality of life. However, her experience was that this is not the case. However, it will change their way of life, she referred to the situation in Guanacaste, that region has had big tourist projects for many years, but it has not changed the quality of life, or economic possibilities of the locals. She felt quite strongly that the benefit from the mine will not be for the local communities, it will be for IISA.

One of the social change processes that would result is Cultural differentiation**,** which here is defined to be an increase in the differences between various groups in the community based on cultural values, traditions, rituals, language, traditional skills and so on. In the above ex-post section, it was described how the CMP had already resulted in a decrease of community cohesion. If the mining operation was allowed to continue the divisions and inequality within the communities are only expected to get worse. Not everyone would be able to benefit as much from the mining operation, only a select few, around 250 jobs would be created of which 75% IISA has committed to hiring locally, however it is unclear if locally means from within Costa Rica or the local communities around the mine. Therefore, there are relatively few that would be able to work directly at the mine and thus reap the greatest reward. Their neighbours or other community members who weren't able to work would be left out. These kinds of instances could produce even greater tensions within the communities and result in even great inequalities. Van Schooten *et al*. (2003, p.78) make reference to this by noting that "some sectors of society, or groups in society,

are able to adapt quickly and exploit the opportunities of a new situation. Others (for example, various vulnerable groups) are less able to adapt and will bear most of the negative consequences of change. Social impacts, therefore, are implicitly context dependent". In this case shop keepers could take advantage of the increased spending power of those that are working at the mine and be able to sell more good and make more profit. They could also take advantage of the improved road to increase goods available for sale. However, the poorest and most marginalized members of the community will only be left further behind.

In addition, those able to work for IISA will acquire skills and different cultural values from community members that don't work for the mine. This could result in social differentiation and inequality in the communities. The CMP could create and increase differences between members in these communities. This is a real danger in this mining operation. If the CMP has already caused divisions and tensions in these communities, if it is allowed to continue these tensions could get worse and possibly even result in community violence.

This would not only create economic inequalities and exacerbate existing ones, but would have cultural impacts also. Heidi Murillo, a member of the Northern Front in opposition to mining and Conservation Federation of Costa Rica (FECON) felt there would be a big change in the way of life of these farmers, a change of their habits and more broadly a change in their culture. She worded the process as a "loss of culture". In her view this mining operation would change the lifestyles of community members so much that they would lose their own culture.

The increase of job opportunities could also result in the increased presence of temporary construction/mine workers and this in turn will have an impact on local culture and way of life. The in migration of temporary workers could bring other cultural values and morals into the region. Community members also feared that there could be an increase in crime and violence as a result of this influx of temporary workers. They feared that this trend would only continue if the mining operation was allowed to continue.

As a result of increased income and spending power, or certain members of the communities, the ones that have been employed by the IISA, there could be some second and higher order change process such as inflation in the price of goods in the area. Shop keepers could try to take advantage of the increase spending power of these people. However, this will negatively impact those people in the communities that are not employed by the mine. It will be harder for them to get goods and services. They will be in a difficult situation.

However, another factor that needs to be considered and one that will undoubtedly have a big impact is that IISA, where feasible is committed to supporting the Cost Rican economy by purchasing locally. During construction, concrete and most materials necessary to construct auxiliary buildings will be purchased in-country. During operations, most food, fuel and lubricants will be purchased from local suppliers. This would substantially stimulate the local economy. (Ward, I.R *et al*., 2007 p. 15)

By purchasing locally there will undoubtedly be benefits to the local economy. Farmers and cattle ranchers will also benefit if IISA purchases food from them to feed their

workforce. Since demand for goods will increase, so will the price of goods also. This will bring benefits to the sellers and suppliers, but will hurt locals who need to buy the same goods. It could be that there will be a dual standard in the price of goods. For example, as in many developing countries there is the "local price" and "foreigner price" for goods. The locals could potentially still get the goods for a cheaper price. However, if the company is buying in bulk, it could mean that they will negotiate a good discount. Therefore, it is difficult to know exactly how much this will benefit the local suppliers. These indirect economic benefits are difficult to measure, but there should be significant stimulus to the local economy.

4.2.2.2 Deteriorating environmental conditions

Many community members that I spoke with were worried about the potential environmental impacts that this kind of mining operation would have. This dramatic conversion of land use could have some serious impacts. Community members were worried this would lead to a decrease in the quality of living environment, many had already complained about decreases in quality and availability of water, simply based on the impacts of the exploration phase of the mining operation. They were worried that these would only get worse if the mine became fully operational.

Another possible impact would be the decrease of environmental amenity value/aesthetic quality. Eco-tourism is what people felt could be used to develop the region, having a mine would hinder those kinds of plans. Many in the region were worried about the impacts of the mine in regard to personal safety and hazard exposure, lots of talk about cyanide and potential contamination of rivers and ground water, this is a perceived threat. These worries also lead to perceived changes in levels of health. There were claims of increased respiratory and skin diseases. They associated these with the mining operation. It can be debated whether these were caused by the CMP or something else.

4.2.2.3 Conversion and diversification of economic activities

One of the social change processes that are hoped for is that the CMP with their additional investment into the region will result in the continued diversification of economic activities. Above the impacts of their training programmes has already been discussed. However, there is hope that these kinds of activities and investments by the company will increase in the future and will result in even more economic opportunities.

IISA is funding a feasibility study, for setting up a cooperative in the area; the study is being prepared by the Canadian Cooperative Association. Some of the areas of activity which are being considered are organic agriculture, forestry products, textiles and furniture manufacture. Where possible the proposed cooperative will be involved in activities associated with the construction and operation of the mine. Funding of the socioeconomic development will be through payment into a trust fund based on the tonnage of ore treated by IISA and grants from international organizations will be also be pursued. A dedicated manager with support staff will be employed to ensure the smooth running of the programs (Ward, I.R *et al*., 2007 p. 15).

It is estimated that the seven communities around Crucitas will receive 4.6 million dollars in social development funding over the entire project lifecycle. This will be administered through the trust fund for the development of these communities. When this figure is broken down it comes to just under $55,000 per community per year over the 12 years of the project. This is a significant investment into community development. If the funds are used effectively they can result in potential sustainable development in the region. The economic base could be diversified resulting in many more economic opportunities for local community members.

However, if this trust fund is used inappropriately and proper investment is not made into the communities, the CMP could lead to the concentration of economic activities in the region. Other activities such as farming and cattle rearing will diminish, and the local communities will become dependent on this mining operation. This is what should be avoided at all costs. The life cycle for this mine is short, only 12 years. Therefore, the CMP could have potentially disastrous economic impacts on the local economy and the communities could be much worse off when the company leaves than before it came.

4.3 Economic impacts

Mining companies often cite taxes and royalties that they pay to governments and municipalities as direct benefits the country will receive from their mining operations.

In the case of the CMP the direct economic benefits go as follows. It should be noted that these projections done at the 2008 gold price of 750 dollars an ounce, if the price of gold goes up all numbers go up and vice versa. The municipality of San Carlos would receive a 2% royalty which amounts 14.4 million in total over the life cycle of the project. According to John Thomas this is 25% of the annual budget for the municipality of San Carlos. The municipality of San Carlos will also get for a patent 0.15% of receipts and 1% of profits, which amounts to another 4.1 million dollars. These would be a sizable increase in the amount of money the local government would be able to invest into the municipality, to better infrastructure and services provided.

Corporate income tax with appreciation allowances included comes to a total of 79.7 million dollars that will be paid to the Costa Rican government over the entire project life cycle. In addition, all taxes will be paid on wages of the 260 fulltime jobs and indirect employment that will be that will be created, this will also be a sizable benefit to the region.

For comparison purposes, after paying for capital cost and taxes and operating costs, IISA hopes to get 195.8 million dollars back in profits.

The income that Costa Rica would earn through taxes is sizable and needs to be taken into consideration. How the government will use this money is open for debate, and will largely determine how useful it will in the end be for Costa Ricans. If invested well it could be used for a lot of good in developing the “forgotten corner” of Costa Rica, where Crucitas is. There is great potential when receiving this amount of income.

According to the La Nación newspaper, Costa Rica stands as the most visited nation in the Central American region with a $1.92-billion-a-year tourism industry, with 1.9 million foreign visitors in 2007 (La Nación. 19.12.2007). Costa Rica transformed itself from a "low-key destination for nature lovers into the foremost ecotourism destination in the Americas" (Honey, 2008, p.5). Ecotourism is extremely popular with the many tourists visiting the extensive national parks and protected areas around the country. Costa Rica was a pioneer in this type of tourism and the country is recognized as one of the few with real ecotourism.

How would mining activities impact on the tourism industry? The economic benefits that the CMP would provide Costa Rica are meager compared with what it generates through tourism. If the CMP would negatively impact on the sustainability image of Costa Rica, this could then negatively impact the tourism industry and result in significant economic decline.

Costa Rica has invested a great deal in protecting its forests, especially given the tourism and watershed services they provide. However, little is known about how much tourism revenue is actually generated by forests and protected areas, and to what extent local communities benefit from different kinds of tourism (World Bank, WAVES, 2013). This kind of information would be useful.

Another concept to consider is the "option value" and "non-use value" if the CMP is halted now. These concepts were derived from World Bank (2012), "Moving beyond GDP, how to factor natural capital in decision making". Specifically, option value refers to the value of having the option to use a resource in the future even if they are not using it in the present. For ecosystems, the option value describes the value placed on maintaining ecosystems for possible future uses, some of which may not yet be known (there may be plants with unknown medicinal uses, for example). Non-use value is derived from the fact that the natural environment is maintained, including both the value individuals attach to the existence of the ecosystem resource as well as its availability to others (in current as well as future generations) (P.12).

The authors also make reference to the challenges in accurately producing these values. Option values and non-use values can only be done through survey-based methods, which raise issues of reliability and robustness. Environmental economists are developing measures for the value of ecosystem services; however, these also vary in terms of reliability.

It is very difficult evaluating and putting monetary values to ecosystem services. Mechanisms are continually being developed and are being utilized by different state and non-state actors. Even though this discussion is a very interesting and pertinent one, it is beyond the scope of this study.

4.4 Larger issues that need to be considered

4.4.1 International Law

This study has examined the biophysical risks. The CMP would be located in an international biosphere reserve. This inherently increases the standard to which all development activities must adhere to. Any development must be done in a sustainable way. This study has also looked at the social impacts; the area is poor and is in need of development. The mining operation could bring much needed revenue and waged labour to the area, which would benefit local community members and the region in general.

However, there is one factor that has not yet been considered and this is one of the most significant factors to be considered when deciding whether the CMP should be allowed to continue. This deals with international law. In previous sections Nicaragua has been mentioned, and the potential impacts the CMP could have on the Rio San Juan. The CMP is located in the San Juan River basin and if there were any accident or contamination it would be in Nicaragua within hours of the incident. Costa Rica and Nicaragua have several binding agreements that prevent Costa Rica from engaging in an activity that could cause harm to the Rio San Juan. What are these agreements?

Nicholas Boeglin a specialist in international law, is a professor at the University of Costa Rica and a member of the World Commission on Environmental Law of IUCN. In an interview with him he noted that there are many international treaties and agreements that limit Costa Rica's right to engage in activities that may cause environmental damage to another country's territory, these include:

a) the Cañas Jerez Treaty of 1858, which obligates Costa Rica to "defend" the San Juan River, in this sense, Costa Rica should protect the San Juan River from any damage or danger;
b) the 1996 Regional Convention for the Management and Conservation of Natural Forest Ecosystems and the Development of Forest Plantations, within the Central American Integration System (SICA) of 1996, which obligates the Central American States to "ensure that the activities within their jurisdiction or control do not cause harm to the environment of their country, nor to other countries in the region";
c) the 1992 Rio Declaration on Environment and Development, which places responsibility on Costa Rica for ensuring that "the activities carried out within its jurisdiction or under its control do not cause damage to the environment of other States or to areas outside of its national jurisdiction";
d) the 1972 Stockholm Declaration on the Human Environment, that establishes the obligation of the States to "ensure that activities that are carried out within their jurisdiction or under their control do not damage the environment of other States or areas located outside of their national jurisdiction";
e) The 1997 Convention on the Law of Non-navigational Uses of International Watercourses, which reaffirms that "States with waterways should, when using international waterways, take all appropriate measures to prevent causing significant damage to other States with the waterway."

The CMP due to its location and the potential risks associated with mining in this area, to implement the CMP would be in contradiction with these treaties that Costa Rica has

ratified. According to Professor Boeglin, it would be very reckless and unwise for the Costa Rican government to allow such a project. He even went as far as to say such activity would be criminal if not illegal from the perspective of international law.

It is very important to have Nicaragua up to date with this process. Since this project is so close to the Nicaraguan border they need to be taken into account. All the water that leaves the mine through rivers will eventually end up in Nicaragua. The Minister of environment has said that Costa Rica is sovereign in Crucitas, and of course they are, however, according to Nicolas Boeglin, the simple fact is you cannot allow a project that can potentially allow damage to another state. Through all of this Nicaragua has responded calmly and are requesting documentation with regard to the mine, they are clearly worried about potential environmental damage to the Rio San Juan. Nicolas Boeglin goes on to state that, by allowing a project so close to another country, Costa Rica is exposing itself for international action, and international reparations for environmental damage which can be very expensive. Therefore, if there is an accident during the lifecycle of the mine, or after closure, 20, 50 or 100 years down the road, the CMP could become very costly for Costa Rica.

Taking into account downstream or off-site receivers is one of the recommendations made by Ward, I.R *et al*. (2008, p.12) Technical Report on Feasibility study update, for the Crucitas Mining Project. An excerpt directly from the report is added below.

> "Although standard treatment systems can reduce concentrations to below industrial guidelines, discharges after treatment often exceed the more strict water quality guidelines of downstream receivers. In such cases, a permit is usually required to discharge effluents that will impact the water quality of receivers off-site. Often times supplemental ecological and aquatic assessments on the receiving water courses are required as part of environmental assessment studies. The environmental assessment should be reviewed to ensure that due consideration has been given to potential changes in the receiving water quality, and appropriate changes to the water treatment system should be made if necessary."

This directly means the Nicaragua needs to be taken into account and informed about the process. Nicaragua may need to issue a permit to allow this project to continue and discharge effluents into the Rio San Juan. No such permit was even requested. Therefore, legally this could be a difficult situation for IISA and Costa Rica. The risks associated with the CMP make it very difficult to justify.

5. **DISCUSSION**

The purpose of this study has been to evaluate whether the benefits will outweigh the negative impacts of the CMP. To answer this, a wide range of the biophysical and social impacts were integrated within the conceptual framework created by Slootweg *et al*. (2001). The goal of this thesis was to bring out the most important factors that will affect this decision.

With the biophysical impacts most of them can be mitigated with appropriate techniques and strategies. With deforestation, the deforested area is not very large and if the reforestation is managed and maintained well, then the impacts on the biological corridor could be mitigated. Potentially in 50 to 100 years the area could have greater biodiversity than it has today. However, this would require concerted effort on behalf of IISA and the closure phase could take longer than 18 months. The risk of the project expanding is always there, if IISA is able to implement a successful project they will undoubtedly want to expand into other areas of the biological reserve. It would be very difficult to stop at that point. Therefore, as mentioned this is a very important decision that the country is faced with.

With regard to the impacts on water, the ARD, erosion and runoff can be mitigated and the quality of tailings improved. If ARD is prevented all together then impacts on ground water would be minimized. Damage to the local aquifer is inevitable but damage to the regional aquifer could be minimized. Any dewatering that occurs could be quite rapidly remedied, due to the nature of the rock, with high infiltration rates. With proper management the biophysical impacts can be mitigated. However, as mentioned above several times there are great risks that not everything will go according to plan. The high precipitation rates and seismic activity will undoubtedly increase the risks of implementing a project like this. Are the risks too great?

The precautionary principle should be mentioned as a principle for guiding action in this instance (see Lofstedt, 2003, Riley, 2000, Blewitt, 2008 p.70). The 1992 Rio Declaration outlines it in Principle 15, which states: "In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation". There has been some controversy surrounding the Precautionary principle, Peterson (2006) warns that in some cases the use of the precautionary principle is not a reasonable rule for rational decision making.

However, from the data gathered in this research and the specific case of the CMP, it would appear that the application of the precautionary principles would be warranted in this case. There are great risks and due to these risks it would be wise to follow another course of action.

With regard to the social impacts, there have been both positive and negative impacts ex-post and ex-ante. The improved infrastructure has already brought benefits to the region and to the communities. It has brought more job opportunities working directly for the CMP or then through initiatives started by the CMP to expand and diversify economic activities. Over the entire life of the mine, there would undoubtedly be increased employment opportunities and increased investment into the area. However, there have been some unintentional negative impacts also. The decrease in community cohesion and harmony, is regrettable, some deterioration of health and the environment or at least perceived deterioration of these. These would likely also increase over the life of the mine. Some unfulfilled promises by IISA have resulted in distrust and disillusionment of community members toward the company. This could be no fault of IISA, they were forced to shut down operations before they really even got started. They would have very little capital at this stage to invest in community programmes or provide jobs. Could IISA

have done things differently and would it result in different outcomes? IISA has made an effort to invest in the local communities, but how much investment is enough?

At the local level, what is primarily at issue is whether local communities will receive an appropriate balance of benefits to compensate for the costs associated with the negative impacts on their livelihoods. Esteves and Vanclay (2009) have noticed that while the local community bears most of the environmental and social costs of mining, most of the profits (rents) flow elsewhere. This has led to growing demands that a sufficient portion of the benefits/rents should flow to local communities to ensure they are adequately compensated. This also seems to be very much the case with the CMP.

Burke and Logsdon (1996) raise a problem that is certainly the case with the CMP and most likely virtually every mining company. They argue that companies are ill-equipped to address social problems. A company is more likely to be committed to social projects that directly support 'core business', such as utilising local employment, building a local supply base, ensuring that the infrastructure and service needs of employees and their families are met, and facilitating skills transfer between employees and community groups. Gaining support from senior management of mine sites to long-term social projects is easier when focus areas are shown to benefit the site's strategic goals (p. 496). While this is good to a degree it could be done better.

Esteves and Vanclay, (2009) argue that mines can be a source of real development. In their opinion the goal is to embed concepts of sustainability and social development into core business strategies by linking the future of the company with the future of the local community. This can be done through strategies and using tools like the 'Social Development Needs Analysis' (SDNA) that highlight a key question that mining companies should be asking, "What are the priority social issues that should be addressed in order for us to contribute to sustainable development of the community and create value for our business"(p.137)?

An example of a mining company attempting to put these principles into practices is Anglo American plc, with their Socio-Economic Assessment Toolbox (SEAT). SEAT is an attempt by Anglo American to incorporate impact assessment into ongoing management of operations. It is linked to improving the implementation and contribution of activities such as: increasing local procurement and outsourcing to support local business development; establishing new community investment initiatives; developing human capital; setting up partnerships; and post-closure planning. More information can be found on their website (http://www.angloamerican.com/). These kinds of tools are very encouraging, they can enable mining companies improve their business by working with communities.

Petkoski and Twose (2003) highlight the importance of appropriate interaction between the companies and communities, they aptly warn of the dangers of the 'Santa Clause syndrome'. They advise that companies especially in the extractive industries should refrain from entering into long-term, unilateral commitments to community development programs since these can generate false expectations and community dependency, as well as undermine the proper role of the State. They go on to suggest that greater sustainability and reduced business liabilities would be achieved where companies learn to partner with local government on community projects, dovetailing their social investment programmes

with the strategic social and economic priorities of a mandated democratic planning and political process at district or regional level (p.26).

Through the course of this research it became evident that IISA did use some of these strategies and tools to build connections with local communities and improve the conditions in these local communities. However, if more would have been done, perhaps IISA would have received wider support.

There were some interesting impacts at the national level; questions have been raised about the capacity of the government to monitor and regulate a project like this. MINAET has had a poor track record of ensuring mining companies do not damage the environment. It seems quite clear that the technical capacity needs to be improved before they will be able to handle a project like this. Due to the risks of mining in the humid tropics, such regulatory bodies need to be exemplary. The impacts of the CMP on the image of Costa Rica were also very interesting. Many citizens felt mining did not fit in with their national identity, they were proud of their nature. Costa Rica's landmass encompasses only .03% of the earth's surface, but contains 5% of earth's biodiversity, a density that is unmatched anywhere else in the world. Many Costa Rican's feel this biodiversity is worth preserving and are opposed to activities that may threaten this. In a poll by National University's Idespo research institute in May 2010, 86 percent of Costa Ricans were against the CMP and 77 percent opposed open-pit mining in general (Leff, 2011). Costa Rican's see the link between biodiversity and tourism; many were worried as to how the CMP would impact the tourism industry that makes up a large part of their foreign income.

Economically there are clearly benefits that will extend from the local level right up to the national level. The economic gains that Costa Rica would receive are quite substantial. The tax revenue generated would help tackle Costa Rica's mounting budget deficits. However, these revenues would have lasted only 10 years. And there are risks of compromising a much more valuable and important tourism industry. As Yamileth Astorga said the "Country is too small for both activities". President Chinchilla has remarked that "Costa Rica is headed towards a model of economic development that coexists with the environment" (Leff, 2011). This probably would be the best course of action.

There are some limitations to this study. Firstly, there are several ways to answer the research question. The method chosen for this research was an environmental and social impact assessment that looks at a wide range of impacts. However, this same question could be answered or at least supplemented through an ecosystem service valuation. During the course of this research the question of how can economic values be placed on a pristine environment, can we put a value on clean air and clean water? How would we value the nature that would be lost?

Ecosystem valuation is a more and more widely used tool in determining the impact of human activities on an environmental system, by assigning an economic value to an ecosystem or its ecosystem services. A good example of this is the World Bank initiated partnership WAVES (Wealth Accounting and the Valuation of Ecosystem Services). What does ecosystem valuation look like? For example, a forest once valued by what its trees fetch on the timber exchange might instead be valued according to the carbon dioxide it absorbs, the animals it supports, the water it filters and the firewood it provides. Or it could be revalued with future generations in mind. That might lead to higher felling fees, pricey

replanting requirements or more expensive wood. Some might rethink the economic benefit of cutting it down. Science would become a more important factor in economic decision-making ("Environmental accounting aims to assign dollar value to nature's bounty", 2012).

In the results section above an ecosystem evaluation was carried out when the project was at the end of the exploration phase and mine clearing had started. It would be interesting to know what the estimated cost of the entire CMP would be. The value of the ecosystem services lost could be directly compared to the economic benefits received from the CMP. This would be a useful addition to complement this study, and a more informed decision could be made. Ecosystem valuation also has its limits and shortcomings (see de Groot *et al*. 2010). These would also need to be recognized.

6. **CONCLUSIONS AND RECOMMENDATIONS**

Over the course of this research the main biophysical and social impacts and change processes have been presented and discussed. There are both positive and negative impacts that will result from the CMP.

One of the issues that kept coming up is that there are great risks involved with this project. These risks are increased due to the location of the CMP. If the CMP was located somewhere else the situation would be completely different. The CMP is located in a San Juan-La Selva biological corridor and part of the buffer zone of the Rio San Juan Wildlife Refuge and the Indio-Maiz Biological Reserve. If any contamination were to occur it would be in an ecologically sensitive area with lots of biodiversity and wildlife. This zone is in the humid tropics, it is seismically active with high precipitation, and any contamination would spread quickly through rivers and streams. These factors increase the risks of accidents and contamination substantially. However, the one factor that increases the importance of these other factors is the CMP's close proximity to Nicaragua. Any accident or spill would be within Nicaragua within hours of the event. Very quickly the CMP could flare up into a bi-national dispute due to trans-boundary water pollution. This could be very costly for Costa Rica.

Due to the mines close proximity to Nicaragua the legality of the entire mine can be questioned. Some could interpret that Costa Rica is in breach of international treaties it has ratified if it allows the CMP to continue. This could potentially pose a great problem for Costa Rica.

It is the conclusion of this research that the risks are too great with the CMP. It would be best for Costa Rica to exercise the precautionary principle and not develop the CMP. It will result in loss of revenues in the short term; however, option and non-use values remain.

Alternative strategies for development should be followed that will not compromise the integrity of the environment. For example, it could be more beneficial for local residents of the Crucitas region, if the government supports and helps to implement tourism-based plans and initiatives. Tourism is one of the main industries in the country and it could be expanded to this area due to the rich biodiversity. This kind of development in that zone

would help secure the creation of jobs for more than just a couple hundred people for some 10 years. Development in line with environmental protection would be the most prudent option to achieve true sustainable development. Costa Rica should pursue development that is “at peace with nature”.

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Appendix 1

ARTICLE 17 - Environmental Impact Assessment.
Human activities that alter or destroy elements of the environment or generate waste, toxic or hazardous materials will require environmental impact assessment by the National Environmental Technical Secretariat established in this law. Prior approval from the agency is essential to begin the activities, works or projects requirement. The laws and regulations which shall indicate activities, works or projects would require an EIA.

ARTICLE 18 - Approval and cost evaluations.
The approval of the environmental impact assessments shall operate before the National Environmental Technical Secretariat (SETENA); these assessments should be conducted by an interdisciplinary team of professionals, registered and authorized by the National Environmental Technical Secretariat in accordance with guidelines prepared by it. The cost of the environmental impact assessment shall be borne by the person concerned.

ARTICLE 19 - Resolutions.
The resolutions of the National Environmental Technical Secretariat shall be informed and reasoned. They shall be binding on both the individual and for the authorities and public bodies.

ARTICLE 20 - Enforcement of judgments.
The National Environmental Technical Secretariat shall establish tools and means to monitor compliance with the resolutions of the environmental impact assessment. In cases of violation of its contents, may order the cessation of work. The applicant, the author of the study and those who pass will be, directly and severally liable for the damages caused .

ARTICLE 21 - Guarantee compliance.
In all cases of activities, works or projects subject to environmental impact assessment, the assessing body shall fix the amount of the guarantee of compliance with environmental obligations shall render the person concerned. This warranty will be up to one percent (1%) of the amount of the investment. When the activity does not require building infrastructure, the percentage shall be the value of the land involved in the project.
The guarantee should be of two types:
a) In compliance during the design and implementation of the project.
b) In operation for the period, which can range from five to ten years, depending on project impact and risk of the population of the surrounding area.

The performance security shall remain in effect during the implementation or operation of the work, activity or project and will be reviewed annually to adjust to the requirements of environmental protection.

ARTICLE 22 - Dossier evaluation.
Persons, natural or legal, private or public, will have the right to be heard by the National Environmental Technical Secretariat, at any stage of the evaluation process and the operational phase of the work or the project. The comments of stakeholders be included in the record and accounted for the final report.

Within five working days following the receipt of an environmental impact assessment, the National Environmental Technical Secretariat shall extract it to the municipalities in whose jurisdiction the works, the activity or project. It also will give profuse disclosure by mass media, to the list of studies submitted to it.

ARTICLE 23 - Advertising information.
The information contained in the record of the environmental impact assessment will be public and will be available for consultation by any person or organization. However, interested parties may request that information be kept confidential integrated into the study, if published would affect industrial property rights.
ARTICLE 24 - Inspection of files.
The technical criteria and the weightings for analyzing environmental impact studies by the National Environmental Technical Secretariat should be public knowledge.

That within the legal framework, as regards the approval of environmental impact assessments; they must be performed by an interdisciplinary team of professionals, registered and licensed by Technical Secretariat Environmental National.

Appendix 2

In Fig. 9, the general framework, as described by Slootweg *et al*. (2001), is presented. The framework provides a sequence of steps to determine the impacts that may result from a (proposed) activity. The starting point of analysis is an activity that can be a biophysical or a social intervention. (Bear in mind that a proposed project can be composed of a large number of different activities.) The steps that follow are described below, the letters correspond to the letters in the diagram:

(A) Biophysical interventions lead to biophysical changes being defined as changes in the characteristics of the recipient media soil, water, air, flora, and fauna (e.g., a dam changes river hydrology).

(B) Each direct biophysical change can result in a chain of second-order and higher-order biophysical changes (e.g., a reduction in river flow will result in reduced submersion of downstream floodplains, which may in turn influence the recharge of groundwater aquifers under these plains, etc.).

(C) Projects can also carry out social interventions that lead to social change processes being defined as changes in the characteristics of social components (individuals, families, functional groups, or a society as a whole); the nature of these characteristics can be demographic, economic, socio-cultural, emancipatory, institutional, land use, etc. (e.g., the construction and operation of a dam can attract migrant workers).

(D) Higher-order social change processes. Each direct social change process can lead to second-order and higher-order social change processes (e.g., inmigration of foreign workers may lead to segregation, which in turn may lead to marginalisation).

(E) Social change processes lead to biophysical changes. A change in the social characteristics of a community can lead to biophysical changes (e.g., population growth can lead to occupation and conversion of new land).

(F) Most biophysical changes will only affect the area where the activity is carried out; these are so-called onsite changes. However, a number of biophysical changes will have a wider area of influence and will cause offsite changes. A knowledgeable expert will be capable of determining the geographical range of influence of these changes. Knowing the potential area of influence, one can identify the ecosystems and land-use types that lie within the boundaries of the area of influence. Different biophysical changes can have different areas of influence; for each expected biophysical change, one has to define the area of influence and determine the ecosystems and land-use types that may potentially be influenced.

(G) Each ecosystem or land-use type provides a unique set of functions that are valued by society; these functions are often referred to as goods and services provided by nature. Under the influence of biophysical changes, these functions may change. Impacts are defined as the changes in the quality or quantity of the goods and services (= functions) provided by an ecosystem or land-use type (including both biotic and abiotic environment).

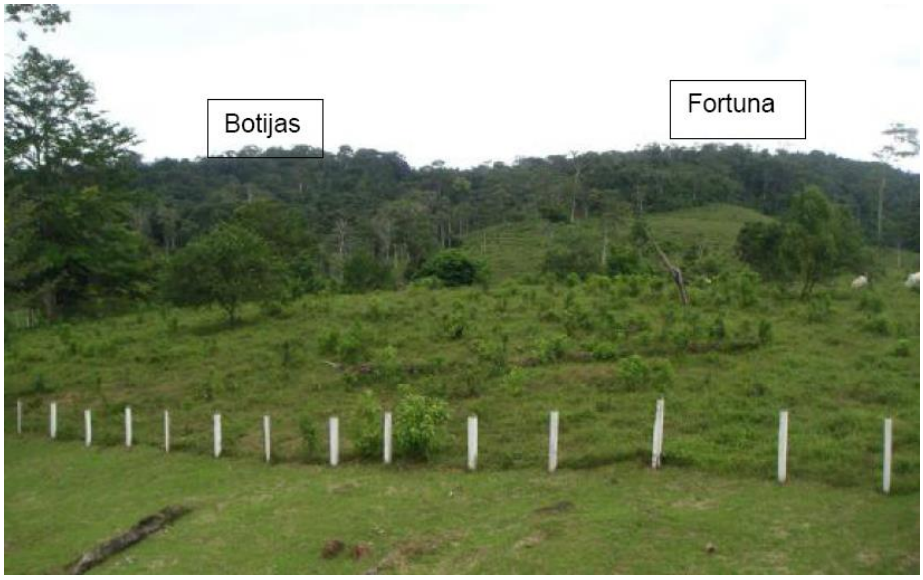
(H) A change in the functions provided by the natural environment will lead to a change in their value for human society. The function concept is principally anthropocentric, translating nature into functions for human society. Society puts a value on these functions. Biodiversity provides functions that are converted into use and non-use values to human society. Values can be expressed in economic, social, or ecological terms.

(I) Social change processes cause social impacts.

(J) As human beings or society as a whole are able to respond to impacts, the experience of social impacts, in some cases, leads to so-called invoked social changes processes (e.g., people may decide to move elsewhere after the emergence of social tensions, or when productivity of natural resources diminishes).
(Slootweg and Kolhoff, 2003, p. 660-661)

Appendix 3

Photo's of the CMP and events related to it.



Picture of Botijas and Fortuna hills and location of open pits


Picture of Computer laboratory built by Infinito Gold

School built in Crucitas

Photo of a bridge constructed by IISA

IISA advertisement of their reforestation efforts

Photo of mine site with the different species found

Photo of an electricity pole on the road to Crucitas

Photo of IISA tree nursery at Crucitas mine site

A sign created for demonstration in opposition to the CMP

Photo from one of the demonstrations