



ENV/Mining Program

# ENVIRONMENTAL ASSESSMENT OF THE ENV/MINING PROGRAM

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## ACRONYMS

ASGM – Artisanal Small-scale Gold Mining

ANM - National Mining Agency

BEO - Bureau Environmental Officer

BIOREDD+ - USAID/Colombia’s Biodiversity Project, focus on Reducing Emissions from  
Deforestation and Degradation

BMP – Best Management Practices

CDM – Clean Development Mechanism

CFR – Code of Federal Regulations

CODECHOCO – Colombian Environmental Agency for the Department of Chocó

CORANTIOQUIA - Colombian Environmental Agency for the Department of Antioquia

EA - Environmental Assessment

EMP - Environmental Management Plans

ENV/Mineria – USAID/Colombia’s BIODREDD+/Mining Project

NTEFP - non-timber forest products

RIA - Reforestadora Integral de Antioquia S.A.

SIMCO - Colombian Mining Information System

UPM – *Unidades de Production Minera* (Mining Production Units)

USAID - United States Agency for International Development

WP - Work Plans

## EXECUTIVE SUMMARY

Colombia is currently facing a major challenge with respect to the exploitation of its mineral resources. The country acknowledges the economic value and potential of its mining sector and is working to support an operative mining sector that will generate employment and wealth, without resulting in major negative impacts on the physical, biotic, and social environment. Gold, one of the minerals with the greatest wealth generating potentials, is unfortunately embroiled in a complex situation of illegality and informality with enormous environmental and social consequences on the country. The failure to apply firm environmental practices and the prevalent use of mercury in gold mining has caused irreparable environmental damage on soils, the atmosphere, and water sources in Colombia, and has negatively impacted communities living in the mining regions. In addition, the failure to implement industrial safety and occupational health practices contributes to dangerous working conditions for miners. Furthermore, illegality and informality in mining promotes a culture of illegality and abandonment of environmental stewardship.

With the goal of collaborating with Colombia in the legalization and formalization of gold mining, the reduction in the use of mercury, and the rehabilitation of areas impacted by informal gold mining, United States Agency for International Development (USAID) created the ENV/Mining Program, whose execution requires evaluation through an Environmental Assessment (EA) to consider any potential, significant negative environmental impacts of the Program. This program will not promote or condemn mining. The program promotes legal Artisanal Small-scale Gold Mining (ASGM). Like this, this EA does not look at the environmental impacts of a mining operation as such. It focuses on the activities performed to achieve program goals. The actions undertaken as part of ENV/Mining are mitigation activities themselves: reduced use of mercury and recuperation of degraded areas by mining operations. The EA is constructed around these activities.

As mentioned above, an EA of the ENV/Mining Program was carried out per the guidelines set forth in Title 22 of the Code of Federal Regulations (CFR) 216.3 (a) (4), identifying the significant issues related to the actions proposed by USAID/Colombia. These significant issues are evaluated through an analysis of three possible alternatives: (i) Alternative A, the “no action” alternative, is to not take any action; (ii) Alternative B would be to proceed with the proposed activities of the ENV/Mining Program and; (iii) Alternative C would be to proceed with the proposed activities of the ENV/Mining Program, but with a broader scope and some additional considerations.

The EA determined that the alternative that best responds to the significant issues identified, within the framework of the current budget and time allocated to the Program, is Alternative B: proceeding with the proposed activities of the USAID/Colombia ENV/Mining Program. The implementation of the ENV/Mining Program will help mitigate significant negative impacts from unauthorized small-scale gold mining in the project area by reducing the use of mercury, formalization of mining activities, and restoration of lands damaged by informal gold mining. The program targets ASGM operations that are or can become legal and its activities are mitigation actions themselves. Included in this EA is a management plan, presenting actions for mitigation, monitoring, training, and associated costs for these activities.

## I. INTRODUCTION

Colombia has been a mining territory dating back to before the Spanish Conquest. Indigenous peoples long exploited and adored minerals such as gold, followed by the Spanish conquistadors who later colonized these territories who extracted these minerals on a large scale, giving rise to the complex history of gold mining in Colombia. Following the Colonial era, Colombia continued to be a country with an extensive mining industry. This economic activity was carried out using traditional methods throughout many regions of the country and continues to be one of the only sources of income for entire communities. Mining currently poses major social, environmental, economic, and political challenges to Colombia. The country has significant mineral resources and aims for mining to be one of the five engines of the national economy. Unfortunately, mining is carried out primarily in areas with little State presence or control. As such, many mining operations work in a clandestine manner in areas with insecure public order where excessive and uncontrolled amounts of chemicals such as cyanide and mercury (particularly in gold mining) are used and operations are carried out without regard of environmental and worker safeguards. This has led to many unfortunate, negative consequences on the country's natural resources and social fabric.

The BIOREDD+ (Reducing Emissions from Deforestation and Degradation) Project, funded by the United States Agency for International Development (USAID), aims to support Colombia's efforts in the sustainable natural resource management through the achievement of four main components: (i) strengthen environmental governance; (ii) improve climate change adaptation and mitigation; (iii) improve conservation of biodiversity and; (iv) reduce of the use of mercury in gold mining in the departments of Antioquia and Chocó recover areas degraded by gold mining, which constitutes the ENV/Mining Program. ENV/Mining Program intends to make an important contribution to improving the environmental and social performance of the country's mining sector and is the subject of the current environmental assessment (EA).

The purpose of this EA is to: (i) analyze the potential environmental impacts (positive and negative) arising from the activities proposed by ENV/Mining to address environmental issues associated with informal ASGM in two geographic regions of Colombia: Antioquia and Chocó and; (ii) comply with USAID Environmental Regulation 22 CFR 216. The "need for action" of this activity is focused on how to improve an undesirable "existing condition" (synonymous with the baseline) of the informal gold mining sector, to a "desired future condition" that results in better environmental, social, and economic outcomes.

The proposed activities under the ENV/Mining Program are rooted in a goal to help ASGM operations that within the current legal framework could be legalized in selected geographies in Antioquia and Chocó, while becoming, more environmentally and socially sustainable, formalized, and entrepreneurially sound. The "desired future condition" of this action is aimed at the following areas: (i) reducing the use of mercury for the extraction of gold in specific areas of the departments of Antioquia and Chocó; and (ii) rehabilitating areas that have been affected by unregulated activities of alluvial gold mining.

This "desired future condition" will be attained by the ENV/Mining Program through a set of proposed activities in support of the ASGM sector:

- Support to mining rights legalization
- Formalize agreements with local, regional, and national government authorities
- Create alliances between informal miners and large formal mining companies
- Organize and strengthen small mining associations
- Support the preparation and approval of mine work plans (*PTO: Plan de trabajo y obras*) by the relevant authorities
- Support the preparation and approval Environmental Management Plans (EMP) by the relevant authorities
- Support enforcement of environmental, social, Industrial Safety and Occupational Health, and tax regulations by the State
- Promote gold mining technologies that reduce or eliminate mercury from the production cycle while maintaining or increasing gold recovery.

The "desired future condition" for lands negatively impacted by informal gold mining will be achieved through the following activities:

- Establishment of long-term (30 years) legally binding agreements between land owners, small miners associations and regional government for the establishment of commercial forestry plantations
- Re-contour lands degraded by informal and illegal gold mining
- Facilitate land use change from degraded areas by unauthorized mining operations (*pasivo ambiental*<sup>1</sup>) to commercial forestry plantations
- Assist landowners to obtain forest use permits for plantations to authorize future harvest and generate income
- Support fast income generating activities like beekeeping to generate income for small miners while commercial plantations mature
- Support land titling in degraded areas, where feasible.
- Create a more favorable social, political, and physical environment to allow natural ecosystem functions and conserve biodiversity
- Support enforcement of environmental, social, Industrial Safety and Occupational Health, and tax regulations by the State.

Per the guidelines set forth in Title 22 of Code of Federal Regulations (CFR) 216.3 (a) (4), the USAID Bureau Environmental Officer (BEO) for Latin America and the Caribbean determined that the proposed action was likely to cause significant negative impacts on the environment and therefore issued a "Positive Determination", whereby an Environmental Assessment (EA) is required.

One of the main tasks of the EA process is to identify the significant environmental issues associated with the ENV/Mining Program proposed by USAID/Colombia. This identification or

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<sup>1</sup> *Pasivo ambiental* is defined as a degraded area by unauthorized mining activity where nobody is legally responsible for the environmental damage.

scoping process engaged representatives of the Colombian government, private institutions, USAID/Colombia staff, and contractors in preparation of the Scope Statement that included:

- Definition of the scope and importance of the problem areas to be analyzed in the EA, including potential direct and indirect effects and cumulative impacts of the Program on the environment
- Identification and elimination of non-significant issues from the EA
- Description of the EA preparation process and timeframe, variations required in the EA format, and a decision-making time-table
- Description of how the assessment will be conducted and what disciplines will participate therein.

The Scoping Statement and the EA satisfy USAID'S commitment to protect the social and biophysical environment from the potential negative impacts of its projects. The "*Environmental Threshold Decision*" LAC-IEE-14-02, issued on October 16, 2013 by the BEO for Latin America and the Caribbean stipulates a "Positive Determination".

The "positive determination" was issued for the following proposed Program activities:

- Reduction of the use of mercury by small informal mining organizations
- Rehabilitation work in areas affected by unauthorized mining activities.

Essential sections of the Scope Statement include:

- Significant issues: These are issues within the scope of the ENV/Mining Program and were considered highly important according to the Program objectives
- Non-significant issues: Although these issues are within the scope of the ENV/Mining Program, they are considered to have a low impact and can be analyzed in less depth
- Connected actions: These are actions associated with or ancillary to the main actions proposed by the ENV/Mining Program, which are noted but not subject to in-depth analysis
- Issues beyond the scope of the Program: These issues are directly linked to the illegal mining sector in which ENV/Mining Program will operate, but are considered to be outside the scope of Program objectives.

## **Summary of Scoping Statement Results**

The following significant and non-significant issues arose directly as a result of stakeholder input obtained during formulation of the approved Scoping Statement.

### **Significant issues**

*Informality in the possession, use, and exploitation of lands subject to gold mining.* The ENV/Mining Program is not meant to directly resolve the issue of formalization in the possession, use, and exploitation of the land *per se*. However, proposed actions to rehabilitate

land degraded by unauthorized gold mining (*pasivo ambiental*) will have the effect of promoting legalization processes.

*Informality in the process of acquiring, processing, and marketing gold.* Informality in gold mining has caused and continues to cause serious impacts on the environment. The primary impacts from informality along the marketing chain for gold to be addressed by the ENV/Mining Program include: degradation and loss of soil; damage to water resources and biodiversity; deforestation; failure to implement and uphold industrial safety and occupational health standards and; very poor organization of informal mining activity.

*Use of mercury in the gold mining process.* Reducing the use of mercury in selected geographies within the departments of Antioquia and Chocó is one of the main goals of the proposed ENV/Mining Program activities. By legalizing and formalizing ASGM activities and improving the technology used in gold extraction processes, the use of mercury is expected to decrease, thus reducing emissions and exposure from mercury gases, contamination of soils and water resources, negative impacts on biodiversity, and the health risks to workers, their families, and communities where gold mining is carried out.

## Non-significant issues

*Planting of Acacia mangium.* *Acacia mangium*, an exotic, potentially invasive species, is a fundamental part of rehabilitation efforts of lands degraded by alluvial gold mining. *A. mangium* is an exotic, non-native species in Colombia, originally from Australia. The weighing of benefits and potential risks of its use in the ENV/Mining Program requires careful consideration and justification. The following references relate to *A. mangium* as a potential invasive species:

- “Cookies on Invasive Species Compendium” (<http://www.cabi.org/isc/datasheet/2325>) Introduced *A. mangium* has been found to be associated with invasion events in Africa, Western Australia, American Samoa, Chuuk (Federated States of Micronesia), Sabah (Malaysia), and Bangladesh (Haysom and Murphy, 2003). It is also recorded as invasive in Brazil (Instituto Horus, 2011).
- “Global Invasive Species Database” <http://www.issg.org/database/species/ecology.asp?si=198&fr=1&sts=&lang=EN> – and - <http://www.kew.org/science-conservation/plants-fungi/acacia-mangium-brown-salwood> - *A. mangium* is a fast-growing tree that produces many seeds. Used for forestry and ecological restoration, it was widely planted and cultivated in many Pacific islands. It has naturalized in many cases and it is a threat to indigenous flora. *Acacia mangium* is a major plantation species in the humid tropical lowlands of Asia. Its success is due to its extremely vigorous growth rate, tolerance of highly acidic, low nutrient soils, ability to grow reasonably well where competition is severe (for example *Imperata* grasslands), relative freedom from disease, wood properties that make it suitable for a wide range of uses, and ease of establishment in cultivation. Plantations in Indonesia and Malaysia are the resource base for a large pulp and paper industry. Other uses include fuel wood and timber for building furniture and particle board.

- “Pacific Islands Ecosystems at Risk” ([http://www.hear.org/pier/species/acacia\\_mangium.htm](http://www.hear.org/pier/species/acacia_mangium.htm)) *Acacia mangium* has a high risk to invade sites. Naturalized species in many places in the Pacific region and in the Caribbean region, including American Samoa, Hawaii, Palau, Singapore, Costa Rica, and the Dominican Republic. From the “Global Compendium of Weeds” - it is considered a naturalized, environmental weed.

The planting of *A. mangium* is contemplated as part of the ENV/Mining Program to rehabilitate severely degraded lands as a result of alluvial gold mining. The planting of *A. mangium* is considered a non-significant issue for the following reasons:

- *A. mangium* has been widely planted in the Bajo Cauca region of Antioquia for more than 20 years; thus, it would not be newly introduced to the region under the ENV/Mining activity. During this time, it has not become a serious invasive species, threatening native trees as in other parts of the world. Where *A. mangium* is grown on a commercial scale in Southeast Asia, there is no evidence the species has become established in intact, native forests to the exclusion of native species.
- The Bajo Cauca region has climatic extremes that compound the already harsh physical and nutritional edaphic conditions of degraded alluvial mined lands. The region has an extended, annual dry season (approximately four months per year) and average annual temperatures are high (28° C). This combination of climatic variations and harsh soil conditions creates conditions too severe for native species. Field trials have demonstrated that on degraded sites (without clay or loam soil fractions), *A. mangium* is the only species able to thrive under such harsh conditions and in this sense is a “species of last resort” where other species, especially native hardwoods, have little chance of survival.
  - As a fast growing, pioneer species, it has been observed in the field that *A. mangium* trees create a closed canopy and mature very quickly, and thus serves as a “nurse crop” to improve site conditions favorable for the establishment of native vegetation, including native tree species, as seeds of native species are deposited by wind, birds and other animal beneath the *Acacia* canopy. Scoping Statement authors saw a mature stand of *A. mangium* in Bajo Cauca with a well-developed understory composed entirely of native hardwood species; i.e. no natural regeneration of *A. mangium*. Native species can compete well with *A. mangium* on better sites, conditions that are not present within degraded alluvial mined lands where this species will be used.
  - Based on field observations where *A. mangium* has been planted on degraded mining sites, as stands of *A. mangium* mature, understory conditions will create favorable for local native trees and other vegetative species to become established, replicating the process observed on better sites where *A. mangium* has been planted.
- *A. mangium* will be very limited in its ability to move beyond degraded mined lands because the species requires exposed mineral soils to germinate. In the Bajo Cauca region, landscapes surrounding degraded mined lands are composed of three primary land

uses: (1) pasture lands for cattle; (2) small to medium-sized stands of native hardwood species; and (3) tree plantations primarily composed of rubber trees. All three of these land uses maintain permanent vegetative cover and soil conditions that are unfavorable for germination of *A. mangium* seeds.

- Extreme seasonal droughts and nutrient poor soils are other conditions that will prohibit the spread of *A. mangium* by seed outside of the degraded mined areas where it is planted. Even on a degraded mining site, successful establishment of *Acacia* seedlings requires incorporation of organic matter and fertilizer in the planting hole to aid survival, a “jump start” that seeds deposited outside the degraded mining areas would not have.
- While virtually all potential sites where *A. mangium* might be used are degraded mining areas, some of which have been mined repeatedly and are therefore extremely damaged. Nonetheless, soil quality varies and will be taken into account in restoration efforts on a case-by-case basis. For this reason, and to give the process of reintroducing native species a head start, at least ten percent of all trees planted will be native species, which will be planted on the more favorable micro-sites (better soils and more adequate moisture).
- RIA (Reforestadora Integral de Antioquia S.A., a primary ENV/Mining partner) has significant experience planting *A. mangium* in the Bajo Cauca region and has successfully rehabilitated degraded sites using *A. mangium*.

**Photograph I.1 - *A. mangium* on severely degraded, nutrient-poor soils typical of alluvial mined lands not apt for native hardwood species to germinate and survive**



Connected actions are ancillary activities to the ENV/Mining Program that can generate additional environmental and socio-economic benefits. These include beekeeping that will be done in association with restoration and reforestation activities on areas damaged by unauthorized gold mining. Connected actions, such as beekeeping, have both an ecological and economic function with the potential to generate income for landowners and ASGM associations while commercial plantations grow to a harvestable age. It is expected that reforestation activities associated with restoration of degraded mined areas will create a significant number of local jobs both during the plantation establishment phase as well as in the medium and long term via plantation maintenance and harvesting trees during the plantation cycle. This will withdraw hand labor to small scale mining operations and will establish a more reliable source of income for community associations. Connected actions will be addressed in conjunction with the recommended alternative.

### **Issues beyond the scope of the Program**

- High economic dependence in the intervention areas on mining
- Issues associated with acid mine drainage and heavy metals
- Influence of armed actors in the informal gold mining activity carried out in the areas of Antioquia and Chocó.

### **Environmental Assessment framework**

Once the Program's Scoping Statement was completed, submitted, and approved, the EA for the ENV/Mining Program was conducted, framed by the following factors:

- Five-year time horizon to evaluate the environmental impacts of the activities proposed by ENV/Mining Program
- Input from Program stakeholders in order to learn their points of view with regards to activities proposed by the ENV/Mining Program. In the course of conducting the EA, interviews were conducted with representatives of the Ministry of Mines and Energy, National Mining Agency, Codechocó, Antioquia Secretary of Mines, and Program implementing partners (mining associations, *Reforestadora Integral de Antioquia - RIA*, *Gestión y Expansión Empresarial* and *Armónica*, and private companies)
- Consider at least three alternatives
- Assess the three alternatives to determine how they address the significant issues identified in the Scoping Statement and identify a recommended alternative
- Create a Management Plan for the set of activities proposed, which includes mitigation measures, a monitoring plan, a training plan, and a draft budget for the execution of these activities.

## 2. PROPOSED ACTIONS

USAID/Colombia has created the ENV/Mining Program to transition an existing, unfavorable condition to a desired future condition, and in turn fulfill the specific objectives of raising the environmental, economic and social performance of the informal gold mining sector to one that is legal and formal and environmentally and socially sound. ENV/Mining focuses its efforts and resources on the implementation of two major components: (i) reduction of the use of mercury by the small-scale informal mining sector and; (ii) rehabilitation of areas damaged or degraded by unauthorized gold mining activities. It is important to clarify that while the ENV/Mining Program is focused on incorporating informal gold mining operations into the formal gold mining sector and mitigating the negative environmental impacts of current mining activities, the Program will purposely avoid supporting any actions that may inadvertently expand mining activities beyond current areas nor will the Program attempt to address all current issues relating to gold mining in Colombia.

It is important to note that the activities proposed under the Program's two components are entirely mitigation driven and generate net positive environmental outcomes. In other words, each component in and of itself is comprised of a set mitigation measures designed to address serious on-going (e.g. indiscriminate use of mercury) and past (e.g. degraded mined out alluvial deposits) negative impacts to the environmental and human health. A detailed description will be provided of the actions proposed by the ENV/Mining Program, starting with the target regions where they are carried out. Later in this assessment, these activities are described in detail and the economic resources available for investment by the Program are discussed.

As small-scale gold mining represents a temporal land use, the Program aims to restore lands degraded by alluvial gold mining to more permanent productive uses. In broad terms, rehabilitation efforts include measures to stabilize soils, prevent ongoing contamination of water resources and return mined-out lands to agreed-upon post-closure uses. Restoration can impose significant costs with the use of heavy equipment to re-contour alluvial mined lands and may inadvertently cause additional impacts if not conducted correctly. For this reason, restoration efforts supported by the Program aim to follow Best Management Practices (Section 7) to re-establish, to the extent possible, the pre-mining topography and natural water courses and quickly reestablish vegetative cover that can jump start the longer-term process of fully restoring ecological and hydrological functions.

### 2.1 Location of the ENV/Mining Program

The actions of the ENV/Mining Program are to be carried out in 20 municipalities in the departments of Antioquia and Chocó (Table 2-1), providing support to public entities at all levels, mining associations, and small-scale mining production units to promote the legalization and formalization of gold mining, implementation of processes to improve the technical, economic, social and environmental performance of the activity, and to establish public-private agreements for the recovery of areas damaged by informal gold mining. USAID/Colombia selected two regions to carry out the ENV/Mining Program. These regions contain a high concentration of mining activities and have some of the highest levels of gold production in Colombia. Gold mining has the potential of producing some of the most severe environmental

and social impacts, making these regions of great concern to Colombia. The ENV/Mining Program will only be carried out in areas not legally protected by the Colombian government, so it will not operate in National Parks, Forest Reserves covered by Law 2, Highland Complexes, or regionally and locally protected areas. Maps 2.1 and 2.2 show the geographic area where the ENV/Mining activities will be carried out.

**Table 0-1 Municipalities where ENV/Mining Program activities will be carried out**

Department	Subregion	Municipality
<i>Antioquia</i>	Northeast	Remedios
		Segovia
		San Roque
	Western	Buriticá
	Lower Cauca	Nechí
		Tarazá
		Caucasia
		El Bagre
		Cáceres
		Zaragoza
<i>Chocó</i>	Middle and Upper Atrato River	Bagadó
		El Carmen de Atrato
		Lloró
		Quibdó
	Lower, Middle and Upper San Juan River	Condoto
		Cantón San Pablo
		Istmina
		Nóvita
		Sipí
		Tadó

Source: ACON- Member of INERCO Group

**Map 0.1 Departments where ENV/Mining activities will be carried out**



Source: ACON- Member of INERCO Group

**Map 0.2 Municipalities where ENV/Mining activities will be carried out**



Source: ACON- Member of INERCO Group

## 2.2 Description of the activities proposed by ENV/Mining Program

The primary two components of the ENV/Mining Program are: (i) reduce mercury usage by small-scale, informal gold mining associations; and (ii) rehabilitate select lands that have been significantly degraded as a result of past alluvial gold mining activities. It is important to reiterate that the ENV/Mining Program has been purposefully designed to mitigate some of the most adverse environmental and human health impacts associated with traditional small-scale, informal gold mining and result in net positive environmental outcomes. This EA is focused on the impacts the ENV/Mining program will have and not on the impacts of mining activities *per se*.

- *Reduction of the use of mercury by small-scale informal gold mining units.* This component encompasses two main areas of work: (i) legalization and formalization of small-scale gold mining production associations and; (ii) improving technologies used by those associations.
  - *Legalization and formalization of small-scale informal gold mining production units.* This component provides support for small scale mining associations to work towards the legalization (per existing Colombian laws and regulations governing the sector) of their operations, which implies their operations have legal mining titles and/or rights. Support to the formalization process involves conclusion of agreements between legal claim holders, landowners and mining operators. Both processes, legalization and formalization, require compliance with Colombian and environmental, mining, labor, and fiscal laws and regulations.
- *Supporting the rehabilitation of degraded areas by unauthorized mining activities.*
  - The proposed activities for this component are aimed at working through public-private partnerships to establish commercial forest plots and/or forest plantations in areas that were degraded by gold mining, for which, due to the illegality of gold mining activities, it is not possible to link them legally to the person responsible for environmental liabilities generated on abandoned alluvial gold mined areas (*pasivos ambiental*). The proposed activities include improving the landscape intervened by mining, re-contouring degraded areas with heavy equipment to achieve an approximation of the original topography, establishing forest tree nurseries, planting a mixture of native and exotic trees, and providing related technical assistance/forestry extension services.

To apply for direct legalization of their operations or to legalize operations through the formalization process, traditional or informal gold miners will be required to submit a Work Program and an Environmental Management Plan (EMP) to the appropriate government authorities. Under the guidance of the ENV/Mining Program, these documents will eliminate or significantly reduce the use of mercury in gold processing. The Program plans to reduce the use of mercury used to process gold from the current ratio of 7.5 g of mercury to obtain 1 g of gold.

### 2.2.1 Legalization and Formalization of Small-scale, Informal Mining Associations

- *Strengthen and train small-scale gold mining associations in order for them to provide support to their members in matters relating to the Colombian legal framework in mining, environmental, Industrial Safety and Occupational Health, and tax issues.* The associations will be strengthened through subcontracts with firms specializing in two areas: i) the design and application of comprehensive strategies for organizational expansion and development, personnel training, formalization and management, and in the preparation of productive projects. And ii) strategic analysis and project design, from defining internal policies and due diligence to continuous improvement in social and environmental management, legalization and formalization of mining associations and technical assistance in administrative planning, geology, mining, safety and occupational health in mining, and the prevention and mitigation of environmental impacts.
- *Advise informal gold miners on the preparation of their Work Plans and EMPs required to legalize their activities per Decree 2715 / 2010.* Expert consultants with extensive gold mining experience will carry out this activity.
- *Analyze gold mining associations enrolled in the Program to determine the processes they must follow in order to legalize their operations.* This analysis determines whether the legalization process should be carried out by public or private means as follows: Public means apply when the mining production unit is located in an area that does not overlap with any other mining title that has already been requested and awarded. If this is the case, the informal mining production unit must submit the Work Plan and EMP to the relevant authorities (ministry of mines, mining secretariat and regional environmental authority) to apply for a mining concession.

Private means are applicable when the mining production unit is located within the mining title of a third party (this is usually the case in Colombia, because most of the mining titles were granted to major national and international mining companies). In these cases, ENV/Mining recommends operating contracts between small operators and the major companies provided the small operators meet labor and tax obligations and comply with the Environmental Management Plans approved for the company's operations. Under this model, the gold extracted by small operators will be processed by the companies under controlled conditions per the approved Environmental Management Plans and monitored by the competent Colombian environmental authorities. ENV/Mining also recommends the transfer of areas as a mechanism of legalization and formalization. This method proposes reaching agreements with large companies to revert unused titled claims to the government to open areas that informal miners can apply for. The ENV/Mining Program has identified companies such as *Mineros S.A*, *Minatura S.A.*, and *Gran Colombia Gold* as companies in the areas of influence of the Program that may participate in this initiative.

- *Strengthen the regulatory framework in the field of formalization in collaboration with the Ministry of Mines and Energy, Antioquia Secretary of Mines, and Ministry of the Environment and Sustainable Development.* ENV/Mining will collaborate in the development of documents such as the Environmental Guide to Formalization, Regulations for Formalization Subcontracts, and Regulations for the Reversion of Mining Claims.

- *Design and implement educational campaigns to promote the culture of legality in the regions where the ENV/Mining activities will be carried out.*

### **2.2.2 Improved Technologies for Informal Small-scale Gold Mining**

This area of work includes demonstration of the benefits of alternative non mercury technologies for gold recovery. Gold is now extracted by two different methods (alluvial or “placer” and ore or “hard rock” mining) in the regions where the ENV/Mining Program operates. The Program will only carry out technical activities in alluvial mining areas where non-mercury technologies will be demonstrated at a small-scale pilot center.

In alluvial mining, the gold is “loose”, so it can be separated from sediments and other minerals. Mercury is currently used in this type of mining to trap fine and coarse gold, making it heavier and allowing better recovery. ENV/Mining has identified technologies such as gravimetric techniques, to obtain the same or improved recovery of gold without the need to use toxic, harmful mercury. These technologies include centrifugal concentrators, trommel screens, condensing tables, and mechanical pans. ENV/Mining plans to install small-scale pilot plants for the processing of alluvial gold with the above equipment that employ non-mercury/gravimetric technologies.

In hard rock mining, underground tunnels are excavated to extract the mineralized vein in which the gold is contained. In this type of mining, the gold may be loose, but it is mainly associated with sulfides. This natural condition requires the extraction of gold using more complex metallurgical techniques than in alluvial mining, involving physical chemical processes that use toxic chemicals, such as cyanide. ENV/Mining will not install pilot plants that use floating and cyanidation processes for the processing of gold ore in the subregions where it will be operating. ENV/Mining will be limited to providing **technical assistance only** at the educational level on this method.

In addition to demonstrating non-mercury alternative technologies for the extraction of gold and resulting environmental and health benefits, ENV/Mining will also provide training in simple techniques to improve gold capture and thus reduce the amount of mercury used in the process. These techniques include boulder screens, inclination control, progressive capture based on size, gate piling, and optimizing flow in proportion with width.

### **2.2.3 Recovery of Areas Damaged by Informal Mining**

This component proposes implementation of pilot post-mining restoration activities in areas damaged and abandoned by informal gold mining by recontouring and reforestation. It is important to clarify that ENV/Mining will rehabilitate damaged areas that have been abandoned by informal mining operators, thus making it impossible to assign responsibility for mitigation of legacy environmental impacts and liabilities.

As noted above, and to be discussed in depth further on in the EA, one of the main impacts associated with alluvial mining is the loss and degradation of soils. In this placer mining, gold is recovered from alluvial plains along rivers and streams by digging and pumping sediments that are then sifted and washed to separate the soil, sand, and gravel mixture from the gold particles. Once the ore is concentrated, mercury is added to amalgamate the gold as it adheres to the mercury. Finally, the gold is recovered by heating and vaporizing the mercury.

Due to the informality and lack of control by environmental authorities, this entire process is usually carried out without even minimum measures to mitigate environmental impacts or protect miners and others from the risks of handling mercury. Informal alluvial gold mining requires removal of all vegetation and scraping or washing off the soil horizons in order to access the mineral-rich sediment deposits underneath. Thus, the organic and mineral soil layers, which have taken thousands of years to form, are eroded and washed into rivers and streams. As an area is mined with heavy equipment and dredges, vast amounts of water are used to sift and wash gold-laden sediments that are then deposited haphazardly over the mining area. Done repeatedly, the original topography is almost entirely altered and abandoned areas are covered with coarse, infertile material devoid of most nutrients, clays, silts, and organic matter and are often contaminated with mercury. Irregular topographies, altered natural drainages, and infertile “soils” with very low water-holding capacity combine to create conditions that pose significant challenges to mitigating impacts and restoring the original landscape and productive capacity of a given site. Photographs 2-1, 2-2 and 2-3 illustrate the condition of the land before intervention and environmental rehabilitation by actions such as those proposed by the ENV/Mining Program.

#### **Photograph 0-1 Alluvial Gold Mining in Lower Cauca**



Source: ACON- Member of INERCO Group

**Photograph 0-2 Alluvial Gold Mining in Lower Cauca**



Source: ACON- Member of INERCO Group

**Photograph 0-3 Alluvial Gold Mining in Lower Cauca**



Source: ACON- Member of INERCO Group

Experience by *Reforestadora Integral de Antioquia S.A. (RIA)* and others in Colombia and elsewhere have demonstrated how to restore such areas notwithstanding their highly degraded state. The ENV/Mining Program intends to expand and refine these restoration practices in collaboration with landowners mitigate and remedy the situation using planting commercial to allow reincorporation of degraded areas into productive uses. RIA is a public-private company that creates and manages forest resources through the production, manufacturing, and sale of

wood and non-timber products, thus favoring its industrial development as a competitive company that generates added value based on parameters of efficiency, profitability, and quality<sup>2</sup>.

The process to recover degraded lands ("*pasivos ambientales*" in Spanish) requires an initial inventory to identify the target properties, based on a set of technical criteria, and to initiate contact with the landowner to confirm interest in the project. If the area is no longer commercially viable for future mining and the landowner agrees to participate with the ENV/Mining Program, the legal status of the property is then verified. Since most properties do not have publicly registered deeds, following a positive preliminary verification, the Program provides assistance to the landowner to legalize the property. Once the legal and other requirements of the Program are met, a reforestation contract is signed between RIA and the landowner for a 30-year term. This contract establishes the commitments of the both parties and profit-sharing arrangements for the sale of future timber. The landowner is responsible for recontouring the area to be reclaimed to approximate the original topography. RIA is responsible for the costs of planting, maintenance, and subsequent sale of the wood where the economic benefits are distributed 70% - 15% - 15% between RIA, the landowner, and the association of small-scale producers enrolled in the process, respectively.

Once the contract is signed, the mounds and depressions remaining from mining operations are leveled and filled to reestablish, to the extent possible, the original topography and water channels. This is done using heavy machinery, thus making this operation one of the most expensive in the restoration process.

#### Photograph 0-4 Pilot Project for the Recover of Areas Damaged by Mining



<sup>2</sup> [www.Riaforestal.com](http://www.Riaforestal.com)

Source: ACON- Member of INERCO Group

### Photograph 0-5. Plowing Furrows for Seedling Establishment



Source: ACON- Member of INERCO Group

Once recontouring is completed, the site is prepared for tree planting by making furrows in the coarse aggregate that covers the reshaped area. Pilot tests conducted by RIA and USAID in the Bajo Cauca region of Antioquia (Photograph 2-6) have shown *Acacia mangium* to be the best species for the precarious environmental conditions found on abandoned alluvial mined lands. In Program supported areas, planting will consist of 90% *A. mangium* and 10% native species such as abarco, tambor, caracolí, roble and samán, which will be planted on sites with relatively better edaphic conditions. Photographs 2-6 and 2-7 show partial results from this type of plantation design.

### Photograph 0-6 Plantation of *Acacia mangium* in Bajo Cauca



Source: ACON- Member of INERCO Group

**Photograph 0-7 Plantation of *Acacia mangium*, Rio Rayo mine, Municipality of Tarazá**



Source: ACON- Member of INERCO Group

To generate income in the short term, the Program plans to introduce beekeeping as an ancillary economic activity to the commercial plantation. *A. mangium* produces excellent quality nectar that attracts bees, which makes the two activities compatible, generating income for landowners while plantations mature and reach the age of their first commercial thinning.

Under the current program cycle, the ENV/Mining Program has a budget of US\$ 6.5 million and an initial duration of two years. However, the intention is to build mechanisms into the Program to ensure that most activities and associated mitigation measures will extend at least for five years. These mechanisms include the private cost- and benefit-sharing restoration and reforestation contracts, provision of legal and technical services by mining associations to their members, and monitoring Program and future activities by the appropriate levels of government of Colombia authorities who are also direct Program stakeholders. The environmental and mitigation management measures discussed in this EA were developed based on the requirements of USAID and include mitigation measures (Section 7), a monitoring timetable, training requirements, and the delegation of recommended responsibilities.

In essence, the main components of the ENV/Mining Program constitute a set of environmental mitigation and remedial measures. This extends to site restoration to remedy existing environmental liabilities where no responsible party can be legally identified, reducing future impacts on the environment and human health by decreasing or eliminating the use of mercury in gold mining, and strengthening small-scale mining associations to raise environmental awareness

and provide legal and technical services to members in the future . The reduction or elimination of the use of mercury will have a long-term positive impact on soils, water and air resources, and biodiversity, which will have direct and indirect benefits to the communities living in these mining regions as well.

The ENV/Mining Program includes other measures that are part of the design and implementation of the Program to avoid or reduce environmental impacts from Program activities and build the capacity of national and local organizations to continue activities beyond the life of the Program. Further, as noted above, several “connected actions” are proposed to enhance socio-economic outcomes through generation of income from non-gold mining sources, including commercial tree plantations and beekeeping. The suite of measures and actions that are part and parcel of the ENV/Mining Program include:

- *Strengthen the Colombian regulatory framework in relation to the formalization process.*
  - Strengthen mining associations to provide assistance to their members
  - Implement processes legalization and formalization of small-scale miners
- *Coordinate at the national level with the Colombian Government (National Mining Agency), Departmental level (Antioquia Secretary of Mines; CODECHOCO), and municipalities to implement the laws and regulations that regulate the sector at the local level.*
  - Provide support to the legalization and formalization process for small-scale miners
  - Formulate municipal action plans to reduce mercury use
  - Strengthen the capacities of the municipalities in mining areas provide technical, legal, and organizational assistance to miners associations
  - Application for Special Mining Reserve Areas (SRA) for mining communities.
- *Improve communication and collaboration between the Ministry of Mines and Energy and the Ministry of the Environment and Sustainable Development for a more coordinated approach.* This will result in a more manageable Environmental License application process for miners.
- *Strengthen the capacities of gold producer associations to provide legal and technical assistance to the members.*
  - Environmental regulations
  - Labor obligations
  - Alternative technologies for extracting gold without using mercury
  - Formulation and submittal of Work Plans and EMPs to proper authorities.
- *Investigate new markets for gold that recognize extraction in compliance with environmental and social standards and the feasibility of enrolling small-scale mining in environmental certification programs to enter these markets.*
- *Design/implement an educational campaign to support a culture of legality in the mining regions.*

### 3. BASELINE

#### 3.1 Legal Framework Applicable in Colombia for Informal Mining

The institutional and legal framework of the small and medium-scale gold mining sector in Colombia is complex due to the number of national, regional, and local government entities involved in the mining sector and a lack of regulatory clarity. The topic of informal, illegal, traditional, and large-scale mining is routinely debated by experts, the media, environmentalists, and miners. As a result, there is great political interest in overcoming the various issues surrounding the sector<sup>3</sup>. The ENV/Mining Program will coordinate its activities with the following government stakeholders:

- Ministry of Mines and Energy:
  - National Mining Agency (ANM)
- Ministry of the Environment and Sustainable Development and relevant Regional Environmental Authorities:
  - Corantioquia (Department of Antioquia)
  - Codechocó (Department of Chocó)
- Secretary of Mines, Antioquia Governor's Office.

As an indicator of the complexity of the legal framework around mining and to point out the legislative framework applicable in Colombia relating to mining, the following is a partial listing of the laws and regulations that had or have a bearing on mining in Colombia<sup>4</sup>.

##### Mining:

- Decree 2636 / 1994 - Legalization of Informal Mining 1994
- Law 685 / 2001 - Mining Code Mining Code applicable in Colombia as of 2001
- Decree 2390 / 2002 - Legalization of Informal Mining 2001
- Decree 2653 / 2003 - Regulates Article 63 of Law 685 / 2001. Appointment of Experts to determine interference between the holder of the mining title and legalization
- Law 1382 / 2010 - Amendment of the Mining Code Law 685. In force until May 2013 before declared unconstitutional
- Decree 2715 / 2010 - Legalization of Traditional Mining 2010
- Ruling C-366, Constitutional Court - Law 1382 / 2010; Declared unconstitutional
- Decree 1970 / 2012 - Amended Decree 2715 / 2010
- Decree 0933 / 2013 - Provisions on the formalization of traditional mining and modified definitions from the Mining Glossary

##### Royalties:

- Law 141 / 1995 Royalty Law. The National Royalties Fund and the National Royalties Commission were created
- Law 756 / 2002 - Amendment of Law 141 / 1994. Established criteria for the distribution of royalties

<sup>3</sup> Colombian Treasury Inspector's Office, 2013.

<sup>4</sup> Colombian Treasury Inspector's Office, 2013.

Environmental:

- Law 2 / 1959 - For development of forestry and protection of soil, water and wildlife, the following forest reserve categories were established: "Protective Forest Areas"; "Forests of General Interest" and; per Legislative Decree No. 2278 / 1953 - Forest Reserve Area of the Pacific
- Decree Law 2811 / 1974 - National Code of Renewable Natural Resources and Environmental Protection
- Law 99 / 1993 - Creation of the Ministry of the Environment and the National Environmental System, charged with environmental management and conservation and renewable natural resources
- Law 388 / 1997 - Territorial Development Law. Amended Law 9 / 1989 and Law 2 / 1991
- Law 1333 / 2009 - Establishes environmental punitive procedures
- Law 373 / 1997 - Establishes the program for the efficient use and conservation of water
- Law 430 / 1998 - Environmental regulations relating to hazardous waste
- Law 1021 / 2006 - Establishes the administrative organization required by the State and regulates activities related to natural forests and forest plantations

Social:

- Law 21 / 1991 - Approved ILO Convention 0169
- Law 70 / 1993 - Policy on Afro-Colombian Communities
- ILO Convention 169 - Convention on indigenous and tribal peoples

Criminal activities:

- Law 599 / 2001 Article 333 - Sanctions for the contamination and extraction of minerals and hydrocarbons
- Law 1453 / 2011 Article 36 - Sanctions for the contamination and extraction of minerals and hydrocarbons
- Convention 027 / 2007 – Inter-institutional Convention between Ministry of Mines and Energy - Ministry of the Environment, Housing and Territorial Development - Ingeominas

National Development Plans:

- Law 812 / 2003 - National Development Plan 2002 - 2006
- Law 1151 / 2007 - National Development Plan 2006 - 2010
- Law 1450 / 2011 - National Development Plan 2010 - 2014

National Mining Development Plans:

- Mining NDP 2002 - 2006 - National Mining Development Plan 2002 - 2006
- Mining NDP 2007 - 2010 - National Mining Development Plan 2007 - 2010
- Mining NDP envisioned up to 2019 - National Mining Development Plan up to 2019

**3.2 Institutional Framework Involved with ENV/Mining**

The ENV/Mining Program will involve different public institutions for execution of its activities. Among the most important are:

*Ministry of Mines and Energy* - The Ministry of Mines and Energy is charged with directing national policy for mining, hydrocarbons, and energy infrastructure in Colombia. It is responsible for managing the country's non-renewable resources ensuring the best use thereof (Ministry of Mines and Energy, 2014).

*National Mining Agency* - The National Mining Agency is a technical entity that works to promote the mining sector based on transparency, efficiency, and environmental, social, and productive responsibility. Its duties include the management of mineral resources in an efficient, effective, and transparent manner by encouraging, promoting, granting titles, monitoring, and controlling mining in order to maximize the sector's contribution to the comprehensive, sustainable development of the country (National Mining Agency, 2014).

*Secretary of Mines, Antioquia Governor's Office* - It is the duty of the Secretary of Mines of the Antioquia Governor's Office to design, promote and manage policies, plans, programs, and projects for the economic and social development of the mining sector. This public entity is required to ensure the department's policies promote and encourage technical and rational exploration and exploitation of mining resources and application of regulations delegated by the national Government in relation to the control and legalization of mining and administration of granting and monitoring mining titles (Secretary of Mines, 2012).

*Ministry of the Environment and Sustainable Development* - The Ministry of the Environment and Sustainable Development leads the management of environmental and renewable natural resources at the national level. It is responsible for defining policies and regulations for the recovery, conservation, protection, management, and sustainable use of renewable natural resources and the environment in order to ensure sustainable development, subject to the duties assigned to other sectors (Ministry of the Environment and Sustainable Development, 2014).

*CORANTIOQUIA* - The Regional Environmental Authority (CAR in Spanish) is in charge of implementing policies, plans, programs, and projects regarding the environment and renewable natural resources, as well as applying existing legal provisions on the disposal, management and use thereof in accordance with regulations, standards and guidelines issued by the Ministry of the Environment and Territorial Development. CORANTIOQUIA is in charge of environmental control and monitoring in the department of Antioquia (CORANTIOQUIA, 2014).

*CODECHOCÓ* - Promotes the sustainable development and protection of the environment by implementing policies, plans, programs, and projects regarding the environment and renewable natural resources, as well as applying existing legal provisions on the disposal, management and use thereof in accordance with regulations, standards, and guidelines issued by the Ministry of the Environment and Territorial Development. CODECHOCÓ is in charge of environmental control and monitoring in the department of Chocó (CODECHOCÓ, 2014).

## 3.3 Gold Mining in Colombia

### 3.3.1 Brief History

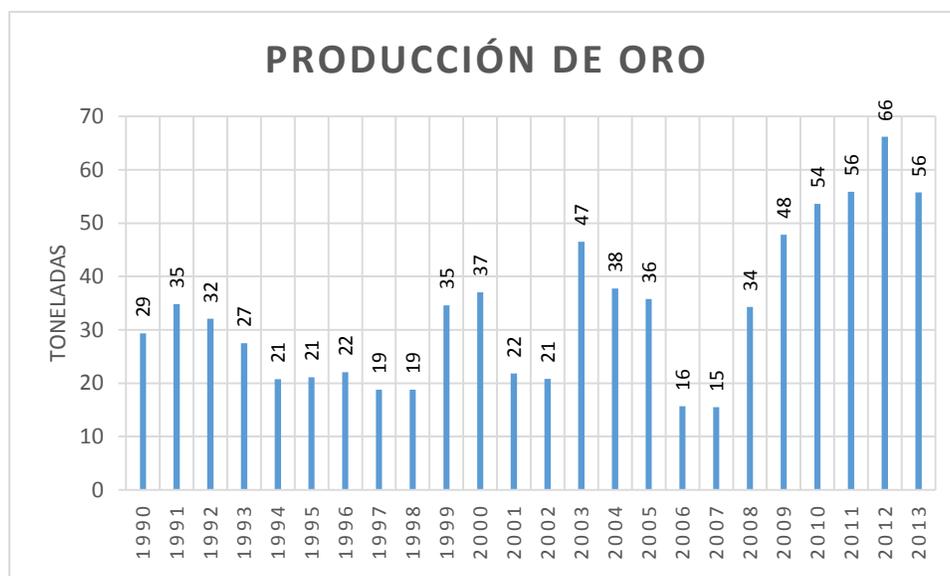
Mining has been a core economic activity in Colombia since Pre-Columbian times. Indigenous cultures carried out highly valued ceramic work and goldsmithing. In the beginning, mining activity gave rise to regional trade characterized by the barter of several minerals. During Colonial times, mining grew quickly with opened the gateway to the trade of African slaves. The people who benefited most from the colonial system were perhaps the traders from Antioquia who transported gold to other regions of New Granada and abroad in exchange for other goods such as textiles and food (Fedesarrollo, 2008).

At the end of the 19th Century, mining companies such as Pato Consolidated Company and South American Gold set up operations in the basins of the San Juan, Nariño, and Barbacoas Rivers. Another company that was established around that time was Mineros de Antioquia, which was located in the basins of the Bagre, Nechí, and Tarazá Rivers. In 1918, the municipality known today as Caucaasia was founded, whose boom in gold mining was achieved in the 1980s.

The international depression of the 1930's was felt by the sharp drop in prices of certain commodities such as coffee and other raw materials that made up a significant proportion of Colombian exports. It was in this period that the importance of mining, particularly for gold, attained prominence in the national economy (Fedesarrollo, 2008).

Until 2002, state policies were conservative in relation to mining activities. Up to then, 1,889 mining titles had been awarded nationally. Between 2005 and 2009, the number of mining titles granted increased to 8,982 under the policies of President Alvaro Uribe. Similarly, the administration of President Juan Manuel Santos (2010-present) made development of the mining sector a priority by establishing the "*Prosperidad para Todos*" (Prosperity for All) Development Plan 2010 - 2014 with the mining-energy sector designated as one of the engines of the country's economy (Colombian Treasury Inspector's Office, 2013). Over the last few years, gold mining has increased significantly. In 2013, production of gold reached approximately 56 tons (UPME, 2014) and production is expected to reach 80 tons by 2019 (GDP Colombia, 2011).

*Exhibit 0.1. Gold Production in Colombia*



Source: *Unidad de Planeación Minero Energetica*, 2013

### 3.3.2 Definition of illegal, traditional, and informal mining operations

When issues associated with mining in Colombia are discussed or assessed, it is very important to distinguish between illegal, informal, and traditional mining because different actions must be taken depending on the type of mining operation for conceptual clarity and to understand the implications of each type of mining operation in relation to environmental, institutional, and administrative regulations and possible criminal activity. Distinguishing among these three categories has been a challenge for the Colombian government. Table 3-1 below provides two definitions for informal, illegal, traditional, and criminal mining. The first is the official definition (with contradictions) and the second is the definition proposed by the Colombian Treasury Inspector's Office.

**Table 0-2 Mining Definitions**

Type of Mining	Official Definition	Definitions Suggested by the Colombian Treasury Inspector's Office
<b>Illegal mining</b>	The mining carried out without being listed in the National Mining Registry and, therefore, with no mining title. The mining carried out in an informal manner, outside the law. It also includes mining work or projects with no mining title. This includes mining covered by a mining title, where the extraction is carried out outside the area granted in	Corporate extraction of minerals for sale without complying with all the mining, labor, environmental and tax regulations. The objective is the appropriation of mining income, it has no political motive and it does not confront the State in a violent manner. This type of mining is often accepted at the local level due to the job opportunities and the income generated; it

	the license. (Decree 2191 / 2003, Mining Glossary)	includes small and medium-scale miners that have progressed to mechanized processes, hiring labor informally, or coexisting with gold-panners and traditional and informal miners.
<b>Traditional Mining</b>	Traditional mining has been carried out since before the effect of Law 685 / 2001, in a specific area in a continuous manner by individuals or groups or associations with no mining title listed in the National Mining Registry, in mineral deposits owned by the State and, due to the socioeconomic characteristics thereof and the location of the deposit, are the main source of subsistence and income for these communities, in addition to being considered a source of regional supply. This type of mining is also informal and can be subject to formalization processes. Therefore, it is understood that traditional mining is a kind of informal mining. (Decree 0933 / 2013)	Persons or groups devoted to extracting alluvial minerals and construction materials by informal means for their subsistence. In general, the volumes produced are larger than those obtained by gold-panning and the material extracted is sold or placed on the local market. It is also considered an informal activity that takes place generation after generation, in association with persons beyond the immediate family and, on occasions, alternates with other economic activities such as farming and fishing.
<b>Informal Mining</b>	Constituted by small and medium-sized mining units owned by individuals with no accounting records. (Decree 2191 / 2003, Mining Glossary)	Persons or informally organized groups that extract minerals in volumes larger than gold-panning and traditional mining, using mechanized equipment purchased in informal or legal markets. In some cases, the activity involves family businesses that hire labor informally and they are associated with small and medium-sized mechanized miners. Their condition of informality lies in operating without a mining title or environmental license, noncompliance with labor laws, involving workers not enrolled in social security, precarious health and safety conditions, and may or may not pay royalties or taxes.
<b>Legal Mining</b>	This is mining covered by a mining title, which is the written administrative act granting the right to explore and exploit the soil or subsoil owned by the nation, according to the Mining Code. The	This is mining carried out with a mining title and an environmental license and in compliance with all health and safety standards. Workers are compliant with labor regulations and operations have a

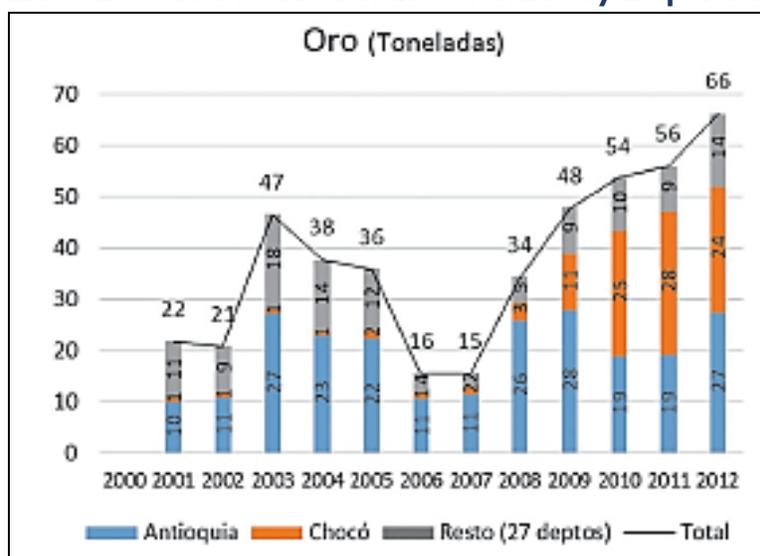
	mining title is supposed to be listed in the National Mining Registry. (Decree 2191 / 2003, Mining Glossary)	social license from the communities in the area of influence of the mine, fulfill all their contractual obligations and, in general, their activities are based on respect for the Constitution and the general and regional laws of the country.
<b>Criminal Mining</b>	This type of mining has not been officially defined.	Extraction of minerals to fund criminal activities. In general, these are illegal, armed organizations, guerrilla groups or criminal bands that directly, or by means of third parties, carry out mining activities, particularly for gold, cobalt, and tungsten, and are sometimes linked with transnational criminal organizations.

Source: ACON, 2014

According to the above definitions, the ENV/Mining Program will work with traditional, informal, and illegal mining. Under no circumstance will the Program engage with criminal mining operations or activities.

### 3.3.3 Current Status of Mining in Colombia

Between 2006 and 2012, gold mining was carried out mainly in the Department of Antioquia. However, since 2009 production increased in the Department of Chocó, contributing 39% to the national production, close to the 42% of total production in the Department of Antioquia. The remaining 19% of national gold production is distributed among 27 other municipalities (Colombian Treasury Inspector's Office, 2013). This equates to 81% of the gold produced in Colombia being concentrated in the departments of Antioquia and Chocó, the two departments where the ENV/Mining Program will operate.

**Exhibit 0.2. Gold Production in Colombia by Departments**

Source: Colombian Treasury Inspector's Office, 2013.

The Mining Census (2011) conducted by the Ministry of Mine and Energy surveyed a total of 14,357 Mining Production Units (UPM in Spanish), providing the following results:

- Only 37% of UPMs have a mining title with 63% operating informally and illegally
- Nationally, the mining of non-metal minerals is predominant with 47% of the UPMs, followed by metallic minerals at 31% of the UPMs
- Mining is carried out mostly by men (95%)
- 19% of UPMs surveyed have a mining title and an environmental permit or environmental document, that is to say, they are fully legal
- In Antioquia, of 2,025 UPMs surveyed, 79.1% are illegal or informal
- In Chocó, where 527 UPMs were surveyed, 99.2% are illegal or informal
- 71.1% of the UPMs surveyed do not comply with safety or occupational health requirements.

At present, the large-scale mining sector represents one of the main economic engines in Colombia, generating 836,000 direct and indirect jobs in 2011 and significant investments in infrastructure, public services, and social and environmental management.

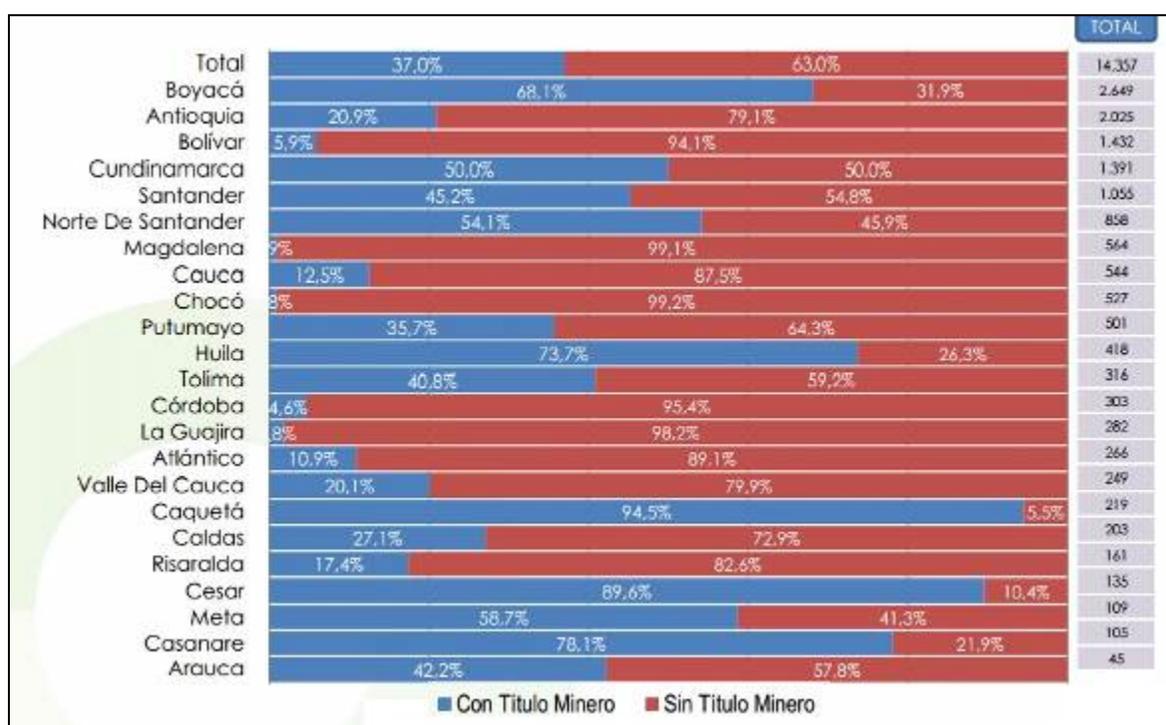
According to a study conducted by the Colombian Treasury Inspector's Office (2013), as of 2008, mining production accounted for 7.7% of the country's GDP, almost surpassing farming as one of the main economic sectors of the Colombian economy. Following coal, which represents 88% of the country's mining production, nickel and gold are the most representative Colombian mining products in international markets. In the case of gold, Colombia is the twenty-second largest producer, accounting for 1.2% of world gold production.

According to the 4,133 gold UPMs surveyed by the Mining Census (2011):

- The UPMs dedicated to gold mining represent 29% of all mining operations nationally, with or without a mining title
- 3,584 UPMs do not have a mining title, which represents 40% of total illegal mining operations in the country
- 86.7% of gold UPMs surveyed are illegal or informal.

Exhibit 3.3 shows by department the percentage of UPMs that do not have mining titles. The results are a national concern and quantify the importance of taking action in the departments of Chocó and Antioquia that have among the highest percentages of illegal operations.

**Exhibit 0.3. Mining Production Units Surveyed by Department**



Source: Mining Census, 2011

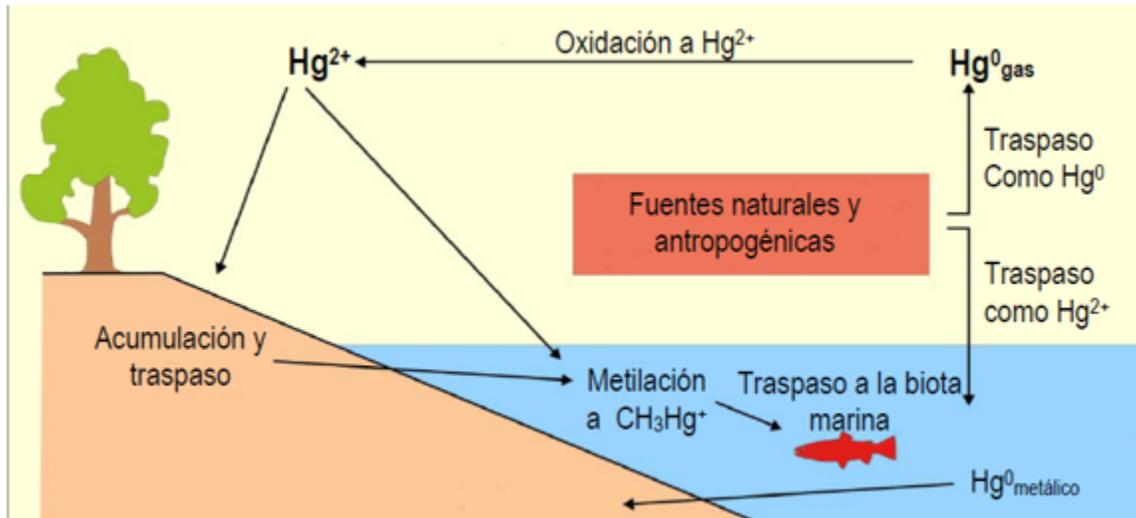
### 3.4 Impacts of Illegal Gold Mining in Colombia

The following is a summary of the impacts caused by informal gold mining in Colombia. It is important to point out that in the areas where the ENV/Mining Program will operate, there are two very different types of mining and that they lead to very different, mostly environmental, impacts. Informal mining may generate greater impacts on the environment, public health, and public order. The following are the main negative impacts caused by informal gold mining:

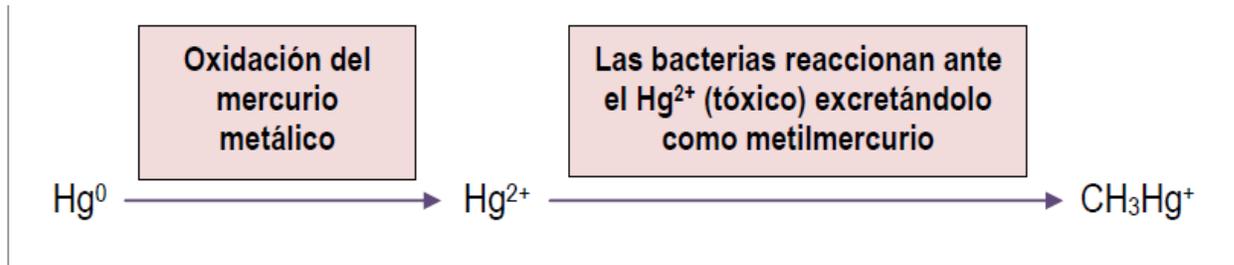
- Mercury is used during the processing of gold because, due to its properties, it adheres to the gold forming, thus an amalgam that allows the separation thereof and the extraction of other elements. The amalgam is collected in a fine cloth that, and when pressed by hand, allows the removal of excess mercury. This procedure releases mercury residue that accumulates in rivers, streams, swamps, lakes, etc. Once the mercury-gold amalgam is obtained, it is taken to a low-temperature furnace to evaporate the mercury contained in the amalgam, thus leaving the gold free from mercury.
- The use of mercury raises serious concerns for human health and natural resources. Law No. 1658 / July 15, 2013 establishes that the use of mercury must be eradicated in Colombia from all industrial and production processes within no more than 10 years and, for use in mining, within five years.
- Mercury is widely used in illegal alluvial and hard rock or ore mining in Colombia, including Chocó and Antioquia where the ENV/Mining Program will operate.
- Mercury occurs in three main forms - gas phase ( $\text{Hg}_{\text{gas}}^0$ ), oxidized mercury ( $\text{Hg}^{2+}$ ), and particularly methylmercury ( $\text{CH}_3\text{Hg}^+$ ). However, gold mining does not use any of these forms, but rather metallic mercury ( $\text{Hg}^0$ ). The transformation of mercury through the environment is complex as shown in Exhibit 3.4.

### Exhibit 3.4. Mercury Cycle

Source: Oyarzun, 2011



Gold mining transforms mercury from a metal to gas, mainly when the gold amalgam is heated in furnaces to separate the gold from the mercury. In water, mercury undergoes the following transformation process to become methylmercury, the most dangerous and toxic form.



Source: Oyarzun, 2011

Below are the most significant impacts caused by mercury:

#### Health impacts

- Mercury released into the atmosphere can be inhaled by persons directly or it can be precipitated by rainfall and deposited in water sources where, by the action of microorganisms, it is transformed into methylmercury or dimethylmercury. This is how methylmercury works its way up the food chain via a process called bioaccumulation.
- The primary sources of mercury that can have a negative impact on human health are mercury emissions in the air, resulting from the combustion of gold-mercury amalgams and the intake of fish contaminated with mercury (methylmercury).
- Mercury gas, generated by burning the gold-mercury amalgam, is inhaled by miners and often by their families, including children, causing permanent neurological damage. Mercury can be particularly harmful to children and pregnant women.
- The mercury that is not inhaled during the burning process is released in the atmosphere, where it can be absorbed and processed by a wide variety of living organisms.
- Once the mercury is released in bodies of water, it enters the food chain through the digestion of bacteria, which processes and transforms it into methylmercury, a much more toxic compound that then bioaccumulates in the food chain as it accumulates in the tissues of living organisms, increasing in concentration at higher trophic levels of the food chain.
- The bioaccumulation of mercury is particularly problematic in waters that flow through mining areas, especially in the Nechí and Cauca Rivers in Antioquia and the San Juan River in Chocó, as it bioaccumulates in larger fish species that are consumed by residents in downstream communities.
- In its different chemical expressions, mercury causes multiple diseases in humans, which are more severe congenitally and in children. Symptoms include cerebral damage, kidney failure, and neurodevelopmental deficits, among others.

### Contamination of water sources

- Illegal gold mining in Colombia pollutes water sources due to the dumping of fine solids, from the effluent of chemical compounds used in processing the gold, such as cyanide and mercury, and the generation of mine acids that are one of the main problems associated with mining because it allows the dilution of heavy metals in water such as mercury, lead, and cadmium, thus promoting their transport and intake.
- Acid mine drainage results in the oxidation of sulfided minerals and the leaching of associated metals from sulfurous rock when exposed to air and water. The resulting sulfuric acid is transported from the mine by surface waters and then deposited in ponds, streams, rivers, lakes and nearby aquifers. These metals tend to dissolve and move more easily in the acid waters associated with acid mine drainage. When transported by water, the metals can travel considerable distances, contaminating surface and underground water sources.
- Acid mine drainage can occur in in alluvial as well as ore mining, but is mainly associated with ore or hard rock mining and large-scale open pit mining due to the oxidation of the sulfides in the rock.
- Clearing of large areas for the extraction of alluvial gold and the subsequent contamination of soil and water resources due to the uncontrolled use of mercury, causes direct and indirect negative impacts on aquatic ecosystems and rivers (including wetlands and flood plains), which leads to the degradation of ecological and hydrological functions.
- Degradation of ecological functions is important because natural restoration processes can take significant periods of time (decades, even centuries), a process the ENV/Mining Program aims to jump-start and accelerate.

### Air pollution

- Illegal gold mining pollutes the air due to the emission of mercury gases (the process of breaking up the mercury-gold amalgam). However, there can also be other heavy metals involved, as well as particulate matter.

### Deterioration and loss of soil

- Illegal gold mining causes negative impacts on soil, either due to the partial or total loss of the soil or from contamination with chemicals used for processing the gold, such as mercury, fuel, lubricants, and other substances.
- Soil loss is mainly associated with alluvial mining since soil layers must be removed to access the gold is deposited in lower sediments. In some cases, this operation is carried out several times to the point that all fine soil material, such as silts and clays, has been washed away, leaving behind infertile soil/gravel contaminated with mercury that has a low water-holding capacity.

- Alluvial mining includes two different methodologies: (i) Use of heavy machinery such as backhoes, loaders, and/or bulldozers to collect the material; and (ii) Use of dredges to collect material from sediments at the bottom water courses. Both methodologies lead to significant deterioration of water courses and riparian vegetation.

#### Impacts on the biotic component

- Illegal gold mining generates deforestation due to its direct and indirect interventions. Direct interventions happen when trees and other vegetation are cleared from the work area. This impact is even greater in the case of alluvial mining, which is carried out in open pits in riparian areas. An example of indirect interventions is the purchase and sale of illegal timber, mainly used as supports in mining tunnels. Deforestation also destroys the habitat of local fauna.

#### Economic impacts:

- Gold mining causes impacts to farming activities due to loss of soil, changes in land use, and effects on cattle productivity. However, it is also a source of income for the population, even though employment is informal.

#### Impacts to public order and security

- Mining as an economic activity that results in lucrative profits, attracting illegal groups to the sector for the purposes of extortion and kidnapping (Colombian Treasury Inspector's Office, 2013).
- During 50 years of armed conflict, the last two decades have seen an increase in government attention to reduce illegal crop production coupled with increased international prices for raw materials. This has motivated illegal armed groups to delve into illegal gold mining by pressuring and recruiting traditional miners or becoming directly involved in illegal exploitation themselves (Colombian Treasury Inspector's Office, 2013, taken from Massé and Camargo, 2013).
- According to data reported by the Colombian Treasury Inspector's Office (2013), organized crime launders approximately US\$ 5 billion (10 trillion Colombian pesos) per year through mining, equivalent to 5.4% of GDP.
- The following are the main methods used for money laundering:
  - Purchasing gold from an illegal mine and using a formal mine as a front
  - Importing gold smuggled from neighboring countries to appear as if it was produced from a formal mine
  - Purchasing imported mining machinery with US dollars earned from drug trafficking.

## **4. ENVIRONMENTAL AND SOCIOECONOMIC CHARACTERIZATION OF THE AREA OF INFLUENCE**

The ENV/Mining Program plans to conduct its activities in the departments of Antioquia and Chocó. The environmental and socioeconomic characteristics of the areas of influence of the ENV/Mining Program in each subregion are detailed in Annex 1.

## 5. DESCRIPTION OF ALTERNATIVES

As part of the Environmental Assessment, three alternatives are proposed (Alternatives A, B and C), including an assessment of each proposed alternative and a comparison of alternatives to respond to the significant issues identified and presented in the Scoping Statement. The following is a description of Alternatives A, B and C.

### 5.1.1 Alternative A

Alternative A is to take no action (corresponds to the baseline) to mitigate the impacts currently generated by informal gold mining in Colombia. Alternative A will allow the mining situation to continue generating and accumulating environmental and social impacts as described in the baseline.

### 5.1.2 Alternative B

Alternative B corresponds to the set of activities proposed by the ENV/Mining Program. These activities as described in detail in Section 2 and summarized below.

*Reduction in the use of mercury by small-scale informal mining units.* Activities under this component are aimed at supporting small-scale informal mining units in the legalization and formalization process. The objective is for small-scale miners to comply with the current environmental legislation on the use of mercury and environmental management. Other actions to reduce the use of mercury include providing technical assistance on the use of non-mercury technologies for processing gold, improved capture of mercury, and mercury recycling processes. This activity will reduce mercury exposure to aquatic and terrestrial fauna, and offer additional health benefits to miners and their families. Mercury recovery is not an activity supported by the Program. Rather, gravimetric gold recovery that does not use mercury will be demonstrated by small-scale pilot centers that pose low environmental risks, mostly from the potential for fuel spills (diesel or gasoline) while refueling engines. This will be mitigated via worker training, limiting the amount of fuel stored (less than 100 gallons) and locating pilot centers away from drainages and population centers. The pilot gold recovery centers could pose risks to worker safety via accidents from moving machinery that will be mitigated by implementing worker training, installing safety signage, using protective equipment, operating only during daylight hours, and assuring ample space for machinery to maneuver.

*Post-mining restoration of areas affected by unauthorized mining operations.* Under this component, the ENV/Mining Program proposes working with public-private associations to establish commercial forest plantations. This includes the improvement of the land used in the mining process by contouring affected areas to the original topography to the extent possible and

establishing forest tree nurseries, planting a mixture of native and exotic trees, and providing related technical assistance and forest extension services. The potential impacts of primarily using a sometimes aggressive exotic species, *Acacia mangium*, is addressed in the Scoping Statement and considered as non-significant issue in the case of the ENV/Mining Program.

The restoration process could cause short-term impacts to water resources and pose safety hazards to workers during the process of recontouring mined areas and preparing sites for planting using heavy equipment, which will be mitigated by the Program. Use of heavy equipment will be minimized to the extent possible and will not be used during rain events or when ground conditions are excessively wet. Any present native vegetation will not be disturbed and equipment will not enter undisturbed water courses. The use of lubricants and hydraulic fluids and fueling will be done in a flat area at least 50 yards from water sources. A minimum amount of fuel will be stored on-site at any one time. As in the operation of the pilot processing centers, worker safety from accidents with moving machinery will be mitigated by implementing worker training, installing safety signage, using of protective equipment, and operating only during daylight hours. The Management Plan and Mitigation Plan provide details on mitigation measures to be taken.

*Implementation of production programs for the recovery of lands intervened by informal gold mining activities in the Department of Chocó* will differ slightly as those in Antioquia to account for different conditions .

- Reforest mainly, if not exclusively, with native species only. A soil analysis will determine whether a restoration program can be carried out with native species. If the soil conditions are too deficient, it will be necessary to combine native species with exotic species in order to favor the formation of soils. The Program will promote the recovery of the soil and the landscape and damaged ecosystems. It will create patches of connectivity and provide timber with high commercial value as a result of the sustainable use of the rehabilitated forests.
- Carry out enrichment activities in areas with a mild degree of alluvial gold mining interventions with species whose objective will be the extraction of non-timber forest products (NTFPs), such as dyes, latex, fiber, and bark. Based on the principle of precaution, this alternative will not provide for the obtainment of products for human consumption because there is no scientific certainty with regards to the contamination of these products as a result of the mercury contained in the soils intervened by mining. The inclusion of palms is a high value option for the Chocó region, which produces crafts with native species of the region such as Wuerregue Palm, Quitasol Palm, Chocolatillo, and Tetera. The Program will produce benefits such as the promotion of sustainable crafts, the recovery of endangered plant species, and income generation for local populations (Afro Communities and Indigenous Reservations).

### **5.1.3 Alternative C**

Alternative C includes all the ENV/Mining Program activities proposed by USAID/Colombia in Alternative B plus other measures designed to broaden and deepen the scope of the two

ENV/Mining core components - reduction in the use of mercury and rehabilitation of areas degraded by informal gold mining. Alternative C was not formulated through a rapid brainstorming or random planning, but rather encompasses many of the suggestions made by various Program stakeholders and beneficiaries in the course of preparing this EA, and are wholly congruent with the objectives of BIOREDD+ and the ENV/Mining Program.

Alternative C, or the ENV/Mining+ alternative, proposes the following activities to fulfill its objectives of reducing the use of mercury, rehabilitating areas affected by informal mining, and implementing best management practices in gold mining:

*Research focused on expanding knowledge on the impacts of mercury in priority watersheds that supply water to nearby populations:*

- Scientific studies to establish the movement of mercury from soil to plantations and from plantations to products for human consumption, such as honey
- Soil studies to determine the location, distribution, and concentration of mercury on the land that will be rehabilitated by the ENV/Mining Program through commercial plantations. These studies will be conducted as a baseline to determine the state of contamination of soils and subsequent potential for the use thereof
- Studies on how mercury is absorbed by plants and might be transmitted to bees, honey, and other products for human consumption.

*Comparative economic studies on the profitability of small-scale mining units once they have been legalized and formalized to evaluate the impact of legalization and formalization on the income miners:*

- Current profitability of informal operations compared to legalized and formalized operations
- Current profitability of informal miners compared to operators that are legalized, formalized, and trained by ENV/mining in business management
- Current status of profits by informal mining operations compared to operations that have been legalized, formalized, and enrolled in the "federation of small-and medium scale gold miners".

*In-depth baseline studies prior to the interventions of the ENV/Mining Program.* Baseline environmental and socioeconomic studies would be conducted at a detailed level in the municipalities where action will be taken in order to establish a clear action plan to better target Program interventions for the best environmental and social results. The watersheds that supply water to communities are the top priority of these studies.

*Comprehensive, technified process of gold mining and processing:*

- Develop pilot processing plants whose technology provides a comprehensive process of the environmental management of its impacts that is not limited to providing small-scale miners with benefits to obtain better gold recovery without the need to use mercury in the process. The pilot production facilities will have the necessary equipment, processes and management measures to meet all the legal environmental standards in Colombia
- The comprehensive nature of these pilot plants will complement productivity starting at the initial stages; reinvestment, related business, new markets, etc.

- Implement pilot gravimetric processing pilot plants for ore mining operations where cyanidation is used to increase gold recovery and introduce environmental management measures in compliance with national and international environmental standards.

*Support creation of a regional cooperative or umbrella federation of small and medium-scale gold miners.* The organization would provide services for members to access national and international markets in compliance with international standards of environmental and social performance, such as:

- Promote the legalization and formalization of small and medium-scale informal mining by means of the training and assistance of associations and production units on legal, tax, social, and environmental matters.
- Training business development, procedures established for the legalization and formalization of mining, implementation of Industrial Safety and Occupational Health standards and environmental management in mining processes, and promotion of food security and nutrition activities to reduce the effects of exposure to mercury among Program beneficiaries.
- Provide technical training for small-scale miners in the technical assessment of proposed mining investments and access to financial resources through the "federation".
- Deliver assistance and training for small and medium-scale miners in the preparation and implementation of Environmental Management Plans (EMP) and Work Plans.

*Formalize the trade of minerals,* starting with the purchase of ore concentrates at market price premiums for subsequent sale on the domestic market (Central Bank of Colombia) and international markets that recognize the environmental and social standards achieved by their members.

*Identification of gold mining companies that have mining titles with the potential to sign association agreements with small and medium-scale mining associations to carry out operations within their mining claim.* Only companies that meet all environmental and social standards for gold mining will be included in the ENV/Mining Program and will be declared "Green Partners". The ENV/Mining Program will not encourage the signing of association agreements with companies that are non-compliant with environmental Colombian environmental legislation. Strengthening Regional Environmental Authorities to more effectively fulfill their environmental enforcement and monitoring responsibilities will help to verify if companies are compliance and thus eligible to become "Green Partners".

*Promote literacy activities* through the National Literacy Program for beneficiaries of the ENV/Mining Program in order to facilitate their access to trainings and increase the impact of capacity building activities.

*Collaborate with the Colombian government, through the Ministry of Mines and Energy to build a portal for public access to information on the mining sector.* Specifically, resources would be invested in strengthening SIMCO, the Colombian Mining Information System, to identify areas available for staking new gold mining claims, streamline and make transparent the claim and titling application process, and provide information on current mining operations. This measure would increase the State's efficiency to carry out legalization and formalization procedures.

*Ancillary activities associated reforestation actions to restore areas damaged by gold mining:*

- In collaboration with government entities, subsidize housing construction using wood harvested from commercial plantations in reclaimed mining areas in the area of influence of the Program. This activity would create demand for wood, create local jobs, and improve the quality of life of the region's inhabitants.
- Produce support timbers for ore mines with *Acacia* wood from plantations. Currently, ore mine support timbers come from native forest species. To carry out this activity, a study would first be conducted to analyze the necessary specifications required for tunnel support timbers. If this option is viable, the timber produced by *Acacia* plantations will decrease the demand for illegally harvested native species.
- Create timber processing units through technical assistance on the processing of *Acacia* wood for existing sawmills. This intervention will generate employment, boost the economy in the region with a deep-rooted mining vocation, and add economic value.
- Develop Clean Development Mechanism (CDM) forestry projects. This includes meeting certain mandatory conditions, such as the checklist to be complied with for the Chocó region. This type of project produces benefits such as income generation from the sale of timber at the end of a forest rotation, income generation from the sale of carbon credits, and carbon sequestration.
- Implementation of voluntary carbon market projects, where practical, a mechanism that is less rigorous than the regulated CDM market where the scale of projects can be as small as 200 hectares. These projects are required to undergo financial feasibility evaluations prior to the execution stage. This project will result in benefits such as income from the sale of timber, income from the sale of carbon credits on the voluntary market, and carbon sequestration.

*Expand support to government entities in the implementation of regulations for the mining sector.*

- Provide training for public mining and environmental entities in Colombia, on mining, environmental, and social topics. The training will be carried out by recognized international experts with extensive experience in mining.
- Share more broadly experiences gained by the ENV/Mining Program, including legalization and formalization processes and low risk processing technologies. Support policies and develop additional administrative procedures for legalization and formalization of mining in Colombia based on Program experiences.

## **6. ENVIRONMENTAL IMPACT ASSESSMENT**

### **6.1 Geographic Assessment**

The following set of maps illustrates the geographic areas and different environmental and social scenarios that the ENV/Mining Program will face when operating in proposed regions. The geographic analysis includes two scenarios. The first scenario is in reference to the areas for environmental protection. Protected areas are areas recognized by the Colombian State where certain anthropogenic activities are prohibited. These areas include national parks, forest reserves declared by Act 2 / 1959, uplands, and regional and local protected zones. The second

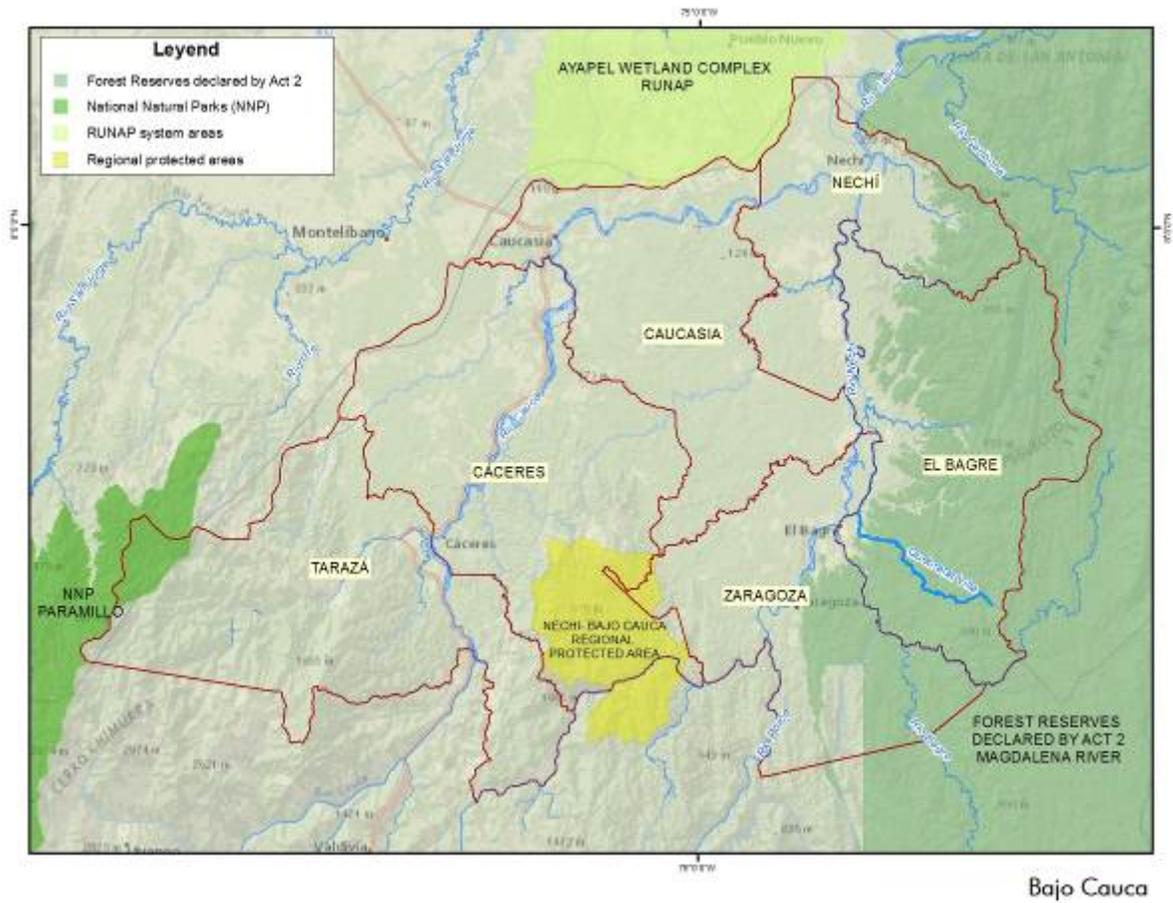
scenario is in reference to the presence of indigenous and tribal communities. Indigenous and tribal communities correspond to land granted by the State in compliance with ILO Convention 169 to indigenous, tribal, and Afro-Colombian peoples for their use, management, and conservation.

Both scenarios entail different requirements. In the case of protected areas, all mining or agroforestry activities are currently prohibited such as those proposed under Alternative C. In order to implement these productive projects in forest reserves, procedures are established by the Ministry of the Environment and Sustainable Development to change the status of a given area. The ENV/Mining Program will not advocate for or support changes in protected area status and will limit activities within the municipalities outside of protected areas. If the Program considers activities in areas occupied by indigenous and tribal communities, prior consultation with the communities would need to be carried out. If the beneficiaries of the Program are members of an indigenous or Afro-Colombian community and mining is taking place within its collective lands, these groups will be required to apply for the corresponding mining titles based on the common procedures established by law, but with the right of precedence in the application.

Accordingly, the maps below outline the geographic scope of action of the Program, which shows the relationship between municipalities of interest to the ENV/Mining Program, environmental protection areas, and the presence of indigenous and Afro-Colombian territories. These maps were generated utilizing the “Tremarctos Geo-service”.

Near the eastern side of the Bajo Cauca subregion and the municipalities of Bagre, Zaragoza, and Nechí, is the Forest Reserves of the Magdalena River (Act 2 / 1959). The ENV/Mining Program must assess the exact location where it plans to carry out activities in the municipality of El Bagre to avoid incursions into the Magdalena River Forest Reserve. The Nechí – Bajo Cauca regional includes protected areas in the municipalities of Cáceres and Zaragoza and a small fraction of the Paramillo National Park is in the municipality of Tarazá. (Map 6.1)

Map 6.3 Bajo Cauca Subregion

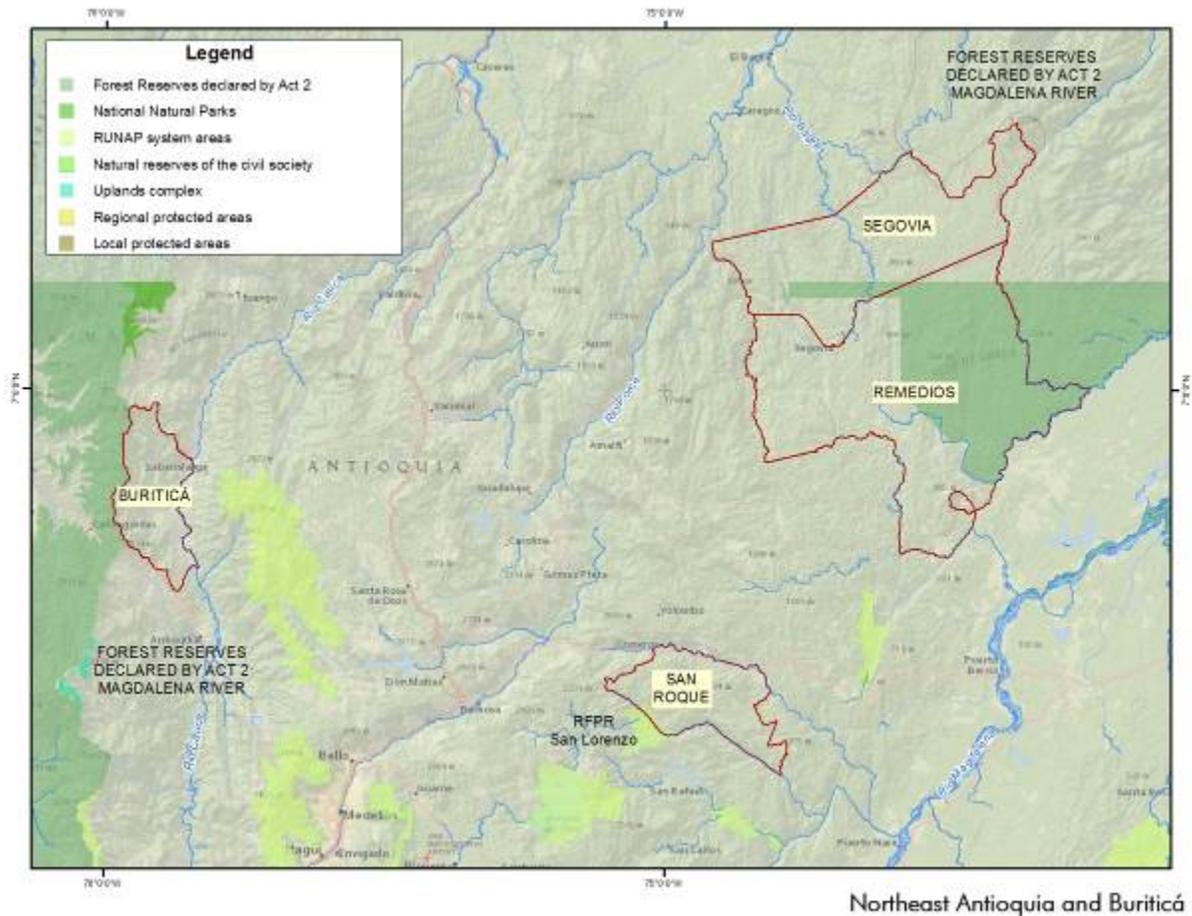


Source: ACON- Member of INERCO Group



In the Northeastern Subregion, large portions of the municipalities of Remedios and Segovia have been declared part of the Magdalena River Forest Reserves. In addition, the municipality of San Roque includes a small portion of the San Lorenzo Regional Protective Forest Reserve. The municipality of Buriticá does not have any protected areas, but is bordered by the Pacific Forest Reserve declared by Act 2 / 1959. (Map 6.3)

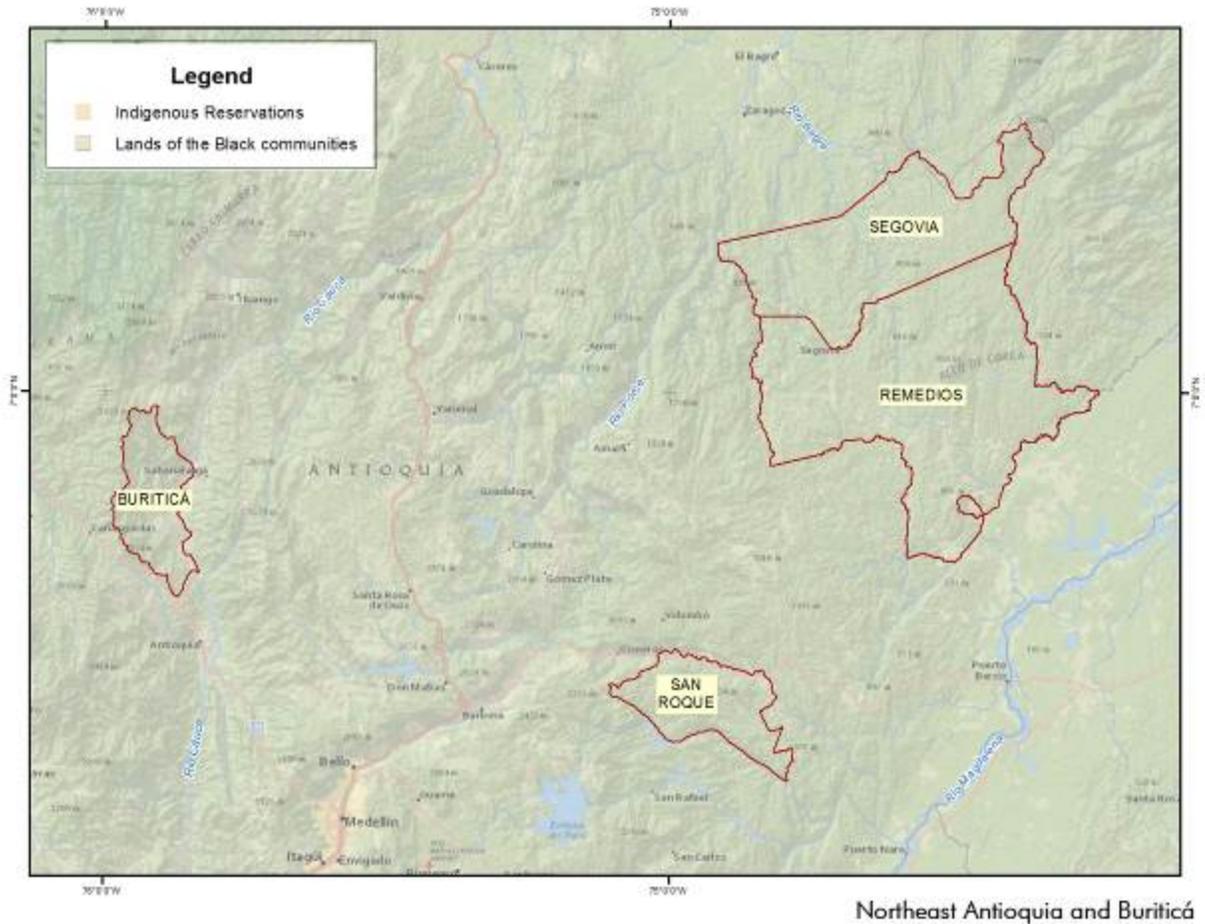
**Map 6.5 Northeastern Area and the Municipality of Buriticá**



Source: ACON- Member of INERCO Group

In the subregion of northeastern Antioquia and the municipality of Buriticá, there is only one indigenous territory in the municipality of Segovia. (Map 6.4)

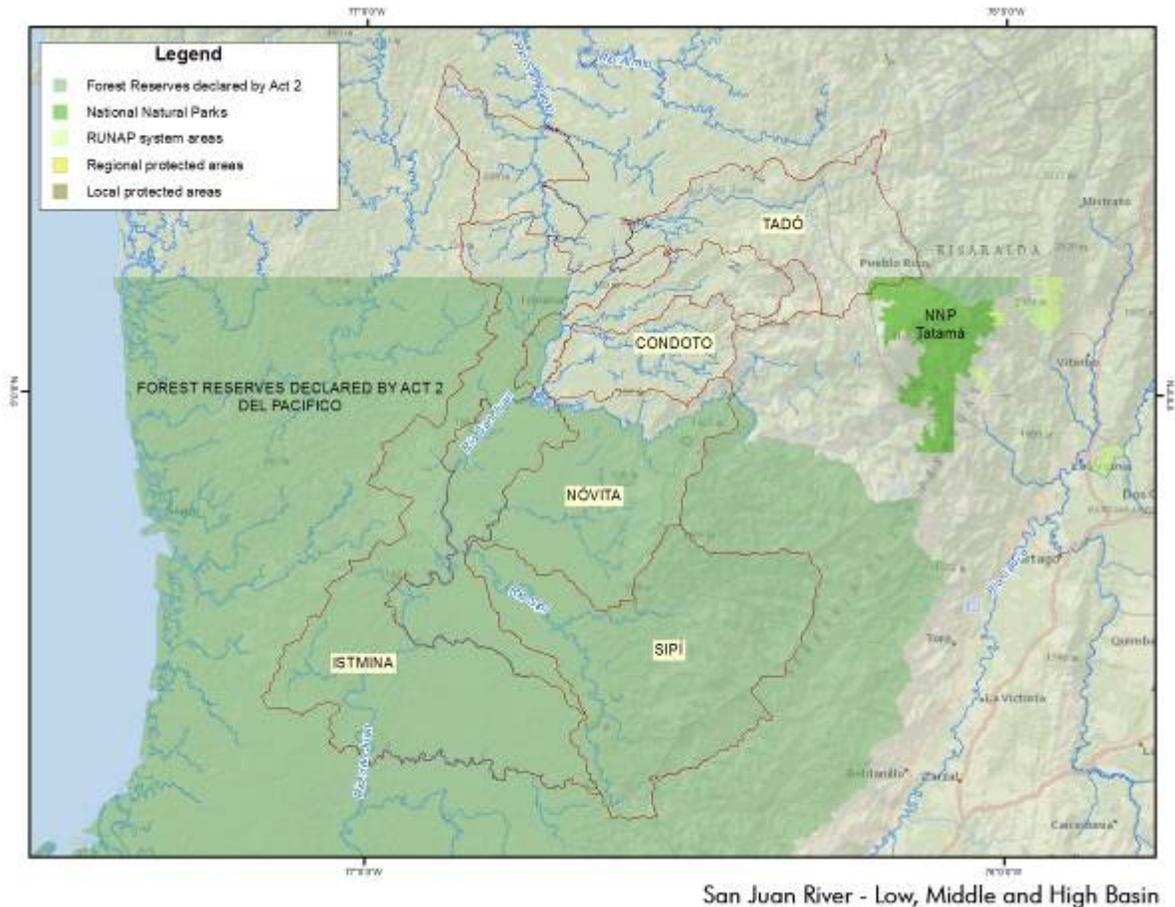
**Map 6.6 Northeastern Area of Antioquia and the Municipality of Buriticá**



Source: ACON- Member of INERCO Group

Much of the Pacific region of Colombia was declared a Forest Reserve by Act 2 / 1959, creating the Pacific Forest Reserve. Map 6.5 shows that the Pacific Forest Reserve overlaps most of the municipalities proposed by the ENV/Mining Program. Only the municipalities of Condoto and Tadó are outside the Forest Reserve, and the municipalities of Istmina and Nóvita have a small area outside of declared protected areas. The Tatamá National Park is also in this subregion, with small area within the jurisdiction of the municipality of Tadó. (Map 6.5)

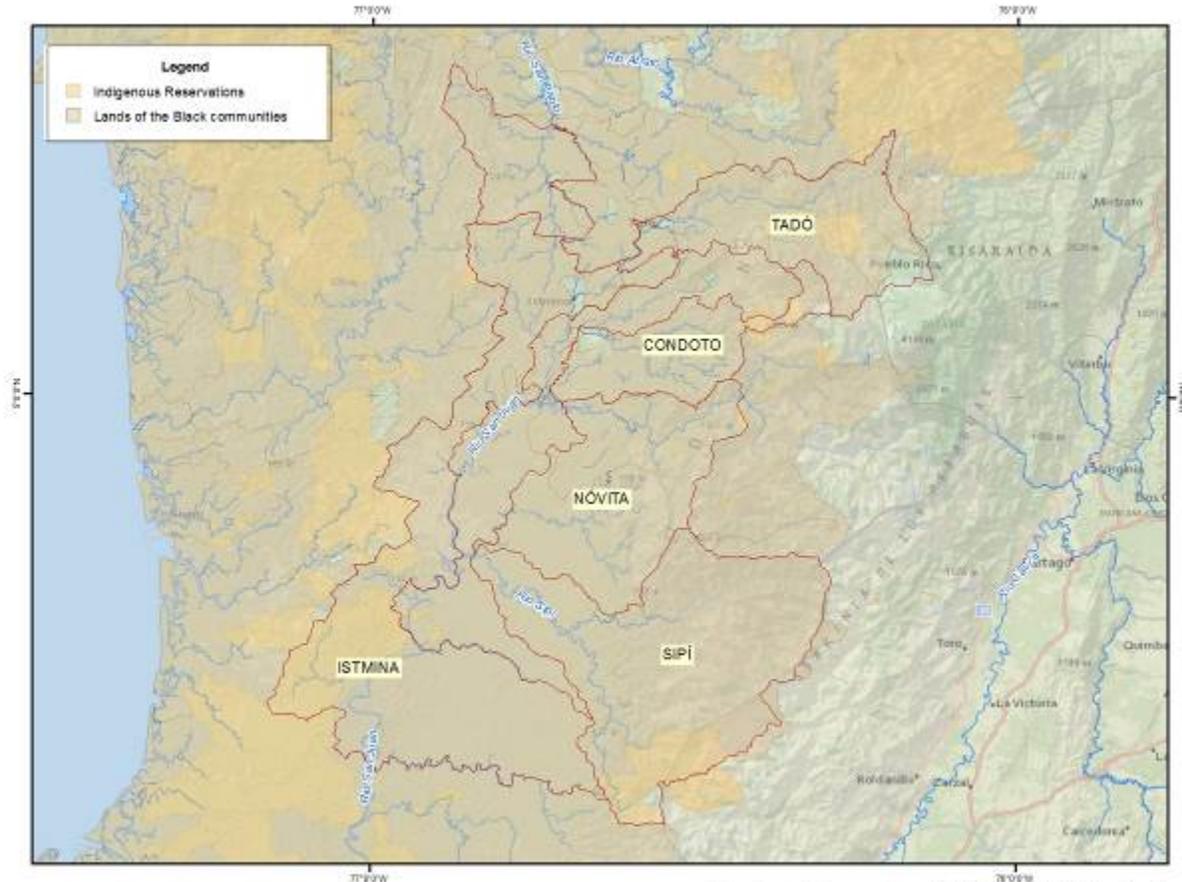
**Map 6.7 Upper, Middle, and Lower San Juan River**



Source: ACON- Member of INERCO Group

In the San Juan River subregion almost the entire area where the ENV/Mining Program plans to operate is in indigenous or Afro-Colombian territories. Any intervention by the Program in this subregion must comply with the provisions agreed in Law 21 / 1991 and Law 770 / 1993. (Map 6.6)

**Map 6.8 Upper, Middle, and Lower San Juan River**

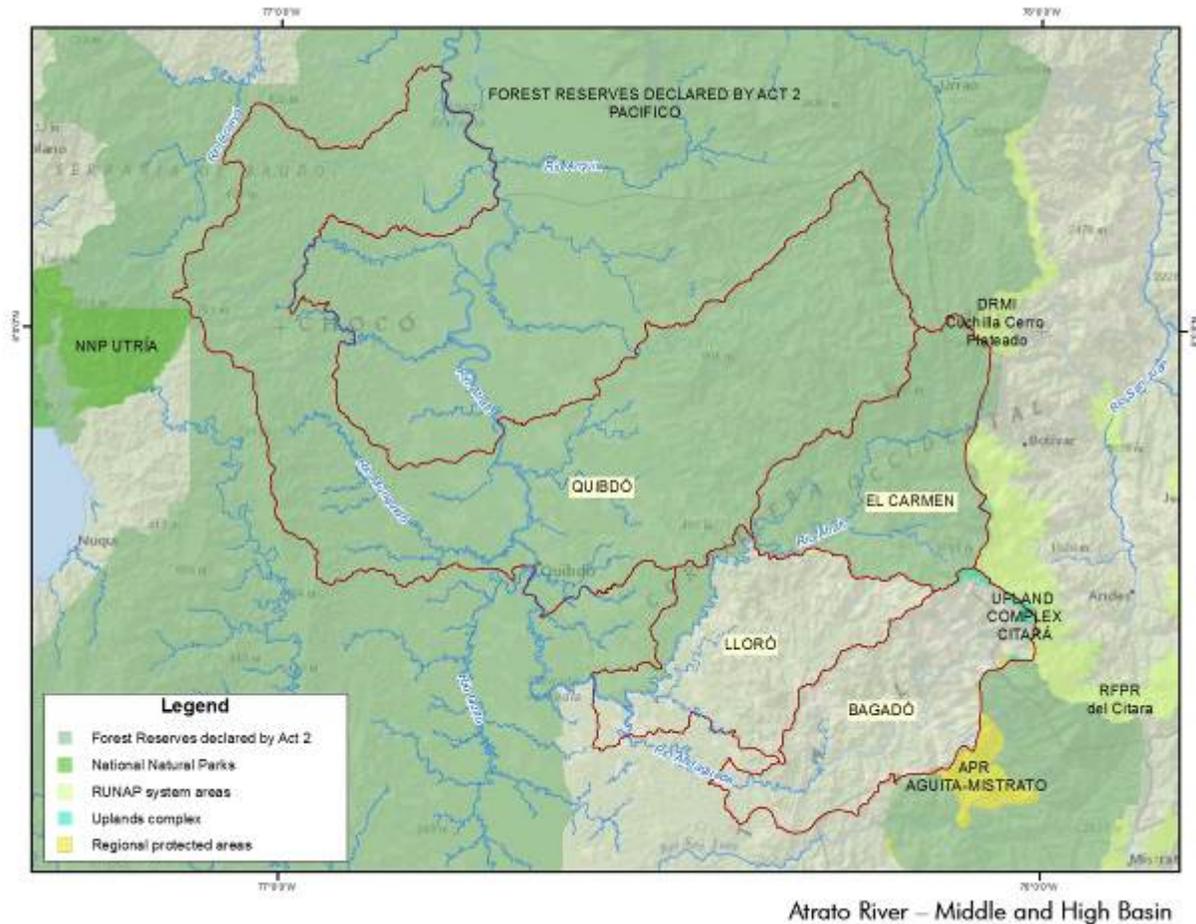


San Juan River - Low, Middle and High Basin

Source: ACON- Member of INERCO Group

Similar to the San Juan River subregion, almost the entire intervention areas proposed by ENV/Mining in the Middle and Upper Atrato River subregion overlaps with the Pacific Forest Reserve. As illustrated in Map 6.7, the entire municipality of Quibdó and the municipality of El Carmen and a small area of the municipality of Lloró are in the reserve. Additionally, another protected area, the Citara uplands complex, is located in the municipality of Bagadó and is an area of special environmental importance to the country.

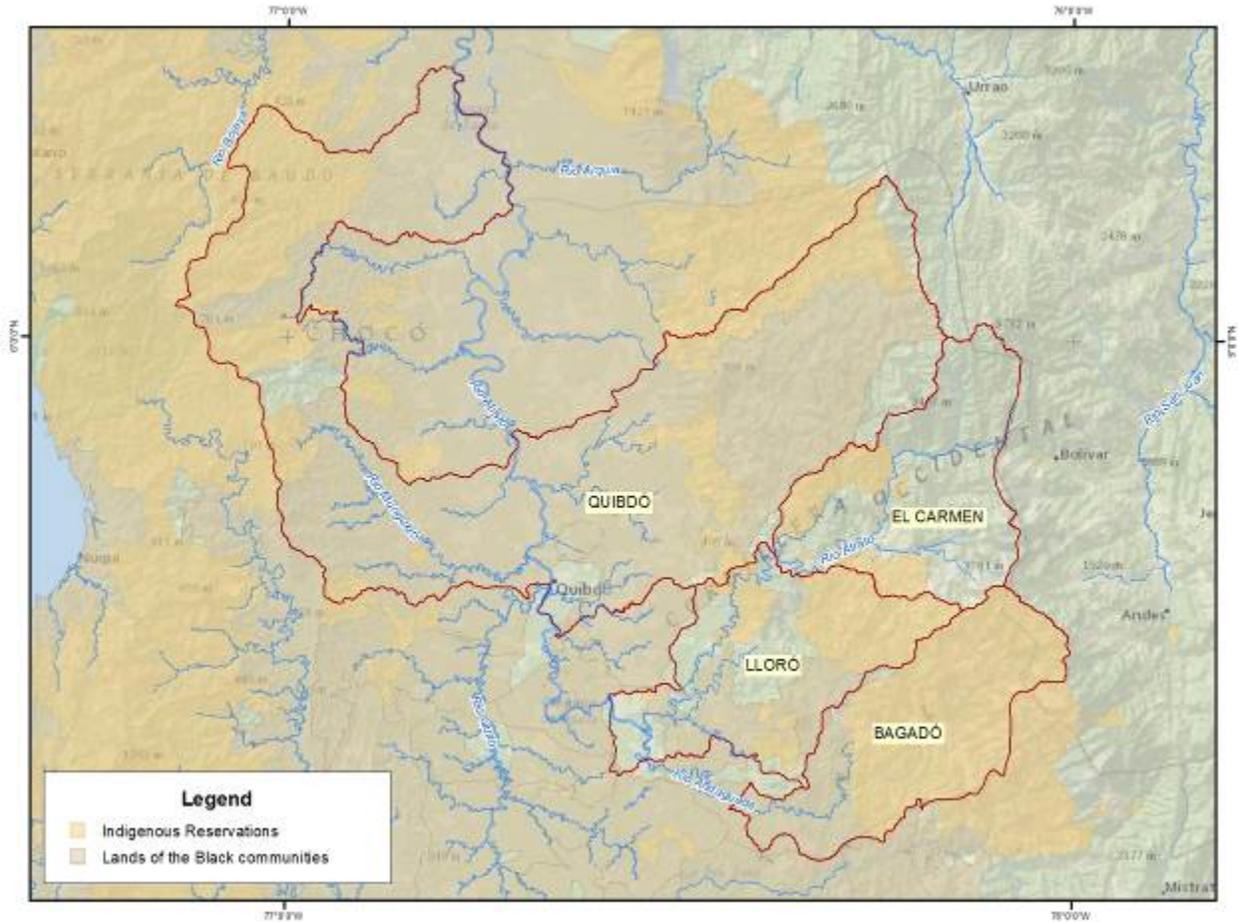
**Map 6.9 Middle and Upper Atrato River Subregion**



Source: ACON- Member of INERCO Group

As Map 6.8 illustrates, most of the area proposed by ENV/mining in the Middle and Upper Atrato River subregion overlaps with indigenous and Afro-Colombia territories.

**Map 6.10 Middle and Upper Atrato River Subregion**



Atrato River – Middle and High Basin

Source: ACON- Member of INERCO Group

## 6.2 Comparative Analysis of Alternatives

This section of the Environmental Assessment is focused on how each of the three alternatives - A, B and C - responds to the three significant issues identified:

- Informality in the possession, use, and exploitation of land damaged by gold mining
- Informality in performing the economic activity of acquiring, processing, and marketing gold
- Use of mercury in the gold mining process.

Below, each of the alternatives are compared to the significant issues discussed above. The comparisons are initially done by an assessment matrix for each alternative, followed by a justification of the rating and an explanation of how each alternative responds to each significant issue and the potential impacts thereof (positive or negative).

**Table 6-3 Comparison of Alternatives**

Issues	Alternatives	Alternative A (no action)	Alternative B (ENV/Mining)	Alternative C (ENV/Mining+)
		Total	Total	Total
Informality in the possession, use, and exploitation of land damaged by gold mining	Land Titling	0	+ 2	+ 2
	Weak institutional and State presence	0	+ 3	+ 3
Informality in performing the economic activity of acquiring, processing, and marketing gold	Deterioration and loss of soil	0	+ 4	+ 5
	Deforestation	0	+ 4	+ 4
	Deficient or inexistent industrial safety and occupational health practices	0	+ 4	+ 4
	Corporate and organizational strengthening	0	+ 4	+ 4
Use of mercury	Air pollution	0	+ 4	+ 5
	Contamination of water sources	0	+ 4	+ 5
	Impacts on biodiversity and the landscape	0	+ 4	+ 5
	Impacts on human health	0	+ 4	+ 5

Source: ACON- Member of INERCO Group

### **6.1.1 Informality in the possession, use and exploitation of land damaged by gold mining**

*Alternative A* - This alternative does not address the significant issue and does not propose any associated mitigation measures. As a result, the issues relating to the informal use and possession of natural resources will continue in the regions of Antioquia and Chocó, causing negative environmental, social, and fiscal impacts. The continuation of the situation corresponds to a cumulative impact in which environmental liabilities will continue to accrue without a responsible party to which they can be attributed. Deforestation will increase due to the illegal sale of wood for ore mining and informal gold mining in the alluvial plains in the Cauca, Nechí, San Juan, and Atrato river basins. The deterioration of soils will continue to restrict productive uses and watersheds will be negatively impacted, making local populations rely on this resource for fishing and water more vulnerable. In addition, the State will continue to be absent from these territories, with the potential for human rights violations and loss tax receipts from the productive use of these lands.

*Alternative B* - The activities under this alternative address the significant issue of arresting degradation in areas damaged by mining in selected regions of Antioquia and Chocó departments. The activities proposed by the ENV/Mining Program are designed to provide miners and landowners with guidance on applying for land titles in order to access Program assistance to rehabilitate areas damaged by informal gold mining. Land-titling, in turn, will increase the sense of property ownership, encourage a culture of formality in the area, increase the presence of State authorities, and achieve significant environmental and socio-economic benefits. These properties will become titled and productive through Program activities and contribute to the region's economic development through the new sources of income, payment of taxes, and creation of jobs. Considering the above, the implementation of the ENV/mining Program in the departments of Antioquia and Chocó will lead to major positive environmental, social, and economic benefits.

The potential impacts of restoring degraded, abandoned alluvial-mined gold lands are decidedly positive compared to Alternative A. Alternative B entails the movement of significant quantities of mine tailings, mostly sand and /gravel and, to a lesser degree, soil, to re-contour sites to an approximation of their original topography. Such work brings attendant risks of additional soil erosion and contamination of water resources from mercury in the soil. Section 7 describes mitigation measures to be employed to reduce the risks of soil erosion and sediments escaping from work areas.

*Alternative C* - Alternative C has the same scope as Alternative B regarding the promotion of land titling, and thus will lead to the same positive environmental, social, and tax benefits as Alternative B.

### **6.2 Informality in performing the economic activity of acquiring, processing and marketing gold**

*Alternative A* - This alternative does not address the significant issue of acquiring, processing and marketing gold and does not propose any type of action to deal with the issue of illegality and informality in the gold mining industry in the departments of Antioquia and Chocó. The

negative impacts attributed to informal gold mining will continue, thus increasing the environmental impacts to soils, water resources, and vegetation. Informal miners will continue to work with deficient or non-existent Industrial Safety and Occupational Health practices, placing them and their families at risk. Mining operations will continue to be carried out without planning, a business strategy, or payment of taxes. On the other hand, informal mining will continue to be persecuted by authorities with the risk of confiscation of mining equipment and machinery, thus increasing distrust and the risk of conflict as well driving illegal operators deeper into illegality and possibly association with criminal gangs.

*Alternative B* - The activities included in this alternative directly address this significant issue. The activities proposed by the ENV/mining Program are designed to formalize and legalize small and medium-scale informal alluvial and hard rock ore mining in the regions where the Program will operate. Planned strategies are properly focused on mitigating the significant issue by means of working to strengthen the capacities of miners to operate legally and adopting a formal business culture with robust environmental practices. Similarly, the formalization process will require miners to comply with mining, environmental, health and safety, labor, and tax regulations that govern the sector. The legalization and formalization of small and medium-scale mining will encourage an increase in the presence of State authorities in the region, which will be in charge of overseeing and monitoring activities.

The following are the activities proposed by ENV/Mining to address the significant issues:

- Strengthen and train small-scale mining associations in order for them to provide support to their members in matters relating to the Colombian legal framework in mining, environmental, industrial safety and occupational health, and tax issues
- Provide support to analyze informal mining production units in order to establish and advise them on procedures to legalize and/or formalize their operations
- Advise informal gold miners in the preparation of Work Plans and Environmental Management Plans (EMP) required to legalize their activities. The design of the Work Plan and the EMP are to be evaluated by a third party to ensure documents meet all technical and administrative requirements. Poorly designed plans could negatively impact Program beneficiaries and possibly the reputation of miners associations, USAID/Colombia, and Colombian government entities and thus jeopardize continuation of the Program.
- Strengthen the Colombian legal framework through associations with State entities for the development of documents such as the Environmental Guide to Formalization, Regulations for Formalization Subcontracts, and Regulations for the Return of Areas
- Establish agreements and subcontracts between informal miners and major companies that have mining titles to enable small-scale miners to formalize their operations and comply with Colombian mining, environmental, and labor law. The ENV/Mining Program must verify compliance with Colombian law by the major mining companies that might participate in the partnership agreements. A company's failure to adhere

to good environmental and social practices may lead to negative impacts on the natural resources and the image of USAID/Colombia.

The activities proposed by the ENV/Mining Program will result in significant positive environmental, social and tax outcomes at the municipal, departmental and national levels. However, care must be taken by the Program to ensure that Work Plans and EMP prepared by small miners are technical sound and feasible.

*Alternative C* - The activities under this alternative directly address the significant issue. Alternative C increases the scope of Alternative B by incorporating other complementary activities, most importantly support for the creation of a cooperative or “federation” of small and medium-scale gold miners, providing them with advice on mining legalization and formalization. The “federation” will be directly involved in gold processing in a way that would allow miners to directly access national and international markets in compliance with international environmental and social standards.

The implementation of Alternative C will result in higher positive environmental, social, and tax impacts than Alternative B mostly from centralized processing of gold using low or non-mercury methods that would also increase gold recovery and be more aligned with international standards with few negative impacts compared to gold processing currently carried out by individual UPMs. Implementation of these additional measures will require a greater investment and a long time than currently envisioned for the ENV/Mining Program.

### **6.3 Use of mercury in the gold mining process**

*Alternative A* - This alternative does not address the significant issue, so the current use of mercury and associated significant negative impacts on air quality, water sources, biodiversity, and the health of miners and their families will continue unabated and contravene Colombian policies and law that propose eliminating mercury in mining activities within five years. This, in turn, will further encourage a culture of informality and illegality in the sector.

*Alternative B* - The activities proposed in this alternative directly address the significant issue identified. The ENV/Mining Program as designed have been designed to fulfill the goal of reducing the use of mercury in mining by 20% in the regions of influence of the Program. One of the key strategies to achieve this objective is through operating contracts or associations between small-scale mining and major companies with mining titles that meet the environmental regulations and do not use mercury in gold processing.

The following are the activities proposed by Alternative B to address the significant issue:

- Encourage the legalization and formalization of informal gold mining in order for there to be control and monitoring by the environmental authorities in this activity
- Provide support in the development of Work Plans and EMPs

- Use demonstrative and practical means to teach the benefits of using alternative technologies for the extraction of gold that do not use mercury
- Installation of pilot plants to demonstrate the benefits of technologies that do not use mercury in gold processing
- Establish operating contracts between informal miners and major companies that hold legal mining titles where the ore extracted or recovered by small-scale miners will be processed at plants operated by the large companies without the use of mercury.

The implementation of the ENV/Mining Program will bring major positive impacts for Colombia from the reduced mercury used in informal gold mining activities. ENV/Mining should identify large-scale mining companies to serve as partners of the Program that comply with environmental and social regulations in force in Colombia and that already do not use mercury in gold processing.

*Alternative C* - The activities contained in this alternative directly address the significant issue in the departments of Antioquia and Chocó. The advantage of this alternative is that not only are impacts from mercury use mitigated, but also other impacts caused by mining, such as contamination from cyanide. With regard to the reduction or elimination of the use of mercury, Alternative C proposes the same activities as Alternative B; however, this alternative proposes a more comprehensive approach including the implementation of best management practices to eliminate, mitigate, or remedy a wider array of environmental impacts attributed to gold mining.

The following are activities proposed under this alternative to address the significant issue:

- Design and implement advanced-technology extraction plants with high percentages of gold recovery and in compliance with international performance standards
- Implement processing plants that do not use mercury in the gold mining process and implement the following methods:
  - Gravimetric in the case of alluvial mining
  - Cyanidation in the case of gold ore mining
- Implement accelerated cyanide degradation processes
- Build tailings dams to handle solids
- Implement systems to control smelting
- Ensure plan compliance with national and international environmental standards.

The creation of a cooperative or federation of small and medium-scale gold miners is unique in Alternative C. This organization will be a forward thinking solution for ensuring comprehensive sustainability of the mining sector and sustainability in business management and environmental and social practices. The federation would:

- Provide services required for miners to access domestic and international markets
- Ensure compliance with international development standards in legal, tax, social and environmental matters
- Provide training in the preparation and assessment of projects in order to support viable projects on the technification of exploitation and exploration by assigning credit resources on the part of the federation
- Process and sell gold directly with a goal to attain a price premium in domestic and international markets that recognize environmental and social standards
- Identify gold mining companies that have mining titles to sign association agreements with small-scale miners who carry out exploitation activities within their mining titles
- Carry out gold processing in advanced-technology plants with high percentages of gold recovery and in compliance with all international performance standards.

The implementation of Alternative C will result in a much higher level of positive environmental outcomes than Alternative B; however, implementation will be a major challenge for ENV/Mining and the Colombian government in terms of complexity and requires major economic investments and a time commitment that would exceed the two 2 years allotted to the implementation of the ENV/Mining Program.

In addition to an analysis of each Alternative against the significant issues, a less rigorous analysis of “connected actions” associated with Alternative B is warranted. To recap, two “connected actions” are proposed:

- Beekeeping projects connected to the recovery of areas damaged by gold mining to generate income for land owners while the timber is grown to harvestable age
- Job creation in reforestation and plantation maintenance.

Beekeeping practices that do not involve use any chemical pesticides are proposed. Local extension agents trained in beekeeping, using non-chemical pesticide management, will train project affiliates in the correct rearing and management methods. Employment generation through tree planting activities and plantation management over the medium and long term will result in positive economic impacts to local communities.

### **6.3 Selection of the Suggested Alternative**

Alternative C will have the most positive impacts on the three significant issues identified. However, Alternative B is the best fit to address these issues through the ENV/Mining Program given current timeframes and budgets. Due to a relatively short time-frame (two years) and constrained budget, Alternative B is considered to be more viable to attain the desired condition.

The impacts caused by the ENV/Mining Program are largely positive, owing to the mitigation nature of the two primary components, to the extent that the desired condition of the Program is a positive condition in which the best environmental, social, labor, and economic conditions for Colombia exist.

Based on the comparative analysis of the alternatives, the authors of the Environmental Assessment recommend that Alternative B be implemented; e.g. the actions proposed by ENV/Mining will associated mitigation measures (Section 7). However, should the ENV/Mining Program be extended beyond its current two year duration and additional funding be made available, then Alternative C selected additional actions should be reconsidered as the preferred option.

## 7 MANAGEMENT PLAN

During the implementation phase of the recommended alternative, it will be necessary to take selected mitigation measures to reduce or eliminate negative environmental impacts that may potentially be generated by the Program. The mitigation measures to be implemented in the geographic regions selected by the ENV/Mining Program are organized under each of the three main Program components:

- Legalize and formalize informal alluvial and ore gold mining operations in compliance with Colombia mining, environmental, and labor regulations
- Rehabilitate areas damaged by informal alluvial gold mining
- Reduce the use of mercury in informal alluvial and ore gold mining.

The proposed Management Plan identifies mitigation measures aimed at safeguarding natural ecosystems affected by small-scale gold miners and other neighboring parties from potentially adverse impacts of small-scale gold mining and, in some cases, actions proposed by the Program. The aim is to prevent adverse impacts from occurring or to limit their significance to an acceptable level. Preventative, risk adverse, and pro-environment actions are mitigation strategies that will used.

The actions proposed by ENV/Mining will not be carried out in any legally declared protected areas. This includes forest reserves under Act 2, national parks, public natural reserves, uplands areas, and regional and local protection zones. Therefore, the geographic scope of the ENV/Mining Program will be as follows:

**Table 0-4. Program Location Proposed by Alternative B**

Department	Subregion	Municipality
<i>Antioquia</i>	Northeast	Remedios
		Segovia
		San Roque
	Western	Buriticá

	Lower Cauca	Nechí
		Tarazá
		Caucasia
		El Bagre
		Cáceres
		Zaragoza
<i>Chocó</i>	Middle and Upper Atrato River	Bagadó
		Lloró
	Lower, Middle and Upper San Juan River	Condoto
		Nóvita
		Istmina
		Tadó

Source: Adapted by the ACON Team of Consultants, 2014

In the proposed Management Plan, priority was given to preventative measures. Preventative measures include modifying, or in some cases, determining to not proceed with a proposed activity to prevent or limit potential impacts. An example of a preventative measure aimed at modifying a proposed would be identifying a new location or changing the design of a demonstration gold processing pilot plant. In the case of a proposed intervention in an alluvial mine located within a forest reserve or other protected area, this would be an instance where a preventive measure to proceed with said Program activity would be instituted.

Risk adverse measures are also proposed. These measures aim at minimizing impacts of proposed activities by implementing parallel activities designed at reducing undesirable impacts of a proposed activity on the environment and natural resources and human health. For example, use of non-mercury gravimetric methods to extract gold particles from alluvial sands will mitigate the use of mercury which is associated with negative impacts to natural ecosystems and human health. Use of non-mercury gravimetric methods to extract gold particles from alluvial sands is a key component of the ENV/Mining Program.

The Program will also take proactive measures to generate positive environmental outcomes. For example, post-mining rehabilitation investments will be made aimed restoring ecosystems so as to accelerate long-term natural processes through healthy ecosystem. This activity is also a key component of the ENV /Mining Program.

This section of the EA discusses the use of environmental “Best Management Practices (BMPs) for the Program’s two primary components: (i) reduce mercury use by small-scale gold mining associations; and (ii) restore degraded alluvial-mined lands. As discussed earlier in the EA, the reduction of mercury usage is an important mitigation measure to address the negative consequences of mining on the environment and natural resources and human health. Primary measures to reduce mercury usage includes: (i) link hard-rock gold mining associations to large gold mining companies that do not use mercury in their operations; and (ii) introduce mechanical/gravimetric methods for small-scale, alluvial gold mining associations that involve no mercury usage.

The following two tables (Table 7-1) below summarize the key aspects of the Management Plan. These tables also outline mitigation measures to be utilized in the rehabilitation/restoration of degraded, alluvial-mined lands.

**Table 7.2 Mitigation measures for rehabilitation/restoration of degraded alluvial-mined lands**

Activity Description	Impacts	Affected Resource	Mitigation Measures
Use of heavy equipment, such as dozers, to recontour abandoned, alluvial gold mines.	Exhaust emissions, dust, and noise during earth moving operations. Temporary impacts to surface water from recontouring operations.	Vegetation	<ul style="list-style-type: none"> <li>• Revegetation of disturbed areas using exotic (<i>Acacia mangium</i>) and native, local tree species.</li> <li>• Any present native vegetation will be minimally disturbed, equipment will not enter undisturbed, natural water courses.</li> <li>• Within the Dept. of Chocó, reforest areas only with local, native species.</li> </ul>
		Wildlife	<ul style="list-style-type: none"> <li>• Restoration of disturbed/ destroyed habitats through revegetation measures.</li> </ul>
		Surface water	<ul style="list-style-type: none"> <li>• Erosion and sedimentation controls such as grade control structures. Restoration of natural contours and drainage patterns at disturbed sites.</li> <li>• The use of</li> </ul>

			<p>lubricants and hydraulic fluids and fueling will be done in a flat area at least 50 yards from water sources. A minimum amount for fuel will be stored on-site at any one time.</p> <ul style="list-style-type: none"> <li>• To minimize the risk of water contamination (bodies of water beyond original mining operations) from any elemental mercury that might be present in the soil, soil movement will be contained within the large depressions formed by the original mining operations; if necessary, construct berms around sites.</li> </ul>
		Noise and vibration	<ul style="list-style-type: none"> <li>• Restricted hours of operation for heavy equipment if near populated areas.</li> </ul>

Modified from original source: USEPA, EIA Technical Review Guidance: Non-Metal and Metal Mining; May 2011; <http://www2.epa.gov/sites/production/files/2014-04/documents/miningvol1.pdf>

<b>Alluvial-Mined Land Restoration Mitigation Measures</b>		
<b>Affected Environment</b>	<b>Potential Restoration Design Measures</b>	<b>Monitoring, BMPs, and Mitigation Measures</b>
Air	Dust Control: Minimize disturbed areas – recontour only those lands in need of restoration to prevent soil erosion.	<ul style="list-style-type: none"> <li>• Dust Control Measures</li> <li>• Reestablish vegetation on disturbed areas as soon as practical after disturbance.</li> </ul>
Water	<p>Sediment and Erosion Control:</p> <ul style="list-style-type: none"> <li>• Identify and employ slope stabilization practices when necessary.</li> <li>• Construct drainage ditches only, where necessary, associated with internal access roads.</li> <li>• Use appropriate structures at culvert outlets (ref. – internal access roads) to prevent erosion.</li> <li>• Recreate drainage systems to approximate original hydrology, especially in sensitive areas such as erodible soils or steep slopes.</li> <li>• Construct sedimentation structures within recontoured lands to impound surface water runoff and sediment.</li> </ul>	<p>Sediment and Erosion Management Program:</p> <ul style="list-style-type: none"> <li>• BMPs implemented to control erosion during recontouring operations (operations to entail extensive cut/fill to approximate original contours); recontour slopes to prevent slope failures/extensive erosion.</li> <li>• Side slopes and benches of permanent water catchments will be designed to stabilize and minimize erosion.</li> <li>• Disturbed soils will be restored, via revegetation, as soon as practical after recontouring operations.</li> <li>• Catch basins, drainage ditches, and culverts (for internal access roads) will be constructed.</li> <li>• Utilize existing water catchments to allow for wetlands to be reestablished through natural processes over time; allow for natural revegetation processes for aquatic species.</li> </ul>
	<p>Water Quality Control Measures:</p> <ul style="list-style-type: none"> <li>• Minimize effects to streams and rivers when dewatering pits/temporary catchments and direct or</li> </ul>	<p>Monitor site restoration activities to ensure the effectiveness of the implemented measures. Mitigation measures may include, but are not limited to:</p>

	indirect blockage/ diversion of upstream source water flow.	<ul style="list-style-type: none"> <li>• Re-contour sites to allow for aquifer re-charge to occur.</li> <li>• Re-contour sites to approximate original drainage patterns.</li> </ul>
Soils/Geologic	<p>Soils:</p> <ul style="list-style-type: none"> <li>• Design runoff control features to minimize soil erosion.</li> <li>• Use special construction techniques in areas of steep slopes and erodible soils.</li> </ul>	<p>Soil management to include the following provisions:</p> <ul style="list-style-type: none"> <li>• Revegetate disturbed soils as quickly as practical.</li> <li>• Apply erosion controls to reduce soil erosion (e.g., jute netting, silt fences, and check dams)</li> <li>• Use of heavy equipment will be minimized to the extent possible and will not be used during rain events or when ground conditions are excessively wet.</li> </ul>
	<p>Geology - Within abandoned sites, identify unstable slopes and local factors that can cause slope instability (groundwater conditions, precipitation, seismic activity, slope angles, and geologic structure).</p>	<p>Mitigation for geologic resource includes:</p> <ul style="list-style-type: none"> <li>• Avoid creating excessive slopes during recontouring operations.</li> <li>• Construct catch basins, drainage ditches, and culverts (for access roads to facilitate revegetation and long-term maintenance).</li> <li>• Reestablish the original contour and drainage pattern to the extent practicable.</li> </ul>
Biological/Ecological	<p>Wildlife, Ecology and Vegetation:</p> <ul style="list-style-type: none"> <li>• Protect existing protective buffers to exclude unintentional disturbance of important resources adjacent to degraded sites.</li> <li>• Prevent water contamination from heavy equipment fluids (coolant, diesel, and hydraulic oil),</li> </ul>	<p>Wildlife, ecologic, vegetation management Program should:</p> <ul style="list-style-type: none"> <li>• Educate workers regarding the occurrence of important natural resources in the area and the importance of protection.</li> <li>• Instruct equipment operators regarding spill prevention practices and response actions in</li> </ul>

	so as to prevent impact on aquatic systems.	<p>equipment refueling to minimize accidental contamination of soil &amp; water resources.</p> <ul style="list-style-type: none"> <li>• Restoration plan requirements - identify revegetation, soil stabilization and erosion reduction measures. Revegetation plan to specify location, types and densities of species (with a preference towards native species – on best micro-sites), mulching/ fertilization requirements. Identify responsible parties for implementation and monitoring.</li> <li>• On better soils within rehabilitation projects, reforest with native/local tree species.</li> <li>• Establish mercury-free gold pilot processing plants to extract gold particles.</li> </ul>
Land	<p>Land Use:</p> <ul style="list-style-type: none"> <li>• Minimize the amount of land disturbance and develop and implement erosion control BMPs.</li> <li>• Establish a restoration plan to ensure that all impact areas are restored.</li> </ul>	Land Program - Implement a restoration plan.
Human Health & Safety associated with re-contouring operations	<ul style="list-style-type: none"> <li>• Conduct a safety assessment to describe potential safety issues - work practices, security, transportation of heavy equipment, emergency procedures, and fire control and management.</li> </ul>	<p>Health and Safety Program should address:</p> <ul style="list-style-type: none"> <li>• All of the safety issues identified in the assessment and all applicable safety standards set forth by local governments.</li> </ul>

Modified from original source: USEPA, EIA Technical Review Guidance: Non-Metal and Metal Mining; May 2011; <http://www2.epa.gov/sites/production/files/2014-04/documents/miningvol1.pdf>

In addition to the environmental mitigation measures summarized above, other measures will be applied per Industrial Safety and Occupational Health regulations.

### **Connected actions and their role as mitigation measures**

As mentioned earlier, “connected actions” are those that are directly linked to the ENV/Mining Program, nor aimed at directly reducing mercury use or restoring degraded lands, but can generate ancillary ecological and socioeconomic benefits where restoration activities occur. As such, beekeeping will be promoted as a new productive alternative for communities in mining areas. This will not only generate employment and income from the sale of honey and other bee products in the short-term, but will also play an ecological function by introducing pollinators to assist in the natural restoration process. No pesticides (e.g. fungicides to control mites) will be used in apiculture activities. Reforestation and subsequent maintenance and harvesting of plantations on post-mining areas is another example of a productive alternative that will generate unskilled and skilled jobs over the short and long-term.

The costs of mitigation measures in the Management Plan is equivalent to 4% of the total ENV/Mining Program budget (approximately US \$6.5 million) or US\$ 260,000, as summarized in the table below. This includes monitoring and assessment actions. The BIOREDD+ ENV/Mining team, in collaboration the USAID/Colombia Mission Environmental Officer (MEO) or delegate, shall monitor the implementation of the recommended mitigation measures. The Mitigation and Monitoring Plan (Management Plan) below describes potential environmental impacts, mitigation measures, monitoring indicators and frequency, responsible parties, time, and budget for mining activities that fall under the ENV/Mining Program scope.

Mitigation - Monitoring - Assessment: ENV/Mining							
Current Activity	Description of Impact	Mitigation Measures	Monitoring Indicator	Person or Entity Responsible	Training Plan - Implement Mitigation Measures	Estimated Cost - Monitoring/ Assessment of Mitigation Measures (US Dollars)	Monitoring Frequency
Alluvial gold or gold ore mining carried out informally without mining titles and without applying environmental and social practices to mitigate impacts.	Since work is carried out on an informal basis, small-scale mining does not comply with mining and environmental rules/regulations that regulate the sector; therefore, there are negative impacts on biodiversity, water, soil, air, and human health.	Strengthening of mining associations to provide legal and technical assistance for members in order to comply with the rules and regulations that govern the mining sector.	Number of associations of small-scale miners with improved capabilities to provide their members technical and legal assistance, and take part in the implementation of mitigation measures and environmental monitoring.	BIOREDD+, Armónica, and Expansión y Gestión Empresarial**	Armónica has a methodology and training plan.	33,800	Quarterly
		Provide technical assistance in order for miners, through associations, to comply with (1) mining legislation, (2) environmental legislation, (3) labor and safety legislation, and (4) business regulations.	Number of miners' associations implementing environmental and mining regulations.	Armónica	Armónica has a methodology and training plan.	31,200	Quarterly

\* Armonica and Gestion Empresarial are subcontractors under the current Bioredd+ program. In the event that a second phase of the program, subcontractors with equivalent capacities will be hired to perform these tasks.

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Mitigation - Monitoring - Assessment: ENV/Mining							
Based on the policy of the Ministry of the Environment and Sustainable Development (and the National Authority for Environmental Licensing), it is almost impossible for an informal miner to get an Environmental License, even if the miner meets the requirements required to apply for one.		Better communication and collaboration between the Ministry of Mines and Energy and the Ministry of the Environment and Sustainable Development to allow informal miners to obtain an Environmental License and to establish articulated policies.	Number of environmental licenses issued to miners' associations.	BIOREDD, Armónica, mining consultants, Antioquia Secretary of Mines, Ministry of Mines and Energy and Ministry of the Environment and Sustainable Development.	Armónica will train miners' associations in the application process for environmental licenses.	10,400	Monthly
Use of mercury by small-scale informal gold miners.	The use of mercury in the gold extraction process has many harmful effects on physical resources (soil, water and air), biological resources (flora and fauna), and human health (especially children and pregnant women). Mercury is a heavy metal that accumulates in the environment and converts into more toxic forms in the	The most effective measure to deal with this issue is to stop using the metal. Small-scale miners will partner with major companies that do not use mercury and have the respective environmental license. Use alternative technologies that do not involve the use of mercury.	20% reduction in the purchase and use of mercury.	Specialist on the ENV/Mining team	BIOREDD will develop and implement "best practices" to explore, extract and process gold on behalf of small-scale miners' associations.	33,800	Monthly

Mitigation - Monitoring - Assessment: ENV/Mining							
	presence of bacteria. Its harmful effects on people are well documented. In general, impacts (on the environment and human health) of the indiscriminate use of mercury cause direct, indirect and cumulative impacts; the cumulative impacts will continue in the long-term.						
Deforestation of native forests by small-scale miners. This has cumulative negative impacts on the watersheds of the Cauca, Nechí, San Juan and Atrato Rivers in the departments of Antioquia and Chocó. There are many degraded lands that have been abandoned by informal alluvial and gold ore	Abandoned alluvial-mined gold lands are largely devoid of vegetation, contain much active erosion, contain numerous ill-planned, temporary water catchments, and provide little to no long-term prospects for productive activities.	Construction of erosion and sedimentation controls to minimize erosion. Restore an approximation of natural contours and drainage patterns. Heavy equipment refueling and lubrication to be done in a flat area at least 50 yards from water sources. Store a minimum amount of fuel on-site at any one time. Contain soil movement within the large depressions formed by the original mining operations; if	Number of hectares restored to approximate original contours.	RIA	RIA	Recontouring costs are covered by private landowners through formal, written agreements with RIA. RIA cost shares reforestation costs with private landowners; done via formal, written agreements.	Quarterly

Mitigation - Monitoring - Assessment: ENV/Mining							
<p>miners. No legally responsible party can be identified for these abandoned alluvial-mined lands due to the informal execution of the activity.</p>		<p>necessary, construct berms around sites. BMPS for sediment and erosion control: recontour slopes to prevent slope failures/extensive erosion; side slopes and benches of permanent water catchments will be designed to be stable and minimize erosion; disturbed soils will be restored, via revegetation, as soon as practical after recontouring operations; catch basins, drainage ditches, and culverts (for internal access roads) will be constructed; utilize existing water catchments to allow for wetlands to be reestablished through natural processes over time; allow for natural revegetation processes for aquatic species. Use of heavy equipment will be minimized to the extent possible and will not be used during rain events or</p>					

Mitigation - Monitoring - Assessment: ENV/Mining							
		when ground conditions are excessively wet. Instruct equipment operators regarding spill prevention practices and response actions in equipment refueling. Revegetation plan to specify location, types and densities of species (with a preference towards native species – on best micro-sites), mulching/fertilization requirements. Reforest with native/local tree species on best micro-sites.					
Deforestation of native forests by small-scale miners. This has cumulative negative impacts on the watersheds of the Cauca, Nechí, San Juan and Atrato Rivers in the departments of Antioquia and Chocó. There are many degraded lands that have been abandoned by informal alluvial	Deforestation of the tropical/humid forest by informal alluvial gold mining has much more impact than deforestation in other parts of Latin America. The alluvial mining process requires the deforestation of areas that, after extracting gold, form completely infertile soils, preventing the	Planting abandoned, alluvial-mined lands with productive forest species that the communities can later use. After testing several species, the exotic species <i>Acacia mangium</i> showed the best results in damaged soils. A combination of <i>Acacia mangium</i> (90%) and native species (11 species; +/- 10% of the areas)	Number of hectares rehabilitated with <i>Acacia mangium</i> , native species (broadleaf and of the areas of activities), among others.	BIOREDD* and Reforestadora Integral de Antioquia (RIA)	RIA has a methodology and training plan.	52,000	Quarterly

Mitigation - Monitoring - Assessment: ENV/Mining							
and gold ore miners. No legally responsible party can be identified for these abandoned alluvial-mined lands due to the informal execution of the activity.	natural regulation of the sites where the work was done.	will be used. The topographic preparation of the land impacted by mining will be carried out to restore the natural drainage of the sector and speed reducers will be built to mitigate the impacts of erosion. Any present native vegetation will be minimally disturbed, equipment will not enter undisturbed, natural water courses. Within the Dept. of Choco, reforest areas only with local, native species.					
Existing gold mines operating based on informal mining in which there is no certainty on the legal status of the occupation of the land.	There is predominant illegality and informality in the sector of small-scale gold mining, its practices and the failure to comply with environmental, mining, safety and occupational health regulations have caused adverse impacts in Colombia.	Encourage the legalization and formalization of small-scale mining.	Environmental and mining permits obtained.	BIOREDD in collaboration with the Antioquia Secretary of Mines, Ministry of Mines and Energy, CODECHOCO and Ministry of the Environment and Sustainable Development.	Armónica has a methodology and training plan.	10,400	Quarterly
		Develop "Environmental Management Plans" (EMPs) and "Work Plans" for each	Number of EMPs and Work Plans created and approved by the Colombian	Team of BIOREDD, Armónica and expert advisors in gold mining.	Armónica has a methodology and training plan.	13.000	Quarterly

Mitigation - Monitoring - Assessment: ENV/Mining							
		Mining Production Unit, which is a requirement in the legalization process. Miners will be trained in how to implement and execute Environmental Management Plans.	authorities.				
Existing gold mines operate based on informal mining in which there is no certainty on the legal status of the occupation of the land.		Train miners in environmental regulations, labor obligations, alternative technologies, and the implementation of environmental best practices in gold mining.	Number of miners trained in topics of environmental regulations, labor obligations, alternative technologies and environmental best practices.	Team of BIOREDD, Armónica and expert advisors in gold mining.	Armónica has a methodology and training plan.	15,600	Quarterly
		Enroll small-scale miners in environmental certification Programs	Number of small-scale gold mining operations/associations enrolled in environmental certification Programs.	BIOREDD Team	BIOREDD will develop and implement a training plan.	7,800	Quarterly
		Propose, design and adopt legal and regulatory instruments to facilitate the development and formalization of small-scale mining.	Number of new legal and regulatory instruments proposed, designed and implemented to facilitate the formalization of informal miners.	BIOREDD Team and Armónica	BIOREDD will develop and implement a training plan.	10,400	Quarterly
		Design and implement a communications	Number of beneficiaries of the communication	BIOREDD Team	BIOREDD will develop and implement a	10,400	Quarterly

Mitigation - Monitoring - Assessment: ENV/Mining							
		campaign to support a culture of legality in the mining regions.	campaigns to create a culture of legality in the Program regions.		training plan.		
The municipalities and the Regional Environmental Authorities do not have the tools and resources to face the challenge of the legalization and formalization of small-scale mining.		Strengthen the capacities of the municipalities and the regional environmental authorities in mining areas in order for them to provide technical, legal and organizational assistance to small-scale miners. They will also be responsible for the control and monitoring of these mining operations.	Number of municipalities with the capacity to provide technical, legal and organizational assistance to UPMs and small-scale miners' associations.	BIOREDD Team and Armónica	Armónica has a methodology and training plan	10,400	Quarterly
Small-scale miners do not have access to strong markets that will pay the price stipulated by the international market for their gold.	If small-scale mining does not have access to stable markets or mechanisms to process the gold, in compliance with environmental good practices, they will go back to using mercury in the gold extraction process.	Support the development of new markets that recognize the added value of the gold produced based on international environmental and social standards.	Number of miners with access to new markets that recognize the economic value of gold obtained by mining operations adhering to high environmental and social standards.	BIOREDD Team and Expansión y Gestión Empresarial	Expansión y Gestión Empresarial has a methodology and training plan.	10,400	Quarterly
Mining associations, including miners' families, do not have good job	Miners exploit alluvial gold or gold ore, often illegally and/or informally, causing major	Explore other business options (non-mining) to generate income and quality of life in the	Number of business plans (not in the field of mining) developed.	BIOREDD Team and Expansión y Gestión Empresarial	Expansión y Gestión Empresarial has a methodology and training plan	10,400	Quarterly

Mitigation - Monitoring - Assessment: ENV/Mining							
opportunities; in many areas, mining is the only option.	damage to the natural resources of Colombia and to the human health of its citizens.	mining regions of the country. .					

## 8 ENVIRONMENTAL ASSESSMENT TEAM

### **Gabriel Medina**

Civil Engineer specialized in the management of natural resources, the environment, and disaster prevention, with knowledge of the Code of Federal Regulations, and full command of legal and technical environmental project topics. He has worked as the Project Director at Ambiental Consultores & Cía. LTDA., where he was able to apply his knowledge in strategic environmental assessments, environmental impact studies, environmental management plans, amendment of environmental licenses, environmental assessment of alternatives, and providing legal assistance, planning, design, and guidance for different industrial-environmental issues. He has more than 24 years of professional experience in these fields and more than six years of experience in mining project assessments and studies. He has been a consultant to public and private national, regional, and local entities and for international agencies such as the United Nations Development Program, the Organization of Ibero-American States, and the World Bank, among others.

### **Specialist in Socioeconomic Sciences - Silvia Feria**

Bachelor of Communications with a master's in strategic communication, she has more than nine years of professional experience in community relations, management of social procedures, and social and communicational research, in addition to the design and implementation of communication strategies. She has participated in mining projects and social development projects (economic, gender, citizen watch and vulnerable populations) in Peru and Colombia. She is specialized in the field of citizen participation, environmental and social impact assessments, corporate social responsibility programs, gender, multiculturalism, involuntary resettlement, and intercultural dialog.

### **Specialist in the Management of Natural Resources - Jeimmy Avendaño Reyes**

Specialist in the management of natural resources with the skill and ability to plan, develop and execute activities and processes in areas related to forestry environmental, and related sectors, based on the principles of sustainable development. Experienced in the preparation and execution of environmental management plans, in physical-biotic assessments (floristic inventories, climate, geological and edaphic characterization), as well as components of assessments, zoning, and formulation. Experienced in the implementation of agroforestry plantations in the watershed of the San Juan River in Chocó.

### **Environmental Specialist – José Alejandro Bernal**

Environmental and sanitary engineer, and bilingual specialist in strategic management with more than seven years of experience in environmental statistics and indicators, climate change with emphasis on carbon markets, and civil works. Master's candidate in environmental management. He has worked with international entities such as the Andean Community of Nations, the United Nations Development Program (UNEP), and the Economic Commission for Latin America and the Caribbean (ECLAC), reporting environmental indicators. He worked as a member of the

national technical committee of the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Project led by the World Bank.

**Environmental Specialist - Felipe Vásquez**

Bilingual environmental engineer, with more than three years of experience in the gold mining sector. He is in charge of the design and operation of the tailings dam, design of the accelerated cyanide degradation system, and the risk assessment and analysis of environmental impacts caused by the operation of the processing plant, smelting, and the operation of three major underground mines.

**GIS Specialist - John Freddy Gómez**

Surveying and geodesy engineer with more than ten years of experience in the supervision of capture, editing, structuring and generation of digital cartographic products. More than ten years of experience using ArcInfo, ArcGis, and AutoCad Map packages, among others.

**Environmental Expert - Bruce Bayle**

Forest Engineer with more than 30 years of experience in the field of natural resources and environmental analysis in the US and other countries. He worked with USAID as a regional environmental advisor for 11 years in Latin America and the Caribbean and he is a specialist in biodiversity throughout the region. Extensive experience in USAID regulations.

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