ENVIRONMENTAL IMPACT ASSESSMENT
FOR THE PROJECT
CEMENTOS PROGRESO, FACTORY SAN JUAN

Cementos Progreso, S. A.

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2. EXECUTIVE SUMMARY OF THE EIA

The object of this EIA is to assess potential impacts on physical, biotical, and social and economic environment when building and operating a new cement facility with a capacity of 4,500 tons of clinker per day, equal to nearly 6,075 tons of cement, on a 24-hour basis (three shifts) per day, throughout the year, except for the days when stopped for facility maintenance. In addition, the study will describe precautionary, mitigation, and compensation measures of the previously identified and valued impacts. The assessment is required pursuant to Section 8, Environmental Protection and Improvement Act, Decree 68-86, and the Regulations for Environmental Evaluation, Control and Follow-Up, Governmental Act 23-2003.

The project "Cementos Progreso, San Juan Facility" is located at the property San José Ocaña, San Juan Sacatepéquez, city and department of Guatemala, and its coordinate measurements are UTM 748163 t 1631207 Latitude N 14º44'35" and Longitude O 90º41'54", and its object is the production of cement to be distributed in the domestic market.

Cementos Progreso Sociedad Anónima has leased a piece of land from Inversiones Dos Pinos S. A., for the cement project facility. The area to be used will have a surface of 64 hectares within the concession area covering approximately 2,000 hectares, and within the San José Ocaña property of 860.7 hectares.

In Guatemala, the annual growth rate for cement demand by the construction sector is 8%; in addition to the Central American market, therefore, the development of this project is justified. Cementos Progreso, S. A., the promoter, conducted technical evaluations in several sites and in different parts of the country to know the raw material potential, taking into consideration the location on the matter of demand for materials. The selected site has the required mineral quantity and quality, and also the site is closed with the area of more demand of products, the Metropolitan Area of Guatemala (MAG).

Cementos Progreso, S. A., will purchase raw material from Minerales Industriales de Centro América (MINCESA), per cubic meter ex-plant, and will process it in a crusher. The environmental impact assessment (EIA) of the exploitation of the quarry by MINCESA was filed August 16, 2006 to the Ministry of Environment and Natural Resources of Guatemala for approval. On January 26, 2007, under resolution 120-2007, the Ministry of Environment and Natural Resources of Guatemala approved such assessment.

The project development consists of four stages: Stage 1, pre-construction; Stage 2, construction; Stage 3, Operation; and Stage 4: Abandonment or Closedown. The first stage, pre-construction, consists of the studies conducted to select the best location of the cement facility within the property, always taking into account its proximity to the mineral source (quarry), that the facility will not be settled on a valuable raw material area (limestone or loams) and out of sight of the neighboring communities. The assessments conducted did not

cause any environmental impact, because the studies consisted on visits to the site and laboratory analysis.

The second stage of the project development will consist of the activities regarding the installation of the plant which will last approximately 24 months and will employ 1,800 people. The activities to be carried out will consist of: earthworks, excavation and building foundation and footings to assemble the equipment and structures, water, drainage power, moving the equipment to the facilities, and mechanical and electrical assembly, and vacuum testing in the facility.

The third stage is the plant operation, and will consist of a cement manufacturing process, including processing, storage, and transportation to customers, as well as the maintenance of the facilities. The duration of this stage will be at least 25 years.

The fourth stage is abandonment, and if that occurs, will consist of dismantling the cement facility, a possible office and shop demolition, and revegetation and/or reforestation of the area.

The area to be used by the cement facility will be 64 hectares, and the platforms with the edifications will be placed in 26 hectares, and its boundaries are lands of San José Ocaña, a forestry property, and the road from Cruz Blanca village to San Antonio Las Trojes. The area of influence of the plant is divided into two: direct (AID) and indirect (AII). The cement facility, offices, and shops will be installed in the direct area of influence.

An indirect area of influence is such area that includes the project's neighborhoods, particularly such neighborhood which may have a material positive and/or adverse effect as a result of the project activities. Therefore, AII includes the Cruz Blanca and San Antonio Las Trojes villages, as well as the remaining neighboring communities, because persons from these populated places will work during the construction and operation of the facility, and might be affected in their health and safety due to the environmental and transit impacts. The 12-kilometer, 4-lane highway to be built from the new cement facility to the CA-1 highway, will be used for the transportation of the product to the distribution and sales points. The construction of this highway will be subject to a specific EIA.

There is no planning in the city with regard to soil use, or any territorial ordering plan. The concession area (2,000 ha.), where the cement facility will use 64 ha., approximately 62% is covered with wood and forest plantations; 18% with bushes and brushes; 11% annual agriculture; 7% natural pasture; and the remaining 2% coffee, fruit trees, vegetables, and flower greenhouses. The occupation forms of the concession area may be summarized as follows:

- Rural communities, although some communities, due to their proximity with the capital municipal district of San Juan Sacatepéquez may be considered semi-urban communities;

- Means of communication consisting of rural roads and the main road connecting with San Juan Sacatepéquez. Limited means of transportation mainly used for the movement of persons and agricultural, forest, and commercial products;
- Domestic, small-scale livestock activity;
- Subsistence agriculture. This farming is continuous and affects the entire landscape. Occurs both in flat parts and in hills;
- Areas reforested with pine trees *Pinus pseuostrobus* in form of mono-specific forests, replacing the original vegetation of a Subtropical, very Humid, Low Mountain Forest; and,
- Gallery forests with an acceptable conservation degree, which contributes with high aesthetic value to the local landscape.

The relief of the concession area is a steep relief; 56% of the entire area has slopes larger than 20% (high soil erosion susceptibility). Mean annual rainfall is 52.57 inches (1,337.7 mm) in approximately 99 days in one year. Wind speed range is 2 - 5 kilometers/hour (1.25 – 3.13 miles/hour) and the wind direction during the dry season is to the North, and in the rainy season to the Southeast. The cement facility will be located in the micro-basin of the Pachum River, Pixcayá River inflow. The river flows during the dry season are low, and dry parts may also be seen. Waters are clear, with few suspension sediments, and practically without transportation of alluvial material, although bacteriological pollution is reported caused by the discharge of laundry wastes and solid and liquid wastes. Groundwater vulnerability is high due to rock permeability. Air quality is good, but sporadically affected by the dust generated by the transit of vehicles inside the property, and from Cruz Blanca to Las Trojes; all air quality parameters, including total suspended particles are reported below the WHO value guides. Audible levels are low due to the low vehicle transit; 85% of the time the range of sounds is between 31.3 and 42.7 decibels (Leq = 39.6 dB).

The concession area has representative vegetation samples typical of a Subtropical very humid, low mountain, forest. The property where the project will be developed is of forest use, with a Management Plan approved by the NFI (National Forest Institute). Wild fauna, although assorted, is not plentiful. The fauna species indicators within the property provide an acceptable conservation degree. The project is not located within a protected area, special protection area, or any other category that needs to be preserved in accordance with CONAP (National Council of Protected Areas). No archeological traces or historical values were found in the direct influence area of the project.

It is believed that significant environmental impacts will occur during the construction and operational stages of the cement facility. The activities of the pre-construction and abandonment stages will also create insignificant impacts compared to the two construction (which will last two years) and operational stages. With the construction and operational stages, the operational stage will be the stage of more relevance due in part that it will last at least 25 years.

The relevant activities to be carried out during the project development stages were analyzed, and in order to value its impacts in the various environmental factors were grouped by

relevance in the following activities: i) Earthworks and waste material disposal; ii) Construction, operation, and closing of the camp; iii) Construction of edifications and maintenance of facilities; iv) Operation of the cement facility; v) Abandonment of edifications, dismantling of the plant, recovery of affected areas (revegetation and reforestation) and employee benefits under the law.

Likewise, the main impacts to the physical, biotical, and social and economic environment producing the relevant activities described above were analyzed, which are: i) gas emissions; ii) dust generation; iii) noise generation; iv) transportation of fines through runoff and wastewater treated at the Sunuj ravine, and from this ravine to the Pachum River; v) solid waste production; vi) natural resources consumption (water, limestone); vii) biological diversity affectation; viii) landscape alteration; ix) effects on occupational health; x) job creation; xi) cement production; xii) waste disposal as alternative fuels.

Qualification of environmental impacts will be on the following environmental factors: i) air quality; ii) noise and vibration; iii) surface and ground water; iv) soil and subsoil; v) flora; vi) fauna; vii) cultural and historic resources; viii) landscaping; ix) industrial safety and occupational health; and, x) socioeconomics.

A summary of the environmental impact assessments is set forth below which may be created by the development of the project during the various stages of the project, and the result of the valuation. The main environmental impacts generated by the project, according to the valuation, are summarized as follows:

The relevant activity described as intense due to its degree of effect on the environment will be:

- The operation of the cement facility.

The environmental factors affected by these intense activities will be:

- Air quality (gas and dust emissions);
- Noise degrees;
- Surface and ground waters (fines and treated wastewater);
- Occupational health and safety (accidents); and,
- Jobs, services, and taxes.

The relevant activities described as moderately aggressive on the environment will be the following:

- Earthworks and waste disposal;
- Construction, operation, and closing of the camp; and,
- Construction and operation of edifications and facilities maintenance.

Finally, the activity described as minimum effect on the environment will be:

- Plant dismantlement, recovery of the affected areas (revegetation and reforestation) and payment of employee benefits.

As a final point, the matrix includes in the environmental impact assessments all relevant interactions, avoiding making a huge effort to compile and interpret information for non-existent or insignificant interactions, to such extent that the significant negative impacts on the environment will have to be a reason to take mitigation, prevention, control and/or compensation actions.

Upon analyzing the results of the significant negative or positive or non-existing impact assessments matrix, the following results have been obtained:

- 5% of environmental impacts will be positive and significant, with a mean affectation degree, as it will change some characteristics of the social and economic environment;
- 16% of environmental impacts will be positive and not significant;
- 8% of environmental impacts will be negative and significant, with a mean affectation degree, as it changes some characteristics of the physical and social and economic environment;
- 55% of environmental impacts will be negative and not significant, usually, local, temporary, direct, and reversible impacts; and ,
- 16% will be non-existent interactions.

Mitigation, control, prevention and/or compensation actions will be designed to the significant negative impacts to be executed during the various stages of the project development. Upon analyzing the negative impacts described above, it may be considered that most of them may be alleviated and compensated with the applicable actions suggested in the Project Environmental Management Plan.

The social impact of the construction and operation of the cement facility will be positive for the general economy of the country, for the Metropolitan Area of Guatemala (cement offer), for the municipal district of San Juan Sacatepéquez (community investment tax relief) and for the families of permanent employees and contractors (employment and services income).

The direct jobs to be created during the construction stage of the cement facility will be similar to that generated during the construction of the third line in San Miguel, Sanarate between 1996 and 1998. In 1996, when the third line was installed, approximately 1800 workers were employed during the 2-year construction period. Therefore, it is estimated that a similar amount of workers will be employed during the installation of the cement facility in San Juan Sacatepéquez. A large percentage of these workers are expected to be from the municipal district of San Juan Sacatepéquez, which will depend on the specialized labor offer for the required positions.

200 regular workers and 200 additional persons as contractors will be employed during the operational stage of the cement facility. It is estimated that nearly 60% of the regular workers and 50% of the contractors will be residents of the municipal district of San Juan

Sacatepéquez, based on the occurrence at the cement facility in San Miguel, Sanarate, operating since 1974.

The development of the new cement facility at the San José Ocaña property will change the municipal district of San Juan Sacatepéquez as never before. Changes will be positive (jobs and related services), as long as the community members share these benefits. Due to the current poverty conditions in certain community sectors and despite there will be employment opportunities and a related demand for services, which make them sensitive, because if they are not qualified for the jobs required, they will not be employed. The neighboring communities and Cementos Progreso must reach agreements to strengthen the benefits, by promoting job training for workers and their families to apply for different permanent or indirect jobs to be created by the facility, as well as for any other service.

With regard to the project acceptance, 45 out of 48 persons surveyed in the communities near the project are in agreement with the installation and operation of the cement facility, 1 person does not agree, and the remaining two persons did not give their opinion. Therefore, the project is fully accepted, despite the debate on the project as to whether be a gold and uranium mine. To this effect, the answers of some of the persons interviewed show their lack of information or little information on the industrial objectives of Cementos Progreso, as well as their reliability on the false rumors spread on the project. A greater convincing effort is especially needed in the San Antonio Las Trojes village, where the surveys were not conducted for lack of endorsement by the city authorities.

93.76% of the persons surveyed expressed their agreement with the project if natural resources are protected, if jobs are given to people in the communities, and cooperation is given for the development of the city. This question is one of the most relevant questions of the survey, because the large percentage of acceptance of the project is strong evidence that they support the project development.

The results of the surveys show that there is a high level of acceptance to the project development because it will bring benefits to the neighboring communities, specifically employment and demand of related services. Moreover, it is evidenced that unreliable information have been going round in the communities, because the plant in site will be a cement facility, promoted by Cementos Progreso (a corporation widely known across the country as a cement manufacturer), and by no means is it related to gold and uranium mining. The persons interviewed recommended to provide fluid and continuous information to carry out the project for the benefit of everyone.

Below is a summary of the Environmental Management Plan (EMP), which includes the specific actions to prevent, mitigate, and compensate the impacts on the various environmental factors during the construction and operational stages of the San Juan facility. The cement kiln to be installed in the San Juan Sacatepéquez site will have a preheating tower and calciner (PHP), acknowledged as the best technology available (BAT). The measures will meet the legal domestic requirements and the IFC guidelines for cement facility (IFC 2006). The cost of the EMP mitigation actions will be US$ 11.2 million dollars.

Mitigation Actions of Impacts on the Atmosphere:
Air emissions in manufacturing cement will be generated by the management and storage of raw materials and products, and by the operation of kilns, clinker coolers, and cement mills. In San Juan, as mentioned before, the best technology available in cement facility will be used, being the pre-heater and pre-calcinator (PHP), which will guarantee that the air emissions will be small and controlled.

Dust:

Construction Stage

Dust emissions during the construction stage will be mainly generated by earthworks and truck trafficking in dirt roads. The actions to be performed by the contractors, which will become part of their agreements, will be:

- Hosing down the working areas (platforms) and dirt roads, by water sprinkling;
- Restricting the truck speed in dirt roads, to control dust and also prevent accidents; and
- Covering with plastic or any other material any construction materials that may create dust.

Operational Stage

Dust emissions will be generated by the handling and storage of raw materials and products, including crushing and sifting raw materials, solid fuel handling and storage (coke) and transportation of materials in trucks or belt conveyors, and packing. The measures to be implemented during the plant operation will be:

- Use of a lineal system in handling raw materials and products, to minimize the transfer points, as the sites from which dust is raised;
- Covering the belt conveyors of raw materials and products, and installing emission controls at the transfer points;
- Routinely cleaning the return of the belt conveyors;
- Storing the crushed and pre-mixed raw material in covered places;
- Storing coke in tanks and/or covered yards;
- Storing the solid wastes used as alternative fuels that may raise dust, in wind-protected locations;
- Storing clinker in tanks with automatic extraction outlets;

- Storing cement in tanks, with automatic extraction outlets and bulk loading;

- Routinely maintaining the plant components and applying good cleaning practices to minimize air outlets and spills. The Maintenance Division of the Facility will have a Predictive Maintenance Unit, just like the unit currently available in San Miguel. Furthermore, it will have a Maintenance Administration Center (MAC) that will establish inspection routines and the creation of corrective and preventive working orders, among others;

- Transporting and handling raw materials and products in enclosed systems maintained under negative pressure, by removing the dust with sleeve filters;

- Using a mobile suction unit to keep dust from paved areas;

- An automatic bag-filling and handling system will be available;

- Catching dust from the kiln and cooler with filters, and recycling it to the raw materials storage silo, or directly to the clinker kiln feeder, respectively;

- Using sleeve filters to collect and control fine particles emissions from the coke-oven gases;

- Using sleeve filters to catch thick particles from the cooling gases;

- Catching the mill dust in sleeve filters and recycling it to the same mill; and,

- Water sprinkling access road and the roads within the facility, and all dirt roads, restricting the speed limit in the access road to the dirt roads within the facility, to control dust and prevent accidents.

Nitrogen Monoxides

Construction Stage

Nitrogen monoxides emissions during this stage will be generated by the internal-combustion engines of the construction machines and equipment. The actions to be implemented by the contractors will be:

- Give appropriate and timely maintenance to the machines and construction equipment.

Operational stage

Nitrogen monoxide emissions (NOx) are associated with high temperature in the combustion processes in the cement kiln operation. The technologies for control and prevention, in addition to an appropriate kiln operation will be the following:

- Maintain the secondary air flow as low as possible (reduction of oxygen);
- Use low NOx burners to avoid critical emissions. There are other technologies available such as catalytic, non-selective reduction, that might be used at the San Juan Cement Facility; and
- Develop a combustion process in stages.

Sulphur Dioxide

Construction Stage

Sulphur dioxide emissions during this stage will be generated by the internal-combustion engines of the machines and construction equipment. The action to be implemented will be:

- To give appropriate and timely maintenance to the machines and construction equipment.

Operational Stage

Sulphur dioxide emissions in cement manufacturing are mainly associated with the contents of volatile or reactive sulphur in raw materials and with fuels quality. The control and prevention technologies, in addition to an appropriate kiln operation will be:

- The hot gases from the pre-heater will be used in the mixing mill to dry the raw materials forming the raw mix, thus, recovering the calorific energy and reducing the sulphur dioxide contents in the gases. This is obtained due to the CO_2 ability to react with the calcium present in the limestone to form gypsum (calcium sulphate $CASO_4$);
- Select a fuel with less sulphur contents. Although coke has comparatively high sulphur contents (approximately 6%), no significant emissions will occur due to the contact at the pre-heating tower; and
- Select materials from the quarry with low-volatile sulphur contents, which may be found in the pyrite. Pyrite was found in one of the loam deposits at the San Juan quarry, therefore, it will be handled through its selective exploitation in the cement manufacturing process.

Greenhouse Effect

Operational Stage

Greenhouse effect gas emissions, particularly with carbon dioxide (CO_2 are mainly associated with the combustion processes and with the limestone decarbonization. Carbon monoxide contributes with a small portion of the greenhouse effect gases (< 1%), and due to a low-combustion efficiency. Evidently this is an undesirable situation for the process because it increases the costs for a low energy use. The control and prevention technologies, in addition to an appropriate kiln operation will be:

- Producing mixed cements that reduce fuel consumption, and consequently, the CO_2 emissions for every ton of product;

- Selecting and operating the manufacturing process in order to promote energetic efficiency (dry/pre-heater/calcinator); and,

- Selecting a fuel with a low proportion of carbon and calorific value contents. Coke will be used, but also wood from the energetic forests and industrial wastes, as alternative fuels. The alternative fuels are expected to represent up to 15% of the total consumption.

Heavy Metals

Operational Stage

Heavy metals, particularly lead, cadmium and mercury, may become significant emissions in cement manufacturing, and are taken to the kiln through raw materials and fossil and alternative fuels. To limit heavy metal emissions, the following are the actions to be implemented:

- Efficient actions for the reduction of dust, as mentioned before, which will also catch any suspended metals;

- A continuous control of the heavy metals contents in raw materials and in fuels, limiting the entrance of volatile metals. There will be a laboratory to conduct this type of analysis;

- No wastes with high-organic content as alternative raw material (AFR) will be used, which will conform with the alternative fuels (AFR) use Holcim's policy; and,

- No alternative fuels will be use during the start-up and stop-off operations. Bunker will be used in these operations.

Other Atmospheric Contaminants

Operational Stage

Cement kilns have a heavy alkaline environment, high-resistance times, and high-flame temperatures, and for that reason, kilns are used to burn wastes. These characteristics allow the kilns to destroy several types of hazardous materials, including solvents, hydrocarbon wastes, used tires, plastic wastes, organic chemical wastes such as PCBs, organic chlorided pesticides and other chlorided materials. The use of these wastes as fuel may result in volatile organic compound emissions (VOCs), dioxins (PCDDs), furans (PCDFs), hydrogen fluoride (HF), hydrogen chloride (HCl) and toxic metals, if not properly operated and controlled. The prevention measures and the control technology for these pollutants will be the following:

- Non-volatile heavy metal emissions will drop when implementing dust reduction measures;
- Injecting fuels with volatile metals or with a high concentration of volatile organic compounds (VOC), directly inside the main burner instead of the secondary burners;
- Avoid use of fuels with high halogen contents in the secondary burner (auxiliary burner); and,
- Maintain the minimum cooling time of the kiln gas (500 - 200 ^{o}C), to avoid or minimize dioxin regeneration and destroyed furans (PCDDs and PCDFs), designated as persistent organic pollutants (POPs).

Mitigation Measures of the Impacts on Surface and Ground Water:

Construction Stage

Runoff may carry solids, the management of both liquid and solid waste created in the camp, accidental hydrocarbon spills will be potential sources for the affectation of surface and ground water. Besides, groundwater will be required for the construction and for the camp. The actions to be implemented during this stage will be:

- Sustained groundwater exploitation. Water extraction from the wells will be measured out based on pumping and recovery tests.
- Using wetland or extended aeration to treat wastewater in the camp. Portable latrines will be available in the work fronts far away from the camp bathroom facilities;
- Channeling runoff from the working areas to certain selected points to be collected by sedimentation pits (settling tank of fine particles) and/or filtering screens, to hold most of the fines, before discharging such particles to the inflow ravines (Sunuj) to the

Pachum River. Furthermore, the tanks and/or screens will be cleaned after every substantial rain;

- Covering fine aggregates in such a manner that in the event of a substantial rain, that will prevent the dragging of fines towards the inflow ravines of the Pachum River;

- Having oil pits available to change oil from the machines and collect it in containers for further storage, while being recycled. Specific oil drums will be available for recycling;

- Preventing fuel and lubricant spills in the shop areas or in the work fronts. Will immediately clean any accidental spills. Any collected hydrocarbon wastes will be deposited in drums, for subsequent recycling or will be sent to the San Miguel Cement Facility to be used as fuel;

- Classifying solid waste generated at the camp and work fronts and will have paper, plastic, glass, filters, tires, batteries, and junk recycling containers available, and will properly dispose of (bury) the organic wastes in a site. The remaining wastes will be recycled or co-processed at the San Miguel cement facility; and,

- Properly and timely maintaining the wastewater treatment plant.

Operational Stage

Water is used to cool several pieces of equipment in different stages of the cement manufacturing process, although it remains unpolluted, even if the temperature rises. The cement facility operation will require groundwater. Runoff water may drag any solids found in the coke and alternative fuels storage areas, as well as fine dust in the waterproof areas, and might be contaminated; dust prevention measures in the raw materials, clinker, coke and alternative fuels storage areas mentioned above will minimize the pollution of the runoff water. Liquid and solid wastes are mainly generated by administrative activities. The measures to be implemented in this stage will be:

- Using again the process water by passing it through cooling towers;

- Extracting groundwater on a sustainable basis avoiding affecting the neighboring communities' wells. Well water extraction will be measured out based on the pumping and recovery tests.

- Using wetland system to treat wastewater with its treated effluent fulfilling the current set of rules (236-2006) for new generating entities;

- Channeling the land runoff of the cement facility (26 hectares will waterproofed and the remaining 38 will not be waterproofed) to selected points with sedimentation pits and/or filtering screens, in order to hold most fines, prior to discharge to the inflow

ravines (Sunuj) into the Pachum River. Besides, the sedimentation pits and/or filtering screens will be cleaned after every substantial rain;

- Building energy dispersers in key points for the rainfall water discharge towards the ravines (Sunuj);

- Covering any raw material or product temporarily stored in the open to avoid the dragging of fines to the inflow ravines of the Pachum River, in the event of substantial rain;

- Having oil pits available to change oil from the machines and collect it in containers for further storage, before being used as fuel in the cement facility kiln. Specific oil drums will be available for internal collection of lubricant wastes;

- Preventing fuel and lubricant spills in the shop area or in any other place in the facility. Immediately cleaning any accidental spills. Any collected hydrocarbon wastes will be deposited in drums to be subsequently used as fuel in the cement kiln;

- Classifying solid waste produced at the plant and will have paper, plastic, glass, filters, tires, batteries, and junk recycling containers available and will properly dispose of (bury) any organic wastes in a site inside a piece of land of the facility. Any other wastes will be recycled or co-processed in the kiln. All solid waste production will be disposed of or treated at the facility; and,

- Appropriate and timely maintenance to the wastewater treatment plant.

Mitigation Measures of the Impacts on Soil and Subsoil:

Construction Stage

The soil cut to build the platforms and the weatherproof of the platforms will have a permanent effect on it. Waste material disposal from the earthworks will affect the soil on which such waste material will be disposed of. The measures to be implemented during the construction stage will be:

- Minimizing earthworks during the platform construction stage;

- Piling and protecting the organic soil from the land leveling, and platform conformation to avoid it from being conveyed by runoff, and to be subsequently reutilized in revegetation and reforestation. If the soil is not to be used within a short period of time, it must be piled up in at a low height to avoid compactation, and will be revegetated to prevent it from losing its chemical properties, i.e. with legume plants which are noteworthy for their ability to fix atmospheric nitrogen into the soil.

Operational Stage

Solid waste produced during the Operational stage will be handled as follows:

- Recirculation of all processed solid waste (remainders of limestone, shale, clinker, raw flour, or cement), or will be used as filling material in quarry rehabilitation, according to physical or chemical characteristics; and,
- Classifying and disposing of solid waste (garbage), to be recycled, composted, or co-processed in the premises. By doing this, there is no waste accumulation or outlets to dumps or garbage collectors outside the property.

Mitigation Measures of Impacts on Flora and Fauna:

Construction Stage

Vegetation cutting, noise, dust, and truck traffic produce adverse effects on flora and fauna of the site, and on the neighboring area. The measures to be implemented during the construction stage will be:

- Minimizing vegetation cutting, and, as far as possible, keeping tree stems above 10 cm. (3.94 inches) wide, mainly within the boundaries of the cement facility and in areas outside the platforms;

- Fencing the cement facility perimeter with trees to compensate vegetation cutting and landscaping;

- Banning hunting of wild fauna, and purchasing animals in captivity;

- Regulating the speed limit for trucks reducing noise levels and the possibilities of knocking down animals, and preventing accidents;

- Posting speed limit signs which should be seen at night;

- Limiting truck and vehicles circulation during night-time hours to prevent accidents and avoid scaring fauna away;

- Filling all holes, ditches, pits, and any other excavation or depression not being used, to prevent being used as a fauna trap;

- Avoiding unnecessary noises caused by horns, running engines, whistles, and so on, to prevent fauna from being affected; and,

- Minimizing light intensity used at night to prevent fauna from being affected. The lights will be directed to specific worksites, thus avoiding lighting on nocturnal fauna habitat, and turning off the lights when not needed.

Operational Stage

As a priority conservation measure, gallery forests will be maintained in the ravines and beds of the Pachum River, as the highest fauna diversity may be found in this river. All vegetation patches still available will be preserved, and all highly disrupted areas in the gallery forests will be recovered. Below please find other measures:

- Creation of shock absorbing areas to be used as filter and "sponge" to absorb the adverse effects of the cement facility operations, protecting the areas near the water sources and the ecosystem around the bed of the Pachum River and its tributaries. These shock absorbing areas must cover a larger area in the parts nearest to the cement facility, recommending a 500 – 800-meter thick area;

- Maintain reforested areas near the banks of the Pachum River, to work also as shock absorbing areas, which must be grown without any forest management plan, as well as the pine tree forest area of the Sunuj ravine;

- Continuing forest management as usual in the rest of the area of the property;

- Determining and regulating natural resources extraction (firewood, wood, pine tree needles, trees, bromeliads, hunting animals, among others), to mitigate the adverse effects thereon, and will guarantee such services to the communities, but will not use such services up;

- An integral handling of the basin, especially because most of it is inside the San José Ocaña property, promoting connectivity of the various patches in the surrounding area, by a joint effort of the neighboring communities and properties within the same basin. This way, the price of natural services will increase, and will be guaranteed as sustainable in the short, medium, and long term.

Prevention Measures of Impacts on Landscaping and Cultural and Historic Resources:

Pre-Construction Stage

- Selecting the location of the cement facility where the visual topography allows the nearest communities (Sector I and II of San Antonio Las Trojes) to move as further away as possible, and not to be seen from the San Antonio Las Trojes village and Cruz Blanca and from the remaining neighboring communities.

Construction Stage

- Remodeling the altered topography in such a way as to adjust it as much as possible to the natural topography;

- Using waste materials from the earthworks to fill depressions where needed, giving added value to the land, and rectifying the altered topography;

- Planting trees and bushes in the perimeter of the site of the cement facility to be used as visual screens in the facilities; and

- Stopping any works if some archeological trace is found in the site, and contacting IDAEH.

Preventive Measures on Occupational Health and Safety:

Construction Stage

Contractors will have occupational health and safety programs to be disclosed by placing such programs in conspicuous places at the work fronts which will be stringently followed. For the achievement of these programs, occupational health and safety seminars will be conducted for all employees. Other measures are set forth below:

- ✓ Posting appropriate signs to prevent accidents, truck entrance and exit, among other points;

- ✓ Putting up hazardous materials and industrial signs;

- ✓ Periodic maintenance to the equipment and machinery, for safety;

- ✓ No smoking during working hours. Define smoking areas during breaks;

- ✓ Provide materials and equipment loading and unloading areas;

- ✓ Keep fire extinguisher devices in a conspicuous place;

- ✓ Industrial protective gear must be worn to carry out every particular activity; and,

- ✓ Give instructions and training to vehicle drivers.

Operational Stage

Cementos Progreso S.A has implemented occupational health and safety policies for both San Miguel and La Pedrera cement facilities, and these policies will also be revealed at the new San Juan cement facility, and place in conspicuous places, and must be duly followed. In addition, it will develop and implement an Industrial Safety Program for cement manufacturing activities, according to the corporate safety policies and good engineering practices.

Below please find some specific measures to mitigate dust, heat, noise, physical impacts, radiation, and during the operation of the plant, in order to reduce such effects on the employees.

Dust

- ✓ Use of closed, air-conditioned cabins;
- ✓ Use dust extraction and recycling systems to remove dust from the working areas, particularly in the mills;
- ✓ Ventilation (suction) in the parking areas; and,
- ✓ Use of proper personal protection gear (EPP).

Heat

- ✓ Use protective surfaces where workers proximity or close contact with high-temperature equipment is expected. Use appropriate personal protection gear, including gloves and shoes for isolation;
- ✓ Minimize the working time required in high-temperature environments, implementing short-term shifts in these places; and,
- ✓ Keep available and in use, as required, air or oxygen respirators.

Noise

- ✓ Use fan silencers and/or these fan silencers will be confined in such a way that noise will not affect the environment;
- ✓ Closed rooms will be available for mill operators and generally for machine operators;
- ✓ Noise barriers will be available; and,
- ✓ Personal protection gear will be available.

Physical Impacts

- ✓ An occupational health and safety system will be available providing precautionary measures for physical impacts, which will be implemented by the Department of Occupational Health and Safety. This program will include training, monitoring and performance analysis.

Radiation

- ✓ Provide appropriate and timely maintenance to the gamma-ray and laser-ray analyzer, by the supplier's specialized staff. Workers will be isolated and not exposed to radiation from these pieces of equipment.

Other Industrial Health Aspects

- ✓ Preventive medical services available. Furthermore, in the event of accidents, including dermatitis caused by contact with cement or with some chemical agent. The company will require the use of personal protection gear, depending on the associated risk.

Measures to Prevent Impacts on Social Environment:

The persons interviewed suggested measures to create a good relationship among the communities, the authorities, and the company, to be implemented by the company, as follows:

- ✧ There will be dialogue with the community and the community leaders:
  - o COCODES and COMODE;

- ✧ Supporting community development:
  - o Social works; and,
  - o Support to local authorities in maintaining the neighboring roads;

- ✧ Employing persons from the neighboring communities:
  - o Salaries will be competitive, according to the specialization required for each position;

- ✧ Environmental protection:
  - o Dust control;
  - o Minding the water; and,
  - o Controlling heavy traffic;

- ✧ Informing the community of any problem and controls;
  - o Establishment of a "Community" Communication Office
  - o Developing political and social information, disclosure, and incidence of the project for the neighboring communities; and,
  - o Will have a telephone number and a complaint book available

The characteristics and magnitude of the project deserves that the organization to be organized implement appropriate and prompt mitigation measures divided into three: i) For strictly environmental measures; ii) For such measures associated with occupational health and safety aspects, and iii) For any aspects related to occupational health and safety of the neighboring communities. Cementos Progreso, S. A. will be responsible for the execution of the mitigation measures within the Environmental Management Plan. Besides, as Cementos Progreso is a Holcom partner, the Swiss Group, it must also meet its requirements, which are based on the IFC 2006 requirements.

Environmental Aspects:

During the cement facility construction, which will take two years, Cementos Progreso, will retain several specialized companies. During that stage, Cementos Progreso will appoint a full-time Environmental Supervisor supported by other professional for an appropriate follow-up and control of the EMP by the contractors, and will report directly to the Project Manager, who is the person in charge of the construction designated by Cementos Progreso.

During the operational stage of the cement facility, which will last at least 25 years, Cementos Progreso will strengthen its current Safety, Occupational Health, and Environment Division, to expand the operations to the new cement facility in San Juan, in addition to San Miguel and La Pedrera (LP). The duties and responsibilities of the Operations Manager, the Environmental Coordinator, the Plant Manager, and the Environmental Officer will be fully defined.

Occupational Health and Safety Aspects:

The Occupational Health and Safety aspects will have a system similar to the system available at the Cementos Progreso organization for its operations at the San Miguel and La Pedrera cement facilities. The risky areas and activities in the facility, based on the number of hazards and its magnitude will be as follows: outside and in the cabin (inside). Moreover, occupational risks more commonly present in the Organization will be caused by: dust exposure; noise exposure, flammable substances exposure; and exposure to biological hazards in bathroom facilities.

The cement facility owned by the Cementos Progreso Organization, as mentioned before, is a partner to Holcim, a Swiss group, which has clearly established its policies and guidelines on Occupational Health and Safety. Holcim has designed its own occupational risk program called “OH&S Management System”, which is to be implemented in all cement facility which is part of the group; therefore, such program will be implemented in the cement facility to be installed at the San José Ocaña property. The Holcim Management System is very similar to the OHSAS 18001:1999 International Standard Requirements.

The Holcim OH&S System is based on a pyramid of ascending elements to be met, and certified with independent audits. The pyramid is known as the “OH&S Holcim Pyramid” and each activity in such pyramid is known as “block”. Each block is a requirement supported by procedures and formats locally developed, with clearly established responsibilities.

It is important to mention that the Holcim Management System also covers contractors, whose performance in Occupational Health and Safety issues will also be monitored. All responsibilities will be previously established in the agreements, including pecuniary penalties in the event of nonperformance. Contractors shall be delivered a 2-hour induction course on occupational hazards and working regulations.

The Cementos Progreso Organization as such has characterized itself for implementing within its management the principles of Corporate Social Responsibility (CSR), as evidenced by the fringe benefits to the employees in addition to the benefits established by the local laws, such as medical and dental services provided to the employee and his/her family, i.e., spouse and

children under 18, health insurance (no dental or maternity or pregnancy coverage) and life insurance covering any type of death of an employee. In addition, employees are prescribed medicines for free, including not only top-quality drugs, but also specialized antibiotics. All these benefits will also be provided to the future employees of the cement facility.

Cementos Progreso has defined a policy within the OH&S Management System listed in the OHS-CP-GG-PO-01 Rev. 0. Such policy is transcribed below:

Health and Safety Policy

We are committed with the Health and Safety of:
-Any persons performing any job in our company.
-Any persons we have contact with such as visitors, suppliers, customers…

Therefore:
-We provide safe and healthy working areas
-We implement occupational safe and health regulations.
-We offer any persons performing an employment activity in our company the necessary resources and training to implement occupational safe and health regulations.
-We promote occupational safe and health practices for any persons in contact with our company such as visitors, suppliers, customers…
-We measure and assess the performance results of our occupational health and safety.

This policy was defined by the Management of the Organization and is revised on a monthly basis, as part of the Management revision of the OH&S system by the top corporate officers. This policy will be made known to all employees of the cement facility.

Community Health and Safety Aspects:

The Community Communication Office will be responsible for anticipating and informing on any health and safety issue caused by the operation of the cement facility to any members of the neighboring communities. The Office shall consist of professional and technicians experts in the social and communication area. The Office will develop a political and social incidence, information, and disclosure of the project to the neighboring communities. It will have a phone number available as well as a complaint book. Besides, as Cementos Progreso is a partner of Holcim, a Swiss group, Cementos Progreso must also meet these requirements, as well as the Corporate Social Responsibility principles.

A monitoring program is suggested to properly address the environmental consequences created by the construction and operation of the cement facility, in order to check that the actions required for its prevention, mitigation, and/or correction are working properly as expected. Monitoring will consist of a regular check of the mitigation and/or correction actions, aimed to watch the appropriate operation of the project and its environmental compatibility with the surroundings. In addition to the legal requirements of the country, the guide values of the International Financial Corporation (IFC 2006) for cement manufacturing

will be used to monitor air emissions, liquid wastes, energy and resources consumption, emissions and wastes generation, and heat production consumption and capacity, at the new cement facility in San Juan.

During the construction of the cement facility, the Project Manager together with the Environmental Supervisor will be responsible for monitoring the project, with the cooperation of external professionals and laboratories contracted to conduct some of the projected actions. During the operation of the cement facility, the Environmental Officer of the Cement Facility, will be responsible, together with the Manager of the Cement Facility, for monitoring the effectiveness of the actions indicated in the EMP, and for such purpose, the Manager of the Cement Facility will also have the technical assistance of professionals and laboratories in the country.

From the point of view of natural and anthropic threats, earthquakes will be the main risk faced by the project, however, there are also possibilities of fire, both created by the project and by external surroundings, taking into consideration that this is a forest property; as well as spills from waste of hydrocarbon and other chemical substances. The purpose of a contingence plan in an emergency is to establish the appropriate procedures to control such occurrences.

Emergencies have been classified in such a way that different status will be taken within the facilities upon the occurrence of events that are noteworthy such as: Natural phenomena (earth tremor or earthquake, hurricanes), fire, and large proportion of accidents, hazardous materials spills (processing materials or fuels). All these events are classified as emergencies, as would put human life and the facilities in danger, and would have a material adverse effect on the environment. Emergencies are defined by three keys. The organization to be structured to face an emergency will be through a Directing Group, a Director, a Coordinator, the Support Group, and the Brigade.

Cementos Progreso, S. A., the Project Developer, is a corporation experienced in cement manufacturing, because it has manufactured cement at La Pedrera zone 6 property at the City of Guatemala for 107 years; and during 34 years at the San Miguel, Sanarate facility. The company is aware that it must abide by the laws of the country, and must take good care of the natural resources and the environment, because soil resource is the raw material of its business. As mentioned before, the compliance of the current regulations in the country on environmental protection, natural resources, cultural heritage, and workers' health will be part of the environmental policy of the project.

Cementos Progreso, S. A., has oriented its general policies and environmental Management policies, understanding the development in terms of improving quality of life of the persons which whom it interacts. Below is described the environmental policy on which Cementos Progreso will aim the Project activities.

ENVIRONMENTAL POLICY OF CEMENTOS PROGRESO, S.A.

We are committed to a continuous improvement of our environmental performance.

Our support is:

- **An Environmental Management System.**
- **Training and Awareness of our Staff.**
- **Efficient and rational use of our supplies, and, wherever possible, the replacement of non-renewable natural resources for alternative materials.**
- **Environmental impact prevention of our activities.**
- **Compliance with the Law and with Environmental Requirements.**
- **Good relationship with the interested parties**

Therefore, Cementos Progreso, S. A., will aim its operations, practically and operationally, to preserve the health and safety of its employees, contractors, and any persons present in the operations area of the cement facility, and will take good care of the environment through good engineering practices, good behavior of its employees, and the environmental recommendations given through environmental management tools, such as this EIA.

Last, but not least, Cementos Progreso is expected to have a corporate social responsibility plan aimed at the neighboring communities. The company, through the Information Office to be installed at the cement facility, will endeavor to maintain good relationships with the neighboring communities.

3. INTRODUCTION

The project consists of building and operating a new cement facility to produce 4,500-ton clinker per day, equal to approximately 6,075 tons of cement, in 24 hours (three shift), throughout the year, except when the facility stops operations for maintenance. The cement manufacturing project will contribute to the development of the municipal district of San Juan Sacatepéquez and its influence zone, including the areas nearby the capital city, by satisfying a cement demand, and offering job opportunities.

The object of the EIA is to asses any potential impacts on the physical, biotical, and social and economic environment of the construction and operation of a new cement facility, and describes the prevention, mitigation, and compensation measures of the previously identified and valued impacts. The assessment is a requirement of Section 8, Environmental Protection and Improvement Act, Decree 68-86, and of the Regulations for Environmental Evaluation Control, and Follow-up, Governmental Act 23-2003.

Taking as reference the accepted conventional methodologies to give a quality-quantity valuation to the impacts identified according to the attribution of degrees of importance, the Vecente Conesa methodology has been used. The methodology for the valuation of environmental impacts created by the activities of the various stages of the project is made to estimate the magnitude of such impacts and determine any corrective actions to be incorporated to it. First of all, an analysis of the project is made not taking into account the mitigation actions incorporated in the different stages to assess the adequacy of such actions, and if it is necessary to introduce new corrective actions. Environmental monitoring will allow verifying the workability and effectiveness of the mitigation measures suggested in the respective chapter.

The assessment was developed by Asesoría Basterrechea Asociados, S. A., in 20 weeks, with the technical support of licensed experts employed by Cementos Progreso, S. A., Project Developer. To develop the EIA, the terms of reference provided by the Ministry of Environment and Natural Resources were taken as guidance.

The “Cementos Progreso, San Juan Cement Facility” project, is at the San José Ocaña property, Cruz Blanca village, municipal district of San Juan Sacatepéquez, Department of Guatemala. The cement facility site will have a 64-hectare area within the concession area which is approximately 2,000 hectares, and within the San José Ocaña property (860.7 hectares).

The annual growth rate for the cement and construction materials demand in the country is 8%, which is a good reason for the development of projects with this purpose. Cementos Progreso, S. A., conducted technical assessments in several locations in different parts of the country to consider the potential of raw material, also taking into account the location in connection with the demand for construction materials. The selected piece of land has the

required mineral quantity and quality, and is relatively nearby the area with the larger demand of construction materials (cement), such as the Metropolitan Area of Guatemala (AMG).

4. GENERAL INFORMATION

4.1 Legal Documentation

- ✓ A notarized photocopy of the taxpayer's identity number certificate, TIN, of the Project Developer
- ✓ A notarized photocopy of a Land Registry certification of the site where the project will be built
- ✓ A notarized photocopy of the appointment to office of the legal representative
- ✓ A notarized photocopy of the identity card of the legal representative
- ✓ A notarized photocopy of the Business Licenses (company and corporation, as applicable)
- ✓ Full original clipping of the press advertisement or a photocopy of the invoice

Notarized documents are attached in Appendix 1.

4.2 Information on the Professional Team Developing the EIA

The assessment was developed by Asesoría Manuel Basterrechea Asociados, S. A., Environmental License No. 05 issued by the Ministry of Environment and Natural Resources of Guatemala, and Code 305 of the current Registry of the National Pre-Investment Funding System (SINAFIP in Spanish). All licensed experts and technicians participating in the EIA are: Manuel Basterrechea Díaz, Civil and Environmental Engineer, PhD, License No. 1,264, and Environmental License 059 issued by the Ministry of Environment and Natural Resources; Jorge Eduardo Romero Gramajo, Geologist, License 3,599, and Environmental License 012 issued by the Ministry of Environment and Natural Resources; Carlos Enrique Quezada Jerez, Sociologist, License No. 1330, and Environmental License 063 issued by the Ministry of Environment and Natural Resources; Liza Ixcot, Sergio Pérez (mammalian fauna), Hugo Enríquez (mammalian fauna), Manuel Acevedo (herpetofauna and avifauna), Enio Cano (enthomofauna), Geologists; and, Carmen Elizabeth Ramos Hernández, Archeologist, license No. 5,314. Notarized documentation is included in Appendix 2.

In addition, Medicines Ambient ales S. A., was hired to monitor air quality and noise quality in the property and in one yard of one of the houses in San Antonio Las Trojes; Onsite Laboratories Mexico carried out the monitoring and analysis of the chimney gases from the cement facility in San Miguel, Sanarate; COFEPRO was the company which performed the hydrogeological assessment in the area of influence of the San Juan Cement Facility.

5. PROJECT DESCRIPTION

5.1 General Summary of the Project

The project is the installation of a cement manufacturing plant to sell cement in the domestic and Central American markets. The activities to be carried out at the facility during the cement manufacturing process (4,500 tons clinker/day) will be the following: i) crushing; ii) pre-.mix and storage; iii) raw flour grinding and mixing; iv) pyroprocessing; v) cement grinding; and vi) cement packing and storage. Besides, the solid fuels (coke) grinding will be necessary to generate power for the clinker manufacturing process. Cement will be conveyed in trucks to the customers by the new road to be built, and for which the pertinent EIA will be conducted.

Cementos Progreso, S. A., the promoter, has extensive experience in the manufacturing of cement. It was established 107 years ago in La Pradera property, in zone 6, and 33 years ago in the San Miguel property, Sanarate. November 13, 2006, Cementos Progreso submitted the EIA for processing aggregates at the San José Ocaña property, a site where materials will be crushed to be sold in the domestic market, and to be used also as raw material for the production of cement. The EIA was approved by the Guatemalan Ministry of Environment and Natural Resources on February 6, 2007, under Resolution No. 259-2007; a copy of such resolution is enclosed in Appendix 3.

The company extracting the material to be supplied to the cement facility will be Minerales Industriales de Centro América, Sociedad Anónima (Mincesa), who was awarded a 2,000-hectare concession for an open-cast quarry mining exploitation at the San José Ocaña property, municipal district of San Juan Sacatepéquez; this company presented the EIA to the Guatemalan Ministry of Environment and Natural Resources on August 16, 2006, for rock extraction, which was also approved January 26, 2007, under resolution No. 185-2007; a copy of the resolution is included in Appendix 3.

Cementos Progreso leased from the owner of the land, Inversiones Alto Pino, S. A., 64 hectares of land to install the cement facility.

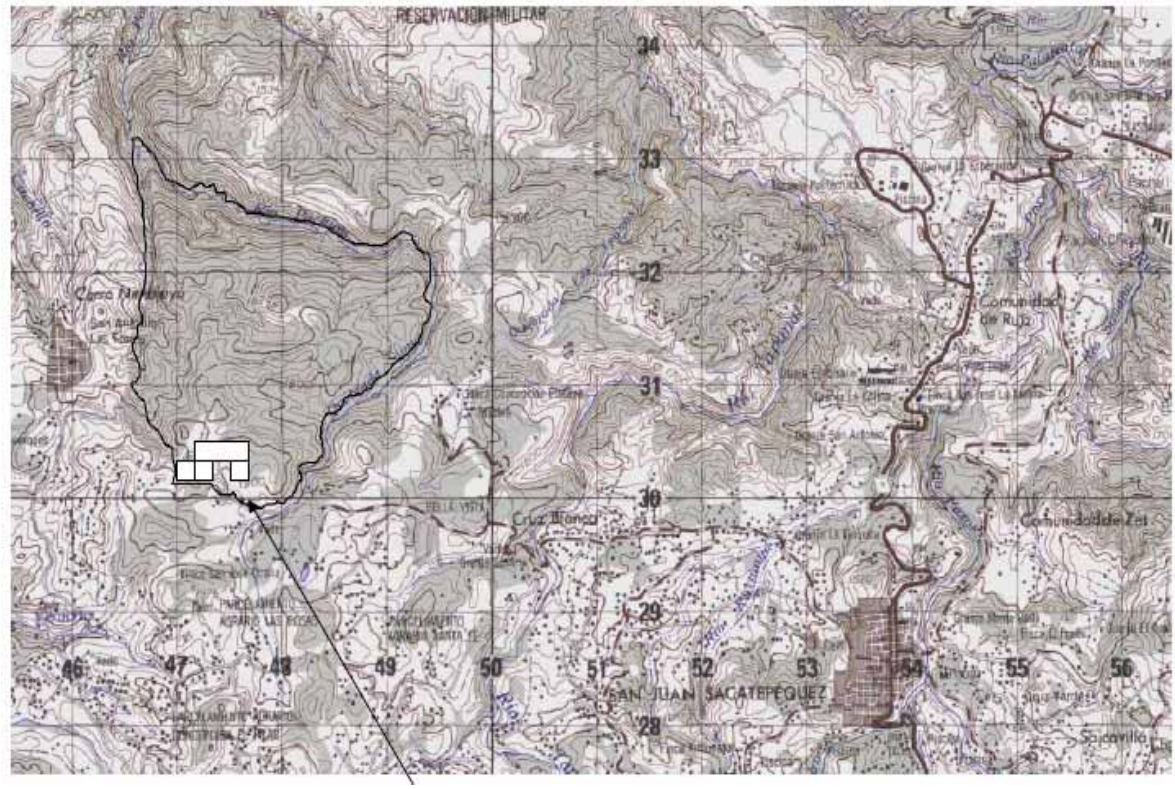
5.2 Geographical Location and Area of Influence of the Project

El Project area is located in the San José Ocaña property, Municipal district of San Juan Sacatepéquez, Department of Guatemala. Map 5.1 illustrates the area of installation of the cement facility (64 ha.) within an area covering the concession of Minerales Industriales de Centro América, S. A. (2,000 ha.), also indicating the neighboring communities and the access roads. The boundaries of the cement facility will be the forest areas of the San José Ocaña property, and the dirt road from Cruz Blanca to San Antonio Las Trojes.

The influence area of the Project is divided into two: direct (AID) and indirect (AII). The direct influence area will be the site of the cement facility. Drawing 142 II-99/AO 11-02AA in Appendix 4 of the drawings shows the cement facility location within the property, and its UTM coordinates are: 747,148 (X) and 1,630,276 (Y). Map 5.1 shows the location of the cement facility, and drawing 5.1 shows the general arrangement of the cement facility.

The indirect influence area is including the Project neighborhood, particularly such neighborhoods which may have a material positive and adverse effect by the activities of the Project. The area includes the Cruz Blanca and San Antonio Las Trojes Villages; Figure 5.1 shows the Las Trojes community seen from the San José Ocaña property.

Figure 5.1 View of the indirect influence area of the Project, including areas with con annual crops, dirt roads, and the San Antonio Las Trojes community.



Map 5.1. suggested for the San Juan Cement Facility of Cementos Progreso. S.A (please refer to the Spanish version of the EIA).

5.3 Political-Administrative Location

The site of the Project is the San José Ocaña property, municipal district of San Juan Sacatepéquez, Department of Guatemala, in a rural area, and the nearest communities are the San Antonio Las Trojes Village, 2 kilometers away by dirt road, and Cruz Blanca Village, 6 kilometers away, from the entrance to the cement facility.

Access to the Project site is through the road from San Juan Sacatepéquez to Cruz Blanca Village. The road is a two-way paved road and may be passed at all times. A dirt road takes from the Cruz Blanca Village to the facility's entrance, but the road is in good condition, and may be passed throughout the year. Figure 5.1 above shows the project's access road.

Another access to the Project is through the road from Santo Domingo Xenacoj to San Pedro Sacatepéquez and detour to Pajoques, Santa Fe de Ocaña and Cruz Blanca, these last stretches are dirt roads.

5.4 Technical Justification for the Project, Works, Industry or Activity and its Alternatives

In addition to what is known as natural cements and other mortar cements made of lime and other processed natural components, Portland cement is a material that has revolutionized the construction industry and has contributed to drive up modern civilization. The cement manufacturing process has become better and better over the years and as a result of the technological progress in electronics, development of materials, improvement of processes, and the use of alternative fuels, mixtures of raw materials may be designed to produce different cement types. No other cement manufacturing processes are known to this date due to the reaction syntherization process whereby elements react to each other to form the basic mineral compounds for cement, which requires high temperature, obtained from a fuel efficient and controlled combustion in the rotary kiln.

Since 1996, Cementos Progreso began a search for appropriate and adequate raw material resources for cement manufacturing, foreseeing that the construction materials demand would increase in the future parallel to the growth of the population and the development of the country. Several economic, socioeconomic, and feasibility studies were conducted during this period, and the analysis and conclusions of such studies have contributed to reinforce the initial predictions on an increased cement demand. Table 5.1 shows the increase of the cement demand for the San Miguel cement facility.

Table 5.1 Cement Production at the San Miguel, Sanarate Cement Facility, 1990 through 2005

Year	Clinker Production (MT)	Cement Production (MT)	% annual growth
1990	741,593	910,477	
1991	759,008	899,607	-1.2
1992	762,760	928,123	3.1
1993	740,024	913,041	-1.7
1994	620,501	776,572	-17.6
1995	812,239	971,970	20.1
1996	729,746	900,940	-7.9
1997	807,256	1,013,274	11.1
1998	1,044,869	1,341,440	24.5
1999	1,427,938	1,774,623	4.3
2000	1,506,186	1,854,879	4.3
2001	1,445,708	1,835,936	-1.0
2002	1,560,114	2,061,974	11.0
2003	1,521,474	2,064,002	0.1
2004	1,454,883	2,052,952	-0.1
2005	1,757,542	2,330,779	11.9

The average growth rate in the last 15 years has been 6.1%, equal to approximately 100,000 tons. However, relevant variations have occurred over the years; for example, production plummeted 17.6% in 1993, and in 1998, as a result of the introduction of a third line, the production grew 24.5%. In 2002 and in 2005 the production grew 11% and 12%, respectively. In brief, the annual growth rate of the cement demand is estimated at 8% which substantiates the need to expand the cement production capacity to cover the increasing demand.

The ratio between clinker production and cement production for the 1990 - 2001 periods was around 0.81, with a range of 0.79 and 0.84; however, from 2002 to 2005, the ratio has dropped to 0.74, with a range of 0.71 and 0.76. Therefore, for cement facility purposes it is estimated that 1 MT of clinker will produce 1.35 MT of cement (0.74).

From the options studied and evaluated for the installation of the cement facility, three alternatives have been chosen, and from these three, the current location was selected mainly because of:

- ✓ The proximity to the main markets and consumption centers of cement and construction materials;
- ✓ The raw material potential available in the area of the Project, in the amounts and with the necessary quality of its components to be used in the manufacturing of cement; and,
- ✓ The need for investment in the country, to contribute to the creation of enclave development and job opportunities in regions with high, non-metallic mining potential where its communities had not had, until now, a possibility of a better standard of living.

5.5 Estimated Area of the Project

The area to be used by the cement facility is 64 hectares. In the drawings 142 II-99/AO 3-01AA and 142 II-99/AO 3-02AA, Appendix 4, the perimeter fence of the cement facility and details thereof are shown. The cement facility will be located inside the San José Ocaña property of 860.7 hectares; consequently, it will use approximately 8% of the total property area. The main activity of the property now is forest management, with a plan approved by the NFI.

5.6 Activities to be performed in each Stage of the Development of the Project and Execution Time

The Project is to be developed in four stages: Stage One: Pre-Construction; Stage Two: Construction; Stage Three: Operation; and Stage Four: The Abandonment Stage. Stage One: Preconstruction consists of the studies carried out to select the best location for the cement

facility within the property, always taking into consideration its proximity with the mineral source (quarry-crusher), camouflaged from the neighboring communities. The assessments did not cause any environmental impact because the studies consisted of visits to the site and laboratory analysis.

Stage Two of the development of the Project will consist of activities in connection with the installation of the cement facility, which will last approximately 2 years. The activities to be carried out will consist of: construction of the access road to the plant, ground leveling to build the platforms, foundation excavation for the erection of the edifications, water systems, drainage, and power installation, mechanic and electric installation, and vacuum testing of the cement facility.

Stage Three is the operation of the facility and will consist of the cement manufacturing process, including processing, storage, and delivery to customers, and maintenance of the facilities. The extent of this Stage will be at least 25 years.

Stage Four is withdrawal, and, if abandonment occurs, will consist of dismantling the cement facility, likely office and shop demolition, and revegetation and/or reforestation of the site of the cement facility, if no other use is given to the site.

5.6.1 Flow Table of Activities

Below please find the schedule of activities for the various development stages of the Project.

Activity	**Months**													
	Days	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**2 Years**
Contact with suppliers	7													
Base proposal -Supplier A	41													
Base proposal -Supplier B	41													
Clarification –Basic Engineering Pre-beginning	25													
Basic Engineering Contracts	58													
Basic Engineering	70													
Turnkey Proposal Assessment	7													
Turnkey Agreements	23													
Supplier A	12													
Meeting No. 3 Pre-negotiation Supplier A	5													
“Clean Proposal” delivery Turnkey by Supplier A	7													
Supplier B	12													
Meeting No. 3 Pre-negotiation Supplier B	5													
“Clean Proposal” delivery - Turnkey Supplier B	7													
Successful Bidder Decision	5													
Review by Cempro	3													
Review by HGRS	3													
Successful Bidder Decision and Notice	2													
Execution of Turnkey Contract	1													

Construction	630													
Permits	200													
Camps	60													
Manufacturing	450													
Civil	660													
Mechanic	360													
Electric	360													
Vacuum testing	60													
Production	0													

5.6.2 Construction Stage

5.6.2.1 Infrastructure Development

The main items of work during the construction stage are shown in Table 5.2 below, which are: earthworks (2,695,883 m^3), excavation (103,873 m^3); concrete (99,780 m^3); reinforcing steel (11,479 tons); straightedge (227,292 m^2); structure (10,756 tons); linings (102,163 m^2); and masonry (14,680 m^2). The drawings 142 II-99/MT 03-01 al 08AA, Appendix 4 show the platform location and their cross sections. Drawings 142 II-99/EA 06-001 - 03AA, Appendix 4 show the architectonic view of the storage and service facilities of the buildings. Drawings 142 II-99/CR 03-01 - 03AA illustrate the cement facility and the cross sections of the access road.

Table 5.2 Work Items and Quantities Required for the Installation of the Cement Facility

	Average Amounts						
	Excavation (m^3)	**Concrete (m^3)**	**Reinforcing steel (ton)**	**Straightedge (m^2)**	**Structure (ton)**	**Linings (m^2)**	**Masonry (m^2)**
Limestone crusher	2,420	1,726	216	5,720	122	1,690	320
Clay crusher	2,040	1,050	128	3,690	53	1,110	420
Limestone storage	7,150	6,810	749	12,864	1,991	30,640	
Clay storage	7,950	6,814	750	13,046	1,880	30,910	
Gypsum crusher	2,460	978	118	3,330	45	1,010	370
Gypsum storage	6,400	5,549	610	10.545	1,462	24,940	
Gypsum transportation	710	210	27	516	212	126	
Mill feed	1,150	1,276	166	2,555	232	1,100	
Raw mill	2,035	3,040	322	6,034	198	25	140
Gas conditioning	1,300	2,900	350	5,680	194	50	
Raw flour tank	2,240	5,338	639	11,340	123		70
Kiln feed	30	21	2	60	42	270	
Pre-heater	2,100	2,498	290	2,390	1,904	1,704	
Kiln	1,200	1,764	172	1,725	23		
Cooler	2,500	3,636	445	9,964	119	462	100
By pass	310	509	54	2.250	80	590	
Coal mill							
Clinker transportation	150	65	8	190	59	860	
Clinker storage	6,120	9,468	1,260	16,830	439	2,370	
Cement Kiln feed	1,550	3,166	402	7,540	421	2,100	
Cement mills	2,800	5,009	595	11,470	96	450	3,000
Cement transportation	60	34	3	82	81	200	
Cement tank	3,700	6,811	746	11,100	320	810	
Cement tank	3,640	6,750	740	10,905	119		
Cement tank	3,640	6,750	740	10,905	119		
Packing machine	1,200	3,745	464	16,687	162	440	3,555
Fuel discharge	700	295	35	1,195	13	90	
Fuel preparation	1,540	1,180	88				
Fuel preparation	230	244	25	715	8		300
Compressor room	700	295	35	1,195	13	90	322
Compressor room	700	295	35	1,195	13	90	322
Water cooling	600	1,007	111	4,615	10		320
Fire extinguishing system							
Piping	854	515	35	1,078	132		
Truck scales	350	141	19	155			20
Entrance gate sentry box	20	25	3	90			15
Crusher Substation	1,900	190	40	870	3		208
Additives Substation	1,900	190	40	870	3		208
Raw flour Substation	2,500	469	64	2,362	3		330
Kiln Substation	2.400	731	96	2,224	3		360
Cement Mills Substation	4,600	1,378	156	4,532	10		920
Packing machine substation	2,300	689	78	2,266	5		460
Main Substation	3,460	810	104	3,548	3		420
Control and Laboratories Building	1,250	1,530	176	7,775	32		2,500
Cable tunnel	13,014	3,885	344	15,189	9		
Total:	**103,873**	**99,780**	**11,479**	**227,292**	**10,756**	**102,163**	**14,680**

5.6.2.2 Equipment and machinery

For the civil works and infrastructure construction process the use of equipment and machinery such as tractors, drag shovels, and trucks will be required, as well as machines for concrete conveyance and placement. In order to move and place the equipment and components of the facility at the exact location during the assembly process, conventional machines and tools will be used, such as mobile hydrolic cranes of different capacities, hoists, tower cranes, tackles, sheaves, etc.

5.6.2.3 Transportation Mobilization and Mobilization Frequency

Mobilization of machines and equipment to be used during the construction stage will be by trucks and trailers. The mobilization frequency will be more at the beginning of the construction stage, with the transportation of machinery and equipment; subsequently, all construction materials will be transferred.

Transferring equipment to the cement facility will require approximately 2,000 low boy trips, approximately 6 trips per day during six months, by the new highway to be built, and for which the respective EIA will be developed; 80,000 tons of equipment are estimated to be moved, and each low boy may convey 40 tons. The largest load will be the kiln rings, with an approximate diameter of 5 meters, and will have 14 sections.

5.6.3 Operational stage

5.6.3.1 Infrastructure Development

No additional infrastructure has been planned to be installed or built in short or medium-term, during the Operational stage. If an expansion of the new cement facility or lime processing facility is required, the pertinent EIAs will be performed.

5.6.3.2 Equipment and Machinery

Drawing 5.1 above shows the general arrangement of the cement facility and in the remaining drawings in Appendix 4, the information presented is expanded. The activities to be carried out in the cement facility during the cement manufacturing process (4,500 tons per day) will be as follows: i) crushing; ii) pre-mixture and storage; iii) raw flour grinding and mixture; iv) pyroprocessing; v) cement grinding and, vii) cement packing and storage. Furthermore, solid fuel grinding (coke) will be necessary for power generation in the cement manufacturing process.

Below is a detailed description of the cement manufacturing process (see drawing 015 06A-001 101-A in Appendix 4, Drawings).

Crushing, transportation, and storage of limestone, loam, shale and additives:

Limestone and loam extracted from the quarry will be moved by dump trucks to the respective receiving hoppers in the crushing facility. Subsequently, materials will be conveyed by plate feeders to a one-rotor hammer crusher with capacity to process up to 1,200 metric tons per hour (MTPH). The size of the crushed material will be less than 5". This crusher will also be used to reduce the limestone used as additive in the cement mills.

Another crusher will be installed to process shale and volcanic materials also extracted from the quarries which will be used to correct the proportions of the components of the raw materials mixture. This double-roller type machine will be designed to process up to 1,200 MTPH, with a similar arrangement to the limestone crusher. All crushed materials will be transferred to the storage and pre-homogenization complex in belt conveyors.

It will be necessary to install a third crusher for the preparation of additives to be used as part of the raw materials and as components in the formulations of the different types of cement. This crusher will also be a double-roller type machine, with a capacity to process a maximum of 275 MTPH. This crusher will form an independent unit of the raw materials crusher to be extracted from the quarries (limestone, loam and shale) and will be placed within the cement facility, because the additives will generally be brought into the property from an outside location, and will require a especially conditional area for handling, processing, and storing such additives.

Pre-Homogenization and Longitudinal Storage of the Main Raw Materials:

Storage and pre-Homogenization Systems will be used to mix and store in bulk the main raw materials, such as limestone, loam and shale. The storage and longitudinal pre-homogenization system is designed to form a continuous accumulation of material in longitudinal piles (Chevron type). Piling will be carried out by the coming and going of a piler traveling the galley from one side to the other, creating layers of material forming a chevron-shaped cross section on a predetermined longitude, to achieve certain mixture factor. This mixture factor will be based on a standard deviation of the chemical composition of the material going in and out of the accumulation pile.

The material will enter the storage and homogenization area (pre- homogenization galley) on a rubber belt conveyor from the crusher, and will be unloaded by a hopper installed in the central part of the piler arm. The piler will be mounted on a rail system which will allow it to travel in a pre-determined longitude, adjusting in each journey the vertical travel. This condition will allow the falling distance of the material to be less than 6 feet (1.80 meters), which will reduce segregation and dust emissions.

The material will leave the homogenization area (pre-homogenization galley) from one of the pile ends using a bridge reamer which will work cross-sectionally in the same natural material sliding. The sweeping movements of the plow will make the material to slide to the pile base where the reamer chain will drag it to the exit of the conveyor belt. The homogenized material will be transferred from the galley to the feeding hoppers of the raw flour mixing mill by a rubber belt conveyor.

Additives Storage Area:

Additives to correct the raw flour composition such as steel waste, fluorite and bauxite will be stored in a closed area. These materials will be piled up using a sliding aerial piler. Other additives such as clay and silica for the raw flour mill, and gypsum and pozzolan for cement mills, will be moved in by dump trucks to unloading hoppers. A plate feeder will move these materials to a belt conveyor provided with a selector gate which will make transfer of additives easier, whether towards the belt conveyors of the additives storage silos in the cement mills area, or towards the storage piles of the covered area, nearby the storage areas of the other additives.

Raw Flour Grinding:

The clinker manufacturing process will begin with the preparation of raw flour, and for such purpose it will be necessary to submit these five raw materials to a grinding process: i) limestone, loam, and shale mixture obtained from the pre-homogenization pile; ii) steel waste; iii) bauxite; iv) fluorite; and, v) high-calcium limestone. Five tanks have been provided for the storage of these raw materials.

A vertical roll crusher mill will be used to cover the grinding and drying needs of the materials making up the raw flour. The mill will be designed to process 360 MTPH of gross material, and reduce it to a maximum fineness grain of 12% retained on a 200-mesh sieve. The installed mill power will be approximately 3,300 kW.

The different raw material components will be fed at the entrance of the mill by belt conveyors. The mill entrance will be provided with a metal detector which will trigger a two-way valve that may change the flow direction to a relieve container to prevent any metallic pieces appearing in the material flow being fed from damaging the internal mill parts.

When entering the mill, the material fed will be distributed on a crushing turntable through the feeding chute. The rotation table speed will drive the material towards the grinding groove, forcing it to pass under the rolls.

The partially ground material will pass above the overflow ring of the rotating table to find an ascending current of hot gas from the kiln pre-heater, which will flow through the nozzle ring, towards the upper part of the crusher mill. Hot gas will cause immediate moisture evaporation, drying the material to cause the moisture contents in the product to be 0.9%

Gas stream will drag the ground material to the high-efficiency separator mounted in the upper part of the body of the crushing mill, which will classify it by separating fines from thick grains and causing the thick grains to go back again to the rotating table to be recycled in the crushing circuit to achieve a size reduction and discharge.

The hot gas stream to be used to dry the material will also be the means of transportation of the crushing product and inside the crushing mill, two stages will stand out: a first stage in the internal circulation, and a second stage in the separator. Finally, the ground material will be conveyed to the separating cyclones (4 x 5,000 mm) through an induced centrifugal air, and the gas flow coming out from the battery of cyclones will be purified in the main kiln filter.

The product resulting after the grinding will come out of the mill by the gas stream crated by the forced-draft fan of the mill, and will convey the fine material to the separating cyclone station. (4 x 5,000 mm).

Hot gases will come from the pre-heaters' system of the kiln, and will be used by the mill to dry the materials that will enter the grinding process, using the contents of heat in the materials. The necessary amount of hot gases will be supplied to the mill based on the moisture content of the raw material and on the drying requirements.

The mill will be provided with a specific recirculation duct around it to insure the continuous supply of air flow needed in the outlet of the mill, regardless of the pre-heater gas characteristics or the characteristics of the raw materials.

The crusher mill will also have a flow material recirculation (FMR) used to return the material falling from the mill table again to the feeding process, using for that purpose, a bucket elevator which moves the load to the feeding process. The FMR system will maintain a reduced speed in the nozzle ring because from this moment it will not be necessary to maintain the suspended thick material inside the mill. This speed reduction will result in a less pressure fall through the mill, which at the same time result in power savings in the mill fan. The flow material recirculation rate of the mill will be in a range of 10 and 25 % of the material being fed.

Having adjustable overflow ring and a nozzle ring working together with the hydraulic pressure of the crushing rolls and with a high-efficiency separator will make it possible to optimize the mill operation within a broad range, caused both by the gases conditions and by the materials characteristics.

The mill will also have mouthpieces for the liquid additive on the mill table as crushing collaborator, if its use is deemed necessary. This additive is typically a mixture of synthetic amines, or even water, depending on the desired objective. The final result is less power consumption and an improved particles distribution.

The mill feeding will be automatically controlled based on the changes of the differential pressure within the mill. In addition, the flow of gases through it will be maintained by the

control loop over the fan by the differential pressure sign in the entrance of the cyclones and the engine power.

The largest proportion of raw finished mixture scattered in the gas stream will be removed by the battery of cyclones located immediately after the mill. The remaining particles will be separated from the gases by a sleeve filter which will deal with the handling of the gases coming both from the raw flour mill and from the pyroprocessing system. Gas will be forced to pass by the sleeve filter by the work of an air shaft which will expel the filtered gas to the atmosphere through a common chimney. The feeding dust of the raw flour and of the pre-heater gases will be removed by the sleeve filter and returned to the process, whether to the raw flour feeding tank or directly towards the kiln feed.

When the crushing system is not operating, the pre-heater gases will be cooled by a cold injection, at a temperature of around 200º C and deviated to the sleeve filter. The descending duct will be provided by a gate that will let the entrance of fresh air to prevent high temperatures from causing a premature damage of the filter sleeves.

Raw Mix Storage and Homogenization:

The raw mix homogenization system will consist of a CF-type tank (controlled flow) which will combine the storage and homogenization capacities in the same tank. The tank will have an internal diameter of 16 meters and will be 47 meters high. The material will get into the tank through a central opening by a bucket elevator and an irrigation ditch (air chute). The bottom of the tank will be divided into seven hexagonal sectors. Each sector will be subdivided into six triangular segments. The bottom of the tank has 42 segments.

The tank will have porous air boxes independently activated by the air coming from rotary fans. The central part of each of the seven segments will be provided with an outcrop opening covered by a pressure release cone, and provided with shutoff valve.

The raw mix extracted from each outlet will be pneumatically conveyed to a tank to be subject to an additional mixture process by the action of strong air stirring.

The controlled-flow tank (CF) will also be equipped with an internal aeration system, and will have a pre-assigned extraction program. The operation of the aeration system will insure that the full contents of the material in the tank remains in motion, and the extraction from the tank and aeration of the 42 triangular segments be controlled in such a way that a differentiation in the raw flour retention time may be achieved.

The raw mix extracted from the CF tank will be transferred to a kiln feed tank installed right below the tank. An accurate measurement of the material feeding the kiln is obtained by using this feeding system FLS-LOW, and this material will be conveyed by irrigation ditches and a bucket elevator to the entrance of the pre-heaters system.

Pyroprocessing System for Clinker Manufacturing:

The pyroprocessing system consists of a pre-heater, a calcinator, a kiln, and a cooler. The system is designed to guarantee a clinker capacity of 4,500 metric tons per day (TMPD).

The simple on-line type pre-heater will consist of five cyclone stages. The raw mix feed to the pre-heater will be through the gas entrance duct of the higher cyclone stage. The material will be pre-heated in its passage through each of the five stages prior to entering the calcinator where part of the fuel (approximately 40%) will be burned to obtain a raw mix calcinations of 92-95%. The combustion air into the calcinator will be supplied through the ascending duct and from the tertiary air duct coming from the cooler.

The calcinator is designed to burn 100% of mineral coal or petcoke. Combustion in the calcinator will be controlled to obtain a continuous temperature in the gases of the following stage, in such a way that the reason for the calcination of the material entering the kiln may remain unchanged.

An inverted "V" form accessory placed in the middle inside the container forming the calcinator will ensure a complete mix among hot gases, fuel and raw flour for a complete combustion and optimal heat transfer.

The pre-heater design and the calcinator will include the proven nitrogen monoxides ($NO_{x)}$ reduction controls created by the high-combustion temperatures. The reduction in the formation of the NO_x is achieved by two methods:

i) When the calcinator fuel is burned with less oxygen than required for a full combustion, a "reduction zone" is formed (O_2 deficiency) and one of the products of the reaction is carbon monoxide (CO). As a result of that, two types of reactions are carried out. In one of them, CO and the unburned fuel particles available in the area effectively react with the thermal NO_x and decompose it. In the other reaction, which is best served by high temperatures, the fuel nitrogen atoms react with the NO_x in absence of oxygen. The "reduction zone" temperature is controlled by a simple bypass of the material from the cyclone to the next lower stage of the pre-heater to the raising tube of the kiln and towards the lower cylindrical part of the calcinator. Experience has shown that the maximum reduction zone of NO_x is designed for retention times of 0.15 seconds to minimize the total area subject to reduction conditions, and at the same time reaching the less possible NO_x emissions.

ii) The calcinator will also operate by using a high-temperature oxidation zone. This is achieved by bypassing the cyclone material from the lowest part of the second pre-heater stage to the upper cylindrical part of the calcinatory by other bypass. This creates a high-temperature area in the lower cylinder of the calcinator resulting in faster fuel combustion by reducing NOx formation by not allowing the necessary time for its formation. This is particularly effective when using low volatile fuels such as coke.

The gas from the calcinator will enter the lower collection stage of the pre-heater cyclones, where the material will be separated and conveyed to the kiln chamber. From this point the material will enter the kiln to conclude the calcination and execute the clinkerization process.

Gas expelled from the pre-heaters will be channeled by a duct connected to the forced-draft fan. The forced-draft fan of the calcinator will maintain the required gas volume in the kiln and the calcinator in order to have the necessary speeds to maintain the material in suspension and also to suck up the necessary air to achieve full combustion of the fuels used.

A defined control of the gas separation from the kiln and the tertiary air coming from the cooler will be achieved by a pressure-regulating valve placed in the tertiary air duct.

Gas coming from the forced-draft fan will be used for the drying process in the raw mix and coal or petcoke (coke) crushing systems.

The kiln will be a 2-support, 5-meter diameter by 65-meter long type kiln, designed for a nominal rotational speed of 3.6 rpm and a maximum speed of 5.0 rpm. The hot clinker at a temperature of 1400-1450º C will come out of the kiln and fall into the transverse bar, multiple movement cooler, to be cooled. The combustion air required in the kiln and calcinator will be taken from the cooler.

The excess air in the cooler will be dedusted by a cyclone and will be used afterwards in the raw flour mill or in the cement mill or in both, depending on the demand.

Transversal Bar, Multiple Movement Cooler:

A MMC 468/14 x 75 transversal-bar cooler will be used for cooling clinker. With this equipment it is expected that the total clinker production will be cooled at a temperature of approximately 100º C with a cooling air load of 2.30 kg air/l kg clinker. Total installed air for the cooler will be 2.53 kg air/l kg clinker.

The system will use 7 separate cooling fans to provide air to the plates. The grid will be fixed to eliminate the need of an additional air seal, which will ensure a better efficiency in the supply of cooling air, and will eliminate the clinker spill below the cooler. In addition, the air distribution plates will have bags which will improve air distribution through the bed formed by the clinker.

The air used for clinker cooling in the controlled impact section (CIS) and in the transversal bar frontal module will be recovered and used as secondary air in the kiln, and as tertiary air in the calcinator. The remaining cooling air (not used as combustion air) will be extracted by the cooler ventilation system. The cooling air will be supplied by fans equipped with piezometric sensors and pressure-regulating valves that will control the primary air division. A MFR valve below each individual plate will automatically control the air flow towards each plate ensuring a continuous air load regardless of the physical characteristics of the clinker. The control of

the MFR valves on the pressure-regulating valves of the fans will let to reach a better cooling efficiency.

All of the above will lead to an excellent air flow distribution control and thickness of the clinker bed, reducing the cooling air requirement, and increasing the tertiary secondary air, with less spare air volume, and less fuel consumption.

Cement Grinding:

Two vertical mills have been suggested for cement grinding, with the characteristics shown in Table 5.3.

Table 5.3 Design Specifications for a Cement Mill

Type of Mill	2 x OK 33-4
Type of Separator	ROKS 40.0
Production capacity	148 MTPH
Product Fineness	380 m^2/kg (Blaine)
Type of product	CFB/100% pozzolan
Product temperature	97º C
Mill Type Filter	Bags

Materials feeding the mill will be extracted from their storage silos by gravimetric feeders developed to regulate the appropriate proportions. For the extraction of pozzolan from the appropriate tank, a plate feeder will be used, which in turn will feed the pertinent gravimetric feeder.

Materials will be subsequently conveyed to the entrance of the mill by a feeding conveyor system. This conveyor system will be equipped with a metal detection system and an electromagnet for the protection of the internal parts of the mills, which will be monitoring the feeding flow before entering the mill. Any detected metal will activate a gate which will bypass the portion of the material conveyed with the metal contents to a waste container to prevent it from falling into the mill.

The cement components will enter the mill by the feeding duct at the rear of the body of the feeding duct, oriented in such a way that will force the material to fall directly into the center of the crushing table. The mill access is provided with a rotatory valve to minimize the entrance of false air.

The table rotation will force the material to travel to the end of it and pass under the milling rolls where the grinding work will be conducted. Having passed by the milling rolls, the material will leak on the overflow ring to fall into the nozzle ring, to be received by a gas upstream current that will convey the material to a separator and return part of the material again to the crushing table. The speed of the gases coming from the nozzles will be regulated

in such a way that a fraction of the material will fall through the nozzle ring and may get out of the mill through the rejection outlet.

The rejection material will be recollected under the grinding table and going out by the feeding chute and will return to the mill feeding system by a circulating material return system. The material carried by the gas stream will each the separator where it will be classified in two fractions: the product (fines) to be moved by the current to the bag filter, and the thick, which will be returned to the mill to be reprocessed until the required grain fineness is obtained.

Product Collection with Bag Filters:

The final product will come out of the separator by the upper part conveyed by the gas stream to the sleeve filter where the material particles will be separated from the gas stream. Product fineness will be according to the gas flow from the mill and the speed of the separator rotor. The collected finished product in the filters will be conveyed to the cement storage silos. The system will be provided with a continuous sampling mechanism of the finished product.

The gas passing through the mill and the separator will be moved by a fan. The fan will be placed after the purified filter and gases will be recycled at the entrance of the mill gases by a duct connected to the mill outlet. The filters to be installed in the cement facility San José Ocaña, in San Juan Sacatepéquez, are listed and located in 4 drawings identified as 14211-99/A004-01-AA in Appendix 4.

Cement Storage and Packing:

The cement tank area will consist of 3-10,000 MT concrete tanks (two will be used to store cement CFB and one to store pozzolan) and one tank divided inside into 5-2,000 MT each compartments will be used to store different types of pozzolan cements, which will be manufactured by a continues mix station feed by CFB cement and crushed pozzolan, in the specified proportions. The cement tanks will work with the continuous flow storage system (CFS) which will allow the simultaneous storage and extraction of the product.

The steep slope of the tank bottom nearby the vertical tank wall (20º to vertical) will guarantee that very little cement will remain retained in the tank if deemed necessary to empty it completely for cleaning purposes. In addition, the aired supports s placed in the center of the bottom of the tank will have a 15º horizontal slope, making cleaning easier and letting very little cement remaining in this area when the tank is emptied.

The manually-operated sliding gate at the extraction point of the tank will be designed to be used in case of repair or maintenance of the equipment installed downstream. The extraction will be controlled by pneumatically-driven flow-control gates. These gates will have a very quick closing reaction time, (< 2 sec.) and will be just right to control the loading flow of bulk transportation.

Secondary Tanks:

A secondary tank will be installed for out of specification cements resulting from the changes from one product type to another. This material may be measured out when going back to the process and will be fed to the line of supply of the cement mills. It will also have a bulk transportation loading system as an alternative way of unloading the material from the tank.

Packing and Dispatching Station:

The cement tanks area will have three bulk loading stations, three paper bag automatic packing machines, three palletizers, and one jumbo-bag filling station.

Fuel Storage Area:

Solid fuels such as mineral coal and petcoke will be stored in a closed area, together with the additives. These materials will be piled up by using a sliding aerial piler. A plate feeder will convey these materials to a belt conveyor.

Fuel Grinding:

The solid fuel TIRAX mill will be a closed-circuit, air-swept ball mill. Fuel will be conveyed from the storage site to the feeding tank, from which fuel will be extracted to be fed to the mill through closed circuit, designed to minimize false air entrance.

Fuel will enter the mill drying compartment which will be provided with lifters to maximize heat transfer from the hot gases to the material. As long as the material travels, it will reach the crushing zone passing through a diaphragm dividing the mill chambers. Crushing will be performed by steel balls. The crushing chamber will be equipped with a classifying armor.

Finely ground particles will be lifted and suspended by the gas stream. Because the mill will be swept in its entire longitude by the gases, the suspension material will come out of the mill with the stream and will be directly suctioned towards the separator.

The separator will be equipped with frequency-controlled motor unit to manipulate the size of the product. The thick particles will be returned to the mill to pass again through the grinding process. Fines will be dragged by the gas stream and recovered in the sleeve filter collector to be conveyed to the storage silo for subsequent consumption.

A fan will be installed to cause gas flow passage through the mill, which will work with the clean gases from the filter. Gases will be driven up the chimney. A gas control valve will be installed in the supply duct to regulate the flow. An air admission valve in the mill entrance will also be installed. This valve will be used to make adjustments in the gas flow according to volume and temperature. During a mill interruption, this valve will be used to air the system.

A gas analyzer will be installed to monitor at all times the oxygen contents of gases in the crushing system. An apparatus will also be available to detect carbon monoxide (CO) concentration and used to avoid formation of explosive atmospheres or fire causing atmospheres in the filter or in the tank or in the coal storage silo during an interruption. A CO_2 application system will also be applied to keep the system motionless and fight fires in the tank and the filter.

The crushing system has not been designed for a motionless operation; therefore, the mill will not operate with fuels with volatile matter contents exceeding 26%. Table 5.4 describes the characteristics of the fuel mill.

Table 5.4 Mill Design Specifications

Mill type	TM 40 x 5.0 + 2.8	
Separator type	RTKM 22.5	
Maximum feeding size	0% + 35 mm 5% + 25 mm	
Fuel type	Petroleum Coke	Bituminous coal
Production capacity	23 t/h (dry)	26 t/h (dry)
Product fineness	maximum 5% + 90 µm	maximum 12% + 90 µm
Feeding moisture	maximum 10.0%	maximum 10.0%
Maximum drying capacity	10% - 0.5% moisture	10% a 0.5% moisture
Hardgrove Index	minimum 32	minimum 45

5.6.3.3 Vehicle Flow and Expected Mobilization Frequency

The number of trucks carrying cement is estimated according to the production of the new facility; i.e., around 310-23.375 MT/day trucks will circulate on the new highway to be built from the cement facility to highway CA-1.

Access from highway CA-1 West will be at Santo Domingo Xenacoj and will have approximately 12 kilometers. The highway will be a 4-lane road, and the first 10 kilometers will go through properties without any surrounded communities; then, there is a 2-kilometer stretch where the highway will pass near a sector of the Pajoques community, before entering the San José Ocaña property. This new highway will be subject to specific EIA.

5.7 Utilities

5.7.1 Water Supply

Water consumption rate during the cement facility operation will be approximately 200 liters/tons of clinker (see Table 5.5), which includes cooling makeup water value, services,

and the remaining minor loads; the number of regular employees (200) and contractors (200, including drivers), and other water needs.

Table 5.5 shows water consumption per metric ton of cement produced at the San Miguel, Sanarate cement facility, included as reference for the water supply of the future cement facility in San José Ocaña, San Juan Sacatepéquez, as it has been designed in such a way that water consumption is less than the mentioned reference. In summary, the 4,500 MT clinker to be produced every day at the new cement facility would require approximately 900 m^3 of water per day (165 gpm).

Table 5.5 Water Consumption at the San Miguel, Sanarate Cement Facility

Year	2002	2003	2004	2005	2006
Consumption (m^3)	324,077	297,956	4300,336	409,012	565,517
Liter/TM clinker	208	235	206	232	302

Water supply source will be groundwater extracted by a pumping system. The production testing of the exploratory well (PA1; coordinates UTM 0746994N; 1630405N) drilled within the San José Ocaña property and within the exploration area (Southwest) to assess the nearby water-bearing potential, indicated that water level tends to stabilize at a pumping rate of 115 gpm (COFEPRO 2007), a flow representing approximately 70% (165 gpm) of the cement facility requirements. For this reason, two additional wells will be drilled in the Northern part of the property, as no volcanic rocks emerge from it, and it has low hydraulic conductivity, predominating carbonated rocks, with a better potential for good water bearings in the hydric discharge zone (COFEPRO 2007). Drawing 142 II-99/AO 13-01AA in Appendix 4 shows the location of the PA1 well, the location of the two wells to be drilled, and the mechanic wells available in the nearby communities.

5.7.2 Wastewater and Rainfall Drainage

Bathroom facilities and showers, kitchen sinks and water reservoirs will be available at the project, where wastewater will be treated by water treatment plant (wetland), like the system used by the cement facility San Miguel, in Sanarate. Such water treatment is known as wetland and consists of four main components:

1. A substratum, which may be soil, sand or rocks;
2. Plants adjusted to water-saturated anaerobic substrata;
3. A water column at a certain speed; and
4. A population of aerobic and anaerobic microorganisms.

Microorganisms such as bacteria, fungus, algae, and protozoaires come into contact with the pollutant matter and alter it to extract the nutrients and energy required to develop and complete their respective life cycles. The effectiveness of building artificial reservoirs used for

wastewater management is a result of that. These reservoirs must be designed to develop and maintain desirable microorganism populations in optimal conditions.

Aquatic plants have two very important indirect purpose: One is that the stems and the leaves significantly increase in population the area where microorganisms grow. The other is the ability of the plants to convey atmospheric gases including oxygen to the roots, which let the roots survive in an anaerobic environment.

Pollutants removal in a wetland is approximately 80-90% as far as biochemical oxygen demand (BOD) and total suspension solids (TSS) is concerned. In other words, wastewater treatment by aquatic plants will produce an effluent with levels of approximately 10-20 mg/l of BOD and TSS and a coliphorm colony count of approximately 50-150 per 100 ml of water. Drawings 142 II-99/EA 13-01AA and 142 II-99/EA 13-02AA in the Appendix show the wastewater drainage system, and its treatment and facts, respectively.

Rainfall will be channeled away by rain gutters that will drain off to the Sunuj ravine. Drawing 142 II-99/EA 13-01AA in Appendix 4 shows the rainfall drainage system.

5.7.3 Power

El power consumption rate will be approximately 100 Kw-hr/tm cement, similar to the cement manufacturing consumption at San Miguel, Sanarate (see the second column in Table 5.6.) Table 5.6 determines the current power consumption at the cement facility in San Miguel, Sanarate, which was used to estimate the future demand of the new cement facility.

If the cement facility has the capacity to produce 4,500 tm/day of clinker and for each MT of clinker approximately 1.35 MT of cement (6,075 day of cement) may be obtained, it is estimated that the cement facility will use approximately 25 MW. Table 5.6 indicates also that the greater power consumption will be in the pyroprocessing system, consisting of a pre-heater, calcinatory, kiln, and cooler. This power consumption includes power demand for offices, dressing rooms, cafeteria, warehouses, and shop, and the wells water pumps.

Power in the area is supplied by DEOCSA and the electrical connection will come from Inter-American Highway CA-1, site of installation of a distribution line on the border of the new highway to be built. An EIA will be in progress for the power transmission line of approximately 12 kilometers.

Table 5.6 Power Consumption per MT of Cement Produced at the San Miguel, Sanarate Cement Facility

Year	Power Consumption (MWh)	Power Consumption (KWh/TM)	Pyroprocessing Consumption TJ	Auxiliary Equipment Consumption TJ	MJ/TM clinker	MJ/TM cement
1990	92,126	98	2,837	44	3,116	3,164
1991	90,932	108	2,930	65	3,257	3,329
1992	89,537	102	3,014	61	3,247	3,313
1993	89,544	104	2,988	52	3,272	3,329
1994	83,728	99	2,500	37	3,219	3,267
1995	99,133	98	3,265	42	3,360	3,403
1996	93,323	96	2,924	53	3,246	3,304
1997	100,420	103	3,106	53	3,066	3,118
1998	132,674	99	3,971	72	2,960	3,014
1999	174,343	98	5,490	100	3,094	3,150
2000	177,233	96	5,754	64	3,102	3,137
2001	189,102	103	5,440	69	2,963	3,000
2002	203,991	99	5,653	78	2,742	2,780
2003	185,834	90	5,407	78	2,619	2,657
2004	195,287	95	5,512	73	2,685	2,721
2005	225,240	97	6,547	77	2,809	2,842

5.7.4 Access Roads

Access to the Project is through the road from San Juan Sacatepéquez to Cruz Blanca Village, to continue by the dirt road to the El Pilar I and II, Santa Fe Ocaña and San Antonio Las Trojes Villages. At the highway junction just before arriving to the first two villages, turn North, and approximately 6 kilometers ahead is the access to the Project site. Generally, the dirt road to the project is in good conditions throughout the year.

Another access to the project is by the road from Santo Domingo Xenacoj to San Pedro Sacatepéquez and detour to Pajoques, Santa Fe de Ocaña and Cruz Blanca. From the road detour, there is a dirt road, and even though it may be passed throughout the year, during the rainy season the road is in bad conditions.

Cementos Progreso will build a new public access road from the new cement facility to Inter-American Highway CA-1, approximately 12-kilometers long. It will be necessary to change 387.19 meters of the dirt road between San Juan Sacatepéquez and Las Trojes, from Kilometer 8 + 532.32, and an application for approval has been filed with the mayor of the city, and with the National Highway Administration, Appendix 5 includes a letter sent and received by the

mayor of San Juan Sacatepéquez and the National Highway Administration's letter approving the change.

5.7.5 Public Transportation

No public, but private transportation is available in the area. Bus service is available from the capital city of Guatemala to the capital municipal district of San Juan Sacatepéquez every 15 minutes. Transportation to the San Antonio Las Trojes village is available in buses or pick ups.

The project will not require the use of public transportation because employees will arrive in their own cars, and for such employees who do not have a car, the company will provide microbus transportation from and to San Juan Sacatepéquez. Employees living in San Antonio Las Trojes and the nearby communities will probably use bicycles or will get there on foot.

Counts for light-duty vehicles, buses, trucks and other vehicles (motorcycles and bicycles) were conducted Saturday, February 10, and Monday, February 12, 2007. Appendix 6 includes the Traffic Report in the San Juan Sacatepéquez, Cruz Blanca, and Las Trojes stretch.

Results are shown in Table 5.7. Results indicate that a maximum of 400 vehicles travel from and to Las Trojes, approximately 50% of which are motorcycles and bicycles on Saturday (day off) and 20% Monday (working day). During business days approximately 70% are light-duty vehicles.

Table 5.7 Vehicle Count in the Area of Influence of the Project

Day/Type of Vehicle	San Juan-Cruz Blanca	Cruz Blanca-Junction	Las Trojes Junction
Saturday Total	**1370**	**974**	**320**
Light-duty vehicles	854	525	135
Buses	169	162	20
Trucks	41	32	15
Other	306	255	150
Monday Total	**1348**	**1160**	**380**
Light-duty vehicles	894	750	274
Buses	208	200	30
Trucks	46	40	6
Other	200	170	70

5.7.6 Other

Cellular telephone service is available in the Project area. There is a cellular telephone tower in Santa Fe de Ocaña providing good coverage.

5.7.7 Labor

5.7.7.1 During the Construction

During the construction Stage, which will take approximately 24 months, roughly 1,800 persons will be employed. During the installation of the third production line of cement in San Miguel between 1997 and 1998 nearly the same number of people was employed. Consequently, a similar number is estimated to be employed during the two years for the construction of the cement facility in San José Ocaña, San Juan Sacatepéquez.

5.7.7.2 During the Operation

It is estimated that the new cement facility in San José Ocaña, will need approximately 200 regular employees, for the three shifts. However, a similar number of people will be linked to the operation of the cement facility, such as truck drivers transporting the product, and customers and suppliers.

5.7.8 Camps

The installation of the cement facility will require setting up a camp as a shelter for the employees of the various contractors. The camp will have all utilities operational for the workers, as well as wastewater treatment systems, rainfall and health drainage, and solid waste management. Cementos Progreso S.A. will establish in the agreements executed with the contractors an adequate liquid and solid waste management, as well as the health conditions prevailing in the camp.

5.8 Raw Material and Materials to be used

5.8.1 Construction Stage and Operation

The materials used during the construction of the cement facility will be: concrete (99,780 m^3); reinforcing steel (11,479 tons); straightedge (227,292 m^2); structure (10,756 tons); linings (102,163 m^2); and masonry (14,680 m^2).

The raw materials to be used for cement manufacturing will be: limestone, loam, shale and additives (steel waste, fluorite and bauxite, clay, silica, gypsum and pozzolan). Besides, pet coke will be used as fuel.

5.8.2 Inventory and Chemical, Toxic, and Hazardous Materials Management

During the construction Stage chemical materials such as fuels and lubricants will be managed, as well as welding equipment using acetylene and oxygen. A 4,000-gallon fuel deposit tank will be built upon obtaining the necessary fuel storage licenses from the Ministry of Energy and Mining. The construction of the fuel storage and delivery systems will be performed according to the standards of the Ministry, including all necessary safety systems. The estimated fuel monthly consumption is approximately 6,000 gallons of diesel. Lubricants and greases will be stored in a warehouse. The estimated consumption will be 400 gallons of lubricants, and will have all the necessary safety systems. Any personnel in contact with lubricants will be properly trained in lubricant handling, emphasizing on the environmental damages lubricant spills may cause. Lubricant and grease wastes will be stored in 55-gallon drums, and sent to the cement facility in San Miguel, Sanarate to be used as fuel.

During the operational stage of the cement facility, chemical, toxic, and hazardous materials will be: i) Chloridric and sulphuric acids, sodium hydroxide, and other chemical products. These materials will be neutralized before pouring them to the drainage which will conduct these materials to the wastewater treatment plant (wetland); ii) the gamma- ray analyzing source (isotope). The supplier will change the source and will deal with the disposal thereof; iii) Acetylene and oxygen to be used in the welding works. These gases will be consumed and supplier will take the tanks to be filled up again; iv) Lubricants for equipment and engines. Wastes will be used as fuels in the kiln; v) Fuels for the kiln. Bunker fuel will be used to shut down and start up the kiln; and propane gas will be employed once every year when starting-up the kiln in completely cool conditions.

5.9 Waste Management and Final Disposal (Solid, Liquid and Gaseous Wastes)

5.9.1 Construction Stage

5.9.1.1 Solid, liquid (including drainage) and gaseous wastes

Solid wastes will be any garbage coming from the activities carried out by the employees at the camp, and for such purpose it has been established that drums identified as garbage collectors will be placed in the places more often visited by the workers; a site within the property will be made available to bury any organic wastes, after classifying garbage. Non-recyclable wastes will be sent to the cement facility in San Miguel to be used as fuels.

Another type of solid waste to be created will be the waste from wood fragments, block, iron, tie wire, wood and plastic equipment packing, which is expected to be minimum quantities if an appropriate building planning is performed. These construction wastes will also be deposited in the site made available within the property. In any event no solid waste resulting from the construction Stage in the site of the cement facility or within the property will be burned.

Liquid wastes will be any wastes produced by the employees both in the work fronts and in the camp. Portable bathroom facilities will be provided in the work fronts far away from the camp. The wastewater treatment plant (wetland) will be one of the first works to be built, in order to dispose of the wastewater coming from the bathroom facilities of the 1,800 construction workers, which will also be used during the subsequent operational stage of the cement facility. If necessary, an extended aeration plant will be installed to treat wastewater from the camp, but no wastewater without secondary treatment will be discharged to the Sunuj ravine.

Gas emissions to the atmosphere by the engine exhaustion of construction machines and equipment, these emissions will be the standard emissions from the new machines to be purchased for the development of the Project. In addition, the machines and equipment will be given routine maintenance; therefore, there will be minimum gas emission intensity.

5.9.1.2 Toxic and Hazardous Wastes

During the construction stage toxic and hazardous wastes such as lubricants, must be disposed of. Oil wastes from the change of oil of construction machine and equipment will be properly stored in drums, and then sent to the cement facility in San Miguel, and used as fuel in the kilns.

5.9.2 Operational stage

5.9.2.1 Solid, Liquid, (including drainages) and Gaseous Wastes

All solid wastes will be internally managed within the San José Ocaña property, as managed now at the cement facility in San Miguel, Sanarate. All solid wastes will go to compostation (organic), recycling (metals) or co-processing (plastic, cloth, glass, etc.). Cementos Progreso has the procedures to manage regular solid wastes and the process currently used in the San Miguel cement facility, which will be used also in the new cement facility in San José Ocaña, San Juan Sacatepéquez. No residues will be burned in open cut for any reason whatsoever.

Wastewater from the cement facility will be treated in wastewater treatment plant (wetland), like the system used at the cement facility in San Miguel, Sanarate described in paragraph 5.7.2, above.

Oil changes created during the operation period collected and stored in a specific place in appropriate containers, under the responsibility of cement facility manager these wastes will be burned in the kiln.

Gas emissions will come from the machines and equipment combustion engines; these will be newly acquired (new), therefore, gas emissions will be reduced to a minimum, and appropriate and timely maintenance will be given. Carbon dioxide and traces of some other gases normally occurring in the combustion processes will be created in the kiln. The main mill chimneys will have particle concentration measurement devices, while the kiln chimney will also have CO, CO_2, NOx, SOx, monitoring devices, and if operating with alternative fuels, a continuous measurement apparatus for volatile organic compounds will be available. In all these events, and in the absence of local regulations, the guide values suggested by International Finance Corporation (IFC 2006) will be fulfilled.

5.9.2.2 Toxic and Hazardous Wastes

As mentioned in paragraph 5.8.2 above, during the operational stage of the cement facility, toxic and hazardous wastes will be:

i. Any reactive to be used in the quality control laboratory, basically consisting of acids and typical bases of an industrial laboratory. These materials will be neutralized before dumped into the drainage which will conduct the materials to the wastewater treatment plant (wetland);

ii. Another possible source of toxic wastes is the gamma-ray analyzing source (Californio 252). The supplier will change the source and will deal with its disposal; and,

iii. Equipment and engines lubricant wastes. Wastes will be collected and used as fuels in the kiln.

5.10 Concurrence with the Land Use Plan

No municipal planning is available in the area of the Project regarding the use of land, nor is there any development plan; what is seen in the surroundings of the cement facility site is forest plantations, the dirt road from Cruz Blanca to Las Trojes, the sawmill and coffee plantations. The owner of the San José Ocaña property has been sustainable managing the forest for several years, according to the Forest Management Plan approved by the NFI.

The cement facility will cover 64 hectares, and the quarry in the first 25 years will be using 50 hectares; therefore, the remaining 860.7 hectares (746.7 ha.), will continue to be used in the same agricultural and forest activities as used today.

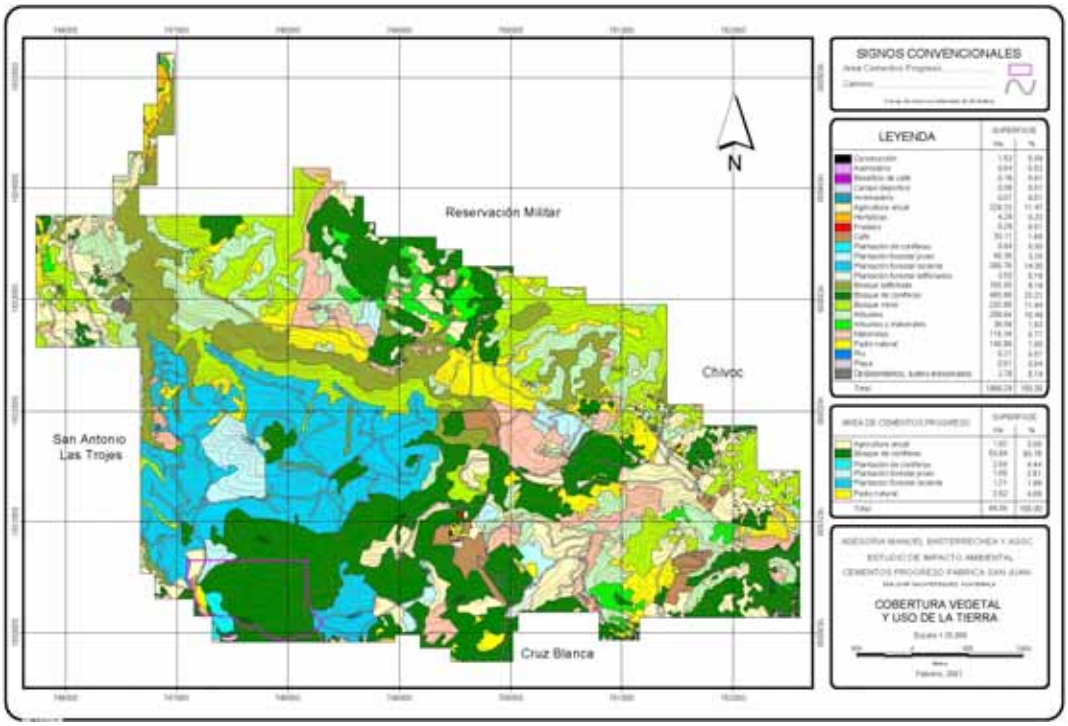
Map 5.2., shows a plant coverage and the current land use of the exploration area (2,000 ha.), and the cement facility (64 ha.), approximately 62% of the exploitation area is covered with forest and forest plantations: 18% bushes and brushes; 11% annual agriculture; 7% natural pasture, and the remaining 2% coffee, fruit trees, vegetables, and flower greenhouses.

Approximately 85% of the 64 hectares of the cement facility is a coniferous forest. Below is a brief description of the ways of occupation of the space in the exploration area:

- Rural communities, although some communities, due to the proximity to San Juan Sacatepequez may be considered semi-urban communities (Cruz Blanca);
- Means of communication consisting of rural roads and the main road connecting to San Juan Sacatepequez;
- Domestic, small-scale livestock activity;
- Subsistence agriculture, this is a continuous for of occupation and affects the entire landscaping, and occurs both in flat parts and hills;
- Areas reforested with pine trees, *Pinus pseuostrobus*, in form of mono-specific forests (Figure 5.2), where the original vegetation of the Subtropical very humid, low mountain, forest; and
- Gallery forests presenting an acceptable preservation degree (Figure 5.3), which gives high asthetic value to local landscaping and to biological diversity;

Figura 5.2 Reforestación con pinos cerca del sitio de la fábrica de cemento.

Figura 5.3 Bosque de galería en el cauce del río Pachum.



6. LEGAL FRAMEWORK

The State's roles and responsibilities under the Guatemalan Political Constitution of 1985 have been broadened to include environmental management. The Constitution provides that the State, the municipal districts, and all those living within the national territory are mandated to promote social, economical, and technological development in order to prevent environmental pollution and maintain the ecological balance. Section 97 literally reads: "all necessary regulations shall be adopted with the purpose of ensuring that fauna and flora development, as well as land and water usage activities, are undertaken on a reasonable basis".

Specific environmental concerns are regulated under the Environmental Protection and Improvement Act (Congress Decree 68-86) enacted expressly to contribute to the protection, preservation, and development of the country's natural resources, as well as to prevent deterioration, misuse or destruction thereof, and environmental recovery at large. Section 8 specifies that an environmental impact assessment is to be submitted for the review and expert opinion of the National Environment Committee prior to the execution of a project.

Under Congress Decree 90-2000, CONAMA was annexed to the Ministry of Environment and Natural Resources (MARN). MARN's rules of procedure were approved by Government Resolution 1-2001. On January 27, 2003, the new Regulations for Environmental Evaluation,

Control, and Follow-up were approved pursuant to Government Resolution 23-2003, which embodies the new directives for preparing and submitting EIAs (Environmental Impact Assessments), effective as of November 15, 2003.

The maximum admissible limits for domestic and agro-industrial wastewater discharges were issued in 1989. Legislative Decree 236-06 was enacted in 2006: Regulations for the discharge and reuse of wastewater and sludge disposal.

The Protected Areas Act (Congress Decree 4-89) was issued in 1989 and subsequently amended in 1996. This law purports to ensure the optimal performance of the baseline ecological processes and the vital natural systems for the benefit of all Guatemalans, to succeed in preserving wildlife in the country, to attain sustained utilization capacity of the species and ecosystems throughout the country, to defend and preserve the nation's natural heritage, as well as to clearly demarcate protected areas within the national territory, in the public and social interest.

The new Forestry Act (Decree 101-96) declares that reforestation and forest conservation are to be addressed as matters of national urgency and in the social interest. To this end, forest development and ensuing sustainable management will be promoted. The responsibility of enforcing said law rests with the National Forest Institute, INAB.

Decree 48-97 comprises the Mining Law enforced by Mining Directorate-General of the Ministry of Energy and Mining. The Law defines all minable materials in the national territory, the mining licenses application and concession granting process, the time frames for obtaining reconnaissance, exploration, exploitation and/or export licenses.

The new Health Code was approved in 1997 under Congress Decree 90-97. Chapter IV thereof addresses health and environmental aspects.

Furthermore, Sections 471 and 474 of the Civil Code – Decree-Law 106 – read as follows: Section 471. Proprietary benefits. "The property owner is entitled to the benefits thereof and to any property gained by accession, pursuant to the provisions set forth in the Chapter on Property Law of the Civil Code". Section 474. Prohibition of excavation works that may cause damage to neighboring property. Site excavation or construction works that undermine the soil of neighboring property, failing to carry out all essential consolidation works to prevent further damage, is hereby prohibited.

7. AGGREGATE AMOUNT OF INVESTMENT

Table 7.1 shows the key line item values of the new cement facility. Approximately 40% of the aggregate amount of investment will be allocated to the purchase of mechanical and electrical equipment and about 35% to civil works. In addition, about 3.2% (US$ 11.2 million) will be invested in pollution control equipment, as described in Chapter 13, Environmental Management Plan (See Table 13.1).

Table 7.1 Cash Flow for the Cement Facility construction (in millions of dollars)

	Year of Execution				
Line Item	**2006**	**2007**	**2008**	**2009**	**Total**
Land	10.00				10.00
Surveys	4.00				4.00
Roads	6.00	3.00			9.00
Overhead power transmission lines	0.50	0.50			1.00
Earthworks	6.00	6.00			12.00
Worksite and utility services (water supply, piping, etc.)	0.50	1.50			2.00
Engineering	3.10	3.00			6.10
Civil works		90.0	20.00	8.30	118.30
Mechanical and electrical equipment	4.00	77.00	57.00		138.00
Mechanical installation		7.00	7.00	2.40	16.40
Electrical wiring and installation			2.80	2.00	4.80
Project management		1.47	1.47	0.36	3.30
Unforeseen expenses				22.05	22.05
Totals	**34.10**	**189.47**	**88.27**	**35.11**	**346.95**
Cost per ton installed: 247.82					
Costs according to the 5-30-2006 FLS proposal					

8. DESCRIPTION OF PHYSICAL ENVIRONMENT

8.1 Geology

8.1.1 Regional Geological Aspects

Four geological units within the project's area of influence are reported in the region, as shown in Figure 8.1, and are described as follows:

- Piroclastic deposits: pumice tuffs, worked-over tuffs, and pumice lapillis (Qp);
- Unsplit volcanic rocks (Tv) that include andesite-basalts, ash-flows, and rhyolites;
- Unsplit Cretaceous carbonates (Kcs), mainly limestone and loam;
- Granite and/or diorite irruptives probably from the Cretaceous-Tertiary period (Kti).

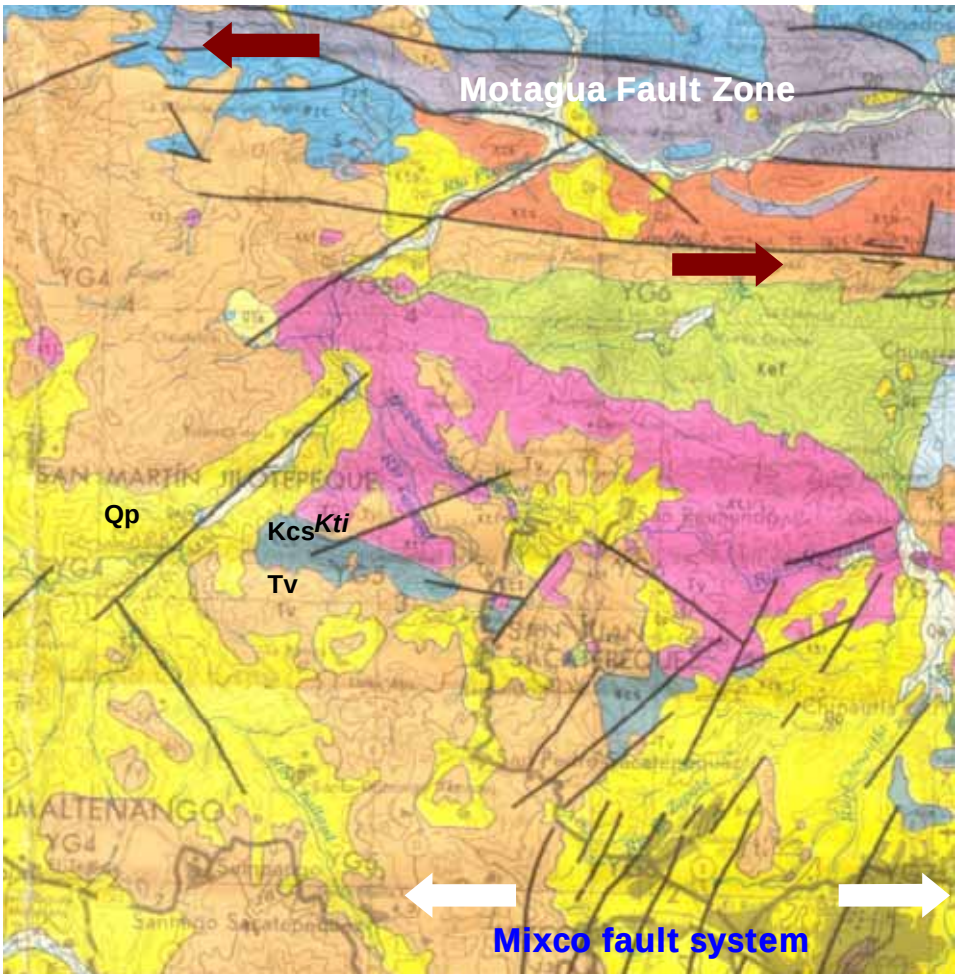


Figure 8.1 Regional Geology showing the area of influence of the proposed project. Nomenclature is described above. The arrows indicate the direction of relative movement of the geological fault zones. Source: Modified from IGN, 1990.

The project site is located at the center of two structural systems of different origin. The Motagua Fault Zone (counterclockwise movement) lies to the North, and the Mixco extensional faults to the Southeast, which also shape the Western boundary of the Ermita Valley. The structural behavior within the project area is influenced by both fault systems.

The region's main fault traces found in the project area of influence Appendix a practically bimodal distribution (Figure 8.2). The primary mode shows a NW58 bearing and the secondary mode shows smaller N135 weightings. The primary mode is actually a secondary system associated to the Motagua fault zone rather than to the Mixco fault system.

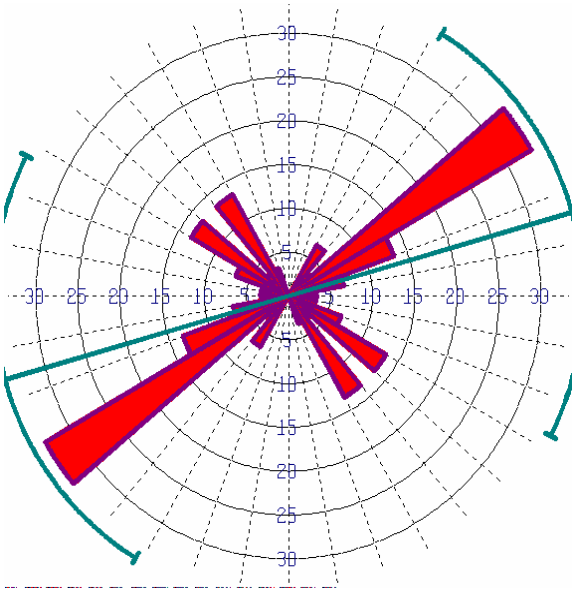


Figure 8.2 Modal distribution rose diagram of the main lineations associated to the regional faults. The primary mode of the regional geological faults Appendix a NW58 orientation.

8.1.2 Local Geological Aspects

Eight lithological units are reported at the local level (see Figure 8.7 below):

- Recent deposits: Quaternary alluvium deposits (Qal) distributed in the form of sediments carried by river currents in the area's natural drainageways;
- Quaternary pumice piroclastic deposits and pumice ash: Composed mainly of medium to fine-grained, light to reddish brown, worked-over and compact subaerial and submarine lapillis and pumice tuffs (Qp). Tuffs indistinctly cover plains and depressions, revealing greater potentiality and thickness south of the area, where they are estimated to exceed 20 meters. Thickness measurements observed in the drilled areas vary and may Appendix thicknesses exceeding 100 meters;

- Coarse-grained Quaternary Conglomerate: Largely locally-deposited andesite clasts associated to fault outcrops (Qtc);
- Andesite flows and olivine and pyroxene andesite flows (Qta);
- Tertiary Basalt Extrusions: Rock groupings which may be extrusions from the Padre Miguel tuffs usually corresponding to laminated basalt and andesites, with a significant olivine pyroxene content, partially meteorized and/or altered, making up small deposits of kaolinized material (Tpm);
- Carbonates corresponding to the Átima formation (Ka): Mainly gray, crystalline, moderately stratified and heavily fractured limestone, calcarenites, breccias and loams. This lithological unit is described in detail as follows:

  - ✓ **Limestone B (CB):** Stratified, fine-grained, silicified, partly grayish, with chert levels and an estimated thickness between 80 and 100 meters;
  - ✓ **Loam (M):** Fine-grained, dark gray color, with loam and limestone interlayering mainly on rock footwall and hanging wall, with strata of a thickness not exceeding 25 cm. Thickness of unit is estimated between 60 and 80 meters. Some strata packages Appendix scattered pyrites;
  - ✓ **Calcarenites:** Medium-grained, grayish brown, limy sandstone of an estimated thickness not exceeding 10 meters. This unit is an unmappable unit, however, it may be useful as a guide layer; and,
  - ✓ **Limestone A (CA):** 80 to 90-meter run of medium to fine-grained gray limestone and light-gray recrystallized limestone interlayering, slightly breccia-type and probably slightly dolomitized. Another upper run containing pure, fine-grained, grayish white, massive and marbleized limestone of an estimated 70 to 80 meters in thickness. Thickness of the Limestone A unit is estimated between 150 and 180 meters. Total carbonate thickness (the entire column) is estimated to exceed 300 meters.

- Breccia (Cretaceous? Kb): Comprised of angular and subangular nodules and fragments of intermediate and basic igneous rock – mainly gabbro and diorite - partially silicified, dark gray or matte black, with granite and metamorphic rock fragments in smaller proportion that are fractured, breccia-type, superficially meteorized, and contained in an aphanitic matrix which exhibits deep reddish tones when meteorized. Soil situated above the breccia shows a deep red color, derived from the strong oxidation of iron present. Its origin and morphology have yet to be defined and are probably tectonic. The area in contact with granite exhibits a granitic matrix breccia, evidencing that granite is of much younger origin and has intruded the breccia; and,
- Tres Sabanas Granite (Kts): Exhibits grain size variations, from coarse to medium, it shows partial meteorization and its irregular-shaped contact with the breccia is the result of intrusion. Lithologies have been identified as granite, quartz monzonite, granodiorite, and quartz diorite. The dotted line indicates the foliated flow zone near the contact area.

8.1.3 Structural Analysis and Evaluation

Structural analysis is based on the main lineations associated to the main fault system shown in the Geological Map (Figures 8.1 and 8.7). For a better understanding of the fault system behavior, refer to Figure 8.3 below.

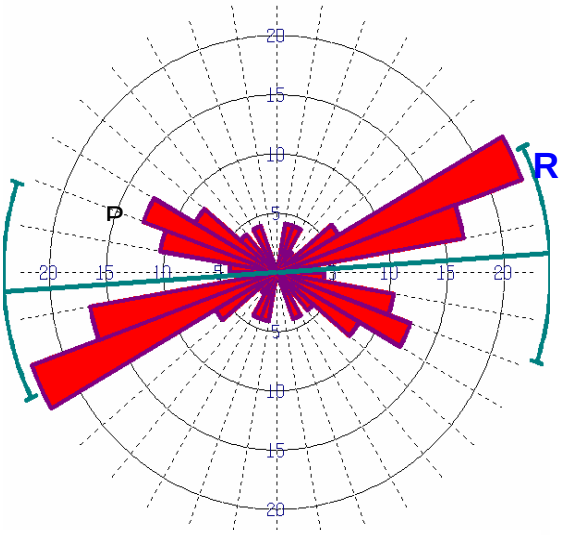


Figure 8.3 Rose diagram of fault strikes in project area. Bimodal distribution with order of relevance N070 and N115.

A primary fault system with a Northeast bearing is observed, as well as a perpendicular secondary system with a Northwest bearing, derived from intrusions and tectonic activity which has impacted the zone. The fault distribution is clearly bimodal with the main mode of orientation being NW70 and the subordinate mode being N115.

Given the area's topography and as a result of the unit distribution within the area, this fault is NW70 oriented, and may be interpreted as a secondary Riedel type (R) fault system associated to the Motagua fault system. The other fault with a N115 orientation is also associated to the Motagua fault system, yet it is a Skampton-type (P) secondary system.

Considering that the tectonic breccias and the basic complex have been emplaced, contact with upper units must be the result of fault activity. The zone in contact with granite exhibits breccia with a granitic matrix, evidencing that granite is of a more recent origin and has intruded the breccia.

Strata (Figure 8.4), measured mainly in the carbonate unit (limestone and loam), are generally NWW-SEE oriented, with dips sloping both to the NE and to the SW, where 50% of all dips Appendix a slope between 40 and 49 degrees; 20% between 30 and 39 degrees (see Figure 8.5). Measures have shown 10% of dips ranging from 20-29 degrees, 70-79, and 80-89 degrees.

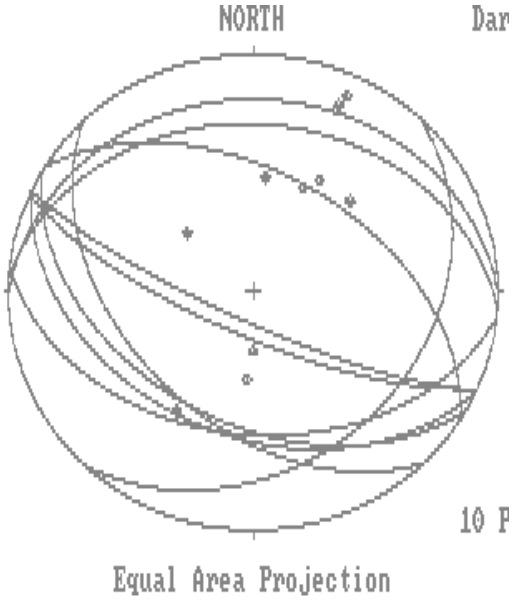


Figure 8.4 Stereographic representation of beddings measured in the carbonate unit.

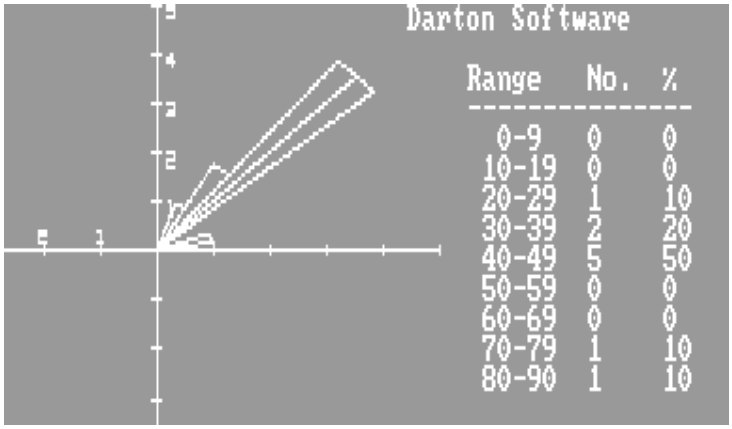


Figure 8.5 Percentage distribution of dip values measured in the carbonate unit in the project area.

Due to the relative spatial distribution and the pole distribution, antiformal and synformal structures, with axis slightly tilted SEE (see Figure 8.6), at a 06° angle to the N118, are found in the area. At least 2 tectonic deformation events are evident. To the NNE, a compression event has occurred which is probably responsible for the carbonate unit fold.

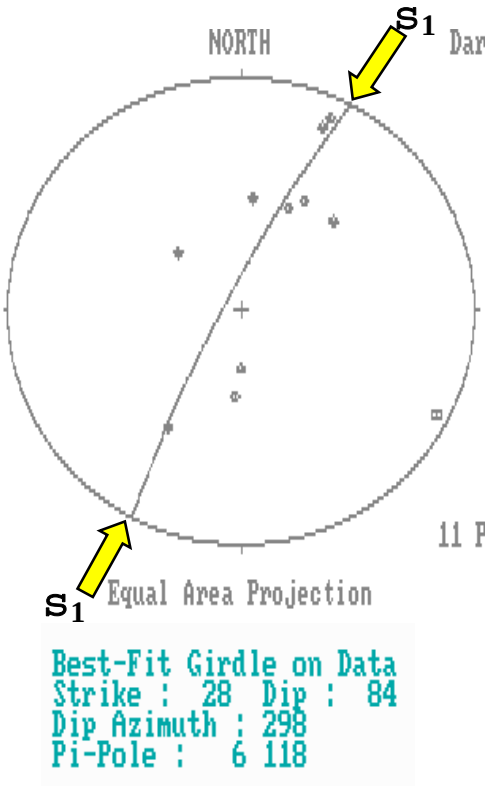


Figure 8.6 Pole distribution of beddings defining a subhorizontal axis fold (06° to the N118) and a compression event to the NNE-SSW.

8.1.4 Geotechnical Characterization

Test drillings provide geotechnical data that will be used as a basis for designing the cut embankments and foundation works of the site infrastructure. In the main limestone quarry zones, organic soil layers may range from 0.50 to 2.50 meters. Thickness of the pumice blanket and lythic tuffs within the quarry area may range from 5 to 20 meters, above the carbonate unit. Several paleosoil horizons may be bound at a depth of 10-12 meters. A relevant aspect in this zone lies in its northern border where some limestone outcrops occur with little or no blanket at all, thus facilitating its removal.

Soils, tuffs, and lapillis are easy to strip, as well as the rocks displaying meteorization above degree III. Removal will become more difficult in units with ledge rock outcrops or a degree of meteorization that is lower than III, as is the case with granitic rocks, basalts, marbleized limestone, and cemented or silicified lythic tuffs. The degree of fracturing presented by the lithological units will facilitate their fragmentation and removal.

Erecting the foundations in any infrastructure work will no longer be a problem since thickness of organic soil does not exceed 2.50 meters, or even less in certain areas. Once soil has been removed, the infrastructure will be built on hard and suitable lithological units. Stripping of rocks exhibiting a degree of meteorization above III is also advisable for building the required infrastructure that will normally not be too weighty. No difficulties or inconveniences are expected from the supporting capacity of the lithological units in the project area.

8.1.5 Geological Map of the Project Area (PA) and Direct Area of Influence (DAI)

Figure 8.7 shows a geological map of the project area and its area of influence. Carbonates corresponding to the Átima formation (Ka) are reported in the project area (PA). The following lithological units are reported in the direct area of influence (DAI): Recent deposits corresponding to Quaternary Alluvium Deposits (Qal); Quaternary pumice piroclastic deposits in general, and pumice ash, composed mainly of subaerial and submarine lapillis and pumice tuffs (Qp); Coarse-grained Quaternary Conglomerate, composed mainly of locally deposited andesite clasts associated to fault outcrops (Qtc); Andesite flows and olivine and pyroxene andesite flows (Qta); Tertiary Basalt Extrusions (Tpm); Cretaceous Breccia (Kb); and Tres Sabanas Granite (Kts).

Eighteen (18) wells were drilled in the project area for exploratory purposes, allowing for the construction of stratigraphic columns, as described below (Micensa 2006 quoted by COFEPRO 2007):

- ✓ The oldest rocks in the project area are composed of loamy soil underlying in fault contact with a heavily fractured and faulted thick carbonated layer;

- ✓ Thickness of the carbonated layer ranges from 400 to 600 meters. This layer is in fault contact with 200 to 300-meters thick Tertiary volcanic rocks. They appear to be heavily affected by hydrothermal alterations, measuring up to 100 meters in thickness; and,

- ✓ Lastly, a thin pumice 50-meter thick layer occasionally overlying all lithological units described above.

Map Key:

Qal: Recent alluvium deposits
Qp: Pumice deposits
Qta: Andesites
Qtc: Fault-related conglomerates
Tpm: Tertiary basalts
Ka: Átima Formation Limestone
Kb: Intermediate and mafic rock breccias

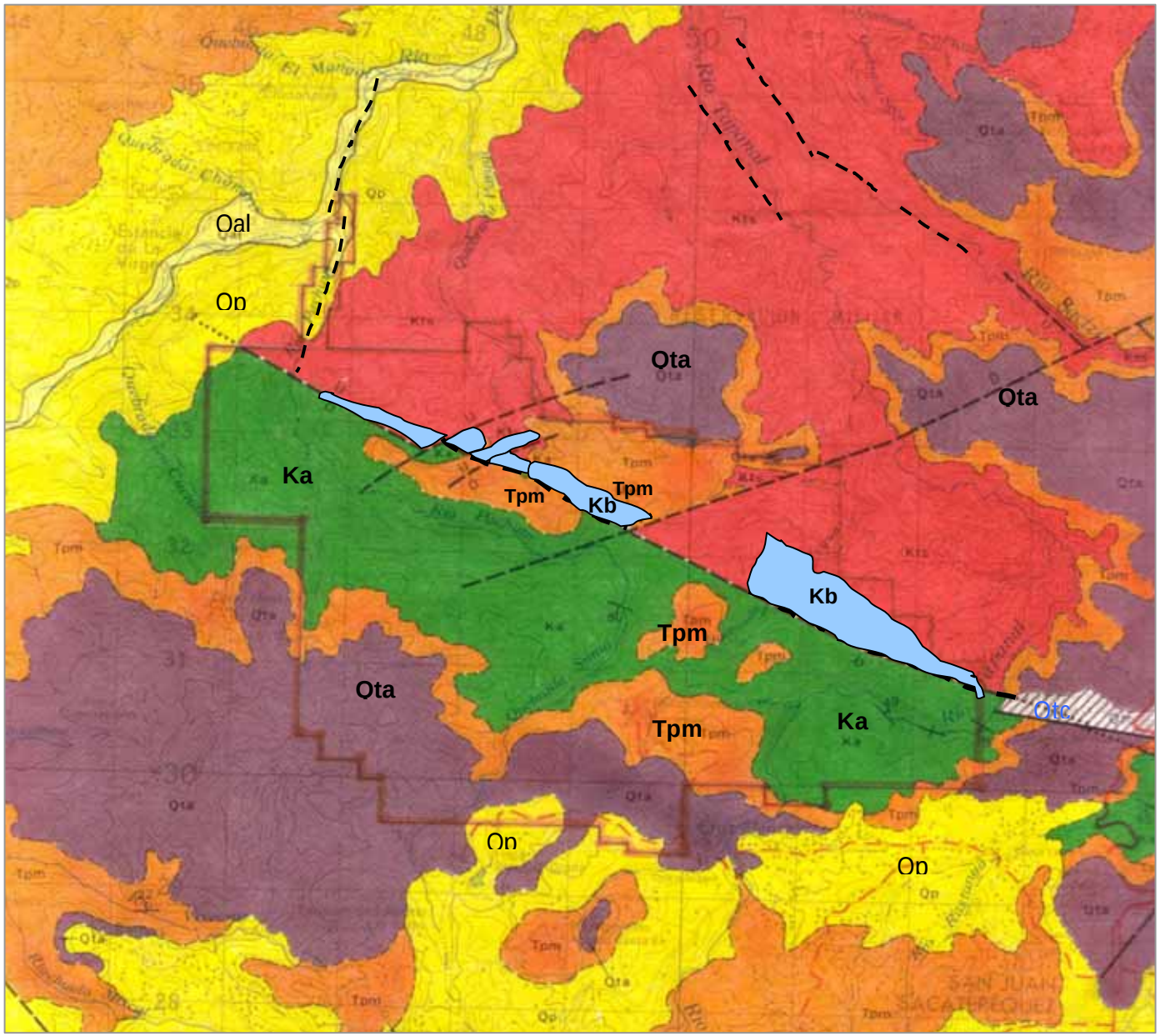


Figure 8.7 Local geological map. Source: Modified from IGN, 1981.

8.2 Geomorphology

8.2.1 Geomorphologic Description

Altitudes measured in the licensed exploitation area (2,000 hectares) vary by 800 meters (1,960 masl to 1,080 masl), evidencing a rugged landscape. Map 8.1 shows three angles of the elevation model of the exploitation area, with a circle enclosing the location of the cement facility.

Map 8.2 shows that slopes found in 56% of the total exploitation area range from 20 to 55%, and are mostly located at both sides of the Pachum riverbed and in the main occasional ravines that cut down into the river. A mere 6% of the total area exhibits slopes ranging from 0% to 6%. Slopes in the remaining 38% of the total area range from 6% to 20%. Again, those areas with slopes greater than 20% are highly sensitive to erosion.

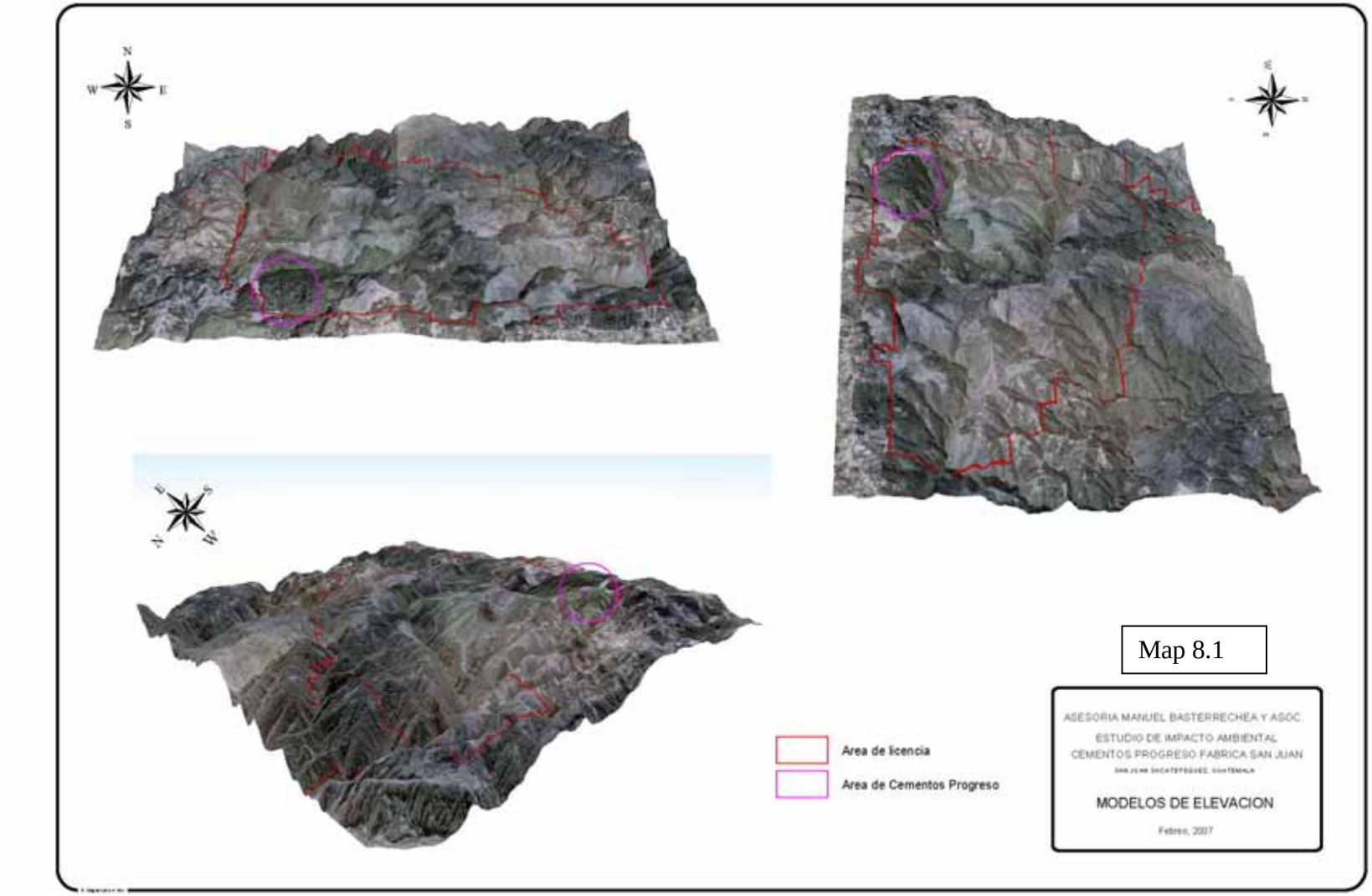
8.3 Soils

According to the Simmons et al classification and to the MAGA-INAB-FAO-PAFG (2001) soil series map, mostly Cauque (Cq) and Guatemala pending Stage (Gtp) soils are encountered at the San Juan Sacatepéquez municipal district, and to a lesser extent, Chuarrancho (Chr) and Chinautla (Chn) soils, and Rough surface Areas (Af). These soils are to be used for agriculture and forestry; uneven terrains should be utilized for maintenance forest, whereas flat terrains should be used for temperate agriculture.

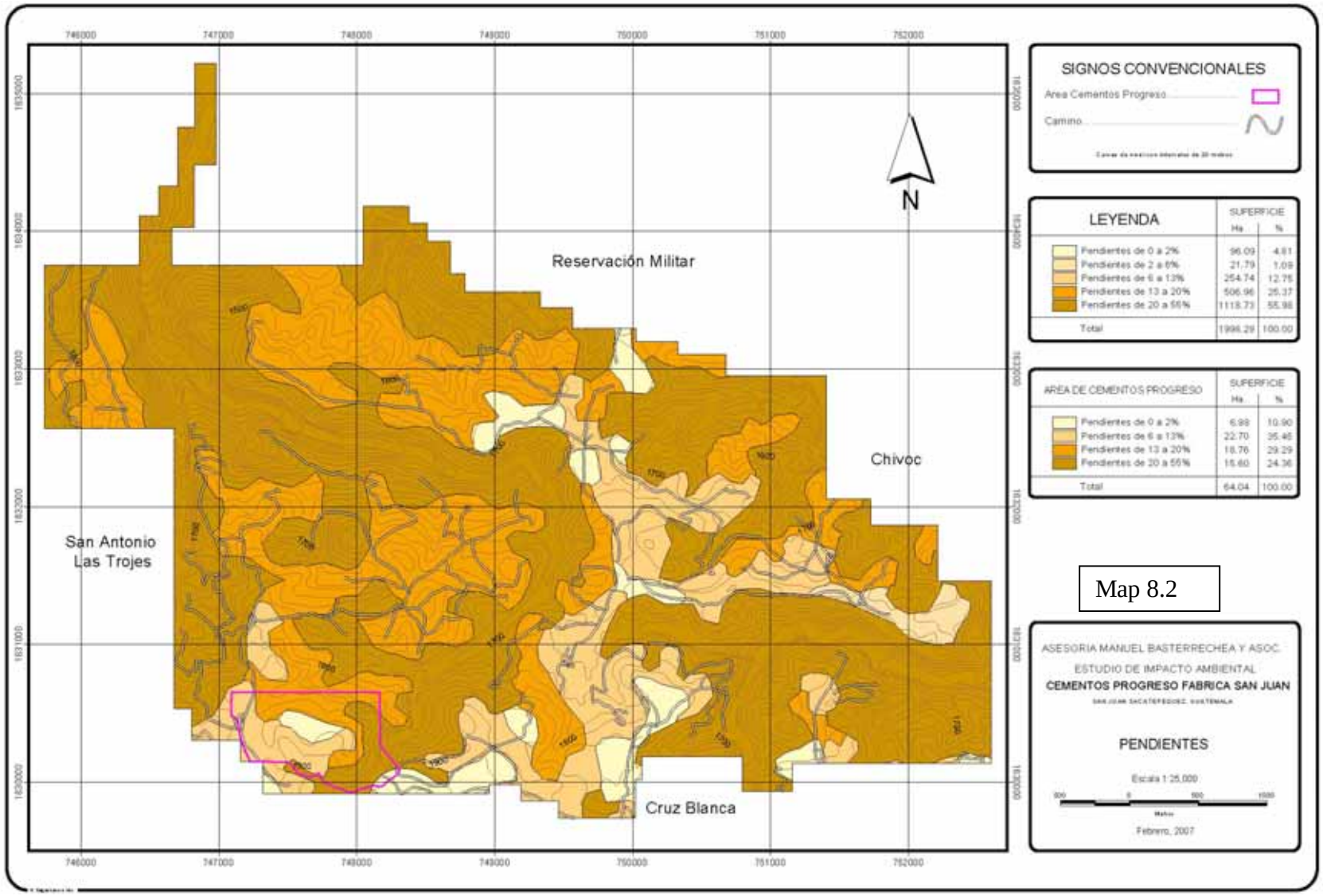
88.66% of the total exploitation area comprises Guatemala pending Stage soils; the cement facility will be located on these types of soils that are typically distinguished by their segmented relief and sloping angles greater than 20%. Types vary from near typical loamy soils to a very thin layer of yellowish brown loamy soil.

These soils must either be reforested with trees or used as grazing land; the latter only on the least sloping sites which should be monitored to prevent erosion and compacting. The total area shown in the Soil Reconnaissance Classification covers 8,970 hectares, i.e., 0.082% of the country's total area; Chimaltenango and Guatemala.

The Rough Surface Areas (uneven, coarse-textured terrain) occupy 9.01% of the licensed exploitation area. This unit had not been surveyed elsewhere in the country during the Soil Reconnaissance Classification of Guatemala as the map's scale does not allow for such detail. Areas where this type of soil is found are included in other types of soils, particularly in the Patzité, Zacualpa, and Fraijanes soils. According to the Soil Reconnaissance Classification, these areas cover 28,173 hectares, accounting for 0.259% of the country's area. This type of soil is found primarily in the departments of Guatemala, El Progreso, and Chimaltenango.



(Environmental Impact Assessment - ELEVATION MODELS, February 2007 - License Area - Cementos Progreso Area)


746000
747000
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1635000
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1633000
1632000
1631000
1630000
N
Reservación Militar
Chivoc
San Antonio
Las Trojes
Cruz Blanca
SIGNOS CONVENCIONALES
Area Cementos Progreso
Camino
LEYENDA
SUPERFICIE
Ha
%
Pendientes de 0 a 2%
Pendientes de 2 a 6%
Pendientes de 6 a 13%
Pendientes de 13 a 20%
Pendientes de 20 a 55%
96.09
4.81
21.79
1.09
254.74
12.75
506.96
25.37
1113.73
55.98
Total
1996.29
100.00
AREA DE CEMENTOS PROGRESO
SUPERFICIE
Ha
%
Pendientes de 0 a 2%
Pendientes de 6 a 13%
Pendientes de 13 a 20%
Pendientes de 20 a 55%
6.99
10.90
22.70
35.46
18.76
29.29
15.60
24.36
Total
64.04
100.00
Map 8.2
ASESORIA MANUEL BASTERRECHEA Y ASOC.
ESTUDIO DE IMPACTO AMBIENTAL
CEMENTOS PROGRESO FABRICA SAN JUAN
PENDIENTES
Escala 1:25,000
Febrero, 2007

(“Reservación Militar” = Military Reservation)

(CONVENTIONAL SIGNS

Cementos Progreso Area - Road)

(MAP KEY - “Pendientes” = Slopes - “Superficie” = Surface Area - “Escala” = Scale)

_____

The remaining 2.33% within the licensed exploitation area is occupied by Cauque type soils. This type of soils comprises deep, well-drained soils that have developed in a humid-dry climate on top of a hard and thick layer of pumice volcanic ash. To a depth of 15 cm. the topsoil is a loamy or sandy loamy, friable, very dark brown soil. The soil underlying the topsoil at a depth of about 35 cm. is a sandy loamy, friable, dark brown soil. To a depth of about 75 cm, subsoil is a hard and loamy, though friable, dark to dark brown soil.

The deepest soil layer, encountered at about 110 cm. is a loamy, hard, dark yellowish brown soil, composed of partly decomposed pumice containing a few fragments of unmodified pumice. The substrate is composed of coarse, cemented, nearly white pumice. The vertical slopes of excavations made in the substrate are held in place for many years. Deep cuts display a series of volcanic eruptions and soil formation periods.

Summing up, soils found primarily in this area are closely related to their parent rock: soils of lesser distribution (Fluvisols) derive from alluvial soils and are located in flood zones and alluvium deposits in riverbeds; Andosols, which usually originate from pumice and more siliceous-type rock deposits; and Chemozems deriving from limestone, typically found in some places as the so-called “terra rosa” soil.

8.4 Climate

Two weather stations have worked on a regular basis in the region covered by the project and its surrounding areas: INCAP Experimental Station (1985-1989) and El Pilar Station (1979-1989), both in the municipal district of San Juan San Juan Sacatepéquez, department of Guatemala. The INCAP Experimental Station is located in the municipal district of San Juan San Juan Sacatepéquez, at 14°43´00” North latitude, 90°39´00” West longitude, and at 1,845 masl. El Pilar Station was also located in the San Juan Sacatepéquez municipal district at 14°42´22” North latitude, 90°42´44” West longitude, and at 2,000 masl.

The annual average rainfall is 1,337.7 mm, with the standard deviation being 167.3 mm and the variance ratio 12.5%. On average, the rainy season begins during the second half of May (115.9 mm) with a standard deviation of 34.2 mm and a variance ratio of 29.5%; the rainy season declines during the first half of November (33.1 mm), with a standard deviation of 16.4 mm and a variance ratio of 49.6%.

Throughout this zone, the heaviest rainfall period occurs in June (278.1 mm), July (219.8 mm), August (214.6 mm), September (286.1 mm), and October (129.9 mm), with variances of 13.8%, 14.5%, 5.0%, 0.7% y 18.0%, respectively. Thus, flash floods are more likely to occur during this period (June-October). The driest months of the year are January (8.7 mm), February (4.6 mm), March (3.2 mm), April (39.8 mm), November (33.1 mm), and December (4.2 mm), with monthly variances of 40.1%, 24.6%, 39.8%, 8.7%, 49.8% y 80.8%, respectively.

A total of 99 days with rainfall exceeding 0.1 mm has been recorded as average rainfall, with an inter-monthly standard deviation of 7 days and a variance ratio of 6.92%. In this region, the months reporting the greatest number of rainy days are: June (18 days), July (14 days), August (15 days), September (19 days), and October (11 days). The months reporting the lesser number of rainy days are: January (1 day), February (2 days), March (1 day), April (5 days), May (7 days), November (5 days), and December (1 day).

The multi-annual average temperature is 19.2° C, with an inter-monthly standard deviation of 1.6° C and a variance ratio of 8.5%. Data was obtained from the INCAP Experimental Station.

The lowest average temperatures have been recorded in January (16.6° C), February (17.8° C), November (18.0° C), and December (16.0° C), an average of 17.3° C, with a standard deviation of 0.8° C, and a variance ratio of 4.4%; whereas the months reporting average temperatures higher than 19.2° C, which may be considered as above-average months of the year, are March (19.6° C), April (20.1° C), May (20.7° C), June (20.8° C), July (20.8° C), August (20.2° C), September (20.3° C), and October (19.7° C), with an inter-monthly average of 20.2° C, standard deviation of 0.4° C, and a variance ratio of 2.1%.

The minimum multi-annual average temperature recorded is 14.4° C, with a multi-monthly standard deviation of 0.8° C and a variance ratio of 5.8%. At a monthly level, the average minimum temperatures are lower during January (13.0° C) and February (13.1° C). Minimum temperature averages are higher in the months of June (16.0° C), July (15.1° C), and August (15.0° C). The absolute minimum temperature has been recorded at 6° C with a multi-monthly average of 10.2 ° C, a standard deviation of 2.9° C, and a variance ratio of 29.0%; the country's highlands present a high variability in minimum extreme temperatures. The highest absolute minimum temperature has been recorded in the months of June and September, at 14° C.

The multi-annual average maximum temperature is 24.4° C, with a multi-monthly standard deviation of 1.6° C and a variance ratio of 6.6%. Maximum monthly temperature averages are lower in January (22.6° C), November (22.3° C), and December (21.4° C). The maximum temperature averages are higher in March (25.9° C), April (26.4° C), and May (26.5° C). The absolute maximum temperature has been recorded at 31.0° C, with a multi-monthly average of 28.0° C, standard deviation of 1.7° C, and a variance ratio of 6.1%. The highest absolute maximum temperature has been recorded in March (30.0° C), and December (31.0° C).

The multi-annual average relative humidity is 80.2%, with a standard deviation of 5.1%, and a variance ratio of 6.4%. The minimum relative humidity values have been observed in January (73%), February (72%), March (76%), and April (76%), while the maximum values have been recorded in June (85%) and September (86%).

The multi-annual average of hours of bright sunshine is 2,400 hours, equivalent to an average of 6.58 hours per day. The multi-annual average solar radiation recorded is 250 Watts/square meter.

The recorded multi-annual average potential evapotranspiration is 1,459.8 mm, with an inter-monthly standard deviation of 17.5 mm and a variance ratio of 14.4%. The months that present a higher monthly evapotranspiration rate are March (135.9 mm), April (140.5 mm), and May (147.0 mm); while the months that present a lower rate of evapotranspiration are January (106.1 mm), February (110.7 mm), November (95.3 mm), and December (94.7 mm).

The dominant modal direction and average speed of the wind are East-Northeast and 2-5 kilometers/hour, respectively, especially during the dry season. Throughout the dry season, the influence of cold fronts blowing through brings in relatively dry winds from the Northeast and the East, with the dominant winds blowing in having a northerly component. The dominant winds during the rainy season have a southerly component (180°-270°), blowing in from the Pacific Ocean; these winds are laden with water vapor and cause rains Exhibiting warm front characteristics; also affecting are tropical waves from the East, and cyclone activity from the Caribbean. Rainfall caused by the vertical ascent of the intertropical convergence zone coming in from the Southern Hemisphere also plays an important role in the season's climate.

8.5 Hydrology

8.5.1 Surface Water and Groundwater

The licensed exploitation area, associated to this EIA (around 2,000 hectares), is located within four microbasins of the Pixcayá River sub-basin, namely, in order of importance, the Pachum River microbasin (which covers 48% of the total area), the Tapanal River microbasin (36%), the Parquí ravine microbasin (12%), and La Cuchilla ravine microbasin (4%). The project area is situated on the Pachum River microbasin. Map 8.3 shows the surface drainage of the licensed exploitation area's microbasins. The Pixcayá River is the main collector in the zone, empties into the Motagua river (a Caribbean Sea watershed), and is located to the west and north of the project area. This river has been polluted by domestic and agro-industrial wastewater discharge into its tributaries.

The Pachum River rises near the center zone of the San José Ocaña farmstead, and it is known by the name of Sunuj along its initial flow path. The river spring near the main house is used as a water supply source for human use and consumption. Water is passed through a dam and collected for nursery garden irrigation. Over the summer, the upstream and midstream regions of the Pachum River streamflows are low; dry places are actually seen downstream. Streamflows in the lower part of the river down to the estuary remain steady, though always low.

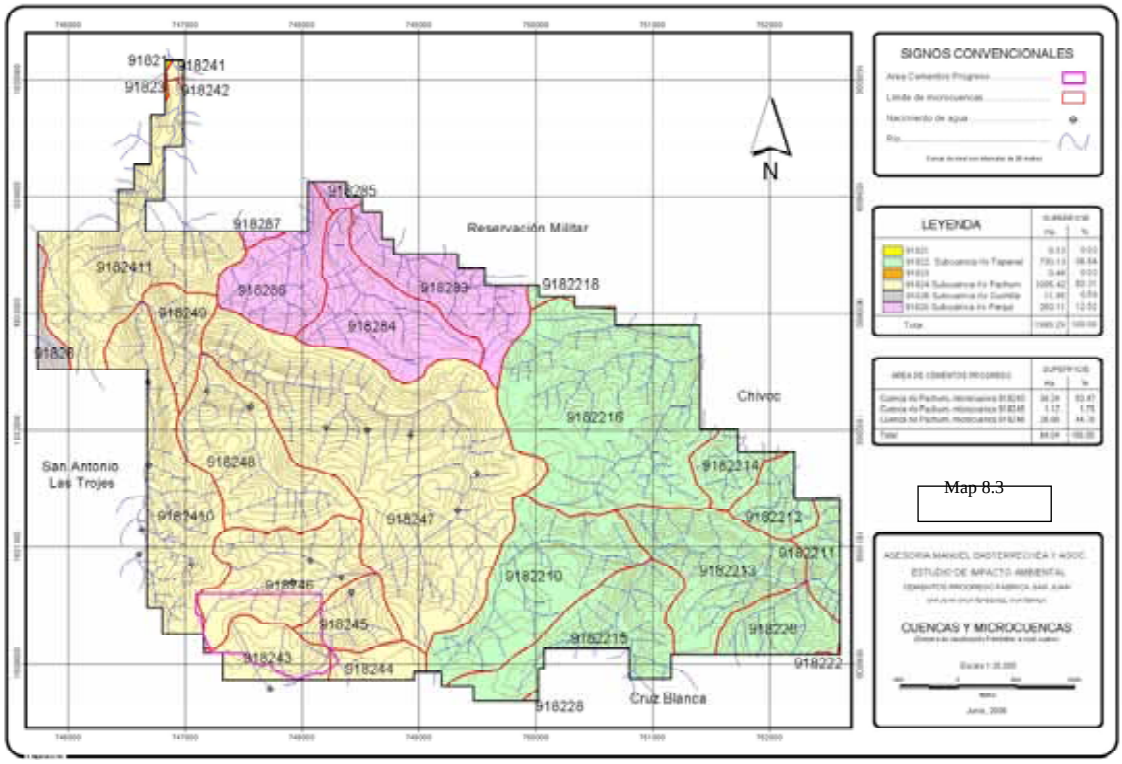
On the basis of the photogeological and field survey (Figure 8.8) 12 permanent water springs and 5 additional water springs (occasional springs) were identified in the project zone during the rainy season. These springs represent a water discharge zone with strong structural control, as inferred by the fact that one of the spring conglomerates is emplaced in the vicinity of the fault contact (N65W) between granite and limestone that controls the Pachum River's

main flow. Water springs are located near the ravines and the Pachum River, as shown on the microbasin Map 8.3.

Figure 8.8 Permanent springs (NP) and occasional springs (NI) for the project area and location of the PA1 exploratory well (white dot)

The importance of the Pachum River for this project resides in its relative proximity to the project area, as it constitutes the main drainage system within the zone. Devices designed for trapping suspended solids must be incorporated during the project construction and operation. In the winter, the Pachum River's flow rate is either low or moderate and steady, being fed by baseflow having circulated through the diverse lithologies found in the zone. Usually, these waters are clear, transporting a low concentration of suspended sediments and practically no alluvial materials (bed load).

Harnessing of surface water proves to be an extremely difficult task, since, during the dry summer months, streamflow is exploitable to a certain extent from the Pixcayá River and the lower part of the Pachum River only; however, elevations of potential uptake sites vary in more than 300 meters, and distance exceeds 2 kilometers, from the project site. In consequence, only partial harnessing of the Sunuj Ravine is possible during the rainy season, but low streamflows do not meet the project's demand. It is for this reason that other water supply sources, especially groundwater sources, are needed. In conclusion, availability of surface water is insufficient; therefore, groundwater must be utilized for this project.



(CONVENTIONAL SIGNS: Cementos Progreso Area - Microbasin boundary - Water spring - River)

According to a probe conducted by COFEPRO (2007), surface hanging and non-confined aquifers are found in the first 2 to 3 meters underneath the surface, measuring from 10 to 18 meters in saturated thickness. However, aquifer yield is notably reduced during the dry season and renders an insufficient supply for communities, calling for the need to drill mechanical wells. The COFEPRO (2007) hydrogeological assessment report on the project area of influence is attached as Appendix 7.

The semi-confined aquifer is partially isolated from the hanging aquifer system and extends northward where it lies in close contact with the West Pachum main riverbed and the lower part of the Pachum River (COFEPRO 2007). Groundwater level is found at a mean depth of 27 meters south of the area. Mechanical wells drilled south of the project area present an average saturated thickness of 250 meters, which is indicative of very good existing hydrogeological conditions for water supply. The exploratory well identified as PA1 is the closest to the project site. The groundwater level for this well was reported at 152 meters. Figure 8.9 shows the preliminary spatial distribution of groundwater level in the project area of influence. Figure 8.8 shows that the distribution of springs in the Pachum River microbasin is strongly linked to the flow network lines which cluster springs at the center of the microbasin (COFEPRO 2007).

Delimitation of the water recharge and discharge zones in the area is relevant for project water management. The water recharge zone is located in the high parts of the microbasins

dominated by volcanic plateaus and the region's aquifer groundwater level reaches down to a depth of 27 meters (COFEPRO 2007). The project's direct areas of influence and exploitation (2,000 hectares) are situated outside the water recharge zone (see Figure 8.10).

On the other hand, the water discharge zone is defined to the south by the water spring system shown on Figure 8.8, near the 16° and 31´ position (NW65 bearing). Figure 8.10 shows the boundaries of both the water discharge and the recharge zones. The intermediate zone between the recharge zone and discharge zone is called a groundwater flow zone, as shown in Figure 8.10.

In sum, given the projected water demand for cement manufacturing, the reservoir considered for water supply purposes is the deepest semi-confined aquifer, rather than the surface hanging aquifer system, as this aquifer's yield is sufficient for meeting the project's water supply needs without impacting its sustainability (COFEPRO 2007).

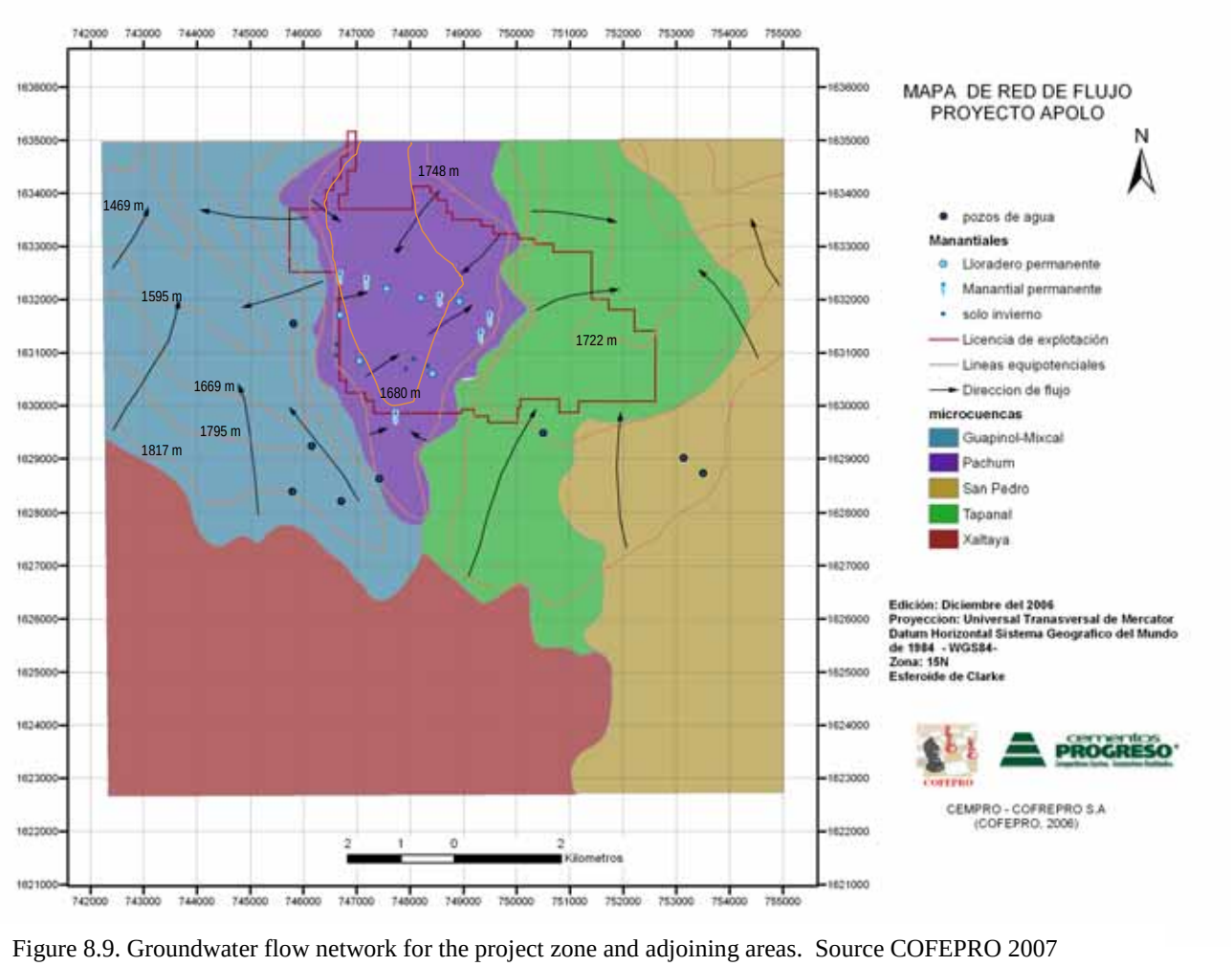


Figure 8.9. Groundwater flow network for the project zone and adjoining areas. Source COFEPRO 2007

(In order of appearance:
FLOW NETWORK MAP
APOLO PROJECT

Water Wells
Water springs
Permanent seepage zones
Permanent water spring
Winter only
Exploitation license
Equipotential lines
Flow direction
Microbasins

Edition: December 2006
Projection: Universal Transverse Mercator System
Horizontal Datum 1984 World Geodetic System
Zone: 15N; Clarke's Spheroid)

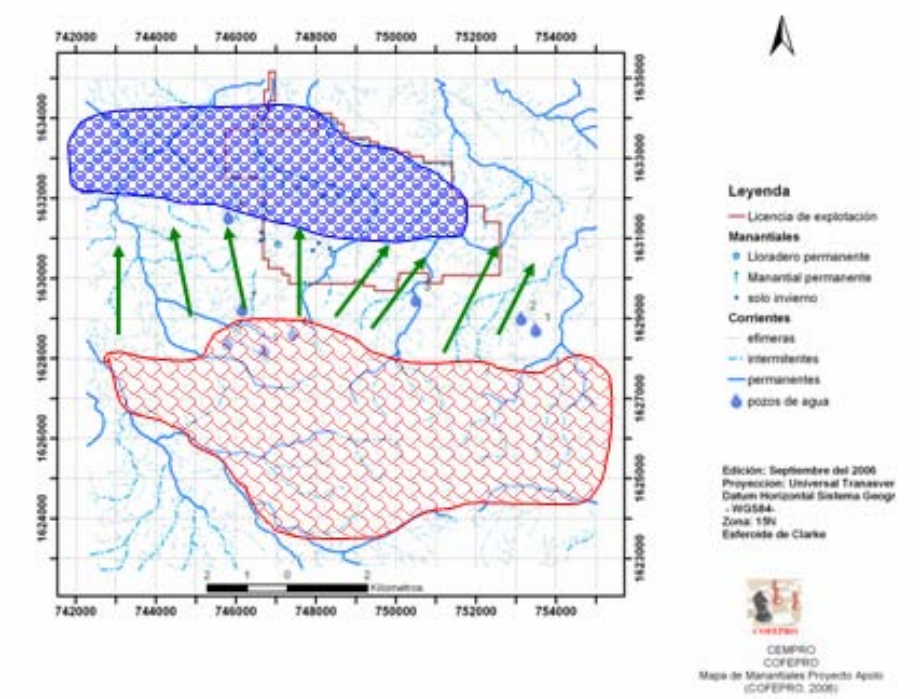


Figure 8.10 Spatial distribution of water recharge zones (red), flow zones (green arrows), and water discharge zones (dark blue sector) for the project. Source: COFEPRO 2007

In order of appearance:
Map Key
Exibition Licence
Water Springs
Permanend seepage zones
Permanend water spring
Winter only
Currents:
XXX lived
Occasional Permanent
Water well
Edition: September 2006
Projection: Universal Transverse Mercator System
Horizontal Datum 1984 World Geodetic System – WGSS4-
Zone: 15 II
Clarke's Spheroid
Apolo Project Water Spring Map

8.5.2 Water Quality

A water sample was drawn from the Pachum River flowing within the area, near the quarry site (N14º 44´ 34.6¨ and W 90º 41´ 42.5¨) on May 11, 2006 (results are shown on Table 8.1 below).

Table 8.1 Results obtained from the physical, chemical, and bacteriological analysis of a water sample drawn from the Pachum River on May 11, 2006.

Parameter	MAL	MPL	Results
Ph	7.0 – 7.5	6.5 – 8.5	8.1
Conductivity (mmhos/cm)	0.1	0.75	*0.91*
Hardness (mg/l $CaCO_3$)	100	500	276.8
Turbidity (NTU)	5.00	15.00	<5.00
Nitrate (mg/l		50.00	2.6
Calcium (mg/l)	75.00	150.00	88.7
Magnesium (mg/l)	50.00	100.00	13.4
Sulphates (mg/l)	100.00	250.00	*450.00*
Boron (mg/l)		0.30	0.2
Copper (mg/l)	0.05	1.50	<0.1
Iron (mg/l)	0.10	1.00	<0.1
Manganese (mg/l)	0.05	0.50	<0.1
Zinc (mg/l)	3.00	70.00	1.2
Chlorides (mg/l)	100.00	250.00	<10.0
Bacteriological Analysis			
	Admissible Limit		Results
Aerobic bacteria count (CFU/ml)			47,600
Total coliform bacteria (500 MPN/100 ml)	Less than 2		*500*
Faecal coliform bacteria (30 MPN/100 ml)	Less than 2		*30*
Escherichia coli (30 MPN/100 ml)	Less than 2		*30*

Source: Analytical Solutions. May 17, 2006.

As expected, results show high water hardness and pH controlled by the block of carbonated rocks located at the center of the project area; the water does not appear to be cloudy. Calcium and sulphate concentrations were higher than the maximum acceptable and permissible limits set by the COGUANOR NGO 29 001:99 standards for drinking water. The high sulphate concentration reported in the water sample seems to be related to the high content of pyrite disseminated in the black lutites and loams and/or to the gypsum horizons reported in loams. The other chemical parameters analyzed lie under the maximum acceptable and permissible limits set. The microbiological analysis values of the water sample are beyond the limits set by the COGUANOR standard, evidencing bacterial contamination in water.

Establishment of a baseline for water resources found in the project area of influence began in September 2006, under the responsibility of COFEPRO (2007). To this end, the monitoring network shown on Table 8.2 was established. Monitoring activities will continue during the life of the project. Since most of the project interventions will be located in the central part of the Pachum microbasin, their impact may be properly documented at the Pachum Bajo (low part of the river) and Pachum Alto (high part of the river) sites in order to propose the mitigation measures that are to be taken. The site proposed at Pachum Oeste (western part of the river) is particularly significant since a permanent water spring is located in this ravine, which is used by some residents of Las Trojes; this water spring seems to be representative of the regional groundwater level outcrop. Although significant interventions to the east of the concession area have not been considered in this project, a monitoring site on the Tapanal microbasin will serve to elucidate and establish differences and similarities between both hydrogeological systems where the concession area is located. Even though the Las Trojes

community lies outside the concession area, proximity to the area justifies the setting up of a water quality monitoring site for its water supply well.

Table 8.2. Location of the Hydrogeological Monitoring Sites

Site No.	Name	UTM	
		East	North
1	Pachum Bajo	0747729	1632256
2	Pachum Alto	0747926	1629516
3	Tapanal	0750494	1629350
4	Pachum Oeste (Las Trojes Water Spring)	0746850	1632350
5	Las Trojes Water Tank	0746000	1631350
6	PA1 Well	0746994	1630405

Source: COFEPRO 2007

The above results are those obtained from samplings performed by COFEPRO during September and October 2006. On September 2006, sampled sites were: Pachum Bajo, Pachum Alto, Tapanal, and Las Trojes Water Spring. During the month of October 2006, the same sites were sampled once again, except for Las Trojes Water Spring; the Las Trojes Water Tank was sampled instead as it is the inhabitants' main site of consumption. Water quality will be monitored at each site during the life of the project.

Water quality testing has been performed for human, industrial, and agricultural use purposes – the three major water usages in the area. Testing has been conducted in accordance with the COGUANOR[1] standard, the Ministry of Environment and Natural Resources (MARN[2]) Regulations, the World Health Organization[3] standard, and the U.S. National Academy of Sciences[4] (NAS). Comparison of results obtained from the two monitoring stages is shown in Table 8.3 and 8.4.

Table 8.3. Comparison of Results from the Water Quality Analysis for the four Sampled Sites. September 2006.

Parameter	Results	COGUANOR-NGO 29001		MARN 2006 Regulations (MPL)	WHO 2004	NAS 1972
		[1]MAL	[2]MPL			

[1] Guatemala Standards Commission -COGUANOR-, 1999, Guatemala Mandatory Standard NGO-29,001. 1st Revision. Ministry of Economy. 14 p.

[2]Regulations for the discharge and reuse of wastewater and sludge disposal, 2006, Government Resolution 236-2006. Ministry of Environment and Natural Resources. 25 p.

[3]World Health Organization, 2004, Guidelines for Drinking-water Quality. 540 p.

[4]National Academy of Sciences, 1972, Water Quality Criteria. Report for USEPA. 595 p.

	Pachum Bajo	Water Spring	Pachum Alto	Tapanal	Human consumption				Irrigation
Aerobic bacteria count ([3]CFU/ml)	22,580	510	13,970	57,000					
Total coliform bacteria ([4]MPN/100ml)	>1600	80	>1,600	>1,600					
Faecal coliform bacteria (MPN/100ml)	>1600	7	>1,600	>1,600	<20[a]	<200[a]	< 1x10[4]		
Escherichia coli (MPN/100ml)	>1600	2	>1,600	>1,600					
pH	7.2	7.0	7.4	7.5	7.0-8.5	6.5-9.2	6-9		
Electrical conductivity ([5]mohms/cm)	0.25	0.10	0.18	0.23					<2
Hardness (mg/l $CaCO_3$)	152.5	31.25	83.3	100.45	100.0	500.0			
Turbidity ([6]NTU)	102.0	10.00	19.0	21.00	5.0	25			
NO_3^- ([7]mg/l)	5.3	5.5	4.3	14.9	--------	45.0	20	50	
Ca^{+2} (mg/l)	49.7	9.65	25.4	30.95					
Mg^{+2} (mg/l)	6.3	1.75	9.7	5.6	50.0	150.0			
$S0_4^{-2}$ (mg/l)	17.0	<4.5	<4.5	6.0	200.0	400.0			
Boron (mg/l)	0.4	0.2	0.1	0.15	--------	1.0		0.5	0.5-2
Copper (mg/l)	< 0.1	<0.1	<0.1	<0.1	0.05	1.5	3	2	
Iron (mg/l)	0.7	0.1	0.3	0.2	0.1	1.0			
Manganese (mg/l)	< 0.1	<0.1	0.1	<0.1	0.05	0.5		0.4	
Zinc (mg/l)	<0.1	<0.1	<0.1	<0.1	5.0	15.0			
Cl^- (mg/l)	10.0	<10.0	<10.0	<10.0	200.0	600.0			>106
[8]S.A.R.	0.18	0.31	0.24	0.29					<9
Alkalinity ($CaCO_3$ ppm)	112.5	32.5	77.5	82.5					
Na^+ (mg/l)									3-9
Phosphorus (mg/l)	< 0.1	<0.1	<0.1	<0.1			10		
K^+ (mg/l)	7.6	<0.1	3.3	6.7					
CO_3^{-2} (mg/l)	<5.0	<5.0	<5.0	<5.0					
HCO_3^- (mg/l)	137.3	39.7	94.6	100.7					90-520

[1]MAL = maximum acceptable limit; [2]MPL = maximum permissible limit; [3]CFU/ml = Colony Forming Units/milliliter; [4]MPN/100ml = Most Probable Number/100 milliliters; [5]mohms/cm = milliohms/centimeter; [6]NTU = Nephelometric Turbidity Units; [7]mg/l = milligrams per liter = parts per million (ppm); [8]S.A.R. = Sodium Adsorption Ratio; [a] limits suggested by USEPA.

Table 8.4. Comparison of Results from the Water Quality Analysis for the four Sampled Sites. October 2006.

Parameter	Results				COGUANOR-NGO 29001		MARN 2006 Regulations (MPL)	WHO 2004	NAS 1972
					[1]MAL	[2]MPL			
	Pachum Bajo	Las Trojes Water Tank	Pachum Alto	Tapanal	Human consumption				Irrigation
Aerobic bacteria count ([3]CFU/ml)	5,650	570	5,900	>57,000					
Total coliform bacteria ([4]MPN/100ml)	1,600	4	>1,600	>1,600					
Faecal coliform bacteria (MPN/100ml)	900	2	>1,600	>1,600	<20[a]	<200[a]	< 1x10[4]		
Escherichia coli (MPN/100ml)	500	< 2	>1,600	>1,600					
Ph	7.7	7.6	7.8	7.7	7.0-8.5	6.5-9.2	6-9		
Electrical conductivity ([5]mohms/cm)	0.30	0.28	0.18	0.22					<2
Hardness (mg/l $CaCO_3$)	125.2	64.0	70.0	78.8	100.0	500.0			
Turbidity ([6]NTU)	23.0	< 5.00	17.00	19.00	5.0	25			
NO_3^- ([7]mg/l)	12.3	10.4	13.3	37.3	--------	45.0	20	50	
Ca^{+2} (mg/l)	37.4	20.3	16.1	18.5					
Mg^{+2} (mg/l)	7.7	3.2	50.0	7.9	50.0	150.0			
$S0_4^{-2}$ (mg/l)	< 4.5	< 4.5	<4.5	< 4.5	200.0	400.0			
Boron (mg/l)	0.5	0.4	0.5	0.5	--------	1.0		0.5	0.5-2
Copper (mg/l)	< 0.1	<0.1	<0.1	<0.1	0.05	1.5	3	2	
Iron (mg/l)	0.8	<0.1	0.7	0.5	0.1	1.0			
Manganese (mg/l)	< 0.1	<0.1	0.1	<0.1	0.05	0.5		0.4	
Zinc (mg/l)	<0.1	0.5	0.1	<0.1	5.0	15.0			
Cl^- (mg/l)	< 10.0	<10.0	<10.0	<10.0	200.0	600.0			>106
[8]S.A.R.	0.18	1.33	0.26	0.28					<9
Alkalinity ($CaCO_3$ ppm)	112.8	< 130.8	79.2	68.4					
Na^+ (mg/l)									3-9
Phosphorus (mg/l)	0.3	0.4	0.3	0.6			10		
K^+ (mg/l)	1.8	1.9	1.7	2.7					
CO_3^{-2} (mg/l)	< 5.0	<5.0	<5.0	<5.0					
HCO_3^- (mg/l)	136.2	158.1	96.6	83.4					90-520

[1]MAL = maximum acceptable limit; [2]MPL = maximum permissible limit; [3]CFU/ml = Colony Forming Units/milliliter; [4]MPN/100ml = Most Probable Number/100 milliliters; [5]mohms/cm = milliohms/centimeter; [6]NTU = Nephelometric Turbidity Units; [7]mg/l = milligrams per liter = parts per million (ppm); [8]S.A.R. = Sodium Adsorption Ratio; [a] limits suggested by USEPA.

Below please find an interpretation of the results obtained above, as described by COFEPRO (2007).

Microbiological Characteristics:
Monitoring results indicate high water pollution levels caused by faecal residues that were similar in most samples. Except for samples drawn from Las Trojes water spring and Las Trojes Water Tank, all samples contain high levels of faecal coliform bacteria, a fact that is indicative of frequent contact with this type of coliform bacteria. These results correspond with those obtained for E. coli bacteria, that present a high pollution level implying recent contact with wastewater, with the exception of the sample taken from Las Trojes tank where results (2 MPN/100ml) vary greatly from other samples (>1600 MPN/100ml). In this respect, the Las Trojes tank exhibits a similar behavior to that of El Manantial.

Nitrate contents, though relatively low, also indicate microbiological contamination in water. In the absence of individual and clustered wastewater treatment systems in this zone, of an adequate site for solid waste disposal (landfill), and owing to the practice of laundry washing in the Pachum River's surface water sources, wastewater discharges and waste disposal are the major sources of water pollution.

Turbidity:
According to test results, turbidity values observed at Las Trojes, Pachum Alto, and Tapanal sites were slightly above the maximum permissible limit and remained stable while being monitored over two months. For Pachum Bajo, the river's turbidity showed a significant rise in the month of September of up to about 104 NTU, well beyond the maximum permissible limit, since rainfall during this period increases the transport of suspended sediments in the river. Turbidity values dropped to 24 NTU in October.

Hardness, Alkalinity, and pH:
Values for these two water quality parameters are consistent with the area's geological characteristics as they are somewhat controlled by the presence of volcanic and carbonated rocks that behave as a regulator for maintaining pH in slightly alkaline conditions and providing moderate calcium and magnesium levels which account for the hardness levels considered to be normal, except for the slightly high levels encountered in the Pachum Bajo. This is attributable to the fact that the river drains mostly limestone in its low and medium paths. Hardness concentrations are not high enough to cause kidney stones.

In reference to the potential of Hydrogen (pH), a slight tendency toward alkalinity is observed in every monitored site. Values showed an increase during the month of October, yet this variation is not significant. The pH values found range from 7.2 to 7.8. Hardness and pH results correlate well with those obtained for alkalinity since water pH levels are considered to be slightly alkaline.

Carbonates and Bicarbonates:
Dissolution of limestone and dolomite strengthened by CO_2 and/or organic or inorganic acids input constitutes one of the carbonate and bicarbonate sources in the area. According to water quality standards, the water bicarbonate content values are considered to be hazardous (90-500

mg/l). Bicarbonate contents range from 40 to 137 mg/l; the highest level was found in the Pachum Bajo (137.3 mg/l), while the lowest was encountered at Las Trojes Tank (39.7 mg/l). Bicarbonate values in water showed no significant variation over time, but rather exhibited a tendency to remain constant.

Electrical Conductivity, Boron, Chloride, Sodium Adsorption Ratio, and Sodium:
According to standard values, results indicate a very low risk of salinization in terms of electrical conductivity and chlorides. Below maximum limits Sodium Adsorption Ratios and boron levels were reported. In small quantities, boron is essential to plant growth. Boron owes its presence in this area to the volcanic rocks found in the region. In terms of quality parameters, water is fit for human consumption, agricultural and/or industrial use.

Metal Contents:
Contents of the five metals tested were below the detection limit.

Definition of Hydrogeochemical Facies:
The term hydrogeochemical facies has been used to describe bodies of groundwater revealing differing chemical compositions. Facies are defined in terms of lithology, dissolution kinetics, and flow patterns of aquifers. The classification of hydrogeochemical facies is made on the basis of dominant ions, and triangular[5] diagrams are used to exemplify their distribution.

The lower part of the Pachum River contains an Mg-Ca-HCO_3-type dominant hydrogeochemical facies that is consistent with the enclosing calcareous lithology. However, the water spring which probably contains water from recent rainfalls and groundwater from volcanic rocks exhibits a Na+K-Cl-type hydrogeochemical facies.

The September diagram shows that water quality from the lower part of the Pachum River is quite different from that prevailing in the river's intermediate and high parts – water richer in calcium and magnesium due to limestone and dolomite drainage. Likewise, the water spring differs from the other three sites in that its ionic content is extremely low, possibly owing to its composition, mainly rainwater.

As with the Piper graph, the Stiff graph shows that samples from Pachum Alto and Tapanal have an intermediate chemical composition possibly conditioned by the drainage volcanic rocks. The chemical composition of the project waters reveals a strong influence from regional lithologies.

8.5.3 Streamflows (maximum, minimum, and mean)

Maximum streamflows were calculated on the basis of maximum rainfall reported in the project zone as no hydrometric stations are present in the Pachum River, or in any other neighboring river. Table 8.5 shows the estimated maximum streamflows for 60, 120, and 200

[5] Piper, A., 1944, A Graphic Procedure in the Geochemical Interpretation of Water Analyses: Transactions of the American Geophysical Union, v. 25, p. 914-923.

milliliters per hour of rainfall. Estimated streamflows for the Pachum River microbasin, considering a surface area of 975.92 hectares, a runoff ratio of 0.5, and the three different rainfall intensities, are 81.33, 162.65, and 271.09 m^3/second, respectively.

Table 8.5 and 8.6 show the extreme maximum streamflows of the different microbasins in the licensed exploitation area. The extreme maximum streamflow of the Pachum River at the confluence with the Pixcayá River, based on a maximum rainfall intensity of 200 milliliters/hour and a duration of 5 minutes, is estimated at 387.83 m^3/second; for a rainfall intensity of 120 milliliters/hour and a duration of 20 minutes, streamflow is estimated at 232.69 m^3/second; and for a rainfall intensity of 60 milliliters/hour and a duration of 60 minutes, streamflow is estimated at 116.35 m^3/second. The flood response time of the Pachum River at the confluence with the Pixcayá River is estimated at 35 minutes.

8.5.4 Flood levels

Cross-sections of riverbeds and ravines existing in the project area are V-shaped due to the steep slopes on both riverbanks. In general, tree cover in gallery forests along both sides of the Pachum River and the Sunuj ravine is dense, as shown on Map 5.2, plant coverage and current use of soil, in paragraph 5.10 above. As evidenced by high-water marks left behind on both sides of the riverbed as flood waters receded, the river level rises about 2 meters during maximum-height river floods, yet they pose no threat to houses or crops for none are found near the Pachum riverbed and the Sunuj ravine. In conclusion, no flooding occurs in the project area.

8.5.5 Currents, Tides, and Storm Surges

The project is located at more than 1,000 meters above sea level, and at a distance of more than 100 kilometers from the Pacific Ocean, and is therefore unaffected by currents, tides, or storm surges.

Table 8.5. Calculation of Maximum Extreme Streamflows per Microbasin

Microbasin	C	i (mm/hr)	A (has)	Q (m^3/seg)
La Cuchilla	0.5	200	139.99	**38.89**
La Cuchilla	0.5	120	139.99	**23.33**
La Cuchilla	0.5	60	139.99	**11.67**
Pachum River interfluvial	0.5	200	975.92	**271.09**
Pachum River interfluvial	0.5	120	975.92	**162.65**
Pachum River interfluvial	0.5	60	975.92	**81.33**
No 1	0.5	200	39.40	**10.94**
No 1	0.5	120	39.40	**6.57**
No 1	0.5	60	39.40	**3.28**
No 2	0.5	200	56.96	**15.82**
No 2	0.5	120	56.96	**9.49**
No 2	0.5	60	56.96	**4.75**
No 3	0.5	200	204.25	**56.74**
No 3	0.5	120	204.25	**34.04**
No 3	0.5	60	204.25	**17.02**
No 4	0.5	200	124.80	**34.67**
No 4	0.5	120	124.80	**20.80**
No 4	0.5	60	124.80	**10.40**
No 5	0.5	200	91.19	**25.33**
No 5	0.5	120	91.19	**15.20**
No 5	0.5	60	91.19	**7.60**
Parquí Ravine interfluvial	0.5	200	72.75	**20.21**
Parquí Ravine interfluvial	0.5	120	72.75	**12.13**
Parquí Ravine interfluvial	0.5	60	72.75	**6.06**
No 2	0.5	200	70.03	**19.45**
No 2	0.5	120	70.03	**11.67**
No 2	0.5	60	70.03	**5.84**
No 3	0.5	200	94.95	**26.38**
No 3	0.5	120	94.95	**15.83**
No 3	0.5	60	94.95	**7.91**
Las Yeguas Ravine	0.5	200	261.48	**72.63**
Las Yeguas Ravine	0.5	120	261.48	**43.58**
Las Yeguas Ravine	0.5	60	261.48	**21.79**
Tapanal River interfluvial	0.5	200	576.38	**160.11**
Tapanal River interfluvial	0.5	120	576.38	**96.06**
Tapanal River interfluvial	0.5	60	576.38	**48.03**
No A1	0.5	200	161.04	**44.73**
No A1	0.5	120	161.04	**26.84**
No A1	0.5	60	161.04	**13.42**
No A2	0.5	200	260.66	**72.41**
No A2	0.5	120	260.66	**43.44**
No A2	0.5	60	260.66	**21.72**
No A14	0.5	200	111.35	**30.93**
No A14	0.5	120	111.35	**18.56**
No A14	0.5	60	111.35	**9.28**
No A15	0.5	200	72.35	**20.10**
No A15	0.5	120	72.35	**12.06**
No A15	0.5	60	72.35	**6.03**
No A4	0.5	200	71.53	**19.87**
No A4	0.5	120	71.53	**11.92**
No A4	0.5	60	71.53	**5.96**
No A3	0.5	200	143.07	**39.74**
No A3	0.5	120	143.07	**23.85**
No A3	0.5	60	143.07	**11.92**
No A6	0.5	200	31.62	**8.78**
No A6	0.5	120	31.62	**5.27**
No A6	0.5	60	31.62	**2.64**
No A7	0.5	200	24.79	**6.89**
No A7	0.5	120	24.79	**4.13**
No A7	0.5	60	24.79	**2.07**

Table 8.6 Calculation of Maximum Extreme Streamflows based on Maximum Rainfall Intensities in 5, 20, and 60 minutes, for a return period of 30 years and Determination of river flood response time in each microbasin

Intensity	200 mm/hr	120 mm/hr	60 mm/hr
Duration	5 minutes	20 minutes	60 minutes
Return period	30 years	30 years	30 years

Microbasin	Max. streamflow m^3/sec	Max. streamflow m^3/sec	Max. streamflow m^3/sec	Longitude meters	Slope %	Response time minutes	Comments
Pachum River	271.09	162.65	81.33	9200	37.50	**34.9**	Up to confluence with the Pixcayá river
No 3	56.74	34.04	17.02	3000	37.50	**14.7**	Up to confluence with the Pachum river
No 4	34.67	20.80	10.40	2000	27.00	**12.3**	Up to confluence with the Pachum river
No 5	25.33	15.20	7.60	1800	16.00	**11.3**	Up to confluence with the Pachum river
	387.83	**232.69**	**116.35**				
Parquí Ravine	20.21	12.13	6.06	2666	22.00	**16.5**	Up to boundary of area to be evaluated
No 2	19.45	11.67	5.84	2650	22.00	**16.5**	Up to confluence with Parquí Ravine
No 3	26.38	15.83	7.91	3300	22.00	**19.5**	Up to confluence with Parquí Ravine
	66.04	**39.63**	**19.81**				
Tapanal River	160.11	96.06	48.03	13330	16.88	**63.5**	Up to boundary of area to be evaluated
No A1	44.73	26.84	13.42	4660	23.50	**24.8**	Up to confluence with the Tapanal river
No A2	72.41	43.44	21.72	6600	23.50	**32.4**	Up to confluence with the Tapanal river
No A14	30.93	18.56	9.28	2665	5.25	**28.9**	Up to confluence with the Tapanal river
No A15	20.10	12.06	6.03	2660	5.25	**28.9**	Up to confluence with the Tapanal river
No A4	19.87	11.92	5.96	2400	37.50	**12.4**	Up to confluence with the Tapanal river
No A3	39.74	23.85	11.92	5332	37.50	**22.8**	Up to confluence with the Tapanal river
No A6	8.78	5.27	2.64	1050	27.00	**7.5**	Up to boundary of area to be evaluated
No A7	6.89	4.13	2.07	800	37.50	**5.3**	Up to boundary of area to be evaluated
	403.56	**242.13**	**121.07**				
La Cuchilla Ravine	38.89	23.33	11.67	4800	37.50	**21.1**	Beginning of boundary of area to be evaluated
Las Yeguas Ravine	2.63	43.58	21.79	5330	21.20	**28.7**	Up to confluence with the Tapanal river

8.5.6 Vulnerability to Groundwater Contamination

Vulnerability to groundwater contamination is high due to limestone permeability. Table 8.7 shows the results of the water quality analysis from a sample drawn from the well drilled for the project (PA1; UTM 746,994E; 1630405N) on December 2006 (COFEPRO 2007).

Table 8.7. Water Quality from PA1 Well. December 2006.

Parameter	Results	COGUANOR-NGO 29001		MARN 2006 Regulations (MPL)	WHO 2004	NAS 1972
		[1]MAL	[2]MPL			
	PA1	Human consumption				Irrigation
Aerobic bacteria count ([3]CFU/ml)	15,530					
Total coliform bacteria ([4]MPN/100ml)	30					
Faecal coliform bacteria (MPN/100ml)	<2	<20[a]	<200[a]	< 1x10[4]		
Escherichia coli (MPN/100ml)	<2					
pH	6.6	7.0-8.5	6.5-9.2	6-9		
Electrical conductivity ([5]mohms/cm)	0.28					<2
Hardness (mg/l $CaCO_3$)	71.1	100.0	500.0			
Turbidity ([6]NTU)	9.0	5.0	25			
NO_3^- ([7]mg/l)	36.7	---------	45.0	20	50	
NO_2 (mg/l)	0.04					
NH_4 (mg/l)	0.17					
Ca^{+2} (mg/l)	22.8					
Mg^{+2} (mg/l)	3.4	50.0	150.0			
$S0_4^{-2}$ (mg/l)	<4.5	200.0	400.0			
Boron (mg/l)	<0.1	---------	1.0		0.5	0.5-2
Copper (mg/l)	<0.1	0.05	1.5	3	2	
Iron (mg/l)	0.1	0.1	1.0			
Manganese (mg/l)	<0.1	0.05	0.5		0.4	
Zinc (mg/l)	0.4	5.0	15.0			
Cl^- (mg/l)	<10.0	200.0	600.0			>106
[8]S.A.R.	1.66					<9
Alkalinity ($CaCO_3$ ppm)	82.8					
Na^+ (mg/l)	32.2					3-9
Phosphorus (mg/l)	<0.1			10		
K^+ (mg/l)	2.7					
CO_3^{-2} (mg/l)	<0.5					
HCO_3^- (mg/l)	101.0					90-520

[1]MAL = maximum acceptable limit; [2]MPL = maximum permissible limit; [3]CFU/ml = Colony Forming Units/milliliter; [4]MPN/100ml = Most Probable Number/100 milliliters; [5]mohms/cm = milliohms/centimeter; [6]NTU = Nephelometric Turbidity Units; [7]mg/l = milligrams per liter = parts per million (ppm); [8]S.A.R. = Sodium Adsorption Ratio; [a] limits suggested by USEPA.

Below is an interpretation of the water quality parameters measured in the PA1 well, as described by COFEPRO (2007).

Microbiological Characteristics:
The microbiological analysis results indicate that groundwater in the zone exhibits a certain degree of bacterial contamination as total coliform bacteria and aerobic bacteria

counts were low. Faecal coliform bacteria and the presence of Escherichia coli are below the detectable limit (<2).

However, levels of nitrate content are somewhat high in relation to those reported in surface water, which points to a certain degree of microbiological contamination, yet lower than the maximum permissible limit (MPL) determined by the COGUANOR standard. Nitrite levels were higher than the standard's MPL.

Turbidity:
The turbidity value was higher than the maximum acceptable limit (MAL) yet lower than COGUANOR's MPL. Besides, this value is comparable to values reported for surface water, except for the Pachum Bajo.

Hardness, Alkalinity, and pH:
A slight tendency toward acidity (6.6) has been observed for potential of Hydrogen (pH), unlike surface water which is observed to be alkaline (7.2 and 7.8). Hardness and pH results correlate well with those obtained for alkalinity, although groundwater is less alkaline than surface water.

Carbonates and Bicarbonates:
Bicarbonate concentration in groundwater is similar to and carbonate concentration is lower than that in surface water. The low carbonate concentration value correlates well with the alkalinity value.

Electrical Conductivity, Boron, Chloride, Sodium Adsorption Ratio, and Sodium:
In terms of electrical conductivity and chlorides and in accordance with standard values, results indicate a very low risk of salinization of both groundwater and surface water. Below maximum limits Sodium Adsorption Ratios and boron levels were also reported.

Metal Contents:
As with surface water, concentrations of the five metals tested were below the detection limit.

Other Parameters:
When related to alkaline pH values or in high concentrations, ammonium may be toxic given that it is highly soluble in water. The ammonium concentration reported was 0.17 mg/l, a low value that does not present toxicity hazards since pH value is mildly acid (6.6).

8.6 Air Quality

Air samplings from different sites and on different dates were performed in order to test the quality of air in the project site and its area of influence. The first sampling was performed within the Santa Fe Ocaña farmland, at the quarry site (N 14º44´34.6" and W 90º41´42.5"), on April 9 and 10, 2006, over a period of 24 hours; the second sampling was performed November 23-24, 2006, at the future cement facility site (N 14º44´8.5" and W 90º42´15.7"), as well as at the backyard of a house in San Antonio Las Trojes Village (N 14º44´37.3" and W 90º42´54.4"). Photograph 8.1 shows the air sampling equipment installed at the house backyard in Las Trojes.

Sampling results were compared to the World Health Organization (WHO) guide values. Table 8.8 shows results obtained from samplings performed April 9-10, 2006, and Table 8.9 shows those obtained on November 23-24, 2006.

Table 8.8 Results obtained from Air Quality Analysis conducted April 9 - 10, 2006

Site	PM10 µg/m^3	PST µg/m^3	SO_2 µg/m^3	NO_2 µg/m^3	pH U	PSD mg/cm^2
Site within property (quarry)	17	21	18	13	7.00	0.0010
WHO	**150**	**-**	**125**	**40**	**7.00**	**0.0167**

[PS10] Concentration of Suspended Particles Smaller than 10 microns in micrograms per cubic meter of air (µg/m^3)
[TSP] Concentration of Total Suspended Particles in micrograms per cubic meter of air (µg/m^3)
[SO_2] Concentration of Sulphur Bioxide in micrograms per cubic meter of air (µg/m^3)
[NO_2] Concentration of Nitrogen Bioxide in micrograms per cubic meter of air (µg/m^3)
[pH] Concentration of Potential of Hydrogen (U)
[SP] Concentration of Sedimentable Particles in milligrams per square meter (mg/cm^2)
Source: Mediciones Ambientales (Environmental Measurements) 2006

Table 8.9 Results obtained from Air Quality Analysis conducted November 23 - 24, 2006

Site	PM10 (ug/m^3)	PST (ug/m^3)
Cement Facility Site	13	27
Las Trojes house backyard	8	21
WHO	**150**	**-**

Source: Mediciones Ambientales (Environmental Measurements) 2006.

As expected, and after applying the methods recommended by the U.S. Environmental Protection Agency to both the first and the second sampling, results obtained were found to be below the recommended limits of the World Health Organization and the World Bank. Sampling and lab analyses were conducted by Environmental Solutions (Soluciones Ambientales) Laboratory; reports are attached as Appendix 8.

Photograph 8.1 View of air sampling equipment installed at the Las Trojes house backyard.

Dominant winds have a northerly component during the dry season and a south-westerly component during the rainy season (180°-270°). Weather conditions prevailing in the sampling area from November 23 to November 24, 2006, are shown on Table 8.10. November is when the strongest winds usually blow, so strong wind conditions on such dates were ideal for sampling air quality as the wind would contribute in raising dust from areas lacking plant cover.

Table 8.10 Weather Conditions present during Air Quality Sampling (November 23 - 24, 2006)

Parameter	November 23, 2006	November 24, 2006
Average temperature	10	14
Maximum temperature	18	22
Minimum temperature	6	3
Rainfall (mm)	0	0
Min./max. relative humidity (%)	26/82	66/82
Average humidity (%)	65	68
Average wind speed (km/h)	27	24
Maximum wind speed (km/h)	40	38
Wind direction	N	N

Source: Mediciones Ambientales (Environmental Measurements) 2006.

In summary, air quality in the project area is acceptable, and the existing periodic sources of air quality deterioration are: i) Burning of stubble in adjoining crop areas thereby releasing gases into the atmosphere; ii) Heavy truck traffic, particularly during forest management activities whereby dust is generated, and iii) Motor vehicle traffic on unpaved, dirt roads generating particulates and heavy gas emissions from diesel fuel combustion.

Air quality values are baseline values; thus, how much they actually raise during cement facility construction and operation activities may be determined at the time of sampling. In

any event, values for different air quality parameters must be below those proposed by the World Bank and the World Health Organization.

8.6.1 Noise and Vibration

Sound levels were measured over 24 hours beginning on April 9 at 11:04 at the same site where quality of air was measured, near the quarry zone. Results are described below and shown on Graph 8.9.

Leq Equivalent continuous sound level = 39.6 dB.
Lmin Minimum sound level recorded over the measurement period = 27.5 dB (on April 10, 2006 at 10:13:53).
Lmax Maximum sound level recorded over the measurement period = 75.8 dB (on April 9, 2006 at 11:14:06).
L_{90} Sound level surpassed 90% of interval of time measured = 31.3 dB.
L_{50} Sound level surpassed 50% of interval of time measured = 34.3 dB.
L_{10} Sound level surpassed 10% of interval of time measured = 39.8 dB.
L_{5} Sound level surpassed 5% of interval of time measured = 42.7 dB.

The area presents low sound levels as reflected by the equivalent sound level measured on the sampling period of Leq 39.6 dBA. Leq value represents the stable sound level that, over any given measurement period at any given location shows the same A-weighted level than that of sound which varies over time. In addition, 85% of the sampling period sound levels were positioned between 31.3 and 42.7 dB, with a minimum level of 27.5 dBA.

The maximum recorded level of 75.8 dBA was due to equipment installation activities, such as calling out instructions to sentinels and occurred after nine minutes following the start of the sampling period. In this case, with low sound levels on site, any alien sound is highly audible, such as conversations carried out near the sound level meter.

On November 23, 2006, sound levels were measured at the backyard of the San Antonio Las Trojes house, where air quality was sampled. When the grinding mill located near the house where measurements took place is running, the sound decibel level mounts to 74.6. Values reported from the house backyard were as follows:

Leq Equivalent continuous sound level = 50.3 dB.
Lmin Minimum sound level recorded over the measurement period = 48.3 dB.
Lmax Maximum sound level recorded over the measurement period = 63.4 dB.

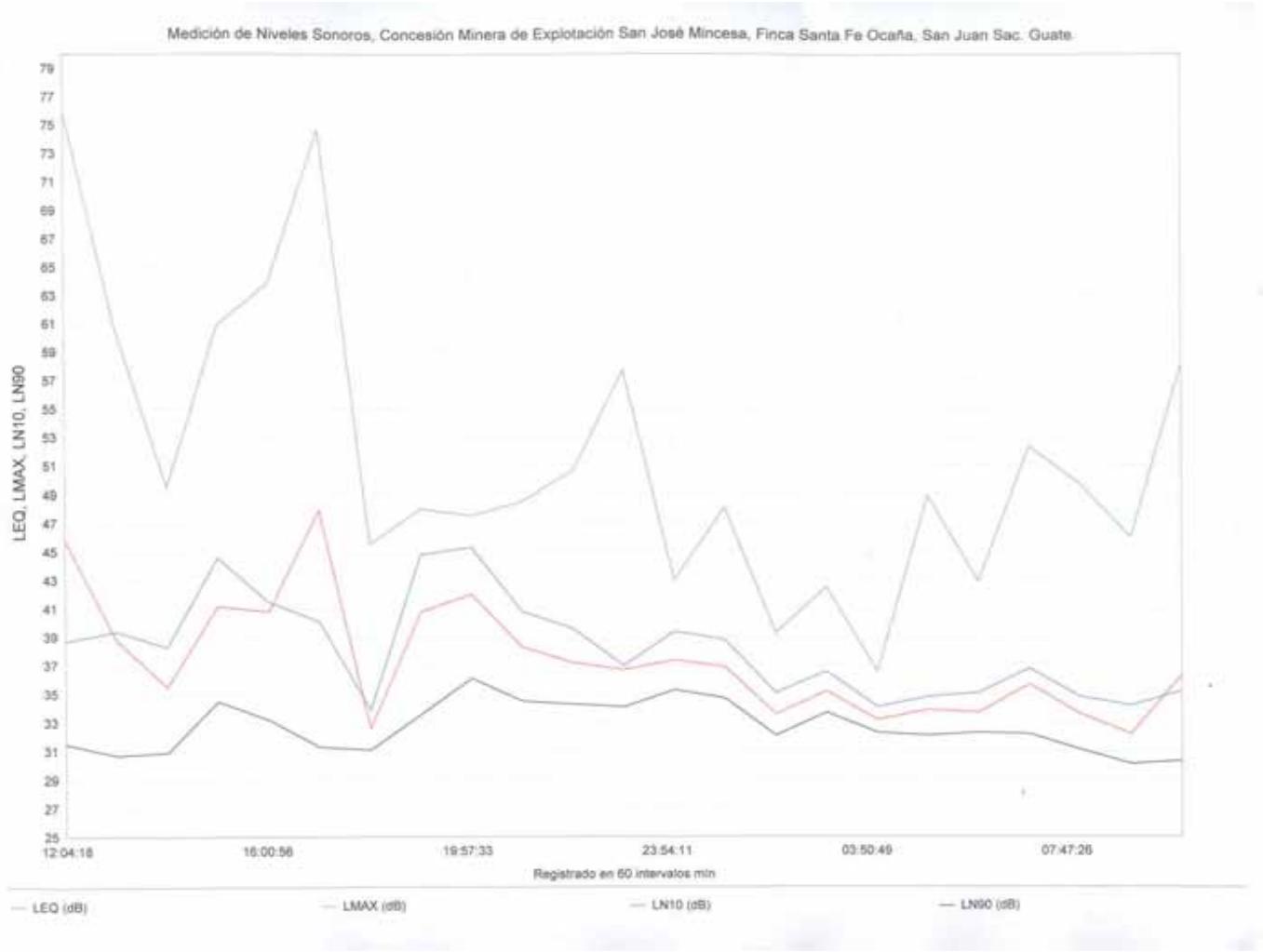


Chart 8.9 Sound levels measured in the project area. (Above heading: Sound Level Measurements, San José Mincesa Mining Concession, Santa Fe Ocaña

8.6.2 Odors

No foul or bad odors were perceived on the project site. Ongoing forest management activities have not caused bad odors. Burning of solid waste, decomposing of solid waste found in ravines, and discharge of wastewater are presently generating bad odors in the indirect area of influence.

8.6.3 Radiation Sources

No power transmission lines or telephone antennas are installed inside the farmstead; therefore, no sources of ionizing and non-ionizing radiation are created.

8.7 Natural Threats

Tremors, earthquakes, and mass landslides in combination with excessive rainfall during the rainy season are the primary natural threats that must be considered within the project area of influence.

8.7.1 Seismic Threat

The Modified Mercalli Intensity Scale value assigned to the project zone is VIII (Figure 8.11), in accordance with zoning performed at the time of the 1976 earthquake. Intensity effects for the project zone are as follows (Espinosa et al, 1976):

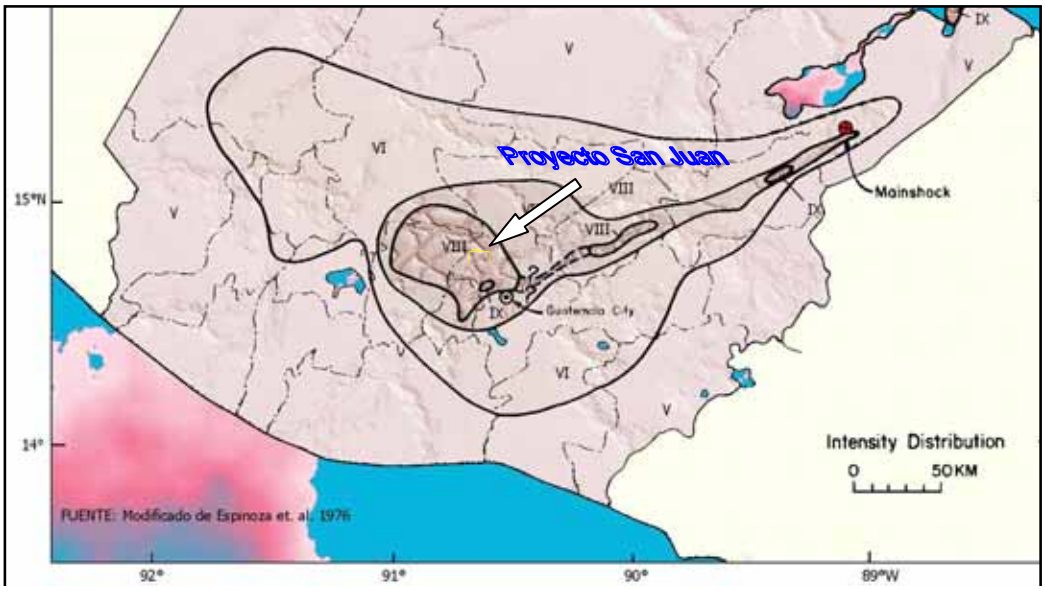


Figure 8.11 Modified Mercalli Intensity Map for the Guatemala primary seismic event of 1976. The circle encloses the main shock epicenter location of the February 4, 1976, earthquake; the solid line indicates the approximate isoseismic contour. Also shown is the project location.

Minor damage to specially-designed structures; considerable damage to ordinary solid and substantial buildings, with partial collapse. Considerable damage in poorly-built structures. Walls thrown out of frame structures, fallen chimneys, factory stacks, columns, monuments and walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in groundwater table of wells. Persons driving automobiles disturbed.

In the neighboring municipal district of Chimaltenango, back then with a population of 4,182 inhabitants, 900 lives lost, 844 persons injured, and 85% of property damage was reported (A. Espinosa et al, 1976). For the San Juan Sacatepéquez municipality, the following statistical data were collected as to destruction of basic infrastructure: 915 houses destroyed in the urban area, 5,860 houses destroyed in the rural area. Damage percentages are shown below on the map of areas affected by destruction in the 1976 earthquake as Figure 8.12; destruction in populated zones within the project area was estimated between 90 and 100%. The zone intended for the construction of the cement production facility is uninhabited.

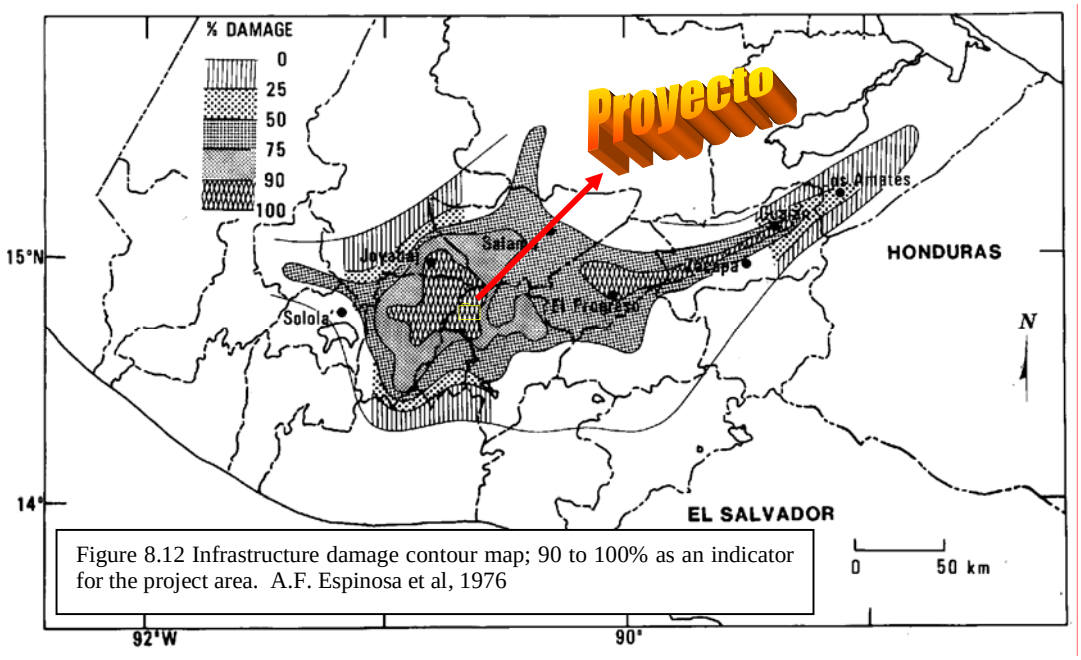


Figure 8.12 Infrastructure damage contour map; 90 to 100% as an indicator for the project area. A.F. Espinosa et al, 1976

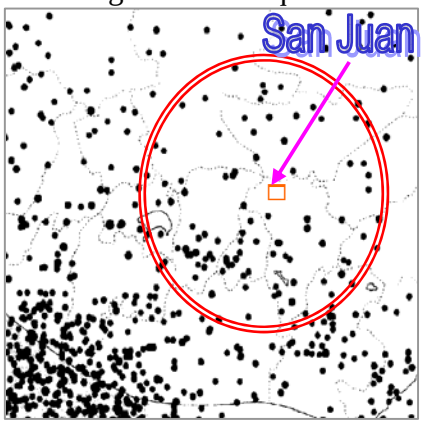
The Guatemalan Association of Structural and Earthquake Engineering (AGIES) locates the project site on macrozone 4.2, at the boundary with macrozone 4.1, by applying the criterion of dividing seismic zones from 0 to 4. Given the country's high seismic risk, zones 0 and 1 have not been mapped. The greater the zone number, the greater the requirements are for seismic protection.

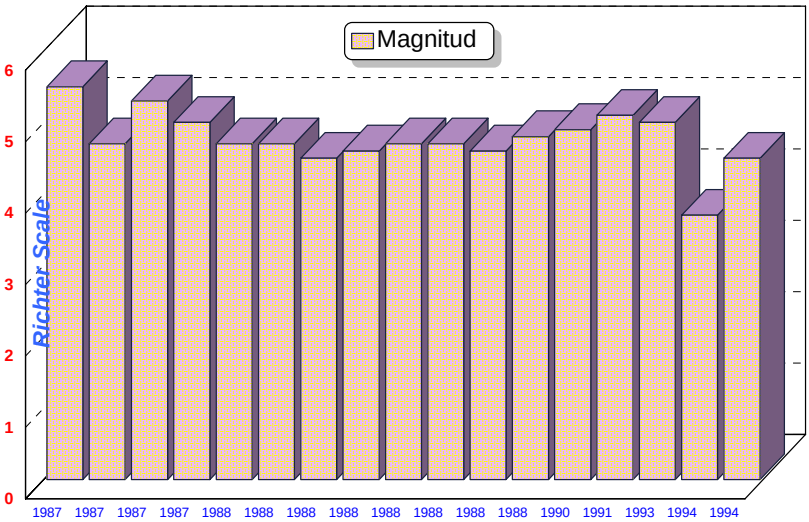
The seismicity index (Is) number for the project site is 4, understood as a measurement of the relative magnitude expected from any earthquake in any given location. It is an indicator of the seismic protection level required for construction design. For zone 4.2, with an Is number of 4, effective peak ground acceleration (Aa) corresponding to the basic earthquake design is 0.30g (2.94 m/s^2), and the effective surface acceleration (A_T) corresponding to the frequent

earthquake design gained its peak at 0.15g (1.47 m/s^2). However, an increase by not less than 17% of the above peak acceleration values is recommended.

The estimated peak ground acceleration corresponding to a return period of fifty (50) years is 2.05 m/s^2 (E. Molina et al, 1999) for the project area of concern. For a return period of 500 years (A. Kiremidjian, et al, 1977), the estimated peak ground acceleration is 0.25g (2.45 m/s^2), according to accelerations calculated for the 1976 earthquake in the cement facility area.

Earthquake epicenter occurrences for the 1984-2004 period in the department of Guatemala and adjacent areas were investigated (see Figure 8.13), with the purpose of depicting seismic activity occurring in the project site zone. Magnitude 4.0 and greater earthquakes were considered in this investigation since they would impact to a larger degree upon the existent and future infrastructure.





(Magnitude)

Figure 8.13 Epicenters of earthquakes of magnitudes 4 to 5.7 on the Richter scale reported for the 1984-2004 period (bar graph) depicting the San Juan project area and surrounding epicenters (above). Source: INSIVUMEH, July 2004.

8.7.2 Volcanic Threat

The project area is located within an area identified as being at very low risk of falling piroclastic material. In this area, there is no danger of molten lava flows or volcanic mudflows.

8.7.3 Mass Movements

Mass movements and erosion in the area of concern may occur mainly in steep sloping zones and areas affected by anthropic interventions (Photograph 8.2), whether from crop planting or artisanal exploitation of construction material. In general, no significant mass landslides were identified within the project area (see Figure 8.14), though slopes bearing meteorised rock as well as slopes on the Pachum riverbed, are more likely to slide and erode (Photograph 8.3).

Photograph 8.2 Some anthropic interventions in the project are of influence that promote local erosion and mass movements of no significance.

Figure 8.14 No significant mass landslides (red dots) are reported for the project area. Taken from MAGA, 2001

Photograph 8.4 Meteorization in lithological units promotes erosion and mass movements. Meteorization in the area occurs mostly at the local level and is not significant.

8.7.4 Erosion

Some local mudflows and cone-shaped mudslide movements which include small amounts of soil and rock occur during the rainy season due to heavy rainfall. Runoff usually washes down sediments such as erosion material from the area. According to the MAGA (Guatemala Ministry of Agriculture, Livestock, and Food) 2001, susceptibility to erosion for the project area ranges from 0 to 10 Ton/Ha/year.

8.7.5 Flooding

The project area is not generally exposed to flooding (Figure 8.15), but rather, due to the area's geomorphology, it is exposed to runoff, as mentioned above, as well as to occasional torrential streams flowing down from ravines during severe rainy seasons.

Figures 8.15 Flood sites map indicating location of project area. Taken from MAGA, 2001.

igure 5.3 Gallery orest along the achum riverbed.

(In order of appearance:
High flood occurrence rate
Medium flood occurrence rate
Low flood occurrence rate
Areas sensitive to flooding from drainage
Main rivers)

8.7.6 Others: Forest Fires

The area may be exposed to forest fires, especially during the dry season. This is usually the case as a result of the favorable existing conditions for fire ignition: low humidity brought on by the dry season, plentiful amounts of flammable material, oxygen carried by the wind, and potential ignition sites, particularly as a consequence of land burning and clearing practices. As they do not present high fire susceptibility, gallery forests are the exception, with greater moisture levels and natural enclosed protection from the winds.

8.7.7 Susceptibility

The greatest natural threat existing within the licensed exploitation area is the occurrence of earthquakes, because of their devastating effects, such as those endured in the 1976 earthquake. Other recurring natural phenomena, yet having less significant effects, are erosion and mass movements in steep sloping sites. The falling of volcanic ash and the risk of flooding in the area are quite remote. Anthropic threats are posed by fires, and, to a certain extent, by increasing erosion processes caused by a change in soil use from land with forestry potential to clean cropping.

9. DESCRIPTION OF THE BIOTIC ENVIRONMENT

According to the classification system proposed by Höldrige[6], the Project area presents samples that are representative of vegetation typical of a Very Humid Low Subtropical Mountain Forest. It includes a belt that covers from Mixco in the Department of Guatemala, moving North-west and passing through San Juan, San Pedro, San Lucas Sacatepéquez, Chimaltenango, San Martín Jilotepeque, Zaragoza, Santa Cruz Balanyá, San José Poaquil, Chichicastenango, Santa Cruz del Quiché, Momostenango, Huehuetenango, up to the border with Mexico. There is also a small belt surrounding Lake Atitlán.[7] The total surface of this vegetation life zone is 9,769 sq kilometers, 8.98 per cent of the total surface of the country.

9.1 Flora

The plant communities in the area contain indicators of the plant life typical of higher lands in Guatemala. Native species are represented by: "Pinabete", "paschaco" (*Abies guatemalensis*), Sweet Pine, "pacha" or "curtidor" (*Pinus ayacahuite*) and Pine from the hilltops (*Pinus hartwegii*). In the lowlands, these tree stands may mix with other species of conifers such as: (*Pinus montezumae* var. *rudis*, *Cupressus lusitanica*, *Litsea glaucescens*), oak, (*Quercus sp*).

9.1.1 Threatened, Endemic or Endangered Species

Few threatened species are reported in the region with the exception of *Inga vera* or Bitze found in CONAP Index No. 3; "Ciprecillo" or *Podocarpus oleifolius* which is endangered, according to CONAP in Index N° 1. Oak or "Encino" *Quercus oleoides* is listed in index N° 2 or is considered threatened because its distribution is restricted. The threat to the forest cover is due to illegal felling, forest fires and the progress of the agricultural border, although the property has always carried out forestry management.

9.1.2 Indicator Species

The species that are indicative of a healthy or recovered ecosystem must show specimens of species like those shown in Table 9.1, particularly with the variables typical of gallery forests.

In addition to tree species, the following bush vegetation is reported present: Canac, Yellow Milk, Salvia Santa (*Buddleja Americana*) and others. (Table 9.1)

[6] MAGA, INAFOR, DIGESA, Classification of recognition level life zones in Guatemala. Guatemala, 1982.
[7] MAGA, INAFOR, DIGESA, Classification of recognition level life zones in Guatemala. Guatemala, 1982.

Table 9.1 Vegetation of the Very Humid Low Subtropical Mountain Forest

Common name	Scientific name
Common cypress	*Cupressus lusitanica*
White pine	*Pinus ayacahuite*
Canac	*Chirantodendron pentadactylon*
Pine from the hilltops	*Pinus hartwegii*
Bitze	*Inga vera*
Sad Pine	*Pinus pseudostrobus*
Alder	*Alnus jorullensis*
Oak	*Quercus oleoides*
Yellow milk	*Zinowiewia sp.*
Sage	*Budleia sp.*

Source: Personal data collection

9.2 Fauna

The stock of species in a specific site provides data and information essential to natural resource conservation and management of the site (Oliver and Beattie 1993). The arthropod, reptile and amphibian, bird and mammal biodiversity study was conducted at the San José Ocaña property between December 19and 23, 2006. Collection sites were:

Site	Approximate location	Latitude	Longitude	Elevation (m.a.s.l.)
Pachum River	4 Km. N and 6.5 km W of San Juan Sacatepéquez	14º 45´ 17.9´´	90º 42´ 10.3´´	1540
Pine Forest	2 Km. N and 6 Km. W of San Juan Sacatepéquez	14º 44´ 21.1´´	90º 41´ 59.6´´	1880

The Pachum River site (camp) has latifoliate forest vegetation, where oak predominates. There are some pines and cypresses, particularly around the site where the camp was set up. The site identified as Pine Forest is located in the high part of the property and has mainly a pine plantation with some oaks, *Arbutus xalapensis, Mimosa* sp., blueberries. Illustration 9.1 in the following page shows the location of the two sampling sites in San José Ocaña Property.

Appendix 9 contains a technical report prepared by the team of biological diversity researchers in San José Ocaña Property. The report describes the methodologies used to collect specimens of arthropods, reptiles and amphibians, birds and mammals as well as a broad discussion on the outcomes.

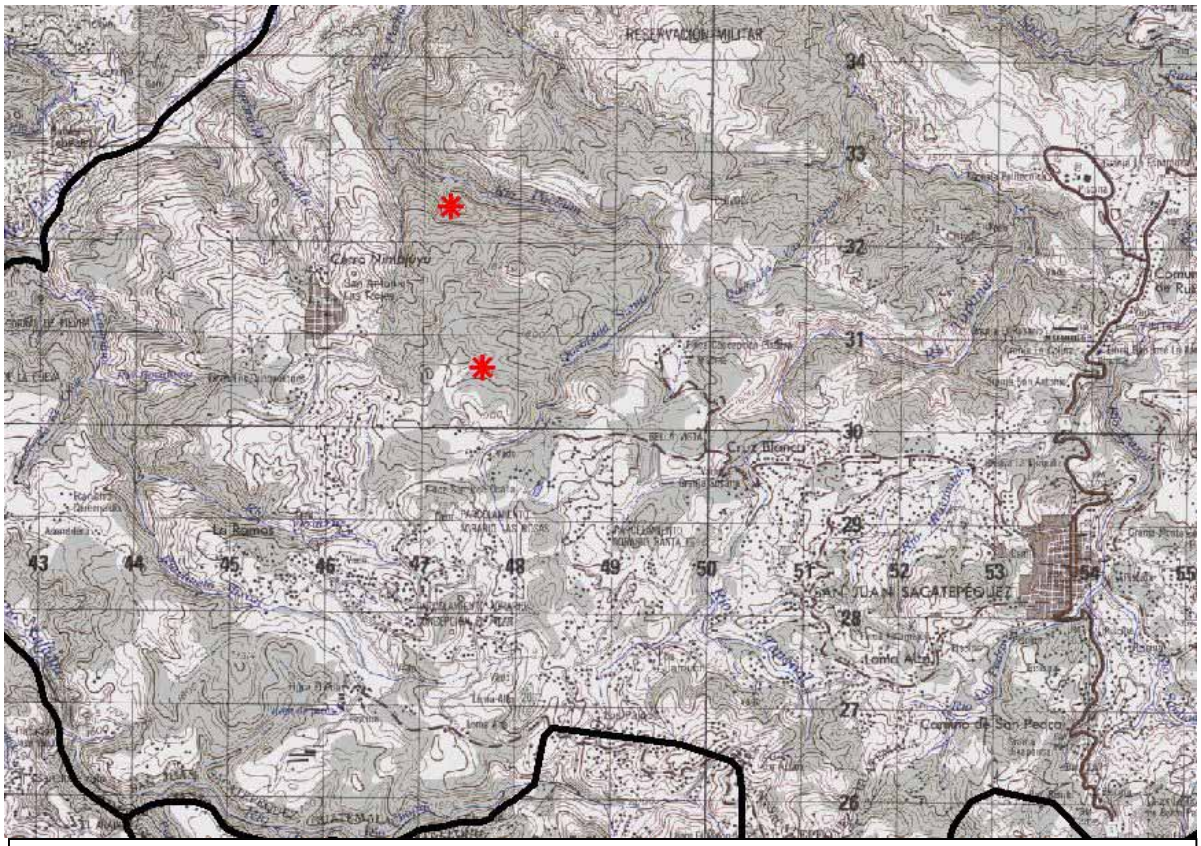


Figure 9.1 Location of sampling sites for the biological diversity study.

Below is a summary of the main conclusions of the technical study.

- ✓ According to the results obtained from disturbance indicator species collection in the different taxa, the conclusion is that San José Ocaña Property is very disturbed and that the collection site identified as the Pachum River appears to be very sensitive to environmental variations such as changes in soil use, the disposal of surrounding water flows and other anthropogenic activities;

- ✓ Beetles that are widely found in Guatemala were reported present, which, with the exception of *Uroxys micros* and *Ateuchus guatemalensis*, are associated to disturbed habitats (*Dichotomius annae, Copris lugubris, Copris aspericollis, Ateuchus guatemalensis, Uroxys micros, Aphodius lividus*). Among mammals, the best example of disturbance is the presence of a large amount of vampire bats (*Desmodus rotundus*), in this case associated specifically to the presence of cattle and other animals;

- ✓ Beetle species such as *Verres hageni, Passalus punctatostriatus* and *Publius agassizi* have been reported present in similar locations close to San José Ocaña Property but this time they were not collected in the sites due to human intervention in the forest; fallen tree stumps and firewood collection prevents their decomposition that would permit passalides to colonize them;

- ✓ Despite the high level of disturbance in the property, there is a small area worthy of conservation, on the shores of the Pachum River, where one of the two sampling sites was established. Rare species typical of the area were found, which are indicative of connectivity with other regions, and therefore considered to be a remnant of a significant habitat which is of value for conservation and protection. The area of the Pachum River flow (surrounding ravines) is a region where biological diversity of the entire zone comes together, which indicates that it can work as a biological corridor for mammals, birds and some insects (i.e. butterflies) and as a path for local migratory populations in the case of the pine-oak forests (bats and birds); and

- ✓ The recorded population of the tree frog *Ptychohyla hypomykter* presents characteristics that are different from the rest of the populations in the country. This is the discovery of a new population that is relatively isolated due to fragmentation and the extensive deforestation that forests and ecosystems surrounding this basin have been subjected to. The geographic distribution of this frog covers the Caribbean water flow from the South of Mexico, Guatemala, Belize and Honduras. It is considered a species with restricted distribution or regional endemic characteristics.

As a priority conservation measure, the recommendation is to keep gallery forests in the ravines and river-beds of the Pachum River where most fauna diversity is found; to preserve the patches of vegetation that are still in place and to recover the highly disturbed areas of gallery forests. In so doing the surviving fauna of the site will be protected. The basin works as a point of convergence of species from different regions as a "nesting" site for local migratory populations and as a biological corridor for the entire biological diversity of the region.

9.2.1 Threatened, Endemic or Endangered Fauna Species

The species of threatened fauna in the property include every commercially valuable species, as pets, food or furs, and particularly birds and mammals. In addition, there are fauna species that are under pressure from anthropogenic activities such as hunting, deforestation, propertying and fires or the slash and burn practice, which affect arthropodes, amphibians, reptiles and mammals.

Amphibians and reptiles are the most sensitive to changes in the ecosystem and therefore the most endangered species. Two species of amphibians endemic to Guatemala, that is, of restricted distribution, were collected at the property, namely the *Cranopsis íbarrai* toad and the *Ptycohyla hipomykter* tree frog as well as the *Geophis rhodogaster* snake.

In the group of the arthropodes and mammals, species that should not be in this region were collected and therefore are considered rare and will be the object of further studies: the *Dermanura azteca* and *Enchistenes hartii* bats and *Heliconius hortense* and *Morpho montezumae* butterflies.

9.2.2 Indicator Species

In the specific case of San José Ocaña Property, taxonomic groups would be sought out that measure the status of biological diversity and monitor indicator species populations that are sensitive particularly to anthropogenic activity. The following indicator species will be used to this end:

- Day butterflies of the Papilionoidea superfamily and the copronecrophagous beetle of the Scarabaeinae subfamily;
- *Cranopsis* [= Bufo] *ibarrai*, toad larvae to verify the quality of water sources, since this species is very sensitive to pollution; and,
- The frequency of pest presence may be used to measure the degree of pollution from solid waste, for example the ratio of "domestic" species vs wild species: *Didelphys virginiana* vrs. *D. marsupialis*, *Sigmodon* vrs. *Peromyscus*.

9.3 Protected Areas and Fragile Ecosystems

The extraction license area (2,000 hectares) does not present protected areas or fragile ecosystems; it should be noted, however, that the commitment to comply with the Environmental Management Plan (EMP) is extremely promising for the conservation of the increasingly reduced biological biodiversity in the site.

The project is not located in a protected area, in an area requiring special protection or in another type of area requiring conservation practices, according to the Geographic Information System (GIS) of the National Protected Area Council (CONAP). Appendix 10 contains the CONAP certification showing that the project is outside of the protected areas of this agency.

10. DESCRIPTION OF THE SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

10.1 Population Characteristics

City:

According to the XI National Population and VI Housing Census (INE 2002) the municipal district of San Juan Sacatepéquez has a total population of 152,583 citizens, 75,415 men and 77,168 women. 81,584 live in urban areas and 70,999 live in rural areas. Most of the people (99,853) belong to the Maya Cakchiquel ethnic group. The remaining (52,730) are not Maya. Most speak Spanish (84,224) and the rest speak the Maya Cakchiquel language (55,005). Of the total literate population (84,005), 45,688 are men and 38,317 are women. The school-age population is 120,034.

52,487 are economically active, and of these, 36,297 are men and 15,560 are women. The manufacturing industry employs 13,320 persons, farming uses 12,173 persons, public administration hires 9,349, construction gives jobs to 6,720, community services employ 3,680 persons, transportation employs 2,262 persons and financial services give jobs to 1,606 persons. Of the total economically active population, 14,742 are unqualified workers.

San Juan Sacatepéquez has 28,297 homes, of which 23,822 homes are owned, 2,549 are rented, 1,605 are on loan and 321 are under a different form of tenure conditions. Of the total number of houses, 15,151 have water connection 1,948 share the water connection and 341 use the public utility their water containers; 6,934 obtain water from a well, 2,801 buy water from trucks, and 777 take water from rivers or streams. Regarding waste water disposal, 9,437 homes discharge these into the public drainage system, 1,442 into a septic tank; 708 homes use a cleanable bathroom and 10,722 use latrines.

As for energy for lighting: 25,459 use electric power, 76 solar panels, 433 regular gas and 2,270 other forms of lighting. Of the total number of homes, 445 use electric power to cook, 13,538 use propane gas, 166 regular gas, 14,011 other forms of cooking and 60 use coal. To dispose of their solid waste, 3,565 use the municipal garbage collection service, 6,026 use private services, 10,515 burn their trash, 586 dump trash anywhere, 1,392 bury it and 213 use other forms of disposal.

Regarding houses to live in, San Juan Sacatepéquez has 32,211 dwellings, of which 28,398 are a formal house, 97 are apartments, 213 are rooms in neighborhoods, 1,375 are huts, 2,023 are improvised dwellings and 105 are other types of housing. Of the total number of houses, 623 have brick walls, 21,132 are cinder block walls, 280 are concrete, 5,312 are adobe walls, 1,488 are wooden, 1,670 are made of tin sheets, 282 are made of mud-straw, 1,319 are made of cane and 105 are made of other materials. House roofs are made of concrete in 4,294 houses, 24,702 are made of tin sheets, 2,718 are asbestos-cement, 287 are made of shingle, 63 are made of straw or palm leaves and 147 are made of other materials. And as regards the floors of the houses, 1,458 use ceramic blocks, 5,694 are made of cement bricks, 207 are made of

clay blocks, 11,638 are cement, 112 are parquet, 118 are wooden, 7,437 are soil and 5,547 are made of other materials.

The municipal district of San Juan Sacatepéquez shows little indication of extreme poverty when compared with other cities of the country. It is an industrious city with a labor force that works mostly in Guatemala City and in San Pedro Sacatepéquez. The city tends to diversify its productive activity towards industry. For instance, San Juan Sacatepéquez is the largest furniture manufacturer in the country.

In 2002 and 2005 Asesoría Basterrechea Asociados, S.A. carried out studies about the acceptability of industrial activity diversification in the cities of Huehuetenango, San Juan Sacatepéquez and Tecpán Guatemala. In San Juan Sacatepéquez, 82% of the people interviewed responded that industry generates the largest number of jobs. At this time, interviewees had many expectations and were excited about industry diversification. They favor non-metallic construction material mining.

In February 2006, Gamma Servicios Integrados S. A. analyzed the formal and non-formal activities of the people of San Juan Sacatepéquez engage in, as well as other aspects such as the value of land, social fear, etc. This report revealed a lack of stable employment in San Juan Sacatepéquez, with the exception of the garment assembly (maquila) work that is done in San Pedro Sacatepéquez. In farming, the main activity involves flower-growing and in industry, furniture manufacturer is at the lead. Informal economy consists of small businesses, independent craftsmen, service employees among others. The Gamma company report also indicated that people do not believe that farming is a development engine and that industry is not generalized towards the labor force in the city. Flower culture is a good option in farming, but only 15% of the people engage in it, namely, the people who own land. In addition, it is very difficult to find land for crops due to high prices and the high cost of agricultural inputs. Interviewed farmers stated that if they could do something different, they would, particularly if they could switch to furniture manufacture, garment assembly (maquila), trade and other industries. Farming in the city is done only for family consumption. Job opportunities will help eliminate their fear of crime, violence and the lack of basic inputs.

Las Trojes and Cruz Blanca villages:
The communities closest to the project area are San Antonio Las Trojes and Cruz Blanca. Las Trojes has 4,755 citizens and Cruz Blanca 16,509 citizens. On the issue of health, both San Antonio Las Trojes and Cruz Blanca have a type B medical supply center.

School coverage in Las Trojes and Cruz Blanca is shown in Table 10.1.

Table 10. 1 Education Coverage in Las Trojes and Cruz Blanca

Community	No. of students	Community	No. of students
Las Trojes		***Cruz Blanca***	
Luis Adolfo Toledo Juárez co-ed rural public school. Day school.	459	Cruz Blanca village co-ed rural state school No. 870 Day school	856
San Antonio Las Trojes co-ed rural state school. Night school.	441	Cruz Blanca village co-ed rural state school. Night school.	631
Sector II San Antonio Las Trojes Sector 2 co-ed rural state school.	94	Joya de Las Flores teaching cooperative institute	70
		Fuerza Estudiantil co-ed school	180
		Monte Hermon co-ed evangelical school	167
		Padre Antonio Rocco mater Orphanorum school	81

The economy of San Antonio Las Trojes is almost entirely a subsistence economy with most of the citizens engaging in farming, particularly corn and beans. There is limited trade in view of the distance of the capital municipal district of San Juan Sacatepéquez.

The economy of a large part of the population in Cruz Blanca is based on agriculture, mostly flower-growing for export as well as vegetable production for internal consumption in the city. There is also furniture manufacture and marketing for domestic use as well as small stores and businesses.

The most urgent needs of Las Trojes are: to pave the road, to pave the streets of the village and to build drainage systems. The needs of Cruz Blanca are: highway maintenance and the construction of a drainage system in one part of the village since the other sector is under construction.

10.2 Highway Security and Vehicle Circulation

The municipal district of San Juan Sacatepéquez is reached through National Highway 5. Access to the capital city is paved from Guatemala City and crosses San Pedro Sacatepéquez.

Access to the Project area starts in the turn to the Cruz Blanca village. From this village on, the road is a dirt road and takes the direction of San Antonio Las Trojes. In general, the dirt road is in good condition with the exception of small sections during the rainy season. Paragraph 5.6.3.3 of chapter 5 states the number of vehicles that travel on that road on a weekend (Saturday) and on a work day (Monday) in the section from Cruz Blanca to Las Trojes. The total number of vehicles is less than 400, where motorcycles and bicycles are 50% and 20% depending on whether it is a weekend day or a work day, respectively.

Inside San José Ocaña Property, where the Project is located, are a number of roads used for forestry management that can be used throughout the year. There is also a system of rural roads that connect several properties, plots of land and small communities.

10.3 Emergency Services

The police station in San Juan Sacatepéquez addresses security emergencies in Cruz Blanca and Las Trojes. In addition, most of the people have mobile phones and the municipal police are in constant communication with assistant mayors for crime control activities or to do prevention work or to address emergencies.

The firefighters of San Juan Sacatepéquez address emergencies as the health centers and posts. There is a type B health center in San Juan Sacatepéquez run by the Ministry of Public Health. As indicated before, there are health centers in Cruz Blanca and Las Trojes. There are private medical services that take care of emergencies in the area. In serious cases, in view of the fact that San Juan Sacatepéquez is close to Guatemala City, patients or victims of accidents are transferred to Guatemala City hospitals.

San Antonio Las Trojes is characteristic for social control standards, since there is an established order that responds to community organization. There are billboards with advertising that state that they are organized against crime, which has reduced the number of crimes.

10.4 Utilities

The capital city of San Juan Sacatepéquez has domestic water supply for the people of the urban sector as well as drainage systems and power grid. Public and private solid waste collection services have been introduced recently. There is passenger and cargo transportation to and from Guatemala City and neighboring cities and villages.

The capital municipal district of San Juan Sacatepéquez also has preschool, elementary and high schools as well as private school. There is a private highschool and a music school plus typing and tachigraphy academies and English schools.

There is transportation from San Juan Sacatepéquez three times a day going to San Antonio las Trojes that passes in front of San José Ocaña Property. There is a bus from Cruz Blanca as well as pick up truck transportation with no schedule that provides freight service and passenger transportation to Cruz Blanca, Las Trojes, San Juan Sacatepéquez and other area communities.

Pick-ups and other types of private vehicles operate in the various properties and communities that help transport people in emergencies or out of courtesy. There is also a motor-tricycle service called Tuk-Tuk that run taxi rides among San Juan Sacatepéquez, Cruz Blanca, San Antonio Las Trojes and neighboring communities.

San Antonio Las Trojes and Cruz Blanca have electric power and drinking water. As indicated above, villages have health centers and school buildings.

10.5 Local Perception about the Project

Before the outcomes of the interviews carried out between January and February 2007 among members of the communities that are in the neighborhood, background details are provided below:

A. Local perception about previous EIA studies in the property where the cement facility will be installed and will operate:

In May 2006, interviews were conducted with members of project neighboring communities to learn what the local perception of the quarrying and processing process, as part of the EIA work. The ethnic Kakchiquel group in the area of influence of the project is homogeneous as to its cultural, social and economic level as well as for its level of organization, which leads to similar responses to the questions asked in the survey (interviews).

The communities of the area of influence selected for the survey about the quarry mining and material processing Project were: in San Juan Sacatepéquez, Cruz Blanca and San Antonio Las Trojes; and in San Martín Jilotepeque, the Estancia de la Virgen village.

The survey form asked the same question more than once, in a different way, in order to have a greater level of certainty about the answers, particularly as concerns acceptance of the project, questions or concerns, and the way to minimize conflicts among the community, the company and the authorities. Some questions offered the possibility of several answers. The questions asked were these:

- Whether the interviewee had knowledge of rock extraction and its processing to obtain construction material in the area of San José Ocaña;
- If a member of the family works or worked in a business of this type;
- If the interviewee knew about the San José Mincesa project and how was the information obtained;
- Interviewee's opinion about the rock extraction activity and its processing;
- The benefits that this project could bring to the community;
- The type of conflict that might arise or what would be a matter of concern about the project;
- What would be ways to resolve the conflict;
- How bothersome would the Project be; and
- Based on these opinions, would interviewee support or reject the project.

Responses were confirmed with a second evaluation in the form that asked:

- If the relevant Government Ministries carry out inspections and do monitoring, would you support the project? and

- What measures would be more effective to avoid conflicts between the community and the company.

The results of the responses to the 100 interviews conducted in May 2006 in the three communities (50 in San Antonio Las Trojes; 30 in Cruz Blanca; and 20 in La Estancia de La Virgen) were systematized and relevant results are presented below. The full report may be seen in the EIA of the quarry and the aggregate crushing plant. Copy of the environmental and Natural Resource Ministry opinion is attached in Appendix 3.

a.1 About acceptance of quarry and crushing Project:

Question No. 1: "Modern technology will be used to extract rock and process it, that will not generate hazardous pollution for human beings or natural resources, since ongoing controls will be conducted both by MINCESA as by the Ministry of Energy and Mines and the Ministry of the Environment and Natural Resources". In view of this, would you support the project? The responses to this question show that 91% of the interviewees would support the project, as indicated in the table below.

Would support the project	91
Would not support the project	9
Total	100

Question No. 2. "if the Environmental Impact Assessment of the San José Mincesa Project, that this survey is a part of, is authorized by the Ministry of the Environment and Natural Resources in view of the reliability of its outcomes, and if there are controls and monitoring set in place by said Ministry about the environmental quality of extraction and processing facilities" would you be satisfied and would you support the project? The responses to the question show that 98% of the interviewees would support the project.

Would support the project	98
Did not answer	2
Total	100

The reasons given by interviewees to support the Project are the following:

- Benefits for the community;
- Controls that avoid environmental pollution;
- Benefits for the city;
- Sources of employment; and
- Protection of natural resources (water and forest).

Suggestions made by interviewees to generate a good relationship among the communities, the authorities and business were the following:

- Talk to the communities and their leaders;
- Support community development;
- Give employment to people from the community;
- Protect the environment;
- Take care of the forest and to reforest;
- Take care of water;
- Control dust and heavy traffic;
- Report problems and controls to the community;
- To do social work;
- Pay good salaries; and
- Communicate with COCODES and COMUDES.

a.2 Criteria expressed by Social Agents and Authorities about the Quarry and Crusher:

The opinions of Member VI of the Municipal district of San Juan Sacatepéquez, of the schoolteachers in the villages, of COCODES leaders, of assistant mayors and of members of various committees, provided in the surveys conducted in May 2006, agree with those of the members of the communities in that they consider the San José Mincesa project a positive project provided that it helps improve and maintain the environmental quality of the area that has a beautiful forest landscape. They added that they would also like to see benefits for the city through the payment of duties, taxes and others.

On June 4, 2006, a meeting was held with local authorities of San Antonio Las Trojes and the social researchers. The attendants produced a document where they asked that the Managers of the company report on the specific operations that they would conduct in the area, before they engage in operations.

On Wednesday, June 21, 2006, officers of MINCESA and of the company that conducted the EIA, Asesoría Basterrechea Asociados, S.A. met with the mayor of San Juan Sacatepéquez, Mr. Lázaro Pirir Equite, to explain the objectives of the company and the project as well as to give him background information on the environmental impact assessment study. On June 27, 2007, a letter was sent to the Mayor ((Reference 067/2006 from Manuel Basterrechea) with a summary of the San José Mincesa project content, as well as of the company that is promoting the project and the timeline of the work done so far, in order to know the local perception about the project. This is a requirement by the Ministry of the Environment and Natural Resources. With these documents, the Mayor was to explain the case to the City Council, and if required, would request the presentation of the project to the Council.

a.3 EIA Follow-up of the Quarry and the Crusher

The EIAs of the quarrying operations and the crusher plant were submitted to the Ministry of the Environment and Natural Resources on August 16, 2006, and on November 10, 2006 respectively. These assessments were made available to anyone interested in them. The Municipal district of San Juan Sacatepéquez requested the support of the School of Engineering of the State University (Universidad de San Carlos) through its energy and Mines Postgraduate Studies Center (CESEM) to evaluate the EIA. The Dean of the School of Engineering and members of CESEM met with officers of Mincesa to obtain details of the

project. The EIA for the quarry was approved on January 26, 2007 and on February 6, 2007 the study for the aggregate crushing plant was approved.

a.4 Meetings and Visits to the Cement Facility in San Miguel, Sanarate.

Between the date when the EIA of the aggregate crusher plant was presented (November 2006) and the surveys to obtain opinions on the cement facility (January and February 2007) was conducted, Cementos Progreso officers have conducted several meetings and visits to the cement facility in San Miguel Sanarate, with authorities and members of communities that are close to the cement facility. These are summarized in Table 10.3 below. The persons who participated in the first two visits to the cement facility in the San Miguel Sanarate property on December 20, 2006 and January 20, 2007 respectively, are listed in Tables 10.4 and 10.5 below.

Table 10.3 Meetings and Visits with Authorities and Neighbors of Communities that are Close to the Project

Communities	**Sector II, Cruz Blanca**	**Joya de Las Flores, Cruz Blanca**	**Visit to San Miguel**	**Lo de Ramos, Cruz Blanca**	**Sector II, Las Trojes**
Date of the meeting	2-12-2006	19-12-2006	22-12-2006 y 20-01-2007	8-1-2007	11-1-2007
Participants	2 members of the auxiliary City Hall; 3 members of COCODE and two members of the community	The President, Mr. Toribio Curup and 8 more members of the COCODE and of the Water committee	17 persons in the first visit and 64 in the second visit. See list of persons in tables 12.3 y 12.4	2 members of the auxiliary City Hall; 5 members of the COCODE; 1 MEMBER OF THE school board and one member of the water committee	3 members of the auxiliary City Hall and 3 members of the Development committee
Questions asked	what is the real environmental impact? We do not want to fill our children's lungs with dust. The wind runs from south to North. Will it harm Las Trojes? Is this meeting to get permission or to inform people? Will you bring workers from other cities and countries? Will the destruction of the will have an effect on the climate and will it destroy the landscape? What will each community get? We want a guarantee that there will be no adverse impact and if there are: what will be done about it?	Will tunnels be drilled? How will you get to the property (highway)? Are you part of the San Marcos mining company? Will cement be cheaper? What happens if the neighbors oppose the project? We want a copy of the EIA.	A summary of the second visit was drafted that lists the comments of visitors. See Appendix 10.	Exploration wells will suck water from water wells? will the highway change the course of the water that currently goes to the wells? Was an exploration license extension requested? What does the Project involve?	Is it really only Cementos Progreso or is there a mining company behind the Project? Will you export your entire production from this site? Is it true that the highway will produce vibration to the degree that the water wells will dry up?

Table 10.4 Persons who visited the Cement Facility in San Miguel, Sanarate on December 22, 2006

Name	Reference
Abdiel López	Esmirna Association Pastor
Ángel Ojer	(Comes with Abdiel López)
Jorge Parir	(Comes with Abdiel López)
Efraín Patzán	(Comes with Abdiel López)
Florencio Raxón	Does upholstery / Creator of the firefighters unit
Laura Chet de Raxón	(Wife of Florencio Raxón)
David Raxón	(Son of Florencio Raxón)
Lucas Surui (minor)	(Relative of Florencio Raxón)
Carlos Tepep(minor)	(Relative of Florencio Raxón)
Madeleine Raxón (minor)	(Relative of Florencio Raxón)
Hugo García	Owner of Empacadora AGROEXPORT
Aris García	Responsible for the Shell Gas Station (Hermanos García)
Fulvia García	Responsible for the Shell Gas Station (Hermanos García)
Fidel García	Responsible for the Shell Gas Station (Hermanos García)
Elvira Rac	(Wife of Guillermo Rac / Carpenter)
Christian Rac (minor)	(Son of Guillermo and Elvira Rac)
Óscar Rac (minor)	(Son of Guillermo and Elvira Rac)

Table 10.5 Persons who visited the Cement Facility at San Miguel, Sanarate on January 20, 2007

Name	Reference
Lilian Hernández	Head of the School Board of Joya de Las Flores
Miguel Ángel Subujug	Member of the former School Board of Joya de Las Flores / Has a store in the school
María Isabel Chitay	Wife of Mr. Miguel Ángel Subujug
Joselino Larios	Father of teacher María Cristina Larios (Joya de Las Flores school)
José Pedro Larios	Uncle of teacher María Cristina Larios (Joya de Las Flores school)
Teacher María Cristina Larios	Joya de Las Flores School
Teacher Ana Mercedes Curup	Joya de Las Flores School
Teacher Irma Yolanda Toxcón	Joya de Las Flores School
Teacher Margarita Pac	Joya de Las Flores School
Teacher Rubén Ajcip	Joya de Las Flores School
Toribio Curul	Assistant Mayor of Cruz Blanca / President COCODE Sector 4 / Cruz Blanca
Enrique Yup	Assistant Mayor of Cruz Blanca
Vicente Chitay	Member of COCODE Sector 4 / Cruz Blanca
Felipa Canahuí	Mother
Marta Ofelia Chaicoj	Mother
Miguel Tubac Patzán	Father / Pacajay
María Gerónima Locón	Mother
María de los Ángeles Vásquez	Joya de Las Flores School / Member 2 / School Board
María Bernardina Vásquez	Daughter of María de los Ángeles Vásquez
Francisco Guamuch	Joya de Las Flores School / Member 1 / School Board
Fulgencio Sequen	Joya de Las Flores School (former President of the School Board)
Gavino Sequen	Brother of Fulgencio / Father
Luis Raxón	Son of Florencio Raxón
Daniel Raxón	Son of Florencio Raxón
Maximiliano Pirir	Set Village Community / Santa Fe Ocaña
Lexter Pirir Chavac	Brother of Maximiliano Parir
Nazario Raxón	Member of the Commission created by the Municipal Council to assess the project
Natanael Boch	Member of the Commission created by the Municipal Council to assess the project

Name	Reference
Antonio Pirir	Member of the Commission created by the Municipal Council to assess the project
Venancio Patzán	Member of the Commission created by the Municipal Council to assess the project
Justo Pirir	Member of the Commission created by the Municipal Council to assess the project
David Raxón	Member of the Commission created by the Municipal Council to assess the project
Jonathan Raxón	Member of the Commission created by the Municipal Council to assess the project
Xarlyn Raxón	Member of the Commission created by the Municipal Council to assess the project
Mynor Alberto Chaicoj	Member of the Commission created by the Municipal Council to assess the Project
Walter Alfredo Chaicoj	Member of the Commission created by the Municipal Council to assess the Project
Alicia Estela Chaicoj	Member of the Commission created by the Municipal Council to assess the project
María Trinidad Subuyuj	Member of the Commission created by the Municipal Council to assess the project
Juan Carlos Vicente	Member of the Commission created by the Municipal Council to assess the project
Luis Chitay	Member of the Commission created by the Municipal Council to assess the project
Evelina Santucci	Principal of the elementary School for girls (San Juan Sacatepéquez)
Claudia Solís	
Frida de García	Teacher of El Refugio school / Member of the Board of ECOSABA
Carlos Tale	Member of the Traders Associations of San Juan
Manuel Vásquez	Member of the Traders Associations of San Juan
Ricardo Iquité	Member of the Traders Associations of San Juan
Félix Concoha	Agronomist
Juan Alberto Cuc Chávez	Politician of Cruz Blanca (proponed by Lázaro Pirir)
Buenaventura Sian	Comunidad de Ruiz / Trader (man)
Blas Chajón	Teacher of Instituto República de Austria
Arturo Sequen	
Inés Sicán	Owner of Comercial Guadalupe / Works with many weavers / He belongs to a sisterhood of the Catholic Church
Aura Marina Asturias de Granados	Principal of the School of Commerce
Mario Arnoldo Granados	(Husband of Aura Marina Asturias)
Marisa Castellanos	Neighbor San Juan Sacatepéquez
Leocadio Jocop	"El Jordán, S.A." furniture facility
Marta Lidia Tubac	(Wife of Juan Alberto Cuc Chávez)
Héctor Concoha	Historian (Brother of Felix Concoha)
Josué Concoha	(Son of Héctor Concoha)
Eddy Vinicio Sicán	Teacher of Instituto República de Austria
María Estela Boj	Teacher of Instituto República de Austria
Mario García	Owner of Farmacia San Juan
Rolando Cotzojay	Owner of Mueblería Legacy *
Alba Acjic	(Wife of Rolando Cotzojay) *

The questions of the participants in the second visit to the cement facility in San Miguel Property in Sanarate, on January 20, 2007 were the following. Also shown below are the answers by Cementos Progreso officials:

Question (P): How many minerals will be extracted? Response (R): the exploration license covers most non-metallic minerals used in the construction industry. In practice, it will not be more than 4: limestone, loam, volcanic sand and shale.

P: What chemicals will be used to produce cement? The cement production process differs from other minerals such as metallic minerals in that no chemical product is used in its production, except the quarried raw materials, electric power and heat.

P: The flames that we see at night coming out of the stacks are carbon monoxide? R: Gas temperature in a stack is of not more than 150°C, for which reason there are no flames, which would burn the fabric filters. Gases coming out of the stacks are carbon dioxide and water vapor that are the main products of every combustion process. Monoxide is the result of

incomplete combustion which does not occur in our case and this can be confirmed in gas analyzers.

P: Will you use explosives and how will these affect the neighborhood? R: Explosives are used for some hard parts of the quarry but they are low in intensity and do not produce vibration beyond 200 meters; the closest population (Las Trojes Sector II) is 1,900 meters away from the quarry.

P: How will dust affect our health? R: the design of the new facility will ensure a clean process. In addition, it will have dust emission control through filters and European standards will be met.

B. Local perception on the installation and operation of the cement facility in San José Ocaña Property, San Juan Sacatepéquez

After the second visit to the cement facility in San Miguel Property, in Sanarate, it was deemed appropriate to conduct interviews to learn the opinion of local authorities and citizens about the project in San José Ocaña Property in the Cruz Blanca village, San Juan Sacatepéquez. The members of the communities that are close to the project site were interviewed from January 23 to February 6, 2007. The list of persons interviewed and the form of each interview as well as the corresponding report are included in Appendix 11.

48 persons were interviewed in the capital municipal district of San Juan Sacatepéquez in Las Trojes Sector II and Cruz Blanca. Because the authorities in San Antonio Las Trojes ("sector I") did not approve of the interview to be done in the community, it was done with villagers who work in San José Ocaña Property. In view of this, the distribution of the 48 interviewees by place of residence was the following:

Place	**Number of interviewees**	**%**
Las Trojes sector II village	15	31.25
Las Trojes (sector I) village:	6	12.50
Cruz Blanca village	20	41.67
San Juan Sacatepéquez capital	7	14.58
Total:	**48**	**100.00**

The results of the survey show that the constant in the responses by the villagers is the same as those of the first survey conducted in May 2006 about rock extraction and the crushing project as well as about the concerns related to water, forests, dust, traffic, etc.

Regarding acceptance of the company, 45 of the 48 persons agree with the installation and operation of the cement facility (93.76 %), 1 person is not in agreement (2.08 %) and the other two persons did not give an opinion (4.16 %). Therefore, like in May 2006, there is full acceptance of the project despite doubts expressed that it may be a gold and uranium mine. In this sense, the responses of some of the interviewees reflect the lack of or insufficient information about the industrial objectives of Cementos Progreso. Greater persuasion efforts are needed in San Antonio Las Trojes, where the interviews could not be conducted due to lack of endorsement by local municipal authorities.

Below are the results of each one of the questions asked in the survey. The sum of the percentages over 48 (100%) are consistent when the response deals with only one question, but there are questions where the interviewee has the option to offer more than one response and therefore the percentage calculation is based, not on the number of interviewees (48) but on the total number of different answers obtained.

Are you familiar with the way cement is made?

Responses	**Number of interviewees**	**Percentage (%)**
Yes	20	41.67
No	28	58.33
Total	**48**	**100.00**

Around 60% of the interviewees are unfamiliar with the way cement is made.

What good or positive aspects for your community do you think would come from the construction and operation of the modern cement facility?

The following 61 responses were obtained to this question:

Responses	**Number of interviewees**	**Percentage (%)**
Did not answer	3	4.92
Would bring sources of employment	37	60.65
Cheaper product	6	9.84
Would improve highways	6	9.84
Benefits for the community	7	11.48
Reforestation of the area	2	3.27
Total	**61**	**100**

Interviewed members of the community believe that jobs will be the main benefit from the new cement facility (60.65%) that, added to other benefits for the community (11.48%) account for almost three fourths.

What social or environmental concerns does the cement facility construction and operation raise? Or what have you heard about that?

Responses	**Number of interviewees**	**Percentage (%)**
Did not answer	13	25.00
Would not have an effect	10	19.23
That dust will cause a negative effect	8	15.38
That water sources will be contaminated	12	23.08
Other: -Pollution -Truck traffic -Information problems -Outsiders	9	17.31
Total	**52**	**100**

25% of the interviewees did not answer this question, possibly because they are not aware of how it may affect the facility. 19.23% of the interviewees responded that the facility operation would not affect them. The two main concerns of the interviewees are: the water well (23.08%) and the dust (15.38%). Pollution and truck traffic are mentioned to a lesser degree.

If the company offers the guarantee to protect natural resources such as forests, water and air while in operation, to give jobs to community members and to cooperate in the socio-economic development of the area, as well as to meet the controls established by the Ministries of the Environment and of Energy and Mines, would you agree with the project? Would you support it?

Responses	**Number of interviewees**	**Percentage (%)**
Did not answer	2	4.16
YES	45	93.76
NO	1	2.08
Total	**48**	**100.00**

93.76% of the persons interviewed stated that they agree with the Project if natural resources are protected, if community members are employed and if the Project cooperates with the development of the city. This is one of the most important questions in the survey and the high percentage of acceptance of the project shows that they support it. The percentage of favorable responses received in the survey of May 2006 repeats itself here since the project is accepted as a source of social development, particularly in view of it being a source of jobs. The opinions given in the survey are personal but may vary in the case of a group, particularly when rumors, lack of accurate information and vested interests are involved.

What recommendations would you make to ensure that the Project can be developed in harmony with communities?

Responses	**Number of interviewees**	**Percentage (%)**
Report to the community and its leaders	37	74
Employ people from the community	9	18
Take people to meet the cement facility in San Miguel, Sanarate	4	8
Total	**50**	**100**

The main recommendation given by 74% of the interviewees was that the community and its leaders be informed of the Project. Another recommendation was to give jobs to neighboring community members (18%), and that people be taken to visit the facility in San Miguel, Sanarate (8%).

What opinions have you heard about Cementos Progreso and its project in the area?

Responses	**Number of interviewees**	**Percentage (%)**
Did not respond	7	12.96
That it will be a gold or uranium mine	21	38.89
That it will be a cement facility	8	14.82
Other: -That it will affect water sources, the forest and the people, due to the dust. -It will be a tunnel and an underground highway	18	33.33
Total	**54**	**100.00**

These responses reflect, on the one hand, that there are outsiders that have disseminated inaccurate information about the project (38.89% of the interviewees stated that this will be a gold and uranium mine) and, on the other hand, the need for more communication about the true objectives of the Project by the company proposing it (14.82% of the interviewees offered knowledge that it will be a cement facility).

Have you been present or have you heard about the information that Cementos Progresso officials have provided to members of the communities, authorities and local leaders?

Responses	**Number of interviewees**	**Percentage (%)**
Yes	22	45.83
No	26	54.17
Total	**48**	**100.00**

Despite the fact that 45.83% of the interviewees stated that they know that Cementos Progresso officials informed about the Project, most said that they learned this from third parties (neighbors or friends) but not because they were present.

Have you heard that Cementos Progreso will set up an Information Office to report on the development of the project and on the social benefits for the communities?

Responses	Number of interviewees	Percentage (%)
Yes	19	39.58
No	29	60.42
Total	**48**	**100.00**

Around 40% of the interviewees have heard about the information office that the company will set up at the Project site to inform the community about its development.

What is your opinion about Cementos Progreso having an information office to answer questions from the members of neighboring communities about the project?

Responses	Number of interviewees	Percentage (%)
Did not answer	2	4.17
Answered positively	46	95.83
Total	**48**	**100.00**

The high percentage of positive answers (95.83%) confirms the need and interest on the part of the people to have more information. One of the interviewees suggested providing information through the media. The responses were of this nature: It would be a good thing because the community would be informed; it would be good because questions would get answered; it would be good because people would be informed; it would be good for people to feel safe; it would be excellent; it is necessary; it would avoid social conflict; it can become important and it would be good to provide information through the media.

In order of priority, say what you would suggest to avoid misinformation about the operations of Cementos Progreso that can have a negative effect on its relationship with communities close to the project.

Responses	Number of interviewees	Percentage (%)
Did not answer	9	15.52
Answered with an opinion	48	84.48
Total	**58**	**100.00**

84.48% of the interviewees mentioned several ways to avoid misinformation as follows: keep the community informed; meet with the community; take people from the community to see the facility; meet with community leaders; stay in touch with the community; make the Project known; talk to community leaders; and use the media.

Would you agree with the creation of a permanent dialogue committee between communities and the company and to stay in constant touch through the information office to look for feasible solutions to problems that may arise in the area of misinformation?

Responses	Number of interviewees	Percentage (%)
Did not answer	1	2.08
Yes	45	93.76
No	2	4.16
Total	**48**	**100.00**

The positive response by 93.76% of the interviewees confirms the favorable view that the people have of finding solutions to problems that may arise in the area as a result of misinformation about the project through dialogue.

One last opinion or suggestion that you may have about the content of this interview:

Responses	Number of interviewees	Percentage (%)
Did not respond	38	79.17
Gave an opinion	10	20.83
Total	**48**	**100.00**

79.17% of the persons interviewed "Did not respond", because they feel that what they had said before is enough. The opinions that confirm this are: help the community; build a highway; explain the project to the Catholic and evangelical churches; and hire persons from San Juan Sacatepéquez to persuade communities.

The outcomes of the surveys done indicate that there is a high level of acceptance of the development of the project because it will take benefits to neighboring communities, particularly employment and services-provision opportunities. In addition, it is evident that inaccurate information has been disseminated in the communities, since this will be a cement facility to be built by Cementos Progreso (a company that is known throughout the country as a cement manufacturer) and in no way related to gold and uranium mining. Interviewees suggested that an ongoing flow of information will lead the Project to be developed in a way that it will benefit all.

10.6 Community Infrastructure

The infrastructure in the municipal district of San Juan Sacatepéquez includes a paved highway, public and private schools, a Catholic church and evangelical temples, a municipal market, a health post, as well as a Social Security care center for its members. A child care center called El Bosque operates at the capital of San Juan Sacatepéquez. It is a hospital for infant tuberculosis cases and operates with private funds.

The city has electric power and a network of rural roads in good conditions between the communities. It also has mobile phones. Mail and telecom services are available. Television networks serve the homes of the communities.

The populated areas of the city have school buildings and sports courts and fields. Health centers and posts are in place. Water systems are established. There are Catholic churches and evangelical prayer sites. The area is mostly Catholic.

Infrastructure and other needs that have been given a priority at the city are:

- The expansion of telephone networks;
- The expansion of rural road maintenance networks;
- The expansion of sports facilities;
- The expansion and enhancement of potable water services;
- Better health facilities; and
- Better mobile telephone service.

10.7 Community Displacement and/or Movement

The Project will be developed in a private property with forestry management where there is no possibility to displace communities or families. Quite the contrary, the project will attract people to the area with its socio-economic benefits and supply of jobs and commercial and productive activity diversification.

The people who currently collect firewood and plant corn in the property will be able to continue to do so in the remaining areas of the property. The cement facility will use up 64 of the 860.7 hectares of San José Ocaña Property.

10.8 Description of the Cultural Environment; Historic, Archaeological, Anthropological, Paleontology and Religious Value

Through a Government resolution of March 8, 1923, the capital of San Juan Sacatepéquez had its category raised from town to village. It has huge cultural ethnographic as well as ethnological cultural wealth from the Cakchiquel nation and, despite its closeness to Guatemala City and modern productive processes, such as the garment assembly industry (maquila), customs, myths, rites, legends of the vision of the world, and the history of that indigenous nation have not been lost.

The parish, destroyed by the 1917/18 earthquakes, reconstructed in 1923 and restored a few years ago, had 4 silver altars. The most widely worshipped religious image is that of the Christ in the Cross, also known as the Precious Blood of Christ. The groups of religious leaders (cofradías) of San Juan, of the Virgin of the Rosary, of Jesus of Nazareth, of the Holy Cross and of the Holy Grail have existed in San Juan. The parish is an rural parish of the Archdiocese of Guatemala. Birth certificate books date back to 1698, marriage certificate records are available from 1758 and death certificates from 1717 are kept.

The local festivity is celebrated during the week of June 24. The church celebrates the birth of its Patron Saint, Saint John the Baptist. The predominant indigenous language is Cakquichel.

Catholic churches are colonial works of art and are listed by several texts of colonial religious travelers such as the Archbishop don Pedro Cortés y Larraz who stated about the Cakchiqueles and their culture that: "… there are no abuses, scandals or vices here. There is no idolatry or superstition in the people of the parish". Most colonial buildings were lost in the 1976 earthquake but there are some religious remains at the capital.

The Archaeological Atlas of Guatemala does not identify archaeological sites in the Project area. This has been confirmed by the Archaeological, Pre-Hispanic, Colonial and Republican Registry of the Cultural Heritage office of the Ministry of Culture. Appendix 12 contains the

certificate issued by the Archeological, Pre-Hispanic, Colonial and Republican Registry of the Cultural Heritage office.

Archaeological reconnaissance work was done in San José Ocaña Property, particularly in the North side that borders with the Pachum River and Sumo Ravine, including the Pachum will. Bibliographic research of several authors was carried out as well as research in the archives of the Pre-Hispanic, Colonial and Republic Monument Department. No archaeological site is described there, particularly in the polygon under research.

No pre-Hispanic structures were seen that would lead to establish the existence of an archaeological site. The area researched is in a high pine forest and in reforested areas. The soil has therefore gone through changes brought about by these activities. The soil is very loose and mixed with small pebbles. The slopes of the hill present large rocks without pre-Hispanic writings.

10.9 Landscape

The landscape in the area of influence of the Project is rural. The landscape in the area of the project is within the physiographic region of volcanic highlands. Altitudes range from 1,400 to l,976 m.a.s.l.

Outside of San José Ocaña Property is a landscape of corn plantations and hills with and without vegetation cover. Populations concentrate in the centers of villages, farms and plots of land. There is no population dissemination. San José Ocaña Property, where the Project is located, is forest land with forest properties registered with INAB and PINFOR as indicated on the signs posted in the properties.

10.10 Socially Sensitive and Vulnerable Areas

Socially sensitive areas are communities where the degree of adaptation to changes produced by new productive activities is slow or difficult due to the specific characteristics of the population (levels of poverty, including education, services, etc.). Socially vulnerable areas are communities that are unable to prepare to face natural disasters (earthquakes) or man-made disasters (chemical spills or fires resulting from an industrial process) due to limited organization and the inability to properly respond to them.

San Antonio Las Trojes and Cruz Blanca villages are the closest communities to the Project. Currently, both communities as well as other similar neighboring communities (La Ramos, Santa Fe Ocaña, El Pilar) are not considered to be socially sensitive since the different kinds of activities that they have engaged in have gone through a process of adaptation that now makes them a part of the environment. Some evidence that the communities have adapted to change are these:

- The workers of San José Ocaña Property who come from San Antonio Las Trojes, Cruz Blanca and other communities specialize in forestry, including sawmilling and

others work in flower culture. This suggests that the farmers of clean, perennial crops such as corn were able to enhance their revenues and learn to plant new crops (coffee and nurseries) as well as to engage in other activities (forestry). Around 150 persons from neighboring communities work in San José Ocaña Property; from Las Trojes sector II 70%; from San Fe Ocaña, 20%; from El Pilar sector II, 5%; and the remaining 5% from the other communities (Las Trojes I, Pilar I, La Ramos); and,

- In view of the lack of their own trees for firewood, members of San Antonio Las Trojes reached an agreement with the owner of San José Ocaña Property to collect the branches left behind after trees are felled. In addition, members of neighboring communities plant corn in the fields of the property where all the trees have been felled and in exchange for this privilege they plant and care for the small trees during the first years of life. These examples suggest that they were able to find a solution to address their needs (for firewood and soil to plant).

The development of a project such as the installation and operation of a cement facility will represent a drastic change in the activities currently carried out in the area and will require a process of adaptation by all those involved. Both the communities and company officials will need to make contributions so that adapting to change takes place in a way that will lead all to feel the benefits.

To be able to say that the communities close to the project are not vulnerable to natural or man-made events is harder to affirm because there are no municipal or community preparedness or response plans for such emergencies. The 1976 earthquake has been the natural phenomenon that has possibly had the greatest impact on communities that are close to the project, but man-made events like those listed above have not occurred in the area. Therefore we believe that, in current conditions, communities are vulnerable to natural and man-made events.

11. CHOICE OF ALTERNATIVES

11.1 Alternatives Considered

In 1996, Cementos Progreso started a search for sources of raw materials adequate and sufficient to make cement, foreseeing that the demand for construction materials in the future would grow parallel to population growth and the development of the country. Several economic, socio-economic and feasibility studies were performed during this period of time, and the analyses done and their conclusions have helped reinforce the initial predictions about a growing demand for cement.

Three of the options that were studied and evaluated were chosen, and from these the current location was finally chosen due to:

- ✧ The need to expand cement production capacity to cover the growing demand for cement and construction materials;

- ✧ The closeness of major cement and construction material markets and consumption centers;

- ✧ The existing potential of raw materials in the area, in the amounts and with the quality required in its components to be used to make cement; and,

- ✧ The need to invest in the country in order to favor the creation of development poles and sources of employment in areas with a high potential for non-metallic mining where communities had not, to this date, had the possibility to improve their life quality.

The legal aspect is also considered since Section 39 of the Constitution, in addressing private property, provides for right of citizens to properly use private property for personal or family development. The Constitution of Guatemala guarantees private property as a right inherent to humans, and every person may freely dispose of his/her goods under the Law. On the other hand, the State guarantees the exercise of this right and shall create the conditions that facilitate for the owner the use and enjoyment of his/her assets in a way that will lead to individual progress and national development for the benefit of all Guatemalans.

One of the alternatives evaluated was to not carry out the project. In that case, the promoters of it would not carry out the investment that they intend to make with an aim to set up production facilities that would pay the cost of the initial investment in the medium term and would then turn into a profitable business. Employment would not be generated either through hiring locals to build the project, which would mean a lack of income for the families of potential workers, or the production of construction materials. For these reasons, the area in San José Ocaña Property presented the best choice for the success of the operation.

11.2 Chosen Alternative

The piece of land in San José Ocaña Property, with a surface of 860.7 hectares, is located in the municipal district of San Juan Sacatepéquez, in the department of Guatemala. It has the necessary land (64 hectares) to set up the cement facility as well as the amount and quality of minerals required. In addition, it is close to the area with a high demand for construction products, namely the metropolitan area of Guatemala. The project will contribute to the development of the municipal district of San Juan Sacatepéquez and its direct and indirect areas of influence including areas close to Guatemala City through the supply of construction materials and employment opportunities.

As indicated in Chapter 5, paragraph 5.4, in addition to natural cement and other types of mortar made from limestone and other natural processed components, Portland cement is a material that has revolutionized the construction industry and has contributed to promote modern civilization. The process of cement production has been enhanced with time and, thanks to technological breakthroughs in electronics, the evolution of material, the enhancement of processes and the use of alternate fuels, it is now possible to design raw material blends to produce different types of cements. No other processes are known to date to make cement, due to the fact that the syntherization reaction, which is the process through which elements react among them to form the basic chemical compounds of cement, require high temperatures which are obtained from the efficient and controlled combustion of fuels in a rotation kiln.

In summary, the benefit will be the supply of construction materials at more affordable prices than those made in other parts of the country in view of the closeness to areas where there is demand since freight costs will be lower.

12. IDENTIFICATION OF ENVIRONMENTAL IMPACT AND DEFINITION OF MITIGATION MEASURES

This chapter identifies and assesses potential environmental impacts generated during different stages of the project as well as prevention, mitigation and compensation measures.

One of the most widely recognized methodologies is used to assess potential environmental impact, namely, the Vicente Conessa methodology that is an adaptation of the Leopold matrix. This methodology assesses qualitative and quantitative impacts that have been identified according to the weigh allocated to them. Impact is assessed on the basis of the Delphi method that consists of the opinion that specialists assign to impact relevance. The professionals on physical, biotic and socio-economic aspects who participated in the EIA study are: Geologist Jorge Eduardo Romero Gramajo, Active member 3,599, with Ministry of the Environment and Natural Resources (MARN) environmental license number 012; Biologists Liza Ixcot, Sergio Pérez (mammals), Hugo Enríquez (mammals), Manuel Acevedo (reptiles, amphibians and birds), Enio Cano (insects); Sociologist Carlos Enrique Quezada Jerez, Active member 1,330 with Environmental License 063 of MARN; Archaeological Carmen Elizabeth Ramos Hernández; and Manuel Basterrechea Díaz, PhD in Civil and Environmental Engineering, Active member 1,264, with MARN Environmental License 059.

Before identifying potential environmental impact, it is necessary to define the project's direct and indirect areas of influence. As indicated in paragraph 5.2, the direct area of influence is the zone where potential environmental impact resulting from project activity will occur at the same time and in the same place where those activities take place. The direct area of influence (DAI) is where the cement facility and its associated activities (office and services) will operate. The DAI will cover 64 hectares and the facility will operate during at least 25 years and is in San José Ocaña Property, close to the source of materials (San José Mincesa quarry). Forestry activities are currently conducted in the direct area of influence.

The indirect area of influence (IAI) is the area where there could be environmental impact resulting from the Project, but is different from the area where the activities will be carried out. IAI covers a more extensive area, which is defined in and out of the property and includes the neighborhoods of the project, particularly those which could be positively and negatively affected as a result of project activities. In this sense, the area includes San Antonio Las Trojes and Cruz Blanca since the project will hire persons from these and other communities to work at the facility. Potential environmental effects are also considered. The sale of facility products will represent an important traffic of trucks and therefore a two-lane paved highway will be constructed that may be expanded to four lanes, from the facility to highway CA-1 that will be the object of a specific EIA study.

12.1 Environmental Impact Identification and Assessment

12.1.1 Methodology

As provided for in the terms of reference issued by MARN (Ministry of the Environment and Natural Resources), a conventional methodology is to be used to address project activities that create an impact on the environment, and assess them by analyzing the various stages of the project. Project development involves four stages as indicated in paragraph 5.6. The first one is pre-construction; the second is construction; the third one is operation and the fourth one is the abandonment stage.

The first stage or pre-construction stage consists of the studies performed to select the best location for the cement facility in the property, taking into account its closeness to the source of minerals (quarry) and at the same time that the site is not on an important source of raw materials. Another criterion was that it should be as far as possible from Las Trojes and Cruz Blanca, in order to have as little impact on their current social and environmental conditions as possible. Other activities carried out during the preconstruction stage involve water, air, sound sample-taking, hydro-geological assessment and biological inventories to establish an environmental baseline, as well as hearing the opinions of neighboring communities about the project. Assessment done had no environmental impact since it involved site visits and cabinet analysis.

The second Project development stage will involve the activities needed to install the facility and its duration will be of around 24 months. The main activities to be carried out during the construction Stage are grouped as follows:

- The construction of a temporary warehouse and guard's room to store materials, equipment and machinery and to care for and watch them;

- Sending the construction machinery and equipment to the place where the facility will be set up with the operators to build platforms to install the components of the facility, including the office and the shop as well as the camp;

- Preparing the area for the facility in 26 out of the 64 hectares will involve cutting down trees and clearing the ground of vegetation and bushes. Leveling the ground will involve removing the topsoil and keeping it and protecting it with plastic (polyethylene) until it is used again, as well as building ditches and cross-cutting filtration mesh on natural drainage to trap solids during rainfall runoff;

- Building the camp that will be in use during the 24-month installation of the facility and provide basic services to build the project (electric power, water supply and drainage system and primary treatment). The time estimated to install the camp will be 60 days. Said camp will have an office, a warehouse, a dining room and a shop and will have water, drainage and electric power. In addition, there will be visitors parking, parking for machinery, for trucks carrying components for the facility and for company vehicles. Because of the large number of workers (1,800) proper management of liquid and solid waste will be important.

- Receiving construction materials for the facility: Construction materials will be purchased, transportation will be assigned and delivery in the work area will be coordinated.

- Building the civil works of the various components of the facility. The time estimated for civil works is 660 days.

- Installing the various mechanical and electrical components of the facility. Time estimated for the mechanical and electrical set up is 360 days.

- Perform tests in the empty facility. Time estimated to run these empty-facility tests is 60 days.

The third stage of the development of the project will begin once the empty facility tests render satisfactory results. It is estimated that this will be done at the beginning of the third year and will last at least 25 years. The main activities that will be performed in the cement and limestone production operation will be:

- ✓ Limestone, loam, shale and additive crushing, transportation and storing;
- ✓ Raw material pre-homogenization and storing;
- ✓ Reception, preparation and storing of corrective material;
- ✓ Raw blend milling;
- ✓ Raw mix storage and homogenization;
- ✓ Clinker production (pyroprocessing);
- ✓ Clinker cooling in multiple movement cross bar cooler;
- ✓ Additive reception, preparation and storing;
- ✓ Cement milling;
- ✓ Cement storing and packaging;
- ✓ Bag filter product collection;
- ✓ Secondary tanks;
- ✓ Parking station;
- ✓ Fuel storage area;
- ✓ Fuel milling;

- ✓ Cement delivery to clients (the construction and use of the highway to be built will be the object of a specific EIA);

Finally, the fourth and last Stage of the project involves abandonment. It is difficult at this time to estimate when that will occur since it will be dependent on the depletion of the quarry or on cement production prices ceasing to be competitive. Time of abandonment activity will start from the last year of facility operation. Every activity necessary for the ecological restoration of the site to its original natural condition or at least similar to it will be undertaken. The most important activities to be performed during the abandonment stage will be the following, to be performed according to the new use to be given to the land.

- Abandonment of the components of the facility;
- Demolition of the buildings if needed or if they do not have another use;
- Abandonment of fuel deposits;
- Reforestation of the facility site with native species. If that is not possible, the closest to the native species will be used in order to create a vegetation screen;
- Replanting areas as required to prevent the erosion caused by water and wind and to mimetize visual effect; and,
- Pay workers their fringe benefits under the Law.

Regarding environmental aspects to be considered in impact identification and assessment, the conditions listed in the terms of reference of MARN were taken into account. Some were grouped together and others were added. They include: i) air quality; ii) noise and vibrations; surface and underground water; iv) soil and subsoil; v) flora; vi) fauna; cultural and historic resources; viii) landscape; ix) industrial safety and occupational health; and x) socio-economic factors. Some of the reasons to group some aspects together and add others are: first: noise was added (in view of the impact of noise for workers), industrial safety and occupational health (the effects of risky activities on workers); and second: soil and subsoil were grouped, as were surface and underground water, in view of their close relationship which allows them to be considered together.

Criteria used to assess Project activity impact on the environment are five, which are described below:

Criterion 1. When the Project generates or presents a health risk to the people and the general environment. The following factors will be considered to determine the level of risk:

a. Industrial waste generation, recycling, collection, storing, transportation or disposal, addressing its composition, hazardous level, amount and concentration of flammable, toxic, corrosive and radioactive matter to be used in the various stages of the activities proposed:
b. The generation of liquid or gaseous effluents or of their combination, with concentrations higher than allowed in the primary environmental quality standards of environmental legislation in force;
c. Noise, vibration or radiation levels, frequency and duration;
d. Household waste production, generation, recycling, collection and disposal, when their characteristics pose a health hazard for the population exposed;

e. The composition, quality and amount of gas leaks or particles generated in the different stages of development of the activities proposed;
f. The risk of pathogen and sanitary vector proliferation resulting from the application of investment plan implementation, or the implementation of programs or projects;
g. The generation or promotion of solid waste discharges whose concentrations exceed secondary quality or emission standards.

Criterion 2. If the Project generates or presents significant alterations of the amount and quality of natural resources, including soil, water, flora and fauna, and particularly when the biological diversity and territories or resources with an environmental and/or legacy value are affected. The following factors shall be considered in order to assess the significance of their impact on natural resources:

a. The degree of soil conservation alteration;
b. Fragile soil alteration;
c. Short, medium and long-term erosion process generation or increase;
d. Fertility loss in soils adjacent to the project;
e. Induction of soil degradation;
f. Accumulation of salts and/or contaminants in the soil;
g. Alteration of vulnerable, rare, insufficiently known or endangered flora and fauna species;
h. Alteration of the state of conservation of flora and fauna species;
i. Introduction of exotic flora and fauna that did not previously exist in the territory in question;
j. Promotion of mining, production or fauna, flora or other natural resource activities;
k. The presence or generation of an adverse effect on biota, particularly that which is endemic to the area;
l. Introduction of native forest cutting;
m. Replacement of species that are endemic or were left behind;
n. Alteration of the representation of local, regional or national vegetation or ecosystems;
o. Extraction, use or management of native fauna;
p. Effects on biological and biotechnological diversity;
q. Alteration of water receiving bodies over ecological flows;
r. Alteration of the physical, chemical and biological parameters of water;
s. Modification of current water uses;
t. Alteration of ground water bodies; and
u. Alteration of surface, continental, ocean and ground water quality.

Criterion 3. When the Project generates or presents significant alterations of the attributes that gave an area its classification as a protected area or as an area with landscape and aesthetic value. In order to assess if significant alterations of an area classified as protected or with landscape and/or tourist value have occurred, the following factors are to be considered:

a. The effect on, intervention or use of natural resources in a protected area;
b. The generation of new protected areas;
c. Modification of old protected areas;
d. The loss of representative and protected environments;

e. The effect on, intervention or use of land with landscape and/or tourist value;
f. Obstruction of visibility in areas with landscape value;
g. Modification of the landscape makeup;
h. Promotion of landscape beauty exploitation; and
i. Promotion of recreational and/or tourist activity promotion.

Criterion 4. When the Project leads to resettlement, displacement and the relocation of human communities as well as significant alterations of the life systems and customs of human groups including urban spaces. This criterion is to be considered if the following effects, characteristics or circumstances occur:

a. Inducing human communities in the area of influence of the project to resettle or relocate temporarily or permanently;
b. Having an effect on human groups protected by special provisions;
c. Transforming economic, social or cultural environmental activities of the local human group or community;
d. Blocking access to natural resources that are the basis for an economic subsistence activity in neighboring human communities;
e. Generating social network break-up;
f. Changes in local demographics;
g. Altering the life systems of ethnic groups with a high cultural value; and
h. Generating new conditions for human groups or communities.

Criterion 5. When the Project generates or causes alterations to monuments that are anthropologically, archaeologically or historically valuable and that belong to the cultural heritage. In order to determine if significant alterations are generated in this regard, the following factors will be considered:

a. Damage, modification and degradation of a historic, architectural, public, archaeological monument, typical zone or natural sanctuary;
b. The extraction of elements from areas with pieces or constructions with a historic, architectural or archaeological value; and
c. Damaging archaeological resources in any of their forms.

12.2 Impact Analysis

Below we analyze potential environmental impacts generated during the various Stages of the Project. As indicated before, the potential environmental impact will be done of the installation stages and above all, of the cement facility operation.

For each environmental factor, a description is done of the activities during the cement facility installation and operational stages that can potentially affect them. Secondly, current levels of each environmental aspect are considered prior to starting the project (baseline). Thirdly, estimation is done of how the environmental baseline will change as a result of the activities to be carried out during the various Stages of the project.

In order to have a reference to estimate how much or how the environmental baseline will change due to the impact that will be generated from the operation of the new cement facility, the following is a description of the evolution of San Miguel Property, in Sanarate, where the Cementos Progreso cement facility has been operating for the last 33 years, with a production larger than the one to be installed in San Juan Sacatepéquez. One can then infer what will probably occur at San José Ocaña Property and the neighboring communities as a result of the operation of the cement facility.

Finally, in this section, the modified Leopold matrix is used to assess environmental impact generated by the different activities to be carried out during the cement facility construction and operation in San José Ocaña Property.

12.2.1 Environmental Impact Analysis during the Civil Works Stage and the Installation of the Cement Facility Components.

Platforms will be built in the facility construction and installation stage (ground leveling in around 26 of 64 hectares) to set up the various components of the facility that will require moving 2,695,883 m^3 of ground. Ground will be moved to make flat platforms to build the facility. Topographically high sites will be cut and depressions will be filled with proper compacting and level control for platforms to be safe and stable. Slopes will have adequate cut angles to make them stable as well as the necessary protection and drainage work. Slopes that may erode will be reforested and protected with new vegetation and if need be, with water proofing through construction materials such as concrete, geotextiles, etc. Civil works will consist of 103,873 m^3 of excavation, foundation and floor casting, building of columns and beams that will need concrete (99,780 m^3), reinforcement steel (11,479 tons), as well as masonry (14,680 m^2) and forms (227,292 m^2). 10,756 tons of metallic structure will then be installed and lined (102,163 m^2). This work will take 24 months.

Forestry management activities are currently carried at San José Ocaña Property involving the selective cutting of trees and their delivery to the sawmill as well as the establishment of nurseries and planting and caring for trees and the maintenance of the dirt roads inside the property. The following is a description of the impacts on physical, biotic and socio-economic factors during the 24 months that the activity to set up the various components of the facility will last.

i) Air Quality:

Air quality will be affected by gas combustion from construction machinery and equipment and from the dust that the ground movement and vehicle traffic will generate in dust roads. The biggest effect will be felt in the property, in the site where the facility will be constructed, but also outside of it, because of vehicle traffic that will convey construction materials and machinery and equipment.

The outcomes of air quality parameters measured at San José Ocaña Property and in the backyard of a house in San Antonio Las Trojes village and reported in Tables 8.8 and 8.9 of paragraph 8.6 of Chapter 8 above, showed that they are below the guide values of the World

Health Organization (WHO). The concentration of suspended particles under 10 micras (PM_{10}) reported are under 20 ug/m^3 and the WHO value is 150 ug/m^3. In addition, PM_{10} values reported in the backyard of a house in San Antonio Las Trojes were similar to those reported in San José Ocaña Property and under WHO values. Sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) reported in the property were 20 and 15 ug/m^3, also lower than WHO values (125 ug/m^3 and 200 ug/m^3, respectively). Current sources generating the concentrations of the various air quality parameters in the property are: vehicle traffic in the property for forestry management activities that are relatively low in intensity. Outside of the property, current sources of air quality deterioration are: vehicle traffic in dust roads, burning of stubble before planting crops (corn) and burning of solid waste in house backyards. Again, these sources of dust and gas emissions into the atmosphere are intermittent and sporadic.

During the 24 months that the construction stage will last, air quality parameter concentrations will increase with respect to annually reported values, but with prevention and mitigation measures to be implemented, to be described in Chapter 13, (irrigation and maintenance of machinery and equipment, among others), they will remain under the WHO (2005) and IFC (2006) guide values.

ii) Noise:
In the construction stage, noise and vibrations will come mainly from machinery and construction equipment operation. The biggest effect will be felt in the property and by construction workers.

The outcomes of noise intensity levels during 24 continuous hours in San José Ocaña Property, listed in paragraph 8.6.1 of Chapter 8 above, showed a Leq of 39.6 decibels, and in the backyard of a house in San Antonio Las Trojes, of 50.3 decibels. Current noise and vibration sources in the property are caused by vehicle movement and forestry management activities such as tree felling and log milling. Outside of the property, vehicle engines and the operation of corn milling engines are the main sources of noise.

During the 24 month duration of the construction stage, noise levels will increase above current values, but with prevention and mitigation measures to be implemented, to be described in chapter 13 (timely maintenance to machinery and equipment, keeping vehicle circulation speed at a minimum and constant, among others) these values in the property will be under 65 decibels (a value considered acceptable for mixed-use area).

iii) Surface and Groundwater:
Earthworks are the main activity during the construction stage that could have an effect on surface water (quality degradation) and ground water (spring silting). Inadequate earthworks waste material disposal (2 million m^3 cut and0.7 million m^3 filling), could favor conveyance of the soil to Rio Pachum through the various spread-out gorges (Sunuj) during rainfall runoff. Waste water generated in the camp, which could be a source of surface and ground water pollution, would receive secondary treatment. Additionally, it will be necessary to have portable latrines in work sites and the company leasing them will be responsible for their proper maintenance. Changing oil or other fluids or solids while repairing machinery and equipment would affect ground water if discharged on the ground. During this stage, ground water (well) will be needed to meet the needs of the camp and of the construction.

During the rainy season, the Pachum River carries small, moderate and continuous water flows fed through base flows that have gone through the various rock formations of the area. The results of water physical, chemical and bacteriological parameters in several points in Rio Pachum reported in items 8.1, 8.3 and 8.4, of paragraph 8.5 of Chapter 8 above showed that surface water is contaminated, its hardness and alkalinity are consistent with the geology of the area and metals are under detection limits.

The exploration well identified as PA1 in the property is the closest to the project site and the groundwater level was reported at 152 meters. The semi confined aquifer is partially isolated from the hanging aquifer system and extends North where it is in close contact with the main streamflow of the West Pachum current and the low part of the Pachum River. In addition, the project and production areas of influence (2,000 hectares) are outside of the water recharge zone. Ground water quality (PA1 well) reported in Table 8.7 of paragraph 8.5.6 of Chapter 8 above shows some bacteriological pollution, less turbid and less alkaline than surface water. Metals are under detection limits. Ground water can become polluted due to the characteristics of the subsoil. The yield of well PA1 and of two additional wells to be drilled to supply the project with water guarantee sustainable supply without disturbing current yields of the mechanical wells in the area.

During the 24 months of the construction stage there will be demand for ground water, the generation of household waste water and the possibility of hydrocarbon waste spills. The yield of the wells will be enough and sustainable to cover water demand; camp waste water will be treated and there are measurements to prevent and collect possible hydrocarbon waste spills. Regarding earthworks, most of it will take place during the first three months. Prevention and mitigation measures are in place (placement of waste material in adequate places, carrying out most of the earthworks during the dry season or when there is less rainfall during the rainy season) so that solids will not get carried to Rio Pachum and deteriorate its quality when rainfall runoffs occur.

iv) Soil and Subsoil:

Soil will be removed during the earthworks Stage and later during excavation work. Topsoil will be properly stored for later use in replanting activities. There may be eventual oil and diesel spills from machinery and equipment and the spill of solid waste on the ground during this stage, as indicated in paragraph iii) above.

The ground where the cement facility will be built belongs to the slope Stage series which is characterized by sectional relief. It varies from almost typical clay loam, a very thin layer of yellowish brown clay loam (paragraph 8.2 of Chapter 8). Agro-forestry is the adequate use for these soils. Forestry management is currently done in these soils.

The area where the soil and subsoil must be removed to build the platforms will be affected almost forever unless it is rehabilitated in the abandonment stage: As indicated before, (paragraph iii above) organic topsoil will be properly stored to use in replanting work. The rest will be properly disposed of in the property. Hydrocarbon waste spills on the ground will be prevented to the extent possible but if they occur, recovery and proper disposal measures are

in place. Solid waste will be properly managed in the property: i) wood waste (pallets, crates, etc) will be taken to the cement facility in San Miguel, Sanarate, for use as alternative fuel in the clinker kiln. It would also be given away to use as timber in neighboring communities; ii) organic waste will be used to make compost through earthworm technology to use in the Agrobosques company nurseries that will be installed before the construction Stage; iii) metallic waste will be temporarily stored in the property and gradually removed by a carrier that will take it to Aceros de Guatemala for recycling. Transportation frequency will be determined in a way that will avoid accumulation but which is financially profitable for the carrier; and iv) various types of waste will be taken to the kilns in San Miguel with MARN authorization. This whole waste management system will of course require intensive training programs and strict controls to ensure that the workers hired handle waste properly. The infrastructure needed for the temporary storing of waste will be a part of the project. At this time, other possible uses for the waste have not been defined but if recycling alternatives are made available for some specific materials during the construction or operation of the project, this type of solution will be favored and will be implemented.

v) Flora:
The construction of the cement facility will require cutting trees and vegetation in the area where it will be set up.

As indicated in paragraph iv) above, agro forestry is the adequate use for soil in the property. Based on the property's soil use capacity (potential use) 25.8% of the area is for forest production (860.7 hectares). Tree stands include pine, cypress, oak and other latifoliate species. The change of the five-year Forest Management Plan under license DR-I-56-M-2006 of the San José Ocaña property underway for the use of soil in 127 hectares in this property was requested from INAB in December 2006. Appendix 13 includes both requests.

As stated in the case of soil, flora will be affected forever in the area where the cement facility will be set up. Compensation measures will be implemented by replanting and reforesting in other areas of the property.

vi) Fauna:
Machine and construction equipment operations will generate levels of noise that could affect the fauna living close to the source of noise. Dust produced by earthworks could also affect local fauna. Untreated wastewater discharges, the disposal of solid waste anywhere would also affect water and land fauna. Earthworks will affect animal species living in the subsoil. Construction workers might hunt animals.

The biodiversity study of arthropods, reptiles and amphibians, birds and mammals performed in the San José Ocaña property showed that despite the high level of disturbance in the property due to forestry activities, there is a small area worthy of conservation on the banks of the Pachum River where one of the two sampling sites was established (paragraph 9.2 of Chapter 9 above). Rare and native species were found in the site; these species are indicators of connectivity with other regions, believed to be the remnant of significant habitat worthy of conservation and protection. The streamflow area of the Pachum river (neighboring ravines) is one where biological diversity from the entire area comes together, which indicates that it

may work as a biological corridor for mammals, birds and some insects (butterflies, for example) and as a path for local migratory populations in the case of pine-oak forests (bats and birds).

During the 24 months of the construction stage there will be more intensive intervention in the property than is currently the case and therefore, Chapter 13 will contain the proposal of measures to prevent and mitigate potential impact on fauna. The gallery forest of the Pachum River will be preserved.

vii) Landscape:
Construction of the cement facility will affect its environment because of the types and the height of its components. Maximum height will be 110 meters.

The current landscape of the property is one typical of rural areas with forestry and agricultural activities.

The location of the cement facility was chosen to make it harmonious with its environment and, to the extent possible, to prevent it from being visible from neighboring communities.

viii) Cultural and Historic Resources

Earthworks and excavation could affect cultural and historic resources, if any.

No cultural or historic resources have been reported at the San José Ocaña property. There has been intervention practically in the entire surface of the property in view of forestry activities carried out there. Therefore, it can be said that there are no vestiges in the area where the cement facility will be set up.

If traces are found during the course of Project activities, work will be stopped until the findings are analyzed and authorization to continue is received from IDAEH.

ix) Industrial Safety and Occupational Health:

Occupational accidents could occur during the construction stage. It is estimated that there will be 1,800 workers at that time. Workers will be temporarily and occasionally disturbed by the dust and noise produced during this stage.

Forestry management activities involve certain labor risks since chainsaws are used to cut down trees and logs are moved around. Because forestry activities have been carried out at the property for some time now, the property workers are experienced and accidents are few.

Contractors and subcontractors will need to have an industrial safety and occupational health program in place to prevent accidents. If this is not the case, they will need to follow the occupational health and safety regulations in place for Cementos Progreso, S. A. Every worker will have to use adequate personal protection gear: industrial goggles and gloves, protected tip shoe wear, masks, etc. Machinery and equipment will be given proper and

timely maintenance. In addition, accident prevention lectures must be given at the start of every work day in order to minimize accidents.

x) Socio-economic Factors:

Around 1,800 temporary jobs will be generated during the construction stage, many of which will be for persons from neighboring communities. In addition, services will be required (food provision) that may be supplied by people from the area. Property workers normally walking through property roads to take care of forestry management activities and people walking on the road in front of the facility site may be disturbed by dust and traffic waiting, by earthworks and vehicles raising dust and making noise.

There is currently unmet work demand in the area of influence. Farming does not yield enough income for local farmers in neighboring communities. Vehicle traffic on the dirt road between Cruz Blanca and Las Trojes is under 400 vehicles per day, 50% of which are bicycles and motorcycles on weekends, and 20% during the week.

The trouble to the property workers and the persons traveling on the road that leads from Cruz Blanca to Las Trojes could be resolved with preventive measures (through irrigation, maintenance of construction machinery and equipment, setting up signs of truck entry and exit points, among others). Company policy will be to hire the largest number possible of people from neighboring communities who meet work requirements and qualifications.

Environmental Impact Analysis of the Cement Facility Operational Stage

The cement facility operational stage involves storing, loading and conveying minerals to the mill on conveyance belts, mixing and high temperature cooking (kiln), to then load the product in bulk or in bags. It also involves facility and service maintenance activities. Cement manufacture will operate in continuous periods 24 hours a day.

The largest amount of the physical, biotic and socio-economic impact will be produced during this stage of the project that is planned for at least 25 years. As stated before, in order to predict probable environmental impact during the cement facility operation, visits were made to the cement facility at San Miguel, Sanarate, in operation since 1974, to collect and generate information. In 1998, with the entry into operation of the third line, the facility produces 6,400 tons/day of cement, which is 1.42 times greater than the projected production in San José Ocaña in San Juan Sacatepéquez (4,500 tons/day). Even when there are differences in physical, biotic and socio-economic aspects between the properties in San Miguel Sanarate and San José Ocaña, in San Juan Sacatepéquez, the comparison is valid since the cement facility operation will be similar.

The following photographs show the cement manufacturing process in San Miguel, Sanarate, similar to the process that will be used in San José Ocaña in San Juan Sacatepéquez.

Photograph 8.3 Mass landslide on the Pachum riverbank, north of the project area

Asesoria ManueL Basterrecea Asociados. S.A.

As we will see below, the main impact from the operation of the cement facility in San José Ocaña in San Juan Sacatepéquez, considering the experience of over 33 years in San Miguel, Sanarate and using bibliographic references will be: dust, gas emissions, landscape changes; biological biodiversity disturbance; noise; solid waste, waste and runoff water, and the use of natural resources. In addition, there will be effects on occupational health and industrial safety. There will be positive effects such as permanent and contractor employment and the production of cement for domestic consumption. According to the Environmental Policy of Cementos Progreso, S.A. the use of a kiln as a waste disposal alternative is beneficial to the environment and to society.

i) Air Quality:
Air quality will be impacted particularly due to the dust and gases generated in the cement manufacturing process. In addition, machinery and equipment engines and trucks produce gas emissions. The number of trucks transporting cement is dependent on production at the new facility, that is, there will be around 310 23.375 mt trucks traveling each day on the new highway to be built from the facility to highway CA-1.

As indicated in paragraph 12.2.1 i), the outcomes of air quality parameters measured at San José Ocaña showed that they are under the WHO and WB guide values, with current sources of deterioration being vehicle traffic on dirt roads in and out of the property (current daily traffic of trucks is less than 15), the burning of stubble before planting and the burning of solid waste in household backyards.

Table 12.1 shows results in terms of particles of less than 10 micras (PM_{10}) and total suspended particles (PST) in the villages neighboring San Miguel Sanarate. These are compared against WHO guide values. As stated in the report of the lab that took the samples, the wind was strong on the day of the sampling and created quite a bit of dust. The air quality report is included in Appendix 14. The following photographs show the sites where dust was measured.

Table 12.1 Air Quality Results in the Villages neighboring the Cement Facility in San Miguel, Sanarate, on February 2 and 3, 2007

Sampling sites	Coordinates		PM_{10} (ug/m^3)	PST (ug/m^3)
Dolores village	N 14^0 48´37.1¨	O 90^0 17´21.64¨	72	87
Sinaca village	N 14^0 48´20.7¨	O 90^0 16´40.7¨	64	80
World Health Organization (2005)			150	-

Source: Environmental measurements 2007.

The results of gas emissions from kiln 2 stacks (that uses approximately 85% oil coke and 15% alternative fuels) and of kiln 3 (that uses 100% oil coke) in the cement facility in San Miguel, were measured by Onsite Laboratories from México, on December 16 and 17, 2006 and are presented in Table 12.2. Appendix 15 contains the lab results signed by company officials.

The results of air quality parameters are compared against International Finance Corporation (IFC) parameters and show that all are met. Values of less than (<) are due to the fact that they are under the lab equipment detection limit. The new cement facility to be installed in San José Ocaña, in San Juan Sacatepéquez, will be more modern than the

Photo 12.1 House in Dolores where the air quality simple taking was placed. The street in front is a dirt road.

existing facility in San Miguel Sanarate and, therefore, kiln gas emission quality parameters will also be under IFC guide values.

Photo 12.2 House in Sinaca where the PST and PM_{10} PM sampling equipment was placed. The street is cobblestone.

Dust produced during the cement production process will be controlled by sleeve filters to be installed in different parts of the facility that will be described in the prevention and mitigation measures in the next Chapter (Environmental Management Plan). In addition, dust will be produced by trucks traveling on the dust road. The road will be irrigated to mitigate this and it will get constant maintenance. A mechanical vacuum will be available in the water-proofed area to collect very fine dust.

The remaining kiln gas emission quality parameters will be controlled in the kiln process itself, with strict control of oxygen concentration (3.5% in the kiln chamber) to guarantee efficient combustion. Fuel dosage control will guarantee a constant flame, which will keep NOx emissions at a minimum, as will the combustion process design in the roaster described in Chapter 5. The use of a preheating tower kiln will ensure close contact between alkaline raw materials and combustion gases, which dispose of sulphuric oxide emissions, and a strict fuel quality control (alternative and conventional) ensures low heavy metal emission levels. If there were significant sulphur and organic material concentrations in raw materials, selective use will be made of them to prevent SO_2 or volatile organic compound emissions.

The new facility will have completely new equipment with state-of-the art automatic control systems, with which operation parameters will be automatically corrected and compensated for. This ensures stable operations according to parameters established. Cementos Progreso, S.A. has its own Environmental and Optimization Divisions that have the objective of monitoring and correcting environmental performance, resource consumption and efficient operations in the new facility, similarly to what is currently done in San Miguel Sanarate.

Table 12.2 Results of Kiln 2 and 3 Gas Emissions of the Cement Facility in San Miguel, Sanarate, December 16 and 17, 2006

Parameters	**Results /1**		**IFC guide**
	Kiln 2	**Kiln 3**	
Sampling date	Dec 17, 2006	Dec. 16, 2006	
Measured flow (m^3/min)	3660.50	6202.97	
Sampling reliability			
Percentage of isocinetism		99.60	
Moisture in gaseous current (%)		18.78	
Gas concentration through continuous measurement			
O_2 (%)	10.54	10.28	Unregulated
CO_2 (%)	17.8	19.5	Unregulated
CO (%)	371	67.1	Unregulated
N_2 (%)	71.24	70.22	Unregulated
NOx (NO_2) (mg/m^3)	692.6	735.6	800
HCT © (mg/m^3)	5.4	5.3	10
Particles, mg/m^3			
Concentration	2.50	1.25	100
Gas concentration through moisture (mg/m^3)			
Sulphur dioxide (**SO_2**)	< 0.72	< 0.69	400
Hydrochloric acid (**HCL**)	< 0.0249	< 0.0234	10
Ammonia (NH_3)	< 0.00042	< 0.00040	
Concentration of metals (mg/m^3)			
Arsenic (*As*)	0.01961	0.01947	
Cadmium (Cd)	< 0.01421	< 0.01391	
Cobalt (*Co*)	0.00054	0.00720	
Chromium (*Cr*)	< 0.01421	0.01533	
Copper (*Cu*)	< 0.01421	< 0.01391	
Mercury (Hg)	< 0.00023	0.00032	0.05
Manganese (*Mn*)	0.04042	0.14472	
Nickel (*Ni*)	< 0.01421	0.02003	
Lead (*Pb*)	< 0.02842	< 0.02782	
Antimony (*Sb*)	< 0.14212	< 0.13908	
Selenium (Se)	< 0.00028	< 0.00028	
Tin (Sn)	0.12775	0.25022	
Talium (Ti)	< 0.02842	< 0.2782	
Vanadium (*V*)	< 0.14212	< 0.13908	
Zinc (Zn)	0.29560	4.21587	
Total metals			0.5
Cadmium y Talium			0.05
Concentration of dioxins and furans (mg/m^3)			
Total equivalent toxicity	0.03	0.02	0.1
Concentration of benzene (mg/m^3)	< 0.35	< 0.31	

Source: Onsite Laboratories of México, 2007

1/ O_2, N_2 y CO_2 are presented on the basis of stack conditions. Every other component is presented on a dry basis, 10% oxygen, 273.15 K temperature and 101.32 kPa pressure

ii) Noise:
Noise in this stage will come basically from the operation of the various components of the cement facility and from truck and loader engines. These noise levels will affect mostly the workers of the facility. If this noise is not lowered to adequate levels, it will obviously affect the health of the workers and the staff directly involved in facility operations full time, based on time of exposure and noise intensity.

As stated before in paragraph 12.2 ii), the levels of noise in the Project site are very low (39.6 dB) and are sporadically altered by truck traffic and chainsaws during forestry activities. The noise levels produced in the cement facility processing area in San Miguel are of up to 100 decibels at 3 meters from the main sources (compressors and roller mills), but this equipment is in a building and therefore these values drop significantly outside. Inside, every worker uses hearing protection, audiometry testing are run and the company provides ergonomic protectors every year which are tailor made for each worker.

Table 12.3 shows the results of sound level measurements in the backyards of houses at Dolores and Sinace that are next to the cement facility in San Miguel, Sanarate, which were conducted between February 2 and 3, 2007. The Environmental Measurement report is contained in Appendix 14.

Table No. 12.3 Noise Measurement Results

Site	Leq	Lmin	Lmáx	L_{90}	L_{10}	L_5	LDN	CNEL	Sampling time H:M:S
	Expressed in dB As								
Dolores village	53.8	40.5	86.3	44.7	54.4	57.6	60.0	60.5	24:00:10
Sinaca village	58.1	31.8	91.3	42.8	57.4	60.9	65.7	65.9	24:16:02

Source: environmental measurements, 2007

Results are expressed as:

Leq Continuous equivalent sound level. The stable sound level that has the same sound energy with A weight as the sound that varies in time, in a given period of time measurement and in a given location.

Lmin Minimum sound level recorded during the measurement period

Lmáx Maximum sound recorded during the measurement period

L_{90} Sound level exceeded 90% of the measurement time

L_{50} Sound level exceeded 60% of the measurement time

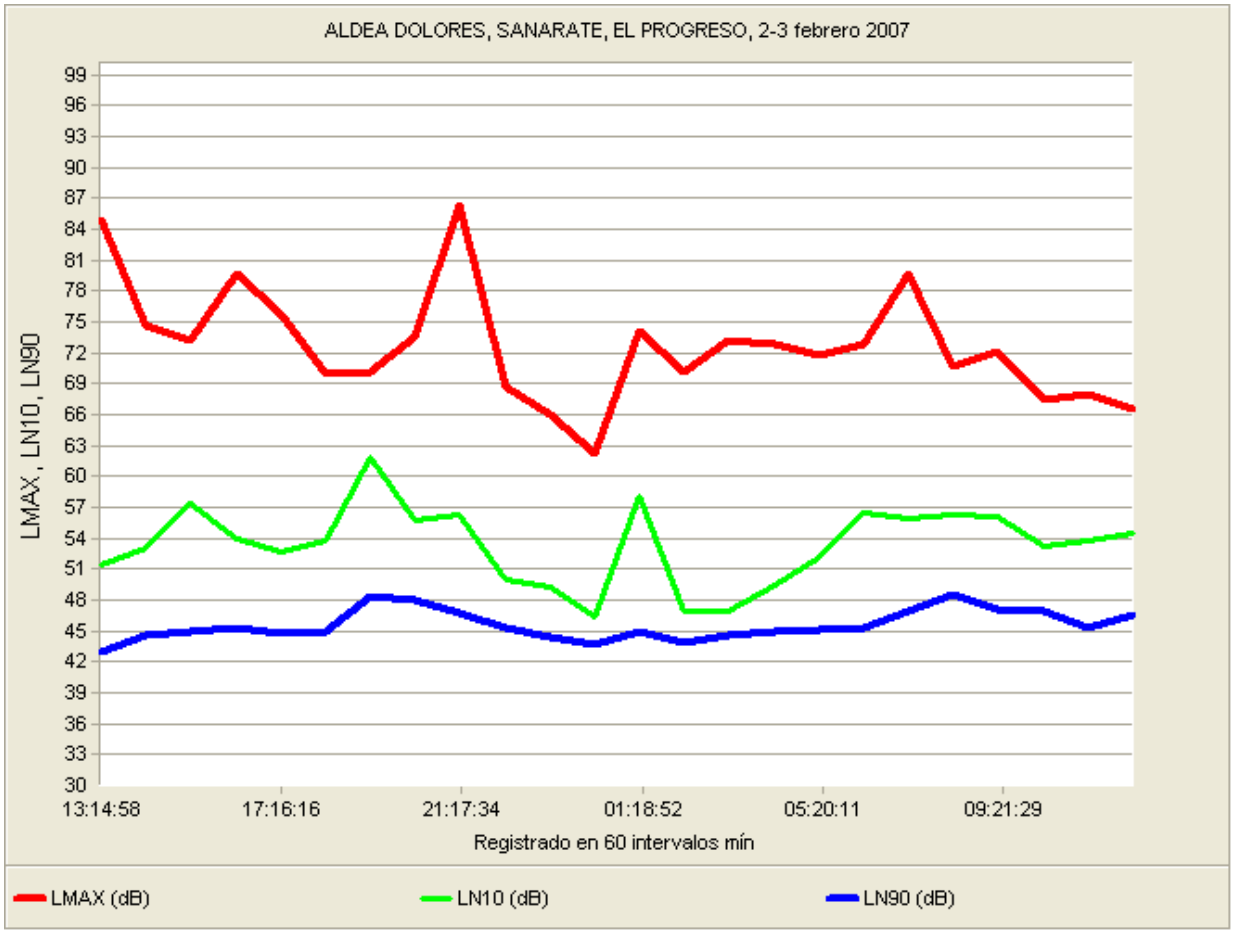
L_{10} Sound level exceeded 10% of the measurement time

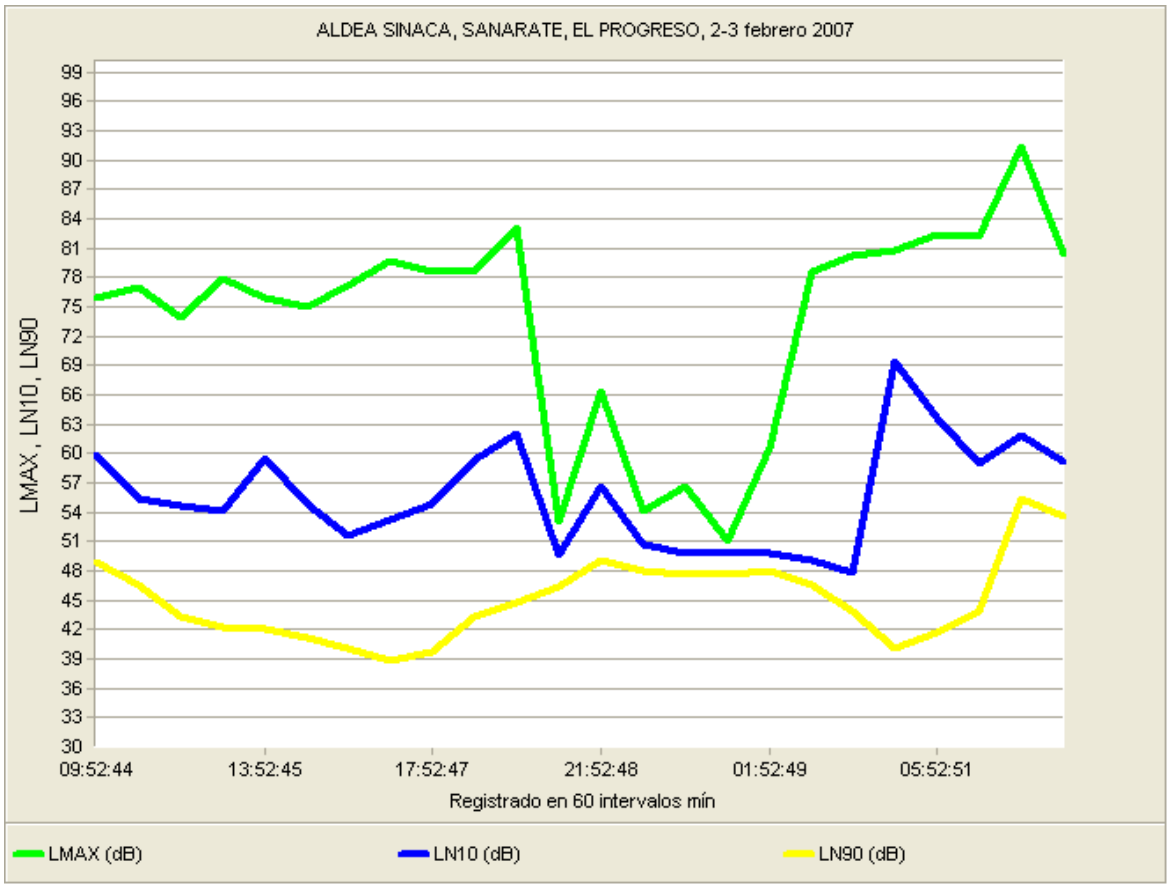
L_5 Sound level exceeded 5% of the measurement time

LDN: Day/night average level estimated with an additional value of 10 dB for the period between 10:00 pm a 7:00 am

CNEL: Average level of exposure: the community is exposed to noise in 25 hours with additional factors for the period between 7:00 and 10:00 p.m. with a 5 dB increase, and from 10:00 p.m. to 7:00 a.m. with a10 dB. 0 increase

The graphs below show the different noise intensity values in Dolores and El Sinaca between February 2 and 3, 2007.





Based on this information, it is deemed that noise impact will be significant for workers, who will need to use hearing protection gear. Noise in the facility's boundaries will be of under 65 dB (Leq).

iii) Surface and Groundwater:

Water quality at the Pachum River could be affected by fine particles carried there through local drainage. Fine particles may be carried mainly during intensive rain periods by runoffs, partially or totally do to natural drainage. The area that has been waterproofed by facility facilities will alter the rate of infiltration locally and will increase runoff in this area during the rainy season. Waste water discharged by the regular workers of the future cement facility (around 200) and a similar number of contractors will contaminate the receiving water body unless it is treated. The cement production process does not produce industrial waste water. Water demand by the cement facility will be supplied through three mechanical wells, whose performance will not affect the annual recovery of the semi-confined aquifer in the area or the mechanical wells already in place in the area.

As stated in paragraph 12.2.1 iii) above, during the rainy season the Pachum river carries small, moderate and continuous flows that are fed by the base flow that has passed through the various rock formations of the area. Water quality is poor: it presents bacteria pollution. Water hardness and alkalinity are consistent with the geology of the area, and metals are well

under detection limits. Regarding ground water, the semi-confined aquifer is partially isolated from the hanging aquifers and extends North where it remains in close contact with the main flow of the West Pachum current and the low part of the Pachum River and marks some bacteria pollution and is less turbid and less alkaline than surface water.

Wastewater discharged by regular workers and contractors will get primary treatment (septic tanks) and secondary treatment (humid artificial). This is the system currently used in the cement facility in San Miguel, Sanarate. The water quality results at the point of entry and exit of the treatment plant are shown in Table 12.3 and the report of ECOQUIMSA is attached in Appendix 16. Values shown on Table 12.3 show 95% efficacy in BOD removal. This system also removes nutrients. Treated water is used to irrigate green areas.

Table 12.3 Effluent Quality in the San Miguel, Sanarate Treatment Plant

Parameter	Article 20 of Regulation 236-2006	Waste wager San Miguel	
		Exit	Entry
Chemical Oxygen Demand (mg/l)	--	86	332
Biochemical Oxygen Demand (mg/l)	--	14	147
Total solids (mg/l)	--	764	632
Solids that can be deposited as sediment (ml/l)	--	<0.1	0.4
Suspended solids (mg/l)	3,500	16	84
Floating matter (mg/l)	Present	Absent	Present
Oils and greases (mg/l)	1,500	5.0	8.7
Total nitrogen (mg/l)	1,400	11.40	14.6
Total phosphorus (mg/l)	700	8.52	8.84
Fecal coliforms (NMP/100 ml)	$< 1 \times 10^8$	9.3×10^3	4.6×10^6

Sources: ECOQUIMSA, October 2005

The performance of the mechanical wells that will be drilled to supply the needs of the new cement facility in San José Ocaña, San Juan Sacatepéquez and the observation wells will be continually monitored to confirm that the rate of use is sustainable and will not affect the mechanical wells in place in neighboring communities. The volume of ground water to be used in facility operations will not cause local lowering of the groundwater level, nor will it affect the performance of existing mechanical wells, since the wells that will be drilled will be located in discharge zones and not in recharge areas.

Runoff coming from the area that will be waterproofed will be managed through the rain water drainage system that will guide the water in such a way as to prevent washouts and carrying of solids.

iv) Soil and Subsoil:

Soil will be slightly affected during the operation of the cement facility due to accidental spill of hydrocarbon residues or due to the inadequate management of solid waste. On the other hand, the plan is to replant green areas.

The soil of the area where the cement facility will be built belongs to the slope Stage series which is characterized by sectional relief. Agro forestry is the adequate use for these soils. Forestry management is currently done in these soils.

The EMP includes measures to be adopted if a spill occurs, as well as the management of solid residues. Table 12.4 shows the solid residues used as alternative fuel in the kilns of the cement facility in San Miguel, Sanarate, which are owned by the plant and by several clients in the country, except for the wood that comes from the energy forests in the property. Solid waste generated in the cement production in the new plant in San José Ocaña will also be managed in the property.

Table 12.4 Use of Alternative Fuels in the Cement Kilns in San Miguel

Alternative fuels	Consumption (MT/year)	Thermal substitution	
		Not renewable (%)	Renewable (%)
Used oil	13,088	4,890	
Wood	3,638		0.740
Vegetable waste	150		0.050
Paper/cardboard waste	46		0.010
Plastic	200	0.070	
Other types of waste	221	0.040	
Solvents	9	0.004	
Various liquids	18	0.002	
Contaminated land	380	0.005	
Mud at the bottom of tanks	105	0.039	
Oil sludge	137	0.075	
Polluted water	173	0.002	
Subtotal		5.1	0.8
Total	18,165	5.93	

Source: Management San Miguel, January 2007

v) Flora:

Operations in the new cement facility in San José Ocaña will not affect the vegetation of the area.

As stated in paragraph 12.2.1 v) above, agro forestry is the adequate use for the soil of the property. Tree stands include pine, cypress, oak and other latifoliate species.

Flora will not be affected during the operational stage of the facility because it will have already been removed during the previous installation stage. Landscaping will be done of the site in order to prevent dust. In addition, forestry management will continue in the rest of the property and the gallery forest of the Pachum River will be conserved.

vi) Fauna:
The presence of workers, vehicle traffic, noise and dust produced by facility operations may be the main causes that will affect fauna. Truck movement will also produce a barrier effect on local fauna movement and migration. Planting grass and bushes in production areas will partly compensate fauna, together with measures to mitigate dust and noise and truck speed.

Having fines carried towards the flow of the Pachum River would have a negative impact on water organisms (crabs and snails) since their refuge, reproduction and feeding habitat would silt. In addition, mammals in the area drink water from springs and lagoons at the Pachum River and therefore, silting would threaten their survival.

As stated in paragraph 12.2.1 vi) above, despite the high level of disturbance of San José Ocaña, there is a small area worthy of conservation on the banks of the Pachum River. Rare and native species were found there that are indicative of connectivity with other regions. For this reason it is considered the remnant of a significant habitat worthy of conservation and protection. The area through which the Pachum River flows (neighboring ravines) is a region where biological diversity of the entire region comes together, which indicates that it can be a biological corridor for mammals, birds and some insects (butterflies, for example) and a path for local migratory populations in the case of pine-oak forests (bats and birds).

Therefore, controlling fines at the source (storage sites, parking areas, and inner streets) will be a priority in order not to have a negative impact on water organisms. In addition, the gallery forest of the Pachum River will be the object of conservation activities.

vii) Landscape:
The new cement facility will already be constructed in the operational stage and therefore will not generate additional visual effects. Eventually, in the morning, the moisture of stack gases and of the cooling towers may condense and form a visible, temporary smoke trail.

The current landscape of the property is one typical of a rural area with forestry and agricultural activities. The location of the cement facility was chosen to prevent it from being visible from the road leading from Cruz Blanca to San Antonio Las Trojes or by those populations. The illustration in the next page shows that the facility will not be visible from Las Trojes, except from some dispersed houses in Sector II.

viii) Cultural and Historic Resources

The new cement facility operation will not affect cultural and historic resources.

As stated above, no cultural or historic resources have been reported at the San José Ocaña property. There has been intervention practically in the entire surface of the property in view of forestry activities carried out there.

Should there be vestiges, they would be found in the stage prior to the construction of the facility. However, if findings are reported, work will be stopped until the findings are analyzed and authorization to continue is received from IDAEH.

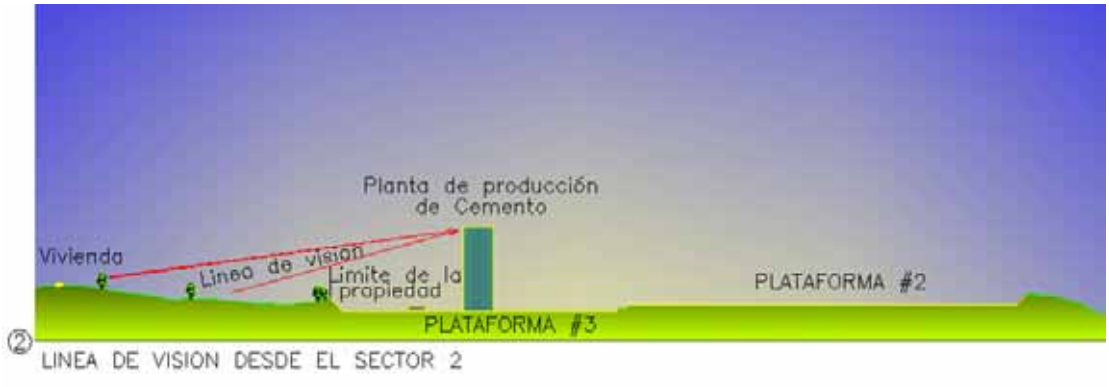
ix) Industrial Safety and Occupational Health:
Work accidents could occur during the cement facility operation due to machine and equipment operation and to related activities (transportation).

Table 12.5 presents accident statistics at the cement facility in San Miguel, Sanarate in 2006. This information is part of the health and safety management system of Cementos Progreso and will also be a part of the work routine in the new cement facility in San José Ocaña, San Juan Sacatepéquez. Table 12.5 provides evidence of the low frequency indexes, since only 4 accidents are reported (representing 71 lost days) despite the large number of men/hours worked during the year.

Table 12.5 Accident Statistics for 2006 in San Miguel, Sanarate

Plant personnel (PP)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Number of workers													
Men/hours worked	148,551	48,640	149,783	150,949	156,072	148,335	152,353	156,142	158,885	190,128	153,561	142,358	
Number of accidents	1	0	0	0	0	1	0	0	1	0	0	1	4
Lost Time Injury Frequency Rate	6.73	0.00	0.00	0.00	0.00	6.74	0.00	0.00	6.29	0.00	0.00	7.02	
Los days	21	0	0	0	0	28	0		2	0	0	20	71
Lost Time Injury Severity Rate	141.37	0.00	0.00	0.00	0.00	188.76	0.00	0.00	12.59	0.00	0.00	140.49	
Incapacitating injury index	0.95	0.00	0.00	0.00	0.00	1.27	0.00	0.00	0.08	0.00	0.00	0.99	

Source: Management San Miguel, January 2007.


Planta de producción
de Cemento
Vivienda
Linea de vision
Limite de la
propiedad
PLATAFORMA #2
PLATAFORMA #3
②
LINEA DE VISION DESDE EL SECTOR 2


Planta de producción
de Cemento
Linea de vision desde la comunidad
PLATAFORMA #3
Area de
Viviendas
Viviendas
Limite de
la propiedad
Viviendas
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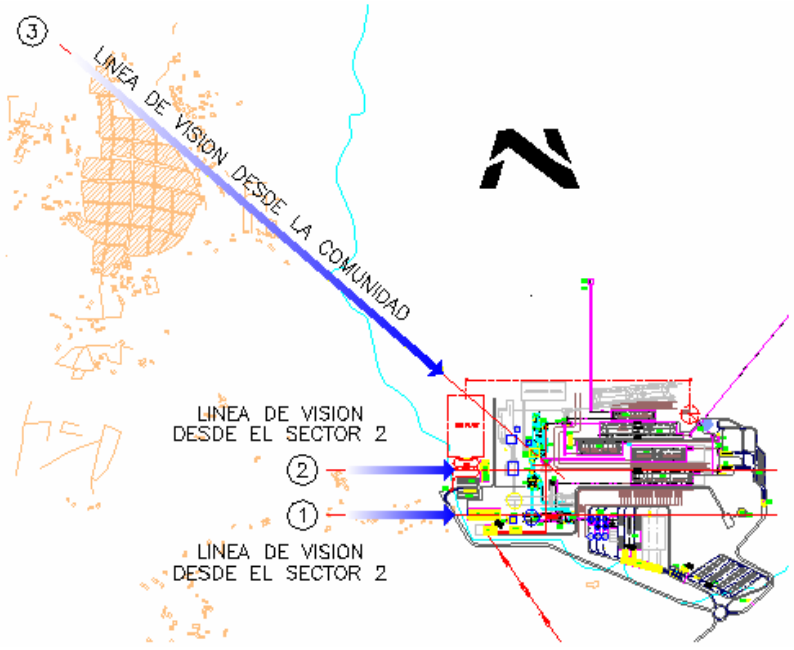
LINEA DE VISION DESDE LA COMUNIDAD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LINEA DE VISION DESDE LA COMUNIDAD
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DESDE EL SECTOR 2
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①
LINEA DE VISION
DESDE EL SECTOR 2

x) Socio-economic Factors:
Job creation will have a positive impact since workers from neighboring communities will be employed. The payment of local taxes to the City and company investment in basic infrastructure will favor the communities around the new facility. There will be economic development in the entire San Juan Sacatepéquez city and in neighboring cities.

In order to estimate the number of jobs that will be created during the operational stage of the new cement facility at the San José Ocaña property, in San Juan Sacatepéquez, Tables 12.6 and 12.7 list the number of regular workers and contractors at the cement facility in San Miguel, Sanarate, and where they come from. These tables show that 55% of the more than 600 regular workers in San Miguel come from Sanarate, as do about 50% of the contractors (See Tables 12.6.b and 12.7.b, respectively)

There is currently unmet demand for work in the area of influence: farming does not provide local farmers enough income. Vehicle traffic to Las Trojes is very low (under 400 vehicles, of which less than 15 are trucks). There are no houses on the boundary with the property in the area where the cement facility will be built.

Table 12.6a Origin of the Regular Workers at the Facility in San Miguel, Sanarate

Place	Number	Percentage
El Progreso	413	70
Guatemala	121	21
Other departments	56	9
Total	590	100

Table 12.6.b Origin of the Regular Workers in El Progreso

Place	Number	Percentage
Sansare	4	0.7
Sanarate	330	55.9
Guastatoya	40	6.8
San Antonio La Paz	32	5.4
San Cristóbal Acasaguastlán	4	0.7
San Agustín Acasaguastilán	2	0.3
Morazán/Jícaro	1	0.2
Total	413	70

Table 12.7a Origin of Contractor's Workers

Place	Number	Percentage
El Progreso	382	59
Guatemala	199	31
Escuintla	51	8
Jalapa	12	5
Zacapa	5	1
Total	649	100

Table 12.7.b Origin of Contractor's Workers in the Department of El Progreso

Place	Number	Percentage
Sanarate	322	49
San Antonio La Paz	46	7
Sansare	6	1
Guastatoya	5	1
San Agustín	3	1
Total	382	58

Table 12.7c Origin of Contractor's Workers in the Department of Guatemala

Place	Number	Percentage
Guatemala City	135	21
Mixco	29	5
Palencia	5	1
San Miguel Petapa	12	2
Villa Nueva	18	3
Total	199	31

Surveys were conducted among persons from Dolores and Sinaca, the communities that are closest to the cement facility, in order to learn the opinion of the communities neighboring the facility in San Miguel, Sanarate, about the benefits or problems that the operation has brought to them. The opinion of the facility neighbors, after 35 years in operation, are shown below and can lead to assume what could be expected in the communities that are close to the new cement facility in San José Ocaña, San Juan Sacatepéquez. Appendix 17 contains the report of this social research activity as well as the surveys and the names of the persons interviewed.

Do you feel that Cementos Progreso has helped raise the level of development of the communities in the area?

Response	Number	Percentage (%)
Yes	50	100
No	00	00
Total	**50**	**100**

100% of the persons interviewed feel that the company has made a contribution to raise the level of development of communities in the area.

If your answer was yes, say, in your opinion, what has been the contribution made by the company

From the social perspective: there were 55 responses

Response	Number	Percentage (%)
Did not respond	14	25.45
Responded positively that a contribution has been made that favors development	41	74.55
Total	**55**	**100**

Responses were consistently the following: the community has improved; development has come to the community; it has brought growth to the village; and, it brought development to the village.

From the economic perspective: the responses were 56.

Response	Number	Percentage
Did not respond	1	1.79
Responded positively	55	98.21
Total	**56**	**100**

The responses were consistent in two directions: it creates jobs and it has brought development to trade and the community

From the cultural and education perspective: 57 very consistent answers were obtained here:

Response	Number	Percentage
Did not respond	3	5.26
Confirm their support	52	91.23
Deny support	2	3.51
Total	**57**	**100**

Responses were consistently the following: improvement of the village school; creation of the Cementos Progreso school; support to the public school; computer center for the village; support for the community school with books; school materials donation to the school; and assistance given to the schools of the area.

From the perspective of infrastructure: The total number of answers was 53, as follows:

Response	Number	Percentage
Did not respond	1	1.88
Confirm their support	45	84.91
Deny their support	7	13.21
Total	**53**	**100**

The responses were consistently the following: maintenance of highways and the road; construction of a classroom; construction of a computer center; school improvements; maintenance in the village; and maintenance of a bridge.

What other benefits do you believe that Cementos Progreso has promoted and have not been mentioned in this interview?

52 responses are reflected below:

Response	Number	Percentage
Did not respond	31	59.62
Responded	21	40.38
Total	**52**	**100**

Responses were the following: computer center; support for the festivity of the village; medical center for the workers; reforestation; education for the workers; support for the church; snack for children on Children's Day; support to build streets; support for sports; and bathroom construction for children.

Do you believe that the community has faced environmental problems caused by the operation of the facility?

Response	Number	Percentage
Yes	25	50
No	25	50
Total	**52**	**100**

This response emphasizes the new quarry in front of the village of Dolores.

If your answer is yes, say what have been the problems:

Response	Number	Percentage
Did not respond	25	49.02
Dust	21	41.18
Fine dust particles	3	5.87
Change of direction of the river caused by the rubble thrown in by Cementos Progreso	2	3.93
Total	**51**	**100**

Officials at the San Miguel facility were asked about this response. They stated that they do not dispose of rubble in the river. It is possible that this is done by persons who do not belong to the cement facility and the neighbors are simply assuming that the culprit may be Cementos Progreso.

Regarding the dust created by the new quarry, the problem has been identified and the company started corrective action in 2007 by covering the area with a stable material (shale) to be followed by reforestation. Air quality analyses were done in neighboring villages and although it was confirmed that exposure levels meet World Health Organization guidelines (see Table 12.1), appropriate improvements will be carried out in order to eliminate this disturbance for the neighbors.

Do you think that Cementos Progreso has protected and has helped take care of the environmental quality of the area?

Response	Number	Percentage
Did not respond	2	4
Yes	48	96
Total	**50**	**100**

96% of the interviewees responded that the company has protected and has helped preserve the environmental quality of the area.

If your answer is yes, say what do you think are those benefits to the environment?
The 48 persons who state that Cementos Progreso has protected environmental quality offered 54 responses that identify the benefits, as follows: reforestation; trees have been planted; filters are used in the facility.

Do you think that the Company has contributed to improve highways and roads in the area?

Response	Number	Percentage
Yes	42	84
No	8	16
Total	**50**	**100**

84% of the interviewees feel that the company has contributed to the improvement of the highway and the roads of the area.

Do you believe that the company has helped reforest the area?

Response	Number	Percentage
Yes	31	100
No	00	00
Total	**50**	**100**

All of the interviewees say that the company has reforested the area.

Do you believe that the company has brought in persons from distant places to work and that this has generated conflict in your community?

Response	Number	Percentage
Yes	3	6
No	47	94
Total	**50**	**100**

94% of the interviewees believe that the person has not brought persons from distant places to work at the facility.

What is your comment about support for education, culture and sports that Cementos Progreso gives to the communities?

Response	Number	Percentage
Did not respond	10	20
Responded	40	80
Total	**50**	**100**

80% of the answers were consistent and stated: it is good because it helps the community; it is good because it improves education in the community; it is good because it improves the community; it is excellent; it is good; and it is good that they help the schools.

Do you or a member of your family work for Cementos Progreso?

Response	Number	Percentage
Yes	18	36
No	32	64
Total	**50**	**100**

No family members, in the case of 64% of the interviewees, work for Cementos Progreso. This means that two thirds of the people who were interviewed do not obtain income from the company. Perhaps they benefit indirectly.

Does a child in the family attend the Cementos Progreso school?

Response	Number	Percentage
Did not respond	18	36
Responded	32	64
Total	**50**	**100**

Reasons why they do not attend the Cementos Progreso school: they attend the community school; he/she studies at the school in El Chile village; does not have small children; his/her children are too young to go to school; because she goes to school in Sanarate; his children are already in high school; they have already finished school; the village where the family lives is too far from the school.

Reasons why they attend the Cementos Progreso school: because they work at the facility; because the education they receive there is better; for the high academic level; for the support that the school gives to the children; and because the village where the family lives is closer to the facility.

Have you or a member of your family used the medical services of the company?

Response	Number	Percentage
Yes	20	40
No	30	60
Total	**50**	**100**

The reasons for using the Medical Center of Cementos Progreso are that they are workers of the company and/or relatives of a worker. People who responded “no” to this question said that they do not use it because they have no relationship with the company

What do you think the condition of the community would be if Cementos Progreso did not operate in the area?

Response	Number	Percentage
Poorly	50	100
In good condition	0	0
Total	**50**	**100**

100% of the interviewees responded consistently as follows: it would be in poor condition because there would be no jobs; it would be in poor condition because we would need to go outside of the village to find a job: the village would be poorer; it would be in poor condition because there would be no development in the village; it would be different because there would be no support for the community; the villages would not be there.

What do you think the conditions of the communities of the Cementos Progreso area will be like in the future?

Response	Number	Percentage
Did not respond	13	26
Responded	37	74
Total	**50**	**100**

74% of the interviewees responded as follows: they will be in good conditions provided that there are jobs; the community will be in better conditions; there will be more development; the community will continue to improve.

Do you think that the communities are happy with the way Cementos Progreso manages environmental control, and with the economic, social and cultural contributions that it makes?

Response	Number	Percentage
Did not respond	4	8
Yes	46	92
Total	**50**	**100**

92% of the interviewees responded yes, with the following reasons given: because it helps the community; because it brings work to the community; because it provides support for the community; it brings benefits to the community; because it brings development to the community.

12.2.3 Environmental Impact Analysis during the Abandonment Stage of the Cement Facility

The operation of the cement facility will have a useful life of at least 25 years and probably longer. When the time comes to abandon the facilities of the cement facility, it will be necessary to dismantle the infrastructure and probably to replant the platforms unless they are given other uses. In addition, all liquid and solid waste will be properly collected and disposed of. Regular workers and contractors will be affected when they no longer have that source of income.

i) Air Quality:
Air quality will be affected by combustion gas emissions from the machinery and construction engines and by the dust that will be produced when structures are demolished, clearing the grounds of the facility and engaging in replanting and reforestation activities.

Combustion gas emissions and dust in this stage will be specific and intermittent and will be slightly greater than current emissions when forestry management activities are carried out and less than during the facility operational stage.

ii) Noise:
In this Stage, noise will come mainly from truck traffic and demolition machinery and equipment and from replanting and reforesting equipment.

High noise levels in this stage will be specific and intermittent and slightly higher to current noise levels when forestry activities are carried out in the property and, at any rate, lower than the noise produced during the facility operational stage.

iii) Surface and Groundwater:
Demolition, clean-up and replanting and reforestation work will have a minimal effect on surface and ground water. However, it will be necessary to identify the proper place to place rubble and other remains form the demolition so that, with intensive rainfall, solids will not be carried to the Pachum River. Waste water resulting from the presence of workers will be discharged into portable latrines since it is possible that restrooms will be demolished; the leasing company will give them proper maintenance.

iv) Soil and Subsoil:
The main concern would be the proper disposal of rubble and the waste coming from the demolition in an ideal site in order to produce as little negative effect as possible on the soil. There could be oil and diesel spills from the machinery and equipment used in the demolition, in clearing, replanting and reforesting the site as well as the spill of solid residues on the soil during that stage.

v) Flora:
In the activities that we expect to carry out in this stage, there is a possibility that platforms will be replanted and reforested (around 26 hectares) after structures have been dismantled and demolished. This will be good for the biotic environment. However, it may be that the owner decides to give the area different industrial or agricultural and animal husbandry uses.

vi) Fauna:
Likewise, replanting and reforesting these areas will have a positive effect on the fauna of the region. However, noise and truck traffic will have a negative effect on fauna, but comparatively less than during the facility operational stage.

vii) Landscape:
Landscape alteration will be minimal at this stage, and positive when dismantling the components of the cement facility and with the probable replanting and reforestation of the facility site.

viii) Cultural and Historic Resources
Activities to be carried out in this stage will not have an effect on cultural and historic resources.

ix) Industrial Safety and occupational Health:
Work accidents may occur in this stage. Workers will be instructed to wear adequate personal protection gear.

x) Socio-economic Factors:
Temporary jobs will be created for some persons in neighboring communities. However, the greater effect will be caused by the loss of income for direct and for indirect workers. Once the decision is made to close down the facility, probably one or two years before, the company will make it known to their workers and contractors, in such a way that they can find new income alternatives.

12.2.4 Environmental Impact Assessment

12.2.4.1 Methodology

Impact assessment is done with the purpose of estimating their significance and to select, if need be, the corrective measures to be included in the project. The first thing that needs to be done is to determine if the project has mitigation measures in place that may be included in different Stages, in order to determine if they are enough, and if it is necessary to introduce new corrective measures. Environmental monitoring will make it possible to verify the functionality and effectiveness of mitigation measures to be proposed in the appropriate Chapter.

With the use of accepted conventional methodologies that could lead to a qualitative-quantitative assessment of the impacts identified in the agreement with their degree of significance, the methodology explained below will be used in this chapter to assess the potential impact that will be inherent to the project.

The type of impact was based on the proposal made by Vicente Conesa, 1997, in the Methodological Guide to Assess Environmental Impact. The research done by Andrés Monsón and Teresa Alcaide, 1994, of Environmental Impact Assessment Methodologies for Highways (Spanish Highway Association, 1994) was also consulted. It uses a matrix from which some ideas of form were taken to present impact scores in the form of a matrix in this study.

It is thus that a verification-scoring matrix is prepared based on the modification of the Leopold matrix (Environmental and Economic Geology, 1998-2005) which compares each

environmental factor to project activities, summarizing current and potential impact that could be expected from the mining activities involved in this project. The score is also included in this matrix based on the criteria presented below.

Each case is rated depending on whether the interaction is purely positive (+) or negative (x), or both (+/x); whether it is insignificant or inexistent (○). For the purpose of the analysis, emphasis is placed on interactions designated as "x", "+" y "+/x" that have a relevance (those that are significant are represented like this: ✸), with the purpose of identifying adequate measures to reduce negative effects and those that will enhance the positive effects of the project. The following nomenclature is used to assess and rate impact:

On extension:

• = **Local**: was joined to the specific so that it refers to an area that influences only a part of the surface of the project in the license area. Its extension may be a few meters to tens of square meters.

= **Area**: in this study it refers to an extension that influences not only the local surface but also its area of influence, by defining thousands or tens of thousands of square meters of measurable areas that can also cover the closest communities.

On persistence:

t = **Temporary**: refers to a given duration in time. The duration of the effect may be less than a year (***fleeting)*** to duration of between 1 and 3 years.

r = **Permanent**: scores an impact of indefinite duration. For the purposes of this study, a duration of more than 10 years is accepted.

On the cause-effect relationship:

☛ = **Direct**: the effect of the immediate influence of an environmental factor. For example: cutting vegetation in a gallery forest.

D= **Indirect or secondary**: impact whose effect involves an influence delayed in time with regard to the interdependence or relationship of one environmental factor with another.

On the significance of the impact:

✸ = **Significant**: the certainty of the impact is considered in this score, in this case, as **probable** and **true**. The degree of the **effect** or **disturbance** and **benefit**, which is **medium** in this case (**m_e**, some of the characteristics of the site are modified) , **greater** (**m_a**, all or most of the characteristics are modified); **synergic** (**s**, the simultaneous presence of several agents or actions mean environmental influence greater than the aggregate effect of individual influences analyzed in isolation); **accumulative** (**a,** with the extension in time of the agent or activity influencing the environment, its seriousness increases progressively in the light of a lack of mechanisms in the site to temporarily eliminate them similar to the increased action that causes the impact: environmentally fragile site).

★ = **Not significant**: this store is understood as opposite to significant.

® = **Residual**: residual impact is one which takes place after preventive and corrective measures are adopted. Some do not consider corrective measures; others may be fully eliminated although in most cases, their magnitude is reduced.

These residual impacts may be scored on the basis of their capacity to recover:

Not recoverable (**Y**): the alteration or loss of the site cannot be repaired;
Irreversible (**&**): assumes the inability or extreme difficulty to return the site to its condition prior to the action that produced it; and,

Reversible (**´**): the alteration may be assimilated by the environment in a measurable manner in the short, medium or long term in view of the natural processes of ecological succession and self-cleaning mechanisms of the site.

There are two more variables that are important and have to do with the significance of the impact and the aggressiveness of the activities in the environment:

Likelihood of occurrence: Even when this is a subjective qualitative assessment of the certainty that the impact may occur, it contributes to the global store and to assign a priority to mitigation measures to be applied.

- **Low: B;**
- **Medium: M;**
- **High: A; y,**
- **Certain: C_S**

Intensity of the activity (Aggressiveness) on the site: Even though this is a subjective rating, it does indicate the degree of intervention and effect that the activities of the Project will have on the environment whether specific or not for an area, and allows the joint identification of project activities with the strongest impact on the environment.

- **Minimum or Compatible: C;**
- **Moderate: $M_{o;}$**
- **Intensive: I; y,**
- **Severe: S.**

The matrix allows the inclusion of impact assessment, all relevant interaction and avoids the need to assign a big effort to compile and interpret information for inexistent or not significant interactions with regard to the objectives presented as major by the Environmental Impact Studies for this project under evaluation.

12.2.4.2 Assessment of the Environmental Impacts Generated during the Development of the Project

Environmental impact for the construction and operation of the cement facility will be assessed. Pre-construction and abandonment stages would also produce impacts, as explained above, but not as significant as those of the construction (2 years in duration) and operational stages. Between the construction and operational stages, the latter will be the most important because it will last at least 25 years: the plant in La Pedrera, zone 6 in Guatemala City, has been in operation 107 years, and the plant in San Miguel. Sanarate, has been in operation 33 years.

The relevant activities to be carried out during the project development Stages were analyzed and grouped based on relevance, in order to assess their impact on various environmental factors: i) earthworks and disposal of waste material; ii) construction, operation and closure of the camp; iii) construction of the buildings and facility maintenance; iv) Operation of the cement facility; v) Abandonment of buildings dismantling of the facility, recovery of affected areas (replanting and reforesting) and the payment to workers of fringe benefits under the Law.

Similarly, the main impacts of the most relevant activities listed above on the physical, biotic and socioeconomic environment were analyzed: i) gas emissions; ii) the generation of dust; iii) noise generation: iv) having fines carried to the Pachum river; v) the production of solid waste; vi) the use of natural resources (water, limestone); vii) effects on biological diversity; viii) changes to the landscape; iv) effects on occupational health; job creation; xi) cement production; xii) waste disposal as alternative fuels.

The following environmental factors will be rated to score environmental impact: i) air quality; ii) noise and vibrations; iii) surface and ground water; iv) soil and subsoil; flora vi) fauna; vii) cultural and historic resources; viii) landscape; ix) industrial safety and occupational health; and, x) socio-economic factors.

The matrix on the following page assesses the effects of the most significant activities to be carried out during the course of the project on the physical, biotic and socioeconomic environment, with the use of the Delphi method.

Table 12.1 Project Impact Identification and Scoring

Relevant activities in Project development	Likelihood of occurrence: Summary of potential impacts: Gas emissions	Dust generation	Noise generation	Carrying fines through runoff and treated waste water to Pachum river	Solid residue generation	Natural resource consumption	Biological diversity affected	Landscape changed	Effects on occupational health	Job creation	Cement production	Residue disposal alternative	*Aggressiveness of the activity in the site*	Impact rating in environmental factors: Air quality	Noise	Surface and ground water	Soils and subsoil	Flora	Fauna	Landscape	Cultural and historic resources	Industrial safety and occupational health	Socioeconomic factors
Earthworks and waste material disposal	B	Cs	Cs	A	Cs	M	M	Cs	B	Cs	-	-	Mo	X t	X t	X t D ®	X • r &	X • r &	X • tD ®	X • r &	○	X • t ★	+ ★
Construction, operation and closure of the camp	B	B	B	Cs	Cs	Cs	B	B	M	Cs	-	-	Mo	X t	X t	X t ®	X • t	X • t	X • tD ®	X • t	○	X • t ★	+ m_e
Building construction and facility maintenance	B	B	M	B	Cs	Cs	M	Cs	Cs	Cs	-	-	Mo	X r ★	X r ★	X r m_e	X • r ★	X • r ★	X • r D ★	X • t ★	○	X • r ★	+ m_e
Operation of the cement facility	Cs	Cs	Cs	Cs	Cs	Cs	M	Cs	Cs	Cs	Cs	Cs	I	X r ✸ m_e	X r ✸ m_e	X r D ✸ m_e	○	○	X r D ★	○	○	X • r ✸ m_e	+ ✸ m_e
Dismantling of the facility, recovery of areas affected by it and payment of benefits under the law	B	B	M	B	B	B	M	Cs	B	B	-	-	C	X t ★	X t ★	X t D ★	+ m_e	+ m_e	+ m_e	+ m_e	○	X • t ★	+ ★

Likelihood of occurrence: Low: B; Medium: M; High: A; and Certain or sure: C_S
Intensity of the activity (Aggressiveness) on the site: Minimum or compatible: C; Moderate: M_o; Intense: I; and, Severe: S
Impact score: + = positive; x = negative; ○ = no impact; • = local; = area; t = temporary; r = permanent; ☛ = direct; D = indirect; ✸ = significant; m_e = medium; ★ = not significant; ® = residual; Y = not recoverable; & = irreversible; ´ = reversible.

12.3 Social Impact Assessment

The social impact of the cement facility construction and operation will be positive for the general economy of the country, for cement supply, for the municipal district of San Juan Sacatepéquez (revenues from the payment of taxes will be invested in the communities) and for families of permanent and contractor workers (revenues for employment and services).

The direct employment to be created during the construction Stage of the cement facility will be similar to that of the third line in San Miguel Sanarate between 1996 and 1998. In 1996, when the third line was installed, around 1,800 workers were hired for the 2 years that the construction work took. It is estimated that a similar number of workers will be hired to set up the cement facility in San Juan Sacatepéquez. A large number of these workers will come from the municipal district of San Juan Sacatepéquez.

Around 200 regular workers will be hired plus 200 additional persons to be hired as contractors. It is estimated that around 55% of the regular workers and 50% of the contractors will come from the municipal district of San Juan Sacatepéquez.

The building of the new cement facility in San José Ocaña Property will generate unprecedented changes in San Juan Sacatepéquez. Changes will be positive (employment and associated services) to the extent that members of the communities work or otherwise benefit from the presence of the facility. Because of the current conditions of poverty of certain sectors of the communities and despite the fact that income opportunities through employment and associated services will be created, if they are not qualified to do the work required, they will be vulnerable to the possibility that they may not be hired. Neighboring communities and Cementos Progreso should reach agreements to enhance benefits and should promote training for the workers and their families so that they may be eligible to the different types of permanent or indirect jobs that the facility will create, as well as other forms of employment.

Regarding acceptance of the project, 45 of the 48 persons interviewed in the communities closest to it agree with having the cement facility built and operating there. One person is in disagreement and the other 2 persons did not give an opinion. Therefore, there is full acceptance of the project despite rumors that it will be a gold and uranium mine. In this sense, the answers of some of the interviewees reflect the lack of information or the insufficient information on the industrial objectives of Cementos Progreso. It is necessary to do more work to persuade the village of San Antonio Las Trojes, where interviews could not be conducted due to lack of endorsement by the local municipal authorities.

93.76% of those interviewed stated that they agree with the project if natural resources are protected, if local citizens are hired and the company makes contributions to the development of the city. This is one of the most important questions in the survey and the high level of acceptance of the project is evidence of the support that it enjoys.

The outcomes of the surveys show a high level of acceptance for the construction of the project because it will bring benefits to neighboring communities, particularly employment and the demand for related services. In addition, it becomes evident that inaccurate information has been circulated in the communities about this project which is promoted by Cementos Progreso (that is a well known company in the country for its manufacture of cement and in no way associated to gold and uranium mining). The persons interviewed suggested that the constant flow of information will help the project become a reality for the benefit of all.

12.4 Summary of Environmental Impact Assessment

A summary of the environmental impacts that could be brought about by the development of the various stages of the project, and the outcomes of the assessment contained in the previous matrix is offered below. The main environmental impacts to be generated by the project according to the assessment contained in the matrix are summarized next:

The most significant activity rated as intensive for its degree of impact on the environment will be:

- The operation of the cement facility

Environmental factors that will be affected by these intense activities will be:

- Air quality (gas and dust emissions);
- Levels of noise;
- Surface and ground water (fines and treated waste water);
- Occupational health and industrial safety (accidents); and
- Employment, services and taxes.

The activities rated as moderately aggressive to the environment are:

- Earthworks and the disposal of waste materials;
- The construction, operation and closure of the camp; and
- The construction and operation of buildings and installation maintenance.

Finally, the activity that is rated as having a minimal effect on the environment will be:

- Dismantling the facility, recovering affected areas (through replanting and reforestation) and the payment of fringe benefits to workers.

Last, the matrix includes the environmental impact assessment of all the relevant interactions, and avoids assigning a too much weight to the compilation and interpretation of information for interactions that are inexistent or not significant, in such a way that significant negative impacts on the environment will have to be the object of mitigation, prevention, control and/or compensation measures.

The results of the assessment of significant negative or positive impacts and those that are inexistent show the following results:

- 5% of the environmental impacts will be significant, positive, with a medium effect level, since they will change some characteristics of the socio-economic medium;

- 16% of the environmental impacts will be positive, not significant;

- 8% of the environmental impacts will be negative, significant, of a medium level of effect since they modify some of the characteristics of the physical and socio-economic environment;

- 55% of the environmental impacts will be negative, not significant, usually local, of a temporary nature, direct and reversible; and

- 16% of the interactions will be inexistent

Mitigation, control, prevention and/or compensation measures will be designed for significant negative impacts for implementation during the various Stages of the project. In analyzing the negative impacts herein described, it is believed that most of them can be mitigated and subject to compensation with measures whose application are proposed in the following chapter on the Environmental Management Plan for the Project.

13. ENVIRONMENTAL MANAGEMENT PLAN (PGA)

The activities that will take place throughout each Stage of project development have been analyzed in the previous chapter on impacts and described in order to assess their effect on the various environmental factors. The activities were grouped by relevance as follows: earthworks and disposal of rubble and debris; setting up, running and taking down the construction camp; the construction and operations of the buildings and maintenance of the facilities; operation of the cement works; and closing down the plant, recovering affected areas (replanting and reforestation) and the severance and dismissal of employees.

The main effects on the physical, biological and socioeconomic environments were assessed in a similar fashion in order to ascertain the impact of the activities described in the previous paragraph. These effects are as follows: social-economic (employment generation and community health and safety); occupational health and safety (full time as well as contract staff); air quality (gas and dust emissions); surface and groundwater; noise, fauna, soil and subsoil, landscape and flora. The relevant environmental issues pertaining to cement works in general are as follows (IFC 2006): i) air emissions; ii) energy and fuel consumption; iii) water runoff; iv) waste material generation; and v) noise generation. In addition, safety and occupational health issues for both permanent, as well as contract personnel, are taken into consideration, as are the health and safety issues that affect neighboring communities. For that reason, the prevention, control, mitigation and compensation measures will factor in each of these variations.

The measures covered by the Environmental Management Plan expect to be as comprehensive as possible in preventing, avoiding and counteracting the impacts taking place in performing the activities or parts thereof that may instigate impacts or to reduce (minimize) the impacts by limiting the degree or magnitude of the action or its implementation (Ministry of the Environment and Natural Resources – MARN 2003). On the following pages, Table 13.1 summarizes the Environmental Management Plan measures to prevent, control, mitigate and counteract activities which are primarily taking place during the operation of the cement works. This period will generate the greatest proportion of impacts due to the projected length of time (25 years) in effect, as compared to the length of the construction stage (two years) and the closedown stage (one year).

Table 13.1 Mitigation Measures included in the EMP, as follows:

Impact on Environmental Variable	Source of Impact	Environmental Impact	Pertinent Environmental Regulations Applied	Established Measures	Implementation Timeframe	Cost per Mitigation Measure (Q)	Responsible Party	Performance Indicator established to Monitor Compliance
Air	Earthworks, excavations and truck traffic	Dust	Environmental Protection and Improvement Legislative Decree No. 68-86	Water spray on construction platforms and leveled land using tanker trucks and sprayers; keep construction material that might raise dust, well covered.	Throughout construction Stage (two years)	Costs included within Contractor Budget	Contractors	Dust controlled to levels within WHO guidelines. No complaints filed by either passers by or employees.
	Machinery and equipment motors, including trucks	Noise		Mandatory use of ergonomic ear plugs for all heavy machinery and equipment operators and their assistants; Timely and appropriate maintenance on machinery and equipment motors.				Noise controlled to levels within WHO guidelines. No complaints filed by either passers by or employees.
	Operating the cement works	Dust, nitrogen oxide, sulfur dioxides, heavy metals and other pollutants		Air purification filters (US$ 4.6 million); kiln filters (US$ 3.0 million); cement grinder filters (US$ 1.0 million) y fuel grinder filters (US$ 1.0 million). Total= US$ 9.6 million	Throughout the productive life of the cement works	The cost for all filter systems is US$ 9.6 million	Plant Manager	Emissions comply with IFC (2006) guideline limits
	Operating the cement works and truck traffic	Noise		Soundproofing noisiest equipment		Costs included within equipment budget		The noise levels on the premises comply with legislation in place for mixed zoning areas.
Soil and Subsoil	Inappropriate disposal of waste from earthworks as well as construction rubble; Land leveling in preparation of construction platforms. Hydrocarbon on residue spills and solid waste.	Spills and waste affecting soil quality; Soil loss from removal and waterproofing	Environmental Protection and Improvement Legislative Decree No. 68-86	Store and protect displaced soil for later use; avoid oil spills during machinery and vehicle maintenance and, should they take place, recover and store in drums for later co-processing (in San Miguel kilns). Build and maintain a water treatment plant at the construction camp. Classify solid waste, implement composting for organic waste and recycle or co-process the remainder (San Miguel kilns); forbid burning solid waste within the premises.	Throughout the construction stage	Costs included within Contractor Budget	Contractors	No evidence of fine particle runoff from the worksites is present in local waterways (streams and Pachum River). No evidence from oil spill residues or solid waste burning is present; neither is trash littered in the vicinity.
	Accidental hydrocarbon residue and other chemical spills as	Affecting soil quality from disposing of spill residue and waste.		Avoid spills; should they occur, recover them using clean up machinery. Classify solid waste, implement organic waste composting and recycle or co-process the remainder in the kilns; forbid burning solid waste within the	Throughout the productive life of the cement works	Spill clean up machinery US$ 0.6 million, maintenance costs are	Plant Manager	No evidence originating from the plant is present in local waterways (streams and the Pachum River), No

	well as solid waste.			premises. .		included in the facility's annual operating expense budget.		evidence of oil residue or other chemical substances, nor of charred solid waste is present or littered in the vicinity.

Impact on Environmental Variable	Source of Impact	Environmental Impact	Pertinent Environmental Regulations Applied	Established Measures	Implementa-tion Timeframe	Cost per Mitigation Measure (Q)	Responsible Party	Performance Indicator established to Monitor Compliance
Surface and Groundwater	Inappropriate disposal of fine particles and of liquid and solid wastes; residual hydrocarbon spills	Deteriorating the water quality of the Pachum River and of groundwater	Environmental Protection and Improvement Legislative Decree No. 68-86 Legislative Decree No. 236-06: Regulations on Runoff and Waste Water Reuse and Disposal of Sludge	Put up curbs or small retaining structures around temporary piles of construction material to ensure that there is no runoff with fine particle matter. Keep the piles of material covered to ensure that heavy rainfall does not erode or flush out the material. Appropriately dispose of the debris from earthworks while ensuring that local waterways remain unobstructed as well as that the material does not wash into the waterway. Avoid spilling motor oil on the soil during machinery and equipment maintenance. Should it take place, recover and dispose of the material in drums for its later use as fuel (San Miguel kiln). Build and maintain a waste water treatment plant. Classify solid waste, bury organic waste in an appropriate site on the premises and recycle or co-process the remainder (San Miguel kiln). Prohibit burning solid waste.	Throughout the Construction Stage	The costs of curbs or retaining structures, maintenance pits for oil changes, drums to store recycled motor oil and the disposal of solid waste are included within the contractor's budget; the cost of building a waste water treatment plant is US$ 0.2 million.	Contractors	No evidence of fine particles washing down from the worksites is present in local waterways. There is no evidence of residual oil spills. There is no evidence of solid waste littered or burned. Runoff from the wastewater treatment plant falls within the limits under Regulation 236-2006.
	Inappropriate disposal of fine particles, liquid and solid waste, pumping groundwater;	Deterioration in the water quality and changing course of the Pachum River, as well as overexploitation of groundwater.		Avoiding hydrocarbon and other chemical substance spills; should they take place, recover and dispose of the material in such a way as to enable later use as fuel. Provide maintenance for the wastewater treatment plant. Classify solid waste; compost the organic residue at an appropriate site on the premises and recycle or co-process (kiln) the remainder; forbid burning solid waste.	Throughout the productive life of the cement-works	Sweeper is US$ 0.2 million. Maintenance costs covered within the plant's annual operating budget.	Plant Manager	There is no evidence of sediment washed down from the cement works. There is no evidence of hydrocarbon residue or other chemical spills. Water from the wastewater treatment plant complies with values set forth under Regulations 236-2006. There is no evidence of solid waste being littered or burned.
Flora and Fauna and Aquatic and Terrestrial Biospheres	Cutting down shrubs and tree cover; presence of personnel in the area; Raising dust; generating noise; truck traffic.	Loss of trees and shrubs; altering the natural habitat; fauna that is startled by noise; trucks or occasional traffic accidents	Environmental Protection and Improvement Legislative Decree No. 68-86; NATIONAL FORESTRY MANAGE-	Planting trees along property lines; prohibit workers from hunting wildlife. Implement measures to control noise as described earlier. Set speed limits for truck traffic.	Throughout the Construction Stage	Costs included within Contractor Budget	Contractor	No accidents involving wildlife are reported; a log is kept to ensure truck traffic remains within speed limits.

		becoming barriers to fauna.	MENT INSTITUTE (INAB)					

Impact on Environmental Variable	Source of Impact	Environmental Impact	Pertinent Environmental Regulations Applied	Established Measures	Implementation Timeframe	Cost per Mitigation Measure (Q)	Responsible Party	Performance Indicator established to Monitor Compliance
Flora and Fauna and Aquatic and Terrestrial Biospheres	Presence of personnel in the area; dust generation; noise generation; Truck traffic.	Alteration of natural habitats. Fauna startled by noise. Truck traffic and occasional accidents creating barriers to wildlife. .	Environmental Protection and Improvement Legislative Decree No. 68-86; NATIONAL FORESTRY MANAGEMENT INSTITUTE (INAB)	Keep the riparian forests on the Pachum River. Forbid workers from hunting wildlife. Implement measures to control noise as described above. Set speed limits to regulate truck traffic.	Throughout the productive life of the cement works	Cost included under the plant's annual operating budget.	Plant Manager	The riparian forests along the Pachum River are conserved. No accidents involving wildlife are reported. A log is kept on truck drivers complying with speed limits.
Occupational Health and Industrial Safety	Movement of construction machinery and equipment	Potential worksite and traffic accidents	Health Code Regulations	Adequate signage indicating access to the project and routes on the premises. Critical points where signage will be required may include areas of poor visibility for truck traffic; post signs indicating speed limits in effect, narrow lanes, etc. Provide orientation workshops on industrial and personal safety. Place pertinent signs warning of hazardous situations. Have a first aid kit on hand. Have efficient communication systems available (landlines, mobile phones) and have fire department phone number handy in case of emergencies. Designate appropriate parking areas.	Throughout the construction Stage	Making the signs and holding the workshops on occupational and environmental health and safety issues will be responsibility of one person who will be in charge of these aspects exclusively for the contractor and will be included under the contractor budget.	Contractor	Accident logs show none or just minor incidents. Adequate signs are posted at key points. A first aid kit is available. The phone number of the nearest fire station is posted in a visible spot.
	Machinery and equipment in movement for both construction and earthworks	Noise and Dust		Ensure worker's mandatory use of protective equipment against dust and noise. Monitor noise and dust to ensure that workers are not affected and suggest additional measures (enclosing primary and secondary grinders). Provide regularly-scheduled maintenance on equipment to ensure safe use and minimize noise.		Costs covered above under air quality and noise during construction		Workers use appropriate protective equipment at all times when required. Dust and noise levels remain within projected ranges.
	All activities taking place on the premises.	Affecting human health		Disseminate information on the Health and Occupational Safety Program measures to both permanent and contract staff. Hold regular workshops on industrial safety and basic hygiene standards for all staff. Provide regular training for both administrative as well as technical staff. Perform routine	Throughout the productive life	Purchasing gas emission monitoring equipment (US$ 0.6 million), maintenance is covered under the	Plant Manager	Logs covering the content, dates and description of the workshops on health and Occupational Safety. Monitoring and logs on accidents

				monitoring of gas emissions.		plant's annual operating budget.		and incidents

Impact on Environmental Variable	Source of Impact	Environmental Impact	Pertinent Environmental Regulations Applied	Established Measures	Implementation Timeframe	Cost per Mitigation Measure (Q)	Responsible Party	Performance Indicator established to Monitor Compliance
Cultural and Historical Resources and Landscape	Earthworks and excavations	Affecting national	Protection of National Heritage Sites, Civil Code Regulations	Despite the fact that it is highly unlikely that any archaeological sites are located on the property, immediately notify the Institute of History and Anthropology if any relics are discovered.	Throughout construction Stage	No cost	Contractor	No relics were found. Should they have been, upon review, IDAEH would have authorized continuing with earthworks and excavations.
	Building the cement works	Affecting the landscape	Environmental Protection and Improvement Legislative Decree No. 68-86	Place the cement works on the site in such a way as to ensure that most of it is not visible from most of the areas in San Antonio Las Trojes and that it remains out of sight of the remaining communities in the area.	Throughout the pre-construction Stage	No Cost	Project developer	Most of the cement works can't be seen from San Antonio Las Trojes or from neighboring communities.
Socioeconomic Environment	Employment and Municipal revenue	Construction workers´ wages; Municipal revenue; boosting the local economy	Labor Code Regulations	Preference to employ people from the neighboring communities; pay municipal taxes as applicable; open an Information and Community Relations Office; maintain fluid communications with local authorities; have a plan in place to disseminate information on the plant's activities to ensure harmonious relations with neighboring communities.	Throughout construction Stage	No cost to contractors. Cementos Progreso will set up the Office within the project site as construction begins.	Contractors/ Cementos Progreso	No complaints are filed by neighbors. If any are, they are amicably resolved.
		Permanent and contract employee salaries; Municipal revenue; Impacts on the economy			Throughout the productive life of the cement works		Plant Manager	
	Emissions and truck traffic	Affecting the health and security of residents of neighboring communities	Environmental Protection and Improvement Legislative Decree No. 68-86	Air filter systems and prevention measures against traffic accidents		Costs of the air filter systems and safety measures, among others, have already been covered under Air Quality and Safety		Compliance within IFC guidelines

						as described above.		
					Total:	US$ 11.2 million = Q.85.2 million 1US$ = Q. 7.6		

For a more thorough explanation of the items contained above in Table 13.1 summarizing the Environmental Management Plan, specific measures to prevent, mitigate and counteract impacts on various environmental factors throughout the Stages of construction and operation of the San Juan cement works are described in detail below. The kiln to be installed at the facility will have a cutting-edge technology (BAT) pre-heating tower and calcinatory (PHP). The measures comply with national legislation as well as IFC guidelines for cement works as described in Chapter 1.0 (IFC 2006).

I. Measures Counteracting Atmosphere Impacts

Emissions into the air when producing cement are generated by the handling and storage of raw material and products, as well as by the firing in the kilns, clinker cooling and grinders. As mentioned earlier in this report, the San Juan facility will have the best available technology for cement works. Specifically, the preheater and precalcinator (PHP) will ensure that emissions are kept to a minimum and controlled.

A description follows of specific measures to prevent, mitigate and compensate for impacts on the atmosphere by setting up the plant. The first section describes the measures taken during the construction Stage for the plant, followed by those during the operational Stage. If there are no measures described in either Stage, it is expected that environmental effects are non-existent or insignificant.

Dust:

Dust emissions are among the most significant impacts from cement works.

Construction Stage

Dust particle emissions during the construction stage will be generated mainly from the earthworks and truck traffic on the building site. The measures that the contractors must take and that are described within their contracts are as follows:

- Spray water over work areas (platforms) and dirt roadways;
- In order to keep dust to a minimum and to avoid accidents as well, restrict the speed at which vehicles can transit on the dirt roadways, and
- Use plastic or other appropriate product to cover the construction material that might generate dust.

Operational Stage

Dust emissions will be generated by the handling and storage of raw materials and products, including grinding and screening the raw material, handling and storing the solid fuel (coke),

and transporting the material by truck or conveyor belts and packaging. The measures to be implemented throughout the operational stage of the plant are as follows:

- Use a linear system in handling raw materials and products in order to keep transfer points to a minimum, which is where dust is raised;
- Cover the conveyor belts transporting raw material and products and install emission controls at transfer points;
- Regularly clean the returning conveyor belts;
- Store the ground up and pre-mixed raw material in enclosed or covered areas;
- Store the coke in silos or covered areas;
- Store the residual solids to be used as alternative fuel sources, that could potentially generate dust, in areas sheltered from wind;
- Store clinker in silos with an automatic discharge device;
- Store cement in silos with an automatic discharge and bulk loading;
- Provide regularly-scheduled maintenance to the plant components and include good practice cleaning measures in order to keep drafts or spills to a minimum. A Preventive Maintenance Unit will be placed within the plant's general Maintenance Department such as it is in San Miguel. In addition, a Maintenance Management System (MMS) will be set up to establish routine inspections and create preventive and corrective work orders, among other aspects;
- Transport and handle raw materials and products within enclosed spaces, under negative pressure, and using dust-removing sleeve air filters;
- Use a mobile vacuum unit in order to avoid the dust accumulating on paved areas;
- Include an automatic bag-filling and handling system;
- Use filters to capture dust from the kiln and cooler and recycle to the raw material storage silo or directly to the clinker kiln, respectively;
- Use sleeve air filters to gather and control fine particle emissions from the kiln gas output;
- Use sleeve air filters to capture coarse particles in the cooling gases;
- Gather the mill dust in sleeve air filters and recycle back to said mill, and,

- Spray water on the unpaved access and property roadways. Restrict speed limits on the access road, as well as on the unpaved roads on the property in order to minimize dust and prevent accidents.

Due to their high relevance for plant operations in cement works, the following is a brief description of sleeve air filters and their components. Table 13.2 specifies the location and description of the sleeve air filters to be installed at the plant. Appendix 18 includes specifications on the sleeve air filters that will be used, as well as blueprint sets 1411-99/A004-01 through 04-AA. Appendix 4 describes the location of each one.

Description:

The sleeve-type air filters that will be used for dust control on the principal equipment of the new cement works will be state of the art technology designed for line maintenance and equipped with automatic self-cleaning systems. The cleaning system relies on compressed air to ensure deep, thorough and efficient clearing without any internal moving parts. These filters will also have a unique pre-separation system that will be extremely beneficial in ensuring moderate to high particle rates in the gas flows.

The particle-laden gas will flow through the access point through multiple entries towards the area where the sleeves are installed. This design enables the speed with which the gas enters to be reduced enough to separate the particles from the current and significantly reduces the amount of dust that settles on the sleeves. This will, in turn, reduce the need for compressed air to clean the sleeves and will prolong the productive life of the filters, as well as reduce energy consumption.

Table 13.2 Key: Filters Located at Cement Works in San José Ocaña, San Juan Sacatepéquez

Area	Code	Description
Pet coke Receiving		
	L11-BF1	dust removal from pet coke/coal receiving area
	L21-BF1	dust removal from the coal/pet coke hopper and chute system
	L61-BF1	recovery of pulverized coal/pet coke and purging the air flow mechanism from the grinder
	L91-BF1	dust removal from the pulverized coal hopper
	L91-BF2	dust removal from the pulverized pet coke hopper
Additive Receiving		
	K11-BF1	Dust removal from the gypsum/ pozzolanic ash receiving area
	K9A-BF1	Dust removal from both primary and secondary conveyor belts
	K91-BF1	Dust removal from the tertiary 1 conveyor belt
	K92-BF1	Dust removal from the tertiary 2 conveyor belt
	K91-BF2	Dust removal from the feeder belts and pozzolanic, gypsum hoppers 1
	K92-BF2	Dust removal from the feeder belt and pozzolanic, gypsum hoppers 2
	K91-BF3	Dust removal from the feeder belt and limestone hopper 1
	K92-BF3	Dust removal from the feeder belt and limestone hopper 2
Raw Material Preparation		
	211-BF1	Dust removal from the marlstone and limestone grinding system
	212-BF1	Dust removal from the volcanic ash grinding system
	291-BF1	Dust removal from the sieve feeder belt
	291-BF2	Dust removal from belt transitions
	291-BF3	Dust removal from the raw material stacker
	291-BF4	Dust removal from the limestone kiln stacker
	291-BF5	Dust removal from the high calcium limestone stacker
	291-BF6	Dust removal from the transition to the limestone deposit belt
	292-BF1	Dust removal from the ground volcanic ash conveyor system
Preparation of Correctives		
	X11-BF1	Dust removal from the grinder and conveyor transition
	X91-BF1	Dust removal from the transition from deposit conveyor
	X91-BF2	Dust removal from the distribution conveyor belt
	X91-BF3	Dust removal from the limestone and sand hoppers and chutes
	X91-BF4	Dust removal from the fluorine / hematite hopper conveyor system

Area	Code	Description
Rawmix Preparation		
	312-BF1	Dust removal from the reclaimed volcanic ash conveyor
	311-BF1	Dust removal from the limestone/marlstone hopper
	312-BF2	Dust removal from the volcanic ash hopper
	331-BF1	Dust removal from the correctives hopper discharge
	331-BF2	Dust removal of the conveyor transition feeding into the grinder
	361-BF1	Dust removal from the detour into the metal detector system
	361-BF2	Dust removal from the elevator and grinder load conveyor
	391-BF1	Dust removal from the cyclone discharge conveyor
	391-BF2	Dust removal from the loading point for the homogenization silo elevator
	391-BF3	Dust removal from the discharge point of the elevator over the silo
	391-BF4	Dust removal from the homogenization silo and load points
Clinker Production		
	421-BF1	Filter on the rawmix grinder and the preheater
	421-BF2	Dust removal from the filter discharge system and elevator
	421-BF3	Dust removal from the loading system in the raw material pre-hopper
	411-BF1	Dust removal from the raw material pre-hopper
	431-BF1	Dust removal from the raw material pre-hopper discharge
	431-BF2	Dust removal from the preheater load system
	471-BF1	Dust removal from the clinker transport system
	491-BF1	Dust removal from the clinker silo load system
	491-BF2	Dust removal from the unacceptable clinker silo load system
Cement Mills		
	511-BFB	Dust removal from the clinker silo conveyor
	511-BF1	Dust removal from the Grinder 1 feeder system
	531-BF2	Dust removal from the Grinder 1 feeder system
	531-BF1	Dust removal from the additive conveyor system to Grinder 1
	561-BF1	Grinder 1 main filter
	561-BF2	Dust removal from the Grinder 1 recirculation system
	561-BF3	Dust removal from the metal detector system detour
	591-BF1	Dust removal from Grinder 1 main filter discharge
	591-BF2	Dust removal from the Grinder 1 cement elevator
	512-BF1	Dust removal from the Grinder 2 feeder system
	532-BF2	Dust removal from the Grinder 2 feeder system
	532-BF1	Dust removal from the additive conveyor system to Grinder 2
	562-BF1	Grinder 2 main filter
	562-BF2	Dust removal from the Grinder 2 recirculation system
	562-BF3	Dust removal from the metal detector system detour
	592-BF1	Dust removal from the Grinder 2 main filter discharge
	592-BF2	Dust removal from the Grinder 2 cement elevator
	591-BFE	Pozzolanic ash silo filter
	591-BFF	Cement silo filter
	591-BFG	Cement silo filter
	591-BFA	Cement 1 silo filter
	591-BFB	Cement 2 silo filter

Area	Code	Description
	591-BFC	Cement 3 silo filter
	591-BFD	Cement 4 silo filter
Mixing Plant		
	U61-BF1	Dust removal from the mixer conveyor system
	U91-BF1	Dust removal from the mixed cement elevator
	U91-BF2	Dust removal from the cement silo distribution system
Packing and Shipping Plant		
	616-BF1	Dust removal from the cement hopper
	615-BF1	Dust removal from the cement hopper
	623-BF1	Dust removal from the loading system for bulk cement
	622-BF1	Dust removal from the loading system for bulk cement
	613-BF1	Dust removal from the cement hopper
	611-BF1	Dust removal from the cement hopper
	613-BF2	Dust removal from the cement conveyor system to the orange packager
	621-BF1	Dust removal from the loading system for bulk cement
	614-BF1	Dust removal from the cement hopper
	612-BF1	Dust removal from the cement hopper
	612-BF2	Dust removal from the cement conveyor system to the red packager
	611-BF2	Dust removal from the cement conveyor system to the blue packager
	611-BF3	Dust removal from the cargo elevator to the blue packager
	612-BF3	Dust removal from the cargo elevator to the red packager
	613-BF3	Dust removal from the cargo elevator to the orange packager
	661-BF1	Dust removal from the blue packager/pallet assembler
	662-BF1	Dust removal from the red packager/pallet assembler
	663-BF1	Dust removal from the orange packager/pallet assembler

Components:

The filters are built in such a way as to be able to distinguish the two sections that separate the contaminated gas from the filtered gas. The lower section will contain rows of sleeves. The upper section will contain the purging tubes to clean the sleeves and will provide support for those, as well as for the grills. Both sections will be built from 5mm steel sheeting. They will have internal, as well as external structures, built from sectional tubing that will make the filter self-standing and resistant to the loads generated by the elements.

Upper Panels:
Panels will make up the walls of the filter as well as contain the support plates for the grills and the sleeves, the cleaning tubes and the access gates. These will the most important part of the filtration system since they comprise the barrier between the flow of clean gas and the gas to be filtered.

Sleeves:

The sleeves will be manufactured from material meeting the filtration process requirements based primarily on the temperature of the gases to be eliminated. The filter bags for the rawmix and cement will be made from acrylic fiber and will each be fifteen feet long and six inches in diameter withstanding a maximum operating temperature of 127º C. It is estimated that the number of sleeves required by the filter will be around 5,616 providing a filtration surface area of 10,108 square meters.

The sleeves for the kiln filter will be fiberglass and each will be twenty feet long and five inches in diameter, withstanding a maximum operating temperature of 260º C. It is estimated that the number of sleeves will be 9,360 providing a filtration surface area of 22,463 square meters.

The filter sleeves for the pet coke grinder will be manufactured from acrylic felt and will each be twelve feel long and six inches in diameter withstanding a maximum operating temperature of 160º C. It is estimated that the filter will have 615 sleeves and the filtration surface will be 1,077 square meters.

Venturi Scrubbers:

The Venturi scrubbers will be manufactured from carbon steel and will be installed in the upper area of each of the grills where the sleeves will be placed. They are designed to improve the effectiveness of filtration and gas circulation through the sleeves.

Compressed Air Valves:

A valve will be in place at each row of sleeves and will be used to regulate compressed air to clean the sleeves.

Hoppers:

The hoppers will be manufactured from carbon steel sheeting into a pyramidal shape. The will be designed to handle bulk material with densities up to 1000 kg/m^3 and will be equipped with a gauge to measure the content level.

Intake and Output Multiples:

These will be manufactured from carbon steel sheeting and will be used to properly distribute the intake and output of gases in the filter. The will be placed along the entire length of the filter and will enable a low speed flow.

Access gates:
These will be in place to separate the filter compartments during cleaning and maintenance.

Collected Dust Discharge System:

The will encompass several rotary valves and spiral conveyors that will transport the dust to the main conveyors and will ensure that the process is sealed off to false air entry that could throw the filter operation off balance.

Service and Maintenance Platforms, Structural Support and Access Gates

These will be steel structures to enable accessing the various sections of the filter for servicing the components, and to enable replacing the sleeves or accessories under maintenance.

Instrumentation and Control Systems

These are sets of electric, electronic and pneumatic devices to enable adjusting the filter operation in response to the operating conditions of the process.

Collected Material Discharge System:

This will be comprised of valves, hoppers and spiral conveyors designed to remove collected material and prevent the entry of false air that could affect filter operations.

Nitrogen Oxides

Construction Stage

The nitrogen oxides emissions during this stage will be generated by the combustion engines on machinery and construction equipment. The measures to be implemented by the contractors are as follows:

- Provide adequate and timely maintenance on the machinery and construction equipment.

Operations Stage

The nitrogen oxides (NOx) emissions during this stage will be linked to the high temperatures during the combustion process in the cement kilns. The prevention and control techniques, in addition to properly operating the kilns, are as follows:

- Maintain secondary air flows as low as possible (oxygen reduction);
- Use low NOx, burners to avoid critical emissions. Other technology is available, such as non-selective catalytic reduction, that could be used in the San Juan facility; and
- Develop a staged combustion process

Sulfur Dioxide

Construction Stage

Sulfur oxides emissions throughout this stage will be generated by combustion engines on the machinery and construction equipment. The measure to be implemented is:

- Provide adequate and timely maintenance on the machinery and construction equipment.

Operations Stage

Sulfur dioxide emissions during cement production are linked mainly to the content of volatile or reactive sulfides in the raw material or to fuel quality. In addition to properly running the kiln, the techniques for control or prevention are as follows:

- Heated gases from the preheater will be used in the mix grinder to dry the raw material going into the rawmix, recovering the energy calories and reducing the sulfur dioxide content in the gases. This is possible due to the ability of CO_2 to react with the calcium present in the limestone to form gypsum (calcium sulfate $CASO_4$);

- Select the fuel with the lowest possible sulfide content. Even though pet coke has a relatively high sulfur content (around 6%), there will be no significant emission due to the contact that will take place in the preheating tower; and,

- Select quarried material with the lowest possible volatile sulfide content which is found in pyrite. Pyrite was found in the San Juan quarry within one of the marlstone deposits. Therefore, its use in the cement works process with be managed via selective quarrying.

Greenhouse Effect Gases

Operations Stage

The emission of greenhouse gases, especially carbon dioxide (CO_2) is linked primarily to the combustion process and to the oxidation of limestone. Carbon monoxide is a very small percentage of the greenhouse effect gases (< 1%), and is due to low combustion efficiency. This is obviously an undesirable effect in the process because it increases costs due to poor energy efficiency. In addition to proper running of the kilns, additional control and prevention techniques are as follows:

- Produce mixed cement which reduce energy consumption as well as rates of CO_2 emissions per ton;

- Select and operate the cement works based on the process that will enable the greatest energy efficiency (dry/preheated/precalcinated), and

- Select the fuel with the lowest possible carbon to energy ratio. Pet coke will be used, as will firewood from manager energy forests and industrial waste to be used as alternative fuel sources. It is expected that the use of alternative fuel sources will increase up to 15% of total fuel consumption.

Heavy Metals

Operational Stage

Heavy metals, especially lead, cadmium and mercury, could attain significant emission levels in cement processing. They are present in the kiln through raw material, fossil and alternative fuel sources. To reduce heavy metal emissions, the measures to be implemented are as follows:

- Implement effective measures to reduce dust, as described earlier in this report, which will also trap bound metals;

- Implement continuous control measures for heavy metals in raw materials and in fuels, limiting inputs of volatile metals. A laboratory will be available for this type of analysis;

- Will not use wastes with high organic content as alternative raw material (AFR), which is in line with Holcim´s policy for the use of alternative fuel sources; and

- Will not use alternative fuels during the start up firing or stoppage maneuvers. Bunker fuel will be used during these procedures.

Other air pollutants

Operational Stage

Cement kilns have predominantly alkaline content, have high residence times and high flame temperatures which is why they are used to burn waste. These characteristics enable the kilns to destroy all types of dangerous material, including solvents, hydrocarbon residue, used tires, plastic residue, organic chemical residue such as PCBs, expired organic chlorine pesticides and other chlorides. The use of these wastes as fuel can lead to volatile organic compounds (VOCs), dioxins (PCDDs), furans (PCDFs), hydrogen fluorine (HF), inorganic chlorine

compounds (HCl) and toxic metals if the kilns are not properly fired and controlled. Preventive measures and control techniques for these types of pollutants are as follows:

- Upon implementing dust reduction measures, the emission of non volatile heavy metals is reduced;
- Directly injecting the fuels that contain volatile metals or high concentrations of volatile organic compounds into the main burner rather than into auxiliary burners;
- Avoiding the use of fuels with high halogen content in auxiliary burners; and,
- Keep gas cooling times in the kiln to a minimum (between 500 to 200^{o}C), to avoid or reduce the regeneration of destroyed dioxins and furans (PCDDs and PCDFs), known as persistent organic pollutants (POPs).

II. Measures Counteracting Impacts on Surface and Groundwater

Specific measures to prevent, mitigate and counteract impact on surface and groundwater are described below. The first section describes the measures to be taken during the construction stage, followed by the operational stage of the cement works.

Construction Stage

The potential sources affecting surface and ground water would include runoff that might carry solids, the control of liquid and solid wastes generated at the construction camp site and accidental spillage of hydrocarbons. In addition the construction process and camp will place demands on groundwater supplies. The measures to be implemented throughout this stage include:

- Sustainable use of groundwater. Well water extraction will be controlled and regulated based on pump tests and recovery times.
- Waste water from the construction camp will be treated via a wetland system or extended aeration. Portable latrines will be installed on worksites that are at some distance from bathroom facilities at the camp;
- Runoff from the worksites will be channeled to specific areas with sedimentation tanks (fine particle decantation) and/or sieves in order to capture the greatest possible amount of fine particles prior to flowing to local streams (Sunuj) or the Pachum River. In addition, the tanks and/or sieves will be cleaned after each heavy rainfall;
- Fine grade aggregates will be kept covered during heavy rains to avoid runoff to streams feeding into the Pachum River;

- Oil change pits will be available for machinery maintenance to enable recovering used motor oil, storage and proper recycling. Appropriate storage containers specifically for recycling used motor oil will be available;

- Fuel and oil spills will be prevented in the machine shop areas and at worksites. Should they accidentally take place, clean up will be immediate. Hydrocarbon residues will be collected and stored in drums for later recycling or will be shipped to the San Miguel facility for use as fuel;

- Solid waste from the construction camp and work sites will be classified in separate containers for paper, plastics, glass, filters, tires, batteries and metals; and organic waste will be appropriately disposed of (landfills). The remaining waste will be recycled or co-processed at the San Miguel cement works; and,

- Provide timely and adequate maintenance on the waste water treatment plant.

Operational Stage

Water is used to cool several types of equipment throughout various stages of cement production. Even through the water remains unpolluted, the temperature increases. Operating the cement works requires the use of groundwater. Water runoff could carry solids found in the area surrounding the pet coke and alternative fuel storage facilities, as well as fine dust from the sealed areas that could pollute the water. Dust prevention measures in place at the raw material, clinker, pet coke and alternative fuel storage facilities, as described earlier, minimize pollution of runoff. Liquid and solid wastes are generated primarily from management activities. The measures to be implemented throughout this stage include:

- After running it through cooling towers, reuse water from the cement process;

- Sustainable extraction of groundwater without detriment to neighboring communities. The wells will be regulated to extract water based on pump test and recovery times.

- Waste water will be treated through artificial wetland systems and water training off the wetlands will comply with regulations (236-2006) in effect for new generating units;

- Channeling the runoff originating on the entire property (26 hectares will be waterproof and the remaining 38 will not) to selected sites set up with sedimentation tanks and/or filter sieves will capture the greatest possible amount of fine particles prior to reaching streams or waterways feeding the Pachum River. In addition, the tanks and/or sieves will be cleaned following each heavy rainfall;

- Energy dissipaters will be built at key points along the water flows into streams and waterways (Sunuj);

- Any raw material or product that requires temporary storage outdoors will remain covered to avoid heavy rainfall washing fine particles into the streams and waterways feeding into the Pachum River;

- Oil change pits will be available for machinery maintenance to enable recovering used motor oil, storage and later use as fuel for the kilns. Appropriate storage containers specifically for collecting and storing used motor oil will be available;

- Fuel and oil spills will be prevented in machine shops or any area on the premises. Should one accidentally take place, clean up will be immediate. Hydrocarbon waste will be collected and stored in drums for their subsequent use as kiln fuel;

- Solid waste from the cement works and facilities will be classified in separate containers for paper, plastics, glass, filters, tires, batteries and metals; and organic waste will be appropriately disposed of (landfills) in an appropriate site on the premises. The remaining waste will be recycled or co-processed in the kiln. All the solid waste that is generated will be disposed of or treated at the facility, and

- Timely and appropriate maintenance will be performed on the waste water treatment plant.

III. Measures counteracting Soil and Subsoil Impacts

Measures to prevent, mitigate and counteract the impacts on the soil will be in addition to those described earlier regarding surface and groundwater that will also affect soil and subsoil. The first section describes those during the construction stage followed by those throughout operational stage.

Construction Stage

Cuts into the soil to erect platforms as well as their waterproofing, will permanently affect the soil. Disposing of earthworks waste material will affect the soil below. The measures to be implemented during the construction stage are as follows:

- Keep earthworks to a minimum during platform construction;

- Pile up and protect organic soil extracted during ground leveling and platform construction in order to avoid it being eroded and enable its later use for replanting and reforestation. If the soil won't be used for a short period of time, it can be placed in low piles to avoid compacting, then adding organic material to aid in maintaining soil quality, i.e. leafy matter to absorb nitrogen from the air and fix it in the soil.

Operational Stage

The solid waste generated during operations will be handled as follows:

- Recirculation of all solid wastes from the process (limestone residue, shale, clinker, raw flour, or cement) or use them as filler at the quarries according to their physical or chemical properties; and,

- Classify and dispose of the solid waste (trash) in order to ensure that it all is managed on the premises via recycling, composting, or co-processing. This will ensure that no waste accumulates awaiting disposal off site. Appendix 19 describes the processes for classification, collection and on site disposal of the facility's solid waste.

IV. Measures counteracting Impacts on Flora and Fauna

The specific measures to prevent mitigate and counteract the impacts on flora and fauna are described below. The first section describes the measures to be taken during the construction stage followed by those throughout the operational stage.

Construction Stage

Cutting down vegetation, noise, dust and truck traffic will affect flora and fauna on the site and neighboring areas. The measures to be implemented during this stage are as follows:

- Reduce cutting down vegetation to a minimum and, whenever possible, avoid cutting down trees with trunks larger than 10 cms. in diameter, especially those around the perimeter of the property and those not on the platforms;

- Use trees to fence in the property; this will make up for the vegetation that is cut down and improve the landscape;

- Prohibit hunting local wildlife, as well as purchasing animals held in captivity;

- Regulate maximum speed limits for truck traffic in order to reduce noise levels, reduce the likelihood of running over wildlife and avoid accidents;

- Place signs posting maximum speed limits. The signs should be visible at night;

- To avoid accidents and to avoid startling wildlife, restrict truck and vehicular traffic after nightfall;

- In order to avoid inadvertently trapping wildlife, repair or fill in holes, well holes, ditches or any other excavation that is not in use;

- In order to prevent damage to fauna, avoid unnecessary noise created by horns, running engines, whistles, etc.

- To avoid affecting fauna, avoid intense lighting in place at night. Focus lighting on specific work sites, avoid lighting up fauna habitat areas, as well as ensure dimming lights that are unnecessary.

Operational Stage

The wildlife diversity in the riparian forests in the ravines and banks along the Pachum River make them a conservation priority. Any patches of vegetation that are still remaining in the area will be conserved and those areas of the riparian forest that have been disturbed will be recovered. Additional measures are described below:

- Create buffer zones to filter and "sponge" up the negative effects of running the cement works. Protect those areas in close proximity to water sources and the ecosystem surrounding the Pachum River bed and tributaries. These buffer zones should be larger in the areas closer to the cement works. A width of between 500 to 800 meters is recommended;

- In order to create additional buffer zones, keep the area on the banks of the Pachum River reforested and enable the growth without any type of forestry management. The same applies to the pine forest area surrounding the Sunuj stream;

- Keep forestry management in place as has been the case on the remainder of the premises;

- Design a formal system to control natural resource extraction (firewood, pinecones, trees, bromeliads, prey animals, among others) thereby mitigating negative effects and ensuring that communities do not exhaust the resources;

- Develop integrated basin management, especially because almost all of it falls within the San José Ocaña property. Use joint efforts with neighboring communities to encourage developing a green belt in and around the property along the same river basin. This will increase the value of natural resources; ensure their sustainable use in the short, medium and long term.

V. Measures counteracting Impacts on the Landscape and Cultural and Historical Resources

Specific measures to prevent mitigate and counteract the impact on the landscape, and cultural and historical resources are described as follows. The first section includes measures taken during the pre-construction stage, followed by those in place during the construction stage.

Pre-construction Stage

- Identify the location for the cement works on a site on which the topography allows the greatest possible distance along the line of sight from neighboring communities (Sectors I and II in San Antonio Las Trojes) and where it can't be visible from the village of San Antonio Las Trojes and Cruz Blanca or from other neighboring communities.

Construction Stage

- Remodel any altered topography to resemble the natural environment as much as possible;
- Use waste material from the earthworks to fill in depressions where needed and where it adds value to the property and corrects altered topography;
- Plant trees and shrubs along the perimeter of the facility to screen the view of the cement works, and;
- Should any archaeological relic be discovered, immediately stop construction and contact the pertinent authorities (IDAEH).

VI. Measures counteracting Impacts in the Areas of Safety and Occupational Health

Specific measures to prevent impacts in the areas of safety and occupational health are described below. The first measures will be applied during the construction stage, followed by those during the operational stage.

Construction Stage

The contractors will have safety and occupational health programs in place and will post notices in places that are in proximity and visible to work sites, as well as ensure strict compliance. To achieve these objectives, they will have presentations on industrial safety and occupational health for all the workers. The following are additional measures:

- ✓ Put up appropriate signage to avoid traffic accidents at truck entry and exit points, among others;
- ✓ Put up signage warning of hazardous conditions and other industrial situations;
- ✓ Provide regularly scheduled maintenance on equipment and machinery to ensure safe operation;

- ✓ Prohibit smoking during working hours. Define specific areas to allow smoking on breaks or off duty;
- ✓ Set aside appropriate parking areas for loading and unloading equipment and material;
- ✓ Keep fire extinguishers and other emergency devices visible at hand;
- ✓ Industrial protective gear will be mandatory use depending on the specific activity to be performed, and
- ✓ Provide vehicle operators with instructions and training.

Operational Stage

Cementos Progreso, S.A. has policies in place on safety and occupational health in both the San Miguel cement works, as well as the La Pedrera facility. These policies will be applied in the new facility in San Juan as well. They will be posted in visible areas in order to ensure strict compliance. In addition, the Industrial Safety Program will be developed for all activities pertaining to cement production in accordance with the safety policies and with engineering best practice. This will be achieved by training local personnel in safety and occupational health measures. In addition, the following measures will be applied:

- ✓ As part of the procedures for OH&C, regular inspections will take place to evaluate hazards and minimize risks in work areas;
- ✓ Install adequate signage to prevent traffic accidents at truck entry and exit points, among others;
- ✓ Install signs alerting to danger and post industrial signage;
- ✓ Provide regular maintenance on equipment and machinery to ensure safety and reduce noise levels;
- ✓ Prohibit smoking for the personnel during working hours. Set aside smoking areas for use during breaks;
- ✓ Designate appropriate parking areas for cement loading;
- ✓ Keep fire fighting devices readily available and visible;
- ✓ Provide lectures or presentations on safety and occupational health for workers. Provide regularly scheduled training at both management and technical levels;

- ✓ Use of industrial protection equipment will be mandatory and pertaining to the particular activity that is being carried out;

- ✓ Provide vehicle drivers with instructions and training, as well as annual eye exams, at a minimum.

Specific measures to mitigate dust, heat, noise, physical impacts, radiation, etc. during the operation of the cement works, in order to minimize their effects on workers, are described below:

Dust:

- ✓ Will use enclosed cabins and air conditioning;

- ✓ Will use extraction and dust recycling systems to remove dust from work areas, especially at the grinders;

- ✓ Will have ventilation (suction) in packaging areas, and

- ✓ Will use appropriate personal protection equipment.

Heat:

- ✓ Will use protective surfaces in those areas in which workers will be in close proximity to high temperature equipment. Will use personal protection equipment as appropriate, including gloves and insulated shoes;

- ✓ Will minimize the work time required within high temperature areas by setting up shorter shifts to cover those areas, and,

- ✓ Will keep air or oxygen canisters available or in use as required.

Noise

- ✓ Will use silencers on the fans and/or confine the fans in such a way as to ensure that the noise is not affecting the environment;

- ✓ Will have enclosed rooms for the grinder operators and for other machinery operators in general;

- ✓ Will have sound barriers, and

- ✓ Personal protection equipment will be available.

Physical Impacts

- ✓ Will have a health and Occupational Safety management system in place that will include preventive measures regarding the physical impacts which will be implemented by the Safety and Occupational Health Department. This program will cover training, monitoring and performance evaluations.

Radiation

- ✓ Provide timely and appropriate maintenance on the gamma ray and laser ray analyzers by personnel specially trained by the supplier of the equipment. The workers will not be exposed to radiation from this equipment since they will be insulated.

Other aspects of industrial health

- ✓ Will have preventive medical care. Preparation in case of accidents, including dermatitis caused by contact with cement or other chemical agents. The company will have regulations to cover the use of personal protection equipment depending on the type of risk associated with the activity.

VII. Measures counteracting Impacts on the Social Environment

Interviewees suggested putting measures in place to create positive relations among the communities, local authorities and the company. The measures will be implemented by the company, as follows:

- ✧ Create dialogue among the community leadership:
  - o COCODES (Community development councils) and COMODE(Municipal development councils);

- ✧ Provide support in community development:
  - o Set up social projects; and
  - o Support local authorities in maintaining local roadways;

- ✧ Employ members of the local communities:
  - o Pay competitive wages based on the skill levels required for each position;

- ✧ Protect the environment:
  - o Control dust;
  - o Protect water sources, and
  - o Regulate heavy traffic.

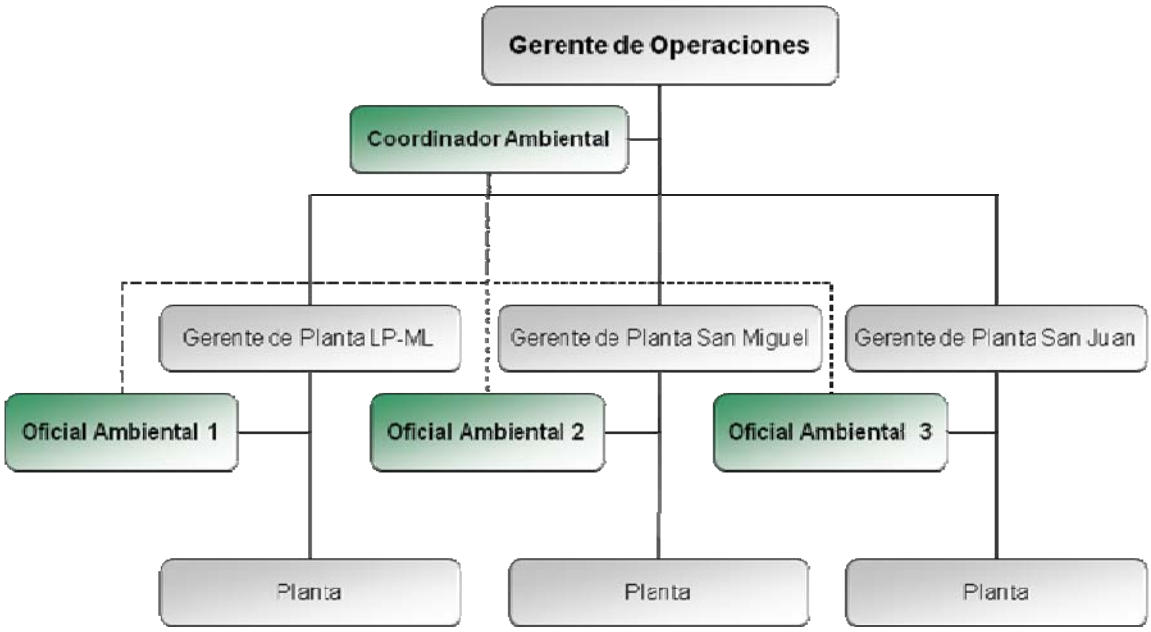
- ✧ Inform the community of any problem situation and the controls put in place;
  - o Set up a “Community” Communications Office;

- Prepare an information, dissemination and political and social impact program for the project as regards neighboring communities;
- Post relevant signs, such as "no job openings available" once demand has been met;
- Will have a phone number available and a place to log complaints;
- Set up appropriate signage to prevent traffic accidents at the truck entry and exit points, among others, and,
- Limit unauthorized passengers or personnel within the property and on access roads.

13.1 Project Organization and Implementation of Mitigation Measures

The characteristics and the scope of the project warrant the fact that the organization that will be set up to implement mitigation measures in a timely and appropriate fashion be divided into three main areas: i) addressing environmental measures, per se; ii) addressing measures pertaining to the areas of health and Occupational Safety, and iii) addressing areas pertaining to the health and safety of neighboring communities. The party responsible for implementing the mitigation measures under the Environmental Management Plan is Cementos Progreso, S.A. In addition, since Cementos Progreso is associated with the Swiss group, Holcim, it must also comply with those requirements which, in turn follow guidelines set forth by the International Finance Corporation (IFC 2006).

Environmental Aspects:
During the construction of the facility, which will take two years, Cementos Progreso will contract several specialized companies. Throughout this stage, Cementos Progreso will assign an Environmental Supervisor in a full time role and backed by an additional staff professional to ensure appropriate follow up and PGA monitoring on behalf of the contractors.



This person will report directly to the Construction Supervisor responsible to Cementos Progreso.

Throughout the operational stage of the cement works that will last for a minimum of 25 years, Cementos Progreso will strengthen the current Health, Safety and Environmental Department within the company. This will enable it to broaden its operations regarding the new cement works in San Juan, as well as for San Miguel and La Pedrera (LP). The following chart illustrates current efforts towards setting up the Environmental Division in Cementos Progreso:

Translation Note
Key to text above:
Gerente de Operaciones/Operations Manager
Coordinador Ambiental/Environmental Coordinator
Gerente de Planta/Plant Manager
Oficial Ambiental/ Environmental Officer
Planta/Plant or cement works

The roles and responsibilities of the Operations Manager, the Environmental Coordinator, the Plant Manager and the Environmental Officer are described below from lower levels on the organizational chart to highest:

Environmental Officer for the Plant:

The Environmental Officer for the new San Juan facility will have the following responsibilities:

- Perform environmental monitoring throughout the new facility in San Juan;
- Maintain close communication with the Cementos Progreso Environmental Coordinator;
- Organize the environmental data and information gathering process for the plant's performance evaluation;
- Keep the Plant Manager and the Environmental Coordinator apprised of environmental situations in general, as well as of specific incidents in particular;
- Prepare proposals to improve the environmental performance of the facility;
- Provide and organize training courses for plant personnel, and
- In coordination with the Plant Manager, ensure that workers are well informed on the environmental aspects of the facility.

Plant Manager

The role and responsibilities of the San Juan Plant Manager will be as follows:

- Will be responsible for compliance with legal requirements (in environmental issues);
- In conjunction with the plant Environmental Officer and with the company Environmental Coordinator, will implement EMP measures;
- Will validate the reports on the plant's environmental performance;
- In conjunction with the plant Environmental Officer, will generate propose measures to improve the plant's environmental performance, and
- In conjunction with the plant's Environmental Officer, will maintain close and productive contacts with local authorities.

Cementos Progreso Environmental Coordinator

The role of the Cementos Progreso Environmental Coordinator, including responsibilities for the new facility in San Juan, is as follows:

- Report environmental issues to the company's Operations Manager;
- Will provide the General Manager, the Operations Manager or the Plant Managers with support on environmental issues, as appropriate;
- Coordinate environmental aspects throughout the entire company in all areas;
- Keep the Environmental Management System (EMS) in perfect working order and coordinate efforts towards international certification;
- Will prepare the company's environmental reports and will suggest measures and projects that will improve the company's environmental performance;
- Ensure monitoring of atmospheric emissions;

- Verify compliance with the use of alternative fuels as regards Holcim´s policy on AFR;
- Maintain close contacts with the company's Operations Manager and propose strategies, policy, guidelines, recommendations and action plans for specific situations or in response to new regulations;
- Coordinate and supervise the implementation of the environmental impact assessments for new products or processes;
- Ensure that all company employees receive training and assessment on environmental issues;
- Keep current and high quality data on the company's environmental activities to ensure that it is readily available for reports to authorities, academia, NGOs and other interested parties;
- Prepare inputs, make recommendations and supervise the company annual budget regarding environmental activities;
- Keep abreast of environmental legislation and ensure compliance at all times, and
- Be the company's key contact point on environmental issues.

Operations Manager

The role of Cementos Progreso Operations Manager, including the new facility in San Juan, will be as follows:

- In coordination with the company Environmental Coordinator, design the policies, strategies, guidelines and budget and make recommendations to the Board of Directors;
- Ensure that environmental aspects are adequately factors in to all decision making;
- Supervise and support the work of the company Environmental Coordinator;
- Support the Managers and Environmental Officers at each facility;
- In conjunction with the company's Environmental Coordinator, provide optimal distribution of environmental information to all interested parties;

Health and Occupational Safety:
The Health and Occupational Safety Units will have systems similar to the one that Cementos Progreso has in place at the San Miguel and La Pedrera facilities. The high risk areas and activities in the facilities will be listed in order according to number of risks and degree of hazard: exterior, cabin (interior). Likewise, the occupational hazards that are most prevalent within the company are those related to dust exposure, noise exposure, flammable substance exposure and biological risk exposure in bathroom facilities.

The cement works owned by Cementos Progreso, as mentioned earlier, is associated to the Swiss Holcim group which has clearly defined guidelines and policies regarding Occupational Health and Safety. Holcim has designed its own program for occupational hazard management known as the "OH&S Management System". This system is mandatory for all facilities that belong to the group. Therefore, implementation will be mandatory at the facility to be set up in San José Ocaña.

Holcim´s OH&S system is based on a pyramid of elements that must be complied with in ascending order and certified by external audits. The pyramid is known as the Holcim OH&S Pyramid and each one of the activities in the structure are known as blocks. Each block is a requirement and is backed by procedures and formats developed locally with clear definitions of responsibilities.

Holcim has an Occupational Health and Safety Management Handbook which includes general descriptions of the system as well as lists the overall requirements. It does not describe how to implement it. Therefore, the procedures to implement the system operations that will be in place at the San Juan facility will be prepared.

It's worth mentioning that the Holcim Management System also covers contractors whose performance is evaluated regarding occupational health and Safety issues. All of the responsibilities will be set forth within the contracts and financial sanctions will be determined in cases of non-compliance. Contractors will be given a two-hour orientation session to cover occupational risks and work standards.

The Holcim Management system is very similar to the requirements covered by OHSAS (Occupational Health and Safety Assessment Series) 18001:1999 International Standards. The following chart compares the requirements and additional steps. Table 13.3 lists each of the total number of 19 blocks compared to the OHSAS 18001 and clearly illustrates that it is a more comprehensive system:

Table 13.3 Comparative Analysis between Holcim OH&S System and OHSAS18001:1999

Holcim OH&S System	Relationship to OHSAS 18001: 1999 Requirements
Block 1: Roles and Responsibilities	Section 4.4.1 Structure and Responsibility
Block 2: Hazardous occupational activities	Section 4.3.1 Risk identification, risk analysis and controls
Block 3: Hazard identification and risk assessment	idem
Block 4: Scheduled inspections	Section 4.4.6 Operational Controls
Block 5: Legal Obligations	Section 4.3.2 Legal and other requirements
Block 6: Management and planning commitment	Section 4.4.1 Structure and Responsibility
Block 7: Orientation and Training	Section 4.4.2 Training, Awareness and Competency
Block 8: Investigating incidents and accidents and corrective actions	Section 4.5.2 Accidents, Incidents, Non-Compliance and Preventive and corrective actions
Block 9: Industrial Hygiene and Evaluation	Section 4.5.1 Performance indicators and monitoring
Block 10: Communication with personnel and involvement	Section 4.4.3 Communication and Advice
Block 11: Information and reports	Section 4.51 Performance indicators and monitoring
Block 12: Safe labor procedures	Section 4.4.6 Operational Control
Block 13: Inspection and testing	Section 4.4.6 Operational Control
Block 14: Design Safety	Section 4.3.1 Hazard identification, analysis and risk control
Block 15: System improvement audits	Section 4.5.4 Audits

Block 16: Occupational rehabilitation	Not included
Block 17: Supplies	Not included
Block 18: Change Management	Not included
Block 19: Health and wellbeing	Not included

The Cementos Progreso organization has a reputation for implementing Corporate Social Responsibility throughout its entire management structure. This is evidenced by the employee benefits provided in addition to those required by local legislation; i.e., on site medical and dental services for both the employee and their immediate family (spouse and children under 18), health insurance (does not cover orthodontics or maternity), life insurance for the employee. In addition, the company provides medication free of charge, not just OTC medication, but specialized antibiotics as well. This benefit package will be provided to new employees hired for the new facility.

Personnel recruitment is also subject to the Quality Management System (QMS) which implies that it is appropriately documented and subject to procedures. The entire process is managed by the Human Resources Division who will submit three candidates to the area supervisor who will review their ability to fulfill the requirements. The three candidates have already been through testing and interviews, including a medical examination prior to their employment. If a candidate does not meet the medical requirements, he or she will not be hired.

Once the person has been hired and has met other requirements such as signing a contract, qualifying for medical insurance, etc., the orientation period begins. Orientation is provided on two separate occasions each month and requires a three-day session broken down into two days on general orientation (background, vision, mission, employee benefits, Corporate Social Responsibility, OH&S System, fire extinguishers, first aid and reforestation field trip). The third day is devoted to field trips to the specific area for which the person is being hired.

Following this orientation, the training stage specific to the position will be provided by the immediate supervisor. This training includes an explanation of the risk chart in the areas of Health and Occupational Safety within the specific work area, as well as providing the basic personal protection equipment and specialized equipment to be used depending on the specific risks inherent to the position.

System Components

The Occupational Safety and Health Plan for the cement works takes into consideration the following aspects: policy, hazard identification procedures and occupational risk analysis; legal requirement identification procedures; management programs and objectives; organization; Safety and hygiene committee; training; documentation; operational controls; emergency preparedness and response: accident rates and system audits.

- ✓ <u>Policy</u>

Cementos Progreso has designed a policy within the OH&S Management system that is described in OHS-CP-GG-PO-01 Rev. 0. The document is transcribed below:

Safety and Health Policy

We are committed to the Health and Safety of:
-Those persons performing their job within our company.
- Those persons with whom we have contact such as visitors, suppliers or customers….

We, therefore:
-Provide safe and hygienic work areas
-Implement health, safety and hygiene standards
-Provide the people who perform a job within our company with the resources and necessary training in order to comply with the health, Safety and hygienic standards
-Encourage good health and Safety practice for those persons who come into contact with our company such as visitors, suppliers and customers
- Monitor and evaluate performance indicators for our workplace health and Safety.

This policy was set by the company's General Management and is reviewed monthly as part of management's general overview of the OH&S System. It is sent out to all of the cement works employees.

- ✓ Identify occupational hazards and risk analysis

Blocks numbers 3 and 4 within the OH&S System are entitled respectively, "Identify hazards and risk analysis" and "Scheduled inspections". Both blocks include the objective of identifying hazards within operations and evaluating occupational risks. To this end, they apply a matrix that combines the parameters of probability, occurrence and severity.

In terms of carrying out regularly scheduled inspections, these are performed weekly with a systematic checklist that has been prepared previously. Recommendations will be issued as part of these inspections, which will then be transformed into corrective actions or preventive measures within the OH&S System. They are logged into the computer program that manages corrective actions and preventive measures "SIAACOP" (Corrective Actions and Preventive Measures Management System).

The company also has a position on staff known as "Risk Managers" who have received specialized training to identify hazards as well as on the methodology to assess risks. The risks are logged into a computer program known as "SICCOD" (Document Management System).

On the other hand, Block number 14 entitled "Design Safety" takes identifying hazards and risk assessment into consideration for each new project. Blocks number 18 "Change Management" and number 17 "Supplies", deal with safe design regarding structural modifications, technological change and supplies, respectively. Emphasis is placed on the fact that any modification or new project should include prior hazard identification and a risk evaluation process. Likewise, procurement requires clear specifications for any purchase and should be subject to the risk analysis and should be evaluated following Occupational Safety and Health standards.

- ✓ Identifying legal requirements

Block number 5 covers the OH&S System issue on "legal obligations". A review has been made of all local legislation pertaining to Health and Occupational Safety, including the Conventions of the International Labor Organization (ILO) that have been ratified by Guatemala, as well as the ILO´s recommendations that have yet to be ratified by Guatemala.

There is a specific procedure in place (OHS-CP-UG-PR-05) which was developed jointly by both the Occupational Health and Legal departments to identify and access the legal requirements applicable to the company's performance in the areas of health and Occupational Safety. A procedure has been put in place to identify and monitor the degree of compliance with applicable legislation, local as well as international, as well as best practice in the cement industry, ILO agreements, etc. to ensure compliance with all applicable requirements. In cases of non-compliance, an action plan is developed. Likewise, hard copies of the legislation applicable to the company are on file. A matrix is in place to perform comparative analysis between applicable legislation to the company and responsible compliance with said legislation. .

According to information provided by the head of the Occupational Health Unit, there is no legislation in effect at this time regarding Health and Occupational Safety which is in a state of non-compliance. Similarly, the head of La Pedrera Human resources division has stated that the company has never faced legal action in this area from an employee.

- ✓ Internal Regulations on Safety and Hygiene

Internal Safety and Hygiene Regulations are in place per se, and a pocket edition has been printed up entitled "Basic Standards for Accident Prevention". This booklet is given to each employee during their initial company orientation process. It covers the following issues:

- Role of security agents
- Order and Cleanliness;
- Hand tools;
- Personnel and Material Transportation within the Facility;
- Demolition and Debris Disposal;
- Excavations;
- Scaffolding;
- Portable ladders;

- Working at Heights;
- Elevating loads;
- Mobile equipment and cranes;
- Electrical currents;
- Soldering and metal cutting;
- Welding;
- Working and handling explosives, and,
- Infractions and sanctions.

Community Health and Safety Issues:

The Office for Community Communication will be responsible to anticipating and reporting on any problem pertaining to health and Safety that the cement works may cause for members of neighboring communities. The Office will be staffed by professionals and technicians with expertise in social communication. The Office will prepare a program covering information, dissemination and political and social aspects of the project as they relate to neighboring communities. A phone number and complaint log will be provided. In addition, since Cementos Progreso is associated with the Swiss Holcim group, it must also comply with requirements originating from that relationship in addition to complying with principles of corporate social responsibility.

13.2 Follow up and Environmental Monitoring

In order to deal appropriately with environmental consequences generated by the construction and operation of the cement works, a program to monitor the impacts has been proposed. The program will verify the measures that are required for the prevention, mitigation and/or correction in compliance with expectations. Therefore, the monitoring will encompass regular evaluations of the mitigation and/or correction measures taken to ensure the appropriate implementation of the project and its environmental compatibility with the surroundings.

The actions are listed according to frequency during which they should take place (monthly, after every rainfall, continuously, etc.). Table 13.4 summarizes the items to be monitored as well as the time frames.

If the monitoring program results in identifying a measure that is not achieving the desired result, or is considered unnecessary, the monitoring plan should be as flexible as necessary in order to identify any new action required, as well as the environmental parameters to be used as reference points in order to effectively reduce the negative impacts on the environment.

Throughout construction of the facility, the Environmental Supervisor will work jointly with the contractor supervisor in being responsible for the monitoring and will be able to access professionals or off-site laboratories that will be able to carry out the foreseen actions.

Monitoring water, air, sound, biological and social qualities will be carried out by private laboratories and reputable professionals. The environmental supervisor will keep a daily log reporting the degree of compliance with measures included in the EMP and any other additional actions that have been carried out, as well as other pertinent incidents (spills, accidents, complaints, among others).

Throughout the operation of the cement works, the Plant Environmental Officer, in conjunction with the Plant Manager, will be responsible for monitoring the effectiveness of the measures covered by the EMP. They will also have access to technical professionals and offsite laboratories.

Table 13.4 Environmental Monitoring

Action	*Time Frame*
Monitor accurate implementation of the proposed environmental management plan in order to prevent, control, mitigate and compensate for the potential environmental impacts foreseen in developing the project.	Continuously; throughout construction and operation under the responsibility of the supervisor and the environmental officer, respectively
Review that the Safety and occupational health measures proposed in the respective plans contribute to prevent, avoid or reduce the risk of accidents or health issues. This implies controlling generation of dust, noise, workplace or traffic accidents, water and food quality, among others throughout the construction and operational stages.	Continuously; throughout construction and operation and under the responsibility of the environmental supervisor, the head of occupational health and the coordinator of industrial Safety, respectively
In order to prevent, reduce or avoid complaints from neighboring communities, provide follow up for communication and dissemination, considering the political and social impact within the area of influence. Check the entries in the complaint log as well as the response. Verify that the phone is in working order for receiving complaint calls.	Monthly; throughout the construction and operation under the responsibility of the supervisor and the environmental officer, respectively
In order to determine the concentration of fine particles and ensure that it remains within acceptable levels and below WHO (2005) guidelines, monitor dust generation blowing into or against the wind within property boundaries.	Quarterly, under the responsibility of an off-site lab during construction then twice yearly during operations
Monitor gas emissions from the kilns and ensure that concentrations remain within IFC guidelines (2006)	Twice yearly; under the responsibility during operations of specialized Cementos Progreso personnel who will have the necessary equipment

Action	*Time Frame*
Monitor noise level generated within property boundaries to verify that they remain within guidelines and below WHO limits.	Monthly; under the responsibility of an external lab during construction and twice yearly during operations
Verify that the protective curbs surrounding mounds of fine particles are in good condition and that the sedimentation tanks and filter sieves are unobstructed	Following every heavy rainfall; during construction and operation and under the responsibility of the supervisor

Action	*Time Frame*
	and environmental officer, respectively
Monitor water quality of the Pachum River, both upriver and downstream of the discharge originating from the cement works facility. Verify the presence of fine particles in streams and in the Pachum River.	Monthly; during the rainy season; under the responsibility of an external lab during construction and during the first year of operations
Monitor the quality of plant runoff and wastewater treatment	Twice yearly; under the responsibility of an external lab
Verify that no hydrocarbon spills take place in the workshops or other sites on the property	Daily; under the responsibility of the environmental supervisor during construction and monthly during operations under the responsibility of the environmental officer
Verify that solid waste is being classified, recycle inorganic waste and adequately dispose of organic waste on the property. Verify that solid waste is not burned.	Weekly; under the responsibility of the environmental supervisor during construction
Verify that timely maintenance is performed on the portable latrines placed near worksites.	Weekly; under the responsibility of the environmental supervisor during construction
Monitor the groups of biological taxonomy that have the following characteristics: i) Phenology or well known seasonality of the selected groups; ii) taxonomy that is well known in the country; iii) distinct habitat association; iv) susceptible to anthropogenic change.	Seasonal; under the responsibility of an external team of biologists
Monitor that the Pachum River riparian forests are conserved	Monthly; during construction and operations under the responsibility of the supervisor y environmental officer, respectively
Verify that adequate plant and shrub cover are permanent around the property boundaries as well as in the areas not in use. Also review the areas that are landscaped to ensure the same situation.	Monthly; under the responsibility of the environmental supervisor during construction
Keep data on traffic accidents involving animals	Daily; under the supervision of the environmental supervisor during construction
Check traffic signs to ensure that they remain in good condition and in place on access roads and property roadways (post speed limits, caution, etc.)	Weekly; during construction and operations under the responsibility of the supervisor and the environmental officer, respectively

Action	*Time Frame*
Verify that the access road approaching the plant has adequate maintenance to reduce the likelihood of traffic accidents	Weekly; during construction and operations under the responsibility of the supervisor and environmental officer, respectively

Verify that all employees use personal protection equipment	Continuously; during construction and operations under the responsibility of the supervisor and environmental officer respectively
Verify that the extinguishers are loaded and that portable first aid kits are complete based on suggested contents.	Monthly; under the responsibility of the supervisor and environmental officer; a company will be hired to verify the extinguishers are in working order

Tables 13.5a through 13.5d describe the guideline limits set by the International Finance Corporation (IFC 2006) recommended for cement production which are applied to monitor air emissions, runoff, energy and resource consumption, production of emissions and waste and consumption and heat generation at the new facility in San Juan.

Table 13.5a Air Emission Levels for Cement works

Parameters	Unit	Guideline Level
Dust (new system)	mg/Nm^3	40
Dust (from other sources – clinker cooling-cement grinder)	mg/Nm^3	50
SO_2	mg/Nm^3	400
NOx	mg/Nm^3	800
HCI	mg/Nm^3	10
Hydrogen Fluoride	mg/Nm^3	1
Total organic carbon (TOC)	mg/Nm^3	10
Dioxins and furans	mg TEQ/Nm3	0.1
Cadmium + Thalium (Cd + Tl)	mg/Nm^3	0.05
Mercury (Hg)	mg/Nm^3	0.05
	mg/Nm^3	0.5

Total metals = arsenic, lead, cobalt, chrome, copper, manganese, nickel, vanadium and antimony. All levels measured at 273^{o} C, 101.325 KPa, 10% O2 and dry base.

Table 13.5b Concentration in Cement works runoff / 1

Parameters	Unit	Guideline limits
pH	-	6 - 9
Total suspended solids	mg/l	50

/1 = In addition, compliance will also follow guidelines from the Ministry of Environment and Natural Resources, Decree 236-2006 Regulations for discharge

Table 13.5c Resource and Energy Consumption

Consumption per Product Unit	Unit	Values
Fuel energy- cement	GJ/t clinker	3.0-4.2
Electricity-cement	kWh/t cement equivalent	90 - 150
Electricity – clinker grinding	kWh/t	40 - 45
Substitute raw material used in clinker production	%	2 – 10
Substitute raw material used in cement production	%	0 – 70/80 with high homo = 0 – 30 with volcanic ash

Table 13.5d. Producing Emissions and Waste

Generation per Product Unit	Unit	Values
Waste	kg/t	0.25 – 0.6
Emissions:		
Dust	g/t cement equivalent	20 - 50
Nox	g/t cement equivalent	600 – 800
SOx	Kg/t	0.1 – 2.0
CO_2:		
origination from oxidation	Kg/t	500 - 500
from fuel	Kg/t cement equivalent	150 – 350

Table 13.5e Consumption and Heat Generating Capability

Kiln	Heat Consumption (vapor) (MJ/t clinker)	Maximum Production Rates (t/day)
Preheater and pre-calcinator (PHP)-3-6 stages	3,000 – 3,800	12,000

13.3 Environmental Recovery Plan for Closedown or Abandonment

The time frame for cement works operations is a minimum of 25 years, but experience in other Cementos Progreso facilities in Guatemala indicated that the time frame could be extended. San Miguel has been in operation already for 34 years and La Pedrera, for more than 100. Therefore, preparing an Environmental Recovery Program for such a long-term situation could be somewhat precarious. Nevertheless, it is important to note that throughout the operation of the new facility, every attempt will be made to avoid environmental liabilities for a future closedown and ensure replanting and reforestation. This is all in addition to all efforts to prevent, control and counteract environmental impacts. The following list includes specific guidelines to ensure environmental recovery of the land or define other areas that remain untouched by the project for their use as receptors for compensation measures.

The environmental recovery plan begins, for all intents and purposes, when the mitigation, prevention and/or compensation measures are implemented from the initial construction of the facility. Even more so at the pre-construction stage when the site is selected and it is ensured that it remains out of sight of the neighboring communities. The objective of the plan is to return the land to its original vocational use (forestry) or to another type of use based on the requirements of the surrounding areas (reforestation) or to future development plans by the owners of the project. In the first instance, the inclination would be towards an ecological recovery of the land (recovering flora, trees and shrubs); the second instance would be geared

towards new uses for the land which could range from agricultural applications to urban or recreational developments, to name a few.

The final stage of the Closedown and Environmental Recovery Plan for the area must be prepared a year prior to shutting down the project. For that reason, the specific actions proposed under the Monitoring Program and the implementation of the EMP gain even greater significance. Cementos Progreso, S.A. has continuously reforested various sections of the property on which the San Miguel facility is located. It, therefore, has experience that can be applied to reforesting any necessary areas on the San José Ocaña property. In addition, the San Jose Ocaña property has a forestry management plan in place that has been authorized by the National Forestry Institute (INAB). This can be understood to mean that there are no major obstacles to recovering the land that will be affected by the cement works (64 hectares, 26 of which will be built upon).

The following items describe some of the measures to be applied for recovering the land when the closedown date is approached.

- Replanting can be an immediate recovery measure for the fragile landscape. For that reason, reforestation with native species already found on the property; preferably fast-growing species. It is recommended that trees be planted along the inner property lines surrounding the facility. Likewise, native grasses can be planted on the land that is not being used by the cement works. This will improve the setting, the landscaping and the use of the facility.

- There will be a negligible amount of solid waste generated since what isn't recycled will be used as alternative fuel for the kilos. .

- If at all possible, dismantle the cement works during the dry season.

- Fill all the holes, ditches, wells or any other excavation that could present a danger for future accidents on the site.

No doubt, an effective control system, along with technical and environmental follow up within legal parameters, will avoid inappropriate management of the area within the facility. By keeping within these parameters, therefore, the activity is not perceived as having as much of an impact on future uses of the soil. In this manner, the governmental controls (Ministry of Energy and Mining and the Ministry of the Environment and Natural Resources, primarily) will exercise their authority and carry out regularly-scheduled inspections of the cement works while in operation, in order to verify that its management is adequate and follow up with the Management and Environmental Monitoring Plan, primarily.

The project to be developed is known as Cementos Progreso, San Juan Cement works, and will comply with legal parameters as well as technical and environmental ones. It will seek a balance between the investment to be made and the environmental and engineering measures that will be implemented throughout its operation.

14. RISK ANALYSIS AND CONTINGENCY PLANNING

I. Identified Risks

One of the threats to the project that may evolve into a risk is the population groups that systematically oppose mining, making no discrimination between metallic and non-metallic mining. These groups could organize protests or demonstrations that could hinder or delay the opening and operations of the project. This situation is despite the fact that the project will be located on private property and despite that it has complied with procedures to obtain all required permits (Ministry of Natural Resources, Ministry of Energy and Mines, San Juan Sacatepequez Municipality).

In this sense, Cementos Progreso, S.A. should proceed with caution and with careful attention to precise compliance with environmental policy and the EMP, as well as to responding to the concerns expressed by local populations. A strategic information and communications campaign describing the project is important and may be instrumental in ensuring that perceptions of the inhabitants in neighboring communities be based on real and coherent facts.

From the perspective of natural and anthological threats, the main concern would be earthquakes affecting the project. Nevertheless, the fact that the project is located in forested areas means that fires originating from both the external surroundings as from within the project itself, could also constitute possible risks. In addition, hydrocarbon waste spillage and other chemical incidents pose risks. The area that has been selected for the project site, and the surrounding land, do not pose a risk of floods or landslides.

14.1 Contingency Plan

A contingency plan in the face of an emergency of any type is described below as well as in Appendix 20, which breaks down specific plans for earthquakes, fires, chemical spills, and bomb threats. These plans were based on those that are in place at the cement works in San Miguel, Sanarate.

Objective:
The objective of the plan is to have appropriate procedures in place to control emergencies that may take place within the San Juan facility. The scope of the plan encompasses all areas on the property.

Emergencies:
Emergencies are classified in such a way as to have a different priority within the facility based on the type of occurrence requiring an emergency response; i.e., natural disasters (tremors or earthquakes, hurricanes), fires and large-scale accidents, fuel and chemical spills. Any one of these situations would be considered an emergency if posing a threat to human

life, to property or if generating negative impacts on the environment. The emergencies are based on a three-alert system.

Emergency Code 1:

Code 1 will be used in the facility when an accident takes place that could put lives in danger or threaten structural damage, equipment damage, processing material or fuel spills. In addition this code will be in place on occasion of natural disaster (earthquakes, tremors or hurricanes). The facility should be evacuated either partially or in its entirety. Code 1 type emergencies require the following ABC procedures:

Procedure"A":

- Communications equipment will be set on receiving, awaiting instructions. Procedures handbooks should be reviewed;
- Communications will fall under the control of the communications team. Should external assistance be required, an outside emergency telephone list will be available;
- All incoming calls requesting information will be handled by the communications team, and
- When the emergency has concluded, the communications team will resume normal communications conditions with in the facility as well as externally.

Procedure "B":

- The logistics team will be on standby alert within the warehouse area;
- The team will ensure supplies of any materials or equipment that may be required to deal with the emergency, and
- Once the emergency has concluded, the team will ensure that any material or supplies that were not required be returned to the warehouse.

Procedure "C":

This procedure applies exclusively to safeguarding the premises in cases of emergency.

External:

- Ensure that the perimeter of the facility be strictly controlled in case of emergency.
- Avoid the entry of unauthorized persons, specifically to the site of the emergency. Only authorized personnel may enter with prior clearance from the Emergency Director, the Emergency Coordinator or the person designated in their stead.

Internal:

- A safety barrier should be erected beyond which persons not involved in the emergency or support teams should not approach, increasing their risk; and ,
- Coordinate orderly access for all vehicles that require entry into the emergency area.

Emergency Code 2:

This code will be in place when an accident takes place that could cause destruction of property or that could halt part of the cement works without necessarily affecting the entire operation. The emergency director will determine whether evacuation of the area is required and whether procedures ABC described above should be followed.

Emergency Code 3:

The factory will assume Code 3 when an accident takes place that could cause minor property damage or could require interrupting some of the activities within the facility. An emergency can begin as Code 3 and jump to Code 1 or it could be declared a Code 1 emergency from the onset.

Organization:
The organization in place to cope with an emergency will be a team comprised of the Director, the Coordinator, the Support Group and the Brigade.

Emergency Group Director:
The group will be comprised of several people; each of whom has a hierarchical position to ensure evacuation of the facilities at a given moment where great risk is foreseen. This group will include the manager and the plant's division supervisors.

Emergency Director:
The plant manager or, in his stead, the engineer on duty, will become the emergency director. The emergency director will appoint a deputy to cover when he is away from the premises. During night shifts, the night shift engineer on duty will assume the role of both director and coordinator.

Emergency Coordinator:
The emergency coordinator will be in charge of facilitating an immediate response to the emergency using all resources available to him in order to avoid the loss of human life or property damage. In addition, he is responsible for support to the evacuation route monitors.

Support Group:
The support group is made up of:

- Quality control supervisor;
- Kiln supervisor;
- Cement grinder supervisor;
- Mix grinder supervisor;
- Electricity supervisor;
- Mechanics supervisor;
- Instrumentation supervisor, and
- Optimization supervisor.

Emergency Brigade:

The emergency brigade will be comprised of 25 people per shift. The will all be trained in prevention and fire fighting, first aid, evacuation and hazardous material emergencies, among others. The in-house brigade will include:

- Chief of emergencies;
- Chief of intervention;
- First line intervention team;
- Second line intervention team;
- Alarm, evacuation and rescue team, and
- First aid team

Communications:

When a Code 1 emergency is declared, the support team will take over the plant's reception lobby as command center. The main purpose will be to efficiently manage all communications within the facility as well to external sources. The emergency director will be provided with constant updates and external emergency response teams will be provided with support as needed. The support team will include:

- Plant human resources manager;
- Plant receptionist, and
- Plant Manager's secretary.

Logistics:

Upon declaring a Code 1 emergency, the support team will be stationed in the material warehouse in order to be able to provide any supplies that may be required to contain, control or correct the incidents that are contributing to the emergency. This group will include:

- Warehouse Manager, and
- Two warehouse staff.

Watch guards:

When a Code 1 emergency is declared, the watch guard team will take over strict control of access and departure points throughout the facility. The watch guard manager will be in close communication with the emergency director and with the emergency coordinator to ensure his personnel's support for barricades, traffic control, restricting access, etc. The watch guard group will include:

- Chief of watch guard staff
- Watch guard supervisor
- All guard staff.

Evacuation Routes:

Evacuation routes will be designed based on emergency code and category.

15. ENVIRONMENTAL SCENARIO CHANGED BY THE DEVELOPMENT OF THE PROJECT, WORK, INDUSTRY OR ACTIVITY

This Chapter analyzes the environmental quality of the area of the Project before being implemented, and presents a forecast of the results of the development of the Project.

A. Current Environmental Status in the Area of the Project

The general environmental status analysis of the concession area of 2,000 hectares (the cement facility will use a surface of 64 ha.), before developing the Project activities has already been put forward in depth in Chapters 8, 9, and 10 of the baseline, and partly also in Chapter 12 of Impact Identification. Table 15.1 summarizes the environmental status and the current social conditions in the area of the Project, which may be summarized as follows:

Air quality in the zone is good, and noise levels are low. Dust, gases, and noise sources are the roads within the property, and the dirt road between Cruz Blanca and Las Trojes, the truck engines during forest management, and of the vehicles in the road between Cruz Blanca and Las Trojes, burning of domestic garbage and weeds.

Surface hydric resources are not used for human supply, and present a certain degree of bacteriological pollution, because persons wash cloths in the water sources of the inflow ravines of the Pachum River. Groundwater hydric resources are used through mechanic wells to supply the communities in the area.

In the area of the Project land vocation consists of forest management and preservation, and the current main use of the land is according to its vocation because the San José Ocaña property is a property with forest management. A Forest Management Plan has been approved by the NFI (National Forest Institute) and recently approval to change the use of soil has been requested.

There is no report in the concession area and therefore, in the site, or in protected areas or in fragile ecosystems. However, the gallery forest of the Pachum River benefits the preservation of bird, amphibious, reptiles, and mammal species.

The nearest communities to the project are the San Antonio Las Trojes and Cruz Blanca Villages. The financial condition of the community of San Antonio Las Trojes is precarious, because agricultural activities do not provide enough income. Despite most of the persons interviewed in the neighboring communities consider that the construction and operation of the cement facility will bring tangible benefits such as job opportunities and demand for services, there is concerned about the rumors heard on the environmental effects may cause the cement facility.

Table 15.1 Description of Environmental, Socioeconomic, and Hazardous Aspects in the Area of the Project

Assessment Aspects	Current Condition	Forecast
Environmental Quality		
Noise levels	Noise levels are low, because there are not any loud activities.	Despite mitigation measures, noise levels will be higher than the current noise levels, but will be below the value guide provided by WHO.
Air quality	Air quality is good, because there are no relevant emission sources, except in the proximities to the low-quality dirt roads, which create dust caused by traffic.	Despite prevention and mitigation measures, air quality will be below the current quality, but will be below the value guide provided by WHO. Roads will be improved.
Lands	Forest vocation lands with tree coverage.	64 hectares will be used; 26 of which will be utilized for constructions, and upon the abandonment stage would go back and have tree coverage.
Surface Waters	Water of the Pachum River is not used for human supply due to its seasonality and poor bacteriological quality.	The Pachum River system will change because it will drain water throughout the year as a result of treated wastewater discharge. Dragging fines to the river will be avoided. The wastewater treatment plant effluent will comply with Decree 236-06.
Groundwater	Groundwater is used for human supply and is high-quality water.	Soil weatherproofing will not affect the local hydric recharge, and the demand will not affect the current performance of the mechanic wells available in the communities.
Habitat	The gallery forest of the Pachum River preserves bird, amphibious, reptiles, and mammal species, as well as flora species.	The gallery forest will be preserved, although fauna will be affected by the noise.
Global Assessment =	The environmental quality of the Project site is good, due to a good air quality, a good preservation condition of the gallery forest of the Pachum River housing certain fauna and flora diversity and an adequate land use (forest management); however, water quality of the Pachum River is bacteriologically polluted.	Noise levels will be higher and air quality will be lower than current conditions, but will be below the limit values provided by WHO. The area will have environmental management, in addition to the current forest management by preserving the gallery forest and preventing bacteriological pollution of the Pachum River and groundwater overexploitation.
Social Conditions		
Noise and dust effects	Low noise and dust levels due to low vehicle traffic.	Increase of the current noise and dust levels, due to an increased vehicle traffic. There is a project to build a new road which will not pass through populated areas.
Vehicle traffic increase	Vehicle accidents occurrence is low due to low traffic.	Horizontal and vertical clearance traffic signs will be provided to prevent accidents.
Income	Low family income in the area. People are mainly dedicated to agriculture.	Income will increase for the persons trained for the new direct or indirect jobs.
Training, organization, and	Low formation and organization levels	Training and organization will be promoted,

communication		with a fluid communication with the local authorities and communities.
Global Assessment =	Precarious social and economic conditions of the people in San Antonio Las Trojes.	Families of regular workers and contractors will improve their social and economic conditions. .
Conclusion =	**The site has good environmental quality and the social and economic conditions of most families in the community of San Antonio Las Trojes are precarious.**	**Environmental quality will meet the value guides issued by the Ministry of Environment and Natural Resources, WHO, and WB; and the social and economic conditions of the families, the city, and the region will be improved.**

On the other hand, Cementos Progreso has two cement facilities operating several years ago, with the most recent cement facility doing business for 34 years, and therefore, has been strengthening the Environmental Division in order to satisfy all national legal requirements, but also Holcim's requirements. Below is a list of the environmental programs currently carried out in the cement facility San Miguel, Sanarate: Blue Sky Project; Quarry Rehabilitation; Integral Waste Management; Mixed Cement Manufacturing; and Use of Alternative Fuels.

	Environmental Program			
Initiatives	**01. Blue Sky/5Ss**	**02. Quarrel Rehabilitation**	**03. Waste Management**	**05. Green Cements**
Efficiency in the use of resources				✓
Clinker Factor Reduction				✓
TSR Increase				✓
Chimney Monitoring System	✓			✓
5S's Implementation	✓		✓	
Quarry Rehabilitation		✓	✓	

Below please find the way the different areas of the cement facility in San Miguel, Sanarate, are involved in each of the defined environmental programs, which shows the development standards available at Cementos Progreso in meeting domestic and international requirements.

	Environmental Program			
Areas	**01. Blue Sky/5Ss**	**02. Quarrel Rehabilitation**	**03. Waste Management**	**05. Green Cements**
Quarry	✓	✓	✓	
Crushing	✓		✓	✓
Raw flour	✓		✓	✓
Clinker	✓		✓	✓
Cement	✓		✓	✓
Dispatches	✓		✓	
Generation	✓		✓	
Limekiln	✓		✓	
Storeroom	✓		✓	

Laboratory	✓		✓	✓
Management	✓		✓	
Third Parties	✓		✓	
General S.	✓		✓	
Shops	✓		✓	
Civil Works	✓		✓	
Optimization	✓			✓
Alternate Comb.	✓			✓
Environment	✓	✓	✓	✓
Occupational Health	✓		✓	
SAC				✓

15.1 Environmental Quality Forecast of the Area of Influence

Based on the current environmental location of the area of influence of the Project described in the above paragraph and summarized in Table 15.1, an environmental quality analysis is made which will probably have the area from its implementation, taking into consideration the measures to apply from the Environmental Management Plan and from the Contingency Plans, described in Chapters 13 and 14 above, respectively.

The third column of Table 15.1 above forecasts the environmental quality upon the operation of the cement facility, summarized as follows:

The Project development means job opportunities for some neighbors of San Antonio Las Trojes and of other villages and from the municipal district of San Juan Sacatepéquez. It will also create businesses, mainly in the area of influence, with the income received by the regular workers and by the contractors. Besides, the availability of processed aggregates and their sale in the area will certainly in part reduce the price of these supplies such as building materials in this part of the country, generating a benefit for the region as well.

Dust and noise will increase and will continue for the operation of the cement facility, especially in the area of direct influence of the Project (64 hectares), but will not affect any community because the cement facility is located 2 kilometers from the San Antonio Las Trojes village. There will be no dust when building the new road, and noise will not be relevant because the road will not pass through any populated area. Cement transportation will bring truck movement, which will strengthen the occurrence of road accidents. Stringent road signs and traffic management within the area of the Project must be implemented, as in the access road to the property. As mentioned before, the road to be built will be subject to a specific EIA in addition to this assessment.

Moreover, the cement facility will be camouflaged from the San Antonio Las Trojes and Cruz Blanca villages, as well as from the remaining neighboring communities. The gallery forest of

the Pachum River, which harbors several endemic fauna and flora, will be preserved; and actions will be implemented to preserve the Pachum River from physical, chemical, and bacterial pollution. Groundwater pumping to supply the cement facility demands will not cause any hazard to the mechanic wells available which provide water to the neighboring communities.

The population perceives there will be some change of the environment which will affect the social life of the immediate, even regional environment; although income from the direct or indirect jobs of the members of the neighboring communities will have a material positive effect on the families.

The opinions given by the surveyed population are a reflection that the project will cause certain changes in some environmental aspects, part of which may be, on one hand, the opposition to the "mining" development in the area, and on the other, the creation of expectations for an improved standard of living of the population by increasing the family income of the workers with the direct and indirect activities to be created by the development of the Project. Therefore, a relevant aspect considered by Cementos Progreso S. A., is having fluent and permanent communication with the local authorities of the neighboring communities.

Some groups in the country oppose metallic mining activities. The relevance of the systematic opposition of these groups and that some sectors of the population do not seem to differentiate non-metallic mining activities from metallic mining activities. This situation may limit the development actions of the Project framed within the right of the company to develop the project in a private piece of land, which will use state-of-the-art technology for cement manufacturing, and will represent a benefit for the region.

15.2 Summary of Environmental Commitments, Mitigation and Contingency Actions

Part of the regulations governing the presentation of the environmental impact assessment indicates that the owner or Project Developer must subscribe an "affidavit" accepting to fulfill the recommendations and indications in the pertinent EIA, this commitment has a legal binding which may be penalized even with jail, therefore, environmental commitments are clearly defined in the EIA, in the mitigation measures as part of the Environmental Management Plan and the contingency plans on occupational health and safety. Attached to the EIA is the affidavit.

Table 15.2 below summarizes the environmental commitments established in the EMP, and the Risk Analysis and Contingency Planning, establishing the environmental general outlines that will govern the Project development in its most relevant stage (cement facility operation) according to environmental factors.

Table 15.2 Summary of Environmental Commitments

Means	Impact	Recommended Action	Officer in Charge
Environment	Noise caused by the construction machines and equipment, particularly during earthworks	Compulsory use of ergonomic ear plugs for the machine and equipment operators and assistants; and, Timely and adequate maintenance of the machinery and equipment engines, including trucks.	Project Manager, Contractors and Occupational Health and Safety Supervisor
	Noise caused by the equipment in the cement facility and by truck movement	The cement facility components will be the best technology available; noisy equipment will be sealed, and workers will be in noise-isolated cabins, and will use personal protection gear.	Plant Manager and Occupational Health and Safety Supervisor
Air quality	Dust generated mainly during earthworks and excavation; gas emissions from combustion engines	Watering the access road with sprinklers and tanker; Cover the trucks to prevent the sand from falling or straining; and, Timely and adequate maintenance to machinery and equipment engines.	Project Manager and Contractors
	Dust and gas emissions to the environment created during the operation	Kiln, cement mill, and coke mill cleaning filters. Sweeper; and, Annual monitoring of gas emissions with the specialized equipment to be acquired.	Plant Manager and Environmental Officer
Surface and ground water	Unsuitable disposal of fines and wastewater to the inflow ravines of the Pachum River	Placing small bulwarks or retaining walls around the piles of materials; Cover the stacked material to prevent it from being washed or dragged by substantial rain; Properly waste material disposal; Build in the camp, and give maintenance to, a wastewater treatment plant.	Project Manager and Contractors
Surface and ground water	Hydrocarbon waste spills	Avoid oil spills on the floor from oil changes in machinery and equipment, and if any spills occur, recover and dispose of such oil spills in drums for subsequent incineration, in the San Miguel kiln, or recycling.	Project Manager, Contractors and Environmental Supervisor
	Solid Waste	Classify solid waste, bury organic waste in a site within the land, and the rest recycle and co-process in the San Miguel kiln; and, Prohibit burning solid wastes.	
	Unsuitable disposal of fines and wastewater to the inflow ravines of the Pachum River	Place filtering screens for solid retention and give maintenance after each substantial rain; and, Maintenance to the wastewater treatment plant (wetland)	Maintenance Supervisor and Environmental Officer
	Groundwater pumping	Exploitation will be performed according to the sustainable performance in the three wells	
	Hydrocarbon and chemical substances waste spills	Prevent spills; and, Clean spills with a special machine.	
	Solid Waste	Classify solid waste, produce compost products with organic waste, recycle and co-process in the kiln; and,	

Means	Impact	Recommended Action	Officer in Charge
		Prohibit burning solid wastes.	
Soil and subsoil	Loss of land for removal to build the platforms	Store and protect the stripped topsoil for subsequent use; and, Restore the land of the works by revegetation and reforestation (abandonment stage).	Project Manager; Contractors and Environmental Supervisor
	Spills of hydrocarbon wastes	Avoid oil spills on the floor from oil changes in machinery and equipment, and if any spills occur, recover and dispose of such oil spills in drums for subsequent incineration, in the San Miguel kiln, or recycling.	
	Liquid Waste	Build a wastewater treatment plant and provide appropriate maintenance.	
	Solid Waste	Classify solid waste, bury organic wastes in a site within the facility, recycle or incinerate the rest in the San Miguel kiln; and, Prohibit burning solid wastes.	
	Hydrocarbon waste and chemical substances spills	Prevent spills; and, Clean spills with a special machine	Maintenance Supervisor and Environmental Officer
	Solid Waste	Classify solid waste, produce compost products with organic wastes, recycle and co-process the rest in the kiln; and Prohibit burning solid wastes.	
	Liquid Waste	Maintenance to the wastewater treatment plant (wetland)	

Means	Impact	Recommended Action	Officer in Charge
Flora and Fauna	Tree and Bush Cover Cutting	Revegetate and reforest the land upon the closing of the cement works, using bushes and gramineas of local species; and, Create live fences in the limits of the cement facility.	Project Manager and Environmental Officer
	Presence of personnel in the area	Ban employees from hunting wild fauna.	
	Dust generation; and noise generation	Implement noise control measures indicated above; and, Implement noise control measures indicated above.	
	Truck traffic	Establish speed limits in the road to the cement facility	
	Fauna and flora	Preserve the gallery forest of the Pachum River	Plant Manager and Environmental Officer
Cultural and historic resources	Trace destruction during earthworks	If during the land preparation, earthworks or excavations of the foundations of the edifications any archeological traces are found, the work will be stopped until IDAEH issues an opinion that it may continue.	Contractors and Environmental Supervisor
Landscaping	Buildings and components construction works of the	The cement facility location is not visible from the San Antonio Las Trojes village and the remaining	Project Developer

	facility	neighboring communities.	
Safety and Occupational Health	Risk of occupational accidents	Disclose the measures of this EMP to the local employees; Give regular lectures on occupational safety and Basic health standards to all personnel; Provide training on a regular basis both in the administrative area and in the technical area; Lecture workers on occupational safety awareness before starting operations; Adopt, as a standard procedure, the compulsory use of the minimum personal protection gear according to the activities to be carried out; penalizing any workers who do not use such protective gear; Monitor noise and dust to avoid any trouble to workers; Regular maintenance should be given to the equipment for safety and to minimize noise; and, Hold workers responsible for the good use and care of the personal protection gear; if misplaced or destroyed, workers must report it as soon as possible for replacement;	Project Manager, Contractors and Occupational Health and Safety Supervisor

Means	**Impact**	**Recommended Action**	**Officer in Charge**
Safety and Occupational Health	Risk of occupational accidents	Implement the Occupational Health and Safety Program; Appropriate and preventive road signaling to and within the cement works; Give induction courses to personnel on occupational safety; Assign proper loading areas.	Occupational Health and Safety Supervisor
Social and economic means	Incentive to local economy	Give jobs preferably to persons from the nearby communities.	Project Manager and Human Resources Manager
	Local perception on the project	Community members and local authorities were interviewed; Maintain fluent communication with the local authorities; and, Disclose a cement facility disclosure program to have an harmonic operation with the neighboring communities.	
Natural Phenomena	Earthquakes, fire, and storms.	Several actions provided in the Contingence Plan.	Project Manager, Contractors and Environmental Supervisor; and, Plant Manager, Occupational Health and Safety Supervisor and Environmental Officer
Risks from human activities	Fire, spills, and accidents	Actions provided for in the Occupational Health and Safety Program and Contingency Plan.	Project Manager, Contractors and Environmental Supervisor; and,

			Plant Manager, Occupational Health and Safety Supervisor and Environmental Officer

5.3 Environmental Policy of the Project

Cementos Progreso, S. A., the Project Promoter, is a company experienced in cement manufacturing, because it has manufactured cement during 107 years now at the La Pradera zone 6 property, in the City of Guatemala and during 34 years at the San Miguel property, in Sanarate, and is aware of its obligation to abide by the laws of the country, and to take good care of natural resources and the environment, because the land resource is the raw material of its business. As mentioned before, observance of the current regulations in the country on environment protection, natural resources, cultural heritage, and the employees' health, will be part of the environmental policy of the Project.

Cementos Progreso, S. A., practices the principle that: "Human beings are the center of sustainable development. Human being has the right to a productive and healthy life in harmony with nature"; and that "Environmental protection must be an integral part of the development process to achieve a sustainable development"

Cementos Progreso, S. A., will direct its operations, practically and operationally, to preserve and ensure the safety and health of its employees, contractors and any persons who may have been present in the operations area of the cement facility, as well as to take care of the environment through good engineering practices, behavior of its employees, and the environmental recommendations given through environmental management tools, as this EIA.

The Environmental Impact Assessment of the cement facility, attempts to establish a balance between the development of human activity and the environment, but does not intend to avoid development with financial benefit for the owners, who act in this case as investors. Preserving ecosystems, landscaping and territory resources means extracting the production of goods and services with a tolerable alteration without changing the essence which may have a material adverse effect mainly on the human being. To this effect, "preserve" means making good use.

Cementos Progreso, S. A., accepts the responsibility of the Occupational Safety, Health, and Environment Program, and with its "actions" and "policies" seeks to convey to all its employees, as a commitment to the human being and their environment. All Cementos Progreso employees are responsible for cooperating in implementing all aspects of the Occupational Safety, Health, and Environment Program, in order to prevent occupational accidents and making good use of the resources used in its operations, whether natural and processed resources.

And last, but not least, Cementos Progreso will have a corporate social responsibility plan addressed to the neighboring communities. The company, through the Information Office to be installed in the cement facility, will make sure good relationships with the neighboring communities are maintained.

Cementos Progreso, S. A., aims its general and environmental management policies, understanding development in terms of improving the standard of living of the persons it interacts. Below is a description of the environmental policy on which Cementos Progreso will aim the activities of the Project.

ENVIRONMENTAL POLICY OF CEMENTOS PROGRESO, S.A.

We are committed to a continuous improvement of our environmental performance.

Our support is:

- **An Environmental Management System.**
- **Training and Awareness of our Staff.**
- **Efficient and rational use of our supplies, and, wherever possible, the replacement of non-renewable natural resources for alternative materials.**
- **Environmental impact prevention of our activities.**
- **Compliance with the Law and with Environmental Requirements.**
- **Good relationship with the interested parties**

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17. APPENDIXES

Appendix 1: Notarized documents of the Project Promoter
Appendix 2: Notarized documents of the company conducting the EIA
Appendix 3: Resolutions issued by the Ministry of Environment and Natural Resources
Appendix 4: Drawings of the San Juan Cement Facility
Appendix 5: Application filed with the Mayor of the Municipal district of San Juan Sacatepéquez and to the Guatemalan Highway Administration for the amendment of 387.91 m of the dirt road stretch between San Juan and San Antonio Las Trojes villages, from Km 8+532.32
Appendix 6: Traffic Report in the San Juan Sacatepéquez, Cruz Blanca and Las Trojes stretch
Appendix 7: Report on the Hydrogeological Assessment of the Area of Influence of the Project
Appendix 8: Air Quality Report, conducted November 23 and 24 2006, at the site of the Project, and in the backyard of a house at the San Antonio Las Trojes village
Appendix 9: Biological Diversity Report in el area of the Project
Appendix 10: Certification issued by CONAP that the area of the Project is off the Protected Area
Appendix 11: Social Investigation Report on the cement facility
Appendix 12: Certification issued by IDAEH that there is no archeological site in the area of the Project
Appendix 13: Application for Modification of the five-year Forest Management Plan in execution, Forest License No. DR-I-56-M-2006 of the San José Ocaña property and, application for change of land use in 127 ha in the San José Ocaña property
Appendix 14: Air Quality and Noise Report in the villages of Dolores and Sinaca, San Miguel, Sanarate, February 2 -3 2007
Appendix 15: Gas Emissions Quality Report of the kilns in the cement facility in San Miguel, Sanarate, conducted by ONSITE Laboratorios México
Appendix 16: Water Quality Report of the Wastewater Treatment Plant Effluent in San Miguel, Sanarate
Appendix 17: Social Investigation Report on Social and Environmental Impacts of the Operation de the cement facility in San Miguel, Sanarate
Appendix 18: Description of the Sleeve Filters
Appendix 19: Procedures for the Classification, Collection, and Internal Disposal of Solid Wastes
Appendix 20: Guidelines in case of Earthquake, Fire, Chemical Product Spills in Drums, Storage silo Spill, Personal Accidents, and Bomb Threats.