Executive Summary

1. INTRODUCTION

The present Executive Summary corresponds to the **"La Higuera Hydroelectric Project, Tinguiririca River, VI Region, and Chile"**. The project is located in the Tinguiririca river basin, approximately 70 km east from the city of San Fernando. The project will construct two run of river hydroelectric power plants; that is, they do not consider regulation reservoirs. The project as a whole will generate about 300 MW of power. The generated energy will be transported to the Central Interconnected System (SIC) by mean of a high-voltage 154-KV line. This line extends between the La Higuera Station and the city of San Fernando.

2. PROJECT DESCRIPTION

2.1 OVERVIEW

Identification of Project and its Holder	Name Holder	Hidroeléctrica La Higuera S.A.
	RUT*	96.990.050-5
	Legal Representative	Roberto Aigneren
	RUT	21.163.116-3
	Address	Avda. Andrés Bello 2687, Edificio del Pacifico, Piso 18, Las Condes
	Telephone – Fax No.	754 1000 946 1626
Objective	Develop a run of river hydroelectric project with two power stations. The project will make comprehensive use of existing water resources in the first section of the Tinguiririca river basin. The generated energy will be transferred to the Central Interconnected Electric System by mean of a 38 km long high voltage electric line between La Higuera Station and San Fernando.	
Political & Administrative Location	The project is located south of the road, which extends between the village of Puente Negro and the El Flaco Hot Springs. The project will develop in the administrative jurisdiction of San Fernando County, Province of Colchagua, VI Region Libertador General Bernardo O'Higgins.	
Location according to Current Territorial Planning	The project is located off the urban limits and is ruled by the San Fernando's Communal Regulation Plan.	
Access Ways	From Santiago, through Highway N° 5 to San Fernando. Then through route I-45 from San Fernando to the Project area.	

* National Revenue Service identity number

2.3 HUMAN SETTLEMENTS IN THE PROJECT AREA:

In the area where the project is located, there are no populated areas. The nearest centers are:

- The City of San Fernando located at 70 km to the north east of the project zone.
- Town of Puente Negro, the nearest centre, located 30 km to the north east of the project zone.
- El Flaco Hot Springs, a temporal vacations resort (open December-April), located 7 km to the south east of the Tinguiririca intake development.

2.4 ACCESS

The only, partially paved, public road to entry the project zone is route I-45 from San Fernando to El Flaco Hot Springs. Other ways to approach the project zone are private gravel roads, trails, or tracks within private land. Some of these ways allows for the transit of lightweight four wheel drive vehicles, but most of them are only appropriate for pedestrians or horses.

3. DESCRPTION OF PARTS, ACTIONS AND PHYSICAL WORKS

3.1 GENERAL CHARACTERISTICS OF THE PROJECT

The main characteristics of the project are:

Characteristics	Confluencia Station	La Higuera Station
Installed power	145 MW	155 MW
Design flow	50 m^3/s	50 m^3/s
Gross head	344 m	372 m
Turbines	2 Francis Vertical	2 Francis Vertical
Synchronic generators	2 Vertical synchronic	2 Vertical synchronic
Transmission line	154 KV	154 KV

3.2 DESCRIPTION OF PARTS, ACTIONS AND PHYSICAL WORKS

The project is designed with two run of river hydroelectric power plants. The different units that are part of this complex are included in the following list.

Confluencia Power Station

A) Water intake and conveyance system Portillo 1 (intake, spillway and headrace canal)
B) Water intake and conveyance system Portillo Azufre (dam, pondage, spillway, headrace tunnel)
C) Water intake Riquelme (intake and desander)
D) Water intake Tinguiririca (dam, pondage, spillway, intake, and desander)
E) Water intake el Ciruelo and La Gloria (intake and desander)

F) Tinguiririca headrace system (pressure culvert and headrace tunnel)
G) Confluencia headrace tunnel
H) Surge tank and valve house
I) Penstock
J) Confluencia powerhouse and tailwater canal
K) Substation and high voltage line (Confluencia-La Higuera)

La Higuera Station

A) Los Helados water intake and conveyance system (intake and desander)
B) Azufre water intake (dam, spillway, headrace canal)
C) Azufre conveyance system (canal and headrace tunnel)
D) Tinguiririca water intake (spillway, intake, desander)
E) Headrace Tunnel
F) Peak capacity Pondage
G) Surge tank and valve house
H) Penstock
I) La Higuera Powerhouse and tailwater canal
J) Infrastructure, preliminary and temporary works
K) Hydro mechanical and Electrical Equipment
L) Electric Substation
M) High voltage line La Higuera-San Fernando
N) Access roads

3.3 AMOUNT OF INVESTMENT

The project's total investment amount comes to approximately 250 million American dollars.

3.4 PROJECT'S SERVICE LIFE

Given its characteristics, the project's service life is indefinite. As to the possible early abandonment due to extraordinary causes, the owner of the project is required to re-establish the initial existing environmental conditions. It would be necessary to apply control procedures for circumstances that may give rise to adverse impacts after finishing the operations.

4. STAGES OF THE PROJECT

4.1 SURVEYING STAGE

The project's surveying stage has involved the search for information in literature with the same purpose fieldwork was carried out in several campaigns. The surveying stage related to the project's environmental aspects was carried out between December 2001 and December 2003. During this period project-related bibliography was collected and analysed. A detailed study of the Hydrology in the project's direct influence area was also performed. The results of this study allowed performing calculations in order to

define ecological flows. During this period and especially between February and May 2002 and December 2003 various fieldwork campaigns were made with the purpose of gathering the necessary information for the Environmental Impact Assessment (EIA), and Environmental Impact Declaration (High Voltage Electric Transmission Line La Higuera-San Fernando).

4.2 CONSTRUCTION STAGE

This stage is described below based on the activities required for the project's different units.

ACTIVITIES	DESCRIPTION
Works installation	Works will be specially installed for the units located in the project's area. Campsites are with offices, warehouse, machinery yard, chemical toilet services, drinking water facilities, parking zone, etc. There will be a larger campsite provided with aggregate, asphalt and concrete plants as well as potable water and wastewater treatment plants, cafeteria and workshops, as well as 2 or 3 smaller campsites with similar facilities.
Clearing & cleaning	Clearing of vegetation and cleaning is limited to the construction sectors. Unnecessary trees and bushes cutting will be avoided. The residues generated by necessary clearing activities will be disposed in an authorized dump area.
Land moving	Scarping, levelling of the land through excavations and fills. Excavations for the foundations of buildings and structures will comply with the project's regulations. Construction of the different units for Higuera and Confluencia power plants will not be simultaneous.
Construction and improvement of roads	Construction of the access to the project's different working zones, construction of internal roads, and specific improvements to route I-45 are considered.
Constructions and buildings	Mainly two powerhouses and the maintenance building. At the main campsite the construction of modular buildings intended for offices, lodging, toilet services, workshops, and cafeteria are considered. All the campsite buildings will be dismantled after the project's construction stage is fulfilled.
External Works	They are associated to the facilities of the different units and will be implemented early in the construction stage. The external works correspond to: **Construction of internal roads and parking zones:** Each unit includes access roads from the main road. Access may be gravelled. Parking zones are also considered as required. **Roads Sign System:** Will be installed in all the units to serve as a guide to traffic of vehicles and to inform persons about restrictions of use in the different sectors. **Illumination Systems:** These systems will be associated to the uses of the different units.
Infrastructure Works	**Wastewaters:** from the main campsite will be collected and treated in a treatment plant. Design for this plant will be included in the project's detail engineering. **Potable Water**: Will be provided by an *ad-hoc* plant. **Rainwater System:** Will be provided for every unit. Design will be included in the project's detail engineering **Electric Installations:** Generators in every work will provide Energy
Operation of Vehicles and Machinery	It includes heavy work machinery and vehicles in the construction area. Heavy work machinery will correspond to back diggers, cranes, bulldozers, concrete mixers, compaction rollers and levellers, etc. Vehicles include tank trucks, pick-ups, and buses for workers' transport.

ACTIVITIES	DESCRIPTION
Handling and Disposal of Wastes	**Surpluses of dirt and debris removing:** will be temporarily stored in especially moist conditioned places and in stabilized stacks disposed in authorized dumps. **Domestic solid wastes:** will be collected in closed garbage containers and disposed at least once a week in a sanitary landfill. **Wastewaters from works:** there will be chemical toilet facilities supplied by a registered provider in a quantity adequate to the number of works. **Wastes from maintenance of vehicles and machinery:** The maintenance of vehicles and machinery will be performed in a service zone provided with a foundation and recovery chutes. The wastes will be stored in closed drums, labelled, and disposed in registered dumping place.
Dumps	Surpluses from of dirt removing and construction materials will be disposed in existing dumps located in the project zone.
Closure of Activities and Cleaning	As the construction works are finished, land used in the work installation will be closed and cleaned. The works installations will be dismantled and t wastes will be disposed in an authorized dump. The works site will be restored according to a previously defined restoration program.

4.3 OPERATION STAGE

The actions, works, requirements, and processes involved in the functioning of the project or activity are described in the following table. The maintenance and conservation measures are considered.

ACTIVITIES	DESCRIPTION
Functioning and maintenance of works	The hydroelectric complex will be provided with basic services of drinking water, sewage treatment system, electricity, and garbage withdrawal. The maintenance and operation of these services and the specific functioning of the different units are considered. The project considers a remote control operation for all units. Therefore, only a small number of employees will be required. The work maintenance will be performed as established in a program. La Higuera Hydroelectric Plant will develop a program during detail engineering stage.
Functioning and maintenance of infrastructure and services	**Basic Services:** This implies the maintenance and appropriate operation of all the basic services. **Roads:** Imply the maintenance and operation of gravel roads and the maintenance and cleaning of sanitary systems. **Disposal of Solid Wastes:** The frequency of collection and disposal of solid wastes will be defined according to the number of persons living and/or working in the power plant.

5. PLAN FOR COMPLIANCE WITH THE CURRENT ENVIRONMENTAL LEGISLATION

5.1 GENERAL LEGAL FRAMEWORK

- The Fundamental Political Statute (Constitution of the State of Chile) (1980)
- Act Nº 19.300, General Framework Act for the Environment.
- Supreme Decree Nº 30/97 of the Ministry General Secretariat of the Presidency, Regulation for the Environmental Impact Assessment System and its modifications set in Supreme Decree Nº 95/2001, which modifies the regulation for the environmental impact assessment system. Published in the Official Newspaper on Saturday December 7, 2002.

5.2 SPECIFIC REGULATION

The Project complies with the specific applicable regulations.

6. JUSTIFICATION FOR THE EXECUTION OF AN EIA

Below is a description of the effects, features, or circumstances of article 11 in the environmental act N° 19.300 that gives rise to the EIA, and of articles 6, 9 and 11 of the EIAS regulation (Supreme Decree 30/97as modified by Supreme Decree 95/01).

Article 6 letter a)	The intervention by the project's works of the aquatic flora and fauna habitat will be the least possible. However, there are two ichthyic species respectively listed as vulnerable and in danger of extinction that justifies the presentation of an EIA.
Article 6 letter l)	The intervention of the native vegetation will be the least possible. However, there are plant species listed in the red book as conserved and protected as well as subject of intervention restrictions that justify the presentation of an EIA.
Article 6 letter m)	
Article 6 letter o)	Intervention in this area is an activity that must be carried out very carefully due to special features of soils. Intervention is subject of multiple conditions and restricted uses of the soil. Therefore, the presentation of an EIA is justified.

7. ENVIRONMENTAL BASELINE

The categories for the different environmental elements are summarized below and are organized as Physical, Biotic, Human, Cultural, and Patrimonial Environments.

7.1 PHYSICAL ENVIRONMENT

- Climate and Meteorology
  The study area lies at an approximate latitude of 34º45' S. In summer (December to March), the sector is under the South Pacific Anticyclone influence, but also in spring time and early fall. In the winter months (June, July, August, and part of September) the South Pacific Anticyclone weakens, allowing the south lows to dominate weather conditions. In general, this zone is characterized by a clear distinction of the four seasons. Precipitation in the project area is concentrated between May and October.

  - **Temperature**: For the province, the temperature ranges between 21.5ºC in January, the warmest month, and 8ºC in June, the coldest month.
  - **Precipitation:** Inter annual variations are significant, while there are very dry months as in 1968 and 1998 with 313 and 311.8 mm, respectively. The rainiest years are around 2,000 mm (1982 with 2,082 mm and 1997 with 1,987 mm). This means that the difference between the driest year and the rainiest one is 6.7 times and in absolute terms of 1,770 mm.

- Air Quality
  At present, in the project sector there are no activities that generate emissions to the atmosphere. In the area where the project will be developed the only significant

source of atmospheric contaminants are the sector's gravel roads, through which a much-reduced number of vehicles circulate. In this regard, the only impact on the air quality is near these roads, where the dust is deposited (mainly particulate material of >75 um in size), which is suspended by the vehicles that travel along them).

- Geology

  The studied area corresponds to the upper part of the Tinguiririca river basin in the Andes range. Elevations range from 600 m a.s.l. up to 3,500 m a.s.l. Along this area, the project's site crosses a section of some 25 km along the Tinguiririca river and of some 12 km along the Azufre river Mesozoic volcanic and volcano sedimentary basement rocks, folded moderately, in an N-S orientation axe. The Mesozoic layer is covered by unfolded Tertiary series of a similar composition, and is sheered in the central part of the section by Tertiary plutonic bodies of granodioritic composition. Covering said section towards the headwaters of the Tinguiririca river and its main affluents, there are wide andesitic and basaltic, Quaternary volcanic deposits, originated in volcanoes Fray Carlos and Tinguiririca, which are the highest summits in the project area. Both volcanoes show weak fumaroles activity and thermal waters.

- Geological Risks

  Geological survey of the project's area allows the following conclusions:

  - **Rock quality**: The headrace tunnels will be excavated in regular-to-good quality, KCM volcanic and volcano sedimentary rocks, and, in a lesser proportion in good-to-very good quality, fresh granodiorites of moderate fracturing (TG). A small tunnel section will cross low-to-regular quality sediments.

  - **Faulting**: The above-mentioned NW-SE faulting and fractures, parallel to the Tinguiririca, are completely stable. In general, the NE-NNE regional faulting is equally stable. They include two questionable sites that may require a certain spatial consideration. The altered and fractured fault crossroad to the right of Los Helados, and in the El Guairabo sector, in which small landslides associated to the fault traces suggest possible micro displacements.

  - **Displacements**: The slopes of the project area are stable and some landslides occur in the sites pointed out. In addition to already old, mass displacements: in the mid course of the La Gloria tributary stream, and in the headwaters of Los Helados none of which threatens the project areas. Downstream from the Azufre intake there is a rather modern displacement which made necessary to displace the axis downstream of the originally projected intake. In the narrow space generated by the landslide itself, which produces low consolidation, pyroclastic deposits are exposed. As there are non-consolidated pyroclasts of that type in the sector, it is possible that new landslides similar to the surface layer develop in the future. It would be convenient to monitor this activity. Nevertheless, sites of immediate danger have not been observed.

- **Avalanches**: Lagoons in the periphery of and associated to the Universidad glacier, as well as lagoons associated to other glaciers in the surroundings feeding the Tinguiririca basin, conceal, in our opinion, the greatest danger of geodynamic risk to the projected works. A specialized evaluation is recommended.

- **Volcanism**: The extensive volcanic apparatus of the Tinguiririca includes some 10 craters, of which only two present a weak solfataric activity, with deposition of sulphur. There are also various thermal water occurrences in the zone, of which the most known are those of Aguas Calientes and the El Flaco hot springs. The last explosive eruption occurred in 1927 and since then there had been no signs of reactivation, as in all the other volcanoes in the zone. Although volcanoes are unpredictable, in the short term we infer a low volcanic risk.

- **Seismicity**: The design seism will not produce important relative displacements in the faults that eventually may exist in the project area. In the geological study no important faults crossing the Project zone, have been detected. For the cortical seism that will control the design of the Project, the state-of-the-art seismic design will be applied. It considers the continuous operation of the hydroelectric plants after an earthquake. Therefore, seismic environmental impacts produced by the pipelines, tunnels or equipment, will not be considered.

- **Ground waters**: Current background information allows drawing the following conclusions with respect to ground waters.

  - The majority of the tunnels will be excavated beneath ground waters. Only portals will be above the freatic level.
  - The hydraulic gradient generally follows the surface drainage gradient.
  - Groundwater outcrops can be observed mainly in the zone of the most important faults. These conditions may produce flows of 10-15 l/s and even higher. These initial values will drop rapidly and stabilize at a fraction of the original flow. In the saturated zones, the maximum pressures expected are approximately from five to six Mpa.
  - It is expected that during the construction of tunnels there may be sectors where up to 100 l/s should be pumped out.
  - The supply of groundwater to the tunnels is expected to be around 12.5 l/min/ml.

- **Geomorphology**: The study area is located in the middle course of the Tinguiririca river basin between the 670 m a.s.l. and 1.260 m a.s.l., which may place it in a low-to-medium mountain conditions. Nevertheless, due to the present morphological landscape, mainly dominated by steep slopes it must be considered as a full mountain range (see Figure 2). The lower parts of the study area are covered with abundant native vegetation (corresponding to the red and reddish areas in the satellite image), whereas the high summits have not vegetation at all. Summits are full covered with snow during the winter months and partly covered in the springtime. These high areas stand out for their grayish, light-blue, and white color when covered with snow. The image shows where the La Higuera Hydroelectric Project will be located as well as the current roads and the roads that will be constructed.

- **Hydrological Aspects**: In the sector where the project is located, it is possible to distinguish two large territorial units separated by the watershed lines of El Perejil, the Tinguiririca river and the El Azufre river-Portillo river complex. These units are characterized by a constant altitude increase in a relative short distance. This steep slope determines a high rainfall and a rapid flow into the waterways.

- **Noise:** The noise baseline consisted of the characterization of the existing background noise in the project's influence area. The sector has no permanent human receivers.

7.2 BIOTIC ENVIRONMENT

- Flora and Vegetation
  The study describes the project area in terms of flora and vegetation present in the intervention places, making floristic inventories and a gross estimation of the biological parameters as well as revising the conservation aspects. The more widespread species, that is, those that appear more frequently in the project's various zones, are quillay, *Kageneckia oblonga, Colliguaja integerrima*, *Diostea juncea*. With respect to species with conservation problems existing in the project-intervened areas, there are three species that are cataloged as vulnerable (Cordilleran Cypress, Oak, and Puya). An endangered species has also been cataloged for the basin (South Belloto). In addition, there are six protected species (Espino, Bollén, Litre, and Maitén. Boldo and Quillay).

- Fauna
  In the project's direct influence area four general types of animal habitat were registered:

  - **Water bodies**: mainly rivers, tributary streams, and small lagoons from watersheds.

  - **Riparian environment**: corresponding to ecotone zones between the water body itself and the xerophitic thicket. A low cover vegetation strip and few species characterize it.

  - **Thicket**: in sectors below 1.000 m a.s.l., it is characterized by vegetation ranging from 30% to 50% and average height between 5 and 7 m. Above 1.000 m a.s.l. the average height of the thicket varies between 2 and 4 m, with vegetation covering between 10% and 100% of the soil surface.

  - **Prairies**: Above 1.450 m a.s.l., it is possible to observe natural prairies, usually used during summer time as forage for cattle.

- Singular aspects of the Fauna in the Project's Influence Area

The Chilean parrot Tricahue is the most important aspect in the terrestrial fauna inhabiting the project's direct influence area. In the section that runs from, Tinguiririca and, Azufre river-junction to Portillo river there are four *"loreras"* (colonies of parrots Tricahue *Cyanoliseus patagonus),* an endangered species. Torrent ducks, find their habitat in the Tinguiririca river basin but in very low densities. Transects performed on different days covering sections between the La Higuera sector (Sampling Point 1) and tributary stream El Ciruelo (Sampling Point 21) only four individuals (minimum number) arranged at very regular distance intervals were detected on a same day. In addition, a couple was registered in the Azufre river, but on different days from those mentioned above. With respect to the species of amphibians, in the influence area, they were practically not detected during the 2003 campaigns. However, it is predicted that these species may become very important as the habitat of quiet waters increases in river sections submitted to ecological flow conditions. Minimal flow is very appropriate for their development, thus even encouraging the colonization of other species of amphibians in the project zone.

- Conservation
  In relation to the conservation of the fauna described for the direct influence area, eight species of birds, eight of mammals, eight reptiles, and two amphibians were classified in different conservation categories, according to Supreme Decree Nº5, Regulations for the Hunting Act.

- Aquatic Flora and Fauna
  It has been studied based on the following components: Benthos, Aquatic Flora, and Fish fauna. All the analyzed streams correspond to Mountain rivers with variable flows.

- Sampling Places
  The selection of sampling stations was made according to the project's activities and the inspection of the field. During field work all the affluent streams to the project's direct influence area were visited and inspected. In order to define the sampling stations streams presenting higher flow or more related to the project's works were selected.

- Benthos
  All the samples were taken in shallow sectors with a water column depth less than 50 cm and with more or less similar bottom conditions, which is stones in sizes less than 15 cm, settled on a coarse sand matrix. Samplings were performed in duplicate using a conventional 30x30-cm quadrant Surber net. Stones and the substrate inside the quadrant were washed trapping the organisms in the net.

  From the analysis of the totality of samples collected in the study, Insects dominated the total abundance per group. In fact, 99.46% corresponds to larval states of aquatic insects. Only 0.54% corresponds to other groups. Three groups of organisms characterize communities of benthonic and planktonic micro algae in the studied watercourses: Cyanobacteria, Chlorophytes and Diatoms. A larger variety in the

micro algae community composition and specific richness was observed in Los Guanacos and La Gloria tributaries.

Lesser specific richness was registered in the Tinguiririca river downstream from the La Higuera Powerhouse and the Riquelme stream, a tributary of Del Azufre river. The smaller diversity of micro algae corresponds to the Tinguiririca river, upstream from the Intake, the Portillo river, and the Azufre river. As to the water quality, in general, the results showed a low saline content in terms of macro-ions. There is a scarce predominance of some typical salts present in the water of tributaries La Gloria, Los Helados, Riquelme, Los Guanacos, and Los Cuyanos.

Low concentration of calcium bicarbonate, magnesium sulfate, and sodium chloride were measured in these fluvial systems. The higher dissolved matter concentration was observed in the Tinguiririca river upstream of the Intake and in El Portillo river. The benthonic fauna presented an absolute predominance of the Class Insects. The biodiversity in the area, with an average of 2.00 bits, agrees with the values characteristic for this high-cordillera aquatic systems and is very close to the values registered in Chile for similar high-mountain, fluvial systems.

- Ichthyic Fauna
  As to the ichthyic fauna, the first field campaign described two species, the small catfish (*Trichomycterus areolatus*) and the rainbow trout (*Oncorhynchus mykiss*). These two species were described again in the second campaign with a greater abundance and a wider distribution than in the first campaign. In the second campaign, species of freshwater toyo (*Diplomystes nahuelbutaensis*) and *pejerrey* (*Basilichthys australis*) were collected. The species of freshwater toyo was caught using a spinner in river sections with smaller runoff conditions that allowed applying electric fishing gear in a greater width of the riverbed. The second species not described in the first campaign, the *pejerrey*, was caught in a station that was not previously sampled: Tinguiririca in Puente Negro. It is important to note that this station is outside of the Project's direct influence area.

- Biologic diversity of the ichthyic fauna
  For the fish fauna in the second campaign, that has comparable quantitative estimations and statistics that are more significant. The biodiversity indexes were calculated for each station and for the main rivers and affluent estuaries. The widespread Shannon Wienner biodiversity index indicates a general low diversity, which is expectable for sections of Chile's Andean rivers. The Tinguiririca river presents from upstream to downstream an increased Shannon Wienner index value (and of all the biodiversity indicators). Biodiversity values ranged between 0 bit at the Tinguiririca Intake and 1.242 bit in Puente Negro, which would also be the sampling station with the greatest diversity of all the sampled stations. The tributary streams present homogenous indexes characterized by the presence of only one species: the rainbow trout, unlike the El Membrillo stream where catfishes were present.

7.3 HUMAN ENVIRONMENT

A) Socioeconomic and Cultural Aspects

The objective is to describe and analyze the more relevant characteristics of human populations involved in the project. To reach this objective we made an identification and characterization of the affected parties from the analysis of secondary information sources, direct observation of the study area and personal interviews.

a) Socioeconomic and Demographic Characterization

From the socioeconomic point of view, the district shows a detrimental situation as compared to mean national socio-economic levels. Its lower economic condition, partly conditioned by the primary and extractive character, rurality, and lower educational coverage of the regional economy, among others, cooperate to maintain lower socioeconomic indexes. In the period 1990 – 1997, in global terms, the regional GDP was below the national GDP, with a global growth of only 41.4% as compared to the 75.3% increase at the national level. This shows a negative effect with respect to the relative participation rate in its contribution to the national GDP. The Region's economic behavior had affected its work force, which increased in a percentage below the national average. The global growth rate of the work force came only to 18.4%, whereas at the country level it came to 20.8%. As to the poverty levels, the sixth region presented levels above those registered at the national level. Nevertheless, gave an improvement relation to previous years thanks to a strong reduction of poverty at the regional level. In this context, the socio-economic category of indigent was the one that largely decreased in percentage terms, with a rate of approximately 60.4%. With respect to the non-indigent poverty, it decreased at a smaller pace (24.6%) as compared to the global poverty. All the consulted levels (municipality, leaders, affected and favored population), agree on the importance of the project both for the country and for the local populations. The positive aspects of the project that determine a very favorable attitude toward it are, in first place, the supply of electric energy to the Central Interconnected System and the fact that the project has a low impact on the environment. In second place, the potential benefits related to the repair of part of the road to the El Flaco Hot Springs and, in Puente Negro, for the generation of new workplaces. There is no interference between this and other community development projects or restrictions to it. There are no oppositions to the project. It rather presents a highly friendly image to the local community.

7.4 CULTURAL AND PATRIMONIAL ENVIRONMENT

B) Archeological and Cultural Inheritance

C) Historic Inheritance: Are Sites for habitation, funerals, or ceremonies temporarily found in the Post Hispanic Age. We found relevant evidences corresponding to the 1890 Sulfur Deposit, in the Direct Influence Area (DIA).

D) Anthropological Inheritance: Are objects from imprecise or unknown date that have a relevant cultural value. These elements are absent in the field revised.

E) Archaeological Inheritance: Are Sites for habitation, funerals, or ceremonies temporarily found in the Pre-Hispanic Age. During the field visits, we identified five archaeological sites. Two of them are in the Direct Influence Area (DIA) and three in Indirect Influence Area (IIA). In addition, are three isolated findings in the DIA. In addition, a direct findings reference is available in the Los Cipreses house and two potential sectors.

F) Palaentological Inheritance: Ore deposits of pieces corresponding to mineralized organic remainders from geological ages. The described traces are absent on the surface of the inspected field.

G) Religious Inheritance: Are Cultural manifestations, typical of some religious creed, such as sanctuaries and peregrination places. We identified in the IIA ive points associated to the access road to the El Flaco Hot Springs, corresponding to shrines.

H) Characterization of National Monuments: Historical monuments are those declared as such by supreme decrees enacted at the request and with a previous agreement of the Council. By law, these monuments are ore deposits or pieces found on or under the surface of the national territory, including palenteological pieces. There are no historical monuments in the project site.

In the Direct Influence Area, there are two archaeological sites, 3 isolated findings and a finding reference:

1) The Shelter Las Huertecillas, located at 100 m from the main campsite.
   Coordinates UTM: 6.145.592 N – 357.120 E, Sam 56
2) Lithic Workshop La Mina Sector
   Coordinates UTM: 6.151.630 N – 344.000 E, Sam 56
3) Two Isolated findings: sites one and two.
   Coordinates UTM: 6.150.498 N – 367.113 E, Sam 56
4) One Isolated finding N° 3.
   Coordinates UTM: 6.148.500 N – 365.400 E, Sam 56
5) Reference on Los Cipreses finding.
   Coordinates UTM: 6.145.592 N – 359.000 E, Sam 56.

We recommend performing boring exploratory works and eventual rescue of the sites, prior to starting works.

In the project's IIA we found three sites:

1) Shelter Casa Pintada: rupestrian paintings.
   Coordinates UTM: 6.149.500 N – 350.417 E, Sam 56

2) Shelter La Alfalfa 1 creek.
   Coordinates UTM: 6.149.795 N – 350.739 E, Sam 56.

3) Shelter ravine La Alfalfa 2
Coordinates UTM: 6.149.755 N – 350.300 E, Sam 56.

We recommend to fence and/or signalize the sites in order not to damage or alter them.

In the project's DIA, a relevant historical site is found:

1) Corresponds to Foundations of administration house and ruins of furnace walls of the old sulfur deposit and work (1890). We recommend to fence and signalize the area near the ruins in order not to damage or alter them.

In the project's IIA, on the public access road to the El Flaco Hot Springs, four points of interest have been identified, corresponding to the category of religious patrimony (popular religiosity): a shrine, three grottos dedicated to Virgin Mary and a shrine for militaries.

2) Grotto on rock, south bank of the Tinguiririca river.
3) The Grotto that exists on the basement of suspended bridge, in north bank of Tinguiririca river.
4) Grotto on rock wall, in the south bank of the Tinguiririca.
5) Shrine of militaries.

As they are important landmarks for visitors to the El Flaco Hot Springs, their conservation has been recommended.

Sectors with a high potential for findings of archaeological remainders.

1) Sector 1, work Nº 4. Intake La Gloria (UTM: 6.137.250 N – 361.050 E, Sam 56)
2) Sector 2, work Nº 8. Main campsite. (UTM: 6.145.850 N- 357.000 E, Sam 56)
3) Sector 6, work Nº 1. Access road to the Powerhouse (UTM: 6.151.700 N– 343.150 E, Sam 56)

The presence of an archaeologist has been recommended when performing site clearance. Other recommended mitigation measures are:

1) Training lectures to workers teaching the appraisal and protection of the cultural patrimony.
2) Signaling through notices that teach, but at the same time, clearly indicate the penalization for the destruction of patrimonial sites.
3) Monitoring of the protection measures and evaluation of the state of conservation of existing patrimonial sites.

7.5 LANDSCAPE AND AESTHETICS

The landscape where the Project is located was characterized both aesthetically and perceptually.

- Definition and Description of the Local Landscape Units: There are two landscape units mainly defined by the physiological component. They coincide with existing visual basins and correspond to unit Nº1 Hills, Mountain Ranges and unit Nº2 that is related to fluvial ecosystems. These units are analyzed below:

CHARACTERISTICS	UNITNº 1 HILLS AND RANGES	UNIT Nº 2 RIVER BED
Spatial characteristics, conditions of visibility and visual incidence of the Local Landscape Units	Open, extensive, rounded basin, limited by the ranges of hills surrounding the Project area. Depending on the visibility, it is possible to have access to panoramic views with third planes of sight and with vanishing points found in all directions. The area has a high visual incidence due to the perpendicular sight axis and high intervisivility between points of observation.	Closed and fitted landscape with a lengthened basin, where the ravine of the riverbed dominates as the major landscape configuration. The great morphological complexity of the unit reduces the radius of visual incidence, providing a high compactness and low visual intervisivility.
Morphological Characteristics	The morphology is dominated by extensions with little slope and hills. The dominant elements of the topography are the flatlands on the lower part of the valley and the middle and upper parts of the hills that provide a background and act as basin-edge.	The great richness determined by the formation of a narrow gorge where the hillsides are large convex volumes arranged by the ravine, which fall on a deep slope. The predominant background resources are rocky outcroppings and cliffs.
Vegetal Characteristics	The vegetal masses forming the unit are the sclerophilic forests in the lower parts of the lands and of ravines and degraded thickets of hawthorns on the hillsides.	The vegetation of aesthetic importance are the sclerophilic forest, the trees of the ravines, and the puya plants in the southern part of the basin, which give the landscape a great richness of color and texture. The rest corresponds to thickets of quillay trees and hawthorn.

The analysis results of the main landscape criteria allow defining the following:

CRITERIA	APPRAISAL	
	UNIT Nº 1 HILLS AND RANGES	UNIT Nº 2 RIVER BED
Visual Quality	Medium High	Medium
Visual Fragility	Medium	Medium
Level of Landscape Sensibility	High	Medium

In summary, the project's landscape area, for the Hydroelectric Power Plants La Higuera and Confluencia, is described as a portion of the VI region's cordilleran zone, in which two landscape units were defined. One of which is inserted in the rough relief unit of hills and mountain ranges, and the other corresponds to the riverbeds. Nevertheless, it should be taken into account that within the analysis made to the two landscape units, there are zones with greater landscape sensibility, as compared to the visual basin. Within these more vulnerable areas are the engineering

works relating to the Intakes, Intake dams, Powerhouses, Penstocks and, of course, the works corresponding to the location of the access roads to the works.

7.6 RISK OR CONTINGENCY ZONES

The environmental risk zones determined for the environmental system in the project's influence area are described below:

COMPONENT	STAGE	RISK ZONE	AGENTS	TYPE OF RISK
Air Quality	Construction	Project's units with construction	Vehicles and machinery with malfunctioning	Temporary air contamination by
Geomorphology and Soils	Construction	Work areas and roads	Spillages of fuels, greases and/o oils to the	Soil contamination
	Construction and Operation	Mass removal risk zones	Heavy precipitations with high temperatures	Mass removal
Hydrological Aspects	Construction	Ravines in the Project area	Spillages of fuels, greases and/or oils to the ravines	Temporary pollution of ravines
			Unauthorized discharges of solid wastes in canal and streams	Pollution and possible morphological alterations of
Hydrological Aspects	Construction and Operation		Freshets	Risks of floods due to obstruction of
Noise	Construction	Sensible noise points	Operation of malfunctioning machinery	Temporary acoustic pollution
			Extra time Works, at night or on holidays	
Vegetation and Flora	Construction	All the Project area	Human presence and activities	Cutting of vegetation for Work or others
	Construction and Operation		Human presence and activities	Risk of forest fires
Fauna	Construction and Operation	All the Project area	Human presence and activities	Illegal hunting of fauna specimens
Human Aspects	Construction	Nearby houses and access to the land	Road accidents during the project construction	Damages to people or vehicles by road accidents
Infrastructure	Construction	Infrastructure near the project	Road accidents during the project construction	Accidental damage to existing infrastructure
Archaeology	Construction and Operation	Archaeological sites (identified or not) in the project area	Accidental excavations, road accidents or third-party actions	Accidental or voluntary destruction of some archaeological site in the Project area

8. ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLANT

The project's environmental impact assessment was made by using the criteria defined in Act N°19.300 on the Environmental Framework and on the EISS Regulation (Supreme Decree Nº30/97), MINSEGPRES, modified by Supreme Decree Nº 95/01, MINSEGPRES). This assessment was carried out by identifying the project's activities or actions that may cause environmental impacts and the environmental components and elements of each medium that may suffer such impacts. The potential positive effects that the project will generate in its surroundings are also considered. The results of the impact assessment made for the project are included below.

8.1 POSITIVE IMPACTS

Twelve positive impacts of the Project were defined. Most of the positive impacts are related to the Human Environment and associated to the support to the economic development and improvement of the community's life quality that the project will give to the District of San Fernando, and indirectly to the sixth region.

8.2 NEGATIVE IMPACTS OF THE PROJECT IDENTIFIED FOR THE CONSTRUCTION STAGE

Eighteen negative impacts of the Project on the different environmental components were identified. The only significant impact is the potential alteration of the fish habitat existing in the project area. Four medium and mitigable impacts were identified, which are associated to the possible generation of erosive process and the alteration of the landscape by the cutting of vegetation and dirt moving. The remaining 11 impacts are minor ones and are related to the different environmental components (emissions of dust and noise, the cutting of vegetation and its effect on the sector's native fauna).

8.3 NEGATIVE IMPACTS OF THE PROJECT IDENTIFIED FOR THE OPERATION STAGE

Eighteen negative impacts of the project are considered. Only one is considered significant and is related to the loss of habitat for the aquatic flora and fauna, especially the ichthyic fauna in the project area. The remaining are minor impacts.

8.4 MANAGEMENT PLAN

The Management Plan developed for the EIS considered the mitigation, restoration, and compensation actions that correspond to each of the impacts identified and produced by the project's activities on the media: Physical, Biotic, Human, and Cultural-Inheritance environments. The following table shows the most relevant measures:

Measures/Environmental Management Strategy	Management Plan		
	Mitigation	Restoration	Compensation
Displacement of destabilized taluses must be avoided by using walls, meshes and/or vegetation	X		
In river beds subjected to an ecological flow system, the loss of aquatic habitat must be compensated by creating meanders, drops and pools that allow developing fauna of aquatic invertebrates; oxygenating the water and the habitat of ***T. Areolatus.and Diplomystes*** sp.	X		
Construction of Penstock. The natural gradient characteristics and vegetal covering must be respected in the design in order to avoid erosion, restoring the vegetation after completing the construction of the work.	X		
For compacted soils, it is necessary to develop a recovery program of the soil characteristics through improving its structural quality by adding compost.		X	
For conserved species, it will be necessary to establish a rescue program for individuals affected ***Puya berteroniana*** and ***Neoporteria*** sp. A specimen plantation program will be established in the same elimination zones, at a 10:1 ratio			X
The materials generated by the tunnel construction and the construction debris are deposited in the dumps assigned after withdrawing the vegetal soil. This soil will be used to cover this sterile material prior to renewing the vegetation.	X		
Modification of habitat, recreation of habitat for terrestrial fauna destroyed by the project's activities.		X	
To minimize the emissions of particulate material to the atmosphere, a humectation program will be applied for roads, dumps, and accumulation of volatile material.	X		
Control of outside workers.			
Contracting of local labor.			X
Fencing and signalization of historical and cultural inheritance sites.			

9. CITIZENSHIP PARTICIPATION STRATEGY

The activities that were developed to carry out the Formal Citizenship Participation as established in the EIAS Regulation Rule are listed below:

Stage I: Diagnostics and Focalization	Once the main social actors were identified, meeting places were defined and the meetings scheduled accordingly.
Stage II: Preliminary Activities	As soon as the EIS was brought forward to the CONAMA-VI R, the support material for the citizenship meetings was prepared.
Stage III: Citizenship Discussion	At this stage, the population and local authorities were informed about the project and its main environmental impacts and corresponding mitigation measures. Observations, suggestions, and contributions by the social players were obtained in relation to the proposed solutions. In each session, the participants were given

	an explanatory brochure and the project's General Location and Soil Use Plan was explained. At this stage, meetings were held with the public and political authorities, and with the social leaders and the parties affected by the project.
Stage IV: **Collection of observations, appraisal and dissemination of the results from the promotion meetings**	The CONAMA VI Region was responsible for the receipt of observations about the project and the appraisals based on its resolution, which were notified by certified letter to the citizenship organizations and to the people that has made observations, as mentioned above.
Stage V: **Communication of the Environmental Qualification Resolution (EQR)**	At this stage, the CONAMA VI Region will inform all those persons or institutions that brought forward observations about the corresponding Environmental Qualification Resolution. In the same way, they will be informed about the way in which said observations were appraised.

10. HIGH VOLTAGE LINE

10.1 DESCRIPTION OF THE PROJECT

The line is located in the Seventh Region, Province of Colchagua, and District of San Fernando and is developed along the Tinguiririca River. It begins in the switchyard of the La Higuera Power plant, located 4.0 km upstream from the confluence of the Tinguiririca and Clarillo rivers and finishes in the Tinguiririca Substation, located 3.0 km to the west of the South Highway 5. It is a double-circuit line, therefore it will have 6 phases and consist of 87 pyramidal, framed-steel towers with a superstructure that includes framed-steel cross. The foundations are made of concrete approximately 2 to 4 m deep. The conductor is made of braided aluminum, of 28.1 mm in diameter. The conductor is supported by the structures by means of chains with disc insulators made of porcelain, and the corresponding line hardware. The line will have an optical fiber guard wire (OPGW) in order to protect it from atmospheric discharges and additionally allow establishing the telecommunications between the Station and the Central Interconnected System. The line will be provided with beacons for air navigation on river and road crosses.

The Tinguiririca substation will consist of the necessary maneuver equipment for the connection and disconnection of the line in case of failures and/or repairs. This equipment will be installed on a platform with its corresponding foundations. For the high-voltage interconnection between the pieces of equipment, conductors will be installed, which is supported on framed-steel frameworks by means of insulator chains similar to those of the line. In order to protect the installations from atmospheric discharges, a guard wire will be installed on these structures.

11. POWER BACKUP

In order to protect partial or total generation failure of the two Power plants during the peak-energy demand, a diesel backup, 47-MW gas turbine is provided; backup turbine

is located in the Industrial Park at the town of Coronel, VIII Region, Chile. The information provided below has been taken from the Environmental Impact Declaration for a similar turbine that the company PSEG Generación is installing in the same location as the one proposed to act as the backup power supply, according to the agreement signed between Hidroeléctrica La Higuera and PSEG Generación.

11.1 CHARACTERISTICS OF THE TURBINE

The project consists of the installation and operation of a 47-MW, natural gas turbine in the Industrial Park of Coronel, with the purpose of increasing the quality and safety of the electric supply in the zone, especially in the system's peak demand or under dry hydrology conditions.

The turbine's pieces of equipment are the following:

Erection of Main Equipment

It corresponds to the installation of the following pieces of equipment of the Thermoelectric Station:

Turbo generator:
- Turbine
- Generator
- Reduction Box
- Skid Water Injection
- Skid Lubrication
- Skid LM 6000
- Air Compressor
- Emergency Generator
- Switch Equipment
- Black Start System
- Turbine Air Filters
- Silencer
- Exhaust Shat
- Generator Air Inlets
- Generator Air Outlets
- Monorail Tackle

Water Plant
- Raw Water Tank
- Impulse Pumps
- Multilayer Filters
- Softener
- RO Pumps (reverse Osmosis)
- RO Membranes
- RO Water Tank
- RO Impulse Pumps
- Demineralization Floors

Demineralized Water
Demineralized Water Impulse Pumps
Demineralized Water Filters

Oil Refrigeration System
Coolers
Cooling Tower Primary Circuit Pumps
Cooling Tower Secondary Circuit Pumps

Gas System
Gas Intake Skid
Filter & Regulation Skid
Gas Compressor

Petroleum System
Petroleum Tank
Tank Cooling System
Measuring System
Loading Pumps
Impulse Pumps
Filters

Management System for Industrial Liquid Wastes
Water Plant Waste Neutralization Tank
Waste Storage Tank (oil, petroleum)

Installation of Electric Equipment

It corresponds to the installation of the following pieces of equipment of the Thermoelectric Station:

Control System
Control Room
Control System Cabinets
Computers and Monitors
Signal & Control Wiring
UPS for Control System

66-kV Electric System
Generator Switch
Generator-Transformer Cable Duct
11.5 / 66- kV Transformer
Transformer Disconnectors
11.5 kV-Arrester
66 (132) kV-Arrester
66-kV Instrument Transformer
66-kV Potential Transformer
66-kV Current Transformer

SS.AA. Electric System
66 / 3.3-kV Auxiliary Transformer
3.3-kV / 380-V Transformers
66-kV / 380-V Auxiliary Transformer
3.3-kV Switches
Layout and 3.3-kV Wiring
CCM 3.3-kV CCM
380-V CCM & TD
Layout and 380-V Wiring
CCM & TD Storehouse
120-V Battery Rack
120-V Charger Rack
120-V Inverter Rack
24-V Cadmium Nickel Batteries
24-V System Chargers
24-V Inverter
Layouts & 120-V Wiring
Layouts & 24-V Wiring
Battery, Charger & Inverter Building

11.2 SERVICE LIFE OF THE PROJECT

The turbine is installed for an indefinite time so that it can supply the Central Interconnected System, as required. Nevertheless, commercial evaluations indicate an operation period of 25 years.

Anyway, if its disassembly is necessary, this is a simple operation, since it is a modular piece of equipment. The operation period for this turbine is expected to be between August 2004 and July 2029.

- Description of the Energy Generation Process: In a simple open cycle, the turbine consists of a gas generator and a high-pressure turbine mounted on the same axis. The generator is composed of an axial flow and a dual-burner combustion chamber where a high-speed gas flow is produced that drives the high-pressure turbine.

  The other axis, which is not mechanically coupled to the axis mentioned above, is mounted on the power turbine and the alternator so that the gases that worked in the high-pressure turbine drive the power turbine causing the shift of the alternator.

  The combustion system is composed of a combustion chamber, carbonating injectors, spark plugs, temperature detectors, and transition elements. The high pressure air enters through the holes of the combustion chambers and the fuel through the injectors, which produces a homogenous mixture in the appropriate proportion of air and fuel. The design of the fuel injectors allows maintaining, in the combustion chamber, the adequate atomization of the diesel or dispersion of the natural gas, in case of eventually using this fuel. The change of fuel is performed with the machine in operation.

The combustion is started by a high-voltage discharge produced in the spark plugs located in the first chambers. From the chambers with fire, the ignition is distributed to the other chambers through pipes connecting the reaction zones.

The expansion of the hot gases generated by the combustion is transformed into drive energy in the power turbine. The power turbine, drives a synchronous generator to produce electric energy.

During its operation, the turbine does not emit any type of solid or liquid waste.

11.3 OPERATION CONDITIONS

The turbine will be part of the Central Interconnected System (SIC), whose operation is coordinated by the Economic Dispatch Load Center CDEC-SIC, an agency in which all the SIC-generating companies are represented. In this context, the equipment will always be available for operation; however, its functioning is more likely to take place in Fall-Winter, daily in the period 17:00h and 24:00h.