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1 INTRODUCTION

The following is the characterization of the service area or Baseline of the "Electric Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power Plant – Alfalfal S/S", taking into consideration the effects, features or circumstances which are referred to in article 11 of the Law on Environmental Requirements, and the potential environmental impacts as identified in the Annex 5 Impacts Matrix.

This characterization includes the areas corresponding to the installation of the lines and expansion of the Alfalfal S/S, describing in detail each element of the environment likely to be affected during the construction and maintenance of the Project, indicating their present situation and their possible future evolution, according to their most relevant attributes.

2 PHYSICAL ENVIRONMENT

The characterization of the physical environment includes an analysis of the climate and meteorology, geology and geomorphology, hydrogeology and hydrology. It also considers the noise levels and the use and quality of the soil, this latter characterized by its usability and suitability-based classification, and territorial regulation in the site zone of the Project.

Areas representing risks and contingencies for the population and/or environment as a consequence of natural phenomena are also included.

2.1 Climate and meteorology

2.1.1. Introduction

The following are the climate and meteorology antecedents of the site area of the Project "Electric Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power Plant – Alfalfal S/S" consisting in two transmission lines having a total length of 17.1 km, aimed at connecting the energy generated by the Alto Maipo Hydroelectric Project to the Central Interconnected Grid (SIC).

Furthermore, the Project also contemplates the expansion of the existing Alfalfal S/S by 0.45ha to install the corresponding connections to the new lines.

The Project will be located in the Municipality of San José de Maipo, Cordillera Province of the Metropolitan Region of Santiago.

2.1.2 Definition of the service area

The climate and meteorology features of the Municipality of San José de Maipo have been established as direct service area (DSA), while the indirect service area (ISA) includes the climate and meteorology features prevailing in the Metropolitan Region of Santiago.

2.1.3 Results

i) Background

According to the data presented by Romero (1983) the site area of the Project is, in general terms, under the influence of a climate having a **warm anticyclone character, with alternate thermal and cyclonic depressions**.

These climate systems prevail from 27°S (southern limit of the Atacama Desert, near the city of Copiapó) to approximately 42°S (near the city of Puerto Montt).

The climate of Central Chile is expressed as a succession of modified tropical, polar and Antarctic air masses, and humid and dry periods.

The orographic effect of the Andes Mountain Range is responsible for the austral extension of the warm anticyclone influences, which are significantly reduced in importance, especially when compared to the net predominance that they have in the same latitudes, but over the oceanic space.

The anticyclone conditions are slightly more important between May and September, and are prevailed over by unspecified conditions during the remainder of the year.

Winds from the S and SE are evident, from the point of view of the higher volume flow directions. The first are observed during the summer and are linked to the greater intensity of the pressure in the south-eastern Pacific Ocean, and the higher pressure gradient between it and the continent. Variable flow is observed during winter, basically from the west, coinciding with the high pressure lowering of intensity and transfer of the depressions towards the north.

The mainly wintry occurrence of bad weather in those latitudes occurs when the high pressure of Chile sets off towards the north. Only then do the cyclones enter with their associated fronts, causing rains. In summer, the cyclonic bad weather is excluded when the anticyclones go back to their usual average positions. However, the occurrence of episodic summer bad weather is possible; although of similar nature, it seems to be strongly controlled by changes in oceanographic conditions, as it is accompanied by significant rises in the surface temperature of the sea.

The climate of Central Chile is then dominated by a mostly dry summer receiving very strong radiation energy, and a more humid, cloudy, rainy and cold winter. Spring and fall show transitional features between the seasons.

Bad weather episodes, concentrated in winter, are associated to depression fronts crossing this part of the country and causing precipitations. While these fronts follow a well developed course in winter, in spring or summer they happen as sporadic interruptions of good weather: one or two cloudy days, northern winds, colder temperatures and rain.

Another source of bad weather in Chile is the thermal depression which follows periods of good weather and causes cloudy days and light rains, with slight and sporadic falls in temperature.

These conditions are short lived and can be observed in the coastal regions and central basins.

ii) Climate of the Metropolitan Region of Santiago (IIA).

The main climatic features shown by the Metropolitan Region belong to the **Mediterranean type, long dry season and rainy winter.** The average yearly temperature is 13.9°C; January is the hottest month reaching an average of 22.1°C, while July is the coldest month averaging 7.7°C. The average yearly precipitations reach 356.2 mm. Precipitations diminish from the coast towards the middle depression, to increase again towards the Andes Mountain Range, creating the general bioclimatic lines of the region.

Concerning precipitations, these are irregular, as one year can be very rainy and the following one can be very dry. In the Colina sector and to a lesser degree the zone of Santiago, there are drier climates with wider thermal fluctuations; this reflects the encroachment of the steppe climate, due to the presence of the relatively high Coastal Mountain Range, which acts as a screen. Regarding the relative humidity of the Santiago basin, this diminishes progressively.

Table 4-1 Maximum, average and minimum temperatures °C) and precipitations (mm)

Parámetro	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	Total
T. Media	20.9	19.9	17.6	14.2	11.1	8.5	8.1	9.5	11.5	14.5	17.3	19.9	14.4
T. Mínima	13.0	12.4	10.7	8.0	6.3	4.3	3.9	4.8	6.1	8.2	10.1	12.0	8.3
T. Máxima	29.7	29.7	26.9	23.3	18.7	15.2	14.9	16.7	19.0	22.3	25.4	28.4	22.5
Precipitación	0.4	0.8	3.2	10.4	42.2	70.4	86.6	51.8	22.0	13.4	9.2	2.1	312.5

Fuente: Atmósfera (2008). http://www.atmosfera.cl/HTML/datos/datos02.html

Figure 4-1 Santiago Climograph (33⁰ 23'S, 70⁰ 47'W)

Source: Atmósfera (2008). http://www.atmosfera.cl/HTML/datos/datos_02.html.

The presence of the Coastal Mountain Range and the distance from the sea are the main factors causing the continental features of the climate of the Metropolitan Region. According to the information given by the Chilean Weather Bureau (Dirección Metorológica de Chile), two types of climate are seen in this region:

- Warm temperate climate with winter rains and a long dry season (7 to 8 months)
- Warm temperate climate with a dry season lasting 4 to 5 months.

The following is a description of the climates:

Warm temperate climate with winter rains and a long dry season (7 to 8 months)

The main characteristic is given by the precipitations that fall mainly in winter, from May to August. About 80% of the yearly precipitations fall during this period. These precipitations fall as snow in zones over 1,500 masl. Occasional snowfalls happen in lower sectors. The dry season comprises 7 to 8 months, when less than 40mm fall in each month. In some of the summer months, the normal precipitation is even less than 1mm. Both mountain ranges have important climatic effects. The Coastal Mountain Range, with some summits over 2,000 masl hinders a greater maritime influence, except when the thermal inversion layer rises above 1,000m and is associated to western winds in the lower levels, allowing the low coastal fogs to come in along the river valleys.

Another effect is that of reducing the amount of precipitations in the sectors near its eastern slope, this is evident when comparing yearly rainfall figures for Valparaíso, where there is a yearly rainfall of over 370mm, to what falls in Pudahuel –only 262mm– taking into account that Pudahuel is further south than Valparaíso, a latitudinal difference of 40km. The Andes Mountain Range causes the reverse effect: precipitations increase as altitude rises. This can be observed in the records of the Queltehues Station which more than double those of Quinta Normal.

The Andes Mountain Range causes the reverse effect: precipitations increase as altitude rises. This can be observed in the records of the Queltehues Station which more than twice those of Quinta Normal.
The continental situation of the Region causes the relative humidity to be low; the yearly average is slightly over 70% only.

Besides, thermal amplitudes are high: there is a difference of almost 13°C between the hottest month (January) and the coldest (July) and the average difference between maximum and minimum daily temperatures is of 14 to 16°C.

The main wind direction is southeast, more persistent in summer, and of an average intensity of 15 km/h. Light breezes predominate in winter.

Warm temperate climate with a dry season lasting 4 to 5 months.

This climate is present a the higher cordilleran zones of the Region, where temperatures below 0°C are more frequent thus turning the rain into snow, as the main winter precipitation. The rainy period is also longer, and the dry season lasts only 4 to 5 months.

iii) Climate of the San José de Maipo Municipality (DIA)

According to the Koeppen classification, the zone has a warm temperate climate with a long dry season. It is characterized by heavy winter rains and snow. The average temperature of the coldest month ranges between 3°C through 18°C from Las Melosas to the border with Argentina, including as well all the high ranges of the canyon; this is defined as an ice climate due to altitude, characterized by a temperature below 10°C for the warmest month, and an average minimum below 5°C for the coldest

Concerning precipitations, the yearly average is between 500 to 800mm. Rains are caused by the winds which blow very strongly upon the northern slopes of the mountains. This typical mountain climate allows summer tourism activities such as: Bathing in the rivers and streams, mountain climbing, thermals and others. In winter, the climate allows sports activities such as skiing, glacier climbing and others such as thermalism; observation of rock falls, and geologic features.

2.2 Noise

2.2.1 Introduction

In this section, the preoperational noise levels in the "Electric Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power Plant – Alfalfal S/S", consisting in two electrical energy transmission lines of 17.1 km long, which will allow to connect the energy generated by the Alto Maipo Hydroelectrically Project to the Central Interconnected Grid (SIC), are established. In turn, the Project also contemplates the expansion of the existing Alfalfal S/S by 0.45 ha to install the corresponding connections to the new lines.

The line layout will be developed along the basin of the Colorado River, where the presence of isolated houses was identified along the line, and a higher housing density in the Maitenes S/S sector, including houses and a school, was identified.

2.2.2Definition of the study area

The study area considered for this component corresponds to the noise sensitive receptors found near the Project; in this case the Los Maitenes and El Alfalfal localities.

2.2.3 Results

i) Background

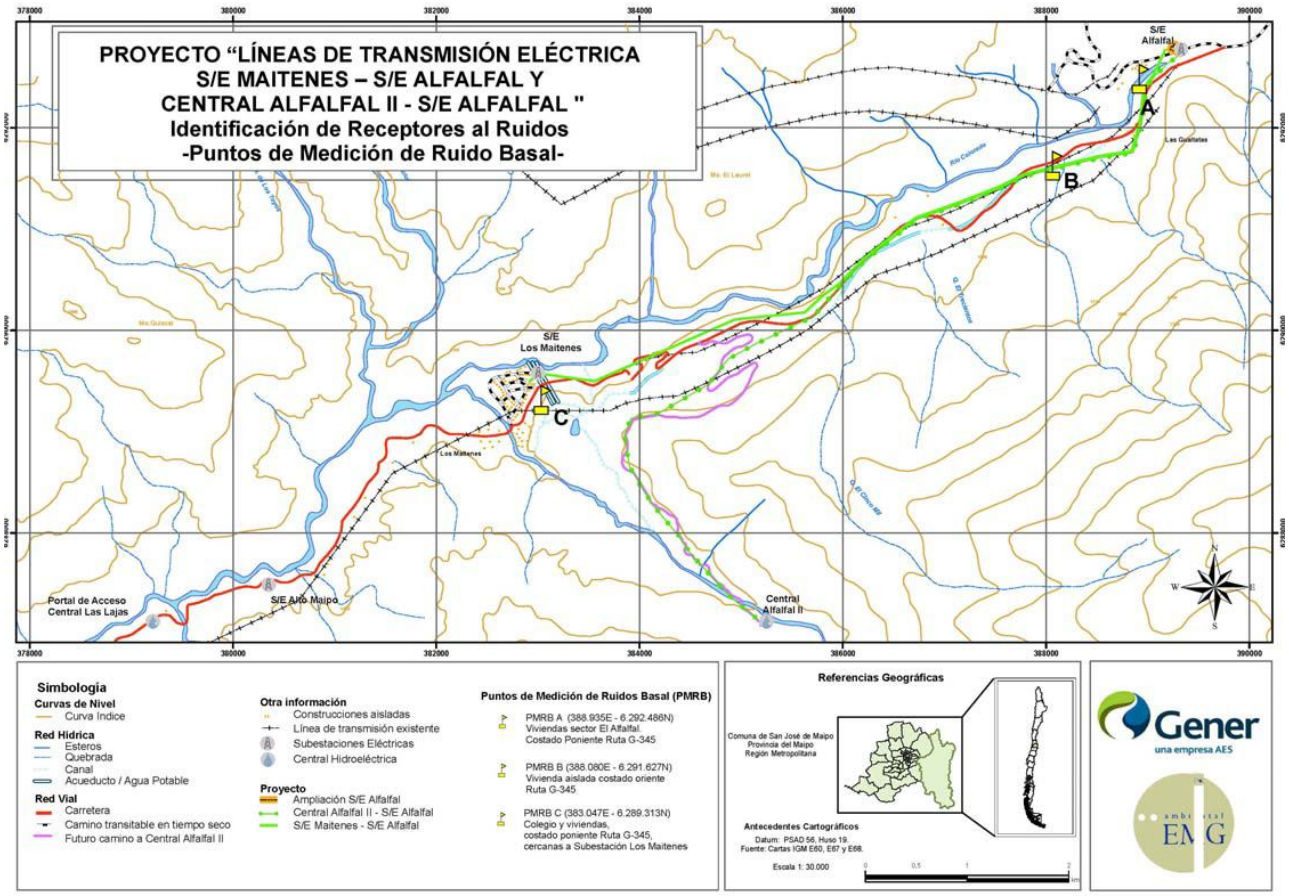
A field visit to this area of the Project was carried out on November 11, 2008, so as to identify sectors sensitive to noise and likely to receive more acoustic contamination as a result of the construction and operation of the Project. Measurements of basal noise during the day were made on that occasion. The night time basal noise measurements were done on October 02 2009.

The following equipment was employed in both occasions so as to characterize the noise baseline:

- Type 2 Integrating Sound Level Meter Delta OHM HD2010.
- Acoustic calibrator 94 dB, 1 KHz, Delta OHM HD9102.
- Windscreen
- 1.5m tripod
- Garmin 38 GPS
- Digital photographic camera.

Figure 4-2 shows the position of the noise sensitive receptors near the site area of the Project The zones having more noise sensitive receptors are shown in green and correspond to the Alfalfal and Maitenes S/Ss accesses.

Figure 4-2 Identification of noise sensitive receptors



Source: Own preparation based on the IGM E60, E67 and E68 maps, 1:50.000 scale.

Therefore, measurements were focused in these areas, belonging to the main noise sensitive receptors.

The table below shows the UTM coordinate (Datum PSAD 56) of each basal noise measurement point, the distance to the line, and a description of the environment.

Table 4-2 Position of the basal noise measurement points

Punto	Coordenada UTM Datum PSAD 56		Distancia (m)	Descripción
	Este	Norte		
A	388.935	6.292.486	80	Viviendas sector El Alfalfal. Costado Poniente Ruta G-345.
B	388.080	6.291.627	50	Vivienda aislada costado oriente Ruta G-345.
C	383.047	6.289.313	70	Colegio y viviendas costado poniente Ruta G-345, cercanas a S/E Maitenes

Fuente: Elaboración propia

It must be pointed out that no noise sensitive receptors were identified between the Maitenes S/S and the Alfalfal II Power Station; therefore no basal noise measurements were made there.

The following is a photographic record of the sites selected for basal noise measurements.

Figure 4-3 Photographic record of Points A, B and C

POINT A

POINT B

POINT C

Source: Own preparation

Basal noise levels

Measurements of the Equivalent Noise Level (NPSeq) were made with a Weigh A and Slow Response filter, according to the method established by S.D. No 146/97 to measure the background noise. The instrument was installed at 1.5 meter height.

The table below summarizes the minimum instantaneous levels (NPSeq), and maximum(NPSmax), as well as the main noise sources as identified during the measurement period, from higher to lower importance.

Table 4.3 Basal noise levels dB (A) Day and night periods

Punto NPSeq NPSmín NPSmáx Fuentes de ruido
Horario Diurno
A 52 50 59 Río, vehículos livianos y pesados, pájaros, personas, martillo, insectos, viento, gallo.
B 63 48 82 Vehículos livianos y pesados, río, viento, pájaros, insectos.
C 63 52 81 Vehículos livianos y pesados, niños colegio, pájaros, río, insectos, viento, S/E Maitenes.
Horario Nocturno
A 52 49 66 Río, vehículos livianos, pájaros, personas, perros.
B 58 56 72 Vehículos livianos, río, pájaros.
C 46 45 55 Río, pájaros, perros, S/E Maitenes.
Fuente: Elaboración propia.

Figure 4.4 Basal noise levels in dB (A) Day and night periods

Periodo Diurno
0 20 40 60 80 100
A B C
Puntos
NPSeq en dBA
NPSeq NPSmín NPSmáx
Periodo Nocturno
0 20 40 60 80 100
A B C
Puntos
NPSeq en dBA
NPSeq NPSmín NPSmáx
Fuente: Elaboración propia.

Source: Own preparation

The Equivalent Noise levels measured in the evaluated points fluctuate between 52 and 63 dB (A) and an average level of 59 dB (A) during the day, while night time levels fluctuate between 46 and 52 dB (A) and an average of 52 dB (A).

The main noise sources are the light and heavy vehicles, the Colorado River sound, and those typical of semi-rural areas, such as birds, wind, domestic animals, the wind in the trees and insects.

2.3 Geology and geomorphology

2.3.1 Introduction

The main results of the study on the Geology, Geomorphology and Natural Risks of the Project "Electric Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power Station – Alfalfal S/S" as part of the Environmental Impact Assessment to be submitted to the Environmental Impact Assessment System (SEIA).

The details of this document are given in Annex 8.

The Project will be developed in the Colorado Canyon of that river, located in the Municipality of San José de Maipo belonging to the Cordillera Province, Metropolitan Region.

Generally speaking, the Project will be framed by Andes Mountain Range, which features high mountains and a young relief recently formed. Some of the geologic units present in the area studied date from the Cenozoic era, tertiary period. Therefore, the Project will be placed over alluvial, lacustrine and mostly recent gravitational deposits.

From a geomorphologic point of view, the Project will be sited on the terraces formed by the deposits carried by the Colorado River.

2.3.2 Definition of the service area

The direct service area (DSA) of the Project is determined by the geologic and geomorphologic units over which the line towers and the planned expansion of the electrical substation will be located.
The indirect service area (ISA) corresponds to the Colorado Canyon geomorphologic unit where the Project will be located, in some zones on the slope, and in others on the alluvial terraces, also called plains.

2.2.3 Results

i) Geology

General geology of the area studied

The electric transmission system analyzed herein will be located in a canyon of the Andean mountains system, east of the city of Santiago, and specifically on a terrace of the Colorado River valley. In this canyon, rock outcrops dating from the Carboniferous era to the present, can be found.

The lines will be laid in an area showing Paleozoic, Mesozoic, and Cenozoic rocks, even though the Project will be mainly established on upper tertiary and quaternary Cenozoic epoch rocks.
These rocks have an important presence and belong mainly to continental volcanic and volcano-sedimentary strata such as tuffs, volcanic breccia, lavas and sediments set discordantly over previous terrains and to sedimentary and filling fluvio-glacial deposits.

Geologic units present in the area studied

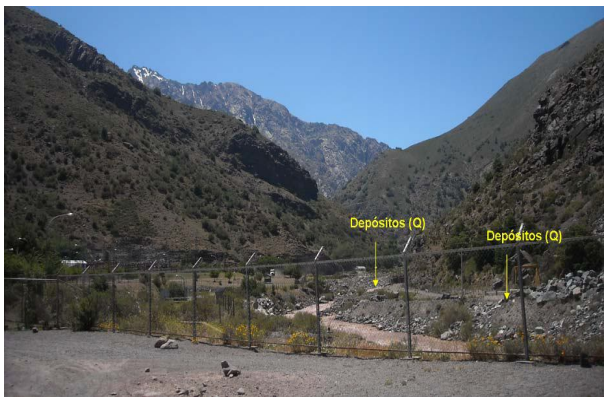
The Project will be mostly located over sedimentary, volcanic and sedimentary rocks belonging to the Quaternary Period and to the Upper Tertiary in some sectors.

The geologic units identified in the area of the Project belong to:

Fluvial, fluvioglacial, alluvial, lacustrine and gravitational deposits (Q).

The fluvial, fluvioglacial, lacustrine and gravitational deposits are associated to the filling of the Central Depression; the alluvial deposits form large terraces in the Maipo River valleys. Figure 4-5 shows alluvial deposits near the El Colorado River.

Figure 4-5 Deposits belonging to the (Q) unit, near the Alfalfal S/S



Fluvial and alluvial deposits

Fluvial deposits above an elevation of 1,500 masl change progressively to glaciofluvial, without changes in their essential features. The towers are to be placed upon this unit below this elevation, therefore only those fluvial deposits which were carried by the river and formed terraces near it will be considered (Thiele, 1980).

Lacustrine deposits

These are small deposits, accumulated in lakes behind some frontal moraines or deposits produced by material tumbling down into the valleys. These are mainly laminated silt and clay deposits.

Gravitational deposits

These are the most abundant in the area surveyed. The most important ones are those produced by the creeping of the soil and talus, producing detritic accumulations at the base of soft slopes (Thiele, 1980).

The deposits and materials produced by the talus are more important as elevation increases towards the interior of the valleys, that is to say their numbers increase the higher above sea level they are found. The newer materials are completely loose, many are stabilized but others could generate gravitational processes.

Farellones Formation (TSF)

The name of this formation is determined by the sequence of layers that outcrop near the Farellones locality, defined As a strong unit made up by classic terrigenous sedimentites, andesitic, rhyolitic and basaltic lavas and pyroclastic rocks alternating with sediments deriving from the weathering of those effusive rocks.

The sequence is formed by lavas, tuffs and ignimbrites having breccia intercalations. Lavas show a manifest dominance over tuffs and breccia. The alternation of finer Volcanoclastic rocks, in layers 4 to 5 meters thick, gives a marked stratification of the series, which helps to tell it apart from the Abanico Formation, which has more massive appearance in the terrain.

The lapilli tuffs are light grey and have 4 to 12mm diameter rhyolitic and porphyry andesite clasts in a fine cineritic matrix. Ignimbrites are light grey and show a fluidal texture, with andesite and obsidian clasts. Volcanic breccias contain angular fragments over 2mm in diameter. These rocks seem to be strongly altered locally to clay, limonite, hematine and silica. Lacustrine sedimentites are finely stratified conglomerates, sandstones and lutites; their outcrops are found at the western side of the Laguna Negra pond and the moraine of the same name.

The estimated age of this formation is the Miocene and is distributed from north to south, outcropping in better formed and less deformed layers than the Abanico Formation, keeping a sub-horizontal position to a maximum inclination of 25°. Slight angular disconformities are seen in this sequence, which seem to be very common in this type of volcanic units.

ii) Geomorphology

General geomorphology of the area studied

The Project will be established in the Central Zone of the country; from a geomorphologic point of view this zone shows three well-defined basic units. Andes Mountain Range, Intermediate Depression and Coastal Mountain Range.

The Andes Mountain Range reaches heights about six thousand meters in this sector, while the Coastal Mountain Range reaches two thousand meters; The intermediate depression forms closed basins, filled by fluvio-glacio-volcanic sediments resulting from the action of the rivers that carried them. The Santiago basin is the most typical.

The Quaternary period glaciations also produced important outcomes in the morphology of the Central Zone, as the Glacial shapes predominate in the morphology of the high Andes Mountain Range valleys, while the superficial forms of the Longitudinal Valley, also called Intermediate Depression, are composed by the sedimentation of the glaciers and the fluvioglacial rock movements.

The most important high peaks in the area are the Nevado Juncal (6,100m); Nevado de los Piuquenes (6,017m); Cerro Marmolejo (6,110m) and the San José Volcano (5,880m).

The Project will be located between 750 and 1,500 masl that is to say in the short horizontal space of the Mountain Range called piedmont, specifically the Colorado Canyon.

Geomorphologic units present in the area studied

Generally speaking, the San José de Maipo Municipality is framed by the Andes Mountain Range which has a young upheaval relief.

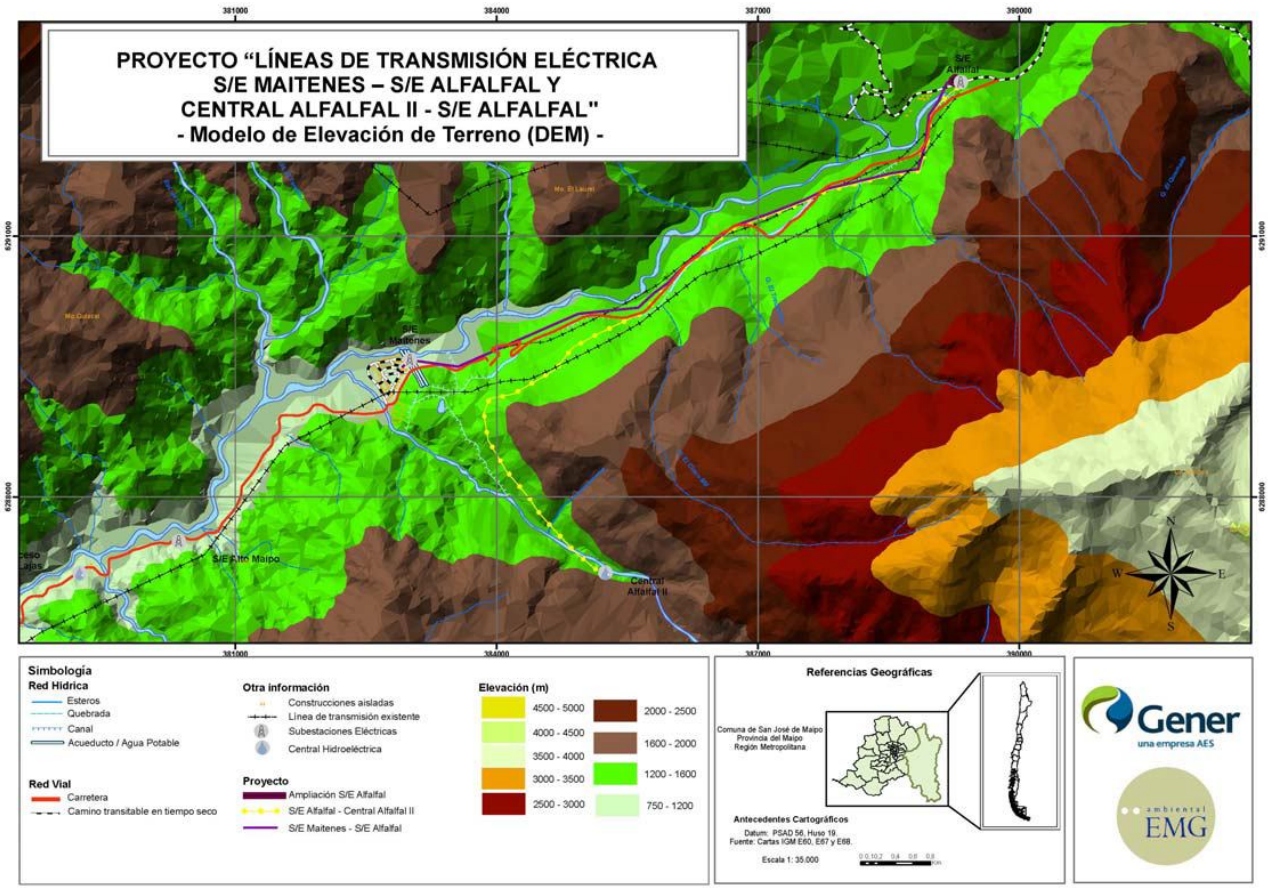
This Municipality is configured first by a fault front which expresses itself in an abrupt mountainous landscape with mountain ranges and deep valleys called "cajones", among them the Colorado River Canyon where the Project will be sited.

The San José de Maipo Municipality shows the following main geomorphologic elements: Mountain, piedmont, fluvial terraces, creeks, river bed and the river channel. The Project will be placed in the piedmont of the canyon.

Figure 4-6 shows the Colorado River canyon, the exposure of its abrupt slopes and concretely the location of the Project which will be placed in the north-facing slope, where the relief is less pronounced, that is to say its configuration is nearer to a terrace due to a heavy accumulation of sediments. The southern exposure slope is distinguished by its darker tones as compared to the northern one and in general its grades are steeper.

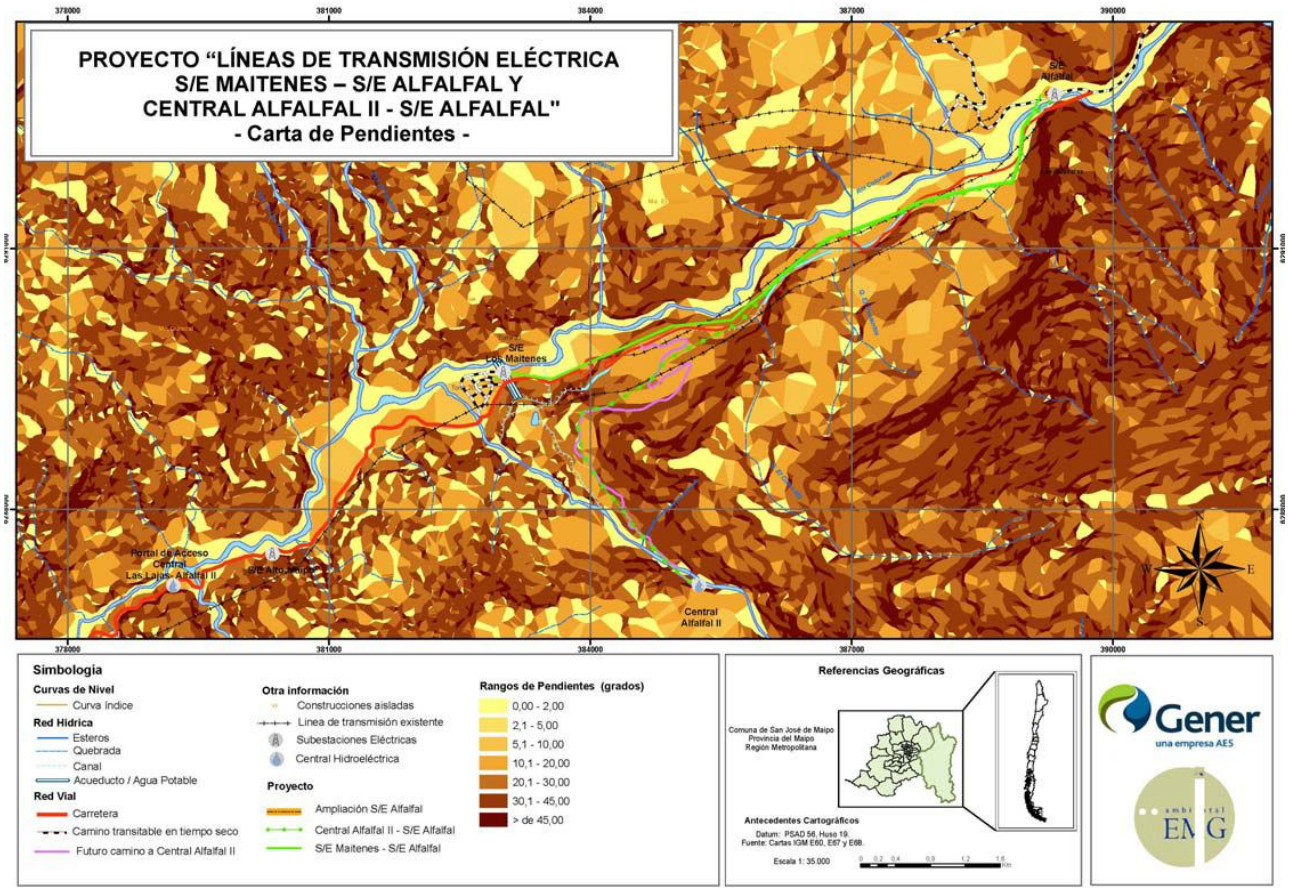
The grades chart shown in Figure 4-7 gives the inclination of the terrain where the Project is located, so as to put the possibility of occurrence of risks into its context.

Figure 4-6 Digital Elevation model



Source: Own preparation based on the IGM E60, E67 and E68 maps, 1:50.000 scale.

Figure 4-7 Grades chart



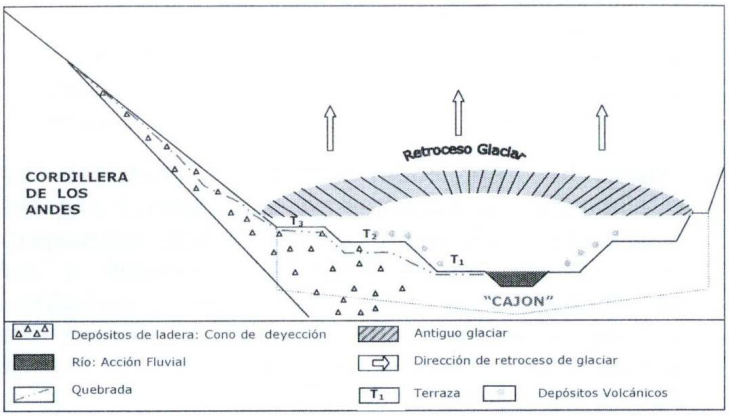
Source: Own preparation based on the IGM E60, E67 and E68 maps, 1:50.000 scale

It can be observed that in general the Project will be placed in the flatter zones of the Colorado Canyon, where a series of deposits have accumulated; however, some vertices are placed in zones having steep grades.

In general, less than 50% of the Project is placed in flatter zones with grades between 0-10 % and most of it is located in sectors with moderate grades and in the sunny hillside (northern exposure) and an altitude (between 750 and 1500 masl) which represents the foothills.

The section of the line to be developed between the Alfalfal II Power Plant and the Alfalfal S/S is mainly located in sectors with steep grades, and is found in the talus of hillsides or mountains of the steep canyon of the Aucayes stream.
On the other hand, the geomorphology of the Colorado Canyon has been the result of erosive processes, undermining and tectonic processes that generated different folds and fractures during different geological stages. Besides, the features of the present relief have their origin in the process called by Bürgel "fluvio-glacio-volcanic". The following diagram explains the forces at work in the formation of the canyons system, among them the Colorado canyon.

Figure 4-8 Formation of the Canyon. Schematic of the Fluvio-Glacio-Volcanic process



The glacial retreat accounts for the formation of an incipient valley, as a product of the erosion associated to this phenomenon. This retreat produced the main features of the relief, as are the abrupt slopes of steep mountains along a deep canyon. On the other hand, the river causes a fluvial action consisting in the erosion and accumulation of material, this double action has formed different terrace level (T1, T2 and T3 in the schema).
The action of deposit on the hillsides also manifested itself with great energy in the linear sliding and the violent irruption of lateral cones, perpendicular to the axis of the river, which modify it interrupting the regular geomorphologic sequence. The deposit of those materials has formed the dejection cones and the union of these formed the talus. There is also the factor of deposit of volcanic material which has formed different deposit levels and generated a complex relief. The volcanism forced masses of materials to fall into the lower valleys filling them, creating creeks, affluent rivers, different base levels, and bottling up of the waters.

Therefore, the geomorphology has been the result of the joint action of processes such as accumulation and erosion of deposits along the years creating different geomorphologic features that can be observed along the line and are detailed below.

Dejection cones and erosion cones

The dejection and erosion cones are the result of the accumulation of sediments in the cordillera piedmont or simply in the lower zones of the slopes, derived from the erosion and landslides of material from the upper zones, where the rocks split as a result of the freeze-thaw process, and are also carried to the lower zones under the force of gravity or the runoff action of the water.

The dejection cone is associated to the accumulation of sediments due to water action while the erosion cone results from the sliding of the sediments due to the force of gravity.

The following is an erosion cone found in the southern slope near the El Alfalfal Bridge, fronting the Project and within the Farellones geologic formation.

Figure 4-9 View of an erosion cone placed in the southern hillside of the Project, next to the El Alfalfal Bridge.

These geomorphologic units can be told apart taking into account the position and size of the sediments. The erosion cone has clasts, rubble stones or in general larger size sediments which are found below the smaller and finer sediments, as the force of gravity gives stronger energy to the larger sediments. The dejection cone is recognized because the finer deposits are sent to the base of the cone as the product of water action and the clasts or bigger deposits stay above the finer sediments.

Slope

The union of these cones is known as Slope. Half of the Project will be placed over slope sectors, fluctuating between strong and moderate grades. A large part of these formations is colonized by vegetation.

Old slides

The flows or landslides are gravitational movements of coherent material displaced at high speed over a surface; these are produced by a dynamic surface upon an immobile surface that can be a diaclase, fracture, fault or stratification plane parallel to the slope.

Old slides can be observed in some sectors of the Project, these are consolidated and cemented.

Figure 4-10 Sliding of a cemented rock mass and below it a dejection cone.

The above figure shows a rock mass belonging to an old already consolidated landslide and below it a dejection cone beginning to be colonized. This image belongs to the El Alfalfal sector.

The section of the Project between the Maitenes and Alfalfal S/Ss will also be placed on the northern exposure side of the Colorado Canyon; However, it will also cross flat zones belonging to a second terraces level, older than the present river terrace and which could be called an alluvial terrace produced by the accumulation of deposits. The alluvial plain or terrace, where part of this line will be placed, belongs to a system of stepped terraces, with successions of incision slopes and horizontal-plane surfaces which are testimonies of old fluvial plains abandoned by the river.

The part of the Project to be developed between the Alfalfal II Power Plant and the Alfalfal S/S is also established in an upper terrace of the Aucayes stream, specifically the northern exposure side. Part of the line will be placed upon the southern slope, with sharp grades.

Alluvial terraces

These are portions of land in the shape of banks, leveled by the sediments which filled them by being carried and deposited by a stream.

iii) Natural Risks

A natural risk is considered as such when there is human population presence or else some natural phenomenon can affect the normal development of human activities, affecting infrastructures and associated installations.

Geologic risks include the probability of seismic movements in zones near the Project or in its service radius (between parallel 33° 00' and 33° 30' and longitudes 70° 30' and 71 °00'), this probability is inferred from the significant seisms recorded in the past and the faults existing in the zone.

The geomorphologic risks arise mainly from geomorphic processes, described in the report concerning the geomorphology present in the Project; among those are landslides and flows.

Geologic risks

The occurrence of big earthquakes is due to the sudden release of elastic or deformation energy accumulated in the contact of tectonic plates which move as a result of convection phenomena redistributing thermal energy.

These big earthquakes have been recorded by the Seismologic Service of the University of Chile, which listed for this zone the main earthquakes of a magnitude equal or greater than 7.0 in the Richter scale

The earthquakes listed occurred in a radius of approximately 100km surrounding the zone of the Project.

The destructive seisms recorded for the studied zone are listed below, since 1570 until May 2005, between coordinates 33° 00' and 33° 30' latitude south and 70° 30' and 71 °00' west longitude.

Table 4-4 Record of the most destructive earthquakes in the zone, from 1570 to 2005.

Fecha Magnitud del sismo (escala Richter) Ubicación (lat/long)
08 de febrero 1575 8.3 33º40´ / 70º61
13 de mayo 1647 8.5 35º / 72º
08 de julio 1730 8.7 33º050 / 71º63
19 de noviembre 1822 8.5 33º050 / 71

Fecha Magnitud del sismo (escala Richter) Ubicación (lat/long)
26 de septiembre 1829 7.0 33º050/71º630
2 de abril 1851 7.1 33º320 / 71º420
16 de agosto de 1906 7.9 33º000 / 72º00
28 de marzo de 1965 7.4 32º418 / 71º100
8 de julio de 1971 7.5 32º511 / 71º207
16 de octubre de 1981 7.5 33º134 / 73º074
Fuente: http://ssn.dgf.uchile.cl/home/terrem.html. Servicio Sismológico Universidad de Chile.

Source: http://ssn.dgf.uchile.cl/home/terrem.html. Servicio Sismológico Universidad de Chile.

Ten significant seismic movements have occurred within the service area of the Project as recorded by the Seismologic Service of the University of Chile; this sector, as well as the whole national territory, shows possibilities of repeated occurrences of big earthquakes.

Geomorphologic risks

The geomorphologic risks are linked to morphogenetic processes and are associated to the geomorphologic features present in the studied area, such as the erosion and dejection cones, old flows and alluvial terraces.

The risks can then be classified as falls, landslides, flows – and
slow movements. The first is characterized by the free fall of material down the slope as a result of gravity, this risk or process causes the formation of the erosion cone.
In the sector surveyed these processes show mainly on the southern side, in the northern side (where the Project is placed) there is less probability of occurrence of this phenomenon; However, there are some creek sectors where this kind of downhill movement of material occurs.

The flows respond to the same logic as the previous risk, however, the sediments move as fluids due to the presence of water.
This can happen during the winter, with heavy snowfalls and rains. These flows are also called mud slides and occur when all the material of a hillside is waterlogged and flows down to the valley is a catastrophic way.

The flows are due to gravity movements: a dynamic surface slides over a static surface.

2.4 Use and quality of the soil

2.4.1 Introduction

Together with a description of the series and phases likely to be found in the site area for the Project "Electric Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power Plant – Alfalfal S/S", this section contains the environmental background data corresponding to the Soil. The use of soil categories, drainage, and fruit growing aptitude are also covered. The present use of the soil is also described, as a complement. Later, an analysis of the territorial situation of the lands involved was made by reviewing the existing regulations and norms concerning the use of the soil.

The Project will be developed in the Colorado Canyon of the river of the same name, located northeast of the Municipality of San José de Maipo belonging to the Cordillera Province, Metropolitan Region of Santiago.

2.4.2 Definition of the service area

The direct service area (DSA) taken into account for this component is the zone considered for the execution of the Project, that is:

- Line between the Maitenes and Alfalfal S/Ss, 7.6 km long and a 30 m wide restriction strip.
- Line between Alfalfal II Power Plant and Alfafal S/S, 9.5 km long, and a 40 m restriction strip.
- Area for the expansion of the Alfalfal S/S.

2.4.3 Results

i) Soil usage capacities

The soils in the area of service of the Project belong to the valley formed by the Maipo river and are of alluvial-coluvial origin, or mixtures of both. In the case of Miscellaneous River Soils (MR) and stratified alluvial terraces (TE), these are occasionally used for small scale agricultural production, given their inherent inability to retain water and their mainly coarse nature.

Based on the information existing at the CIREN, there are three Series of soils in the area of the Project, all located in hillsides and terraces formed by the Colorado river. Their usage capacities range from VI to VII. Other identified areas are not assigned soil use capacities, as they are they correspond to the river canyon itself.

The types of soils identified are coluvial Miscellaneous, river Miscellaneous and Stratified alluvial Terraces (TE-7).

The distribution of the different soil types within the area of the Project is shown in the following figure.

Figure 4-11 Series and use capacities of the soils in the area of the Project.

S/E Maitenes
S/E Alfalfal
C. Alfalfal II
Leyenda
Línea S/E Maitenes – S/E Alfalfal
Línea Central Alfalfal II – S/E Alfalfal
Tipo de Suelos
TE-7; Capacidad de uso: VIs0
MC; Capacidad de uso: VIIe
MR; Capacidad de uso: VIII
R; capacidad de uso: VIII
Nota: R corresponde a sustrato rocoso.
Fuente: Elaboración propia.

Miscellaneous soils

The soils of the miscellaneous type incorporate the varieties Miscellaneous Coluvial (MC) and Miscellaneous River (MR), as described below.

Miscellaneous coluvial (MC)

This corresponds to stony grounds, broken down and forming fans upon the middle and lower part of the hills. They are made up from gravel, stones and boulders, heterogeneous, unconsolidated, with a fine sandy to frank-sandy texture. Classified as:

- Usage capacity: VIIe
- Drainage Class: 5
- Irrigation Category: 6
- Fruit Growing Aptitude: E
- Erosion: 1
- Agricultural Aptitude: 7

River Miscellaneous (MR)

Corresponds to soils in a position of recent alluvial terrace, of scant profile development, with high content of gravels and large rubble and scant arbustive vegetation. Classified as:

- Usage capacity: VIII
- Drainage Class: 6
- Irrigation Category: 6
- Fruit Growing Aptitude: E
- Erosion: 0
- Agricultural Aptitude: 8

Stratified alluvial terraces (TE)

Correspond to stratified soils placed in the recent terraces of rivers, stream and water courses of the Metropolitan Region.

TE-7

Corresponds to stratified soils, of sandy texture, thin, flat, with moderate surface stoniness, excessive drainage and subject to occasional flooding. Classified as:

- Usage Capacity: VIs0
- Drainage Class: 6
- Irrigation Category: 5
- Fruit Growing Aptitude: E
- Erosion: 0
- Agricultural Aptitude: 6

Synthesis

From the review and analysis of the collected information about the zone, it was possible to identify three types of soils, from defined soils series to miscellaneous soils, as detailed below:

Table 4-5 Soils identified in the area of the Project.

Suelo Fase	Capacidad de uso	Clase de drenaje	Categoría de riego	Aptitud frutal	Erosión	Aptitud agrícola
Misceláneo coluvial MC	VIIe	5	6	E	1	7
Misceláneos río MR	VIII	6	6	E	0	8
Terrazas aluviales estratificada TE – 7	VIs0	6	5	E	0	6

Severe use limitations are seen in all the identified soils, mainly due to the scant development and low water retention, excessive grade, limited depth and excessive stoniness, among other characteristics.

ii) Agricultural use of the soils

There is a total of 12,800 inhabitants in the San José de Maipo Municipality, on a surface of 4.989 km^2 occupying nearly 90% of the Cordillera Province, and representing over 30% of the total surface of the Metropolitan Region.

It belongs to the high basin of the Maipo River, which is the main river of the Metropolitan Region. Given the great extension of the high Maipo basin, the main water reserves of the Metropolitan Region are located here. At the same time, it is an important flora and fauna reservation area. Its landscape and vicinity to the city of Santiago have allowed an important tourism development of the Municipality during all seasons of the year.

An important mining activity has been and is still being carried out in the zone. Initially, gold and silver mining, now mainly non metallic mining (mostly sandstone and gypsum).

A 73% of the surface of the Municipality corresponds to the high cordillera where it is not possible to find developed soils as such, only a rocky substrate with scant evolution. The remaining 27% represents a surface of 122,079 ha with soils of different degrees of evolution. The soil surfaces and their respective uses are shown in the following table.

Table 4-6 Use of the soils in the San José de Maipo Municipality

Uso del suelo	Superficie (ha)	Porcentaje
Cultivos anuales y permanentes	736	0,60%
Forrajeras	446	0,36%
Suelos en barbecho	170	0,14%
Pradera mejorada	743	0,61%
Pradera natural	14.452	11,84%
Plantaciones forestales	273	0,22%
Bosque nativo	26.722	21,89%
Matorrales	77.891	63,80%
Infraestructura	647	0,53%
Total de suelo	**122.080**	**100.00%**

As it can be seen from this table, the main uses of the soils in the Municipality are determined by the scrubland, the native forest and the natural prairie, in decreasing order. The scrubland occupies 64% of the area and then follows the native forest with 22%; the natural prairie is last with 12%.

The use of the soils in the area of the Project corresponds mainly to zones with natural vegetation, mostly covered by native species forming part of a sclerophyll formation of the Central zone of the country (scrubland, native forest and natural prairies).
Occasionally, it is possible to find introduced species grown wild, as well as some cultivation.

The vegetation found in the stretch between the Maitenes and Alfalfal S/Ss is described below:

Table 4-7 Formations and/or species present in the stretch between the Maitenes and Alfalfal S/Ss

Ubicación	Formación y/o especies presentes*
Torre 23	quillay, bollén, pimiento.
Entre Torre 23 y frente a Torre 34 (próximo a río Colorado)	bollén, cactus, quillay y espino.
Entre Torre 34 y Torre 40 (ambos próximos a río Colorado)	alfalfa
Frente a Torre 40 (próximo a río Colorado)	quillay, colliguay, bollén, cactus, romerillo.
Frente a Torre 42 (próximo a río Colorado)	espino, quillay, bacaris, palqui.
Sector S/E Alfalfal	En el entorno se encuentran quillay, maitén, bollen y olmo.

*__Scientific designations:__ quillay (*Quillaja saponaria*); romerillo (*Baccharis linearis*); espino (*Acacia caven*); palqui (*Cestrum parqui)*; colliguay (*Colliguaya odorifera*); maitén (*Maytenus boaria)*; bollén (*Kageneckia oblonga);* cactus *(Echinopsis chiloensis ssp);* olmo *(Ulmus minor);* alfalfa (Medicago sativa); pimiento (Schinus molle).

Source: Own preparation.

As can be seen in the above table, the main use of this soil is that of protection of wildlife and only a small portion is destined to livestock, growing artificial alfalfa prairies.

iii) Territorial Regulations

Generally speaking, the Project is ruled by the provisions of the General Urbanism and Building Regulations (OGUC) and the Regulation Plan for the Santiago Metropolitan Area (PRMS).

It should be stressed that the San José de Maipo Municipality does not have its own instrument to regulate the use of soil, so it is governed by the provisions of the General Urbanism and Building Regulations (OGUC).

General Urbanism and Building Regulations (OGUC).

This instrument allows the classification of the type of infrastructure concerning the Project as well as the restriction of occupation of the subjacent grounds.

Article 2.1.29 classifies the electric transmission line as an energy infrastructure; so, the development of any kind of buildings both under and within its protection strips or zones is forbidden (Article 5.1.9).

The same article 2.1.29 specifies that, in the territorial planning instruments regarding rural areas, this type of installation will always be admitted, and only the requirements or conditions for the construction of such installations or buildings, necessary with respect to this type of use of the soil, may be set forth.

On the other hand, it states that the distribution network, communications and domiciliary services and in general the infrastructure layouts, will always be understood as admitted and will follow the provisions established by the competent authorities. The territorial planning instrument must recognize the protection strips or zones determined by the norms in force, and assign them to parks, highways or the uses determined by such norms.

Likewise, it defines the protection strip or radius (in its classification of the zones or grounds generated by the human activates or intervention, within which are included high voltage towers) as a risk area constituting potential danger for human settlements (Article 2.1.17).

Concerning the soil uses as identified by the PRMS, it only refers to the Protection areas for Natural Value Resources (Article 2.1.18), defining them as sea, lake or river borders, national parks, national reserves, natural monuments, high summits, and all specific areas or natural elements as protected by the laws in force. It specifies that, in these sectors, non-building zones or zones with restricted building conditions will be established.

Regulation Plan for the Santiago Metropolitan Area

Concerning the territorial situation of the area for the localization of the Project, this is governed by the Regulation Plan for the Santiago Metropolitan Area (PRMS) of 1994, being developed over areas of Natural Value, specifically a Ecological Preservation Area.

The development of activities that ensure the permanency of the natural values will be allowed in these areas, restricting their use to the following purposes: Scientific, cultural, recreational, sports and tourism, with the minimum indispensable installations and/or buildings for their development.

The regulations that will govern these activities and their complementary uses as well, such as: safety equipment, communications, health, trade and public parking space will be defined in every instance by the Regional Metropolitan Ministry Board of Housing and Urbanism, taking into consideration their specific characteristics and the pertinent studies approved by the corresponding competent entities.

2.5 Hydrology and Hydrogeology

2.5.1 Introduction

The purpose of this study is to establish the baseline for the area corresponding to the Project "Electric transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power Plant – Alfalfal S/S" from the hydrologic and hydrogeologic point of view.

The Project will be developed in the Canyon of the Colorado River, located in the Municipality of San José de Maipo Cordillera Province, Metropolitan Region.

2.5.2 Results

i) Hydrological characterization

The Project will be located in the sub-basin of the Colorado river, extending from the sector of the Maitenes S/S, passing by the Alfalfal S/S, and from there to the future Alfalfal II Power Plant, in the Colorado River basin, one of the main tributaries of the Maipo River.

Draining network

The draining network along this reduced layout is of the dendritic type, where tributary streams subdivide above the River like three branches. The main water course is the Colorado river, and on its eastern river is sited the Alfalfal S/S.

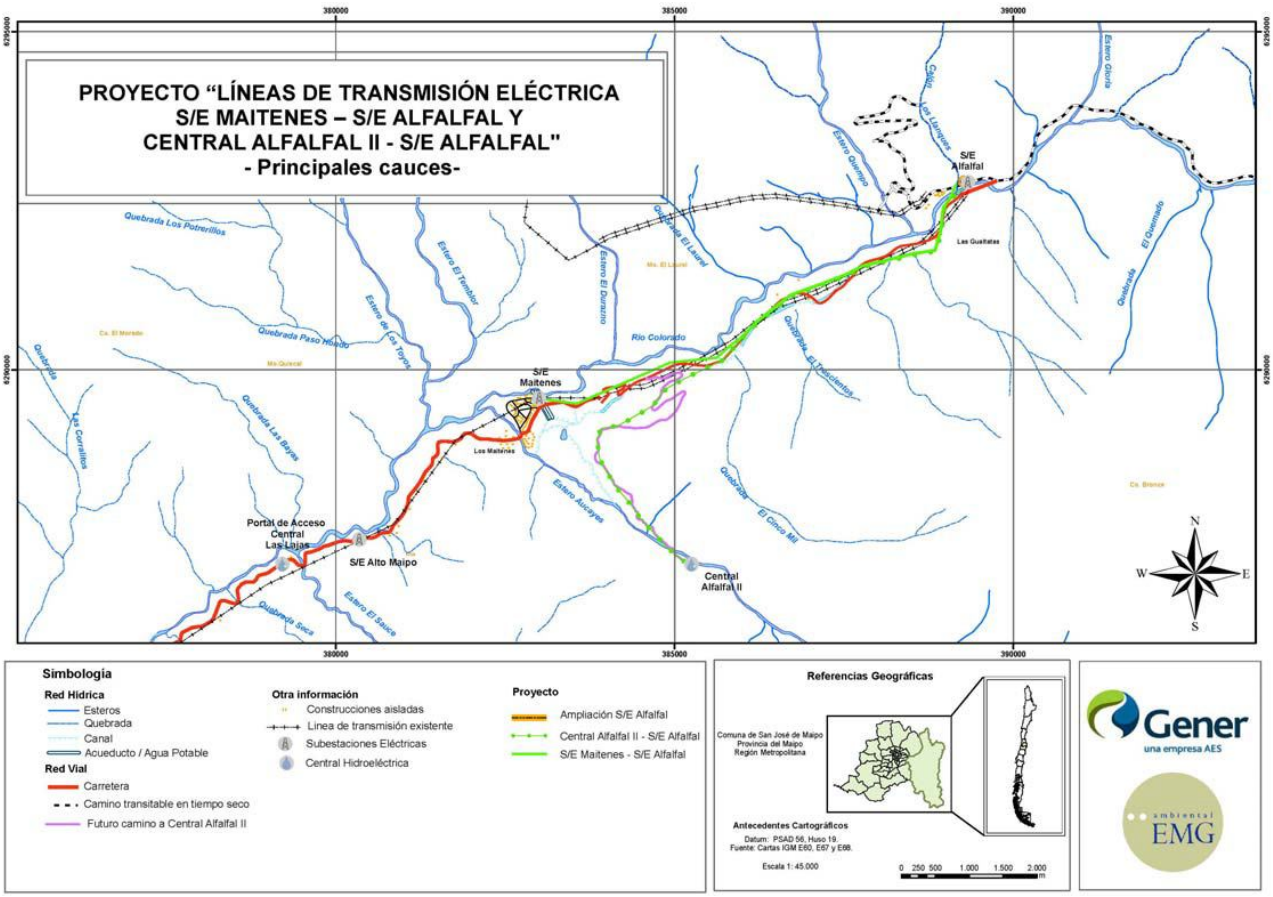
The Colorado river is a second order water course, born in the high peaks of the Tupungato volcano and receives as main tributary the Olivares river. The Colorado River basin has three sections:

- Sub-basin of the Olivares River, with an average yearly flow of 10,1 m3/s;
- Basin of the Colorado River, before the junction with the Olivares River, with an average yearly flow of 25 m3/s;
- Basin of the Colorado River, before the junction with the Maipo River, with an average yearly flow of 33 m^3/s.

The Colorado river has an altered natural hydrologic regime, that is, it is subject to human intervention corresponding to the Maitenes and Alfalfal hydroelectric plants.

The layout includes the lower and middle section of the Colorado River, as second order water course.

Figure 4-12 Main water bodies in the proximities of the Project



Source: Own preparation based on the IGM E60, E67 and E68 maps, 1:50.000 scale.

According to the antecedents submitted in Chapter 1, the lines cross the Colorado River at one time, but this will not imply the installation of structures in its bed. The surface of this sub-basin is of 507.2 km2; the channel has and average width of 60 meters in this sector.

Aucayes Stream

It is characterized by the presence of the typical natural vegetation of the zone on the banks of the creek, the axis being quite cleared since it has a permanent flow which is used mostly in the upper zone for human consumption, irrigation and hydroelectricity. The median grade is of 6%.

The Aucayes Canal is placed on the right bank of the stream (See Figure 4-13).

Figure 4-13 Aucayes Canal

Source: Own preparation on the basis of a Google Earth image.

Figure 4-14 Aerial view of the Aucayes Canal on the right bank of the stream

Source: Own preparation on the basis of a Google Earth image.

An intake has been built on the Aucayes stream, coordinates UTM N 6.287.477 and E 384.634 as can be seen in the following figure.

Figure 4-15 Intake on the Aucayes stream

Source: Own preparation

Fluviometry

The available fluviometry information needed for the characterization was obtained from the DGA, mainly from the study "Evaluation of the Surface Water Resources of the Maipo River Basin (STD N° 145) of May 2003. The pluviometric data was obtained from the National Water Bank of the DGA.

Concerning the drainage networks, the reference is the IGM mapping, charts E60, E67 and E68 scale 1:50.000 and implemented for their analysis with the SIG arc view software.
Colorado River

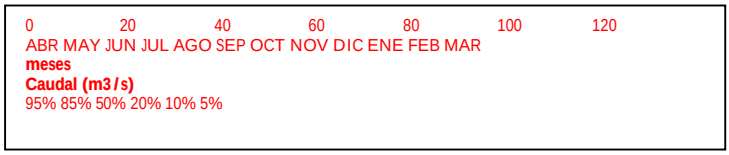
The hydrometric control of the Colorado River (in its distal section) is performed by a flow measurement station called "Colorado River Before Junction with the Maipo River". The average monthly flow for different surplus probabilities is shown in the following table.

Table 4-8 Average monthly flow of the Colorado River before its junction with the Maipo River (m3/s)

Probabilidad de excedencia	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	ENE	FEB	MAR
95%	11,5	10,12	8,87	8,25	8,73	9,53	11,79	17,73	25,55	30,84	28,25	20,24
85%	13,84	11,87	10,82	10,27	10,62	11,83	15,04	23,26	33,59	39,17	34,42	24,26
50%	18,93	15,57	15,19	14,91	14,84	17,11	22,79	36,93	53,52	58,85	48,22	33,01
20%	24,42	19,42	20,01	20,17	19,46	23,09	31,93	53,75	78,14	81,91	63,38	42,39
10%	27,77	21,7	23,02	25,04	22,34	26,91	38,00	65,33	95,14	97,10	72,84	48,11
5%	31,13	23,97	26,03	29,92	25,21	30,74	44,06	76,90	112,13	112,29	82,30	53,82

Source: DGA

Figure 4-16 Flows generated in the Colorado River basin (m^3/s) +



Source: Own preparation.

According to the data shown in Figure 4-16, it is clear that the Colorado River regime is strictly nival.

In short, it is noted that the Colorado River has a nival regime, a steep grade, and therefore a high erosive power, which is a key aspect for the location of the Works associated to the supporting towers considered in the Project, which has been defined sufficiently far from the channels, so there is no intervention of natural water courses (see detail of the location of the structures in Annex 1).

ii) Hydrogeologic Characterization

The hydrogeologic units identified for the area of the Project correspond to the Rock unit and the Filling unit, a short description of these is given below.

Rock Unit

This unit has lithological, structural, geomechanical and/or hydraulic (properties) that do not make it suitable to develop good aquifers. It is represented by the Miocene Volcanic Unit (Tsf) corresponding to volcanic rocks, andesitic, rhyolitic an basaltic lavas plus pyroclastic rocks alternating with sediments derived from the weathering of those effusive rocks. The rocks of this unit have been isotopically dated between 17.3 and 18.5 Ma, which allows assigning them to the Upper Tertiary (Miocene). They are distributed in a N-S strip parallel to the Abanico Formation volcanic unit and immediately to the east of it, covering a large part of the Colorado River Valley. The permeability of this volcanic unit is practically nil.

Filling units

There are different filling units within the area of the stretch from Maitenes to Alfalfal S/Ss; according to their permeability characteristics they constitute different hydrogeologic units, which are described below:,

- Fluvial deposits (Qf)
- Old fluvial deposits (Qf)
- Slope rubble and/or Dejection Cones (We)

Fluvial deposits (Qf)

These include coarse grained clastic sediments, located on the banks of the present bed of the larger rivers. They correspond to sediments of the river bed that have been carried, formed mainly by gravel and sandy gravel of good selection, with scant or nit compacting. These are not important aquifers. The sediments of this unit have low compacting, good selection and high porosity and permeability.

Old fluvial deposits (Qfa)

These are terraced deposits found backing to the axis of a determined fluvial water course and represent the different stages of the fluvial erosion cycle of a water course in particular. These are polimictic deposits, very homogeneous, slightly stratified with rounded clasts up to 20cm in diameter. These are aquifers of minor importance. The sediments of this unit show high to middle compacting, depending on the sector of the terrace, they show good selection and medium porosity, low to middle permeability values.

The following figures show the Aucayes stream and Colorado River terrace deposits. Figure 4-17 clearly shows the outcropping of the volcanic deposits of the Farellones Formation, constituting a border to water runoff.

Terraced deposits on the right bank of the Aucayes stream, with outcrops of impermeable volcanites of the Farellones formation

.

Terrazas
Central Maitenes
Estero
Aucayes
Formación
Image not copied

Figure 4-18 Terraced deposits on the Aucayes Stream (Ta) and Colorado River
(Image not copied)

Slope rubble and / or Dejection Cones (Qe)

The hillsides are covered by a discontinuous layer of fragmented material resulting from intense fracturing and weathering processes. Given their great permeability, these deposits help pluvial reloading.

iii) Hydraulic properties

The following are the hydraulic properties which will be described further on:

- Permeability:
- Static level;
- Ground water movement, and
- Productivity of the wells.

Permeability

The recent pluvial deposits show high to medium, permeability values of 10 to 10^{1}•. The terraced fluvial deposits show lesser permeability values due to their greater degree of consolidation, showing mainly in the upper levels.

Static level;

No data about water levels were found for the Colorado River sector, but according to the regional trend the phreatic level is assumed to correspond to the river elevation in the case of fluvial deposits and in terraces to be conditioned by the height of the terrace in which they are placed.

Ground water movement

The underground water movement in the recent fluvial deposits of the Colorado River and the older ones (terraced) is determined by the flow lines normal to the equipotential or isopiestic lines, these being predominantly northwest –south east and in concordance with the regional surface runoff pattern.

Productivity of the wells

There are no data about construction of production wells in the area of the Project, therefore a representative value will be assumed for the outputs on the basis of zones having similar characteristics associated to fluvial deposits, of the order of 2 -31/s/m.

3 BIOTIC ENVIRONMENT

The characterization of the biotic environment includes a description and analysis of the biota, considering aspects such as: Identification, placement, distribution, diversity and abundance of the flora and fauna species composing the existing ecosystems in the service area, or study, indicating if applicable, the presence of species belonging to some conservation category.

3.1 Flora and Vegetation

3.1.1 Introduction

The following is the result of the survey for Information on the Flora and Vegetation Baseline for the Project sited in the Cordillera Province; Santiago Metropolitan Region This section considers the analysis and evaluation of the different vegetational systems found in the service area of the Project, both the characteristic vegetation as well as the flora constituting these systems.

3.1.2 Definition of the study area

For the preparation of the baseline of the vegetational systems present in the sector studied, a service area consisting in a strip of approximately 150 meters on each side of the layout, both for the representation of the existing vegetation and the survey of the associated flora. The spatial representation of the area surveyed is shown in Figure 1 of Annex II and Figures 4-20 and 4-21 (pages 4-44 and 4-45).

3.1.3 Results

i) Biogeographic framework

This sector is biogeographically inserted in the Neotropical region, Andean-Patagonic Domain, Central Chilean Province which is characterized by its containing species of very diverse origin, with a high endemism and an arbustive arborescent physiognomy, with sclerophyll type foliar morphology (Cabrera and Willink, 1973[3]). It has recently been proposed to exclude this area from the Neotropical region, creating the Austral Region, where practically the whole country would be included (Morrone, 2002[4]).

At the national level, the area of study is circumscribed within two Biogeographic regions. Region of the High Andean Steppe, sub-region of the Mediterranean Andes, Andean Sclerophyll Scrubland formation, indicating that. Strictly speaking, it should be included in the region of the Scrubland and Sclerophyll Forest But, given the important diversity of floristic elements; the author has preferred to include it in the ecologic region as mentioned (Gajardo, 1994[5]). This formation shows several floristic associations, the following are footnotes:

3 Cabrera, A. y Willink, A. 1973. Biogeografía de América Latina. Monografía N°13, Serie Biología, O.E.A. 120 p. (*Biogeography of Latin America*)
4 Morrone J. 2002. Biogeographical regions under track and cladistic scrutiny. Journal of Biogeography 29:149-152.
5 Gajardo, R. 1994. La Vegetación Natural de Chile: clasificación y distribución geográfica. Ed. Universitaria, Santiago. (*The Natural Vegetation of Chile: classification and geographic distribution*) recorded in the hillsides and alluvial terraces *Quillaja saponaria-Lithrea caustica, Quillaja saponaria-Colliguaja odorífera, Puya berteroana- Trichocereus chiloensis, Colliguaja integerrima- Tetraglochin alatum* and in the banks of the water courses *Kageneckia angustifolia-Guindilia trinervis* (as *Valenzuelia trinervis),* (Gajardo, 1994[6]).

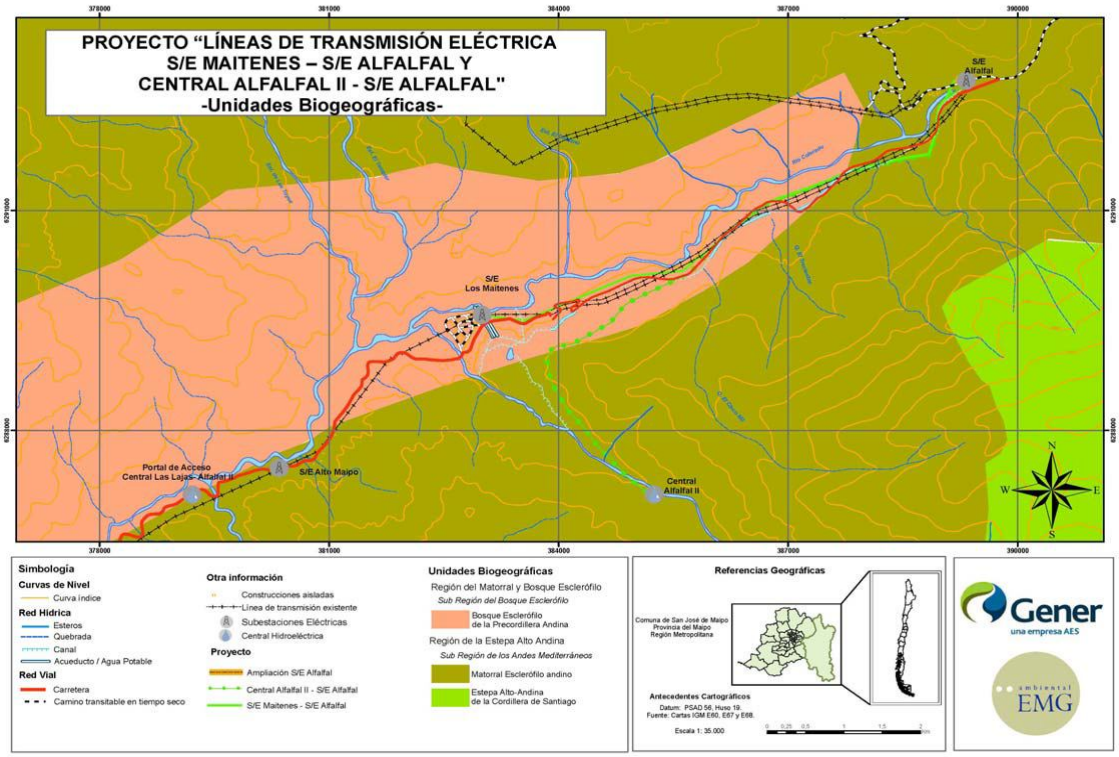
The second region where the layout is inserted is that of the Scrubland and Sclerophyll Forest, sub-region of the Sclerophyll Forest, Sclerophyll Forest of the Andean Pre-Cordillera formation, whose distribution is limited due to the steep grades of the low and medium hillsides of the Andes Cordillera, causing a sharp altitudinal stratification. The distribution pattern of the existing plant communities is mainly dominated by the altitude variation and exposure (Gajardo, 1994[7]). The same previous floristic associations are more frequent and structurally more complex in this region. The different vegetation groups show a marked seasonality, where aridity and summer drought mark the dormancy of most of the species accompanying the dominant ones. This dormancy continues up to the winter, where low temperatures limit growth, springtime being the development season for these systems.

However, this vegetation, originally an arborescent scrubland with dominance of arboreal sclerophyll species (Litre, Quillay, Bollen) and arbustive (Colliguay, Bío-bío) with succulents in the sectors of higher aridity (Quisco and Chagual), is at present heavily intervened, especially in flat sectors with deep soils, where agriculture has completely transformed the landscape and the attributes of the original populations, communities and systems. This transformation continues now as a process, maybe without the intensity degree implied in agriculture, but in respect to the modification of natural attributions, by means of urbanization and unregulated tourism.

The following are the results of the field visit to the service area of the Project. The layout was inspected in order to establish the environmental sensitivity of the vegetation, and the different vegetational groups present were established, determining their degree of naturalness and detecting those species having known conservation problems. Figure 4-19 shows the regional and local Biogeographic framework of the Project (Gajardo, 1983[8] and 1994[9])

Footnotes:
6 Gajardo, R. 1994. La Vegetación Natural de Chile: clasificación y distribución geográfica. Ed. Universitaria, Santiago.
7 Gajardo, R. 1994. La Vegetación Natural de Chile: clasificación y distribución geográfica. Ed. Universitaria, Santiago.
8 Gajardo, R. 1983. Sistema Básico de Clasificación de la Vegetación Nativa Chilena. U. de Chile–CONAF. Santiago de Chile.
9 Gajardo, R. 1994. La Vegetación Natural de Chile: clasificación y distribución geográfica. Ed. Universitaria, Santiago.

Figure 4-19 Regional Biogeographic structure



Local vascular flora

Species richness and relevant groups

The local vascular flora was evaluated by means of 8 inventories in different representative vegetation formation composing the natural vegetation system of the area studied and whose taxonomic summary is shown in table 4-9. A total of 144 vascular plant species was detected, which correspond to 2.8% of the national flora. The list of the detected species in the area of study is shown in Annex 11, which indicates, besides the taxonomic data of each species its conservation conditions, geographic origin and common name.

Taxonomically speaking, the local flora includes the divisions *Magnoliophyta*, *Polypodiophyta* and *Pinophyta,* the first being the most important as to the number of species detected in the sector, reaching a total of 136 entities, which represent 2.7% of the national flora of this division. The second group is that of the ***Polypodiophyta*** which are represented locally by a total of seven species, which represents 4.7% of the flora belonging to this group on the national level. The third group, the *Pinophyta,* has only one species, corresponding to 6.7% of the group in the national level.

The taxonomic classes *Liliopsida* (monocotyledons) and *Magnoliopsida* (Dicotyledons), are found within the *Magnoliophyta*; the first represented by a total of 19 species; the *Poaceae* family (Gramineae) is relevant, having 15 species. The second class has a total of 117 species, the most numerous are the families *Asteraceae, Scrophulariaceae) Fabaceae* and *Rosaceae* with 31, 9, 8 and 7 species respectively. Table 4-9 is a taxonomic summary of the local vascular flora for each of the taxonomic groups recorded in the area of study.

Table 4-9 Taxonomic summary of the vascular flora present in the area of service of the Project and their representation as to the number of Families, Genera and Species present, compared to the national flora, Metropolitan Region. March and November, 2008.

DIVISIÓN	FAMILIAS		GÉNEROS		ESPECIES	
CLASE	Loc.	Chile %	Loc.	Chile %	Loc.	Chile %
Polypodiophyta						
Polypodiopsida	1	22 4,5	2	46 4,3	7	137 5,1
Sphenopsida	0	1 0,0	0	1 0,0	0	2 0,0
Lycopsida	0	3 0,0	0	4 0,0	0	9 0,0
Psilotopsida	0	1 0,0	0	1 0,0	0	1 0,0
Total División	**1**	**27 3,7**	**2**	**52 3,8**	**7**	**149 4,7**
Pinophyta						
Pinopsida	0	3 0,0	0	8 0,0	0	8 0,0
Gnetopsida	1	1 100,0	1	1 100,0	1	7 14,3
Total División	**1**	**4 25,0**	**1**	**9 11,1**	**1**	**15 6,7**
Magnoliophyta						
Liliopsida	5	30 16,7	14	214 6,5	19	1069 1,8

DIVISIÓN	FAMILIAS		GÉNEROS		ESPECIES	
CLASE	Loc.	Chile %	Loc.	Chile %	Loc.	Chile %
Magnoliopsida	42	132 31,8	89	743 12,0	117	3906 3,0
Total División	**47**	**162 29,0**	**103**	**957 10,8**	**136**	**4975 2,7**
Total	**49**	**193 25,4**	**106**	**1018 10,4**	**144**	**5139 2,8**

Source: CEA Ltda.

Origin, Conservation Status and Degree of Singularity of the Local Flora

According to the Biogeographic origin of the species detected in the area, there are 29 alochtonous species and 115 autochthones. The larger number of autochthones species in the area of the study is explained by the fact that the sampling and location of the floristic inventories were directed to gathering information in those units having native flora and discarding in many cases the sectors with high human intervention, where alochtonous species predominate.

As regards the presence of species with conservation problems, one small specimen of the succulent *(Austrocactus spiniflorus)* belonging to the Rare category was detected in rock fissures of the Aucayes creek, related to the derivation point of the intake canal to the Los Maitenes Plant (PMF 6, see figures 4-20 and 4-21). Another three species are classified as vulnerable, one arboreal (at present arborescent) *Kageneckia angustifolia* (Franjel) (one individual at PMF 8, see Figures 4-20 and 4-21) and two succulents: *Puya berteroana* (chagual) (pMF 2, PMF 4 and PMF 7, see figures 4-20 and 4-21) and *Pyrrhocactus curvispinus* (Quisquito) (pMF 2, PMF 4 and PMF 6, see figures 4-20 and 4-21). The summary of the conservation status for the area is shown in Table 4-10.

Table 4-10 Summary of the conservation condition of the local flora associated to the service area of the Project. March and November, 2008

Estado de Conservación	Origen	Total
Vulnerable	Autóctona	3
Rara	Autóctona	1
Sin Información	Autóctona	52
Sin problemas	Autóctona	59
No Aplica	Alóctona	29
Total general		**144**

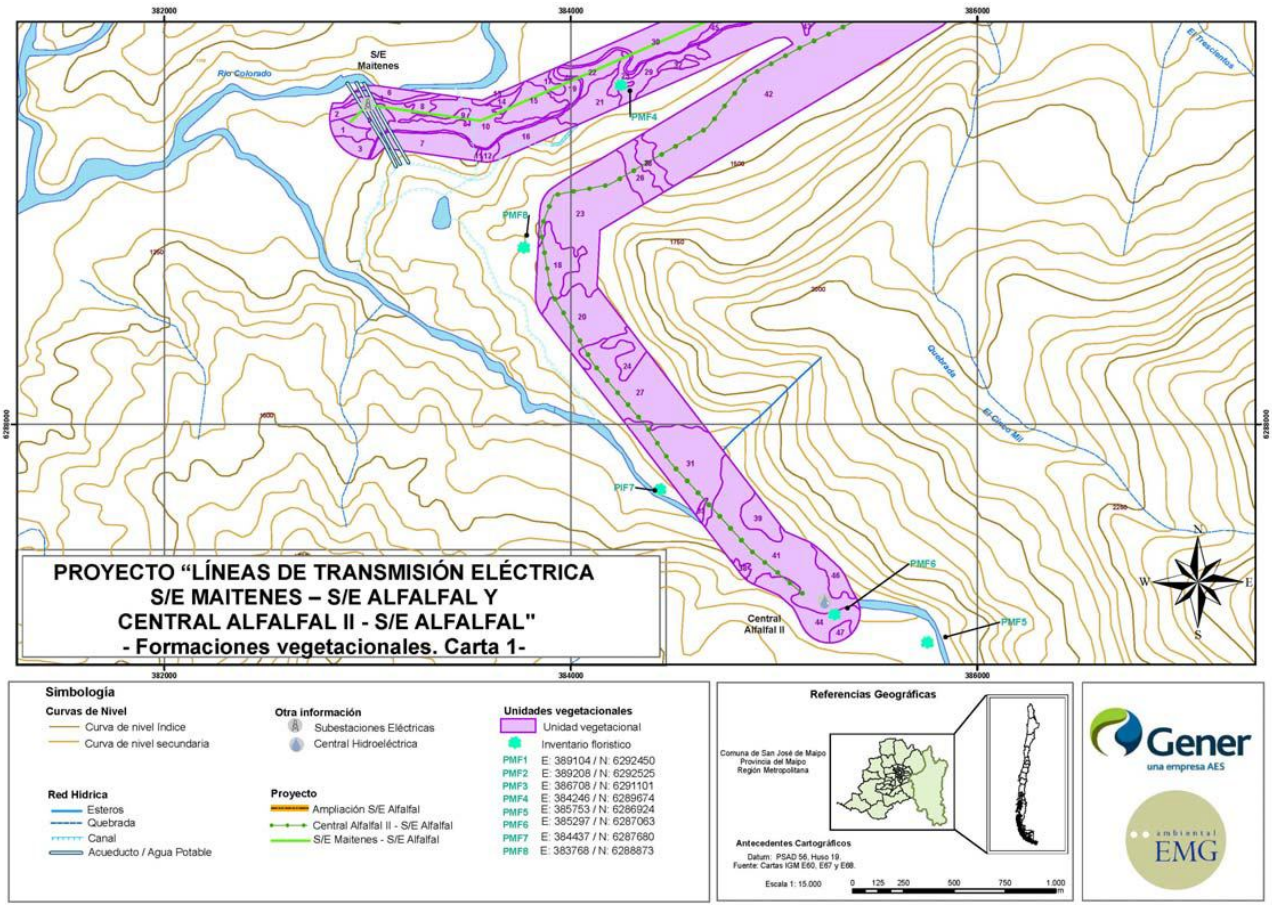
Source: CEA Ltda.

Concerning the singularity of the flora no local or regional endemic entities were detected, the majority belongs to typical species of the sclerophyll formation of Central Chile.

iii) Vegetation

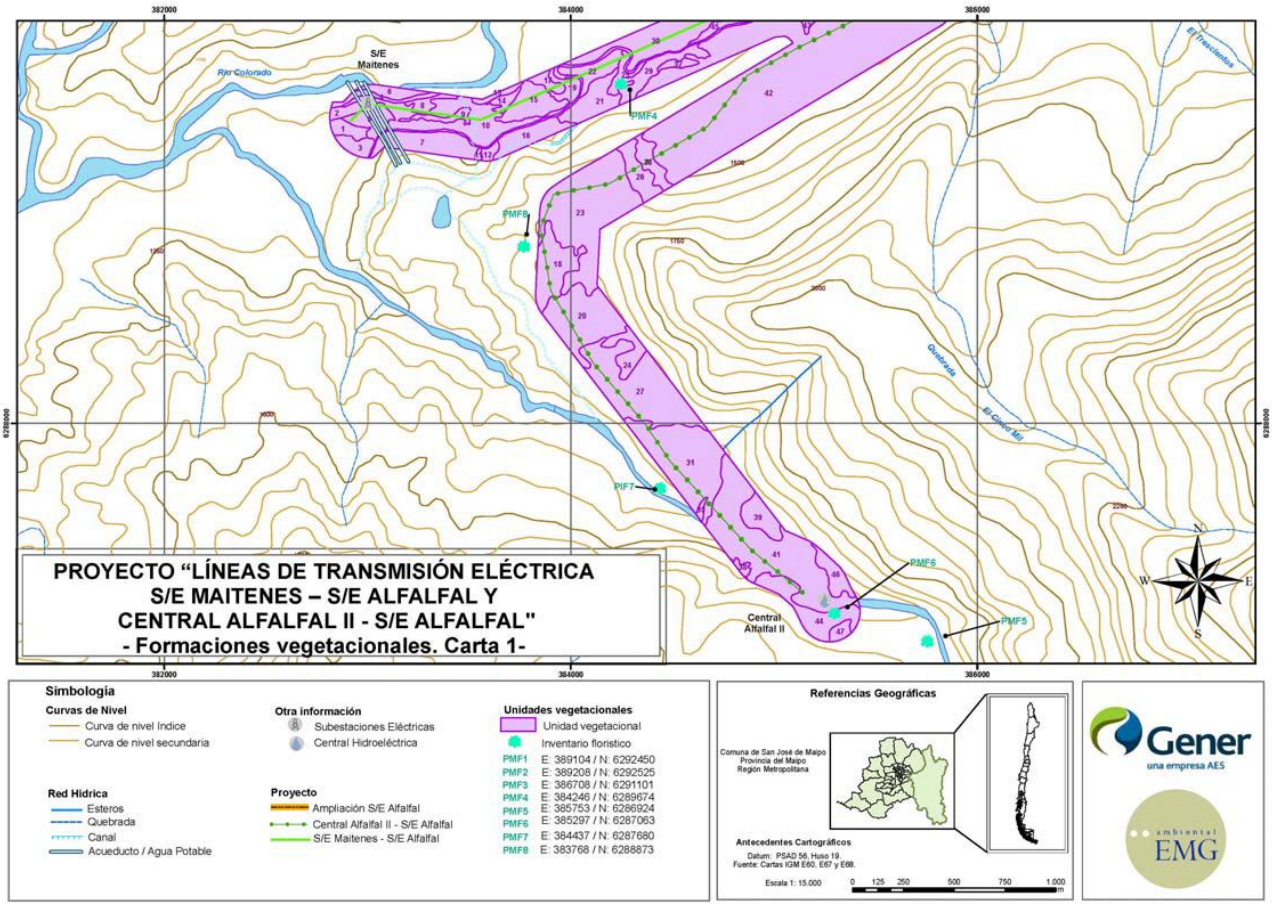
The vegetation of the area studied was evaluated by defining 107 polygons which represent different stages of its horizontal or vertical structure and the composition of dominant species (See figures 4-20 and 4-21). The descriptions correspond to each unit of this chart and are given in the Appendix to Annex 11.

Table 4-20 Plant formations identified in the area of location of the Project. Chart 1



Source: CEA Ltda.

Table 4-21 Plant formations identified in the area of location of the Project. Chart 2



Source: CEA Ltda.

Table 4-11 is a summary of the surface covered by the different vegetation categories, grouping the vegetation units present in the area studied.

It can be seen that most of the surface related to the Project corresponds to scrubland, with 307.89 ha of the evaluated surface. Within this type of use in the area of service, those sectors defined as scrublands with trees and succulents are relevant, covering a total of 137.88ha. There, the presence of autochthonous woody species, as remains of the original vegetation, is combined with the scrubland, which shows the high degree of alteration of the vegetation. It is significant that there is no vegetation assigned to the Forests type, because, although they correspond to tall scrubs and in some cases quite dense, their arboreal stratum (tall woody) under 25% of cover, which reflects the high and generalized degree of alteration of the area.

In general, the larger structures and high cover percentages are associated to the low hillsides, of shaded exposure and steep grades; those characteristics provide on the one hand better conditions for biological development and on the other determine restrictions for traditional agriculture and ranching.

Table 4-11 Summary of the surface covered by the vegetational categories (use of the land) of the differentiated units in the service area of the Project. March and November, 2008

Uso de la tierra	Superficie	Nº polígonos
Vegetación natural		
Matorral arborescente con suculentas	13,97	5
Matorral con árboles y suculentas	137,88	22
Matorral ripariano	19,41	8
Matorral-pradera	37,75	8
Matorral con suculentas	98,88	17
Total Vegetación Natural	**307,89**	**60**
Usos no vegetacionales		
Residencial	1,34	1
Zona denudada	53,49	29
Zona industrial	23,62	4
Agrícola	16,19	3
Cuerpo de agua	15,65	10
Total usos no vegetacionales	**110,29**	**47**
Total general	**418,18**	**107**

Fuente: CEA Ltda.

Another important point is the high diversity of the recorded dominant arborescent species: four autochthonous tall woody species and one alochtonous grown wild, which would indicate the forest vocation of this area, while only four dominant species are low woody species, reaffirming the idea of greater vertical structures of the vegetation. Finally, among the dominant herbaceous species, of the 9 detected species. Four correspond to introduced species, and even some of them show ruderal characteristics. The recorded dominant species and their cartographic codes are shown in Table 4-12, listed according to their biological type.

Table 4-12 Dominant species in the vegetation cartography surveyed in the area. March and November, 2008

Código de especie dominante	Especie
Leñosas altas	
AC	Acacia caven
CM	Crataegus monogyna
LC	Lithrea caustica
QS	Quillaja saponaria
SP	Schinus polygamus
Leñosas bajas	
Bs	Baccharis salicifolia
Cp	Cestrum parqui
Gi	Gymnophyton isatidicarpon
Hu	Haplopappus uncinatus
Herbáceas	
bp	Baccharis pingraea
cm	Centaurea melitensis
cp	Carduus picnocephalus
cr	Cortaderia rudiuscula
cv	Chenopododium ambrosioides
ha	Helenium aromaticum
hi	Hirshfeldia incana
ta	Tessaria absinthioides
vm	Vulpia megalura
Suculentas	
Suculentas tC	Trichocereus chiloensis

Fuente: CEA Ltda.

3.1.4 Summary

The following can be concluded from the results obtained in the survey for the baseline of the Project:

The local flora is made up by a total of 144 vascular flora species belonging to 106 genera in 49 families. These entities, according to their geographic origin, are divided in 115 autochthonous species and 29 alochtonous. Four (4) species with conservation problems were detected: one Rare succulent and three (3) vulnerable, the less frequent being *Kageneckia angustifolia* (Franjel) was found in a single inventory, mainly because the layout is placed outside the preferred distribution area of this species, which is a little higher in altitude, and *Puya berteroana* (Chagual) recorded in three inventories, given its preferred distribution in rocky terrains of warm exposure (north and west components) The other species at present classified as vulnerable ***(Pyrrhocactus curvispinus***: Quisquito) is a frequent species, and there would not be particular problems to prevent it being damaged,

The local vegetation was delimited and characterized in 107 polygons grouped in 10 types of use of the land or vegetation types of two used of the land, considering natural vegetation and non-vegetational uses. The units with natural vegetation cover 307.89 hectares of the evaluated area (418.18), while the non vegetational use including the river body, industrial and denuded zones as well as residential areas, cover 110.29 ha.

A high degree of alteration was detected when evaluating the structures of this vegetation and the composition of dominant species, Both due to the tendency to forest structures as well as the composition of the dominant species, in a large proportion tall woody species , Probably remnants of the original vegetation and the high participation of herbaceous alochtonous species showing a ruderal behavior.

3.2 Fauna

3.2.1 Introduction

The following information is the result of the survey of the terrestrial fauna baseline for the Project "Electric Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power plant – Alfalfal S/S" Which includes an analysis and evaluation of the different reptiles, amphibians, birds and mammals identified in the area of service of the Project.

3.2.2 Definition of the study area

The field visit was carried out in two campaigns: The field visit was carried out in two campaigns: The first carried out on March 11, 2008 and the second on November 24 of 2008. The layout of the line was surveyed in both campaigns, defining in situ a total of 9 sampling stations (5 in the first campaign and 4 in the second). The placement and description of these is shown in Table 4-13 and Figure 4-23. In general, the sampling sites are placed near the channel of the Colorado River from the future Alfalfal II Plant in the higher sector (1,530 masl) to the Maitenes S/S sector (1,087masl); corresponding to hilly environment, with rocky grounds and sclerophyll scrubland with different cover degrees (low to median density), with/without cactuses and puyales. The human intervention degree is medium to very high and is fundamentally given by the presence of the existing S/Ss, houses, road, livestock and cultivation. The human intervention level is medium to very high and is fundamentally given by the presence of the existing substations, houses, road, livestock and cultivation.

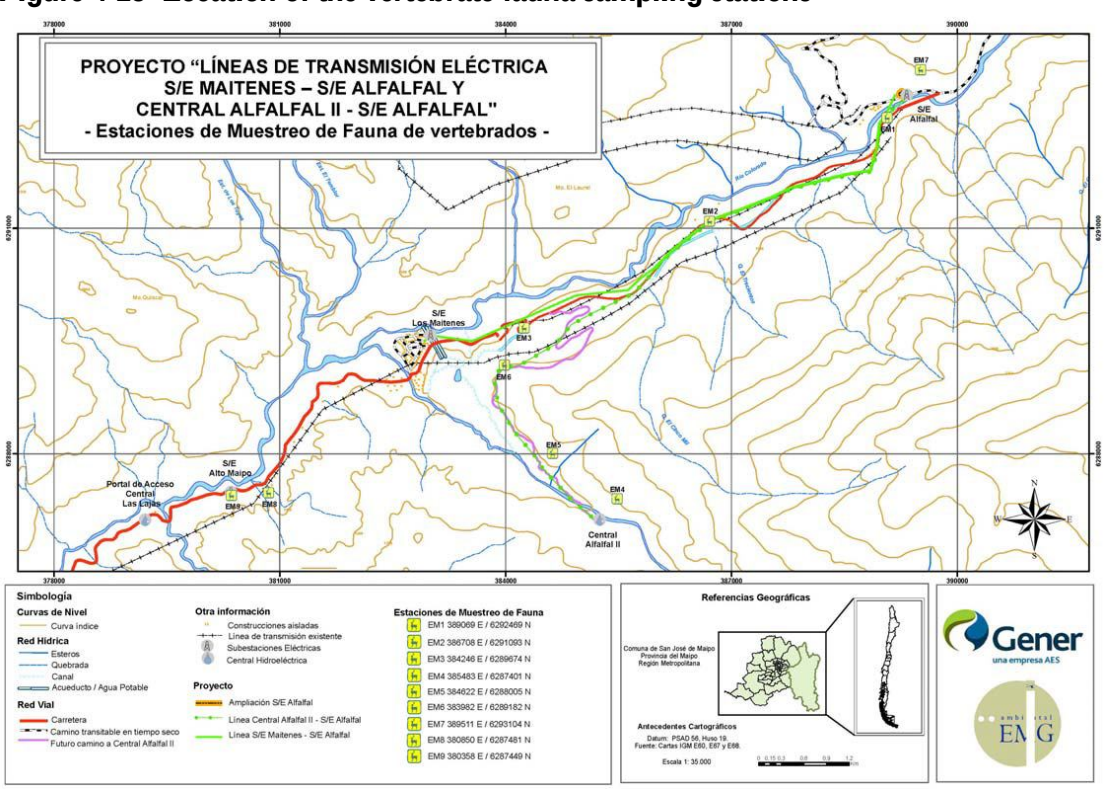
Table 4-13 Vertebrate Fauna Sampling Stations (EM), Metropolitan Region

EM	Coordinates UTM (PSAD56)	Reference	Summary characterization
EM1	389069 E / 6292469 N / 1333 m	Downstream from the Alfalfal S/S (near tower 44 Maitenes-Alfalfal S/Ss)	River bank and canal, rocks, hill base Medium to high human intervention (roads, canal, S/S). Thin sclerophyll scrubland, Thin sclerophyll scrubland.
EM2	386708 E / 6291093 N/ 1293 m	Near Tower 36, Line Maitenes-Alfalfal S/Ss.	Hill base, thin sclerophyll scrubland, cactus, rocks median human intervention
EM3	384246 E / 6289674 N/ 1287 m	Before Maitenes S/S (near Tower 9 Line Alfalfal II Plant – Alfalfal S/Ss)	Hill. Rocks, thin sclerophyll scrubland and puyales, grade median human intervention
EM4	385483 E / 6287401 N / 1530 m	Alfalfal II Plant – lower part of the Totorilla sector (near the future Alfalfal II Plant)	Terrace side of the stream. Sclerophyll forest (quillay – bollén), rocky sectors.
EM5	384622 E / 6288005 N / 1442 m	Alfalfal II Plant – Intake sector, north hillside southern exposure (Between Tower 2 and Tower 7 Line Alfalfal II Plant – Alfalfal S/S).	Rocky hillside, creek, thin sclerophyll scrubland, grade side of Aucayes stream.
EM6	383982 E / 6289182 N / 1453 m	Alfalfal Plant – foot of the El Yoque mountain (near the Gener auxiliary pond, near Tower 7 Line Alfalfal II Plant-Alfalfal S/S)	Sclerophyll scrubland with dominant presence of tralhuén and manzanilla prairie. Besides presence of quillay, bollén and rocks.
EM7	389511 E / 6293104 N	Alfalfal S/S – Sector electric plant and parking.	Very strong human intervention. Sector within the S/S, parking with grass and isolated introduced species trees.
EM8	380850 E / 6287481 N / 1114 m	West of the Los Maitenes S/S, near the future Alto Maipo S/S	Hill, thin sclerophyll scrubland, strong human intervention, arid materials removal, road, houses).
EM9	6287449 N /380358 E / 1087 m	Near future Alto Maipo S/S, and near Route G-345	Plateau at the side of the river, medium density sclerophyll scrubland, median human intervention (livestock).

Source: CEA Ltda.

Figure 4-22 Sampling stations: Figure 4-22 Sampling stations: EM2 (upper left): EM3 (upper right) EM5 (lower left) and EM7 (lower right), with thin sclerophyll scrubland and strong human intervention (in the last case)

Figure 4-23 Location of the vertebrate fauna sampling stations



3.2.3 Results

i) Vertebrate Fauna

At least 27 species were seen in the study area, of which 20 are birds, 5 reptiles and 2 mammals; no amphibians were recorded (although their presence is possible). Table 4-14 is a summary of the species observed in the whole area of the Project. Seven of the total of the species (that is 25.9%): The five lizards, the condor and a mammal (zorro culpeo) are in one of the "conservation states" defined by the SAG (2006), five species being considered vulnerable, 4 lizards: *Liolaemus lemniscatus*, *L. nigroviridis*, *L. monticola, and L tenuis*, and the condor (*Vultur gryphus*), while one species is considered as inadequately known: The zorro culpeo (*Pseudalopex culapaeus*), and one species is catalogued as out of danger: *Liolaemus fuscus*. Considering the protection criteria (SAG, 2006), 22 species (81,5%) have some protection degree. Thus, 17 species are considered as beneficial for silvo-agro-pastoral activity (B), 16 species are considered as beneficial for the maintenance of balance of the natural ecosystems (E) and five species are considered as having reduced population (See details of the species in Table 4-14).

Concerning the origin of the 27 species observed, 6 are endemic of Chile, with 4 reptiles and 2 birds (*L. nigroviridis*, *L. monticola*, *L.fuscus*, *L. tenuis*, *Pteroptochos megapodius, and Mimus thenca*), 19 are native and 2 introduced (see Table 4-14).

Table 4-14 Vertebrate species Recorded in the Study Area. Project "Electric transmission Lines Maitenes – Alfalfal S/Ss and Alfalfal II Power Plant – Alfalfal S/S Metropolitan Region

Especie Nombre Común
Criterios de Protección
SAG 2006
Origen
REPTILES (6 especies)
Liolaemus lemniscatus Lagartija lemniscata S, E, Vulnerable Nativa
Liolaemus nigroviridis Lagarto negroverdoso S, E, Vulnerable Endémica
Liolaemus monticola Lagartija de monte S, E, Vulnerable Endémica
Liolaemus fuscus Lagartija oscura B, E, Fuera de peligro Endémica
Liolaemus tenuis Lagartija esbelta S, E, Vulnerable Endémica
AVES (20 especies)
Vultur gryphus Cóndor B, E, Vulnerable Nativa
Elanus leucurus Bailarín B, E Nativa
Milvago chimango Tiuque B, E Nativa
Sephanoides sephaniodes Picaflor chico B, E Nativa
Vanellus chilensis Queltehue B, E Nativa
Picoides lignarius Carpinterito B, S Nativa
Callipepla californica Codorniz No aplicable Introducida
Pteroptochos megapodius Turca B Endémica
Asthenes humilis Canastero B Nativa
Leptasthenura aegithaloides Tijeral B Nativa

Especie Nombre Común
Criterios de Protección
SAG 2006
Origen
Turdus falcklandii Zorzal Sin información Nativa
Troglodytes aedon Chercán B, E Nativa
Pygochelidon cyanoleuca Golondrina dorso negro B, E Nativa
Tachycineta leucopyga Golondrina chilena B, E Nativa
Mimus thenca Tenca B Endémica
Elaenia albiceps Fío-fio B, E Nativa
Anairetes parulus Cachudito B, E Nativa
Curaeus curaeus Tordo Sin información Nativa
Diuca Diuca Diuca Sin información Nativa
Zonotrichia capensis Chincol B Nativa
MAMÍFEROS (2 especies)
Pseudalopex culpaeus Zorro culpeo E, Inadecuadamente conocido Nativa
Oryctolagus cuniculus Conejo No aplicable Introducida
Fuente: CEA Ltda.

Abbreviations of Protection Criteria E = Beneficial for the maintenance of natural ecosystems balance; B = Beneficial for the forestry, agricultural and ranching activities; S = reduced population densities.

ii) Frequency and relative abundance of species

Five lizard species were recorded in this sampling, 64 individuals in 7 of the 9 stations (77.8 frequency). The dominant species was the lemniscata lizard (*Liolaemus lemniscatus*), with 24 individuals (37.5%) in 4 sites, followed by lizard de monte (*L. monticola*), with 21 specimens (32.8%) recorded in 6 sites. The other species recorded were lizard oscura (*L. fuscus*), with 12.5% (in 4 sites), the lizard esbelta (*L. tenuis*), with 15.6% in 4 sites and the lizard negroverdosa (*L. nigroviridis*) with only one recorded specimen (in one site, see the following table).

The sampling recorded 56 individual belonging to 20 bird species, the most abundant were the thrush with 9 individuals (16,1%), followed by the Turkish bird (10,7%) and finch (8,9%;), while a scant presence of the other species was recorded.

Of the observed mammals, indirect evidences were recorded for zorro culpeo (faeces) in one site, and rabbit faeces in 4 sites.

The species richness by sampling station varied between 2 to 12 species (See Table 4-15).

Table 4-15 Results of the vertebrate census carried out in the study sector.

Nombre Común	Estaciones de Muestreo Abundancia									
	EM1	EM2	EM3	EM4	EM5	EM6	EM7	EM8	EM10	N	%
REPTILES											
Lagartija lemniscata	12	1	2	9	24					37	5
Lagarto negroverdoso	1	1								1	6
Lagartija de monte	7	8	2	1	2	1				21	32,8
Lagartija oscura	1	3	1	3	8					12	5
Lagartija esbelta	1	1	7	1	10					15	6
Subtotal Reptiles	9	23	3	3	3	0	0	18	5	64	100
AVES											
Cóndor	1	1								1	8
Bailarín	1	1								1	8
Tiuque	1	1								1	8
Picaflor chico	2	2	4							7	1
Queltehue	2	2								3	6
Carpinterito	1	1								1	8
Codorniz	2	2								3	6
Turca	2	2	1	1	6					10	7
Canastero	1	1								1	8
Tijeral	1	1								1	8
Chercán	1	2	1	4						7	1
Golondrina dorso negro	4	4								7	1
Golondrina chilena	1	1								1	8
Zorzal	1	1								1	8
Chercán	2	2								3	6
Tenca	2	1	1	1	5					8	9
Fío-fío	1	1								1	8
Cachudito	1	1	2							3	6
Tordo	5	1	3	9						16	1
Diuca	2	3	5							8	9
Chincol	2	2								3	6
Subtotal aves	4	5	11	2	9	6	5	12	2	56	100
MAMIFEROS											
Zorro culpeo	X	-	-								
Conejo	X	X	X	X	-	-					
RIQUEZA TOTAL	6	7	6	4	8	7	2	12	6	28	

Note: 1. The total abundance (N) and relative (%). The order of the species follows that of Table 4-14.
Note 2: X indicates indirect presence (faeces, footprints)

4 HUMAN ENVIRONMENT

The characterization of the human environment includes an analysis of the socioeconomic and socio-cultural aspects in the direct and indirect service area of the Project. It also includes aspects concerning the cultural and archaeological heritage as well as detailed description of the existing Landscape and Tourism

4.1 Social Environment

4.1.1 Introduction

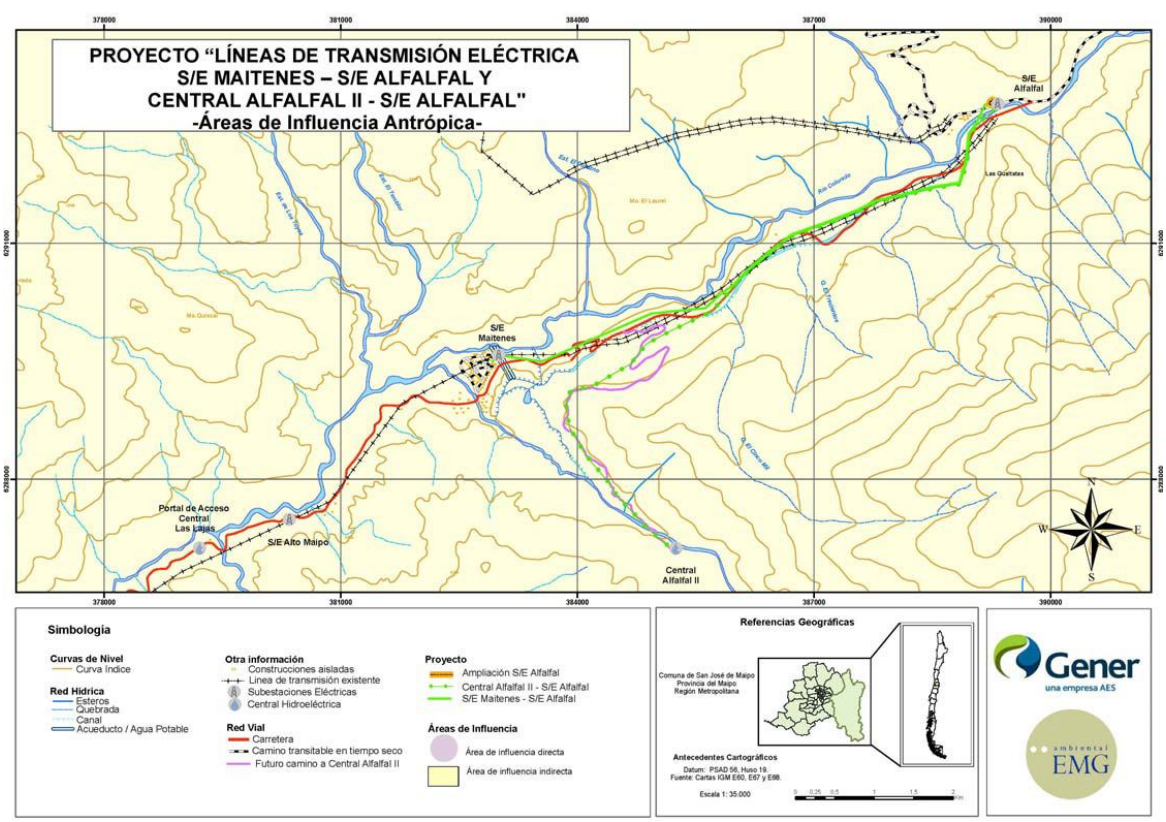
The characterization of the socioeconomic and socio-cultural aspects has the purpose of describing and analyzing the geographic, demographic, socioeconomic and basic social welfare of the populated areas near the Project.

There are two main parts in this section: the first provides the geographic, demographic, socioeconomic and basic social welfare data concerning the indirect service area (ISA) and in the second the same type of data is given for the direct service area (DSA)

4.1.2 Definition of the service area

In order to establish the baseline of the social environment, the localities near the Project have been considered as direct service zone (DSA), that is, Los Maitenes and El Alfalfal; and as indirect service area (ISA) the Municipality where the layout will be established, that is San José de Maipo.

Figure 4-24 Service Area Social Environment Component



4.1.3 Results

i) Characterization of the indirect service area (ISA)

Geographic dimension

The Metropolitan Region of Santiago is the most heavily populated region of the national territory: its 6,745,651 inhabitants represent 40% of the total population of the country. Its density is 437.9 inhabitants/km^2.

The Project will be located in the Municipality of San José de Maipo, Cordillera Province, under the jurisdiction of the Metropolitan Region of Santiago, which also includes the provinces of Santiago, Chacabuco, Maipo, Melipilla and Talagante. The total surface of the region is 15.403 km^2.

Table 4-16 Background of the Metropolitan Region of Santiago

Unidad Político administrativa	Superficie km2	% Regional	Habitantes (2008) Nº	% Regional
Provincia				
Santiago	2030.3	13.2	4985893	73.9
Cordillera	5528.3	35.9	706299	10.5
Chacabuco	2076.1	13.5	178255	2.6
Maipo	1120.5	7.3	454529	6.7
Melipilla	4065.7	26.4	157569	2.3
Talagante	582.3	3.8	263106	3.9
Región Metropolitana	**15403.2**	**100.0**	**6.745.651**	**100.0**

The Project will be established in the Cordillera Province as a whole. The following table shows the surfaces, inhabitants and densities for the Municipality, Province and Region contemplated in the Project..

Table 4-17 Inhabitants and surface of the Municipality, Province and Region contemplated by the Project

Unidad Político administrativa	Superficie km2	% Regional	Habitantes (2008) Nº	% Regional	Densidad (hab/km2)
Comuna de San José de Maipo	4989	31,6	14316	0.2	2.7
Provincia de Cordillera	5528.3	35.9	706299	10.5	85.9
Región Metropolitana	15403.2	100	6745651	100.0	437.9

According to the data given by the INE (2002), San José de Maipo has a lower urbanization index as compared to the situation of the province and region: it is of 69.9% only.

Table 4-18 Urban/rural population of the area studied (2002)

Unidad Político Administrativa	Urbana Nº Habitantes	Urbana Porcentaje	Rural Nº Habitantes	Rural Porcentaje	Total
Comuna de San José de Maipo	9311	69.6	4065	30.4	13376
Provincia de Cordillera	511565	97.8	11291	2.2	522856
Región Metropolitana	5875013	96.9	186172	3.1	6061185

Demographic dimension

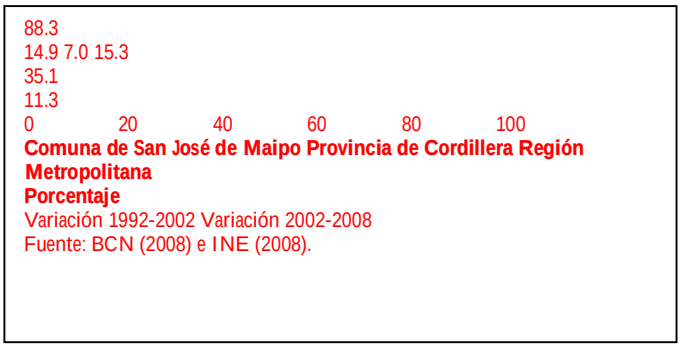
The description of the demographic dimension contemplates aspects concerning population variation, structure of the local population by age, sex, and schooling and alphabetization level, described below.

Population variation

Generally speaking, all the evaluated politico-administrative units evaluated (that is region, province and Municipality) have grown in terms of population quantity during the periods 1992 to 2002 and 2002-2008. However, there are differences in this growth, depending on the scale of the politico-administrative unit in question. In effect, the San José de Maipo Municipality had a lower positive variation as compared to the provincial and regional average for the two periods considered. In effect, the San José de Maipo Municipality had a lower positive variation as compared to the provincial and regional average for the two periods considered.

The most significant variation took place in the Cordillera Province (much higher than the regional and municipal average); this situation would be due to the population weight of the Puente Alto Municipality, as compared to the other municipalities within the province (San José de Maipo and Pirque).

Figure 4-25 Population growth. Periods 1992 to 2002 and 2002 to 2008



Considering the special situation of the Municipality studied, the data shown indicate that the population would be of 14,316 inhabitants in 2008; this practically means a growth of 7% as compared to that shown in the last Census. It is important to note that there has not been such as strong urbanization process in this Municipality as that which has occurred in the neighboring municipalities, particularly Puente Alto and La Florida. In effect, San José de Maipo has placed itself as a tourism and recreation area and has attracted the real estate market in recent years (as the Hacienda El Peñón Project). Furthermore, the development of Projects in this sector is strongly restricted as a function of the Metropolitan Regulation Plan of Santiago of 1994, which States that a large part of the area is an Ecological Preservation zone, besides, it has been declared as a Tourism Interest Zone (therefore most of the Projects that would be developed must submit an Environmental Impact Assessment study). This situation has led to the consequence of establishing homes in large pleasure parcels and isolated homes in the main settlements of the Municipality (among them El Canelo, El Manzano, San José de Maipo, El Volcán, Lo Valdés and Los Maitenes) preventing a higher density.

Structure of the population by sex

Concerning the distribution of the population by sex shown in Table 4-19, there is a slight predominance of the female population over the males in the region and province units. However, this tendency is reverted

at the municipal scale; this situation corresponds to a usual characteristic of the rural zones, given the traditional female emigration from those areas.

Table 4-19 Distribution of the population by sex. Periods 1992 to 2002 and 2002 to 2008

Unidad Político Administrativa	Hombres		Mujeres		Índice de
	Cantidad	Porcentaje	Cantidad	Porcentaje	Masculinidad
1992					
Comuna de San José de Maipo	6091	51.1	5832	48.9	104.4
Provincia de Cordillera	161875	49.3	166585	50.7	97.2
Región Metropolitana	2615058	48.5	2780267	51.5	94.1
2002					
Comuna de San José de Maipo	7202	52.2	6588	47.8	109.3
Provincia de Cordillera	283953	49.2	293527	50.8	96.7
Región Metropolitana	2937193	48.5	3123992	51.5	94.0
2008					
Comuna de San José de Maipo	7559	52.8	6757	47.2	111.9
Provincia de Cordillera	347010	49.1	359289	50.9	96.6
Región Metropolitana	3290280	48.8	3455371	51.2	95.2

Fuente: BCN (2008) e INE (2008).

Concerning the above, when the masculinity indexes are analyzed, it can be seen that this has increased slightly at the regional scale; while growth has been nearly 5% at the municipal scale. On the other hand, it has tended to diminish slightly at the provincial scale.

Distribution of the population by age groups

Regarding the distribution of the population by age groups, it is possible to see a major trend with some variations between territorial units, a tendency to aging, where the number of births is less as compared to the quintal that follows it (5 to 9 years old) (See Figure 4-26). The distribution of the population in the Municipality follows mostly the regional average, And has significant differences as compared to the provincial panorama.

When the regional situation is analyzed, the drastic decrease of the younger age groups of the population can be observed quite clearly, as well as the tendency to aging. On the other hand, the provincial panorama is quite different at the municipal level, except for the 20 to 39 age groups. In effect, the young population is still quite significant in the Cordillera Province, reaching 37.2% (taking into account the 0 to 19 years population); when the senior adults' population is analyzed for that unit, there is scant presence, not reaching 5% of the total.

At the municipal level, it can be seen that San José de Maipo has indicators over the regional average for the groups from 8 to 9 years and 25 to 49 years. The adult population in this Municipality is also significant and reaches 8.1% of the total.

Figure 4-26 Distribution of the population by age groups. Projection to 2005

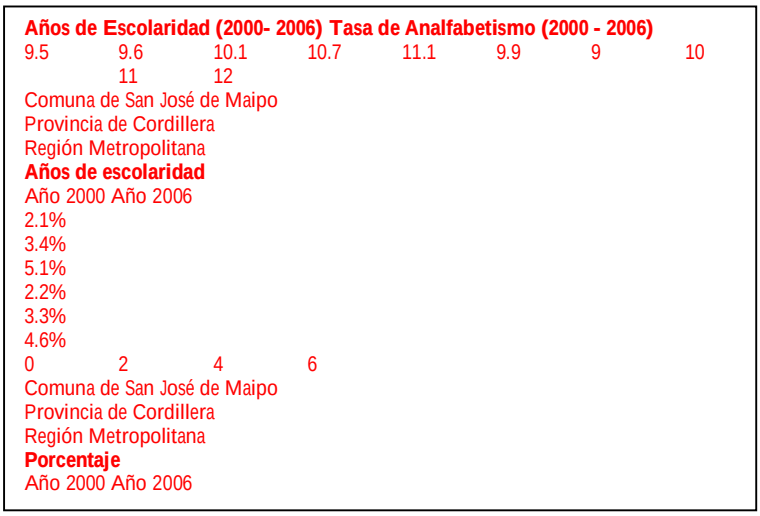
0
2
4
6
8
10
12
0- 4 5-9 10-14 15-19 20-24 25-29 30-34 35-39 40-44 45-49 50-54 55-59 60-64 65-69 70-74 75-79 80+
Grupos Etarios
Porcentaje
Comuna de San José de Maipo Provincia de Cordillera Región Metropolitana

Schooling and educational level

When analyzing the data of the Casen survey of 2000 and 2006, a slight increase in schooling years can be seen in the resident population of the evaluated territorial units; the larger difference is observed on the regional and municipal scale, where the increase was of 1.2 and 0.8 years for the assessed period.

Likewise, analphabetism decreased in the municipal and provincial units; the greatest difference during the period analyzed also occurred in San José de Maipo, where it decreased by 0.5%.

Figure 4-27 Schooling years and analphabetism rate



Source: MIDEPLAN (2002 and 2006).

As seen in Figure 4-27 (left) the school years reach 11.1 in 2006, for the regional scale. This figure is slightly higher when compared to the average of the Cordillera Province, which has a rate of 10.7 years. This situation could be explained by the rural characteristic of some of the municipalities of that politico-administrative unit. Likewise, this situation shows that a small sector of the population has not been able to finish the mandatory schooling (primary and high school).

If the situation of the Municipality studied is analyzed, it is seen that the schooling years are even less, that is 10.2 years.

On the other hand, examining the situation of analphabetism for 2006, it can be seen that the San José de Maipo Municipality has the highest rate within the analyzed politico-administrative units. The differences between the provincial and regional units are also important, and the lowest at the regional scale (2.1%).

Socio-economic dimension

The description of the socioeconomic dimension includes the economically active population (PEA), the employment and unemployment levels as well as the presence of productive activities derived from the extraction of natural resources on the part of the human group.

Economically active population (PEA) and work force

Considering the population projections for the year 2005 made by the INE, it is possible to establish that the economically active population would reach about 68% in all the territorial units assessed.

Table 4-20 Economically active population. Projection to 2005

Unidad Político Administrativa	De 0 a 14 años		De 15 a 64 años		Más de 65 años	
	Número	%	Número	%	Número	%
Comuna de San José de Maipo	3278	23.2	9698	68.7	1148	8.1
Provincia de Cordillera	1140940	23.3	3349715	68.3	414060	8.4
Región Metropolitana	1589442	24.3	4446696	68.0	502758	7.7

Fuente: Elaboración propia sobre la base de antecedentes de INE (2008).

The larger percentage of the indicated PEA is found at the provincial scale, followed by region and Municipality, both having practically the same percentage.

On the other hand, the work force is shown at the municipal and provincial level for 2000 and 2006. As can be seen in the following table, during those period the unemployment rate at the San José de Maipo Municipality was higher than the provincial level. Likewise, the municipal work force is also lower.

If the situation of each unit is analyzed for those periods, a decrease in the total work force of the San José de Maipo Municipality can be observed, differing from what happens at the provincial scale. When the unemployment percentage is analyzed, there is a decrease in both territorial units as compared to the 2006 situation.

Table 4-21 Work force

Unidad Político Administrativa	Año 2000		Año 2006	
	Total Ocupados	Desocupados	Total Ocupados	Desocupados
Comuna de San José de Maipo	58.3	89.9	10.1	56.8	92.4	7.4
Provincia de Cordillera	58.6	91.2	8.8	58.9	93.1	7.0

Fuente: MIDEPLAN (2008).

Economic activities

As shown in Figure 4-28 most of the economically active population of all the evaluated politico-administrative units work in the trade sector, followed by industry and real estate activities.

The sector shown as *other* incorporates activities of the mining sector, electricity, gas and water distribution. Banking, fishing, organization and extraterritorial offices.

At the municipal level, it is noted that almost 13% of the PEA works in trade related activities, about 10% in the public administration and defense sectors and 9% in the building sector.

Likewise, if the corresponding region and province are compared, a 4.4% of the PEA is employed in the Hotels and Restaurants sector.

Figure 4-28 Population by economic activity (Percentages)

0 5 10 15 20 25
Comercio al por mayor y al por menor
Administración pública y defensa, etc.
Construcción
Transporte, almacenamiento y otros
Actividades inmobiliarias y otras
Hogares privados con servicio doméstico
Agricultura, ganadería, caza y silvicultura
Industrias manufactureras
Enseñanza
Servicios sociales y de salud
Otras actividades de servicios
Hoteles y restaurantes
Otros
Comuna de San José de Maipo Provincia de Cordillera Región Metropolitana
% % % % %
Fuente: INE (2002).

Likewise, it is noted that there is scant representation of the population in activities related to primary production sectors (agriculture, ranching and forestry) at the provincial and regional level, while it reaches 7.4% of the PEA at the municipal level.

Basic social welfare dimension

The description of the basic social welfare contemplates aspects related to the poverty level of the population as well as the health security system and the corresponding birth and death rates present in the evaluated territorial units.

Poverty

The following table shows the poverty situation at the people and homes level for the years 200 and 2006. According to this data, it is possible to affirm that there has been a decrease both in the number of poor persons and poor homes for all the evaluated units. The San José de Maipo Municipality has recorded a decrease of 7.9% in the total of poor persons; this difference is mainly explained by the reduction in the number of destitute persons. A similar situation is observed in the analysis of poor homes, where the main reduction is shown by the group non destitute poor. The San José de Maipo Municipality has recorded a decrease of 7.9% in the total of poor persons; this difference is mainly explained by the reduction in the number of destitute poor. A similar situation is observed in the analysis of poor home, where the main reduction is shown in the group of non destitute poor.

Table 4-22 Poverty situation at the personal and homes level. Years 2000 and 2006 (percentages)

Unidad Político Administrativa
Año 2000 Año 2006
Pobres no indigentes
Pobres indigentes
Total
Pobres
Pobres no indigentes
Pobres indigentes
Total
Pobres
Personas
Comuna de San José de Maipo 14.7 4.3 19 7.5 3.6 11.1
Provincia de Cordillera 12.4 4.9 17.3 7.6 3.0 10.6
Región Metropolitana 11 4.1 15.1 8.2 2.4 10.6
Hogares
Comuna de San José de Maipo 11.8 3.8 15.7 6.4 3 9.4
Provincia de Cordillera 10.6 3.7 14.3 S/I S/I 9.3
Región Metropolitana 8.6 3.3 11.8 6.6 2 8.6
Fuente: Elaboración propia sobre la base de MIDEPLAN (2008).

When analyzing the specific situation of 2006, shown in Figure 4-29 it is possible to see that the San José de Maipo Municipality shows the highest indicators among the units studied, considering the total of poor and destitute persons; however, it is 0.7% lower than the regional average in the destitute persons category. The same scenario is apparent when observing the figures for poor homes. The same scenario is apparent when observing the figures for poor homes

Figure 4-29 Situation of poor persons and homes. Year 2006

7.6 8.2
6.4 6.3 6.6
3.6 3.0 2.4
3 2.5 2
7.5
0 3 6 9 12
Comuna de San José de Maipo
Provincia de Cordillera
Región Metropolitana
Comuna de San José de Maipo
Provincia de Cordillera
Región Metropolitana
Pobreza en Población Pobreza en Hogares
Porcentaje
Pobre no indigente Pobre indigente
Pobreza en Población Pobreza en Hogares

Source: Own preparation on the basis of MIDEPLAN (2008)

Home income level

The following table shows the income level of the homes at the regional,
provincial and municipal level. Generally speaking, it can be seen a significant increase in income during the period in the territorial units analyzed. At the municipal level, income increased by 8% while they increased only 6% at the provincial scale, and by 22% in the region; these variations to not correspond to a significant increase in the subsidies granted by the state to these units.

It is important to indicate that the San José de Maipo Municipality is the one that receive the largest amount of money as cash subsidy during the two periods considered, but in so case is this over $5,000 pesos.

The income increase at the regional level is worthy of note, the average family who received almost $ 651 thousand pesos per month in the year 2000 began receiving almost $ 800 thousand pesos in 2006, which is an increase of about 22% in six years.

Table 4-23 Average home income. Years 2000 and 2006 (percentages)

Unidad Político Administrativa
Año 2000 Año 2006
Ingreso autónomo
Subsidio monetario
Ingreso monetario
Ingreso autónomo
Subsidio monetario
Ingreso monetario
Comuna de San José de Maipo $ 533073 $ 4941 $ 538014 $ 579721 $ 4987 $ 584709
Provincia de Cordillera $ 604284 $ 4236 $ 608519 $ 642790 $ 4855 $ 647645
Región Metropolitana $ 647915 $ 3432 $ 651347 $ 795268 $ 4401 $ 799669
Fuente: MIDEPLAN (2008).

Health

Welfare health system

Concerning the health welfare systems related closely to the income level of the families, It is possible to note a considerable increase of the persons adhering to the public health system (FONASA), especially at the provincial level, where an increase of 12% was recorded, in detriment of the private and self-sustained systems and another for the period 2000 to 2006. Likewise, it is noted that both the province and Municipality show an almost 10% greater percentage in 2006, as compared to the regional adhesion to the public system.

If the situation is analyzed at the municipal level, it can be seen that almost three quarters of the population of San José de Maipo is enrolled in the public system in the year 2000, this figure increased a little more than 5% in 2006.

Table 4-24 Population according to Health Welfare systems (percentages)

Unidad Político Administrativa
Año 2000 Año 2006
Sistema publico
Isapre
Particular y otro
Sistema publico
Isapre
Particular y otro
Comuna de San José de Maipo 73.4 14.1 12.1 79.3 12.9 7.8
Provincia de Cordillera 66.4 20.7 10.6 78.4 15.5 6.0
Región Metropolitana SI SI SI 70.1 20.4 9.4
Fuente: BCN (2008).

Infant birth and death rates

Concerning the birth rate, it is possible to note a general decrease during the 200 to 2006 period; this situation is mainly quite clear at the provincial level. The same is seen as regards the infant death rate.

Concerning the birth rate, it is possible to note a general decrease during the 2000 to 2006 period; this situation is mainly quite clear at the provincial level. The same is seen as regards the infant death rate. Now, if the situation is analyzed for 2006 only, it can be seen that the birth rate is practically the same for the province and the Municipality, while the infant mortality rate shows some more significant differences, in effect at the provincial scale a decrease of almost 4 deaths of children for every 1000 born alive is recorded-

.

Table 4-25 Infant birth and death rates, 2000 to 2006 period

Unidad Político Administrativa
Año 2000 Año 2006
Tasa de Mortalidad Infantil
Tasa de Natalidad
Tasa de Mortalidad Infantil
Tasa de Natalidad
Comuna de San José de Maipo 5.4 16.9 10.9 13.1
Provincia de Cordillera 4.4 17.3 6.7 13.3
Región Metropolitana SI SI 7.2 14.2
Fuente: Elaboración propia sobre la base de BCN (2008).

4.1.4 Characterization of the direct service area.

i) Populated localities

The transmission line begins at the Maitenes S/S, then proceeds to the east, following the orientation of the Colorado River and Route G-345, up to the Alfalfal S/S, which is east of the Alfalfal settlement. On the other hand, the line between the future Alfalfal II Plant and the Alfalfal S/S will run mainly upon the mountain range limiting the Colorado Valley to the southeast. There are no populated areas in this line, except El Alfalfal, found near the connection substation of El Alfalfal.

ii) Geographic dimension

The localities of Los Maitenes and El Alfalfal are within the San José de Maipo Municipality, kilometers 13 and 22 of Route G-345, communicating to the El Volcán road.

Los Maitenes is sited at 1,350 masl and 59km away from the center of the city of Santiago, while El Alfalfal is sited at 1,500 masl and at a distance of approximately 68km from the center of the city

Figure 4-30 General overview of the El Alfalfal settlement - El Alfalfal (image not copied)

Figure 4-31 General overview of the Los Maitenes settlement (image not copied)

iii) Demographic Dimension

Los Maitenes and El Alfalfal have been characterized as hamlets by the INE, that is, these are human settlements with a proper name having three or more houses near each other, with less than 301 inhabitants and not forming part of another entity.

It is important to note that these hamlets are not found in the statistics of the 1992 census, therefore only the 2002 census statistics will be used.

Structure of the population by sex

Concerning the structure of the population by sex, it can be seen in table 4-26 the predominance of the male population over the female in the two populated entities analyzed. This is a characteristic situation of rural sectors. It is important to connect this distribution to the economic activities developed in that sector, directly associated to the existing hydroelectric plants, as well as the Rio Colorado mining company found near these localities.

Table 4-26 Distribution of the population according to sex at Los Maitenes and El Alfalfal (2005)

Entidad poblada	Total		Hombres		Mujeres		Índice de Masculinidad
	Nº	%	Nº	%	Nº	%	
Los Maitenes	149	81	54.4	68	45.6	119.1	
El Alfalfal	98	53	54.1	45	45.9	117.8	

Fuente: INE (2005).

4.2 Cultural and Archaeological Heritage

4.2.1 Introduction

The following Baseline antecedents refer about the Heritage and archaeological aspects identified for the area of the Project "Electric Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power plant – Alfalfal S/S" of AES Gener S.A., which will be sited in the San José de Maipo Municipality Cordillera Province, Metropolitan Region.

The Project will consist of two electric transmission lines with a total extension of 17.1km, to connect the Las Lajas and Alfalfal II plants -both approved in the agenda of the Alto Maipo Hydroelectric Project (PHAM)- to the Central Interconnected System (SIC).

The electric transmission system has two lines:

- Line between the Maitenes and Alfalfal S/Ss: A 110kV circuit, 7.6km long.
- Line between the Alfalfal II Power Plant and El Alfalfal S/S: Two 220 kV circuits, 9.5 km long.

Furthermore, the Project also contemplates the expansion of the existing Alfalfal S/S by 0.45ha to install the corresponding connections to the new lines.

The research was focused on the investigation and identification of national monuments (archaeological, paleontology, historic, public, typical zones, nature sanctuaries), and religious heritage represented by worship places near the area contemplated for the Project, such as graveyards, churches, grottoes and shrines.

4.1.2 Definition of the service area

The following were considered as direct service areas of the Project:

- Sector contemplated for the line between the Maitenes and Alfalfal S/Ss: 7.6km long and a restriction strip of 30 meters, equivalent to a surface of 22.8 ha.
- Sector contemplated for the line between Alfalfal II Power Plant and El Alfalfal S/S: 9.5 km long and a restriction strip of 40 meters, equivalent to a surface of 38.0 ha.
- Area for the expansion of the existing Alfalfal S/S, 0.45ha.

4.2.3 Results

i) Bibliographic review

Declared National Monuments

The bibliographic analysis and the review of the Archives of the Council of National Monuments concerning the direct service area of the Project allowed confirming that there are no declared national monuments, historical, nature sanctuaries or typical zones (Cabeza, A y M. Vega 1997).

Archaeological monuments

The settlement pattern of the pre-Hispanic population in the area of the Project tends to prefer places such as "rinconadas", sheltered sites near minor water courses, transit places, rocky overhands and sites of extraction of mineral and stone raw materials.

Between the high and middle basin of the Maipo River there is a gradient of sites from the maximum heights with Incaic High Places Sanctuaries (Cabeza, A. 1984: 1998); mountain passes (Thomas, C. et al., 1995); settlements in the interior tributaries and small valleys (Saavedra, M. 1993; Saavedra, M. et al., 1991; Stehberg, R., 1978); limited development sites in the area of opening of the Canyon to the Central Valley, in the zones of the Mapocho, Clarillo and Pirque Rivers (Cabeza, A. y P. Tudela, 1985; Cabeza, A. et al., 1992) and extensive sites inhabited since the Early Pottery period up to the Historical period located upon interfluvial terraces on the southern bank of the Maipo River (Vasquez, M. y L. Sanhueza, 1999, Personal Communication).

On the other hand, there are researches and archaeological prospecting in the general area and also areas immediate to the Project works, both scientific and in the framework of the SEIA.

For the general background, there are studies on the Olivares river, the sector called Cantera Infiernillo Norte inside the La Disputada Mine; the south bank of the Maipo River in the El Toyo locality and also in the La Yerba Loca stream (Sánchez, R. 2000a; 2000b; 2002; 2004; Hermosilla 2008), which would allow to estimate at first sight the probabilities of discovering archaeological sites in sectors involved in the Project as low. However, this does not mean that there are no settlements in the area, in fact several important archaeological sites have been found in the Farellones sector and the El Plomo mountain (Domínguez, G. 1965; Reyes, F. 1958) and in the High Cordillera of the Metropolitan Region and the 5th Region there are archaeological sites from the Archaic period up to the Inca presence horizon (Cabeza, A., 1984), Both with dwellings, graveyards and other for specific functions such as the extraction of stone and mineral raw materials (Cornejo, L. and J. Simonetti. 1992; 1997-98).

There are several Aleros (sheltered overhangs)in the upper part of the Maipo River, with Hunters occupation, some from the Archaic period. For the Laguna Lo Encañado, Luis Cornejo has noted on the one hand the presence of an Incaic road or "capac añam", joining the eastern and western slopes of the Andes and a structure which could correspond to a shack (Cornejo et al., 2006). As well as the presence of a series of shelters in overhangs called La Morrenas in the eastern bank of the Manzanito stream, with occupation from the Late Archaic 1725 - 1260 b.C.; to the Early Pottery period, circa 0 - 1000 years a.C. (Cornejo et al., 2003; Peralta et al., 2000; Galarce et al., 2005).

As said, there are antecedents about the presence or archaeological sites quite near or immediate to the sectors involved in the Project, corresponding to the Colorado River – Aucayes stream. For the Colorado River sector, there are antecedents About sites of the Early Pottery period in the Quempo Stream, although far from the Project works (Cornejo et al., 1997), and in the Aucayes stream a small camp of the Pottery period, distant from the area of the Project (Sánchez 2007).

Table 4-27 Description of the Site N°1 Aucayes Stream

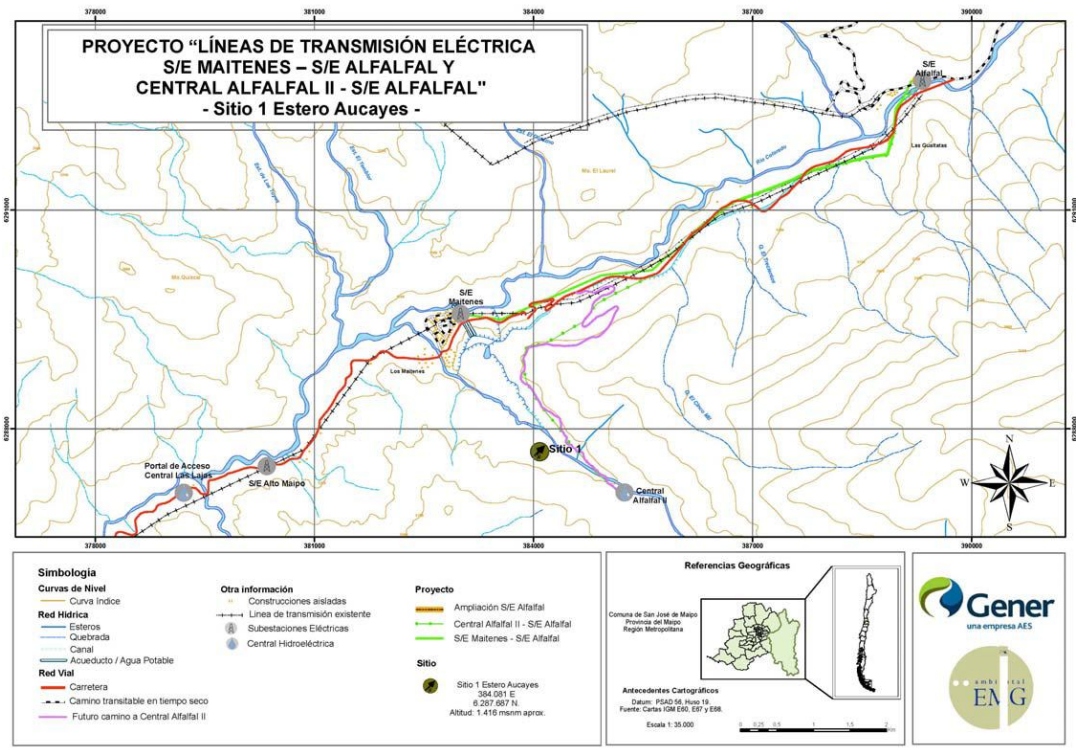
FACTS SHEET 1. Aucayes 1 Site	**AUCAYES STREAM SECTOR**
Type: Open Camp	Corresponds to a very low density dispersion area which an archaeological record composed almost entirely by stone material, only one indefinite ceramic fragment was detected. This area is sited in a small terrace south of the Aucayes stream. The stones material corresponds to nucleus derivations without modification in their edges, worked from local raw materials, where the major presence of andesite is noticed. Besides, there is the presence of a grinding tool, made of granodiorite and fractured. No indicative materials were detected but it clearly is a pre-Hispanic settlement.
Coordinates	Datum PSAD56 E: 384.081 and N: 6.287.687. Altitude: approx. 1,416 masl.
Total defined	North-South axis: 30m.

measurements	East-West axis: 40m. Approximate total: 1,200m^2.
Location	The site is located in a flat surface on the southern bank of the Aucayes stream.
Service area: Indirect	Located on a terrace in the southern bank of the Aucayes stream, approximately 500 m from the layout of the electric line to be developed between the Alfalfal II Plant and the Alfalfal S/S.
Conservation condition Very good.	The general condition of the site is very good, no human or natural alterations are detected.

Cultural materials identified at the Aucayes 1 Site

Source: Own preparation.

Figure 4-32 Location of the Aucayes 1 Site in relation to the Project



4.2.4 Archaeological prospecting

As suggested by the antecedents, the archaeological prospecting allowed to record an archeological site, of which there were already antecedents (Sánchez, 2007). The general area corresponds to a medium obtrusive sector given by the presence of grassland and native forest. The electric line between the Alfalfal II Plant and Alfalfal S/S, 0 9.5km, will be established hear this site, where hillsides are abrupt and there are few terraces east of the Colorado River, except a small sector at El Alfalfal.

The longer line goes by the northern side of the Aucayes stream, up to the Alfalfal II Plant. The prospecting allowed relocating the mentioned archaeological site, corresponding to a small camp with presence of stone material, ceramics and grinding material in the southern bank of the Aucayes stream, that is to say the hillside opposite to the development of the Project.

Figure 4-33 Aerial view of the area contemplated for the Project, sector G-345 (left) and area Alfalfal S/S (right)

(Image not copied)

4.3 Landscape

4.3.1 Introduction

The following report provides the results of the survey of the baseline landscape components associated to the Project "Power Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power plant – Alfalfal S/S

The Project is inserted in the landscape generated by the Colorado River hydrographic basin, belonging to the San José de Maipo Municipality between the Los Maitenes and El Alfalfal localities.

From an aesthetic point of view, the landscape has a great richness and diversity of landscape attractions, including patches of native vegetation, the river, cascades, rock formations and high peaks scenic backgrounds. Varied human interventions are seen upon this scene, road, energy transmission, minor human agricultural and mining settlements; this defines an area that while having some human interventions, keeps a scenic richness, produced by the morphology which provides natural mitigation. In spite of the above it is important to note that part of the Alto Maipo Hydroelectric Project will be sited in this area and will consist of new interventions in the sector, especially in the Aucayes stream area.

The landscape intervened by the Project and analyzed here is basically defined by its geomorphologic features, involved in the evolution process of the Andes Cordillera, as consequences of the erosive action of the water, as glaciers in a first instance and to the erosive action of the rivers and rains later on. The climate characteristics, similar to those of the Santiago basin (Mediterranean type) are gradually modified, depending on altitude and defining the plant cover of the landscape.

The Colorado River is a tributary of the Maipo River and its hydrographic basin is smaller, but its grades are steeper in a much shorter distance, showing as a narrow canyon discharging into the Maipo River.

Minor and informal tourism activities, subsistence trade, industry and energy projects coexist in this landscape. These features define a floating population related to those activities and a resident one, which uses the zone for dwellings and works in the San José de Maipo Municipality cities and others nearby.

To make the *landscape* concept clear and to characterize the components, this term will be understood as the visual or external manifestation of the territory, derived from the combination of a series of physical causal

factors as the geomorphology and climate; biological as the vegetation and fauna within a landscape and the occurrence of natural or human interferences. This *landscape* is generated starting from what an "observer" can perceive about the territory, fundamentally by sight and other senses. Therefore the *landscape* becomes a physical reality experienced individually by men, according to their culture and personality and conditioned by their physical perception capacities (de Bolós, 1992). Therefore the approximation to the landscape is from ones own ground; what matters is not so much the landscape-territory as a whole but the part of it that appears to the observer, that is the visual surroundings that are perceive from the observation point.

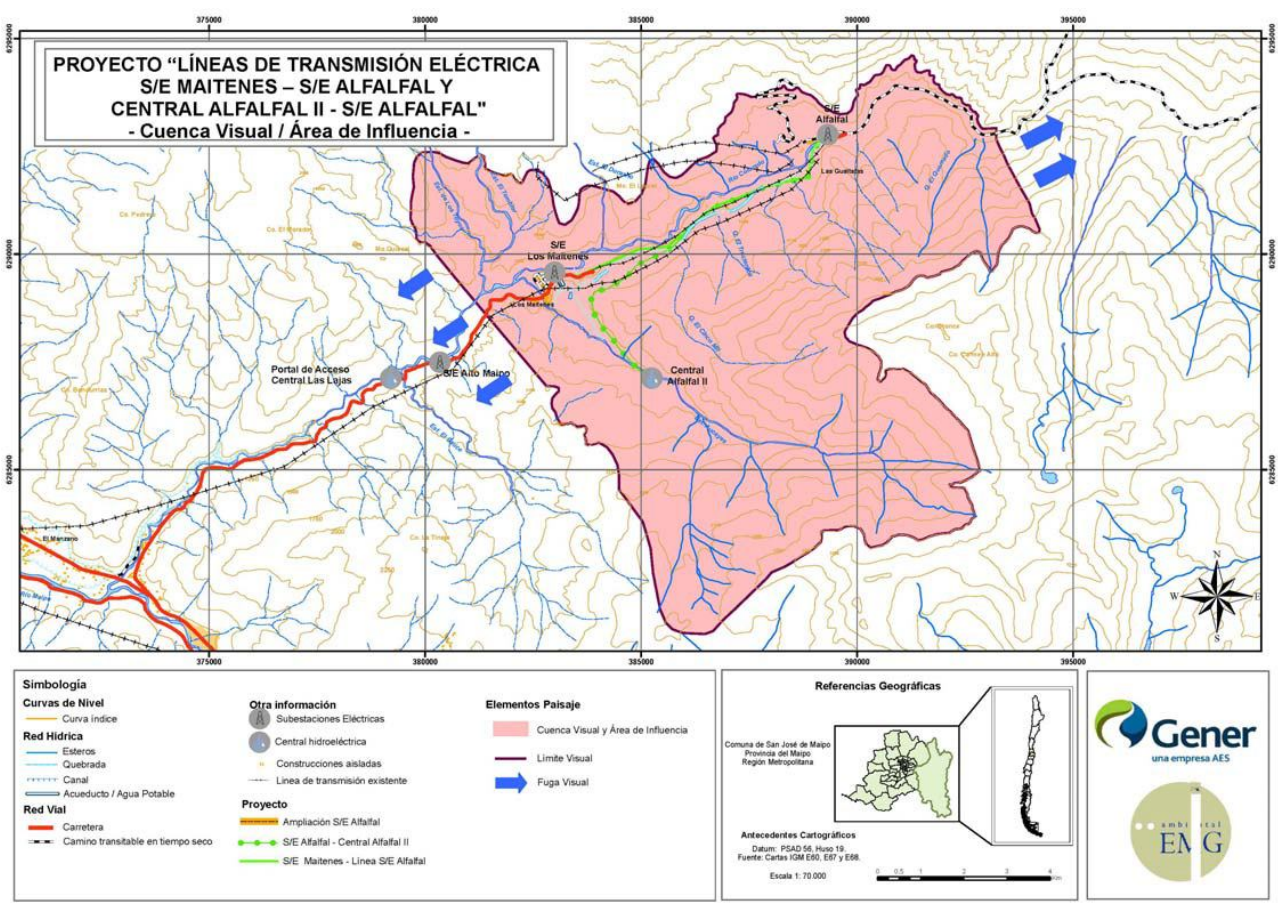
The present report characterizes the landscape as a function of three concepts as stipulated in letter f.7, Article 12 of the Third Chapter of the Environmental Impact Assessment System Regulations (D.S. Nº 30/97) and its modifications (D.S. Nº 95/01), of the General Secretariat of the Presidency Ministry, so as to comply with the stipulation of letter C) of Article 15, Title III of the same Regulations.

4.1.2 Definition of the service area

The service area will be understood as the whole portion of the territory where the Project will be placed and which is visible to an observer. From this characteristic, the definition of the visual basin corresponds to the service area, since it acts as a section of the territory and landscape within visual reach.

Figure 4-34 shows the visual basin and the service area of the Project for the landscape component.

Figure 4-34 Visual basin and service area. Landscape Component



Source: Own preparation based on the IGM E60, E67 and E68 maps, 1:50.000 scale.

4.3.3 Results

i) Definition and characterization of the Landscape Units (UP)

As a first approach, a general identification of the territory was carried out on the basis of IGM maps, 1:50.000 scale and aerial photographs (Google Earth), allowing a first diagnosis and identification of homogenous units.

The visual reconnaissance of the landscape was done during a field survey, identifying both the landscape components and their visual response to possible actions, beginning by the fragmentation and zoning of homogenous areas and identifying the landscape units as such. To carry out the spatial division, which included the whole service area, the relief of the study area and the plant cover were taken into account, as fundamental components in the definition of recognizable patches.

Three landscape units were identified and are detailed in the following table.

Table 4-28 Description of the Landscape Units identified in the area studied

N°	Name of the Landscape Unit	Background
1	Colorado River Canyon	Unit formed by the Colorado River and its banks shaped by fluvial terraces. Presence of the river and some zones of natural silting, dense sclerophyll forest patches of high-medium height and some minor areas of cultivation and human settlements (small hamlets and isolated houses).
2	Mountain range	Unit formed by the mountain ranges of the Colorado River basin. Characterized by steep hillsides, predominance of natural prairie and native scrubland of the arbustive type and low density. To be noted in this unit, rocky outcrops, natural silting, creeks and cascades.
3	Aucayes Stream	Unit corresponding to the Aucayes stream micro basin. Formed by the creek, the stream bed and the neighboring mountain formations. Its main feature is the very steep hillsides, where rocky outcrops predominate and the vegetation is of the xerophytic type scrubland.

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Source: Own preparation.

Figure 4-35 (Page 4-93) shows an aerial view of the study areas, the identified landscape units and the Project.

The index cards of the UP1, UP2 and UP3 below are detailed description of the elements configuring each of the landscape units. These elements correspond to morphology, space, soil surface, vegetation, water courses or bodies, human action, scenic background, singular areas and/or interesting landscape landmarks.

Table 4-29 Description of the elements forming the landscape unit.
Facts Sheet UP1 – N°1 Landscape Unit Colorado River Canyon

Name of the UP	COLORADO RIVER CANYON
	(image not copied)
Visual characteristics	Description
1.1 Morphology	The unit is formed by a terrain where the horizontal plane of the river and the terraces predominate in the morphology, as well as the medium and high grades associated to the foot of the hillside, talus cuts and creeks. The forms are linked to the river bed and the formation of fluvial terraces and natural silting present in the talus cuts of the river.
1.2 Space	The UP shows spaces molded by the characteristic geomorphology of the cordillera and its condition as catchments basin, in this case associated to the Colorado River. The observer is place in a medium - low point, a condition that, added to the previous characteristics define a medium space, with very clear visual limits defined by the mountain ranges.
1.3 Soil Surface	Heterogeneous surface. In the river sector, surface associated to the riparian corridor, different

	from the banks where talus zones and natural silting zones. Stones of different granulometry are very apparent. On the hillsides, rocky substrate and places where the herbaceous substrate predominates.
1.4 Vegetation	The unit has a sclerophyll type forest and mixed native scrubland in the banks and bottom of the creek, species such as quillay, litre, boldo, molle and colliguay are to be noted; minor cultivation patches are observed and some introduced species, besides isolated trees.
1.5 Fauna	There are some bird species in this UP, observed mostly on the banks of the river.
1.6 Water courses or bodies	The Colorado River is a predominant element in the scene of this unit
1.7 Human action	This unit is formed by the river canyon and its fluvial terraces; the latter are the area where small settlements and isolated houses are concentrated, besides cultivation (mostly fodder and fruit trees) and various industrial installations (as is the case of the mining industry and power substations). The paved road, Route-G345 is the limit between UP1 and UP2, so this element is present in both units. According to the figure shown in Appendix B of Annex 15, the works of the Alto Maipo Hydroelectric Project which would be placed in this unit correspond mainly to the access portal to the Las Lajas Plant, the intake works and discharge of the Alfalfal II Plant
1.8 Scenic background	The mountains are the scenic background that predominates in this unit. This element is of great relevance for the unit.
1.9 Singular areas and/or landscape landmarks	The Landscape unit has singular areas of landscape interest, specifically associated to sections of the river.

Source: Own preparation.

Table 4-30 Description of the elements forming the landscape unit.
Facts Sheet UP2 – N°2 Landscape Unit: Mountain Range

Name of the UP	MOUNTAIN RANGE
Image not copied	
Visual characteristics	**Description**
1.1 Morphology	The unit has a terrain of strong morphology where steep slopes predominate – over 45% – and the presence of minor sites with softer slopes. This unit is characterized by its typical cordilleran morphology and high mountain conditions.
1.2 Space	In this unit the views are determined by the position of the observer, panoramas are limited due to the basin condition of the area, where the mountain ranges are present as clear foregrounds.
1.3 Soil Surface	The ocher and dark colors predominate on the surface, where the presence of an herbaceous stratum of the prairie type gives a continuous texture, of seasonal color, mixed with a predominantly rocky surface.
1.4 Vegetation	The Landscape unit is characterized by the presence of native plants of the xerophytic scrubland type. The presence of the natural prairie is noticeable, there the herbaceous stratum predominates and blends into the arbustive scrubland, where the presence of espino, colliguay, molle, chagual, cactus is noted. Some sclerophyll-type patches are observed in a lesser proportion and associated to the lower elevations.
1.5 Fauna	There are several bird species in this landscape unit; they are most often observed in the scrubland near the creeks, the observation of eagles, skates and condors is noted as elements of interest.
1.6 Water bodies or courses	Some minor water courses are observed in this landscape unit, such as cascades and streams associated to the creeks.
1I7 Human action	This landscape unit has a medium degree of human intervention, mainly due to the existence of some minor installations, power lines and high towers, besides the paved road that acts as a limit between units.
1.8 Scenic background	The scenic background that predominates in this unit is constituted by the farther views of the mountains ranges. As is the case of the previous unit, the scenic background is a very relevant element.
1.9 Singular areas and/or landscape landmarks	The unit has singular areas associated to rock outcrops which enrich the visual quality of the landscape, besides some cascades that are visual landmarks a long the paved road to the Alfalfal (Route G-345).

Source: Own preparation.

Table 4-31 Description of the elements forming the landscape unit.
UP3 Facts Sheet - N° 3 Landscape Unit: Aucayes Stream

Name of the UP	AUCAYES STREAM
Visual characteristics	**Description** 
1.1 Morphology	The unit has a terrain of strong morphology where steep slopes of over 45% predominate. This unit is characterized by its typical cordilleran morphology and high mountain condition.
1.2 Space	In this unit the views are determined by the height of the observer. When the observer is at a higher point, he can view panoramas associated to a wider amplitude, at low altitude the space is bound by the creek basin, very contained and with close barriers as a product of the topography.
1.3 Soil Surface	The ocher and dark colors predominate on the surface, where the presence of an herbaceous stratum of the prairie type gives a continuous texture, of seasonal color, integrated to a predominantly rocky surface, associated to higher peaks and farther views.
1.4 Vegetation	This landscape unit is characterized by the presence of native vegetation of the forest and sclerophyll scrubland type (in the lower sections and associated to the water course) and xerophytic (present in the middle sections of the mountain sides). The presence of the natural prairie is noticeable, there the herbaceous stratum predominate and blends into the arbustive scrubland, made up by espino, colliguay, molle, chagual and cactus among others.
1.5 Fauna	There are several bird species in this landscape unit; they are most often observed in the scrubland near the creeks, the observation of eagles, skates and condors is noted as elements of interest.
1.6 Water bodies or courses	The Aucayes Stream is observed in this landscape unit, as well as some minor and/or seasonal courses. Generally speaking, the Aucayes stream is an element present and important in the unit however, it does not predominate in the scene, mainly due to the topography of the land, which restricts visual access to certain observation points.
1l7 Human action	This landscape unit shows a relatively low human intervention degree. Although there are some specific interventions (intake and irrigation canal) these are not perceived visually and are very small as compared to the extension of the territory. In spite of the above and according to the figure shown in Appendix B of Annex 15, the works of the Alto Maipo Hydroelectric Project to be considered in the baseline, are mainly the future access road to the Alfalfal II Plant (6.1km long) as well as the access portal to it.
1.8 Scenic background	The scenic background that predominates in this landscape unit is constituted by the farther views of mountains ranges where rocky outcrops and snow peaks are important As is the case of the previous units; the scenic background is a very relevant element.
1.9 Singular areas and/or landscape landmarks	The unit shows rocky outcrops that constitute singular areas and enrich the visual quality of the landscape; they are associated to the mountain condition. The Aucayes stream is also a singular interest area.

Source: Own preparation.

ii) Visual Quality of the Landscape (CV)

An adaptation of the indirect method to valuate the components of the landscape proponed by Aguilo (1992) et al was used to determine the visual quality (CV) of the defined landscape units. This involves both qualitative and quantitative techniques and weighting of each element that contributes to the visual quality of the unit and the study area in general.

The following table lists the value assigned to each of the existing components, for each landscape unit. This evaluation was done both nominally and numerically, to as to tabulate the results.

Table 4-32 Valuation of the Visual Quality of the Landscape

COMPONENTS	Visual Quality Value for each UP		
	Colorado River Canyon	Mountain range	Aucayes Stream
MORPHOLOGY			
Soft hills, flat valley bottoms, little or no singular details, grades between 0 and 15%			
Interesting erosive formations or varied relief in size and shape. Presence of interesting forms and details, but not dominant or exceptional. Grades between 15 and 30%	Medium (2)		
Very mountainous relief, market and prominent or else relief of great superficial variety, dunes systems or presence of a very particular feature. Grades over 30%		High (3)	High (3)
VEGETATION			
Little or no variety or contrast of the vegetation.			
Some variety in the vegetation but only one or two types.	Medium (2)	Medium (2)	
Great variety or plant formations, with interesting forms, textures and distribution- Visually attractive species.			High (3)
FAUNA			
Absence of landscape important fauna.			
Sporadic presence at the site, or not showy species, or low species richness.	Medium (2)	Medium (2)	Medium (2)
Presence of permanent fauna at the place, showy species or high species richness.			
WATER			
Absent or not perceived.			
Water in movement or still, but does not dominate the landscape-		Medium (2)	Medium (2)
Dominant factor in the landscape, clear and clean appearance, white water (rapids, cascades), and water mirrors in repose, large water bodies.	High (3)		
HUMAN ACTION			
Intensive and extensive modifications which reduce or obliterate the scenic quality.			
The scenic quality is affected by modifications of small harmony, although not totally, or the actions do not add visual quality.	Medium (2)	Medium (2)	Medium (2)
Free from aesthetically undesirable modifications or with modifications of favorable outcome on the visual quality.			

The works of the Alto Maipo Hydroelectric Project have been considered for the determination of the Visual Quality in these Landscape Units, as these will be already built or in the building stage at the moment of starting the works for the Project analyzed here (Maitenes S/S-Alfalfal S/S and Alfalfal II Plant – Alfalfal S/S Electricity Transmission Lines).

COMPONENTS	Visual Quality Value for each UP		
	Colorado River Canyon	Mountain range	Aucayes Stream
SCENIC BACKGROUND			
The adjacent landscape does not have any influence on the quality of the whole.			
The surrounding landscape moderately increases the visual quality of the whole.			
The surrounding landscapes strongly increase the visual quality.	High (3)	High (3)	High (3)
SINGULARITY OR SCARCITY			
Quite common in the region.			
Characteristic, but similar to others in the region.	Medium (2)	Medium (2)	Medium (2)
Unique, scarce or very rare in the region, good possibilities to observe exceptional fauna and flora,			

Source: Own preparation.

Results of the Landscape Visual Quality

The values obtained for each of the components that incident in the visual quality of the landscape are shown in the following tables, which summarize the results based on the detailed valuation carried out for each landscape unit.

Table 4-33 Visual Quality of the Landscape UP1 – Colorado River Canyon

Component	Visual quality component (nominal and numeric)	
Morphology	Medium	2
Vegetation	Medium	2
Fauna	Medium	2
Water	High	3
Human action	Medium	2
Scenic background	High	3
Singularity or scarcity	Medium	2
Results	**Medium CV**	**2,29**

Component	Visual quality component (nominal and numeric)
The UP1 Colorado River Canyon has a Medium Visual Quality This corresponds to the values of the evaluated components, which are mostly in the medium range. The morphology is characterized by a flat horizontal plane at the level of the river and terraces and slopes associated to the talus, silting and foot of the slopes. The vegetation is heterogeneous as mixed forests of the sclerophyll and native scrubland are observed in the banks and bottoms of the creeks besides smaller cultivated patches and some isolated introduced species. Concerning the fauna of interest, some birds associated to the scrubland and river bed are observed; the human action corresponds mainly to small settlements, isolated houses, inner farm tracks, existing electric transmission lines as well as the future Alto Maipo Hydroelectric Project works have been considered (Access Portal to the Las Lajas Plant and intake works and discharge of the Alfalfal II Plant). The singularity or rarity show a medium range, as this is a typical cordilleran landscape at the regional level. All the elements are assessed in the medium range, which when weighted with the water in the high range as the Colorado River is a dominant element in the scene and the scenic background has great landscape relevance, gives d final result of 2.29 that is a medium value tending to high.	

Own preparation.

Table 4-34 Visual Quality of the Landscape UP2 – Mountain Range

Component	Visual quality component (nominal and numeric)	
Morphology	High	
Vegetation	Medium	2
Fauna	Medium	2
Water	Medium	2
Human action	Medium	2
Scenic background	High	3
Singularity or scarcity	Medium	2
Results	**Medium CV**	**2.29**
The UP2 Mountain Range has a Medium Visual Quality This unit corresponds to both slopes forming the hydrographic basin of the Colorado River and has several components with a medium value, as is the case of the vegetation observed: diversity of species as patches of sclerophyll forest and others of arbustive xerophytic scrubland and herbaceous prairie besides cactuses and succulents. The same can be said about the presence of fauna, some birds are observed. Regarding water some minor courses are observed: cascades in the streams associated to creeks. Human action: roads, power lines and minor buildings, as for the, this landscape is catalogued as interesting but fairly common in the region. The morphology has a high value: terrain with steep slopes and interesting relief (grades over 45%) and the scenic background is an element of great relevance for the unit. These two elements increase the visual quality level; weighted with the medium values this give a final medium value tending to high.		

Table 4-35 Visual Quality of the Landscape UP3 – Aucayes Stream

Component	Visual quality component (nominal and numeric)	
Morphology	High	3
Vegetation	High	3
Fauna	Medium	2
Water	Medium	2
Human action	Medium	2
Scenic background	High	3

Component	Visual quality component (nominal and numeric)	
Singularity or scarcity	Medium	2
Results	**High CV**	**2,43**
The UP3, Aucayes Stream has a High Visual Quality, given by the how values of practically all its components. This unit is characterized by high visual quality values in respect to morphology, as there are strong and interesting grades; the vegetation is interesting due to the contrast of types, colors and textures. The scenic background is of great importance and relevant for the unit, mainly due to mountains and snowy peaks. The fauna receives a medium rate evaluation since some interesting birds are observed but are not outstanding from a landscape point of view. The water is present in the Aucayes stream and minor water courses, but they do not predominate in the scene. Concerning the human action, which at present is scarcely visible as compared to the size of the territory, at the time of starting the works for the Project analyzed here, There will be some interventions due to the Alto Maipo Hydroelectric Project a (mainly road and Alfalfal II Power Plant); this has already been incorporated into the assessment by defining the range as medium as concerns the singularity or scarcity: this is a very interesting landscape but common in this environment. The weighing of the results gives a high visual quality to this unit, as most of the components have a high value (the final value of the visual quality in the lowest range of the table, from 2.3 to 3.0).		

Source: Own preparation.

iii) Visual fragility of the Landscape (FV)

An adaptation of the method of Aguilo et al (1992) as shown in the following table was used to determine the visual fragility of the defined. (1992) landscape units.. Based on this method, values were assigned to a series of factors participating in the reality of a visual landscape, as are the biophysical, visualization, singularity and visual accessibility.

The following table shows the visual fragility valuation for each of the already described landscape units.

Table 4-36 Valuation of the Visual Quality of the Landscape

DESCRIPTION OF THE FACTORS	Visual Fragility Value for each UP		
	Colorado River Canyon	**Mountain range**	**Aucayes Stream**
BIOPHYSICAL FACTORS			
a) Grades			
Grades between 0 and 15%, dominance of the horizontal plane			
Grades between 15 and 30%, terrains with soft or undulating modeling.	Medium (2)		
Grades over 30%, terrains with dominance of the vertical visualization plane		High (3)	High (3)
b) Vegetation density			
Large forest masses 100% cover			
Discontinuous vegetation cover Dominance of the arbustive stratum	Medium (2)		
Large spaces without vegetation Isolated groups Dominance of the herbaceous stratum		High (3)	High (3)
C? Vegetation contrast			

DESCRIPTION OF THE FACTORS	Visual Fragility Value for each UP		
	Colorado River Canyon	**Mountain range**	**Aucayes Stream**
High species diversity, strong and interesting contrasts			
Medium species diversity, with evident contrasts but not outstanding	Medium (2)		Medium (2)
Monospecific vegetation, not evident contrasts		High (3)	
Height of the vegetation			
Height over 10m. Great strata diversity			
No great height of the masses (< 10 m), nor strata diversity.	Medium (2)		
Arbustive or herbaceous vegetation, not over 2m in height or without vegetation		High (3)	High (3)
VISUALIZATION			
Size of the CV			
Extensive regular basins generally rounded.			
Irregular basins, mix of both categories.	Medium (2)	Medium (2)	Medium (2)
Close or near vision (0 to 500m). Foreground dominance			
b) Shape of the CV			
Extensive regular basins generally rounded.			
Irregular basins, mix of both categories.	Medium (2)	Medium (2)	Medium (2)
Long basins, generally unidirectional along the view or very restricted			
c) Compactness			
Views closed or with obstacles. Constant presence of shady zones or lesser visual incidence.			
The landscape has zones of lesser visual incidence, but in a moderate percentage.	Medium (2)	Medium (2)	Medium (2)
Open panoramic views. The landscape does not have holes, or elements to obstruct the visual lines.			
SINGULARITY			
a) Uniqueness			
Common landscape, no visual richness or very altered.			

Interesting landscape but usual, without presence of singular elements,			
Singular landscape notable, with richness of unique and distinctive elements.	High (3)	High (3)	High (3)
b) Traditional value			
Absence of sites or morphologic features ingrained in the local life.			

DESCRIPTION OF THE FACTORS	Visual Fragility Value for each UP		
	Colorado River Canyon	**Mountain range**	**Aucayes Stream**
Sites or morphologic features usually ingrained in the local life. Sometimes used as references and constituted as symbols.	Medium (2)	Medium (2)	Medium (2)
Sites or morphologic features strongly ingrained in the local life, used as references and constituted as symbols.			
c) Historic value			
Absence of monuments or sites historically recognized as such,	Low (1)	Low (1)	Low (1)
Monuments or sites not recognized in the history of the region, without transcendence outside the local scene.			
Monuments or sites important in the history of the region, with transcendence outside the local scene.			
VISIBILITY			
a) Visual accessibility			
Low visual accessibility, scarce or short views.			
Medium visibility, occasional, combination of both levels.			Medium (2)
High visual perception, visible at a distance and without major restrictions.	High (3)	High (3)	

Source: Own preparation.

Results of the Landscape Visual Quality

The values obtained according to the factors associated to the visual fragility of the landscape are shown in the tables below, from the detailed assessment of each landscape unit as per the above table.

Table 4-37 Visual Fragility of the Landscape UP1 – Colorado River Canyon

Factors	Visual Fragility Factor (nominal and numeric)		
Biophysical factors	Grade	Medium	2
	Vegetational density	Medium	2
	Vegetational Contrast	Medium	2
	Height of the vegetation	Medium	2
Visualization	Size of the CV	Medium	2
	Shape of the CV	Medium	2
	Compactness	Medium	2
Singularity	Uniqueness	High	3
	Traditional value	Medium	2
	Historical value	Low	1

Factors	Visual Fragility Factor (nominal and numeric)		
Visibility	Visual access	High	3
Results		**Medium FV**	**2,09**
The UP1 shows a **Medium Visual Fragility,** this condition is due to the assessment of most of its components as in the			

medium range. Concerning the biophysical factors, this units has a medium slope, where the horizontal plane of the river canyon and the fluvial terraces predominate, besides the grades of the talus, silting and foot of the slopes. As concerns vegetation, its visual fragility indexes are measured according to three parameters: Density, contrast and height of the vegetation; this means that the vegetation has low density, leaving a great proportion of the ground exposed, which, added to the dominance of lower strata (arbustive and herbaceous) and at the level of contrast of species diversity, color and texture, make it more fragile due to the exposure and vulnerability (capacity to absorb the landscape).

Concerning visualization, this unit is characterized by its irregular visual basin, long and with panoramic views conditioned by the spatiality and height of the observer; there characteristics give it a median value, as does the compactness shown in some stretches, mainly as a product of geomorphology and vegetation. Concerning singularity, there are diverse values: uniqueness is high, since it is an interesting and singular landscape, the traditional value is medium, since the Colorado River and its localities are recognized at the local scale only and the historical value is low: There are no old settlements, except those associated to industries (electric power and local mining). This unit has a high visual accessibility, mainly due to spatiality, absence of visual barriers and height of the observer, privileged at the level of the basin.

Given these characteristics, this unit has a weighted visual quality result of 2.09 that is in the medium range.

Source: Own preparation.

Table 4-38 Visual Fragility of the Landscape UP2 – Mountain Range

Factors	Visual Fragility Factor (nominal and numeric)		
Biophysical factors	Grade	High	
	Vegetational density	High	
	Vegetational Contrast	High	
	Height of the vegetation	High	
Visualization	Size of the CV	Medium	
	Shape of the CV	Medium	2
	Compactness	Medium	2
Singularity	Uniqueness	High	3
	Traditional value	Medium	2
	Historical value	Low	1
Visibility	Visual accessibility	High	3
Results		**High FV**	**2,45**

The UP2 has a **High Visual Fragility**; this condition is given by the weighting of the results which average into the high range. Concerning the biophysical factors, this unit has a high visual fragility, given by the grades of the territory, which are over 45% in its slopes. The vegetation has the same value as its density is low, leaving large patches without vegetation (rocky sector, associated to the higher elevations) and low contrast; there is little contrast of visually different species (color, texture) and low, since the mainly herbaceous lower strata predominate (mixed with small arbustive patches, some succulents and cactaceae). All these factors, associated to the grades and vegetation, make this territory visually more fragile as a product of its visual exposure and vulnerability to any type of intervention. In general the visualization of the basin is characterized by

Factors	Visual Fragility Factor (nominal and numeric)

medium values as concerns the shape, size and compactness (existence of zones visually hidden). This unit belongs to an irregular basin, of medium size, long shape and compactness zones associated to geomorphologic features. The singularity is low in historical value since it belongs to a landscape that does not have heritage value and medium in traditional value, because, although it is recognized, this is mostly at the local scale. Concerning uniqueness, the value is high as it is considered a singular landscape, noteworthy, with richness of unique elements and distinctive as it is the case of the cascades and rocky outcrops, added to the colors, textures and visual richness of the sonic cordilleran background. This unit has a high visual accessibility, mainly due to spatiality, absence of visual barriers and height of the observer, privileged at the level of the basin. Given these characteristics, this unit has a weighted visual quality result of 2.45 that is in the high range.

Source: Own preparation.

Table 4-39 Visual Fragility of the Landscape UP3 – Aucayes Stream

Factors	Visual Fragility Factor (nominal and numeric)		
Biophysical factors	Grade	High	
	Vegetational density	High	
	Vegetational Contrast	Medium	2
	Height of the vegetation	High	
Visualization	Size of the CV	Medium	
	Shape of the CV	Medium	
	Compactness	Medium	
Singularity	Uniqueness	High	
	Traditional value	Medium	
	Historical value	Low	1
Visibility	Visual access	Medium	
Results		**Medium FV**	**2,27**

This UP shows a Medium Visual Fragility, mainly due to the weighting of the fragility rating of its biophysical factors, visualization, singularity and visibility. The grounds of this unit have high grades; therefore the observer has a greater ease of visualization. As to the vegetation, it is of low density and height, as patches without vegetation predominate (associated to the higher elevations) and others of xerophytic scrubland, mostly arbustive and herbaceous. The vegetation contrast is in the medium range, as there is a diversity of associations placed in an heterogeneous fashion and distributed attitudinally (sclerophyll, xerophytic, cactaceae and succulents).
Concerning visualization, the size and shape of the visual basin have a medium value, as it is an irregular basin of medium size, with dominance of different planes. As regards compactness, this has a medium value, as there are many zones visually hidden to the observer; to some extent this protects it as to its weaknesses and vulnerability given by its condition and the characteristics of its factors. This UP has diverse singularity values. The historical value is low since this landscape does not have an heritage value and medium in traditional value because, although it is recognized, this is mostly at the local scale. Concerning uniqueness, the value is high as it is considered a singular landscape, noteworthy, with richness of unique elements and distinctive (cascades and rocky outcrops) added to the colors, textures and visual richness of the scenic cordilleran background.
Visual accessibility is rated as medium, mainly due to the hemmed in spatiality, which opens into panoramas when the observer reaches greater heights.
Given these characteristics, this unit has a weighted visual quality result of 2.27 that is in the medium range.

Source: Own preparation.

4.3.4 Landscape Classification

The landscape units of the study area have been characterized by the evaluation of each homogeneous unit, describing the landscape components and their esthetic categories. Once the information that led to the definition of the visual quality and fragility was obtained, classified and analyzed, the results of the landscape value were grouped and interpreted in different ways according to the specific characteristics of the area studied.

Starting from the combination of the indexes obtained for the visual quality and fragility obtained from this analysis, these were grouped and interpreted according to the classification described in the method.

These results, obtained from crossing the values, allowed determining territorial zones according to the landscape classes of the study area.

The following table summarizes the indexes obtained in the evaluation of the visual quality and fragility of the landscape, used for the analysis of the landscape classification.

Table 4-40 Quality and visual fragility of the Landscape Units

UP Number	Name	Visual Quality	Visual Fragility ..	Class
UP1	Colorado River Canyon	Medium CV	Medium FV	III
UP2	Mountain range	Medium CV	High FV	III
UP3	Aucayes Stream	High CV	Medium FV	II

Source: Own preparation.

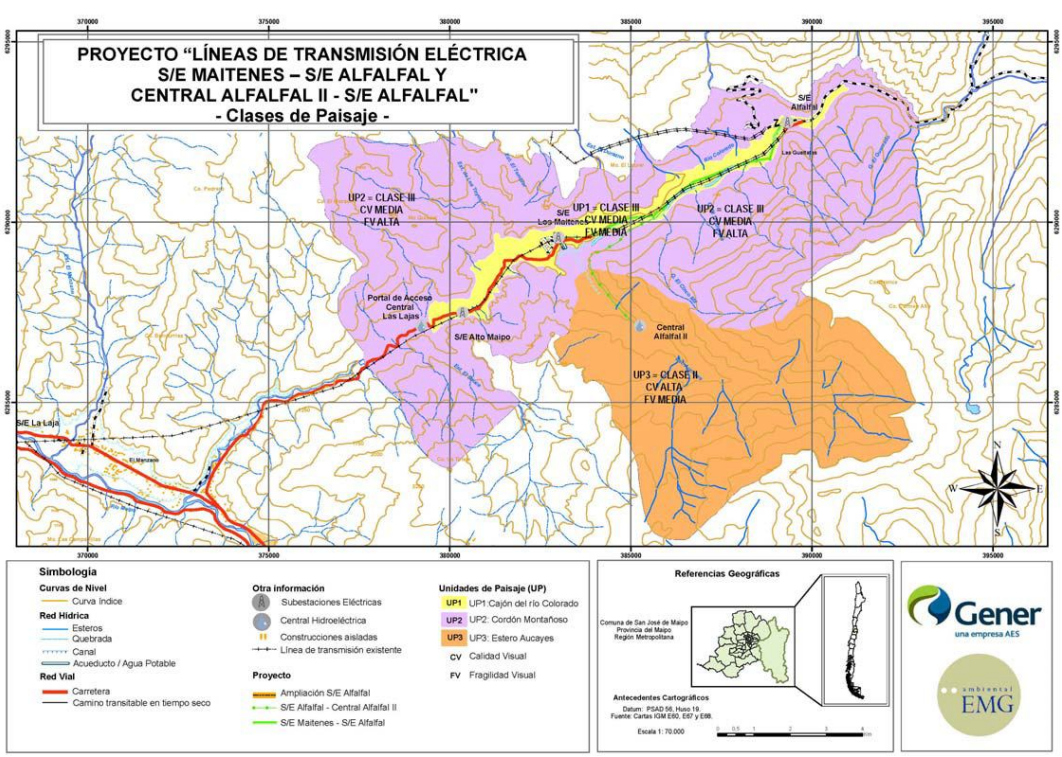
The evaluated landscape units belong to **Class II and III** according to the combination of the quality and fragility results. The relationship between medium visual quality and variable fragility (In the case of UP1 medium and UP2 high) characterize it as Class III, and those of high visual quality and medium fragility as Class II.

The **UP1 Colorado River Canyon and UP2 Mountain Range**, correspond to a Class **III** landscape as of medium **quality and medium and high fragility**, respectively. To this must be added the cascades and rocky outcrops as singular areas and/or of landscape interest. A Class II landscape has a variable restriction degree that is a higher pressure level on the landscape is allowed, but it does not accept strong landscape impacts.

The **UP3 Aucayes Stream** is classified as a **Class II**, landscape, defined as of **high quality and medium fragility**, in principle suitable for the promotion of activities requiring landscape quality and causing only slight impacts on the landscape. Its degree of use restriction is high (for example, tourism in general, projects of low impact or adding landscape value, others).

The following figure shows the landscape units of the service area and the results concerning the Landscape Class, a condition that explains the resistance degree to possible impacts.

Figure 4-35 Landscape classes in the service area units



4.4. Tourism

4.4.1 Introduction

The present study corresponds to the baseline survey of the tourism component in the area studied, belonging to the Project "Electric Transmission Lines Maitenes S/S – Alfalfal S/S and Alfalfal II Power plant – Alfalfal S/S.

The Project will consist of two electric transmission lines with a total extension of 17.1km, to connect the Las Lajas and Alfalfal II plants - both approved in the framework of the Alto Maipo Hydroelectric Project (PHAM) - to the Central Interconnected Grid (SIC).

This electric transmission system will have two lines:

- Line between the Maitenes and Alfalfal S/Ss: an 110kV circuit, 7.6km long.
- Line between the Alfalfal II Power Plant and El Alfalfal S/S: Two 220 kV circuits, 9.5km long.

Furthermore, the Project contemplates the expansion of the existing Alfalfal S/S by 0.45ha to install the corresponding connections to the new lines.

The Project is inserted in the landscape of the Colorado River hydrographic basin, belonging to the San José de Maipo Municipality between the Los Maitenes and El Alfalfal localities.

The review of the bibliographic antecedents of the San José de Maipo Municipality shows that it has a consolidated tourism offer, recognized at the regional level.

This Municipality has historically been the leisure and recreation point of the city of Santiago, a condition that it still holds. This role was generated due to its vicinity to the regional capital, highways that provide an easy access, the richness of the landscape and lately the diversification of tourism offers.

It must be pointed out that in spite of these conditions it has not been possible to develop a planned and coordinated development between the public and private entities; this has caused a scattered tourism development, with a large number of informal activities not able to create basic tools to ease the organization and integration of the sector. Basic tools are the cadaster of attractions, tourism facilities and services in general, besides formal records of the tourism activities carried out in the zone. At present there are only partial records of formal activities at the municipal and local level.

The San José de Maipo Municipality was declared a Tourism Interest Zone (in January 2001), according to Decree D.L.Nº 1.224 and D.S. Nº 515 when the declaration process was started). This defines it as a protected area.

4.1.2 Definition of the service area

Two strategies have been developed to define the area of service of the Project. The first, based in the direct and close relationship between the tourism development of the zone and the landscape, allows defining an indirect service area (ISA) as a first step. The second corresponds to the direct relationship between the existing tourism offer in the main localities and the Project.

Concerning the landscape, its relationship with tourism and the visual perception of the territory, it is defined as AII, as the visual basin of the landscape component. That is the whole portion of the territory in which the Project is visible by some observer from some road or access, both near and far away (See Figure 4-34, page 4-77).

The direct service area (DSA) is defined as the territory having an established tourism offer and found near the Project. In this context, all localities having some type of offer are considered as DSA.

Generally speaking, the tourism offer both of attractions as of tourism facilities is concentrated in the main settlements and connecting roads. In this case, route G-3345 (Colorado River sector) and the neighboring localities, including the section of the layout placed in the Aucayes Stream.

Concerning the localities, these are as follows:

Table 4-41 Localities with tourism offers (DSA)

Comuna	Localidades asociadas
San José de Maipo	
Los Maitenes	
El Alfalfal	

Fuente: Elaboración propia

4.4.3 Results

i) General background (Metropolitan Region)

The tourism of the Metropolitan Region is characterized by being strongly centered in Santiago, with a tourism offer that, although wide, is strongly focused on winter sports centers, tours of the capital and in a lesser manner related to the Cajón Del Maipo zone. Therefore, the tourists arriving to the region, unless following a personal initiative to seek tourism alternatives, do not receive information about the different tourism activities of the zone (Martínez, 2005).

According to Martínez (2005), the tourism sectors as developed on the regional level are the following:

- Rural tourism (agro tourism, estates tourism, wine routes).
- Ecotourism (flora and fauna observation).
- Adventure tourism (horseback riding, trekking, hiking, rafting, kayaking).
- Health tourism.
- Industrial tourism.

The tourism statistics show a majority of visitors from the province of Santiago (See Table 4-42) as it is the economic center and capital of the country, followed by the Cordillera province, its tourism target is the San José de Maipo Municipality, given its high connectivity with the center of Santiago, scenic cordilleran beauty and rural character.

Table 4-42 Visiting tourists per Province (2006)

Provincias	Totales	Chilenos	Extranjeros
Cordillera (San José de Maipo)	14.4910	13.417	1.074
Maipo	4.688	4.686	2
Melipilla	2.095	2.063	32
Santiago	1.211.495	369.683	841.812
Talagante	604	604	0

Fuente: INE (2006)11.

ii) Tourism at the Province level (Cordillera)

In this level of analysis it is interesting to note that for the Cordillera province, where the Project is sited, there is a Provincial Strategic Plan based in a spatial conception of development, which guides the public and private actions so as to face the main concerns of a territory: Development of production activities, poverty, social development and environmental protection.

The strategic plan envisages that the municipalities of Puente Alto, Pirque and San José de Maipo, will follow strategic guidelines concerning tourism:

- Transform the province into the door to "Santiago Andino", carrying out diffusion its natural attractions and promoting activities related to ecotourism;
- Develop and promote Ecotourism in Pirque and San José de Maipo;
- Define the benefits and support for the entrepreneurs who would wish to invest in the Cajón del Maipo;
- Negotiate long term soft loans to improve the tourism infrastructure.

iii) Tourism at the municipal level (San José de Maipo)

The San José de Maipo Municipality is associated to tourism as a result of its cordilleran nature, its advantages linked to its large territory made up by valleys and mountains of great landscape value and suitable for sports and leisure (PLADECO, 2000).

San José de Maipo is the Municipality having the highest tourism activity development, mainly by its cordillera connotation which allows the development of multiple activities, its rural character and nearness to the city of Santiago.

According to the SERNATUR cadaster (2007), the Municipality has 38 attractions in different categories, as shown in the following table:

Footnote; 11 Tourism lodgings per Municipality 2006 Sernatur - INE

Table 4-43 Tourism attractions of the San José de Maipo Municipality

Jerarquía	Categoría	Nombre del atractivo	Comuna	Localidad sector
Nacional	Museo o manifestación cultural.	Capilla y Casa del Ex Fundo El Manzano (MH)	San José de Maipo	El Manzano
Regional	Sitio Natural.	Predio Cascada de Las Animas (SN)	San José de Maipo	San Alfonso
Nacional	Museo o manifestación cultural.	Estación de Ferrocarriles de San José de Maipo (MH)	San José de Maipo	San José de Maipo
Nacional	Museo o manifestación cultural.	Iglesia y Casa Parroquial de San José de Maipo (MH)	San José de Maipo	San José de Maipo
Nacional	Museo o manifestación cultural.	Edificio del Ex Sanatorio Laennec (MH)	San José de Maipo	San José de Maipo
Regional	Sitio Natural.	Centro de Esquí Lagunillas	San José de Maipo	Lagunillas
Regional	Sitio Natural.	Baños Morales	San José de Maipo	Baños Morales
Regional	Sitio Natural.	MN El Morado	San José de Maipo	El Morado
Regional	Sitio Natural.	Baños Colina	San José de Maipo	Lo Valdés
Regional	Sitio Natural.	Volcán Maipo	San José de Maipo	San José de Maipo
Regional	Sitio Natural.	Volcán San José	San José de Maipo	El Morado
Regional	Folclore.	San Alfonso	San José de Maipo	San Alfonso
Regional	Realización técnica, científica o artística.	Embalse El Yeso	San José de Maipo	Embalse El Yeso
Regional	Sitio Natural.	Cerro Purgatorio	San José de Maipo	La Obra
Regional	Folclore.	El Volcán	San José de Maipo	El Volcán
Local	Folclore.	El Romeral	San José de Maipo	El Romeral
Regional	Folclore.	San Gabriel	San José de Maipo	San Gabriel
Regional	Folclore.	El Melocotón	San José de Maipo	El Melocotón
Local	Folclore.	Los Maitenes	San José de Maipo	Los Maitenes
Local	Sitio Natural.	Sector El Alfalfal	San José de Maipo	San José de Maipo
Regional	Folclore.	El Canelo	San José de Maipo	El Canelo
Regional	Folclore.	El Manzano	San José de Maipo	El Manzano
Regional	Folclore.	El Guayacán	San José de Maipo	El Guayacán
Regional	Folclore.	Las Vertientes	San José de Maipo	Las Vertientes
Regional	Folclore.	La Obra	San José de Maipo	La Obra
Regional	Folclore.	El Ingenio	San José de Maipo	El Ingenio
Local	Sitio Natural.	Termas del Plomo	San José de Maipo	Embalse El Yeso
Nacional	Realización técnica, científica o artística.		San José de Maipo	San José de Maipo
Local	Sitio Natural.	Río Olivares	San José de Maipo	Los Maitenes

Regional Sitio Natural. Puerta de Los Sapos San José de Maipo San José de Maipo
Local Sitio Natural. Pozas Los Azules San José de Maipo San José de Maipo
Local Sitio Natural. Pozas La Gringa y El
Puma en Fundo El Toyo
San José de Maipo San José de Maipo
Regional Sitio Natural. Sector Melosas San José de Maipo Las Melosas
Regional Sitio Natural. Valle del Río Maipo San José de Maipo Río Maipo
Local Sitio Natural. Valle del Río Colorado –
Estero Las Monjas
San José de Maipo San José de Maipo
Local Sitio Natural. Cerro Picos Negros San José de Maipo San José de Maipo
Nacional Sitio Natural. Cerro Puntiagudo y La Plancha
San José de Maipo Lo Valdés

Source: Tourism attractions cadaster SERNATUR (2007)

Of the total of 38 attractions identified, 52% belong to the Natural Site category, and 32% to the Museum or Cultural Manifestation category. The Folklore and Technical, Scientific or Artistic activities are found in lesser proportions: 11% and 5% respectively.

Concerning hierarchy, 60% of the attractions are Regional, 24% Local and 16% National. Therefore, only 16% of the attractions belongs to Hierarchy 2: Attraction of an exceptional nature in a country, able to stimulate a flow of tourism (current or potential); over half of the attractions are of category 1 (Regional) because they have some striking feature able to interest long distance visitor; 24% correspond to category 0, that is attractions without sufficient merits to be considered at the level of the others, but which nevertheless are part of the tourism patrimony, as complementary elements.

Public Policies for the development of the tourism activity

PLADECO San José de Maipo (2000-2006)

The Municipal Development Plan of San José de Maipo, in the context of tourism puts forward the following:

"In order to maintain the exploitation of the tourism potential now existing in the Municipality over time, it is necessary to:

- Strengthen the tourism consciousness of the local population, private and public sectors;
- Increase the environmental awareness levels of the visitors from neighboring municipalities:
- Strengthen the Municipal Tourism Bureau, recognizing its role as guide and planner of tourism activities;
- Improve the services of the tourism facilities within the Municipality;
- Increase the levels of tourism information and road signs in the Municipality;
- Improve the present infrastructure and guide future investments towards it, so as to aid the development of the tourism activity in the Municipality;
- Improve the present safety levels of the Municipality:
- Guide the tourism development of each zone of the Municipality according to its vocation and potential;
- Widen the seasonal tourism demand of the Municipality by diversifying the offer.
- Maintain or improve the quality of the tourism attractions of the Municipality."

Terms of reference for the preparation of a ZOIT Territorial Management Plan (SERNATUR, 2001)

The procedure to declare the San José de Maipo Municipality as a National Tourism Interest Zone (ZOIT) began in January 2001, according to D.L. N° 1.224 and D.S. N° 515,

It is understood that the declaration of a ZOIT has the purpose of protecting and sustain the tourism activity in the area.

This is defined as an area having essentially rural characteristics, of large extension, where besides relevant tourism resources there are other uses or activities showing basic compatibility with them. The tourism attractions offered are of a wide variety and contribute to form circuits and/or tourism areas generally not exploited, of a potential nature, it being necessary to safeguard the preservation and valuation of the tourism resources, For this purpose it is necessary to have a Territorial Management plan of an extensive nature to properly safeguard and guide its tourism development.

Integral Plan for the Management of Tourism Quality – ZOIT San José de Maipo (Regional Metropolitan Office – Planning Department and Sernatur, 2001)

In order to implement the idea of an integral management, it is proposed to develop the following five strategic actions as basic programs of the plan:

- Strategies for the development of human resources;
- Strategies for the quality management of tourism services;
- Strategies for the sustainable management of tourist destinations;
- Strategies for the development of tourism products;
- Strategies to position the image of a destination of quality.

Private and public actors in the San José de Maipo Municipality (Agulló, 2002)

Business and Tourism Chamber of the Cajón del Maipo

Created in 1995 and at present comprises 12 tourism entrepreneurs who have as common interest to attain synergies to develop tourism and organize themselves in their dealings with institutions. They hold meetings constantly, where the idea of establishing tourism information offices in the Cajon del Maipo, in an agreement with SERNATUR and the Municipality of San José de Maipo, arose from.

Rio Colorado Research Institute Center

Non-profit Private Corporation created in 1968, whose purpose is to preserve the environment by means of ecological research of flora and fauna species in natural ecosystems, teaching, and environmental education.

Economic Importance of Tourism at the Municipal Level

A transformation of the population concentration of about 30% has been observed during the last four decades. Agricultural activity decreased in 3.4% and mining in 8% between 1972 and 1982. The services area increases by 8% and construction by 7.2% (Agulló, 2000).

Therefore, it can be seen that the San José de Maipo Municipality has been largely transformed to tourism as time went by.

It is estimated that by 2008, the national market visiting the Cajón del Maipo will amount to 50,000 visitors monthly during the fall and winter up to 4.000 visitors a month during spring and summer, estimating a total demand of 1,650,000 people between one day visitors and tourists. This, added to foreign demand allows an estimate of nearly 1,740,000 visitors a year for San José de Maipo (OTAS, 2000).

iv) Characterization of the local tourism offer

The Municipality is divided in four tourism zones, this classification was generated by PLADECO (2000-2006), and those concerned with the direct service area will be described.

Zone 1, area 2: Los Maitenes – El Alfalfal

Both towns are in the Colorado River Canyon and followed the creation of the hydroelectric plants. They are reached by a paved road (Route G-345) surrounded by mountain landscape, where a warm wind called "El Raco" is generated. Andinism, excursions, geologic and archaeological researches are carried out here.

Zone 2, area 2: Colorado River Canyon

Geographically, this unit belongs to the higher section of the Colorado River canyon, there is scant tourism development, but a great potential to reach better process levels.

Given the geographic characteristics of this unit, the fragility of the ecosystems and the geologic risks factors, only excursion camps could be established in some sectors, as more than a day is needed to visit some of the attractions.

Tourism attractions

Are considered as tourism attractions all those defined according to the SERNATUR cadaster (2007) and placed in the service area defined for the Project. The indirect service area is considered, on the one hand, related to the landscape component and the visual perception of the territory (views and visual reach); and the direct service area, linked to the layout of the lines and the nearness to the attractions.

The cadaster shows the existence of two tourism attractions, detailed in the following table.

Table 4-44 Tourism attractions in the Project service area

N°	Jerarquía	Categoría	Nombre del atractivo	Comuna	Localidad	sector	Descripción
1	Local	Folclore.	Los Maitenes	San José de Maipo	Los Maitenes		Funciona en el Río Colorado y es una de las plantas que entregan energía a Santiago. Su puesta en servicio fue en 1923 y reconstruida en 1987 después del aluvión del río Colorado de noviembre de 1987.
2	Local	Sitio Natural.	El Alfalfal	San José de Maipo	Sector El Alfalfal		Es la principal central hidroeléctrica de la cuenca del Maipo con una potencia de más de 180 MW. y se ubica en el cajón del río Colorado, cercana a la central hidroeléctrica Maitenes.

Fuente: Catastro atractivos turísticos, SERNATUR (2007).

Only two tourism attractions are located in the area, both of local hierarchy, Los Maitenes corresponding to the folklore category, and the El Alfalfal sector, natural site category. Both sites are related to the existing substations and constitute an attraction linked to the existing installations.

Although there are no other attractions in the sector, as recorded by Sernatur, the Colorado River canyon is a sector where informal activities are carried out, such as walks, trekking, horseback riding, photography, mountain climbing, picnic, bathing and biking, mainly associated to the scenic beauty of the place and the presence of interesting natural resources (flora and fauna).

The same is true for the Aucayes stream sector, although not associated to attractions on the cadaster, the territory appears as a site of great landscape beauty and interesting resources as is the case of the flora, fauna geomorphology and scenic backgrounds.

Tourism activities

Some minor tourism activities are developed in the zone, specifically localized; all those where there is a relation with a determined space or natural site (special interests) predominate.

The activities recorded by the PLADECO are as follows:

- Walks and excursions: Excursions of the middle and high mountain are carried out; these must be preferably guided by greater specialization on the part of the operators.
- Andinism: Carried out in the upper part of the Colorado River canyon; given the hard physical effort required, should be undertaken by people having basic mountain climbing training.
- Visits to the river banks: Tourists arrive to the zone sporadically and spontaneously.
- Picnic: There are no places prepared for it, but there are some informal sites.

- Camping: This is done spontaneously; the tourist is attracted by the mountain atmosphere.
- Flora and fauna observation. Given the landscape characteristics of this zone, this activity is recurrent along the whole space. Activities related to photography and contemplation.
- Horseback riding: Horseback riding is carried out in some specific sites, informal operators work out of the Alfalfal sector.

Infrastructure and tourism connectivity

According to the San José de Maipo PLADECO (2000), the infrastructure and tourism connectivity in the service area show the following features:

- Observation points: Not identified. It should be stressed that there are optimum zones for their installation.
- Paths: There are a large number of paths in the zone allowing reaching the different attractions. .
- Bridges and catwalks: Not identified in the zone.
- Refuges: Not identified in the zone.
- Tourism information offices: Not identified in the zone.
- Condition of the roads: Quite good and paved up to El Alfalfal, belonging to Route G-345; followed by a gravel road which makes access to the place difficult, especially in winter due to the mud.
- Road and tourism signs: Insufficient road signs, deteriorated and badly placed; tourism information is non-existent.
- Parking and stopping places: The zone does not have authorized or well established parking and stopping places.
- Types of transport: There is no public transport.
- Nearness to urban center: The nearest centers are Puente Alto and La Florida. However, given its infrastructure and safety levels it is possible to consider San José de Maipo as the nearest center having basic emergency services.
- Communications level: Non existent

- Safety, health, and energy levels: The zone does not have suitable health and safety levels due to its scant development. Energy is almost non-existent. It should be mentioned that the Alfalfal Power Plant is located in the zone and sends electrical energy to the Municipality and the city of Santiago.

Tourism facilities

Concerning the facilities, which include bed and board plus other services, the offer is quite restricted at Los Maitene3s and El Alfalfal, there is only one hostelry, placed in the Los Maitenes sector, as shown in the following table.

Table 4-45 Tourism facilities at the local level in the service area.

Nombre Dirección y teléfono	Localidad	Ubicación en el espacio turístico	Servicios	Pertenece a cámara de turismo
Casa patronal Los Maitenes	Camino El Colorado	Los Maitenes Zona 1 - Área 2	Hostería	NO

Generally speaking, there are no tourism facilities in this zone, except the hostelry at Los Maitenes and some informal businesses beside private grounds which offer the possibility of camping, picnic, spaces near the river, walks or horseback riding.

5 BUILDINGS ENVIRONMENT

The characterization of the built environment includes a description of the main infrastructure works which will be used by the Project. In this case, the most relevant for the Project are the energy and highway infrastructure.

5.1 Energy infrastructure

5.1.1 Introduction

This report provides a summary description of the existing and projected energy infrastructure in the planned site area of the project "Electric Transmission Lines Maitenes S/S - Alfalfal S/S and Alfalfal II Power Plant - Alfalfal S/S. This infrastructure includes run-of-river hydroelectric plants, high voltage lines and electric substations.

5.1.2 Results

The energy infrastructure near the project is made up by the hydroelectric plants of Los Maitenes, Alfalfal I, Queltehues and Volcán and their respective substations and transmission lines needed to carry the electric power they produce.

All the above plants are owned by AES Gener S.A. and are placed in the Maipo River sector in the case of the Queltehues and Volcán plants, and in the Colorado River Canyon for the Maitenes and Alfalfal I Plants. The construction of the Alfalfal II y Las Lajas plants in this canyon is also projected; those plants are part of the Alto Maipo Hydroelectric Project, also owned by AES Gener S.A.

Some background data corresponding to said structures is shown below.

i) Power Plants

As indicated above, the power plants are located in the proximities of the Project area. This group of four power plants has an approximate power of 250 MW. The construction of the Las Lajas and Alfalfal II is projected in this sector, together, they will provide a maximum power of 530 MW. Therefore, this geographic area provides approximately 775 MW of electric power to the Interconnected Central Grid (SIC).

Table 4-46 summarizes the main characteristics of the Alfalfal, Maitenes, Queltehues, Volcán, Alfalfal II and Las Lajas power plants.

Table 4-46 Power plants in the proximities of the Project.

The main characteristics of the power plants are described below.

Alfalfal I Hydroelectric Power Plant

The Alfalfal I Power Plant is placed on the right bank of the Colorado River, in the Cajón del Maipo, near km 22.5 of Route G-345.

The works for this plant were started in March 1985 with the construction of the access road.

The first unit of this Plant started operating in June 1991, and the second one in August of the same year.

This is a run-of-river plant, with a total power of 160 MW; it uses the waters from the Colorado and Olivares Rivers by mean of spur headraces which join into a common intake to reach the fall zone. This plant has a 16.5 m3/s intake in the Colorado River, upstream of its confluence with the Parraguirre stream and a second intake in the Olivares River (main tributary of the Colorado River) with a capacity of 14 m3/s and placed 12 km upstream of the confluence. The Colorado River intake is situated at 2,100 masl, while that of the Olivares River is placed at 2,041 masl.

These intakes include intake works, sand traps and loading chamber. They deliver the water to the Plant, designed for a flow of 27 m3/s by means of a pressure tunnels system approximately 22.5km long having sections varying between 10 and 18 m^2; these tunnels start from the loading chambers of the respective intakes and end at the fall point of the Plant.

The fall zone is placed on the right bank of the Colorado River and includes the surge shaft, a 45° ironclad shaft, powerhouse cavern, discharge works, restitution of the waters to the Colorado River and a siphon which crosses that river to feed the Maitenes plant intake.

Maitenes Hydroelectric Plant and Maitenes Auxiliary Plant

The Maitenes Plant began operations in march 1923, with three generators and the Auxiliary Plant started operations with two generators the following year. Both plants are located on the eastern bank of the Colorado

River, tributary of the Maipo River, near km 25 of Route G-345. Both are run-of-river plants, with a total output of 30.9 MW and an average yearly production of 128 GW/h.

The generation load is obtained from the Colorado River and the Aucayes stream. The Maitenes intake is situated at 1,350 masl approximately, facing the control building of the Alfalfal Hydroelectric Plant. The capacity of the Maitenes headrace is of 11 m3/s and it is 8.1km long. These plants have also an 110,000 m^3 surge tank; the pressure shaft of the auxiliary and main plants starts here; the plants can operate on a hydraulic series.

The Main Maitenes Plant was buried under a mud slide in November 1987; its equipment was repaired and the controls systems modernized, it reassumed operations in 1989.

Volcán Hydroelectric Plant

The construction of this plant began in June 1940 and it began operations in September 1944. It has a 13 MW nominal power generator and two Pelton horizontal turbines. This Plant is placed upstream from the surge tank of the Queltehues Plant.

The Volcan Plant is a run-of-river installation with an average yearly output of 98 GW/h. The generation flow is obtained from the El Volcán River.

The intake of this Plant is placed at 1,414 masl approximately: it has automatic radial sluices and a sedimentation pond to remove sand from the water; the main canal has a capacity of 9.10 m3/s and is 12.5km long.

Queltehues Hydroelectric Plant

The Queltehues Plant is a run-of-river installation and it started operations in 1938. It has a total of 3 units and the total output is of 41.07 MW.

Las Lajas and Alfalfal II Plants

As mentioned before, the Las Lajas and Alfalfal II plants are part of the PHAM, and it is expected that they will start operations during the second semester of 2013.

The new Alfalfal II plant will be located in the sub-basin of the Colorado River, downstream from the present Alfalfal I Plant, while the second plant, Las Lajas, will be placed on the south bank of the Colorado River, in the El Sauce sector. The Alfalfal II will use the water coming from the upper reaches of the Volcán and Yeso rivers, 700m downstream from the discharge if the reservoir, while the Las Lajas Plant will use the waters coming from the discharges of the Alfalfal I and II plus those of the intermediate catchments of the Colorado River and sub-basin of the Aucayes Stream.

ii) <u>Substations</u>

The Alfalfal, Maitenes (on the Colorado River Canyon), and Las Lajas (on the Maipo River Cajón Maipo) all owned by AES Gener are near the location area of the Project. The Las Vizcachas and La Florida substations are found towards the Puente Alto and La Florida sectors.

The construction of the Alto Maipo S/S is projected as part of the Alto Maipo Hydroelectric Project, it will be placed south of the Maitenes S/S, also in the Colorado River Canyon.

iii) <u>Transmission lines</u>

The characteristics of the transmission lines situated near the Project area are summarized below.

Table 4-47 Electric transmission lines situated near the Project

Nombre	Puesta en servicio	Tensión kV	Longitud km	Capacidad MVA
Alfalfal - Almendros	1991	220	43,5	300
Maitenes - Alfalfal	1986	12	7,5	6.5
Alfalfal - Bocatomas	1986	12	32	6.5
Maitenes - Bocatoma	Maitenes 1920	6.6	7,2	--
Maitenes - Las Lajas	1923	110	16,4	75

5.2 ROADS

5.2.1 Introduction

The following report shows the antecedents concerning the highways infrastructure situated near the Project "Electric Transmission Lines Maitenes S/S - Alfalfal S/S and Alfalfal II Power Plant - Alfalfal S/S, which will be used either to bring the supplies during the construction of the line and the expansion of the Alfalfal substation, and to carry out the maintenance during its operation.

5.2.2 Definition of the service area

Considering that most vehicles associated to the Project will access Route G-25 from Av. Circunvalación Américo Vespucio, either from the north or south, the direct service area (DSA) is determined by the array of road sections and relevant Crossroads comprised between Av. Departamental in the Municipality of La Florida and the El Manzano sector in the Municipality of San José de Maipo.

This area includes Route G-25 (between Departamental and El Manzano) and Route G-345 (between El Manzano and the Alfalfal Power Plant), these roads will be used both for the transport of the personnel and of the materials and supplies required by the Project.

The following tables show the most important sections and Crossroads of the transport route:

Table 4-48 Road sections

Tramo	Ruta	Entre	Comuna	kilómetro Inicio	Longitud Fin (km)
1	G-25	Departamental y Diego Portales	La Florida	0	6 6,0
2	G-25	Diego Portales y Eyzaguirre	Puente Alto	6	11,5 5,5
3	G-25	Eyzaguirre y Ruta G-345	Puente Alto – San José de Maipo	11,5	28,3 16,8
4	G-345	Ruta G-25 y acceso a Central Alfalfal	San José de Maipo	0	22,8 22,8

Table 4-49 Crossroads

Punto	Entre	Comuna
1	Av. La Florida / Av. Departamental	La Florida
2	Av. la Florida / Rojas Magallanes	La Florida
3	Av. la Florida / Trinidad Oriente	La Florida
4	Av. La Florida / San José de la Estrella	La Florida
5	Av. Camilo Henríquez / Av. Diego Portales	La Florida y Puente Alto
6	Av. Camilo Henríquez / El Peñón	Puente Alto
7	Av. Camilo Henríquez / Eyzaguirre	Puente Alto

Punto Entre Comuna
8 Ruta G-25 / Acceso Ruta G-421 Puente Alto 9 Ruta G-25 / Ruta G-345 San José de Maipo

The following figure shows the direct service area and the transport route which will be used during the construction stage of the Project.

Figure 4-36 Direct service area and transport routes (Figure not copied)

5.2.3 Results

i) Present highway situation

The road sections described below are the same as those indicated in Table 4-49.

Table 4-50 First section: Route G.25 (Av. La Florida / between Av. Departamental and Av. Diego Portales

(IT WAS NOT POSSIBLE TO COPY THE TABLE)

Table 4-51 Second section: Route G.25 (Av. Camilo Henríquez / between Av. Diego Portales and Eyzaguirre (Las Vizcachas Crossing)

(IT WAS NOT POSSIBLE TO COPY THE TABLE)

Table 4-52 Third section: Route G-25 (Camino al Volcán), between Eyzaguirre and Route G-345

(IT WAS NOT POSSIBLE TO COPY THE TABLE)

Table 4-53 Fourth section: Route G - 345 (Access to Los Maitenes), between Route G-25 and El Alfalfal

(IT WAS NOT POSSIBLE TO COPY THE TABLE)

ii) Crossroads

The physical and operational sketches of the relevant Crossroads as considered in this study are described below, noting the most important present conditions as are the geometry, width of the roadways and lanes, regulation (traffic lights or priority signs) width of the lanes, and timing of each traffic light phase.

Crossroads N° 1: Av. La Florida / Av. Departamental

Type: Four lane, dual roadway level crossroads, regulated by traffic lights.

Observed conflict: There are operational problems in the left hand turn from Departamental East to La Florida South, due to the scant reserve capacity of the central median of Av. La Florida. Therefore, when waiting for the green Light of Av. La Florida, part of the vehicles remains in the north roadway of Av. Departamental, preventing the passing of vehicles from east to west. There is a "no left turn" there which is usually disregarded by the drivers turning in large numbers.

Figure 4-37 Crossroads N° 1 Av. La Florida / Departamental

(Legends to the figure)

N INTERSECCIÓN N°1
AV. LA FLORIDA / DEPARTAMENTAL
AV. MACUL DEPARTAMENTAL
10,5 m
1,5 m 3,5 m
10,5 m
10,5 m
16 m
10,5 m
3,5 m 3,5 m
10,5 m
1,5 m
1,5 m
HOMECENTER
DEPARTAMENTAL AV. LA FLORIDA
20
3
ROJO **23 50**
FASE 1 AMARILLO **FASE 2**
TIEMPOS DE SEMÁFORO (SEGUNDOS) PUNTO DE CONTROL N° 1, AV. LA FLORIDA / AV. DEPARTAMENTAL
3
VERDE AMARILLO ROJO
VERDE **47**
N N
Av. Departamental
Av. La Florida
Av. La Florida

Crossroads N° 2: Av. La Florida / Rojas Magallanes

Type: Four lanes level crossing, regulated by traffic lights.

Observed conflict: Long vehicle lines are observed at Rojas Magallanes Oriente, especially during the peak morning hour. The traffic lights do not have an intermediate phase allowing controlling the left hand turns.

Figure 4-38 Crossroads N° 2 Av. La Florida / Rojas Magallanes

(Legends to the figure)

INTERSECCIÓN Nº 2 N
AV. LA FLORIDA / ROJAS MAGALLANES
AV. LA FLORIDA ROJAS MAGALLANES
23 m
23 m
10,5 m
10,5 m
10,5 m
10,5 m
14 m
3,5 m
14 m
3,5 m
3,5 m
3,5 m
ROJO 52
VERDE 27
AMARILLO 3 FASE 2 AMARILLO 3
ROJO 30
FASE 1
VERDE 49
TIEMPOS DE SEMÁFORO (SEGUNDOS) PUNTO DE CONTROL N° 2,
AV. LA FLORIDA / ROJAS MAGALLANES
Av. N N
La Florida
Av. La Florida
R. Magallanes R. Magallanes
Fuente: Ambitrans Ingenieros Consultores Ltda

Crossroads N° 3: Av. La Florida / Trinidad Oriente

Type: Four lanes level crossing, regulated by traffic lights.

Observed conflict: Long vehicle lines in Av. La Florida in the left hand turn from La Florida Norte to Trinidad Oriente. The obstruction is generated by the large number of vehicles turning from west to north.

Figure 4-39 Crossroads N° 3 Av. La Florida / Trinidad Oriente

(Legends to the figure)

INTERSECCIÓN Nº 3 N
AVENIDA LA FLORIDA / TRINIDAD ORIENTE
AV. LA FLORIDA TRINIDAD ORIENTE
25 m
24m
10,5 m
10,5 m
10,5 m
10,5 m
7 m
3,5 m
7 m
3,5 m
8 m
3,5 m
3,5 m
7 m
20 m
3 AMARILLO 3
TIEMPOS DE SEMÁFORO (SEGUNDOS) PUNTO DE CONTROL N° 3, AV. LA FLORIDA / TRINIDAD ORIENTE
FASE 1
VERDE 52
FASE 2
VERDE 25
AMARILLO
ROJO 28 ROJO 55
Av. N N
La Florida
Av. La Florida
Trinidad Oriente Trinidad Oriente
Fuente: Ambitrans Ingenieros Consultores Ltda.

Crossroads N° 4: Av. La Florida / San José de la Estrella

Type: Three lanes level crossing, regulated by traffic lights.

Observed conflict: Long vehicle lines are formed at the left turn from San José de la Estrella towards La Florida Norte, especially during the morning peak hour.

Figure 4-40 Crossroads Nº 4 Av. la Florida / San José de la Estrella N
(Legends to the figure)

INTERSECCIÓN Nº 4
AVENIDA LA FLORIDA / SAN JOSÉ DE LA ESTRELLA
AV. LA FLORIDA
SAN JOSÉ DE LA
ESTRELLA
15 m
16 m
10,5 m
7 m
10,5 m
7 m
7 m
3,5 m
3,5 m
3,5 m
3,5 m
7 m
8 m
TIEMPOS DE SEMÁFORO (SEGUNDOS) PUNTO DE CONTROL N° 4, AV. LA FLORIDA / SAN JOSÉ DE LA ESTRELLA
FASE 1
VERDE 54
FASE 2
VERDE 22
AMARILLO 3 AMARILLO 3
ROJO 25 ROJO 57
Av. N N
La Florida
Av. La Florida
San José de La Estrella San José de La Estrella
Fuente: Ambitrans Ingenieros Consultores Ltda.

Crossroads N° 5: Av. Camilo Henríquez / Diego Portales

Type: Four lanes level crossing, regulated by traffic lights.

Observed conflict:
The left lane of Diego Portales has a single bidirectional 7m wide roadway, with a small central lane which channels the flows.
Large numbers of vehicles from the condominiums recently built in the eastern sectors and the limited width of the roadway generate lines and delays for the users, especially during the morning peak hour-

Figure 4-41 Crossroads N° 5 Av. Camilo Henríquez / Diego Portales

(Legends to the figure)

INTERSECCIÓN Nº 5 N
AV. CAMILO HENRIQUEZ / DIEGO PORTALES
AV. LA FLORIDA DIEGO PORTALES
20m
25m
10,5 m
10,5 m
10,5 m
10,5 m
3,5 m
7 m
3,5 m
7 m
3,5 m
3,5 m
15 m
6 m
14 m
AV. CAMILO
HENRIQUEZ
AMARILLO 3 AMARILLO
30 ROJO 50
TIEMPOS DE SEMÁFORO (SEGUNDOS) PUNTO DE CONTROL N° 5, AV. CAMILO HENRÍQUEZ / DIEGO PORTALES
FASE 1
VERDE 47
FASE 2
VERDE 27
3
ROJO
N N
Av. Diego Portales Av. Diego Portales
Av. Camilo Henríquez Av. Camilo Henríquez
Fuente: Ambitrans Ingenieros Consultores Ltda.

Crossroads N° 6: Av. Camilo Henríquez / El Peñón

Type: Three lanes level crossing, regulated by traffic lights.

Observed conflict: Not apparent, except for high traffic volumes usually taking place during peak hours. In general, vehicle movement is fluid in this crossroads.

Figure 4-42 Crossroads N° 6 Av. Camilo Henríquez / El Peñón

V. CAMILO HENRIQUEZ / EL PEÑÓN
AV. CAMILO HENRÍQUEZ EL PEÑON
19 m
10,5 m
7 m
7 m
3,5 m
3,5 m
7 m 19 m
10,5 m
3,5 m
3,5 m
7 m
20 m
22 m
ROJO 34 ROJO 46
FASE 2
VERDE 31
AMARILLO 3 AMARILLO 3
TIEMPOS DE SEMÁFORO (SEGUNDOS) PUNTO DE CONTROL N° 6, AV. CAMILO HENRÍQUEZ / EL PEÑON
FASE 1
VERDE 43
Av. Camilo Henríquez N Av. Camilo Henríquez N
El Peñón El Peñón
Fuente: Ambitrans Ingenieros Consultores Ltda.

Crossroads N° 7: Av. Camilo Henríquez / Eyzaguirre

Type: Three lanes Crossroads, regulated by the traffic signals STOP and YIELD.

Observed conflict: Traffic volumes are considerably less in this Crossroads as compared to Av. La Florida during the whole day, excepting morning and evening peak hours, large vehicle volumes meets into this Crossroads at those times. However, the operation of the Crossroads is mostly fluid during the rest of the day.

Figure 4-43 Crossroads N° 7 Av. Camilo Henríquez / Eyzaguirre

INTERSECCIÓN Nº 7 N
AV. CAMILO HENRIQUEZ / EYZAGUIRRE
AV. CAMILO HENRÍQUEZ EYZAGUIRRE
SANTIAGO PUENTE ALTO LAS VIZCACHAS
10,5
7 m
7 m
7 m 7 m
7 m
7 m
Fuente: Ambitrans Ingenieros Consultores Ltda.

Crossroads N° 8: G-25 / Route G-421

Type: Three lanes level crossing, regulated by STOP traffic sign.

Observed conflict: No conflicts are observed. Vehicles move at low speeds.

Figure 4-44 Crossroads N° 8, G-25 / Route G-421

N
CAMINO AL VOLCÁN
Ruta G-25
INTERSECCIÓN Nº 8
RUTA G-25 / RUTA G-421
50
3 m
3 m
3 m 3 m
3 m 3 m
60
ACCESO A RUTA G-421
3 m
Fuente: Ambitrans Ingenieros Consultores Ltda.

Crossroads N° 9: G-25 / Route G-345

Type: Three lanes level crossing, regulated by STOP traffic sign and located in a rural zone.
No road conflicts are observed.

Figure 4-45 Crossroads N° 9, G-25 / Route G-345

N
ACCESO LOS MAITENES (RUTA G-345)
CAMINO AL VOLCAN (RUTA G-25)
INTERSECCIÓN Nº 9
RUTA G-25 / RUTA G-345
50 m
50 m
E
LOS MAITENES
3 m 3 m
3 m
3 m 3 m
Fuente: Ambitrans Ingenieros Consultores Ltda

iii) Present highways demand

The daily and hourly transit volumes of routes G-25 and G-345 were obtained from the measurements of flow carried out by Ambitrans Ingenieros Consultores in October 2008 for the Alto Maipo Hydroelectric Project (PHAM). These are classified by type of vehicle and the values are adopted for the present study since no more than a year has elapsed since they were made.

The measurement points were as follows at that time:

- Point N° 1: Crossroads Av. La Florida / Av. Departamental (La Florida)
- Point N° 2: Crossroads Av. La Florida / Rojas Magallanes (La Florida)
- Point N° 3: Crossroads Av. La Florida / Av. Trinidad Oriente (La Florida)
- Point N° 4: Crossroads Av. La Florida / San José de la Estrella (La Florida)
- Point N° 5: Crossroads Av. Camilo Henríquez / Av. Diego Portales (Puente Alto)
- Point N° 6: Crossroads Av. Camilo Henríquez / Av. El Peñón (Puente Alto)
- Point N° 7: Crossroads Av. Camilo Henríquez / Eyzaguirre (Las Vizcachas)
- Point N° 8: Crossroads Route G-25 (Camino al Volcán) / access to Route G-421 Las Vertientes (San José de Maipo)
- Point N° 9: Crossroads Route G-25 (Camino al Volcán) / Route G-345 access to Los Maitenes (San José de Maipo)

The counts were made during 12 continuous hours: from 7:00 to 19:00 and each hour was divided into quarters so as to find the vehicle traffic variations during the hour and obtain a finer precision concerning the peak periods during the day.

The type of vehicle classification was as follows:
VL: automobiles, taxicabs, group cabs, station wagons, jeeps, pickup trucks and boxcars under 1,000kg.
C2E : 2 axle normal trucks
C+2E : Normal trucks 2 + axles, semi-tow trucks and tow trucks.
BTB : Buses and vans.
The location of the measured points is shown in the figure below. Figure 4-47 shows a sketch of the movements recorded in each crossroad.

Figure 4-46 Location of the measurement points.

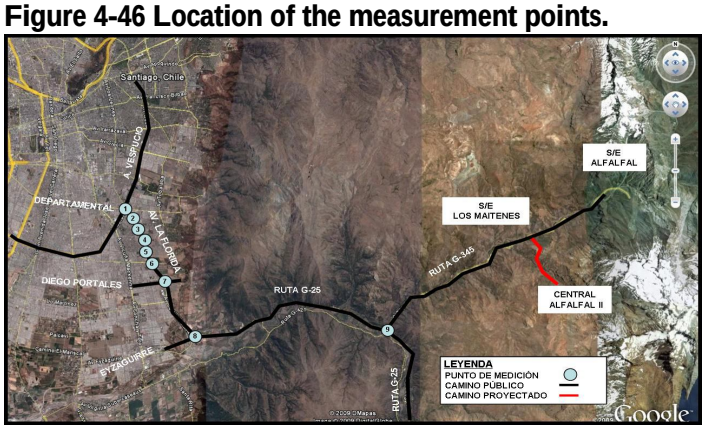


Figure 4-47 Sketch of the movements recorded

Figura 4-47 Croquis de los movimientos censados
N PUNTO DE CONTROL Nº 1 AV. LA FLORIDA AV. DEPARTAMENTAL
10 9 11 7 6 8 3
4 5 1 2
ROJAS MAGALLANES
N PUNTO DE CONTROL Nº 2 AV. LA FLORIDA
4 5 6 1 2 3 9 8 7 11 12 10
N PUNTO DE CONTROL Nº 3 AV. LA FLORIDA TRINIDAD ORIENTE
4 5 6 1 2 3 9 8 7 11 12 10
PUNTO DE CONTROL Nº 4 N AV. LA FLORIDA SAN JOSÉ DE LA ESTRELLA
1 2 4 3 6 5
PUNTO DE CONTROL Nº 6 N AV. CAMILO HENRÍQUEZ EL PEÑÓN
1 2 4 3 6 5
PUNTO DE CONTROL Nº 5 N AV. LA FLORIDA AV. DIEGO PORTALES
4 5 6 1 2 3 9 8 7 11 12 10
AV. CAMILO HENRÍQUEZ N
PUNTO DE CONTROL Nº 8 RUTA G-25 (CAMINO AL VOLCÁN)
3 4 1 2 56
ACCESO RUTA G - 421

iv) Flow versus Time graphs.

The following flow versus time graphs allow to visualize the variations of the vehicle volumes during the whole measuring period. This is expressed as equivalent vehicles (VEQ) so as to show the effect of commercial vehicles in the traffic of the roads.

Figure 4-48 Traffic during the peak hour (mobile hour). Control Point 1. Crossroads Av. La Florida / Av. Departamental

Punto de Control Nº 1
Intersección Av. La Florida / Av. Departamental
3.600
4.600
5.600
6.600
7.600
07:00 - 08:00
07:30 - 08:30
08:00 - 09:00
08:30 - 09:30
09:00 - 10:00
09:30 - 10:30
10:00 - 11:00
10:30 - 11:30
11:00 - 12:00
11:30 - 12:30
12:00 - 13:00
12:30 - 13:30
13:00 - 14:00
13:30 - 14:30
14:00 - 15:00
14:30 - 15:30
15:00 - 16:00
15:30 - 16:30
16:00 - 17:00
16:30 - 17:30
17:00 - 18:00
17:30 - 18:30
18:00 - 19:00
HORA
TOTAL DE VEHÍCULOS EN LA INTERSECCIÓN (VEQ)
Fuente: Ambitrans Ingenieros Consultores Ltda.

Figure 4-49 Traffic during the peak hour (mobile hour). Control Point 2. Crossroads Av. La Florida / Rojas Magallanes

Punto de Control Nº 2
Intersección Av. La Florida / Rojas Magallanes
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
07:00 - 08:00
07:30 - 08:30
08:00 - 09:00
08:30 - 09:30
09:00 - 10:00
09:30 - 10:30
10:00 - 11:00
10:30 - 11:30
11:00 - 12:00
11:30 - 12:30
12:00 - 13:00
12:30 - 13:30
13:00 - 14:00
13:30 - 14:30
14:00 - 15:00
14:30 - 15:30
15:00 - 16:00
15:30 - 16:30
16:00 - 17:00
16:30 - 17:30
17:00 - 18:00
17:30 - 18:30
18:00 - 19:00
HORA
TOTAL DE VEHÍCULOS EN LA INTERSECCIÓN (VEQ)
Fuente: Ambitrans Ingenieros Consultores Ltda.

Figure 4-50 Traffic during the peak hour (mobile hour). Control Point 3. Crossroads Av. La Florida / Trinidad Oriente

Punto de Control Nº 3
Intersección Av. La Florida / Trinidad Oriente
2.500
3.000
3.500
4.000
4.500
5.000
5.500
07:00 - 08:00
07:30 - 08:30
08:00 - 09:00
08:30 - 09:30
09:00 - 10:00
09:30 - 10:30
10:00 - 11:00
10:30 - 11:30
11:00 - 12:00
11:30 - 12:30
12:00 - 13:00
12:30 - 13:30
13:00 - 14:00
13:30 - 14:30
14:00 - 15:00
14:30 - 15:30
15:00 - 16:00
15:30 - 16:30
16:00 - 17:00
16:30 - 17:30
17:00 - 18:00
17:30 - 18:30
18:00 - 19:00
HORA
TOTAL DE VEHÍCULOS EN LA INTERSECCIÓN (VEQ)
Fuente: Ambitrans Ingenieros Consultores Ltda.

Figure 4-51 Traffic during the peak hour (mobile hour). Control Point N°4. Crossroads A. La Florida / San José de la Estrella

Punto de Control Nº 4
Intersección Av. La Florida / San José de la Estrella
2.500
3.000
3.500
4.000
4.500
5.000
07:00 - 08:00
07:30 - 08:30
08:00 - 09:00
08:30 - 09:30
09:00 - 10:00
09:30 - 10:30
10:00 - 11:00
10:30 - 11:30
11:00 - 12:00
11:30 - 12:30
12:00 - 13:00
12:30 - 13:30
13:00 - 14:00
13:30 - 14:30
14:00 - 15:00
14:30 - 15:30
15:00 - 16:00
15:30 - 16:30
16:00 - 17:00
16:30 - 17:30
17:00 - 18:00
17:30 - 18:30
18:00 - 19:00
HORA
TOTAL DE VEHÍCULOS EN LA INTERSECCIÓN (VEQ)
Fuente: Ambitrans Ingenieros Consultores Ltda.

Figure 4-52 Traffic during the peak hour (mobile hour). Control Point 5. Crossroads Av. Camilo Henríquez / Av. Diego Portales

Punto de Control Nº 5
Intersección Av. Camilo Henriquez / Av. Diego Portales
2.500
3.000
3.500
4.000
4.500
5.000
5.500
07:00 - 08:00
07:30 - 08:30
08:00 - 09:00
08:30 - 09:30
09:00 - 10:00
09:30 - 10:30
10:00 - 11:00
10:30 - 11:30
11:00 - 12:00
11:30 - 12:30
12:00 - 13:00
12:30 - 13:30
13:00 - 14:00
13:30 - 14:30
14:00 - 15:00
14:30 - 15:30
15:00 - 16:00
15:30 - 16:30
16:00 - 17:00
16:30 - 17:30
17:00 - 18:00
17:30 - 18:30
18:00 - 19:00
HORA
TOTAL DE VEHÍCULOS EN
LA INTERSECCIÓN (VEQ)
Fuente: Ambitrans Ingenieros Consultores Ltda.

Figure 4-53 Traffic during the peak hour (mobile hour). Control Point 6. Crossroads Av. Camilo Henríquez / El Peñón

Punto de Control Nº 6
Intersección Av. Camilo Henríquez / El Peñón
1.500
2.000
2.500
3.000
07:00 - 08:00
07:30 - 08:30
08:00 - 09:00
08:30 - 09:30
09:00 - 10:00
09:30 - 10:30
10:00 - 11:00
10:30 - 11:30
11:00 - 12:00
11:30 - 12:30
12:00 - 13:00
12:30 - 13:30
13:00 - 14:00
13:30 - 14:30
14:00 - 15:00
14:30 - 15:30
15:00 - 16:00
15:30 - 16:30
16:00 - 17:00
16:30 - 17:30
17:00 - 18:00
17:30 - 18:30
18:00 - 19:00
HORA
TOTAL DE VEHÍCULOS EN
LA INTERSECCIÓN (VEQ)
Fuente: Ambitrans Ingenieros Consultores Ltda.

Figure 4-54 Traffic during the peak hour (mobile hour). Control Point 7. Crossroads Av. Camilo Henríquez / Eyzaguirre

Punto de Control Nº 7
Intersección Av. Camilo Henríquez / Eyzaguirre
1.000
1.500
2.000
2.500
3.000
07:00 - 08:00
07:30 - 08:30
08:00 - 09:00
08:30 - 09:30
09:00 - 10:00
09:30 - 10:30
10:00 - 11:00
10:30 - 11:30
11:00 - 12:00
11:30 - 12:30
12:00 - 13:00
12:30 - 13:30
13:00 - 14:00
13:30 - 14:30
14:00 - 15:00
14:30 - 15:30
15:00 - 16:00
15:30 - 16:30
16:00 - 17:00
16:30 - 17:30
17:00 - 18:00
17:30 - 18:30
18:00 - 19:00
HORA
TOTAL DE VEHÍCULOS EN LA INTERSECCIÓN (VEQ)
Fuente: Ambitrans Ingenieros Consultores Ltda.

Figure 4-55 Traffic during the peak hour (mobile hour). Control Point 8. Crossroads Av. G-25 / Access Route G-421

Punto de Control Nº 8
Intersección Ruta G-25 / Acceso a Ruta G-421

250	300	350	400	450	500
07:00 - 08:00					
07:30 - 08:30					
08:00 - 09:00					
08:30 - 09:30					
09:00 - 10:00					
09:30 - 10:30					
10:00 - 11:00					
10:30 - 11:30					
11:00 - 12:00					
11:30 - 12:30					
12:00 - 13:00					
12:30 - 13:30					
13:00 - 14:00					
13:30 - 14:30					
14:00 - 15:00					
14:30 - 15:30					
15:00 - 16:00					
15:30 - 16:30					
16:00 - 17:00					
16:30 - 17:30					
17:00 - 18:00					

Fuente: Ambitrans Ingenieros Consultores Ltda.

Figure 4-56 Traffic during the peak hour (mobile hour). Control Point 9. Crossroads Av. G-25 / Route G-345

Punto de Control Nº 9
Intersección Ruta G-25 / Ruta G-345

	200	250	300	350	400
07:00 - 08:00					
07:30 - 08:30					
08:00 - 09:00					
08:30 - 09:30					
09:00 - 10:00					
09:30 - 10:30					
10:00 - 11:00					
10:30 - 11:30					
11:00 - 12:00					
11:30 - 12:30					
12:00 - 13:00					
12:30 - 13:30					
13:00 - 14:00					
13:30 - 14:30					
14:00 - 15:00					
14:30 - 15:30					
15:00 - 16:00					
15:30 - 16:30					
16:00 - 17:00					
16:30 - 17:30					
17:00 - 18:00					
17:30 - 18:30					
18:00 - 19:00					
HORA					
TOTAL DE VEHÍCULOS EN LA INTERSECCIÓN (VEQ)					

Fuente: Ambitrans Ingenieros Consultores Ltda.

These graphs were used to determine the peak times during the day, and so obtain the individual hourly ranges representing the "mobile hour". The use of this allows determining time windows to identify precisely the maximum volumes during the hour (See Tables 4-54 and 4-55).

The vehicle volume obtaining during those periods were transformed to equivalent flows, according to the factors recommended in Volume 3 of the Urban Highways Handbook of the Housing and Urbanism Ministry. "Recommendations for the design of Urban Road infrastructure elements" (See Table 4-54). This transformation allows showing the effect of the reduction of the capacity of a road. As total vehicles per hour. Each commercial vehicle (trucks and buses) has the effect of several light vehicles in the flow of transit, as shown in the following table:

Table 4-54 Equivalence factors

TIPO DE VEHÍCULO	FACTOR DE EQUIVALENCIA
Vehículos livianos	1.00
Camiones de 2 ejes	2.00
Camiones de +2 ejes	2.50
Taxibuses	1.65
Buses	2.00

Source: Ambitrans Ingenieros Consultores Ltda.

Table 4-55 Periods (2008) Peak Periods

Punto Nº	Intersección	Punta mañana	Punta mediodía	Punta tarde
1	Av. La Florida / Av. Departamental	07:30 a 08:30	12:30 a 13:30	18:00 a 19:00
2	Av. La Florida / Rojas Magallanes	07:00 a 08:00	13.00 a 14:00	18:00 a 19:00
3	Av. La Florida / Trinidad Oriente	07:00 a 08:00	13.00 a 14:00	17:30 a 18:30
4	Av. La Florida / San José de la Estrella	07:00 a 08:00	13.00 a 14:00	17:30 a 18:30
5	Av. Camilo Henríquez / Av. Diego Portales	07:00 a 08:00	13.00 a 14:00	17:15 a 18:15
6	Av. Camilo Henríquez / El Peñón	07:00 a 08:00	14:00 a 15:00	17:00 a 18:00
7	Ruta G-25 / Eyzaguirre (Las Vizcachas)	07:30 a 08:30	13.00 a 14:00	18:00 a 19:00
8	Ruta G-25 / Acceso a Ruta G-421 (Las Vertientes)	07:45 a 08:45	11:30 a 12:30	17:00 a 18:00
9	Ruta G-25 / Ruta G-345 (Acceso a El Alfalfal)	08:00 a 09:00	11:45 a 12:45	16:15 a 17:15

Table 4-56 shows the flows in equivalent vehicles for each of the identified peak periods.

Table 4-56 Peak period flow (2008) Total vehicles in the Crossroads (veq/hour)

Punto Nº	Intersección	Punta mañana	Punta mediodía	Punta tarde
1	Av. La Florida / Av. Departamental	7519	4157	6080
2	Av. La Florida / Rojas Magallanes	5347	3853	4522
3	Av. La Florida / Trinidad Oriente	5420	3454	4515
4	Av. La Florida / San José de la Estrella	4652	3113	4182
5	Av. Camilo Henríquez / Av. Diego Portales	5044	3342	4424
6	Av. Camilo Henríquez / El Peñón	2888	1858	2407
7	Ruta G-25 / Eyzaguirre (Las Vizcachas)	2401	1305	2894
8	Ruta G-25 / Acceso a Ruta G-421 (Las Vertientes)	489	422	442
9	Ruta G-25 / Ruta G-345 (Acceso a El Alfalfal)	337	351	