VI. DESCRIPTION, CHARACTERIZATION AND QUANTIFICATION OF CURRENT ENVIRONMENT AND PHYSICAL, BIOLOGICAL AND SOCIOECONOMIC ASPECTS OF THE SITE AND AREA OF DIRECT AND INDIRECT INFLUENCE

This chapter presents the current environmental characterization of the project area and its surroundings, without the implementation of the project. It is divided into three main sections: physical, biological and socioeconomic aspects, including the perception aspect or landscape.

VI. 1 IDENTIFICATION OF THE DIRECT AND INDIRECT AREAS OF INFLUENCE .

The direct and indirect Area of Influence of the Project was defined for the total contour of the project, as follows.

VI. 1.1 Direct Influence Area *(AID)*

The direct area of influence includes project construction site: paved surface, shoulders, drainage ditches, cut and fill slopes and intersections with existing roads. To facilitate the collection of field data the area under study was defined using strips, as detailed:

- Station 0+10 to Station 3+910 (starting of opening section) 40 m wide
- Station 3+910 to Station 8+900 (crossing with Río Grande San Miguel) 80 m wide
- Station 8+900 to station 17+370 (crossing with Las Delicias) 140 m wide
- Station 17+370 to station 25+020 (final) 80 m wide

Additionally at the intersection with the main roads, level crossings or traffic circles will be built for which data was collected in triangles of 250 m by 250 m. These are:

- Station 3+910, site where opening starts
- Station 13+060, site of the intersection with Ruta Militar (RN18)
- Station 21+865, site of intersection with road to Unión (CAÍ)
- Station 25+020, site of intersection with road to the detour to El Delirio (RN17)

VI. 1.2 *Area of Indirect Influence (AII)*

The area of indirect influence of the project varies significantly depending on the analysis of the environmental component that will be impacted by the project, from a couple of meters in the case of land and several miles in the case of social aspects.

In conducting the environmental impact assessment in each of the components of the environment, the level of the impact expected in each area was established, indicating the area of influence of each impact, which is established by confronting project activities with the particular environmental characteristics and cannot be generalized.

For methodological purposes and to define the minimum assessment area to be reviewed, the width of the catchment area was established, based on the following criteria:

- Dispersion of noise and dust, which is one of the main effects during road construction
- Wastewater, potential receiving bodies adjacent to the project site.
- Biological and fauna: ecosystems, flora and fauna of relevance in areas surrounding the Project.
- Social and landscape aspects: the presence of population centers and homes adjacent to project area.

For this reason a width of 500 m on either side of the minimum axis was established for the assessment, throughout the course of the project, and also to conduct the field visit in this area. A larger area was discussed for each topic, which is detailed in each of the sections by topic. For hydrology, socioeconomic and landscape a much wider area was documented, according to the impact of each area. A qualitative and quantitative description is given only in certain aspects, regarding the indirect area of influence.

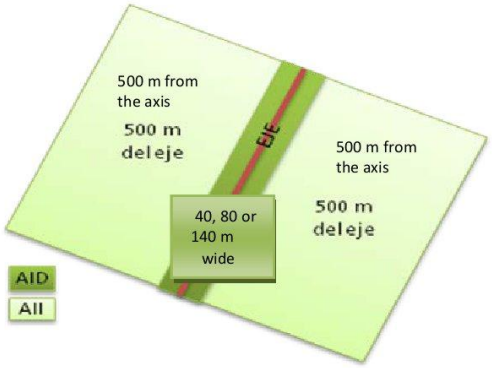


Figure No. VI.l. Diagram showing general widths for the Direct Influence Area (AID) and the Indirect Influence Area (AII) for field survey analysis, even though in some areas larger widths were considered for various reasons.

VI.2 IDENTIFICATION OF CURRENT USE OF PROJECT OUTLINE

In the "land use" section there is a breakdown of the current land use for the project outline, which is summarized in the following table. To define land uses we used the same terms used by the MARN in the land use map, MARN 2008.

TABLE No. VI.1. CURRENT LAND USE IN PROJECT LAYOUT

LAND USE	PERCENTAGE
SECONDARY FOREST	1.5%
LOW SHRUBS	17.8%
CROP AND GRASS LANDS	60.6%
MIX: SEMIURBAN-CROP AND GRASS LANDS	14.8%
SEMIURBAN	5.4%
TOTAL	100.0%

Source: Field Survey Eco Engineers

The project crosses semi-urban areas, with combined uses: agricultural and livestock, residential, commercial, institutional. Agricultural areas, with basic grain crops, pastures, natural grasslands and shrubs.

The construction of a primary road presents some incompatible uses, due to the interruption of traffic, noise, pedestrian safety, among others. The following uses are generally considered incompatible[1]: neighborhood trade, institutional such as schools, clinics, hospitals, protected natural areas, among others. These establishments are present in the project area particularly at the expansion section of the Pan American Highway, where small businesses can be found, as well as restaurants, nurseries, churches and schools.

There is a natural area proposed as a potential protected area (station 0 +980), which is an area of lava from the volcano of San Miguel, the project borders at the road expansion stretch, which is considered of an incompatible use, since road construction generates the development of human activities. Further details of this area are presented later in this document.

However, all of these uses are identified in the project expansion area, since there is already a primary road, and therefore no changes in land use are expected to expand this stretch. The construction of two roads, on the other hand, provides access to the above identified uses, as it will be a two lane highway with shoulders on the sides, improving circulation, although the presence of the road can generate a barrier for pedestrians and the effects of noise, dust and smoke, both in the construction and operation phases.

[1] 'Principles of urban design / environmental Schjetnan Mario Manuel Jorge Peniche and Calvillo

VI.3 PHYSICAL ASPECTS

VI.3.1 *Climate*

El Salvador is located within the tropical climate area with two seasons, rainy and dry in the year, during which there are marked variations in rainfall. The rainy season occurs in the atmospheric summer in the Northern Hemisphere, between the dates of May 21 to October 16. The dry season lasts from November 14 to April 19. There are also statistically speaking two periods in transition, the dry rainy which occurs between April 20 and May 20 and the rainy dry from October 17 to 13 november[2]. See Blueprint VI. 1 Climate.

TABLE No. VI.2. ESTIMATED DURATION OF SEASONS

TIME OF YEAR	STARTS	ENDS	No. OF DAYS
DRY SEASON	14 November	19 April	157
DRY RAINY TRANSITION	20 April	20 May	**31**
RAINY SEASON	21 May	16 October	149
RAINY DRY TRANSITION	17 October	13 November	**28**

Source: http://www.snet.gob.sv/ver/meteorologia/clima/perfiles+climatologicos/

The route of the project presents elevations above sea level between 79 and 286, locating it in the **Tropical Savanna Climate zone or Tierra Caliente,** (0-800 m) according to Koppen, Sapper and Lauer.

There are two weather stations in the municipality of San Miguel, both close to the project area, El Papalon and UES, both in San Miguel, from which the weather data were taken. The National Service of Territorial Studies (SNET) provided the data.

Table No.VI.3 below includes a summary of major representative meteorological parameters, including climate data on: temperature (maximum[3], and minimun[4] and absolute), rainfall (annual), relative humidity (given in%) and Wind (speed), solar radiation and evapotranspiration. Blueprint VI-1 presents maps of key climate parameters.

TABLE No. VI.3. SUMMARY TABLE OF MONTHLY AVERAGES OF MAJOR CLIMATOLOGICAL VARIABLES OF EL PAPALON STATION, SAN MIGUEL

Year/Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Rainfall (mm)	1.2	0.7	3.8	28.8	175.4	257.7	202.2	240.8	313.7	203.0	51.5	5.0
Average Temperature (^{9}C)	27.3	28.1	29.1	29.8	29.0	27.9	28.0	27.8	26.8	26.8	26.8	26.9
Max. Av. Temp. (^{9}C)	36.7	37.6	38.2	38.3	36.0	34.1	34.8	34.5	33.2	33.3	34.1	35.6
Min. Av. Temp (^{9}C)	17.7	18.3	20.1	22.1	23.0	22.5	21.8	21.9	22.0	21.6	20.0	18.2

[2] Ministry of Economy, "Atlas of El Salvador".
[3] Max temperature, the highest values reached in the year.
[4] Min. Temperature, the lowest values reached in the year.

Year/Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Average Abs. Max. Temp. (^C)	38.4	39.6	40.4	40.8	39.6	36.7	36.8	36.9	35.4	35.0	36.1	37.2
Average Abs. Min. Temp.(^C)	14.8	15.5	17.1	19.2	20.7	20.8	19.9	20.1	20.5	19.6	17.3	15.4
Sunlight hr/day	9.1	9.5	9.5	8.7	7.5	7.3	8.5	8.3	6.9	7.6	8.2	8.8
Relative humidity (%)	59	56	57	60	70	76	73	75	81	79	73	64
Potential evapotranspiration (mm)	158	160	198	201	192	168	180	176	150	148	141	146
Average Wind Speed Beaufort Scale	1.5	1.6	1.5	1.5	1.3	1.1	1.2	1.2	1.2	1.1	1.2	1.4

Source: http://www.snet.gob.sv/ver/meteorologia/clima/perfiles+climatologicos/

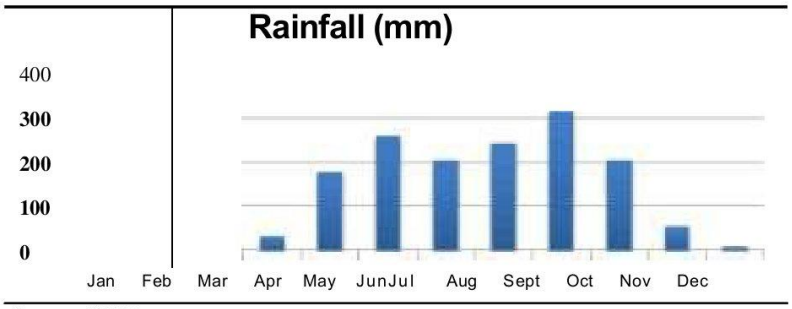
VI.3.1.1 Rainfall

According to the information reflected in VI.4 the months with the highest rate of rainfall are from April to November, with the highest rainfall in the months of June and September, the latter reaching an average of 315.9 mm. As in the rest of the country, the driest months are December, January, February and March, mainly January and February with 0.8 and 1.2 mm respectively.

TABLE No. VI.4. SUMMARY TABLE OF MONTHLY RAINFALL AVERAGE FROM 1960 to 2010, AT THE EL PAPALON STATION IN SAN MIGUEL

Year/Month	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
AVERAGE 1960-2010	0.8	1.2	4.0	26.1	183.9	254.2	205.4	245.5	315.9	204.6	51.6	5.5	1445.43

Source: SNET



Source: SNET

Figure No. VI.1. Average Rainfall 1960-2010, El Papalón Station

Reviewing the records of several years, El Papalon station has had an average annual rainfall in the range of 1,300 to 1,500 mm.

VI.3.1.2 Temperature

Based on the analyzed records, it can be expected that extreme temperatures between 37.6 and 40.5 ° C, might occur mainly in the months of March and April, in which measurements have been reported up to 40.5 ° C at the Station of San Miguel, UES, as can be seen in the following table.

TABLE VI.5. AVERAGE MAXIMUM TEMPERATURES AT THE SAN MIGUEL STATION U.E.S. FROM 2001 TO 2010.

Y/M	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
2001	37.4	38.3	38.1	39.9	36.0	34.5	35.1	35.4	33.5	34.1	34.7	37.7	36.23
2002	38.5	39.7	40.2	40.5	38.5	34.0	35.0	35.3	33.5	34.3	34.7	37.0	36.77
2003	39.2	40.1	37.8	39.3	37.0	35.2	35.5	35.8	34.4	34.1	34.6	35.2	36.52
2004	36.1	36.2	39.6	38.4	37.3	35.0	34.9	36.5	34.3	34.3	35.0	36.6	36.18
2005	37 0	38 4	38 1	38 9	35 4	34 5	35 4	35 2	34 1	30 8	33 9	35 5	35.60
2006	36 1	36 8	38 2	37 6	35 5	33 2	35 8	35 9	35 3	34 4	33 9	35 9	35.72
2007	37 3	38 0	39 4	39 3	37 6	36 4	37 2	34 3	33 8	319	34 1	35 6	36.24
2008	36.7	37.9	38.6	38.5	35.9	35.2	34.7	34.9	34.2	32.7	34.7	35.6	35.80
2009	36.5	37.9	38.1	39.3	36.6	34.0	35.8	36.2	35.4	34.6	33.9	35.1	36.12
2010	35.7	37.5	38.7	38.1	35.6	33.4	33.5	33.7	32.6	34.6	34.4	34.8	35.22

Source: SNET

As shown in Table No VI.6 the lowest temperatures that could occur in this area range between 18.2 and 24.6 ° C, these being mainly between the months of December, January and February.

TABLE NO. VI.6. AVERAGE MINIMUM TEMPERATURE AT THE SAN MIGUEL STATION, U.E.S. 2001 TO 2010.

Y/M	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
2001	18.3	18.8	19.8	21.9	24.0	22.6	22.3	22.5	22.7	22.5	20.2	19.7	21.30
2002	18.9	18.4	–	–	–	–	–	–	–	–	–		
2003	–	20.0	22.2	23.8	23.0	24.3	22.6	22.4	22.6	22.9	22.0	20.0	22.35
2004	19.1	19.7	22.7	23.1	23.4	22.9	22.4	22.9	22.5	22.8	20.8	20.2	21.88
2005	18.8	18.2	23.2	23.5	23.0	23.1	23.0	22.0	22.3	22.3	20.6	20.3	21.69
2006	19.7	19.7	20.5	23.1	23.5	22.9	22.9	22.5	22.4	22.8	21.5	21.1	21.88
2007	19.5	19.6	21.5	23.6	24.2	23.1	22.9	22.6	22.6	22.4	20.8	19.2	21.83
2008	19.4	20.3	21.2	23.2	23.5	23.1	22.3	22.6	23.0	22.4	20.7	19.4	21.76
2009	19.7	19.7	20.1	22.6	23.2	22.9	22.8	22.7	23.1	22.8	21.7	20.2	21.79
2010	20.2	21.8	22.2	24.6	24.2	23.7	23.1	23.2	23.3	22.0	20.5	18.7	22.29

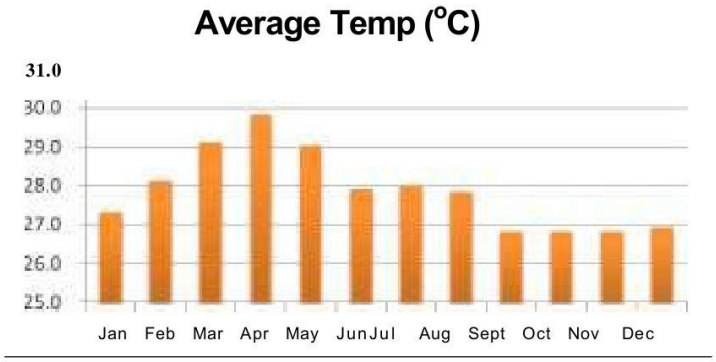
Source: SNET

The records of El Papalon Station show that there are extreme temperatures between 22.2 ° and 38.2 ° C that have occurred in the area, a little variation from the UES station, presenting the highest temperatures in the months of February and March.

TABLE NO. VI 7. TEMPERATURES AT EL PAPALÓN STATION IN SAN MIGUEL

Month/ Temperature	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Minimum	17.7	18.3	20.1	22.1	23.0	22.5	21.8	21.9	22.0	21.6	20.0	18.2
Average	27.3	28.1	28.1	29.8	29.0	27.9	28.0	27.8	26.8	26.8	26.8	26.9
Maximum	36.7	37.6	38.2	28.3	26.0	34.1	34.8	34.5	33.2	22.2	34.1	36.6

Source: SNET



Source: SNET

Figure No. VI.2. Average Temperature, El Papalón station

VI.3.1.3 Evaporation-transpiration

Annual averages in the Project area range from 1900 to more than 2000 mm a year. This is due to the high temperatures in the area, which cause the high evapotranspiration rates.

The following graph shows that at El Papalón, evaporation transpiration averages range from 141 mm to 201 mm; having a direct relationship with monthly max average temperatures.

Source: SNET

Figure No. VI.3. Potential Evapotranspiration in mm at El Papalón station

VI.3.1.4 Winds

Figure VI.4, shows that throughout the year the average wind speed is quite low and varies from 1.1 to 1.6 points on the Beaufort scale, which defines that the average wind speed ranges from 2-5 km / h, or 1 to 3 knots (nautical miles / hr). This type is called **light breeze** winds and produce small sea waves with no foam, while on ground its manifestation is that smoke indicates the direction of the wind. The prevailing wind direction is from the south.

Nationally, similar characteristics, such as those described below are perceived:
During the Northern Hemisphere winter, cold air masses of polar origin move from west to east in mid latitudes. These cold air masses start in El Salvador under the name of "North", especially in the period from November to February. For this reason during January the "North" winds predominate with average speeds from 13 km / h in the mountainous areas of the Northern Range, decreasing to 6 km / h in the inland valleys, then increasing to 12 km / h in the Coast Mountains to end with speeds around 9 km / h in the Coastal Plain.

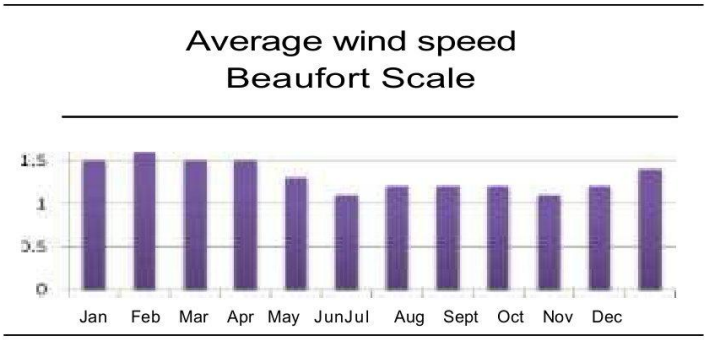
In February, conditions are similar, with a tendency to slightly decrease both the frequency of the winds or "Norths" and average speeds; on the other hand, we begin to observe a brief predominance of south winds associated with the sea breeze in the Western (central region) and Eastern (southern sector) areas in the country.

The dominance of southern winds is evident from February until May which is precisely the period of transition to the rainy season.
Starting in July, average speeds tend to increase, especially in the mountainous areas of the North. Also south winds diminish and the North winds associate with strong trade winds.

August and July, is the midsummer period (reduced rainfall during the rainy season). Thus, although the wind direction remains the same as in July, the speeds decrease.

In September southern winds predominate once again with reduced speeds, as this is the wettest month of the year in most of the country.

In October, there is a gradual increase in north winds and speeds. Once again anticyclonic systems in a wedge shape can be seen. During November and December the average speeds increase further, and the complete dominance of "North" winds is evident.

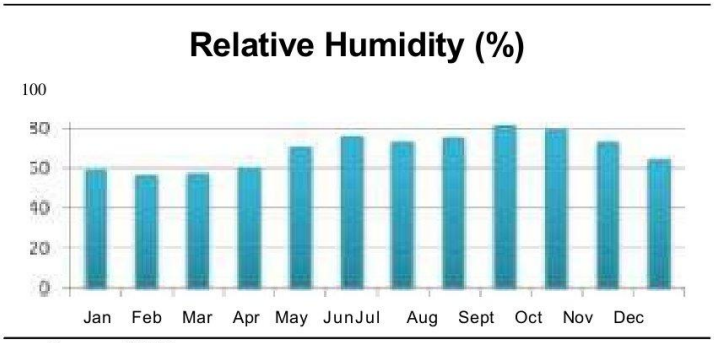


Source: SNET

Figure No. VI.4. Average wind speed, Beaufort scale

VI.3.1.5 Humidity

Regarding relative humidity averages, it can be observed that the highest rates occur in the months of June to November, being the highest 81% in September, while the lowest percentages occur in the months of January, May and December, with the lowest percentage, 56%, in February. As detailed in Figure VI.5.



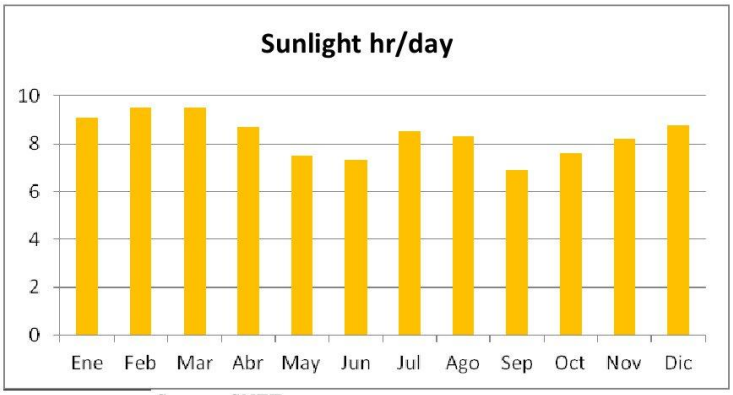
Source: SNET

Figure No. VI.5. Relative air humidity averages in %

VI.3.1.6 Sunlight

The area where the project is located receives between 8 and 9 hours of sunlight a day, which is considered a high average, compared to some areas of the country where only 6.5 hours / day (North, the Department of Morazan) is received.

Specifically, at El Papalon station, the averages range from 6.9 to 9.1 hours / day, as seen in Figure VI.6 Where September has the lowest average, attributing this to the fact that this is the month with the greatest rainfall rate, in other words the least sunny month of the year.



Source: SNET

Figure No. VI.6. Sunlight per hours/day

VI.3.2 *Air Quality*

No air quality records were found for the city of San Miguel. The only city that has been monitored is San Salvador.

The city's main source of air pollution is smoke from the combustion of motor vehicles. The use of wood for cooking in rural areas is also a source of air pollution. We identified industries that generate greenhouse gases in the area of direct and indirect influence of the project.
We monitored air quality at five points along the project. These sites were selected by dividing the project layout into similar distances and we looked for safe places to install the equipment. See blueprint Air Quality VI.2.

Details of the methods used are presented in Annex VI. 1. The following table presents a summary of the parameters identified. The parameters evaluated were:
1. Nitrogen dioxide (NO2), passive monitoring
2. Sulfur Dioxide (SOX), passive monitoring
3. Carbon monoxide (CO), target metering equipment
4. Carbon Dioxide (CO2), target metering equipment
5. Particulate matter (PM), high volume method
6. Hydrocarbons (HC), passive monitoring

Sampling sites are shown in the following image.

Figure No. VI.2. Location of Air Quality Sampling sites

The following table shows the average results obtained in the five air quality measurement sites, which are plotted in blueprint VI-2.

TABLE NO. VI.8. RESULTS OF AIR QUALITY SAMPLING, CONDUCTED BETWEEN AUGUST AND OCTOBER 2011, SM BYPASS.

#	LOCATION	STATION	NO2(u.g)	SO2 (ug)	CO (ppm)	CO2 (ppm)	PM	HC
1	Pan-Am. Highway (CA-1), Km 129.5, Moncagua	0+200	2.9	1.3	260.00	558.33	175.31	ND
2	Cantón El Obrajuelo, Quelepa	5+240	-	0.4	256.67	462.67	115.93	ND
3	Lotificación Campos, Cantón Hato Nuevo	13+240	0.7	0.2	261.00	592.33	129.44	ND
4	Had. Roberto Cubías, Cantón El Papalón	20+260	1.7	0.3	261.00	563.67	90.26	ND
5	Sr. Chavez, between road to LaUnión (CA-1) y El Delirio (RN17)	22+800	-	0.3	256.33	567.33	99.32	ND
6	Plan de Las Mesas	9+780	Not assessed	Not assessed	238.69	547.25-	104.69	ND
7	Roosevelt Avenue, San Miguel	FUERA DE AID	-	-	268.55	598.35	362.21	ND
-	SALVADORAN STANDARD	-	100	80	10,000	-	260	-

Source: Air monitoring report, Eco Ingenieros

In order to assess whether limits really represent good air quality, The Special Regulation of Environmental Quality Technical Standards was reviewed, which sets out max levels allowed to be generated in ambient air for a given space.

The World Bank established that a project should not contribute by more than 25% to those levels to allow for the sustainable development of a given area.
The figure below illustrates current air quality levels compared to the standard in percentages to facilitate its reading

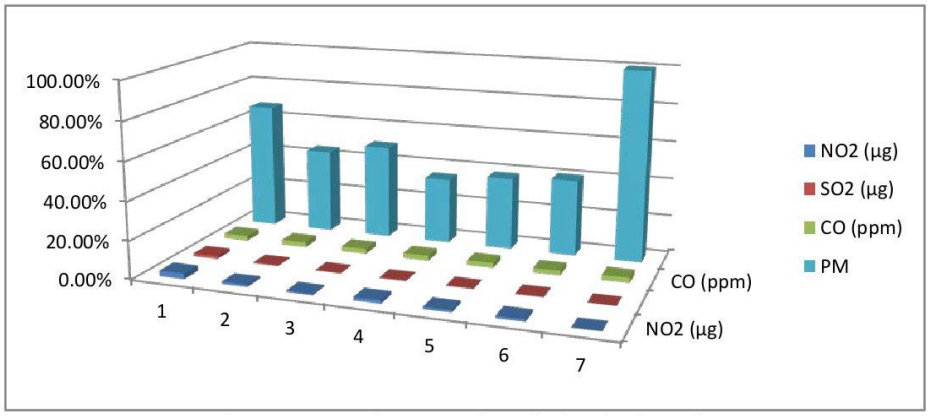


Figure No. VI.7. Outcomes of the Air Quality Analysis

TABLE No. VI.9. ALLOWABLE AIR POLLUTION RATES IN ACCORDANCE WITH DECREE 40

PARAMETERS	UNITS	MAX PERMITED VALUES	PERIOD
Sulfur dioxide (SO2)	u.g/m3	80	Annual
Sulfur dioxide (SO2)	u.g/m3	365	24 hours
Carbon monoxide (CO)	u.g/m3	10,000	8 hours
Carbon monoxide (CO)	u.g/m3	40,000	1 hour
Nitrogen oxides (NOX)	u.g/m3	100	Annual
Nitrogen oxides (NOX)	u.g/m3	150	24 hours
Total suspended particles (PST)	u.g/m3	75	Annual
Total suspended particles (PST)	u.g/m3	260	24 hours

Source: Air monitoring report, Eco Ingenieros

Regarding CO it was determined that the levels ranged between 261.00 and 256.33 ppm, being the 8-hour standard 10,000, these values represent 2.6% of the standard.

Regarding particulate matter, the highest value was found at Roosevelt Avenue, in the City of San Miguel, the area along the Pan American Highway (CA-1), and at Hato Nuevo, near the Ruta Militar road (RN18), where there are dirt roads; the ranges are between 67% and 38% from the standard.

With regard to NO2 and SO2, the values are well below recommended rates for both annual and for 24 hours, indicating that there is good air quality, which is explained by the presence of nonpolluting industries.

No hydrocarbon values were detected above the detection method limits.

VI.3.3 *Noise*

The main source of noise in the city is caused by motor vehicles, as also for air pollution.

In the expansion section of the Pan American Highway (CA-1), the main source of noise is the circulation of existing vehicles in both the ADI, as in the IIA.

In the opening section, at intersections with major streets, vehicles are the main source of noise. Other sources of noise are the occasional use of pumps for water extraction from wells and some farm equipment. See Blueprint VI.3 Noise and Vibration.

Noise monitoring was carried out with a decibel meter equipment to establish the noise baseline in the area, in thirteen sites presented in the following figure.

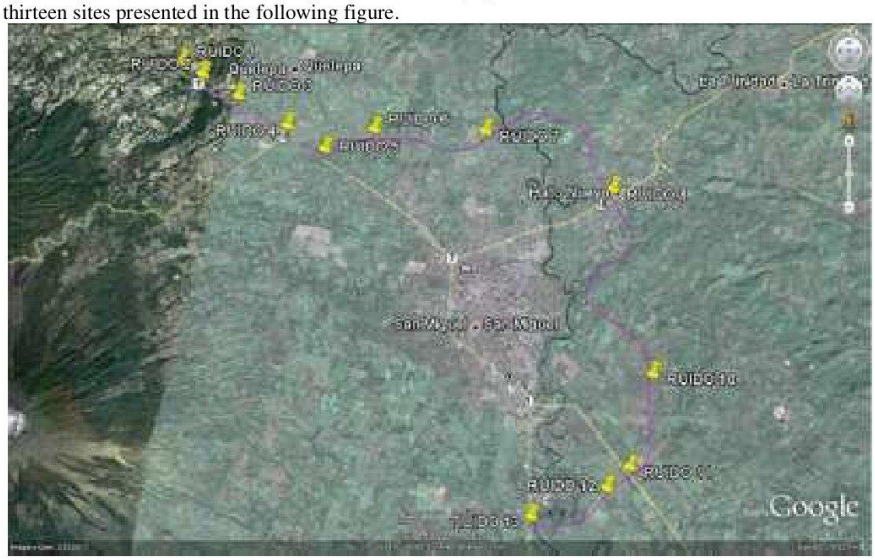


Figure No. VI.3. Noise Monitoring Sites

Noise was measured during daytime and nighttime hours. During monitoring all possible sources of noise detected were annotated. Annex VI.2 shows a detail of the environmental noise identified, which is summarized in the following table together with the measurement method.

Noise was measured during the day between 11:20 am and 3:00 pm. At night measurements occurred from 6:10 pm until 8:40 pm, for security reasons. The measurement was made at 1.20 m above ground level, with a decibel equipment at each site.

TABLE No. VI.10. NOISE LEVELS MEASURED AT 13 SITES OF THE PROJECT IN DB (A), SM BYPASS, 2011

REF	DESCRIPTION	STATION	DAYTIME			NIGHTIME		
			MIN	AV.	MAX	MIN	AV.	MAX
1	Project start	0+00	50.0	66.8	78.0	62.0	68.8	76.0
2	Detour to Moncagua	0+200	68.0	76.0	84.0	60.0	71.6	86.0
3	Detour to Quelepa	1+320	70.0	77.6	86.0	66.0	71.8	84.0
4	Detour to Las Placitas	2+780	66.0	72.4	80.0	68.0	78.4	90.0
5	Start of the opening section	3+700	68.0	78.0	88.0	66.0	72.4	82.0
6	Intersection with the old road to Quelepa	5+240	40.0	40.8	58.0	44.0	54.8	66.0
7	Intersection with road to cantón Agua Zarca	8+240	46.0	63.6	80.0	54.0	64.0	72.0
8	Intersection with Ruta Militar (RN18) in Hato Nuevo.	13+080	62.0	76.4	90.0	66.0	76.0	88.0
9	Intersection with a rural road to cantón Las Delicias	17+360	40.0	44.0	50.0	40.0	42.8	46.0
10	Intersection with a secondary rural road to	19+240	40.0	40.4	42.0	40.0	40.4	42.0
11	Intersection with road to La Unión (CA-1)	21+865	66.0	77.6	86.0	70.0	79.2	88.0
12	Intersection with a secondary rural road	22+780	44.0	62.0	76.0	40.0	42.4	48.0
13	End of project, Road to El Delirio (RN-17)	25+022	52.0	68.4	88.0	60.0	74.8	90.0

Source: Noise Assessment Eco Ingenieros

Sites 1 to 5, located along the current Panamerican Highway (CA-1) have constant noise levels, due to the Street and this does not vary significantly either during the day or night, since vehicles pass at all times along the road. There is an average of 74.2 dB (A), with a minimum of 50.0 dB (A) and a maximum of 88.0 dB (A), for the day; at night the average was 72.6 dB (A) with a minimum of 60.0 dB (A) and a maximum of 90.0 dB (A).

At the expansion section rates vary, due to the changes in land use, road interceptions and other. In sites 8, 11 and 13, major roads cross, but the levels are similar to those of the Pan American Highway (CA-1), there is an average of 74.1 dB (A), with a minimum of 52.0 dB (A) and a maximum of 90.0 dB (A), for day and night, averaging 75.7 dB (A), with a minimum of 60.0 dB (A) and a maximum of 90.0 dB (A).

Sites in predominantly rural areas (sites 6, 7, 9, 10 and 12), the expansion section has lower levels, there is an average of 50.2 dB (A), with a minimum of 40.0 dB (A) and a maximum of 80.0 dB (A), for day and night, averaging 48.9 dB (A), with a minimum of 40.0 dB (A) and a maximum of 72.0 dB (A).

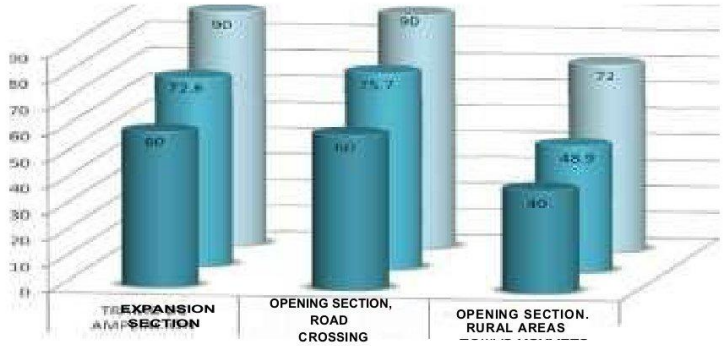
TABLE No. VI.ll. MAXIMUM AND MINIMUM AVERAGES PER AREA

DESCRIPTION	DAYTIME			NIGHT TIME		
	MIN	AV.	MAX	MIN	AV.	MAX
EXPANSION SECTION	50.0	74.2	88.0	60.0	72.6	90.0
OPENING SECTION, ROAD CROSSING	52.0	74.1	90.0	60.0	75.7	90.0
OPENING SECTION, RURAL AREAS	40.0	50.2	80.0	40.0	48.9	72.0
NORMABM	**55**			**45**		

Source: Air monitoring report, Eco Ingenieros

Source: Air monitoring report, Eco Ingenieros

Figure No. VI.8. Daytime noise levels in dB (A)



Source: Air monitoring report, Eco Ingenieros

Figure No. VI.9. Night time noise levels in dB (A)

The latest stationary emission standard proposed does not include noise levels. World Bank Guidelines are used in which it establishes 55 for day time and 45 for night time, for

residential, institutional, educational, industrial and commercial areas, 70 for the day and night. A day is from 7 am to 22 hrs pm, and night from 22 hrs to 7 am.

In the sites sampled on the Panamerican Highway (CA-1) and main highway crossings noise levels are high. In rural areas levels of ambient noise are low.

The World Bank recommends not to exceed in 3 dB the levels at the nearest receiving body.

VI.3.4 *Vibrations*

The baseline data for ground vibrations was collected, as well as for noise, the main source of vibration in the area are passing vehicles.

The brand of the equipment used was ERBESS, model DIGIVIBE 50 and consists of the following:

• An accelerometer with a magnetic base and a 1.8 m cable with a USB connector
• Software to measure vibrations and obtain spectra in frequency.

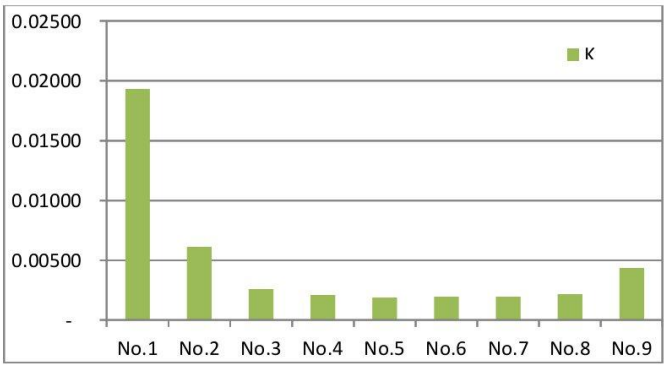
The equipment allows measuring vibration in acceleration, velocity and displacement; Real time analysis, vibration graphs, amplitude against time and immediately amplitude versus frequency, and phase analysis.

The table summarizes the results, which are compared with the standard of the community of Madrid, in the absence of national legislation. This standard evaluates vibration in terms of acceleration (m2 / s) and frequency (Hz). Comparisons with the standard for residences were made, which is the lowest in terms of existing land uses.

TABLE No. VI.12. OUTCOMES OF THE VIBRATION ANALYSIS

Sample	k	k	k	k	k	Avg. k	Highest k	Residential k standard	% of standard
No.l Pan-Am	0.01930	0.00278	0.00126	--	--	0.00778	0.01930	2.00	0.97%
No.2 Salitre	0.00100	0.00535	0.00275	0.00608	0.00246	0.00353	0.00608	2.00	0.30%
No.3 Sinai	0.00261	0.00210	0.00200	0.00220		0.00223	0.00261	2.00	0.13%
No.4 Hato Nuevo	0.00206	0.00135	0.00174	0.00170	0.00203	0.00178	0.00206	2.00	0.10%
No.B Apacunque	0.04000	0.00190	0.00164	0.00164	--	0.01130	0.04000	2.00	0.10%
No.6 Hacienda Cubias	0.00140	0.00198	0.00181	0.00178	0.00167	0.00173	0.00198	2.00	0.10%
No.7 CAÍ to La Unión	0.00198	0.00129	0.00190	0.00157	0.00167	0.00168	0.00198	2.00	0.10%
No.8 House of Mr. Chevez	0.00213	0.00184	0.00190	0.00158	0.00180	0.00185	0.00213	2.00	0.11%
No.9 Ave. Roosevelt	0.00434	0.00174	0.00177	0.00100	0.00172	0.00211	0.00434	2.00	0.22%

Fuente: Estudio de vibraciones, Eco Ingenieros



Source: Vibration Assessment, Eco Ingenieros

Figure No. VI.10. Comparison of vibrations at sampling sites

VI.3.5 *Geomorphology and Reliefs*

The project is located at elevations between 83 and 279 meters over sea level. There are two geomorphological units: the "Volcanic Chain" and the "Interior Trench", described below.

- The young volcanic chain, covers around 20% of the national territory in the western part of the country and separates the Central and Interior Trenches with a narrow and irregular band with an elevation of 700 masl., and in some cases it reaches 1,000 meters above sea level. The volcanic complex includes the Tecapa-San Miguel complex, to the south-west area of the project.
- The Great central depression, which has scattered valleys and mountainous areas and streams, throughout the whole project site. This depression possibly originated during the late Pliocene era to the early Pleistocene era. Project area comprises the plains of San Miguel and the hills of San Miguel and Yayantique. See blueprints VI.4 Geomorphology and Relief.

The benchmark to analyze the relief and topography is the classification developed by CENTA reliefs / FAO.

VI.3.5.1 Reliefs and Slope Description

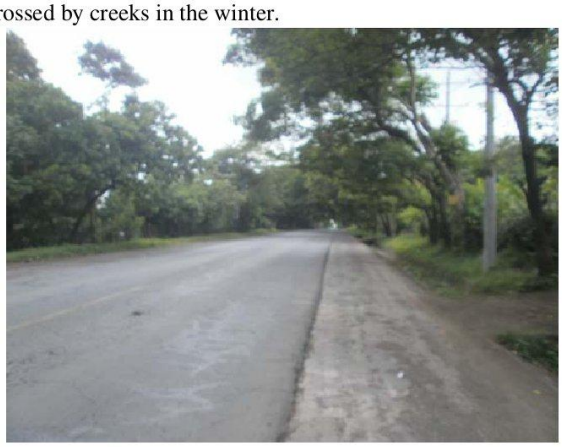
Below is a description of the relief in the direct and indirect area of influence of the project divided into sections with a similar topography, based on the topographic map and the observations gathered during the field visits. The slope and relief map is presented in appendix VI-5 Slopes.

VI.3.5.1.1 Station -0+10 a 3+910

The Pan American Highway (CA-1) will be expanded in this section defining the topography of the area with an almost constant slope of 1.77% throughout the project outline from west to east, from an elevation of 279 meters to 210 masl.

Most of the route along this section on the south side of the land is above street level but on the north side it is just below street level, in most land plots the difference in land level is less than 1 m, giving the appearance of being almost flat.

Between stations 1 0 +900 to +010 and stations 3 +710 to 3+910 , the presence of lava flows elevates the ground to 5 m above street level. At stations 2 +060, and 3 +240 and 3 +610 the project outline is crossed by creeks in the winter.



Photograph No. VI. 1. Prevailing view of the opening section, with land slightly above or below street level, dominated by gentle slopes

VI. 3.5.1.2 Station 3+910 to 8+850

The terrain is mostly flat, gently rolling or rolling, with interspersed slopes ranging from 1.5% to 8.3% steepness.

Photograph No. VI.2. Typical view between station 3 +910 to 8 +850, with flat, slightly ridged and ridged areas.

VI. 3.5.1.3 Station 8+800 to 9+000: Río Grande crossing

At the junction with Rio Grande, the river runs through very high slopes of 89%, especially at the edges.

Photograph No. VI.3. View from the north of the Rio Grande crossing

VI.3.5.1.4 Station 9+000 to 12+950

From the junction of the Rio Grande de San Miguel it moves up the slope of several hills: Las Mesas, El Manchon, Tincute, Tacuazín y Costilla de casa; running along steep slopes, at the point where streams intersect between hills, the slopes increase. After station 5+350 it starts to ascend from 100 meters at river bank to 170 m, and down again until Station 7 +600 to 123 meters above sea level where the terrain is flat again.

Photograph No. VI.4. View to the east from station 9 +750, where the slopes along the project can be seen from station 12 +100 and ascending to lots near the Ruta Militar (RN18), in the area of Hato Nuevo, to 116 meters.

VI.3.5.1.5 Station 9+100 to 9+900

Approaching the Taishihuat River, there is a change in the topography of the Military Route (RN18) area, from an altitude of 110 masl to the center of the river with an altitude of 90 meters. As we approach the river, the slopes become more pronounced. There are 8% steep slopes at the beginning, and near the river steepness is up to 46.9%, and 12% slopes at the other side of the river. In this section the terrain is rolling, gently rolling and even hilly.

Photograph No. VI.5. Flat area along the Taishihuat River, with a rugged area with slopes up to 46% in steepness approaching the river in the background

VI.3.5.1.6 Station 13+750 to 16+350

In this section the project crosses the slopes of several hills: Lomas Taishihuat and Loma Escondida, down the west. The highest elevation is 185 masl. The predominant slopes vary from 12% to 30%, with hilly and broken terrain. Several streams cross this section.

Photograph No. VI.6. In the background we see the hills along the project path, in the area with the largest concentration of slopes.

VI.3.5.1.7 Station 16+350 to 19+300

Rolling and hilly terrain predominates with slopes between 4.70% to 23.80%. At the beginning of station 16 +350, lands are flat to gently rolling; Near stations 16 +740 to 17 +080 a hill known as Nombre de Jesús, with an altitude of 95 masl to 135 masl passes in the center and goes back down to 100 masl. From this point the terrain is rolling until station 18 +100. After passing a gently rolling section 20 m long the terrain becomes rugged with slopes averaging 26.7% in steepness up to station 18 +380.
After this point the terrain is rolling and hilly, with slopes between 4.70% and 21%.

Photograph No. VI.7.
View from the top of the hill at station 15 +020, south-west

VI.3.5.1.8 Station 19+300 to 25+0.21.522

En In this section of the project flat and slightly undulating terrain prevails, with slopes as smooth as 0.8% to 3.2%. This slightly wavy flat stretch is interrupted only by small land areas with a ridged, and broken topography. At station 22 +000, land is very rugged represented by slopes greater than 70%. The crossing of the Rio Grande de San Miguel at Station 24 +778, also represents another abrupt change in the slope of the section considered.

Photograph No. VI.8. Flat terrain near station 23+280

VI.3.5.2 Summary of Slopes and relief

The following Table shows the slopes and topography between project stations.

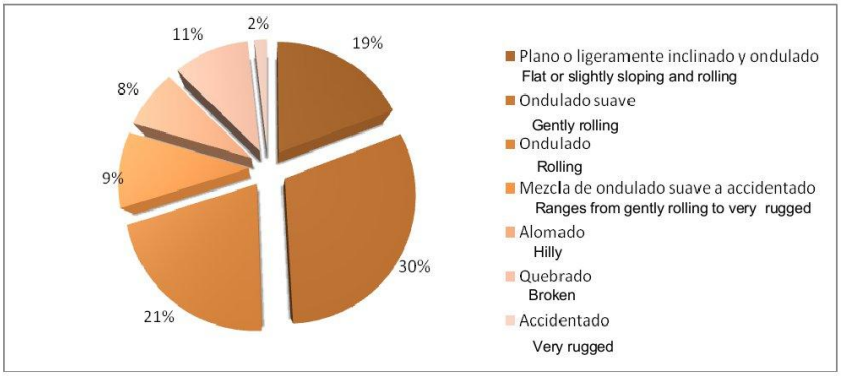
TABLE No. VI.13. RELIEF AND SLOPES BY SECTIONS

STATION RANGE		TYPE OF RELIEF	DOMINANT SLOPE
7+760	7+150	Flat or slightly sloping	4.50%
7+150	6+850	Rolling	5%
6+850	6+750	Rugged	41.60%
6+750	4+200	Mildly rolling	2.90%
4+200	3+910	Rolling	5.50%
250mx250m around P2		Rolling	8.30%
3+910	4+010	Rolling	9.50%
4+010	4+650	Mildly rolling	2.30%
4+650	5+700	Rolling	8.30%
5+700	5+900	Mildly rolling	2.80%
5+900	6+200	Flat or slightly sloping	1.50%
6+200	6+800	Rolling	4.50%
6+800	7+600	Flat or slightly sloping	1.70%
7+600	8+000	Rolling	5.33%
8+000	8+400	Flat or gently sloping and rolling	1.5% and 11.4%
8+400	8+800	Rolling	4.20%
8+800	9+000	Rolling, hilly and very rugged	8%, 13.5% and 89.6%
9+000	9+200	Mildly rolling	2.30%
9+200	9+550	Hilly	20.30%
9+550	9+700	Rolling	8.80%
9+700	10+300	Hilly	19.10%
10+300	10+450	Rolling	6.70%
10+450	10+800	Rolling and rugged	11.8% and 40%
10+800	10+000	Hilly	18%
11+000	11+150	Rugged	42%
11+150	11+250	Hilly	12.80%
11+250	11+350	Rugged	42.00%
11+350	11+450	Rolling	12%
11+450	12+100	Mildly rolling	3.80%
12+100	12+150	Hilly	15.38%
12+150	12+950	Rolling and very rugged	8.1% and 72%
250mx250m around P7		Rolling and hilly	8% and 14%
13+200	13+650	Rolling	8.50%
13+650	13+750	Rugged	46.90%
13+750	13+900	Rolling	12%
13+900	16+400	Broken	30%
16+400	16+650	Mildly rolling	2.80%
16+650	17+100	Hilly	23.80%
17+100	18+050	Mildly rolling	5.90%
18+050	18+150	Rolling and hilly	9% and 35%
18+150	18+250	Mildly rolling	3.30%
18+250	18+400	Broken	26.70%
18+400	18+450	Mildly rolling	4.70%
18+450	18+600	Hilly	21%
18+600	19+300	Rolling	6.70%
19+300	20+250	Mildly rolling	3.20%
20+250	20+750	Gently rolling and rugged	2.8% and 40%
20+750	22+000	Flat or slightly sloping	0.80%

250mx250m around 21+780		Slightly sloping, rolling and very rugged	1.4%, 1.8% AND 71.4%
22+000	23+480	Flat or slightly sloping	1.20%
23+480	23+880	Rolling and hilly	6.9% and 22.2%
23+880	24+580	Slightly sloping and rugged terrain	0.9% and 10%
24+580	24+630	Hilly	15.50%
24+630	24+830	Mildly rolling	3.60%
24+830	25+022	Rolling, rugged and very rugged	3.3%, 46.5% and 100%
250mx250m around P11		Mildly rolling	2.60%

Source: Field survey and analysis, ECO Engineers

As seen in the next graph, undulated terrain predominates along the Project outline, as well as wavy, sllightly wavy, flat to soft slopes along 60% of the Project outline.



Source: Field Survey and topographic analysis, Eco Ingenieros

Figure No. VI.ll. Project terrain types

VI.3.6 *Geology*

This paragraph intends to define and identify geological formations, typical of a project of this kind for the San Miguel By Pass and its area of influence, comprised of 6 formations, two geological formations dating from the Pliocene to early Holocene eras, and the identification of the geologic materials that make them up, being supplemented by geological maps. See Blueprints VI.6.

The document also includes a brief chronology of the most significant seismic events that have affected the east of the country, some of them have considerable antiquity, only the date and destructive features were recorded.

Similarly, the geological maps along the line proposed show the focal points of epicenters of seismic activity, both originating in the local volcanic chain of the Benioff zone, the first with a chronological range from the period 1730-2001 and the second for a period from 1900-2001, with magnitudes > 3, and varying depths and also the faults, joints and scarps of terraces found along this section, which must be taken into account when designing the road and during the execution of works.

According to the topographic quadrants, scale 1: 50, 000, pages 2556 and 2556 I II, called San Miguel and Jocoro respectively, that belong to the department of San Miguel, the very variable physiographic conditions are evident, which vary from flat terrain to sloped, ranging from gentle to steep slopes within the outline of the project. See Blueprint VI.6 Geological. The geological report prepared by Father Arrupe Foundation in August 2011 was reviewed, which is included in Annex VI.3.

VI.3.6.1 Area Geomorphology

The different topography of the project area, is generally constituted by Quaternary sediments in the low areas, while brown pyroclastic flows, semicompacted, ignimbrites, and relatively hard brown tuffs can be observed in the hilly areas. Similarly, dacitic material and in equal proportion basalt material is present, the latter two being found scattered in isolated nuclei along the project outline.

In the northeastern part of the project (the middle of the strip studied), the foot of the mountain is dissected, presenting both a relief that transcends from moderate, relatively inclined to slopes above 35%.

With regard to external and internal drainage, it ranges from moderate to high in the most rugged areas and very low in the flatter areas, so that during the rainy season the soil is kept moist enough, and possibly preserved this way in the early months of the year very close to the low water period.

In general terms these soils may also have a considerable depth, and are generally friable, porous and with a high water retention capacity.

East of Rio Grande de San Miguel, in the northern and the eastern part of the project but south east of Rio Taisihuat (both parts in the middle of the project area), there are mountainous areas that are heavily dissected and compound, and also brown semicompacted tuffs superimposed on semi hard pyroclastic flows, sometimes interspersed with volcanic agglomerates.

The northwest corner of the city of San Miguel and in greater proportion the south and southeast, show a topography that ranges from moderate to almost flat, consisting of ancient peniplanes with alluvial soils, which are cut by rivers and streams with shallow beds.

The geomorphological features of the area are:

Plains: most of the area lies in a tectonic depression, filled by materials carried or transported by the wind. Also with contributions from volcanic materials.

Denudational volcanic hills: formed by ancient volcanoes affected by erosion and in some cases by tectonism. This type of morphology is evident in the hills of Las Mesas, Manchon, La Quebradona, El Limon, Volcancillo and La Escondida, which are relatively old, affected by weathering and erosion.

Lava flows: At the beginning of the project outline, lava flows from the Chaparrastique volcano, with gentle slopes on the edges and a slightly undulated terrain on the surface.

Oxbow lakes: lake or lagoon formed by avulsion of the river meandering. It is seen in large floodplains and lake flow plains.

Paleocanal: Linear deposition of river, or lake due to a preexisting drainage either as a channel or oxbow. Observed in the left margin of the Rio Grande, along the Road to El Delirio (RN17).

Chaotic blocks: Grouping of blocks and stones of different shapes and sizes, by mechanical action, at the foot of steep slopes.

VI.3.6.2 Geology of the assessed area

Most of the area assessed consists of sedimentary materials from recent pyroclastic deposits and quite weathered acid lavas, and some areas with hydrothermal alterations.

The geotechnical research revealed alluvial deposits, with variations of reworked material (epiclastits) or tuffs and consolidated lacustrine sediments.

Upon starting engineering works for a new vehicular access road, it is essential to carry out a geological study to define the capacity of materials for the foundations of various works on the sites, as well as their resistance to erosion.

The geological study conducted was mainly focused on this project because it is exactly where various engineering works will be performed. Based on this review, and on the study of outcropping soils, and the review of the strata exposed in the rivers and streams that cross this stretch, we noted the following stratigraphic sequence, which is described from the most recent to the earliest, as presented in the geological maps produced for this project. See blueprint VI-5.

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I. **River sediments belonging to Qf member, San Salvador Formation**, Holocene period of the Quaternary era, characterized by having a heterogeneous particle size, that is, it is constituted by fine and coarse permeable particles which together are part of the coastal plain and to a lesser extent the of country's central graben.

   These sediments have been carried by major rivers running from the north - south, to which some tributaries are added that at times run parallel and sometimes semiper pendicularly; sediments are deposited in these plains with the advantage that they constitute exploitable aquifers located at different depths. Also worth noting is that these sediments can be valued as foundation materials since they are well confined. In the south of the project area, very close to the Rio Grande de San Miguel, some terrace scarps are reported, which give some instability to the ground, possibly due to deflation, this causes subsidence that at some point eventually causes water logging, especially during the rainy season .

II. **Yellowish brown tuffs belonging to s3'a member, San Salvador formation.** These tuffs are semicompact, and therefore easier to cut. They have lime granules and low permeability. The maximum thickness in the project area does not exceed 3 meters, so some parts of the project lie on this material and others on pyroclastic flows or ignimbrites.

III. **Andesites and dacites,** are effusive volcanic rocks, possibly from one of the three main units in the eastern region, especially those comprising the volcanic group of San Miguel defined by Meyer-Abich as volcanic strata, with eruptive material generally with intermediate-basic features. This material corresponds to s2 members, San Salvador formation. For this study the most representative component, is recorded on the Pan American Highway (CA-1) at the same point where the opening of the new road will happen. The lava flows sometimes are shown as slags, and are superimposed on pyroclastic flows. This is the reason that the latter show a red coloration in some areas, caused by calcination produced by deposition of Dacite and andesite at elevated temperatures , characterized also by being fractured, so secondary permeability is medium to high.

IV . **A relatively small gap may be reported to the si member, San Salvador formation is pressed by members s2 and Qf and partially by s3'**, in this particularly complicated delimitation case due to the dynamic geological bounding in the area. This material is mainly composed of andesitic and tuffaceous materials assignable to the Tecapa complex. The unit is described as a sequence of acid pyroclastic, basic to intermediate volcanic epiclastites, partly contemporaneous with s2member (Wiesemannl975)

V. **Volcanic material assignable to c2 member, Cuscatlan formation,** especially for the mountainous area, the middle portion of the project, which consists mainly of dacite outcrops associated to tuffs, which according to Wiesemann (1975), have effusive characteristics of the acid and intermediate acid types, partly contemporaneous to c1member and to a lesser extent to c3member. This material possibly originated from the Obrajuelo, Pitahaya, El Duende and El Piche complex, (Baxter 1984). The area that has this formation reports geological faults (see Geological blueprint in the Apendix)

VI. **Pyroclastic flows or ignimbrites are recorded, assignable to the Cuscatlan formation** from the Pliocene to Pleistocene eras. These materials have a tuffaceous condition with a high degree of cohesion, ie from moderately hard to very hard, reason why they enjoy great stability, even forming vertical or almost vertical strata with thicknesses up to 6 meters. To this we must add that the hardest ones possess good seismic behavior, and are therefore considered as excellent foundation materials These pyroclastic flows are also very resistant to erosion, and also waterproof, except in certain places where they are fractured, showing in these cases a secondary permeability. These two aspects should be considered in the management of water and runoff during the implementation and completion of works.

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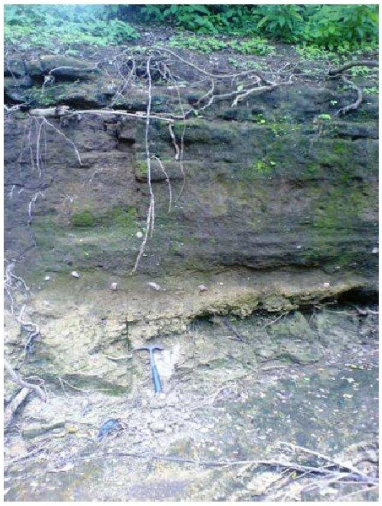
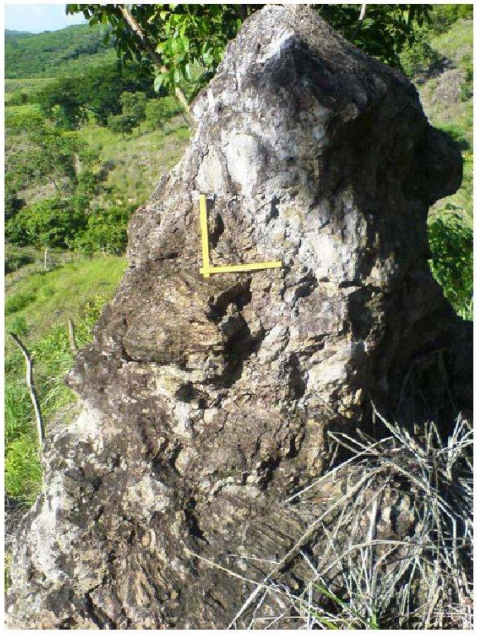
Photograph No. VI.9. Detail of the strata corresponding to fluvial sediments Qf member, present in the southern part of the project, along the banks of Rio Grande de San Miguel, the continuous dynamics of soils in this area are due to the effects of erosion that cause extensions of scarps in terraces, registered in the field inspections.



Photograph No. VI.10. Detail of the strata exposed in El Papalon River, (west bank) shows an ascending order from the riverbed, consolidated ignimbrite material possibly assignable to a member chronologically earlier than Qf strata overlying it, and immediately above this, there is tuffaceous material redeposited , followed by Quaternary colluviums sediments, mainly composed of sections with interbedded pyroclastic rocks.

Photograph No. VI.ll. Detail of the strata exposed in El Papalon River (east bank) showing the same ascending order of the previous figure, except that it is possible to determine the finely stratified layers with thicknesses from 2cm to 7cm, consisting of pumice tuffs to this material possibly redeposited. These are overlain by river sediments with heterogeneous granulometry, stratified among each other, mainly consisting of sections with interbedded pyroclastic rocks

Photograph No. VI.12. Loma Los Escuerzos, showning volcanic material, consisting mainly of pyroclastic flows and tuffs, with basalts of a regular size intercalated and dispersed and also dacites to a lesser extent.



Photograph No. VI.13. Review of exposed cropping rocks on El Escondido hill, constituted by dacites mainly related to molten tuffs. The material corresponds to c2member and the area where this material is located is also related to the fault system in Obrajuelo and El Escondido.

Photograph No. VI.14. Sample of dacite, associated to molten tuffs at the south end of El Escondido hill corresponding to c2 member. In this place faults and joints, associated with the fault system of Obrajuelo and El Escondido were reported.

VI.3.6.3 Geological Description by Sections

The following table shows the superficial geological formations along the course of the project, indicating its approximate boundaries.

TABLE No. VI.14. GEOLOGICAL FORMATION BY PROJECT SECTIONS

SECTION				FORMATION
Station	3+910	A	4+100	s2 Member, San Salvador Formation, composed of volcanic material, especially dacites and andesites sometimes associated to pyroclastic flows .
Station	4+100	A	5+100	Member, San Salvador Formation, comprised of sedimentary material and fluvial and lacustrine deposits
Station	5+100	A	6+800	QF Member, San Salvador Formation, composed of sedimentary material and fluvial and lacustrine deposits
Station	6+800	A	8+450	s3'a member San Salvador formation, generally comprised of volcanic material, Brown tuffs, ignimbrites and pyroclastic flows.
Station	8+450	A	9+300	QF Member, San Salvador formation, generally composed of volcanic material, brown tuffs, ignimbrites
Station	9+300	A	11+500	C2 Member, Cuscatlán formation, volcanic material, particularly tuffs and dacites.
Station	9+650	A	10+800	Member Cuscatlán formation, comprised mainly of welded tuffs, pyroclastic material and basalts.
Station	11+500	A	12+550	QF Member, San Salvador formation, comprised of

SECTION				FORMATION
				Sedimentary material composed of fluvial and
Station	12+550	A	14+000	Member, Cuscatlán formation, comprised mainly by welded tuffs, pyroclastic material and basalts.
Station	14+000	A	16+600	C2 member Cuscatlán formation, Volcanic material, comprised especially of tuffs and dacites.
Station	16+600	A	18+150	QF Member, San Salvador formation, comprised of sedimentary material and fluvial and lacustrine deposits.
Station	18+150	A	19+400	Member, Cuscatlán formation, composed mostly of welded tuffs, pyroclastic material and basalts.
Station	19+400	A	25+022	QF Member, San Salvador formation, comprised mainly of sediments and river and lake deposits.

Source: Field data gathering, Eco Ingenieros

VI.3.6.4 Structural Geology

There are certain types of rocks in the crust of the earth that fracture when internally subjected to a series of very high stresses that exceed their limit of resistance, and then one of the blocks affected either up or down is displaced, thereby releasing energy that is distributed in different directions and velocities in the form of seismic waves, thereby giving birth to a geological fault. In our country there are four major geologic faults, which are detailed below:

- The first fault system moves to the northwest - southeast, and is considered the main one in our country, primarily because it consists of very young faults and secondly because the seismic activity is related to it. These activities caused stress such as grabens, which is crossed in the middle from the west northwest to the east southeast.
- Faults belonging to this system usually run North 30 ° West and with a dip ranging in 65 ° and the vertical. It is known that all gushing products in he country come from volcanoes along this system, indicating that this one is the youngest.

- The second set of faults is considered subordinate to the former. It runs northeast - southwest, reason why it is is also considered responsible for the seismic activity in El Salvador. With respect to this Project the geological faults registered that belong to this system are the ones located east of the Taisihuat River, as can be seen in the geological map; however, special emphasis should be given to the southern part of the project, since the soil is unstable due to waterlogging and deflation, caused by soil geological equilibrium, especially in the vicinity of the Rio Grande de San Miguel, in this area.

- The third system is characterized especially by being the oldest, and runs east west and consists of normal faults, which are associated with the formation of the Central Graben, which in our country is called the Central Pit.

- The fourth geological fault system moves north - south and is not important. It extends over very short distances.
- As we know a fault has to be given the utmost attention, especially if it is considered an active one. Hence the importance of carrying out studies which describe the terrain and geological conditions, mainly the behavior or response when a very violent earthquake occurs, all for the purpose of reducing the risk associated to existing impact, which are also affected populations within registered isostatas.
- The tectonics within the area under study mainly responds to the stresses caused by the subduction zone of the Cocos Plate under the Caribbean plate. The area is influenced by the regional structure called the Central Graben, whose current kinematic motion corresponds to a dextral displacement moving mainly E-W.

VI.3.6.5 General Project Geology

Most of the project route is made up of recent sediments, forming flat alluvial terraces, mainly at the Rio Grande de San Miguel banks and its tributaries. These consist of alluvial pebbles, sand and silt, partly mixed with clays. Generally, these floods are not good foundation because they are too loose, as they are of a recent geology.
No organic matter was found in soils and / or gravel at excavated depths greater than 1.5 m, one can assume that the necessary stripping should not exceed 1.5 m depth.

VI.3.6.6 Seismicity

The seismic activity in the project area occurs throughout the country. According to the studies carried out, El Salvador has two, well-defined seismogenic sources which are listed below.

1. "Fosa Central": It is located within the geological structure known as Central American Graben and locally as Fosa Central.This geological structure extends to the west - Northwest - East South - East, and covers the middle part of the country. It is characterized by a very disastrous seismic history, and has seismic foci that sometimes are associated with continental volcanic chains. Additionally, there is the element of shallow hypocenters, which generally range between 1 to 11 kilometers and the proximity of the Epicentral areas to many important cities. All of this activity is known with the name of intraplate and is due to the movement that occurs in the geological faults. These earthquakes have had maximum intensities of VII to IX levels in the Mercalli modified scale and magnitude of up to 7. 0 or a little more in the Charles Richter scale, sometimes with destructive results.

2. **Subduction zone.** The second seismic zone is located in the Pacific Ocean, which is related to the movement of the Cocos and the Caribbean tectonic plates. Epicenters are located at distances ranging between 10 and 100 kilometers off the Salvadoran coast, with hypocenters at depths that can vary between 30 to 80 km. Intensities and magnitudes are, in general terms, similar to those mentioned above and on more than one occasion, they have caused great damage. The most clear example is the earthquake that took place on 13 January of 2001.

The area of this project is located at the southern end of the "Fosa Central", and according to the seismic history available in the country, especially for the eastern part, the most important seismic impact for this region of El Salvador, can be detailed as follows:

1. 1838; a series of strong earthquakes were reported, affecting the municipalities of Jucuapa, and Chinameca, registering in the latter, a considerable destruction of the city There is no destruction due to earthquakes recorded in other nearby cities, possibly because they did not exist, were not founded at the time or were not considered by the source's author.
2. 1859; Earth tremor strongly felt in San Miguel, due to the record of an earthquake with an epicenter that has no clear location or intensity, but one that caused the city of La Union to collapse as well as the populations of the Gulf of Fonseca's, recorded tsunami in the Gulf's shoreline.
3. 1898; Earthquake strongly felt in much of the department of San Miguel, whose its origin is considered t be near the Gulf of Fonseca as it caused the city of the Union collapse again.
4. 1919; the city of La Union and the city of San Miguel were affected by an earthquake whose epicenter was located in the Gulf of Fonseca, affecting at the same time some urban concentrations in the Republic of Nicaragua, particularly close to the city of Chinandega. The source does not indicate the intensity of it.
5. Between 1978 and 1951, the local literature on disasters due to seismic activity, recognized the subregion "Jucuapa Chinameca" as critical and the catastrophes of 1951 received technical and scientific interest from the UN and Meyer Abich, who was the Director of the national geological service at the time.
6. 2001. Earthquake with maximum intensity of IX and magnitude of 7. 6, with its epicenter in the Pacific Ocean, occurred on January 13, and caused damage nationwide.

According to seismic zoning of our country, delimited in zone I and zone II, the area being studied is located within zone I. These two areas are based on the area's effective peak acceleration, suitable for the area of study in which the local geology and soil characteristics play an important role, as they influence greatly the movement of the territory. This indicates that amplified movements are substantially higher when it comes to geological materials that have a stone of rock nature.

According to the Regulations for Structural Safety of constructions in our country (1994), the horizontal seismic coefficient shall be considered equal to 0. 16 for zone 1, in which, this project, is located, as is was mentioned before.

In the project area, there is a seismic threat, even when pyroclastic flows have a good seismic behavior precisely due to their hardness; however it it necessary to pay special attention to the project areas that cross areas considered the most geologically active , such as faults, supposed faults, joints or steep terraces; the latter located to the south of the project and which is characterized by highly permeable soils and still in a geologic equilibrium process.

VI.3.7 *Edaphology*

Soil is the result of progressive physical and chemical alteration of rock materials caused by the influence of biological and environmental factors; such alteration is characterized by a permanent dynamism and a peculiar development that, over time, becomes a complex and variable mixture of components.

The soils are classified according to several criteria: according to their texture, their level of development, the layers that form them and their productivity.

VI.3.7.1 Soil Groups

The physiography of the project's area of influence comprises two types of landscapes : low isolated hills and low plains with layers of loose pyroclastic materials and alluvial.

Soils range from little to heavily developed and go from shallow to moderately deep. They are usually stony. They belong to the Grandes Grupos de los Latosoles Arcillo Rojizos (Reddish Clayey Latosols), “Grumosoles” and Alluvials.

project, the main characteristics and properties of taxonomic classes existing in the outline are described; they are also shown in the pedological map of El Salvador (according to the the F.A.O. soil classification system). In the project outline we found approximately 8.8 km of the path of the road outline of soil ; Reddish Clayey Latosols, 10.5 km of Grumosols and 3.1 km of alluvial. See Drawing VI-9 Type of Soil.

VI. 3.7.1.1 Reddish Clayey Latosols

Latosols soils are well developed, with surface soils and clay loam as well as plastic clay subsoil. These lands are reddish-brown and have block structure. The substratum are usually weathered to a considerable depth depending on the type of original material and topography. Some of these soils rest on "talpetate" at depths of less than a meter. This “talpetate” is permeable to water in a slow manner only. Internal drainage of the Latosols ranges from slow to good and the topography varies usually from wavy to choppy wavy.

In the areas where these soils to the onset of the outline and between stations 3 + 910 9 + 100; from 19 + 600 to 23 + 030 and 22 + 780 to 25 + 022 are flat land with gentle hills; rock outcrops are observed (photograph1) and in some areas there is "talpetate" (See photograph 2). These areas have soils that belong to the classes II, III and IV.

Photograph No. VI.15. View of rocky material at the opening in the first kilometers of the road outline.

Photograph No. VI.16. Another view of the rocky material at the beginning of the opening.

Photograph No. VI.17. View of the surface soil which is reddish brown.

VI. 3.7.1.2 Grumosoles

"Grumosoles" are clayey soils, which range in color from black to dark grey. Are very plastic and sticky with slow permeability. Subsoils are heavy and speckled, and almost always rest upon nearly impermeable tuffs and conglomerates.These soils are very damp and cohesive during the rainy season, and fissure deeply during the dry season.

However, it is important to note that, from the point of view of the agronomic properties of the soil and its influence on plant nutrition, "Grumosoles" have a productive capacity much greater that the Latosols that are eroded or degraded on the surface, as its black surface horizon acts as mulch, maintaining the water reserves longer on the horizon B of the profile.

Regarding their intrinsic characteristics, the "Grumosoles" are very clayey and homogeneous due to the constant mix of the horizon. On surface, they show dark colors, including black, despite its low content in organic matter (approximately 2%). They are very plastic and sticky with a slow permeability. The subsoils are heavy and speckled and almost always rest upon conglomerates and tuffs which are nearly impermeable.

These soils are very damp and cohesive during the rainy season and during the dry season they become deeply fissured. As a result, when they are wet they are very sticky, plastic and therefore difficult to work with; when dry, they are very hard and they crack. They are deep, and slightly permeable soils where the drainage difficulties cause swamp areas very difficult to walk through, even for cattle. They cover relatively plain surfaces without showing and erosive processes. They are considered of moderate or low productivity and therefore, not suitable for permanent crops due to the contractions produced when the profile is drained. However, when irrigation becomes possible, good harvest can be obtained.

In the project's area of influence Grumosoles soils are in the stations 9+100 to 19+ 600; these are flat lands ranging from plain to semi-plain, the soils are dark and when they are drained, they crack (see photograph 4) soils, **IV, V, VI, VII** and **VIII.**

Photograph No. VI.18. View of the surface soil Grumosoles on the road outline.

VI.3.7.1.3 Alluvial

In general, the low plains, almost without dissection, are found mostly at elevations of approximately 100 meters above sea level, and are part of the area of the wide Grande River valley in San Miguel ;there are extensive plains of recent alluvium subject to floods. These have drainage ranging from rather poor to very poor, and remain damp during most of the dry season.

These soils are in the course of the outline at approximately at 3,840 meters between stations 19 + 600 to 22 + 780 combined with Latosols .These soils are found on the course of the outline on the terraces of the River El Papalón and Las Trojas and the Cemetery streams.

These are poorly evolved soils that have been developed on very young material transported by the watercourses and are deposited on the plains. They are primary soils that lack developed horizons or young soils that can be found on steep surfaces recently eroded.

The textures of these soils vary from sandy loam to clay loam, with stratifications containing light and heavy layers at different depths. In some areas a layer of "talpetate" is found near the surface. The surface soils are dark and usually rich in organic matter.

They are highly fertile soils, but its potential agricultural use is restricted due the farming difficulties associated with its high content of loam fraction contained in the horizons and profile. Soils of agrological classes III and IV are found in these areas.

Photograph No. VI.19 Surface view of alluvial soil

Alluvial soils were also found near the edge of the Taishihuat River.

VI.3.7.1.4 Soil groups per project sections

TABLE No. VI.15. MOST RELEVANT FEATURES OF SOIL GROUPS FOUND WITHIN THE PROJECT'S DIRECT INFLUENCE AREA, SAN MIGUEL BYPASS

SOIL GROUPS	DESCRIPTION	PROJECT STATIONS
Reddish, clayey latosols	Reddish clayey latosols are characterized by their red color, sometimes tending to yellow or brown depending on the type and degree of oxidation of the iron ores. They have a loamy/clayey texture on the surface and a clayey texture beneath, they are very vulnerable to erosion when vegetation cover is removed; however, when vegetation cover remains, this gives the superficial horizon somewhat darker shades due to increased organic matter content. In these circumstances, their productive potential is high and good crops can be obtained with adequate fertilizer. However, in steeper areas, the risk of erosion is high and therefore permanent crops or pastures are recommended.	3+910 to 9+100, 21+500 to 22+000, combined with alluvial soils, 22+780 to 25+022. (8.8 km)
Grumosoles	If the water layer is temporary and is too low in the summer to allow soluble salts to migrate all the way to the surface, these soils behave as extremely dry soils during the summer. Most of the low rainfall and humidity evaporate and do not penetrate into the profile. Then the soil cracks up causing even deeper dessication.	9+100 a 19+600 (10.5 km)
Alluvial	Thse are poorly evolved contributing soils which have developed on very young material carried by streams and deposited on coastal plains and inland valleys. On the other hand, they present certain common features such us an almost flat topography, the presence of a permanent water table with fluctuations throughout the year.	19+600 a 22+780 (3.1 km)

Source: Field survey, ECO Ingenieros

VI.3.7.2 Land classification by its usability

The capacity study of land use is in fact an interpretative study related to the expected productive behavior of a soil, inferred from the influence of each one of the factors included the analysis.

The classification used in the agrological analysis of El Salvador that was carried out is called Sistema Americano (American System -USDA) and it was modified in order to adapt it to specific country needs.

Based on the interpretation of the combined effects of climate, topography and soil characteristics, its use limitations, fertility, management requirements and the erosion risks, El Salvador territory has been classified considering its production capacity and using the eight agrological classes defined in the USDA methodology.

The agrological classes used to define different levels of productive suitability and deterioration risk of the soil on a gradient ranging from higher to lower potential; the land has been included in Class I, which show the best properties for an intensive agricultural activity, and in contrast, lands that are part of Class VII, include those of lower potential.

The following description shows the different uses of soil according to the established stations and distances that they occupy in the outline. See Drawing VI-10 Class of Soil.

In the case of the areas of influence of the Project, Class II is located at the initial part of the project, before the intersection with Río Grande in San Miguel. Soils of moderate slopes are between 3 and 4% (soft wavy); limitations due to puddling, defining the soil as such: soil that stays very wet with scattered puddles after heavy rains. However, despite the limitations described which prevent the adoption of measures to preserve its productive capacity, its productive potential is very high.

In the beginning, class III is combined with II, and at the end of the project, its fertility is low.

Classes IV are shallow soils with a poor natural drainage they that remain swamped at least four months of the year, present erosion and/or texture limitation; this class is located between the stations 8 + 9 900 + 050, 11+ 600 to 12 + 600, 12 + 900 to 13 + 950, 17 + 650 to 17 + 950 18 + 150 to 20 + 600 and 23+830 to 24 + 930; 23+530 to 24+030; 24 630 to 24+930.

Soils in class V, are soils with a slope of 0 to 6%, with very poor natural drainage, i.e. that remain puddled during more than 6 months a year and with a very thin or very thick texture from the surface; these are found between stations 13+950 to 14+500. Soils associated with class VIII and VII are found between stations 17 +950 and 18+050.

Soils in class VI are soils with a texture considered thick from the surface, so they are limited to certain crops and generally are prone to erosion- and particle-size-problems, which significantly determine vegetation development; these are found between stations 9 + 050 to 11+ 600, 12 + 600 to 12 + 900.

Class **VII**, in the case of areas in the outline, is attributed to very swamped land that remains under a layer of free water almost continuously and has a thick texture from the surface; they have low fertility and are located between the stations 14 + 750 to 16 + 850 .

In the case of soil class **VIII**, where crops cannot be grown. On the outline we mostly found rocky soils that are suitable for wildlife only. They are between the stations 13 + 950 to 14 + 750, associated with class V and 16 + 850 250 + 17, 18 + 050 to 18 + 150.

TABLE No. VI.16. RELEVANT FEATURES OF AGROLOGIC SOILS FOUND IN THE DIRECT INFLUENCE AREA OF THE SAN MIGUEL BYPASS ROAD PROJECT

CLASS	DESCRIPTION	PROJECT STATIONS
	Soils suitable for intensive agriculture	
CLASS II	This class is made up soils subject to moderate limitations on use. They have a low risk of deterioration. They are good soils. They can be cultivated on using appropriate, easily applied tillage methods. These soils differ from those in class 1 in various aspects. The main difference is that they are gently sloping, subject to moderate erosion, medium depth, can occasionally become flooded and may require drainage. Each of these factors requires special attention. Soils may require the application common practices such as level crops, belts, rotations aimed at soil conservation, water control or tillage methods. Frequently, they require a combination of these practices.	4+060 to 4+200; 5+600 to 6+250; 6+750 to 7+550; 7+950 to 8+650
CLASS III	Soils in this class are subject to important limitations in terms of their use for cultivation. They present serious risk of deterioration. These are moderately good soils. They can be cultivated on on a regular basis, provided they are managed with proper crop rotation or an appropriate treatment. They are moderatley sloping, the risk of erosion is more severe, and their fertility is lower. They require cultivations systems providing adequate crop protection from erosion and to preserve soil structure (belts, grades, terraces, etc.). They can be cultivated with herbaceous crops rather than row crops. They need a combination of different practices to be safe for cultivation.	0+00 to 4+060; 4+200 to 5+600; 6+250 to 6+750; 7+550 to 7+950; 8+650 to 8+900; 20+600 to 23+530; 24+030 to 24+630; combinada con clase IV; 24+930 to 25+022
CLASS IV	Land that can be cultivated occasionally and limited to herbaceus crops, such as grasses. They can be low-fertility soils, shallow soils, or located on steep slopes.	8+900 to 9+050; 11+600 to 12+600; 12+900 to 13+950; 17+650 to 17+950; 18+150 to 20+600; 23+830 to 24+930; 23+530 to 24+030; 24+630 to 24+930
	Soils of limited use, generally unsuitable for intensive cultivation	

CLASS V	They are lands with very severe constraints for intensive cultivation. The limitations are such that the cost of correction is very high or almost impossible to implement. Stony or waterlogged soils. They must maintain permanent vegetation such as grasses or forests. Limited use for average yield crops: rice, grasses, corn, yuca.	13+950 to 14+500 associated with class VIII and VII 17+950 to 18+050
CLASS VI	Land with severe limitations that make it unsuitable for intensive agricultural use; limited to permanent crops including fruit trees, forests and grasslands. They require careful conservation and management measures.	9+050 to 11 +600; 12+600 12+900
CLASS VII	Their use is restricted to permanent vegetation such as forests and require careful management. Steeply-sloping, eroded, arid or flooded soils.	14+750 to 16+850
CLASS VIII	Land restricted from agricultural use. Fit only for permanent vegetation to protect wildlife or for recreation. Stony soils, barren rocks or extremely steep slopes.	13+950 to 14+750 associated with class V and 1from 6+850 to 17+250; 18 +050 to 18+150

Source: Field survey, ECO Ingenieros

TABLE No. VI.17. SOIL CLASS BY PROJECT STATION

PROJECT STATIONS	CLASS
0+00 a 4+060	CLASS III
4+060 a 4+200	CLASS II
4+200 a 5+600	CLASS III
5+600 a 6+250	CLASS II
6+250 a 6+750	CLASS III
6+750 a 7+550	CLASS II
7+550 a 7+950	CLASS III
7+950 a 8+650	CLASS II
8+650 a 8+900	CLASS III
8+900 a 9+050	CLASS IV
9+050 a 11+600	CLASS VI
11+600 a 12+600	CLASS IV
12+600 a 12+900	CLASS VI
12+900 a 13+950	CLASS IV
13+950 a 14+500	associated with class VIII and VII
14+500 a 14+750	CLASS V
14+750 a 16+850	CLASS Vil
16+850 a 17+250	CLASS VIII
17+650 a 17+950	CLASS IV
17+950 a 18+050	CLASS V
18+050 a 18+150	CLASS VIII
18+150 a 20+600	CLASS IV
20+600 a 23+530	CLASS III
23+530 a 24+030	CLASS IV
PROJECT STATIONS	**CLASS**
24+030 a 24+630	CLASS III combined with class IV
24+630 a 24+930	CLASS IV
24+930 a 25+022	CLASS III

Source: Field survey, ECO Ingenieros

The agrological classification carried out by MAG during the inspection on July 26, 2012 determining the soils are suitable to change from forest and agricultural use, to the construction of the Bypass. This is presented in Annex IV. 16.

VI.3.8 *Hydrology and limnology*

VI.3.8.1 Watershed: San Miguel Rio Grande in San Miguel

The project of bypass San Miguel is contained in the watershed of the Rio Grande in San Miguel whose drainage has a tendency from north to sounth until it flows into the Pacific Ocean. 30 streams darin into the Grande River: (Qda. Agua Tibia, Qda. Chichipate, Qda. de Lajas, Qda. del Cementerio, Qda. El Amate, Qda. El Borbollón, Qda. El Caballo, Qda. El Carrete, Qda. El Espino, Qda. El Garabato, Qda. El Gómez, Qda. El Jalacatal, Qda. El Volcán, Qda. La Cruz, Qda. La Escondida, Qda. La Gallina, Qda. La Isleta, Qda. La Joya, Qda. La Quebradona, Qda. Las Playuelas, Qda. Las Trojas, Qda. Los Coyotes or La Coyota, Qda. Los Cujules, Qda. Los Reyes, Qda. Manzanares, Qda. San Andrés, Qda. Tempisque o La Laguna, Qda. Turicentro, Qda. Las Lomitas o La Quebradona, Zanjón Qda. La Ermita y 62 ríos (Río Adobera, Río Araute, Río Budines or Vargas, Río Chapeltique, Río Chiquito or La Joya, Río Chispas, Río Comacarán, Río El Astillero, Río El Borbollón, Río El Censo, Río El Chagüite, Río El Chorro, Río El Corrozal, Río El Guayabal, Río El Guiscoyol or El Rito, Río El Jute, Río El Lagartillo, Río El Muerto, Río El Papalón, Río El Peñón, Río El Potrero, Río El Pueblo, Río El Rodeo or Pelón, Río El Tejar, Río El Volcán, Río El Zapotal, Río Galdámez, Río Grande De San Miguel, Río Gualabo or Las Cañas, Río La Angostura or Agua Zarca, Río La Majada o Playuelas, Río La Montana or El Chagüite, Río La Poza, Río La Presa, Río Las Cañas o Gualobo, Río Las Flores, Río Las Garzas, Río Las Marías, Río Las Trancas, Río Loro, Río Los Abelines, Río Los Amates, Río Los Magarin, Río María Luisa, Río Paso Las Minas, Río San Antonio Chávez, Río San Diego, Río San Esteban, Río San Francisco, Río San Francisquito, Río San Juan, Río San Sebastián o Santo Tomás, Río Santa María, Río Seco, Río Sirigual o San Pedro, Río Taisihuat, Río Toronjo o El Ingenio, Río Valle Nuevo, Río Villerias, Río Yamabal, Río Yoloaiquín, Río Yububa o Seco. Los afluentes más importantes del Río Grande de San Miguel son el Río Taisihuat, Río Guayabal and less important, Rio San Esteban.

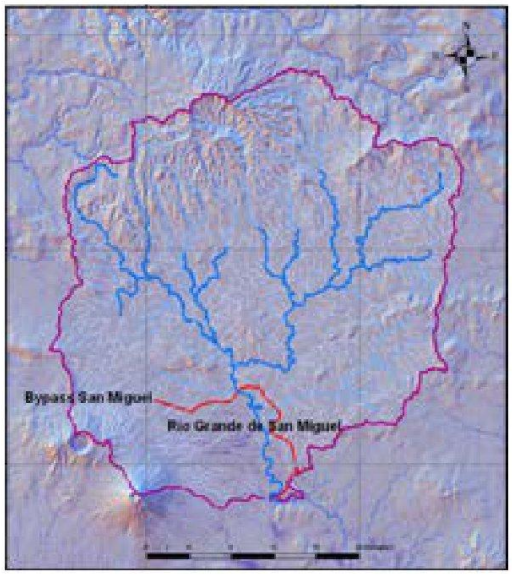
Annex VI.4 presents the Hydrological and Hydrogeological Study of the Project.

The main types of drainages observed are:

- **Sub-dendritic:** This type of drainage is observed in almost all of the areas crossed by the outline, mainly in the northeast sector at Las Lomas, Las Mesas and El Manchón, as well as the northeastern area, where the density of the drainages is moderate due to the fact that materials are relatively recent (Plio-Pleistocene). Few riverbeds or streams have a significant depth; the majority are surface currents.
- **Radial divergent**: This pattern is typical in volcanic structures. In the área they are identified at the northeastern mountainside of the Chaparrastique or San Miguel volcano; it has sparse or shallow drainage , since due to the age of the materials that it crosses, it is not well developed..
- • Structural: The outline of certain rivers and streams whose outline appears to be associated with faults of fractures. The east and west outlines of Taisihuat river are associated with main outline of El Salvador's fault, towards its Northern section.

A little further north, the Agua Frìa and El Saltillo streams seem to be affected by the structures that section them in right angles and is continuously affected by the faults that have a tendency towards East-West. Still in the northern area, minor drainages are associated with a fracturing pattern northeast-southeast, with a relatively straight course. The main drainage system is sub-dentritic.

The ArcGis 9.2 software was used to delimit the watershed. The result was data that allowed morphological characterization. In the next image we present the delimitation of the watershed and the Project location.



Source: Hydrologial and hydrogeological report.

Figure No. VI.4 Rio Grande de San Miguel Watershed

The main parameters of the watersheds are as follows:

- *Area (A)*

. The horizontal projection of the entire watershed drainage area.
A = 1,1361173,900 m2.
For this reason, it is considered "medium large"

- *Axial length(L)*

Straight distance between the highest part of the watershed and lowest part of the estuary.

L = 38,067.03 m

- *Perímeter (P)*

The horizontal projection of the watershed P's turning point.
= 218,420 m

- *Average width (W)*

Relation between the area and the axial length of the watershed.
W= 1,1361173,900 m2/38,067.03 m W = 29,846.67 m

- *Form factor(Ff)*

Ff = Average Width (W) / Axial length(L)
Ff = 29,846.67 m / 38,067.03 m
Ff=0.78

The form factor indicates that the Rio Grande watershed in San Miguel tends to be somewhat rounded because its value is close to 1. For this reason, it should tend to show a water flow that is not too fast. However, the highest part of the watershed is not in the area farther away from the point of exit. Therefore, the shape is atypical, not regular and has a low elevation mountain range on its limits and elevated areas in the Chaparrastique, El Pacayal and Cacahuatique volcanoes.

- *Compactness coefficient (Kc)*

Kc = P/ (2^nA)
Where P is the perimeter in Km and A is the watershed area in Km2
Kc= 1.8280

According to the previous value, the watershed is considered to have an oblong oval or oblong rectangular shape. The flow or runoff is superficial due to its shape, which contributes to its uniform distribution in the entire area.

- *Average gradient of riverbed*

Riverbed length = 77,847.59 m
Maximum elevation = 2,090.00 msnm
Minimum elevation = 73.80 msnm
Average gradient of riverbed = 2.59 %

The gradient is considered very low.

- *Ordered*

Drainage
Based on a river map at a sclae of 1:25,000, Rio Grande in San Miguel has an order of Horton drainage of 7

•*Draingae Density(Dd)*
Dd = Ld/A
Total Length of the drainages in the watershed (Ld) = 2,
225,932.91 m Dd = 2,225.93 Km/ 1,136.17 Km2 = 1.96 Km/
Km2

The drainage density in the Rio Grande de San Miguel can be considered very low, although this parameter depends on the scale of the drawing, so it must be clarified that the working scale is 1:25,000. The consequence of a low drainage density is that, the surface runoff concentrates in few riverbeds, favoring the river erosion.

There are four predominant uses of soil in the watershed: Crop Mosaic, Pastures and Vegetation cover most of the watershed. The other three are Natural Pastures, Basic Grains and Mosaic of Crop and grass lands.

In general, the watershed has a predominant gradient between 2 and 7% in the lower part of the watershed. The gradients on the higher part exceed 7% and the majority of the gradients are 15 to 30% .

The soils present in the watershed of the Rio Grande in San Miguel are Alluvial Andisols, Grumosols and reddish clayey Latosols , Clayey Acid lathosols, lithosols. The main soils are reddish clayey Latosols and Grumosoles which are located the high and medium parts of the watershed. The predominating soils found in the watershed have a slow permeability and this aids in the formation of high runoff and consequently, potential floods.

The Rio Grande in San Miguel has an average gradient of 0.43%, in the area near the city and has formed wide alluvial terraces throughout its riverbed which consist of gravel and sand that have a different particle size and medium degree of roundness.

In the watershed, 9.43% of the uses correspond to forests and coffee, and 83% of the soil use of the watershed is for agriculture and cattle raising. The scarce plant coverage could be one of the causes of the decrease in water filtration and the increase of surface runoff.

The Bypass section at the beginning of the road to San Salvador and until it reaches the interception with the Rio Grande in San Miguel, will be built in the areas that have the lowest gradients. The geomorphology of the watershed presents an area of recurrent floods in the alluvial valley of the Rios Grande in San Miguel.

The following table shows the results of the hydrological balance of the Rio Grande de San Miguel river basin up to the hydrometric station at Moscoso Bridge, which follows the path bypass outline almost entirely. This balance has not taken into consideration the demands on the water resource,as only the physical hydrological and hydrogeological media are being characterized; thus, in the end total water availability is obtained.

TABLE No. VI.18. WATER BALANCE FOR RIO GRANDE DE SAN MIGUEL RIVER

STATION	PRECIPITATION	REAL ET	EVAP. URBAN AREAS	SURFACE WATER SUPPLY	WATER RESOURCES (THEORICAL)
MOSCOSO	1,922.00	1,151.55	1.58	644.74	124.12

Source: SNET, 2005

Based on the previous table, precipitation is the only entry and exit point(s) to the system are the real evapotranspiration, evaporation in the urban areas and the surface and underground runoff. Hence, the water availability is 768.87 x 106 m3, distributed in surface and underground runoff, is as follows:

- Surface runoff: 644.74 x 106 m3
- Underground runoff: 124.12 x 106 m3

All values make reference to the renewable water resources that annually occur at the watershed. However, it is important to clarify that there is a resource of undergound wáter stored in the aquifers which has not been defined yet, as it requires very detailed studies in order to define the their geometry.

VI.3.8.2 River and stream crossings

The Project crosses the Grande river in San Miguel at two points: the Taishihuat river and the El Papalón river. The San Esteban River is within the area of indirect influence but does not cross the project at any point. The crossing points of rivers and streams are shown in drawing VI-7. They are also detailed in the following table.

- Three rivers are crossed: Rio Grande in San Miguel (two points), Taishihuat river (1 point) and El Papalón river (3 points). There six river crossing in total.
- 26 stream crossings
- 1 irrigation canal crossing

TABLE No. VI.19. RIVER AND CREEK CROSSINGS

NATURAL DRAINAGE	STATION		Watercourse crossing			Notes
			River course	River (Km2)	Flows (m3/s)	
1	ST. 0	+ 616	C- 1	2.67	35.1	Ojo de Agua Creek – Crosses CA1 Highway
2	ST. 1	+ 486	C-2	1.85	20.8	Unnamed creek – Crosses CA1 Highway
3	ST. 2	+ 036	C-3	12.59	89.3	El Roble Creek – Crosses CA1 Highway
4	ST. 2	+ 165	C-3a	0.044	0.67	Creek with no name – Crosses CA1 Highway
5	ST. 2	+ 753	C-4	0.78	2.05	Cannal. Crosses CA1 Highway, towards El Toro Creek
6	ST. 3	+ 243	C-5	0.09	0.63	El Chile Creek – Crosses CA1 Highway
7	ST. 3	+ 613	C-6	1.23	3.06	Section of El Chile Creek – Crosses CA1 Highway
8	ST. 5	+ 615	C-7	0.81	2.06	Unnamed creek
9	*ST. 5*	*+840*	*C-8*	*0.19*	*0.62*	*Existing 2x1 m irrigation canal*
10	ST. 6	+ 848	C-9	5.94	59.3	El Jacatal Creek
11	ST. 7	+ 602.5	C-10	0.31	7.55	Existing Gutter
12	**ST. 8**	**+920**				**RIO GRANDE DE SAN MIGUEL RIVER, NORTHERN PASS**
13	ST. 9	+ 866	C-12	0.08	2.07	Pedestrian path and bridge
14	ST. 10	+ 394.4	C-13	0.31	8.59	Las Tinajas Creek – Creek Course
15	ST. 11	+ 247	C-14	1.51	27.16	El Platanillo Creek – Footpath
16	ST. 12	+ 126	**C-15**	2.6	34.9	Creek with no name
17	ST. 12	+ 968.7	C-17	0.09	3.86	Los Pasitos Creek and pedestrian pass
18	**ST. 13**	**+770**				**TAISHIHUAT RIVER**
19	ST. 14	+ 149.6	**C-18**	0.08	1.94	Unnamed creek
20	ST. 14	+ 361.9	C-19	0.31	8.59	Unnamed creek
21	ST. 14	+ 545.4	C-20	0.04	1.01	Dry creek. VD-1 (C-20)
22	ST. 14	+ 823.9	C-21	0.06	1.59	Dry creek. Includes vertical drainage VD3B
23	ST. 15	+ 030	C-22	0.12	3.01	Unnamed creek
24	ST. 15	+ 285.1	C-23	0.05	1.37	Unnamed creek
25	ST. 15	+ 543.6	C-24	0.04	1.12	Unnamed creek, includes vertical drainage VD-1
26	ST. 16	+ 649.8	C-26	1.62	21.5	La Escondida Creek
27	ST. 17	+ 750	C-28	3	30.8	Las Lajas Creek

DRAINAGE	STATION		Watercourse crossing			Notes
28	ST. 18	+ 220	C-29	0.15	3.32	La Gallina Creek
29	ST. 18	+ 615.2	C-30	0.18	3.57	Creek
30	ST. 20	+ 580	C-31	13.61	129.5	EL PAPALON RIVER, PASS 1
31	ST. 20	+ 580	C-31	13.61	129.5	El Papalón River – pass 2
32	ST. 21	+980	C-36	22.48	202.7	El Papalón River – pass 3
33	ST. 24	+540				RIO GRANDE DE SAN MIGUEL RIVER, SOUTHERN PASS

Source: JICA Survey Team and Eco Engineers

For the calculation of the overpass works over the Grande and Taishihuat rivers, a hydraulic modelling was carried out. It was done through a physiographic characterization of the area being studied, in the surrounding áreas of both passes, with the purpose of understanding the river course dynamics and its interaction with the works (bridges).

The analysis yielded as a result the maximum water levels for the return period defined in the Project TR 100 years.

We also provide some design considerations regarding the bridge siting, the opening width in each point and the effects produced by the flow rates produced by the corresponding analysis in each case. The design flow rates for a Return Period is 50 and 100 years that were considered in the study are:

TABLE No. VI.20. MAXIMUM EXPECTED RIVER FLOWS: RIO GRANDE DE SAN MIGUEL AND TAISHIHUAT

RETURN PERIOD	RIO GRANDE NORTHERN	RIO GRANDE	TAISIHUAT RIVER
50	1,610.20	2,040.30	274.90
100	1,976.80	2,597.80	368.50

Source: Waterworks modelling

The hydraulic modelling was performed at a 500 meter length in each one of the sections that are studied. For this purpose, a topographic survey was performed and it was complemented with a survey of the project area for the south overpass and the Taisihuat due to the overflowing problem that it presented with the cross-cutting sections used, which are shown in the table.

- *Results for Rio Grande Northern Pass*

TABLE No. VI.21. SUMMARY OF RESULTS FOR NORTHERN PASS OF RIO GRANDE OF SAN MIGUEL

STATION ON RIVER	T(YEARS)	MINIMUM RIVER BED	MAX YR. LEVEL	MAXIMUM DEPTH (Y)	V(m/seg)	AREA (m2)	UPPER WIDTH (T)
0+230	50	89.06	96.10	7.04	3.03	548.51	115.94
	100	89.06	97.05	7.99	3.13	662.32	122.03
0+240	50	89.26	96.15	6.89	2.89	569.75	117.84
	100	89.26	97.11	7.85	2.99	685.42	124.20

Source: Waterworks modelling

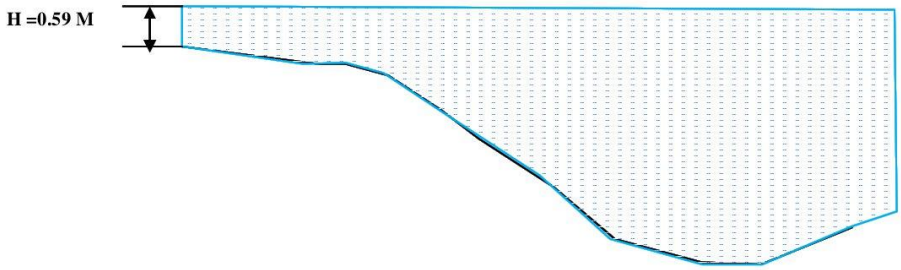
♦ *Results for Rio Grande Southern Pass*

TABLE No. VI.22. SUMMARY OF RESULTS FOR SOUTHERN PASS OF RIO GRANDE OF SAN MIGUEL

STATION ON RIVER	T(YEARS)	MINIMUM RIVER BED LEVEL	MAX YR. LEVEL	MAXIMUM DEPTH (Y)	V(m/seg)	AREA (m2)	UPPER WIDTH (T)
0+210	50	72.41	84.04	11.63	1.94	1744.49	361.86
	100	72.41	85.59	13.18	1.98	2434.62	516.39
0+220	50	72.31	84.04	11.73	1.92	1755.53	635.50
	100	72.25	85.59	13.34	1.97	2433.21	506.11
0+230	50	72.25	84.09	11.84	1.93	1734.30	349.76
	100	72.25	85.59	13.34	1.99	2409.34	520.66

Source: Waterworks modelling

For 50 years there will be no overflowing problem, but there is a considerable width of the flow that has a value of 365.50 meters for station 0+220.00. For T=100 years, the overflowing continues to be a problem at the farthest point of the section, reaching a height of 0.59 above land.



Source: Waterworks modelling

Figure No. VI.5. Río Grande de San Miguel Southern Pass

Summary of Results for Taisihuat River Station 0+241.21

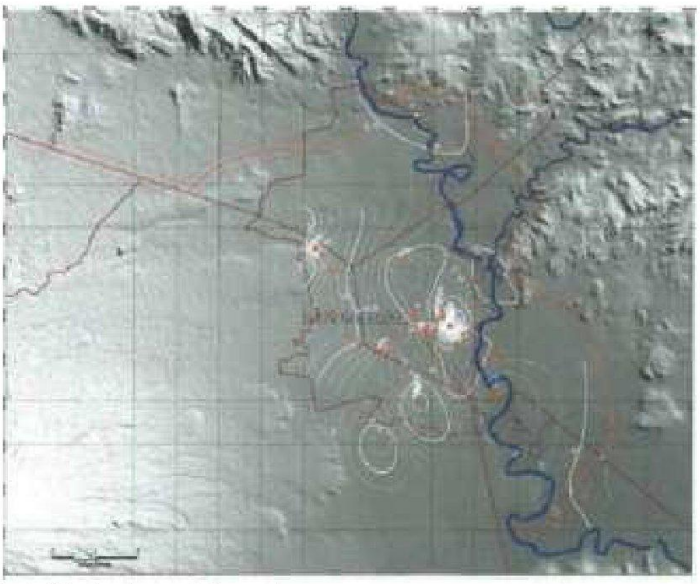
TABLE No. VI.23. SUMMARY OF RESULTS FOR TAISHIHUAT RIVER

STATION ON RIVER	T(YEARS)	MINIMUM RIVER BED	MAX YR. LEVEL	MAXIMUM DEPTH (Y)	V(m/seg)	AREA (m2)	UPPER WIDTH (T)
0+240	50	89.52	93.62	4.10	2.27	126.95	71.98
	100	89.52	94.14	4.62	2.40	165.65	75.13
0+250	50	89.66	93.61	3.95	2.54	124.25	74.22
	100	89.66	94.13	4.47	2.71	163.65	77.21

Source: Waterworks modelling

VI.3.8.3 Hydrogeology

The water table in the project area was estimated based on the existing handcrafted wells in the area. The water tables are rather shallow due to the geological and geomorphological characteristics of the area that is being analyzed, where we find tectonic depression, plains, small hills, areas with erosion material deposits, among others. The levels are between 10 and 30m deep, even though at some points, we found wells that had static level at a depth of 8 m.



Source: Geological Study, Arrupe Laboratories

Figure No. VI.6. Depths of the hydrostatic levels in the area of study

Regarding the hydrogeology of the area, we found three hydrological units as shown in the following image and on the hydrogeological map. Drawing VI-8 Hydrogeology

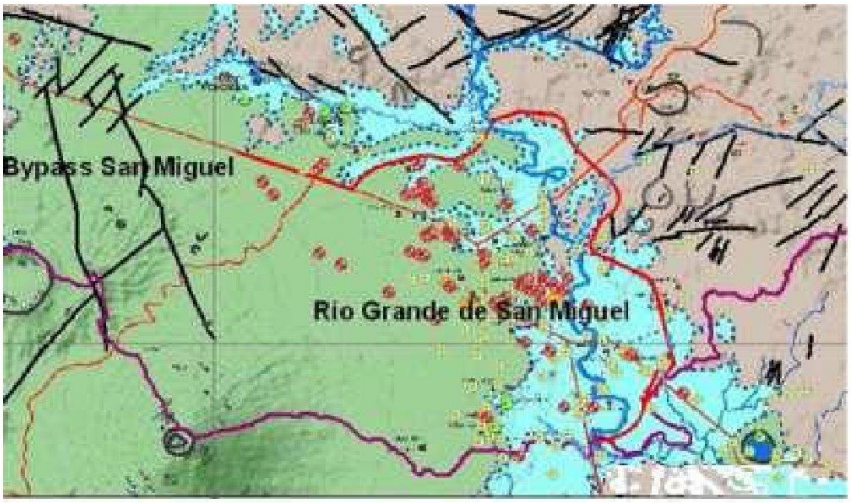


Figure No. VI.7. Project location on the hydrogeological map

The units are described below:

1. Large volcanic fissured aquifer unit, possibly very productive.(green color on the map)
2. Large porous aquifer unit of medium productivity (light blue color in the map)
3. Non-aquifer rock unit (brown color on the map)

VI. 3.8.3.1 Wells that are affected

In the course of the Project, handcrafted and deep wells used by the residents for drinking water supply were found. The wells that may be affected by the Project are single-family wells, i.e. they supply water to one family only. The families that own the affected wells, will be compensated according to PAR with the cost of new well constructions. The following table lists the wells that will be affected. No spring was identified throughout the Project.

TABLE No. VI.24. LOCATION OF WELLS IN THE AREA OF DIRECT INFLUENCE OF THE PROJECT

No.	STATION	WATER TABLE (m from ground level)		ELEVATION (MASL)
		RAINY	SUMMER	
1	1+410	-	-	166
2	1+590	-	-	167
3	4+740	-	-	113
4	4+800	-12 meters	-8 meters	111
5	4+880	-	-	107
6	8+040	--	--	103
7	8+620	—	—	102
8	8+910	-	-	114
9	9+290	—	—	115
10	12+620	-18 meters	-14 meters	97
11	15+010	-	-	101
12	16+520	-12 meters	-8 meters	90
13	16+620	-13 meters	-8 meters	89
14	17+640	-	-	86

Source: Consultation with owners during walkthrough of project layout and topographic map

One deep-drilled well used by its owner as water supply for their farm will also be affected.

VI.3.8.4 Water and well quality

The quality of the water was monitored in order to establish the base line regarding the current water conditions and future monitoring during the execution of the Project.

Considering that the main expected impacts for the water drags sediments during the terracing process, as well as oils and machine oils and also by employees' effluents: toilets, kitchen and cleaning.

The points on the three rivers that the Project crosses and also San Esteban river in the direct area of influence, are included. Two points were sampled at Rio Grande in San Miguel. Additional three points found along the Project were also included. Only the handcrafted wells (excavated) that were not deep, were included.

In order to establish the base line, the NSO 13.49.01:0 from the regulations for "residual waters discharged in a recipient body" was used. This regulation does not specify the parameters for road projects; this is why these parameters are considered for any project discharge. These parameters will be sampled to establish a base line and include those that are relevant to possible Project impacts.
Parameters that must be met:

- DQO 150ml/l
- DBO5 20 60 ml/1
- Setteable solids 1 ml/1
- Total suspended solids 150 ml/1
- Oils and greases 150 ml/1

Additionally, three parameters were sampled to assess the WQI[5]. The additional parameters were Nitrates, Phosphates and total dissolved solids. Using field equipment the pH, dissolved Oxygen and temperature (ambient and sample) were also measured.
5 General Water Quality index (WQI) used by MARN

[5] General Water Quality index (WQI) used by MARN

VI. 3.8.4.1 Background

According to the MARN annual report on quality of water for the Rio Grande in San Miguel of December 2010, the river presents high fecal coliform concentrations that oscillate between 3000 y 24000 NMP/100mi, which indicates bacteria contamination of the surface waters. The highest value was recorded at 250 m water under the Moscoso Bridge in San Miguel city.

Samples were taken in four points from the river that is in the Project area that according to WQI they present "BAD" water quality. Based on this report that is included in annex No, VI.5, none of the sites assessed present water suitable to be used raw and treated with traditional methods, neither for irrigation nor recreational use and human contact.

VI.3.8.4.2 Design Methodology

The "Water Quality Index" (WQI), was developed in 1970 by the United States National Sanitation Foundation (NSF) using an Delphi investigation technique from "Rand Corporation's" (Ball y Church 1980).

At the time, 142 expert panels took place and this technique was commonly used. The INSF has the characteristic of being and a multi-parameter index which was based in three studies.

The measurements of the physical-chemical quality of the water sources were performed at the following points.

TABLE No. VI.25. WATER QUALITY MONITORING SITES

	Location	Type of source	X Lamb	Y Lamb	Elevation MASL
1	Junction with Bypass axis, Southern Sector	River	591779.45	256944.36	76.44
2	Cantón El Papalón	Dug well	593908.31	258875.63	80.26
3	Junction with Bypass axis, Canton El Papalón	River	593944.32	258900.34	79.72
4	Cantón Las Delicias, Caserío Las Hojas	Dug well	593720.86	261649.85	108.39
5	Junction with Bypass axis, Canton Hato Nuevo	River	592351.48	265292.57	92.50
6	Junction with Bypass axis, Northern Sector	River	588587.18	266837.48	91.00
7	Cantón Zamorán	Dug well	588517.91	266867.97	94.47
8	100 meters from the mouth of Río Grande.	River	588406.67	266861.45	104.29
9	Canton El Salitre	Dug well	585553.95	265650.39	165.16

Source: Description and Characterization of the Physical Hydrological and Hydrogeological Environment - San Miguel Bypass Road

Samples from nine points located along the San Miguel Bypass outline were analized. Nine parameters where analyzed in these six samples in order to calculate the WQI. For the other three, only seven parameters were analyzed (fosfate, nitrates and dissolved solids were not tested). We calculated a subindex (Subi) for each one of the samples in which we multiply by its corresponding relative weight according to the table. The sum of these values provides a WQI value for each sample and according to them, it is possible to determine the suitability of the water body according to the interpretation of the WQI shown on the table. The subindexes (subi) and the WQI value interpretation were taken from SNET (2005) and Brown. The laboratory Water Quality Monitoring Results are presented in annex VI.6 as well as the sampling method description. The results on the table show the location of the sampling sites.

TABLE No. VI.26. PARAMETERS ANALYZED FOR CALCULATING THE WQI.

No.	Location	Source type	T °C	pH	O_2 %sat	F.C. MPN/100	BOD mg/L	PO^4 mg/L	NO_3 mg/L	Tot. Sol. mg/L	Tty NTU
1	Río Grande, Southern Sector	River	2.1	7.5	40.0	350,000	3.57	0.62	1.31	262.0	16.6
2	Cantón El Papalón	D.W.	2.1	7.2	25.0	540	3.24	0.64	1.40	462.5	0.9
3	El Papalón River, Canton El Papalón	River	0.4	7.5	44.8	5,400	2.29	N.C.	N.C.	N.D.	6.3
4	Cantón Las Delicias, Caserío Las Hojas	D.W.	0.4	6.7	45.1	º2,400	0.62	0.41	19.18	342.5	0.4
5	Taisihuat River, Canton Hato Nuevo	River	2.0	8.3	54.5	2,800	0.81	N.C.	N.C.	N.D.	3.4
6	Río Grande, Northern Sector	River	1.5	7.7	50.5	2,800	1.20	0.46	1.14	240.5	9.9
7	Cantón Zamorán	D.W.	0.2	6.7	23.3	33	0.71	4.80	10.02	742.5	1.7
8	San Esteban River, Canton El Zamorán	River	0.8	8.0	48.9	7,000	0.54	N.C.	N.C.	N.D.	18.0
9	Canton Obrajuelo, Caserío El Salitre	D.W.	1.2	7.0	46.0	1,100	0.71	0.48	52.49	357.5	0.2

N.D.: No Data, N.D'd.: Not Detected, N.C.: Not Conducted, DT: Temperature Change, 02: Dissolved oxygen,% sat: % saturation, F.C.: Fecal coliforms, BOD: Biochemical Oxygen Demand, PO4: Phosphates, NO3: Nitrates, Tot.Sol.: Total solids, Tty: Turbidity, D.W.: Dug well. Source: Description and Characterization of the Physical Hydrological and Hydrogeological Environment - San Miguel Bypass Road

This table shows the summary of the WQI for the 9 samples analyzed.

TABLE No. VI.27. RESULTS AND CLASSIFICATION OF WATER QUALITY.

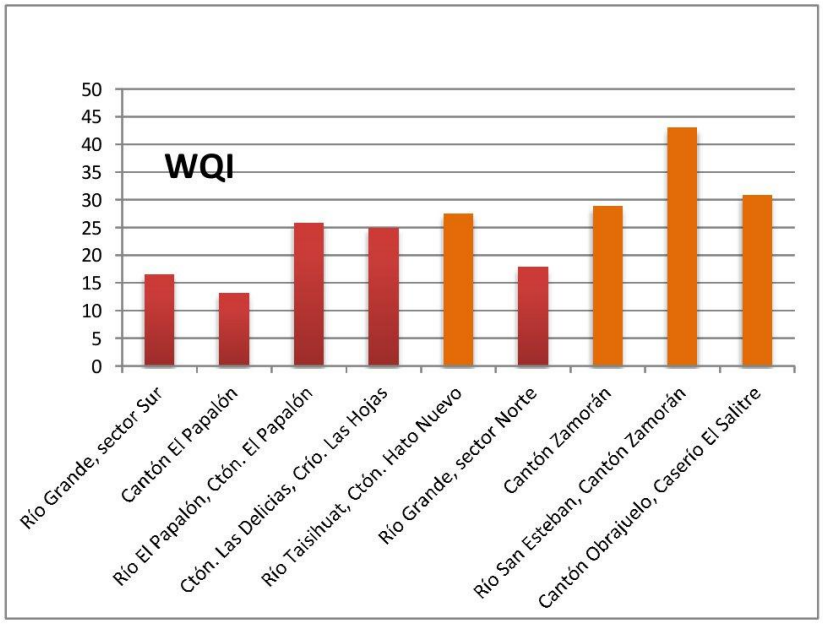
No.	Location	Type of source	index	Number of parameters	Classification	Range	Color
1	Río Grande, Southern Sector	River	16.58	9	Poor	0-25	Red
2	Cantón El Papalón	D.W.	13.2	9	Poor	0-25	Red
3	El Papalón River, Canton El Papalón	River	25.9	6	Poor	0-25	Red
4	Cantón Las Delicias, Caserío Las Hojas	D.W.	24.93	9	Poor	0-25	Red
5	Taisihuat River, Canton Hato Nuevo	River	27.58	6	Bad	26-50	Orange
6	Río Grande, Northern Sector	River	17.88	9	Poor	0-25	Red
7	Cantón Zamorán	D.W.	28.83	9	Bad	26-50	Orange
8	San Esteban River, Canton El Zamorán	River	43.04	6	Bad	26-50	Orange
9	Canton Obrajuelo, Caserío El Salitre	D.W.	30.86	9	Bad	26-50	Orange

Source: Description and Characterization of the Physical Hydrological and Hydrogeological Environment - San Miguel Bypass Road

The NSF index has been adopted by SNET to assess the natural quality of the surface water bodies in El Salvador.

The WQI methodology has been developed to contribute to a better characterization of the water resources in a more expedite way. This enables the prioritization of the water resources that have the best characteristics for use, as well as the recovering of those that are contaminated.

The WQI results range from poor to bad, revealing high levels of contamination. The most adverse parameter in the assesment were the fecal coliforms which is why the type of contamination is bacteriological. The source is possibly the domestic and industrial residual water discharges into the natural recipients. The water quality of the Rio Grande, as it passes through San Miguel city, is negatively affected in all WQI parameters.



Source: Description and Characterization of the Physical Hydrological and Hydrogeological Environment - San Miguel Bypass Roa

Figure No. VI.12. WQI at various sampling points

VI.4 BIOLOGICAL ENVIRONMENT

The objective of a biological study is to describe and analyze the existing natural and artificial ecosystem in the area where the outline and its area of influence is located, paying special attention to the presence of the threatened, endemic or endangered species from the flora and . This includes among others the identification, location, distribution, diversity and abundance of the species part of those ecosystems that may be affected, directly or indirectly by the construction of the Bypass. This information should be used as support for planners and engineers, as well as state and private institutions that participate in the development of this road Project.

VI.4.1 *Methodology*

VI.4.1.1 Flora Methodology

Three types of sampling were performed:

1. Arboreous census in the analysis of a sector within the area of direct influence.
2. Tree quantification on the sampling plots, inside and outside of the direct area of influence.
3. Record the shrub and herb species without a quantification in the sampling plots and the outline course, inside and outside of the direct area of influence.

A reconnaissance of the area being studied was performed, following the line where de Bypass of San Miguel construction is planned, using the axial and lateral marks as a point of reference. The sampling points were located at the points the best representative inventory and for the quantification of the arboreous vegetation, shrubs and herbaceous vegetation. The only activity that was a performed was an inventory of the species, including those that were found at the sampling plots and those found during the course.

After the course, four sectors were identified, based on the type of communities or the plant composition found in different areas of the Project which are: Expansion section, secondary forest, cultivation area and pastures, and riparian forest. This classification was done based on criteria such as the type of existing ecosystem: natural or artificial, the degree of disruption, productive activities, fragmentation degree of the ecosystem, as well as the habitat diversity naturally produced or due to the anthropogenic disruptions. (Meffe y Carroll, 1994; quoted by MARN, 2003).

For the arboreous stratum, a census of trees with a DBH higher than 20cm in the direct area of influence of the Project was performed. The arboreous census was done from July 20 until September 10 of 2011.

Within the sampling plots, a directed, non-probabilistic sampling was also carried out , choosing areas that were representative of the abundance and wealth of species (Fernández y Fernández, s.f); the trees that had a diameter breast height of 1.3 above the ground, at or above 20cm

The sampling of the plots was done in the following dates: July 30 and 31, August 1-5, and 1 and 3 of October of 2011.

Thirty four sampling plots were established of 20x30m (600m^2) each, which represent a total area of 20,400m2, equivalent to 2.04 ha; the orientation was done using a compass incorporated in the suunto inclinometer and they were delimited with a sewing tape measure of 30m (image VI.8). In each plot we recorded the common name of each species, the number of individuals per species, the circumference above ground at 1.3m CBH using a sewing tape measure and height in meters. (Young, 1991). Each plot was georeferenced with a Garmin Etrex GPS and located at a 10m distance away from the path or alteration to reduce the edge effect (MARN 2003). In the following table and image we show the plot locations.

TABLE No. VI.28. COORDINATES OF PLOTS OF THE SAN MIGUEL BYPASS ROAD

CODE NAME	COORDINATES		SECTORS
	LATITUDE NORTH	LONGITUDE WEST	
TAP1	13°30'47.40"	88°15'13.20"	*Expansion Section*
TAP2	13°30'43.70"	88°15'1.80"	*Expansion Section*
TAP3	13°30'40.68"	88°14'54.60"	*Expansion Section*
TAP4	13°30'37.90"	88°14'44.70"	*Expansion Section*
TAP5	13°30'35.00"	88°14'35.20"	*Expansion Section*
TAP6	13°30'29.50"	88°14'18.50"	*Expansion Section*
TAP7	13°30'21.00"	88°13'52.70"	*Expansion Section*
TAP8	13°30'16.28"	88°13'36.68"	*Expansion Section*
BMP9	13°30'11.20"	88°13'18.60"	*Secondary Forest*

CODE NAME	COORDINATES		SECTORS
	LATITUDE NORTH	LONGITUDE WEST	
BMP10	13°30'12.50"	88°13'17.20"	*Secondary Forest*
BMP11	13°30'14.02"	88°13'15.76"	*Secondary Forest*
CPP12	13°30'18.00"	88°13'11.10"	*Croplands and Grasslands*
CPP13	13°30'26.10"	88°13'1.90"	*Croplands and Grasslands*
CPP14	13°30'32.10"	88°12'51.90"	*Croplands and Grasslands*
CPP15	13°30'36.40"	88°12'41.20"	*Croplands and Grasslands*
CPP16	13°30'40.70"	88°12'22.00"	*Croplands and Grasslands*
CPP17	13°30'41.80"	88°11'38.80"	*Croplands and Grasslands*
CPP18	13°30'43.80"	88°11'26.10"	*Croplands and Grasslands*
CPP19	13°30'58.40"	88°11'5.20"	*Croplands and Grasslands*
BRP2O	13°31'13.40"	88°10'54.20"	*Riparian Forest*
CPP21	13°31'5.62"	88° 9'32.36"	*Croplands and Grasslands*
CPP22	13°30'47.30"	88° 974.76"	*Croplands and Grasslands*
CPP23	13°30'32.20"	88° 9'5.60"	*Croplands and Grasslands*
BRP24	13°30'18.40"	88° 8'51.50"	*Riparian Forest*
CPP25	13°29'47.30"	88° 8'49.60"	*Croplands and Grasslands*
CPP26	13°29'37.60"	88° 9'3.40"	*Croplands and Grasslands*
CPP27	13°28'53.30"	88° 8'39.90"	*Croplands and Grasslands*
CPP28	13°27'34.30"	88° 7'55.30"	*Croplands and Grasslands*
CPP29	13°27'10.10"	88° 8'0.00"	*Croplands and Grasslands*
BRP3O	13°25'58.00"	88° 8'49.50"	*Riparian Forest*
CPP31	13°25'56.10"	88° 8'56.50"	*Croplands and Grasslands*
BRP32	13°25'57.90"	88° 9'8.00"	*Riparian Forest*
BRP33	13°25'55.20"	88°9'10.20"	*Riparian Forest*
CPP34	13°25'52.80"	88°9'11.50"	*Croplands and Grasslands*

Source: ECO Ingenieros Team

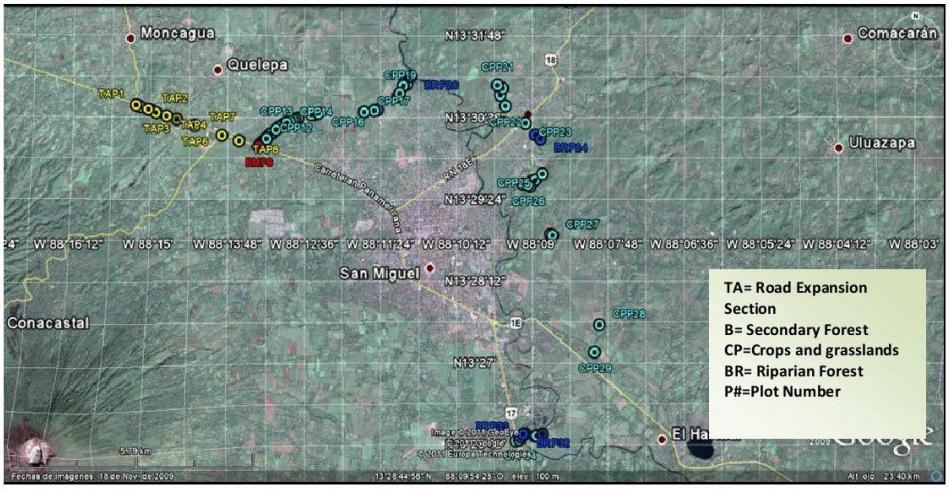


Figure No. VI.8. Location of sampled plots and observation points along the proposed path of the San Miguel Bypass Road

To establish 600 m^2 plots, we followed the criteria proposed by Melo Cruz and Vargas Ríos (2003), aiming to carry out studies about the forest organization, the floral composition or diversity monitoring, trying to find the sampling unit size that is able to express the behavior of the phenomena being assessed. Vester y Saldarriaga (1993) quoted by Meló Cruz and Vargas Ríos (2003) used 400 and 500 m^2 plots in order to assess the structural, architectural and floral characteristics in the secondary forests of the Colombian Amazonia.

Tree height was indirectly determined with a suunto inclinometer, measuring the angle from a fixed and known height until we reach the crown and the value was determined using the formula proposed by Young(1991): **h=d en m x tan α + p**

h= total height
d= distance from the observer in m.
p= observer's height

To determine if a species is a arboreous or shrub, we used the information presented by FAO – the United Nations' Food and Agricultural Organization, which defines a forest as a land surface of over half a hectare (5000 m^2) , with trees that have a height of 5meters and a total forest cover of over 10% or trees that have the potential of meeting those parameters. Likewise, Holdridge (1956, 1970) quoted by Carrasquilla (2006), establishes that the morphological point of view, a tree is a woody plant of 5m or higher that has one sole stem that supports the crown and a diameter at breast height DBH of 10 cm or more.

With the records obtained we created a list of species including the taxonomic categories of family, genus and species. We were also able to determine the abundance of species, the diametric classes and tree heights.

Annex VI.7 presents the information about the trees and the shrubs, ordered by parcel.

VI.4.1.2 Fauna Methodology

We recorded the fauna species detected after walking through the proposed Bypass outline. During the course, we took note of the land vertebrate species observed in the place. The observation frequency for each one.

For the amphibious and reptiles, we used the method of turning over rocks and fallen trunks, fences, clearing, prioritizing the areas where puddles were formed and areas of slow current in the rivers. In order to identify the individuals found, field identification guides were used.

To record birds, we took note of the species seen and heard during the tour. We considered recording the nesting, feeding and distribution areas.

In order to determine the mammal species present in that place, we performed direct observation and searched for indications like tracks, droppings, dens, scratching posts and skeletons.

We also interviewed people that live in the nearby areas in order to identify the presence of some species, especially reptiles and mammals. For this, we utilized field identification guides that were shown to the interviewees to strengthen observation and traces, which facilitated the species recognition. This information was placed on an additional table.

The sampling took place during the following dates: July 30 and 31, August 1 to 5, and October 1 and 2, 2011. The courses of the outlines began at 6:00 am until 5:00 pm. For security reasons it was not possible to carry out the night course.

The results were written also according to the defined flora sections.

VI.4.2 *Life Areas*

The life area with more influence within the area and that affects more directly the Project area is the subtropical humid forest (bh-S), which the largest area in the country and has an average temperature that ranges between 24°C and 22°C in the most elevated parts. The annual precipitation varies between 1,400 and 2,000 mm. These characteristics applies to the entire area : two very defined seasons(regarding the rain): the rainy season and the dry season, that have a duration of six months each, based on the existing tropical monsoon climate. The relative average humidity is 70%and sunlight is of 7.8 h/d.

There are areas that have humid subtropical forest, transitioning to a Tropical and subtropical rainforest

"Subtropical rainforest"
"Subtropical rainforest transitioning to tropical"
"Subtropical rainforest , transitioning to sub rainforest"

There is a predominance of the use of soil for agricultural and livestock in the area, and to a lesser extent , fragmented forests and ornamental vegetation in areas where there is commerce and housing. The original fauna and flora of the land, have been previously affected by the agricultural, livestock, commercial and housing development; consequently there a substitution of the native flora and the only remainder of found along the rivers.

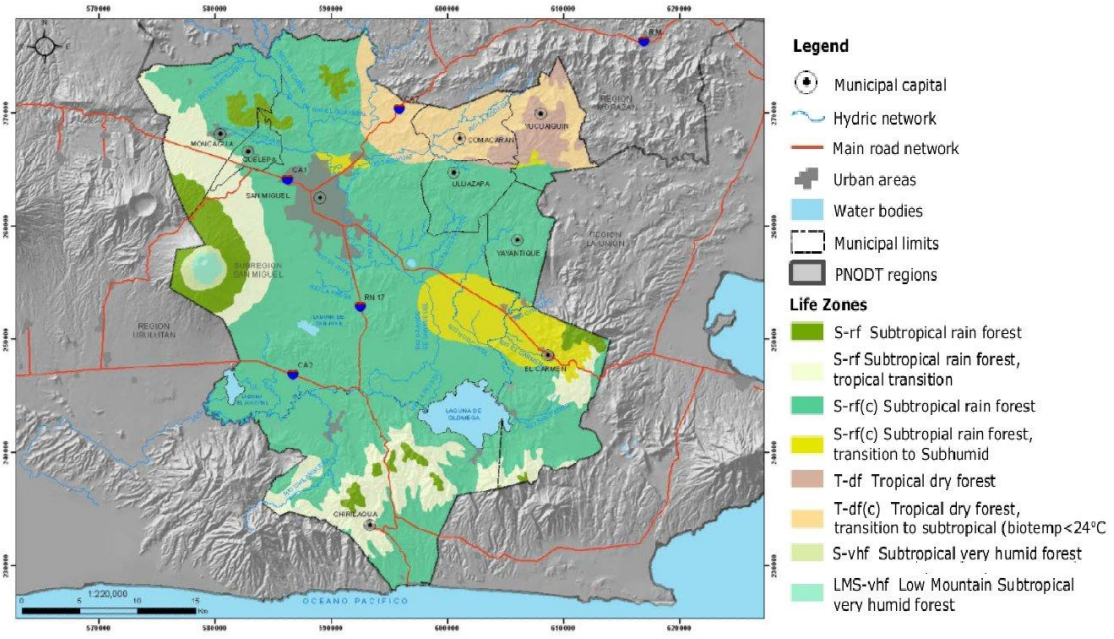


Figure No. VI.9 Map of Life Zones

VI.4.3 *Conceptual Framework: definition of a forest*

For analysis purposes, a forest will be understood according to the definition provided by United Nations's Food and Agricultural Organization, which defines a forest as a land surface of over half a hectare (5000 m^2) , with trees that have a height of over 5 meters and a total forest cover of over 10% or trees that have the potential of meeting those parameters.

Compact vegetation masses with different tree species of different heights that develop in firm ground (including the river limits) are considered forests. They tends to intertwine their crowns regardless if they are perennial or deciduous. It includes primary and secondary forests without considering if they are disturbed or not, or the use assigned for them (CCAD, 2009).

The Marrakech conceives a forest based on a number of quantitative parameter that are related to the vegetation's morphological form ((Neeff & von Luepke, 2005), which is described as: the minimum land surface between 0,05 and 1,0ha with a crown cover (or an equivalent population density) exceeding a range of 10 to 30% and trees that can reach a minimum height between 2 and 5m in their maturity onsite. A forest may consist of dense forest, where the trees of various heights and the understory cover a considerable portion of the land or in a clear wooded mass. Also, the natural forestry masses and all the young plantations between 2 and 5 m are considered forest. The same applies to surface which usually are part of the wooded area but temporarily lack forest population due to human intervention, for example exploitation or natural causes, but it is expected that they will turn back into forests. (CMNUCC, 2001, quoted by Najarro et al. 2005).

For project purposes we used the CCAD definition, in which a riparian forest and secondary forests that were identified, are considered forests

VI.4.4 Descriptions of the ecosystems found.

The sector selected for analysis, that at the same time are ecosystems, are disturbed settings as they do not maintain the characteristics of an ecosystem that show primary vegetation. Four systems were selected for analysis according to what we found during the preliminary walk through. Expansion section, secondary forest, crop and grass lands and riparian forest. Two types of forests were identifies onsite: riparian forests on the river banks and streams and secondary forests in the area. The majority of the course showed crop and grass lands as well as scattered trees. The expansion section has trees planted in rows facing the plots, which is why they were analyzed separately.

It is important to mention that all of these ecosystems are not natural, as they have been heavily disturbed by man.

1. **Expansion section** : Is the expansion section of the Panamercana (CA-1) road, beginning at the Moncagua detour, reaching the place where the secondary forest begins. It is an artificial ecosystem and the vegetation observed is consistent with road mitigation and ornament practices as they are towards the sides of the road;next to these tree rows there are private properties, houses, car shops, small stores and cultivated plots; some of them are abandoned and here, we found herbaceous vegetation considered weed. This area is strongly disturbed by human presence.

2. **Secondaty forest:** Is a relict of a secondary forest based on its diameter and altitudinal distribution. The length is approximately 1.5 km. After the research we concluded that it presents native vegetation and it is considered as a forest due the composition of its structure (crown coverage area) (Flores, 1980). The terrain where it is located is orivate property and is not catalogued as protected. Due to its altitudinal location, the vegetation is decidious lowland forest, and the characteristics are as follows: Bursera simaruba, Ceiba pentandra, Cochlospermum vitifolium, Enterolobium cyclocarpum and Guazuma ulmifolia, among others.

3. **Crop and pasture ecosystem**: This area is severely altered or fragmented due to change in the use of soils, in the growing of basic grains, sugar cane and cattle raising. It presents a diversity of significant speciess, since the fence and boundaries are a space where important plant species can still be found, They have a diverse importance: ecological, timber-yielding, ornament, live fences and medicinal (Chacón León y Harvey, 2010) as it was seen during the course of the project. Vegetation was found is small nucleus as well as scattered trees and the contribution made by the live which allow a representative view of these, that are native or with characteristics from the deciduous lowland forest. The majority of these, loose their leaves during the dry season which lasts approximately six months, according to what was identified on the field. This is the sector has a greater diversity of species.

4. **Riparian Forest:** this community is restricted to the boundaries of the water body, in this case, both sides of the rivers: Rio Grande in San Miguel and Taisihuat river. They are fairly altered as there is sugar cane found on the plots, as well as pasture and species that have been introduced such as *Tectona granáis* "teca". In some streams in the area, we also found relicts of riparian forest.

The existing vegetation in the area of indirect influence will be less affected, as the place is highly fragmented and the vast majority of the project's area are crop and grass lands. Likewise, the riparian forest of Rio Grande in San Miguel is being pressured by the extraction of its natural resources and for the progress made with the agricultural boundary. It is also important to consider the effects to the watershed of Grande river. See Drawing VI-II Ecosystems.

TABLE No. VI.29. FOREST ECOSYSTEMS IDENTIFIED IN THE PROJECT INFLUENCE AREA.

STATION RANGE		ECOSYSTEM
0+500	1+000	Bosque secundario
3+000	4+000	Bosque secundario
8+500	9+000	Bosque ripario
12+000	12+500	Bosque de galería
13+500	14+000	Bosque ripario
20+000	21+000	Bosque ripario
21+500	22+000	Bosque ripario
23+500	25+022	Bosque ripario

Source: Field Survey, Eco Ingenieros

No endemic speciess were identified in the project area

VI.4.5 *Flora within the direct influence area*

Based and on the general inventory of flora, there is a total of 61 families and 147 species that belong to the arboreous, shrub and herbaceous stratum with 71, 26 and 50 species, respectively (Tables No. VI.30 a 32). The family with a larger number of species was Fabaceae with 27. Following that order, followed by these families: Bignoniaceae with 6; Asclepiadaceae, Euphorbiaceae, Moraceae, Poaceae y Rubiaceae with 5, y, Anacardiaceae, Asteraceae, Meliaceae y Verbenaceae with 4.

As we carried out the analysis by stratum, the arboreous stratus presented a larger number of families and species , as 30 families and 71 species were recorded; these corresponded the direct area of influence of the Bypass. The The most representative family is Fabaceae with 18 species; followed by the Bignoniaceae family with 5 and the Anacardiaceae, Meliaceae y Moraceae with 4 species

Regarding the shrub stratum, 15 families and 26 species were reported (chart 2) and regarding this stratum, the families with the largest number of species were Fabaceae, Annonaceae y Euphorbiaceae con 7, 3 and 3, respectively. On the same chart, we see that 3 speciess of the Acacia genus were recorded and for the Annonacea, three species of the Annona.

The herbaceous stratum, 29 families and 50 species (Table No. VI.32). The most representative families, based on the number of species, are Asclepiadaceae and Poaceae with 5, Asteraceae with 4 and Cactaceae and Cyperaceae with three each.

It is important to understand that some species are mentioned in the shrub stratum list, according to the current situation of the individual, but there are still trees, as it is specified in table VI.31, according to the dimensions and conditions. The following definitions were applied:

Arboreous stratum: Comprised of the species that reach a height between 5 and 40m or more; The have an ample distance between them, therefore, they do not compete for light with other trees and they develop high and extended crowns. This is the reason is why they provide intense shade over the lower stratums. (Vickery, 1991; Carrasquilla, 2006).

Shrub stratum: Comprised of the individuals with a woody consistency that have a maximum height of 5m. Is a mixture of real and renewed shrubs which cannot reach maturity due to a lack of light. The shrubs are associated to the river banks, clearings and external limit of the forest. They are distributed with more proximity and the crowns are smaller, rounded and elongated. (Vickery, 1991; Carrasquilla, 2006).

Regarding the ecological significance for the encompassed stratums, and in accordance with the list of threatened or endangered wildlife species MARN (2009), one of them is threatened and 2 are endangered . In accordance with the red list of threated species of El Salvador IUCN (2011), one species is in critical danger (Chart No. VI.31) . Additionally three species were recorded and they belong to the Annonacea family, were reported by Cruz y Deras (2000)[6] as endangered species.

TABLE No. VI.30. GENERAL LIST OF SPECIES IN THE TREE STRATUM,

No.	Family	Scientific name	Vernacular name
1	Achatocarpaceae	*Achatocarpus nigñcans*	"cuenta de agua"
2	Acanthaceae	*Bravaisia intigerñma*	"mangle dulce"
3	Anacardiaceae	*Anacardium occidentale*	"marañón de pepa"
4	Anacardiaceae	*Mangifera indica*	"mango"
5	Anacardiaceae	*Spondias mombin*	"jocote jobo"
6	Anacardiaceae	*Spondias purpurea*	"jocote"
7	Bignoniaceae	*Crescentia a lata*	"morro"
8	Bignoniaceae	*Tabebuia chrysantha*	"cortés blanco"
9	Bignoniaceae	*Tabebuia impetiginosa*	"cortés negro"
10	Bignoniaceae	*Tabebuia rosea*	"maquilishuat"
11	Bignoniaceae	*Tecoma stans*	"san Andrés"
12	Boraginaceae	*Cordia alba*	"tihuilote"
13	Boraginaceae	*Cordia alliodora*	"laurel negro"
14	Burseraceae	*Bursera simaruba*	"jiote"
15	Capparaceae	*Cappa ris indica*	"madresal"
16	Capparaceae	*Crataeva tapia*	"cachimbo"
17	Cecropiaceae	*Cecropia peltata*	"guarumo"

[6] *Colecta y Establecimiento de Anonáceas En El Salvador.* Agronomía Mesoamericana, year/vol. 11, number 002. Universidad de Costa Rica, Alajuela, Costa Rica. Pp. 9195. Published online on Red de revistas científicas de América latina y el Caribe, España y Portugal. Universidad Autónoma de México.

No.	Family	Scientific name	Vernacular name
18	Chrysobalanaceae	*Couepia poliandra*	"sunsapotillo"
19	Cochlospermaceae	*Cochlospermum vitifolium*	"tecomasuche"
20	Combretaceae	*Terminalia catappa*	"almendro"
21	Dilleniaceae	*Curatella americana*	"chaparro"
22	Euphorbiaceae	*Crotón reflexifolium*	"copalchí"
23	Euphorbiaceae	*Sapium glandulosum*	"chilamate"
24	Fabaceae	*Acacia polyphylla*	"zarzo"
25	Fabaceae	*Albinia niopoides*	"conacaste blanco"
26	Fabaceae	*Andira inermis*	"almendro de río"
27	Fabaceae	*Cassia grandis*	"carao"
28	Fabaceae	*Cassia siamea*	Sn
29	Fabaceae	*Delonix regia*	"árbol de fuego"
30	Fabaceae	*Diphysa americana*	"guachipilín"
31	Fabaceae	*Enterolobium cyclocarpum*	"conacaste negro"
32	Fabaceae	*Erythrina berteroana*	"pito"
33	Fabaceae	*Gliricidia sepium*	"madrecacao"
34	Fabaceae	*Hymenaea courbaril*	"copinol"
35	Fabaceae	*Lysiloma divaricatum*	"quebracho"
36	Fabaceae	*Piptadenia constricta*	"pintadillo"
37	Fabaceae	*Piscidia carthagenensis*	"zope"
38	Fabaceae	*Pithecellobium dulce*	"mangollano"
39	Fabaceae	*Poeppigia procera*	"zorro o memble"
40	Fabaceae	*Samanea saman*	"carreto"
41	Fabaceae	*Tamarindus indica*	"tamarindo"
42	Flacourtiaceae	*Xylosma intermedium*	"aguja de arra"
43	Malpighiaceae	*Byrsonima crassifolia*	"nance"
44	Bombacaceae	*Ceiba pentandra*	"ceiba"
45	Meliaceae	*Azadarichta indica*	"neen"
46	Meliaceae	*Cedrela odorata*	"cedro"
47	Meliaceae	*Swietenia humilis*	"caoba"
48	Meliaceae	*Trichilia martiana*	"cola de pava"
49	Moraceae	*Chlorophora tinctoria*	"palo mora"
50	Moraceae	*Ficus goldmanii*	"amate"
51	Moraceae	*Ficus ovalis*	"amate"
52	Moraceae	*Ficus sp.*	"amate"
53	Myrtaceae	*Eucalyptus camaldulensis*	"eucalipto"
54	Myrtaceae	*Siyzygium cumini*	"cerezo de Belice"
55	Pinaceae	*Pinus oocarpa*	"pino"
56	Polygonaceae	*Coccoloba caracasana*	"pa paturro"
57	Polygonaceae	*Triplaris melanodendrum*	"mulato"
58	Rhamanaceae	*Colubrina arborescens*	"shakiro"
59	Rhamanaceae	*Karwinskia calderoni*	"huilihuiste"
60	Rubiaceae	*Calycophyllum candidisimum*	"salamo"
61	Rubiaceae	*Genipa americana*	"irayol"
62	Sapindaceae	*Thouinidium decandrum*	"zorrillo"
63	Sapotaceae	*Sideroxylon tempisque*	"tempisque"
64	Simaroubaceae	*Alvaradoa amorphoides*	"plumajillo"
65	Simaroubaceae	*Simarouba glauca*	"aceituno"
66	Sterculiaceae	*Guazuma ulmifolia*	"tapaculo"

No.	Family	Scientific name	Vernacular name
67	Sterculiaceae	*Sterculia apétala*	"castaño"
68	Tiliaceae	*Apeiba Tibourbou*	"peine de mico"
69	Tiliaceae	*Luehea candida*	"cabo de hacha"
70	Verbenaceae	*Rehdera trinervis*	"cola de iguana o jicarillo"
71	Verbenaceae	*Tectona grandis*	"teca"

Source: Field Survey, Eco Ingenieros

TABLE No. VI.31. GENERAL LIST OF SPECIES IN THE SHRUB STRATUM

No.	Family	Scientific name	Vernacular name	Type
1	Annonaceae	*Annona holoseñcea*	"suncuyita"	tree
2	Annonaceae	*Annona reticulata*	"anona colorada"	tree
3	Annonaceae	*Annona squamosa*	"anona poshta"	tree
4	Apocynaceae	*Stemmadenia donnell-smithii*	"cojón de puerco"	shrub
5	Boraginaceae	*Cor di a panamensis*	"manune"	shrub
6	Cannabaceae	*Celtis iguanaea*	"cagalero"	shrub
7	Euphorbiaceae	*Euphorbia láctea*	"tirabuzón"	shrub
8	Euphorbiaceae	*Jatropha curcas*	"tempate"	shrub
9	Euphorbiaceae	*Ricinus connmunis*	"higuerillo"	shrub
10	Fabaceae	*Acaecía farnesiana*	"espino blanco"	shrub
11	Fabaceae	*Acacia comígera*	"iscanal"	shrub
12	Fabaceae	*Acacia tenuiflora*	"carbón negro"	shrub
13	Fabaceae	*Bauhinia aculeata*	"pie de venado"	shrub
14	Fabaceae	*Bauhinia ungulata*	"pie de venado"	shrub
15	Fabaceae	*Lonchocarpus phaseolifolius*	"pata mu la"	shrub
16	Fabaceae	*Lonchocarpus rugosus*	"chapulaltapa"	shrub
17	Flacourtiaceae	*Casearia corymbosa*	"canjurillo"	shrub
18	Moringaceae	*Moringa oleífera*	"teberinto"	shrub
19	Myrsinaceae	*Ardisia sp.*	"cerezo "	tree
20	Myrtaceae	*Psidium guajava*	"guayaba"	tree
21	Piperaceae	*Piper arboreum*	"piper"	tree
22	Rubiaceae	*Coutarea hexandra*	"quinita"	tree
23	Rubiaceae	*Hamelia patens*	"chichipince"	tree
24	Solanaceae	*Solanum verbasifolium*	"lavatrasto"	tree
25	Ulmaceae	*Trema micranta*	"capulín macho"	tree
26	Urticaceae	*Urera baccifera*	"chichicaste"	tree

Source: Field Survey, Eco Ingenieros

TABLE No. VI.32. GENERAL LIST OF HERBACEOUS SPECIES

No.	Family	Scientific name	Vernacular name
1	Agavaceae	*Agave Americana*	"agave"
2	Amaranthaceae	*Amaranthus espinosas*	**"quilite"**
3	Asclepiadaceae	*Asclepias curassavica*	"señorita"
4	Asclepiadaceae	*Asclepias oenotheroides*	"mata coyote"
5	Asclepiadaceae	*Calotropis procera*	"algodón de playa"
6	Asclepiadaceae	*Gonolobus sp.*	Sn
7	Asclepiadaceae	*Vincetoxicum barbatum*	"cuchamper"
8	Asteraceae	*Ageratum conyzoides*	"mejorana"

No.	Family	Scientific name	Vernacular name
9	Asteraceae	*Baltimora recta*	"flor amarilla"
10	Asteraceae	*Melantera nivea*	"botón blanco"
11	Asteraceae	*Verbesina turbacensis*	"tabaquillo"
12	Bignoniaceae	*Arrabidaea patellifera*	"bejuco"
13	Bromeliaceae	*Bromelia karatas*	"pina de cerco"
14	Bromeliaceae	*Bromelia penguin*	"pina de cerco"
15	Cactaceae	*Acanthocereus tetragonus*	"saite"
16	Cactaceae	*Hylocereus sp.*	"cactus"
17	Cactaceae	*Opuntia sp.*	"tuna"
18	Commelinaceae	*Commelina erecta*	"commelina"
19	Convolvulaceae	*Evulbulos nummularius*	"campanilla"
20	Cucurbitaceae	*Momordica charantia*	"ja ¡vita"
21	Cyperaceae	*Cyperus hybridus*	"coyolillo"
22	Cyperaceae	*Cyperus rotundas*	"coyolillo"
23	Cyperaceae	*Cyperus sp.*	"ciperus"
24	Cytinaceae	*Bdallophyton ameñcanum*	"matapalo"
25	Fabaceae	*Indigofera subfruticosa*	"añil"
26	Fabaceae	*Senna tora*	"frijolillo"
27	Loasaceae	*Gron ovia sean dens*	"pan caliente"
28	Lydodiaceae	*Lygodium venustum*	"crespillo"
29	Malvaceae	*Sida acuta*	"escobilla"
30	Martiniaceae	*Martynia annua*	"uña de gato"
31	Moraceae	*Dorstenia contrajerva*	"contrayerba"
32	Musaceae	*Musa sapientum*	"guineo"
33	Passifloraceae	*Passiflora biflora*	"granadilla de culebra"
34	Passifloraceae	*Passiflora foetida*	"granadilla "
35	Phytolaccaceae	*Petiveria alliance*	"epacina"
36	Phytolaccaceae	*Rivina humilis*	"achotillo"
37	Poaceae	*Cynodon dactylon*	"barrenillo"
38	Poaceae	*Echinocloa colona*	"arrocillo"
39	Poaceae	*Eleusine indica*	"zacate"
40	Poaceae	*Ixophorus unisectus*	"zacate blanco"
41	Poaceae	*Panicum maximum*	"pasto"
42	Portulacaceae	*Portulaca oleraceae*	"verdolaga"
43	Rubiaceae	*Psichotria sp.*	Sn
44	Selaginellaceae	*Selaginella hoffmanii Hieron*	"selaginela"
45	Selaginellaceae	*Selaginella pallescens (C. Presl) Spring*	"flor de jericó"
46	Solanaceae	*Solanum capsicum*	"chile chiltepe"
47	Turneraceae	*Tu mera ulmifolia*	"flor amarilla"
48	Verbenaceae	*Cornutia piramidata*	Sn
49	Verbenaceae	*Lantana cámara*	"cinco negritos"
50	Vitaceea	*Cissus cysiodes*	"bejuco come mano"

Source: : Field Survey, Eco Ingenieros

VI.4.5.1 Ecological significance of flora species

The following table shows those speicies identified as in critical condition along the path of the project.

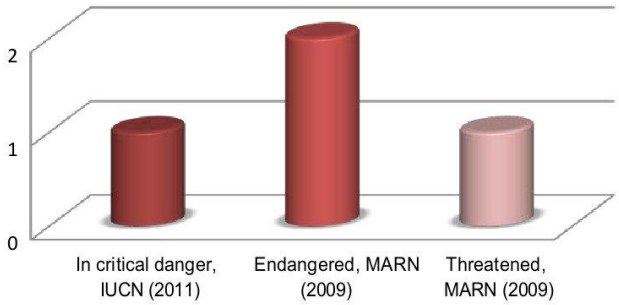
TABLE No. VI.33. ECOLOGICAL SIGNIFICANCE OF FLORA SPECIES , SM BYPASS ROAD 2011

FAMILY	SCIENTIFIC NAME	VERNACULAR NAME	STATUS	IND.	STRATUM	ECOSYSTEM
Acanthaceae	*Bravaisia intigerrima*	"sweet mangrove	Threatened **	3	Tree	Forest
Fabaceae	*Lonchocarpus phaseolifolius*	"pata de mula"	Critically endangered ***	2	Shrub	Croplands and grasslands
Meliaceae	*Cedrela odorata*	"cedro"	Endangered **, Vulnerable***	13	Tree	Croplands and grasslands
Meliaceae	*Swietenia humilis*	"caoba"	Endangered **, Vulnerable***	46	Tree	Expansion section, croplands and grasslands

Cruz and Deras (2000) *; MARN (2009) **; IUCN (2011) ***. *Ind: Individuals*

Source: Field survey, ECO Ingenieros

Regarding the ecological significance for the stratum considered, according to the list of threatened or endangered wildlife species MARN (2009), one is threatened and 2 are endangered and in the red list of threatened species of El Salvador IUCN (2011), one species is in critical danger and two are vulnerable.



Source: Field Survey, Eco Ingenieros

Graph No. VI.13. Number of species in critical ecological condition as per sampling conducted. SM Bypass Road, 2011

Of the Annonaceae family, the *Annona squamosa* "anona poshta" (shrub), *Annona reticulata* "anona colorada" (tree) y *Annona holosericea* "suncuyita", have been reported as endangered species in a publication by Cruz y Deras (2000).

Annex VI.9 provides a list of threatened species and their location in the Project. See Figure No VI-1.

VI.4.5.2 Results of flora by sector

VI. 4.5.2.1 Expansion section

This area basically has two rows of trees (one on each side of the road), mainly ornamental, among which we can highlight *Tabebuia rosea* "maquilishuat" which has the largest number of individuals: 92. It also has a timber-yielding importance; *Enterolobium cyclocrapum* "conacaste negro", 63 individuals but has the largest basal area and FVI and *Lysiloma divaricatum* "quebracho" in the third place with 41 individuals **IVI** (Table No. VI.34). *Gliricidia sepium* "madrecacao" y *Bursera simaruba* "jiote" have ecological importance as it is used as live fences. The majority of the individuals are arboreous.

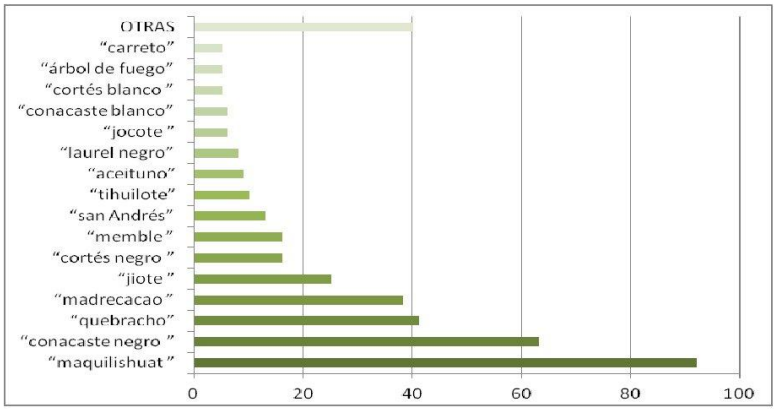
In the same table we observed that, for this sector, we recorded 16 families, 35 species and 398 individuals. The most representative family is Fabaceae with 10 species, followed by the Bignoniaceae family with 5. The diversity value is 2.69 which indicates that there is a medium diversity. The species and individuals are shown in the following table.

TABLE No. VI.34. LIST OF SPECIES IN THE ROAD EXPANSION SECTION

FAMILY	SCIENTIFIC NAME	VERNACULAR	IND.	F	ABM2	IVI
Anacardiaceae	*Spondias purpurea*	"jocote "	6	2	0.2529	4.35
Anacardiaceae	*Anacardium occidentale*	"marañón de pepa"	3	2	0.1466	3.41
Anacardiaceae	*Mangifera indica*	"mango"	1	1	0.1257	1.67
Bignoniaceae	*Tabebuia rosea*	"maquilishuat"	92	7	6.2163	42.21
Bignoniaceae	*Tabebuia impetiginosa*	"cortés negro "	16	3	3.4745	13.59
Bignoniaceae	*Tecoma stans*	"san Andrés"	13	7	0.7337	12.96
Bignoniaceae	*Tabebuia chrysantha*	"cortés blanco "	5	2	0.4889	4.50
Bignoniaceae	*Crescentia alata*	"morro"	1	1	0.0326	1.51
Bombacaceae	*Ceiba pentandra*	"ceiba"	3	2	0.8443	4.61
Boraginaceae	*Cordia alba*	"tihuilote"	10	3	0.7079	7.34
Boraginaceae	*Cordia alliodora*	"laurel negro"	8	3	0.6536	6.75
Burseraceae	*Bursera simaruba*	"jiote "	25	7	1.975	18.10
Chrysobalanaceae	*Couepia poliandra*	"sunsapotillo"	1	1	0.1257	1.67
Combretaceae	*Terminalia catappa*	"almendro"	4	2	0.2992	3.93
Fabaceae	*Enterolobium cyclocarpum*	"conacaste negro "	63	3	24.009	60.61
Fabaceae	*Lysiloma divaricatum*	"quebracho"	41	4	3.6491	21.38
Fabaceae	*Gliricidia sepium*	"madrecacao "	38	2	2.3199	15.93
Fabaceae	*Poeppigia procera*	"memble "	16	1	4.3433	12.67
Fabaceae	*Albinia niopoides*	"conacaste blanco"	6	4	1.8252	9.46
Fabaceae	*Delonix regia*	"árbol de fuego"	5	2	0.8747	5.17
Fabaceae	*Samanea saman*	"carreto"	5	3	1.2054	6.94
Fabaceae	*Andira inermis*	"almendro de río"	2	2	0.1964	3.25
Fabaceae	*Pithecellobium dulce*	"mangollano"	2	1	0.215	2.08
Fabaceae	*Erythñna berteroana*	"pito"	1	1	0.0509	1.54
Malpighiaceae	*Byrsonima crassifolia*	"nance"	2	2	0.1017	3.09
Meliaceae	*Swietenia humilis*	"caoba"	2	1	0.0953	1.87
Moraceae	*Ficus goldmanii*	"amate"	1	1	0.1257	1.67
Moraceae	*Ficus sp.*	"amate"	1	1	0.5675	2.43
Myrtaceae	*Eucaliptus camaldulensis*	"eucalipto"	4	1	0.5862	3.21

FAMILY	SCIENTIFIC NAME	VERNACULAR NAME	IND.	F	ABM2	IVI
Myrtaceae	*Siyzygium cumini*	"cerezo de Belice"	2	1	0.227	2.10
Myrtaceae	*Psidium guajava*	"guayaba"	1	1	0.0314	1.51
Pinaceae	*Pin us oocarpa*	"pino"	4	1	0.6362	3.30
Polygonaceae	*Tñplañs melanodendrum*	"mulato"	1	1	0.1257	1.67
Rhamnaceae	*Colubñna arborescens*	"shakiro"	4	2	0.2337	3.82
Simaroubaceae	*Simarouba glauca*	"aceituno"	9	5	0.8289	9.71
Totales 16	35	35	398	83	58.325	300

IND: Individuals F: frequency AB M2 basal area IVI: importance value index
Source: Field Survey, Eco Ingenieros



Source: Field Survey, Eco Ingenieros

Figure No. VI.14. Number of individuals by species

Photograpgh No. VI.20. View of the expansion section on the current Panamericana road (CA-1); he are trees on the side "garden beds" on both sides ,

VI. 4.5.2.2 Secondary forest

It is comprised of deciduous lowland forest vegetation and it is regarded as a secondary forest because it is comprised of species such as Annona squamosa, Stemmadenia donell-smithii, Ceiba pentandra, Bursera simaruba, Cochlospermum vitifolium, Sapium glandulosum and Guazuma ulmifolia, among others. Also because of the the horizontal and vertical structure shown by the individuals recorded in this community (Chacón León y Harvey, 2010). On the other hand, the majority of the individuals presented a DBH below 20 cm and heights below five m, described in an inverted j graphs; it has been established by (Dechner & Dias, 2004, quoted by García, 2008) for plant communities that part of the regeneration or alteration process. Likewise, SAGPYA y MECOM (2007), quoted by García (2008) established that such distribution is a characteristic of heterogeneous forests.

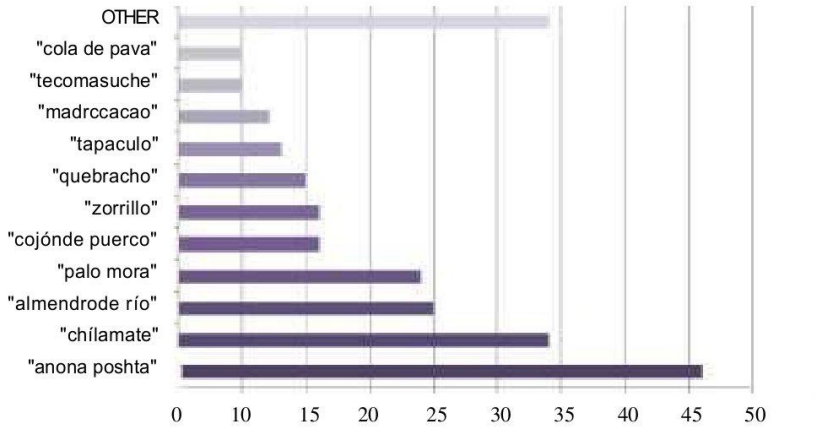
In this sector, the most abundant speciess were *Annona squamosa* "anona poshta" with 41 individuals, *Sapium glandulosun* "chilamate" with 29, *Andira inermis* "almendro de río" with 20 and *Chlorophora tinctoria* "palo mora" with 19 (Table No. VI.35). Also, in the herbaceous stratum by *Verbesina* as "capitanejo o tabaquillo" and *Petiveria alliacea* "epacina o zorrillo" are predominating. In this sector we also found abundance of *Selaginella hoffmanii "*selaginela*"* which belongs to the lower vascular group.

In table No. VI.35 we can see that for this sector we recorded a total of 17 families , 26 species and 195 individuals. The value of the alpha diversity of de Shannon – Wiener was 2.64, which indicates that the forest has a medium diversity.

TABLE No. VI.35. LIST OF SPECIES IN THE SECONDARY FOREST,

FAMILY	SCIENTIFIC NAME	VERNACULAR NAME	IND.	F	AB M2	IVI
Annonaceae	*Annona squamosa*	"anona poshta"	41	3	**0.2**	32.5
Annonaceae	*Annona holosericea*	"suncuyita"	1	1	**0.01**	**3.2**
Apocynaceae	*Stemmadenia donnell-smithii*	"cojón de puerco"	11	3	**0.05**	**13.9**
Bignoniaceae	*Tabebuia chrysantha*	"cortés blanco"	3	1	**0.01**	**4.1**
Bignoniaceae	*Tecoma stans*	"San Andrés"	3	1	**0.02**	**4.5**
Bignoniaceae	*Tabebuia rosea*	"maquilishuat"	1	1	**0**	**3.0**
Bombacaceae	*Ceiba pentandra*	"ceiba"	1	1	**0.09**	**4.8**
Burseraceae	*Bursera simaruba*	"jiote"	1	1	**0.02**	**3.3**
Cochlospermaceae	*Cochlospermum vitifolium*	"tecomasuche"	5	2	**0.15**	**10.6**
Euphorbiaceae	*Sapium glandulosum*	"chilamate"	29	2	**0.71**	**34.6**
Fabaceae	*Andira inermis*	"almendro de río"	20	2	**1.22**	**40.9**
Fabaceae	*Lysiloma divaricatum*	"quebracho"	10	1	**0.89**	26.2
Fabaceae	*Gliricidia sepium*	"madrecacao"	7	2	**0.12**	**11.1**
Fabaceae	*Acacia cornigera*	"iscanal"	4	2	**0**	**7.0**
Fabaceae	*Cassia sp.*	no name	4	1	**0.4**	**13.0**
Fabaceae	*Albinia niopoides*	"conacaste blanco"	2	1	**0.55**	**15.1**
Fabaceae	*Poeppigia procera*	"memble" or "zorro"	1	1	**0.01**	**3.1**
Meliaceae	*Trichilia martiana*	"cola de pava"	5	3	**0**	**10.0**
Moraceae	*Chlorophora tinctoria*	"palo mora"	19	3	**0.07**	**18.4**
Myrsinaceae	*Ardisia sp.*	"cerezo"	1	1	**0**	**3.0**
Piperaceae	*Piper arboretum*	"piper"	1	1	**0.01**	**3.2**
Rubiaceae	*Coutarea hexandra*	"quinita"	1	1	**0**	**3.0**
Simaroubaceae	*Alvaradoa amorphoides*	"zorrillo"	11	2	**0.12**	**13.1**
Solanaceae	*Solanum verbasifolium"*	"lavatrasto"	4	1	**0.01**	**4.6**
Sterculiaceae	*Guazuma ulmifolia*	"tapaculo"	8	2	**0.1**	**11.0**
Tiliaceae	*Luehea candida*	"cabo de hacha"	1	1	**0.01**	**3.1**
Totales 17	**26**		195	41	**4.75**	**300**

IND. Individuals found F: frequency AB M2: basal area IVI: Importance Value Index
Source: Field survey, ECO Ingenieros



Source: Field survey, Eco Ingenieros

Figure No. VI.15. Predominant species in secondary forest with more than 5 reported individuals

While this secondary forest is a forest area within the area, it is private property and consequently it is not protected for its preservation. Moreover, the presence of the corrent road already caused fragmentation in the habitat. The species in the area move into the forest area, the streams for water supply, outside the forest area and the scattered trees in the crop areas and enven into the housing plot division.

VI. 4.5.2.3 Crop and grass lands

These are the predominant areas in the Bypass path and there are mostly comprised of plots used for growing *Zea mays* "maíz" *(maize) Sorghum* sp. "maicillo" y *Saccharum officinarum* "caña de azúcar" *(sugra cane).* The dominance of thicket comprised of Acacia cornígera, A. farnesiana; Bauhinia ungulata y B. aculeata is also notable; natural pastures as welll as relicts of a thicket communities .There are sectors dominated by land with hills and a high percentage rocky areas where there is agricultural activity, specially "maiz" (maize) crops and cattle grazing.

We also found that the herbaceous species such as *Martinia annua* "uña de gato", *Asclepias oenotheroides* "mata coyote", *Selaginella pallescens* "flor de Jericó" y members of the Poaceae, family such as *Eleusine indica* and *Cynodum dactilum* "barrenillo" from the herbaceous stratum, were also frequently observed.

In the sector, 28 families were recorded, 51 speciess and 443 individuals (Table No. VI.36)- On the same table we see that most important biological species was *Pithecellobium dulce* "mangollano" based on the number of individuals as well as due to the basal area and e IVI, 105, 34.56 y 57.58 respectively. This species has ecological significance as it is used for live fences and at the same time is typical to find it in altered soils which allows the connectivity among different adjacent ecosystems. (Chacón León y Harvey, 2011).

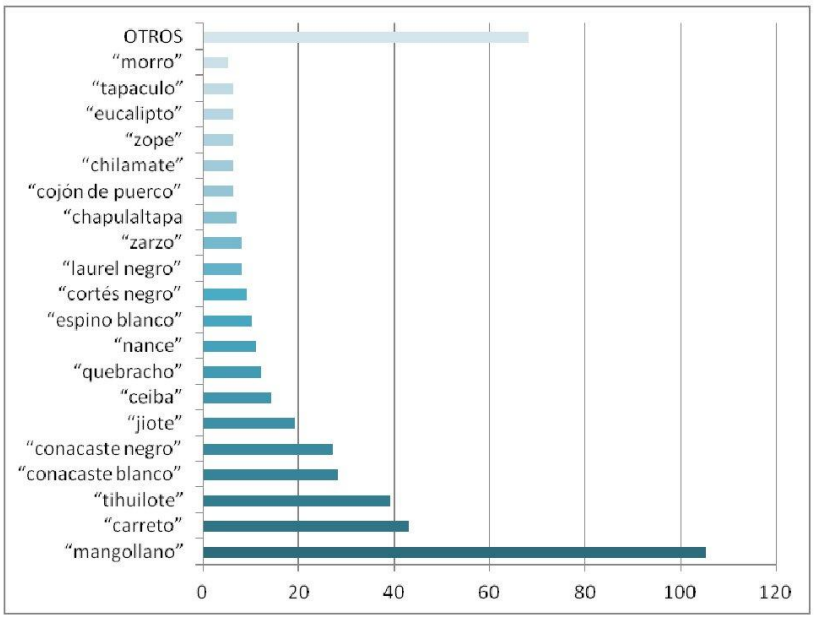
In this table, we also observed that Albizzia niopoides "conacaste blanco" ranks second of IVI by basal area and frequency, followed by *Samanea saman* "carreto" and *Enterolobium cyclocarpum* "conacaste negro" with 28.2 y 27.9, respectively. These speciess are important as they are timber-yielding and present the highest biomass. In this sector, al alpha diversity was reported and the value was 3.07, therefore considered medium.

TABLE No. VI.36. LIST OF SPECIES IN CROP AND GRASS LANDS

FAMILY	SCIENTIFIC NAME	VERNACULAR	IND.	F	AB M2	IVI
Acanthaceae	*Bravaisia intigerrima*	"sweet mangrove"	3	2	6.315	6.859
Achatocarpaceae	*Achatocarpus nigricans*	"cuenta de agua"	1	1	0.018	0.954
Anacardiaceae	*Mangifera indica*	"mango"	1	1	0.785	1.531
Annonaceae	*Annona reticulata*	"anona colorada"	2	2	0.366	2.156
Apocynaceae	*Stemmadenia donnell-smithii*	"cojón de puerco"	6	1	0.084	2.132
Bignoniaceae	*Tabebuia impetiginosa*	"cortés negro"	9	3	0.958	4.895
Bignoniaceae	*Crescentia alata*	"morro"	5	4	0.858	4.631
Bignoniaceae	*Tabebuia rosea*	"maquilishuat"	1	1	0.083	1.002
Boraginaceae	*Cordia alba*	"tihuilote"	39	5	4.989	16.131
Boraginaceae	*Cordia alliodora*	"laurel negro"	8	3	0.413	4.260
Burseraceae	*Bursera simaruba*	"jiote"	19	6	1.100	9.402
Capparaceae	*Capparis indica*	"madre-sal"	4	1	0.260	1.813
Capparaceae	*Crataeva tapia*	"cachimbo"	2	2	0.355	2.147
Cochlospermaceae	*Cochlospermum vitifolium*	"tecomasuche"	3	2	0.144	2.214
Dilleniaceae	*Curatella americana*	"chaparro"	4	2	0.158	2.451
Euphorbiaceae	*Sapium glandulosum*	"chilamate"	6	2	0.672	3.289
Fabaceae	*Pithecellobium dulce*	"mangollano"	105	11	34.568	57.582
Fabaceae	*Samanea saman*	"carreto"	43	10	15.094	28.212
Fabaceae	*Albizzia niopoides*	"conacaste blanco"	28	11	23.061	31.538
Fabaceae	*Enterolobium cyclocarpum*	"conacaste negro"	27	10	19.570	27.970
Fabaceae	*Lysiloma divaricatum*	"quebracho"	12	5	1.544	7.443
Fabaceae	*Acaecía farnesiana*	"espino blanco"	10	1	0.278	3.181
Fabaceae	*Acacia polyphylla*	"zarzo"	8	2	0.675	3.743
Fabaceae	*lonchocarpus rugosus*	"chapulaltapa	7	2	0.757	3.579
Fabaceae	*Piscidia carthagenensis*	"zope"	6	2	1.466	3.887
Fabaceae	*Andira inermis*	"almendro de río"	4	3	1.075	3.855
Fabaceae	*Cassia grandis*	"carao"	3	3	0.672	3.326
Fabaceae	*Hymenaea courbaril*	"copino!"	3	2	0.362	2.378
Fabaceae	*Diphysa americana*	"guachipilín"	1	1	0.045	0.974
Fabaceae	*Tamarindus indica*	"tamarindo"	1	1	0.036	0.967
Flacourtiaceae	*Xylosma intermedium*	"aguja de arra"	1	1	0.042	0.972
Malpighiaceae	*Byrsonima crassifolia*	"nance"	11	3	1.156	5.496
Malvaceae	*Ceiba pentandra*	"ceiba"	14	8	5.421	12.956
Meliaceae	*Azadarichta indica*	"neen"	4	1	0.390	1.911
Meliaceae	*Swietenia humilis*	"caoba"	2	1	0.090	1.233
Meliaceae	*Cedrela odorata*	"cedro"	1	1	0.042	0.971
Meliaceae	*Trichilia martiana*	"cola de pava"	1	1	0.039	0.969
Moraceae	*Chlorophora tinctoria*	"palo mora"	4	3	0.157	3.164
Moraceae	*Ficus sp.*	"amate"	4	2	2.092	3.907
Myrtaceae	*Eucalyptus camaldulensis*	"eucalipto"	6	1	3.016	4.339

Polygonaceae	*Coccoloba caracasana*	"papaturro"	2	2	1.288	2.850
Polygonaceae	*Triplaris melanodendrum*	"mulato"	2	1	0.098	1.240
Rhamnaceae	*Karwinskia calderoni*	"Huilihuiste"	4	1	0.215	1.779
Rubiaceae	*Calycophyllum candidisimum*	"salamo"	1	1	0.385	1.230
Sapindaceae	*Thouinidium decandrum*	"zorrillo"	1	1	0.049	0.977
Sapotaceae	*Sideroxylon tempisque*	"tempisque"	1	1	0.128	1.037
Simarubaceae	*Simarouba glauca*	"aceituna"	1	1	0.010	0.947
Sterculiaceae	*Guazuma ulmifolia*	"tapaculo"	6	4	1.092	5.033
Tiliaceae	*Apeiba tibourbou*	"peine de mico"	2	2	0.103	1.958
Tiliaceae	*Luehea candida*	"cabo de hacha"	2	1	0.176	1.298
Verbenaceae	*Rehdera trinervis*	"jicarillo"	2	1	0.088	1.232
Totales 28	**51**	51	443	140	132.836	300.0

IND. Individuals found F: frequency AB M2: basal area IVI: Importance Value Index
Source: Field survey, ECO Ingenieros



Source: Field Survey, Eco Ingenieros

Figure No. VI.16. Predominant species in crop and grass lands with more than 5 reported individuals.

As seen in the chart, "mangollano" is predominant over other species.

Photograph No. VI.21. Typical view of the area with scattered trees or trees located on the sides of the ploys.

VI.4.5.2.4 Riparian Forest

The majority vegetation was arboreal and this is where we recorded the majority of the individuals with DBH equal or greater than 100 cm; the species that prevailed either for abundance or diameters were *Enerolobium cyclocarpum* "conacaste negro" *Samanea saman* "carrete", *Albizzia niopoides* "conacaste blanco" and *Ceiba pentandra* "ceiba". Most of them were found in the areas influenced by humidity of the Rio Grande in San Miguel and due to the flooded sites and poor drainage in some areas.

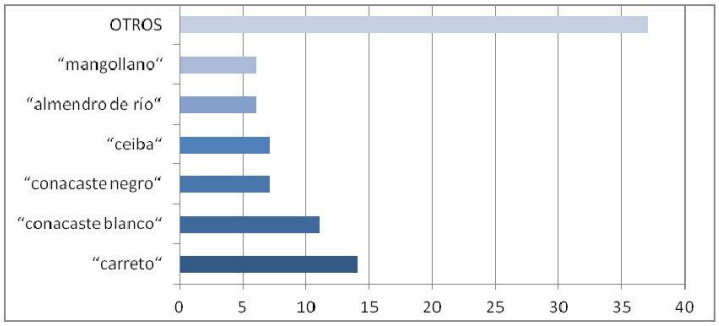
Within the riparian forest (Table No. VI.37), we recorded 18 families, 29 species and 88 individuals. Regarding IVI, the number of individuals and the basal area, the more significant species are *Albizzia niopoides* "conacaste blanco", *Samanea saman* "carrete", *Enterolobium cyclocarpum* "conacaste negro" and *Ceiba pentandra* "ceiba" with 32.11, 30.65, 29.7 y 26.1 respectively. The value for the alpha diversity was 2,94, which is, medium.

TABLE No. VI.37. LIST OF RIPARIAN FOREST SPECIES

FAMILY	SCIENTIFIC NAME	VERNACULAR NAME	IND	F	ABM2	IVI
Anacardiaceae	*Spondias mombin*	"jocote jobo "	1	1	0.6362	4.96
Anacardiaceae	*Mangifera indica*	"mango"	1	1	0.4418	4.46
Bignoniaceae	*Crescentia a lata*	"morro"	1	1	0.1912	3.81
Boraginaceae	*Cordia alba*	"tihuilote"	3	2	0.5402	9.16
Burseraceae	*Bursera simaruba*	"jiote"	1	1	0.2827	4.04
Cecropiaceae	*Cecropia peltata*	"guarumo"	1	1	0.0616	3.47
Chrysobalanaceae	*Couepia poliandra*	"sapotillo amarillo"	1	1	0.2578	3.98
Cochlospermaceae	*Cochlospermum vitifolium*	"tecomasuche"	1	1	0.0718	3.50
Fabaceae	*Albizzia niopoides*	"conacaste blanco"	11	3	5.0366	32.11
Fabaceae	*Samanea saman*	"carreto"	14	3	3.1646	30.65
Fabaceae	*Enterolobium cyclocarpum*	"conacaste negro"	7	3	5.8597	29.70
Fabaceae	*Andira inermis*	"almendro de río"	6	3	2.9608	21.03
Fabaceae	*Pithecellobium dulce*	"mangollano"	6	2	0.4791	12.41
Fabaceae	*Piptadenia constricta*	"pintadillo"	3	1	1.3089	8.98
Fabaceae	*Gliricidia sepium*	"madrecacao"	1	1	0.2827	4.04

FAMILIA	NOMBRE CIENTÍFICO	NOMBRE COMÚN	IND	F	ABM2	IVI
Fabaceae	*Lonchocarpus rugosus*	"chapulaltapa"	1	1	0.0688	3.49
Fabaceae	*Tamañndus indica*	"tamarindo"	1	1	0.0424	3.42
Malvaceae	*Ceiba pentandra*	"ceiba"	7	2	5.3505	26.21
Meliaceae	*Trichilia martiana*	"cola de pava"	1	1	0.1075	3.59
Moraceae	*Ficus sp.*	"amate"	2	1	0.3534	5.36
Moraceae	*Chlorophora tinctoña*	"palo mora"	1	1	0.0316	3.39
Polygonaceae	*Coccoloba caracasana*	"papaturro"	3	2	3.7228	17.43
Rubiaceae	*Genipa americana*	"Irayol"	1	1	0.1304	3.65
Sapindaceae	*Thouinidium decandrum*	"zorrillo"	2	2	0.3264	7.47
Sapotaceae	*Sideroxylon tempisque*	"tempisque"	4	2	1.9242	13.89
Simaroubaceae	*Simarouba glauca*	"aceituno"	1	1	0.0962	3.56
Sterculiaceae	*Sterculia apétala*	"castaño"	3	3	4.4364	21.46
Sterculiaceae	*Guazuma ulmifolia*	"tapaculo"	2	2	0.1930	7.12
Verbenaceae	*Tectona grandis*	"teca"	1	1	0.1257	3.64
Totales 18	**29**	29	88	46	38.48	300

IND: Individuals F: frequency AB M2 basal area IVI: importance value index
Source: Field Survey, Eco Ingenieros



Source: Field Survey, Eco Ingenieros

Figure No. VI. 17. Predominant riparian forest species with more than 5 reported individuals

Photograph No. VI.22. Image of a riparian forest along the Rio Grande in San Miguel, precisely at the crossing point, station 8+910, BYPASS SM 2011

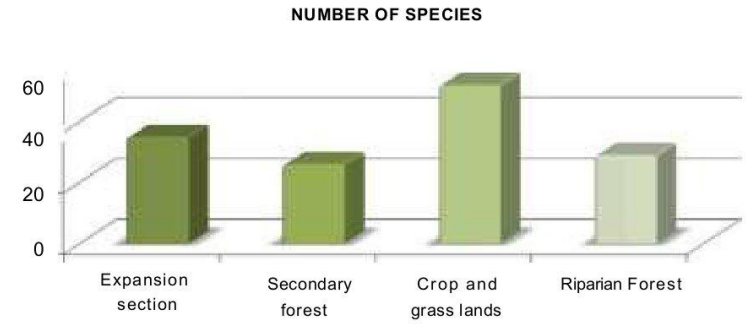
VI. 4.5.2.5 Summary of ecosystems found

Table No VI.38, shows a summary of the plots, individuals, species, density and diversity of the floral inventory.

TABLE No. VI.38. SUMMARY INVENTORY OF FLORA, SAN MIGUEL BYPASS, 2011

ECOSYSTEM	PLOTS	AREA (m2)	RECORDS	SPECIES	DENSITY (IND./m2)	DENSITY IND/HA	DIVERSITY (SHANNON-WIENER)
Expansion Section	8	4,800	398	35	**0.08**	**830**	2.69
Secondary Forest	3	1,800	195	26	**0.11**	**1,080**	2.64
Croplands and grasslands	20	12,000	443	51	**0.04**	**370**	3.08
Riparian Forest	3	1,800	88	29	**0.05**	**490**	2.94
TOTALS	34	20,400	1,124	141	**0.07**	**693**	2.84

Source: Field Survey, Eco Ingenieros

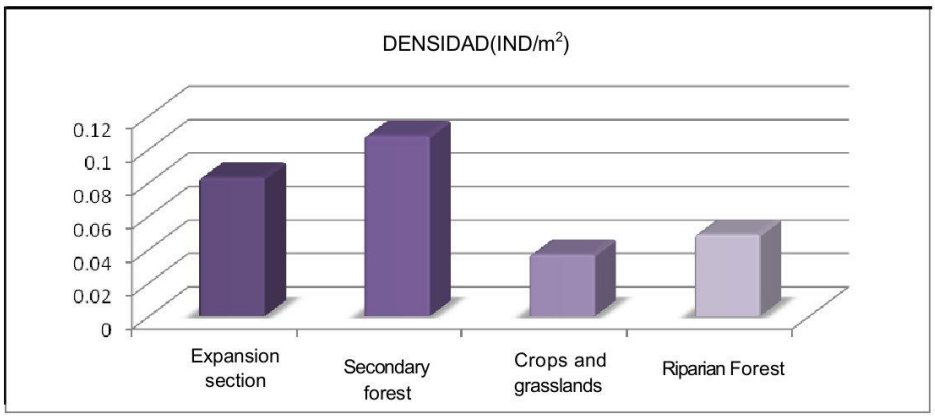


Source: Field Survey, Eco Ingenieros

Figure No. VI.18. Number of species by identified ecosystem .

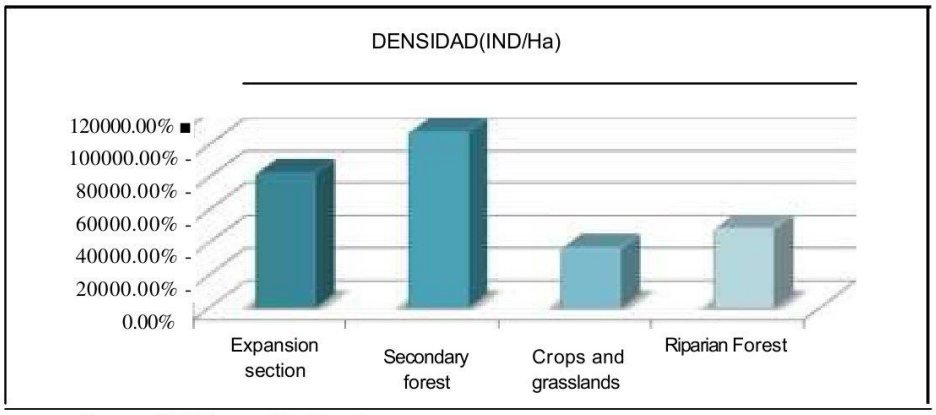
As shown in the graph, the largest number of different especiess was found in crop and grass lands which predominate in the project area and are object of greater human intervention. The same is true for the expansion section, where the existing trees and shrubs have been planted by the people to be used as ornamentation or live fences.

Regarding the tree density , the following graphs illustrate the densities of identified ecosystems. The densities are presented by plots, which is why it is important to bear in mind that within the crop and grass land areas, the plots were sampled in places with the most vegetation in order to obtain information about the existing species.



Source: Field Survey, Eco Ingenieros

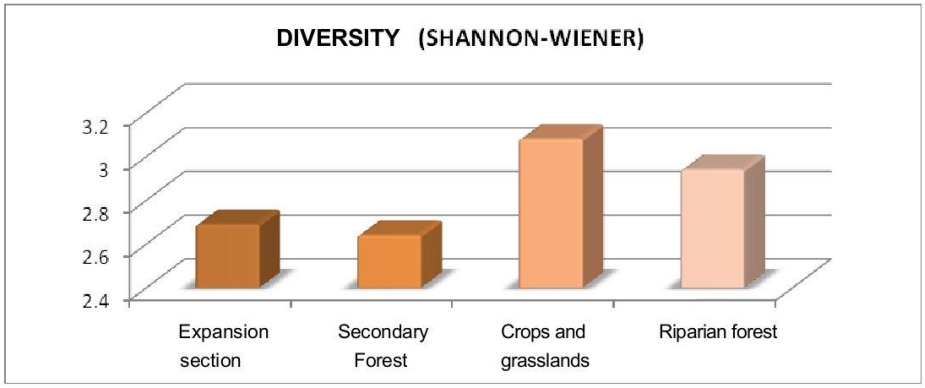
Graph No. VI.19. Density, individuals per square meter, SM BYPASS SM 2011.



Source: Field Survey, Eco Ingenieros

Graph No. VI.20. Density, individuals per hectare, SM BYPASS 2011.

The greatest density of individuals was found in the riparian forest located in the section 3+910 a 5+020, followed by the expansion section.



Source: Field Survey, Eco Ingenieros

Graph No. VI.21. Diversity (Shannon-Wiener), BYPASS SM 2011.

Regarding Shanon-Weiner diversity index, the highest is found in the crop and pastures area, followed by the riparian forest. Although all of them are considered to have a medium index.

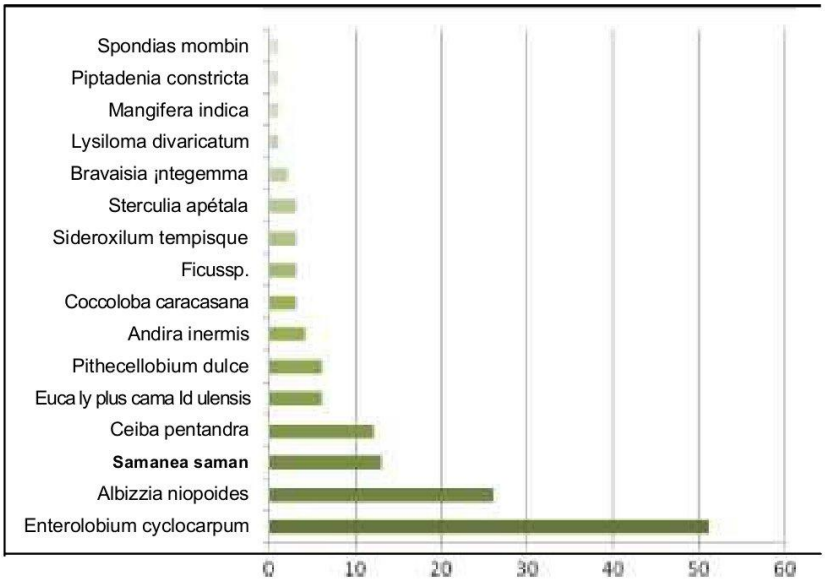
VI.4.5.3 Speciess of ecological importance for their diameter at breast height DBH

Sixteen plant species are reported that have an ecological significance regarding the diameter from the stem to the diameter at breast height (DBH) equal or greater than 80cm make a total of 136 individuals, that were distributed as follows: 36 in the expansion section , 71 in the crop and grass lands and 29 in the riparian forest. *Enterolobium eyeloearpum, Albizzia niopoides* and *Samanea saman* has the greater number of individuals, having 51, 26 and 13 respectively. Other speciess that accumulated a greater number of individuals are *Ceiba pentandra,* with 12, as well as *Pithecellobium dulce ,* with 6 (Table No. VI.39).

TABLE No. VI.39. LIST OF SPECIES WITH DBH GREATER THAN 80 CM.

NO.	SPECIES	IND.
1	*Enterolobium cyclocarpum*	*51*
2	*Albizia niopoides*	*26*
3	*Samanea saman*	*13*
4	*Ceiba pentandra*	*12*
5	*Eucalyptus camaldulensis*	*6*
6	*Pithecellobium dulce*	*6*
7	*Andira inermis*	*4*
8	*Coccoloba caracasana*	*3*
9	*Ficus sp.*	*3*
10	*Sideroxilum tempisque*	*3*
11	*Sterculia apétala*	*3*
12	*Bravaisia intigerrima*	*2*
13	*Lysiloma divaricatum*	*1*
14	*Mangifera indica*	*1*
15	*Piptadenia constricta*	*1*
16	*Spondias mombin*	*1*
Totals	16	136

Source: Field survey, ECO Ingenieros



Source: Field Survey, Eco Ingenieros

Graph No. VI.22. Individuals by species that a DBH greater than 80cm in the area that was sampled. BYPASS SM 2011.

VI.4.6 *Ethnobotanial importance of species encountered*

The antropogenic significance was defined for 40 species and their names as well as use, are included in the following table.

TABLE No. VI.40. SPECIES OF ETHNOBOTANICAL IMPORTANCE IN THE PROJECT AREA SAN MIGUEL BYPASS ROAD. 2011

No.	VERNACULAR NAME	SCIENTIFIC NAME	FAMILY	ANTHROPOGENIC SIGNIFICANCE
1	“olive tree”	*Simarouba glauca*	Simaroubaceae	for food and timber
2	"árbol de fuego"	*Delonix regia*	Fabaceae	Ornamental and firewood
3	“anona colorada”	*Annona reticulata*	Annonaceae	for food
4	“anona poshta”	*Annona squamosa*	Annonaceae	for food
5	"carao"	*Cassia grandis*	Cesalpiniaceae	for food
6	“carbón negro”	*Acacia tenuiflora*	Fabaceae	firewood
7	“caulote”	*Guazuma ulmifolia*	Sterculiaceae	medicinal
8	“cedro”	*Cedrela odorata*	Meliaceae	for timber
9	“caoba”	*Swietenia humilis*	Meliaceae	for timber
10	"cortés blanco"	*Tabebuia chrysantha*	Bignoniaceae	for timber
11	“cortés negro”	*Tabebuia impetiginosa*	Bignoniaceae	for timber, firewood and ornamentation
12	"conacaste negro"	*Enterolobium cyclocarpum*	Fabaceae	for timber, firewood and ornamentation

No.	VERNACULAR NAME	SCIENTIFIC NAME	FAMILY	ANTHROPOGENIC SIGNIFICANCE
13	"conacaste blanco"	*Albizia niopoides*	Fabaceae	timber and firewood
14	"carbón negro"	*Acacia tenuiflora*	Fabaceae	firewood
15	"chichipince"	*Hamelia patens*	Rubiaceae	medicinal
16	"chipilin"	*Crotolaria retusa*	Fabaceae	comestible
17	"cuchamper"	*Vincetoxicum barbatum*	Asclepiadaceae	for food
18	"guachipilin"	*Diphysa americana*	Fabaceae	for timber
19	"guayabo"	*Psidium guajava*	Myrtaceae	for food
20	"jocote jobo"	*Spondias bombin*	Anacardiaceae	for food
21	"jocote"	*Spondias purpurea*	Anacardiaceae	for food
22	"mango"	*Mangifera indica*	Anacardiaceae	for food
23	"marañón"	*Anacardium occidentale*	Anacardiaceae	for food
24	"morro"	*Crescentia al ata*	Bignoniaceae	for food
25	"laurel"	*Cordia alliodora*	Cordiaceae	for timber
26	"madrecacao"	*Glericidia sepium*	Fabaceae	for food and timber
27	"maquilishuat"	*Tabebuia rosea*	Bignoniaceae	for food, firewood and ornamental
28	"nance"	*Byrsonima crassifolia*	Malpighiceae	for food
29	"pito"	*Erythrina berteroana*	Fabaceae	for food
30	"pina de cerco"	*Bromelia karatas*	Bromeliaceae	for food
31	"pina de cerco"	*Bromelia pinguin*	Bromeliaceae	for food
32	"quebracho negro"	*Lysiloma divaricatum*	Fabaceae	firewood
33	"tempate"	*Jatropha curcas*	Euphorbiaceae	medicinal
34	"teca"	*Tectona grandis*	Verbenaceae	for timber
35	"epacina"	*Petiveria alliace*	Phytolaccaceae	medicinal
36	"guineo"	*Musa sapientum*	Musaceae	for food
37	"suncuyita"	*Annona holosericea*	Annonaceae	for food
38	"sunsapotillo"	*Couepia poliandra*	Chrysobalanaceae	for food
39	"shakiro"	*Colubrina arborescens*	Rhamanaceae	for timber
40	"tamarindo"	*Tamarindus indica*	Fabaceae	for food

Source: Field survey, ECO Ingenieros

The enthropogenic significance is attributed to ornamental, edible, timber-yielding and medicinal species. Many of the speciess reported have been planted by the people for their own use.

VI.4.7 *Flora in the indirect area of influence*

The same ecosystems repeat themselves in the areas of indirect influence of the project, as shown in the technical drawing of the project's ecosysems.

Regarding the ecosystems encounteres in the area of indirect influence , there are four points where there are differences worth highlighting and the detail is as follows:

1. Proposed protected area, station 0+980: we found the greatest tree density towards the south, over the San Miguels volcano`s lava
2. Secondary Forest. It extends aproximately 150 to each side along the course of the Panamericana Road (CA-1) from station 3+280 and approximately untiñ 400m pass the station 3+680.
3. Taishihuat river, station 14+700 a 16+120, towards the west, at the foot of the hills and the gallery forest on the river.
4. Rio Grande in San Miguel: station 24+980, towards the north of the axis we found gallery forest's boundaries.

VI.4.8 *Fauna in the direct and indirect area of influence*

Two transects were carried out in order to achieve an thorough search. We recorded the species of fauna that were detected during the course of the proposed outline of the Bypass. During the course, we took note of all the species of land vertebrates that we observed on site. The frequency of of observation for each one was recorded.

In order to determine the mammal species present in the place, we used direct observation and search of traces, excretas, dens, scratching posts and skeletons. (Aranda 1991; Reid 2006).

For amphibians and reptiles the method of turning over rocks and fallen trunks ,fences, and clearings was used, assigning a higher priority to the areas where the puddles were formed and where the areas of the rivers have a slow flow. An identification field guide was used to identify the individuals.

To record the birds, we noted the species that were seen or heard during the course. We considered recording the nesting, feeding and distribution areas.

Interviews with the residents of the neighboring areas were also carried out with the objective of identifying the presence of some species, specially reptiles and mammals. For this purpose, field identification guides were used, which facilitated the identification of species. The information was included in an additional table (VI.49).

VI.4.8.1 Amphibians

Regarding amphibians, only one species was recorded, *Rhinella marina* "sapo sabanero"; there was only one sighting of an adult. In the area we found various places where eggs of this species had been deposited.

TABLE No. VI.41. AMPHIBIAN SPECIES GROUPED INTO FAMILIES RECORDED IN THE PROPOSED PATH OF THE SAN MIGUEL BYPASS ROAD.

ORDER	FAMILY	SPECIES	VERNACULAR NAME	FREQ. /OBS
ANURA	BUFONIDAE	*Rhinella marina*	"sapo sabanero"	1

Source: Field survey, ECO Ingenieros

VI.4.8.2 Reptiles

Twelve individuals of the reptile family were reported. They belonged to 5 families and 5 species. And in chart, 6 we recorded that the most frequent was the *Ctenosaura similis* "garrobo"; 5 individuals were recorded.

TABLE No. VI.42. REPTILE SPECIES GROUPED INTO FAMILIES RECORDED IN THE PROPOSED PATH OF THE SAN MIGUEL BYPASS ROAD.

No.	FAMILY	SPECIES	VERNACULAR NAME	FREQ./OBS
1	EMYDIDAE	*Rhinoclemmys pulcherrima*	tortuga terrestre	**1**
2	GEKKONIDAE	*Gonatodes albogularis*	geko diurno	**2**
3	IGUANIDAE	*Ctenosaura similis*	garrobo	**5**
4	TEIIDAE	*Aspidoscelis deppii*	lagartija corredora	**3**
5	COLUBRIDAE	*Conophis lineatus*	cotina	**1**
	Total		**12**	

Source: Field survey, ECO Ingenieros

VI.4.8.3 Birds

In the studied area, a total number of 952 individuals were recorded that were grouped in 27 families, and 54 species of birds; this data is shown in VI.43.

The most representative families are Tyrannidae and Icteridae with 7 individuals each, and the Columbidae family has 6.
Species with the highest rate of observation are:
White-winged dove with 165 individuals recorded; Columbina Inca with 97; and *Crotophaga sulcirostris* with 94 individuals.

According to the Threatened Species and Endangered Animals Official List (MARN 2009), three species of birds are under the category of being threatened, they are the following: *Aratinga strenua* "Pacific Parakeet", *Burhinus bistriatus* "alcaraván" or "peretete", and *Mycteria Americana* "Wood Stork".

TABLE No. VI.43. BIRD SPECIES GROUPED INTO FAMILIES RECORDED IN THE PROPOSED PATH OF THE SAN MIGUEL BYPASS ROAD.

No.	FAMILY	SPECIES	VERNACULAR NAME	FREQ./OBS	STATUS
1	ANATIDAE	*Dendrocygna autumnalis*	White-winged pichiche	**9**	
2	ODONTOPHORIDAE	*Colinus cristatus*	Quail	**19**	
3	PHALACROCORACIDAE	*Phalacrocorax brasilianus*	pato chancho, cormorán	**1**	
4	ARDEIDAE	*Ardea alba*	garzón blanco	**11**	
		Bubulcus ibis	garza vaquera	**4**	
		Butorides virescens	garcita verde	**9**	
5	CICONIDAE	*Mycteria americana*	Stork	**2**	Threatened
6	CATHARTIDAE	*Coragyps atratus*	common zopilote	**9**	
		Cathartes aura	red-headed zopilote	**30**	
7	ACCIPITRIDAE	*Buteo magnirostris*	road hawk	**4**	
		Buteo nitidus	gray hawk	**3**	
8	BURHINIDAE	*Burhinus bistriatus*	alcaraván, peretete	**1**	Threatened
9	COLUMBIDAE	*Columba livia*	pigeon of Castille	**4**	
		Patagioenas flavirostris	purple pigeon	**5**	
		Zenaida asiática	white-winged pigeon	**165**	
		Columbina inca	long-tailed turtle dove	**97**	
		Columbina talpacoti	red turtle dove	**56**	
		Leptotila verreauxi	retubula, rodadora	**2**	
10	PSITTACIDAE	*Aratinga strenua*	green parrot	**3**	Threatened

No.	FAMILY	SPECIES	VERNACULAR NAME	FREQ. /OBS	STATUS
		Brotogeris jugularis	Catalnica	**50**	
11	CUCULIDAE	*Piaya cayana*	chocolatero, piscoy	**3**	
		Crotophaga sulcirostris	pijuyo, chismuyo	**94**	
12	STRIGIDAE	*Glaucidium brasilianum*	Aurora	**1**	
13	CAPRIMULGIDAE	*Nyctidromus albicollis*	Pucuyo	**3**	
14	TROCHYUDAE	*Amazilia rutila*	brown hummingbird	**1**	
15	TROGONIDAE	*Trogon elegans*	Coa	**1**	
16	MOMOTIDAE	*Momotus momota*	Talapo	**4**	
		Eumomota superciliosa	Torogoz	**16**	
17	ALCEDINIDAE	*Megaceryle alcyon*	kingfisher	**5**	
18	PICIDAE	*Melanerpes aurifrons*	cheje, woodpecker	**11**	
19	TYRANNIDAE	*Tolmomyias sulphurescens*	copetoncito, mosquero	**1**	
		Myarchus tuberculifer	Paragüitas	**2**	
		Pitangus sulphuratus	cristofué, chío	**12**	
		Myozetetes similis	Chío	**5**	
		Megarhynchus pitangua	Chío	**5**	
		Myodinastes luteiventris	chilipío, huisillo	**1**	
		Tyrannus melancholicus	Mosquero	**24**	
20	CORVIDAE	*Calocitta formosa*	Urraca	**2**	
21	TROGLODYTIDAE	*Campylorhynchus rufinucha*	Guacalchía	**49**	
22	SYLVIIDAE	*Polioptila albiloris*	urraquita, monjita	**2**	
23	TURDIDAE	*Turdus grayi*	Cenzontle	**54**	
24	EMBERIZIDAE	*Volatinia jacarina*	Volatín	**2**	
		Sporophila torqueola	Corbatín	**30**	
		Sporophila minuta	Semillero	**11**	
		Aimophila ruficauda	chichiguetero	**17**	
25	CARDINALIDAE	*Saltator coerulescens*	Dichosofuí	**25**	
26	ICTERIDAE	*Agelaius phoeniceus*	Sargento	**8**	
		Dives dives	Tordo	**2**	
		Quicalus mexicanus	Zanate	**20**	
		Molothrus aeneus	Tordito	**23**	
		Icterus spurius	Chiltota	**2**	
		Icterus pustulatus	chiltota espalda rayada	**5**	
		Icterus gularis	chiltota espalda negra	**26**	
27	PASSERIDAE	*Passer domesticus*	common sparrow	**1**	
			TOTAL	**952**	

Source: Field Survey, ECO Ingenieros

VI.4.8.4 Mammals

Regarding mammals, a total amount of 25 individuals, were recorded through sightings and traces (footprints, excrement, perches, scratching places, and bones.) They are grouped in eight families and eight species. See table VI.44

The species with a larger amount of sightings are *Dasypus novemcinctus* and *Procyon lotor* with five, and *Urocyon cinereoargenteus* with five.

According to MARN (2009), out of these species, only one, *Cuniculus paca nelson" lowland paca" or* "tepezcuintle", is considered to be threatened.

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TABLE No. VI.44. MAMMAL SPECIES GROUPED INTO FAMILIES RECORDED IN PROPOSED PATH OF THE SAN MIGUEL BYPASS ROAD

	FAMILY	SPECIES	VERNACULAR NAME	STATUS	FREQ. /OBS
1	DIDELPHIDAE	*Didelphis marsupialis*	Tacuazín, zarigüeya		**2(i)**
2	DASYPODIDAE	*Dasypus novemcinctus*	Cusuco, armadillo		**5 (i)**
3	CUNICUUDAE	*Cuniculus paca nelsoni*	Tepescuintle	Amenazado	**1(i)**
4	DASYPROCTIDAE	*Dasyprocta punctata*	Cotuza		**2 (i)**
5	LEPORIDAE	*Sylvilagus floridanus*	conejo montes		**1(a)/4(i)**
6	MEPHITIDAE	*Mephitis macroura*	zorrillo		**1(i)**
7	PROCYONIDAE	*Procyon lotor*	Mapache		**5 (i)**
8	CANIDAE	*Urocyon cinereoargenteus*	zorra gris, gato montes		**4 (i)**
	Total				**25**

(i) INDICATIONS: FOOTPRINTS, DROPPINGS, BED SITES, SCRATCHING POSTS, SKELETONS) / (A) SIGHTINGS
Source: Field survey, ECO Ingenieros

VI.4.8.5 Description per zones

VI.4.8.5.1 Expansion Section

Two reptile species were found within the ecosystem of the Expansion Section (Chart VI.45): Gonatodes albogularis (2) and Ctenosaura simillis (1).
14 species were recorded from the bird group, out of which 12 are resident birds, and 2 resident and migratory birds.

None of them is in the Endangered and Threatened Wildlife Species Official List of MARN (2009).

Disturbance in this habitat is high due to noise and the heavy traffic of large and small vehicles passing by the highway; this is reflected in the low rate of sighted species; however, there was a higher sighting rate than in the secondary forest, probably because the section was larger, and passes through different zones.

TABLE No. VI.45. BIRD SPECIES RECORDED IN THE EXPANSION SECTION OF THE SAN MIGUEL BYPASS ROAD.

No.	SPECIES	VERNACULAR NAME	SEASONALITY
1	*Colinus cristatus*	Quail	Resident
2	*Coragyps atratus*	common zopilote	Resident and migratory
3	*Patagioenas flavirostris*	purple pigeon	Resident
4	*Zenaida asiática*	white-winged pigeon	Resident and migratory
5	*Columbina inca*	long-tailed turtle dove	Resident
6	*Columbina talpacoti*	red turtle dove	Resident
7	*Eumomota superciliosa*	Torogoz	Resident
8	*Melanerpes aurifrons*	cheje, woodpecker	Resident
9	*Tolmomyias sulphurescens*	copetoncito, mosquero	Resident
10	*Tyrannus melancholicus*	Mosquero	Resident
11	*Campylorhynchus rufmucha*	Guacalchía	Resident
12	*Turdus grayi*	Cenzontle	Resident
13	*Icterus gularis*	chiltota espalda negra	Resident
14	*Passer domesticus*	common sparrow	Resident

Source: Field survey, ECO Ingenieros

VI. 4.8.5.2 Secondary Forest

Neither amphibians nor reptiles were observed in these ecosystems. 9 species of birds were recorded, out of which 8 are resident birds, and one is a visiting, reproductive species, *Myodinastes luteiventris, this species hibernates in South America and breeds in El Salvador* (chart VI.46).

The site is used as a shelter for these species of birds; it's also used as a nesting place, due to the presence of tall trees, it was observed that they are used to build nests.
Some traces of mammals were also seen in this site: scratch places of a *Dasypus novemcinctus,* and bones from a *Didelphis marsupialis*; they possibly utilize the place for shelter and food supply. It also shows a low number of recorded species, probably because of the relatively small forest area that will be impacted by the project.

TABLE No. VI.46. BIRD SPECIES RECORDED IN THE SECONDARY FOREST IN THE PROPOSED PATH OF THE SAN MIGUEL BYPASS ROAD.

No.	SPECIES	VERNACULAR NAME	SEASONALITY
1	*Momotus momota*	Talapo	Resident
2	*Eumomota superciliosa*	Torogoz	Resident
3	*Megarhynchus pitangua*	Chío	Resident
4	*Myodinastes luteiventris*	chilipío, huisillo	Visiting breeder
5	*Campylorhynchus rufinucha*	Guacalchía	Resident
6	*Turdus grayi*	Cenzontle	Resident
7	*Aimophila ruficauda*	Chichiguetero	Resident
8	*Saltator coerulescens*	Dichosofuí	Resident
9	*Icterus gularis*	chiltota espalda negra	Resident

Source: Field survey, ECO Ingenieros

VI. 4.8.5.3 Gallery Forest

In this ecosystem highly impacted by crops, a species of reptile was found: *Conophis lineatus*; 19 species of birds, out of which 6 are resident and migratory birds, one reproductive visitor (*Myodinastes luteiventris*), and one migratory species (*Megaceryle alcyon*).
Among them, the *Mycteria americana* and *Aratinga strenua* fall in the category of **threatened,** this is according to the Endangered and Threatened Wildlife Species Official List (MARN, 2009) (Chart VI.47).
2 mammal species were recorded: *Procyon lotor* and *Mephitis macroura*.

TABLE No. VI.47. BIRD SPECIES RECORDED IN THE SECONDARY FOREST OF THE SAN MIGUEL BYPASS ROAD.

No.	SPECIES	VERNACULAR NAME	SEASONALITY	STATUS
1	*Dendrocygna autumnalis*	White-winged pichiche	Resident	
2	*Phalacrocorax brasilianus*	pato chancho, cormorán	Resident	
3	*Ardea alba*	garzón blanco	Resident and migratory	
4	*Bubulcus ibis*	garza vaquera	Resident	
5	*Butorides virescens*	garcita verde	Resident and migratory	
6	*Mycteria americana*	Stork	Resident and migratory	Threatened
7	*Coragyps atratus*	common zopilote	Resident and migratory	
8	*Cathartes aura*	red-headed zopilote	Resident and migratory	
9	*Zenaida asiática*	white-winged pigeon	Resident and migratory	

No.	SPECIES	VERNACULAR NAME	SEASONALITY	STATUS
10	*Columbina inca*	long-tailed turtle dove	Resident	
11	*Columbina talpacoti*	red turtle dove	Resident	
12	*Aratinga strenua*	Central American green	Resident	Threatened
13	*Brotogeris jugularis*	Cat Inica	Resident	
14	*Piaya cayana*	chocolatero, piscoy	Resident	
15	*Crotophaga sulcirostris*	pijuyo, chismuyo	Resident	
16	*Nyctidromus albicollis*	Pucuyo	Resident	
17	*Trogon elegans*	Coa	Resident	
18	*Momotus momota*	Talapo	Resident	
19	*Eumomota superciliosa*	Torogoz	Resident	
20	*Megaceryle alcyon*	kingfisher	Migratory	
21	*Melanerpes aurifrons*	cheje, woodpecker	Resident	
22	*Pitangus sulphuratus*	cristofué, chío	Resident	
23	*Myodinastes luteiventris*	chilipío, huisillo	Visiting breeder	
24	*Campylorhynchus rufinucha*	Guacalchía	Resident	
25	*Polioptila albiloris*	urraquita, monjita	Resident	
26	*Sporophila torqueola*	Corbatín	Resident	
27	*Saltator coerulescens*	Dichosofuí	Resident	
28	Icterusgularis	chiltota espalda negra	Resident	

Source: Field survey, ECO Ingenieros

VI. 4.8.5.4 Crop and grass lands

This ecosystem recorded a species of amphibious, *Rhinella marin;,* numerous egg deposits were found in the pasture. Among the reptiles, 3 species were found, two of them, the *Ctenosaura similis and the Aspidoscelis depp;,* they were found in the crops and living fences; while the *Rhinoclemmys pulcherrima,* was seen in the pastures.
45 bird species were recorded, out of which 38 are resident species, 6 resident and migratory, and one migratory (*Icterus spurius*).
According to the Endangered and Threatened Wildlife Species Official List (MARN, 2009), two of the recorded species in this ecosystem fall in the category of **Threatened:**
(*Mycteria americana and Burhinus bistriatus*).
The recorded mammals in this ecosystem belong to six species: Didelphis marsupialis, Dasypus novemcinctus, Dasyprocta punctata, Urocyon cinereoargenteus, Sylvilagus floridanus, and Cuniculus paca; this last one, falls in the category of threatened according to the Endangered and Threatened Wildlife Species Official, MARN, 2009.

TABLE No. VI.48. BIRD SPECIES RECORDED IN CROPLAND AND GRASSLAND ECOSYSTEMS OF THE SAN MIGUEL BYPASS ROAD.

No.	SPECIES	VERNACULAR NAME	SEASONALITY	STATUS
1	*Colinus cristatus*	Quail	Resident	
2	*Ardea alba*	garzón blanco	Resident and migratory	
3	*Bubulcus ibis*	garza vaquera	Resident	
4	*Butorides virescens*	garcita verde	Resident and migratory	

No.	SPECIES	VERNACULAR NAME	SEASONALITY	STATUS
5	*Mycteria americana*	Stork	Resident and migratory	Threatened
6	*Coragyps atratus*	common zopilote	Resident and migratory	
7	*Cathartes aura*	red-headed zopilote	Resident and migratory	
8	*Buteo magnirostris*	road hawk	Resident	
9	*Buteo nitidus*	gray hawk	Resident	
10	*Burhinus bistriatus*	alcaraván, peretete	Resident	Threatened
11	*Columba livia*	pigeon of Castille	Resident	
12	*Zenaida asiática*	white-winged pigeon	Resident and migratory	
13	*Columbina inca*	long-tailed turtle dove	Resident	
14	*Columbina talpacoti*	red turtle dove	Resident	
15	*Leptotila verreauxi*	retubula, rodadora	Resident	
17	*Brotogeris jugularis*	Catalnica	Resident	
18	*Piaya cayana*	chocolatero, piscoy	Resident	
19	*Crotophaga sulcirostris*	pijuyo, chismuyo	Resident	
20	*Glaucidium brasilianum*	Aurora	Resident	
21	*Amazilia rutila*	brown hummingbird	Resident	
22	*Trogon elegans*	Coa	Resident	
23	*Momotus momota*	Talapo	Resident	
24	*Eumomota superciliosa*	Torogoz	Resident	
25	*Melanerpes aurifrons*	cheje, woodpecker	Resident	
26	*Pitangus sulphuratus*	cristofué, chío	Resident	
27	*Myozetetes similis*	Chío	Resident	
28	*Megarhynchus pitangua*	Chío	Resident	
29	*Tyrannus melancholicus*	Mosquero	Resident	
30	*Calocitta formosa*	Urraca	Resident	
31	*Campylorhynchus rufinucha*	Guacalchía	Resident	
32	*Polioptila albiloris*	urraquita, monjita	Resident	
33	*Turdus grayi*	Cenzontle	Resident	
34	*Volatinia jacarina*	Volatín	Resident	
35	*Sporophila torqueola*	Corbatín	Resident	
36	*Sporophila minuta*	Semillero	Resident	
37	*Aimophila ruficauda*	Chichiguetero	Resident	
38	*Saltator coerulescens*	Dichosofuí	Resident	
39	*Agelaius phoeniceus*	Sargento	Resident	
40	*Dives dives*	Tordo	Resident	
41	*Quicalus mexicanus*	Zanate	Resident	
42	*Molothrus aeneus*	Tordito	Resident	
43	*Icterus spurius*	Chiltota	Migratory	
44	*Icterus pustulatus*	chiltota espalda rayada	Resident	
45	*Icterus gularis*	chiltota espalda negra	Resident	

Source: Field survey, ECO Ingenieros

VI.4.8.6 Fauna species reported by residents living in the area.

Through personal communication with people living in the area,[7] local fauna are shown Chart VI.49.

[7] Mr. Antonio Cartagena, Mr. Antonio Amaya

TABLA No. VI.49. REPTILE AND MAMMAL SPECIES RECORDED BY THE INHABITANTS OF THE SAN MIGUEL BYPASS ZONE

Group	Species	Common name
Reptiles	*Masticophis mentovañus*	Zumbadora
	Senticolis tñaspis	Ratonera
	Boa constñctor	Masacuata
	Crotalus si mus	Cascabel
	Oxybelis aeneus	Bejuquilla café
Mammals	*Odocoileus virginianus*	Venado cola blanca
	Leopardus pardalis	Ocelote

Source: Field Survey, Eco Ingenieros

VI.4.8.7 Bird distribution

It is important to know bird distribution, because according to Komar and Domínguez (2001), this distribution provides information about the type of habitat recorded for each species in the country.

On chart VI.50 we can see that out the 54 observed species, and according to the distribution, seven are Aquatic Habitat Specialists (W), which were found in the Gallery Forest Ecosystem; 28 are Open Habitat Generalists (OG), and 17 are Altitudinal Generalists (AG), these species were sighted throughout the route.

5 Open Habitat Specialists (OS) were also recorded, and 19 are Forest Generalists (FG).

Out of all of them, 31 are characteristic species to Low Lands (L).

The Open Habitat Generalists (OG) and the Forest Generalists (FG) do not require a forest structure in a good conservation status; therefore, it was expected for these species to be found in a fragmented habitat just like the secondary forest, which is a secondary forest and cropland at the same time.

It is important to highlight that not many Specialist habitat bird species have been found, this indicates that the impact on the proposed section is a disturbed area.

TABLE No. VI.50. LIST OF BIRDS AND DISTRIBUTION ACCORDING TO KOMAR AND DOMINGUEZ (2001) OBSERVED ALONG THE PROPOSED PATH FOR CONSTRUCTION OF THE SAN MIGUEL BYPASS ROAD

No.	SPECIES	VERNACULAR NAME	DISTRIBUTION
1	*Dendrocygna autumnalis*	White-winged pichiche	W
2	*Col irius cristatus*	Quail	OG, L
3	*Phalacrocorax brasilianus*	pato chancho, cormorán	W
4	*Ardea alba*	garzón blanco	W
	Bubulcus ibis	garza vaquera	W
	Butorides virescens	garcita verde	W
5	*Mycteria americana*	Stork	W
6	*Coragyps atratus*	common zopilote	OG, AG
	Cathartes aura	red-headed zopilote	OG, AG
7	*Buteo magnirostris*	road hawk	OG, L
	Buteo nitidus	gray hawk	FG, L
8	*Burhinus bistriatus*	alcaraván, peretete	OS, L,
9	*Columba livia*	pigeon of Castille	OG, AG
	Patagioenas flavirostris	purple pigeon	FG, AG

No.	SPECIES	VERNACULAR NAME	DISTRIBUTION
	Zenaida asiática	white-winged pigeon	FG, OG, AG
	Columbina inca	long-tailed turtle dove	OG, L
	Columbina talpacoti	red turtle dove	OG, L
	Leptotila verreauxi	retubula, rodadora	FG, L
10	*Aratinga strenua*	green parrot	FG, AG
	Brotogeris jugularis	Catalnica	FG, L
11	*Piaya cayana*	chocolatero, piscoy	FG, L
	Crotophaga sulcirostris	pijuyo, chismuyo	OG,AG
12	*Glaucidium brasilianum*	Aurora	FG, L
13	*Nyctidromus albicollis*	Pucuyo	OG, L
14	*Amazilia rutila*	brown hummingbird	OG, L
15	*Trogon elegans*	Coa	FG, L
16	*Momotus momota*	Talapo	FG, AG
	Eumomota superciliosa	Torogoz	OG, L
17	*Megaceryle alcyon*	kingfisher	W, OS,L
18	*Melanerpes aurifrons*	cheje, woodpecker	OG, FG, L
19	*Tolmomyias sulphurescens*	copetoncito, mosquero	FG, L
	Mylarchus tuberculifer	Paragüitas	FG, AG
	Pitangus sulphuratus	cristofué, chío	OG, FG, L
	Myozetetes similis	Chío	FG, L
	Megarhynchus pitangua	Chío	FG, AG
	Myodinastes luteiventris	chilipío, huisillo	FG, L
	Tyrannus melancholicus	Mosquero	OG, L
20	*Calocitta formosa*	Urraca	OG, AG
21	*Campylorhynchus rufinucha*	Guacalchía	OG, L
22	*Polioptila albiloris*	urraquita, monjita	OS, L
23	*Turdus grayi*	Cenzontle	FG, AG
24	*Volatinia jacarina*	Volatín	OG, AG
	Sporophila torqueola	Corbatín	OG, L
	Sporophila minuta	Semillero	OS, L
	Aimophila ruficauda	Chichiguetero	OG, L
25	*Saltator coerulescens*	Dichosofuí	OG, AG
26	*Agelaius phoeniceus*	Sargento	OS, L
	Dives dives	Tordo	OG, AG
	Quicalus mexicanus	Zanate	OG, AG
	Molothrus aeneus	Tordito	OG, L
	Icterus spurius	Chiltota	OG, L
	Icterus pustulatus	chiltota espalda rayada	OG, FG, AG
	Icterus gularis	chiltota espalda negra	OG, FG, L
27	*Passer domesticus*	common sparrow	OG, L

AG: Altitudinal generalist, FG: Forest / Jungle Generalist, FS: Forest / Jungle Specialist, H: Mainly Highlands, L: Mainly Lowlands, OG: Open habitat generalist, OS: Open habitat specialist, W: Aquatic habitat specialist
Source: Field survey, ECO Ingenieros

VI.4.8.8 Ecological significance of fauna species

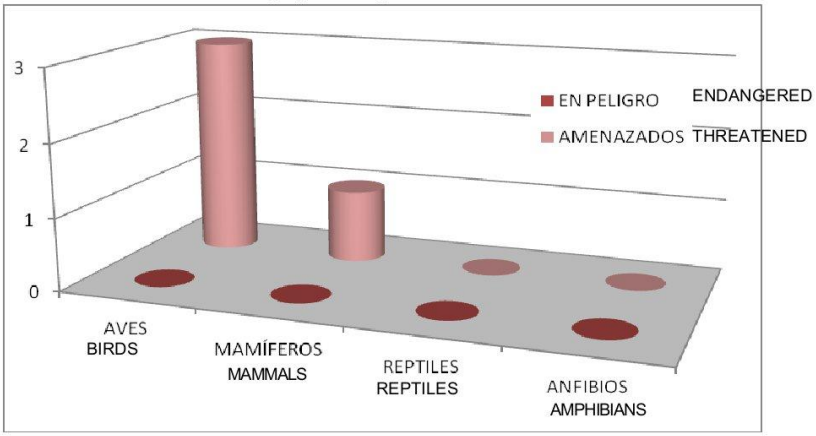
The following table shows the identified species in the project's area that are in a critical status.

TABLE No. VI.51. ECOLOGICAL SIGNIFICANCE OF FAUNA SPECIES, BYPASS OF SM2011

GROUP	FAMILY	SPECIES	VERNACULAR NAME	FREQ. /OBS	STATUS
BIRDS	CICONIDAE	*Mycteria americana*	Stork	**2**	Threatened
	BURHINIDAE	*Burhinus bistriatus*	alcaraván, peretete	**1**	Threatened
	PSITTACIDAE	*Aratinga strenua*	green parrot	**3**	Threatened
MAMMALS	CUNICUUDAE	*Cuniculus paca nelsoni*	Tepescuintle	**1(i)**	Threatened

MARN (2009)
Source: Field survey, ECO Ingenieros

According to the 2009 MARN list of threatened or endangered wildlife species, three bird species and one species of mammal fall in the category of being threatened to extinction.



Source: Field Survey, Eco Ingenieros

Graphic No. VI.23. Number of fauna species that are in critical ecological status according to the sampling, 2011 SM BYPASS

VI.4.9 Project's impact on the analysis sectors

- Expansion section

This area is highly disturbed due to human presence; the current highway has already generated a barrier effect, which will remain with the project's expansion. There are no remains of the native vegetation, with the exception of the lava area, station 0+980 that will be shown later in the report.

The fauna species are characteristic to ecosystems with human presence. Disturbance in this habitat is high because of the noise and the heavy traffic of small and large vehicles passing by; this reflects the low number of fauna species observed, however more species were seen than in the secondary forest.

Trees will be cut down on the right of way, but the inhabitants will contribute by planting species that are similar to the current species.

Even though it is a disturbed area, it shows a larger number of reported species than the forest area itself, and has a high arboreal density due to the presence of ornamental trees.
The project in this section consists of the existing road expansion, which is why its main effect will be tree reduction in the area, due to the expansion.
In the case of fauna, there is no significant impact; it's almost the same to the current status.

- *Secondary forest*

The secondary forest is located in private property, and it's not protected for its conservation. On the other hand, the current highway has already caused fragmentation of this habitat. To obtain water, the present species move around the forest zone and in gorges in the area outside of the forest, around the disperse trees in the cropland, and even in neighborhoods.
Some mammal species use the site as a shelter and a place to feed themselves, and also as a nesting site because of the tall trees.

In the case of the "tepezcuintle" or lowland paca, it possibly lives there, too; but no dens were found; most likely, it moves around in the area; now if the population is impacted, its movements around the area will also be disturbed.

Some authors mention that the "tepezcuintle" is completely vegetarian, that it eats a variety of fruits and vegetables, including sprouts, roots, tubers, bulbs, rhizomes, leaves, and herbs (MÉNDEZ, 1993). According to URIBE and ORTIZ (1993), *Agouti paca* is a rodent that lives by itself or in couples in the gallery forests and grasslands, feeding on tubers, fruit, and fallen seeds. Likewise, LEOPOLD (1977) mentions that "tepescuintles" are strictly vegetarian; they normally prefer different types of fruit and wild seeds, but sometimes they switch to crop products like corn, sugar cane, melons, and pumpkins. . PÉREZ-TORRES (1996) and (CORTEZ, 1993) confirm that they are mainly fruitarian and their diet varies with the season according to fruit availability; they occasionally eat leaves, seeds, and flowers that have a low fecundity.

GONZÁLEZ & RÍOS (2002) report that they live in dens or caves that generally other animals make, and that they adapt these dens to fit their needs; these dens have multiple entries disguised with dry leaves (with two or three exits, chambers to sleep), they are located near sources of water (lakes, ponds, rivers, gorges,) where they usually urinate, defecate, and occasionally mate; these are good locations for them to escape their predators because they are very good swimmers and are able to remain under the water for several minutes.
The nearest gorge is located to the east, in the area where the current road, crops, and pastures are located, it probably moves around these areas.
The forest area will be "cut" in the northern part, leaving approximately a third of the area to the east, and two thirds to the west, these are important areas.

It is important to mention that this zone is composed of private land lots, and that their protection and future use cannot be defined.

- *Crops and pasture zones*

Crop and pasture lands show the largest disturbance due to human presence, with the presence urban and rural neighborhoods.
The slope areas show more vegetation and therefore more presence of fauna.
In these highly divided areas, the fragmentation impact is reduced because of the relatively close to each other walkways, which become walkways for fauna in these areas.

A good portion of this section, where the landfills will be located, trees used as food by the fauna, will be planted on the roadside, by the slopes; these trees will contribute to improve the arboreal coverage and will favor fauna presence, especially birds, moving in the area.

- *Riparian forest*

These remains of fauna and vegetation are highly disturbed due to the crops nearby; there are some river sections where forest continuity is lost.
Bridges are projected to be built at major heights on the terrain, therefore, with the exception of large trees, vegetation and mobilization areas for fauna will not be impacted.
The most vegetated section is the walkway on the Grande de San Miguel River due to the thick vegetation.
On the Taishihuat and Grande de San Miguel rivers northern walkways, there is very little arboreal vegetation on the project's crossing point.

The species classified as threatened or endangered were seen in the most vegetated zones on the Grande de San Miguel River's southern walkway, these will not be impacted by the project.
The Project will be a viaduct in this area, and it will not affect the fauna movement.

Species information details:

♦ Stork, *Mycteria americana*

The stork *(Mycteria americana)* feeds on fish, small mammals, and flying insects. They commonly hunt in small groups of 6 individuals in a compact phalanx. They move their beaks open inside the water from side to side to herd and group fish, and then they shut their beaks abruptly if contact has been made.

It can be found in a variety of habitats with fresh and salt water; they look for areas with shallow water containing fish concentrations.

Swamp lands provide migratory birds with everything they need to survive during the winter time: nice weather, abundant food, shelter, and protection, just like the stork *(Mycteria americana)* and others.

Swamp lands have quiet, warm waters, and this provides birds and crustaceans an ideal setting to mate, feed, and protect their offspring away from sea currents. Birds and animals live on trees or in the grassland; and the tropical weather –warm and humid- favors the presence of several animal species adapted to live in these conditions.

- Green parakeet, *Aratinga strenua*

The green parakeet (Aratinga strenua) lives in forest areas or in partially deforested areas. They are commonly seen along rivers, forest boundaries, and semi-open areas.
They form small flocks of up to 30 individuals, and may gather in an even larger number during the mating season, on trees with good fruition like "higuerones" (Ficus spp.).

They feed on fruit. Their preferred fruit are figs, guavas, and some melastomataceae. They also feed on a fruit called "javillo" *(Hura* sp.), *Hyeronima* on the forest canopy. In open areas they also eat "guava" *(Psidium guajaba).*

- Peretete *(Burhinus bistriatus)*

It lives on the savannah, pastures, burned areas, and areas with open scrub lands. It feeds on insects, warms, snails, scorpions, reptiles, and small frogs, and some seeds and sprouts.
Their nest consists of a scratched area on plain ground. They lay 1 to 2 light-olive colored eggs, with black, light-brown, and gray spots. Eggs measure around 57 x 41 mm. The incubation period lasts some 27 days

VI.4.10 Biological Interest Areas

VI.4.10.1 Protected Natural Areas

According to the definition made by the Protected Natural Areas Law, Legislative Decree No. 579/2005, in article 4, protected natural areas are those areas in the national territory owned by the State, the Municipality, autonomous entities, or private owners, legally established with the objective to promote conservation, sustainable management, and fauna and flora restoration, and related resources and their natural and cultural interactions that may have high significance because of their genetic, historical, scenic, recreational, archeological, and protective values in such a way that they preserve the natural state of the biotic communities and the unique geomorphologic phenomena. "

In the Protected Areas Law was passed on February 2005, Legislative Decree 579, the State acknowledged how sensitive El Salvador's environmental situation was, and it created measures to protect biodiversity and irreplaceable resources; at the same time it guaranteed sustainable development.

Based on this Law, the protected natural areas' map is promulgated for newly declared protected areas in specific agreements and based on local and punctual studies developed by different organizations.

On article 9 this law states:
"The Protected Natural Areas System, from now on called the System, will be constituted by areas that are property of the State, the Municipalities, and autonomous entities. Private lots that are of interest for conservation may be part of the System, if they are in accordance with what article 11 of this law states". ... "Continental and artificial wetlands, craters, lavas, rocky outcrops, lakes, lagoons, artificial or natural coral and rocky reefs, and cliffs are part of the State's natural heritage, and as long as **no private ownership is stated,** they will be considered as national assets. Therefore, **the Ministry will qualify and determine its incorporation into the system.**"

On plan VI-12 for Protected Natural Area, there is a detailed explanation of the project's section with regards to the protected natural areas.
The protected natural area around the San Miguel Volcano, shown in the map, is a "colada de lava" (lava flow), that reaches the project's expansion section, and it crosses on station 0+960.

Figure No. VI.10. Project location with regards to the biological corridor and the protected natural areas
The San Miguel volcano protected area is a lava area that reaches the project's expansion section (dark green) and the biological corridor is shown in light shade.

Figure No. VI.ll. Proposed protected area of the San Miguel volcano in the project's zone

The land on the analysis area is private property; it belongs to several families that are recorded at the CNR. The start point on this area is latitude 13°30´41.14" north, and 88°14´54.68" west longitude, and the end point is latitude 13°30´39.96" north, and 88°14´50.79" west longitude.

For completion, the Ministry of Environment was requested to run its evaluation on this area and its status, a note with the following code was received: MARN-DGGA-PN-GANP-CB-0720/2012, dated May 17, 2012, in which a resolution is issued identifying the area as "potential" to be integrated into the Protected Natural Areas System; it does not have any official protection currently, but it has been taken into consideration, according to recommendations, to include it as part of the compensation because of the areas that will have impermeability. (See annex III.3)

The other considered area is located between stations 3+750 and 4+060 of the Project. We asked the Salvadoran Institute for Agricultural Development (ISTA) about the impact on the proposed protected zone of El Obrajuelo, and as an answer we received the note DR.00.352.12 where they state that after evaluating the zone, the Bypass Project will not cause impact on the property. (See Annex III.4)

It was consulted with the City Hall with regards to a parcel with a forest and it covers some 150 to each side of the Pan American highway (CA-1), from station 3+280 up to some 400 meters after station 3+680. It was verbally reported that those parcels do not belong to the City Hall, and that they are not recorded as a protected natural area; however they didn't want to give us any written document that would support their statement. According to the study, these parcels are private property.

VI.4.11 *Biological corridors*
Based on the investigation, these land lots belong to regular people.
According to article 25 of the protected natural areas, the SANP will be used as a reference for the national biological corridor establishment; this is to prevent any activity that takes place there from damaging the State's Natural Heritage conservation; this will be acheived by holding sustainable, productive activities, contributing to the establishment of the Mesoamerican Biological Corridor.
Biological corridors facilitate physical communication among isolated fragments in order to maintain the natural genetic dispersion and increase species propsperity, for the benefit of endangered wildlife, and vegetation species that depend on birds and other animals to spread their seeds and maintain their diversity (Erazo Sosa & Monterrosa Urías, 2000).
The project does not cross the proposed biological corridor at any point.

YlA.U Current vegetation plans

Beside the plot survey, a topographical survey of all the trees was run on the analysis section in order to determine the total amount of trees in the Project area, just as it was explained in the methodology section.

In the topographic blueprints of structures and trees No. VI-1/1 a VI-1/18, the appendix shows trees location in the project's section, and the trees to be cut down according to the arboreal census. Annex VI.8 shows the Total Arboreal Census

Species vary from the ones recorded in the parcel section, this is because the census team recorded species that were not observed in the plot survey, and even some plots were partially located in the indirect impact area, therefore, they report species that are not in the census.

VI.4.12.1 Trees to be cut down and compensation sites

2,647 trees will be cut down; the list with their location, species, DAP, and height is in annex VI-8. They are summarized per species in the following chart.
27,635 trees will be planted to compensate the felling; this includes the 10x1 compensation of trees, 25x1 of trees in sensitive ecological status, and one thousand trees to compensate the loss of infiltration.

TABLE No. VI.52. TOTAL NUMBER OF SPECIMENS TO BE FELLED BY SPECIES

VERNACULAR NAME	SCIENTIFIC NAME	SPECIES	No. INDIVIDUALS
"olive tree"	*Simarouba glauca*	Simaroubaceae	43
"aguacate"	*Persea americana*	Lauraceae	3
"almendro de río"	*Andira inermis*	Fabaceae	120
"amate"	*Ficus goldmanii*	Moraceae	16
"anona"	*Annona sp.*	Annonaceae	1
Árbol de Almirio			3
Árbol de Floramar			3
"árbol de fuego"	*Delonix regia*	Fabaceae	24
Cablot/Cablote	*Guazuma ulmifolia Lam*		2
"cabo de hacha"	*Luehea candida*	Tiliaceae	1
Candil	*Phlomis liychnitis*		2
"caoba"	*Swietenia humilis*	Meliaceae	7
"carao"	*Cassia grandis*	Fabaceae	40
"carreto"	*Samanea saman*	Fabaceae	93
"castaño"	*Sterculia apétala*	Sterculiaceae	3
"cedro"	*Cedrela odorata*	Meliaceae	4
"caulote"	*Guazuma ulmifolia*	Sterculiaceae	64
"ceiba"	*Ceiba pentandra*	Bombacaceae	36
"cenicero"	*Samanea saman*	Fabaceae	1
"cerezo de Belice"	*Siyzygium cumini*	Myrtaceae	11
"chaparro"	*Curatella americana*	Dilleniaceae	3
Chaperno	*Lonchocarpus sp.*	Fabaceae	28
Chicahuit			12
Chichipate	*Acosmium panamense*		2
Chilamatal			3
"chilamate"	*Sapium glandulosum*	Euphorbiaceae	52
Cicahuite	Lysiloma auritum	Fabaceae	5
Cincho	*Lonchocarpus rugosus*	Fabaceae	11
Coco	*Cocos nucífera*	Arecaceae	20
"conacaste negro"	*Enterolobium cyclocarpum*	Fabaceae	354

VERNACULAR NAME	SCIENTIFIC NAME	SPECIES	No. INDIVIDUALS
"copinol"	*Hymenaea courbaril*	Fabaceae	**3**
"carao"	*Cassia grandis*	Fabaceae	**1**
"cortés blanco"	*Tabebuia chrysantha*	Bignoniaceae	**29**
Ébano	***Diospyros* sp**	Ebenaceae	**1**
Creto			**6**
Crusito			**4**
"eucalipto"	*Eucalyptus camaldulensis*	Myrtaceae	**75**
Flor Amarilla			**1**
"flor de fuego"	*Delonix regia*	Fabaceae	**9**
"guachipilín"	*Diphysa americana*	Fabaceae	**3**
"guanaba"	*Anona muricata*	Annonaceae	**1**
"guayabo"	*Psidium guajaba*		**10**
"huilihuiste"	*Karwinskia calderoni*	Rhamanaceae	**27**
"irayol"	*Genipa americana*	Rubiaceae	**1**
"Jila o shila Colorado"	*Pseudobombax ellipticum*		**1**
"jiote"	*Bursera simaruba*	Burseraceae	129
"jocote jobo"	*Spondias mombin*	Anacardiaceae	**1**
"jocote"	*Spondias purpurea*	Anacardiaceae	**78**
Jute			**1**
"caimito"	*Chrysophyllum cainita*		**1**
Kiwi	*Actinidia chinensis*		**1**
"laurel negro"	*Cordia alliodora*	Boraginaceae	**50**
Limonillo	*Colubrina heteroneura*	Rhamnaceae	**1**
Llama del Bosque	*Spathodea campanulata*	**Bignoniaceae**	**4**
Macaco			**40**
"madrecacao"	*Gliricidia sepium*	Fabaceae	**47**
Mamón	*Melicoccan bijuga*		**6**
"mango"	*Mangifera indica*	Anacardiaceae	**75**
"mangollano"	*Pithecellobium dulce*	Fabaceae	229
Manoleon	*Dendropanax arboreus*		**1**
Manune			**1**
"maquilishuat"	*Tabebuia rosea*	Bignoniaceae	171
"marañón de pepa"	*Anacardium occidentale*	Anacardiaceae	**12**
Matazano	*Casimiroa edulis*		**7**
"palo mora"	*Chlorophora tinctoria*	Moraceae	**11**
Morral			**1**
"morro"	*Crescentia a lata*	Bignoniaceae	**18**
"mulato"	*Triplaris melanodendrum*	Polygonaceae	**3**
Nacaspilo			**1**
"nance"	*Byrsonima crassifolia*	Malpighiaceae	**16**
Naranjo	***Citrus sinensis***	Rutaceae	**4**
Olivo			**3**
Pacún	*Sapindus saponaria*	Sapindaceae	**8**
"papaturro"	*Coccoloba caracasana*	Polygonaceae	**9**
Papelio			**1**
Paraíso	*Melia* ***azedarach***	**Meliaceae**	**2**
Pata de gallo	*Camedrio Teucrium Chamaedrys*		**9**

VERNACULAR NAME	SCIENTIFIC NAME	SPECIES	No. INDIVIDUALS
Paternillo			**6**
Paterno	*Inga paterna*	Fabaceae	**4**
Pepeto	*Inga spp*	Fabaceae	**5**
Pino	*Pinus sp.*	Pinaceae	**6**
"pintadillo"	*Piptadenia constñcta*	Fabaceae	**9**
"pito"	*Erythrina berteroana*	Fabaceae	**6**
"polvo queso o conacaste blanco"	*Albinia niopoides*	Fabaceae	**3**
"quebracho"	*Lysiloma divaricatum*	Fabaceae	**55**
Salamandra			**1**
Sambrano	*Cassia retícula*		**3**
San Andrés	*Tecoma Stans*	Bignoniaceae	**18**
"tamarindo"	*Tamarindus indica*	Fabaceae	**8**
Tapaculo	*Genipa americana*		**4**
"tecomasuche"	*Cochlospermum vitifolium*	Cochlospermaceae	**21**
"teca"	*Tectona grandis*	Verbenaceae	**3**
"tihuilote"	*Cordia alba*	Boraginaceae	397
Tinte			**4**
Zapote	*Pouteria sapota*	Sapotaceae	**1**
"zope"	*Piscidia carthagenensis*	Fabaceae	**1**
"zona o carreto"	*Samanea saman*	Fabaceae	**2**
"zorro o memble"	*Poeppigia procera*	Fabaceae	**10**
TOTAL TREES TO BE FELLED			**2,647.00**

SPECIES	SCIENTIFIC NAME	INDIVIDUALS
Aceituno	*Simarouba glauca*	**43**
Aguacate	*Persea americana*	**3**
Almendro	*Andira inermis*	120
Amate	*Ficus trigonata*	**16**
Anona	*Annona cherimola*	**1**
Árbol de Almirio		**3**
Árbol de Floramar		**3**
Árbol de Fuego	*Grevillea robusta*	**24**
Cablot/Cablote	*Guazuma ulmifolia Lam*	**2**
Cacha	*Abarema idiopoda*	**1**
Candil	*Phlomis lychnitis*	**2**
Caoba	*Swietenia humilis*	**7**
Carao	*Cassia grandis*	**41**
Carreto	*Pithecollobium saman*	**93**

Castaño	*Castanea sativa*	**3**
Cedro	*Cedrela adorata*	**4**
Caulote	*Guazuma ulmifolia*	**64**
Ceiba	*Ceiba pentandra*	**36**
Cenizo	*Chenopodium álbum*	**1**
Cerezo	*Prunus avium*	**11**
Chaparro	*Quercus coccifera*	**3**
Chaperno	*Lonchocarpus sp.*	**28**
Chicahuit		**12**
Chichipate	*Acosmiun panamense*	**2**
Chilamatal		**3**
Chilamate	*Sapium macrocarpum*	**52**
Cicahuite	*Aspidosperma quebracho-blanco*	**5**
Cincho	*Chenopodium álbum*	**11**
Coco	*Cocus nucifera*	**20**
Conacaste	*Enterolobium cyclocarpum*	354
Copinol	*Hymenaea courbaril*	**3**
Cortez	*Tabebuia chrysantha*	**29**
Ébano	*Diospyros ebenum*	**1**
Creto		**6**
Crusito		**4**
Eucalipto	*Eucalyptus camaldulensis Dehn*	**75**
Flor Amarilla	*Cassia fistula*	**1**
Flor de Fuego	*Delonix regia*	**9**
Guachiplin	*Diphyna americana*	**3**
Guanaba	*Annona muricata*	**1**
Guayabo	*Psidium guajava*	**10**
Huilihuiste		**27**
Irayol	*Genipa americana*	**1**
Jila		**1**
Jiote	*Bursera simaruba*	129
Jobo	*Spondias Bombin*	**1**
Jocote	*Spondias purpurea*	**78**
Jute		**1**
Caimito	*Chrysophyllum caimito*	**1**
Kiwi	*Actinidia chinensis*	**1**
Laurel	*Cordia alliodora*	**50**
Limonillo	*Quassia amara* (**Simarubáceae)**	**1**

Llama del Bosque	*spathodea campanulata*	4
Macaco	*Araucaria araucana*	40
Madrecacao	*Gliricidia sapium*	47
Mamón	*Melicoccan bijuga"*	6
Mango	*Mangifera austroyunnanensis*	75
Mangollano	*Pithecolobium dulce*	229
Manolion	*Dendropanax arboreus*	1
Manune		1
Maquilishuat	*Tabebuia rosea*	171
Marañón	*Anacardium occidentale*	12
Matasano	*Casimiroa edulis*	7
Mora	*Madura tinctoria*	11
Morral		1
Morro	*Crescentia a lata*	18
Mulato	*Triplaris melaenodendron*	3
Nacaspilo	*Caesalpinia coriaria*	1
Nance	*Byrsonima crassifolia*	16
Naranjo	*Tabelula rosea*	4
Olivo		3
Pacún	*Sapinda saponaria*	8
Papaturro	*Coccoloba caracasana*	9
Papelio		1
Paraíso	*Melia azederach*	2
Pata de gallo	*CamedrioTeucrium Chamaedrys*	9
Paternillo		6
Paterno	*Inga paterno*	4
Pepeto	*Inga vera*	5
Pino	*Pino ayacahuite*	6
Pintadillo	*Caesalpinia eriostanchys*	9
Pito	*Erythrina berteroana*	6
Polvo de queso		3
Quebracho	*Lysiloma divaricatum*	55
Salamandra		1
Sambrano	*Cassia reticula*	3
San Andrés	*Tecota stans*	18
Tamarindo	*Parkia pendula*	8
Tapaculo	*Genipa americana*	4
Tecomashuche	*Cochlospermun vitifolium*	21

Teca	*Tectona grandis*	3
Tiguilote	*Cordia dentata poir*	397
Tinte		4
Zapote	*Pouteria sapota*	1
Zope	*Schizolobium parahyba*	1
Zorra	*Samanea saman*	2
Zorro	*Wodyetia bifurcata*	10
TOTAL TREES TO BE FELLED		**2,647.00**

The total amount of shrubs to be cut was selected based on shrub density found in the parcels. No shrub census was performed. Calculation in detail:

TABLE No. VI.53. SHRUBS TO BE FELLED, SM BYPASS ROAD, 2011

ZONE	PROJECT AREA (M2)	SHRUBS/M2	TOTAL SHRUBS
Expansion	91,165.25	PER CENSUS	59.00
Secondary forest	29,053.000	0.06333	1,840
Grasslands and croplands*** and riparian forest	1,322,058.010	0.00500	6,610
TOTAL			8,509

The following compensation sites are proposed:

1. Inside the project: Purchased strips of lands for the right of way that are not occupied by it, and that are located in the base of cut and refill slopes, roundabouts, and triangles of the project: 17,777 trees.

2. El Socorro Protected Natural Area form MARN expressed that they would like to help by planting 9,858 trees.
3. 5,013 shrubs within the project's area; and 3,496 shrubs among the tress of the protected natural area in El Socorro.

Tree location, area and amount per site are shown in the following blueprint: Plant and Project Profile, and environmental measures.

VI.4.12.2 Biomass significance

In order to estimate the ecological significance or importance of the identified species in the project's area with regards to the diameter and height of the chest (DAP), individuals were considered with a diameter equal or higher to 80 cm.

Out of the 4,636 identified trees, 654 hold a diameter equal or higher to 80 cm; this is the equivalent to 14.11% of the identified individuals. Now the largest diameters are those diameters holding 2.00, 3.00 and 4.00 meters, these correspond to species like ceiba, conacaste, castaño, and carreto.

VI.4.12.3 Arboreal density

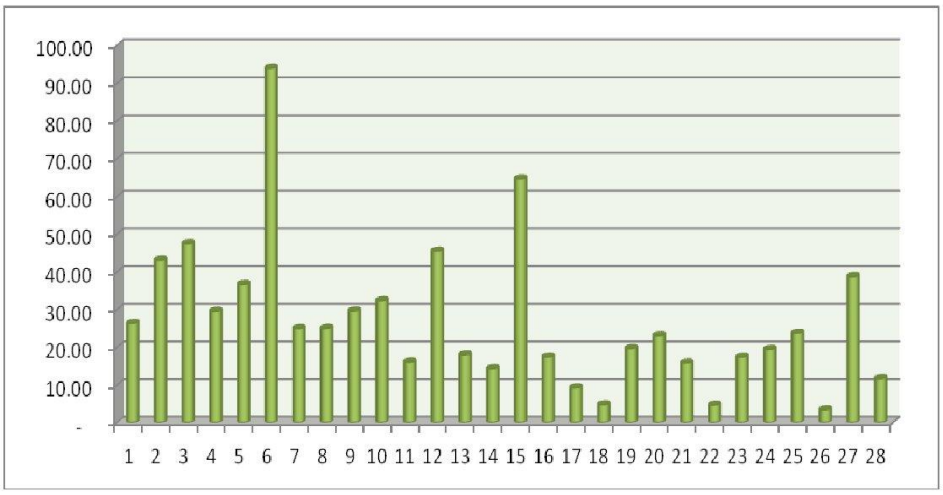
In order to establish arboreal density in the project's area, the areas with a greater number of individuals was identified; 28 zones were determined along the trajectory of the new road. Arboreal density was calculated in each zone, by this we mean the number of individuals per square meter as it is shown in the following chart:

Tree density was calculated in one of the areas, by this we mean the number of individuals per square feet. The detail is presented in the following chart:

TABLE No. VI.54. TREE DENSITY DETERMINED IN THE DIRECT INFLUENCE AREA OF THE SAN MIGUEL BYPASS ROAD PROJECT

No.	STATION	TO STATION	INDIVIDUALS	AREA BETWEEN STATIONS (m2)	INDIVIDUAL / m2	INDIVIDUAL/ HECTARE
1	0+000	0+440	**103**	39,106.61	0.003	26.338
2	0+600	1+520	**259**	60,018.38	0.004	43.153
3	1+600	2+040	**101**	21,266.05	0.005	47.494
4	2+500	3+060	**151**	51,057.18	0.003	29.575
5	3+220	3+600	**69**	18,781.09	0.004	36.739
6	3+700	4+060	933	99,243.91	0.009	94.011
7	4+600	5+400	**209**	83,566.76	0.003	25.010
8	5+620	6+000	**96**	38,317.27	0.003	25.054
9	7+360	7+600	**76**	25,643.19	0.003	29.637
10	8+420	9+280	**354**	109,047.20	0.003	32.463
11	9+480	9+900	**85**	52,736.44	0.002	16.118
12	10+100	10+540	307	67,474.87	0.005	45.498
13	11+200	11+280	**20**	11,093.69	0.002	18.028
14	11+700	11+900	**34**	23,626.16	0.001	14.391
15	12+080	12+140	**49**	7,577.16	0.006	64.668
16	12+860	13+180	**156**	89,393.64	0.002	17.451
17	13+580	13+860	**43**	46,178.03	0.001	9.312
18	14+800	15+440	**54**	113,281.55	0.000	4.767
19	15+520	15+860	**105**	53,243.98	0.002	19.721
20	16+380	16+660	**111**	48,070.41	0.002	23.091
21	17+000	17+800	**151**	94,905.44	0.002	15.911
22	19+000	19+380	**16**	34,219.74	0.000	4.676
23	19+880	20+060	**33**	18,949.23	0.002	17.415
24	20+280	20+920	133	68,252.43	0.002	19.486
25	21+500	21+850	**245**	103,130.00	0.002	23.756
26	21+850	21+980	**45**	130,840.01	0.000	3.439
27	21+980	23+430	**140**	36,103.74	0.004	38.777
28	23+430	25+022	**162**	138,013.62	0.001	11.738

Source: Topographical survey analysis



Source: Field Survey Analysis

Chart No. VI.24. Density of trees in individuals per acre, inaccordance to tree census

There is higher density in the primary and gallery forests.

The expansion section area also has many trees per acre; this is because there are trees on the roadside in the current highway.

VI.5 SOCIO-ECONOMIC, CULTURAL AND AESTHETIC ENVIRONMENT

Below are shown the results of the socio-economic study implemented over the population residing in the area of direct and indirect impact and that will be directly or indirectly impacted by the San Miguel Bypass implementation.

To run the study, a socio-economic survey was implemented in the month of August, and it aimed to determine the social and economic conditions of the population living in the area of direct and indirect impact of the project.

VI.5.1 *Municipalities Impacted by the Project*

The project is located in the province of San Miguel, it covers three municipalities: Quelepa, Moncagua, and San Miguel. The highway will pass through territories in the municipalities of Moncagua, El Papalón community, Quelepa, San José community, El Obrajuelo, and San Miguel; it passes through the following cantons, too: El Sitio, El Zamorán, Santa Inés, El Divisadero, Hato Nuevo, Las Delicias, El Papalón, and El Jute.

VI.5.1.1 Communities of Moncagua

The community of Moncagua borders on the North with the municipality of Chapeltique; to the West with the municipalities of Lolotique, Nueva Guadalupe and Chinameca; to the South with the municipality of San Miguel; and to the East, with the municipality of Quelepa.

The municipality is divided in 11 communities and 4 districts, which are Candelaria, San Pedro, El Calvario, and Independencia.

- *Origins and etymology*

Moncagua is a town of lenca origin, its foundation dates back to the pre-Columbian era. In the poton language, this autochthonous, geographical name means "river of stones and rabbits" because it is composed of the roots "*mon*", rabbit; "*ca"*, stone; and "*gua"* river.

- *Colonial history*

In 1550, it had a population of about 500 persons. In 1740, according to the mayor of San Salvador, Don Manuel de Gálvez Corral, San Pedro Moncagua had 43 tributary indigenous residents; this means a population of about 215 souls. Archbishop Don Pedro Cortés y Larraz says that in 1770, the town was annexed to the parish of San Miguel, with a population of 849 natives distributed in 86 families and 309 Ladinos distributed in 58 families. It belongs to the district of San Miguel since 1786, and became a municipality of the province of San Miguel on June 12th, 1824.

- *Title of Villa*

The National Legislative Assembly appointed it with the title of villa on April 15, as an incentive to the progress reached by the town of Moncagua, in 1889, during the administration of General Francisco Menéndez. On the same date, the *haciendas* of Santa Bárbara and Santa Barbarbarita, which belonged to the jurisdictions of Chapeltique and San Miguel respectively, were annexed to its jurisdiction.

- *Subsequent events*

In 1890, it had a population of 2,060. The municipality of Moncagua lost the valleys or communities of Los Planes, La Cruz, and El Jocote to Chinameca, by the Law of April 30th, 1906. Those valleys were given back by the Law of June 20th, 1916, but were once again segregated by the Law of April 11th, 1918.

- *Public Infraestructure*

The municipality has a city hall, a clinic, 15 schools, 1 technical school, 20 churches, the White Cross, and 1 group of self-help (AA). In the recreational area there are 2 sports fields, 1 sports center, and 2 rivers: El Astillero and El Tejar. The basic services with which this municipality counts are: water, power, telephone, internet, post office, police department, and a local court.

- *Production*

The most cultivated crops are beans, agave, kenaf, fruits, and sugar cane, breeding of cattle, pigs, and poultry. It has an agave factory, dedicated to the elaboration and merchandising of sacks.

VI.5.1.2 Municipality of Quelepa

The municipality Quelepa belongs to the province of San Miguel. It borders at the North with Moncagua and San Miguel; to the East with San Miguel; to the South with San Miguel; and to the West with Moncagua.

It is located in the following geographical coordinates: 13°33'16" LN (northernmost end), 13°29'18" LN (northernmost end); 88°12'26" LWG (eastern end) and 88°16'06" LWG (western end). For its administration, the municipality is divided into the following communities: Obrajuelo, El Tamboral, San José, and San Antonio. The urban area has the following districts: Concepción, Santiago, and San Antonio.

- *Origins and etymology*

In the pre-Columbian times, Quelepa was the settlement of a brilliant native civilization. The ruins of primitive Quelepa scattered on both sides of the Moncagua River or San Esteban River, in an area of about 6 kilometers, from the town of Moncagua, hold a beautiful architecture sighting in the place called Ojo de Agua (Eye of Water). The name Quelepa means "stone jaguars" or "stone pumas"; the name's roots are these: "*que"*, stone; "*lepa"*, jaguar or puma, tiger, and "*tique"* hill, suffix of a place.

- *Colonial history*

In 1550, Quelepa had a population of 250 habitants. In 1740, according to the mayor of San Salvador, Don Manuel de Gálvez Corral, Santiago Quelepa had 15 tributary indigenous residents, meaning around 75 people. In 1770, according to the archbishop don Pedro Cortéz y Larraz, it belonged to the curacy of San Miguel with 138 persons distributed in 18 native families. It became part of the district of San Miguel in 1786.

- *Facts of wars*

On April 13th, 1828, the Guatemalan Colonel don Vicente Domínguez left San Miguel commanding federal troops; after a fierce combat, he defeated the Salvadorian Colonel Guillermo Merino when he reached "Loma del Pleito" ("Fight Hill"), close to Quelepa;. On February 14th, 1845, General Ramón Belloso defeated Honduran General José Trinidad Cabanas with government troops from President General Francisco Malespín, in Quelepa; Trinidad had attacked him under the orders of the Salvadorian Vice-president General Joaquín Eufracio Guzmán. On August 10th, that same year, a bloody battle took place between Quelepa and the Obrajuelo haciendas. In this battle, the Salvadorian troops, under the command of Colonel Nicolás Ángulo, inflicted a tremendous defeat over the Honduran General Santos Guardiola's troops.

- *Subsequent events*

In 1890, it had 780 habitants. It belonged to the province of San Miguel since it was politically established on June 12th, 1824.

- *Public Infraestructure*

This municipality has a city hall, a health clinic, 6 schools, 7 churches and a self-help group. Moreover, there is a sports field, a sports center, a house of culture, a park, and El Tejar river. It also has an archaeological site. The municipality has water, power, telephone, internet, a police station, and a local court. The Municipal Festivities

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are held from July 23rd to the 26th, dedicated to Santiago Apóstol; and from December 3rd to the 9th, dedicated to the Virgin of Conception.

- *Production*

The most cultivated crops are corn, beans, kenaf, and agave. There is also trade for products derived from cattle. Trade consists of buying and selling basic products and crafts, such as baskets. The Salvamex factory is located there; it processes mescal fiber for the elaboration of sacks. There are also the México, Reyes, and San José factories, which elaborate products derived from cement. Some important companies settled in this municipal territory are La Constancia and Pepsi.

VI.5.1.3 Municipality of San Miguel

The municipality of San Miguel is the capital of the province of San Miguel. It borders at the North with the municipalities of Yamabal, Guatajiagua, and San Carlos from the Department of Morazán; to the West with the municipalities of Chinameca, Quelepa, Moncagua, San Rafael Oriente, and El Tránsito; to the South with Chirilagua and Jucuarán; and to the east with the municipalities of Uluazapa, Comacarán, and the province of La Unión. It has thirty-three communities: Altomiro, Anchico, Cerro bonito, Concepción Corozal, El Habillal, El Jute, El Niño, El Papalón, El progreso, El sitio, El Tecomatal, El volcán, Hato nuevo, Jalacatal, La Canoa, La Puerta, La Trinidad, Las delicias, Las lomitas, Miraflores, Monte Grande, San Andrés, San Antonio Chávez, San Carlos, San Jacinto, Santa Inés, El amate, El brazo, El Delirio, El Divisadero, El Zamorano, and San Antonio Silva. The urban area holds 8 districts: El Centro, El Calvario, Concepción, San Nicolás, La Merced, La Cruz, San Felipe, and San Francisco. There are at least 30 residential areas, 23 neighborhoods, 109 lots' divisions and there is a sub-section for "pirate lots".

- Origins

After the Santiago de los Caballeros city foundation on July 25th, 1524, and the villa of San Salvador around April 1st, 1525, the Spanish from the Guatemalan Governance founded a third villa: the *villa of San Miguel de la Frontera,* in the ultra-lempina eastern region of the current Salvadoran territory. The foundation of this villa had political, administrative reasons.

- Foundation of the Villa

At the beginning of April, 1530, Don Pedro de Alvarado arrived to Guatemala, from Spain, via Mexico, and went to the town council on the eleventh day of that month and year. Alvarado sent Captain Luis de Moscoso, with 120 soldiers, in order to settle a Spanish colony in the fertile regions located on the other side of the Lempa River. On May 8th, 1530, the day of San Miguel Arcángel, Captain Moscoso settled a Spanish colony with the title of *villa* and under the name of *San Miguel de la Frontera;* this took place after bringing the native towns who had suffered the unspeakable due to the incursion of the Estete to the Servicio Real; then he informed his boss that that country was a land rich in mines, spices and prosperous towns.

- Indigenous Insurrection

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In 1537, after seven years of its establishment, the formidable insurrection of the lenca town of the center of Honduras and east of El Salvador took effect. In the province of Cerquín (Gracias a Dios), the *Lempira* Chief or "lord of the mountain range" (from *lempa* lord and *era* mountain range) raised the flag of rebellion and called all the neighboring chiefs to take joint action against Spanish domination. The Salvadorean lencas joined the epic saga of the Hero Piraeraor "the mountain of mists" and laid siege to the villa of San Miguel de la Frontera. After a prolonged campaign of more than six months, the Spanish were able to dominate the lencas' bravery, who definitely lost their autonomy, freedom, and independence.

- Progress of the Villa

Towards 1572, the villa of San Miguel was governed through ordinary mayors, being the population of this colony of about 650 habitants. At that time, the villa of San Miguel, which belonged to the bishopric of Guatemala under ecclesiastic matters, exercised jurisdiction over more than 80 native tax-paying towns scattered in 60 parcels. In October of 1575, the Convent of Veracruz de San Miguel was erected in guardianship, given the title of San Francisco; and on October 15th, 1577, 20 indigenous towns were annexed to this convent.

- Title of City

Presbyter chronicler Domingo Juarros says, "This villa was awarded the title of city and, even though we don't know in what year this took place, a document dated August 22nd, 1585, found in the 7th book of the Town Council of the city of Guatemala, folio 190, states that in such year it already had this name, as it says: "*the Monastery of the Santiago City and of the cities of San Salvador and San Miguel".* The geographer, don Guillermo Dawson, says that San Miguel "obtained the title of *city* in 1586". However, San Miguel enjoyed this distinction since many years before, because in the Act of the Intermediate Chapter that the seraphic friars celebrated in the province of Dulce Nombre de Jesús of Guatemala, on November 26th, 1574, it reads: "Build a convent in the city of San Miguel, and name it San Antonio, and R. P. Fr. Juan de Frías is appointed as its guardian and preacher".

- Destruction of the old City

At the beginning of 1586, the city of San Miguel had few adobe and tile houses but plenty of houses made of wood and hay, which were easy preys of the flames of a fearful fire that took place on March 12th of that year. When fray Alonso Ponce arrived to this city on June 27th, 1586, it had about 30 neighbors, meaning around 150 people. Life in San Miguel during the following years must have been really hard because on June 8th, 1590, the City Council presented a request to engineer Francisco de Valverde, in which they asked him the authorization to move the city to the Fonseca port or bay, but their request didn't prosper. In 1594, according to don Juan de Pineda, San Miguel had 60 neighbors, meaning about 300 habitants.

- *Capital City*

The old parties of the San Salvador administration (Usulután, San Miguel, Gotera, and San Alejo) were appointed to the category of *department* (province) with the name of San Miguel and with the "capital" in the city by this same name; this took place when the first Magna Carta of El Salvador was issued on June 12th, 1824. By the law of March 5th, 1827, the party of San Miguel was divided in two: the one with this same name, and the other one named Chinameca. The city of San

Miguel, as capital, and the towns of Quelepa, Moncagua, Chapeltique, Sesori, Cacahuatique (now Ciudad Barrios), San Juan Lempa (now Nuevo Edén de San Juan), San Luis de la Reina, and Uluazapa were included in the party of San Miguel.

- Federal history

During the short period of the Central American Federation, San Miguel was the stage for several battles and crimes closely connected to politicians.

- Division of the province

The large area of the primitive province of San Miguel, which included six districts, while the others only included two, as well as the difficulty of its extended area, along with the recent insurrection of General José Trinidad Cabanas, made the Dueñas administration understand that the best thing was to divide it in three provinces. Dated June 22nd, 1865, the Executive branch of the government issued the corresponding decree, in which the old and big province of San Miguel was divided in three: San Miguel, La Unión, and Usulután. In 1871, the city of San Miguel fell to the power of General Felipe Espinosa, as part of the revolutionary plan commanded by the field marshal don Santiago González against the unpopular administration of Dueñas. A bloody riot took effect on San Miguel on June 21st, 1875: the small "Night of San Bartolomé", directed by the priest don Manuel Palacios, who intended to create difficulties for the liberal government presided by Marshal González. A War Council sentenced father Palacios to capital punishment, but the verdict wasn't executed due to many pleas received from many distinguished people from the locality, especially the one from the President's wife. Palacios' life was spared, and he was transferred to San Salvador. By Law of July 14th, 1875, the province of San Miguel was divided into two: San Miguel and Gotera (later named Morazán), the first one was then formed by the districts of this same name, and Chinameca, this reduced its size since then to its current limits.

- Other events

San Miguel, the eastern metropolis or Pearl of the East, the way it's poetically called, was in 1890 a prosperous and flourishing population. "Its streets - says geographer Guillermo Dawson – are wide, straight and well paved. Its houses are of solid and elegant construction. It is divided in six districts called La Cruz, El Calvario, Concepción, San Francisco, San Felipe and La Merced. Its most important government buildings are City Hall, the Court House, the hospital, the market, the technical school, the post office, and the department of treasury, and the breweries, the parade ground, and the hill of the Cave. Weather in San Miguel is, unfortunately, not very healthy, due to the vapors exhaled by the Camalotal swamp and the marshes that surround it at the southeast of the city; it is on its way to being fixed". "The average temperature is of 27°40 C". "The legacy of the people in San Miguel consists in the harvesting of indigo, and grains, cattle and pigs, and foreign trade". "Population: 23,800 souls". Aside from this data, Dawson adds the following in regard to the most important fair in San Miguel: "Its famous Feria de la Paz (Peace Fair), in the city of San Miguel, is held on November 21st of every year". "This fair is well-known, not only in the Central American republics, but in several States of meridional America, some of them send ships loaded with appliances for trade in that city.

The main articles of transaction are indigo, foreign merchandise, cattle, cheese, etc".

- *Latest* events

On December 31st, 1909, the beautiful National Theater building finished its construction, and given to the municipality. It was built on the "Mendoza's plazoleta" in accordance to the blueprints made by engineer don Marcos A. Letona. On December 15th, 1910, while General José Tomás Calderón was commander and governor, the first "Eastern Agricultural and Industrial Exposition" was opened". On March 15th, 1911, gas lighting was replaced by electric lighting. Finally, by Law of July 11th, 1918, the communities of Socorro or Pasaquinita, and San Nicolás Anchico were segregated from the jurisdiction of San Miguel and incorporated to the one from Yayantique, in the province of La Unión.

- *Important Buildings*

This municipality has a City Hall, a hospital, 13 health clinics, schools, technical schools, 5 universities, churches, the Red Cross, and self-help groups (AA). For recreation it has volcanoes like Chaparrastique or San Miguel, rivers, lakes, El Jocotal, the San Juan de Aramuaca, and Olomega lagoons. Utilities: water, power, telephone, sewage, internet, postal service; they have a police department, a local court, and an agricultural agency. The municipal festivities are held in honor to Virgen de la Paz (Virgin of Peace), the main days are November 20th and 21st, but the most representative of these festivities is the Carnival. It also has the municipal stadium Juan Francisco Barraza, located at the end of the Chaparrastique Street, 10ª Avenida Norte and 4ª Calle Oriente (regional); the Miguel Félix Charlaix Stadium, over Avenida Roosevelt, 7ª and 11ª Calle Poniente; the Students Club, equipped with basketball courts, swimming pools, and classrooms; the Don Bosco Sports Center privately owned. Club Águila soccer team, and Casino Migueleño, movie theaters, bullring locate on a land lot in front of the Municipal Government Center, a theme park, Monte Grande Recreational Park, and La Ronda Tourist center (private), La Cueva tourist center. Theme parks: Club de Leones Park, and Tourist Center Altos de La Cueva. There are several urban parks: Guzmán Park, Park of the Cemetery (located in front of the municipal cemetery) Barrios Park (invaded by informal vendors), Rosales Park (on the west side of the Government Center), Monsignor Víctor Basilio Plantier Children's Park, among the most prominent ones. Campo Corona, located nearby the former train station, where soccer tournaments are held. There is a 5-soccer-fields complex at the old crematorium. There are basketball courts and green areas in urban downtown and in the new residential areas.

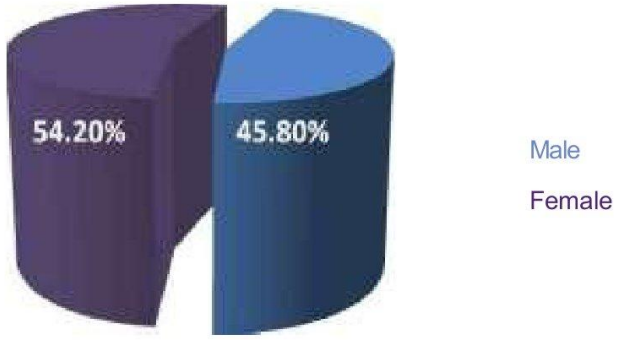
ŕ Industrial Activity

San Miguel has small and medium industry activities in the urban areas; for example factories for food, drinks, clothes, soaps, detergents, cosmetics, among others. But the commercial activity is considerably large because there are a lot of small, medium and large shopping centers, general warehouses, hardware stores, grocery stores, bazaars, stores, restaurants, cafeterias and others.

VI.5.2 Demographic Characterization of Municipalities Impacted by the Project.

The following graph shows the demographic situation in the municipalities of impact of the project; the municipalities of Moncagua, Quelepa, and San Miguel, have an important weight in the demographic dynamics of the department.

Nowadays, the three municipalities add up to 245,118 habitants; 54.20% are females, and 45.80% are males.



Source: VI Pop. Census and V Housing Census -2007, Ministry of Economy
Graph No. VI.25. Total population by Sex - Environmental Impact Study - San Miguel Bypass Road

San Miguel is the main development center of the province, and the urban population's size over the rural population is also crucial. In this regard, the rural area still has a relative big size, but the urban area has become the main economic, social and political motor, both for the province itself, and for the eastern part of the country, too. San Miguel is an important axis, which boosts the activities of the eastern area of the country.

In fact, the city of San Miguel has become the center that serves as interconnection with other municipalities. The main highways of the country, both the Pan American Highway (CA-1), and the Coast Highway, have become the main route of access for mobilization of resources and people in the east of the country and converge on the city.

San Miguel is a development center that also defines the behavior of the two municipalities that will be impacted by the project; therefore, based on the urban structure of San Miguel, Moncagua, and Quelepa, the area has become more urban. It used to be a very agricultural area, but it is currently oriented to promote future human settlements.

Altogether, the three municipalities' area add up 718.43 km2, and San Miguel is the municipality with the largest territorial size. Moncagua presents a relative condition and Quelepa, has a small territory (See table below).

TABLE No. VI.55. NUMBER AND PLACE OF RESIDENCE OF THE OF CENSUS RESPONDENTS, ENVIRONMENTAL IMPACT STUDY, SAN MIGUEL BYPASS ROAD

MUNICIPALITY	SIZE Km^2
Quelepa	22.21
Moncagua	593.98
San Miguel	102.95
TOTAL	719.14

Source: VI Population and Housing Census 2007, Ministry of Economy

These urban areas focus mainly on economical activities. The urban area in San Miguel determines the behavior of the general population; however, it is evident that Quelepa and Moncagua hold the highest number of rural population. Their territories still show a tendency to agricultural and livestock activities, although the territory of Quelepa in the community of San José, has been promoted as the place of settlement for large companies. San Miguel, although it has a mainly urban population, still has rural areas that do not have large human settlements. El Zamorano, El Jute, and El Papalon have rural characteristics; however, a substantial change based on the project's expectations is anticipated, and new land development will take place.

TABLE No. VI.56. POPULATION BY AREA AND SEX, ENVIRONMENTAL IMPACT STUDY – SAN MIGUEL BYPASS ROAD

MUNICIPALITY	URBAN			RURAL		
	FEMALE	MALE	TOTAL	FEMALE	MALE	TOTAL
Quelepa	276	358	634	1,644	1,771	3,415
Moncagua	1,376	1,663	3,039	9,288	10,332	19,620
San Miguel	58,429	71,951	130,380	41,243	46,787	88,030
TOTAL	60,081	73,972	134,053	52,175	58,890	111,065

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

As previously defined, San Miguel is the most populated of the municipalities that will be impacted by the project. It holds the highest relative weight percentage and yet, with a vast territory, it holds the highest level of population density, too.

TABLE No. VI.57. POPULATION BY AREA AND SEX, ENVIRONMENTAL IMPACT STUDY – SAN MIGUEL BYPASS ROAD

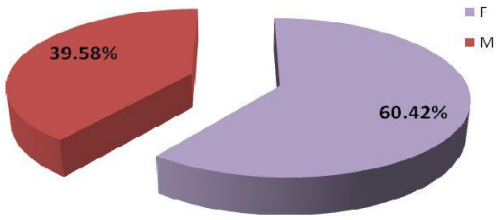
MUNICIPALITY	POPULATION 2007	RELATIVE WEIGHTING	AREA (Km^2)	POPULATION DENSITY (people/Km^2)
MONCAGUA	22,659	9.24%	102.95	220.10
QUELEPA	4,049	1.65%	22.21	182.31
SAN MIGUEL	218,410	89.10%	593.98	367.71
TOTAL	245,118	--	719.14	--

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

VI.5.2.1 Surveyed Population

The following are the most relevant social characteristics found in the population residing in the communities of El Papalón, Valle Alegre (Moncagua); San José, San Antonio (Quelepa); El Sitio, El Zamorán, Hato Nuevo, El Papalón, and El Jute (San Miguel).

S



Source: Socioeconomic survey, SM BYPASS, 2011

Graph No. VI.26. Population Surveyed by Gender

Below is Table VI.58. containing the number of persons surveyed according to their place of residency. We interviewed a total of 318 families, from these, 55 live or own the property in the area directly impacted by the project. Most of them live in the community of El Papalon, 87 people were interviewed for the same number of households; El Papalon-Moncagua, with 10 respondents, corresponding to an equal number of households; and El Sitio, with 4 respondents, also holds an equal number of households. El Zamorano with 12 respondents, Hato Nuevo with 69 interviews, Las Delicias 64, San Antonio 11, San José 57, San Miguel 3, and San Salvador with 1 survey. The census and survey formats are in Annex **VI.ll.**

Figure No. VI.26. Surveyed Population by Sex

TABLE No. VI.58. NUMBER AND PLACE OF RESIDENCE OF RESPONDENTS

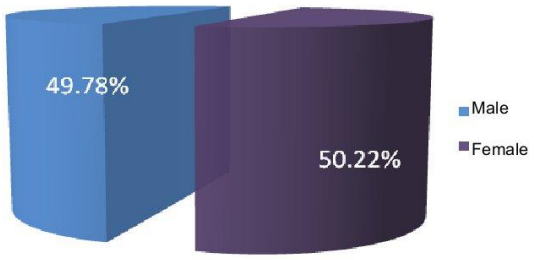
PLACE	FREQUENCY	PERCENTAGE
El Papalón	87	**27.4%**
El Papalón-Moncagua	10	**3.1%**
El Sitio	4	**1.3%**
El Zamorano	12	**3.8%**
Hato Nuevo	69	**21.7%**
Las Delicias	64	**20.1%**
San Antonio	11	**3.5%**
San José-Quelepa	57	**17.9%**
San Miguel	3	**0.9%**
San Salvador	1	**0.3%**
TOTAL	318	100

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

The four persons interviewed, and that live in San Miguel and San Salvador have properties in the project's impact area, so they were included.

VI.5.2.2 Kinship

Out of the 318 surveys conducted, 1,185 people live in 318 households. Out of these, 49.78% are male, equivalent to 574 men, and 50.22% female, representing 579 women.



Source: Socioeconomic Survey, SM BYPASS, 2011
Graph No. VI.27. Total Population According to Gender, BYPASS SM

Findings on family group distribution: 315 are the heads of households, out of which 229 households are led by men, and 86 by women; 3 households share leadership between the man and the woman.

TABLE No. VI.59. HOUSEHOLD HEADSHIP AND KINSHIP

KINSHIP	SEX		TOTAL	PERCENTAGE
	MALE	FEMALE		
Head	**229**	**86**	315	27.32%
Spouse	**14**	**183**	197	17.09%
Son/Daughter	**242**	**221**	463	40.16%
Other relative	**88**	**88**	176	15.26%
Domestic worker	**1**	**1**	2	0.17%
TOTAL	**574**	**579**	1153	100

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

206 households show linkage between the father and the mother; finding that 14 men are spouses, whereas there are 183 female spouses. There are 463 children, 242 are boys, and 221 are girls; and other family members add up to 176 people. There are also domestic workers living in the house; these add up to 2 persons, 1 man and 1 woman.

VI.5.2.3 Age

The age groups defined below, are the demographic dynamics of family groups counted in the area of direct or indirect impact of the project.

In general, there is a predominance of younger age groups that range from 0 to 25 years; they can be defined as the population for infant and young adults, which accounts for 50.91% of the population. The groups of 16-20, 11-15, and 6-10 are the ones that define the characteristics of grouping and behavior of the population in the area.

TABLE No. VI.60. POPULATION BY AGE GROUP, SM BYPASS ROAD

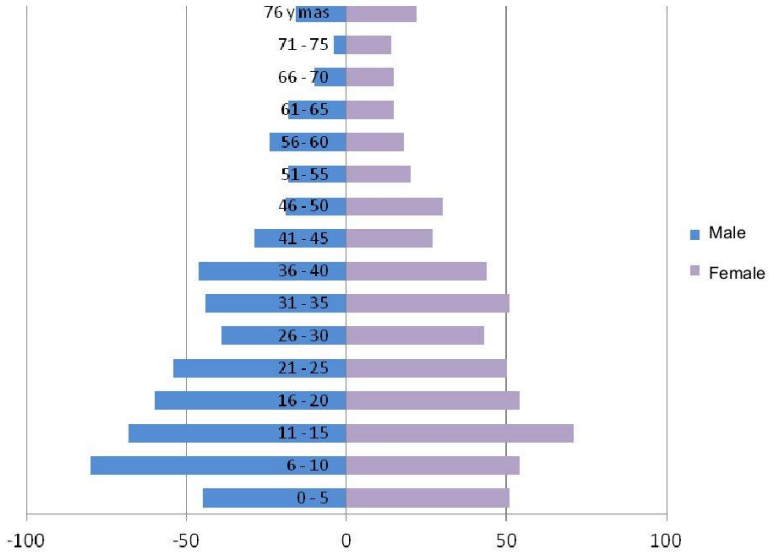
AGE	SEX		TOTAL	%
	Male	**Female**		
0-5	45	51	96	8.33%
6-10	80	54	134	11.62%
11-15	68	71	139	12.06%
16-20	60	54	114	9.89%
21-25	54	50	104	9.02%
26-30	39	43	82	7.11%
31-35	44	51	95	8.24%
36-40	46	44	90	7.81%
41-45	29	27	56	4.86%
46-50	19	30	49	4.25%
51-55	18	20	38	3.30%

56-60	24	18	42	3.64%
61-65	18	15	33	2.86%
66-70	10	15	25	2.17%
71-75	4	14	18	1.56%
76 y mas	16	22	38	3.30%
TOTAL	574	579	1153	100

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

The youth group widens the graph in the population pyramid. It is important to note that under the age group of 16-20 year olds, the population trend is to generate a growth in population numbers. This condition establishes that there is an increasing population growth in recent years. In addition, by looking at the behavior of those in their 20's and up, fluctuation periods can be seen, leading to breaking the trend; and population growth tends to decline dramatically in some periods. The decreasing trend is evident starting from 40 years of age.

On average, surveyed population groups have 3.63 members per household, a characteristic normal to rural areas, but with a tendency to become urban or semi-urban.



Source: Socioeconomic Survey, SM BYPASS, 2011

Graph No. VI.28. Population pyramid

Typical characteristics of the houses

The following aspects highlight the social situation of family groups. The ceiling, the walls, the floor, and the number of bedrooms determine the appropriate conditions for the settling of the family environment; the layout or inadequate access to one of these, generates inadequate settling factors in the lives of each family member, generating an inappropriate setting, especially in sexual matters.

The composition of housing is as follows: houses with tile roof are predominant, with a 52.8%; tin 26.4%; and fiber cement sheet with 14.5%; and 6.3% concrete slab.

TABLE VI.61 NUMBER OF HOMES BY TYPE OF ROOF, SM BYPASS ROAD

ROOF MATERIAL	FREQUENCY	PERCENTAGE
Tile	168	52.8%
Metal panel	84	26.4%
Fiber cement panel	46	14.5%
Concrete slab	20	6.3%
Total	318	100.0

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

As shown in the table below, the majority of the population has permanent housing made with durable materials. 76.4% has a concrete or mixed wall, 9.7% has a semi-permanent housing wall (adobe), 9.1% has a non-permanent wall (tin), 2.2% has bahareque (not permanent); and waste materials is 2.5%. In general terms, there is an 11.6% with higher levels of vulnerability;

a 2.2% shows a medium level of vulnerability, and a 9.7% has a lower level of vulnerability due to being built of adobe. See plan VI-13 Population and Housing in the Project Area.

TABLE No. VI.62. NUMBER OF HOUSES BY WALL MATERIAL, SM BYPASS ROAD

WALL MATERIAL	FREQUENCY	PERCENTAGE
Concrete or mixed construction	243	76.4%
Metal sheet	**29**	9.1%
Adobe	**31**	9.7%
Bahareque	**7**	2.2%
Waste materials	**8**	2.5%
Total	318	100.0

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

As for the type of material with which the floor is built, the one made of mud bricks stands out as the predominant material with 52.6%; then there is dirt floor that represents a 25.2%, followed by the cement floor with 22.3%.

TABLE No. VI.63. NUMBER OF HOUSES BY FLOOR MATERIAL, SM BYPASS ROAD

Flooring material	FREQUENCY	PERCENTAGE
Clay brick	167	52.6%
Cement	**71**	22.3%
Dirt	**80**	25.2%
Total	318	100.0

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

Another important aspect in a home is its internal distribution. Depending on the distribution that a home is allowed, it will generate suitable conditions for family life to settle. The main feature of homes in the area impacted by the project, in terms of their internal distribution, and according to Table No.IV.64, ranges from 1 to 11 rooms; and for domestic uses, especially sleeping, the distribution ranges from 1 to 6 rooms.

By looking at the table below, we can determine that 65.09% of households do not have the right conditions to settle down the family group. They do not have sufficient number of rooms to ensure proper development of daily activities and, as a main aspect, the privacy for activities pertinent to each person. This 65.09% of households use only one room as a bedroom. In fact, among the homes with 2, 3, and 4 rooms, they also use only one room as a bedroom.

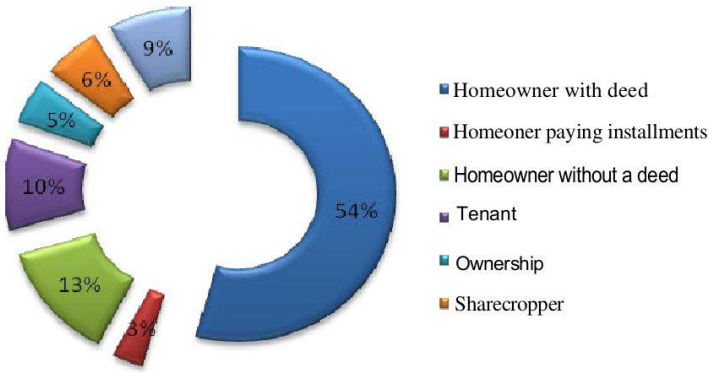
TABLE No. VI.64. NUMBER OF HOUSES BY NUMBER OF ROOMS, SM BYPASS ROAD

Number of rooms	How many are bedrooms?							Percentage
	1	2	3	4	5	6	Total	
1	122	0	0	0	0	0	122	38.36%
2	73	19	3	1	0	0	96	30.19%
3	11	36	10	0	0	0	57	17.92%
4	1	11	8	0	0	0	20	6.29%
5	0	5	4	1	1	0	11	3.46%
6	0	1	3	1	2	0	7	2.20%
8	0	0	0	0	3	0	3	0.94%
11	0	0	0	0	0	2	2	0.63%
Total	207	72	28	3	6	2	318	100
Percentage	65.09%	22.64%	8.81%	0.94%	1.89%	0.63%	100	--

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

VI.5.2.5 Home ownership

In terms of house ownership, 54% are owners with the house deed in their possession, 3% are home owners paying in installments, 13% are owners without a deed, 6% are homesteaders, 10% are tenants, 5% are holders, and 9% report living in a borrowed house.



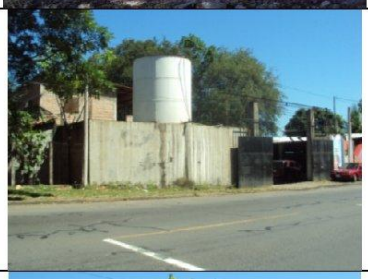
Source: Socioeconomic Survey, BYPASS SM, 2011

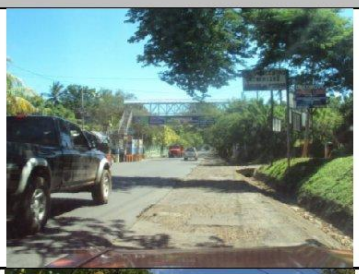
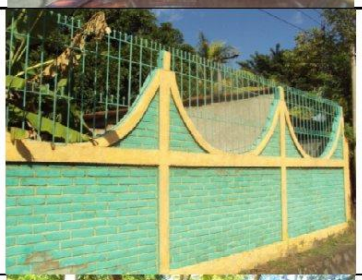
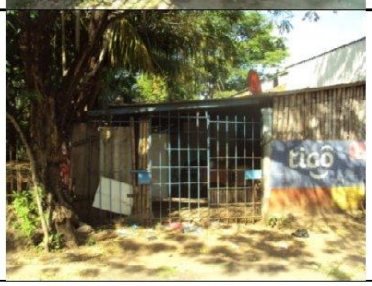
Figure No. VI.29. Home ownership, BYPASS SM

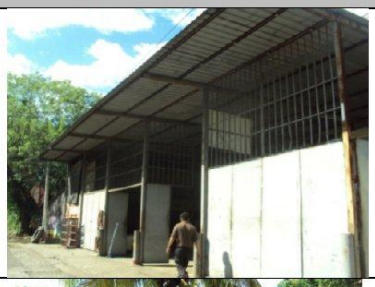
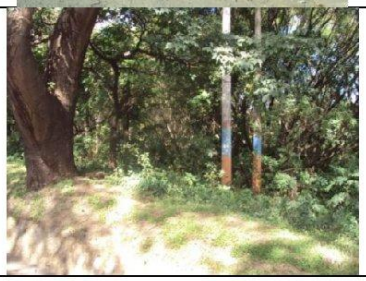
VI.5.2.6 Possibly impacted structures

The structures that maybe totally or partially impacted by the construction of the San Miguel bypass have been identified as follows: 53 houses, 10 galleries, one cafeteria, and a hotel; two stores, a water tank, and 4 warehouses. The following table shows the pictures of the potentially impacted structures.

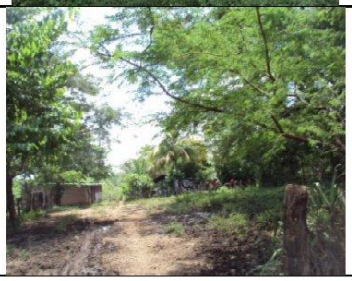
TABLE No. VI.65. STRUCTURES LIKELY TO BE AFFECTED BY THE PROJECT

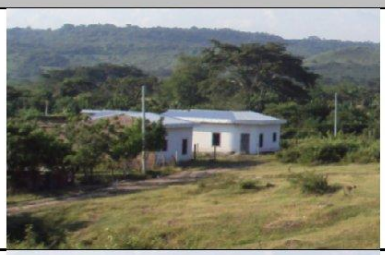
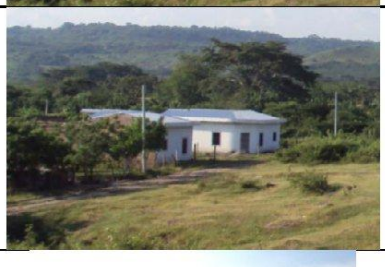
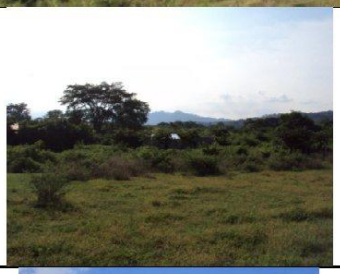
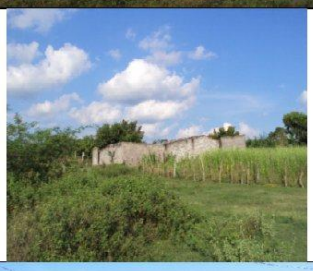
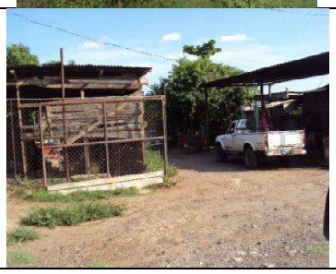
OBS	PICTURE	No.	iMPACT			
			Home	Shed	Wareh	Other
WAREHOUSE (OF A MUSIC GROUP		54			1	
WOODWORK SHOP AND TYRE REPAIR		53		1		
SHOP NEIGHBORHOOD STORE		53	1			
GARAGE AND SMALL STORE		20	1			1
REPAIR SHOP SHED		9		1		
SHED AND TANK		88	1			1
CORNER OF BUILDING USED AS CHURCH		91	1			

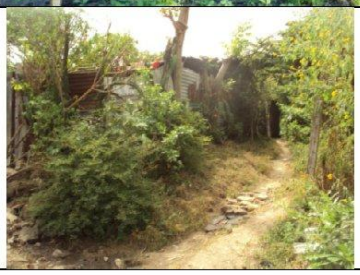
OBS	IMAGEN	No.	iMPACT			
			Home	Shed	Wareh.	Other
SCHOOL OVERPASS AND PERIMETER WALL		92				
CONSTRUCTION THAT LOOKS LIKE A WARE-HOUSE		93	1			
SHED, BRICK COLUMNS AND TILE ROOF		94		1		
FAMILY WOOKWORK SHOP		27	1			
HOME OF MIXED CON-STRUCTION		107	1			

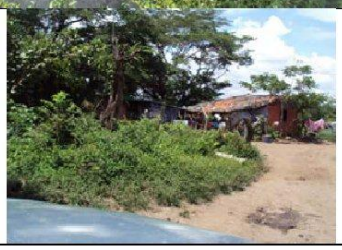
OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Wareh.	Other
AUTO REPAIR SHOP		108		1		
LOS COCOS HOTEL AND DINER		116				1
UNIVERSITY ENTRANCE BOOTH		118			1	
STORE AND DINER NEXT DOOR TO UNIVERSITY		119				1
FOUR COLUMNS AND ROOF IN SECONDARY FOREST		149		1		

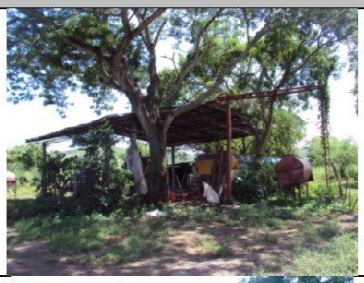
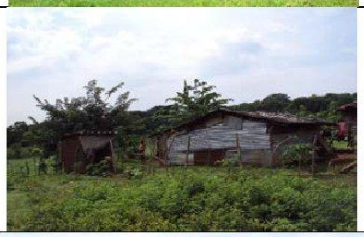
OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Wareh.	Other
Home latrine		173				
Home		175	1			
Two homes		185	2			
Abandoned house		192	1			
Partially built homes		192	4			

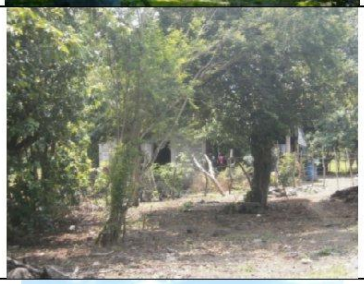
OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Wareh.	Other
Home		195	1			
Four pillar construction		196			1	
Abandoned well and swimming pool		201				
Vacated house		207	1			
Home and cattle shed		218	1	1		

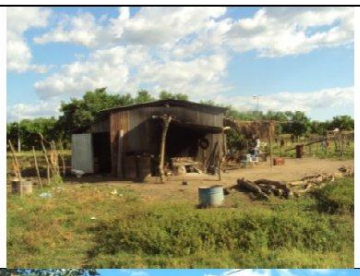
OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Wareh.	Other
MIXED CONSTRUCTION HOME		221	1			
MIXED CONSTRUCTION HOME		221	1			
HOUSE BUILT OF METAL SHEETS		222	1			
TWO MIXED CONSTRUCTION HOMES		222	2			
HOUSE NEXT DOOR TO AUTO REPAIR SHOP		225	1			

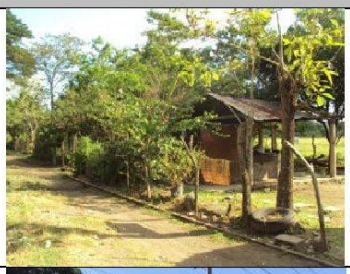
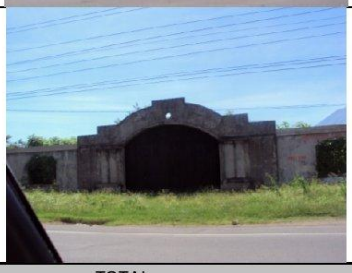
OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Wareh.	Other
WALLED-IN HOME		224	1			
HOME		224	1			
HOME		224	1			
HOME		229	1			
HOME		229	1			

OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Wareh.	Other
HOME NEAR EXIT TO SANTA ROSA		230	1			
HOME		230	1			
HOME		230	1			
HOME		233	1			
HOME		233	2			

OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Warehou	Other
SHED		233		1		
HOME		267	1			
HOME		265	1			
HOME		267	1			
HOME		268	1	1	1	

OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Wareh.	Other
HOME		273	1			
HOME		275	1			
HOME, SHED AND WELL		285	1	1		
HOME		284	2			
WEEKEND HOME		289	1			

OBS	IMAGEN	No.	IMPACT			
			Home	Shed	Wareh.	Other
HOME		292	1			
PRIVATE BRIDGE	NO PIC. AVAILABLE	293-4				
HOME		301	1			
HOME		302	1			
HOME ON GROUNDS OF FENADESAL		303	1			
HOME ON GROUNDS OF FENADESAL		303	1			

OBS	IMAGEN	No.	iMPACT			
			Home	Shed	Wareh.	Other
SHED ON GROUNDS OF FENADESAL		303		1		
HOME		311	3			
MOTEL		323				
PERIMETER WALL		323				
TOTAL			53	10	4	4

Source: Field walkthrough and topography, SM BYPASS ROAD, 2011

VI.5.2.7 Equipment

When asked about the household equipment/appliences, surveyed people said they have beds, televisions, stoves, dining tables, living room furniture, refrigerators, and cookware. People say that they have mostly beds because of their usefulness

TABLE No. VI.66. NUMBER AND TYPE OF EQUIPMENT IN THE HOME, ENVIRONMENTAL IMPACT ASSESSMENT, SAN MIGUEL BYPASS ROAD

PLACE	BEDS	TV SET	STOVE	DINING ROOM FURNITURE	LIVING ROOM FURNITURE	REFRIGER-ATOR	COOKWARE
El Papalón	**82**	**69**	**67**	**13**	**10**	**38**	**55**
El Papalón-Moncagua	**9**	**8**	**8**	**4**	**2**	**4**	**3**
El Sitio	**3**	**4**	**4**	**3**	**1**	**3**	**3**
El Zamorano	**11**	**10**	**10**	**4**	**5**	**5**	**5**
Hato Nuevo	**63**	**56**	**58**	**16**	**21**	**34**	**43**
Las Delicias	**60**	**53**	**48**	**14**	**5**	**31**	**34**
San Antonio	**9**	**8**	**5**	**2**	**2**	**5**	**7**
San José	**44**	**42**	**30**	**9**	**7**	**20**	**22**
San Miguel	**3**	**3**	**3**	**1**	**3**	**3**	**1**
San Salvador	**1**	**1**	**1**	**1**	**1**	**1**	**1**
TOTAL	285	254	234	**67**	**57**	**144**	**174**

Source: Socioeconomic Survey, SM BYPASS ROAD, 2011

VI.5.2.8 Religion

Surveyed people identify themselves significantly as believers of the Christian religion; 43.54% state to be Catholic and 34.17% state to be Protestant. Meanwhile, 2.6% of the population belongs to other religion, and 19.69% state to have no religion.

TABLA No. VI.67. RELIGIÓN SEGÚN SEXO, BYPASS SM

RELIGIÓN	SEX		TOTAL	PERCENTAGE
	Male	Female		
Catholic Christian	235	267	502	43.54%
Evangelical Christian	195	199	394	34.17%
Other	13	17	30	2.60%
None	131	96	227	19.69%
TOTAL	574	579	1,153	100%

Source: Socioeconomic Survey, SM BYPASS ROAD, 2011

VI.5.3 Development Plans

The three city halls in the project's impact area were visited and none of them has development plans or municipal ordinances to define the urban growth or to organize the territory.

San Miguel has an ordinance for the environmental management of the municipality. It aims to create a participative process for the protection, conservation, and recovery of the environmental management to ensure the population's quality of life. This ordinance also aims to coordinate and implement actions related to the duties and rights for natural and legal persons, in order to avoid environmental deterioration; all of this should be in accordance to the application of an environmental plan to help in the decision making process for the municipal authorities.

Article 33 of this municipal ordinance establishes that the holder of any project requiring environmental permission must process it at the Ministry of Environment and Natural Resources, and present a copy of the Ministry's resolution at the Municipality's Environmental Unit.

Article 7 establishes that the Municipal Mayor is responsible for penalizing the contravention of this Ordinance, after verifying the damages caused to the environment, and assessing its impact through a report by the Environment Unit.

Quelepa and Moncagua have not approved this municipal ordinance; however, they have a draft plan on this matter.

VI.5.4 *Economical Characteristics*

The economical situation of the 318 surveyed families is described below. In some cases, the population in working age is not entirely considered, and only the surveyed person is used as reference.

VI.5.4.1 Occupation

The 318 surveyed persons say they perform various activities inside and outside the community, along with their families.

From the next table we can see that a "jornalero" (worker) is the most common activity; this activity is performed by 74 persons that represent 6.42%. Next activity in importance is agriculture, performed by 58 persons; 1 cattle keeper, and 1 stockbreeder. The income in this part of the population is located in the economy's primary sector, as well as trade, which includes 41 persons. Employees are also a significant part of the working population, with 38 persons. Masonry is an important activity as it holds 32 persons; there are also 17 drivers, 13 workers, and 11 persons with various occupations.

TABLE No. VI.68. NUMBER OF POPULATION BY OCCUPATION, SM BYPASS ROAD

CURRENT OCCUPATION/TRADE	SEX		TOTAL	PERCENTAGE
	Male	Female		
N/A	37	36	73	6.33%
Homemaker	0	259	259	22.46%
Helps at home	2	9	11	0.95%
Person with dissabilities	2	1	3	0.26%
Student	190	163	353	30.62%
Pensioner	1	0	1	0.09%
Unemployed	35	27	62	5.38%
Farmer	55	3	58	5.03%
Day laborer	70	4	74	6.42%
Corral keeper	1	0	1	0.09%
Rancher	1	0	1	0.09%
Mason	31	1	32	2.78%
Machine operator	1	0	1	0.09%
Carpenter	2	0	2	0.17%
Chef	0	1	1	0.09%
Cook	0	3	3	0.26%
Merchant	27	14	41	3.56%
Accountant	3	1	4	0.35%
Cosmetologist	0	2	2	0.17%
Seamstress	0	4	4	0.35%
Typist	1	0	1	0.09%
Teacher	0	2	2	0.17%
Electrician	2	0	2	0.17%
Housemaid	0	4	4	0.35%
Employee	26	12	38	3.30%
Nurse	0	1	1	0.09%

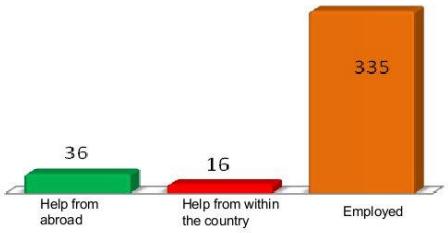
Welder	**1**	**0**	1	0.09%
Plumber	**3**	**0**	3	0.26%
Photographer	**2**	**0**	2	0.17%
Instructor	**1**	**0**	1	0.09%
Gardener	**2**	**0**	2	0.17%
College degree	**1**	**0**	1	0.09%
Mechanic	**6**	**1**	7	0.61%
Driver	**16**	**1**	17	1.47%
Musician	**1**	**0**	1	0.09%
Babysitter	**0**	**2**	2	0.17%
Worker	**12**	**1**	13	1.13%
Various occupations	**6**	**5**	11	0.95%
Industrial machine operator	**1**	**0**	1	0.09%
Janitor	**1**	**1**	2	0.17%
Baker	**4**	**1**	5	0.43%
Pastor	**1**	**0**	1	0.09%
Painter	**2**	**0**	2	0.17%
Police officer	**1**	**0**	1	0.09%
Promoter	**0**	**1**	1	0.09%
Pupusa maker	**0**	**1**	1	0.09%
Secretary	**0**	**2**	2	0.17%
Safety	**7**	**0**	7	0.61%
Taxi driver	**2**	**0**	2	0.17%
Senior citizen	**4**	**7**	11	0.95%
Neighborhood shop attendant	**0**	**1**	1	0.09%
Surveyor	**3**	**0**	3	0.26%
Tortilla maker	**0**	**1**	1	0.09%
Tractor Driver	**1**	**0**	1	0.09%
Sales person	**7**	**7**	14	1.21%
Clerk-Student	**1**	**0**	1	0.09%
Shoe mender	**1**	**0**	1	0.09%
	574	**579**	1153	

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

Among professionals, there are some persons holding a bachelor's degrees, teachers, and accountants. Other important occupations include sales representatives, truckers, topographers, secretaries, painters, janitors, domestic workers, policemen, shoemakers, guards, bakers, and others.

VI.5.4.2 Income

Population's income can be considered enough to satisfy its basic needs. In this sense, income from some activities such as various occupations, domestic work, temporary jobs, and shoemakers, lead to generate income linked to poverty. Despite the fact of being close to the urban area, the project's area still preserves important characteristics of the rural economy, which suggests that the population within the project's impact area is largely poor.



Source: Socioeconomic Survey, BYPASS SM, 2011

Figure No. VI.30. Source of Income, BYPASS SM

336 persons of the 318 homes receive income from different activities. In addition, 36 homes receive income resulting from the help of a relative living outside of the country, and 16 families receive help from a relative inside the country.

VI.5.4.3 Poverty in the project's influence area

Poverty is measured by income, and income in turn is measured by the purchasing capability of the population. The project's direct and indirect impact area is characterized by having an urban, semi-urban, and rural population in poverty. Besides, the income of the 318 homes barely allows having an approximation to the costs of the urban and rural basic food basket defined by DIGESTYC[8], even when, in some families, more than one person works

Based on income, 32.84% receives less than 1 minimum wage; 49.85% receives up to 2 minimum wages; 8.06% receives up to 4 minimum wages and only 9.25% receive more than 5 minimum wages..

TABLE No. VI.69. NUMBER OF POPULATION BY INCOME AS A MULTIPLE OF MINIMUM WAGE

MINIMUM WAGES	Frequency	Percentage
less than 1 minimum wage	110	32.84%
1 to 2 times the minimum wage	167	49.85%
3 to 4 times the minimum wage	27	8.06%
5 to 6 times the minimum wage	31	9.25%
TOTAL	335	100

Source: Socioeconomic Survey, SM BYPASS, 2011

[8] DIGESTYC, General Directorate of Statistics and Census. According to DIGESTYC, the rural basic food basket for August of 2011 went up to $151.61; while urban basic food basket went up to $118.50 for the same date. Source: http://digestyc.gob.sv/

The information on the previous table is in rural minimum wage. Therefore, using income distribution as a parameter to interpret the income according to urban minimum wage would noticeably change the situation, because given the definition of urban income set by the government of El Salvador, it is almost double the rural minimum wage. As the following table shows, the minimum wages considered would establish that there is a greater deal of poverty, according to the income of the surveyed families, if compared with the urban minimum wage.

TABLE No. VI.70. MINIMUM WAGE DISTRIBUTION, MINIMUM WAGE COUNCIL, SM BYPASS ROAD

SECTOR	MAY 2011	
	Daily	Monthly
Trade and Services	$7.47	$224.21
Industry	$7.31	$219.35
Textile and Apparel Maquila	$6.25	$187.60
Agricultural Sector	$3.50	$104.98
Coffee picker	$3.82	$114.70
Sugar harvester	$3.24	$97.20
Cotton picker	$2.92	$87.48
Coffee Mill	$5.07	$151.96
Cotton and Sugar Cane Mill	$3.68	$110.48

Source: Minimum Wage Council, SM BYPASS ROAD, 2011

Table No.VI.71 establishes that the percentage of the low-income population according to income in urban minimum wage is 82.69%; 8.06% has greater purchasing power, and 9.25% exhibit income conditions that allow for a more adequate standard of living.

TABLE No. VI.71. NUMBER OF POPULATION BY INCOME AS A MULTIPLE OF MINIMUM WAGE

URBAN, SM BYPASS ROAD

URBAN MINIMUM WAGE	Frequency	Percentage
Less than 1 minimum wage	277	82.69%
up to 2 times the minimum wage	**27**	8.06%
More than 3 times the minimum wage	**31**	9.25%
TOTAL	335	100

Source: Socio-Economic Survey, SM BYPASS ROAD,

2011 **VI.5.5** ***Economic Activities***

VI.5.5.1 Production

Economic activities are defined as those activities whereby the population carries out different processes in order to obtain products, goods and services, whose final purpose is generating wealth, and economic and social wellbeing in the population. Based on this, it can be seen that the population in the project's direct and indirect area of impact maintains a high degree of economic activities, allowing a dynamization in the economy for the 3 municipalities under project's impact. Further more, the following table shows that Quelepa and San Miguel are centers for economic activities related to the activities of the country's large companies.

TABLE No. VI.72. POPULATION BY ECONOMIC ACTIVITY, ENVIRONMENTAL IMPACT SUTY, SAN MIGUEL BYPASS ROAD

Location	Economic Activity								Total	Percentage
	Agricultural	Livestock Production	Diner / selling	Agro service / hardware	Tailor / Dressmake	Blacksmithing / metal workshop	Small grocery store / small	Cottage sugar		
El Papalón	21	0	0	0	0	0	1	0	22	21.57%
El Papalón-Moncagua	1	0	0	1	0	1	0	0	3	2.94%
El Zamorano	1	0	0	0	0	0	0	0	1	0.98%
Hato Nuevo	18	1	2	2	2	1	2	0	28	27.45%
Las Delicias	29	2	0	0	0	0	0	0	31	30.39%
San Antonio	3	0	0	0	0	0	0	0	3	2.94%
San José	7	0	2	2	0	0	1	2	14	13.73%
TOTAL	80	3	4	5	2	2	4	2	102	100
Percentage	78.4%	2.9%	3.9%	4.9%	2.0%	2.0%	3.9%	2.0%	100	

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

The project makes an impact on the rural areas of the three municipalities. There is a high proportion of farming activities; therefore, the population mainly engages in agricultural activities; this covers 78.4% of the activities; this also strengthens the work of cafeterias/tortilla sellers (2.9%); grain milling (2.0%), and agro-services/hardware sales (4.9%). There is also important cattle production, where 2.9% of the economic activities are related to this activity. Also 2.0% of the activities have to do with the manufacturing industry; 3.9% have to do with foreign retailing, and 2% are iron and metal work.

For local agricultural production, a small percentage of farmers and ranchers hire permanent and seasonal workers; the rest do not use, or do not need permanent or seasonal workers because their production is at such a small scale.

TABLE No. VI.73. TEMPORARY AND PERMANENT WORKERS

LOCATION	PERMANENT	TEMPORARY	TOTAL
El Papalón	**1**	**1**	**2**
El Papalón-Moncagua	**0**	**1**	**1**
Las Delicias	**0**	**3**	**3**
Total	**1**	**5**	**6**
Porcentaje	16.7%	83.3%	100

Source: Socioeconomic Survey, SM BYPASS, 2011

VI.5.5.2 Technical Assistance

Farm production also has very little technical assistance. Of all the producers, 6 mentioned they had received technical assistance in crops, cattle, and marketing their products.

TABLE No. VI.74. TYPE OF TECHNICAL ASSISTANCE, ENVIRONMENTAL IMPACT STUDY SAN MIGUEL BYPASS ROAD

LOCATION	TECHNICAL ASSISTANCE			TOTAL
PLACE OF RESIDENCE	CROPS	LIVESTOCK	TRADE	
El Papalón	**1**	**0**	0	**1**
Hato Nuevo	**1**	**0**	2	**3**
Las Delicias	**1**	**1**	0	**2**
Total	**3**	**1**	2	**6**
Percentage	**50.0%**	**16.7%**	33.3%	**100**

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

Those who do receive support through technical assistance only mention CENTA as the service provider.

TABLE No. VI.75. TECHNICAL SUPPORT PROVIDED TO HOUSEHOLDS, ENVIRONMENTAL IMPACT STUDY, SAN MIGUEL BYPASS

PLACE OF RESIDENCE	CENTA Technical Assistance
Hato Nuevo	**1**
Las Delicias	**2**
Total	**3**

Source: Socioeconomic Survey, SM BYPASS ROAD

VI.5.5.3 Sources of Financing

Financing for local production has to do with the resources the population has access to; that is, the main source of investment is based on their own resources. Of the total number of producers, 19 mention that they have received support in the form of a credit.

TABLE No. VI.76. POPULATION WITH CREDIT FROM FINANCIAL INSTITUTION, ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD

LOCATION	HAS RECEIVED A LOAN
El Papalón	4
El Papalón-Moncagua	1
El Zamorano	1
Hato Nuevo	9
Las Delicias	2
San José	2
TOTAL	19

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

Financing through credit is mostly concentrated in commercial banks (57.9%), individuals 21.1%, and Credit Unions 21.1%.

TABLE No. VI.77. SOURCE OF CREDIT, ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD

LOCATION	SOURCE			TOTAL
	COMMERCIAL BANKS	INDIVIDUALS	CREDIT UNIONS	
El Papalón	2	**1**	1	**4**
El Papalón-Moncagua	1	**0**	0	**1**
El Zamorano	1	**0**	0	**1**

LOCATION	SOURCE			TOTAL
Hato Nuevo	**5**	**1**	**3**	**9**
Las Delicias	**2**	**0**	**0**	**2**
San José	**0**	**2**	**0**	**2**
TOTAL	**11**	**4**	**4**	**19**
Percentage	**57.9%**	**21.1%**	**21.1%**	

Source: Socio-Economic Survey, SM BYPASS ROAD,

2011 **VI.5.6** *Vulnerable People and Groups*

Some vulnerable groups have been identified: single mothers, senior citizens, and people with disabilities, people with terminal illnesses, and other groups such as underprivileged children. Out of this set of groups, the survey identifies the following:

TABLE No. VI.78. NUMBER OF VULNERABLE PERSONS, ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD

LOCATION	VULNERABLE PERSONS							PERCENTAGE
	Single Mother	Underage Single Mother	Street Child	Senior citizen	Person with dissabilities	Terminally ill	Total	
El Papalón	**4**	**0**	**0**	**12**	0	**1**	**17**	18.28%
El Papalón-Moncagua	**0**	**0**	**0**	**2**	0	**0**	**2**	2.15%
El Sitio	**2**	**0**	**0**	**0**	0	**0**	**2**	2.15%
El Zamorano	**2**	**0**	**0**	**1**	0	**0**	**3**	3.23%
Hato Nuevo	**18**	**0**	**0**	**12**	2	**0**	**32**	34.41%
Las Delicias	**2**	**1**	**1**	**10**	0	**3**	**17**	18.28%
San Antonio	**3**	**0**	**1**	**2**	0	**0**	**6**	6.45%
San José	**7**	**0**	**0**	**4**	1	**0**	**12**	12.90%
San Miguel	**2**	**0**	**0**	**0**	0	**0**	**2**	2.15%
San Salvador	**0**	**0**	**0**	**0**	0	**0**	**0**	0.00%
TOTAL	**40**	**1**	**2**	**43**	3	**4**	**93**	100
Percentage	43.0%	**1.1%**	**2.2%**	46.2%	3.2%	**4.3%**	100	

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

The largest segment of the vulnerable groups is that of senior citizens with 46.2%. Single mothers are a special group with vulnerability, they comprise 43%; and unmarried underage mothers at 1.1% are a highly vulnerable group because they have to carry the burden of housework and produce some type of income.

The terminally illed population is at 4.3%, people with disabilities at 3.2%, and street children at 2.2%.

Added to the specific groups considered above, there is a group whose living conditions show signs of being precarious, insufficient or in need. An example of this is the 23.5% of the population living in temporary or semi-permanent shelters made of rapidly deteriorating materials; they are exposed to the environment, or are mainly vulnerable to weather phenomena. Simultaneously, these groups receive an income that does not enable them to meet their basic necessities. The survey describes 82.69% who receive income below 1 urban minimum wage, and a 32.84% receiving less than 1 rural minimum wage; they are considered as part of the rural population.

VI.5.7 *Health*

The population in Moncagua, Quelepa, and San Miguel located in the direct and indirect area of influence go to the government health clinics in their area of residence for medical attention. The people in Moncagua go to the Moncagua and Nueva Guadalupe health clinic. The Quelepa residents attend the health clinic in Quelepa, and some go to the health clinic at El Sitio. The residents of San Miguel go to Carillo, Zamorano, La Presita, San Carlos, Hospital San Juan de Dios, Centro de San Miguel, El Sitio, Las Delicias, The Salvadoran Institute for Social Security (ISSS) Roosevelt, and Nuestra Sra. De La Paz.

TABLE No. VI.79. VISITS TO NEAREST HEALTH CENTER, ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD

NEAREST HEALTH UNIT	FREQUENCY	PERCENTAGE
Carrillo	105	33.02%
Zamorano	**91**	28.62%
Quelepa	**53**	16.67%
La Presita	**33**	10.38%
Moncagua	**9**	2.83%
San Carlos	**6**	1.89%
Hospital san Juan de Dios	**4**	1.26%
Centro de San Miguel	**3**	0.94%
El sitio	**2**	0.63%
Delicias	**1**	0.31%
ISSS Roosevelt	**1**	0.31%
Nuestra Señora de la Paz	**1**	0.31%
Nueva Guadalupe	**1**	0.31%
No answer	**8**	2.52%
Total	318	100.0

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

Distance travelled to the nearest health center: of 1 - 2 kilometers (50.3%), 3 - 5 kilometers (36.2%), more than 5 kilometers (7.9%).

TABLE No. VI.80. DISTANCE FROM THE COMMUNITY TO THE NEAREST HEALTH UNIT, ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD

LOCATION	1 - 2 km	3 - 5 km	more than 5 km	N/R	Total
El Papalón	**40**	**40**	**0**	**7**	**87**
El Papalón-Moncagua	**7**	**1**	**0**	**2**	**10**
El Sitio	**0**	**2**	**1**	**1**	**4**
El Zamorano	**2**	**7**	**2**	**1**	**12**
Hato Nuevo	**50**	**20**	**0**	**0**	**70**
Las Delicias	**15**	**29**	**19**	**1**	**64**
San Antonio	**3**	**5**	**2**	**0**	**10**
San José	**43**	**8**	**1**	**5**	**57**
San Miguel	**0**	**3**	**0**	**0**	**3**
San Salvador	**0**	**0**	**0**	**1**	**1**
TOTAL	160	115	**25**	**18**	318
Percentage	50.3%	36.2%	**7.9%**	**5.7%**	100

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

When asked about their illnesses, the surveyed population stated that they are afflicted with Cancer, Diabetes, AIDS, heart diseases, hepatitis, leukemia, epilepsy, tuberculosis, hypertension, and asthma. It is important to note that of the 318 respondents 42.77% (136) responded that someone in the family had one of these conditions. The fact that there are some cases of AIDS is important for the project. This disease is a risk for the external population entering the area, mainly construction workers.

TABLE No. VI.81. NUMBER OF PEOPLE WITH DISEASES CONSIDERED SERIOUS, SM BYPASS EIA.

PLACE OF RESIDENCE	Disease										Total	Percentage
	Cancer	Diabetes	AIDS	Heart	Hepatitis	Leukemia	Epilepsy	Tuberculosis	Hypertension	Asthma		
El Papalón	1	11	0	8	0	0	3	0	4	i	28	20.59%
El Papalón-Moncagua	0	2	0	0	0	0	0	i	0	0	3	2.21%
El Sitio	0	0	0	0	0	0	1	0	0	0	1	0.74%
El Zamorano	0	1	0	3	0	0	2	i	1	0	8	5.88%
Hato Nuevo	1	7	1	9	1	2	6	3	11	5	46	33.82%
Las Delicias	0	9	2	4	0	2	0	0	2	4	23	16.91%
San Antonio	0	3	0	2	0	0	1	1	0	0	7	5.15%
San José	0	5	0	2	0	0	2	1	4	3	17	12.50%
San Miguel	0	1	0	0	0	0	2	0	0	0	3	2.21%
Total	2	39	3	28	1	4	17	7	22	13	136	100
Percentage	1.5%	28.7%	2.2%	20.6%	0.7%	2.9%	12.5%	5.1%	16.2%	9.6%	100	

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

The municipalities impacted by the project show the following prevalence of illnesses: ARIs, general infections, diarrhea, intestinal parasites, and other illnesses including pneumonia, arterial hypertension, and cancer.

TABLE No. VI.82. GENERAL MORBIDITY, ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD

TOTAL PERSONS	ARIs		PARASITISM		INFECTIONS (skin, eyes, urinary)		DIARRHEA		OTHER DISEASES		TOTAL
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	
Moncagua	**3,566.00**	**5,250.00**	**504.00**	**576.00**	**744.00**	**1,404.00**	**480.00**	**936.00**	**168.00**	**720.00**	**14,348.00**
Quelepa	996.00	1,192.00	72.00	72.00	48.00	120.00			48.00	24.00	2,572.00
San Miguel	35,464.00	40,099.00	1,352.00	1,660.00	3,624.00	8,128.00	5,640.00	5,328.00	984.00	3,408.00	105,687.00
TOTAL	40,026.00	46,541.00	1,928.00	2,308.00	4,416.00	9,652.00	6,120.00	6,264.00	1,200.00	4,152.00	122,607.00

Source: MSPYAS Statistics

VI.5.7.2 Conditions inside the house

These diseases are related to the population's living conditions. This indicates that the conditions of health inside the home are determinant for the population's health. Based on observation, the following table shows that most of the population is exposed to conditions that enable vector propagation. Each carries a certain level of risk or exposure to vector-carried disease. Most of the population states that there are rats in their homes. Flies are also found in a large number of homes, as well as cockroaches and mosquitoes.

TABLE No. VI.83. NUMBER AND TYPE OF VECTORS BY COMMUNITY, ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD

LOCATION	TYPE OF VECTOR FOUND IN THE HOME			
	Mice	Flies	Cockroaches	Mosquitoes
El Papalón	68	61	31	34
El Papalón-Moncagua	7	3	2	1
El Sitio	2	2	2	1
El Zamorano	6	8	7	7
Hato Nuevo	37	38	26	18
Las Delicias	54	48	30	11
San Antonio	9	7	6	5
San José	39	26	18	14
San Miguel	3	3	2	2
	225	196	124	93

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

VI.5.7.3 DOMESTIC ANIMALS

The population keeps domestic animals in their homes. These animals are determined by their usefulness, for example, dogs are good for the household security, and cats are used to control mice. Chicken and ducks are used for food.

TABLE No. VI.84. NUMBER AND TYPE OF DOMESTIC ANIMALS BY COMMUNITY, ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD

LOCATION	DOMESTIC ANIMALS			
	Dogs	Cats	Chickens	Ducks
El Papalón	57	23	45	6
El Papalón-Moncagua	5	2	0	0
El Sitio	2	1	1	0
El Zamorano	7	4	5	0
Hato Nuevo	42	31	22	4
Las Delicias	41	21	35	6
San Antonio	7	5	7	1
San José	40	13	20	2
San Miguel	3	2	1	0
TOTAL	204	102	136	19

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

VI.5.7.4 Health infrastructure

In general, there is one or more Health Units in every municipality, depending on the population of the municipality. In the case of San Miguel, because of the importance of this city and its population density, there are 11 Health Units, 1 third-tier National Regional Hospital ("San Juan de Dios") and seven health centers. The "San Juan de Dios" Hospital's radius is of regional influence and covers several municipalities of the area, including other departments. It provides the following services:

TABLE No. VI.85. SERVICES PROVIDED AT THE REGIONAL HOSPITAL OF SAN MIGUEL

SERVICE	COUNT
Provision of Hospital Beds	324
Medical Offices	**101**
Dental Offices	**13**
Operating Rooms	**6**
ICU Wards	**3**
Delivery rooms	**5**
X-ray rooms	**2**
Clinical Laboratories	**7**
Cytology Laboratories	**1**
Colposcopy Clinics	**1**
Ultrasonography Rooms	**1**

Source: MSPYAS Report

There is also a Social Security hospital and several private hospitals in the city, *Centro Médico de Oriente, San Francisco and Nuestra Señora de la Paz*. All hospitals are in the urban area of the city.

The two Health Units closest to the projects are the Health Unit of *Colonia Carrillo* and the Health Unit of *Colonia Zamorano*, although there are five health units in the urban area to which the population can have access.

Moncagua and Quelepa have two health units, in the municipal capital, that service the entire municipality. Following is a detail of the existing health units. In the Project direct area of influence no health center was identified.

TABLE No. VI.86. LOCATION OF HEALTH CENTERS WITHIN THE PROJECT's INDIRECT INFLUENCE AREA

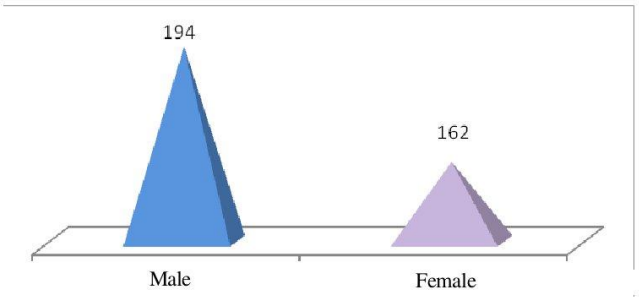
LOCATION	ADDRESS	AREA OF INFLUENCE
MONCAGUA	Bo. El Calvario, Moncagua, San Miguel	The municipal capital and the southern area of the municipality.
QUELEPA	Bo. El Centro, Quelepa	Entire Municipality
EL ZAMORAN	Col. Betania, Av. China, Cantón El Zamoran, San Miguel	North and west areas of the municipality
Martin Zaldivar (COLONIA CARRILLO)	Calle Principal, Colonia Carrillo, 1ª Etapa, CASA No. 2, San Miguel	South-eastearn area of the municipality

Source: MSPYAS Report

Drawing VI-14 Health System and Influence Area, shows the radius of influence of the health units, which users are located in the Project indirect influence area.

VI.5.8 *Education*

From the population identified in the Socio-economic Study, 356 people are currently studying. From which, 162 are women (45.51%) and 194 are men (54.49%). These 356 people account for 30.87% of the total population.



Source: Socio-economic Survey, SM Trunk Road, 2011

Figure No. VI.31. Student Population, by sex, SM TRUNK ROAD

Among the population in the communities, there are a total of 70 children of less than 5 years old, and therefore, they do not have the necessary age perform any economic activity to support the household or to study. There are also 2 disabled children, and two girls that have schooling age but do not attend school, although they are not classified as illiterate, given that they have the possibility to attend a school.

There are also 202 illiterate people (17.52%).

TABLE No. VI.87. POPULATION BY SCHOOLING LEVEL, SM BYPASS ROAD

LEVEL	SEX		TOTAL	PERCENTAGE
	Male	Female		
N/A	**36**	**34**	70	6.07%
Illiterate	**103**	**99**	202	17.52%
Person with dissabilities	**1**	**1**	2	0.17%
In school age but not	**0**	**2**	2	0.17%
Kindergarten	**24**	**23**	47	4.08%
First Cycle	**107**	**100**	207	17.95%
Second Cycle	**124**	**121**	245	21.25%
Third Cycle	**103**	**101**	204	17.69%
High School	**62**	**86**	148	12.84%
College	**14**	**12**	26	2.25%
TOTAL	574	579	1153	100

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

The total population that studied or is currently studying is 76.06% of the census population. 48% is attending or has attended Kindergarten; 17.95% the First Cycle; 21.25% the Second cycle; 17.69% have attended or are currently in Third cycle; 12.84% are in *Bachillerato (High School education),* and the university population currently studying or that have completed their studies is 2.25%.

VI.5.8.1 Educational Infrastructure

The City of San Miguel is a regional center, and therefore it has all the education levels, including university studies. There are public and private education centers of all levels.

In the municipality of San Miguel there are 190 schools, both public and private. In Quelepa there are 7 and in Moncagua 23, for a total of 220 schools in the three municipalities. From these 15 are in the Indirect Project influence area, here under detailed, and which radius of influence is shown in Drawing VI-15 Schools and Influence Area.

TABLE No. VI.88. PUBLIC AND PRIVATE SCHOOLS IN THE PROJECT'S INFLUENCE AREA

CODE	SCHOOL NAME	ADDRESS	MUNICIPALITY
12918	CANTÓN VALLE ALEGRE SCHOOL	CANTÓN VALLE ALEGRE	MONCAGUA
12926	"MARÍA LUISA PARADA" SCHOOL	SEGUNDA CALLE ORIENTE BARRIO INDEPENDENCIA, MONCAGUA	MONCAGUA
12942	CANTÓN SAN ANTONIO SCHOOL	CANTÓN SAN ANTONIO, JURISDICTION OF QUELEPA, DEPARTAMENT OF SAN MIGUEL	QUELEPA
12945	CANTÓN SAN JOSÉ SCHOOL	CANTÓN SAN JOSÉ JURISDICCIÓN DE QUELEPA DEPARTAMENT OF SAN MIGUEL	QUELEPA
12946	CANTÓN EL OBRAJUELO SCHOOL	CANTÓN EL OBRAJUELO MUNICIPALITY OF QUELEPA, DEPARTAMENT OF SAN MIGUEL	QUELEPA
12978	COLONIA EL CARMEN CANTÓN HATO NUEVOSCHOOL	COLONIA EL CARMEN, CANTÓN HATO NUEVO, SAN MIGUEL 5 KILÓMETROS FROM SAN MIGUEL ALONG THE MILITARY ROUTE (PN18), BY ENTRANCE OF CAÑAS AUTO REPAIR SHOP, ON THE LEFT, I KILOMETER WEST COMING FROM SAN MIGUEL.	SAN MIGUEL
12985	COLONIA LA AGROPECUARIA CANTÓN HATO NUEVO SCHOOL	ROAD TO COMARCA, COLONIA AGROPECUARIA	SAN MIGUEL
12990	COLONIA LA CONFIANZA SCHOOL	MAIN STREET, COLONIA LA CONFIANZA	SAN MIGUEL
12995	COLONIAS UNIDAS SCHOOL	201 FELIX MIGUEL CHARLAIX AVENUE, SAN MIGUEL	SAN MIGUEL
13021	COLONIA CARRILLO SCHOOL	MAIN STREET, COLONIA CARRILLO	SAN MIGUEL
13031	MARIA LAURA ESCOBAR SCHOOL	CASERÍO APACUNQUE, CANTÓN LAS DELICIAS, PAN AMERICAN HIGHWAY (CA-1), ROAD TO MONSANTO	SAN MIGUEL
13035	CASERÍO LAS HOJAS, CANTÓN LAS DELICIAS SCHOOL	CASERÍO LAS HOJAS, CANTON LAS DELICIAS, MUNICIPALITY OF SAN MIGUEL, ROAD TO LA UNION, ROAD TO LA GALLINA, TWO BLOCKS BEFORE EL PAPALÓN SCHOOL	SAN MIGUEL
13041	CANTÓN HATO NUEVO SCHOOL	MILITARY ROAD ROUTE (RN18) KILOMETER 142, TURN TO SANTA ROSA DE LIMA, CANTON HATO NUEVO	SAN MIGUEL
13059	CANTÓN EL PAPALÓN SCHOOL	KM 145, PAN AMERICAN HIGHWAY (CA-1), ROAD TO LA UNION	SAN MIGUEL
13071	HERBERT DE SOLA SCHOOL	OLD ROAD TO QUELEPA	SAN MIGUEL
13090	COLONIA LA CARMENZA, CANTÓN HATO NUEVO, SCHOOL	MAIN STREET, COLONIA CARMENZA, CANTON HATO NUEVO, SAN MIGUEL.	SAN MIGUEL

Source: Interview with school principals

The radius of influence of *Universidad del Oriente,* and *Universidad de El Salvador* covers the entire Eastern zone, and students travel to the education center by bus or in their own cars.

In the direct Project influence area there is one school: "*Canton San José*", station 1+340.

Each one of the schools was visited to identify their radius of influence and determine the possible impact of the project's presence, the summary of the interviews is presented in Annex No. IV. 12. The following table shows this information.

TABLE No. VI.89. NUMBER OF STUDENTS, GRADE LEVEL, AND HOMETOWN OF STUDENTS OF SCHOOLS LOCATED IN THE DIRECT INFLUENCE AREA OF THE SM BYPASS ROAD, 2011.

SCHOOL	No. OF STUDENT	GRADE LEVEL	HOMETOWN	AVERAGE DISTANCE	FARTHEST LOCATION
Cantón San José School	325	9th Grade	Caserío Las Lomitas, Colonia El Castaño, Canton San Antonio, Canton Valle Alegre, Colonia	2 km	Caserío Los Catalanes
National Institute of Moncagua, Barrio Independencia	483	From 1st Grade to 12th Grade	City of Moncagua, Cantons of Estancia, Tangolona, Ejidos, Papalón, Valle Alegre, La Reforma. And Hamlets: St. Barbara, El Cerro, Los Negros. City of Chapeltique, Cantons of San José and Quelepa	From 4-6 Km and even 8 Km away in a few cases	Canton Papalones, Chapeltique
Barrio El Centro Preschool	80	Preschool	Urban cantons and colonias: La Reforma, Los Ejidos, Gualamar, Valle Alegre and Tangatona	2 km	Canton Valle Alegre
Maria Luisa Parada Moncagua School	1032	9th Grade	Barrios: San Pedro, Independencia, Candelaria, El Calvario, Hacienda La Reforma. Hamlets: El Tejar, Valle Alegre, Hualama	1 - 1.5 km	Canton Hualama, Chapeltique
Caserío Agua Zarca Santa Inés School	367	Preschool – 9th Grade	Surrounding villages** and townships:** Agua Zarca, Chispa, Achistal, Divisadero, Sta. Inés, Zuniga, Altamira, Asentamiento, San Jacinto, Concepción	7 – 8 km	Township of Concepción Corozal
Colonia La Confianza El Zamorán School	745	Pre-kindergarten-Grade 12	Township of El Zamorán	1 km	Village of Agua Zarca, Township of
La Carmenza Hato Nuevo School	425	Preschool – 9th Grade	Township of Hato Nuevo and surrounding areas	0.5 km	Eben Ezer Housing Development, Township of
Cantón Hato Nuevo School	508	9th Grade	Townships and villages: El Tamarindo, Las Delicias, La Trinidad, El Guayabal, Agua Fría, Colonia Agropecuaria, El Carmen, Agua Fría, La Carmenza, La Dolores.	2 km	El Tamarindo
Colonia Agropecuaria School	55	6th Grade	Colonia Agropecuaria, Dolores and Road to El Guayabal	1 km	Road to El Guayabal and Agua
Colonia Carrillo School	884	9th Grade	Colonia Carrillo, La Pradera, Línea Férrea, Las Pampas Housing	1 km	Las Pampas
Las Hojas, Las Delicias School	36	4th Grade	Village of Las Hojas	0.5 km	Las Hojas Village
Maria Laura Escobar School	56	6th Grade	Apacunque Village and Rio Grande Village	0.5 km	Rio Grande Village

Source: Interview with school principal or representative

VI.5.9 *Institutional presence and community organization*

According to the survey information, 9 out of the 10 places are organized. The type of organization found is the Community Development Organization, Community Board, Water Administration Councils, School and Church Council; the boards, legal or not, are defined from the Community Development Associations, which maintain the interaction between the population and other municipality actors. From the participating communities, 23 people participate in ADESCOS, 3 in Committees, 21 in Community Boards, 5 in Water Administration Boards, 2 in School Councils, and 5 in Church Councils; 260 people do not participate. The different organizations have both male and female participants, there are in total 45 people that belong to some type of organization, from which 18 are women and the rest are men.

The following table shows a leadership or participation map of the population in the different community organizations.

TABLE No. VI.90. NUMBER OF PEOPLE PARTICIPATING IN COMMUNITY BOARDS AND ORGANIZATIONS - ENVIRONMENTAL IMPACT STUDY - SAN MIGUEL BYPASS ROAD.

Township	Name	Participates in an Organization							Total
		ADESCO	Committee	Board	Community board	Water board	School board	Church organization	
El Papalón	Benito Mejia	1							**1**
	Dina Esperanza Salazar				1				**1**
	Narcisa Susana Sánchez				1				**1**
	Sabino Alvarez	1							**1**
	Samuel Alvarez			1					**1**
El Papalón, Moncagua,	Santos Raúl Argueta José Ernesto Garay	1		1					**1** **1**
	Maribel Chavez Dina de la Paz Ticas Carlos Colindres			1		1		1	**1** **1** **1**
	José Orlando Alvarenga			1					**1**
	Olga Argueta de Salazar			1					**1**
	Oscar Colindres	1							**1**
	Reynaldo Lozo	1							**1**
	Sebastián Hernández Alfaro			1					**1**
Hato Nuevo	Sonia Nohemy Márquez Alma Delfina Chavez	1 1							**1** **1**
	Carlos Antonio Rodríguez						1		**1**
	Concepción Martínez		1						**1**
	Evelith Yaneth Vasquez	1							**1**
	Franco Aguirre	1							**1**
	Gilber Ernesto Argueta	1							**1**
	Hircia Hernández							1	**1**
	Ipolito Ramos	1							**1**
	José Milton Vasquez			1					**1**
	José Neptali García	1							**1**
	José Porpilio Rodríguez	1							**1**
	Juan Ángel Gómez						1		**1**
	Juan Carlos Zalmeron							1	**1**
	Karen Villanueva	1							**1**
	Lilian Martínez	1							**1**
	Manuel Antonio	1							**1**
	Maria Luisa Guevara			**1**					**1**
	Maria Vasquez	1							**1**
	Mauricio Ramos Sorto			**1**					**1**
	Santos Deomides Villatoro	1							**1**
	Saúl Benitez			**1**					**1**

	Sebastián Pérez Hernández			**1**					**1**
	Sonia Ochoa			**1**					**1**
	Teresa de Jesús Martínez			**1**					**1**
	Wilberto López			**1**					**1**
Las Delicias	Yessica Ortiz	1		**1**					**1**
San Miguel	José Carlos Vásquez	1							**1**
	Roberto de Jesús Cubias								**1**
	Sonia de Argueta			**1**					**1**
		20	**1**	**16**	2	1	2	3	**45**
		20	**1**	**16**	2	1	2	3	**45**

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

VI.5.10 Project Perception

The population's perception about the Project can be divided into four aspects: The existence of community infrastructure that could suffer the impact of the Project, the existence of sites that deserve being protected and the opinions on the positive and negative aspects of the Project.

Regarding the existence of community infrastructure that could suffer an impact, the population expresses that there could be an impact on quarries 0.6%; wells 14.5%; water pipelines 4.4%, sport facilities, 2.9%; churches 6%; it is necessary to clarify that it can be a direct or indirect impact, as is the case for the soccer courts. Annex VI. shows the photographic reports of the plots.

TABLE No. VI.91. TYPE COMMUNITY INFRASTRUCTURE, ENVIRONMENTAL IMPACT STUDY, SAN MIGUEL BYPASS ROAD

PLACE OF RESIDENCE	INFRAESTRUCTURA COMUNITARIA						TOTAL
	Public water faucet	Well	Piped water	Sports courts	Churches	Not applicable / No answer	
El Papalón	0	19	0			66	**87**
El Papalón-Moncagua	0	0	1	0	0	9	**10**
El Sitio	0	0	0	0	0	4	**4**
El Zamorano	0	1	0	2	0	9	**12**
Hato Nuevo	2	15	12	1	6	34	**70**
Las Delicias	0	4	0	5	7	48	**64**
San Antonio	0	3	1	0	0	6	**10**
San José	0	3	0	0	5	49	**57**
San Miguel	0	1	0	0	0	2	**3**
San Salvador	0	0	0	0	0	1	**1**
	2	46	14	9	19	228	318
	0.6%	14.5%	4.4%	2.8%	6.0%	71.7%	

Source: Socio-Economic Survey, SM BYPASS ROAD, 20111

When asked if there are any sites considered as cultural heritage in the community, the population identified the existence of tourist sites 7.5%; 4.7% identified historic sites; and 3% identifies archeological sites in San Antonio, near Quelepa.

TABLE No. VI.92. IDENTIFICATION OF CULTURAL HERITAGE SITES, ENVIRONMENTAL IMPACT STUDY OF SAN MIGUEL BYPASS ROAD CONSTRUCTION PROJECT

PLACE OF RESIDENCE	CULTURAL HERITAGE SITES IN THE COMMUNITY				TOTAL
	Tourist Attractions	Historical Sites	Cultural Heritage	Did not respond	
El Papalón	**6**	**0**	**0**	**81**	**87**
El Papalón-Moncagua	**0**	**1**	**0**	**9**	**10**
El Sitio	**2**	**1**	**0**	**1**	**4**
El Zamorano	**0**	**1**	**0**	**11**	**12**
Hato Nuevo	**0**	**0**	**0**	**70**	**70**
Las Delicias	**0**	**1**	**0**	**63**	**64**
San Antonio	**0**	**1**	**1**	**8**	**10**
San José	**16**	**10**	**0**	**31**	**57**
San Miguel	**0**	**0**	**0**	**3**	**3**
San Salvador	**0**	**0**	**0**	**1**	**1**
TOTAL	**24**	**15**	**1**	278	318
Percentage	**7.5%**	**4.7%**	**0.3%**	87.4%	100

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

VI.5.10.1 Project feedback in the area of direct influence of the project

Following is the more significant information of the responses of the population about the Project, in the census conducted by the owners and inhabitants of the Project outline. The population identifies positive and negative aspects, which are essential to generate, during the construction phase, a future action strategy.

For the population the project means an improvement or development both for the country and for the communities on which the project will have an impact. In this sense, 31.31% of the population states that the local population will receive benefits, as will the country in general. Likewise, and in terms of importance for the improvement of San Miguel, the population considers that the Project is necessary to decongest the center of San Miguel; and have been waiting for many years for the Project to be developed. 21.21% point out it is necessary to decongest San Miguel.

12.63% manifest that the added value of the land would increase and this will favor each one of the land owners. 9.6% expresses that trade will increase and there will be greater mobility of goods in the zone. Also, for the users of collective transportation there will be increased access to transportation, and for the zone of El Zamorano, access to bus routes will be improved, many of which at present do not reach this zone, 4.55% considers there will be a reduction in travel time, which will result in the reduction of fuel expenses and therefore, the will have an impact on the care of the vehicular park which will be improved since vehicles will deteriorate less. For 14.65% one of the important aspects is that jobs will be generated.

TABLE No. VI.93. POSITIVE ASPECTS OF THE PROJECT WITHIN THE DIRECT INFLUENCE AREA , ENVIRONMENTAL IMPACT STUDY OF SAN MIGUEL BYPASS ROAD CONSTRUCTION PROJECT

POSITIVE ASPECTS	FREQUENCY	PERCENTAGE
Will benefit the population and the country	**62**	31.31%
Necessary to decongest San Miguel	**42**	21.21%
Appreciation will increase	**25**	12.63%
Trade will increase	**19**	9.60%
Fuel savings	**9**	4.55%

Access to transportation	**12**	6.06%
Will generate jobs	**29**	14.65%
TOTAL	**198**	100

Source: Socioeconomic census of property owners, SM BYPASS ROAD, 2011

On the negative aspects, the population states the following: It will not benefit the communities (36.3624.5%), because this is a nation Project, and therefore, it is not reflected expressed in direct investment mechanisms on the population that lives in the project influence area. In addition, there is fear that the prices are not fair, and the price paid for the land will not be its true worth.

Also, more criminality will be generated (6.828%) and there will be higher municipal taxes (2.27%); 4.55% sees no positive aspects in this Project.

TABLE No. VI.94. NEGATIVE ASPECTS OF THE PROJECT IN THE DIRECT INFLUENCE AREA , ENVIRONMENTAL IMPACT STUDY OF SAN MIGUEL BYPASS ROAD CONSTRUCTION PROJECT

WEAKNESSES	FREQUENCY	PERCENTAGE
Properties will be affected	**32**	36.36%
There will be more accidents	**16**	18.18%
They will not pay what the land is worth	**10**	11.36%
It will not benefit the communities	**18**	20.45%
There will be more crime	**6**	6.82%
More taxes	**2**	2.27%
No strengths at all	**4**	4.55%
	88	

Source: Socioeconomic census of property owners, SM BYPASS ROAD, 2011

VI.5.10.2 Positive aspects of the population in the area of indirect influence of the project

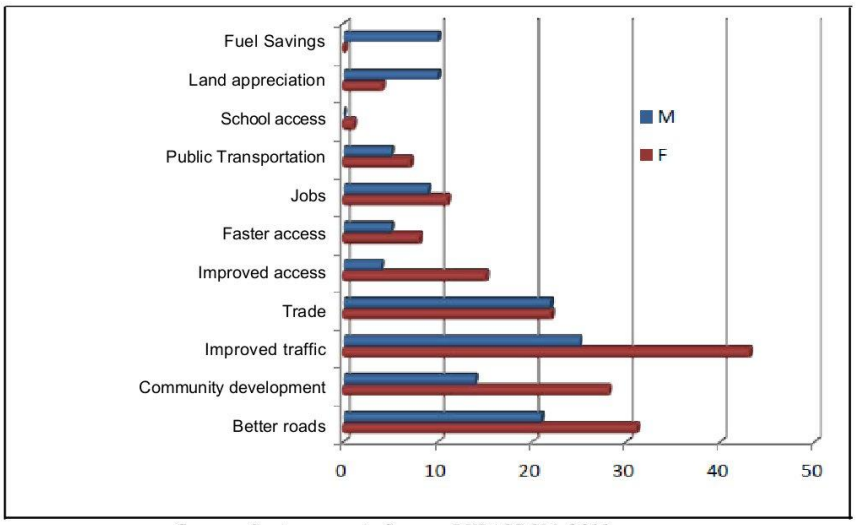
To assess the perception of the population, the results of the survey and the census conducted are presented hereunder. Therefore, the following tables reflect the opinion of 633 people interviewed.

On the San Miguel Trunk Road Project's positive aspects, it is observed that 16.35% mentions that the streets will be improved, which will result in less deterioration of the vehicles: also the possibility of communities improving is observed (13.21%); traffic will be improved (21.38%), which will lead to the decongestion of San Miguel. Access to the communities will be increased (5.97%), which will allow a greater mobilization of the population and in some cases the existence of collective transportation (3.77%) towards the communities. There will also be a reduction in the travel time (4.09%); employment will be generated for the population that lives in the zone (6.29%); there will be access to schools and other services; land added value will be increased in the zone.

TABLE No. VI.95. POSITIVE ASPECTS OF THE PROJECT WITHIN THE INDIRECT INFLUENCE AREA , ENVIRONMENTAL IMPACT STUDY OF SAN MIGUEL BYPASS ROAD CONSTRUCTION PROJECT

OPINION	Sex		Total	PERCENTAGE
	F	M		
Improve the roads	**31**	**21**	**52**	16.35%
Community development	**28**	**14**	**42**	13.21%
ImproveS traffic	**43**	**25**	**68**	21.38%
Business	**22**	**22**	**44**	13.84%
Improves access	**15**	**4**	**19**	5.97%
Faster access	**8**	**5**	**13**	4.09%
Jobs	**11**	**9**	**20**	6.29%
Public transportation	**7**	**5**	**12**	3.77%
Access to school	**1**	**0**	**1**	0.31%
Increased property appreciation	**4**	**10**	**14**	4.40%
Fuel savings	**0**	**10**	**10**	3.14%
Did not know/did not answer	**8**	**5**	**13**	4.09%
None	**8**	**2**	**10**	3.14%
Total	**186**	**132**	318	100

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011



Source: Socioeconomic Survey, BYPASS SM, 2011

Figure No. VI.32. Positive Aspects of the Project - IIA

VI.5.10.3 Negative aspects of the population in the direct influence area of the project

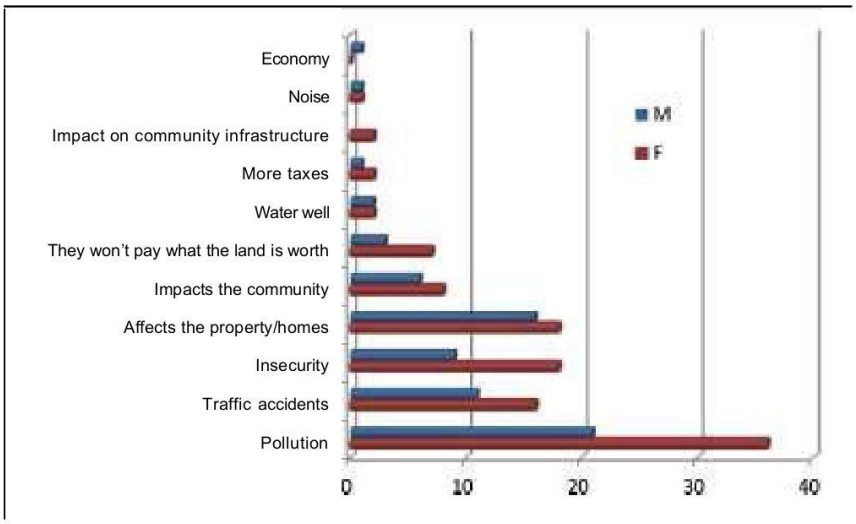
Regarding the negative aspects, the results, as a whole, of the surveys and the census conducted revealed that 11.32% does not observe any negative aspects in the Project; the rest identify more frequently contamination, an increased possibility of traffic accidents happening, due to drivers speeding, the impact on housing, land and insecurity. They also consider that the Project will have an impact on private and community infrastructure, as well as on wells, potable water pipelines, noise and the non-adequate payment

of the land, and tax increase, among others. Also, once the Project has been completed, more pollution will be generated in the zone due to the noise of the Project machines and cars.

TABLE No. VI.96. PROJECT'S DIRECT INFLUENCE AREA WEAKNESSES, ENVIRONMENTAL IMPACT STUDY OF THE SAN MIGUEL BYPASS ROAD CONSTRUCTION PROJECT

OPINION	F	M	FREQUENCY	PERCENTAGE
Pollution	36	21	**57**	17.92%
Traffic accidents	16	11	**27**	8.49%
Insecurity	18	9	**27**	8.49%
Affects land / housing	18	16	**34**	10.69%
Affects the community	8	6	**14**	4.40%
They will not pay what the land is worth	7	3	**10**	3.14%
Water wells	2	2	**4**	1.26%
Increased taxes	2	1	**3**	0.94%
Impact on community infrastructure	2		**2**	0.63%
Noise	1	1	**2**	0.63%
Economy	0	1	**1**	0.31%
Did not know/did not answer	56	45	101	31.76%
No strengths at all	20	16	**36**	11.32%
Total	186	132	318	100

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011



Source: Socioeconomic Survey, BYPASS SM, 2011 **Gráfico No. VI.33.** *Negative aspects, by sex*

VI.5.11 *Road Network and Transportation*

VI.5.11.1 Transportation Medium

When consulted about which is the means of transportation most widely used by the population to go from their homes to San Miguel or other destinations, the population responded that most of the time they travel by bus 85.8%; by car 4.7%; 3.5% use pick-up trucks; 0.3% ride motorcycles and 2.5% bicycles. The transportation services provided by buses and pick-up trucks in the Project area cost twenty-five cents (in dollars) per way ($0.25), from the areas near the project to the City of San Miguel. The fair for the route form *canton Las Delicias* to the city of San Miguel is slightly above fifty cents (dollars) ($0.50). Another means of transportation used in the Project zone is the *cayuco* (canoe), which is used to cross *San Miguel Rio Grande*, always in *Canton Las Delicias,* which costs fifty cents (dollar) ($0.50) for the trip.

TABLE No. VI.97. MOST USED MEANS OF TRANSPORT, ENVIRONMENTAL IMPACT STUDY OF THE SAN MIGUEL BYPASS ROAD CONSTRUCTION PROJECT

	MEANS OF TRANSPORT						
	Bus	**Car**	**Pick-up**	**Motorc**	**Bicycle**	**No answer**	
El Papalón	**76**	**7**	**1**	**0**	**2**	**1**	**87**
El Papalón-Moncagua	**8**	**0**	**1**	**0**	**0**	**1**	**10**
El Sitio	**3**	**1**	**0**	**0**	**0**	**0**	**4**
El Zamorano	**10**	**0**	**1**	**0**	**1**	**0**	**12**
Hato Nuevo	**62**	**2**	**3**	**0**	**2**	**1**	**70**
Las Delicias	**56**	**2**	**2**	**1**	**1**	**2**	**64**
San Antonio	**7**	**2**	**0**	**0**	**0**	**1**	**10**
San José	**48**	**1**	**3**	**0**	**2**	**3**	**57**
San Miguel	**3**	**0**	**0**	**0**	**0**	**0**	**3**
San Salvador	**0**	**0**	**0**	**0**	**0**	**1**	**1**
TOTAL	273	**15**	**11**	**1**	**8**	**10**	318
Percentage	85.8%	**4.7%**	**3.5%**	**0.3%**	**2.5%**	**3.1%**	

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

The population has its own means of transportation, which it uses for social and economic activities, among which the car ranks first (11.6%); followed by carts 14.2%; pick up cars 7.2%; motorcycles 1.6%, and animals to carry loads 0.3%; and 63% state they have no means of transportation or did not answer the question.

TABLE No. VI.98. OWNERSHIP OF MEANS OF TRANSPORT, ENVIRONMENTAL IMPACT STUDY OF SAN MIGUEL BYPASS ROAD CONSTRUCTION PROJECT

TOWNSHIP	MEANS OF TRANSPORT							TOTAL
	CAR	PICK-UP TRUCK	BEAST OF BURDEN	MOTOR-CYCLE	CART	BICYCLE	NO ANSWER	
El Papalón	16	5	1	1	1	18	45	**87**
El Papalón-Moncagua	2	0	0	1	0	1	6	**10**
El Sitio	0	0	0	0	0	0	4	**4**
El Zamorano	1	2	0	0	1	1	7	**12**
Hato Nuevo	11	8	0	2	1	8	40	**70**
Las Delicias	5	3	0	1	1	11	43	**64**
San Antonio	0	2	0	0	0	1	7	**10**
San José	2	3	0	0	0	4	48	**57**
San Miguel	0	0	0	0	0	1	2	**3**
San Salvador	0	0	0	0	0	0	1	**1**
Total	37	23	1	5	4	45	203	318
Percentage	11.6%	7.2%	0.3%	1.6%	1.3%	14.2%	63.8%	

Source: Socio-Economic Survey, SM BYPASS ROAD, 2011

VI.5.11.2 Road Network

The project surrounds the City of San Miguel; therefore, in several parts it crosses the different entry or exit roads of the city. The main paved roads that will cross the Project outline will be:

- Pan-American Highway (CA-1) to San Salvador, and the west region of the country.
- *Ruta Militar* Highway (RN18) to *San Francisco Gotera, Santa Rosa de Lima*, border with Honduras and surrounding zones.
- Pan-American Highway (CA-1) to *La Unión* and eastern zones.
- Road to *El Delirio* (RN17) that communicates the south of the country.

The most frequent trip destination is the City of San Miguel, to procure supplies, for recreation purposes, and employment, among others. All the secondary roads reach the paved roads towards the City. In the initial zone of the expansion section, station 7+750, the inhabitants visit more the municipal capitals of Quelepa and Moncagua.

Photograph No. VI.23. Pan-American Road in the expansion section, leading to the City of San Miguel

Photograph No. VI.24. Section of Project intersection with the Highway to La Unión (CA-1)

Photograph No. VI.25. Section of the intersection with the Ruta Militar Highway

The land where the Project crosses communicates with the city or with these highways through ballast roads (covered with compact ballast) and rural roads. Some are in good conditions, and others require maintenance.

Photograph No. VI.26. Typical ballast road in the Project area.

Photograph No. VI.27. Ballast Road in por conditions near station 9+170

The following secondary roads are crossed:

1. Old road to Quelepa, ballast in good conditions
2. Road to Rio San Esteban, rural road
3. Road to Hacienda el Salitre, rural road
4. Road to Loma Quebrachada
5. Road to Altos de Hato Nuevo
6. Brook to Pasitos and Pedestrian crossing
7. Road to Hacienda el Milagro
8. Road to Apacunque
9. Existing Road
10. Road to las Hojas
11. Existing Road
12. Road to Housing Development Santa María, ballast in good conditions, is crossed in two different points.

Rio Grande de San Miguel and Taishihuat River are currently a barrier for people crossing to San Miguel, from the north and east zones, mainly the places that are far from the main roads and where there are bridges. In the zone of Canton Las Delicias, people use a canoe to cross to the other side during the winter (rainy season), and to get to a few minutes from the city of San Miguel, which otherwise would take them at least an hour to travel, going around by the existing roads.

The same happens in the site known as "Las Mesas", where there is a cable with a "basket" to cross Rio Grande nearby Colonia La Confianza. The route through the existing roads would also take more than one hour.

Photograph No. VI.28. *Canoe used to cross Rio Grande de San Miguel near station 16+150*

Photograph No. VI.29. Crossing by cable over the river near station 9+150

The means of transportation used the most are pick-up cars or by foot, according to the distance and load one is carrying. The pick-up trucks take people to the bus stations in the main roads, from where they can go to the city or to other destinations See Drawing VI-16 Road Network and Transportation

VI.5.11.3 Crossings

The following table shows in detail the points where there the San Miguel Trunk Road will cross with existing roads and with cattle pathways. It indicates also the solution for the crossing or an explanation of why it is not included in the design proposal.

TABLE No. VI.99. POINTS OF INTERSECTION WITH STREETS, ROADS AND CATTLE PASSES

STATION		PROPOSED STRUCTURE	LENGTH (m)	DIMENSIONS (m)	NOTE
0	+200	NOT PROPOSED			It will maintain is current use as cattle pass.
1	+320	NOT PROPOSED			It will maintain is current use as cattle pass.
2	+780	NOT PROPOSED			Will be kept as is
4	+195/+800	NOT PROPOSED			Dirt footpath between plots with access from both sides of the future road, so construction of a pass is not warranted.
5	+ 254	Bridge	43.00		Old road to Quelepa, used as cattle pass.
5	+ 339	Bridge	16.00		Road to San Esteban River
5	+ 970	Bridge	6.00		Existing road to Hacienda El Salitre
7	+ 050	NOT PROPOSED			Footpath between plots, with several access points along the road
7	+170	Underpass		4x2.5	Proposed streets of an abandoned housing development, does not affect residents. A pass was enabled at station 7+170
7	+ 160	NOT PROPOSED			
7	+ 219				
7	+278.65				
7	+341				
7	+400				
7	+460				

STATION		PROPOSED STRUCTURE	LENGTH (m)	DIMENSIONS (m)	NOTE
7	+520				
7	+600				
8	+240	Roundabout			Road to Canton Agua Zarca,
8	+250 a 450	NOT PROPOSED			Streets of Los Angeles housing developments. Only cull-de-sacs are affected, therefore no communication within the development is cut off.
8	+ 300				
8	+ 355				
8	+ 415				
8	+ 508	NOT PROPOSED			Narrow dirt road between plots. The project road is at-grade with the plots, therefore there will be access to the area from the road. Presently the only access is a dirt path.
9	+070	Underpass		2.5x2.5	Cattle Pass
9	+174	Bridge	16		Road to Canton Las Mesas.
9	+ 764	NOT PROPOSED			Footpath to Cerro Tablón de las Mesas with very little use, there will be access to it at station 9+866.
9	+866	Bridge	15.00		Pedestrian path and bridge
11	+226.5	Bridge over street and creek	23.00		Dirt road to plots in the area, little used, pass is enabled at foot of bridge
11	+ 821	Bridge	9.62		Road to Loma Quebrachada, also used as a cattle pass.
12	+457	Bridge	10.00		In this section, inner streets of various housing developments are cut off by the project, including Josselyn, Altos de Hato Nuevo and others; all of these developments have access via back streets connecting with the Military Route Road; one pass will be left to facilitate communication between both sides.
12	+575 A +789	NOT PROPOSED			
12	+ 588	NOT PROPOSED			
12	+ 638	NOT PROPOSED			
12	+ 735	NOT PROPOSED			
12	+ 789	NOT PROPOSED			
12	+789 a +900	NOT PROPOSED			
12	+960 to 13+053	NOT PROPOSED			
12	+968.7	Underpass		4X2.5	Los Pasitos Creek and pedestrian pass
13	+070	ROUNDABOUT AND AT-GRADE			Military Route, also used as cattle pass
13	+ 077 to +380	NOT PROPOSED			Access to several housing developments is interrupted by the new road in this section; these areas will be accessible through other streets of the Military Route, so that access will not be interrupted.
13	+164	NOT PROPOSED			
13	+322.5	NOT PROPOSED			
13	+ 423 a +537	NOT PROPOSED			
16	+ 522	Bridge	25.00		Road to Apacunque (Hacienda el Milagro)
17	+367.5	Bridge	17.00		Road to Apacunque and Las Delicias, and cattle pass
18	+ 832.5	Underpass		4X2.5	Existing road to housing development
19	+ 250	Bridge	8.00		Dirt road to Las Hojas and Apacuqnue, and cattle pass
19	+ 700	Underpass		2.5x2.5	Cattle on the Hacienda estate lands.
20	+ 000	Underpass		2.5x2.5	Cattle on the Hacienda estate lands.
20	+ 200	Underpass		6x4	Existing dirt road provides access to farm, which is divided into two parts.
20	+ 412	Underpass		2.5x2.5	Dirt road provides access to three plots.
20	+ 896.6	Underpass		2.5x2.5	Dirt road providing access to rural plots.
21	+ 335	Underpass		2.5x2.5	By means of underpasses at station 21 +335 and 21 +535 there will be access to plots in a rural development and homes built on FENADESAL grounds.
21	+348	NOT PROPOSED			
21	+ 348 a +443	NOT PROPOSED			
21	+ 535	Underpass		2.5x2.5	
21	+ 479	NOT PROPOSED			

STATION		PROPOSED STRUCTURE	LENGTH (m)	DIMENSIONS (m)	NOTE
STATION 21	+ 688.45	NOT PROPOSED			There is access via the road through underpass at station 21+535
STATION 21	+873	ROUNDABOUT AND AT-GRADE			CA-1 TO LA UNIÓN
STATION 22	+ 760	NOT PROPOSED			Road to Santa María housing development is not cut off by viaduct
STATION 23	+ 520	NOT PROPOSED			Road to Santa María housing development is not cut off by viaduct
STATION 24	+676.9	NOT PROPOSED			Road to Santa María housing development is not cut off by viaduct
STATIO	+021.522	ROUNDABOUT			RN-17, Road to El Delirio

Source: JICA and ECO Survey Team

VI.5.11.4 Cattle passes and grazing zones

Given that these are grazing areas, in the direct and indirect Project influence area there are cattle pathways. The land is mainly private property, and there is no cooperative land of collective use, the cattle pathways coincide with the access roads to the settlements and cantons.

There are three types of cattle pathways and grazing zones:

1. Small, up to 100 heads move the cattle from the pastureland to the stables, where they spend the night, mornings and afternoons. There are eight crossings, which are in existing roads that will not be cut-off by the Project, in one of the crossings, besides the bridge on the road; an additional crossing was placed, in season.

2. Large groups, El Paso in CA-1, road to La Unión. They move in groups of 500 animals in average, from January to March, that move the cattle from north to south seeking water during the dry season, and they return at the end of May. They only cross twice a day, two ways, and there are several groups of more than 500 heads. Due to the presence of the viaduct it will not be modified, the crossing is at one side of the road and from north to south and vice versa.

3. Grazing land, crossing land devoted to cattle grazing that will be divided by the project. These are between station 19+300 to 20+250, where the cattle pathways will be located (est. 19+500 and 20+000) and stations 22+000 to23+500, where the project is a viaduct and will not be impacted by animal crossing.

See Drawing VI-17 Cattle Crossing. This section is between the Pan-American Highway (CA-1) to La Unión and El Delirio Highway

VI.5.12 *Current Land use*

Based on the Land Use Map (MARN, 2002), existing maps and the field data collected for the PROYECT, the land use for this area, in the direct and indirect area of influence of the Project, has been identified. The modified land use map (See Drawing VVVI-18 Land Use).

The land is predominantly used in activities related to basic grain cropping, extensive cattle growing, and grazing land, and to a lesser extent bastions of forest. The uses identified can be classified as follows:

1 Secondary forest.
2 Gallery or riparian forests.
3 Low shrubs vegetation.
4 Farming land.
5 Semi-urban.
6 Semi-urban combined with other farming land.
7 Rivers.

VI.5.12.1 Detailed description of the land use by section

Following is a description of the predominant land use by Project section

*. **VI.** 5.12.**1.1** Station 0+010 to 3+260*

The expansion route, since it is nearing the City of San Miguel has generated the invasion of land, which used to be for farming, for housing and trade. In this zone we have a combination of uses, which has generated disorganization, and no defined urban structure.

In this area there are:

- One-family housing in individual plots or belonging to housing developments.
- Businesses: carwash, Pepsi distributing company, La Constancia distributing company, ESSO gas station, small stores, spare parts store, plant nursery, hotels, etc.
- Institutions: UNIVO University and San Jose School (Quelepa).
- Crops and grazing land
- Forests, small relics in creek crossings and in the area proposed as protected zone

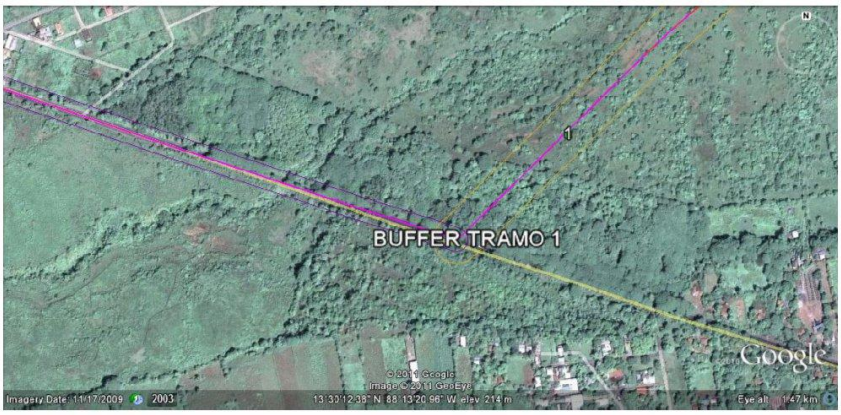
.

The Housing Development El Obrajuelo is located between stations 2+780 and 3+160.

Photograph No. VI.30. View of the combined land uses on the Pan-American Highway (CA-1) in the expansion section: businesses, housing, farming and institutional.

VI. 5.12.1.2 Station 3+260 a 4+020

In this segment there is a secondary forest that provides good plant coverage. The forest lies from the north side 680 m north before reaching 3+910 and goes all the way to 380 after the station 3+910 380 m after the station. The Project, in its opening section in the north side, divides this forest into two sectors. The land in which the forest rests is private property.



Photograph No. VI.31. Aerial view of the secondary forest

VI. 5.12.1.3 Station 4+020 to 8+210

In this zone the land is imminently rural, for farming and with scattered housing. There is grazing land and crop zones (corn and sugar cane mainly). In this farming land there is scattered housing.

Photograph No. VI.32. Farming land between Pan-American Highway (CA-1) and the road to Riverside

Between stations 7+160 to 7+600 there is an abandoned housing development where only the ditches and cordons were built.

In the indirect influence area of this section we have the same use of land, except between stations 7+600 to 8+150, where the project axis goes by at 50 m of the surrounding wall of the Housing Development "Riverside Gardens". This Housing Development has houses with all the services for a "luxury" residence.

VI. 5.12.1.4 Station 8+210 to 8+400

El direct Project influence area goes through the "Los Angeles" housing development, which is a semi-urban development, with only power and potable water, and dirt streets. The plots impacted were abandoned. Three of these plots have constructions underway, which were also abandoned. In addition, the direct influence area touches the surrounding wall, well, water tank, and the plots of the Housing Development "Anagil Afife" which is similar to Riverside Gardens, with all the services for luxury residences.

The two housing developments above referred are inside the indirect influence area of this section.

Photograph No. VI.33. View of urbanized land use in this project section, housing project Anagil Afife and abandoned half-built houses in housing development Los Angeles.

VI. 5.12.1.5 Station 4+550 to 5+450

In this section, the Project crosses farming land with crops and rural housing. In this point there are some different lands detailed as follows:

- *Tourist Center (Turicentro)* abandoned, reaching Rio Grande, station 8+750 to 8+870, with some abandoned structures, such as swimming pools, sidewalks and benches. These are in poor conditions. The structures are surrounded by trees.
- Gallery forest in the river crossing, practically formed by a line of trees.
- Buried pipelines and structures to generate power, abandoned in a plot of land, property of CAESS (According to the registry in CNR). From station 8+250 to station 8+200.

In the indirect influence area there are the same farming lands and the rest of the abandoned Turicentro.

Photograph No. VI.34. View of swimming pool in tourist resort, no longer used and rural house across the river

VI. 5.12.1.6 Station 9+300 to 11+250

In this zone there is land that in the past was used for cropping, but now it has low shrub vegetation, with scrubland. Some creeks are crossed and there is gallery forest. In some points there are small cropping and grazing parcels.

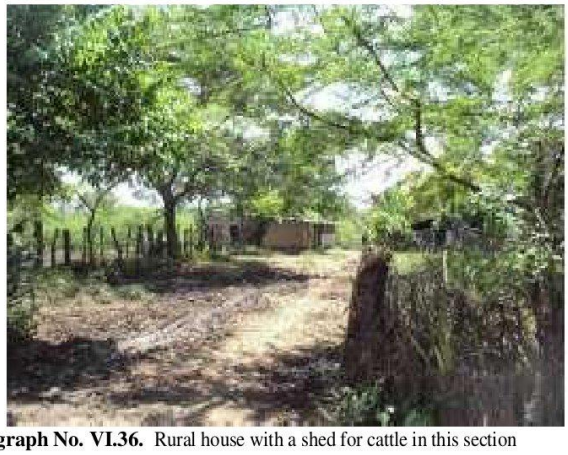
The indirect influence area has a similar use.

Photograph No. VI.35. Typical view in this section with gently rolling slopes with scrubland and some crop patches, with scattered trees

VI.5.12.1.7 Station 11+250 to 12+450

In this area the farming land with scattered housing is repeated, but basically land for cattle grazing. Carbon trees and *espino blanco* are predominant.

In the indirect area of influence we find the same land use.



Photograph No. VI.36. Rural house with a shed for cattle in this section

VI. 5.12.1.8 Station 12+450 to 13+550

In this zone of influence the highway Ruta Militar (RN18), and the proximity to the city of Miguel has generated the development of housing developments, which do not have all the utilities, only power and water. The streets are ballast. There is urban type housing, many of which are built with a combination of materials and good finishing.

In front of the highway commercial businesses have proliferated: car shops, storage, carpentries, etc. In station 12+810 there is a mechanic car shop.

The plots in this area have no constructions; many of them are abandoned and even have basic grain crops.

Station 13+110 is located in the old street to Santa Rosa, with land that is property of the State and that have been invaded with informal housing.

The indirect influence area also uses land for housing, trade and there are idle plots.

Photograph No. VI.37. View of homes and businesses in urban developments near the Military Route Road (RN18).

VI. 5.12.1.9 Station 13+550 to 13+850

In this section there is farming land, predominantly for cattle grazing. It crosses the Taishihuat River, with some relicts of gallery forests.

Photograph No. VI.38 Crossing over Taishihuat River, grazing land can be seen and in the background a gallery forest

VI. 5.12.1.10 Station 13+850 to 16+350

In this zone we also find land that was used for cropping, however, now it presents low shrub vegetation, with scrubland. Some creeks are crossed with gallery forest. In some points there are small plots of land of crop and grass lands.

In the indirect influence area the land is used in the same manner.

Photograph No. VI.39. View of the land with scrubland in the hills east of the Taishihuat River

VI.5.12.1.11 Station 16+350 to 21+800

All this area presents farming land use, where there is predominantly grazing land, although we find an area basic grains. In this area there is a lot of cattle grazing. There are some points of interest:

- El Papalón River, with the gallery forest in station 20+600, 20+350 and 17+900.
- The hill "Nombre de Jesús", has scattered trees and scrubland, station 15+560.

In the indirect area of influence the land use continues being the same, but we find the "María Laura Escobar" school and a church in front of the school.

Photograph No. VI.40. View of the "María Laura Escobar" school, and farming land with rural houses in this section.

VI. 5.12.1.12 Station 21+800 to 22+000

The influence of the Pan-American Highway (CA-1) to La Unión has also generated in this site a disorganized urban development, becoming the continuation of the urban area of the city. Urban land uses in this place are:

- Several housing.
- Gas station
- Warehouse
- A bit farther is El Papalón School

The indirect area of influence also shows the presence of housing and businesses, such as a service gas station at 100m away from the axis.

Photograph No. VI.41. Image of housing, El Papalón school and businesses on the Highway to La Unión (CA-1)

VI. 5.12.1.13 Station 22+000 to 25+022

In this area we find wide land plots namely for cattle grazing. There are no houses in the direct Project influence area.

In the indirect area of influence we find rural housing in the housing developments, and the grazing land above-referred. At the river Banks of Rio Grande de San Miguel there is gallery forest.

Photograph No. VI.42. View of vast flatland for farming use.

VI. 5.12.1.14 Station 25+022

At the west of the road to El Delirio (RN17), in the indirect influence area, there is a housing development called "*Jardines de la Ceiba*", where there are housing and commercial businesses: restaurants, hotels, and other businesses.

Photograph No. VI.43. View of the road to El Delirio (RN17) at the final point of the Project

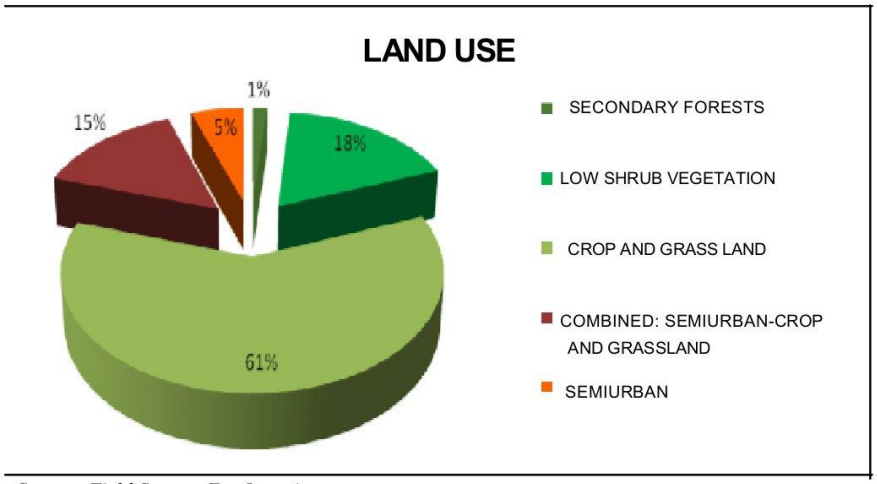
VI.5.12.2 Summary of the land uses in the Project outline

The following table summarizes existing land use in the Project outline.

TABLE No. VI.100.LAND USE BY SECTION IN DIRECT INFLUENCE AREA

SECTION		LAND USE	PERCENTAGE
0+010	3+710	COMBINED: CROPLANDS AND GRASSLANDS	14.8%
3+710	4+020	SECONDARY FOREST	1.5%
4+020	8+210	CROPLANDS AND GRASSLANDS	16.8%
8+210	8+400	SEMI-URBAN	0.7%
8+400	9+300	CROPLANDS AND GRASSLANDS	3.6%
8+300	11+250	LOW SHRUB VEGETATION	7.8%
11+250	12+450	CROPLANDS AND GRASSLANDS	4.8%
12+450	13+5550	SEMI-URBAN	4.4%
13+550	13+850	CROPLANDS AND GRASSLANDS	1.2%
13+850	16+350	LOW SHRUB VEGETATION	10.0%
16+350	21+000	CROPLANDS AND GRASSLANDS	21.6%
21+000	22+500	SEMI-URBAN	0.2%
22+500	25+022	CROPLANDS AND GRASSLANDS	12.6%

Source: Field survey, ECO Ingenieros



Source: Field Survey, Eco Ingenieros

Figure No. VI.34. Percentages of the types of soil use in the direct project influence area

VI.5.13 *Aesthetic landscape evaluation of the area*

Since this is a road Project that modifies the land at the ground level, the landscape will not be largely modified nor will the scenery views that exist in the area. For the Aesthetic landscaping evaluation follows the methodology detailed in the following figure.

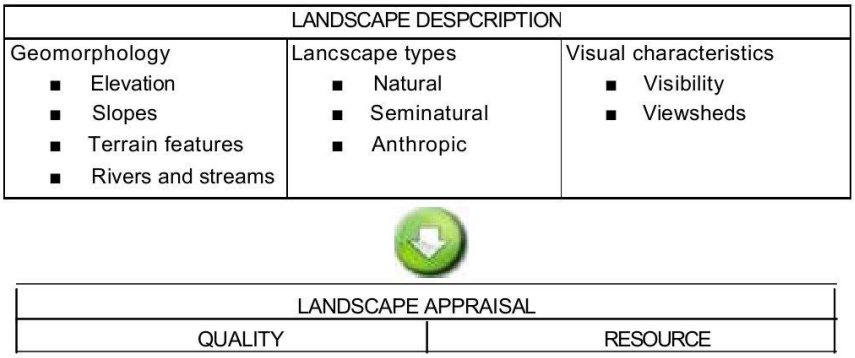


Figure No. VI.12. Methodology for the Analysis of the Landscape

Divided in sections, following is a description of the existing landscape and there is an appraisal of the Project, to identify the impact the Project implementation might have.

The landscape is also classified as follows:

1) **Natural landscape** (remaining ecosystems): are the ecosystems with no or very little human intervention, therefore, it includes primary vegetation, forest with little alteration, and secondary forest in well-advanced recovery stages.

2) **Semi-natural landscape:** group the areas where there is quite evident human intervention, but present a Frank recovery or ecologic succession of the original vegetation. Among this type are included the incipient secondary vegetation, secondary vegetation in intermediary phase and mature forests with a strong intervention.

3) ***Anthropogenic* landscaping:** Characterized by the type of landscape where productive or subsistence anthropogenic activities are developed, dominated by the elements man has introduced. See Drawing VI-19 Landscape

VI.5.13.1 Landscape Description and Views by Sections

The following table No. VI.101 presents a summary of the most relevant characteristics of the landscape and views identified by section. The glossary of terms used is in Annex VI.14.

TABLE No. VI.101. OUTSTANDING FEATURES OF LANDSCAPE AND VIEWSHEDS BY SECTION

LOCATION REFERENCE	LANDSCAPE	VIEWS
0+010 to 3+710	Presence of anthropic landscape: residences, businesses, institutions (schools, university) and croplands. The vistas are wide because of the land topography. There is a point of interest in Station 2 +900 near the proposed protected area of the San Miguel Volcano.	Daily views enjoyed by area residents and people who work there.

LOCATION REFERENCE	LANDSCAPE	VIEWS
3+710 a 4+070	Predominant seminatural landscape with presence of a secondary forest.	The views are also broad because of the topography.
4+070 a 9+250	Predominant anthropic landscape by 95% due to the presence of sporadic homes, housing developments, croplands and pastures. 5% seminatural landscape at the crossing of the Rio Grande de San Miguel, and the land of an abandoned tourist resort at station 8 +850	Throughout, views are magnificent and will be enjoyed by people travelling through the area.
9+250 a 11+400	In general terms in section four, the predominant landscape is anthropogenic mixed with semi natural, riparian forests in creeks, and comprising crop and pasture areas.	The project will be located on a hillside so it will be visible from the flat areas to the east, especially because of the cuts / fills that will be made.
11+400 a 12+450	Seminatural landscape predominates, with presence of pastures and scrubs, and low shrub vegetation	This area is fairly flat, so there will be broad views. However, the area is not one regularly travelled.
12+450 a 13+800	Predominantly anthropic landscape by the presence of developments with homes and businesses, due to the presence of the Military Route road (RN18).	Views in this section are also broad and plenty with the presence of people carrying about their daily activities.
13+800 to 16+300	Landscape is predominantly anthropic combined with semi-natural landscape, by the presence of land used as pasture and low shrubs vegetation.	The project will be visible from different westward points, as it is located on the slopes of hills of the area.
16+300 to 25+022	In this section anthropic landscape dominates by 98%, with presence of occasional homes and croplands and / or grasslands. A 5% seminatural landscape is at the crossing of the Rio Grande de San Miguel and El Papalon River. At the junction of the road to La Union (CA-1) there are homes and businesses.	The project will be visible to people carrying about their daily activities. Because of the flat topography, there will be wide views.
25+022	At the end of the project, on the road to El Delirio (RN17), one finds anthropic landscape with presence of shops and homes.	Views are broad and the project will be seen by all users of the current road.

Source: ECO Ingenieros Team, SM BYPASS ROAD, 2011

VI.5.13.2 Landscape units identified in the Project area

SEMI-NATURAL LANDSCAPE: Due to the presence of secondary forest, there is low shrub vegetation and scrap land and riparian forests.

ANTHROPOGENIC LANDSCAPE:

- o The zones where there is productive or subsistence activities such as growing basic grains, in a lesser scale and pasture produced or natural pasture at a larger scale, always combined with scrub land. In this zone there are scattered houses.
- o Semi-urban zones which are located in all the crossings the Project will have with current roads: Pan-American (CA-1), Military Route (RN18), and the road to El Delirio (RN17).

Specifically on the route planned for the project, the types of landscaping can get grouped, without indicating the order of importance, into four big landscapes:

1) Semi-natural Landscape: crossing of *Rio Grande de San Miguel*, Secondary forest (station 3+910), crossing of the Taishihuat River, El Papalón River, and crossing of the proposed protected area (station 0+980).

Photograph No. VI.44. View of the semi-natural landscape: riparian forest in the Banks of *Rio Grande de San Miguel*

2) Man-made Landscape in the flat areas, represented by urban, semi-urban, peri urban and farming development, represented by scrap land zones and pastures used as grazing land and with basic grains cropping.

Photograph No. VI.45. Man-made Landscape: Crops and scattered houses in flatland

3) Man-made landscape in hill slopes where the Project is located in zones that are higher than the city of San Miguel, with presence of cropping land and scrap land.

Photograph No. VI.46. Man-made landscaping in hill slopes

VI.5.13.3 Elements of visual compatibility

The presence of the city of San Miguel, with the different access roads to the city in several point and semi-urban areas, are sites that are the most visually compatible with the future project.

Photograph No. VI.47. Typical roads crossing the Project area, to and from the City of San Miguel

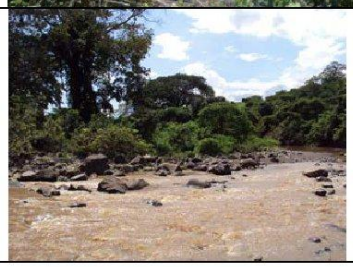
VI. 5.13.4 Visual-Aesthetic perception of the project

Due to the presence of the road, which although smaller in width, people are used to this type of Project. Also the road projects in flat areas do not significantly modify the landscape.
The sections 11+400 to 12+450 and 13+800 to 16+300, where the Project is located in slope zones, are the ones that will generate the greatest change in the landscape, and the perception of the population when cut-offs and fillings are done is negative because of the risk they represent.

VI.5.13.5 Significant landscapes and visual resources identified

The points with significant views, susceptible of suffering the greatest visual impacts are listed in the following table, and their location is shown in Drawing No. VI-19.

TABLE No. VI.102. SUMMARY OF SIGNIFICANT VISTAS IDENTIFIED BYPASS PROJECT SAN MIGUEL

STATION	PICTURE	DESCRIPTION
1+900		View of proposed protected area
3+900		View of secondary forest
8+900		View of Rio Grande de San Miguel, with riparian forest on both sides
13+720		View of Taisihuat River crossing

STATION	PICTURE	DESCRIPTION
24+980		View of second crossing at Rio Grande de San Miguel River

Source: Eco Ingenieros Team, SM BYPASS , 2011

In the Project outline there are no places or sites that group large amounts of population, nor that are recognized for their visual or scenery characteristics.

VI.5.14 *Cultural Values*

With the support of the Ministry of Cultures, an inspection of the Project outline was conducted. Cultural assets are the archeological assets, patrimonial assets and paleontological assets, although the latter are of natural origin. The resolutions issued after such field visit are presented in Annex VI. 15. See Drawing VI-20 Cultural Assets.

VI.5.14.1 Archeological Heritage

In the field tour, some archeological interest sites were identified, which are detailed in the following table, although some sections are included because it was not possible to assess them.

TABLE No. VI.103. ARCHAEOLOGICAL-INTEREST SITES AND MEASURES TO BE ADOPTED

STATION AND COORDINATES	ITEMS FOUND	ACTIVITY TO BE CARRIED OUT
4+100: 13°30'16.1", 88°13'12.7"	Fragments of cultural-interest material occurring in low density, predominantly pottery	Archaeological Monitoring
5+020: 13°30'33.0", 88°12'49.0"	Cultural-interest material occurring scattered in medium density, pottery and obsidian fragments associated with two terraces.	Archaeological Survey
5+500: 13°30'37.8", 88°12'30.1"	Concentration of colored rock fragments from some construction and cultural-interest material occurring in low density	Archaeological Survey
6+000: 13°30'44.6", 88°12'14.8"	Pre-Hispanic material occurring in low density, pottery shards and obsidian and lithic fragments.	Walkthroughs
7+700: 13°30'45.9", 88°II'20.9"	Second concentration of cultural-interest material occurring in medium density, pottery fragments and obsidian in fewer quantity.	Archaeological Survey
9+310: 13°31'20.9", 88°10'41.8"	Outcrop of ignimbrite rocks and basalt with surface depressions, possibly due to human intervention.	Walkthroughs
9+700: 13°31'27.5", 88°10'30.7"	Cultural-interest material on surface, occurring in low density concentration. Small pottery shards	Archaeological Survey

STATION AND COORDINATES	ITEMS FOUND	ACTIVITY TO BE CARRIED OUT
9+750: 13°31'27.77", 88°10'29.03"	Alignment of stones, probably a house foundation, it is unknown if it is of Pre-Hispanic origin.	Archaeological Survey
17+200: 13°28'54.9", 88°08'44.7"	Cultural-interest material occurring in medium density on the surface, pottery and obsidian fragments.	Archaeological Survey
19+750: 13°27'55.5", 88°07'56.4"	It was not possible to make the walkthrough	Walkthroughs
24+180: 13°25'58.5", 88°08'47.2"	*3-*. Concentration of cultural-interest material occurring in high density, decorated pottery, obsidian and lithic fragments.	Archaeological Survey
24+630: 13°25'53.5", 88°09'01.2"	It was not possible to make the walkthrough.	Walkthroughs
24+870: 13°25'53.1", 88°09'13.2"	45. Surface concentration of cultural-interest material occurring in medium density, pottery and obsidian fragments.	Archaeological Survey

Source: Resolution by Secretariat of Culture

Detailed studies were performed at these sites by a specialist in order to determine whether it is necessary to rescue or save the sites identified.

VI.5.14.2 Property of paleontological interest

Two points were identified with sediments that have been characterized as of high level fossil portability, near the gorges of "El Jacatal" and "Las Trojas", both of which are detailed in the following table:

TABLE No. VI.104. PALEONTOLOGICAL-INTEREST SITES AND MEASURES TO BE ADOPTED

STATION AND COORDINATES	ITEMS FOUND	ACTIVITY TO BE CARRIED OUT
6+870: N13°30'43.7", W88°ll'48.2"	Fossil material, geological material belonging to the Cuscatlán formation, sub member C1, fossilized humeral shield of unknown turtle	1 Have the presence of a technician at the start of clearing works and related activities to verify the recovery of materials failing 2 Otherwise begin research work in the area to demarcate the boundaries of the carrier soil. 3 Registry and exhaustive survery of the area to be affected by construction 4 General exploration of nearby soils
20+200: N13°27'40.0", W88°07'53.7"	Sedimentary soil, sediment sequences belonging to ashes mixed with alluvial sediments that are carriers of plant material. Clays appear to be from the Cuscatlán Formation, member C1, belonging to the late Pliocene or early Pliocene.	A paleontological study was conducted by the Ministry of Culture at the request of the MOP, as a result of the study a resolution dated February 7 was issued, which is included in Annex VI-15. The resolution resolves that "the construction of the San Miguel bypass road is authorized to proceed as established in the plans submitted to MUHNES".

Source: Resolution by Secretariat of Culture

The paleontological study in station 6+870 will be completed, before the Project construction.

VI.5.14.3 Cultural heritage

The buildings in the project influence area are informal and formal housing, most of which are part of a level with fibrocement or cooked mud tiles covers. When touring the rural zones with scattered housing aforementioned, no cultural value real estate was identified in the land.

VI.5.14.4 Other sites of interest

Two points of tourism interest were identified in the Project outline.

- Turicentro is private and abandoned, in station 8+850, with some infrastructure in poor conditions, such as swimming pools, benches, gazebos, paths. The Project will impact a corner of this property.
- Proposed protected zone. In station 0+980. The Project affects only the strip of the road expansion. For more details, please refer to the section on "Protected Areas."