X. RISK STUDY AND PREVENTION AND CONTINGENCY PLAN

This chapter contains the risk analysis for the SAN MIGUEL TRUNK ROAD Project to respond to the natural, socio-environmental and anthropogenic hazards, according to the vulnerability of the Project site. The first part presents the concept base that supports the work. After there is a summary of the risk and vulnerability condition of the project area of influence. Following are the scope and methodology of the analysis and the results obtained. Finally, in the last part are the conclusions and the **RISK PREVENTION PLAN,** which is incorporated into the Project ENVIRONMENTAL MANAGEMENT PROGRAM, as environmental measures.

X.1 CONCEPTUAL APPROACH

The road Project risk analysis has been developed under the following concept considerations:

A threat is considered as a phenomenon or set of events that have the potential of causing damage (Muñoz, 2000). Under this approach it is important to know the threat, its characteristics (such as magnitude, intensity, occurrence probability, duration, among others), which are significant in terms of the negative impact that can be generated on the elements exposed.

Vulnerability is understood as the incapability of a system of anticipating, assimilating, resisting and recovering from the damage that can be caused when the threat happens.

The risk is understood as the condition derived from considering the occurrence of one or several phenomena (threat) in a given context (Muñoz, 2000). The term context encompasses the existing vulnerability conditions and the social, demographic, economic and political processes that determine and modify the risk condition, through decision making. According to Cardona (2001) three separate aspects converge simultaneously in the risk : the probability, the consequences and the context, which contribute when trying to estimate any risk and qualification.

It is then understood that, from a holistic perspective, the risk involves different dimensions, all susceptible of quantifying or qualifying the risk and, therefore, whatever methodology is adopted to assess the risk, it is necessary, among other aspects, to generalize and simplify and chose scenarios of the phenomena occurring. In general the scope of a risk analysis is strongly determined by the level of previous knowledge about the hazards and the information available on the exposed elements.

In the framework of the road Project environmental impact study, this chapter intends to establish the risk condition for the Project regarding the geological origin of the threat, as are the volcanic activity, earthquakes and landslides, all of which are present in the area.

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[1] *In fact it refers to mass movements that include landslides as well as flows, falls, among others. Notwithstanding, given that the term landslide is of generalized understanding in the common language it was decided to use it in the report.*

The most probable cost estimate of the fault supposes, among other aspects, establishing probable occurrence scenarios for the phenomena, their combination, request mode (impact, acceleration, displacement, sinking, transportation, etc.), defining vulnerability functions for the different elements exposed, to respond to each one of the requests established and on this base establishing damage levels.

$$RISK = THREAT + VULNERABILITY$$

The evaluation developed allows making an approximation of the road Project relative risk condition and identifying those aspects of the threat or vulnerability that are relevant for the design and implementation of the prevention, mitigation and preparedness measures to respond to possible emergencies.

X.2 THREATS THAT MIGHT IMPACT THE ROAD SECTION

In order to facilitate the understanding of the risk analysis, following is a summary of each one of the hazards, highlighting the significant aspects for the purpose of this study. In general, the project area is exposed to earthquakes, landslides and the San Miguel Volcano is nearby. Both earthquakes that can be caused, and volcanic products thrown by these volcanoes, have a regional impact, and therefore, not only the peripheral road but also the city are exposed to these events. Certain project sections will be developed in slope areas, and consequently, they can also be impacted or trigger instability phenomena.

X.3 NATURAL HAZARDS

The area where this Project will be implemented has a geological nature natural risk , which for this study are all the hazards related with seismic activity, something that is not exclusive of the area, but applies to the entire country, and which, on more than one occasion, has caused damage, both human and material, to the Salvadoran populations.

X.3.1 *Seismic hazard*

According to the studies conducted, El Salvador has two well-defined seismic zones, which are detailed as followed:

1. The zone located in the geological structure known as the Central American Graben and locally as *Fosa Central*. This geological structure runs in west-northeast-east direction, which covers the middle part of the country; it is characterized by it's quite disastrous seismic, with seismic points that in some occasions are associated with the continental volcanic ranges. Also, the little depth of the hypocenters must be added, which in general terms can range between 1 to 11 kilometer and to the proximity of the epicentral areas with very important cities. All this activity is known under the name of intraplate and is due to the movement that takes place in the geological faults.

   These seismic movements have had maximum intensities of VII to IX degrees on the Modified Mercalli Scale and magnitudes of up to 7. 0 or slightly more in the Charles Richter Scale, with sometimes destructive results.

2. The second seismic zone is located in the Pacific Ocean, which is related with the movement of the tectonic plates of Cocos and the Caribbean. The epicenters are at a distance between 10 and 100 kilometers of the Salvadoran coast with hypocenters at depths that can vary between 30 to 80 kilometers. The intensities and magnitudes in general terms, are similar to the ones above mentioned, and in more than one occasion have caused significant damage, where the clearest example is the earthquake of January 13, 2001.

The present Project area, is located in the extreme side of Fosa Central, and according to the seismic history in the country, especially in the east zone, the record of the most important seismic impacts for this region of El Salvador can be detailed as follows:

1. 1838; a series of very strong earthquakes were reported, and had an impact on the municipalities of Jucuapa, and Chinameca, reporting considerable destruction in the city Chinameca. No destruction was recorded due to seism in other nearby cities, possibly due to the fact that on that date these cities did not exist yet, they had not been founded or were not considered by the author of the source consulted.
2. 1859; Strong earthquake felt in San Miguel, due to the recording of an earthquake which epicenter has no clear location or intensity, but that caused the collapse of the city of La Union and the populations of the Islands of the Fonseca Gulf, Tsunamis were recorded in the coastline border of the Gulf.
3. 1898; Strong earthquake felt in most of the department of San Miguel. Its origin is attributed to have happened in the proximity of the Fonseca Gulf, since again the city of La Union collapsed.
4. 1919; the city of la Unión and the city of San Miguel were impacted by a seism, which epicenter was located in the Gulf of Fonseca, affecting also some urban concentrations in the Republic of Nicaragua, namely near the city of Chinandega, the source does not indicate the intensity of the seism.
5. Between 1978 and 1951, the social literature on disasters caused by seismic activities recognizes, since that time, the critical subregion of "Jucuapa Chinameca", the catastrophes of 1951 was of technical-scientific interest, which was assumed by the UN and by Meyer Abich, then the Director of the National Geological Service.
6. 2001. Earthquake of maximum intensity of IX and a magnitude of 7. 6, with its epicenter in the Pacific Ocean, on January 13, and causing damage at the national level.

The latter indicates that in El Salvador the seismic activity should be taken into account in any Project related with construction of civil Works, which means that the seismic risk should be included in all structural designs, to assure a prolonged useful life of the same.

- Seismic Zoning

According to the seismic zone of our country, delimitated in zone I and zone II, the area being studied is located in the zone one. These two zones are based on the peak acceleration of the land, proper of the area studied in which the local geology and the soil characteristics play an important role, given that they significantly influence the land movements. This indicates that amplified movements are substantially larger when it's about geological material that is not of a petrous or rocky nature.

According to the seismic zoning map, the expected acceleration is detailed in the following table and in drawing X-l.

TABLE No. X. 1. EXPECTED SEISMIC ACCELERATION

RETURN PERIOD	EXPECTED ACCELERATION	SECTIONS
500 YEARS	500-530 GAL	0+00 to 24+100
	470-500 GAL	24+100 to 25+020
1000 YEARS	850-700 GAL	Entire project

According to the Regulation for Structural Safety of constructions in our country, 1994, the horizontal seismic coefficient is equal to 0.16 for zone 1, where, as already mentioned, this project is located.

- *Liquefaction*

The liquefaction risk map prepared by MARN, where drawing X-l is presented, shows the high, medium and low susceptibility zones of the Project outline. The high susceptibility zones are near the rivers, where the bridges will be built. The medium susceptibility zones are areas where there will be no structures, only filling.

The liquefaction risk was reviewed with the program Liquefypro5 of Civiltech; explorations BRGS-3 and BRGS-4 present liquefaction risk between 6 and 16 m deep, for exploration BRGS-3 and between 4 and 10 meters deep for exploration BRGS-4. ¨The considerations for this analysis are the following:

- Energetic efficiency of 60% for the SPT equipment, since the hammer of the machine for security reasons, has a controlled strike rhythm for 30 strikes per minute and automatic fall.
- The sampler is standard, except that he SPT camera does not consider "liner" and therefore a correction of 1.2 is applied to take the value of N of the SPT to the standard.
- The boring hole is less than 15 cm, since a helicoidal drilling and a casing was used in order to do the SPT. The correction factor for SPT N for the whole diameter is 1.05.
- No correction has been applied for the water table for the SPT values.
- The volumetric weights were obtained from correlations for sandy or clay material recommended by "Duncan and Buchiani, Performance and use of the Standard Penetration Test in Geotechnical Engineering Practice"
- The value of PGA was consulted for the records of the earthquake of January 13, 2001, where accelerations of approximately 0.2 were recorded in the San Miguel station. This data was obtained from the "Consortium of Organizations for Strong-Motion Observation Systems". The value of 0.2g was the result of the root of the addition of the squares of the horizontal accelerations, recorded for this earthquake.
- Sandy clay CL was considered and the plastic mud MH cannot be liquated.
- The seism magnitude considered was 8.0, since the data commonly recorded in the country do not exceed this value.

As a result of the liquefaction risks found it is recommended to:

- Strengthen the low liquefaction risk zone and limit the contribution by friction, on the load capacity of the pilling in the liquefaction zone.
- It is possible to take measures to prevent liquefaction through embankments that increase the weight of the soil in the liquefaction zone and increase the security factor against liquefaction. The dimensions of the weight of the necessary filling should have a security factor of more than 1.0.

- This makes it necessary to evaluate the consolidation downstream of the Rio Grande de San Miguel River zone, in order to dimension the magnitude of the settlements caused by primary consolidation that could impact bridge performance.
- The liquefaction assessment is subjective, if an important bridge of a considerable size were to be built, it would be prudent to assess the liquefaction risk through direct tests that will allow obtaining a direct parameter for the assessment of such risk and the assessment of the preventive measures.

In general the hydrostatic levels are in a relatively shallow depth (mainly in the range between 10 and 30 m deep). In the area more to the north of the Trunk Road outline there is a zone where it has been found that the water table is very shallow, of approximately 3 m deep. This together with the existence of seismic faults in the zone (mainly in the northern zone of the proposed road outline) and the presence of fine sand and non-plastic clays (alluviums) generates liquefaction problems in the zone of explorations BRGS - 3 and BRGS - 4.

- Land enlargement

Concerning the susceptibility of land enlargement, Figure X-l, we find high, medium and low susceptibility in the project zones, however, where structures are placed as support for the bridges, deep explorations were made to identify the load capacity of the bridges, on rock and solid terrain.

In the terrains identified as susceptibility, fill slopes will be made, and where low susceptibility was identified, due to the hard materials found, the cut-off will be predominant, as can be observed in the Figure.

X.3.2 Landslide hazard

Regarding land movements, as for example, landslides, they do not play an important role in the zone, since the elevations in this area do not have prominent slopes, capable of causing a risk situation for the Works that are intended to be built, except in the mountainous area, above described, that could demand engineering works to stabilize the slopes. See drawing X-4.

The slope is one of the determining factors of the instability of slopes; another factor is alteration of the rock, hydrothermal or by intense meteorization that destabilizes the terrain.

In the Project area, only the sections with a greater inclination, between station 9+500 to 11+800 and station 14+500 to 17+000 a certain instability could be generated, however the materials are non-stable. No landslides taking place were found in the zone, even during implementation period of this study, during the rains caused by the tropical depression of October 2011, there were no landslides in the direct project direct area of influence.

Meteorization, although important does not represent a risk factor for landslides, since rocks with a high level of meteorization will not be cut, according to the field visit conducted by the Geologist.

In the east slope of the Taishihuat River, the presence of rock blocks were detected, that could roll down or cause damage by shock.

X.3.3 *Erosion processes*

Considering erosion as a risk, it is not very importance, because its effects on the terrain, whether in the form of cracks or erosion grooves are minimum, which is due to the presence of river banks and in other sites, of the strongly hard pyroclastic flows already mentioned, covered by semi-compact brown-yellowish colored bedrocks, protected in turn by vegetation with enough capacity to buffer the pluvial impact, or any other mechanic intemperic action.

X.3.4 *Volcanic eruption hazard*

Finally, regarding volcanic risk in the Project area, we have the volcanoes of San Miguel and la caldera Laguna Aramuaca, that although, from the geological point of view, they are considered as active, they are currently in a complete eruptive relief state; therefore their presence today is not considered as a risk.

In El Salvador, the San Miguel volcano is among the most dangerous volcanoes, due to its seismic, eruption history, and the risk it represents for the people and infrastructure. The San Miguel volcano is also characterized by its micro-seismicity, which is relatively high and frequent. The San Miguel volcano is at an altitude of 2,130 m above sea level, and is a stratovolcano, with olivine and augite basalt predominantly.

Photograph No. X.l. The San Miguel volcano seen from the Hato Nuevo area.

There was an ash eruption from the San Miguel volcano in 1970; ash rain in San Jorge, Chinameca and Usulután. Its last eruption was in 1976.

The volcanic risk maps prepared by the USGS for the San Miguel volcano were reviewed, and three types of risks were analyzed: ballistic, collapse, lava, lahar, pyroclastic flows and

ashes; from these, only between stations 0+00 to 0+600 and 1+500 to 2+600, is there a risk of lava flows expected. See drawing X-2.

In this scenario set forth by the risk map

X.3.5 *Flood hazard*

The presence of *Río Grande de San Miguel*, and its two effluents, *Taishihuat* River and *Papalon* River, make their surroundings zones flooding risk area, identified in the floods risk map of MARN presented in drawing X-3.

The flood points located through the field work, and investigation of zones flooded in events in prior years, and the consultation with the inhabitants of the zone, place the zone mainly in the surrounding areas of *Río Grande de San Miguel*.

The final section of the Project between the road El Delirio to La Unión is the section that historically has the highest frequency of floods, given that *Río Grande de San Miguel* does not follow its course, of a meander form, but it crosses directly towards the southeast, through an abandoned meander, in the zone of *Hacienda La Joya*, until *el Cantón El Havillal*, flooding the zone up to levels between 1 m and 1.5 m, according to the residents of the area.

Photograph No. X.2. Image of *rio Grande de San Miguel*, during Agatha tropical storm as seen from the bridge on the road to La Union

Photograph No. X.3. Images of tropical storm Agatha, in the area of the school in Colonia Carrillo, where flooded areas are shown. The school principal shows the level the water reached

.

There are in the area study zones overflowing and flooding risks, with water levels on the land reaching almost lm to 1.5m, especially in the area of influence of *Río Grande de San Miguel*, which is one of the most problematic points at the end of the alignment projected around the *canton El Papalon, la Hacienda El Rincon* and *la Hacienda La Joya*, in rio Grande , due to the increase of its stream, it does not follow its meander form, but crosses directly towards the Southeast, through an abandoned meander by the *Hacienda La Joya*, to *el Cantón El Havillal*, flooding the zone.

The owner of the land in the east slope of Taishihuat River, also reported that in the last year there have been floods in the lower part of its terrain.

The project outline crosses the flooding zone in two points:

1. *Río Grande de San Miguel*, station 8+900. The bridge of the Project crosses over the same, not modifying the natural conditions: the river stream is not modified.
2. El Papalon River, station 20+300, The bridge of the Project crosses over the same, not modifying the natural conditions: the river stream is not modified.
3. *Río Grande de San Miguel*, Stations 23+500 a 25+022. In this Project area, a viaduct has been considered, therefore it will cross rising on the terrain, and not contributing or improving the conditions of the area in terms of the floods.

The Project in these areas will not block the existing communication roads and therefore the exits will be maintained, as they are currently in the area, in the case of an event.

On the other hand, given it is a special type road, it does not connect with rural roads inside the Project; and therefore it will not improve accessibility in the floodable areas either, mainly in the area of the viaduct where the road is raised on the terrain. In the other areas, the roads have been planned over the flooding levels, and consequently allow people to search shelter, but can only access by foot.

Also, the project occupies an area of less than 0.005% of the watershed area , and therefore it does not significantly affect the river flow of *rio Grande de San Miguel*; in fact, with the re-vegetation proposed the idea is to minimize this effect, improving the infiltration of water to the soil, within the same watershed, seeking the hydrological impact “cero”.

Another one of the points that presents no problems is the zone of El Papalon river between station 20+200 to 20+600. It is not in the floodable zones as shown in the following drawing X-1.

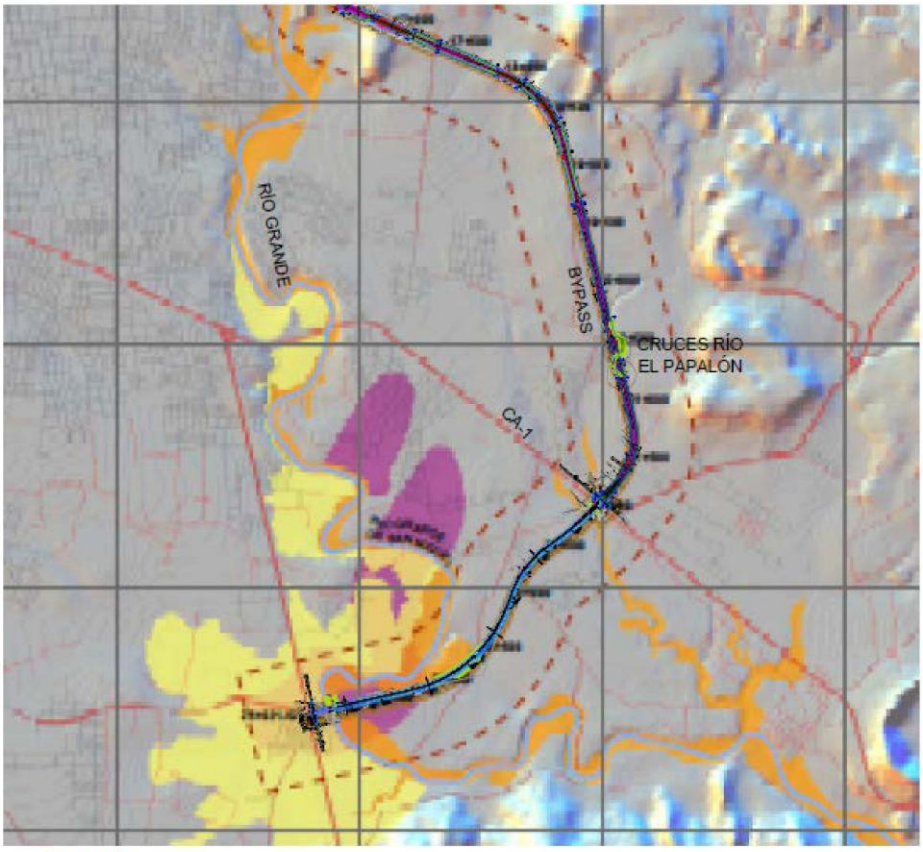

Figure No. X.l. Floodplain map of survey area

In addition, in the zone there are grasslands and crops, mainly without having a direct impact on the river Banks as can be seen in Figure X.2 where the aerial photography shows the sites where the Trunk Road crosses with El Papalon River.

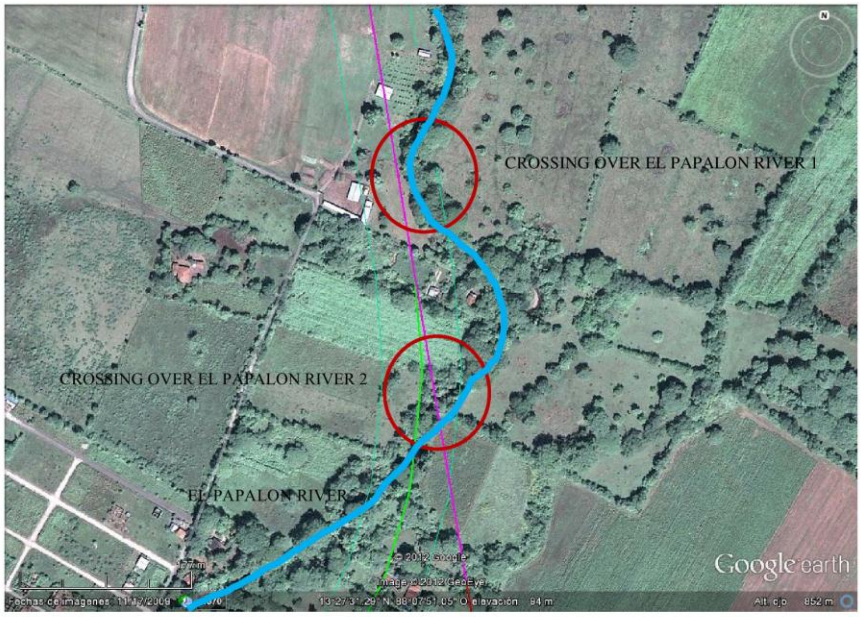

Figure No. X.2.CROSSING OVER EL PAPALÓN RIVER

To analyze the *El Papalon* River as a response to the concerned expressed during one of the public consultations, the dimensions of the section were calculated using Auto CAD, as well as the slope, which was calculated based on the river main line.

The HCANALES Version 3.0 software was used to calculate the maximum flood of El Papalon river for the mainstream area. The figure shows the result of the hydraulic calculation of the section of the river considering a base equal to 10.71 m, which results in a maximum of 2.04 m.

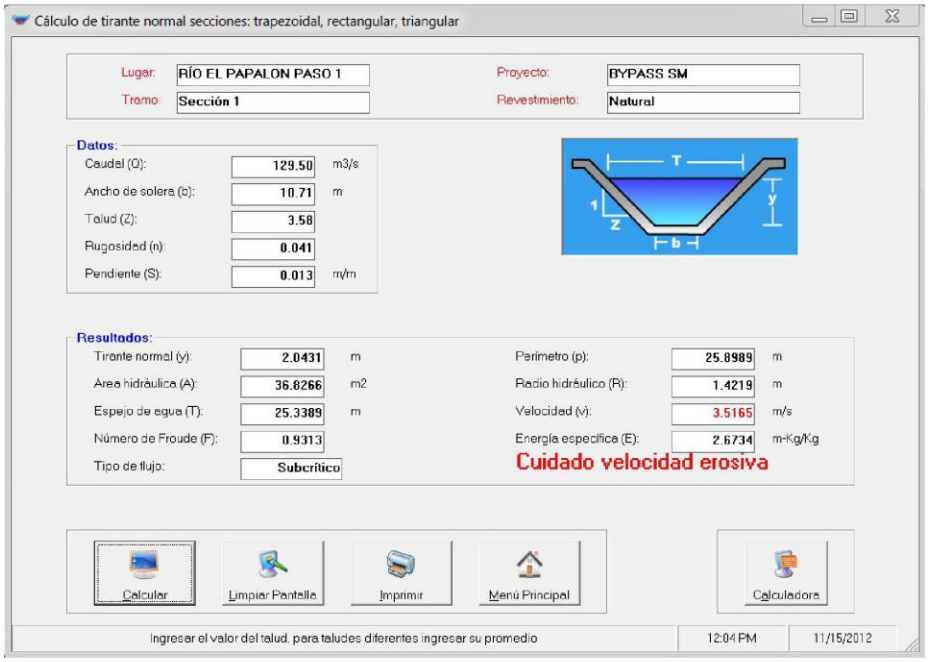

Figure No. X.3. Calculations for El Papalón River

In the section of the zone where there is a road to preserve the access to the land plots in the zone, which also has access by the east side, it can be verified that no flooding will be created in this point and because of the terrain topography the water will move toward the river banks.

In addition, with the calculation of the maximum water levels, as can be seen in the next figure, show that the level of the water of the El Papalon River compared to the low part of the road projected has a difference of 3.77 m , and therefore there is no flooding risk in this point.

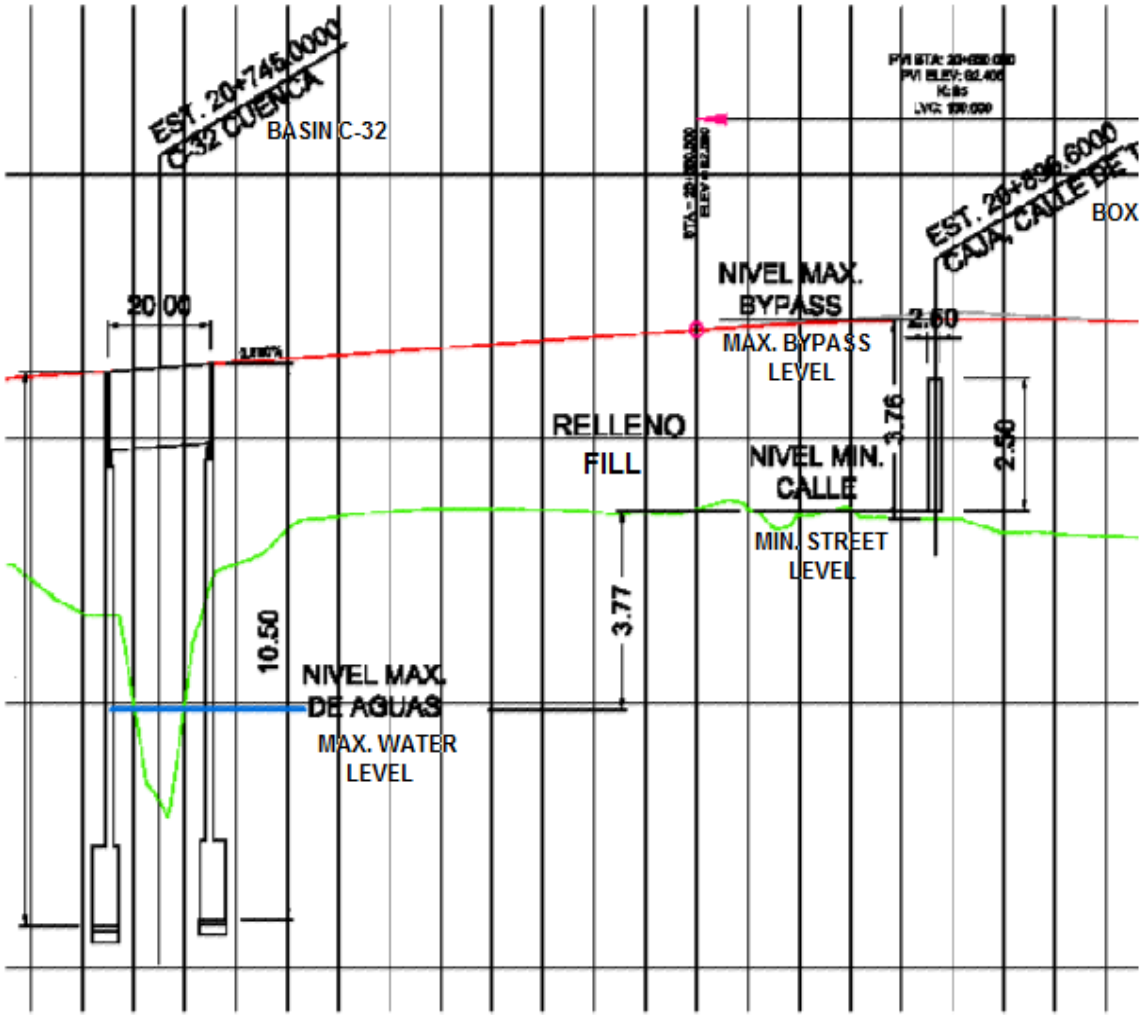

Figure No. X.4. CROSS -SECTION OF EL PAPALON RIVER BRIDGE AND BOX

X.3.6 *Socio-environmental threats*

In the area, despite the high anthropogenic intervention in the Project area, no hazards were identified which are generated by this type of intervention in the Project outline. The more deforested zones are usually the flat lands and there is not much modification in the natural topography of the area.

X.3.7 *Anthropogenic threats*

In the zone anthropogenic threats were identified:

- Security, due to criminality in the city, being the most dangerous areas in the city . No highly dangerous areas were identified in the project outline.
- Fires, due to the habit of burning the sugar cane crop to facilitate its collection, station

X.3.8 *Threat summary*

The following table presents a summary of the risks found in the Project area, described according to their location, intensity, frequency and severity.

To define the level of danger the following concepts were used:

- Frequency: is defined according to the recurrence period of each one of the hazards identified.
- Severity: is defined as the level of impact of a specific hazard (intensity, impact area).
- To define the degree of Frequency (a) and Severity (b), use the following scale: B = Low: 1; M= Medium: 2; A = High: 3; SI. = No information: 4.

TABLE No. X.2. SUMMARY OF THREATS

THREATS	YES / NO	LOCATION	INTENSITY	FREQUENCY	SEVERITY
Flooding	**YES**	Rio Grande de San Miguel, Station 8 +900. El Papalon River, station 23 +000 Rio Grande de San Miguel River, Stations 23 +500 to 25 +022	Elevation: 1.5 m high	MEDIUM , annual	Medium, elevation 1.5 m
Volcanic	**YES**	Stations 0+00 to 0+600 and 1+500 to 2+600, threat by lava flows is expected.	Lava flows	LOW, undetermined	Medium, lava flows
Heavy rains	**YES**	Entire route	Intensity	MEDIUM , annual	X mm
Earthquakes	**YES**	Entire route	Intensity 8, most of the subduction zone	MEDIUM, every 18 years	Medium
Landslides	**YES**	Hillside west of Taishihuat river, station 13+700	None identified	LOW	LOW
Socioenvironmental	**NO**				
Fires	**YES**	Stations 6+500 to 7+100 and 23+100 to 24+500	Burning sugarcane	MEDIUM, twice a year	Medium: Controlled fire

X.4 VULNERABILITY

To continue with the AdR in the PIP, it is necessary to analyze the vulnerability conditions that a Project might have, considering the aspects pointed out in Section 1, that is:

- Analysis of the exposure to a given hazard, that is to say, if it would be or is in the probable impact area (location).
- Analysis of the fragility with which the probable impact of a hazard would face, based on identifying the elements that could be affected and the causes (constructive forms or design, materials, technology).
- Resilience Analysis, that is, what are the capacities available for its recovery (social, financial, productive, etc.) and what alternatives exist to continue providing services under the minimum conditions.

To facilitate this process, a checklist was used as a support tool to determine if such concepts are being included.

TABLE No. X.3. VULNERABILITY CHECKLIST

QUESTIONS	YES	NO	COMMENTS
A. Analysis of vulnerability by exposure			
Does the location chosen for the project location avoid its exposure to hazards?	YES		It was avoided to locate the project in the south of the city in order to not expose it to the area of the San Miguel volcano. The path was also moved away from floodplains
If the intended location for the project is exposed to danger, is it technically possible to change the location of the project to a less exposed area?	YES		No, the slopes of the volcano have already been avoided. Regarding flood zones the most convenient point of approach to the river was sought.
B. Vulnerability Assessment by Fragility (size, technology)			
1. Does construction of infrastructure follow current regulations, according to the type of infrastructure in question? Example: anti-seismic standard.	YES		The design standards of El Salvador, as well as Japanese and American standards were followed
2. Were the geographical and physical characteristics of the area of the project considered when choosing construction materials?	YES		Area borrow pits will be used for aggregates
3. Does the design take into account the geographical and physical characteristics of the area of the project?	YES		Hydrological studies have been conducted to determine maximum floods in line with storms of recent years
4. Does the decision for the **size** of the project consider the geographical and physical characteristics of the area of the project? Example: Has the water intake been designed considering there are times of heavy rains and thus large volumes of water?			Yes. At all stages this has been considered and the road surface has been raised accordingly in flood areas
5. Does the proposed technology for the project consider the geographical and physical characteristics of the area of the project?			Yes. Seismicity, flooding, and other factors have been considered.
6. Do decisions on the project **start and execution dates** take into account the geographical, climatic and physical		No.	They were not taken into account
C. Vulnerability Analysis by Resilience			
1. Are **technical mechanisms** in place in the project implementation area (e.g., alternative systems for service delivery) to address the occurrence of disasters?	YES		It is always possible to mobilize resources to and from the city to various points along various roads.
2. Are there **financial mechanisms** in place in the project implementation area (e.g. funds for taking care of emergencies) to address the damage caused by the occurrence of disasters?	YES		Such mechanisms are in place as part of the national disaster assistance only
3. Are there **organizational mechanisms** (e.g., contingency plans) in place in the project implementation area to address the damage caused by the occurrence of disasters?		NO	No structured plans are in place
4. Does the project **include technical, financial and / or organizational mechanisms** to address damages		NO	They have not been considered

QUESTIONS	YES	NO	COMMENTS
caused by the occurrence of disasters?			
5. Is the project beneficiary population aware of the potential damage that would be generated if the project was affected by a dangerous situation?		NO	The population has not been made aware yet

To determine the degree of vulnerability, assess vulnerability against the following table :

TABLE No. X.4. ASSESSMENT OF THE DEGREE OF VULNERABILITY

VULNERABILITY FACTOR	VARIABLE	LOW	MEDIUM	HIGH
Exposure	(A) Location of the project in relation to condition of hazard	Low, only some sections		
	(B) Site characteristics	Low, no steep slopes or uneven ground		
Fragility	(C) Construction type	Low, construction is considered resistant		
	(D) Application of building regulations	Low, all standards were applied		
Resilience	(E) Economic activity in the area	Low, mainly agricultural		
	(F) Poverty situation in the area			High, there is poverty
	(G) Institutional integration in the area		Medium, there is little presence	
	(H) Level of organization of the population			High, there is no organization
	(1) Knowledge of disaster occurrence by the population		Medium, it is known from experience	
	(J) Attitude of the population towards the occurrence of disasters		Medium, attitude is based on past disaster experience	
	(K) Existence of financial resources for disaster response.			High, no resources are available locally

Project characteristics do not present a high vulnerability since design technologies and standards have been considered. The existing vulnerability is due to the characteristics of the population that lives in poverty conditions, mainly in the rural zones where the project is outlined.

X.4.1 *Location of vulnerable zones*

With the previous criteria and the presence of the population, structures and ecosystems, a vulnerability map was prepared for the Project outline. Drawing X.5 shows this map. The stations are detailed:

1. **High:**
   Homes, institutions, businesses and structures in the expansion section, station 0+00 a 3+000.

Homes - stations 7+500 a 8+500
Scattered homes - station 10+000, south of the same, and access road.
Homes and businesses in developments, 12+500 a 14+000
Homes to the south - station 16+00 a 17+500
Homes - crossing with CAI to La Unión, Station 22+000
Homes and businesses - station 25+022

2. **Medium**
   Proposed protected zone, station 1+000
   Secondary forest, station 3+700 a 4+000
   Riparian forest, 8+900 Riparian forest , 12+800
   Riparian forest, 13+760 - Riparian forest,
   24+00 a 24+500

The rest of the Project outline as low vulnerability.

X.5 RISK ASSESSMENT

When assessing the sites where there are threats and comparing them with sites where there is greater vulnerability, the sites presenting greater risks were determined and they are shown in Figure X.6.

TABLE No. X.5. RISKS IDENTIFIED – SM BYPASS ROAD, 2011

THREATS	LOCATION	VULNERABILITY	RISK
Flooding	Río Grande de San Miguel River, station 8+900.	Bridge, riparian forest, 8+900, project workers during construction	Damage to shore, bridge and forest, and workers during construction
	River El Papalón, station 23+000	Bridge, Riparian Forest, station 23+000	Damage to shore, bridge and forest, and workers during construction
	Río Grande de San Miguel River, stations 23+500 a 25+022	Bridge, riparian forest, 24 +00 to 24 +500	Damage to shore, bridge and forest, and workers during construction, nearby crops
Volcanic	Stations 0+00 a 0+600 y 1+500 a 2+600 threatened by lava flows.	Homes, institutions, businesses and structures in the road expansion section.	Damage to people, infrastructure, workers and construction equipment
Heavy rains	Entire route	The entire area of the project	Flooding, stagnant water, difficult access, small landslides and erosion and landslides on slopes
Earthquakes	Entire route	The entire area of the project	Small landslides, damage to homes, damage to construction camp, landslides on slopes
Landslides	Hillside west of Taishihuat river, station 13+700	Project workers during construction	Harm to workers during construction
	station 9+500 to 11+800	Homes in station 10+000 and access road	Damage to homes and/or construction workers down the slope
	station 14+500 a 17+000	Homes to the south in stations 16+00 to 17+500	Damage to homes and/or construction workers down the slope
Fires	Stations 6+500 to 7+100 and 23+100 to 24+500	Project workers during construction	Damage to workers and equipment during construction

X.6 PROJECT PREVENTION PLAN

According to results of the risk analysis that was conducted, the following prevention risk measures have been identified:

1. Landslides: loose rocks, in the zone of loose rock in station 13+700, east slope of Taishihuat River, in the slope there are loose rocks that could damage the Works or injure the workers due to shock impacts in the event of a tremor or strong rains. Before initiating the works in this area, the rocks that entail the most danger shall be removed.
2. Landslides: land movements, the cut-off and fill slopes have been designed according to the geotechnical study, therefore they meet the expected security factors, and however, there are two zones with population present on the slopes, under the Project outline, with housing present for which additional precautions shall be taken during the construction. It is recommended to install gabions or temporary retention walls, at the lower part of the slope to stop any landslide that could occur during the construction and that could impact the houses. The locations are stations 9+500 and 15+800 to 16+300.
3. Fire: in the area where the sugar cane plantation is burnt, the Works should be coordinated so that during this activity the Works are temporarily suspended, and this way not to cause any damage to the equipment or injure the Project workers. Station6+500 to 7+100, and 23+100 to 24+500.

In addition, the following should be considered, when SNET or the National Emergency Committee generates alerts:

- Volcano risk, temporarily suspend the Works in the expansion section up to station2+500.
- Seism: suspend the works until the project manager authorizes the entry of the workers, especially in the cut-off and filling zones.
- Intense rains: likewise, the project manager will determine those places where works can or not continue, depending on the level of the alert. Asphalt should not be applied in rain conditions as not to contaminate surface waters.
- Floods: between Stations 23+500 to 23+900 the Project crosses a zone near *Río Grande de San Miguel,* where the terrain has a lower level depression in the surrounding. In this section the viaduct will be built, therefore, the project does no impact the current floods patterns. Nonetheless, during the construction in this section, precautions should be taken during intense rains.

X.7 POTENTIAL ACCIDENTS DURING THE CONSTRUCTION AND OPERATING STAGES

To supplement the previous analysis, the potential accidents of incidents , that could occur as a result of the natural or anthropogenic threats above referred, have been evaluated, because of the human factor, during the site preparation, construction and operations phases of the Project.

Table IX.6 below describes possible accidents identified for the Construction Stage and Table IX.7, further down, describes possible accidents during the Operational Stage.

TABLE No. X.6 POSSIBLE ACCIDENTS OR INCIDENTS DURING SITE PREPARATION AND CONSTRUCTION STAGES

ACTIVITY	CAUSE	LIKELIHOOD OF OCCURRING	CONSEQUENCES
1.0 DAMAGE DURING FELLING	**HANDLING OF PRUNING AND CUTTING EQUIPMENT** (CHAINSAWS, SAWS, AXES, MACHETES, ETC.)	**LOW, REQUIREMENT TO:** ADEQUATE EQUIPMENT AND IN GOOD CONDITIONS FOR SAFE WORK AND ADEQUATELY TRAINED PERSONNEL	**WOUNDS, INJURIES AND OCCASIONALLY DEATH**
	FAILURE OF PRUNING AND CUTTING EQUIPMENT (CHAINSAWS, SAWS, AXES, MACHETES, ETC.)	**LOW, REQUIREMENT TO:** CHECK EQUIPMENT DAILY	
	NEGLIGENCE IN THE USE OF SAFETY EQUIPMENT (HELMETS, BOOTS, LIFELINES, HARNESSES, BELTS, ETC.)	**LOW, REQUIREMENT TO:** COMPLIANCE WITH SAFETY STANDARDS	
1.0 DAMAGE DURING DEMOLITION	**HANDLING OF DEMOLITION EQUIPMENT** (DRILLS, HAMMERS, BACKHOE)	**MEDIUM, REQUIREMENT FOR:** ADEQUATE EQUIPMENT IN SAFE WORKING CONDITIONS AND PERSONNEL WITH ADEQUATE CAPACITY	**WOUNDS, INJURIES AND OCCASIONALLY DEATH**
	FAILURE OF PRUNING AND CUTTING EQUIPMENT (CHAINSAWS, SAWS, AXES, MACHETES, ETC.)	**LOW, REQUIREMENT FOR:** DAILY EQUIPMENT CHECKS	
	NEGLIGENCE IN THE USE OF SAFETY EQUIPMENT (HELMETS, BOOTS, LIFELINES, HARNESSES, BELTS, ETC.)	**LOW, REQUIREMENT FOR:** COMPLIANCE WITH SAFETY STANDARDS	
2.0 DAMAGE DURING EXCAVATION AND FOUNDATION CONSTRUCTION FOR BRIDGES AND TUNNELS	**HANDLING OF CONSTRUCTION EQUIPMENT** (CONCRETE MIXERS, VIBRATING COMPACTORS, SHOVELS, BARS, ETC.)	**LOW, REQUIREMENT FOR:** ADEQUATE EQUIPMENT AND IN GOOD CONDITIONS FOR SAFE WORK AND ADEQUATELY TRAINED PERSONNEL	**BURYING OF PERSONNEL, WOUNDS, INJURIES AND OCCASIONALLY DEATH**
	CONSTRUCTION EQUIPMENT FAILURE (CONCRETE MIXERS, VIBRATING COMPACTORS, SHOVELS, BARS, ETC.)	**LOW, REQUIREMENT FOR:** DAILY EQUIPMENT CHECKS	
	LANDSLIDE (DURING EXCAVATION)	**LOW, REQUIREMENT FOR:** SHORING UP OF EXCAVATION SITES	
	RIVER FLOODING (DURING CONSTRUCTION OF ELEMENTS)	**LOW, ONLY DURING RAINFALL EVENTS**	
	NEGLIGENCE IN THE USE OF SAFETY EQUIPMENT (HELMETS, BOOTS, LIFELINES, HARNESSES, BELTS, ETC.)	**LOW, REQUIREMENT FOR:** COMPLIANCE WITH SAFETY STANDARDS	
4.0 DAMAGE DURING CONSTRUCTION OF ACCESS ROAD	**HANDLING OF EXCAVATION EQUIPMENT** BACKHOES, BOBCATS, LOADERS	**LOW, REQUIREMENT FOR:** ADEQUATE EQUIPMENT AND IN GOOD CONDITIONS FOR SAFE WORK AND ADEQUATELY TRAINED PERSONNEL	**WOUNDS, INJURIES AND OCCASIONALLY DEATH**
	DIRT EQUIPMENT FAILURE (BACKHOES, BOBCATS, LOADERS)	**LOW, REQUIREMENT FOR:** DAILY EQUIPMENT CHECKS	
	NEGLIGENCE IN THE USE OF SAFETY EQUIPMENT AND TEMPORARY BARRIERS (HELMETS, SHOES, LIFELINES, HARNESSES, BELTS, FENDERS, TEMPORARY BARRIERS, ETC.)	**LOW, REQUIREMENT FOR:** COMPLIANCE WITH SAFETY STANDARDS	

TABLE No. X.7. POSSIBLE ACCIDENTS OR INCIDENTS DURING THE OPERATIONAL STAGE

ACTIVITY	CAUSE	LIKELIHOOD OF OCCURRING	CONSEQUENCES
1.0 DAMAGE DURING PRUNING OF EASEMENT	**HANDLING OF PRUNING AND CUTTING EQUIPMENT** (CHAINSAWS, SAWS, AXES, MACHETES, ETC.)	**LOW, REQUIREMENT FOR:** ADEQUATE EQUIPMENT AND IN GOOD CONDITIONS FOR SAFE WORK AND ADEQUATELY TRAINED PERSONNEL	**WOUNDS, INJURIES AND OCCASIONALLY DEATH**
	FAILURE OF PRUNING AND CUTTING EQUIPMENT (CHAINSAWS, SAWS, AXES, MACHETES, ETC.)	**LOW, REQUIREMENT FOR:** DAILY EQUIPMENT CHECKS	
	NEGLIGENCE IN THE USE OF SAFETY EQUIPMENT (HELMETS, BOOTS, LIFELINES, HARNESSES, BELTS, ETC.)	**LOW, REQUIREMENT FOR:** COMPLIANCE WITH SAFETY STANDARDS	
2.0 DAMAGE DURING MAINTENANCE ACTIVITIES	**POTHOLE REPAIR**	**LOW, REQUIREMENT FOR:** ADEQUATE EQUIPMENT AND IN GOOD CONDITIONS FOR SAFE WORK AND ADEQUATELY TRAINED PERSONNEL	**ELECTRIC SHOCK, WOUNDS, INJURIES AND OCCASIONALLY DEATH**
	REPAIR OF GUTTERS, CURBS, CENTRAL DIVISIONS	**LOW, REQUIREMENT FOR:** ADEQUATE EQUIPMENT AND IN GOOD CONDITIONS FOR SAFE WORK AND ADEQUATELY TRAINED PERSONNEL	**WOUNDS, INJURIES AND OCCASIONALLY DEATH**
	SLOPE REPAIR	**LOW, REQUIREMENT FOR:** ADEQUATE EQUIPMENT AND IN GOOD CONDITIONS FOR SAFE WORK AND ADEQUATELY TRAINED PERSONNEL	
	NEGLIGENCE IN THE USE OF SAFETY EQUIPMENT (HELMETS, BOOTS, LIFELINES, HARNESSES, BELTS, ETC.)	**LOW, REQUIREMENT FOR:** COMPLIANCE WITH SAFETY STANDARDS	

X.8 CONTINGENCY PROGRAM

Following are two Contingency Programs for the Project, one for the construction phase, and the other for the operations phase.

The programs gathers a number of plans, with prevention and immediate response measures for the most likely disaster cases or accidents to occur in the facilities, considering the main risk factors linked to the nature of the project activities, the technology used and the environment conditions.

In this sense, the programs are made up of a prevention plan, emergency plans with responses to the most potential emergencies, during and after the event. The evacuation plan is omitted due to the type of project object of the study, which includes structures in open spaces.

X.8.1 *CONTINGENCY PLAN DURING THE CONSTRUCTION STAGE*

X.8.1.1 Prevention plan during the construction phase

This plan includes a set of general measures that the constructing company staff should follow to protect the facilities and human resources from accidents. Prevention is the first step of contingency management to avoid any crisis situation on time.

- *Goals*
- To avoid damage to people, human losses and/or material and equipment losses, by preventing accidents, applying safety rules and standards.
- Keep the facilities construction in safety conditions and in order.

This section describes the prevention activities that should be carried out to reduce the risks run in the event of an emergency or accident.

- Verify that the staff has protection gear for their work.
- Review Danger warning signs.
- Review signs and delimitation of the work areas, and the personnel to detour the traffic.
- Implement training programs on prevention plans and measures and response to emergency situation.
- Safety data collection and analysis: including the data analysis and identification of repetitive problems, in order to identify the causes of accidents happening in the facilities, as well as offsetting them in the future.
- Periodical updating of the different plans included in the present contingency program, according to internal and external changes such as purchasing new machinery and / or equipment type, according to changes in the occupational security legislation, and significant environment modifications.
- Staff training on the use of critical facilities in the event of emergencies, such as locating and using the alarms, fire extinguishers, hoses to control fires and any other security device in the plant.
- All the personnel should be trained on security and fire prevention techniques.
- The fuel materials should be stored and disposed of according to the standards established to prevent combustion and spills.
- During the construction the personnel shall have fire extinguishers. These should be loaded and inspected on a monthly basis, to verify they are loaded at all times and placed in accessible places, free of obstacles.

The emergency phones are detailed in the following table, and shall be updated every three months.

TABLE No. X.8. EMERGENCY TELEPHONES[2], 2011.

CITY/MUNI-CIPALITY	MAYOR'S OFFICE	PNC	FIRE DEPARTMENT	HEALTH CENTER
San Miguel	2660-7908	2622-2600 Eastern Region 26222652	San Miguel 913 2669-8526	San Juan de Dios Regional Hospital, 2669-5615; San Miguel Health Unit, 2661-2135; San Miguel Red Cross, 2661-1771; "Nuestra Señora de La Paz" Specialty Hospital San Miguel, 2661-0001
Moncagua	2618-6005			Health Unit 2618-6012
Quelepa	2335-9072			Health Unit 2682-0130

X.8.1.2 Emergency plans during construction

Based on the risk study previously developed, following is the emergency response plan for the emergencies most likely to occur.

Among the most probable emergencies were identified:

- Personal accidents or deaths
- Oil or lubricant spills
- Fire or explosion
- Earthquakes
- Landslides
- Weather conditions

The plans shall be reviewed and updated periodically and shall be accessible for the personnel, in their working sites, during the construction phase. Their effectiveness will be assessed at least once a year.

X. 8.1.2.1 Plan in case of accidents or death of a staff member

The procedure describes the actions the staff should take in the event of injuries, accidents or death of staff members that could require external assistance. All the staff should know the procedure to be followed .

- General steps*:*

All emergency situations shall be reported. The steps to be followed are:

- Assess the case and determine priorities.
- Protect the staff
- Request external assistance if necessary.

Level of seriousness of the emergency:

[2]*Information obtained from each cited entity.*

- *Minor emergencies* will be solved by the employees. This emergency does not influence operations or integrated security and safety practices. Examples of this type of emergency could be falls, minor cuts, scrapes, which in general are incidents that could be an indication of a potential major problem.
- *Moderate emergencies* will be solved by the employees, including the construction responsible. It can influence the operations and integral safety of the facility. Examples of this type of emergency could be a fall with loss of consciousness of the person, fainting, cuts or injuries that need attention, mechanical problems or damage that might stop the operations for one or several hours; it is the emergencies that provoke the temporary incapacity of the staff.
- *Serious emergencies* require the participation of the head of construction and his/her employees. Its influence could be serious and significant for the operation and integral safety in the facility. Some examples of these emergencies are work accidents that cause the loss of a life or a limb, loss of consciousness and burns caused by electric discharges, fire attempt; they cause a total stoppage of the operations
- *Major emergencies* require the participation of the head of construction and his/her employees and an alert and a call for assistance to outside assistance institutions. An emergency of this type has a significant impact is on operations and integral safety. For example, situations where several people suffer burns or wounds, such as fires and earthquakes.

- *Steps to be followed:*

In the event that an employee suffers an accident and needs emergency medical transportation, if possible he/she should be accompanied by a company representative, who should be trained to provide relevant information for the employee to be admitted into the hospital.

Close relatives of the employee that suffered the accident shall be notified, whether by telephone or in person, depending on the seriousness of the emergency. The person responsible for construction will discretely notify them.

First aid assistance shall be provided by one of the persons in charge of construction, who will be trained for this purpose. The possibility of transferring the employee to the nearest health center so that he can be assisted, will be assessed, or the decision made to wait until the medical or rescue assistance arrives.

The assessment of the accident in the work scene will be done according to the following steps:

1. Inspecting the zone to verify the security of the person providing assistance and of the victim. If there is immediate danger for any one of them, they shall be transferred to a safe place.
2. Inspecting the victim to make sure that he/she is breathing , that his/her heart is beating and he/she is not bleeding. These problems should be addressed as a priority.
3. Obtain external medical assistance.
4. Keep the victim calm and still until he/she is transferred or the medical assistance arrives.
5. In the event of death, it can only be confirmed by medical staff.

6. When the injured person has been transferred or the medical assistance is on its way, and the respective legal authorities have been notified, the construction responsible shall be notified.
7. If death is confirmed by a doctor, the construction responsible shall notify the victim's relatives and provide the required assistance.
8. If the accident was due to contact with some hazardous material, it is recommended to immediately read the security sheets, that should be accessible, and if not possible, do the following:

    - EYES: rinse with abundant water for at least 15 minutes, Seek medical assistance.
    - SKIN: rinse with abundant water for at least 15 minutes. If irritated, seek medical assistance.
    - INHALATION: move the person to an open area with fresh air. Seek medical assistance.
    - INGESTION: If the person is conscious, he/she should drink at least 1 or 2 glasses of water. Seek immediate medical assistance.

X. 8.1.2.2 Fuel leakage or spillage

Contain the spill with sand or absorbent material, which should also be available and at hand for this purpose

Move away any source of fire from the spill zone.

Collect the contaminated material and deposit it in containers used for this purpose.

Proceed to the final disposal of this material as indicated in the environmental procedures

Clean and wash the contaminated equipment and infrastructure with biodegradable detergent .

X. 8.1.2.3 Fire or explosion contingency plan

When a fire is detected, the supervisor responsible of the area should be immediately notified. The person that discovers the fire should alert the other employees; the highest hierarchy staff shall assess the situation and request external assistance, if necessary.

Although most of the fires do not require an evacuation, there could be a fire of a great magnitude. When the decision of evacuation is made, all the personnel, other than reaction bodies, shall meet in the areas that have been assigned for this purpose by the emergency responsible.

Fight the fire according to the fires extinguishing training.

The construction responsible or responsible should assess the situation and require external assistance if necessary

If the fire is not rapidly controlled, the facilities should be immediately evacuated.

Under no circumstances shall any employee be allowed to return near the danger zone, to find something or someone, until the fire has been controlled. This type of negligent action could result in the loss of a life that could have been saved. It is the responsibility of trained staff, such as fire-fighters, to evacuate personnel that is trapped in the facility on fire

All the staff should meet in the safety zone established in the evacuation plan, to do a headcount and/or transferred to a health center, if necessary

X.8.1.2.4 Earthquake contingency plan

During the seismic tremor, the staff should seek protection under safe sites, previously identified and move away from risky machinery or equipment

The personnel in the construction plant shall move away from materials stacked at a height of more than 1.5 m, from the ground level.

Once the tremor is over, the place should be immediately evacuated, without running, and go to open areas, move away from construction or finished structures or any other danger. Before the evacuation the Project responsible shall evaluate the work fronts where they are.

If there are any fuel deposits or explosives on the site, you should wait until the main tremor is over and it has been verified that the facilities are safe to allow the entry of qualified staff to repair the damage and make sure there is no risk of explosives, fires or spills of inflammable material. In this sense, the personnel should not be allowed to try to repair the damage. This would only increase the risk of a disaster caused by explosions or fires.

X.8.1.2.5 Landslide contingency plan

If the landslide or slope movement is caused by an earthquake or tremors, proceed according to this type of emergency. The following is also recommended:

Once the slide is over, the place should be immediately evacuated, calmly, without running, and move to open areas far from the construction or finished structures or any other danger.

Before the evacuation, the Project responsible shall evaluate the work site where he/she is.

The immediate line manager should be informed of the event.

X.8.1.2.6 Emergency due to weather conditions

There are weather emergency conditions when there are abnormal conditions or abrupt changes, including hurricanes, high speed winds, etc. When an emergency warning has been issued due to national level weather conditions, the plant manager or supervisor in charge shall make sure that the construction personnel is alerted about the conditions and appropriate measures are taken, according to the case, to minimize the risks for the personnel and equipment.

In the case of this type of emergency, the following action should be taken in the Project site:

Upon receiving an orange or red warning notice, from the national emergency committee, the employees shall ask the Project manager whether construction activities should be stopped or not. In the event of strong rains, the operations will be suspended in the identified flood risk zones. The Project Manager will determine whether it is necessary to implement emergency stoppage procedures.

X.8.1.3 Post-event actions during construction

If the Event damages the structures with such intensity that it exceeds the facilities design criteria, or if there is considerable structural damage, the facilities should be inspected as soon as possible and by trained specialists engineering personnel (Structure Eng.); the personnel will stop the operations in the facilities for their inspection.

The inspection and evaluation of the facilities impacted will be conducted after the risk is over, in the event of an earthquake, after the secondary tremors, and applying the following recommendations:

All inspections will be duly authorized.

The structures engineer will report the level of risk implied for the personnel to continue the construction work

The structures engineer will be in constant communication to notify the outcome of the inspection that could require immediate attention.

The outcomes of all the inspections will be reported to the Project responsible, during the emergency to take the necessary measures to restart the construction activities, as soon as it is considered that the basic safety conditions exist in the facilities and for the equipment.

After the emergency condition has been mitigated, the responsible during the emergency shall prepare a report for the construction responsible detailing the nature of the event, conditions of the facilities and future needs. He will be responsible of getting any external report, for example from the police, insurance, etc. As well as of sending a copy to the person responsible for the Project on behalf of MOP.

The construction responsible shall report any emergency to the Project manager at Mop.

X.8.1.4 Emergency communications

The emergency lines shall remain free to avoid or minimize confusions. When an employee identifies an emergency, he shall first notify his/her immediate supervisor and then the Project Manager.

No information about the accident or emergency to anyone foreign to the Project. The only person authorized to provide information to third parties is the Project Manager, duly authorized by MOP.

X.8.2 *CONTINGENCY PROGRAM DURING THE OPERATING PHASE*

X.8.2.1 Prevention Plan

This plan includes a set of general measures that the constructing company staff should follow to protect the facilities and human resources from accidents. Prevention is the first step of contingency management to avoid any crisis situation on time.

- *Goals*
- To avoid damage to people, human losses and/or material and equipment losses, by preventing accidents, applying safety rules and standards.
- Keep the facilities construction in safety conditions and order.

This section describes the prevention activities that should be carried out to reduce the risks run in the event of an emergency or accident.

- Verify that the staff has protection equipment for their work.
- Review Danger warning signs.
- Review the line right
- Implement training programs on prevention plans and measures and response to emergency situation.
- Safety data collection and analysis: including the data analysis and identification of

repetitive problems, in order to identify the causes of accidents happening in the facilities, as well as offsetting them in the future.

- Periodical updating of the different plans included in the present contingency program, according to internal and external changes such as purchasing new machinery and / or equipment type, according to changes in the occupational security legislation, and significant environment modifications.

Emergency telephones are detailed in table No. X.9, which should be updated every three months, and to be available in the maintenance brigades.

TABLE No. X.9. EMERGENCY TELEPHONES[3] 2011.

CITY/MUNICIPALITY	MAYOR'S OFFICE	PNC	FIRE DEPARTMENT	HEALTH CENTER
San Miguel	2660-7908	2622-2600 Eastern Region 26222652	San Miguel 913 2669-8526	San Juan de Dios Regional Hospital, 2669-5615; San Miguel Health Unit, 2661-2135; San Miguel Red Cross, 2661-1771; "Nuestra Señora de La Paz" Specialty Hospital San Miguel, 2661-0001
Moncagua	2618-6005			Health Unit 2618-6012
Quelepa	2335-9072			Health Unit 2682-0130

X.8.2.2 Emergency plans

Based on the risk study previously developed, the emergency response plan is presented below.

Among the most probable emergencies were identified:

- Personal accidents or deaths
- Earthquakes
- Landslides
- Weather conditions

The plans shall be reviewed and updated periodically and shall be accessible for the personnel, in their working sites, during the construction phase. Their effectiveness will be assessed at least once a year.

X.8.2.2.1 Plan in the case of accident or death of a staff member

The procedure describes the actions the staff should take in the event of injuries, accidents or death of staff members that could require external assistance. All the staff should know the procedure to be followed.

- *General steps:*

[3] *Based on inquiries with each cited agency*

All emergency situations shall be reported. The steps to be followed are:

- Assess the case and determine priorities.
- Protect the staff
- Request external assistance if necessary.

♦ Level of seriousness of the emergency*:*

- *Minor to low-moderate emergency,* will be solved by the employees. This emergency does not influence the operation or the integral security and safety. Examples of this type of emergency could be falls, minor cuts, scrapes, which in general are incidents that could be an indication of a potential major problem.
- *Moderate emergency,* will be solved by the employees, including the construction responsible. It can influence the operations and integral safety of the facility. Examples of this type of emergency could be a fall with loss of consciousness of the person, fainting, cuts or injuries that need attention, mechanical problems or damage that might stop the operations for one or several hours; it is the emergencies that provoke the temporary incapacity of the staff.
- *Serious emergency,* requires the participation of the construction responsible and his /her employees. Its influence could be serious and significant for the operation and integral safety in the facility. Some examples of these emergencies are work accidents that cause the loss of a life or a limb, loss of consciousness and burns caused by electric discharges, fire attempt; they cause a total stoppage of the operations
- *Major emergency,* requires the participation of the person responsible for construction and his/her employees, an alert and assistance call to assistance institutions outside the facilities. Its influence is significant on operations and integral safety. For example, situations where several people suffer burns or wounds and their situations as: fires and earthquakes.

- *Steps to be followed:*

1. In the event that an employee's suffers and accident and needs emergency medical transportation, if possible he/she should be accompanied by person responsible for the line's maintenance, who should be trained to provide relevant information for the employee to be admitted into the hospital.
2. Close relatives of the employee that suffered the accident shall be notified, whether by telephone or in person, depending on the seriousness of the emergency. The line management responsible will be in charge of discretely notifying them.

3. First aid assistance shall be provided by one of the line management responsible , who will be trained for this purpose. The possibility of transferring the employee to the nearest health center so that he can be assisted, will be assessed, or the decision made to wait until the medical or rescue assistance arrives.

The assessment of the accident at the work accident scene will be done according to the following steps:

1. Inspecting the zone to verify the security of the person providing assistance and of the victim. If there is immediate danger for any one of them, they shall be transferred to a safe place.

2. Inspecting the victim to make sure that he/she is breathing , that his/her heart is beating and he/she is not bleeding. These problems should be addressed as a priority.

3. Obtain external medical assistance

4. Keep the victim calm and still until he/she is transferred or the medical assistance arrives.

5. In the event of death, death can only be confirmed by medical staff.

6. Inspect the victim to make sure he/she is breathing, that the heart is beating and that he/she is not bleeding. These problems need to be treated as a priority.

7. Obtain external medical assistance.

8. Keep the victims still and calm until their transfer or the medical assistance arrives.

9. In case of death, it may only be confirmed by medical personnel.

10. When the injured person has been transferred or the medical assistance is on its way, and the respective legal authorities have been notified, the construction responsible shall be notified.
11. If death is confirmed by a doctor, the construction responsible shall notify the victim's relatives and provide the required assistance.

    If the accident was due to contact with some hazardous material, it is recommended to immediately read the security sheets, that should be accessible, and if not possible, do the following:

- EYES: rinse with lots of water for at least 15 minutes, Seek medical assistance.
- SKIN: rinse with lots of water for at least 15 minutes. If irritated, seek medical assistance.
- INHALATION: move the person to an open area with fresh air. Seek medical assistance.
- INGESTION: If the person is conscious, he/she should drink at least 1 or 2 glasses of water. Seek immediate medical assistance.

X.8.2.2.2 Earthquake contingency plan

During the seismic tremor it is recommended to apply the following measures :

Durante During the seismic tremor, the staff should seek protection under safe sites, previously identified and move away from risky machinery or equipment.

Once the tremor is over, the place should be immediately evacuated, without running, and go to open areas, move away from structures.

Before the evacuation, the Project responsible shall evaluate the work site where he/she is.

If there are any fuel deposits or explosives on the site, you should wait until the main tremor is over and it has been verified that the facilities are safe to allow the entry of qualified staff to repair the damage and make sure there is no risk of explosives, fires or spills of inflammable material. In this sense, the personnel should not be allowed to try to repair the damage. This would only increase the risk of a disaster caused by explosions or fires

X.8.2.2.3 Landslide contingency plan

If the landslide or slope movement is caused by an earthquake or tremors, proceed according to this type of emergency. The following is also recommended:

Once the slide is over, the place should be immediately evacuated, calmly, without running, and move to open areas far from the construction or finished structures or any other danger.

Before the evacuation, the Project responsible shall evaluate the work site where he/she is.
The immediate line manager should be informed of the event.

X.8.2.2.4 Emergency due to weather conditions

There are weather emergency conditions when there are abnormal conditions or abrupt changes, including hurricanes, high speed winds, etc. When an emergency warning has been issued due to national level weather conditions, the plant manager or supervisor in charge shall make sure that the construction personnel is alerted about the conditions and appropriate measures are taken, according to the case, to minimize the risks for the personnel and equipment.

In the case of this type of emergency, the following action should be taken in the Project site:

Upon receiving the notice, in the case of strong winds, the employees should suspend the work of the line maintenance

The Project Manager, will determine whether it is necessary to implement emergency stoppage procedures

X.8.2.2.5 Post-event actions

In the case that an event damages the structures with such an intensity that it exceeds the design criteria of the facilities or if there is an important structural damage, it shall be inspected as soon as possible by the specialist engineering personnel, trained on this matter (Structures Engineer); the personnel will stop the operations of the facilities for its inspection.

The inspection and evaluation of the facilities that suffered an impact will be conducted after the risk has passed; in the case of an earthquake, after the secondary tremors, applying the following recommendations:

All the inspections will be conducted with the due authorization.

The structures engineer will report the level of risk that it implies for the personnel to continue with the maintenance tasks of the line

The structure engineer will be in constant communications to notify the results of the inspection that could require immediate attention

The results of all the inspections will be sent to the project responsible, during the emergency to take the necessary measures to restart operations when it is considered that basic safety conditions exist in the facilities and equipment

After the emergency condition has been mitigated, the person in charge during the emergency shall prepare a report for the line maintenance responsible, the conditions of the facilities and the future needs

It should be the person responsible of getting any external report, for example from the police, etc. and send a copy to them, to the Project responsible, for the MOP.

The line maintenance responsible shall report any emergency to the Project manager in the MOP.

X. 8.2.2.6 Emergency Communications

The communications lines shall be kept free to avoid or minimize confusions. When an employee discovers an emergency, he/she shall first notify his immediate supervisor and then the Project manager.

No information on the accident or emergency shall be provided to personnel foreign to the Project. The only person authorized to provide information to third parties is the Project Manager, duly authorized by the MOP.