

VII IDENTIFICATION, PRIORIZATION, FORECAST AND QUANTIFICATION OF POTENTIAL ENVIRONMENTAL IMPACTS, INCLUDING ANY RISK SITUATIONS

The environmental assessment is defined in the Law on the Environment (LMA) (Art. 5) as "The set of procedures that allow the State" based on an Environmental Impact Study, to estimate the effects and consequences that the implementation of a specific work, activity of Project can have on the environment, assure the implementation and follow-up of measures that can prevent, mitigate, compensate or potentiate, these impacts, according to each case".

VII.1 METHODOLOGY

In recent decades the assessment of the environmental impacts (EIA) caused by a Project has gained significant importance, due to the need of achieving a balance between socio-economic development and the conservation of the quality of the environment in which it is implemented. This need even visualizes the EIA as an on-going technique, applied as a tool guide to those responsible of allowing the projects, of deciding the convenience or not of approving them and subsequently, following-up the changes the environment has suffered due to the development, and to search mitigation measures that will achieve the **balance Project / Environment**.

Today, there is a diversity of authors that have tried to systematize this process by applying different evaluation techniques of the impacts generated by a Project, considering for this task, the orientation provided by Weitzenfeld, 1990; López, 1994; Sadar, 1994; CRICA, 1995; Ridgway et al., 1996, among others, to determine the magnitude of the effects expected in the different Project activities, applying the "Methodology of the Integrated Relevant Criteria"¹ to define their impact, as suggested by Panameño and Yáñez, 1993. Given there is no legal pattern established to present the report, the legal system that Ridgway et al., 1996 suggested was retaken, adjusting the multidisciplinary work methodology to follow it up.

The phases of the "Methodology of the Integrated Relevant Criteria" are the following:

1. Break-down of the Project activities.
2. Break-down of the environmental factors with the possibility of being impacted.
3. Contrast activities and environmental factors.
4. Impact evaluation and prioritization.

Following is a description of each one of the phases listed, applied to the PROJECT EIA.

VH.2 BREAK-DOWN OF PROJECT ACTIVITIES

For the EIA, a list of actions or activities with potential impacts was prepared, and ordered in a sequential manner, according to the Project phases, these activities have been determined considering the actions that have been foreseen to be developed in the Project, throughout the outline, selecting the activities with the potential of generating environmental impacts. 23 potential activities of generating an impact during the Project implementation were selected, and distributed in two phases.

¹ Relevant Integrated Criteria, Buroz Castillo (1998) published by Venezuelan Consultants CAURA-FRAGROMEN Ltda

The closing phase has not been taken into account, because for the Project it does not apply, given that the planning is for a period of more than 30 years.

In Chapter IV are explained all the different activities to be developed for the project implementation during each one of its phases. A list of the activities was prepared, considering only those with the potential of generating impacts, grouped or disaggregated, as convenient, related to the ones described in the Project description. 23 activities were identified, established in the site preparation phase (7), construction (13) and operations (3), distributed as follows:

■ Construction activities

- Site preparation activities.
 1. Acquiring the rights of way.
 2. Demolition of the existing structures.
 3. Tree and shrub felling.
 4. Clearing, cleaning and uprooting.
 5. Plant installation.
 6. Quarry and loan Banks management.
 7. Traffic control installation (expansion section).
- Construction Activities.
 8. Traffic control.
 9. Material procurement
 10. Earthmoving.
 11. Construction of tunnels, bridges, level crossings, and viaducts
 12. Minor draining works.
 13. Major draining works.
 14. Slope treatment.
 15. Application of asphaltic concrete paving.
 16. Horizontal signaling.
 17. Vertical signaling.
 18. Several, sidewalks, barriers and other
 19. Closing the plant, moving out and final cleaning.

Operations phase

20. Crossing of vehicles and people.
21. Rain water Draining
22. Road maintenance: potholes repair, pruning vegetation, paint bridges, signaling, etc.

VII.3 BREAK-DOWN OF ENVIRONMENTAL FACTORS

Continuing with the application of the selected methodology, a break-down of environmental factors or elements that could be impacted with the Project implementation was prepared, incorporating only the important ones for the effects of the evaluation and decision-making.

The steps required for the application of the methodology were followed, framed in the technical discussion of the multidisciplinary team and the recognition tours to the zone, foreseeing the direct and indirect relations of the Project actions with the receiving environment, which allowed identifying the possible impacts that could be generated.

Considering the current condition of the environment where the Project "SAN MIGUEL TRUNK ROAD" IS LOCATED, the environmental components were determined, that in the opinion of the multidisciplinary team would be affected by the activities of the study, defining a total of 32, in which were included 11 physical ones, that include: soil (5), water (4), atmosphere (2); biological (5), social (14), and of the landscape (2), that are detailed as follows:

- Physical:
 - o Atmosphere.
 1. Air quality
 2. Noise
 - o Soil
 3. Relief and topography
 4. Soil quality
 5. Soil: Agriculture land
 6. Soil stability
 7. Vibrations
 - o Water
 8. Surface draining pattern
 9. Rivers: Grande de San Miguel, Taishihuat and Papalón
 10. River and creeks quality
 11. Underground water resource
- Biological:
 - o Flora
 12. Secondary and riparian forests
 13. Trees, shrubs and weeds
 14. Commercial flora
 15. Natural areas
 - o Fauna
 16. Wild fauna
- Socioeconomic and cultural:
 - o Socioeconomic
 17. Population
 18. Farming land
 19. Urban development
 20. Farming activities
 21. Agriculture and livestock activities

- 22. Trade activities
- 23. Vulnerable population
- 24. Existing infrastructure
- 25. Utilities
- 26. Local and regional economic development
- 27. Occupational health
- 28. Public health
- 29. Road Network
- 30. Vehicles traffic

o Cultural and Landscape

- 31. Cultural interest sites
- 32. Landscape and Views

VII.4 CONTRAST OF ACTIVITIES AND ENVIRONMENTAL FACTORS

The activities that will be executed under the Project and the environmental factors identified that will receive an impact, were compared in a matrix crossing, using for this purpose a simple double entry matrix that is presented in "Annex VII.I ", "Interaction Matrix ". In this matrix, the impact for the Project activities is pointed out, whether negative, positive or none that they could have on each one of the environmental components considered.

The results obtained from this matrix crossing that is presented in Annex VII-1, is shown in the following table.

TABLE No. VII.I. SUMMARY MATRIX OF OF POTENTIAL ENVIRONMENTAL IMPACTS

ENVIRONMENTAL COMPONENTS		POSITIVE	NEGATIVE
Physical	1 Air Quality	1	5
	2 Noise	0	9
	3 Relief and topography	0	3
	4 Soil Quality	0	6
	5 Soil topsoil	0	1
	6 Soil stability	0	4
	7 Vibrations	0	5
	8 Surface drainage pattern	0	4
	9 Rivers: Grande de San Miguel, Taishihuat and	0	8
	10 Water quality of rivers and streams	0	0
	11 Groundwater resources	0	7
Biological	12 Secondary and riparian forests	0	5
	13 Trees, shrubs and grasses	0	3
	14 Commercial Flora	0	3
	15 Protected areas	0	3
	16 Wildlife	0	14

ENVIRONMENTAL COMPONENTS			POSITIVE	NEGATIVE
Socioeconomic and cultural	17	Population	0	2
	18	Agricultural land	0	4
	19	Urban development	0	1
	20	Agricultural activities	1	3
	21	Farming activities	0	3
	22	Commercial Activities	0	2
	23	Vulnerable population	0	1
	24	Existing infrastructure	0	1
	25	Utilities	0	2
	26	Local and Regional Economic Development	13	2
	27	Local and Regional Economic Development	0	13
	28	Public Health	3	8
	29	Road network	1	3
	30	Vehicular traffic	1	5
	31	Cultural-interest sites	0	1
32	Landscape and vistas	0	4	
TOTAL NEGATIVES				135
TOTAL POSITIVES			20	

Source: Eco Ingenieros Team

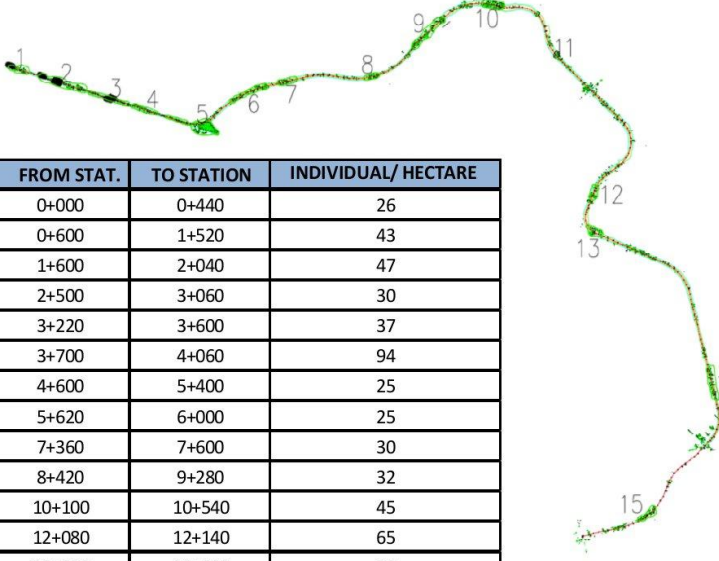
Regarding repeatedness, the components mostly negatively impacted by a repeatedness of 7 are: Noise, soil quality, rivers, underground water resources, wild fauna, occupational health and public health.

VII.4.1 Description and quantification of potential impacts


The main environmental impacts determined through the intersection matrix that have been foreseen will occur when implementing the Project are presented in the following table. Only the impacts considered as SIGNIFICANT in the evaluation impact are described.

ASPECT	IMPACT AND SIGN
CONSTRUCTION: SITE PREPARATION	
1	Emissions into air from demolition of structures N
ACTIVITY	Demolition of structures
DESCRIPTION	Dust and noise generated from the demolition of structures. The impact will be punctual location sites of homes and other structures that will be affected in the area of direct influence. The impact is temporary and of short duration, of a low intensity, since the structures are of relatively small size and localized along the course of the project.
LOCATION	Localized along the course of the project where there are structures to be demolished <ul style="list-style-type: none"> • Station 0 +00 to 3 +720 • Homes or secondary structures at stations 5 +370, 5 +460, 5 +560, 8 +260, 8 +400, 9 +240, 16 +520, 17 +320, 18 +860, 20 +260, 20 +460 • Lotificación Las Margaritas, Joselyn, Alas Campos, San Francisco and Altos de Hato Nuevo, between station 12+460 and station 13+540. • Housing development, station 24+948.264
RELEVANT	The main area affected is the Pan-American Highway (CA1), with partial impacts

ASPECTS	in all lots and buildings in housing developments, with frequent passage of people.	
2	Noise during tree felling	N
ACTIVITY	Cutting down trees and shrubs	
DESCRIPTION	Noise during tree felling from using chainsaw and falling branches and trunks, and the sound will be localized, of short duration, at intervals of the project. Low intensity.	
LOCATION	The entire path of the project	
RELEVANT ASPECTS	It is estimated that noise from tree felling can reach an estimated 50 m on either side of the ROW.	
3	Possible contamination of soil and water by effluents, waste and residues from site	N
ACTIVITY	Demolition of structures, setting up the working camp, felling, quarry management and installation of camp	
DESCRIPTION	The presence of workers during the site preparation stage and field work including demolition, felling of trees and shrubs, clearing, cleaning and grubbing, generate solid waste and liquid effluents. If not handled properly, they can contaminate soil and water. It is estimated that there will be 450 m ³ of rubble from demolition of structures, 27,888.54 m ³ of wood, and an estimated 15,000 m ³ of leaves and waste branches plus waste generated by employees. The impact is temporary only during site preparation, of short duration. The construction debris will be taken to an authorized site or the permit will be processed prior to construction. Branches, leaves and other wastes will be disposed of at an authorized landfill; permits have to be processed prior to construction.	
LOCATION	Project camp and work fronts.	
RELEVANT ASPECTS	<p>Timber volume from the area of direct influence, was calculated at an approximate 23,500 m³. These volumes were calculated according to the Saito (2004) methodology for measuring timber production. In summary, it is defined as: UPPER DBH = DBH (quantified) x 0.75 AVG DAP = UPPER DBH + DAP 2. The cylinder volume formula is applied:</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> $\text{Vol} = \pi \times r^2 \times h$ </div> <p>Where: $\pi \times r^2$ equals the area of the circle (base), and h is the field height (approximate) of each tree, resulting in the volume of an imaginary cylinder.</p>	
4	Transport of sediment to rivers and streams	N
ACTIVITY	Clearing and grubbing and installation of work camp	
DESCRIPTION	During clearing, prior to earthworks, if done in the rainy season, sediment scouring can occur in rivers and streams. Areas with higher expected scouring are where we find the steepest slopes. Impact is temporarily during construction.	
UBICACIÓN	Construction camp and alongside project path from station 4+000 to 21+800	
RELEVANT ASPECTS	In the road expansion section the effect will be less because of the small area of the strip of land. Same is true for station 21 +873 to 24 +548 where only bases of viaduct columns will be cleared, measuring 1.5 x 1.5 m every 15 m, with an estimated total of 802 m ² to be cleared of vegetation.	
5	Reducing infiltration caused by felling	N
ACTIVITY	Felling of trees and shrubs	

DESCRIPTION	By reducing vegetation cover the amount of water that infiltrates into the ground is modified. In wooded areas infiltration is greater than in barren surfaced plots.																																																				
LOCATION	<p>The following table shows the sites with the highest density of trees, according to the survey of trees.</p>  <table border="1" data-bbox="500 651 1006 1165"> <thead> <tr> <th>FROM STAT.</th> <th>TO STATION</th> <th>INDIVIDUAL/ HECTARE</th> </tr> </thead> <tbody> <tr><td>0+000</td><td>0+440</td><td>26</td></tr> <tr><td>0+600</td><td>1+520</td><td>43</td></tr> <tr><td>1+600</td><td>2+040</td><td>47</td></tr> <tr><td>2+500</td><td>3+060</td><td>30</td></tr> <tr><td>3+220</td><td>3+600</td><td>37</td></tr> <tr><td>3+700</td><td>4+060</td><td>94</td></tr> <tr><td>4+600</td><td>5+400</td><td>25</td></tr> <tr><td>5+620</td><td>6+000</td><td>25</td></tr> <tr><td>7+360</td><td>7+600</td><td>30</td></tr> <tr><td>8+420</td><td>9+280</td><td>32</td></tr> <tr><td>10+100</td><td>10+540</td><td>45</td></tr> <tr><td>12+080</td><td>12+140</td><td>65</td></tr> <tr><td>15+520</td><td>15+860</td><td>20</td></tr> <tr><td>16+380</td><td>16+660</td><td>23</td></tr> <tr><td>20+300</td><td>20+900</td><td>27</td></tr> <tr><td>23+500</td><td>23+900</td><td>41</td></tr> </tbody> </table>		FROM STAT.	TO STATION	INDIVIDUAL/ HECTARE	0+000	0+440	26	0+600	1+520	43	1+600	2+040	47	2+500	3+060	30	3+220	3+600	37	3+700	4+060	94	4+600	5+400	25	5+620	6+000	25	7+360	7+600	30	8+420	9+280	32	10+100	10+540	45	12+080	12+140	65	15+520	15+860	20	16+380	16+660	23	20+300	20+900	27	23+500	23+900	41
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RELEVANT ASPECTS	In forests 11% more water becomes infiltrated than on land covered with crops like corn and beans and grass																																																				
6	Reduction of riparian and secondary forest: trees, shrubs and wildlife	N																																																			
ACTIVITY	Cutting down trees and shrubs																																																				
DESCRIPTION	<p>Two forest types were found in the project area: riparian and secondary forest, both will be reduced in the ROW section</p> <p>The secondary forest at the beginning of the project is divided into two parts by the presence of the road, approx. two thirds of the forest to the west and one third to the east.</p> <p>Riparian forests are divided into sections about 25 m wide, although at some points, like at the river crossing over Rio Grande at STation 8+900 and Taisihuat River, station 13+730, the bridge rises high above the river, allowing some vegetation to grow on the banks, giving continuity to the forest..</p>																																																				
LOCATION	Secondary forest sections, Station 3 +500 to 4 +100 and riparian forest sections, 8 +900, 10 +280, 12 +120, 12 +980, 13 +740, 20 +580, 20 +750, 24 +780.																																																				
RELEVANT ASPECTS	<p>In the secondary forest, the most abundant species were <i>Annona squamosa</i> ("anona poshta"), <i>Sapium glandulosun</i> ("chilamate"), <i>Andira inermis</i> ("almendro de río") and <i>Chlorophora tinctoria</i> ("palo mora"). Moreover, the herbaceous stratum is dominated by <i>Verbesina</i> ("capitanejo" or "tabaquillo") and <i>Petiveria alliacea</i> ("epacina or zorrillo"). It is also predominant. In this sector there was also found <i>Selaginella hoffmanii</i> "selaginella" of the lower vascular plants group. The secondary forest is privately owned and is not protected by any conservation ordinance.</p>																																																				

	In the riparian forest vegetation is predominantly arboreal and it is there where most individuals with DBH equal to or greater than 100 cm were recored, dominated by 4 species in terms of abundance and trunk diameters, these are <i>Enterolobium cyclocarpum</i> "conacaste negro" <i>Samanea saman</i> "carreto", <i>Albizia niopoides</i> "conacaste blanco" and <i>Ceiba pentandra</i> "ceiba", the most significant species being <i>Albizia niopoides</i> "conacaste blanco", <i>Samanea saman</i> "carreto", <i>Enterolobium cyclocarpum</i> "conacaste negro" and <i>Ceiba pentandra</i> "ceiba".																									
7	Felling of trees, shrubs and grass during site preparation	N																								
ACTIVITY	Felling of trees and shrubs																									
DESCRIPTION	Felling of trees and shrubs in the expansion path of the project, where we find trees in lines and scattered, and also trees in fences and elsewhere in the project area. An estimated 2,647 trees will be felled in a 1,590,275.84 m ² . The list of species and number to be felled is detailed in Annex No. VI.8. Anthropic activities in the area of expansion: commercial, institutional and housing mainly generated in the presence of trees planted in rows and ornamental species. In the rest of the project, trees were found scattered among crops and pastures.																									
LOCATION	Along the entire path of the project																									
RELEVANT ASPECTS	In the expansion section the following arboreal species were found: <i>Tabebuia rosea</i> "maquilishuat" with the largest number of individuals 92, <i>Enterolobium</i> "black conacaste" with 63 individuals with the largest basal area and IVI, and <i>Lysiloma divaricatum</i> "quebracho" which occupies the third place in terms of the number of individuals found, with 41, see Table No. VI.34. Also ecologically important is <i>Gliricidia sepium</i> "madrecacao" and <i>Bursera simaruba</i> "jote", used as hedgerows. Most individuals are arboreal. In areas of crops and grasslands, species with greater biological significance were <i>Pithecellobium dulce</i> "mangollano" followed by <i>Albizia niopoides</i> "white conacaste" <i>Samanea saman</i> "carreto" and <i>Enterolobium</i> "black conacaste". These species are important because they yield the most timber and biomass. The following species were found in the category of threatened or endangered in the tree census conducted. <table border="1"> <thead> <tr> <th>SCIENTIFIC NAME</th> <th>COMMON NAME</th> <th>STATUS</th> <th>IND.</th> </tr> </thead> <tbody> <tr> <td><i>Bravaisia intigerrima</i></td> <td>mangle dulce</td> <td>Amenazada *</td> <td>3</td> </tr> <tr> <td><i>Cedrela odorata</i></td> <td>cedro</td> <td>Peligro *</td> <td>13</td> </tr> <tr> <td><i>Swietenia humilis</i></td> <td>caoba</td> <td>Peligro *</td> <td>46</td> </tr> </tbody> </table> <p>MARN (2009) *; IUCN (2011) ***. Ind: individuals</p> <p>Endangered species were found in the shrub stratum,</p> <table border="1"> <thead> <tr> <th>SCIENTIFIC NAME</th> <th>COMMON NAME</th> <th>ESTATUS</th> <th>IND.</th> </tr> </thead> <tbody> <tr> <td><i>Lonchocarpus</i></td> <td>patamula</td> <td>En peligro STATUS ***</td> <td>2</td> </tr> </tbody> </table> <p>MARN (2009) *; IUCN (2011) ***. Ind: individuals</p> <p>There can be more shrub species than those found in the sampled plots. Secondary Forest density= 1,080 individuals/hectare and diversity index = 2.64. Riparian forest density = 490 individuals per hectare and a diversity index of 2.94.</p>	SCIENTIFIC NAME	COMMON NAME	STATUS	IND.	<i>Bravaisia intigerrima</i>	mangle dulce	Amenazada *	3	<i>Cedrela odorata</i>	cedro	Peligro *	13	<i>Swietenia humilis</i>	caoba	Peligro *	46	SCIENTIFIC NAME	COMMON NAME	ESTATUS	IND.	<i>Lonchocarpus</i>	patamula	En peligro STATUS ***	2	
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8	Reduction of crops and farmland	N																								
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DESCRIPTION	Reduction of farmland and pastures. The effect is permanent during the life of the project.																																				
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RELEVANT ASPECTS	Dominant areas along bypass path are mostly made up of plots of Zea mays "corn," Sorghum sp. "maicillo" and Saccharum officinarum "sugarcane". Also notable is the dominance of matorrales, native grasses and small patches of chaparral community. There are rolling lands dominating certain sectors and high percentage of rockiness, with farming activity, especially for "corn" and cattle grazing. People also grown fruit near their homes. In these ecosystems, the following species were found in delicate condition in the plots analyzed. <table border="1"> <thead> <tr> <th>SCIENTIFIC NAME</th> <th>COMMON NAME</th> <th>STATUS</th> <th>STRATUM</th> <th>FOUND IN DIA</th> <th>TOTAL TO FELL</th> <th>ECOSYSTEM</th> </tr> </thead> <tbody> <tr> <td><i>Bravaisia intigerrima</i></td> <td>mangle dulce</td> <td>Threatened **</td> <td>Tree</td> <td>3</td> <td>0</td> <td>Forest</td> </tr> <tr> <td><i>Annona reticulata</i></td> <td>anona colorada</td> <td>Endangered *</td> <td>Tree</td> <td>2</td> <td>0</td> <td>Crops and grassland</td> </tr> <tr> <td><i>Cedrela odorata</i></td> <td>cedro</td> <td>Danger **</td> <td>Tree</td> <td>13</td> <td>4</td> <td>Crops and grassland</td> </tr> <tr> <td><i>Swietenia humilis</i></td> <td>caoba</td> <td>Danger **</td> <td>Tree</td> <td>46</td> <td>7</td> <td>Expansion section and croplands</td> </tr> </tbody> </table> <p><i>Cruz and Deras (2000) *; MARN (2009) **; IUCN (2011) ***. Ind: individuals</i></p> Of 13 ebony trees found, 4 will be felled. Of 46 cedar trees found, only 7 will be felled. No mangroves will be felled. It is important to mention that the grassland ecosystem and crops and the area of the current Pan-American Highway (CA1) contained the greatest diversity of species, 52 and 35 respectively.		SCIENTIFIC NAME	COMMON NAME	STATUS	STRATUM	FOUND IN DIA	TOTAL TO FELL	ECOSYSTEM	<i>Bravaisia intigerrima</i>	mangle dulce	Threatened **	Tree	3	0	Forest	<i>Annona reticulata</i>	anona colorada	Endangered *	Tree	2	0	Crops and grassland	<i>Cedrela odorata</i>	cedro	Danger **	Tree	13	4	Crops and grassland	<i>Swietenia humilis</i>	caoba	Danger **	Tree	46	7	Expansion section and croplands
SCIENTIFIC NAME	COMMON NAME	STATUS	STRATUM	FOUND IN DIA	TOTAL TO FELL	ECOSYSTEM																															
<i>Bravaisia intigerrima</i>	mangle dulce	Threatened **	Tree	3	0	Forest																															
<i>Annona reticulata</i>	anona colorada	Endangered *	Tree	2	0	Crops and grassland																															
<i>Cedrela odorata</i>	cedro	Danger **	Tree	13	4	Crops and grassland																															
<i>Swietenia humilis</i>	caoba	Danger **	Tree	46	7	Expansion section and croplands																															
9	Impact on proposed protected area	N																																			
ACTIVITY	Felling of trees and shrubgs, clearing, cleaning and grubbing																																				
DESCRIPTION	A lava flow is found in the area. According to Art. 19 of the Law on Natural Protected Areas, this is considered a potential protected area. The land is currently privately owned. It is vegetated with trees. The affected area is about 950 m2 along both sides of the road. 																																				

	Picture of the area affected by the project. To the north of existing road there is a small area of lav flows from the San Miguel Volcano.	
LOCATION	Station 0+880 a 0+960	
RELEVANT ASPECTS	The lava flow was divided with the construction of the current road, leaving a small area to the north.	
10	Possible impact on wildlife during site preparation	N
ACTIVITY	Felling of trees and shrubs, clearing, cleaning and brubbing	
DESCRIPTION	<p>Reducing vegetation cover reduces wildlife habitat present in the project area, potentially causing ecosystem fragmentation, fringe effect and barrier effect, with dispersion of species and declining populations of flora and fauna.</p> <ul style="list-style-type: none"> • Fragmentation <p>Fragmentation is the process of partial destruction of original habitat leaving behind smaller and scattered habitats within and between other habitat types in the new landscape created (Crow 1990; Opdam et al. 1993 Marham and Bawa 1995 cited by Ochoa Gaona, 2008). It also reduces the initial size of the habitat, increases the fringe area, changes the number of fragments and increases isolation between them (Andr�n 1996; Botkin and Keller 1997, cited by Ochoa Gaona, 2008).</p> <p>Moreover, fragmentation impacts to varying degrees on the dynamics of populations and natural communities. In some cases, it is linked to the extinction of organisms, as it can promote increased predation, parasitism or entry of incompatible species (Crow, 1990 cited by Ochoa Gaona, 2008).</p> <p>Habitats found in the project area are already very fragmented with considerable human presence. Habitat fragmentation affects insects, too, which are of vital importance in ecosystems.</p> <p>While constructing a road affects the area directly, fragmentation can be contained greatly. Habitat fragmentation has two main effects that threaten the survival of species, called barrier effect and fringe effect.</p> <ul style="list-style-type: none"> • <i>Barrier effect</i> <p>The barrier effect occurs when mobility of organisms or of their reproductive structures is impeded, which results in limiting the potential for organisms for dispersal and colonization. Many species of insects, birds and mammals do not cross these barriers, therefore, plants with fleshy fruits or seeds dispersed by animals will be affected too. Due to this fact many animals that consume resources that are scattered cannot move freely across the ground and the species that depend on them are limited in their food, as they cannot move to neighboring habitats. The road acts as a barrier that inhibits animals crossing the road. Making roads more "permeable," i.e. wildlife species can pass through them, reduces the demographic threat, but at the cost of a higher number of animals being hit by traffic. In contrast, increasing the barrier effect of roads reduces mortality, but accentuates the problem of small populations. The barrier effect may affect more species and spread over a wider area than the effects of being hit by cars or avoiding the road.</p> <ul style="list-style-type: none"> • <i>Fringe effect</i> <p>The fringe effect occurs when an ecosystem is fragmented and biotic and abiotic conditions of the fragments and the surrounding matrix are changed (Kattan, 2002). In the case of roads, this effect is present at or near the fringes of the road, which will create conditions with higher temperatures, lower humidity, higher radiation and increased susceptibility to wind. As reported by Goosem (1997), this fringe effect can impact birds for 50 m inland, microclimatic effects for 100 m, and insects for 300 m. As a result of the fringe effect the distribution and abundance of species is modified, changing the vegetation structure and, therefore, the supply of food for wildlife. These changes primarily affect species within the ecosystem that has already been fragmented.</p>	



	<p>These species can be displaced by species from open spaces, which find in the new habitat more favorable conditions for their survival and reproduction. The effect produced is the introduction of generalist or fringe species in forest habitats, species with good dispersal capabilities, able to invade and colonize disturbed habitats. Fringe species are attracted to these new habitats, many of which are predators of eggs or nestlings or nest parasites, reducing the reproductive success of the species living inside these areas (Goosem, 1997). Habitat fragmentation and subsequent isolation of populations is the most significant impact, as the barrier effect and the fringe effect affect food availability and reproductive potential of species. During construction and operation of the Bypass, a physical barrier will be created to prevent transfer of organisms from one place to another; however existing individuals do not present important distribution and abundance, so this will not be a determining factor for their populations.</p>																																																				
<p>LOCATION</p>	<p>Secondary forest sections, station: 3+500 to 4+100; and riparian forest sections, stations 8+900, 13+000, 13+800, 22+000 and areas with greater tree density</p> <table border="1" data-bbox="586 743 1162 1077"> <thead> <tr> <th>FROM STATION</th> <th>TO STATION</th> <th>INDIVIDUAL / HECTARE</th> </tr> </thead> <tbody> <tr><td>0+000</td><td>0+40</td><td>26</td></tr> <tr><td>0+600</td><td>1+520</td><td>43</td></tr> <tr><td>1+600</td><td>2+040</td><td>47</td></tr> <tr><td>2+500</td><td>3+060</td><td>30</td></tr> <tr><td>3+220</td><td>3+600</td><td>37</td></tr> <tr><td>3+700</td><td>4+060</td><td>94</td></tr> <tr><td>4+600</td><td>5+400</td><td>25</td></tr> <tr><td>5+620</td><td>6+000</td><td>25</td></tr> <tr><td>7+360</td><td>7+600</td><td>30</td></tr> <tr><td>8+420</td><td>9+280</td><td>32</td></tr> <tr><td>10+100</td><td>10+540</td><td>45</td></tr> <tr><td>12+080</td><td>12+140</td><td>65</td></tr> <tr><td>15+520</td><td>15+860</td><td>20</td></tr> <tr><td>16+380</td><td>16+660</td><td>23</td></tr> <tr><td>20+300</td><td>20+900</td><td>28</td></tr> <tr><td>23+500</td><td>23+900</td><td>42</td></tr> </tbody> </table> <p>Station 21 +873 to 24 +548 will not suffer this fringe and barrier effect as the viaduct rises high above the ground</p>	FROM STATION	TO STATION	INDIVIDUAL / HECTARE	0+000	0+40	26	0+600	1+520	43	1+600	2+040	47	2+500	3+060	30	3+220	3+600	37	3+700	4+060	94	4+600	5+400	25	5+620	6+000	25	7+360	7+600	30	8+420	9+280	32	10+100	10+540	45	12+080	12+140	65	15+520	15+860	20	16+380	16+660	23	20+300	20+900	28	23+500	23+900	42	
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<p>RELEVANT ASPECTS</p>	<p>Wildlife species found in the project area are indicative of perturbed spaces. No habitat-specialist birds have been found. Species found include: <i>Rhinella marina</i> sapo sabanero, <i>Rhinoclemmys pulcherrima</i> tortuga terrestre, <i>Gonatodes albogularis</i> geko diurno, <i>Ctenosaura similis</i> garrobo, <i>Aspidoscelis deppii</i> lagartija corredora, <i>Conophis lineatus</i> cotina Didelphis marsupialis Tacuazín, zarigüeya, <i>Dasybus novemcinctus</i> Cusuco, armadillo, <i>Cuniculus paca nelsoni</i> Tepescuintle, <i>Dasyprocta punctata</i> Cotuza, <i>Sylvilagus floridanus</i> conejo montes, <i>Mephitis macroura</i> zorrillo, <i>Procyon lotor</i> Mapache, <i>Urocyon cinereoargenteus</i> zorra gris, gato montés, and 54 bird species.</p> <p>According to the list of threatened or endangered wildlife species (MARN, 2009), three species of birds and mammals fall into the endangered category:</p> <ul style="list-style-type: none"> • <i>Mycteria americana</i> Cigüeña, <i>Burhinus bistriatus</i>, alcaraván, peretete, <i>Aratinga strenua</i> perico verde, in the riparian forest of Río Grande de San Miguel River, near station 24+800. Only a few trees will be felled in this section, most birds were observed in areas with higher tree populations, closer to the river, to the south of the project. • <i>Cuniculus paca nelsoni</i>, Tepescuintle, seen in secondary forest area between stations 3 +000 to 4 +000. 																																																				
<p>11</p>	<p>Relocation of people</p>	<p>N</p>																																																			
<p>ACTIVITY</p>	<p>Acquisition of ROW</p>																																																				
<p>DESCRIPTION</p>	<p>The passage of the road through residential areas requires the relocation of families currently living in the direct influence area. Land acquisition and relocation of families will be done</p>																																																				

	<p>following the Resettlement Action Plan project, which has been prepared following the guidelines of the Operational Policy OP. 4.12 of the World Bank, which aims to:</p> <p>(1) When it is not possible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, with providing sufficient investment resources to enable families displaced by the project to share the benefits. Displaced families should be consulted in a meaningful way and should have opportunities to participate in planning and implementing resettlement programs. (2) The displaced families should be assisted in their efforts to improve their quality of life or at least maintain their existing living conditions before displacement or before the start of project implementation, whichever is greater.</p>	
LOCATION	The site for resettlement will be defined jointly with families to be resettled.	
RELEVANT ASPECTS	There are only four homes that are on state land, two on FENADESAL property and two on land formerly occupied by the old road to Santa Rosa. These families are to be resettled. The owners, occupants or tenants will be compensated accordingly with the purchase of land and structures.	
12	Impact on property and structures	N
ACTIVITY	Acquisition of rights of way	
DESCRIPTION	<p>The bypass road construction involves the purchase of land for the right of way. Along the path of the project approximately 588 plots were found that are partially or totally affected by the construction of the road. An estimated total of 588 plots and 557 owners were found. 39% of owners also own other plots in the housing developments identified. The acquisition and appraisal process will be done following the Resettlement Action Plan, as already mentioned. The following table presents the structures identified as potentially affected, according to the survey and field walkthrough.</p>	

OBS	No.	Impact			
		Home	Shed	Wareho	Oth
WAREHOUSE (OF A MUSIC GROUP)	54			1	
WOODWORK SHOP AND TIRE REPAIR SHOP	53		1		
NEIGHBORHOOD CORNER STORE	53	1			
GARAGE OF A HOUSE WITH SMALL SHOP	20	1			1
AUTO REPAIR SHOP SHED, PART	9		1		
1-STORY BUILDING AND TANK	88	1			1
OF BUILDING USED AS CHURCH	91	1			
SCHOOL OVERPASS AND PERIMETER WALL	92				
CONSTRUCTION THAT LOOKS LIKE A WAREHOUSE	93	1			
SHED, BRICK COLUMNS AND TILE ROOF ARE AFFECTED	94		1		
HOUSE IS AFFECTED WHERE THE FAMILY MAKES FURNITURE	27	1			
HOUSE BUILT OF VARIED MATERIALS	107	1			
CABALLERO AUTO REPAIR SHOP, FACING THE ROAD	108		1		
LOS COCOS HOTEL AND DINER ARE AFFECTED	116				1
COLLEGE ENTRANCE BOOTH	118			1	
SMALL SHOP AND DINER NEXT TO UNIVO UNIVERSITY	119				1
FOUR COLUMNS WITH TILE ROOF IN SECONDARY FOREST	149		1		
Latrine is affected	173				
Home	175	1			
Two homes	185	2			
Abandoned house	192	1			
Partially-built homes	192	4			
Home	195	1			
4-column construction	196			1	
A well, sidewalks, and part of abandoned pool	201				
Vacated house	207	1			
Home and cattle shed	218	1	1		
MIXED CONSTRUCTION HOME	221	1			
MIXED CONSTRUCTION HOME	221	1			
HOUSE CONSTRUCTED OF METAL SHEETS	222	1			
TWO MIXED-CONSTRUCTION HOMES	222	2			
HOME NEXT TO AUTO REPAIR SHOP	225	1			
Walled-in home	224	1			
Home	224	1			
Home	224	1			
HOME	229	1			
HOME	229	1			
home near detour to old road to Santa Rosa	230	1			
HOME	230	1			
HOME	230	1			
HOME	233	1			
HOME	233	2			
shed	233		1		
HOME	267	1			
HOME	265	1			
HOME	267	1			
HOME	268	1	1	1	
HOME	273	1			
HOME	275	1			
HOME and shed with well	285	1	1		
HOME	284	2			
WEEKEND HOME	289	1			
HOME	292	1			
PRIVATE BRIDGE	293-				
HOME	301	1			
HOME	302	1			
HOME IN FENADESAL LAND	303	1			
HOME IN FENADESAL LAND	303	1			
SHED, on FENADESAL's grounds	303		1		
HOME	311	3			
MOTEL CONSTRUCTION	323				
PERIMETER WALL	323				
TOTAL		53	10	4	4

LOCATION	Along the entire path of the project	
RELEVANT ASPECTS	Plots range in size from 10x20 m (286 sq. varas) to plots larger than 100 manzanas. The purchase price of the land considers aspects such as: 1. External: Access to land and equipment in the area. 2. Internal: topography, soil drainage, Services: water, power, drainage, soil type (rural only) and current use: uncultivated pasture or crop (rural only). A study of comparative prices in the area was developed a zoning map was drafted, considering the use of rural and semi-urban land, since the project does not cross areas that can be considered as urban. Prices will be revised when the actual purchase process starts. Also included in the property appraisal are the improvements made including walls, mud walls, gates, catchment tanks, wells, and any other type of structure affected by the project, as well as crops, fruit trees, timber trees and others. It is important to mention that in lands where the impact is partial, owners will benefit from the construction of the road, as having ease of accessibility will generate appreciation in the property.	
13	Reduction or division of agricultural land	N
ACTIVITY	Acquisition of rights of way, cutting trees and shrubs, clearing, cleaning and grubbing.	
DESCRIPTION	It will affect land used for cattle grazing, reducing the grazing area. In larger plots the road divides the property into two parts hindering cattle passing from one side to the other. A total of 83 lots used for grazing will be affected in this way, 12 of them with combined basic grains and 16 with combined low shrub vegetation.	
LOCATION	Road expansion sections 0 +00 to 21 +873. Station 21 +873 to 24 +548. No such effect, this stretch being a viaduct.	
RELEVANT ASPECTS	In agricultural areas, based on census information, 9.36% of owners perform livestock-related activities for a total of 19 ranchers. Of these 11 have between 1 and 15 cows; three ranchers have up to 30 cows; three farmers have up to 45 cows; one farmer has up to 45 cows and one farmer has 200 cows. Income from livestock usually is lower than rural minimum wage among families surveyed, and income is also reinvested in caring for the cattle. In addition to cattle, ranchers have other animals, 3 owners have oxen and monthly costs of around \$ 50.00, with no profit to be made; There are 15 bulls distributed among seven owners, one owner has 1 calf, 1 has 2 calves; 1 has 6, 1 has 20, 1 has 25, 1 has 26 and 1 has 80 calves; 1 has 2 young bulls; 1 has 5 young bulls; 1 has 6 young bulls, 1 has 20 young bulls and 1 has 25. Among the census respondents there are families with fowl. 5 owners have up to 20 birds; 2 up to 40, with revenues of \$ 100.00 and costs of \$ 60.00, also, there is an owner who has 400 fowl, his monthly income is \$ 700.00 and costs of approximately \$ 500.00.	
14	Reduction of agricultural land	N
ACTIVITY	Acquisition of rights of way, cutting trees and shrubs, clearing, cleaning and grubbing.	
DESCRIPTION	Land used for agriculture will be affected reducing the incomes of people who own them. 38 plots intended for basic grain crops will be affected, 12 of them have combined areas for grazing.	

LOCATION	Sections are detailed below: <table border="1" data-bbox="659 411 1084 642" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2" style="background-color: #d9e1f2;">STATION RANGE</th> </tr> </thead> <tbody> <tr><td>0+00</td><td>0+500</td></tr> <tr><td>1+000</td><td>3+000</td></tr> <tr><td>4+000</td><td>8+500</td></tr> <tr><td>9+000</td><td>12+000</td></tr> <tr><td>12+500</td><td>13+500</td></tr> <tr><td>14+000</td><td>20+000</td></tr> <tr><td>21+000</td><td>21+500</td></tr> <tr><td>22+000</td><td>23+500</td></tr> <tr><td>24+800</td><td>25+022</td></tr> </tbody> </table>	STATION RANGE		0+00	0+500	1+000	3+000	4+000	8+500	9+000	12+000	12+500	13+500	14+000	20+000	21+000	21+500	22+000	23+500	24+800	25+022
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RELEVANT ASPECTS	<p>The predominant soil types in the project are CLASS II to IV, with 75% of soils suitable for intensive agriculture, and 25% not suitable for intensive agriculture, as presented in the following table, according to soil map and field verification.</p> <table border="1" data-bbox="683 726 1062 961" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="background-color: #d9e1f2;">SOIL CLASS</th> <th style="background-color: #d9e1f2;">PERCENTAGE</th> </tr> </thead> <tbody> <tr><td>CLASS II</td><td>9%</td></tr> <tr><td>CLASS III</td><td>38%</td></tr> <tr><td>CLASS III combined with IV</td><td>2%</td></tr> <tr><td>CLASS IV</td><td>25%</td></tr> <tr><td>CLASS V</td><td>1%</td></tr> <tr><td>CLASS VI</td><td>11%</td></tr> <tr><td>CLASS VII</td><td>8%</td></tr> <tr><td>CLASS VII combined with VIII</td><td>2%</td></tr> <tr><td>CLASS VIII</td><td>2%</td></tr> </tbody> </table> <p>The productive capacity of these soils will be affected with the road and subsequent impermeabilization, rendering the land unsuitable for agriculture. Main crops found along the project path are annual subsistence crop: corn and beans, sorghum and sugarcane.</p> <p style="text-align: center;">Corn</p> <p>Among local production it can be seen in all of San Miguel that there is a high production of corn; among census respondents, production focuses mostly on maize, between Las Delicias and Hato Nuevo; most corn is produced in small scale and is intended only for consumption, as evidenced by the 71.30% of producers with yields less than 1 manzana. Of the 115 producers, 35.05% mentioned that they produce between 1 and 10 quintals, this amount is exclusively allocated to consumption. 26.80% said they produce between 11 and 25 quintals, and also mentioned that they allocate it to consumption but there are five producers who sell a small part of their production. 19.59% produce 26 - 40 quintals, in most of the cases serving for consumption; 10.31% reported producing 60 - 99 quintals. 8.25% are large producers and mentioned producing over 100 quintals.</p> <ul style="list-style-type: none"> • Sorghum <p>Sorghum production is oriented in most cases towards consumption, serving as food for livestock and domestic animals. Among census respondents, 13 families are engaged in the production of sorghum. 3 produce up to 1/2 manzanas; 5 up to 1 manzana; 1 up to 2 manzanas; 1 up to 3 manzanas; 1 up to 4 manzanas; and 2 up to 20 manzanas of sorghum. The estimated production for producers of less than 1/2 manzana is 5 quintals; 4 families produce up to 15 quintals; and 2 produce more than 30 quintals. .</p> <ul style="list-style-type: none"> • Beans <p>Of the households surveyed only two produce beans. A producer in San Miguel, who cultivates two mz., produces 48 quintals and has cost about \$ 200.00, and does not sell his production, intended for seed and consumption. The farmer in Las Delicias cultivates 1 mz. intended for consumption.</p> <ul style="list-style-type: none"> • Fruit 	SOIL CLASS	PERCENTAGE	CLASS II	9%	CLASS III	38%	CLASS III combined with IV	2%	CLASS IV	25%	CLASS V	1%	CLASS VI	11%	CLASS VII	8%	CLASS VII combined with VIII	2%	CLASS VIII	2%
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	Only 3 producers of fruit; 2 are located on the Pan-American Road (CA1) and one resides in the sector of El Papalon, San Miguel. Production is semi permanent, there not being production for years on end; produce is taken to the local market, mostly Bananas, Mangos, Guavas and others.	
15	Impact on social amenities	N
ACTIVITY	Acquisition of rights of way	
DESCRIPTION	It will affect the perimeter walls of a school and a church In reviewing the radii of influence of schools and the sites of highest population density the road becomes a barrier to pedestrian safety. There are also areas that will be left with no access because the road will pass overhead	
LOCATION	Both at station 1+320	
RELEVANT ASPECTS	Detail of impact as follows: <div style="display: flex; flex-direction: column;"> <div style="display: flex; align-items: center;">  <div style="margin-left: 10px;">View of San Jose school, whose perimeter wall will be affected.</div> </div> <div style="display: flex; align-items: center; margin-top: 10px;">  <div style="margin-left: 10px;">View of Evangelical Church, the wall is affected</div> </div> </div> <p>At the Josselyn housing development the road also affects the green areas, but the development is not registered and has not been handed over to the municipality.</p>	
16	Impact on commercial activities	N
ACTIVITY	Acquisition of ROX	
DESCRIPTION	On the road expansion stretch there are businesses that will be temporarily affected by the construction that will have to modify their activities.	
LOCATION	Stations 0+00 a 3+000, expansion section, stations 8+700 and stations 24+948.26.	
RELEVANT ASPECTS	26 commercial lots will be affected partially, consisting of: garages, shops, carpentry shops, hardware stores, canteens, among others.	

17	Temporary impact on infrastructure: power poles, drinking water, drainages	N
ACTIVITY	Demolition of structures and others	
DESCRIPTION	Along the project path there are power lines, water and drainage pipes that might be affected temporarily during construction of the project. The impact is temporary.	
LOCATION	Throughout entire project path	
RELEVANT ASPECTS	The infrastructure is detailed below: 1. Power transmission lines of 25 kV or less: Pan American (CA1) road, road to agua zarca, Housing Development Alas Campos and Housing Development Joselyn, Road to Hacienda El Milagro, road to La Unión (RN18), road to El Delirio (RN17). 2. Potable water pipes on Pan-American Highway (CA1), housing developments: Alas Campos, Josselyn, Altos de Hato Nuevo, road to La Unión (RN18) and Road to El Delirio (RN17). 3. Unused pipe that was used to divert water from the San Esteban River for power generation. Station 8 +340. 4. An electrical substation in Lot 8 on Pan-American highway (CA1). 5. Storm water vaults and pipes crossing the Pan-American road (CA1) at stations: 0+620, 1+490, 2+040. 6. Gutter in station 7 +600, gutters on both sides of roads: 8+240 13+070, 21+810, 24+940. 7. Overpass School San Jose, Quelepa, station 1 +340, owned by the City of Quelepa. 8. Telephone lines.	
18	Risk to people during site preparation	N
ACTIVITY	Felling of trees and demolition of structures	
DESCRIPTION	Felling and demolition of structures generate risk to residents while these activities are being performed. They can damage structures that are not directly affected by the project and even cause harm to residents. The risk is temporary and short term.	
LOCATION	Station 0+00 to station 3+720, and specific homes.	
RELEVANT ASPECTS	There are large trees in terms of trunk diameter and height throughout the course of the project.	
19	Increased commute times during site preparation	N
ACTIVITY	Demolition of structures and felling of trees	
DESCRIPTION	Temporarily, while site preparation works are executed (felling and demolition of structures), will affect traffic in the road expansion section.	
LOCATION	Station 0+00 to station 3+720	
RELEVANT ASPECTS	Commuting time to and from the city of San Miguel, and even within the city, will improve significantly due to the diversion of heavy traffic away from the city.	
20	Increase in productive activities and employment	P
ACTIVITY	Demolition of existing structures, cutting of trees and shrubs, clearing, cleaning and grubbing, installation of work camp.	
DESCRIPTION	Site preparation activities generate employment opportunities in the project area, as well as indirect jobs in transportation, sale of materials and equipment, equipment and vehicle rental, food and lodging. The proximity of the city to the project area generates employment opportunities to local people.	
LOCATION	The entire project path and indirect influence area.	

RELEVANT ASPECTS	Income of surveyed population can be categorized as insufficient to meet basic needs. The project area tends to be rural, yet because of its proximity with the city, still retains important features of rural economy which suggests that the population within the area of influence is largely poor. According to the survey, 32.84% received less than one minimum wage, 49.85% up to 2 minimum wages, 8.06% up to 4 minimum wages and only 9.25% received more than 5 minimum wages. Since poverty is measured through income and income, in turn, by the purchasing power of the population, the area of direct and indirect influence of the project is characterized by having urban, semi-urban and rural population, where most live in poverty. To this is added that income for all 318 homes is barely enough to purchase a food basket as defined by DIGESTYC. The project can be an important source of work and a development opportunity for the area.	
21	Occupational hazards to employees during site preparation	N
ACTIVITY	Demolition of existing structures, cutting of trees and shrubs, clearing, cleaning and grubbing, installation of work camp.	
DESCRIPTION	Occupational hazards related to site preparation activities. Risks are detailed in Chapter X.	
LOCATION	Throughout the entire project layout	
RELEVANT ASPECTS		
22	Health hazard by presence of foreign population during site preparation	N
ACTIVITY	Presence of foreign population hired for demolition of existing structures, cutting of trees and shrubs, clearing, cleaning and grubbing, camp set up.	
DESCRIPTION	During the duration of the works or activities for site preparation, foreign crews interact with the communities living and working in the areas through which the road will pass. It is anticipated that there will be much interaction between construction workers and these communities, which poses a risk of contracting diseases, including AIDS.	
LOCATION	Area of indirect influence along the path of the project where we find greater presence of residences or businesses. <ul style="list-style-type: none"> Homes and businesses on Pan-American Highway (CA1), Station 0 +000 and 3 +720. Land developments: Los Angeles, Riverside and Anagil Afife, in 8 +240. Land developments Las Margaritas, Joselyn, Alas Campos, San Francisco and Altos de Hato Nuevo, between stations 12+460 and 13+540. The most populated areas in the vicinity of the project are the road expansion section, the road to Agua Zarca and Las Margaritas Housing Development. <ul style="list-style-type: none"> Overall in the three municipalities, in populated areas which construction workers will visit or go to outside of working hours 	
RELEVANT ASPECTS	Noise, vibration, dust and smoke also have adverse effects on health (stress, respiratory diseases), and may even increase blood pressure and heart rate.	
CONSTRUCTION		
23	Air pollution caused during transport, earthworks and excavations	N
ACTIVITY	Supply of materials, earthworks, construction of tunnels, bridges and at-level crossings, slope treatment.	
DESCRIPTION	Dust is produced by two main activities: Grading works in general in the project and the movement of vehicles with equipment and materials. The impact is of relatively short duration, but widespread to the direct and indirect influence areas of the project during construction. Dust emissions due to earthworks vary significantly from one day	

	to another, depending on the level of activity, specific operations and weather conditions. A good part of the emissions are the result of the transport of materials on roads used only temporarily. Dust is proportional to the work area, the level of construction, fines aggregates content in the soil (75 micrometers in diameter), weight and vehicle speed. The soil moisture content affects the amount of dust.
LOCATION	The entire path of the project and unpaved access routes used to supply materials to the project: <ul style="list-style-type: none"> • Old road to Quelepa, station 5 +260 • Internal Streets in Hato Nuevo: Land Development of Las Margaritas, Joselyn, Alas Campos, San Francisco and Altos de Hato Nuevo, between station 12+460 and station 13+540. • Road to the Township of Las Delicias • Road to Hacienda La Joya
RELEVANT ASPECTS	From station 21 +873 to 24 +548 there will be less dust generation, since the viaduct construction will not require grading works. <p>Open wells were excavated in different stations of the project for soil analysis. Stations where clays were found are more likely to produce dust. They are only PCA1, 5, 17 18. This is at stations: 8 +200, 16 +700 and 17 +800. Although only a few points along the project path were analyzed, it gives us a general idea of the main material in the different areas, the percentage of fines content is 56.6% on average.</p> <p>According to the geotechnical study, average soil moisture content is 35%, ranging from 25% to 51%, although analyses were conducted in the rainy season.</p> <p>The prevailing wind is from the south with intensities of 1.1 to 1.6 points on the Beaufort scale of 2-5 km / h, this kind of wind is called Light Breeze.</p> <p>Soils found along the path of the project show no predominance of fine materials and the prevailing winds are relatively mild.</p>
24	Risk, noise, vibration caused by supply and general construction processes, and explosions N
ACTIVITY	Supply of materials, earthworks, construction of tunnels, bridges and at-grade crossings, slope treatment, and most construction activities
DESCRIPTION	Acoustic emissions due to the implementation of the project construction activities that involve movement of machinery and equipment, such as: operation of heavy-duty equipment and machinery, grading works in general, application of pavements, construction of drainage and other structures will increase the noise level in the work area of the project, the entire right of way, and access sites by the movement of vehicles on the approaches to the project and the area of indirect influence. <p>Heavy machinery will generate noise greater than 80 decibels, perceptible within a radius of 100 m. depending on the vegetation cover. Although this impact is produced throughout the entire path of the project, its duration is medium duration throughout the construction phase. The impact will disappear at the end of construction.</p>
LOCATION	Throughout the project path and area of indirect influence at a distance of 100 m from the edge of the area of direct influence, where there are more people residing or conducting commercial activities. <p>The more populated areas, in the vicinity of the road expansion section near the road to Agua Zarca and the Land Development of Las Margaritas.</p> <p>Sensitive areas due to the presence of vulnerable populations or the type of activity carried out are: • San José School, Quelepa and UNIVO University</p>
RELEVANT	Noise also produces effects on wildlife, Forman and Alexander (1998) claim that the

ASPECTS	effects caused by noise, and visual pollution caused by vehicular traffic represent more danger to wildlife than animals being hit by cars on the road.	
25	Modification of natural relief	N
ACTIVITY	Earthworks	
DESCRIPTION	The natural relief of the route of the project will be changed to meet the geometric design of the four-lane highway	
LOCATION	The sections with major changes are: • 4 to 6 +200 +960, with minor cuts at 10 m • 9 +100 to 11 +680, with cuts up to 31 meters and fill sections of up to 14 m. The road traverses hill slopes. • 11 +680 to 12 +000, with fills of up to 13 m. • 12 +080 to 13 +700, with cuts of up to 16 m. • 13 +900 to 16 +380, with sections of cuts and fills, but predominantly cuts, the largest being 38 m. Here also the road section traverses hill slopes. • 16 +380 to 16 +760, fill area, up to 18 m. • 19 +760 to 17 +360, cut area up to 25 m. • 17 +900 to 18 +100, cuts of up to 8 m • 18 +100 to 18 +300, fills up to 6 m • 18 +300 to 18 +500, cuts up to 17 m. • 18 +550 to 21 +873, fills between 5 and 7 m high. • 24 +880 to 24 +930, fills for viaduct descent ramp. The natural relief between station 21 +873 and 24 +880 will not be modified with the construction of the viaduct.	
RELEVANT ASPECTS	Given the relatively flat topography of the area, relief changes are not as dramatic even though modifying the relief generates indirect impacts such as: changes in drainage patterns, soil instability, erosion, among others.	
26	Possible contamination of soil and water by effluents, waste and residues from construction	N
ACTIVITY	Supply of materials, earthworks, construction of tunnels, bridges and at-grade passes, slope treatment.	
DESCRIPTION	The presence of workers in the construction phase on the work fronts, an estimated 2,000 people, 1,500 temporary and 500 permanent, will produce housekeeping and office waste, mainly in the form of stationery. Construction itself generates debris, waste paper and plastic packagings, timber, scrap and surplus asphalt material. In Chapter IV: Project Description solid waste management under the project is discussed in greater detail. Liquid effluents and sewage from toilet and waste from food catering services will be produced.	
LOCATION	Project camp and work fronts	
RELEVANT ASPECTS	Even when no MAJOR EQUIPMENT MAINTENANCE ACTIVITIES WILL BE CONDUCTED within the camp, daily activities require applying oil or grease to the equipment for regular maintenance, generating waste such as: wiper rags, oiled cotton, oil containers, empty grease cans in small amounts. Waste is dangerous even though produced in small quantities. It will be disposed of in a drum of at least 55 gallons capacity. Usually MOP states in its contracts that the contractor will be responsible for processing the permits for the establishment and operation of the construction camp, according to the place chosen for its installation, either owned or leased. Waste considered hazardous waste may be produced as in the above case	

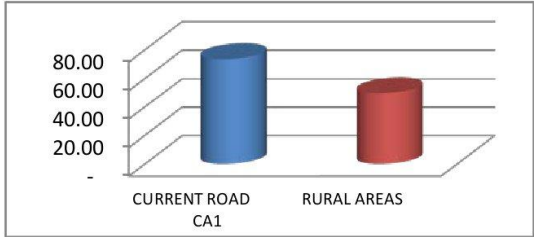
	in the work fronts.	
27	Change in soil quality: topsoil	N
ACTIVITY	Earthworks	
DESCRIPTION	The project route passes through rural areas where soil has organic matter. According to the geotechnical study conducted the depth of organic soil or topsoil is estimated at no more than 1.50 m, but it is usually less.	
LOCATION	Rural plots along the project path.	
RELEVANT ASPECTS	The estimated volume for the entire project is no more than 62,000 m ³ of surplus topsoil	
28	Instability of soil due to cut slopes and fills	N
ACTIVITY	Earthworks, construction of tunnels, bridges and at-grade crossings, slope treatment.	
DESCRIPTION	If not managed properly slopes could become unstable and pose a risk to people, structures, flora	
LOCATION	Throughout the project path cut and fill slopes of all sizes will be generated. See Table IX.1 and	
RELEVANT ASPECTS		
29	Possible erosion processes	N
ACTIVITY	Earthworks, construction of tunnels, bridges and at-grade crossings, slope treatment	
DESCRIPTION	During construction, while performing grading works, especially during the rainy season, if works are not properly protected. During operation if not protected slopes can also be susceptible to erosion processes.	
LOCATION	According to the topograph and project drawings, sites most susceptible to erosion are <ul style="list-style-type: none"> • 9+100 to 11+680, passing through hill slopes • 13+900 to 16+380, passing through hill slopes • 18+300 to 18+500, with cuts of up to 17 m 	
RELEVANT ASPECTS	As a secondary impact, erosion causes sediment to wash into rivers and streams. Most plots traversed by the project are flat, so erosion processes are not expected to be produced. Where erosion is generated, the impact will be temporary and of low intensity, as we have land with a very thin layer of soil.	
30	Vibrations from passing trucks and equipment	N
ACTIVITY	Earthworks and supply of materials	
DESCRIPTION	The constant passage of vehicles produces vibrations in nearby structures where people live or work, affecting their comfort and quality of life. According to the ISO 2631-2 standard, vibration caused by construction is classified as temporary and that caused by the passage of vehicles is classified as intermittent; these are the types of vibration that will be produced by the project. Vibration parameters to measured are level, frequency and duration. We used the current Pan-American Highway (CA1) as our model, and even though it has different characteristics in terms of road type and vehicle speeds, it can give us an idea of the vibration levels expected that can be expected during construction and operation of the project.	
LOCATION	The entire route of the project, except station 21 +873 to 24 +880 where the viaduct will be built.	
RELEVANT ASPECTS	Vibration to which people are exposed at home or at work can be sensed by a building's occupants and affect them in many ways, particularly in terms of comfort and quality of life. Usually complaints about vibrations occur when the magnitude of the vibration is	

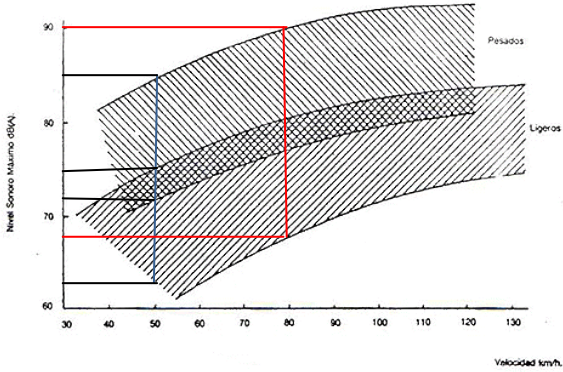
	slightly over detectable levels. They produce side effects such as noise, uncomfortable sensations in the body, interfering with activities like sleep, talk or work, motion noise from doors, windows or other, concern about damage to structures, and even interference in the operation of instruments or equipment sensitive movement. High vibration levels are tolerated for temporary or intermittent events.		
31	Modification of drainage patterns during construction		
ACTIVITY	Earthworks		
DESCRIPTION	Cuts and fills will occur along the highway stretch, modifying natural drainage patterns		
LOCATION	Throughout the project path. Anywhere there are cuts and fills, except in station 21 +873 to 24 +880 where the viaduct will be built.		
RELEVANT ASPECTS			
32	Transport of sediment into rivers and streams		
ACTIVITY	Earthworks, construction of tunnels, bridges and at-grade crossings, slope treatment.		
DESCRIPTION	Having uncovered land during construction, mainly in the rainy season, poses the problem of great amounts of sediment washing into rivers and streams, affect the rivers and streams along the course of the project.		
LOCATION	The entire course of the project, although to a lesser extent between station 21 +873 to 24 +880 where the viaduct goes through.		
RELEVANT ASPECTS	Due to its high flow and relatively large catchment area, the Rio Grande de San Miguel river could hardly be affected by sediment transport.		
33	Reduction of infiltration by the impermeabilization of areas		
ACTIVITY	Application of asphalt concrete paving, miscellaneous: sidewalks, barriers and others.		
DESCRIPTION	Approximately 55.580 m will be impermeabilized in the road construction section and 415.000 m in the road expansion section.		
LOCATION	Along the entire path of the project		
RELEVANT ASPECTS	The section on the Pan-American Highway (CA1) is already partly impermeabilized.		
34	Possible impact on forests and / or trees		
ACTIVITY	Earthworks, construction of tunnels, bridges and at-grade crossings, slope treatment.		
DESCRIPTION	Although it is during the site preparation stage that most impacts on vegetation occurs, the construction phase could affect forests and / or trees, if work areas and trees to be felled are not demarcated.		
LOCATION	Indirect influence area of the project.		
RELEVANT ASPECTS	The greatest presence of trees within the indirect influence area can be found at:		
	FROM STATION	TO STATION	INDIVIDUAL/ HECTARE
	0+000	0+440	26
	0+600	1+520	43
	1+600	2+040	47
	2+500	3+060	30
	3+220	3+600	37
	3+700	4+060	94
	4+600	5+400	25
	5+620	6+000	25
	7+360	7+600	30
	8+420	9+280	32
	10+100	10+540	45
	12+080	12+140	65
	15+520	15+860	20
	16+380	16+660	23

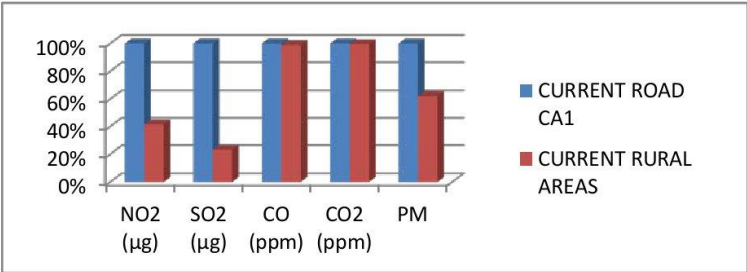
		21+500	21+850	24		
		21+980	23+430	39		
	<p>Other areas in the indirect influence area include:</p> <ol style="list-style-type: none"> Proposed protected area, station 0 +640, we find a higher tree density on the southern lava flows of the San Miguel Volcano. Secondary Forest, stretching about 150 on each side of the path of the Pan-American Highway (CA1), from Station 3 +280 to about 400 m after station 3 +680. T Taishihuat River, Station 14+700 to 16+120, towards the west there are areas with trees at the foot of hills and in forest corridors along the river. Grande de San Miguel River, Station 24+180, north of the axis we find the edges of the gallery forest along theriver 					
35	Possible impact on proposed protected area					N
ACTIVITY	Traffic control, supply of materials, earthworks, minor drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.					
DESCRIPTION	The proposed protected area, consisting of a lava flow, is a sensitive area in which we must take care not to affect more than is strictly necessary.					
LOCATION	Station 0+880 to 0+960					
RELEVANT ASPECTS	The area is covered with trees					
36	Possible impact on wildlife during construction					N
ACTIVITY	Earthworks, construction of tunnels, bridges and at-grade crossings, slope treatment.					
DESCRIPTION	Negative effects on wildlife are produced in the presence of more people in the area, the use of noise-generating equipment and machinery, earthworks and other construction activities					
LOCATION	Rural sections of the project					
RELEVANT ASPECTS	<p>Wildlife hit by cars on the road is the direct impact that is easiest to recognize as compared to others such as fragmentation, ecosystem deterioration and changes in animal behavior. With the rapid development of cities and increasing human populations, the road network has been expanding and thus a growing death threat to wildlife has emerged.</p> <ul style="list-style-type: none"> Changes in reproductive patterns <p>The movement of vehicles along the roads not only affects wildlife being hit on those roads, causing thousands of direct deaths, but also generates changes in the animals' reproductive activities, which can deplete populations and can cause local extinction within the affected region. Forman and Alexander (1998) claim that the effects caused by noise and environmental and visual pollution caused by vehicular traffic generate more wildlife losses than animals being hit on roads. Other factors that have an effect on wildlife are the very movement of cars, vibration, artificial lights and human presence (Goosem, 2002); although several authors coincide that noise is the most negatively influencing factor in these populations (Forman y Alexander, 1998; Spellerberg, 1998; Goosem, 2002).</p> <ul style="list-style-type: none"> Human presence <p>Humans can affect wildlife in so far as animals, to avoid contact with humans, spend energy on foraging or reproductive activities (Primm, 1996); Kerley et al. (2002).</p>					
37	Risk to people during construction					N

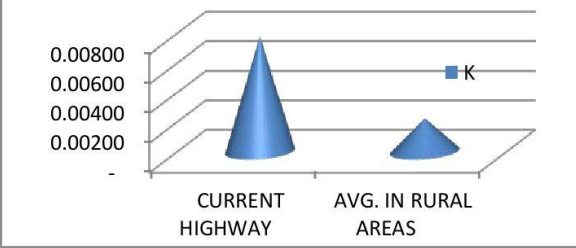
ACTIVITY	Traffic control, supply of materials, earthworks, minor drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.	
DESCRIPTION	Construction works at sites with the highest human presence may create risks of injury and / or damage to private property by the movement of people, equipment and machinery through the area. Also by the digging of trenches and land cutting and filling. The risk is temporary.	
LOCATION	The entire course of the project, with emphasis on regions with human presence.	
RELEVANT ASPECTS	The impact will be more intense in the road expansion section.	
38	Increased commute times during construction	N
ACTIVITY	Traffic control, supply of materials, earthworks, minor drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.	
DESCRIPTION	Temporarily, while site preparation works are executed (felling and demolition of structures); will affect traffic in the road expansion section.	
LOCATION	Station 0+00 to station 3+720	
RELEVANT ASPECTS	Commuting time to and from the city of San Miguel, and even within the city, will improve significantly due to the diversion of heavy traffic away from the city.	
39	Increase in productive activities and employment	P
ACTIVITY	Traffic control, supply of materials, earthworks, minor drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.	
DESCRIPTION	Construction activities generate employment opportunities in the project area, as well as indirect jobs in transportation, sale of materials and equipment, rental equipment and vehicles, food and lodging. The proximity of the city to the project area generates employment opportunities to local people.	
LOCATION	The entire project path and indirect influence area.	
RELEVANT ASPECTS	As mentioned, income earned by the surveyed population can be categorized as insufficient to meet basic needs of the population, with rural characteristics. The project can be an important source of work and a development opportunity for the area.	
40	Occupational hazards to employees during construction	N
ACTIVITY	Traffic control, supply of materials, earthworks, minor drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.	
DESCRIPTION	Occupational hazards related to construction activities.	
LOCATION	The entire project path	
RELEVANT ASPECTS		
41	Risk caused by extraneous populations during construction	N
ACTIVITY	Presence of foreign population for traffic control, supply of materials, earthworks, lesser drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, vertical and horizontal road marking, miscellaneous: sidewalks, barriers and others.	
DESCRIPTION	The presence of foreign populations can pose risks to the health of the population by contagious diseases such as AIDS. The risk is temporary, but the effect is irreversible and long-lasting.	
LOCATION	Area of direct influence of the project where we find the largest presence of residences and business, primarily on the Pan-American Highway (CA1), Station 0 +000 and 3 +720, and developments along the	

	rest of the project layout. The more populated areas, in the vicinity of the road expansion section, near the road to Agua Zarca and the Land Development of Las Margaritas. There are possible impacts in the entire area of the three municipalities where employees will move about during construction.	
RELEVANT ASPECTS		
42	Impact on neighborhood roads and accesses	N
ACTIVITY	Traffic control, supply of materials, earthworks, minor drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.	
DESCRIPTION	With the construction of the project, local roads will be temporarily shut down to vehicular and pedestrian traffic, but at the end of the project, it will significantly improve access in the area.	
LOCATION	Roads to be shut down: Primary routes: • Pan-American Highway (CA1) • Military Route • Road to La Union (RN18) • Road to El Delirio (RN17) Side Roads: • Old road to Quelepa, there will be entry on the other side of the road, affording access to the local school. • Road to the Township of Agua Zarca. • Road to Plan de las Mesas. • Affects scattered homes • Road to Canton Las Delicias -- the only access to several homes; the only other is access across the river. • Road to El Papalon, access to the Township of Las Delicias. • Road to Hacienda, access to scattered homes and residential developments, it is the only access.	
RELEVANT ASPECTS	There are areas of difficult access that will improve significantly with the project, such as the area north of the Rio Grande crossing, station 8 +900 to 11 +780 and surroundings of station 13 + 780-16 +520	
43	Possible impact on cultural-interest sites	N
ACTIVITY	Traffic control, supply of materials, earthworks, minor drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.	
DESCRIPTION	Along the course of the project cultural-interest sites were found: archaeological and paleontological sites, plus sections that could not be assessed, and will be impacted during the construction of the project, mainly by earthworks.	
LOCATION	The location of sites of archaeological and paleontological-interest found are detailed in the table. Stations: 4+100, 5+020, 5+500, 6+000, 7+700, 9+310, 9+700, 9+750, 17+200, 19+750, 24+180, 24+630, 24+870, 6+870, 20+200.	
RELEVANT ASPECTS	At some points it was not possible to make the walkthrough due to the presence of crops, but this will be done before the start of the works. Findings include dispersed cultural-interest material such as ceramics, obsidian, carved stone, all on surface with low, medium and high density. At point 9 +750 aligned stones were found, probably the foundation of a home, but origin is not known. Fossil material found at one point. It is expected that more fossil material will be found, because of the characteristics of the sedimentary material.	
44	Landscape modification during construction	N
ACTIVITY	Traffic control, materials supply, earthworks, lesser drainage works, major drainage works, slope treatment, application of asphalted concrete pavements	

	horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.							
DESCRIPTION	Most of the project's topography is flat to rolling and will not be visible from many places, only from one sector within the city.							
LOCATION	Hills at station 13+780 to 16+520 Station 21+873 to 24+880 where the viaduct goes							
RELEVANT ASPECTS	No sites recognized for their visual qualities or regular presence of persons were found. The dominant figure of the landscape in the area is the volcano of San Miguel, which will not be affected							
OPERATIONAL STAGE								
45	Decreased emissions because of better roads	P						
ACTIVITY	Traffic control, supply of materials, earthworks, minor drainage works, major drainage works, slope treatment, application of asphalt concrete pavement, horizontal and vertical signage, miscellaneous: sidewalks, barriers and others.							
DESCRIPTION	Improved traffic flow reduces commuting time and fuel consumption, and hence emissions of gases such as sulfur dioxide, nitrogen oxides, hydrocarbons, particulate matter, etc.							
LOCATION	Direct and indirect influence areas of the project and the City of San Miguel							
RELEVANT ASPECTS	The levels of dust and smoke produced by passing vehicles may increase in the rural areas to be traversed by the road. Mobile source emissions being variable, it is difficult to estimate the increase in the levels; however, since levels were measured for the current road, these will serve as a parameter for the possible increase in the new road.							
46	Noise of vehicles passing by daily	N						
ACTIVITY	Vehicle and people traffic, rainwater drainage and road maintenance							
DESCRIPTION	Noise generated by vehicle engines, exhaust emissions, and tyre noise on the pavement. At speeds above 90 km / h the predominant noise is that of the tires on the pavement. Current noise levels on the Pan-American Highway (CA1) and road junctions range between 50 and 90 dB (A); in rural areas noise levels range between 52 and 90 dB (A). If we expect to have at least the same level of noise, we would have increases from 8 to 10 dB (A) in rural areas of the project. This can be considered a high increase in noise, which can reach annoying levels and will be permanent.							
	 <table border="1" style="margin-left: auto; margin-right: auto;"> <caption>Noise Level Comparison</caption> <thead> <tr> <th>Location</th> <th>Noise Level (dB(A))</th> </tr> </thead> <tbody> <tr> <td>Current Road CA1</td> <td>~75</td> </tr> <tr> <td>Rural Areas</td> <td>~65</td> </tr> </tbody> </table>	Location	Noise Level (dB(A))	Current Road CA1	~75	Rural Areas	~65	
Location	Noise Level (dB(A))							
Current Road CA1	~75							
Rural Areas	~65							
	Noise level increases with speed, most perceivable noise is that of the wheels on the asphalt							

	<p>At speeds between 40 and 60 km / h, levels of 63-85 dB (A) are expected, the Pan-American highway having recorded levels between 50-88, similar to those expected. With the new road, at speeds of 80 km / h, noise levels between 80 and 90 dB (A) can be expected. In the area of the current road, the increase is not significant, because there are already high levels. In rural areas with average recorded noise levels of 49.55 dB (A), there will be a significant increase of more than 5 dB (A), specifically in areas where homes will be very close to the road.</p>  <p><i>Source: Study of noise generated by vehicles at different speeds and at 15 m away, University of Cordoba, Spain</i></p>	
LOCATION	Rural sections of the project	
RELEVANT ASPECTS	<p>The most sensitive sites in terms of the largest population presence are as follows:</p> <ul style="list-style-type: none"> • Developments of Los Ángeles, Riverside and Ana Gil Afife, at 8+240. • Developments of Las Margaritas, Joselyn, Alas Campos, San Francisco and Altos de Hato Nuevo, between stations 12+460 and 13+540. • Unnamed development, station 23+440 • Unnamed development, station 24+948.264 <p>San José School, Quelepa, station 1+340 and the UNIVO campus, station 2+600, are especially sensitive to increased noise levels, even though they are located by the current road where noise levels are already high.</p> <p>On the other hand, noise levels could decrease by up to 10 db(A) in the city of San Miguel, where heavy traffic will decrease significantly along the Military Route Road (RN18) and Roosevelt Ave.</p>	
47	Noise from maintenance activities	N
ACTIVITY	Road maintenance	
DESCRIPTION	Noise estimated at up to 90 dB (A) but with a frequency of every six months and temporary. It is considered minimal as traffic noise is similar.	
LOCATION	Along the entire path of the project.	
RELEVANT ASPECTS	Maintenance activities producing high levels of noise will not be performed during the early years of the road	
48	Possible soil contamination by effluents, waste and residues during maintenance	N
ACTIVITY	Road maintenance	
DESCRIPTION	Generation of waste and residues from felling and pruning, pothole repair, painting, and other activities. In small amounts, often with six months frequency, temporary.	
LOCATION	Along the entire path of the project	
RELEVANT ASPECTS	Private companies hired for maintenance are required to observe proper waste management practices	

49	Instability caused by water discharges	N																		
ACTIVITY	Vehicle and people traffic, rainwater drainage and road maintenance																			
DESCRIPTION	Increasing impermeabilization will produce more runoff, which, without proper channelling, could generate erosion and gullies in water discharge sites.																			
LOCATION	Along the entire path of the project																			
RELEVANT ASPECTS	The project will have properly designed gutters and pipes for water discharge into rivers and streams.																			
50	Dust, noise, smoke and vibrations by passing vehicles	N																		
ACTIVITY	Vehicle and people traffic and road maintenance: Pothole repair, maintenance, pruning																			
DESCRIPTION	<p>Constant passage of vehicles increases dust, noise, smoke and vibration in the surrounding structures where people live or work, affecting their comfort and quality of life. According to ISO 2631-2 standard, vibration caused by the operation is classified as permanent and as intermittent.</p> <p>We used the current Pan-American Highway (CA1) as a model, despite its different characteristics in terms of road type and vehicle speed. However, it can provide insight into levels of dust, noise, smoke and vibration expected during construction and operation of the project.</p> <table border="1" data-bbox="532 909 1214 1041"> <thead> <tr> <th>AREA</th> <th>NO2 (µg)</th> <th>SO2 (µg)</th> <th>CO (ppm)</th> <th>CO2 (ppm)</th> <th>PM (µg)</th> </tr> </thead> <tbody> <tr> <td>RURAL AVG</td> <td>1.20</td> <td>0.30</td> <td>257.04</td> <td>555.27</td> <td>108.74</td> </tr> <tr> <td>CURRENT ROAD</td> <td>2.90</td> <td>1.30</td> <td>260.00</td> <td>558.33</td> <td>175.31</td> </tr> </tbody> </table>  <p>The graph represents the difference in values, expressed in percentages, for a better understanding. As seen, the levels of NO2, SO2 and PM are most expected to increase in rural areas where the road will pass through, but air quality continues to be high for the relative lack of industries in the area. CO and CO2 levels do not vary significantly.</p> <p>With respect to vibrations, although there is an increase of up to 4 times the current value on the Pan-American highway, used as parameter for the future road, the values remain well below the value of the reference standard used ($K = 1$), if we compare average measured vibration in rural areas.</p>	AREA	NO2 (µg)	SO2 (µg)	CO (ppm)	CO2 (ppm)	PM (µg)	RURAL AVG	1.20	0.30	257.04	555.27	108.74	CURRENT ROAD	2.90	1.30	260.00	558.33	175.31	
AREA	NO2 (µg)	SO2 (µg)	CO (ppm)	CO2 (ppm)	PM (µg)															
RURAL AVG	1.20	0.30	257.04	555.27	108.74															
CURRENT ROAD	2.90	1.30	260.00	558.33	175.31															

		
LOCATION	The entire course of the project	
RELEVANT ASPECTS	<p>As mentioned vibration can be detected by occupants, and vibration can have negative effects of many forms, particularly in terms of comfort and quality of life.</p> <p>Side effects such as noise, uncomfortable sensations in the body, interference with activities such as sleep, speech or work, noise from doors, windows or others, concern over damage to structures, and even interference in the operation of instruments or equipment sensitive to movement.</p> <p>Loud noises can be annoying to people, especially if they are used to live in quiet rural areas</p>	
51	Possible scouring of riverbeds by bridges	N
ACTIVITY	Vehicle and people traffic, rainwater drainage and road maintenance	
DESCRIPTION	<p>With the construction of bridges over the four passes over rivers along the path of the project, the hydraulic area can be reduced, thus increasing the speed of the water, which erodes the riverbed changing its dynamics, which can cause damage to the edges of the river. A model of the hydraulic behavior of the river was conducted, presented in Annex IV.2, in order to design bridges in a way that does not affect the riverbed.</p>	
LOCATION	<p>River crossings:</p> <ul style="list-style-type: none"> • Grande de San Miguel River, station 8+900 • Taishihuat River, station 13+700 • El Papalón River, station 20+750. • Grande de San Miguel, River station 13+800. 	
RELEVANT ASPECTS		
52	Impact of new access road construction on wildlife	N
ACTIVITY	Vehicle and people traffic and road maintenance	
DESCRIPTION	<p>The presence of the road affects the passage of wildlife, nesting patterns, etc., and disturbs the natural habitat because of the presence of humans. Decreasing the mobility of wildlife also affects the distribution of seeds by animals. However the area presents characteristics of being a heavily disturbed area because of human presence. Fragmentation also occurs</p>	
LOCATION	Rural sections of the project with the largest presence of vegetation or forest.	
RELEVANT ASPECTS	<ul style="list-style-type: none"> • Wildlife getting killed on the road <p>Wildlife getting hit by vehicles is the easiest direct impact to recognize compared to other impacts, such as fragmentation, ecosystem deterioration and changes in animal behavior. With the rapid development of cities and increasing human populations, the road network has been expanding and thus poses a growing death threat to wildlife.</p>	

	<ul style="list-style-type: none"> • Changes in reproductive patterns. Circulation of vehicles on the roads not only affects wildlife by animals being hit on roads, causing thousands of direct deaths, but also generates changes in the reproductive activity, which can deplete populations and cause possible local extinction within the affected region. Forman and Alexander (1998) claim that the effects caused by noise and environmental and visual pollution caused by vehicular traffic generate more wildlife losses than animals being hit on roads. Other factors that have an effect on wildlife are the very movement of cars, vibration, artificial lights and human presence (Goosem, 2002); although several authors coincide that noise is the most negatively influencing factor in these populations (Forman y Alexander, 1998; Spellerberg, 1998; Goosem, 2002). • Human presence. Humans can affect wildlife in so far as, in trying to avoid contact with humans, animals spend energy potentially usable for foraging or reproductive activities (Primm, 1996); Kerley et al. (2002). 	
53	Development induced by the presence of the road	N
ACTIVITY	Vehicle and people traffic	
DESCRIPTION	The presence of the road provides easy access to land in the vicinity of it, a benefit that did not exist before and promotes urban development areas along with the deterioration of the existing natural environment. However, most of the project area was already affected by agricultural farming, and other parts also present patterns of urban development, with the presence of developments for residential use. Areas that currently have the highest number of residential developments, homes or businesses are: The entire path of the current Pan-American Highway (CA1), station 0 to 3+940, the section between the Pan-American Highway (CA1) and Rio Grande de San Miguel River, where land Developments like El Obrajuelo, Riverside, Riverside Gardens, and others, have become hubs of urban growth; near the Military Route there are close to 8 housing developments serving as dorms for people working in the city. The land use plan shows that urban development has followed the main roads, precisely because of the ease of access to and from the city. The plots that could be more susceptible to this induced development are flat areas closer to these major highways, although the emergence of new developments along the whole length of the bypass road cannot be ruled out.	
LOCATION	Indirect influence area at stations 8 +980 to 12 +440, 13 +740 to 21 +640 and 21 +740 to 24 +940.	
RELEVANT ASPECTS	The municipalities of San Miguel, Moncagua and Quelepa do not have official urban development plans to orient land use along the course of the project. Several unregistered/unverified land developments have been identified along the path; other developments are in the permitting process, under construction or for sale, attesting to the pressure on the area for more development.	
54	Shorter commute time	P
ACTIVITY	Vehicle and people traffic and road maintenance	
DESCRIPTION	The presence of the road will significantly decongest vehicle traffic on Ave. Roosevelt and Military Road, at the junction to the city, significantly reducing commute time and bypassing the city when travelling to the eastern the departments of San Miguel, La Union and Morazán. The current distance done by driving down Ave. Roosevelt (San Miguel) is 9.50 km, travel time is about 30 minutes at a speed of 40 km/h through commercial, high traffic districts of the city and stopping at several traffic lights. Implementation of the project extends the Ramales Corridor in El Salvador by 5.50 km. The extra distance is offset by the shorter commute which now takes only 9 minutes at a speed of 80 km/h.	

LOCATION	Indirect influence area and main roads in the city of San Miguel	
RELEVANT ASPECTS	It will improve safety by reducing traffic and will replace the existing one-lane roads with a four-lane highway	
55	Boosting economic development in the region	P
ACTIVITY	Vehicle and people traffic, rainwater drainage and road maintenance	
DESCRIPTION	<p>The main objective of the project is to contribute to economic, social, commercial, tourist, and industrial development in the country through enhanced traffic flow in the eastern part of our country, giving users a better alternative and a more efficient mobilization route in and out of the metropolitan area of San Miguel. The main benefits of the project contributing directly and indirectly to economic development are:</p> <ul style="list-style-type: none"> • It contributes to economic growth in the area, by providing the beneficiary population a road in good conditions, which will boost commerce and agriculture in the area. • Savings in vehicle operating costs. • Time savings for passengers. The implementation of the project brings shorter commute times due to increased travel speeds. • Savings through faster freight times. This is an important logistical factor when transporting perishable commodities. It is also very important when transporting high market value products. • Savings in accident costs, as it brings a substantial improvement to the road geometry. • Substantial increase in the number of freight trips made. • Savings in road maintenance costs. • Reduced congestion on the main roads of the city, namely the Military Route and Ave. Roosevelt. 	
LOCATION	Indirect influence area of the project and the entire eastern region.	
RELEVANT ASPECTS		
56	Occupational hazards to employees during maintenance works	N
ACTIVITY	Road maintenance	
DESCRIPTION	Occupational hazards related to maintenance activities.	
UBICACIÓN	Entire project layout	
RELEVANT ASPECTS	This risk already exists in the current road in the section comprised between the Pan-American Highway (CA1) and Station 0 +000 to Station 3 +940. Current road conditions will be improved through the implementation of four-lanes, that even makes maintenance work easier.	
57	Improved health due to less noise, vibration, dust and smoke in the city of San Miguel and surrounding areas	P
ACTIVITY	Vehicle and people traffic	
DESCRIPTION	<p>By decongesting traffic off the main streets of the city, noise, vibration, dust and smoke will be reduced that currently are deteriorating the health of the population in the city and surrounding areas. Also by facilitating access from the indirect influence area to the city of San Miguel on a paved road, the project will help reduce emissions of dust and noise produced when travelling over gravel roads.</p>	
LOCATION	City of San Miguel and surrounding areas	
RELEVANT ASPECTS		

58	Facilitate the movement of people to health centers	P
ACTIVITY	Vehicle and people traffic	
DESCRIPTION	Currently health centers are concentrated in cities such as San Miguel, Quelepa and Moncagua, and in rural areas in the project's influence area. Travelling to these centers is difficult on the existing roads. Families living in sections 9 +000 to 12 +000, 14 +000 to 21 +000 have to travel long distances or cross the river by boat or by cable basket.	
LOCATION	City of San Miguel and surrounding areas	
RELEVANT ASPECTS		
59	Improved road network	P
ACTIVITY	Vehicle and people traffic, rainwater drainage and road maintenance	
DESCRIPTION	By improving traffic flow within the City of San Miguel on its main routes, such as Military Road and Roosevelt Avenue, the project will improve the quality of life of city residents who every day drive down these roads to their places of work, school or to go shopping, etc. People in rural areas traversed by the project will have greater ease of transport over a modern road. The most benefited areas are: <ul style="list-style-type: none"> • El Salitre, • Persons living between station 9 +000 to 12 +500, who spend up to 45 min to reach a paved road or cross the river hanging from a cable. • Persons living between Station 14 +000 to 19 +000 approx, who take long drive down the road to The Papalon, or also cross the river on foot or by boat to get to the city. 	
LOCATION	Municipalities of Moncagua, Quelepa and San Miguel	
RELEVANT ASPECTS	It benefits people from Canton el Sitio, El Papalon and Zamorán.	
60	Facilitates the movement of people and goods	P
ACTIVITY	Vehicle and people traffic	
DESCRIPTION	The project also provides better accessibility to people living in rural areas and commute into the city of San Miguel to buy food and other products	
LOCATION	Rural areas in the indirect influence area the project.	
RELEVANT ASPECTS		

VII.5 ASSESSEMENT AND PRIORITIZATION OF IMPACTS

Subsequently, for those factors with negative effects, the Environmental Impact Value (EIV) was calculated. This value was calculated and a weighting was given to it based on the following integrating criteria:

- Probability of occurring (20%)
- Expected impact intensity (30%)
- Extension impacted by the action (20%)
- Duration of the impact effect (20%)
- Reversibility of the affected impact (10%)

The rate applied to the projection for each effect depends on the following considerations:

- The probability of the impact occurring during the Project, as: high, medium or low.
- The intensity to be exerted in the environment due to this impact as: high, medium or low.
- Considering the extension as: generalized or regional if it affects an area greater than the land or its immediate influence area; local when it affects the Project and/or punctual if it only affects specific Project areas.
- The duration: long (impact of more than 5 years of persistence), medium (effect between 2 and 5 years) or short (impact less than 2 years).

The weighting applied to the above referred considerations is shown in the following table.

TABLE No. VII.2. CALCULATION OF ENVIRONMENTAL IMPACT VALUE

CRITERION	LEVEL	Value to be	WEIGHTING
PROBABILITY	High	2.0	20%
	Medium	1.0	
	Low	0.4	
INTENSITY	High	3.0	30%
	Medium	1.5	
	Mild	0.6	
EXTENSION	Generalized	2.0	20%
	Local	1.0	
	Localized	0.4	
REVERSIBILITY	Irreversible	2.0	20%
	Reversible in the long term	1.0	
	Reversible in the short	0.4	
DURATION	Long	1.0	10%
	Medium	0.5	
	Short	0.2	

Source: Relevant Integrated Methodology Criteria

The values assigned to an impact, according to the levels the consultants team establishes, are later added to obtain the "EIV"; for example, if an impact has a high probability, low intensity, generalized extension, and long duration, its EIV would be 10.

$$EIV = \frac{PROBABILITY}{VALUE} + \frac{INTENSITY}{VALUE} + \frac{EXTENSION}{VALUE} + \frac{REVERSIBILITY}{VALUE} + \frac{DURATION}{VALUE}$$

The following table shows the calculation of the Environmental Impact Value (EIV) for each one of the environmental impacts identified and described in the previous section.

TABLE No. VII.3. CALCULATION OF THE ENVIRONMENTAL IMPACT VALUE (EIV)

EXPECTED POTENTIAL ENVIRONMENTAL IMPACT	PROBABILITY			INTENSITY			EXTENSION			REVERSIBILITY			DURATION			TOTAL
	high	med	low	high	med	low	high	med	low	high	med	low	high	med	low	
	2	1	0.4	3	1.5	0.6	2	1	0.4	2	1	0.4	1	0.5	0.2	
CONSTRUCTION: SITE PREPARATION																
1	Emissions into air from demolition of structures		1			0.6			0.4			0.4			0.2	2.60
2	Noise during tree felling				1.5				0.4			0.4			0.2	3.50
3	Possible pollution of soil and water by		1		1.5				0.4			0.4			0.2	3.50
4	Transport of sediment to rivers and streams			1		0.6		1				4			0.2	6.80
5	Reducing infiltration caused by felling	2			2			1		2			1			8.00
6	Reduction of riparian and secondary forest: trees	2				1.5			0.4		1		1			5.90
7	Felling of trees, shrubs and herbs in preparation	2				1.5		1			1		1			6.50
8	Reduction of crops and agricultural areas	2				1.5		1		2			1			7.50
9	Impact on proposed protected area	2				0.6			0.4	2			1			6.00
10	Possible impact to wildlife during site preparation		1			0.6			0.4	2					0.2	4.20
11	Relocation of people	2				0.6			0.4	2				0.5		5.50
12	Impact on property and structures	2			3			1			1		1			8.00
13	Reduction or division of agricultural land		1			0.6		1			1		1			4.60
14	Reduction of agricultural land		1			1.5		1		2			1			6.50
15	Impact on social amenities	2				1.5			0.4	2			1			6.90
16	Impact on commercial activities		1			0.6			0.4	2					0.2	4.20
17	Temporary impact on infrastructure: poles		1			0.6			0.4			0.4			0.2	2.60
18	Risk to people during site preparation			0.4	3				0.4			0.4			0.2	4.40
19	Increased commute times during construction		1			0.6		1				0.4			0.2	3.20
21	Occupational hazards to employees during			0.4		0.6		1				0.4			0.2	2.60
22	Health hazard by presence of foreign population during site preparation			0.4		1.5		2			2				0.2	6.10
CONSTRUCTION																
23	Emissions into air from transport and movement of	2			3			2				0.4			0.2	7.60
24	Noise from general supply and construction activities	2				1.5		2				0.4			0.2	6.10
25	Modification of natural relief	2				1.5			1		2		1			7.50
26	Possible pollution of soil and water by			0.4		0.6			0.4	2	1				0.2	2.60
27	Change in soil quality: topsoil	2				1.5		1		2			1			7.50
28	Instability of soil due to cut and fill slopes		1			1.5		2			1		1			6.50
29	Possible erosion processes		1			0.6		1		2				0.5		5.10
30	Vibrations from passing trucks and equipment		1			0.6			0.4			0.4			0.4	2.80
31	Modification of drainage patterns during	2				1.5		2			1				0.4	6.90
32	Washing of sediment into rivers and streams	2				0.6	2				1				0.2	5.80
33	Reduction of infiltration by impermeabilization of	2				1.5		1			1		1			6.50
34	Possible impact on forests and / or trees		1			0.6			0.4	2				0.5		4.50
35	Possible impact on proposed protected area			0.4		0.6			0.4	2				0.5		3.90
36	Possible impact on wildlife during construction		1			0.6			0.4	2				0.5		4.50
37	Risk to people during construction		1			1.5			0.4	2				0.5		5.40
38	Increased commute times during construction		1			1.5		1				0.4			0.2	4.10
40	Occupational hazards to employees during			0.4		0.6		1				0.4			0.2	2.60
41	Risk caused by extraneous populations during			0.4		1.5		1		2			1			5.90
42	Impact on roads and access routes for residents		1			0.6		1				0.4		0.5		3.50
43	Possible impact on cultural-interest sites	2				1.5			0.4	2			1			6.90
44	Landscape modification during construction		1			0.6			0.4			0.4			0.2	2.60
OPERATING STAGE																
46	Noise of vehicles passing daily		1			1.5		2			2			1		7.50
47	Noise from maintenance activities			0.4		0.6			0.4			0.4			0.2	2.00
48	Possible soil contamination by effluents,			0.4		0.6			0.4		1				0.2	2.60
49	Instability caused by water discharges			0.4		0.6			0.4			0.4			0.5	2.30
50	Vibrations from passing vehicles			0.4		0.6			0.4		1		1			3.40
51	Possible scouring of riverbeds by bridges			0.4		0.6			0.4		1		1			3.40
52	Impact on wildlife of construction of new		1			0.6			0.4	2			1			5.00
53	Development induced by the presence of road		1			1.5		2		2				0.5		7.00
56	Occupational hazards to employees during			0.4		0.6			0.4			0.4			0.2	2.00

Source: Eco Ingenieros Team

To continue with the process, it was necessary to determine the relevance of the different impacts. To this end, the following scores were considered:

- o Very High when the score is equal or more than 8.0 (MA)
- o High, in the range of 6.1 to 7.9 (A)
- o Medium, in the range of 4.0 to 6.0 (M)
- o Low, equal to or less than 3.9 (B)

This valuation process was applied to a total of 52 environmental impacts, which were the ones that obtained a negative repetitivity value in the comparison matrix for project activities and environmental factors; the results are detailed in the following table:

TABLE No. VII.4. ASSESSMENT AND SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

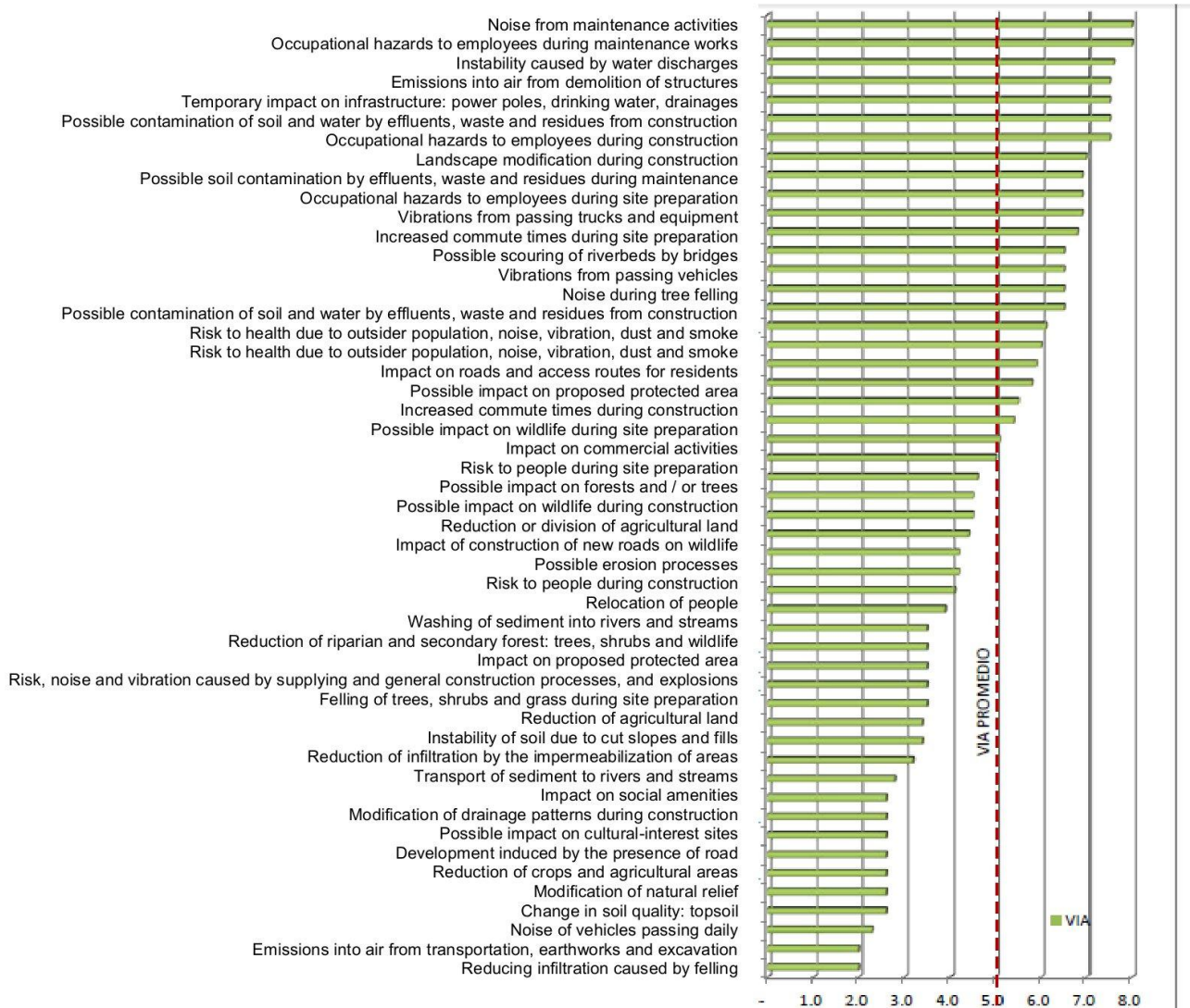
NEGATIVE

COMPONENTS	EIV	SIGNIFICANCE
CONSTRUCTION: SITE PREPARATION		
Emissions into air from demolition of structures	2.6	Low (L)
Noise during tree felling	3.5	Low (L)
Possible contamination of soil and water by effluents, waste and residues from site preparation	3.5	Low (L)
Transport of sediment to rivers and streams	6.8	High (H)
Reducing infiltration caused by felling	8.0	Very High (VH)
Reduction of riparian and secondary forest: trees, shrubs and wildlife	5.9	Medium (M)
Felling of trees, shrubs and grass during site preparation	6.5	High (H)
Reduction of crops and agricultural areas	7.5	High (H)
Impact on proposed protected area	6.0	Medium (M)
Possible impact on wildlife during site preparation	4.2	Medium (M)
Relocation of people	5.5	Medium (M)
Impact on property and structures	8.0	Very High (VH)
Reduction or division of agricultural land	4.6	Medium (M)
Reduction of agricultural land	6.5	High (H)
Impact on social amenities	6.9	High (H)
Impact on commercial activities	4.2	Medium (M)
Temporary impact on infrastructure: power poles, drinking water, drainages	2.6	Low (L)
Risk to people during site preparation	4.4	Medium (M)
Increased commute times during site preparation	3.2	Low (L)
Occupational hazards to employees during site preparation	2.6	Low (L)
Health risk to population during site preparation	6.1	High (H)
CONSTRUCTION		
Emissions into air from transportation, earthworks and excavation	7.6	High (H)
Risk, noise and vibration caused by supplying and general construction processes, and by explosions	6.1	High (H)
Modification of natural relief	7.5	High (H)
Possible contamination of soil and water by effluents, waste and residues from construction	2.6	Low (L)
Change in soil quality: topsoil	7.5	High (H)
Instability of soil due to cut slopes and fills	6.5	High (H)
Possible erosion processes	5.1	Medium (M)
Vibrations from passing trucks and equipment	2.8	Low (L)
Modification of drainage patterns during construction	6.9	High (H)
Washing of sediment into rivers and streams	5.8	Medium (M)
Reduction of infiltration by the impermeabilization of areas	6.5	High (H)

COMPONENTS	EIV	SIGNIFICANCE
Possible impact on forests and / or trees	4.5	Medium (M)
Possible impact on proposed protected area	3.9	Low (L)
Possible impact on wildlife during construction	4.5	Medium (M)
Risk to people during construction	5.4	Medium (M)
Increased commute times during construction	4.1	Medium (M)
Occupational hazards to employees during construction	2.6	Low (L)
Health hazard by foreign people during construction	5.9	Medium (M)
Impact on roads and access routes for residents	3.5	Low (L)
Possible impact on cultural-interest sites	6.9	High (H)
Landscape modification during construction	2.6	Low (L)
OPERATING STAGE		
Noise of vehicles passing daily	7.5	High (H)
Noise from maintenance activities	2.0	Low (L)
Possible soil contamination by effluents, waste and residues during maintenance	2.6	Low (L)
Instability caused by water discharges	2.3	Low (L)
Vibrations from passing vehicles	3.4	Low (L)
Possible scouring of riverbeds by bridges	3.4	Low (L)
Impact of construction of new roads on wildlife	5.0	Medium (M)
Development induced by the presence of road	7.0	High (H)
Occupational hazards to employees during maintenance works	2.0	Low (L)

Source: Eco Ingenieros Team

Figure No. VII.1. Environmental impact value



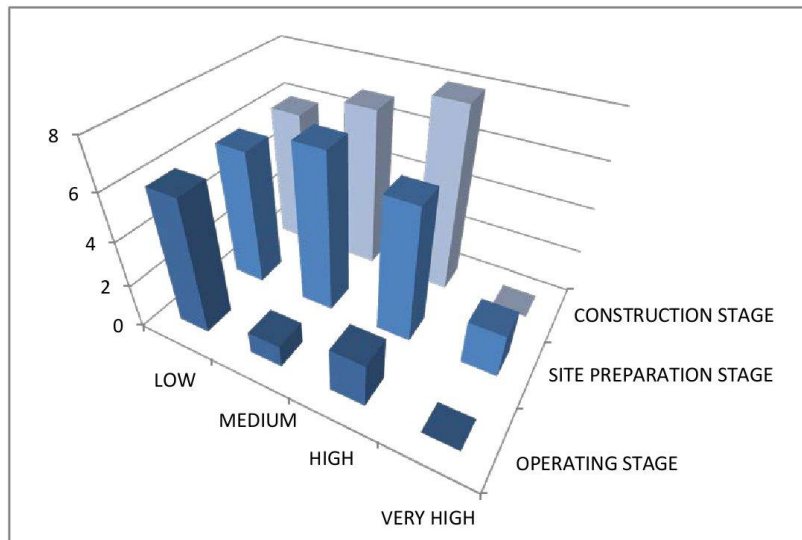
Source: Eco Ingenieros Team

From the 52 environmental components assessed, 18 obtained an importance score of Low (L), 15 scored as Medium (M), 16 High(A) and only 2 as Very High (MA).

TABLE No. VII.5. SIGNIFICANCE OF IMPACTS BY PROJECT STAGE

LEVEL	SITE PREP.	CONST.	OPERATING.	TOTAL
Low (L)	6	6	6	18
Medium (M)	1	7	7	15
High (H)	2	6	8	16
Very High (VH)	0	2	0	2

Source: ECO Ingenieros Team



Source: Eco Ingenieros Team

Figure No. VII.2. Significance of potential impacts by project stage

In general, the average EIV and the integrated Relevance of the negative impacts the Project will cause was determined as **MEDIUM (4.96)**. This is explained by the degree of man’s intervention in the Project area.

The negative impact in order of greater importance is listed here below.

1. Impact on the properties and structures
2. Reduction of infiltration caused by the felling
3. Air emissions by transportation, earthmoving and excavations
4. Cropping reduction and farming zones
5. Modification of the natural relief
6. Change in the quality of the soil: topsoil
7. Noise due to daily passage of vehicles

8. Development induced by the presence of the road
9. Impact of social equipment
10. Modification of draining patterns during construction
11. Possible impact on sites of cultural interest
12. Transportation of sediments to rivers and creeks
13. Reduction of infiltration by the waterproofing of the areas
14. Felling of trees, bushes and weeds to prepare the site
15. Reduction of agriculture land
16. Instability of the soil due to cut-off and filling slopes
17. Risk, Noise and vibrations due to supply and construction in general and by the explosions

VII.6 RISK ANALYSIS

The risk study is presented in Chapter X, and is summarized in the following table:

TABLE No. VII.6. IDENTIFIED RISKS – 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	The entire route	The entire area of the project	Flooding, stagnant water, difficult access, small landslides and erosion and landslides on slopes
Earthquakes	The 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

Source: Chapter "Risk Study"

The outcomes of this analysis are considered in the risk prevention plan as an environmental measure.