
	ENVIRONMENTAL IMPACT ASSESSMENT FOR THE RUMICHACA – PASTO DIVIDED HIGHWAY PROJECT, SAN JUAN – PEDREGAL, SEGMENT CONCESSION AGREEMENT UNDER APP SCHEME No. 15 OF 2015	
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8 ENVIRONMENTAL IMPACT ASSESSMENT

This chapter contains a general methodological framework establishing the interactions of the activities to be developed for the Rumichaca – Pasto Divided Highway Project, San Juan – Pedregal Segment (hereinafter the highway project) with the environmental elements. Based on the foregoing, the likely resulting impact of this interrelation is identified, assessed and described.

According to the results of this assessment, the mechanisms for prevention, mitigation and compensation of the environmental impact that could be caused at different stages of the project shall be determined. Such mechanisms are contained in **Chapter 11 Plans and Programs – Environmental Management Plan**.

The assessment process includes the current dynamics of the environmental elements that are being affected by the activities currently developed in the area by the inhabitants (current activities) through the assessment of the impacts on the abiotic, biotic and socioeconomic environments. Likewise, it contains the possible alterations of the socio-environmental element to be caused by the activities of the highway project.





In this manner, the assessment involves two temporary aspects: Activities carried out by the community, in conditions of use and exploitation of the territory, which were called SCENARIO WITHOUT PROJECT, and the activities subject to this study, called SCENARIO WITH PROJECT (See **Chapter 3. Project Description**) complying thus the provisions of the terms of reference and the methodological guidelines for presentation of environmental studies.

In this section, the environmental aspects and impacts caused by development of activities of the community and the potential impact that may be caused by the planned activities of the highway project are identified and assessed. With the management strategies proposed in **Chapter 11 Plans and Programs – Environmental Management** this impact shall be prevented, mitigated or compensated.

Identification and assessment of the different environmental impacts and effects begin with the integrated analysis of the technical characteristics of the project and the features and dynamics of the environmental components of the study area based on the Terms of Reference for preparation of the Environmental Impact Assessment in road and/or tunnel building projects issued by the Ministry for the Environment and Sustainable Development (MADS) in 2015.

For a better understanding of the methodology used, the main terms of the environmental assessment are defined below:

- **Activity:** it refers to the activities of production, extraction, elaboration, preparation, transformation, manufacturing and assembly of any kind of materials or goods.
- **Environmental Criteria:** group of variables considered for determination of the level of alteration caused by an environmental impact.
- **Socio-environmental Element:** each one of the thematic areas considered relevant in the natural environment assessment, which, along with other environmental elements, compose an ecosystem and can be modified by human and/or natural causes.
- **Phase:** moment, period or state in which a process or project is divided.

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- **Environmental Impact:** any alteration in the abiotic, biotic and socioeconomic environment that is adverse or beneficial, total or partial, and may be attributed to development of a project, work or activity.
- **Environmental Effect:** A measurable consequence on any basic component of the environmental caused or induced by any action of men.
- **Socio-Environmental Interactions:** it is the reaction resulting from an environmental aspect of the activities and a socio-environmental element, which is expressed individually as an environmental impact. Nonetheless, the same type of impact can be derived from several sub-activities (environmental aspects). Such relations are called socio-environmental interactions caused in the same environmental element; in other words, how many times the environmental impact shall arise in one project. For example, land transport and air transport interact with the environmental element independently (two interactions), and they cause the same environmental impact, but with a different degree of variation at noise levels.
- **Environment:** it is the place of relations between beings, relations of situation and action of corresponding location and reciprocity.
- **Abiotic Environment:** set of non-living environmental elements that determine the conditions of an ecosystem and their relations, to which the living organisms and human beings must adapt.
- **Biotic Environment:** set of living organisms that compose an ecosystem interrelating among them.
- **Socioeconomic Environment:** it is composed of the life and work conditions, education, income and life quality of the population living in a specific area.
- **Environmental Aspects/Activity:** they are the actions required to carry out the activities, products or services of an organization or project, which can interact with the environment.





The analysis and assessment of impacts for the activities in the scenario without the project and scenario with the project were based on the environmental impact assessment methodology adapted from the one designed by the Spanish engineer Vicente Conesa, which is, in turn, a modification of the Leopold Matrix of 1971. It consists in a qualitative assessment and is made based on an impact matrix that has the same column structure (impacting actions) and rows (impacted environmental factors or elements).

The alteration degree is determined as follows:

- The values assigned to environmental criteria are added up. Such criteria shall receive a value depending on the level or alteration of the environmental element, the capacity to bear such alteration, the size of the affected area, the possibility of recovery, time of stay of the impact and repetitiveness thereof, according to the criterion assessed. The result of this addition is known as the Environmental Impact Evaluation (IMA).
- The IMA value found is organized in a hierarchy, establishing thus intensity of the impact.

Additionally, the impacts assessed shall have a sign, which shall establish if the impact is considered beneficial or adverse for the environmental element. Such sign is known as Character.

In the case of the scenario with the project, the Environmental Impact Evaluation Value indicates on which impacts the attention shall be focused in a priority manner to formulate the measures of Environmental Management. In **Annex 16. Assessment Matrix**, the aspects and impacts are identified for the different stages considering the activities assessed.

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8.1 DESCRIPTION OF THE METHODOLOGY FOR IMPACT EVALUATION

The steps for evaluation of environmental impacts and how their environmental significance was obtained are described below.

• Identification and Rating of Environmental Impacts

As an initial stage, the highway project activities were analyzed and the resources required for each one are determined and accordingly, the impacts and effects that could be caused by the project were identified for the scenario without the project, the activities developed in the area subject to study and their effect on the environment were determined to have an estimation of the possible impacts. In both scenarios the tool used was a double-entry matrix.

Additionally, the methodology used for evaluation of the environmental impacts includes in its evaluation criteria the impacts considered cumulative, as set forth in Decree 2041 of October 15 2014 of the Ministry for the Environment and Sustainable Development (MADS).





The process of identification and qualification was made in the following general steps:

- **Identification of Project Activities:** brief description of each one of the activities carried out by the community (scenario without the project, see **Chapter 5- Main Characteristics of the Area of Influence**) and activities to be developed as part of the highway project (scenario with the project -See **Chapter 3 Project Description**).
- **Main Characteristics of the Area of Influence of the Project:** based on the information contained in **Chapter 5- Main Characteristics of the Area of Influence** – Abiotic, biotic and socioeconomic environments, there is a diagnosis of the current state of the area subject to study and its current socio-environmental problem.
- **Determination of Required Natural Resources:** the needs of use and exploitation of the natural resources required for the activities planned for the highway project (**See Chapter 7 Demand, Use, Exploitation**).
- **Inventory of Wastes Generated by the Activity:** list of the type of wastes generated by the implicit activities of the different activities both in the no-project and scenario with the projects (domestic, industrial and special wastes) that may cause a negative impact on the environment. (**See Chapter 7 Demand, Use and Exploitation**)
- **Determination of the Significance of the Environmental Impacts and Effects:** to determine significance of the environmental impacts, a matrix containing the activities, environmental aspects and the identified impacts is filled in and such information is crossed with the evaluation criteria (**See Table 8.1**).

Once the impacts are identified and assessed, they are crossed with the Environmental Management Plan (**Chapter 11 Plans and Programs – Environmental Management Plan**), so that they have their corresponding management measures, whether prevention, mitigation and/or compensation.

• Environmental Impact Evaluation (IMA)





Assessment of environmental significance is determined using the criteria of Character, Intensity, Extension, Duration, Periodicity, Recoverability, Reversibility, Moment, Effect, Resilience, Synergy and Accumulation; which are assessed in accordance with the criteria of **Table 8.1**.

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The values of **importance of the environmental impact** are obtained based on weighing of the values of the criteria mentioned in the previous paragraph.

Table 8.1 Criteria for Environmental Impact Evaluation Monitoring and Assessment (IMA)

FEATURE	DEFINITION	SCALE	RANGE
Nature or Character (C)	It is the beneficial (+) or harmful (-) character of the different actions that have an impact on the different factors involved.	Beneficial Detrimental	(+) (-)
Intensity (INT)	It is understood as the alteration degree of the action on the specific environmental element. Low: Its effect is only a minimal modification to the socio-environmental element assessed. Medium: Although there are changes or modifications, they do not represent a serious alteration of the socio-environmental element assessed. High: Its effect causes a serious alteration of the socio-environmental element. Very High: It indicates an almost total alteration of the socio-environmental factor assessed. Total: Total damage or disturbance of the socio-environmental element.	Low Medium High Very High Total	1 2 4 8 12
Extension (EXT)	It makes reference to location of the effects considering the direct and indirect area of influence of the project according to the socio-environmental element assessed. Punctual: When the impacting action causes a much localized effect, that is, only the intervention site. From the social point of view, it refers to the property level. Partial: The effects go beyond the intervention sites, still being within the area of influence of the project. As far as the social environment is concerned, it refers to the district level. Extensive: The effects go beyond the closest sites of the indirect area of influence with respect to the project. From the social point of view, it makes reference to the municipal level. Total: The impact embraces in their entirety both the direct and indirect area of influence. For the social environment its coverage extends to all the populations of the area of influence.	Punctual Partial Extensive Total	1 2 4 8
Duration (DUR)	It is the apparent time during which the impact remains from its appearance. Brief: If the effect lasts less than one month. Temporary: if it lasts between 1 and 3 months. Long Lasting: between 4 and 10 months. Permanent: if the duration is longer.	Brief Temporary Long lasting Permanent	1 2 4 7
Periodicity (PR)	Periodicity refers to the regularity of the manifestation of the impact for the development of the environmental aspect. Irregular: The environmental aspect assessed generates the impact in an unpredictable manner or only once in the time. Regular: The environmental aspect assessed generates the impact in a cyclical or recurrent manner. Continuous: The environmental aspect assessed generates the impact in a constant manner during the time.	Irregular Regular Continuous	1 3 7

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FEATURE	DEFINITION	SCALE	RANGE
Recoverability (RC)	It makes reference to the possibility and the moment of introducing corrective actions or measures to remedy the impacts caused. Recoverable: (immediate or in a medium term) its effect can be eliminated by corrective measures assuming an alteration that can be replaceable (e.g. when the vegetation of an area is eliminated, the fauna disappears; by reforesting the area, the fauna shall return). Mitigable: its effect can be diminished by mitigating measures (e.g. barriers for noise control). Irrecoverable: its alteration or loss of the environment is impossible to repair (e.g. all the cement or reinforced concrete works).	Recoverable Mitigable Irrecoverable	1 4 7
Reversibility (RV)	It refers to the possibility of returning to the initial conditions before the action by natural means, once such action stops acting on the environment. Reversible: The socio-environmental element affected returns by itself to its natural conditions in less than 12 months. Medium Reversibility: The environmental element takes long in returning to its natural conditions, between 1 and 5 years. Irreversible: The environmental element takes more than 5 years, or it is supposed to be impossible to return by natural means to the previous situation.	Reversible Medium reversibility Irreversible	1 4 7
Moment (MO)	The manifestation of the impact is defined from the time elapsed between execution of the action and appearance of the effect on the socio-environmental element considered. Immediate: If the time elapsed is none. Medium Term: if the period goes from 1 to 3 months. Long Term: the impact takes more than three months.	Long term Medium term Immediate	1 2 4
Effect (EF)	Cause-Effect relation	Indirect Direct	1 4
Resilience (RS)	Capacity to absorb disturbances without altering significantly its structure characteristics and functionality. High: Returning to original conditions takes less than two (2) years. Medium: Two to fifteen years (2 -15) are required. Low or Non-Existent: It takes more than 15 years or does not return to its natural conditions without management measures. Note: Rating of the Resilience must be consistent with the rating of reversibility (RV) for negative impacts.	For impacts (-): High Medium Non-existent For impacts (+): Low Medium High	1 2 4 1 2 4
Synergy (SI)	It refers to the union of several impacts that generate bigger effects than the ones generated if they act independently.	Non synergic Synergic	1 4
Accumulation (A)	The impact is increased progressively after execution of the activity, when the action generating it persists in a continued or reiterated manner.	Non-cumulative Cumulative	1 4

Source: Vicente Conesa Fernández-Vitora. Guía metodológica para la evaluación del Impacto Ambiental.
Adapted by GEOCOL CONSULTORES S.A. 2017.

• Environmental Impact Evaluation (IMA)

Assessment of the impacts is a procedure that allows in an orderly fashion establishing the importance of an impact and, based on such assessment, establishing the type of measure of socio-environmental management to be followed.

The importance of the impact is obtained from the correlation of features, considering the equation contained in **Table 8.2**, where a value of the most impacting actions (high negative values), the non-

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impacting actions (low negative values) and the beneficial actions (high and low positive values) shall be obtained.

Accordingly, the severe and critical impacts require special management measures, and the irrelevant or non-significant and moderate impacts require general management measures. The activities that generate critical or inadmissible environmental impacts shall be reassessed, no longer from the point of view of the impact itself, but from the point of view of social and/or environmental feasibility of the project or specific activity. The following table shows the different scales of assessment that can be obtained from the application of the environmental significance assessment according to the aforementioned methodological parameters (See **Table 8.2**).

Table 8.2 Impact Hierarchy Ranks According to the Environmental significance (IMA)

ENVIRONMENTAL IMPORTANCE (IMA)	It is understood as the importance of the impact of an action on a certain socio-environmental element. It is calculated using the following equation: $IMA = +/- ((3 \times I) + (2 \times EX) + DU + PR + MC + RV + MO + EF + RS + SI + A)$	Mild or Irrelevant Impact	< 33
		Moderate Impact	Between 33 – 51
		Severe Impact	Between 52 – 74
		Critical Impact	> 74

Source: GEOCOL CONSULTORES S.A., 2017.

• Level of Global Negative Intervention (NIGN).

The Global Intervention Level is a value established in percentage terms that allows verifying the comprehensive alteration degree of a project or several activities considering the minimum and maximum rating of the environmental criteria assessed.





In this manner, it is a complement of the analysis made through the environmental impact assessment methodology used, in this case, the Methodology of Vicente Conesa Fernández, both for the scenario without the project and the scenario with the project.

The Global Intervention Level is obtained based on the following formula:

$$NIGN = 100\% - \frac{(Int. Max - Int) * 100\%}{(Int. Max - Int. Min)}$$

Where:

- **NIGN** is the Level of Global Negative Intervention of the project (For the scenario without the project, it makes reference to a set of activities developed up to date).
- **Int** is the total intervention of the project or activities, derived from the addition of the negative impacts of all the actions (absolute data).
- **Int. Max** is the maximum negative assessment that it is possible to have for the project or activities (absolute data) (This value corresponds to the number of interactions that would generate negative impacts for the maximum possible value for environmental impact which is of -100).

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- **Int. Min** is the minimum negative assessment that could be obtained (absolute data) (This value corresponds to the number of interactions that would generate negative impacts for the minimum possible value for environmental impact, which is of -14).

The value of the global intervention level of the activities must be compared to the values listed in **Table 8.3**, as to determine mathematically the most impacting activity in socio-environmental terms.

Table 8.3 Assessment and Classification of Impacts





LEVEL OF GLOBAL NEGATIVE INTERVENTION (NIGN)	CATEGORY
0 – 25 %	Low Intervention Level
25.1 – 50 %	Medium Intervention Level
50.1 – 75 %	High Intervention Level
75.1 – 100 %	Very High Intervention Level

Source: Inter-American Development Bank. Environmental Project Analysis. 2006.

8.2 SCENARIO WITHOUT PROJECT

Based on the review of primary and secondary information about the current situation of the environmental components in the area of influence, the effects generated by the activities currently developed in the area of influence were identified. Additionally, a process of consultation of information related to the environmental problems was conducted, including:

- **Environmental Agenda of Municipality of Ipiales.** Prepared by the Municipal Mayor's Office of Ipiales, 2015.
- **Basic Plan of Territorial Planning of the Municipality of Ipiales.** Prepared by the municipal Mayor's Office of Ipiales, 2011.
- **Economic and Informal Assessment of the City of Ipiales.** Prepared by Ciesi Consultores for the Chamber of Commerce of Ipiales, 2011.
- **Economy of the Department of Nariño: Rurality and Geographic Isolation.** Prepared by Joaquín Vilora De La Hoz as part of the Regional Work Documents about Regional Economy of Banco de la República, 2007.
- **Participative Plan of Department Development.** 2016 - 2019. Prepared by the Government of Nariño.
- **Plan of Action on Biodiversity of the Department of Nariño 2006-2030.** Prepared by CORPONARIÑO, the Agriculture Secretariat of the Government of Nariño, the Institute of Research of Biologic Resources Alexander Von Humboldt, University of Nariño, National Natural Parks of Colombia and the University Mariana; with the participation of civil associations and community councils, 2007.
- **Territorial Planning Scheme of the Municipality El Contadero.** Prepared by the municipal Mayor's Office of El Contadero, 2002.
- **Development Plan: Municipal Administration of El Contadero.** Prepared by the municipal Mayor's Office of El Contadero, 2002.
- **Territorial Planning Scheme of Municipality of Iles 2003 - 2012.**
- **Draft Plan of Municipal Development of Iles 2012 - 2015.** Prepared by the municipal Mayor's Office of Iles, 2012.

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- Territorial Planning Scheme for the Municipality of Imues, 2004.
- Municipal Plan of Development Imues 2016 - 2019.

8.2.1 Current Problem

The area of the project shows an important alteration degree; especially in matters related to soil, water resource and vegetation covers. Such problems are mainly associated with development of daily activities of the inhabitants of the area, who lack the proper knowledge about development of their activities and do not have pertinent tools for management of problems related to development of their ways of living. Nonetheless, it is worth noting that the lack of opportunities and low income levels make people carry out activities with environmental repercussions in order to satisfy their basic needs.





The main economic activity of the area is agriculture, which is mainly made in small plots and small holdings and the production of which is intended for family consumption and local and regional trade. However, the extension of the cultivated areas is increasing affecting directly ecosystems as forests, which are cut down or burnt to have new arable areas. Additionally, the agricultural activities are conducted without considering the physicochemical characteristics of the soil making necessary application of agrochemicals and use of irrigation systems that on many occasions take water directly from water bodies with different degrees of contamination. Likewise, the water coming from the cultivation areas runs freely towards the nearby water bodies carrying a big amount of contaminants associated with the agricultural activity.

In the area of interest there are also activities such as livestock breeding, indiscriminate tree cutting, poor management of agricultural plots, inappropriate techniques of tillage and indiscriminate use of chemical fertilizers which cause a serious alteration of the structure and chemical composition of soils making them progressively useless for any sustainable activity. The foregoing facts, in addition to ignorance of the communities about proper management of the soil, are causes of possible problems such as erosion, landslides, mudslides, floods and soil contamination.

Loss of arable soil at the end and beginning of tillage constitutes a factor that contributes significantly to erosive phenomena since the soil remains naked for more than two months, enough time for the water and wind to transport material. Nonetheless, even when the process is not evidenced at a glance, its effects are appreciated indirectly for the loss of soil horizon and yield levels. Almost all the areas exposed (without vegetation cover) to a process of waste of its surface making erosion a threat when the recovery rate of the soil is lower than the waste rate.

Moreover, in the area there is farming of multiple livestock species and their exploitation is made mostly in an extensive traditional manner with limited use of technologies and with workforce mainly belonging to the family cores, its production being limited mainly to self-consumption and local and regional market. Nonetheless, there are some outstanding industries in the agricultural sectors as in the municipality of El Contadero, which has an important poultry industry, slaughtering up to 50,000 birds bi-annually. However, the works of slaughter of these animals are not made in a slaughter plant in compliance with the technical and sanitary standards required by the INVIMA, having repercussions at environmental level both in soils and water bodies which may be contaminated by wastes of the poultry slaughter.

As for the water resource, the basin of river Guaítara has a series of environmental issues of great relevance such as deforestation of the areas near its bed, contamination of its tributary water sources and deposit of solid wastes by the population depending on the resources of this tributary, by its reiterated use in livestock

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farming and domestic activities; causing important environmental problems to the detriment of the quality and quantity of the supply of this important river¹.

Additionally, the families inhabiting the surroundings of the water currents that form the sub-basin of river Guaitara generally wash their clothes in the water currents or in sinks that discharge wastes waters on the rivers or creeks polluting the water currents with detergents. Garbage management is made at the level of each property and dragging of wastes for the effects of rain towards water currents is common².

The limited surface water supply of the micro-basins that are born in the moor, especially in summer periods, is mainly due to the intervention of the communities in the forest and above all the intervention made in the moor and sub-moor, where there are areas of recharge and wetlands. In addition to these problems, there is occupation of the margins of creeks, small riverbeds and wetlands that feed urban and rural aqueducts; as well as the presence of illegal intakes and fraudulent connections, existence of some fish ponds and car washers in the Panamericano sector, and waste of water.

In the specific case of the municipality of Imués poor management of water sources has caused water shortage making necessary to resort to water sources from neighboring municipalities. The water sources of its own are not optimal for human consumption for their degree of pollution due to waste water discharge making its purification very expensive³.

Moorland Paja Blanca is known as the water star from the south of the Department and has an outstanding importance since it is the source of supply of aqueducts from seven municipalities of the department of Nariño. Nonetheless, it has suffered a serious damage for extension of the agro-livestock border and use of its vegetal species as fuel by inhabitants near the area⁴. Water loses systematically quality and quantity for the constant alterations of the natural cycles, which generates an evident water deficit in the urban and rural sectors. This deterioration causes, in addition to a series of alternate difficulties associated with erosion and mudslides, weather alterations, fires and anthropogenic factors such as pollution and deforestation.

Additionally, municipalities of the area do not have a waste water treatment system; therefore, waste waters are discharged directly to the water bodies without any type of treatment. For this reason, there are health and environmental difficulties such as: infections, bad odors, contamination of other surface sources and the soil. Moreover, contaminated waters discharged to the water bodies are used in the irrigation systems for crops intended for human consumption without any type of treatment.

Solid waste management of the municipalities of the area is ineffective since in most of the cases frequency of collection is not enough and the total urban area and even less rural areas are not covered. Likewise, no source separation processes are carried out and final disposal is made through non-technical processes and by poorly trained staff in most cases. This fact causes problems of pollution of the land, water sources and air, which could lead to health issues involving the communities exposed, as well as the biotic and abiotic components of the area subject to study.





Similarly, management of debris is ineffective and in some cases there are not clear guidelines in the matter. Therefore, disposal is made in dispersed areas or particular properties not complying with the technical or

¹ Municipal Mayor's Office of El Contadero. Development Plan: Municipal Administration 2012 - 2015.

² Municipal Development Plan of ILES 2012 – 2015.

³ Municipal Development Plan of Imues 2016 – 2019.

⁴ Development Plan: Municipal administration of El Contadero 2012 – 2015.

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environmental specifications for such purpose. In some cases, these wastes end up in sanitary fillings causing additional problems.

In case of processing plants (slaughterhouses), they operate under poor conditions not complying with the technical requirements or they do not exist as in municipality Iles. For these reasons, slaughter of the different livestock species is made in inappropriate places under unhealthy and environmentally deficient conditions, causing problems of contamination in the soil and water sources.

The fauna of the area subject to study has been mainly affected due to indiscriminate as part of the peasant and indigenous diet for ignorance of the behavior of the species, destruction of their natural habitat and contamination of water sources on which they depend. Additionally, there is the fact that administrations and the community in general ignore the importance of the fauna and this resource has not been properly managed since it is seen as a resource that does not play any role in nature⁵.

Likewise, there are anthropogenic activities that affect directly the flora of the area. Some of such activities are tree cutting for preparation of coal or direct use of wood as domestic fuels, expansion of colonization, development of infrastructure, development of agricultural production systems in steep slopes, erosive anthropogenic and natural processes destabilizing soil and extension of the agricultural border based on burning and indiscriminate cutting of trees and have caused constant loss of the vegetation cover the problem focusing in the Andean area where there are only some remains of native forest. The foregoing causes a transformation of natural habitats, fragmentation of ecosystems, invasions by species introduced, contamination, over-exploitation of biological resources and extinction of some species, among others⁶.

Finally, there has been an environmental deterioration linked to air pollution, especially in the urban areas as a result of the increase of the number of vehicles and motorcycles, essentially leading to an increase of suspended particles that have harmful effects on health.

8.2.2 Description of Activities Identified in the Area of Influence of the Project (Scenario without the Project)

Based on the field information and **Chapter 5. Main Characteristics of the Area of Influence**, the activities currently developed in the area subject to study and that cause environmental impacts are described. It is worth indicating that the activities shown below are described briefly since they shall be identified and assessed depending on the impact they cause in **Section 8.2.6 Analysis of the Matrix per Impacts (Scenario without the Project)**.

• Management of Solid Wastes by the Community

In the municipalities of the area of interest there are problems of disposal of solid wastes, especially in the rural areas not covered by the collection service or where such service is deficient. In **Photograph 8.1** management of this type of wastes by the community is shown.





Photograph 8.1 Examples of Solid Waste Management by the Community

Disposal of Solid Wastes
E: 955820 N: 598517

Burning of Solid Wastes
E: 954388 N: 596850

⁵ Territorial Planning Scheme of Iles 2003 -2012.

⁶ CORPONARIÑO. Plan of Action on Biodiversity of the Department of Nariño 2006 – 2030.

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Disposal of Solid Wastes Near Water Bodies
E: 950179 N: 593808



Source: GEOCOL CONSULTORES S.A., 2017.





• Management of Liquid Wastes by the Community

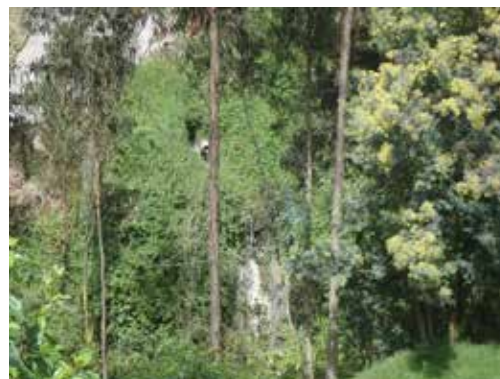
The municipalities of the area subject to study lack waste water treatment systems and discharge of waste waters is made directly on water bodies, as in the case of the municipality of Contadero. Likewise, although some farms have septic wells, in some rural areas, it is common to discharge waste waters directly on the groundwater or water bodies. In **Photograph 8.2** some liquid discharges within the area subject to study are observed.

Photograph 8.2 Examples of Liquid Waste Management by the Community

Discharge of Liquid Wastes on the Ground
E: 949140 N: 592199

Point of Discharges of Waste Waters in Municipality of
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E: 947959 N: 592084

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Point of Discharge of waste waters of Condominium Arcoiris in Creek Seracocha
E: 953969 N: 604810



Source: GEOCOL CONSULTORES S.A., 2017.





• Exploitation of Surface Water Resource

Exploitation of the surface water resource in the area is mainly made through building of water catchment such as tanks or by using pipelines or hoses in the surroundings of water bodies or directly in the beds of such water bodies. **Photograph 8.3** shows some surface water exploitation systems used in the area.

Photograph 8.3 Examples of Surface Water Resource Exploitation by the Community

Aqueduct of Condominium Arcoiris
E: 954060 N: 604342

Water Catchment Creek San Francisco 2
E: 954913 N: 602364

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Source: GEOCOL CONSULTORES S.A., 2017.

• Groundwater Resource Exploitation

There is evidence that in the area groundwater exploitation is mainly made by private individuals or small communities, although it is not a very widespread practice and it is made in a punctual manner. **Photograph 8.4** shows a groundwater well.

Photograph 8.4 Examples of Groundwater Resource Exploitation by the Community

Groundwater Well in District Ospina Perez
E: 952272 N: 595129







Source: GEOCOL CONSULTORES S.A., 2017.

• Forest Harvesting

In the area subject to study of the project, forest harvesting is conducted at small scale in small cultivation areas and is limited to few forest species including eucalyptus. Likewise, cultivation is made for small-scale production activities and domestic activities.

Photograph 8.5 shows a cultivated area with eucalyptus.

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Photograph 8.5 Examples of Forest Harvesting by the Community

Eucalyptus Crops in the riverbanks of the Guáitara
E: 949136 N: 592018



Eucalyptus Crops Near Yamurayán Creek
E: 949136 N: 592018



Source: GEOCOL CONSULTORES S.A., 2017.

• Farming Activities

The main livestock activity of the area subject to study is the farming made in an extensive manner. Nonetheless, there is also pig, poultry and guinea pig breeding, but it is made at small scale in locations near houses and mainly for self-consumption. See **Photograph 8.6**.

Photograph 8.6 Examples of Livestock Activities by the Community





Livestock Activity in the Area subject to study
E: 952098 N: 595329



Livestock Activity in the Area subject to study
E: 952098 N: 595329



Source: GEOCOL CONSULTORES S.A., 2017.

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- **Trade**

Businesses in the area subject to study are mainly carried out by small traders concerned with very diverse activities. Sale of multiple elements characteristic of the region such as crafts and typical food is relevant. **Photograph 8.7** shows some of these small businesses.

Photograph 8.7 Examples of Trade in the Area of Influence of the Project





Guinea Pig (Typical Food) Trade
E:949660 N:592994



Source: GEOCOL CONSULTORES S.A., 2017.

- **Tourism**

The main tourist attraction of the area is the Sanctuary Nuestra Señora del Rosario de Las Lajas which is mainly accessed through the Panamericana Highway. Moreover, a significant part of land tourism towards Ecuador uses this road corridor. **Photograph 8.8** shows the tourist site known as Las Lajas.

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Photograph 8.8 Examples of Tourism in the Area of Influence of the Project

Sanctuary Nuestra Señora de Las Lajas
E: 943404 N: 58082



Down Town of Village Las Lajas
E: 943581 N: 580972



Source: GEOCOL CONSULTORES S.A., 2017.

• Fauna Haunting

Through semi-structured polls with inhabitants of the area subject to study, it was identified that fauna haunting mainly occurs as a measure of protection of domestic animals bred by peasants.

• Quarries

In the area subject to study, stone minerals are exploited through quarries. Some of them extract the material present in the soil while others do it directly from the riverbeds. **Photograph 8.9** shows some quarries located in the area subject to study.





Photograph 8.9 Examples of Quarries in the Area of Influence of the Project

Crushing Plant river Guáitara
E: 955372 N: 602079



Quarry in the Area subject to study
E: 954904 N: 603753



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Crushing Plant
E: 954873 N: 604212



Source: GEOCOL CONSULTORES S.A., 2017.

- **Burning**

In the area subject to study this type of practice was identified. It consists in burning the remaining of crops after harvest as a measure of soil fitting for subsequent crops.

- **Agriculture (Transitory Crops)**

Agriculture is the main economic activity of the area subject to study. **Photograph 8.10** shows three of the most common crops of the area: potato, pea and corn.





Photograph 8.10 Examples of Agriculture Developed by the Community

Potato Crops in the Area subject to study
E: 955766 N: 598044



Corn Crops in the Area subject to study
E: 955442 N: 597457



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Pea Crops in the Area subject to study
E: 949907 N: 593153



Source: GEOCOL CONSULTORES S.A., 2017.

- **Forest Protection and Conservation Plantations**

Within the area of influence of the project there was evidence of forest protection and conservation areas, specifically, a protection area belonging to CORPONARIÑO was identified (See **Photograph 8.11**).

Photograph 8.11 Examples of Forest Plantations in the Area of Influence of the Project





Protected Area of the Papa Sicce Creek
E: 954646 N: 603409



Source: GEOCOL CONSULTORES S.A., 2017.

- **Hydrocarbon Transport (Oil Pipeline)**

It was identified that part of the Trasandino Pipeline, belonging to Ecopetrol, crosses the area subject to study. **Photograph 8.12** shows presence of the oil pipeline in the area.

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Photograph 8.12 Examples of Hydrocarbon Transport in the Area of Influence of the Project

Identification Sign of the Trasandino Pipeline
E: 948257 N: 591991



Transit Area through the AI of the Trasandino Oil Pipeline
E: 948257 N: 591991



Source: GEOCOL CONSULTORES S.A., 2017.

Land Transport

In the area of influence there is a wide road network, including national route 25 or Panamericana Highway. Additionally, in the area there are multiple roads of access to the nearby municipalities and roads of minor level that go through rural areas. **Photograph 8.13** shows some roads identified in the area.

Photograph 8.13 Examples of Land Transport in the Area of Influence of the Project





National Route 25 (Panamericana Highway) Pilcuan - Ipiales
E: 948589 N: 590972



Road of Access Hamlet Culantro
E: 950890 N: 594694



Source: GEOCOL CONSULTORES S.A., 2017.

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8.2.3 Identification of Environmental Impacts (Scenario without the Project)

8.2.3.1 Identification of Impacts of the Community (Scenario without the Project)

For proper and assertive preparation of the environmental impact assessments, it is necessary to know the perception and comments of the community concerning the project to be licensed, as well as an analysis related to the current environment conservation state as a result of the interaction that it has with the activities carried out by the communities and the different economic activities in the area of interest. In order to fulfill this goal, spaces of socialization of the project were developed (in three moments); during the second moment of socialization 28 meetings were held with the districts of the area of influence, in which the identification workshop of impacts and measures of environmental management was developed between March 23 and March 29, 2017. In these meetings, environmental impacts were identified both for the scenario without the project and the scenario with the project (See **Photograph 8.14** and **Chapter 5, section 5.3 Socioeconomic Environment-Participation Guidelines**). Section 8.3.2 shows the standardization of impacts made with the impacts identified by the community and how they were worked in the assessment.

Photograph 8.14 Identification of Environmental Impacts in the Scenario without the Project with the Communities of the Area of Influence of the Project



District El Capulí







District Tablón alto



District San Andrés



District San José de Quisnamuez

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District el Porvenir



District Silamag





Source: GEOCOL CONSULTORES S.A., 2017.

8.2.3.2 Correlated and Definite Impact Identification (Scenario without the Project)

Considering the foregoing, identification of socio-environmental impacts identification is completed in the scenario without the project made preliminarily by the consultant group for later impact assessment (See Table 8.4 through Table 8.5).

Table 8.4 Identification of the Interactions that Caused the Socio-Environmental Impacts in the Scenario without the Project

ENVIRO NMENT	COMPROMISED ENVIRONMENTA L ELEMENT	IMPACTS OF ACTIVITIES EXECUTED IN THE AREA	MANAGEMENT OF SOLID WASTES BY THE COMMUNITY	MANAGEMENT OF LIQUID WASTES BY THE COMMUNITY	EXPLOITATION			FARMING ACTIVITIES	TRADE
					SURFACE WATER RESOURCE	GROUNDWATE R RESOURCE	FOREST		
ABIOTIC	Soil	Modification of soil stability			-	-			
		Change of physicochemical and biologic properties of the soil	-	-				-	
		Change in the use and potential of the soil	-				-		
	Surface Waters	Alteration of riverbeds			-		-	-	
		Alteration in the quality of surface water	-	-			-	-	
		Variation in surface water resource availability			-	-	-	-	-
		Variation of the amount and transport of sediments	-	-			-	-	
		Decrease in the capacity of transport of water sources	-	-			+		
	Groundwater	Alteration in the quality of the groundwater	-	-			-	-	
		Alteration of the groundwater flow network			-	-	-	-	
		Alteration of recharge areas				-	-	-	-
	Air	Modification of air quality by Gases	-	-			-	-	
		Modification of air quality by Particulate Material							
		Generation of Odors	-	-				-	
BIOTIC	Landscape	Variation in the sound pressure levels							-
		Changes in the integrity of the landscape	-				-	-	
	Flora	Modification of vegetation covers					-		
		Changes in the flora structure and composition					-		
		Changes in the structure, extension and availability of habitats of the wild fauna	-				-	-	
		Changes in the composition and structure of fauna communities	-				-	-	
		Alteration of the structural and functional connectivity of the habitats of the wild fauna					-	-	
		Alteration of the soil edaphic fauna	-	-			-	-	
		Changes in the mobility patterns of individuals					-	-	





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ENVIRO NMENT	COMPROMISED ENVIRONMENTA L ELEMENT	IMPACTS OF ACTIVITIES EXECUTED IN THE AREA	MANAGEMENT OF SOLID WASTES BY THE COMMUNITY	MANAGEMENT OF LIQUID WASTES BY THE COMMUNITY	EXPLOITATION			FARMING ACTIVITIES	TRADE
					SURFACE WATER RESOURCE	GROUNDWATE R RESOURCE	FOREST		
SOCIOECONOMIC	Hydrobiology	Changes in the composition and structure of the hydrobiological communities	-	-	-		-	-	
		Alteration of the habitat of hydrobiological communities	-	-	-		-	-	
	Population Structure	Changes in the road accident rates						-	
	Economic and Productive Structure	Fragmentation of properties						-	
		Change in land prices					+	-	
		Change in the economic activities						+	
		Change in the dynamics of use							+
	Health	Change in the health state of the population	-	-		-		-	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.5 Identification of the Interactions that Caused Socio-Environmental Impacts in the Scenario without the Project (Continued).





ENVIRO NMENT	COMPROMISED ENVIRONMENTAL ELEMENT	IMPACTS OF THE ACTIVITIES EXECUTED IN THE AREA	TOURISM	FAUNA HAUNTING	QUARRIES	BURNING	AGRICULTURE (TRANSITORY CROPS)	FOREST PROTECTION AND CONSERVATION PLANTATIONS	HYDROCARBON TRANSPORT (OIL PIPELINE)	LAND TRANSPORT
ABIOTIC	Soil	Modification of soil stability			-		-			-
		Change in the Physicochemical and biological properties of the soil			-	-	-		-	
		Change in the use and potential of the soil			-	-				
	Surface Waters	Alteration of riverbeds	-		-	-	-	+		
		Alteration in the quality of surface water	-		-	-	-	+		-
		Variation in surface water resource availability			-	-	-	+		
		Variation of the amount and transport of sediments			-	-	-	+		

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ENVIRO NMENT	COMPROMISED ENVIRONMENTAL ELEMENT	IMPACTS OF THE ACTIVITIES EXECUTED IN THE AREA	TOURISM	FAUNA HAUNTING	QUARRIES	BURNING	AGRICULTURE (TRANSITORY CROPS)	FOREST PROTECTION AND CONSERVATION PLANTATIONS	HYDROCARBON TRANSPORT (OIL PIPELINE)	LAND TRANSPORT
	Groundwater	Decrease in the capacity of transport of water sources			-	+	-	-		
		Alteration in the quality of the groundwater	-		-	-	-	+		-
		Alteration of the groundwater flow network			-	-	-	+		
		Alteration of recharge areas	-		-	-	-	+		
	Air	Modification of air quality by Gases			-	-	-	+		-
		Modification of air quality by Particulate Material			-	-	-			-
		Generation of Odors								
		Variation in the sound pressure levels			-					-
	Landscape	Changes in the integrity of the landscape			-	-	-	+	-	-
		Modification of vegetation covers				-		+		
BIOTIC	Flora	Changes in the flora structure and composition				-		+		
		Changes in the structure, extension and availability of habitats of the wild fauna				-	-	+		
	Fauna	Changes in the composition and structure of fauna communities		-		-	-	+		-
		Alteration of the structural and functional connectivity of the habitats of the wild fauna				-	-	+		
		Alteration of the soil edaphic fauna				-	-	+		
		Changes in the mobility patterns of individuals		-		-	-	+		-
	Hydrobiology	Changes in the composition and structure of the hydrobiological communities				-	-	+		
		Alteration of the habitat of hydrobiological communities				-	-	+		
SOCIOECONOMIC	Population Structure	Changes in the road accident rates								
	Economic and Productive Structure	Fragmentation of properties					-			
		Change in land prices	+		-		+	+	-	
		Change in the economic activities	+		+		+			
		Change in the dynamics of use	+		+		+			
	Health	Change in the health state of the population	-		-	-	-			

Source: GEOCOL CONSULTORES S.A., 2017.

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Rating of criteria for determination of the Impacts identified is more detailed in **Annex 16. Assessment Matrix**. **Table 8.6** shows a summary table of the rating of the activities in the scenario without the project.

Table 8.6 Summary of Rating of the Activities in the Scenario without the Project

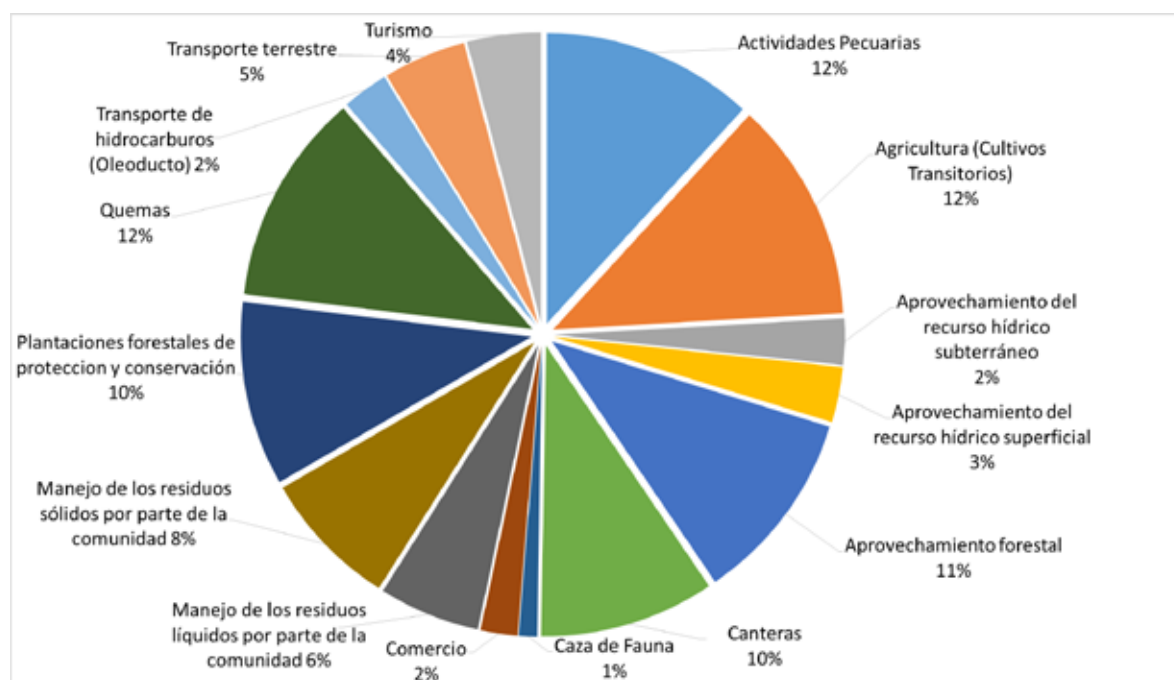
TYPE OF IMPACTS ACTIVITIES	NEGATIVE IMPACTS				TOTAL NEGATIVE	POSITIVE IMPACTS				TOTAL POSITIVE	TOTAL PROJECT
	MILD OR IRRELEVANT IMPACT (> A- 32)	MODERATE IMPACT (BETWEEN - 33 AND -51)	SEVERE IMPACT (BETWEEN - 52 AND - 74)	CRITICAL IMPACT (< A -74)		MILD OR IRRELEVANT IMPACT (< A 33)	MODERATE IMPACT (BETWEEN 33 AND 51)	SEVERE IMPACT (BETWEEN 52 AND 74)	CRITICAL IMPACT (> A 74)		
Management of solid wastes by the community	8	7	0	0	15	0	0	0	0	0	15
Management of liquid wastes by the community	4	5	2	0	11	0	0	0	0	0	11
Exploitation of surface water resource	1	5	0	0	6	0	0	0	0	0	6
Groundwater resource exploitation	1	4	0	0	5	0	0	0	0	0	5
Forest harvesting	9	10	0	0	19	1	1	0	0	2	21
Farming activities	14	8	0	0	22	0	1	0	0	1	23
Trade	3	0	0	0	3	0	1	0	0	1	4
Tourism	5	0	0	0	5	1	2	0	0	3	8
Fauna haunting	2	0	0	0	2	0	0	0	0	0	2
Quarries	4	11	2	0	17	1	1	0	0	2	19
Burning	9	13	0	0	22	0	1	0	0	1	23
Agriculture (Transitory Crops)	2	17	2	0	21	1	2	0	0	3	24
Forest protection and conservation plantations	0	1	0	0	1	7	12	0	0	19	20
Hydrocarbon transport (Oil pipeline)	3	2	0	0	5	0	0	0	0	0	5
Land transport	5	4	0	0	9	0	0	0	0	0	9
TOTAL	70	87	6	0	163	11	21	0	0	32	195

Source: GEOCOL CONSULTORES S.A., 2017.

8.2.4 Results of the Environmental Impact Assessment (Scenario without the Project)

Considering the primary and secondary information collected, in general terms, 195 impacts among the assessed activities and natural environment were assessed and they are positive and negative, the agricultural activity (transitory crops) being the one with the highest number of impacts equivalent to 12%, followed by burning activities and livestock activities equivalent to 11.8% each (See Figure 8.1).

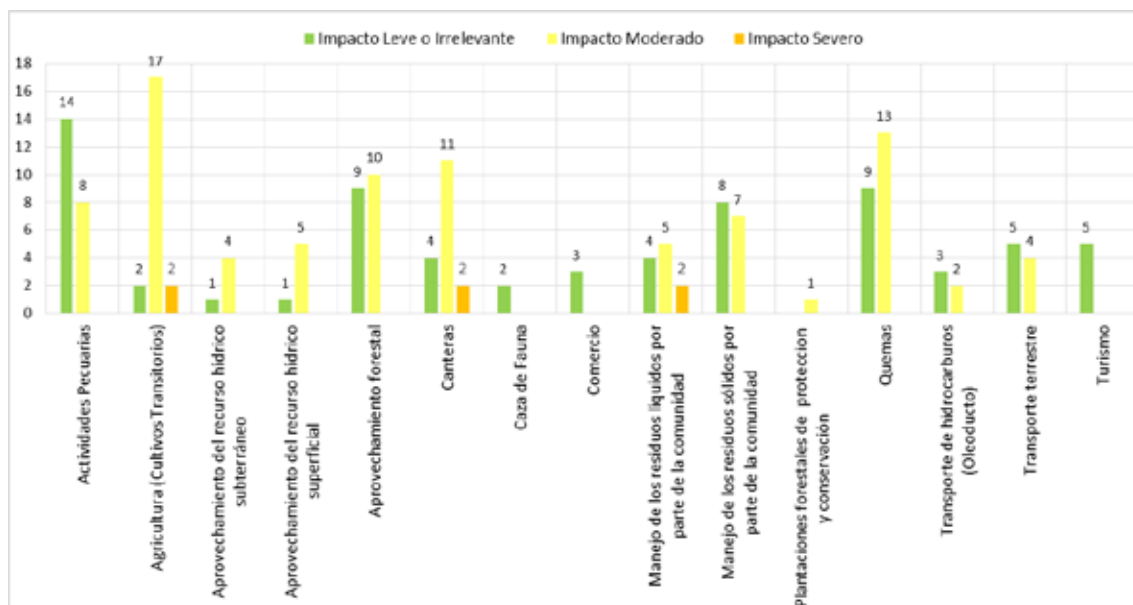
Figure 8.1 Total Activities Generating Socio-Environmental Impacts in the Stage Without Project



Source: GEOCOL CONSULTORES S.A., 2017.

The activities that have produced the highest number of negative impacts are the burning activities (9 mild or irrelevant impacts and 13 moderate impacts for a total of 22 impacts), the livestock activities (14 mild or irrelevant impacts and 8 moderate impacts for a total of 22 impacts) and agriculture (2 mild or irrelevant impacts and 17 moderate impacts and 2 severe impacts for a total of 21 impacts) (See Table 8.6 and Figure 8.2).

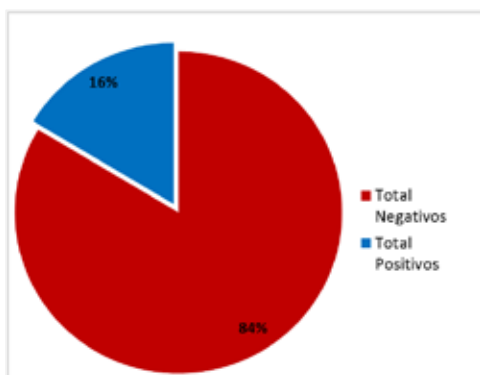
Figure 8.2 Number of Negative Impacts Generated by Activity in the Scenario without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

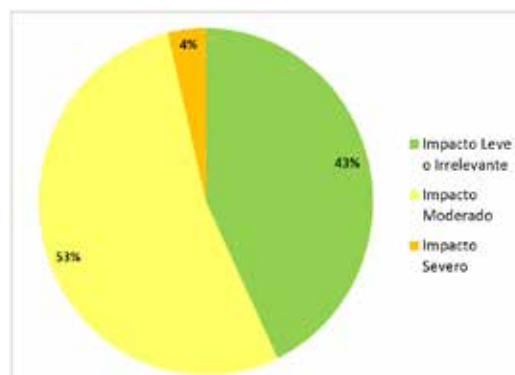
In the discrimination of the group of interactions that caused negative impacts in the activities developed by the community, 43% mild or irrelevant (70 impacts), 53% Moderate (87 impacts) and 4% corresponding to Severe (6 impacts) for a total of 163 negative impacts equivalent to 84% of all the impacts identified. (See Figure 8.3 and Figure 8.4).

Figure 8.3 Percentage of Positive and/or Negative Impacts in the Scenario without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

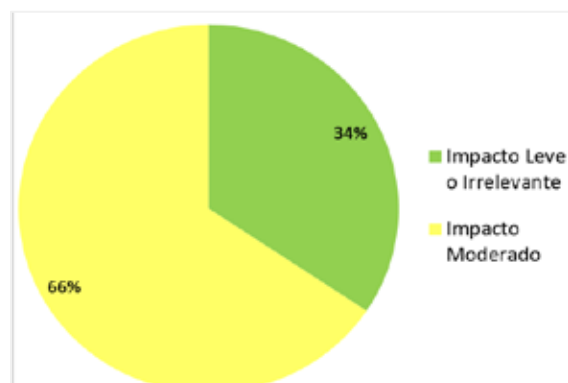
Figure 8.4 Percentage of Negative Impacts According to the Environmental Importance in the Scenario without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

Likewise, for the case of positive impacts there are eleven (11) mild or irrelevant impacts and twenty-one (21) moderate impacts, corresponding to 34% and 66%, respectively. Total positive impacts correspond to 16% of all the impacts identified (See Figure 8.3 and Figure 8.5).

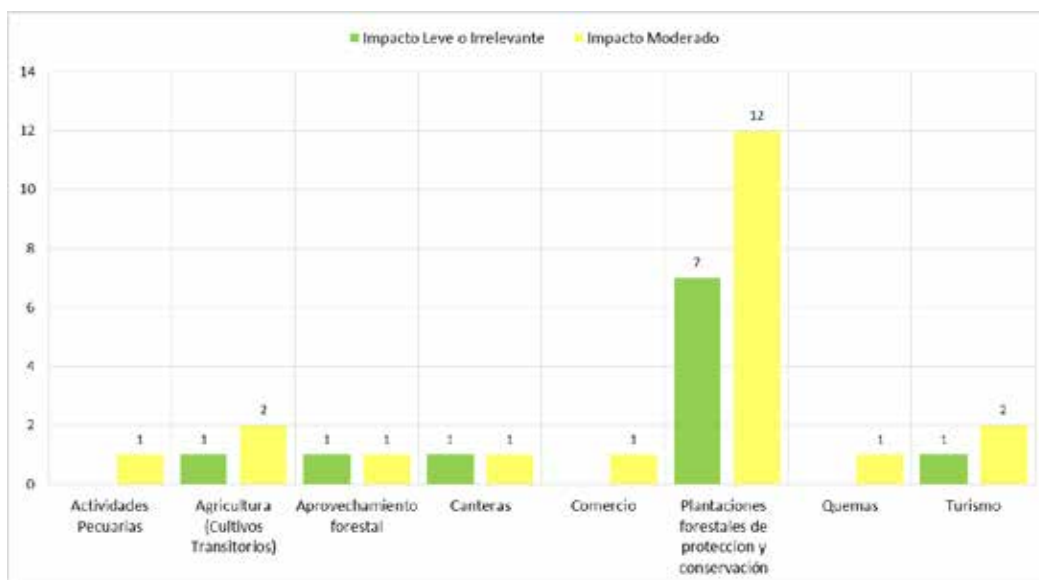
Figure 8.5 Percentage of Positive Impacts According to the Category of Environmental Importance in the Scenario without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

In a general manner, the activities that generate a higher number of positive impacts are the ones of forest protection and conservation plantations (7 mild or irrelevant impacts and 12 moderate impacts); followed by agriculture and tourism each one with 3 impacts (1 mild or irrelevant and 2 moderate) (See Table 8.6 and Figure 8.6).

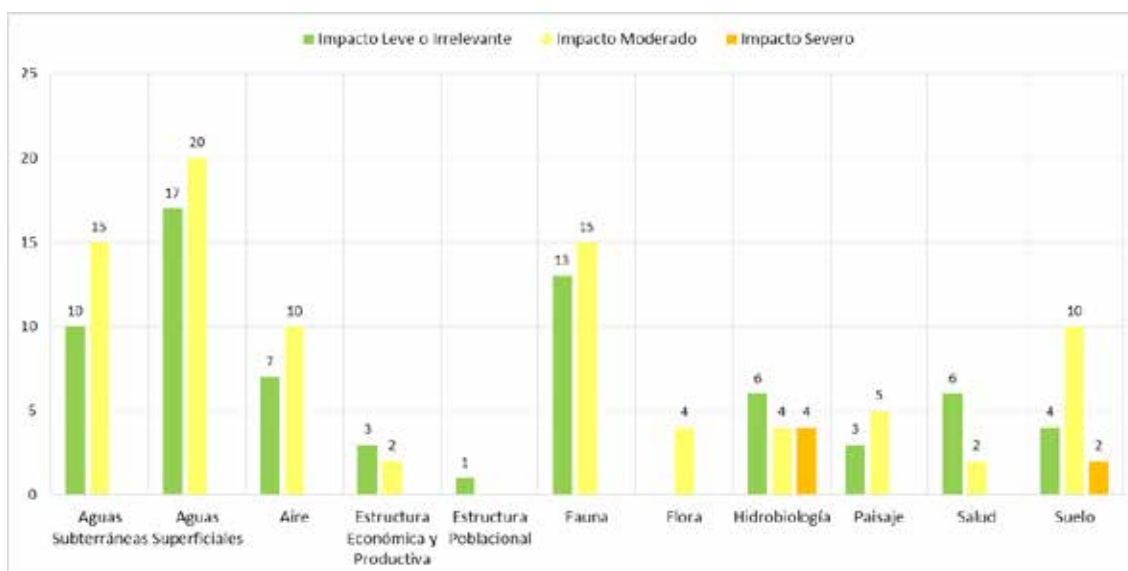
Figure 8.6 Number of Positive Impacts Generated by Activity in the Scenario Without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

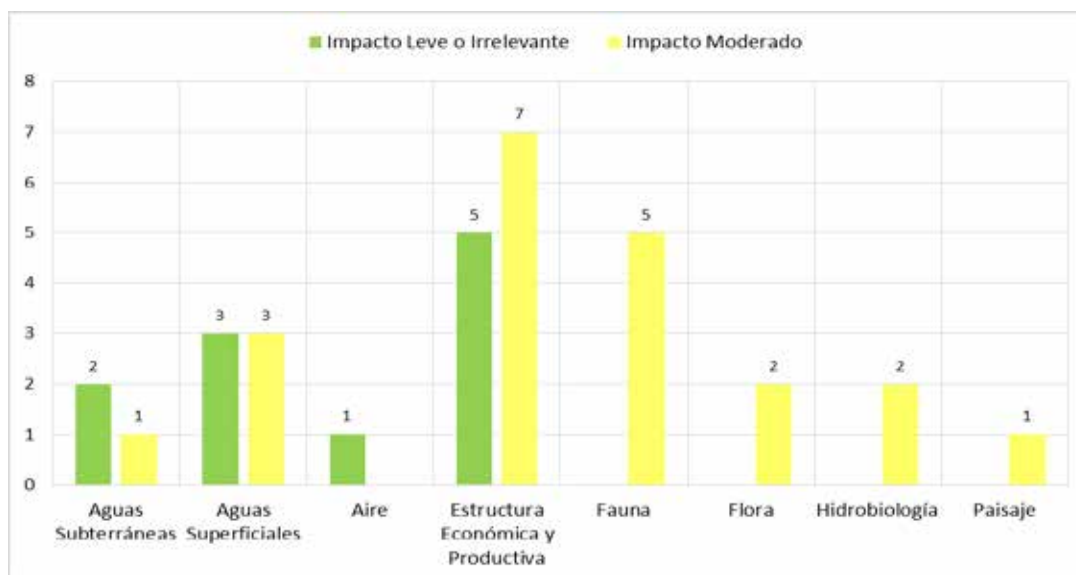
Figure 8.7 and Figure 8.8 show the environmental elements that have been the most affected both positively and negatively by the activities assessed in the scenario without the project according to the assessment of the impacts identified and considering the activities and environmental elements analyzed. It is evidenced that the environmental element with the highest number of negative impacts is the one of surface waters (17 mild or irrelevant impacts and 15 moderate impacts for a total of 37 impacts), followed by the fauna (13 mild or irrelevant impacts and 15 moderate impacts for a total of 28 impacts), while the element with the highest number of positive impacts is the one of the economic and productive structure (5 mild or irrelevant impacts and 7 moderate impacts for a total of 12 impacts), followed by surface waters with (3 mild or irrelevant impacts and 3 moderate impacts for a total of 6 impacts).

Figure 8.7 The Most Damaged Environmental Elements in the Scenario Without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

Figure 8.8 The Most Benefited Environmental Elements in the Scenario without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

8.2.5 Weighing of Environmental Impacts Assessed (Scenario without the Project)

As a complement, the activities that can be the most impacting and the most representative impacts assessed are weighed in order to establish which could affect to the greatest extent the different socio-environmental elements that compose the area of influence, considering the current state from the socio-environmental point of view of the area. Weighing is based on the IMA rating and organizes aspects and impacts in a hierarchy for the global rating.

Table 8.7 and **Table 8.9** show which are the activities that have had an impact to the greatest extent on the socio-environmental environment. **Table 8.8** and **Table 8.10** show which may be the most representative impacts for the scenario without the project, considering the weighing made.

The environmental impacts indicated in the aforementioned tables shall be analyzed in section **8.2.6 Analysis of the Impact Matrix (Scenario without the Project)**.

Table 8.7 Activities that Have Affected Negatively to the Greatest Extent the Natural Environment in the Scenario without the Project

ACTIVITY
Agriculture (Transitory Crops)
Burning
Quarries
Livestock Activities
Forest Harvesting

Source: GEOCOL CONSULTORES S.A., 2017.





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Table 8.8 Most Representative Negative Impacts in the Scenario without the Project

ENVIRONMENTAL IMPACT COMPROMISED	ENVIRONMENTAL IMPACT
Surface Waters	Alteration in the surface water quality
Groundwater	Alteration in the groundwater quality
Groundwater	Alteration of recharge areas
Surface Waters	Alteration of riverbeds
Landscape	Changes in the landscape integrity

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.9 Activities that Have Affected Positively to the Greatest Extent in the Natural Environment in the Scenario without the Project

ACTIVITY
Forest protection and conservation plantations
Agriculture (Transitory Crops)
Tourism
Forest harvesting
Quarries

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.10 Most Representative Impacts in the Scenario without the Project

ENVIRONMENTAL ELEMENT COMPROMISED	IMPACT
Economic and productive structure	Change in the dynamics of use
Economic and productive structure	Change in the land prices
Economic and productive structure	Changes in the economic activities
Surface waters	Variation in the amount and transport of sediments*
Fauna	Alteration of the structural and functional connectivity of the habitats of the wild fauna**

* Associated with the decrease of sediments for the forest plantations

** Associated with improvement of connectivity for forest plantations

Source: GEOCOL CONSULTORES S.A., 2017.

The five activities identified as the ones that have affected negatively the area the most and which impacts are caused with more intensity by such activities, according to the weighing made in **Table 8.7** (see **Table 8.11**) are shown below and **Table 8.12** shows the five activities identified as the ones that have benefited the area the most and which impacts are caused with the most intensity by such activities, according to the weighing made in **Table 8.9**.





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Table 8.11 Most Relevant Impacts in the Activities Identified as the Ones that Have Affected negatively the Area

IMPACTS OF ACTIVITIES	Agriculture (transitory crops)	Burning	Quarries	Livestock Activities	Forest Harvesting
Modification of soil stability	-38		-30		
Change in the Physicochemical and biological properties of the soil	-37	-48	-58	-26	
Change in the use and potential of the soil		-45	-58		-38
Alteration of riverbeds	-49	-40	-51	-40	-44
Alteration in the surface water quality	-48	-26	-40	-39	-25
Variation in the surface water resource	-49	-23	-24	-42	-29
Variation in the amount and transport of sediments	-47	-48	-43	-21	-41
Decrease in the water source transport capacity	-37		-30		
Alteration in the groundwater quality	-48	-26	-28	-39	-25
Alteration of the groundwater flow network	-43	-25	-51	-34	-29
Alteration of the recharge areas	-48	-36	-51	-47	-40
Modification of the air quality for Gases	-28	-33	-38	-38	-32
Modification of the air quality for Particulate Material		-27	-43		
Generation of Odors				-29	
Variation in the sound pressure levels			-34		
Changes in the landscape integrity	-44	-23	-41	-44	-26
Modification of the vegetation covers		-39			-36
Changes in the flora structure and composition		-44			-39
Changes in the structure, extension and availability of habitats of the wild fauna	-49	-41		-25	-45
Changes in the composition and structure of the fauna communities	-44	-48		-22	-36
Alteration of structural and functional connectivity of the habitats of the wild fauna	-49	-41		-25	-36
Alteration of the edaphic fauna	-50	-43		-22	-31
Changes in the mobility patterns of individuals	-36	-41		-22	-34
Changes in the composition and structure of hydrobiological communities	-62	-22		-22	-22
Alteration of the habitat of the hydrobiological communities	-62	-25		-25	-25
Changes in the road accident rates				-22	
Fragmentation of the properties	-34			-30	
Change in the land prices			-34	-31	
Change in the health state of the population	-26	-30	-38	-25	
Mild or Irrelevant Impact					
Moderate Impact					
Severe Impact					
Critical Impact					

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.12 Most Relevant Impacts in the Activities Identified as the Activities that Have Benefited the Area the Most





IMPACTS OF ACTIVITIES	Forest Protection and Conservation Plantations	Agriculture (Transitory Crops)	Tourism	Forest Harvesting	Quarries
Alteration of riverbeds	31				
Alteration in the surface water quality	28				
Variation in availability of the surface water resource	28				
Variation in the amount and transport of sediments	50				
Decrease of the water source transport capacity				44	
Alteration in the groundwater quality	28				
Alteration of the groundwater flow network	20				
Alteration of recharge areas	34				
Modification of the air quality for gases	32				
Changes in the integrity of the landscape	37				
Modification of the vegetation covers	33				
Changes in the flora structure and composition	35				
Changes in the structure, extension and availability of habitats of the wild fauna	48				
Changes in the composition and structure of the fauna communities	46				
Alteration of structural and functional connectivity of the habitats of the wild fauna	49				
Alteration of the edaphic fauna	49				
Changes in the mobility patterns of individuals	49				
Changes in the composition and structure of the hydrobiological communities	49				
Alteration of the habitat of hydrobiological communities	49				
Change in the land prices	25	39	46	32	
Change in the economic activities		32	28		35
Change in the dynamics of use		44	40		29
Mild or Irrelevant Impact					
Moderate Impact					
Severe Impact					
Critical Impact					

Source: GEOCOL CONSULTORES S.A., 2017.

8.2.6 Analysis of the Matrix by Impacts (Scenario without the Project)

The analysis of the matrix by impacts is made by using individual tables (or sheets) for each one of the impacts identified, associating it with the different activities generating it and obtaining a description by the group of professionals in a detailed manner.

Such tables involve definition of the environmental impact, the activities causing the impact, the value of environmental importance obtained through the modified assessment methodology of Vicente Conesa Fernández, and the description of the environmental impact on the different generating activities. It is worth

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clarifying that this tool is also used in the environmental assessment in the scenario with the project. The environmental assessment analysis of each one of the impacts assessed is shown below.

8.2.6.1 Abiotic Environment





Table 8.13 Description of the Impact of Modification of Soil Stability in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SOIL	
ENVIRONMENTAL IMPACT: MODIFICATION OF SOIL STABILITY	
This impact makes reference to the changes on the soil stability during execution of the different activities assessed.	
ACTIVITY	ENVIRONMENTAL SIGNIFICANCE VALUE
Exploitation of the surface water resource	(-35) Moderate Impact
Exploitation of the groundwater resource	(-34) Moderate Impact
Quarries	(-30) Mild or Irrelevant Impact
Agriculture (Transitory crops)	(-38) Moderate Impact
Land transport	(-23) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE ACTIVITIES GENERATING IT:	
Modification of the soil stability is the impact generated by loss of vegetation cover and/or organic soil cover. It can also be caused by another aspect when modeling and triggering agents act such as the presence of water in the soil to decrease cutting resistance of materials. For this reason, the activities related to the water component get a higher score in the impact rating. Development of agriculture in hillsides of steep slope involves generation of laminar erosive processes that may later transform into ruts and gullies modifying thus the stability of current hillsides. Based on the foregoing, the practice of this activity contributes with a negative rating to the impact described. Development of quarries and land transport generate an irrelevant impact on the modification of the soil stability and are considered isolated and punctual activities as the case of development of quarries.	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.14 Description of the Impact of Change in the Physicochemical and Biological Properties of the Soil in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SOIL	
ENVIRONMENTAL IMPACT: CHANGE IN THE PHYSICOCHEMICAL AND BIOLOGICAL PROPERTIES OF THE SOIL	
It consists in the physical, chemical and biological modifications that can be caused to the soil due to the natural and anthropogenic intervention.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-37) Moderate Impact
Management of liquid wastes by the community	(-37) Moderate Impact
Farming activities	(-26) Mild or Irrelevant Impact
Quarries	(-58) Severe Impact
Burning	(-48) Moderate Impact
Agriculture (Transitory Crops)	(-37) Moderate Impact
Hydrocarbon transport (Gas pipeline)	(-29) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
The impact is considered moderate and negative on the activity: disposal of solid wastes generated by the community and disposal of liquid wastes. Disposed wastes come from the domestic activities developed in the different districts that are part of the area subject to study, which are disposed and discharged on the ground; contributing thus to aesthetical deterioration of the natural landscape. Likewise, solid wastes deposited in open air contaminate the soil with pathogen microorganisms, heavy metals and toxic substances. Accumulation of wastes generates losses for farmers and land owners who may eventually use the land for agricultural, livestock breeding, conservation, urban and cultural development; that is, waste disposal affects potential use of soil.	

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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: SOIL
ENVIRONMENTAL IMPACT: CHANGE IN THE PHYSICOCHEMICAL AND BIOLOGICAL PROPERTIES OF THE SOIL
<p>Likewise, it is considered negative and moderate in the agricultural activity due to poor disposal of agrochemicals used for control of weeds and plagues in the different crops, they can remain for a very long time on the soil affecting the micro-flora. They also contribute acidification, loss and blockade of some nutrients, and decrease of infiltration for loss of structure.</p> <p>Moreover, it is considered negative and severe for presence of quarries. Development of this activity increases erosive processes, processes of mass removal, changes in the topographical composition and instability and total soil loss.</p> <p>The impact is also considered moderate because of the burning. This activity affects the stability of aggregates facing action of an external agent as water, wind or tillage. It affects the microbial activity that favors decomposition of the organic matter and availability of the nutrients for plants (Torres et al., 2004).</p> <p>Additionally, the impact is deemed negative, mild or relevant in the livestock activity and hydrocarbon transport (Gas pipeline). It is considered that the activity is conducted in small areas not endangering the ecosystem.</p>

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.15 Description of the Impact of Change in the Use and Potential of the Soil in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SOIL	
ENVIRONMENTAL IMPACT: CHANGE IN THE USE AND POTENTIAL OF SOIL	
It consists in assessing uses of the soil, in accordance with the natural vocation or potential use of the soil	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-39) Moderate Impact
Quarries	(-58) Severe Impact
Burning	(-45) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The impact is considered moderate and negative on the activity: disposal of solid wastes generated by the community. Presence of a site for final disposal of wastes without any environmental control shows in first instance a deterioration of the image and quality of the landscape. It causes losses for farmers and owners of the properties that could eventually be used for development of agricultural, livestock, conservation, urban and cultivation systems; that is, disposal of wastes affects potential use of soil.</p> <p>It is also considered moderate for the burning made for establishment of crops. In this aspect, soils are left devoid of vegetation eliminating on many occasions forests that serve for protection and conservation.</p> <p>Additionally, it is considered severe for the change in the use and potential of the soil for operation of quarries causing total degradation of vegetation, loss of forest resources and capacity of regeneration and total loss of the soil (edaphic properties).</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.16 Description of the Impact of Alteration of Riverbeds in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SURFACE WATERS	
ENVIRONMENTAL IMPACT: ALTERATION OF RIVERBEDS	
This impact makes reference to the changes that arise in riverbeds due to the existing conditions and assessing the activities made by the community.	
ACTIVITY	VALUE O ENVIRONMENTAL SIGNIFICANCE
Exploitation of the surface water resource	(-45) Moderate Impact
Forest Harvesting	(-44) Moderate Impact
Livestock Activities	(-40) Moderate Impact
Tourism	(-17) Mild or Irrelevant Impact





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ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SURFACE WATERS	
ENVIRONMENTAL IMPACT: ALTERATION OF RIVERBEDS	
Quarries	(-51) Moderate Impact
Burning	(-40) Moderate Impact
Agriculture (Transitory Crops)	(-49) Moderate Impact
Forest Protection and Conservation Plantations	(+31) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Most of the surface water currents suffer modifications for hydraulic constructions that regulate their beds and they are deviated to exploitation areas, altering the amount of water that flows by them. In addition to modification of the flow regime, these works have also altered the morphology of the rivers.</p> <p>There are other works that have been executed in their riverbeds, which have modified the morphologic structure, preventing in many cases connectivity of riverbeds with the alluvial plains or modifying the natural habitat of inhabitants of the riverbeds, including quarries or burning that has a significant incidence.</p> <p>Use and exploitation of the surface water resource in a domestic manner or for livestock consumption generate establishment of fixed or mobile catchment points in different sectors of the riverbeds where contamination sources is also favored by having in these sites liquid and solid wastes of fertilizers and fungicides.</p> <p>Moreover, an activity as forest exploitation involves a change in the use of soil around the watershed, which intervenes negatively in the surface sources causing damage and even possible alterations in the physicochemical quality in rivers, creeks or other lentic waters. Other actions that have an important impact are the agricultural activities by the transitory crops that can represent a source of income for inhabitants, but this without measuring the future consequences on different components of the environment, including water consumption for irrigation required by the activity and that involves continuous catchment of surface sources, representing considerable changes in such sources. For this reason, it has a moderate rating for environmental impact of riverbeds.</p> <p>The farming activities are related to water supply to achieve development thereof at individual or industrial scale since they require the resource for feeding and washing animals, as well as for preparation of products derived from them, which has a negative impact for the amounts used in each one of the processes. This allows having conditions for diversification or fragmentation of these riverbeds in a top-down manner.</p> <p>Other activities such as tourism (negative character) and the forest protection and conservation plantations constitute a mild or irrelevant impact since in alteration of riverbeds it does not involve a greater participation.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.17 Description of the Impact of Alteration in the Surface Water Quality in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SURFACE WATERS	
ENVIRONMENTAL IMPACT: ALTERATION IN THE SURFACE WATER QUALITY	
The changes or alteration in the surface water quality values due to the conditions and activities assessed are described.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-43) Moderate Impact
Management of liquid wastes by the community	(-43) Moderate Impact
Forest harvesting	(-25) Mild or Irrelevant Impact
Farming activities	(-39) Moderate Impact
Tourism	(-14) Mild or Irrelevant Impact
Quarries	(-40) Moderate Impact
Burning	(-26) Mild or Irrelevant Impact
Agriculture (Transitory Crops)	(-48) Moderate Impact
Forest protection and conservation plantations	(+28) Mild or Irrelevant Impact
Hydrocarbon transport (Oil pipeline)	(-31) Mild or Irrelevant Impact
Land transport	(-14) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>One of the greatest threats on water resources is degradation of the ecosystems, which often occurs due to the changes in the landscape as clearing, transformation of natural landscapes in agricultural lands, urban growth and open-air mining, among others. Each one of the changes in the landscape has a specific impact, in general, directly on the natural ecosystems and directly or indirectly</p>	

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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: SURFACE WATERS
ENVIRONMENTAL IMPACT: ALTERATION IN THE SURFACE WATER QUALITY
<p>on the water resources.</p> <p>Therefore, alteration of the surface water quality is a generally negative and determining impact concerning degradation of the ecosystems. This is caused by multiple activities of anthropogenic origin mentioned already, among which the most relevant is farming due to the high percentages of consumption of the liquid and water pollution that affects the natural recirculation process, adding the impact generated by management of solid and liquid wastes of the community. There are other human actions with less impact or alteration of the surface water quality as forest harvesting, tourism, land transport, burning controlled by inhabitants, hydrocarbon transport and land transport.</p> <p>Likewise, the forest protection and conservation plantations in the area favor the surface water quality, although its impact is considered mild or irrelevant.</p>

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.18 Description of the Impact of Variation of Surface Water Resource Availability in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SURFACE WATER	
ENVIRONMENTAL IMPACT: VARIATION OF SURFACE WATER RESOURCE AVAILABILITY	
It makes reference to the changes concerning availability of surface water caused by development of the activities found and assessed.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Exploitation of the surface water resource	(-42) Moderate Impact
Exploitation of the groundwater resource	(-24) Mild or Irrelevant Impact
Forest harvesting	(-29) Mild or Irrelevant Impact
Farming activities	(-42) Moderate Impact
Trade	(-14) Mild or Irrelevant Impact
Quarries	(-24) Mild or Irrelevant Impact
Burning	(-23) Mild or Irrelevant Impact
Agriculture (Transitory Crops)	(-49) Moderate Impact
Forest protection and conservation plantations	(+28) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Natural surface water conditions allow biotic development in a region. Therefore, availability of the water resource allows or hinders development of ecosystems and its sustainability in time.</p> <p>Variations in this water availability at surface level have a negative impact transmitted to the surrounding biotic components, which are derived from human actions, especially exploitation and use of the surface water resource for multiple domestic and farming activities. This alters the natural conditions and if combined with certain weather factors, it can endanger some sources for shortage.</p> <p>Groundwater exploitation is also a determining and influential factor in the generation of the impact for reduction of the resource until a possible elimination of its availability for alteration of depletion and discharge zones of the area, although this impact is considered mild or irrelevant.</p> <p>To a lesser extent, forest activities, trade, quarries, controlled burning and brick industry have an incidence on mild or irrelevant assessment of the impact.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.19 Description of the Impact of Variation in the Amount and Transport of Sediments in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SURFACE WATERS	
ENVIRONMENTAL IMPACT: VARIATION IN THE AMOUNT AND TRANSPORT OF SEDIMENTS	
In this impact, changes and variation of the amount and transport of sediments caused by execution of different activities assessed are indicated.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-22) Mild or Irrelevant Impact

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ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SURFACE WATERS	
ENVIRONMENTAL IMPACT: VARIATION IN THE AMOUNT AND TRANSPORT OF SEDIMENTS	
Management of liquid wastes by the community	(-17) Mild or Irrelevant Impact
Forest harvesting	(-41) Moderate Impact
Livestock Activities	(-21) Mild or Irrelevant Impact
Quarries	(-43) Moderate Impact
Burning	(-48) Moderate Impact
Agriculture (Transitory Crops)	(-47) Moderate Impact
Forest protection and conservation plantations	(+50) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The maximum amount of sediments per unit of time that can be transported by a certain flow in a riverbed can be subject to a negative incidence caused by external factors which involve changes such as increase in the volume of sediments and difficulties for transport, resulting in accumulation thereof in the water sources along with contaminant particles.</p> <p>Execution of daily anthropogenic works that have impacts includes mainly forest harvesting, presence of quarries near watersheds and occurrence of controlled burning, as well as agriculture. This impact is considered moderate, has an important influence on variations of the sediments provided to the water sources.</p> <p>Management of solid and liquid wastes by the community has a low or irrelevant level, as well as the farming activities, caused by a controlled management of these wastes avoiding direct disposal to surface sources. There is low livestock consumption. In the area, there is not extensive farming.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.20 Description of the Impact of Decrease in the Transport Capacity of Surface Water Sources in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: SURFACE WATERS	
ENVIRONMENTAL IMPACT: DECREASE OF THE WATER RESOURCE TRANSPORT CAPACITY	
This impact makes reference to the negative variation of the water source transport capacity caused by the different activities assessed.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-24) Mild or Irrelevant Impact
Management of liquid wastes by the community	(-17) Mild or Irrelevant Impact
Forest harvesting	(+44) Moderate Impact
Quarries	(-30) Mild or Irrelevant Impact
Burning	(+48) Moderate Impact
Agriculture (Transitory Crops)	(-37) Moderate Impact
Forest protection and conservation plantations	(-49) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Development of the biogeochemical cycle of the water involves combination of multiple factors that allow change of the water state and conditions facilitating its transport. In this manner, the transport capacity being the maximum load that a water current is able to transport depends on factors such as changes in the slope, roughness (related to cover) and discharge, which are negatively impacted by different actions of the communities that contribute to decrease of this capacity.</p> <p>The most important activities referred in the studied area include forest harvesting, burning and agriculture, in addition to forest protection and conservation plantations that involve changes in the natural cover and, therefore, alteration of surrounding water sources affecting the transport capacity of the resource.</p> <p>Impacts are also caused by activities as establishment of quarries, management of solid and liquid wastes by the community, although they are qualified as mild or irrelevant.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.





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Table 8.21 Description of the Impact of Alteration in the Groundwater Quality in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: GROUNDWATER	
ENVIRONMENTAL IMPACT: ALTERATION OF THE GROUNDWATER QUALITY	
In this impact, modifications to the groundwater values due to activities found and assessed are described.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-38) Moderate Impact
Management of liquid wastes by the community	(-38) Moderate Impact
Forest harvesting	(-25) Mild or Irrelevant Impact
Farming activities	(-39) Moderate Impact
Tourism	(-14) Mild or Irrelevant Impact
Quarries	(-28) Mild or Irrelevant Impact
Burning	(-26) Mild or Irrelevant Impact
Agriculture (Transitory Crops)	(-48) Moderate Impact
Forest protection and conservation plantations	(+28) Mild or Irrelevant Impact
Hydrocarbon transport (Oil pipeline)	(-40) Moderate Impact
Land transport	(-14) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
Alteration of the groundwater quality causes generally a negative impact since it involves a very slow recovery by seasonal runoff cycles and is caused by execution of anthropogenic activities especially the ones that have a direct incidence, such as: management and disposal of solid wastes and liquid wastes, farming activities (organic wastes) and agriculture (seepage of fungicides and fertilizers) that result in an impact assessment of moderate since these activities are primary sources of contamination for the seepage to the vadose and saturated area of the surface aquifers, affecting their natural state. It is possible that aquifers can be contaminated whether by chemical products or pathogen microorganisms; therefore, their use is every time more limited. Additionally, there are other activities not less important, which have an impact on the groundwater quality, including the activities of forest harvesting, tourism, presence of exploitation with quarries and controlled burning made by the inhabitants of the area.	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.22 Description of the Impact of Alteration of the Groundwater Flow Network in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: GROUNDWATER	
ENVIRONMENTAL IMPACT: ALTERATION OF THE GROUNDWATER FLOW NETWORK	
This impact indicates the changes generated in the flow established of the groundwater for development of different activities assessed.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Exploitation of the surface water resource	(-24) Mild or Irrelevant Impact
Exploitation of the groundwater resource	(-47) Moderate Impact
Forest harvesting	(-29) Mild or Irrelevant Impact
Farming activities	(-34) Moderate Impact
Quarries	(-51) Moderate Impact
Burning	(-25) Mild or Irrelevant Impact
Agriculture (Transitory Crops)	(-43) Moderate Impact
Forest protection and conservation plantations	(+20) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
The variation in the groundwater flow network is an impact caused by alteration of the natural conditions of the flow from the recharge area intervening negatively in any part of the hydrological model, which causes alteration in the amount of flow and possible effects on the discharge areas changing or obstructing the natural course of the water resource. Human actions allowing generation of the impact in an important manner and being, thus, rated as moderate are as follows:	

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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: GROUNDWATER
ENVIRONMENTAL IMPACT: ALTERATION OF THE GROUNDWATER FLOW NETWORK
<p>exploitation of the groundwater resource, considering extraction through cisterns or water upwelling, the quarries require use and alteration of the flow network of the area. Agriculture has an impact due to demand of water for irrigation, farming activities in which groundwater is the main source for the processes developed, in addition to the phenomenon of progressive compacting of the soil for the constant traffic of livestock.</p> <p>Other activities intervening in a less relevant manner are exploitation of surface water, tree cutting or forest harvesting, also possible burning and forest plantation for protection-conservation (positive). Their alteration is much less.</p>

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.23 Description of the Impact of Alteration of Recharge Areas in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: GROUNDWATER	
ENVIRONMENTAL IMPACT: ALTERATION OF RECHARGE AREAS	
It refers to the changes in the recharge areas for rain waters, generated during execution of the different activities assessed.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Exploitation of the groundwater resource	(-41) Moderate Impact
Forest harvesting	(-40) Moderate Impact
Farming activities	(-47) Moderate Impact
Trade	(-17) Mild or Irrelevant Impact
Tourism	(-17) Mild or Irrelevant Impact
Quarries	(-51) Moderate Impact
Burning	(-36) Moderate Impact
Agriculture (Transitory Crops)	(-48) Moderate Impact
Forest protection and conservation plantations	(+34) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The alterations generated in recharge areas have a negative but definite impact on the hydrological model of the region modifying the natural conditions of such model so that they can decrease significantly the flow of the water resource, trigger loss of supply, water unbalance and possible contamination.</p> <p>The impact on these areas has several activities that generate and increase the value in a significant manner, including: presence and development of quarries (loss of vegetation cover), farming activities (overcompacting of the soil), exploitation of the resource at underground level (overexploitation of aquifers), agricultural activities through transitory crops (change of the vegetation cover), forest harvesting (loss of vegetation cover), the brick companies in the area (change of use of soil) and forest plantations for conservation-protection (positive-change in the vegetation cover). Nonetheless, the impact in the worst-case scenario is of moderate degree.</p> <p>Activities such as trade and tourism in the region have a mild or irrelevant impact since they are not directly related to the sites defined as recharge areas.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.24 Description of the Impact of Modification of the Air Quality for Gases in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: AIR	
ENVIRONMENTAL IMPACT: MODIFICATION OF THE AIR QUALITY FOR GASES	
Variation in the concentration of gases, coming mainly from combustion processes, which being over the allowed limits can cause changes in the environment.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-33) Moderate Impact

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ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: AIR	
ENVIRONMENTAL IMPACT: MODIFICATION OF THE AIR QUALITY FOR GASES	
Management of liquid wastes by the community	(-35) Moderate Impact
Forest harvesting	(-32) Mild or Irrelevant Impact
Farming activities	(-38) Moderate Impact
Quarries	(-38) Moderate Impact
Burning	(-33) Moderate Impact
Agriculture (Transitory Crops)	(-28) Mild or Irrelevant Impact
Forest protection and conservation plantations	(+32) Mild or Irrelevant Impact
Land transport	(-37) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Modification of the air quality is an impact qualified negatively and is generated with development of human activities in the studied area; mainly for emission of contaminants and gases as SO_x, NO_x, CO, total Hydrocarbons. One of the main causes is combustion of hydrocarbons in the engines of the vehicles used for transport in the panamericana highway and tertiary roads of the area. It was considered a Moderate Impact and the main criterion that leads to this rating is the continuous regularity of the activity.</p> <p>For the area subject to study, agriculture is the activity developed to the greatest extent. This has some implications on the atmospheric component. First, it is directly related to vegetation cutting since an ecosystem function has a connection with fixing of the carbon present in the air of the area, and extension of the agricultural border reduced the number of individuals that catch CO₂ for O₂ production through the photosynthesis process. Likewise, spraying of crops is considered in the rating. Nonetheless, such spraying is occasional. For this reason, it was qualified as mild or irrelevant.</p> <p>Farming development creates the conditions for generation of methane gas since it is formed in a natural manner in the process of digestion of livestock and in decomposition of their feces. This impact was assessed as moderate since it occurs in a continued manner, but it has a low intensity and punctual extension, given that it occurs in small plots and the number of head of livestock is low (there is not extensive farming in the area of influence of the project). It is also associated, during extension of the farming border, with burning made for regeneration of pastures used as food for cattle, as well as for fitting of the land for agriculture.</p> <p>As seen during survey of the primary information, management of solid wastes by some inhabitants is deficient (especially in the rural areas and peripheries of the urban centers), choosing on many occasions open-air disposal or burning of wastes. In the cases in which they are burnt, they seek to reduce their volume, preventing bad odor and avoiding proliferation of vectors caused by decomposition. When garbage is burnt, it generates smoke with harmful chemical substances for men and contaminants for the environment; for example, carbon monoxide, sulfur dioxide, particulate material, heavy metals, dioxins, furans and carbon dioxide. This impact is moderate since intensity is medium and extension of the effects is partial.</p> <p>Likewise, decomposition of the organic matter of untreated waste waters by communities of the area generates gases such as hydrogen sulphide and ammonia, which can disturb communities neighboring the discharge sites that are usually the soil and/or creeks with small flows. Something similar occurs with management of waste waters coming from the places of pig breeding, evidencing that management of manure and waste waters coming from washing of the associated untreated structures, generating decomposition of the organic matter and supplying ammonia and methane⁷, with which gases that affect the atmospheric quality of the sector are produced.</p> <p>Quarries in the area of influence of the project were identified. In such quarries, it is necessary to use machinery and equipment that release gases that deteriorate air quality to a punctual extension, such as CO, CO₂, NO. For this reason, it was identified as a moderate negative impact.</p> <p>Nonetheless, the results of monitoring of the air quality did not report levels higher than the values allowed by the current regulations in none of the monitoring stations and for the total of parameters measured (TSP, PM10, PM2.5, NO_x, SO₂, CO and HCT).</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.25 Description of the Impact of Modification of the Air Quality by Particulate Material in the Scenario without the Project

ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: AIR

⁷ MINISTRY FOR THE ENVIRONMENT, HOUSING AND TERRITORIAL DEVELOPMENT. Environmental Guidelines for the Pig Farming Sector. Bogota 2002.

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ENVIRONMENTAL IMPACT: MODIFICATION OF THE AIR QUALITY BY PARTICULATE MATERIAL	
Variation in the typical concentration of particulate material in an area, which, being above the allowed limits, can cause changes in the environment.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Quarries	(-43) Moderate Impact
Burning	(-27) Mild or Irrelevant Impact
Land transport	(-34) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>During operation of quarries, amounts of particulate material are produced, especially for action of the wind of the area, which carries fine material in the soil and material removed, affecting areas surrounding intervention sites. Likewise, during burning, in addition to generating carbon dioxide, ashes are produced as a result of combustion. Part of such ashes remains as waste in the form of dust deposited in the place where fuel is burnt (wood, pastures, etc.) and part of it can be expelled by the air as part of the smoke and also carried by the wind.</p> <p>Road traffic (which involves transport of quarry material, the transport made by the community, among the other activities developed) causes suspension in the air of dust present in the roads mainly without paving, which later falls on areas neighboring this type of road corridors, the biggest amounts being produced during the dry season. This impact is assessed as irrelevant for burning mainly due to the intensity criteria (low) and regularity (regular) with respect to the other two impacts assessed (land transport and operation of quarries), which obtained a moderate rating since it has an intensity between medium and high, respectively, and a continuous periodicity. This impact for all cases has a brief duration, being mitigable and reversible. Additionally, it is considered a direct and high-resilience impact.</p> <p>In spite of existence of several activities generating this impact, the results of monitoring of the concentrations of total suspended particles (TSP) and particulate material (PM10 and PM2.5) did not report levels higher than the ones allowed by the current regulations.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.26 Description of the Impact of Generation of Odors in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: AIR	
ENVIRONMENTAL IMPACT: ODOR GENERATION	
Emission of odorous substances could cause disturbances in the environment. Bad odors can be unpleasant, cause rejection and affect life quality of people and animals from the environment. Therefore, it is considered as a form of environmental pollution.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-25) Mild or Irrelevant Impact
Management of liquid wastes by the community	(-29) Mild or Irrelevant Impact
Farming activities	(-29) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Considering that management of solid and liquid wastes by the community is poor in the rural areas and periphery of the urban centers. Unpleasant odors associated with such wastes were evidenced in the field phase. This is mainly due to the fermentation caused by offensive odors such as hydrogen sulphide and methane. This impact was identified and assessed as mild or irrelevant since it has a medium intensity, but it is punctual and with a brief manifestation.</p> <p>As for the farming activities, decomposition of feces and waste waters cause odors that are unpleasant in the areas near these places, which was identified during field tours and the information provided by the communities that accompanied this process. Nonetheless, the extension of this alteration is punctual with a low intensity since it does not occur in an extensive manner. Therefore, it was categorized as an impact of mild or irrelevant environmental significance.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.





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Table 8.27 Description of the Impact of Variation in the Sound Pressure Levels in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: AIR	
ENVIRONMENTAL IMPACT: VARIATION IN THE SOUND PRESSURE LEVELS	
Variation in the noise intensity in a certain area for development of different anthropogenic activities such as use of machinery, vehicles and equipment. By exceeding certain levels, they can generate changes in the dynamics of movement of the fauna and discomfort of the communities near the source of emission.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Quarries	(-34) Moderate Impact
Land transport	(-34) Moderate Impact
Trade	(-31) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Noise generation is related to operation of machinery and equipment linked to operation of quarries of material extraction, in addition to the vehicles in charge of transport thereof. This noise is brief, but continuous. However, the quarries are located in rural areas and transport is not made by the urban centers of the towns of the area. For this reason, the impact was assessed as moderate for not being considered important.</p> <p>Moreover, mobilization of vehicles modifies briefly the environmental noise in the areas near the roads and considering the area of influence of the Rumichaca – Pasto Divided Highway Project, Section San Juan – Pedregal has an abundant road network with national highways as the panamericana, municipal and district roads, which are the main noise generating focuses in the area, the impact of variation of sound pressure levels was assessed as moderate.</p> <p>The noise generated by trade is also considered. In general, this impact has the same characteristics, except for intensity, which is low and makes rating of the impact be mild or irrelevant.</p> <p>The sounds generated by wild and domestic animals as dogs, cattle, pigs, horses, poultry, among others, were identified. Although the sound generated by the fauna is not deemed as noise, it is considered as source of emission, represented mostly by birds during the day while at nighttime the noise is generated by amphibians and insects, which increase their activity during those hours.</p> <p>Out of 6 noise monitoring stations installed in the area of influence, 3 stations exceeded the noise levels allowed by current regulations, mostly located in populated centers.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.28 Description of the Impact of Changes in the Integrity of the Landscape in the Scenario without the Project

ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: LANDSCAPE	
ENVIRONMENTAL IMPACT: CHANGES IN THE INTEGRITY OF THE LANDSCAPE	
It corresponds to changes in the landscape units for effect of the transformation of covers, as well as increase in the artificial and discordant elements that reduce landscape integrity. These changes respond directly to use of soil, earth moving, changes in covers and development of activities of the project, which involves changes in the perception of the landscape by permanent and floating observers and in quality and visual fragility.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-23) Mild or Irrelevant Impact
Forest harvesting	(-26) Mild or Irrelevant Impact
Farming activities	(-44) Moderate Impact
Quarries	(-41) Moderate Impact
Burning	(-23) Mild or Irrelevant Impact
Agriculture (transitory Crops)	(-44) Moderate Impact

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ENVIRONMENT: ABIOTIC	
ENVIRONMENTAL ELEMENT: LANDSCAPE	
ENVIRONMENTAL IMPACT: CHANGES IN THE INTEGRITY OF THE LANDSCAPE	
Forest protection and conservation plantations	(+37) Moderate Impact
Hydrocarbon transport (Oil pipeline)	(-38) Moderate Impact
Land transport	(-44) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES	
<p>The impact of management by community of solid wastes was qualified as mild or irrelevant for integrity of the landscape since, even though there is no garbage collection service, a high proportion of the resources generated correspond to organic wastes that are used as food for domestic animals while another type or wastes are burnt or buried. In this manner, this impact was deemed as irrelevant or mild since it is punctual, is not permanent in the environment, has a low intensity and is reversible. As a result, the impact on the visual landscape is not significant since it does not cause a constant alteration on the visibility and quality of the landscape, being present only when it is made and it is not frequent either.</p> <p>As for the impact generated by forest harvesting on integrity of the landscape, it was considered mild or irrelevant since it mostly corresponds to use of introduced species (eucalyptus, mainly). Therefore, it does not represent changes in the natural covers or in the corresponding landscape units. It is a punctual activity and although it occurs often, it does not alter the visual features of the landscape since it is made progressively without having a high intensity. Nonetheless, it is worth mentioning that it is an activity that can have a greater impact in the medium and long term in case of increasing its frequency and volume of exploitation.</p> <p>For the case of farming activities, they have been one of the main factors having an incidence on formation of the current landscape since it has transformed the natural covers into pasture areas for livestock. Accordingly, the landscape units associated with natural covers have been modified, being currently dominant this type of units associated with pasture and crop mosaics and clean pastures decreasing representation of native vegetation and its regeneration potential. This impact was thus considered Moderate since its intensity is high and affects a wide part of the area of influence analyzed, altering integrity of the landscape by reducing presence of features that provide visual quality to the landscape (vegetation, chromatic correspondence, among others).</p> <p>In the case of operation and presence of quarries, they were considered as Moderate since they modify permanently the landscape units, altering both the geomorphology and the cover, in addition to most of the visual features such as the contrast between soil and rock, soil and vegetation, chromatic correspondence increase of presence of discordant elements, among others. Even though it is a punctual impact, its intensity is high and it is considered irreversible in time. For such reasons, it obtained such rating.</p> <p>Regarding burning, this activity was rated with mild or irrelevant importance because although they represent a visual barrier generated by the smoke, it is occasional and does not remain in the concerned environment permanently. It also occurs in a punctual manner, has a low intensity and is immediately reversible.</p> <p>As the case of farming, agriculture has been one of the main activities modeling the current landscape since it has caused a significant transformation in natural covers and the associated landscape units. In this manner, visual features giving quality and integrity to the landscape have been altered, such as the potential of natural regeneration of the vegetation or presence of native vegetation. Agriculture being widespread in the area of influence analyzed and occurring in a constant manner, it was assessed with a moderate environmental importance value.</p> <p>In the case of forest protection and conservation plantations, this activity was assessed as positive although with a moderate importance value since although plantations contribute to maintenance of visual attributes that generate landscape integrity and visual quality, they are mainly eucalyptus plantations, which correspond to an introduced species that may affect in processes such as natural regeneration of vegetation and increase in the contrast between soil and rock for the allelopathy with other species, reducing the positive effect that it may have on perception of the landscape.</p> <p>In the case of hydrocarbon transport, the impact was assessed with a moderate importance value for presence of pipeline at ground level, which diminishes the scene integrity given that such discordant element and other associated structures, as valves and signals, are present. By corresponding to a linear structure, it is considered widespread in the area of influence analyzed with a permanent and direct visual impact.</p> <p>As for land transport, this impact was considered with a moderate environmental importance to the extent that it involves a high frequency and integrity of the discordant elements (vehicles), which reduces significantly the landscape integrity observed and involves a reduction in the visual quality of the landscape given that artificial elements linked to the activity are predominant. The artificial elements associated with the activity. For its characteristics, it was considered extended with a direct effect and a permanent presence in the area affected, although its effects are reversible in the short term and are not considered synergic or cumulative.</p>	





Source: GEOCOL CONSULTORES S.A., 2017.

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8.2.6.2 Biotic Environment

Table 8.29 Description of the Impact of Modification of Vegetation Covers in the Scenario without the Project

ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FLORA	
ENVIRONMENTAL IMPACT: MODIFICATION OF VEGETATION COVERS	
This impact refers to the changes that occur on the natural vegetation covers, especially in terms of surface.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Forest harvesting	(-42) Moderate Impact
Burning	(-45) Moderate Impact
Forest protection and conservation plantations	(+33) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The modification of the natural vegetation covers is an impact qualified negatively for having a harmful effect for the flora element, which is generated with development of anthropogenic activities developed in the area subject to study; mainly the agricultural activity and, to a lesser extent, farming. It occurs in case of forest harvesting or vegetation cutting and burning for fitting of lands, which affect natural vegetation because of the definite change of cover and, with that, its function and structure are eliminated, as well as the environmental services provided by vegetation. This impact was also assessed for the activity of development of forest protection and conservation plantations, with a positive character for presenting benefits for the element assessed by generating cover and vegetation for protection.</p> <p>For the area subject to study, the most widespread productive activity is agriculture with transitory crops of potato, peas, corn, among others, which require removal of the natural vegetation for establishment. Nonetheless, this activity is being developed in the area for several decades. Therefore, nowadays natural vegetation is scarce. There are only remains of dense forest, riparian forest, high secondary vegetation and open rocky grassland or fallow land areas where low secondary vegetation is developed. This impact for the activity of forest harvesting or natural vegetation removal is considered negative or harmful on the flora element and it was assessed as moderate due to the following individual assessments: its intensity is low since the effect is a minimal modification to the flora element; its extension is punctual because, as it was mentioned already, the natural vegetation has very small areas in an scarce manner; the duration is permanent because the activity is made in a constant manner in the entire area and generally in cycles that do not allow development of vegetation; periodicity was considered irregular because of the scarce presence of vegetation; removal of natural vegetation is made only once in an unpredictable manner in time. As for recoverability, this impact is considered recoverable since if corrective measures are implemented, the short- or medium-term effect can be eliminated. Reversibility is considered medium given that, once having stopped effects on the environment, it could be restored by natural means within a period between 1 and 5 years. The moment was considered immediate because the time elapsed between execution of the activity and appearance of the impact on the flora is nonexistent. The effect is direct on the element. Resilience is considered medium because between 2 and 15 years are required to absorb disturbances without altering significantly the characteristics if its structure and functionality. The impact for this activity is considered synergic since the union of several impacts generates bigger effects than the effects generated if they acted independently and it is cumulative because the impact increases progressively after execution of the activity when the actions that generates it persists in a continued or reiterated manner.</p> <p>The activity of vegetation burning for agricultural activities generates a harmful impact on the flora for modification of the natural vegetation cover and it is considered moderate according to the assessment made as follows: the intensity was considered medium because although there are changes or modifications, they do not represent a serious alteration of the flora element. The extension was determined as punctual since the natural vegetation is present in very small areas and in a scarce manner. The duration was considered permanent because the activity is conducted constantly in the entire area. Periodicity is irregular, as in the forest harvesting activity, given that for the scarce vegetation, it is made only once or on an unpredictable basis in time. As for recoverability of this impact, it is considered recoverable because, if corrective measures are taken, the effect can disappear. Reversibility is considered medium given that, once having stopped effects on the environment, it could be restored by natural means within a period between 1 and 5 years. The moment was considered immediate because the time elapsed between execution of the activity and appearance of the impact on the flora is nonexistent. The effect is direct on the element. Resilience is considered medium because between 2 and 15 years are required to absorb disturbances without altering significantly the characteristics if its structure and functionality. The impact for this activity is considered synergic and cumulative.</p> <p>The activity of reforestation of protection and conservation about modification of vegetation covers was assessed as beneficial and with</p>	





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ENVIRONMENTAL ELEMENT: FLORA
ENVIRONMENTAL IMPACT: MODIFICATION OF VEGETATION COVERS
a moderate environmental significance value, according to the following individual assessment: the intensity was considered low because the effect is a minimal modification to the flora element. The extension was determined as punctual since the reforestation projects for protection are small and isolated. Duration was considered permanent because the activity is meant to last in time. Periodicity is irregular since this activity is conducted once or on an unpredictable basis in time. As for recoverability, this impact is considered recoverable because if measures other than the ones established for protection are implemented, the effect could disappear. Reversibility was determined as medium because once actions affecting the environment had stopped, it could return to the initial conditions within a period between 1 and 5 years. The moment was considered long term because the time elapsed between execution of the activity of protection and conservation and appearance of the impact on the flora is longer than three months. The direct effect on the element is direct. Resilience is considered medium because between 2 and 15 years are required to absorb disturbances without altering significantly its structure and functionality characteristics. The impact for this activity was considered synergic and cumulative.

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.30 Description of the Impact of Changes in the Flora Structure and Composition in the Scenario without the Project

ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FLORA	
ENVIRONMENTAL IMPACT: CHANGES IN THE FLORA STRUCTURE AND COMPOSITION	
This impact refers to the changes that occur on quality of the natural vegetation covers, specifically, on the structure and composition of the flora, without considering the criteria of the area.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Forest harvesting	(-42) Moderate Impact
Burning	(-47) Moderate Impact
Forest protection and conservation plantations	(+35) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The changes in the flora structure and composition of natural vegetation covers is an impact qualified negatively for having a harmful effect for the flora element, which is generated with development of anthropogenic activities in the area subject to study. It occurs in case of forest harvesting, which can be selective, or vegetation cutting and burning for fitting the land, which do not necessary eliminate the vegetation cover definitely, but have an incidence on the flora structure and composition. This impact was also assessed for the protection and conservation reforestation activity with a positive character for having benefits for the element assessed by generating vegetation cover that can have a structure and composition similar to the natural ones or that can favor development of these parameters in time.</p> <p>For the area subject to study, as it was mentioned, the most widespread and intense productive activity is agriculture. This requires removal of natural vegetation for its establishment. The impact of change in the flora structure and composition of the natural vegetation is considered negative or harmful for the flora element and it was assessed as moderate due to the following individual assessments: the intensity is low since the effect is a minimal modification of the flora element. Its extension is punctual given that natural vegetation is present scarcely in very small areas. Duration was considered permanent because the activity is developed in a constant manner in the entire area and generally in cycles that do not allow development of vegetation. Periodicity is considered irregular because of the scarce presence of natural vegetation. Vegetation removal is made only once and in an unpredictable manner in time. As for recoverability, this impact is considered mitigable since, in case corrective measures are implemented, the effect on the element can be mitigated. Recoverability is considered medium since once the effect on the environment had stopped, it can return by natural means within a period between 1 and 5 years. The moment was considered immediate because the time elapsed between execution of the activity and manifestation of the impact on the structure and composition of the flora is nonexistent. The effect is direct on the element. Resilience is deemed medium. The impact for this activity was considered synergic and cumulative.</p> <p>Likewise, the activity of vegetation burning for the agricultural activities generates a harmful impact for the flora for changes in its structure and composition in the natural vegetation cover and such impact is considered moderate according to the assessment made as follows: the intensity was considered medium because although there are changes or modifications, they do not represent a serious alteration of the flora element. The extension was determined as partial since the alteration of the structure and composition of the flora goes beyond the intervention sites. The duration was considered permanent because the activity is constantly made in the entire area. Periodicity is irregular as in the forest harvesting activity since because of the scarce presence of vegetation, it is made only once</p>	





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ENVIRONMENT: BIOTIC
ENVIRONMENTAL ELEMENT: FLORA
ENVIRONMENTAL IMPACT: CHANGES IN THE FLORA STRUCTURE AND COMPOSITION
<p>or on an unpredictable basis in time. As for recoverability, this impact is considered mitigable since, if corrective measures are implemented, the effect can be diminished. Reversibility is medium since, once the activity affecting the environment had stopped, it could return to its normal state by natural means in a period between 1 and 5 years. The moment was considered immediate because the time elapsed between execution of the activity and manifestation of the impact on the structure and composition of the flora is nonexistent. The effect is direct on the element. Resilience is deemed medium. The impact for this activity was considered synergic and cumulative.</p> <p>The activity of protection and conservation reforestation on the flora structure and composition was considered as beneficial and with a moderate environmental importance value according to the individual assessment: intensity was considered low because the effect is a minimal modification to the flora element. The extension was determined as punctual since the reforestation projects for protection are small and occur in an isolated manner. Duration was considered permanent because the activity is meant to last in time. Periodicity is regular because the environmental aspect assessed generates the impact in a recurrent manner. This impact is considered recoverable because if measures other than the ones established for protection are implemented, the effect can disappear. Reversibility was determined as medium since once the activity affecting the environment had stopped, it could return to the initial conditions in a period between 1 and 5 years. The moment was considered long term because the time elapsed between execution of the activity of protection and conservation and manifestation of the impact on the composition and structure of the flora is longer than three months. The effect is direct on the element. Resilience is considered medium because it takes between 2 and 15 years to absorb the disturbances without altering significantly its characteristics of structure and functionality. The impact for this activity is considered synergic and cumulative.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.31 Description of the Impact of Changes in the structure, extension and availability of habitats of the wild fauna in the Scenario without the Project

ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FAUNA	
ENVIRONMENTAL IMPACT: CHANGES IN THE STRUCTURE, EXTENSION AND AVAILABILITY OF HABITATS OF THE WILD FAUNA	
<p>This impact occurs as a response to fragmentation and transformation of the vegetation covers, which are key elements to provide habitats to the different species. It consists in a decrease of the size of certain covers or an increase of the number of fragments of resulting habitats. Additionally, an increase in the distance between fragments is evidenced. These events make difficult the exchange of individuals between isolated populations, as well as recovering through recolonization from a possible extinction.</p>	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-31) Mild or Irrelevant Impact
Forest harvesting	(-45) Moderate Impact
Farming activities	(-25) Mild or Irrelevant Impact
Burning	(-41) Moderate Impact
Agriculture (Transitory Crops)	(-49) Moderate Impact
Forest protection and conservation plantations	(+48) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>This environmental impact is caused by six activities, including management of solid wastes by the community and farming activities with a mild or irrelevant environmental significance, the forest harvesting, burning, agriculture (transitory crops), forest protection and conservation plantations having a moderate rating.</p> <p>Management of solid wastes by the community affects natural habitats in a mild manner given that a big part of the area of influence the communities do not have effective management systems. This causes that solid wastes are thrown to the environment in such a way that pollution is evident within forest areas and water sources. The farming activities have a low level in the area subject to study and thus it is considered that their impact is not significant.</p> <p>The activities with the highest ratings are the ones that affect directly habitats, including forest harvesting. In this activity cutting of native and introduced species of tree type causes an alteration of species that have colonized these areas. By eliminating trees, fauna is displaced. An activity is made frequently conducted for renewal of pastures and controlling appearance of pioneer plants is burning. With this activity alteration of habitats is high given that fires end with all the cover of an area. At soil level, microhabitats as dead leaves or hers are completely modified. Animals present generally end up dying.</p>	





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ENVIRONMENT: BIOTIC
ENVIRONMENTAL ELEMENT: FAUNA
ENVIRONMENTAL IMPACT: CHANGES IN THE STRUCTURE, EXTENSION AND AVAILABILITY OF HABITATS OF THE WILD FAUNA
<p>Agriculture (transitory crops) has caused a significant environmental deterioration to the point that existence of another type of cover is very scarce. Some species have been associated with this type of covers, but temporarily given that crops are temporary and do not generate the necessary resources to support complex animal communities.</p> <p>Unlike the aforementioned activities, the forest plantations for protection and conservation have a positive impact since these areas constitute fragments in which the species find shelter and food.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.32 Description of the Impact of Changes in the Composition and Structure of Fauna Communities in the Scenario without the Project

ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FAUNA	
ENVIRONMENTAL IMPACT: CHANGES IN THE COMPOSITION AND STRUCTURE OF THE FAUNA COMMUNITIES	
<p>Human activities on the natural ecosystems generate important changes in the habitats of animal species. In turn, they affect positively or negatively the resident fauna communities. Change in the diversity of animals consists in reduction of the size of populations of the organisms affected and decrease of the density of species (number of individuals per surface unit). The changes in structure are related to modifications that can be caused in the ecologic interactions between species that compose the animal communities and their association with plants.</p>	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-31) Mild or Irrelevant Impact
Forest harvesting	(-36) Moderate Impact
Farming activities	(-22) Mild or Irrelevant Impact
Fauna Haunting	(-30) Mild or Irrelevant Impact
Burning	(-48) Moderate Impact
Agriculture (Transitory Crops)	(-44) Moderate Impact
Forest protection and conservation plantations	(+46) Moderate Impact
Land transport	(-20) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>This impact is caused by development of eight activities, including the activities of management of solid wastes by the community, forest harvesting, farming activities, fauna haunting, burning, agriculture (transitory crops), land transport and forest plantations for protection and conservation. The latter, unlike the other activities, has a positive character in the impact.</p> <p>Among the activities causing the impact in a mild or irrelevant manner there is management of solid wastes, farming activities, fauna haunting and land transport. They are characterized by having a low intensity (1), a brief duration (1), high resilience (1) and synergy with other impacts. Wild fauna haunting is developed throughout the area of influence and is characterized by being present in the lifestyle of the population as a cultural activity that serves to satisfy the food requirements (animal protein). It is worth indicating that haunting is not frequent given that the offer of possible preys low. According to the field work, the few species subject to haunting include opossums (<i>Didelphis marsupialis</i> and <i>D. pernigra</i>), porcupine (<i>Coendou rufescens</i>) and the tapeti (<i>Sylvilagus brasiliensis</i>). In land transport, the decrease of animal populations is related to the high flow of vehicles having an incidence in running over animals both in primary roads and secondary or tertiary roads.</p> <p>In forest harvesting, the fauna diversity is affected by the loss of habitats that modifies the ecologic processes of species (reproduction and feeding). There is wide evidence that shows the adverse effect of fragmentation on the wild life that goes from a decrease of the number of individuals in the population to the loss of species at a local or regional (extirpation) and global (extinction) scale.</p> <p>Burning caused moderate alterations to the fauna. These events cause death of animals of low mobility, especially animals from groups such as amphibians, reptiles, rodents and some birds that make their nests on the ground. As for agriculture, it can be considered the most important activity in alteration of the fauna for its great extent and polluting events that change the dynamics of natural populations. During development of agricultural practices, wild animals are considered negative elements and they are thus sacrificed to avoid possible damages to crops.</p> <p>Establishment of forest plantations for protection and conservation occur in the area as a strategy of environmental rehabilitation of water sources. Along with this objective, the wild fauna has been benefitted for the increase of vegetation covers that offer better conditions concerning offer or resources, nesting areas, shelter, and permanent humidity, among others. It is worth clearing up that</p>	

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ENVIRONMENT: BIOTIC
ENVIRONMENTAL ELEMENT: FAUNA
ENVIRONMENTAL IMPACT: CHANGES IN THE COMPOSITION AND STRUCTURE OF THE FAUNA COMMUNITIES
plantations such as eucalyptus or pine favor certain animals while others do not adapt satisfactorily to the new environmental characteristics. The latter include group includes species with particular needs of habitat or the ones that live exclusively in the interior of the forest.

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.33 Description of the Impact of Alteration of Structural and Functional Alteration of the Wild Fauna in the Scenario without the Project

ENVIRONMENTAL: BIOTIC	
ENVIRONMENTAL ELEMENT: FAUNA	
ENVIRONMENTAL IMPACT: ALTERATION OF STRUCTURAL AND FUNCTIONAL CONNECTIVITY OF HABITATS OF THE WILD FAUNA	
The structural connectivity, understood as the way in which the patches of habitat are distributed in landscape matrix, and the functional connectivity, understood as the capacity of landscape elements to facilitate movements of the species in an effective manner, are two essential aspects for functioning of the ecosystem and maintenance of the dynamics and interactions between different animal and vegetal species. This connectivity may be altered by interventions made to the vegetation covers, affecting not only availability of habitats but also access to the available resources and processes of dispersion, colonization and migration.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Forest harvesting	(-36) Moderate Impact
Farming activities	(-25) Mild or Irrelevant Impact
Burning	(-41) Moderate Impact
Agriculture (Transitory Crops)	(-49) Moderate Impact
Forest protection and conservation plantations	(+49) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>In the normal development of human communities in an area, different activities are recognized both to satisfy basic needs and for economic development. Such activities in some way or another change the regular vegetation dynamics of the areas subject to study, as a result of traditional activities such as forest harvesting, burning, farming and agriculture activities (transitory crops), as well as installation of forest plantations. Mobility corridors for the wild fauna have been strongly degraded to the point that the animal populations have been displaced to small fragments of riparian or dense forest.</p> <p>The activities that cause this impact in a negative manner are as follows: Farming activities have the least environmental significance for connectivity, given that intensity and extension in which they occur are low and punctual. Compared with other anthropogenic actions, domestic animal breeding can generate a minimal competition for resources such as water or vegetation. In contrast, forest harvesting, burning and agriculture are the activities with the greatest environmental significance for connectivity of natural habitats (Moderate). The variables to be considered include low intensity (4); the extension goes beyond sites near the area of influence (4); recoverability is nonexistent (7); and synergy with other impacts as loss of habitats.</p> <p>Throughout the years, the anthropogenic activity in the area of influence of the project has been reducing significantly natural covers to the point that percentages of riparian or dense forests are small. In contrast, covers of crop and pasture mosaics dominate entirely the landscape. Forest harvesting causes fragmentation of possible corridors. By eliminating trees within the matrix, it causes clearings that change considerably the environmental characteristics and interrupt the flow of species. Lastly, burning is an activity that changes the structure of vegetation from undergrowth to tree canopy. Sometimes burning is made in an uncontrolled manner causing its extension to secondary areas of vegetation or areas that serve as points of scale for migratory bird species.</p> <p>Agriculture of transitory crops affects moderately connection of natural habitats since the expansion of the agricultural border in the area of influence is constant. This generates cutting and eradication of the existing natural vegetation. By doing so, medium- and long-term effects are caused such as loss of water sources and deterioration of natural recycling of nutrients. Additionally, sowing of forest plantations acts in a contrary manner to the aforementioned activities since many of such plantations constitute anthropogenic elements that improve the conditions of certain biological corridors. By increasing the tree cover, environmental heterogeneity increases and, thus, it provides ecological niches that can colonize species of high mobility as birds or mammals.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.





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Table 8.34 Description of the Impact of Alteration of the Edaphic Fauna in the Scenario without the Project

ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FAUNA	
ENVIRONMENTAL IMPACT: ALTERATION OF THE EDAPHIC FAUNA	
The soil is a normal constituent of nature with different components and organisms that live in the soil. Any type of physical, chemical or biochemical alteration causes loss of the essential animal elements for its maintenance.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-31) Mild or Irrelevant Impact
Management of liquid wastes by the community	(-35) Moderate Impact
Forest harvesting	(-31) Mild or Irrelevant Impact
Farming activities	(-22) Mild or Irrelevant Impact
Burning	(-43) Moderate Impact
Agriculture (Transitory Crops)	(-50) Moderate Impact
Forest protection and conservation plantations	(+49) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The edaphic fauna is responsible for accumulation and decomposition of the organic matter of soils affecting all the transformation of such organic matter, nutrients and some of the mineral fractions thereof as salts and clays. This fauna has several functions, such as accelerating transformation and incorporation of vegetal and animal wastes to the soil increasing the contract surface on which microorganisms shall act.</p> <p>The result of this assessment is that this impact has a mild importance for management of solid wastes by the community, forest harvesting and farming activities. The activities with moderate rating were management of liquid wastes, burning and agriculture. All of them make the impact negative because the change of cover and modification of physicochemical properties of the soil make difficult that the edaphic fauna is fully developed or is kept under its natural conditions.</p> <p>For the edaphic fauna, the activities affect the environment where they live. Their stability and survival have the greatest impact. The activities with moderate environmental importance are characterized by having a high intensity (4) and extend beyond the area of influence (4 and 8).</p> <p>Management of liquid wastes by the community and agriculture act in a similar manner, mainly affecting the quality of the soil and causing pollution. Soil pollution is a very serious process and extends all over the soil. In this process, moderate accumulation of an element that appears regularly in the edaphic environments is evidenced and this element accumulates until reaching so exaggerated amounts that they contain a significant amount of nitrates and phosphates, among other compounds. Likewise, external elements or compounds also accumulate in the soil. In this case, pesticides and other compounds elaborated synthetically by men alter drastically the edaphic fauna.</p> <p>In burning and agriculture there is loss of organic matter, coming from regenerative processes or remaining biomass in crops. All aspects related to these activities affect soil aggregates, which end getting rid of their constitutive particles (loss of humic gels), worsening its structure and all those properties associated with the soil quality. Likewise, it contributes to decrease of the food resource for edaphic fauna and compact the land.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.35 Description of the Impact of Changes in the Mobility Patters of Individuals in the Scenario without the Project

ENVIRONMENT: BIOTIC
ENVIRONMENTAL ELEMENT: FAUNA
ENVIRONMENTAL IMPACT: CHANGES IN THE MOBILITY PATTERNS OF INDIVIDUALS
Many fauna species have defined territories and specific areas of movement to have access to food resources, shelter sites or reproductive areas. These patterns can be altered by the intervention of the natural environment, including actions such as transformation of the habitat, incorporation of artificial structures, noise generation, thermal radiation, traffic of vehicles and even human presence can be seen by some species as a potential threat that must be avoided by change in their route of movement or site for foraging or shelter.





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ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FAUNA	
ENVIRONMENTAL IMPACT: CHANGES IN THE MOBILITY PATTERNS OF INDIVIDUALS	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Forest harvesting	(-34) Moderate Impact
Farming activities	(-22) Mild or Irrelevant Impact
Fauna Haunting	(-30) Mild or Irrelevant Impact
Burning	(-41) Moderate Impact
Agriculture (Transitory Crops)	(-36) Moderate Impact
Forest protection and conservation plantations	(+49) Moderate Impact
Land transport	(-20) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Seven activities that trigger appearance of this impact were identified. Three of them have mild environmental importance and four of them have moderate environmental significance. Most of them have a negative character for fauna mobility, which is represented by the loss of habitat, increase of the anthropogenic activity that causes higher levels of noise and intervention in ecology of the different animal populations. The only activity with a positive impact is installation of forest plantations for protection and conservation.</p> <p>Although the activities of forest harvesting, burning and agriculture do not cause dramatic changes in the fauna, the negative influence can be evidenced for its mobility, given that in many cases introduction of domesticated animals or the change of cover cause isolation of species in areas that do not have the best environmental and ecologic conditions for their establishment, as well as phenomena, such as burning, chase away animals, this being an instinctive response to preserve their integrity and not to die burnt. Each of these activities accentuate the impact causing loss of connectivity of environment (barrier effect), phenomena of migration and increase of mortality of species, especially amphibians, reptiles and mammals. The relevant evaluation criteria include the moment of manifestation of the impact, which is determined as immediate (4), low recoverability (4) and synergic (4).</p> <p>Within the farming activities, change of mobility occurs as a response to the presence of domestic animals in areas of passage of wild fauna. Wild fauna haunting is an activity that causes the impact in a moderate and constant manner with a low intensity (1). Hunting is a cultural activity not very constant, which causes that the most vulnerable populations change their mobility patterns towards areas with presence of few people and where they can settle to develop their physiologic and ecologic activities. Likewise, it tends to chase away populations of wild animals from their areas of occurrence, especially when dogs are used for such hunting. These alterations involve a temporary or permanent displacement of individuals and, thus, there is a change in composition and structure of the fauna communities.</p> <p>The land transport chases away fauna for the increase of the noise made by the constant movement of vehicles and heavy machinery. Likewise, it causes death of individuals because of hitting and/or collision and, thus, displacement and/or migration of fauna.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.36 Description of the Impact of Changes in the Composition and Structure of Hydrobiological Communities in the Scenario without the Project

ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FAUNA	
ENVIRONMENTAL IMPACT: CHANGES IN THE COMPOSITION AND STRUCTURE OF HYDROBIOLOGICAL COMMUNITIES	
<p>This impact is much related to alteration of the habitat, on which the water species of the different taxonomic groups depend for their development and stay in a specific site in the water column and throughout the riverbed or extension of the water body. The water species are highly sensitive to changes in the conditions of the habitat and in the face of events altering its structure, there can be death of individuals or migration to sites with better conditions, which changes density or presence of species and their distribution. Likewise, it is worth noting that the hydrobiological communities present in the water ecosystems are very important since they constitute an essential element in conservation of biodiversity.</p>	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-38) Moderate Impact
Management of liquid wastes by the community	(-59) Severe Impact
Exploitation of the surface water resource	(-35) Moderate Impact
Forest harvesting	(-22) Mild or Irrelevant Impact
Farming activities	(-22) Mild or Irrelevant Impact
Burning	(-22) Mild or Irrelevant Impact





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ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FAUNA	
ENVIRONMENTAL IMPACT: CHANGES IN THE COMPOSITION AND STRUCTURE OF HYDROBIOLOGICAL COMMUNITIES	
Agriculture (Transitory Crops)	(-62) Severe Impact
Forest protection and conservation plantations	(+49) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>In the area of influence, the hydrobiological communities are poorly represented in the lotic water bodies due to the high levels of pollution and the changes caused to their beds. Under the current conditions of the area subject to study, it was found that seven activities carried out in the area may affect negatively the hydrobiological communities altering the number and type of species, their abundance, distribution of microhabitats and interactions between species of different trophic levels.</p> <p>The activities with the greatest impact correspond to management of liquid wastes by the community and agriculture (transitory crops), the environmental importance of these two activities was qualified as severe because they are directly related to contamination of surface water by disperse sources, including sediments, salts, fertilizers and pesticides, which, in turn, affect totally organisms of water life to the point that the diversity values are critical. These activities of the area of influence cause a significant environmental problem, mainly because agriculture is the dominant anthropogenic practice in the area and links other impacts to alteration of the hydrobiological component. Among the variables assessed, the most relevant interests were intensity (see high 8), periodicity (regular 3) and synergy (synergic with other impacts 4). Exploitation of the surface water resource and management of solid wastes constitute activities that have a moderate impact. Water bodies are subject to a tension that is caused by their interaction with urban centers. This affects diversity of aquatic biota for the poor disposal of solid wastes and over-consumption of water for agriculture, and domestic and industrial use.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.37 Description of the Impact of Alteration of the Habitat of Hydrobiological in the Scenario without the Project

ENVIRONMENT: BIOTIC	
ENVIRONMENTAL ELEMENT: FAUNA	
ENVIRONMENTAL IMPACT: ALTERATION OF THE HABITAT OF HYDROBIOLOGICAL COMMUNITIES	
<p>The aquatic habitats are composed of internal elements as the physical conditions, concentration of dissolved or suspended substances and presence of aquatic communities, as well as external elements of the riverbank (vegetation, slope, use of soil). Any alteration of these components can cause important changes in the structure of the habitat and have an incidence in the composition, abundance and distribution of the aquatic species.</p>	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-38) Moderate Impact
Management of liquid wastes by the community	(-59) Severe Impact
Exploitation of the surface water resource	(-38) Moderate Impact
Forest harvesting	(-25) Mild or Irrelevant Impact
Farming activities	(-25) Mild or Irrelevant Impact
Burning	(-25) Mild or Irrelevant Impact
Agriculture (Transitory Crops)	(-62) Severe Impact
Forest protection and conservation plantations	(+49) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Water bodies have physical characteristics and a chemical composition that depend on the amount of rain, the drainage area, erosion, solubilization and weatherization of soils, evaporation and sedimentation. Due to weather changes there are daily and seasonal cycles that determine the chemical composition of waters. The area of influence of the highway projects has a big amount of rivers and creeks with different characteristics according to their location and influence with the nearby communities.</p> <p>Alteration of aquatic habitats where the hydrobiological communities are found occurs for development of eight anthropogenic activities, including management of solid wastes by the community, forest harvesting, farming activities, burning, exploitation of the surface water resource, management of liquid wastes by the community and agriculture, all of them express the negative alteration of this resource. In contrast, sowing of forest plantations for protection and conservation act positively since it is considered a strategy to recover riverbeds and protect them from drying.</p> <p>The anthropogenic actions identified include management of liquid wastes by the community and agriculture (transitory crops). They have a severe environmental importance, which is represented by contamination of water sources through addition of chemical organic</p>	

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ENVIRONMENTAL ELEMENT: FAUNA
ENVIRONMENTAL IMPACT: ALTERATION OF THE HABITAT OF HYDROBIOLOGICAL COMMUNITIES
<p>or inorganic products, used for fertilization and control of plagues and diseases. Likewise, creeks have high sedimentation levels due to the organic matter dragged from crops and other associated wastes.</p> <p>Disposal of liquid wastes affect critically habitats of the hydrobiological communities due to the high contaminant charge that the liquid wastes discharged to the water bodies provide, generate a significant alteration of the aquatic habitat for the increase of the microbial activity, decrease in oxygen availability, increase of turbidity, among others, which prevents that the high percentage of aquatic communities can carry out their vital processes and survive in these conditions.</p> <p>In case of exploitation of the surface water resource, its rating is moderate for the direct alteration of the lentic systems which occurs for introduction of charges of contaminants such as suspended coliform solids, BOD, which increases the microbial activity and reduces oxygen availability producing a hostile habitat that only some aquatic species can tolerate, as well as water availability since excessive use is depleting habitats where the hydrobiological communities can settle.</p> <p>Management of solid wastes by the community, forest harvesting, farming activities and burning cause a considerable alteration in the structure of the habitat for incorporation of artificial elements and toxic solid elements that are dissolved in the water column.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

8.2.6.3 Socioeconomic Environment





Table 8.38 Description of the Impact of Changes in the Road Accident Rates in the Scenario without the Project

ENVIRONMENT: SOCIOECONOMIC	
ENVIRONMENTAL ELEMENT: POPULATION STRUCTURE	
ENVIRONMENTAL IMPACT: CHANGE IN THE ROAD ACCIDENT RATES	
It consists in assessing road accident rates generated in the roads of the minor territorial units of the project.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Farming Activities	(-22) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The roads are corridors that have the purpose of facilitating people access to different places, whether by vehicles, on foot, in motorcycle or in traction animals as horses, mares or donkeys. Dispersed communities generally use unpaved roads, appropriate for frequent transit towards their farms or on some occasions with heavy machinery. Roads, which are poorly maintained but fulfilling the function of conducting population to their destination, have been opened. Other roads such as the national highway are in good conditions with signaling, but with high traffic flow due to the particular characteristics required, that is, use for population settled in the territory and population going through or arriving from other regions as commercial communication corridors and others.</p> <p>The foregoing allows rating the negative impact with a mild or irrelevant importance level, considering that the population does not express high accident rates that can compromise the population structure of the minor territorial units. In connection with the agricultural activities, the accident rates are low because the existing cattle are scarce in most of the territorial units. Only some associations were identified in the area with the purpose of commercializing dairy provided by the cattle in the region. Likewise, pig and guinea pig breeding in the region is low. Generally, households practice breeding for consumption. Nonetheless, the small amount commercialized does not require heavy load transport, that is, big trucks that generate road accident rates. This is qualified as a negative impact with mild or irrelevant importance level.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.39 Description of the Impact of Fragmentation of Properties in the Scenario without the Project

ENVIRONMENT: SOCIOECONOMIC
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE
ENVIRONMENTAL IMPACT: FRAGMENTATION OF PROPERTIES
Fragmentation of properties is defined as the impact through which the area of the properties is divided in areas smaller than the initial





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ENVIRONMENT: SOCIOECONOMIC	
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE	
ENVIRONMENTAL IMPACT: FRAGMENTATION OF PROPERTIES	
one.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Farming activities	(-30) Mild or Irrelevant Impact
Agriculture (Transitory Crops)	(-34) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>At national level, municipalities have an area defined as "Minimum Production Area" which is subject to different economic activities developed in the area.</p> <p>In the studied municipalities landholding is characterized by having a land distribution in microholdings and smallholdings, that is, properties of less than ten hectares where development of agricultural and farming activities are limited to subsistence production. By being further fragmented, they do not have the area defined for development of productive activities; in other words, they are under the UAF (Family Agriculture Unit) and the minimum production area, values given by the Incoder and the municipality, respectively.</p> <p>Therefore, the impact of <u>Fragmentation of Properties</u> is qualified as negative and with minor or irrelevant importance for the farming activity and moderate for agriculture. In the first case, its rating is due to the fact that it is an activity mainly represented by poultry farming and pig farming, activities that do not require vast tracts of land because they have farms of small space. The impact is mainly produced with the cattle production, which requires big tracts of land for grass ingestion. It is worth noting that in Colombia people do not have the culture of stabled cattle (so far it is developing), cattle production being extensive considering that pastures must recover when the cattle goes through them and not dry the land.</p> <p>In agriculture the rating is given because not having enough tracts of land the population will not be able to develop crops with surplus of production that allow increasing their revenues and improving the quality of crops, that is, sowing shall remain as subsistence production without any added value leading, in turn, to a stagnation of the local economy.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.40 Description of the Impact of Change in Land Properties in the Scenario without the Project

ENVIRONMENT: SOCIOECONOMIC	
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE	
ENVIRONMENTAL IMPACT: CHANGE IN THE PROPERTIES OF LAND	
Changes in the value of the land involve an increase or decrease of value of the square meter (urban and sub-urban area) or hectare (rural area) due to changes in the use of land and the demand to purchase lands.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Forest harvesting	(+32) Mild or Irrelevant Impact
Farming activities	(-31) Mild or Irrelevant Impact
Tourism	(+46) Moderate Impact
Quarries	(-34) Moderate Impact
Agriculture (Transitory Crops)	(+39) Moderate Impact
Forest protection and conservation plantations	(+25) Mild or Irrelevant Impact
Hydrocarbon Transport (Oil pipeline)	(-31) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The impact is qualified as positive, mild and irrelevant in the activities of forest harvesting and forest plantations since in the regions of these activities are not developed with a great dynamism, generating a low probability of speculation about the value of land, that is, there is stability in the land prices that do not generate distortions at the moment of a purchase or sale.</p> <p>Tourism and agriculture have a moderate impact since the value of the land increases for use of the soil, that is, the land being productive; it generates a greater demand by peasants and owners. These lands are the most appealing for their value.</p> <p>The farming activity and quarries are lands that are appealing while they are productive. Their permanent development generates deforestation and erosion. Therefore, in the medium and long term the lands become more unproductive. For this reason, it has a negative character being mild and irrelevant in the farming activity since the cattle moves from pasture to pasture mitigating and increasing the impact generated. In case of quarries, the impact is qualified as moderate since the deforestation process occurs in the medium term and recovery of the land occurs in the long term generating a decrease in price of the land.</p> <p>Hydrocarbon transport generates an easement where there are networks, which may generate added value from time to time.</p>	

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ENVIRONMENT: SOCIOECONOMIC
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE
ENVIRONMENTAL IMPACT: CHANGE IN THE PROPERTIES OF LAND
Nonetheless, pipelines generate certain impediments in the activities that can be developed in their surrounding areas losing thus area for development of agricultural crops, forest crops or other activities. For this reason, the negative impact is qualified as mild or irrelevant considering that the agricultural production of the area is developed with subsistence crops, which do not have restrictions with the required facilities for hydrocarbons transport (oil pipelines).

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.41 Description of the Impact of Change in the Economic Activities in the Scenario without the Project

ENVIRONMENT: SOCIOECONOMIC	
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE	
ENVIRONMENTAL IMPACT: CHANGE IN THE ECONOMIC ACTIVITIES	
This impact refers to the changes that are being generated in the different productive activities in search of new alternatives.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Farming activities	(+47) Moderate Impact
Tourism	(+28) Mild or Irrelevant Impact
Quarries	(+35) Moderate Impact
Agriculture (Transitory Crops)	(+32) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>The farming activity is developed in the area subject to study through cattle production with multiple purposes. The meat is commercialized in the local markets of Ipiales and Pasto. Milk production is sold per liter and processed for different dairy products. This is an activity that is increasing in the region. Likewise, there is poultry and pig production. The former involves production with introduction of technology for installation of barns. Its increase in dedication of workforce and use of soil of this activity is what generates that it has a moderate rating.</p> <p>Tourism generates dynamism in the economy of the region for the different tourists who arrive, which demand goods and services increasing income of people and activate, in turn, artisanal production (especially baskets). Its impact is moderate since it is a cyclical activity, it does not occur permanently during the entire year.</p> <p>Gravel quarries existing in the area have managed to offer a source of employment in addition to the traditional ones in the area. The production is intended for building of properties of the same area, which decreases costs by not having to bring this consumable good from other places. This has helped, in turn, for building to grow in the last years.</p> <p>Agriculture is an activity with purposes of self-consumption and sale of surpluses, is not technology dependant and demand of the workforce other than the owners is scarce, except for the time of harvesting and sowing of potato, only product sown in an intensive manner. The dynamics caused by this activity in the region is relevant since it generates the main livelihood of the people living there. Its impact is considered positive with mild or irrelevant rating since in accordance with the characteristics of production in the households there are one or more people concerned with the activity guaranteeing at all times existence of such crops. Furthermore, in times of sowing and harvesting new job opportunities are generated for the unemployed population. This increases income of the population of the region and new alternatives.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.42 Description of the Impact of Change in the Dynamics of the Employment in the Scenario without the Project

ENVIRONMENT: SOCIOECONOMIC
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE





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ENVIRONMENTAL IMPACT: CHANGE IN THE EMPLOYMENT DYNAMICS	
This impact refers to the changes generated in the supply and demand of jobs due to alterations in the production dynamics.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Trade	(+40) Moderate Impact
Tourism	(+40) Moderate Impact
Quarries	(+29) Mild or Irrelevant Impact
Agriculture (Transitory Crops)	(+44) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>Changes in the job dynamics are qualified as positive since these changes generate in the assessed activities a higher number of jobs, that is, the population has a higher number of vacancies in which they can provide their workforce.</p> <p>Trade in the area subject to study is developed with the presence of stores mainly, which offer basic elements of the family food basket. In these establishments attention of two or more people is required. Work is stable, generating fixed income for people working there. There are, in turn, establishments that provide services in restaurants, service stations and tire change sites that have permanent jobs.</p> <p>Tourism, as well as trade, is an activity that represents important dynamics in the job market of the studied region, especially, in seasons in which cultural and religious events are held since at those times there is the highest number of tourists. Jobs generated by tourism are framed within service provision, that is, it is much related to the trade activity during high season.</p> <p>Transitory crops constitute the activity that required more labor since in the time of harvesting and recollection not only owners of crops are required, but other people are hired per day. This situation involves a higher income of people, who, in turn, demand a greater amount of goods and services, increasing the economic dynamics of the region.</p> <p>The foregoing impacts are qualified as moderate since trade, tourism and agriculture being activities that generate the economic basis of the region, any increase in their productivity gives immediately dynamism in the dynamics of employment.</p> <p>The activity in quarries is qualified as a mild or irrelevant positive impact since it is not an activity developed in the entire area subject to study. Its representation occurs in District El Rosario of municipalities of Ilés and El Juncal de Contadero where there is extraction of gravel and Stone. The workforce required is mainly local and jobs are limited. Nonetheless, people working there have work stability and permanent income.</p>	

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.43 Description of the Impact of Change in the Health State of the Population in the Scenario without the Project

ENVIRONMENT: SOCIOECONOMIC	
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE	
ENVIRONMENTAL IMPACT: CHANGE IN THE HEALTH STATE OF THE POPULATION	
It refers to the alterations that can be caused to health of the population by the anthropogenic activities of the area.	
ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Management of solid wastes by the community	(-21) Mild or Irrelevant Impact
Management of liquid wastes by the community	(-24) Mild or Irrelevant Impact
Exploitation of the groundwater resource	(-41) Moderate Impact
Farming activities	(-25) Mild or Irrelevant Impact
Tourism	(-17) Mild or Irrelevant Impact
Quarries	(-38) Moderate Impact
Burning	(-30) Mild or Irrelevant Impact
Agriculture (Transitory Crops)	(-26) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:	
<p>This impact affects health of the families living in the AID of the project of negative nature considering that disposal of these solid wastes is made mainly through burning leading to prevalence of respiratory diseases. Nonetheless, for being a minimum scale activity developed at level of properties, it is considered that the intensity of the impact is mild and its extension is punctual since exposure is short. Duration of the impact is brief and its periodicity is irregular. Likewise, if change of activity is promoted for disposal of solid wastes in a more environmentally and health friendly. The impact can be recovered and be reversible in the short term. The moment of appearance of the impact is immediate since exposure to smoke from garbage burning makes difficult respiration instantly. This can also involve that the effect of the impact is direct. Nonetheless, it shows a high resilience given that people living in the AID are already familiar with the activity and it is part of their daily life. Finally, due to the different interactions of the impact, it is synergic and</p>	

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ENVIRONMENT: SOCIOECONOMIC
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE
ENVIRONMENTAL IMPACT: CHANGE IN THE HEALTH STATE OF THE POPULATION
<p>cumulative.</p> <p>As already mentioned, in development of the base line of this study, the community of the AID does not have sewage service. For this reason, it must dispose of liquid wastes in septic wells and/or open field. The impact is thus negative and irrelevant for the health of families settled in the AID. Its intensity is low and its extension is punctual for being an activity developed at level of properties and not having a significant impact on such properties. Its duration is brief and periodicity irregular considering that the diseases prevailing in the area do not include gastrointestinal diseases that could be the type associated with this activity, but this does not mean that is not a factor to be considered in the health of the community. The impact is recoverable and reversible in the short term if appropriate actions of management of wastes are taken such as building of sewage. Likewise, the moment of impact is immediate since if the person is contaminated with wastes, the disease could appear in the ensuing 24 hours. This allows evidencing that the effect of the impact is direct and that its resilience is high since people recover from gastrointestinal diseases within less than one week. Finally, due to the different interactions of the impact, it is synergic and cumulative.</p> <p>As for farming activities, the character of this impact is negative considering that within these activities there is pig, cattle and guinea pig breeding. These activities have an incidence, to a certain extent, on the health of the population. For the case of the farming activity although in communities of the area of influence of such activity does not occur to a greater extent, this does not mean that it does not contribute to generation of soil damage for over-pasturing and compacting to name a few. Likewise, in such activity pig and guinea pig breeding is included. As for pig breeding, this could contribute to environmental pollution for the feces of the animal, animal wastes and operation of such activity, as well as for inappropriate lodging conditions that cause unpleasant odors and gases. Despite the aspects mentioned in this paragraph, it is a mild impact given that in the area this animal is mainly bred for self-consumption.</p> <p>As for poultry farming, which is included within these farming activities, it could be considered that although it may generate odors that constitute a type of environmental pollution and, in turn, generated respiratory disturbances and/or psychological alterations affecting life quality of people; it is considered irrelevant since the existing plants for this activity must have plans or programs to minimize the impact. Moreover, poultry farming also occurs to a lesser extent since it is used for self-consumption of the families who are part of the area of the project.</p> <p>Likewise, burning occurs in the area subject to study, mainly associated with management and disposal of solid wastes and affecting health of the families living in the direct area of influence (AID) with a negative and irrelevant nature, considering that this leads to prevalence of respiratory diseases. Nonetheless, for being an activity developed at district level, it is considered that intensity of the impact is medium and its extension is punctual because although it occurs in all districts, it is developed at level of properties. Being a constant but not daily exposure. Duration of the impact is temporary since respiratory diseases associated with this activity can heal between 1 and 3 months; therefore, periodicity is irregular since there is not a time established in which respiratory diseases arise but they are sporadic. Likewise, if change of activity is promoted for disposal of solid wastes in an environmentally and health friendly manner, the impact can be mitigated. Nonetheless, it can become irreversible when exposure is constant and can trigger mortal diseases as CODP. Therefore, it is also evidenced that the moment of appearance of the impact is in the medium term. This also allows noting that the effect of the impact is direct with a medium resilience. Finally, it is not evidenced that it interacts with other bigger impacts and it does not accumulate with other impacts either.</p> <p>The activity of exploitation of quarries is considered a negative impact of moderate environmental significance to the extent that the population and the environment are affected since it reduces and tends to make vegetation, fauna and soil disappear, and it causes changes in the air quality for increase of the particulate material. There is loss of water resource because of degradation of aquifers, deviation of underground current, change in the phreatic level, contamination of water with acid materials, contamination of rivers, degradation of the water resource and visual contamination of landfills, among others. Such conditions end up affecting health of the population. Such impact can be synergic and cumulative. Agriculture can affect health of the communities when, for its development, fertilizers and pesticides are used and they contaminate groundwater (that is, exploitation of this resource can also be affected) and erosion of soil. Nonetheless, it is qualified as mild since although the area is agriculture oriented, most of the properties are small and used for self-consumption, bearing in mind that there are bigger properties used for (transitory) crops.</p> <p>Finally, it is possible to state that the activity concerning tourism can have an impact on health of the population. Since there are resorts in the area, they become points of convergence or meeting of families of the region as an alternative for recreation. Such spaces can cause gastrointestinal diseases for the issue of pools or for disagreements caused by alcohol ingestions in these sites, among others. Nonetheless, this impact has a mild or irrelevant importance since they are situations inherent in these sites and populations manages these situations because they are part of their everyday lives.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

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8.2.7 Level of Global Negative Intervention (NIGN) (Scenario without the Project)

For calculation of the Level of Global Negative Intervention, the methodology described in section 8.1 **DESCRIPTION OF THE METHODOLOGY FOR IMPACT** – Level of Global Negative Intervention (NIGN) was followed.

The maximum and minimum intervention values for the scenario without the project are -16300 and -2282, respectively, considering that the possible value calculated for impact in the methodology of Vicente Conesa Fernández corresponds to maximum -100 and minimum -14. Additionally, 163 interactions that generated negative impacts were identified for the activities of interest of this study in the scenario without the project (Total impacts 195).

Once the impacts were assessed, the sum of the results of the environmental assessment of negative impacts was -5629

Accordingly, the following was obtained:

$$NIGN = 100\% - \frac{(16300 - 5629) * 100\%}{(16300 - 2282)} = 23.87\%$$

The value of the level of global intervention must be compared with the values listed in **Table 8.3**. It can be thus established that the Level of Global Negative Intervention is in the low category considering that there are activities that have generated severe impacts. Such impacts have transformed the ecosystem in the scenario without the project as the case of agriculture, which, due to the poor control of chemical supplies, has affected, to a greater extent, water bodies where disposal of liquid wastes is made. Nonetheless, this alteration is not considered significant given that the intervention category is low.

Additionally, this intervention has been made during several decades affecting environmental quality of the area since its practices mainly in the rural area do not plan measures for management of environmental impacts.





8.3 SCENARIO WITH PROJECT

The highway project contains the phases of Pre-Building, Building; and abandonment and final restoration. In the Pre-Building phase, there shall be activities such as properties negotiation and hiring of the staff. In the Building phase, there shall be activities such as earth moving (Excavation and Filling), installation and operation of camps and in the phase of abandonment and final restoration, there shall be activities such as dismantling of facilities and final cleaning. All the activities of each one of the phases are shown in **Table 8.44** and are being requested in **Chapter 3 Project Description**.

8.3.1 Description of the Activities Generated by the Highway project

Table 8.44 contains the phases of the project with the corresponding activities, which were analyzed in order to establish the possible socio-environmental impacts that they can generate. The assessed activities correspond to activities requested in this study (See **Chapter 3. Project Description**).

Table 8.44 Phases and Environmental Aspects of the Project to Be Assessed

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STAGES	ENVIRONMENTAL ASPECTS
PRE-BUILDING	Outreach and information to the community and competent authorities
	Negotiation of properties and easements
PRE – BUILDING AND BUILDING	Hiring and training of the staff
BUILDING	Mobilization of building materials, supplies, machinery, equipment and staff
	Acquisition of goods and services
	Surface water catchment
	Generation of solid wastes by the project
	Generation of domestic and industrial liquid wastes by the project
	Removal of vegetation cover, stripping and cleaning
	Demolition and removal of the infrastructure existing in the areas to be intervened
	Earth moving (Excavations and Fillings)
	Installation and operation of camps
	Installation and operation of process plants (asphalt, concretes, grinding)
	Operation and maintenance of Machinery and/or equipment
	Building and operation of the Area for Management of Debris and Excavation Material (ZODME).
	Formation of sub-base, base and surfacing
	Formation of wearing course
	Building of hydraulic works (including riverbed occupations)
	Foundation and piling for bridges and viaducts
	Building of superstructure for bridges and viaducts
	Treatment of slopes
	Restoration of vegetation cover and revegetation
ABANDONMENT AND FINAL RESTORATION	Dismantling of temporary facilities and camps
	Final cleaning of the intervened areas
	Landscape management

Source: GEOCOL CONSULTORES S.A., 2017.

Based on the field information and **Chapter 3. Project Description**, the activities that would be developed and generate environmental impacts are described. It is worth mentioning that the activities shown below are described briefly since they shall be identified and assessed depending on the impact they generate in **Section 8.3.5 Analysis of the Matrix by Impacts (Scenario with the Project)**.

- **Outreach and Information to the Community and Competent Authorities**





It consists in communication of the activities related to the project and the scope of the project to the population that may be affected and the authorities of the area of influence. It embraces elaboration of studies and permit procedures before the authorities necessary for development of the project.

- **Negotiation of Properties and Easements**

This activity refers to the actions necessary to acquire the properties and easements located in the area subject to study and places of execution of the project activities.

- **Staff Hiring and Training**

This activity consists in hiring and training of the professional, technical and operating staff required for development of all the civil works and socio-environmental activities related to the project.

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- **Mobilization of Construction Materials, Supplies, Machinery, Equipment and Staff**

It involves land mobilization of the elements necessary for development of the project: materials, supplies, machinery, equipment and staff. It is executed with the use of vans, trucks, dump trucks and low-bed trailers, which shall circulate through the existing roads in the area of intervention implementing the necessary measures to avoid accidents and observing the provisions of the current regulations.

- **Acquisition of Goods and Services**

This activity is considered preliminary, but it may also be developed during other stages of the project. It consists in purchase of goods and hiring of services necessary for development of the project.

- **Surface Water Catchment**

It consists in exploitation of the water resource through building of the infrastructure necessary for catchment and distribution of water for the different activities of the project.

- **Disposal of Solid Wastes of the Project**

It refers to production of solid, domestic and hazardous wastes in the different phases and activities of the project.

- **Disposal of Liquid Domestic and Industrial Wastes of the Project**

It refers to production of liquid wastes such as domestic and industrial waters in the different phases and activities carried out in the project.

- **Removal of Vegetation Cover, Stripping and Cleaning**

This activity is related to removal of the vegetation cover, the organic layer of the soil and its subsequent cleaning for execution of the works of the project.





- **Demolition and Removal of the Existing Infrastructure in the Area to Be Intervened**

This activity refers to total or partial demolition of structures or buildings existing in the areas to be intervened by the project and includes final disposal of the materials derived from demolition. Likewise, it involves withdrawal, change, restoration or protection of the facilities of public and private services that could be affected by the works of the project, as well as management, dismantling, transfer and storage of existing structures.

- **Earth Moving (Excavations and Fillings)**

Excavation is necessary for foundations of the structures, including the volume of material to be removed, mechanically or manually, transport and disposal for execution of the works and the final cleaning necessary for conclusion of the work.

Additionally, fillings are activities that include scarification, leveling and compacting of the land or surfacing to place a new embankment or fit an existing one. It includes wetting or drying, conformation and compacting of materials.

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- **Installation and Operation of Camps**

It embraces installation and operation of transitory or permanent fronts of work and camps, where distribution and storage of building materials and wastes shall be located, as well as the infrastructure where offices and camps for lodging the staff shall be located.

- **Installation and Operation of Process Plants (Asphalt, Concrete, Crushing)**

It corresponds to construction and installation of the infrastructure, equipment yards, crushing plants, concrete, mixtures and other necessary infrastructure for logistics and management of civil works. In these areas, activities for management of solid and liquid wastes, in addition to catchment and discharge, shall be executed.

- **Operation and Maintenance of Machinery and/or Equipment**

This activity is carried out in the machinery and equipment necessary for development of civil works of the project. The foregoing has the purpose of optimizing productivity of equipment and machinery and to reduce probability of generation of impacts on the environment, including preventive and corrective maintenance.

- **Building and Operation of Areas for Management of Debris and Excavation Material (ZODME)**

For management of the remaining materials derived from the stripping and cleaning activities and earth moving, areas for management of debris and excavation materials (ZODME) shall be formed. Management of these areas involves loading and mobilization of excess material, controlled disposal in layers of surplus material, formation of terraces and slopes, compacting of materials, management of runoff waters and revegetation.

- **Formation of Base, Sub-base and Surfacing**

It consists in the supply, formation, leveling and compacting of stone materials (river raw material, rock granular material, etc.) over the land (after stripping, cleaning and earth moving activities) using equipment and machinery such as backhoe, loader, bulldozer, motor grader, vibratory compactor, etc.

- **Formation of Wearing Course**

It consists in the transport, paving and compacting of bituminous products and asphalt mixtures that compose the surface of the wearing course of the road.





- **Building of Hydraulic Works (Including Occupation of River Beds)**

It consists in building of works (generally in concrete) for management of runoff waters and crossing of water bodies (creeks and rivers): pipe sewers, box culverts, ditches, energy dissipaters, filters, sub-drains and drains. This has the purpose of guaranteeing the natural flow of waters. Additionally, it embraces possible installation of pre-manufactured structures.

- **Foundation and Piling for Bridges and Viaducts**

It consists in installation of reinforced concrete structures and embraces building of structures of foundation of brackets, piers, piles, nuts, shoes, wings and columns that serve as support of the superstructure of bridges and viaducts.

- **Building of Superstructure for Bridges and Viaducts**

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It embraces building in concrete and steel of the top part of bridges and viaducts. These structures are composed of beams, struts, armors, boards, slabs, tensioners, curbstones, platforms, and handrails among others.

- **Treatment of Slopes**

It refers to operations necessary to reach the geometric finishing of slopes of embankments and the top layer of rock embankments, as well as slopes of excavations. It also includes protection of the slopes with vegetal materials (use of material of stripping conserved), or artificial materials such as mesh or mortar.

- **Restoration of Vegetation Cover and Revegetation**

It consists in plantation of sods, seeds or biomantle on the areas of the project that require revegetation, slopes, ZODME, abandoned areas, etc.

- **Dismantling of Temporary Facilities and Camps**

It makes reference to activities for dismantling and abandonment of the fronts of the works and material storage sites. It includes movement and transport of materials and wastes, cleaning activities and restoration of intervened areas.

- **Final Cleaning of the Intervened Areas**

It consists in the group of activities focused on cleaning of the areas intervened for the project, as well as removal of the building materials, remaining materials, debris and temporary works from the area leaving it in appropriate cleaned conditions.

- **Landscape Management**

Landscaping (visual) of the intervened areas through implementation of works that integrate the infrastructures of the road with the environment. These activities are generally carried out by using native vegetation.





8.3.2 Identification of Environmental Impacts (Scenario with the Project)

8.3.2.1 Identification of Impacts by Community (Scenario with the Project)

In the process of socialization made in the areas of influence of the project, workshops for identification of impacts were also held. In such workshops, by preparing matrixes and using speaking maps, the population stated the impacts that they considered would be caused by development of the project subject to this study, in conformity with the provisions of Decree 2820 of August 5, 2010, which seeks people participation.

As already mentioned, such meetings were held between March 23 and March 29, 2017, in which the environmental impacts were identified for the project. These workshops were held in the second moment of socialization with a total of 28 socializations with the districts of the area of influence (See Part of the activity in **Photograph 8.15** and **Chapter 5, section 5.3 Socioeconomic Environment-Participation Guidelines**).

Photograph 8.15 Workshop of Environmental Impacts in the Scenario with the Project with the Communities of the Area of Influence of the Project

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District Yarqui



District La Esperanza



District Iscuazan



District Ospina Perez



District Pilcuan



District Silamag

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.45 shows the form used by the community for identification and assessment of the impacts and effects that are considered likely to occur for development of the project, as well as what management measure can be created to mitigate, prevent, compensate or repair the alterations caused.





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Table 8.45 Board Used for Identification of Impacts and Management Measures by the Community

STAGE	PHASES	IMPACTS	CHARACTER	MANAGEMENT MEASURES
PRE-OPERATION	PRE – BUILDING			
	BUILDING			
REVERSAL	ABANDONMENT AND FINAL RESTORATION			

Source: GEOCOL CONSULTORES S.A., 2017.

Photograph 8.16 shows the process of identification of impacts by the communities of the area of influence of the project.

Photograph 8.16 Process of Identification of Impacts of the Scenario with the Project



District Ospina Perez



District La Esperanza



District Silamag

Source: GEOCOL CONSULTORES S.A., 2015.

During socializations of this study, inhabitants of the area of influence, the environmental impacts that are deemed likely to be caused by the project were identified. **Table 8.46** shows in a general manner the impacts identified in the meetings of socialization (workshop of impacts), and the corresponding technical approval of how they were included in the environmental impact assessment in the scenario without the project was made (See **Annex 16. Evaluation Matrix**). It is worth clearing up that the impacts mentioned in the following tables correspond only to the impacts identified by the community and do not represent the total impacts identified by the technical team in charge of preparation of the study.













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Table 8.46 Impacts Identified by the Communities of Municipality of Contadero in the Meetings of Socialization for the Scenario with the Project





PHASE OF THE PROJECT	IMPACT IDENTIFIED BY THE COMMUNITIES*	APPROVED IMPACT – CORRESPONDENCE OF HOW IT IS INCLUDED IN THE STUDY
BUILDING	ABIOTIC	
	Land instability	Modification of soil stability
	Water contamination	Alteration in the surface water quality
	Emission of gases of the machinery pollutes the air	Modification of the air quality for Gases
	Emission of odors	Generation of odors
	Noise generation	Variation of sound pressure levels
	Modification of landscape	Changes in the landscape integrity
	Generation of dust and gas or smoke	Modification of the air quality for Gases / Modification of the air quality for Particulate Material
	Alteration of water	Alteration in the quality of surface water
	Mudslides	Modification of soil stability
	Alteration of water bodies by clearing of vegetation (tree cutting) and ZODMES	Alteration in the quality of surface water
	Air pollution for traffic of machinery and material	Modification of the quality of air by Gases
	Land drying, scarce production	Change in physicochemical and biological properties of soil
	Alteration of water and pollution	Alteration in the quality of surface water
	Decrease of water	Variation in availability of the surface water resource
	Mobilization of machinery – Air pollution	Modification of the air quality by Gases
	The building material could pollute the soil	Change in physicochemical and biological properties of the soil
	Soil infertilization for fields	Change in the use and potential of soil
	Alteration of water sources	Variation in availability of the surface water resource
	CO ₂ Pollution	Modification of air quality by Gases
	Stripping and excavation of sources of water and their quality	Alteration in the surface water quality
	H ₂ O Pollution	Alteration of the quality of the surface water
	Mudslides caused by rains affecting the community	Modification of soil stability
	Pollution caused by chemical substances to the soil, waters and animals	Change in physicochemical and biological properties of the soil
	Alteration of the soil making it sterile for compacting	Change in the use and potential of the soil
	Alteration of the source of the intake	Alteration of the groundwater flow network
	Generation of dust	Modification of the air quality for Particulate Material
	Infertilization of land	Change in the use and potential of the soil
	Pollution caused by vehicles	Modification of the air quality for Gases
	Alteration of water	Alteration of surface water quality
	Generation of erosive processes	Modification of soil stability
	Alteration of the water of creek Quismanuez by building the ZODME	Alteration of the quality of surface water
	Change in the properties of the soil for the ZODME	Change of the physicochemical and biological properties of the soil
	Alteration of creek Manzano Humeadora	Alteration of riverbeds
	Discharge of waste waters	Alteration of the quality of surface water
	Alteration of water	Alteration of the quality of surface water
	Effect of vibration and pollution caused by heavy machinery	Modification of soil stability

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PHASE OF THE PROJECT	IMPACT IDENTIFIED BY THE COMMUNITIES*	APPROVED IMPACT – CORRESPONDENCE OF HOW IT IS INCLUDED IN THE STUDY
	Erosionable area (stability)	Modification of soil stability
	Alteration of some water sources that are currently used for irrigation for animals	Alteration of the quality of surface water
	Generation of dust by concrete and crushing plants	Modification of the air quality for Particulate Material
	Air pollution	Modification of the air quality for Gases
	Reduction of the water resource	Variation in availability of the surface water resource
	Change in the economy	Change in the economic activities
	Soil infertility	Change of the physicochemical and biological properties of the soil
	Change in the water flow	Variation in availability of the surface water resource
ABANDONMENT AND RESTORATION	Noise pollution	Variation of sound pressure levels
	Restoration of areas intervened temporarily	Changes in the landscape integrity
	Landscape improvement	Changes in the landscape integrity
	Landscape beautifying	Changes in the landscape integrity
	Sterilization of lands for ZODME	Change of the physicochemical and biological properties of the soil
BUILDING	Landscape improvement of the intervened places	Changes in integrity of the landscape
	BIOTIC	
	PRE – BUILDING	
	Alteration of the vegetation cover and the native fauna (soil studies)	Modification of vegetation covers / changes in the structure, extension and availability of habitats of the wild fauna
	Loss of vegetation	Modification of vegetation covers
	Definite cutting	Modification of vegetation covers
	Frightening of fauna	Changes in the composition and structure of the fauna communities
	Alteration of the fauna	Changes in the composition and structure of the fauna communities
	Emigration of fauna	Changes in the composition and structure of the fauna communities
	Loss of many native plants	Modification of vegetation covers
	Loss of vegetation and deforestation	Modification of vegetation covers
	ZODMES Improvement of vegetation cover	Modification of vegetation covers
	Insecurity for animals for the use of machinery	Alteration of the structural and functional connectivity of the wild fauna
	Displacement of fauna	Changes in the composition and structure of the fauna communities
	Alteration of forests and the environment	Modification of vegetation covers
	Impact of deforestation	Modification of vegetation covers
ABANDONMENT AND RESTORATION	Alteration of the flora and fauna	Modification of vegetation covers / Changes in the composition and structure of the fauna communities
	Cutting of trees as walnut tree, cedar, native trees	Modification of vegetation covers
	Tree cutting	Modification of vegetation covers
	Definite reconstruction of the flora and fauna	Modification of vegetation covers
	Return of animals	Changes in the composition and structure of the fauna communities
	Improvement in revegetation and reforestation	Modification of vegetation covers
SOCIOECONOMIC		
BUILDING	Generation of jobs	Change in the dynamics of jobs

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PHASE OF THE PROJECT	IMPACT IDENTIFIED BY THE COMMUNITIES*	APPROVED IMPACT – CORRESPONDENCE OF HOW IT IS INCLUDED IN THE STUDY
	Deterioration of tertiary roads	Change in the state of road infrastructure
	Prices of houses have increased	Change in the land prices
	Expectations of the community	Generation of expectations
	Hiring of qualified and non-qualified workforce	Change in the dynamics of employment
	Fragmentation of properties	Fragmentation of properties
	Alteration of the local economy	Change in the economic activities
	Alteration of roads and tertiary roads	Change in the state of road infrastructure
	Generation of accidents	Change in the rates of road accidents
	Displacement	Change in the population dynamics
	Arrival of population	Change in the population dynamics
	Deterioration of roads	Change in the state of the road infrastructure
	Destruction of houses	Change in the state of social and public service infrastructure (collective equipment, aqueduct, sewers, electric energy, etc.)
	Generation of jobs	Change in the dynamics of employment
	Hiring of foreign staff	Change in the dynamics of employment
	Accidents	Change in the rates of road accidents
	Alteration of crops	Change in the economic activities
	Diseases	Change in the health state of the population
	Job generation for hiring	Change in the dynamics of employment / Change in the population dynamics
	Uprooting	Change in the population dynamics
	Payment of properties for under the actual value	Change in the land prices/ Generation of conflicts
	Damages to the life quality	Change in the life quality of the population
	Disintegration of families and districts	Change in the population dynamics
	Mobilization of population from properties required for the project	Change in the population dynamics
	Proper compensation of properties	Change in the land prices
	Improve trade	Change in the economic activities / Change in the supply and demand of goods and services
	Training for the workforce	Change in the dynamics of employment
	Mistrust and conflicts	Generation of conflicts
	Population mobility	Change in the population dynamics
	Change of local economy	Change in the economic activities
	Change in the life quality	Change in the life quality of the population
	Departure of people and abandonment of the district	Change in the population dynamics
	Job opportunity	Change in the dynamics of employment
	Provision of goods and services	Change in the supply and demand of goods and services
	Employment source	Change in the dynamics of employment
BUILDING	Changes in health state of inhabitants	Change in the health state of the population
	Change in social relations	Change in the population dynamics
	Generation of expectations	Generation of expectations
	Alteration of security	Change in the life quality of the population
	Change in the income levels	Change in the Levels of Income
	Alteration of aqueducts	Change in the state of the social and public service infrastructure (collective equipment, aqueduct, sewers, electric energy, etc.)
	Alteration of roads and tertiary roads	Change in the state of road infrastructure
	Generation of accidents	Change in the rates of road accidents
	Health issues	Change in the health state of the population

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PHASE OF THE PROJECT	IMPACT IDENTIFIED BY THE COMMUNITIES*	APPROVED IMPACT – CORRESPONDENCE OF HOW IT IS INCLUDED IN THE STUDY
	Conflicts	Generation of conflicts
	Destruction of heirlooms	Change in the values and cultural practices
	Road accidents for speeding	Change in the rates of road accidents
	Increase of insecurity	Change in the life quality of the population
	Deterioration of existing roads	Change in the state of road infrastructure
	Change in the dynamics of the population	Change in the population dynamics
	Conflicts between the community	Generation of conflicts
	Generation of income	Change in the Levels of Income
	Community organization	Change in social relations
	Destruction of hieroglyphs	Change in values and cultural practices
	Damage to communities for building of sewers	Change in the state of the social and public service infrastructure (collective equipment, aqueduct, sewers, electric energy, etc.)
	Properties for value	Change in the land prices
	Bringing progress	Change in the life quality of the population
	Relocation of houses	Change in the population dynamics
	Alteration of crops	Change in the economic activities
	Alteration of irrigation networks and aqueducts, discharge	Change in the state of the social and public service infrastructure (collective equipment, aqueduct, sewers, electric energy, etc.)
	Risk of road accidents	Change in the rates of road accidents
	Psychological and physical diseases	Change in the health state of the population
	Change in the life quality	Change in the life quality of the population
	Loss of irrigation hydrants and irrigation districts	Change in the state of the social and public service infrastructure (collective equipment, aqueduct, sewers, electric energy, etc.)
	Alteration of the economy and crops	Change in the economic activities
	Alterations to health	Change in the health state of the population
	Displacement of the community for deterioration of the life quality	Change in the life quality of the population
	Alteration of business on the existing road	Change in the economic activities
	Deterioration of roads	Change in the state of the road infrastructure
	Disappearance of small properties that are generally all from the district	Fragmentation of properties
	Subdivision of properties since the road divides them	Fragmentation of properties
	Generation of income	Change in the Levels of Income
	Migration of peasants to the cities	Change in the population dynamics
	Demand of goods and services	Change in the supply and demand of goods and services
	Alteration of the road infrastructure and original roads	Change in the state of the road infrastructure
	Commercialization of products	Change in the level of income
	Alteration of access roads	Change in the state of the road infrastructure
	Alteration of tertiary roads	Change in the state of the road infrastructure
	Change in service provision	Change in the supply and demand of goods and services
ABANDONMENT AND RESTORATION	Change in the population dynamics	Change in the population dynamics
	Changes in the accident rates	Change in the rates of road accidents
	Changes in prices of the properties	Change in the land prices
	Changes in the dynamics of employment	Change in the dynamics of employment
	Change in the state of social infrastructure	Change in the state of the social and public service infrastructure (collective equipment, aqueduct, sewer, electric energy, etc.)
	Generation of conflicts	Generation of conflicts
	Change in the health state of the population	Change in the health state of the population
	Ease of transport	Change in the state of road infrastructure

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PHASE OF THE PROJECT	IMPACT IDENTIFIED BY THE COMMUNITIES*	APPROVED IMPACT – CORRESPONDENCE OF HOW IT IS INCLUDED IN THE STUDY
	Assessment of lots	Change in the land prices
	Change in the family dynamics	Change in the social relations
	Changes of mobility	Change in the state of road infrastructure
	Loss of crops	Change in the economic activities
	Assessment of properties	Change in the land prices
	Change in values and cultural practices	Change in values and cultural practices
	Better transport quality	Change in the life quality of the population
	Improvement of road mobility	Change in the state of road infrastructure

*the impacts identified by the community occur as defined.

Source: GEOCOL CONSULTORES S.A., 2017.

8.3.2.2 Correlated and Definite Identification of Impacts (Scenario with the Project)

In consideration of the foregoing, identification of socio-environmental impacts in the scenario with the project previously made by the consultant groups is completed for subsequent assessment of impacts in the different environments. When the activities do not cause impacts, the impacts are hidden from the matrix for management of the information. Nonetheless, **Annex 16. Assessment Matrix** contains the entire matrix identified (See **Table 8.47** through **Table 8.52**).

Table 8.47 Identification of the Interactions that Would Cause Environmental Impacts (Stage: Pre-Building and Building)

PHASES OF THE PROJECT			PRE-BUILDING		PRE-BUILDING AND BUILDING
ENVIRONMENT	COMPROMISED ENVIRONMENTAL ELEMENT	ENVIRONMENTAL ASPECTS	OUTREACH AND INFORMATION TO THE COMMUNITY AND COMPETENT AUTHORITIES	NEGOTIATION OF PROPERTIES AND EASEMENTS	HIRING AND TRAINING OF THE STAFF
SOCIOECONOMIC	POPULATION STRUCTURE	Change in the population dynamics			-
	ECONOMIC AND PRODUCTIVE STRUCTURE	Change in the supply and demand of goods and services			+
		Fragmentation of properties		-	
		Change in the land prices		-	
		Change in the economic activities			+
		Change in the dynamics of employment			+
		Change in the Levels of Income			+
		Change in the life quality of the population		-	+
	SOCIAL INFRASTRUCTURE	Change in the state of social and public service infrastructure (collective equipment, aqueduct, sewers, electric energy, etc.)		-	-
	COMMUNITY	Generation of conflicts		-	-
		Generation of expectations		-	
		Change in social relations	+		
	CULTURE	Change in values and cultural practices			-
	HEALTH	Change in the health state of the population			

Source: GEOCOL CONSULTORES S.A., 2017.





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Table 8.48 Identification of the Interactions that Would Cause Environmental Impacts (Stage: building - ENVIRONMENT: ABIOTIC).

ENVIRONMENT		PHASES OF THE PROJECT		BUILDING																		
ABIOTIC	COMPROMISED ENVIRONMENTAL ELEMENT	ENVIRONMENTAL IMPACT ASPECTS	MOBILIZATION OF BUILDING MATERIALS, SUPPLIES, MACHINERY, EQUIPMENT AND STAFF	ACQUISITION OF GOODS AND SERVICES	SURFACE WATER CATCHMENT	GENERATION OF SOLID WASTES BY THE PROJECT	GENERATION OF DOMESTIC AND INDUSTRIAL LIQUID WASTES BY THE PROJECT	REMOVAL OF VEGETATION COVER, STRIPPING AND CLEANING	DEMOLITION AND REMOVAL OF THE EXISTING INFRASTRUCTURE IN THE AREAS TO BE INTERVENED	EARTH MOVING (EXCAVATIONS AND FILLINGS)	INSTALLATION AND OPERATION OF CAMPS	INSTALLATION AND OPERATION OF PLANTS OF PROCESSES (ASPHALT, CONCRETE, CRUSHING)	OPERATION AND MAINTENANCE OF MACHINERY AND/OR EQUIPMENT	BUILDING AND OPERATION OF THE AREA OF MANAGEMENT OF DEBRIS AND EXCAVATION MATERIAL (ZODME)	FORMATION OF SUB-BASE, BASE AND SURFACING	FORMATION OF THE WEARING COURSE	BUILDING OF HYDRAULIC WORKS (INCLUDING OCCUPATIONS OF RIVERBED)	FOUNDATION AND PILING FOR BRIDGES AND VIADUCTS	BUILDING OF SUPERSTRUCTURE FOR BRIDGES AND VIADUCTS	TREATMENT OF SLOPES	RESTORATION OF VEGETATION COVER AND REVEGETATION	
	SOIL	Modification of soil stability	-			-	-	-	-	-		-			+	+	+			-		
		Change of the physicochemical and biological properties of the soil		-	-	-	-	-	-	-		-							+		-	
		Change in the use and potential of the soil		-		-		-	-	-		-							+		-	
	SURFACE WATERS	Alteration of riverbeds	-			-	-	-	-			-			-				+	+	-	
		Alteration of the quality of surface water	-	-	-	-	-	-	-	-	-	-	-	-	-	-			+	+	-	-
		Variation in availability of the surface water resource	-			-	-	-	-			-			-	-					-	
		Variation in the amount and transport of sediments	-			-	-	-	-		-		-	-	-	-			+	+	-	
		Decrease in the capacity of transport of surface water sources	-			-	-	-	-			-			-	-			+	+	-	
	GROUNDWATER	Alteration in the quality of groundwater		-	-	-		-	-	-	-		-						+	+		-
Alteration of the groundwater flow network					-		-					-										
Alteration of recharge areas					-		-					-							+			

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ENVIRONMENT		PHASES OF THE PROJECT		BUILDING																	
	COMPROMISED ENVIRONMENTAL ELEMENT	ENVIRONMENTAL IMPACT ASPECTS	MOBILIZATION OF BUILDING MATERIALS, SUPPLIES, MACHINERY, EQUIPMENT AND STAFF	ACQUISITION OF GOODS AND SERVICES	SURFACE WATER CATCHMENT	GENERATION OF SOLID WASTES BY THE PROJECT	GENERATION OF DOMESTIC AND INDUSTRIAL LIQUID WASTES BY THE PROJECT	REMOVAL OF VEGETATION COVER, STRIPPING AND CLEANING	DEMOLITION AND REMOVAL OF THE EXISTING INFRASTRUCTURE IN THE AREAS TO BE INTERFERED	EARTH MOVING (EXCAVATIONS AND FILLINGS)	INSTALLATION AND OPERATION OF CAMPS	INSTALLATION AND OPERATION OF PLANTS OF PROCESSES (ASPHALT, CONCRETE, CRUSHING)	OPERATION AND MAINTENANCE OF MACHINERY AND/OR EQUIPMENT	BUILDING AND OPERATION OF THE AREA OF MANAGEMENT OF DEBRIS AND EXCAVATION MATERIAL (ZODME)	FORMATION OF SUB-BASE, BASE AND SURFACING	FORMATION OF THE WEARING COURSE	BUILDING OF HYDRAULIC WORKS (INCLUDING OCCUPATIONS OF RIVERBED)	FOUNDATION AND PILING FOR BRIDGES AND VIADUCTS	BUILDING OF SUPERSTRUCTURE FOR BRIDGES AND VIADUCTS	TREATMENT OF SLOPES	RESTORATION OF VEGETATION COVER AND REVEGETATION
	AIR	Modification of the air quality for Gases	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
		Modification of the air quality for Particulate Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Generation of Odors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Variation of sound pressure levels	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LANDSCAPE	Changes in the landscape integrity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.49 Identification of the Interactions that Would Cause Environmental Impacts (Stage: Building - Environment: Biotic)

ENVIRONMENT		PHASES OF THE PROJECT		BUILDING																	
COMPROMISED ENVIRONMENTAL ELEMENT		ENVIRONMENTAL IMPACT ASPECTS	MOBILIZATION OF BUILDING MATERIALS, SUPPLIES, MACHINERY, EQUIPMENT AND STAFF	ACQUISITION OF GOODS AND SERVICES	SURFACE WATER CATCHMENT	GENERATION OF SOLID WASTES BY THE PROJECT	GENERATION OF DOMESTIC AND INDUSTRIAL LIQUID WASTES BY THE PROJECT	REMOVAL OF VEGETATION COVER, STRIPPING AND CLEANING	DEMOLITION AND REMOVAL OF THE EXISTING INFRASTRUCTURE IN THE AREAS TO BE INTERVENED	EARTH MOVING (EXCAVATIONS AND FILLINGS)	INSTALLATION AND OPERATION OF CAMPS	INSTALLATION AND OPERATION OF PLANTS OF PROCESSES (ASPHALT, CONCRETE, CRUSHING)	OPERATION AND MAINTENANCE OF MACHINERY AND/OR EQUIPMENT	BUILDING AND OPERATION OF THE AREA OF MANAGEMENT OF DEBRIS AND EXCAVATION MATERIAL (ZODIME)	FORMATION OF SUB-BASE, BASE AND SURFACING	FORMATION OF THE WEARING COURSE	BUILDING OF HYDRAULIC WORKS (INCLUDING OCCUPATIONS OF RIVERBED)	FOUNDATION AND PILING FOR BRIDGES AND VIADUCTS	BUILDING OF SUPERSTRUCTURE FOR BRIDGES AND VIADUCTS	TREATMENT OF SLOPES	RESTORATION OF VEGETATION COVER AND REVEGETATION
BIOTIC	FLORA	Modification of vegetation covers				.															
		Changes in the flora structure and composition				.															
	FAUNA	Changes in the structure, extension and availability of the wild fauna				.							.								
		Changes in the composition and structure of the fauna communities				.							.								
		Alteration of the structural and functional connectivity of the habitats of the wild fauna				.							.								
		Alteration of the edaphic fauna			.	.		.				.	.								.
		Changes in the mobility patterns of individuals				.		.				.	.
	HYDROBIOLOGY	Changes in the composition and structure of the hydrobiological communities
Alteration of the habitat of hydrobiological communities		

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Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.50 Identification of the Interactions that Would Cause Environmental Impacts (Stage: Building - Environment: Socioeconomic)

ENVIRONMENT		PHASES OF THE PROJECT		BUILDING																					
ENVIRONMENT	COMPROMISED ENVIRONMENTAL ELEMENT	ENVIRONMENTAL IMPACT ASPECTS	ECONOMIC AND PRODUCTIVE STRUCTURE	SOCIAL INFRASTRUCTURE	COMMUNITY	CULTURE	MOBILIZATION OF BUILDING MATERIALS, SUPPLIES, MACHINERY, EQUIPMENT AND STAFF	ACQUISITION OF GOODS AND SERVICES	SURFACE WATER CATCHMENT	GENERATION OF SOLID WASTES BY THE PROJECT	GENERATION OF DOMESTIC AND INDUSTRIAL LIQUID WASTES BY THE PROJECT	REMOVAL OF VEGETATION COVER, STRIPPING AND CLEANING	DEMOLITION AND REMOVAL OF THE EXISTING INFRASTRUCTURE IN THE AREAS TO BE INTERFERED	EARTH MOVING (EXCAVATIONS AND FILLINGS)	INSTALLATION AND OPERATION OF CAMPS	INSTALLATION AND OPERATION OF PLANTS OF PROCESSES (ASPHALT, CONCRETE, CRUSHING)	MAINTENANCE OF MACHINERY AND/OR BUILDING AND OPERATION OF THE AREA OF MANAGEMENT OF DEBRIS AND EXCAVATION OF MATERIAL (ZODME)	FORMATION OF SUB-BASE, BASE AND SURFACING	FORMATION OF THE WEARING COURSE	BUILDING OF HYDRAULIC WORKS (INCLUDING OCCUPATIONS OF RIVERBED)	FOUNDATION AND PILING FOR BRIDGES AND VIADUCTS	BUILDING OF SUPERSTRUCTURE FOR BRIDGES AND VIADUCTS	TREATMENT OF SLOPES	RESTORATION OF VEGETATION COVER AND REVEGETATION	
							Change in the life quality of the population																		
Change in the state of the social and public service infrastructure (collective equipment, aqueduct, sewers, electric energy, etc.)																									
Change in the state of road infrastructure																					+	+			
Generation of conflicts		-	-	-																				-	-
Change in values and cultural practices																									

Source: GEOCOL CONSULTORES S.A., 2017.





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Table 8.51 Identification of the Interactions that Would Cause Environmental Impacts (Stage: Abandonment and Final Restoration)

ENVIRONMENT	COMPROMISED ENVIRONMENTAL ELEMENT	PHASES OF THE PROJECT	ABANDONMENT AND FINAL RESTORATION		
		ENVIRONMENTAL IMPACT ASPECTS	DISMANTLING OF TEMPORARY FACILITIES AND CAMPS	FINAL CLEANING OF THE INTERVENED AREAS	LANDSCAPE MANAGEMENT
ABIOTIC	SOIL	Modification of soil stability	+		
		Change of the physicochemical and biological properties of the soil	+		
		Change in the use and potential of the soil	+		
	SURFACE WATERS	Alteration of riverbeds			+
		Alteration of the quality of surface water		+	
		Variation in the amount and transport of sediments			+
	GROUNDWATER	Alteration in the quality of groundwater		+	
		Alteration of recharge areas			+
	AIR	Modification of the air quality for Gases	-	-	
		Modification of the air quality for Particulate Material	-	-	
		Variation of sound pressure levels	-	-	
	LANDSCAPE	Changes in the landscape integrity	+	+	+
BIOTIC	FLORA	Modification of vegetation covers			+
		Changes in the flora structure and composition			+
SOCIOECONOMIC	SOCIAL INFRASTRUCTURE	Changes in the social and public service infrastructure (collective equipment, aqueduct, sewers, electric energy, etc.)			+
		Change in the state of road infrastructure		+	+

Source: GEOCOL CONSULTORES S.A., 2017.

Rating of the criteria for determination of the Environmental significance of the impacts identified is shown in more detail in **Annex 16. Assessment Matrix**. **Table 8.52** shows a summary table of the rating of the activities in the scenario with the project.









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Table 8.52 Summary of Rating of the Activities in the Scenario with the Project

PHASES OF THE PROJECT	ENVIRONMENTAL ASPECTS	NEGATIVE IMPACTS					POSITIVE IMPACTS					TOTAL PROJECT
		MILD OR IRRELEVANT IMPACT (> A-32)	MODERATE IMPACT (BETWEEN -33 AND -51)	SEVERE IMPACT (BETWEEN -52 AND -74)	CRITICAL IMPACT (< A-74)	TOTAL	MILD OR IRRELEVANT IMPACT (< A 33)	MODERATE IMPACT (BETWEEN 33 AND 51)	SEVERE IMPACT (BETWEEN 52 AND 74)	CRITICAL IMPACT (> A 74)	TOTAL	
PRE-BUILDING	Outreach and information to the community and competent authorities	0	0	0	0	0	0	1	0	0	1	1
	Negotiation of properties and easements	0	4	2	0	6	0	0	0	0	0	6
PRE – BUILDING Y BUILDING	Hiring and training of the staff	2	1	1	0	4	0	4	1	0	5	9
BUILDING	Mobilization of building materials, supplies, machinery, equipment and staff	10	5	0	0	15	0	0	1	0	1	16
	Acquisition of goods and services	2	0	0	0	2	0	2	1	0	3	5
	Surface water catchment	10	2	0	0	12	0	0	0	0	0	12
	Generation of solid wastes by the project	5	2	0	0	7	0	0	0	0	0	7
	Generation of domestic and industrial liquid wastes by the project	8	1	0	0	9	0	0	0	0	0	9
	Removal of vegetation cover, stripping and cleaning	9	11	4	0	24	0	0	0	0	0	24
	Demolition and removal of the infrastructure existing in the areas to be intervened	8	2	1	0	11	0	0	0	0	0	11
	Earth moving (Excavations and Fillings)	6	9	4	0	19	0	0	0	0	0	19
	Installation and operation of camps	6	3	0	0	9	0	0	0	0	0	9
	Installation and operation of process plants (asphalt, concretes, grinding)	5	1	2	0	8	0	0	0	0	0	8
	Operation and maintenance of Machinery and/or equipment	3	3	0	0	6	0	0	0	0	0	6
	Building and operation of the Area for Management of Debris and Excavation Material (ZODME).	5	9	8	0	22	0	0	0	0	0	22

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PHASES OF THE PROJECT	ENVIRONMENTAL ASPECTS	NEGATIVE IMPACTS					POSITIVE IMPACTS					TOTAL PROJECT
		MILD OR IRRELEVANT IMPACT (> A-32)	MODERATE IMPACT (BETWEEN -33 AND -51)	SEVERE IMPACT (BETWEEN -52 AND -74)	CRITICAL IMPACT (< A -74)	TOTAL	MILD OR IRRELEVANT IMPACT (< A 33)	MODERATE IMPACT (BETWEEN 33 AND 51)	SEVERE IMPACT (BETWEEN 52 AND 74)	CRITICAL IMPACT (> A 74)	TOTAL	
	Formation of sub-base, base and surfacing	4	2	0	0	6	0	0	0	0	0	6
	Formation of wearing course	2	3	0	0	5	0	0	0	0	0	5
	Building of hydraulic works (including riverbed occupations)	6	4	1	0	11	1	0	0	0	1	12
	Foundation and piling for bridges and viaducts	9	1	1	0	11	1	0	0	0	1	12
	Building of superstructure for bridges and viaducts	2	0	1	0	3	0	1	0	0	1	4
	Treatment of slopes	2	0	0	0	2	5	1	1	0	7	9
	Restoration of vegetation cover and revegetation	1	0	0	0	1	4	12	1	0	17	18
ABANDONMENT AND FINAL RESTORATION	Dismantling of temporary facilities and camps	3	0	0	0	3	1	3	0	0	4	7
	Final cleaning of the intervened areas	3	0	0	0	3	3	1	0	0	4	7
	Landscape management	0	0	0	0	0	3	3	2	0	8	8
TOTAL		111	63	25	0	199	18	28	7	0	53	252

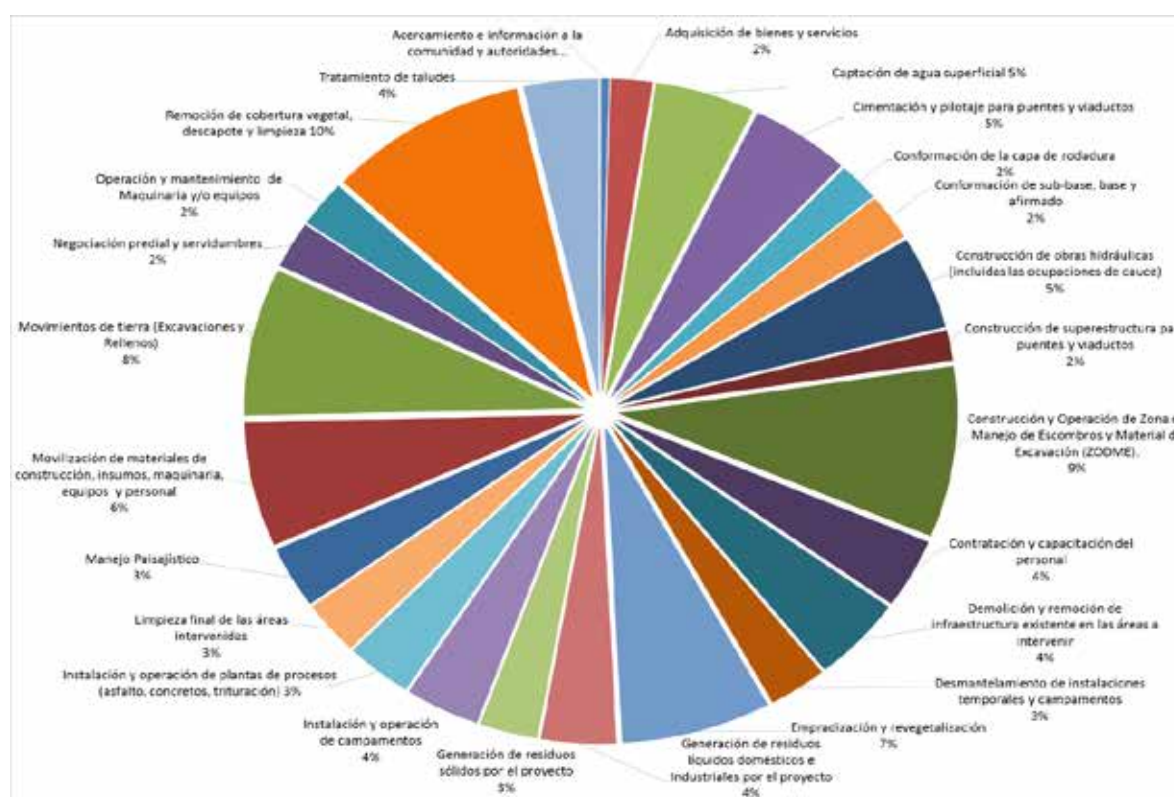
Source: GEOCOL CONSULTORES S.A., 2017.

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8.3.3 Results of the Environmental Impact Assessment (Scenario with the Project)

Considering the scope of the project and the state of the Area of Influence of the highway project, in general terms, 252 impacts were identified among the activities assessed and the current conditions of the area, which would be of positive and negative character, vegetation cover removal, stripping and cleaning being the activity that would have the highest number of impacts with 24 impacts equivalent to 10%, followed by building and operation of area of management of debris and excavation material (ZODME) with 22 impacts that equal to 9%, then, there is the earth moving activity (excavation and fillings) with 19 impacts equivalent to 8% (See Figure 8.9).

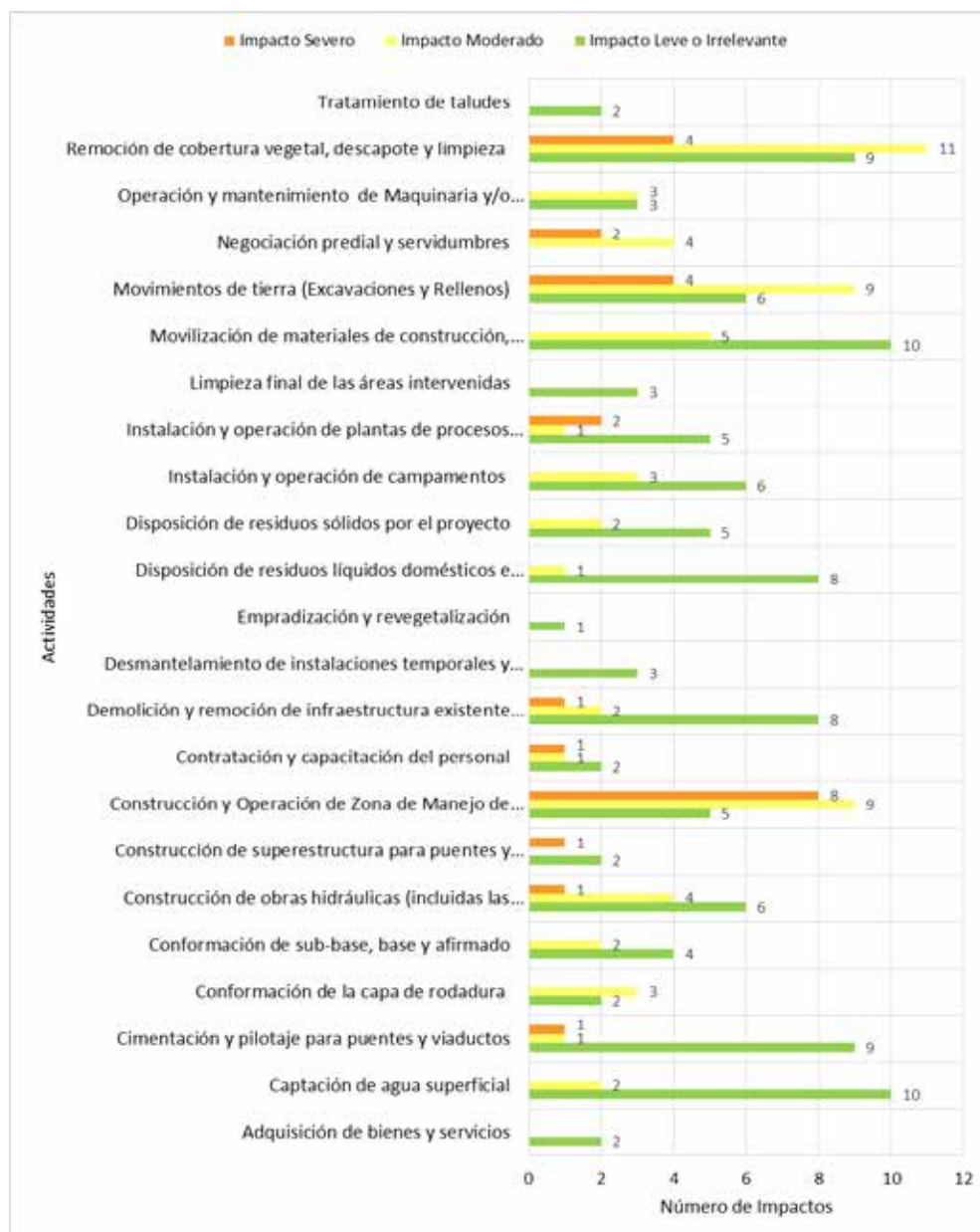
Figure 8.9 Distribution of Interaction of Impacts by Activities of the Project



Source: GEOCOL CONSULTORES S.A., 2017.

The activities that have had the highest number of negative impacts are removal of vegetation cover, stripping and cleaning (9 mild or irrelevant impacts, 11 moderate impacts and 4 severe impacts for a total of 24 impacts); followed by building and operation of areas of management of debris and excavation material (ZODME) (5 mild or irrelevant impacts, 9 moderate impacts and 8 severe impacts for a total of 22 impacts); and in third level earth moving (excavation and fillings) (6 mild or irrelevant impacts, 9 moderate impacts, 4 severe impacts for a total of 19 impacts) (See Figure 8.10).

Figure 8.10 Interaction of Environmental Aspects with Negative Impacts



Source: GEOCOL CONSULTORES S.A., 2017.

The group of interactions that had negative impacts was broken down as follows: 56 % mild or irrelevant (111 impacts), 32% moderate (63 impacts) and 12% corresponding to severe (25 impacts) for a total of 199 negative impacts equivalent to 79% of all the impacts identified (See **Figure 8.11** and **Figure 8.12**).

Figure 8.11 Percentage of positive and negative impacts

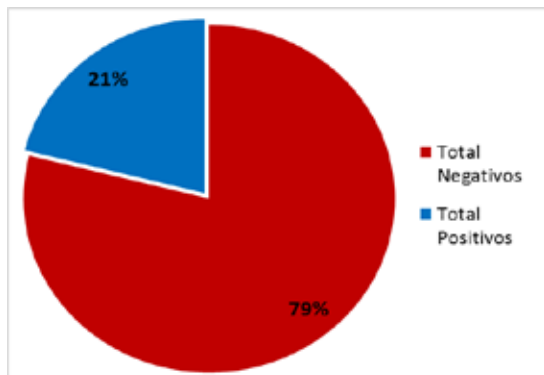
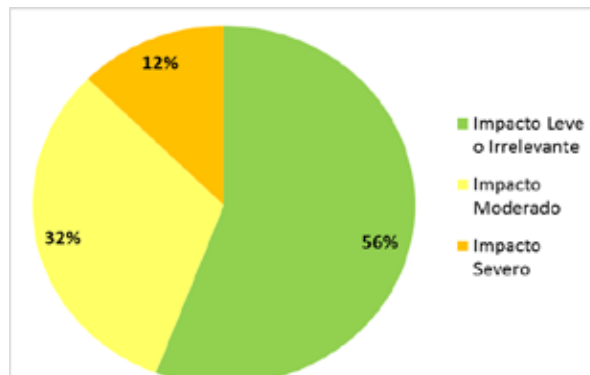


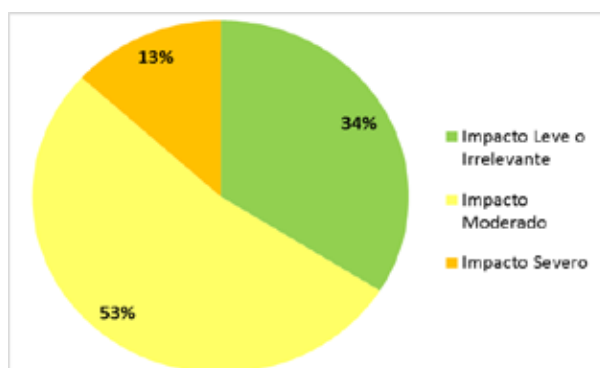
Figure 8.12 Discrimination per type of negative impact



Source: GEOCOL CONSULTORES S.A., 2017.

For the case of interactions that would have positive impacts, they are broken down as follows: 34% mild or irrelevant (18 impacts), 53% moderate (28 impacts), and 13% corresponding to severe (7 impacts) for a total of 53 impacts equivalent to 21% of all the impacts identified (See **Figure 8.13**).

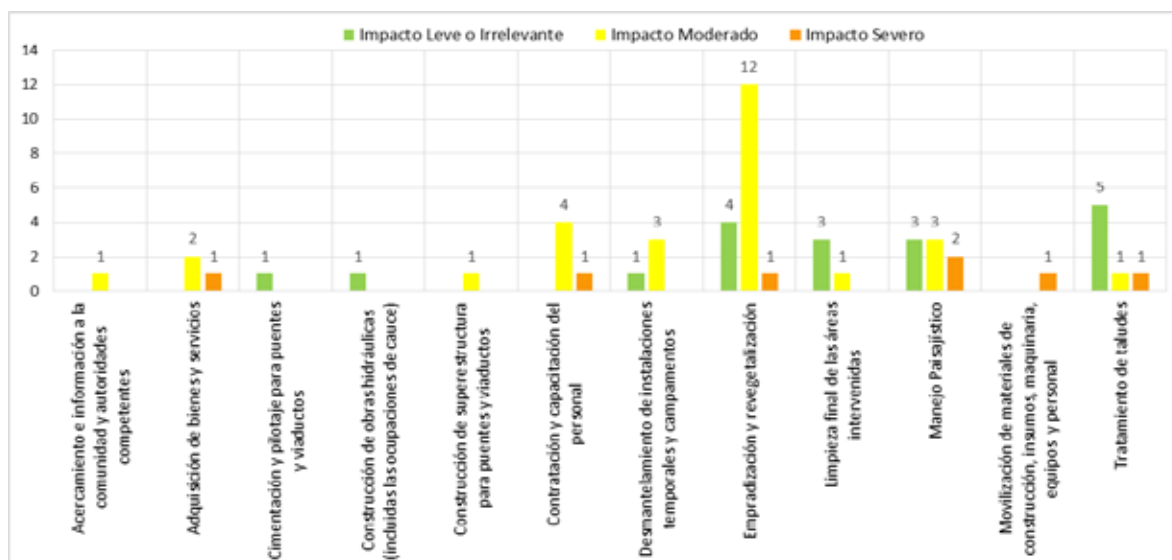
Figure 8.13 Discrimination per Type of Positive Impact



Source: GEOCOL CONSULTORES S.A., 2017.

In general, the activities with the highest number of positive impacts are restoration of vegetation cover and revegetation with 17 impacts (4 mild or irrelevant, 12 moderate and 1 severe), landscape management with 8 impacts (3 mild or irrelevant, 3 moderate and 2 severe); and treatment of slopes with 7 impacts (5 mild or irrelevant, 1 moderate and 1 severe) See **Figure 8.14**.

Figure 8.14 Interaction of Environmental Aspects with Positive Impacts



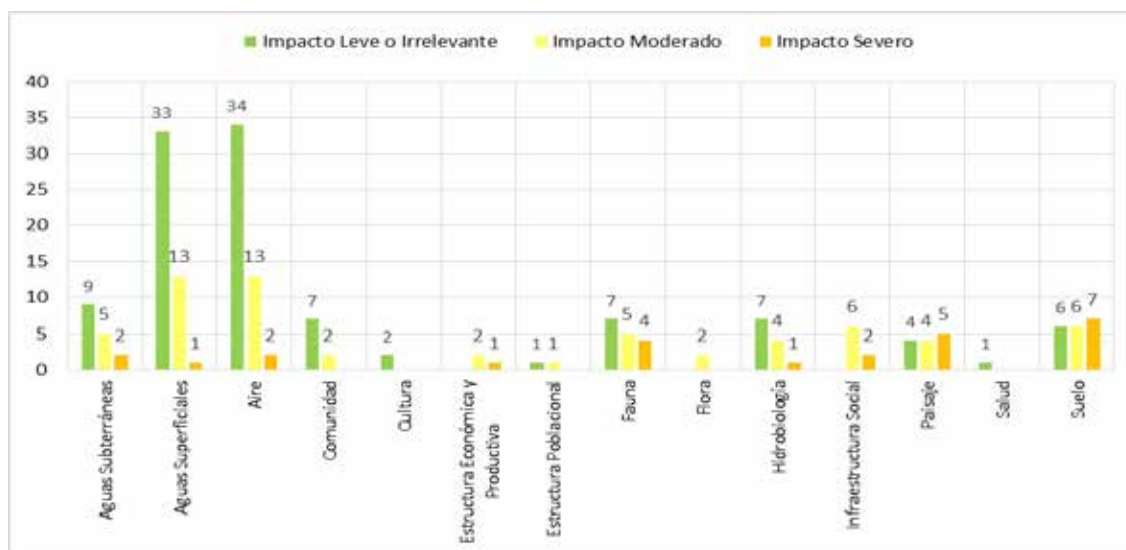
Source: GEOCOL CONSULTORES S.A., 2017.

Figure 8.15 and Figure 8.16 show the environmental elements that could be affected by the activities assessed in the scenario with the project considering the interactions between the activities and the environmental elements analyzed and according to the assessment of the impacts identified.

For the scenario of negative impacts, according to the activities to be developed, the air element has the highest number of possible impacts (34 mild or irrelevant, 13 moderate and 2 severe for a total of 49 impacts), followed by the element of surface waters with 47 impacts (33 mild or irrelevant, 13 moderate, and 1 severe) and in third place, there is the soil element with 19 impacts (6 mild or irrelevant, 6 moderate and 7 severe) (See Figure 8.15).

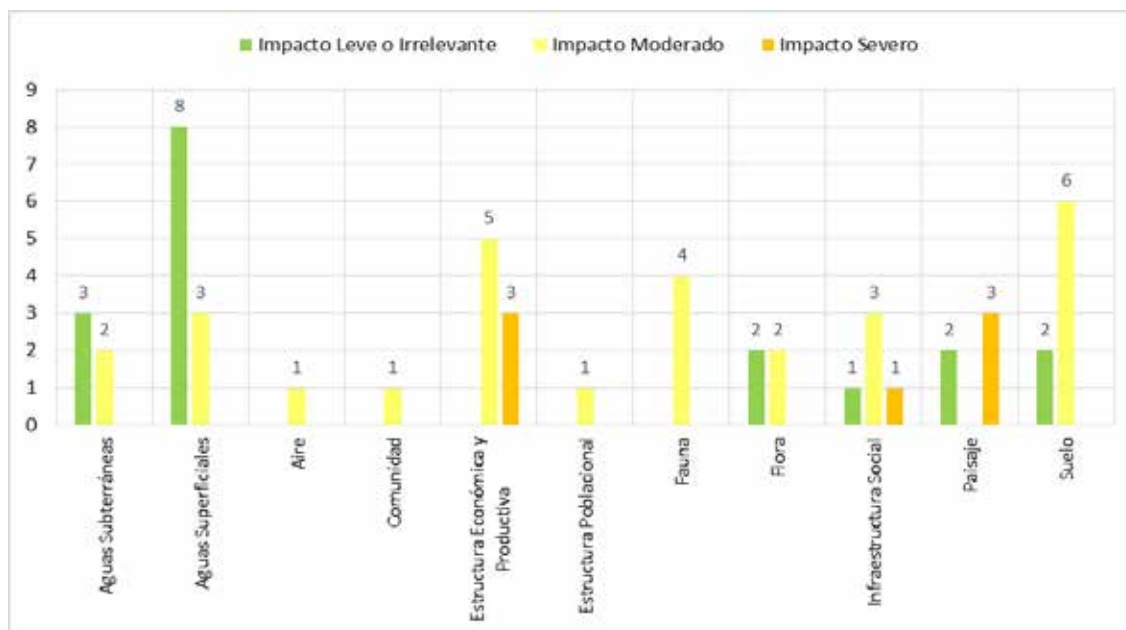
For the scenario of positive impacts, the most benefited elements are surface waters with 11 impacts (8 mild or irrelevant and 3 moderate). This is directly associated with the activity of restoration of vegetation cover and revegetation and treatment of slopes. In second place, there is the element of economic and productive structure with 8 impacts (5 moderate and 3 severe). This is associated with the employment dynamism generated by the project (See Figure 8.16).

Figure 8.15 Environmental Element Affected by Negative Impacts







Source: GEOCOL CONSULTORES S.A., 2017.

Figure 8.16 Environmental Element Benefited by Positive Impacts



Source: GEOCOL CONSULTORES S.A., 2017.

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8.3.4 Weighing of the Environmental Impacts Assessed (Scenario with the Project)

Weighing of the environmental impacts in the scenario with the project was made in the same manner as for the scenario without the project also seeking to establish the most impacting activities globally.

Table 8.53 and Table 8.54 show the activities most likely to have an impact on the socio-environmental environment. Table 8.55 and Table 8.56 contain the most representative impacts that could exist for the project considering the weighing made.

Table 8.53 contains the activity with the greatest negative impact, that is, building and operation of areas of debris and excavation materials (ZODME), followed by removal of vegetation cover, stripping and cleaning and third place, earth moving (Excavation and Fillings). All the activities shall be analyzed with their corresponding impact in section 8.3.5 Analysis of the Matrix per Impacts – Scenario with the Project. As for the activities with a positive impact there is restoration of vegetation cover and revegetation, followed by landscape management and treatment of slopes (See Table 8.54).

Table 8.53 Most Impacting Activities with a Negative Character





ACTIVITY (ENVIRONMENTAL ASPECT)	PHASE
Building and Operation of Debris and Excavation Material (ZODME)	Building
Removal of vegetation cover, stripping and cleaning	Building
Earth moving (Excavation and Fillings)	Building
Mobilization of building materials, supplies, machinery, equipment and staff	Building
Building of hydraulic works (including occupation of riverbeds)	Building
Surface water catchment	Building
Foundation and piling for bridges and viaducts	Building
Demolition and removal of the existing infrastructure in the areas to be intervened	Building
Installation and operation of camps	Building
Installation and operation of process plants (asphalt, concrete, crushing)	Building

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.54 Most Impacting Activities with a Positive Character

ACTIVITY (ENVIRONMENTAL ASPECT)	PHASE
Restoration of Vegetation Cover and Revegetation	Building
Landscape Management	Abandonment and Final Restoration
Treatment of slopes	Building
Hiring and training of the staff	Pre-Building y Building
Dismantling of temporary facilities and camps	Abandonment and Final Restoration
Final cleaning of the areas intervened	Abandonment and Final Restoration
Acquisition of goods and services	Building
Mobilization of building materials, supplies, machinery, equipment and staff	Building
Building of superstructure for bridges and viaducts	Building
Outreach and information to the community and competent authorities	Pre-Building

Source: GEOCOL CONSULTORES S.A., 2017.

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The negative impact with the highest rating is the change in the landscape integrity, followed by variation in the sound pressure levels and modification of the air quality for gases. These impacts shall be explained in section **8.3.5 Analysis of the Matrix per Impacts of the Scenario with the Project** (See Table 8.55).

Table 8.55 Most Representative Negative Impacts of the Project

COMPROMISED ENVIRONMENTAL ELEMENT	IMPACT
Landscape	Changes in the landscape integrity
Air	Variation of sound pressure levels
Air	Modification of the air quality for Gases
Surface Waters	Alteration of the quality of surface water
Air	Modification of the air quality for Particulate Material
Surface Waters	Alteration of riverbeds
Soil	Modification of soil stability
Soil	Change of the physicochemical and biological properties of the soil
Groundwater	Alteration in the quality of groundwater
Surface Waters	Variation in the amount and transport of sediments

Source: GEOCOL CONSULTORES S.A., 2017.

For the positive impacts, most of them are associated with the abandonment and final restoration stage. The most benefited elements are the social infrastructure for creation of a road corridor with the better technical specification and the economic and productive structure for the economic and employment dynamism that the project would bring. These impacts shall be explained in section **8.3.5 Analysis of the Matrix per Impacts in the Scenario with the Project** (See Table 8.56).

Table 8.56 Most Representative Positive Impacts of the Project

COMPROMISED ENVIRONMENTAL ELEMENT	IMPACT
Social Infrastructure	Change in the state of road infrastructure
Economic and Productive Structure	Change in the supply and demand of goods and services
Soil	Modification of soil stability
Landscape	Change in the landscape integrity*
Soil	Modification in the soil stability**

*Associated with the activities of treatment of slopes, vegetation cover restoration and landscape management

**associated with the activities of building of hydraulic works, treatment of slopes and vegetation cover restoration.

Source: GEOCOL CONSULTORES S.A., 2017.

The five activities identified as the activities that have had the most significant negative impact in the area and the impacts that occur with the greatest intensity for such activities are shown below, according to the weighing made in Table 8.53 (see Table 8.57) and Table 8.58 shows five activities identified as the activities that have benefited the most the area and which impacts occur with the greatest intensity for such activities, according to the weighing made in Table 8.54.









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Table 8.57 Most Relevant Impacts in the Activities to be developed by the Project that Could Affect the Area Negatively to Greatest Extent

IMPACTS OF ACTIVITIES	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	Removal of vegetation cover, stripping and cleaning	Earth moving (Excavation and Fillings)	Mobilization of building materials, supplies, machinery, equipment and staff	Building of hydraulic works (Including occupation of riverbeds)
Modification of soil stability	-65	-67	-54	-23	
Change of the physicochemical and biological properties of the soil	-62	-48	-56		
Change in the use and potential of the soil	-62	-51	-56		
Alteration of riverbeds	-47	-47	-46	-19	-58
Alteration of the quality of surface water	-42	-30	-51	-20	-28
Variation in availability of the surface water resource	-30	-30	-30		-34
Variation in the amount and transport of sediments	-43	-23	-43		-18
Decrease in the capacity of transport of surface water sources	-32	-23	-32		-35
Alteration in the quality of groundwater	-42	-30	-51	-20	
Alteration of the groundwater flow network	-45	-27	-72		
Alteration of recharge areas	-69	-36	-49		
Modification of the air quality for Gases	-31	-32	-31	-37	-28
Modification of the air quality for Particulate Material	-34	-25	-34	-34	-25
Variation of sound pressure levels	-28	-25	-28	-34	-28
Changes in the landscape integrity	-55	-72	-44	-32	-44
Modification of vegetation covers		-48			
Changes in the flora structure and composition		-47			
Changes in the structure, extension and availability of the wild fauna	-71	-71			
Changes in the composition and structure of the fauna communities	-50	-50		-31	
Alteration of the structural and functional connectivity of the habitats of the wild fauna	-63	-51			
Alteration of the edaphic fauna	-30	-71	-32		
Changes in the mobility patterns of individuals	-45	-50	-32	-30	
Changes in the composition and structure of the hydrobiological communities	-43	-34			-32
Alteration of the habitat of hydrobiological communities	-55	-41			-42
Change in the rates of road accidents				-25	
Change in the state of the social and public service infrastructure (collective equipment, aqueduct, sewer, electric energy, etc.)			-43	-43	
Change in the state of road infrastructure			-33	-39	
Generation of conflicts				-28	
Change in the health state of the population				-17	
Mild or Irrelevant Impact					
Moderate Impact					
Severe Impact					





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IMPACTS OF ACTIVITIES	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	Removal of vegetation cover, stripping and cleaning	Earth moving (Excavation and Fillings)	Mobilization of building materials, supplies, machinery, equipment and staff	Building of hydraulic works (Including occupation of riverbeds)
Critical Impact					

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.58 Most Relevant Impacts in the activities to be developed by the Project that Could Benefit the Area to the Greatest Extent

IMPACTS/ACTIVITIES	Restoration of Vegetation Cover and Revegetation	Landscape Management	Treatment of slopes	Hiring and training of the staff	Dismantling of temporary facilities and camps
Modification of soil stability					34
Change of the physicochemical and biological properties of the soil	50				48
Change in the use and potential of the soil	49				48
Alteration of riverbeds	47	47	47		
Alteration of the quality of surface water	30		30		
Variation in the amount and transport of sediments	30	30	30		
Decrease in the capacity of transport of surface water sources	30		30		
Alteration in the quality of groundwater	30		30		
Alteration of recharge areas	45	45			
Modification of the air quality for Gases	41				
Changes in the landscape integrity	55	62	55		25
Modification of vegetation covers	44	32			
Changes in the flora structure and composition	46	32			
Changes in the structure, extension and availability of the wild fauna	40				
Changes in the composition and structure of the fauna communities	34				
Alteration of the edaphic fauna	46				
Changes in the mobility patterns of individuals	34				
Change in the supply and demand of goods and services				53	
Change in the economic activities				47	
Change in the dynamics of employment				47	
Change in the Levels of Income				49	
Change in the life quality of the population				36	
Change in the state of the social and public service infrastructure (collective equipment, aqueduct, sewer, electric energy, etc.)		51			
Change in the state of road infrastructure	34	56	31		
Mild or Irrelevant Impact					
Moderate Impact					
Severe Impact					

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IMPACTS/ACTIVITIES	Restoration of Vegetation Cover and Revegetation	Landscape Management	Treatment of slopes	Hiring and training of the staff	Dismantling of temporary facilities and camps
Critical Impact					

Source: GEOCOL CONSULTORES S.A., 2017.

8.3.5 Analysis of the Matrix per Impacts (Scenario with the Project)





Analysis of the matrix per impacts is made by using individual tables (or sheets) per each one of the impacts identified, associating it with the different activities that generate the impact, managing to have a description by a group of professionals in a detailed manner.

Such tables include the definition of the environmental impact, the activities that generate the impact, the value of environmental impact obtained by the modified assessment methodology of Vicente Conesa Fernández and the description of the environmental impact of the different activities that generate it. It is worth clearing up that this tool is also used in the environmental assessment in the scenario without the project. The analysis of the environmental assessment made in each one of the impacts assessed is shown below.

8.3.5.1 Abiotic Environment

Table 8.59 Description of the Impact of Modification of Soil Stability in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SOILS		
ENVIRONMENTAL IMPACT: MODIFICATION OF SOIL STABILITY		
This impact refers to the changes that occur in the soil stability during execution of the different activities assessed.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-23) Mild or Irrelevant Impact
	Catchment of surface water	(-30) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-67) Severe Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-25) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-54) Severe Impact
	Installation and operation of camps	(-22) Mild or Irrelevant Impact
	Installation and operation of process plants (asphalt, concrete, crushing)	(-25) Mild or Irrelevant Impact
	Building and operation of the Area of Management of Debris and Excavation Material (ZODME)	(-65) Severe Impact
	Building of hydraulic works (Including occupation of riverbeds)	(+19) Mild or Irrelevant Impact
	Foundation and piling for bridges and viaducts	(+31) Mild or Irrelevant Impact
	Building of superstructure for bridges and viaducts	(+39) Moderate Impact
	Abandonment and final restoration	(+34) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		

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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: SOILS
ENVIRONMENTAL IMPACT: MODIFICATION OF SOIL STABILITY
<p>Modification of the soil stability is the impact generated by loss of the vegetation cover and/or cover of the organic soil. It can also occur when modeling and triggering agents related to the presence of water in the soil in charge of decreasing resistance to cutting of materials. Execution of cutting and fillings for building of the project has a negative effect on the impact since it modifies the slope of the natural hillsides generating erosive and mass removal processes. Another activity that has a severe impact on soil stability corresponds to building and operation of the Area of Management of Debris and Excavation Material (ZODME) since, with development of this activity, new forms of relief and new conditions of stability in the filling areas are created.</p> <p>Building of civil works during development of the project (installation and operation of camps, installation and operation of asphalt processing plants, concrete, crushing) involves activities that have an irrelevant or mild impact on the soil stability since they correspond to activities that generally occur on geotechnical stable areas and works are implemented for mitigation morphodynamic processes. Mobilization of building materials, supplies, machinery, equipment and staff can have a negative impact on the roads of access where there is high susceptibility to processes of mass removal causing their deterioration.</p> <p>Building of hydraulic works (including occupation of riverbeds), building of superstructures, foundation and piling for bridges and viaducts have a positive impact with a rating from irrelevant to moderate in the soil stability since these works seek to improve the geotechnical conditions of the place or some times to avoid the presence of mass removal, if any.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.60 Description of the Impact of Change in the Physicochemical and Biological Properties of the Soil in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SOILS		
ENVIRONMENTAL IMPACT: CHANGE IN THE USE AND POTENTIAL OF THE SOIL		
It consists in assessing uses of soil, in accordance with the natural vocation or potential use of the soil.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Disposal of solid wastes by the project	(-40) Moderate Impact
	Removal of vegetation cover, stripping and cleaning	(-51) Moderate Impact
	Earth moving (Excavation and Fillings)	(-56) Severe Impact
	Installation and operation of camps	(-51) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-62) Severe Impact
	Restoration of Vegetation Cover and Revegetation	(+49) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The impact is considered moderate for generation of solid wastes by the project. They have a visual impact in the environment. Additionally, they can generate in time pollution for leachates affecting potential use of the soil.</p> <p>It is also considered negative and moderate for removal of the vegetation cover, stripping and cleaning and installation and operation of camps. These activities leave the soil devoid of vegetation, which is being used for protection and conservation of the soil. Likewise, it is considered severe for the earth moving (Excavation and Fillings). In this activity soils lose total productivity due to the loss of the edaphic horizon and changes in the morphology of the profile.</p> <p>It is also considered negative for building and operation of the area of management of debris and excavation material (ZODME). In these areas, potential use of soil cannot be developed. The agriculture, farming and conservation activities shall be affected by development of this activity.</p> <p>The positive impact for activities of restoration of vegetation cover and revegetation is considered moderate since with development of the activity, processes of protection and recovery begin and seek to leave the areas under conditions similar to the initial conditions reducing the processes of erosion and compacting and increasing the infiltration capacity. Further, it contributes to development of the edaphic fauna.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.





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Table 8.61 Description of the Impact of Change in the Use and Potential of the Soil in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SOILS		
ENVIRONMENTAL IMPACT: CHANGES IN THE PHYSICOCHEMICAL AND BIOLOGICAL PROPERTIES OF THE SOIL		
It consists in the physical, chemical and biological modifications that can be caused to the soil due to the natural or anthropogenic intervention.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Disposal of solid wastes by the project	(-31) Mild or Irrelevant Impact
	Generation of domestic and industrial liquid wastes by the project	(-40) Moderate Impact
	Removal of vegetation cover, stripping and cleaning	(-48) Moderate Impact
	Earth moving (Excavation and Fillings)	(-56) Severe Impact
	Installation and operation of camps	(-51) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-62) Severe Impact
	Restoration of Vegetation Cover and Revegetation	(+50) Moderate Impact
Abandonment and Final Restoration	Dismantling of temporary facilities and camps	(+48) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The impact of change in the physicochemical and biological activities of the soil is considered negative and moderate for the following activities: Generation of domestic and industrial liquid wastes by the project, this activity is associated with discharge of domestic and industrial waste waters by spraying fields where appropriate treatment must be guaranteed since wastes waters can contain heavy metals which constitute one of the most concerning groups of environmental pollutants that cause soil degradation, essentially due to their mobility and the low concentrations at which they start having toxic effects.</p> <p>Likewise, it is considered moderate because of removal of the vegetation cover, stripping and cleaning; and installation and operation of camps. Soils in the aforementioned activities are devoid of vegetation, leading thus to compacting processes, loss of structure, loss of productive potential, contamination for oil and fuel spills, and loss of slope stability.</p> <p>It is considered severe for earth moving (Excavation and Fillings) and building and operation of the area of management of debris and excavation material (ZODME), where it is considered that the soil has lost all the natural conditions due to transformations of the natural relief, alteration of the flora and fauna and degradation of soil, increase of erosive processes and alteration to the landscape for lack of restoration of the vegetation layer.</p> <p>The positive impact for the activities of restoration of vegetation cover and revegetation, and dismantling of the temporary facilities and camps is considered moderate since with dismantling the processes of recovery begin seeking to leave the areas under conditions similar to the conditions found initially through revegetation processes.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.62 Description of the Impact of Alteration of Riverbeds in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SURFACE WATERS		
ENVIRONMENTAL IMPACT: ALTERATION OF RIVERBEDS		
It consists in assessing changes in natural riverbeds or creek beds with respect to different building and execution activities of assessed works.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building material, supplies, machinery, equipment and staff	(-19) Mild or Irrelevant Impact





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ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SURFACE WATERS		
ENVIRONMENTAL IMPACT: ALTERATION OF RIVERBEDS		
	Catchment of surface water	(-38) Moderate Impact
	Removal of vegetation cover, stripping and cleaning	(-47) Moderate Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-47) Moderate Impact
	Earth moving (Excavations and Fillings)	(-46) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-47) Moderate Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-58) Severe Impact
	Foundation and piling for bridges and viaducts	(-45) Moderate Impact
	Treatment of slopes	(+47) Moderate Impact
Abandonment and Final Restoration	Restoration of Vegetation Cover and Revegetation	(+47) Moderate Impact
	Landscape Management	(+47) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The impact of alteration of riverbeds caused by development of the phase of building of hydraulic works is described due to direct intervention of water sources such as rivers, creeks and headwaters, among others, modifying the natural conditions of these water bodies through redirection or adjustment of riverbeds to allow development of works.</p> <p>Additionally, the works of removal of vegetation cover, stripping and cleaning; the movements caused by excavation and fillings; catchment of surface water; demolition-removal of existing infrastructure and building-operation of areas of management of debris and excavation material that cause alteration of natural riverbeds though indirectly are qualified as moderate.</p> <p>Treatment of slopes, restoration of vegetation cover and landscape managements are other aspects that have moderate but positive impacts with respect to the changes in surface currents since they favor indirectly stability of riverbeds. It has a mild or irrelevant repercussion on mobilization or transport of building materials, machinery, equipment and staff in the building phase.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.63 Description of the Impact of Alteration in the Quality of Surface Water in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SURFACE WATERS		
ENVIRONMENTAL IMPACT: ALTERATION OF THE QUALITY OF SURFACE WATER		
It consists in assessing alteration of water on the surface in accordance with its natural state and effects of development of works considering the different phases and aspects.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-20) Mild or Irrelevant Impact
	Catchment of surface water	(-28) Mild or Irrelevant Impact
	Generation of solid wastes by the project	(-28) Mild or Irrelevant Impact
	Generation of domestic and industrial liquid wastes by the project	(-27) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-30) Mild or Irrelevant Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-28) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-51) Moderate Impact
	Installation and operation of camps	(-28) Mild or Irrelevant Impact
	Installation and operation of process plants (asphalt, concrete, crushing)	(-28) Mild or Irrelevant Impact
	Operation and maintenance of machinery and/or equipment	(-20) Mild or Irrelevant Impact





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ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SURFACE WATERS		
ENVIRONMENTAL IMPACT: ALTERATION OF THE QUALITY OF SURFACE WATER		
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-42) Moderate Impact
	Formation of sub-base, base and surfacing	(-28) Mild or Irrelevant Impact
	Formation of the wearing course	(-28) Mild or Irrelevant Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-28) Mild or Irrelevant Impact
	Foundation and piling for bridges and viaducts	(-28) Mild or Irrelevant Impact
	Building of superstructure for bridges and viaducts	(-22) Mild or Irrelevant Impact
	Treatment of slopes	(+30) Mild or Irrelevant Impact
	Restoration of Vegetation Cover and Revegetation	(+30) Mild or Irrelevant Impact
Abandonment and Final Restoration	Final cleaning of the areas intervened	(+30) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>Alteration of quality of the surface water sources is caused by different anthropogenic activities in case of establishing the highway project in the area. The activities with the most significant impact are mainly earth moving because of excavation and fillings, as well as building of areas of management of debris and excavation material from fitting of roads. Such activities are assessed as having a Moderate Impact because the activities shall not be carried out in areas with surface water sources (watersheds are respected). Additionally, activities such as formation of sub-base, base and surfacing; formation of the wearing course; building of hydraulic works; installation of camps, equipment, machinery and process plants as asphalt or concrete, as well as removal of vegetation cover, surface water catchment, generation of solid and liquid wastes; and mobilization of supplies, machinery and staff are qualified as mild or irrelevant impact since their intervention is generally indirect on the surface water bodies.</p> <p>Treatment of slopes, restoration of vegetation cover and landscape management are aspects having positive impacts on alteration of the surface water quality since they minimize potential pollution.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.64 Description of the Impact of Variation in Availability of the Surface Water Resource in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SURFACE WATERS		
ENVIRONMENTAL IMPACT: VARIATION IN AVAILABILITY OF THE SURFACE WATER RESOURCE		
It corresponds to assessment of changes in availability of the surface water resource, in accordance with intervention of activities for execution of the works planned.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Catchment of surface water	(-46) Moderate Impact
	Removal of vegetation cover, stripping and cleaning	(-30) Mild or Irrelevant Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-23) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-30) Mild or Irrelevant Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-30) Mild or Irrelevant Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-34) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		

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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: SURFACE WATERS
ENVIRONMENTAL IMPACT: VARIATION IN AVAILABILITY OF THE SURFACE WATER RESOURCE
<p>Availability of the water resource involves conditions of habitability of ecosystems around watersheds and different aspects that contribute to increase of the impact on variation of this availability have an influence for biotic development of the surrounding area.</p> <p>In case of establishing the project in the area of influence, impacts are not weighed as severe. Nonetheless, in the activities of catchment of surface water and building of hydraulic works, the impact is assessed as moderate since the water resource is affected directly. Such catchments and building of hydraulic works obey to a detailed study of water availability and hydraulic behavior of the current.</p> <p>For the case of activities such as removal of vegetation cover, demolition-removal of existing infrastructure, earth moving for fillings or excavation and building of ZODMES, a mild or irrelevant impact is established since the intervention on the use and alteration of water resources is limited and does not represent a direct or frequent incidence.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.65 Description of the Impact of Variation in the Amount and Transport of Sediments in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SURFACE WATERS		
ENVIRONMENTAL IMPACT: VARIATION IN THE AMOUNT AND TRANSPORT OF SEDIMENTS		
It is related to weighing of the variation of the amount and transport of sediments considering the phases and aspects assessed.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Catchment of surface water	(-28) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-23) Mild or Irrelevant Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-18) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-43) Moderate Impact
	Installation and operation of process plants (asphalt, concrete, crushing)	(-23) Mild or Irrelevant Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-43) Moderate Impact
	Formation of sub-base, base and surfacing	(-23) Mild or Irrelevant Impact
	Formation of the wearing course	(-23) Mild or Irrelevant Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-18) Mild or Irrelevant Impact
	Foundation and piling for bridges and viaducts	(-28) Mild or Irrelevant Impact
	Treatment of slopes	(+30) Mild or Irrelevant Impact
	Restoration of Vegetation Cover and Revegetation	(+30) Mild or Irrelevant Impact
Abandonment and Final Restoration	Landscape Management	(+30) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>Variations in the amount and transport of sediments correspond to the impact generated as a result of alterations to the surrounding ecosystems and landscape, including excessive accumulation of sediments, subsequent modification of riverbeds and increase of the level of pollution of the source intervened.</p> <p>Assessing the aspects to be developed in the highway project there are two activities with the highest impact weighing: the first activity is related to earth moving for excavations and fillings (loss of vegetation cover), and the second activity is related to building of areas of management of debris and excavation material ZODME (unconsolidated soils subject to erosion). These works represent a moderate impact.</p> <p>The impacts of the following activities are considered mild or irrelevant: surface water catchment, removal and stripping, demolition and removal of infrastructure, installation and operation of process plants such as concrete, asphalt, and crushing, foundation and piling for bridges or viaducts, and building of hydraulic works.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.









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Table 8.66 Description of the Impact of Decrease in the Capacity of Transport of Surface Water Sources in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: SURFACE WATERS		
ENVIRONMENTAL IMPACT: DECREASE IN THE CAPACITY OF TRANSPORT OF WATER SOURCES		
It consists in review of changes in the capacity of transport of water sources with respect to the proposed phases of building of works.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Catchment of surface water	(-28) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-23) Mild or Irrelevant Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-18) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-32) Mild or Irrelevant Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-32) Mild or Irrelevant Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-35) Moderate Impact
	Foundation and piling for bridges and viaducts	(-28) Mild or Irrelevant Impact
	Treatment of slopes	(+30) Mild or Irrelevant Impact
	Restoration of Vegetation Cover and Revegetation	(+30) Mild or Irrelevant Impact





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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: SURFACE WATERS
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:
<p>The impact referred to as decrease of the capacity of transport of water sources is directly related to anthropogenic factors that allow accumulation of solids and modification of water sources, which leads to a difficult transport.</p> <p>The main aspect that can affect capacity of transport of the water sources is building of hydraulic works, including occupation of riverbeds. In this case a moderate impact is caused by intervention of some water sources that can lead to some type of accumulation of sediments and alteration of such sources.</p> <p>Additionally, most of the activities related to building of the road are assessed as mild or irrelevant. They are related to removal of volumes of land for excavation or fillings, building and commissioning of areas of management of debris and excavation material, foundation and piling for bridges and viaducts, catchment of surface water, demolition and removal of infrastructure existing in the areas to be intervened.</p> <p>Treatment of slopes and restoration of vegetation cover – revegetation are aspects that have positive impacts in the capacity of transport of water sources since they regulate roughness of the land, especially in bed areas or riparian areas.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.67 Description of the Impact of Alteration in the Quality of Groundwater in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: GROUNDWATER		
ENVIRONMENTAL IMPACT: ALTERATION IN THE QUALITY OF GROUNDWATER		
It indicates assessment of the changes in the values of quality corresponding to groundwater considering execution of works with their corresponding phases determined.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-20) Mild or Irrelevant Impact
	Generation of solid wastes by the project	(-27) Mild or Irrelevant Impact
	Generation of domestic and industrial liquid wastes by the project	(-27) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-30) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-51) Moderate Impact
	Installation and operation of camps	(-32) Mild or Irrelevant Impact
	Installation and operation of process plants (asphalt, concrete, crushing)	(-28) Mild or Irrelevant Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-42) Moderate Impact
	Foundation and piling for bridges and viaducts	(-28) Mild or Irrelevant Impact
	Treatment of slopes	(+30) Mild or Irrelevant Impact
	Restoration of Vegetation Cover and Revegetation	(+30) Mild or Irrelevant Impact
Abandonment and Final Restoration	Final cleaning of the areas intervened	(+30) Mild or Irrelevant Impact

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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: GROUNDWATER
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:
<p>It is harder to pollute groundwater than surface water. However, cleaning groundwater, once polluted, takes much longer and is harder and more costly. Given that the water quality refers to the chemical, physical, biological and radiological characteristics that it has, in case of groundwater, any addition of a solid or liquid component becomes an alteration factor in the conditions naturally established. For the case of assessment of the area considering development of the highway project, it is noted that most activities of building, restoration and abandonment have mild or irrelevant impacts.</p> <p>Activities as earth moving with excavation and fillings lead to an impact assessed as moderate, as well as building and operation of areas of management of debris and excavation material (ZODME) since such works include removal of volumes of land, loss of vegetation cover, among others, which favor potential percolation of waters with worse physicochemical and bacteriologic quality. Treatment of slopes and works of restoration of vegetation cover and revegetation, as well as final cleaning of the areas intervened in the phase of restoration favor quality of groundwater.</p>

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.68 Description of the Impact of Alteration of the Network of Flow of Groundwater in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: GROUNDWATER		
ENVIRONMENTAL IMPACT: ALTERATION OF THE NETWORK OF FLOW OF GROUNDWATER		
It consists in assessing the changes that are generated in the flow established of groundwater for intervention with activities for development of the different phases assessed.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Removal of vegetation cover, stripping and cleaning	(-27) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-72) Severe Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-45) Moderate Impact
	Foundation and piling for bridges and viaducts	(-23) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>Alteration of the network of flow of groundwater can be caused by some activities in the phase of building, especially the activities related to earth moving (excavation and fillings) qualified as severe impact: generally giving rise to modifications in the areas of discharge for removal of volumes of land that can cause exposure of lenses of subsurface water or groundwater</p> <p>Building of the ZODME is identified as activities that generate moderate impacts on the network of groundwater flow since the land is covered and thus the possibility of rain water percolation is modified temporarily or permanently.</p> <p>Likewise, removal of vegetation cover, stripping and cleaning, in addition to foundation and piling for bridges and viaducts do not affect significantly the groundwater flow network since superficial or temporary interventions are considered.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.69 Description of the Impact of Alteration of Recharge Areas in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: GROUNDWATER		
ENVIRONMENTAL IMPACT: ALTERATION OF RECHARGE AREAS		
It refers to establishment of an assessment of the alteration of water recharge area with respect to execution of building activities in different aspects assessed.		
PHASE	ASPECT	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Removal of vegetation cover, stripping and cleaning	(-36) Moderate Impact





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ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: GROUNDWATER		
ENVIRONMENTAL IMPACT: ALTERATION OF RECHARGE AREAS		
	Earth moving (Excavation and Fillings)	(-49) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-69) Severe Impact
	Restoration of Vegetation Cover and Revegetation	(+45) Moderate Impact
Abandonment and Final Restoration	Landscape Management	(+45) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>In the scenario with the project, building and operation of areas of management of debris and excavation material derived from maintenance and fitting of roads of ZODME, it generates a severe impact on alteration of recharge areas due to alteration of recharge areas because of accumulation of generally waterproofed materials in potential recharge areas.</p> <p>Likewise, activities as removal of vegetation cover with stripping and cleaning, earth moving generated by activities of excavation and filling generate negative impacts although qualified mild or irrelevant.</p> <p>In turn, restoration of vegetation cover and revegetation and landscape management favor surface water retention and thus the possibility of recharge of surface aquifers.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.70 Description of the Impact of Modification of the Air Quality for Gases in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: AIR		
ENVIRONMENTAL IMPACT: MODIFICATION OF THE AIR QUALITY BY GASES		
Variation in concentration of gases, mainly coming from combustion processes, which being over the allowed limits can cause changes in the environment.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-37) Moderate Impact
	Catchment of surface water	(-25) Mild or Irrelevant Impact
	Disposal of solid wastes by the project	(-35) Moderate Impact
	Disposal of domestic and industrial liquid wastes by the project	(-32) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-32) Mild or Irrelevant Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-28) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-31) Mild or Irrelevant Impact
	Installation and operation of process plants (asphalt, concrete, crushing)	(-41) Moderate Impact
	Operation and maintenance of machinery and/or equipment	(-41) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME)	(-31) Mild or Irrelevant Impact
	Formation of sub-base, base and surfacing	(-31) Mild or Irrelevant Impact
	Formation of the wearing course	(-37) Moderate Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-28) Mild or Irrelevant Impact
	Foundation and piling for bridges and viaducts	(-26) Mild or Irrelevant Impact
	Restoration of Vegetation Cover and Revegetation	(+41) Moderate Impact
Abandonment and Final Restoration	Dismantling of temporary facilities and camps	(-26) Mild or Irrelevant Impact
	Final cleaning of the areas intervened	(-26) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
The modification of air quality is an impact assessed negatively. It occurs during the different stages of development of the project,		





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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: AIR
ENVIRONMENTAL IMPACT: MODIFICATION OF THE AIR QUALITY BY GASES
<p>mainly due to emission of gases such as SO_x, NO_x, CO, total Hydrocarbons, due to use of heavy machinery for building during incomplete combustion in its engines, as well as electric energy generators required in camps.</p> <p>It is considered that during installation and operation of process plants (asphalt, concrete, crushing), operation and maintenance of machinery and/or equipment and formation of the wearing course, which shall use bituminous material that can cause polluting gas emissions for its application at high temperatures, intensity of the impact is higher compared to the other activities because of the size of equipment, the needs of fuel consumption and the time required of operation, emissions being higher. Therefore, it is assessed as a negative impact of moderate nature.</p> <p>Likewise, variation of the air quality for gases which is related to mobilization of building materials, supplies, machinery, equipment and staff depends on internal combustion of engines of the vehicles linked to the project during tours.</p> <p>Importance of the impact is moderate considering that the additional contribution of pollutant gases by the activities of the project comes essentially from operation of equipment and machinery with combustion engines, which, in comparison with the flow of vehicles circulating through the area of influence of the project, is considered a much lower contribution. It is expected that the pollutant gas levels during execution of the project do not exceed the levels allowed by the current regulations, in conformity with the monitoring results of air quality for the scenario without the project where despite the current significant flow of vehicles, the regulations for any of the parameters analyzed were not exceeded in any of the stations.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.71 Description of the Impact of Modification of Air Quality for Particulate Material in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: AIR		
ENVIRONMENTAL IMPACT: MODIFICATION OF THE AIR QUALITY FOR PARTICULATE MATERIAL		
Variation in the typical concentration of particulate material in an area, Such particulate material, when being over the allowed limits, causes changes in the environment.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-34) Moderate Impact
	Catchment of surface water	(-24) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-25) Mild or Irrelevant Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-28) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-34) Moderate Impact
	Installation and operation of process plants (asphalt, concrete, crushing)	(-55) Severe Impact
	Operation and maintenance of machinery and/or equipment	(-38) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-34) Moderate Impact
	Formation of sub-base, base and surfacing	(-28) Mild or Irrelevant Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-25) Mild or Irrelevant Impact
	Treatment of slopes	(-31) Mild or Irrelevant Impact
		(-23) Mild or Irrelevant Impact
Abandonment and Final Restoration	Dismantling of temporary facilities and camps	(-26) Mild or Irrelevant Impact
	Final cleaning of the areas intervened	(-26) Mild or Irrelevant Impact

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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: AIR
ENVIRONMENTAL IMPACT: MODIFICATION OF THE AIR QUALITY FOR PARTICULATE MATERIAL
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:
<p>Changes in the concentration of particulate material in this type of project are, in general, identifiable at sight because the size of particles generally produced is higher than 10 µg. The most affected areas for this impact are the areas near the generation point since generally suspended particles tend to deposit again in a very fast manner. The foregoing is conditioned by the size of particles and speed of the wind in the area.</p> <p>During the building phase, the activities of removal of the vegetation cover, stripping and cleaning, demolition and removal of the existing structure in the areas to be intervened, earth moving (excavation and fillings) and building and operation of ZODMEs. This type of impact can arise generating particulate material or dust because of transfer of material from one site to another and the action of wind. However, it has a brief duration occurring immediately after development of the activity.</p> <p>Nevertheless, in these activities production of the particulate material is not constant in time. Additionally, it has characteristics of recoverability and mitigable being more likely to be generated in the summer. For this reason, it was assessed as an impact between irrelevant and moderate depending on the intensity of each activity.</p> <p>As far as mobilization of building materials, supplies, machinery, equipment and staff is concerned, vehicle traffic can generate emission of particulate material, especially when transport occurs in unpaved roads affecting, as previously mentioned, the areas nearest to the road corridors. This activity has a medium intensity and is partial depending on the length of the unpaved road segment. Further, it is regular, but the impact is recoverable and reversible. For this reason, it was assessed with a moderate environmental significance.</p>

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.72 Description of the Impact of Generation of Odors in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: AIR		
ENVIRONMENTAL IMPACT: GENERATION OF ODORS		
Emission of odorous substances can cause disturbances in the environment. Bad smells can be unpleasant, cause rejection and affect life quality of people and animals of the environment. Therefore, it is considered as a form of environmental pollution.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Disposal of solid wastes by the project	(-29) Mild or Irrelevant Impact
	Disposal of domestic and industrial liquid wastes by the project	(-26) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
Different activities of the project can cause emission of odorous substances. It can generally be caused by an inappropriate management and disposal of solid and liquid wastes. Regularly, decomposition of organic matter for the microbial actions generates gases such as methane, sulfur oxides and nitrogen, as well as hydrogen sulphide, among others. This impact was analyzed and qualified negatively and classified in a mild category because the extension of the activities that generate such impact shall be punctual and with a low and medium intensity.		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.73 Description of the Impact of Variation in the Levels of Sound Pressure in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: AIR		
ENVIRONMENTAL IMPACT: VARIATION IN SOUND PRESSURE LEVELS		
Variation in the noise intensity in an area determined by development of different anthropogenic activities such as use of machinery, vehicles and equipment. By exceeding certain levels, changes can be caused to the dynamics of displacement of fauna and discomfort of communities near the source of emission.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL

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ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: AIR		
ENVIRONMENTAL IMPACT: VARIATION IN SOUND PRESSURE LEVELS		
		IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-34) Moderate Impact
	Catchment of surface water	(-24) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-25) Mild or Irrelevant Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-28) Mild or Irrelevant Impact
	Earth moving (Excavation and Fillings)	(-28) Mild or Irrelevant Impact
	Installation and operation of camps	(-32) Mild or Irrelevant Impact
	Installation and operation of process plants (asphalt, concrete, crushing)	(-52) Severe Impact
	Operation and maintenance of machinery and/or equipment	(-40) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-28) Mild or Irrelevant Impact
	Formation of sub-base, base and surfacing	(-36) Moderate Impact
	Formation of the wearing course	(-34) Moderate Impact
	Building of hydraulic works (including occupation of riverbeds)	(-28) Mild or Irrelevant Impact
	Foundation and piling for bridges and viaducts	(-26) Mild or Irrelevant Impact
	Building of superstructure for bridges and viaducts	(-26) Mild or Irrelevant Impact
	Treatment of slopes	(-28) Mild or Irrelevant Impact
Abandonment and Final Restoration	Restoration of Vegetation Cover and Revegetation	(-22) Mild or Irrelevant Impact
	Dismantling of temporary facilities and camps	(-23) Mild or Irrelevant Impact
	Final cleaning of the areas intervened	(-23) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>During the activities inherent in the civil works, such as removal of vegetation cover, earth moving, building and operation of ZODMEs, building of hydraulic works, among others, the noise associated with operation of the machinery used. Additionally, it shall be considered that location of camps shall be apart and thus increase of the sound pressure levels is not high. Therefore, according to the analysis, there shall be a mild or irrelevant impact since intensity of the impact is between low and medium with a punctual extension, of a brief duration, but with immediate manifestation, affecting directly the regular sound pressure levels of the area to be intervened acting in a resilient and synergic manner.</p> <p>As for the operation of process plants, operation of this equipment can increase the levels of sound pressure in more than 80 decibels (dB), affecting the communities and ecosystems existing in the periphery of camps. For this reason, the analysis established that intensity of the impact can be very high with a partial extension and constant during the project and execution of works in camps. Therefore, a severe environmental importance is considered for such activity.</p> <p>Traffic of vehicles to move building materials, supplies, machinery, equipment and staff increase the levels of sound pressure in the area affecting areas near the roads used by the project. Nonetheless, duration of the effect caused by the impact is considered brief and continuous. It can occur in the entire area of influence covering the length of the roads used, being mitigable and reversible with a direct effect on high resilience. For this reason, it was assessed as a negative impact in the moderate category.</p> <p>Activities of dismantling and removal of infrastructure and equipment, demolition removal of structures and cleaning of the area generate an increase of the levels of sound pressure, but for their short duration and the size of their effects do not cause significant effects on the environment and community.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.









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Table 8.74 Description of the Impact of Changes in the Integrity of Landscape in the Scenario with the Project

ENVIRONMENT: ABIOTIC		
ENVIRONMENTAL ELEMENT: LANDSCAPE		
ENVIRONMENTAL IMPACT: CHANGES IN INTEGRITY OF THE LANDSCAPE		
It corresponds to changes in the landscape units for effect of the transformation of covers, as well as for increase of the artificial and discordant levels that reduce landscape integrity. These changes answer are caused in a direct manner use of soil, earth moving, changes in the covers and development of the project activities, which involves changes in the perception of landscape by permanent and floating and in their quality and visual fragility.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, input, machinery, equipment and staff.	(-32) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-72) Severe Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-62) Severe Impact
	Earth moving (Excavation and Fillings)	(-44) Moderate Impact
	Installation and operation of camps	(-22) Mild or Irrelevant Impact
	Installation and operation of process plants (asphalt, concrete, crushing)	(-25) Mild or Irrelevant Impact
	OPERATION AND MAINTENANCE OF MACHINERY AND/OR EQUIPMENT	(-22) Mild or Irrelevant Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-55) Severe Impact
	FORMATION OF SUB-BASE, BASE AND SURFACING	(-44) Moderate Impact
	Formation of the wearing course	(-47) Moderate Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-44) Moderate Impact
	Foundation and piling for bridges and viaducts	(-62) Severe Impact
	Building of superstructure for bridges and viaducts	(-62) Severe Impact
	Treatment of slopes	(+55) Severe Impact
Abandonment and Final Restoration	Restoration of Vegetation Cover and Revegetation	(+55) Severe Impact
	Dismantling of temporary facilities and camps	(+25) Mild or Irrelevant Impact
	Final cleaning of the areas intervened	(+28) Mild or Irrelevant Impact
	Landscape Management	(+62) Severe Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>Mobilization of building materials, supplies, machinery, equipment and staff was assessed as an impact of mild or irrelevant environmental significance since it can affect the landscape integrity due to the increase in the frequency and presence of discordant elements in the landscape (vehicles, machinery, among others), which causes an increase in the visual sensitivity and a decrease in the landscape integrity and quality, which would have a lower visual absorption capacity of impacts. Nevertheless, these changes are only planned for the building stage not remaining in time.</p> <p>As for removal of vegetation cover, stripping and cleaning, this is one of the most significant impacts being assessed as severe considering the size of the area and cover removed. Although a big part of these areas is established in places previously transformed, there are changes in the ecologic landscape units due to replacement of current covers and change in the use of soil. In this manner, changes are generated in the ecologic landscape units of the potentially affected area, the impact could be considered extensive, permanent and direct on the landscape analyzed.</p> <p>The impact of the demolition and removal of the infrastructure existing in the areas to be intervened was considered with a severe environmental significance because although these areas are associated with landscape units previously modified by anthropogenic activities, on these areas, building of the divided highway is planned increasing presence of discordant elements, initially for the equipment and machinery necessary, as well as debris coming from demolition, which generates a high, extensive, direct and frequent visual impact and shall cause a high visual sensitivity.</p>		

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ENVIRONMENT: ABIOTIC
ENVIRONMENTAL ELEMENT: LANDSCAPE
ENVIRONMENTAL IMPACT: CHANGES IN INTEGRITY OF THE LANDSCAPE
<p>Furthermore, earth moving (Excavation and Fillings) was assessed with a moderate importance value to the extent that it requires cutting material, modifying geoforms and generating changes in the landscape units. For the characteristics of the project, the impact was assessed as extended with a direct and permanent effect on the landscape affecting features such as natural regeneration of the vegetation and dominance of anthropogenic modifications.</p> <p>As for the activities of installation and operation of camps and installation and operation of process plants (asphalt, concrete, crushing), both activities were qualified with a mild or irrelevant importance value since it involves fitting of the land for formation of camps and preparation of building materials, altering in a punctual manner both the nature of the ecologic landscape units and the visual features of form and line of the landscape, its color and textures, replacement of natural elements and use of machinery (discordant elements) reducing the landscape integrity and visual quality of the ensemble analyzed.</p> <p>For the case of the operation and maintenance of machinery and/or equipment, it was considered with a mild or irrelevant environmental significance given that although it has an incidence on the increase of the number and frequency of discordant elements, this is a temporary activity that occurs in the area of influence in a punctual manner without representing significant changes in the landscape by itself.</p> <p>The impact associated with building and operation of the Area of Management of Debris and Excavation Material (ZODME) was considered with a severe environmental importance since it represents a change in the features of line, form and chromatic correspondence, besides altering the processes of vegetation regeneration, intensifying the erosive processes, increasing the contrast between soil and rock, and reducing the quality of the scenic background. These areas are planned in a disperse manner in the area of influence and being close to the roads, they are also linked to an increase in the visual sensitivity.</p> <p>The formation of sub-base, base and surfacing and the wearing course, and building of hydraulic works (including occupation of riverbeds) involve a moderate impact to the extent that it involves presence of discordant elements during building of the works increasing the number of discordant elements that increase visual sensitivity and fragility. By being associated with a linear project, it is extensive with respect to the area of influence and its direct effect shall be permanent in the landscape.</p> <p>For the case of foundation and piling for bridges and viaducts and building of superstructure for bridges and viaducts, it could have a negative impact of severe environmental significance on integrity of the landscape to the extent that it involves building of large-sized infrastructure which represents visually increase in the artificialization of the landscape system and number of discordant elements present generating relevant changes in the visual quality and landscape integrity. Being subject to operation of roads, these structures shall be strongly linked to a high visual sensitivity and although it occurs in a punctual manner, its effects shall be direct and permanent on the landscape.</p> <p>As for treatment of slopes, the impact generated on integrity of the landscape was considered positive with a severe environmental significance for its extension and time of stay in the landscape. As part of this management, in some cases, shrub species are used and they contribute to retain the soil and avoid erosive processes. This increases beauty, quality and landscape integrity.</p> <p>The activity of restoration of vegetation cover and revegetation shall have a positive impact of severe environmental value since it involves recovery of the layer by sowing sobs and pastures. For this reason, it has a positive impact although functionally and ecologically, it does not have a significant repercussion on the intervened landscape.</p> <p>Dismantling of temporary facilities and camps and final cleaning of the areas intervened were considered activities related to positive impacts of mild or irrelevant importance given that it generates an effective visual effect by reducing the number of discordant and artificial elements in the landscape observed, increasing the landscape integrity and quality, although for its punctual nature, it does not represent a more significant effect.</p> <p>Lastly, the impact generated by the activity of landscape management was assessed as positive of severe environmental value. Even though reconfiguration of the landscape is planned, the area represented by landscape units associated with covers transformed as clean and wooded pastures, although visually, it provides integrity in color, texture and form having a positive effect on the visual conditions.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

8.3.5.2 Biotic Environment

Table 8.75 Description of the Impact of Modification of Vegetation Covers in the Scenario with the Project

ENVIRONMENT: BIOTIC
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ENVIRONMENTAL ELEMENT: FLORA		
ENVIRONMENTAL IMPACT: MODIFICATION OF VEGETATION COVERS		
This impact refers to the changes that occur on the natural vegetation covers because of the project activities, especially in terms of surface.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Removal of vegetation cover, stripping and cleaning	(-48) Moderate Impact
	Restoration of Vegetation Cover and Revegetation	(+44) Moderate Impact
Abandonment and Final Restoration	Landscape Management	(+32) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>Modification of natural vegetation covers by the activities of the project is an impact qualified negatively for having a harmful character for the flora element, which is generated for removal of the vegetation cover, stripping and cleaning at the stage of building. It occurs in case of forest harvesting or vegetation cutting to enable the areas for the works, which affects the natural vegetation for the final change of cover and with this elimination of the function and structure, as well as environmental services that this vegetation provides. This impact was also assessed for the activity of restoration of vegetation cover and revegetation, as well as for landscape management with a positive nature for having benefits for the element assessed and generating cover and vegetation for protection.</p> <p>As mentioned for the scenario without the project, the area subject to the study has a high degree of intervention for agricultural activities. Therefore, currently the natural vegetation is almost nonexistent. There are only remains or small areas of fallow land. This impact for the activity of removal of vegetation cover, stripping and cleaning is considered negative or harmful for the flora element and was assessed moderate due to the following individual assessments: its intensity is high since the effect is a serious modification to the flora element; its extension is punctual because the natural vegetation is present in very small areas and in a scarce manner; duration is permanent because there is a change in the use of soil and building of the road does not allow development of vegetation; periodicity was considered irregular because of the scarce presence of vegetation, removal of natural vegetation is made only once. As for recoverability of this impact, it is considered recoverable since if corrective measures are implemented, in the short or medium term it can be eliminated. Reversibility is considered medium since once actions affecting the environment had stopped, it could return by natural means in a period between 1 and 5 years to the initial conditions. The moment was considered immediate because the time elapsed between execution of the activity and appearance of the impact on the flora is nonexistent. The effect is direct on the element. Resilience is considered medium because between 2 and 15 years are required to absorb disturbances without altering significantly the characteristics if its structure and functionality. The impact for this activity is considered non synergic but cumulative because the impact increases progressively after execution of the activity when the generating actions persist in a continued or reiterated manner.</p> <p>The activity of restoration of vegetation cover and revegetation of areas intervened by the project has a beneficial impact for the flora for generation of the vegetation cover and is considered moderate according to the assessment made as follows: the intensity was considered high because the effect is a significant modification to the flora element. The extension is punctual since its effect is localized. Duration is considered permanent because the activity is meant to last in time. Periodicity is irregular since it is made only once in each area. As for as recoverability, this impact is considered recoverable because if measures other than the ones for protection are implemented, the effect can disappear. Reversibility was determined as medium given that once that actions affecting the environment had stopped, it could be possible to return to the initial conditions in a period between 1 and 5 years. The moment was considered long term because the impact on composition and structure of the flora is longer than three months. The effect is direct on the element. Resilience is considered high because less than 2 years are required to absorb disturbances without altering significantly its characteristics of structure and functionality. The impact for this activity was considered synergic and cumulative.</p> <p>The activity of landscape management of areas intervened by the project has a beneficial impact for the flora for management and protection of vegetation cover and is considered mild according to the assessment made as follows: the intensity was considered low because the effect is a minimal modification to the flora element. Its extension is punctual since its effect is localized. The duration was considered permanent because the activity is meant to last in time. Periodicity is irregular since it is made once in each area. As for recoverability, this impact is considered recoverable because if measures other than the ones established for protection are implemented, the effect can disappear. Reversibility was determined as medium given that once actions affecting the environment had stopped, it could return to the initial conditions in a period between 1 and 5 years. The moment was considered long term because the time elapsed between execution of the activity of landscape management of the intervened areas and manifestation of the impact on the flora is longer than three months. The effect is indirect on the flora element. Resilience is considered high given that it requires less than 2 years to absorb disturbances without altering significantly its structure and functionality characteristics. The impact of this activity is considered synergic and cumulative.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.









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Table 8.76 Description of the Impact of Changes in the Flora Structure and Composition in the Scenario with the Project

ENVIRONMENT: BIOTIC		
ENVIRONMENTAL ELEMENT: FLORA		
ENVIRONMENTAL IMPACT: CHANGES IN THE FLORA STRUCTURE AND COMPOSITION		
This impact refers to the changes on the quality of natural vegetation covers for the activities of the project, specifically in the structure and composition of the flora without considering the area criterion.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Removal of vegetation cover, stripping and cleaning	(-47) Moderate Impact
	Restoration of Vegetation Cover and Revegetation	(+46) Moderate Impact
Abandonment and Final Restoration	Landscape Management	(+32) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The changes in the flora structure and composition of natural vegetation covers for the activities of the project is an impact qualified negatively for having a harmful effect for the flora element, which is generated for removal of vegetation cover, stripping and cleaning at the building stage. It occurs in case of forest harvesting or vegetation cutting to enable the areas for the works, which affects vegetation because of loss of structure and function. This impact was also assessed for the activity of restoration of the vegetation cover and revegetation, as well as for landscape management, with a positive character for having benefits for the element assessed by generating cover and vegetation for protection that can have a structure and composition similar to the natural one or that can favor development of these parameters.</p> <p>The impact of changes in the structure and composition of flora of the natural vegetation covers by the activity of removal of the vegetation cover, stripping and cleaning is considered negative or harmful on the flora element and assessed as moderate due to the following individual activities: its intensity is medium given that the effect is not a serious modification to the flora element. Its extension is partial because the effects exceed the areas of intervention. Duration is permanent given that there is a change in the use of soil and building of the road does not allow development of vegetation. Periodicity was considered irregular given that by reason of the scarce vegetation, removal of the natural vegetation is made only once. The impact is mitigable since if corrective measures are implemented, the effect can be reduced in the short or medium term. Reversibility is considered medium because once actions affecting the environment had stopped, it could return by natural means in a period between 1 and 5 years to the initial conditions. The moment was considered immediate because the time elapsed between removal of vegetation and manifestation of the impact on the structure and function of the flora is nonexistent. The effect is direct on the element. Resilience is considered medium since between 2 and 15 years are required to absorb disturbances without altering significantly its characteristics of structure and functionality. The impact for this activity is considered synergic because union of several impacts generate bigger effects than the effects generated if they acted indecently, especially with the impacts on the flora and the soil and it is cumulative because the impact is increased progressively after execution of the activity when the action that generate it persists in a continued or reiterated manner.</p> <p>The activity of restoration of vegetation cover and revegetation of areas intervened by the project has a beneficial impact for the composition and structure of the flora for generation of vegetation cover and it is considered moderate according to the assessment made as follows: the intensity was considered high because the effect is a significant modification to the flora element. Its extension is partial since the effects exceed the intervention sites. Duration was considered permanent because the activity is meant to last in time. It is a regular impact since it is recurrent in time. As for recoverability, this impact is considered recoverable because if measures other than the ones established for protection are implemented, the effect can disappear. Reversibility was determined as medium because once the actions affecting the environment had stopped, it could return to the initial conditions in a period between 1 and 5 years. The moment was considered long term since the time elapsed between execution of the activity of restoration of vegetation cover and revegetation of the areas intervened and manifestation of the impact on the composition and structure of the flora is longer than three months. The effect is direct on the element. Resilience is considered medium since between 2 and 15 years are required to absorb disturbances without altering significantly its structure and functionality characteristics. The impact for this activity was considered synergic and cumulative. The activity of landscape management of the areas intervened by the project generates a beneficial impact on the structure and composition of the flora for management and protection of vegetation cover and considered mild according to the assessment made as follows: intensity was considered low because the effect is a minimal modification to the flora element. Its extension is punctual because its effect is localized. Duration was considered permanent because the activity is meant to last in time. It is a regular impact since it is recurrent in time. As for recoverability, this impact is considered recoverable because if measures other than the ones established for protection are implemented, the effect can disappear. Reversibility was determined as medium because once the actions affecting the environment had stopped, it could return to the initial conditions in a period between 1 and 5 years. The moment was considered long term because the time elapsed between execution of the landscape</p>		

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ENVIRONMENTAL ELEMENT: FLORA
ENVIRONMENTAL IMPACT: CHANGES IN THE FLORA STRUCTURE AND COMPOSITION
management of the areas intervened and manifestation of the impact on the flora composition and structure is longer than three months. The effect is indirect on the flora element. Resilience is considered medium since between 2 and 15 years are required to absorb disturbances without altering significantly its characteristics of structure and functionality. The impact for this activity is considered synergic and cumulative.

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.77 Description of the Impact of Changes in the Structure, Extension and Availability of the Wild Fauna in the Scenario with the Project

ENVIRONMENT: BIOTIC		
ENVIRONMENTAL ELEMENT: FAUNA		
ENVIRONMENTAL IMPACT: CHANGES IN THE STRUCTURE, EXTENSION AND AVAILABILITY OF HABITATS OF THE WILD FAUNA		
This impact occurs as an answer to fragmentation and transformation of vegetation covers, which are key elements to provide habitats to the different species. It consists in decrease of the size of certain covers or an increase of the number of resulting fragments of habitats. Additionally, there is an increase of distance between fragments. These events make difficult the exchange of individuals between isolated populations, as well as their recovery through recolonization to avoid a possible extinction.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Removal of vegetation cover, stripping and cleaning	(-71) Severe Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-71) Severe Impact
	Restoration of Vegetation Cover and Revegetation	(+40) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
This project occurs in the phase of building in the activities of vegetation cover removal, stripping and cleaning; building and operation of the area of management of debris and excavation material (ZODME), restoration of vegetation cover and revegetation. These actions generate this impact in a negative manner affecting to a greater extent the animal species living in the areas through which the divided highway shall pass and the nearby areas. Removal of vegetation cover, stripping and cleaning affect severely habitats of the resident species. By eliminating the vegetation cover habitats and the environmental conditions are totally modified. The intervention to be made by the project causes fragmentation of the habitat and the fringe effect. The fringe effect is caused when an ecosystem is fragmented and the biotic and abiotic conditions of fragments and the surrounding matrix are changed (Kattan, 2002). In case of highways, this effect shall develop in the purlieu or border of the road where conditions with higher temperature, less humidity, more radiation and more susceptibility to the wind shall be created. In building and operation of areas of management of debris and excavation material, the fauna habitat is also affected by loss and fragmentation of the habitats generated by the change in the use of soil, which interrupts the ecologic dynamics around covers such as low secondary vegetation or pasture and crop mosaics. The most relevant variables include: intensity in a very high category (8), duration if permanent (7), reversibility (7) and direct effect (4). For the activity of restoration of vegetation cover and revegetation, the value of environmental significance was moderate and its nature is positive given that the actions to be undertaken allow recovering to a certain extent microhabitats associated with the soil. Additionally, it allows in certain areas regeneration of vegetation cover that could become the potential habitat for grazing species.		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.78 Description of the Impact of Changes in the Composition and Structure of the Fauna Communities in the Scenario with the Project

ENVIRONMENT: BIOTIC
ENVIRONMENTAL ELEMENT: FAUNA





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ENVIRONMENTAL IMPACT: CHANGES IN THE COMPOSITION AND STRUCTURE OF FAUNA COMMUNITIES		
Human activities on the natural ecosystems generate important changes in the habitats of animal species. They affect in turn positively and negatively the resident fauna communities. Change in the animal diversity consists in reduction of size of populations of organisms affected and decrease of density of species (number of individuals per surface unit). Changes in structure are related to modifications that can be generated in the ecologic interactions between the species that are part of the animal communities and their association with plants.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-31) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-50) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-50) Moderate Impact
	Restoration of Vegetation Cover and Revegetation	(+34) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The activities identified as causes of this impact include removal of vegetation cover, stripping and cleaning; building and operation of the area for management of debris and excavation material (ZODME); and restoration of vegetation cover and revegetation. All of them have a moderate value of importance, except for the activity of mobilization of building materials, supplies, machinery, equipment and staff with a mild or irrelevant importance.</p> <p>Mobilization of building materials, supplies, machinery, equipment and staff can originate this impact with a mild or irrelevant environmental significance. Mobilization of elements inherent in the project can affect the fauna communities because of hitting by vehicles that circulate by the roads of access causing death of individuals and loss of net population density for some species that can have low population levels in the area, but act as key species for maintenance of the tropic structure and local diversity. Likewise, some populations of certain species can be disturbed by the noise caused by transport vehicles changing the composition and structure patterns in the fauna community.</p> <p>Removal of vegetation cover, stripping and cleaning is one of the most relevant activities since it has a negative influence on the fauna causing displacement of species due to potential loss of habitats, biological corridors and resources that could serve to develop their vital processes as reproduction and shelter or change the density of local populations. The impact caused by these activities can affect more the amphibian and reptile populations than the others since they have low mobility and their trophic niches are more restricted to certain areas. The most relevant features are duration (7), reversibility (irreversible 7), moment (4) and synergy (4).</p> <p>The impact only interacts with the activity of restoration of vegetation cover and revegetation of intervened areas with a positive character and a moderate environmental significance. Recovery of the areas intervened can favor appearance of resources and improvement of habitat availability contributing to return of some species, increase of density of some populations and improvement of certain interactions affected by the intervention made.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.79 Description of the Impact of Alteration of the Structural and Functional Connectivity of the Habitats of the Wild Fauna in the Scenario without the Project

ENVIRONMENT: BIOTIC		
ENVIRONMENTAL ELEMENT: FAUNA		
ENVIRONMENTAL IMPACT: ALTERATION OF THE STRUCTURAL AND FUNCTIONAL CONNECTIVITY OF HABITATS OF THE WILD FAUNA		
The structural connectivity, understood as the way in which the habitat patches are distributed and related physically in a landscape matrix and the functional connectivity, understood as the capacity of landscape elements to facilitate the movements of species in an effective manner, are two essential aspects for operation of the ecosystem and maintenance of the dynamics and interactions between different animal and vegetal species. This connectivity can be altered by the interventions made to the vegetation cover affecting not only availability of habitats, but also access to the available resources and processes of dispersion, colonization and migration.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Removal of vegetation cover, stripping and cleaning	(-51) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-63) Severe Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
In development of the project, two activities that can have this impact on the fauna were identified. They are removal of vegetation		





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ENVIRONMENT: BIOTIC
ENVIRONMENTAL ELEMENT: FAUNA
ENVIRONMENTAL IMPACT: ALTERATION OF THE STRUCTURAL AND FUNCTIONAL CONNECTIVITY OF HABITATS OF THE WILD FAUNA
<p>cover, stripping and cleaning; and building and operation of the area for management of debris and excavation material (ZODME). The former has a moderate importance value while the latter is qualified as severe.</p> <p>Removal of vegetation cover, stripping and cleaning in the areas to be intervened generate in some segments full alterations to connectivity of habitats. Elimination of a part of the natural cover of the areas where different species live not only alters composition of the habitat, but affects its structure connectivity and reduces the offer of food resources or potential areas of shelter or transit of several species. Likewise, once the cover has been removed, artificial areas with inadequate ecologic conditions are generated and do not constitute a habitat for most of the wild fauna, except for some with high tolerance. This effect goes beyond the intervened areas and remains for a protracted period while the infrastructure remains in the intervention site and can only be reverted by implementing specific actions as revegetation.</p> <p>As for the activity of building and operation of areas for management of debris and excavation material (ZODME), its environmental significance is high given that in such activity an area is fully transformed altering not only the natural cover but also use of soil landscape and ecologic relations existing between the different fauna groups. Loss, transformation and fragmentation of habitat constitute the main consequence that affects ecologic corridors. In this case, certain species can change dramatically some vital ecologic processes, as well as change their patterns of mobility to avoid unfavorable areas for food or reproduction. The most relevant features are intensity (very high 8), duration (permanent 7), reversibility (7) and synergy (4).</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.80 Description of the Impact of Alteration of the Edaphic Fauna in the Scenario with the Project

ENVIRONMENT: BIOTIC		
ENVIRONMENTAL ELEMENT: FAUNA		
ENVIRONMENTAL IMPACT: ALTERATION OF THE EDAPHIC FAUNA		
Soil is a normal constituent of nature with different components and organisms that live in it. Any type of physical, chemical and biochemical alteration causes loss of essential animal elements for maintenance of soil.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Disposal of domestic and industrial liquid wastes by the project	(-29) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-71) Severe Impact
	Earth moving (Excavation and Fillings)	(-32) Mild or Irrelevant Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-30) Mild or Irrelevant Impact
	Restoration of Vegetation Cover and Revegetation	(+46) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The edaphic fauna is responsible for accumulation and decomposition of the organic matter of soils affecting all the transformations of such organic matter, nutrients and some fractions of minerals as salts and clays. This fauna has several functions as accelerating transformation and incorporation of vegetal and animal wastes to the soil increasing the contact surface on which microorganisms shall act.</p> <p>The activities that can cause this impact in a negative manner include disposal of domestic and industrial liquid wastes for the project, stripping and cleaning, earth moving (excavation and fillings), building and operation of the area for management of debris and excavation material (ZODME). All these activities have a mild or irrelevant environmental significance value while the activity of removal of the vegetation cover, stripping and cleaning has a severe importance. Restoration of the vegetation cover and revegetation is the only activity that causes the impact in a positive manner and with a moderate assessment.</p> <p>For disposal of domestic and industrial liquid wastes for the project, earth moving (excavation and fillings), building and operation of the area for management of debris and excavation material (ZODME), the impact on the edaphic fauna is mild. Given that these activities shall be developed after other much more impacting activities (removal of vegetation cover, stripping and cleaning).</p> <p>All the activities that generate a change in the vegetation cover, elimination of the organic layer and subsequent replacement by inorganic elements involve disappearance of all the microorganisms and invertebrates that constitute the edaphic fauna. In building of roads, there is a total change of this environmental element. For recovery, specific actions or natural processes at a very long term are required in the intervened area. In development of the project, this impact is accumulated as the size of the intervened areas is increased.</p>		

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Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.81 Description of the Impact of Changes in the Mobility Patterns of Individuals in the Scenario with the Project

ENVIRONMENT: BIOTIC		
ENVIRONMENTAL ELEMENT: FAUNA		
ENVIRONMENTAL IMPACT: CHANGES IN THE MOBILITY PATTERNS OF INDIVIDUALS		
Many fauna species have defined territories and specific areas of movement to have access to food resources, shelter sites or reproductive areas. These patterns can be altered by intervention of the natural environment, including actions as transformation of the habitat, incorporation of artificial structures, noise generation, thermal radiation, traffic of vehicles and even human presence can be seen by some species as a potential threat that must be avoided by changing their course of movement or site for foraging or shelter.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-30) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-50) Moderate Impact
	Earth moving (Excavation and Fillings)	(-32) Mild or Irrelevant Impact
	Operation and maintenance of machinery and/or equipment	(-29) Mild or Irrelevant Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-45) Moderate Impact
	Restoration of Vegetation Cover and Revegetation	(+34) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>For this impact, six triggering activities were identified. The activities of removal of vegetation cover, stripping and cleaning in the areas to be intervened and building, and operation of the area for management of debris and excavation material (ZODME) have a moderate environmental importance value. These two activities are related to interruption of continuity in the natural habitats, increase of the levels of sound pressure levels for the equipment and machinery used for removal and possible threat by operators of certain species, which are identified collectively as negative factors that make individuals of certain species search other routes for movement or foraging areas. Even though the activity would only be made once, replacement of natural vegetation by structures in concrete or cement would be incorporated in the environment becoming a barrier for movement of several species. Therefore, it is considered that duration of the impact is permanent, but the effect reversible and it can be mitigated with some management measures.</p> <p>As for mobilization of building materials, supplies, machinery, equipment and staff, earth moving (excavation and fillings) and the operation and maintenance of machinery and/or equipment, the effects of mobilization of the fauna are generated as a response of temporary or permanent rejection and scaring of individuals. In linear projects, animals search other mobility areas far from the presence of people. Incorporation of sources of noise (machinery) can be perceived at considerable distances, which leads several species to distance from the disturbing source and search new areas for movement.</p> <p>Restoration of vegetation cover and revegetation is the only activity that generates the impact in a positive manner given that incorporation of natural vegetation can lead to an increase in continuity of the habitat and is a positive factor that allows some species to reuse the routes through which they moved before intervention. This process can occur in the medium and long term, according to the dispersion and tolerance capacity of species to anthropogenic disturbance.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.82 Description of the Impact of Changes in the Composition and Structure of the Hydrobiological Communities in the Scenario without the Project

ENVIRONMENT: BIOTIC
ENVIRONMENTAL ELEMENT: FAUNA
ENVIRONMENTAL IMPACT: CHANGES IN THE COMPOSITION AND STRUCTURE OF THE HYDROBIOLOGICAL COMMUNITIES
This impact is closely related to alteration of the habitat on which the aquatic species of the different taxonomic groups depend for their development and stay in one specific site in the water column and throughout the riverbed or extension of the water body. Aquatic species are highly sensitive to changes in the conditions of habitat and in the face of events that alter their structure and can die or migrate to sites with better conditions, which changes density or presence of species and their distribution. Likewise, it is worth noting that hydrobiological communities present in the aquatic ecosystems are very important since they constitute an essential





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ENVIRONMENT: BIOTIC		
ENVIRONMENTAL ELEMENT: FAUNA		
ENVIRONMENTAL IMPACT: CHANGES IN THE COMPOSITION AND STRUCTURE OF THE HYDROBIOLOGICAL COMMUNITIES		
element in conservation of biodiversity.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Catchment of surface water	(-28) Mild or Irrelevant Impact
	Disposal of domestic and industrial liquid wastes by the project	(-30) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-34) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-43) Moderate Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-32) Mild or Irrelevant Impact
	Foundation and piling for bridges and viaducts	(-28) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The activities of the project identified include six activities that generate changes in the hydrobiological communities, to wit, catchment of surface water, disposal of domestic and industrial liquid wastes for the project, building of hydraulic works (including occupation of riverbeds) and foundation and piling for bridges and viaducts have a mild or irrelevant importance value while for removal of the vegetation cover, stripping and cleaning, and building and operation of areas for management of debris and excavation material (ZODME) it is moderate.</p> <p>In case of activities of building or use of natural resources, several factors or events that cause the impact are identified. Further, during the activities conducted to build the infrastructure (hydraulic works, bridges and viaducts) or to fit the path going through the riverbed to be occupied, amounts of sediments or other pollutant substances that affect directly survival of some aquatic organisms can be generated. Change in the habitat structure and flow of the riverbed in the intervened segment generates a disturbance of the settlement and colonization capacity of some algae species, macroinvertebrates and even fish.</p> <p>Additionally, disposal of liquid wastes can cause an increase in the amount of sediments provided by the aquatic environment and have an incidence in metabolic and respiratory processes of some species. These effects can arise or not depending on the flow of each water body and type of occupation or infrastructure incorporated in such place.</p> <p>In removal of vegetation cover, stripping and cleaning, as well as in building and operation of the area for management of debris and excavation material (ZODME), it is expected that a moderate alteration of the aquatic environment is caused mainly in aspects related to the structure of the riverbed for incorporation of artificial elements and contribution of some wastes during the civil works required for building or introduction of these structures. These changes in the habitat lead to local disturbances that can affect certain aquatic species modifying the composition and structure of some communities settled in the area to be intervened.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.83 Description of the Impact of Alteration of the Habitat of Hydrobiological Communities in the Scenario with the Project

ENVIRONMENT: BIOTIC		
ENVIRONMENTAL ELEMENT: FAUNA		
ENVIRONMENTAL IMPACT: ALTERATION OF THE HABITAT OF THE HYDROBIOLOGICAL COMMUNITIES		
Aquatic habitats are composed of internal elements as physical conditions, concentration of dissolved or suspended substances and presence of aquatic communities, as well as external elements of the riverbank (vegetation, slope, use of soil). Any alteration of these components can generate important changes in the structure of the habitat and have repercussions on the composition, abundance and distribution of the aquatic species.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Catchment of surface water	(-25) Mild or Irrelevant Impact
	Disposal of domestic and industrial liquid wastes by the project	(-30) Mild or Irrelevant Impact
	Removal of vegetation cover, stripping and cleaning	(-41) Moderate Impact
	Building and Operation of the Area of Management of Debris and Excavation Material (ZODME).	(-55) Severe Impact
	Building of hydraulic works (Including occupation of riverbeds)	(-42) Moderate Impact
	Foundation and piling for bridges and viaducts	(-25) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		

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ENVIRONMENTAL ELEMENT: FAUNA
ENVIRONMENTAL IMPACT: ALTERATION OF THE HABITAT OF THE HYDROBIOLOGICAL COMMUNITIES
<p>The impact is negative with a moderate importance value with respect to the activities of removal of vegetation cover, stripping and cleaning and building of hydraulic works (including occupation of riverbeds). Catchment of surface water and disposal of domestic and industrial liquid wastes for the project have a mild or irrelevant importance. Lastly, building and operation of the area for management of debris and excavation material (ZODME) has a severe importance.</p> <p>The activity of hydraulic works (occupation of riverbeds) and removal of vegetation cover, stripping and cleaning can cause alteration of the aquatic habitat for the same factors or events that cause the previous impact: activities conducted to build the infrastructure or adapt the easement through which the riverbed shall occupy, the change in the structure and flow of the riverbed in the intervened segment, and the increase in the amount of sediments that are provided to the aquatic environment during traffic of vehicles. These processes interact to produce changes in the internal conditions of the aquatic habitat making difficult the ecologic dynamics of the communities settled in such area.</p> <p>Building and operation of the area for management of debris and excavation material (ZODMES) could affect seriously aquatic habitats since their location can be near water bodies. In this case, the aquatic habitat would be altered mainly under the conditions of the riverbank and in certain situations the effects can go beyond the water body causing disturbances in the quality of the habitat where different aquatic species develop.</p> <p>As for catchment of surface water and disposal of liquid wastes by the project, alteration would be represented by the alteration in the habitat where the hydrobiological communities develop representing a negative impact, but with a mild environmental significance, since extraction of the water resource only causes a temporary disturbance in availability of the habitat for the hydrobiological communities that develop in the intervened segment. It can also entail an alteration in the physicochemical composition of water decreasing the quality of the aquatic habitat and its capacity to bear metabolic processes of microorganisms and superior trophic guilds.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

8.3.5.3 Socioeconomic Environment

Table 8.84 Description of the Impact of Change in the Population Dynamics in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: POPULATION STRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN THE POPULATION DYNAMICS		
It consists in assessing the manner in which the population structure is modified based on the dynamics that revolve around the activities of the project.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building y Building	Hiring and training of the staff	(-44) Moderate Impact
Building	Acquisition of goods and services	(+35) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The communities of the area of influence are characterized by having grouped and dispersed settlement patters, which indicates that in concentrations of population there are stationary business units such as stores, tire change, miscellaneous services, among others, in order to cover part of the needs of the households settled in the territory.</p> <p>It is important to specify that the base of the economy of inhabitants is agriculture considering that dispersed population is predominant. Such population covers its needs in grouped concentrations/identified sectors in nearby districts or in cities of easy access. Commercially, they are the commercial strategy or sowing products. Another common activity in the population is the unskilled labor in activities of brickwork or building. Such activity can be related to some activities to be developed in the project, especially pre-building and building of works. The impact of the dynamics of the population in relation with <u>hiring and training of staff</u> would be a moderate negative impact due to migration of population from other territorial units outside the area of influence in order to have access to a job. The expectations of external communities for the project area are high as a result of disinformation with respect to the scopes of the project. This aspect limits job opportunities for the staff of the area disregarding it for the new job</p>		

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ENVIRONMENTAL ELEMENT: POPULATION STRUCTURE
ENVIRONMENTAL IMPACT: CHANGE IN THE POPULATION DYNAMICS
<p>opportunities. There is also the concern of the profiles to be required, which would demand education and experience other than the traditional activities. This would limit job opportunities.</p> <p>In connection with the economy of the area, in the building phase, <u>acquisition of goods and services</u> was qualified as a moderate positive aspect given that the population near the project can offer workers, restaurant service, laundry, parking lots, lodging, among others; the different options that generate higher income in a house and increase the economy of a territory.</p>

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.85 Description of the Impact of Change in the Road Accident Rates in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: POPULATION STRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN THE ROAD ACCIDENT RATES		
It consists in assessing modification to the population structure of the smallest territorial units of the project in relation with activities of mobilization of supplies, materials and staff of the project.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-25) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The roads are spaces intended for circulation of vehicles, bicycles, motorcycles or persons towards a certain place. They become a corridor to different destinations for a particular purpose. The roads identified in the project fulfill the same function and have the same characteristics. Some of them are in good state, others in regular and bad state. Regularly, the roads of the area do not have signaling to ensure crossroads and paths, which can become a problem at the moment of starting activities of the project. <u>Mobilization of building materials, supplies, machinery, equipment and staff</u> was qualified as a negative impact with mild or irrelevant importance level since the company in its scopes shall ensure a road plan that shall allow providing traffic safety of such machinery without causing incidents to the population using the road. In order to comply with the requirements established, it is important to analyze risk factors to which people shall be exposed when they move whether by their own means or in vehicles, proposing appropriate measures to avoid risks and protect passive and active people in circulation of roads.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.86 Description of the Impact of Change in the Supply and Demand of Goods and Services in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN THE SUPPLY AND DEMAND OF GOODS AND SERVICES		
It consists in assessing increase or decrease of the demand of goods and services offered in the region generated by circulation of people to the area or by increase of income of the population.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre- Building y Building	Hiring and training of the staff	(+53) Severe Impact
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(+53) Severe Impact
	Acquisition of goods and services	(+53) Severe Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>Execution of infrastructure works makes the economy more dynamic since at the building stage, movement of people and machinery that require different goods and services is necessary.</p> <p>The economic characteristics of the population show that the demand of goods and services is focused on first-need goods and on some occasions restricting use of some of them due to the low level of income of families, the subsistence crops that families have in their properties, the diet being limited to those products.</p>		

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ENVIRONMENT: SOCIOECONOMIC
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE
ENVIRONMENTAL IMPACT: CHANGE IN THE SUPPLY AND DEMAND OF GOODS AND SERVICES
<p>Hiring and training of staff shall allow that the related population obtains a better purchasing power causing an increase in the demand of goods and services and, thus an increase in the supply. People could have access to products that they do not have every day due to their limited income.</p> <p>Mobilization of building materials, supplies, machinery, equipment and staff (floating population) shall require food, housing, transport, among other goods. This demand is satisfied with the supply existing in the area which, according to the characterization made, satisfies the demand of people living in the area without having much production surplus, a situation that involves an increase of production and service provision. This intensifies the economic dynamics generating surplus that satisfies the demand and at the same time, leading to a better life quality of the community.</p> <p>This situation causes a growth wave for <u>acquisition of goods and services</u>, a circle that is getting bigger until reaching the point of balance between the supply and the demand. The increase of income of the population and the floating population generate more demand. This makes real economy more dynamic and such dynamism lasts in time.</p>

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.87 Description of the Impact of Fragmentation of Properties in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE		
ENVIRONMENTAL IMPACT: FRAGMENTATION OF PROPERTIES		
It consists in analyzing the remaining area of the different properties after defining the required area establishing if at the end they have the defined area to conduct the productive activities.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building	Negotiation of properties and easements	(-44) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The characteristics of landholding in the studied area are mainly focused on existence of microholdings (less than three hectares) and smallholdings (properties between 3 and 10 hectares), that is, the areas of the properties where families are located do not have large extensions. There is also the housing infrastructure and some subsistence crops that allow them to guarantee the product of their daily diet.</p> <p>The impact of fragmentation of properties is qualified as negative and moderate since during the pre-building stage in the aspect assessed <u>negotiation of properties and easements</u> there can be division of such properties. In the event that the remaining area is less than the UAF defined by the Incoder or an area less than the minimum production area defined by the municipality remains, it is necessary to move the population to other places. This involves a change in the dynamics of their everyday lives.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.88 Description of the Impact of Change in the Land Prices in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN LAND PRICES		
It consists in assessing variations of the value of the square meter or hectare for execution of the project.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building	Negotiation of properties and easements	(-34) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>Lands of the different regions of the country are assessed for being in a rural, urban or suburban area. Likewise, their productivity level and development provide added value making them more or less costly per area or square meter having a value defined per homogeneous areas.</p> <p>Execution of the project requires defined areas at the pre-building phase during <u>negotiation of properties and easements</u> that allow complying with the area through which the road is going to pass and with the current regulations about safety markings, bike lanes and</p>		

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ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE
ENVIRONMENTAL IMPACT: CHANGE IN LAND PRICES
shoulders. This situation leads to a speculation with the value of the area to be acquired which causes uncertainty among owners waiting for acquisition values other than the ones recognized by the commercial assessments made. This situation occurs because of lack of knowledge about the management of properties conducted and poor information of people seeking to obtain benefits to which they are not entitled (intermediaries).

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.89 Description of the Impact of Change in the Economic Activities in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN THE ECONOMIC ACTIVITIES		
It consists in assessing variations in the traditional productive activities of the region with respect to the new activities generated by execution of the project.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building y Building	Hiring and training of the staff	(+47) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
The impact of change in the economic activities is qualified as positive with a moderate impact since the demand of skilled labor and unskilled labor with people of the region from the region causes that unemployed or underemployed people can find a better job alternative. In turn, they generate new indirect work opportunities indirect to execution of the project that allow opening new alternatives to the traditional options. It is worth highlighting that the activities developed shall not be suspended. They shall be consolidated by satisfying the demand of goods and services required.		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.90 Description of the Impact of Change in the Dynamics of Employment in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN THE DYNAMICS OF EMPLOYMENT		
It consists in assessing decrease or increase in the life quality of the population considering the basic aspects of the economic indicators defined for this purpose as the Gini indicator.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building y Building	Hiring and training of the staff	(+47) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
The impact of change in the dynamics of employment is qualified as positive for the environmental aspects of: hiring and training of the staff since offering training and a formal job to unskilled labor generates added value in their résumés obtaining subsequently new job possibilities not only the area subject to study but also in nearby areas that allow higher income and stable jobs in the medium and long term. This impact is directly related to the impact of change in the life quality of the population. With execution of the project a higher number of jobs are created other than the regular jobs in the area and the registered unemployment, an average of 50% of the population, is reduced. Jobs created are formal. In turn, there is an increase of the demand of labor in the traditional activities to satisfy the demand of goods and services generated by displacement of the skilled labor.		

Source: GEOCOL CONSULTORES S.A., 2017.





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Table 8.91 Description of the Impact of Change in the Levels of Income in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN THE LEVELS OF INCOME		
It consists in assessing variations of income of the resident population generated by execution of the project.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building y Building	Hiring and training of the staff	(+49) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>When hiring unskilled labor with population of the area all the legal obligations were considered. In accordance with the characterization made, it is established that most of the population has daily jobs and is not registered in the social security system. People from the area are hired in compliance with all the current labor regulations, which guarantees at least a payment of a minimum wage with all the other legal benefits.</p> <p>The foregoing involves a better income with stable and safer labor conditions. It is worth stressing that this impact is qualified once in the pre-building phase since it is at that moment when manifestation of the impact begins. Nonetheless, this impact also occurs during the building and maintenance stage since the <u>staff is hired and trained</u> at all times. It is not assessed in other phases to avoid undervaluation of the impact.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.92 Description of the Impact of Change in the Life Quality of the Population in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: ECONOMIC AND PRODUCTIVE STRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN THE LIFE QUALITY OF THE POPULATION		
Variability whether for improvement or deterioration of the life quality of the population considering the basic aspects of the population such as housing, education, health, labor, among others.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building	Negotiation of properties and easements	(-53) Severe Impact
Pre- Building y Building	Hiring and training of the staff	(+36) Moderate Impact
Building	Acquisition of goods and services	(+38) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The impact of change in the life quality of the population is qualified as positive for the environmental aspects of: Hiring and training of staff since by requiring skilled and unskilled labor of the area, the project generates a new work alternative where people shall have economic and work stability during execution of the project. This involves that people shall have a formal employment with all the payments of parafiscal contributions and social security. Likewise, the wage shall not be recognized per day as usual in the area. Families have thus higher income and better purchasing capacity, which involves that they can acquire better and more basic goods and services for their development. For this reason, it was considered a moderate impact.</p> <p>This impact is considered severe in matters related to negotiation of properties and easements to the extent that people located in the design of the road shall negotiate their property and relocate in a space other than the usual on. This condition can originate dissatisfaction for modifying their life styles. Likewise, it can be considered that any change in the life of a human being causes resistance.</p>		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.93 Description of the Impact of Change in the State of Social and Public Service Infrastructure (Collective Equipment, Aqueduct, Sewer, Electric Energy, etc.) in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC
ENVIRONMENTAL ELEMENT: SOCIAL INFRASTRUCTURE





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ENVIRONMENTAL IMPACT: CHANGES IN THE SOCIAL AND PUBLIC SERVICE INFRASTRUCTURE (COLLECTIVE EQUIPMENT, AQUEDUCT, SEWERS, ELECTRIC ENERGY, ETC.)		
It is described as the change caused in the current state (quality and cover) of the social and public service infrastructure for development of the project activities. It is the change in quality and cover of the social services generated by entry of external people who work in the highway project.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building	Negotiation of properties and easements	(-58) Severe Impact
	Hiring and training of the staff	(-58) Severe Impact
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-43) Moderate Impact
	Earth moving (Excavation and Fillings)	(-43) Moderate Impact
	Installation and operation of camps	(-40) Moderate Impact
Abandonment and Final Restoration	Landscape Management	(+51) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
Some of the houses that are located on the design of the highway project shall be possibly required by the project. This action can generate expectations or uncertainty in families for negotiation of their properties and the new place where they shall install guaranteeing that they can continue with development of their daily family, educational and economic activities. In the development of the project provision of some public and social services may also be affected. Therefore, the aspect of negotiation of properties and easements is qualified as negative with a severe environmental significance. Increase of the immigrant population with economic purposes generates saturation of the social services such as education and health, which sometimes do not even cover the entire population of the area and do not comply with the minimum standards of cover and quality. Additionally, poor quality of water for human consumption promotes emergence of diseases and saturation of the health system. Therefore, the aspect hiring and training of staff is qualified as negative with a severe environmental significance. Most of the territorial units are located near main department and national roads, which involves high levels of traffic both of machinery and vehicles. These dynamics represent alterations in the way of life of the communities and represent limitations in mobility, mainly for children and elderly people. For this reason, this impact in the aspect of mobilization of building materials, supplies, machinery, equipment and staff, earth moving (Excavation and Fillings), installation and operation of camps and landscape management was assessed with a negative character and a moderate environmental significance.		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.94 Description of the Impact of Change in the State of Road Infrastructure in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: SOCIAL INFRASTRUCTURE		
ENVIRONMENTAL IMPACT: CHANGE IN THE STATE OF ROAD INFRASTRUCTURE		
Development of the project generates a change in the current state of the road infrastructure used in a recurrent manner by the communities, which has an impact on the economic, cultural and educational activities. It is the impact that generates continuous circulation of heavy vehicles and others towards places where important economic activities are developed. There are changes in the behavior of the population since the roads serve as a means of commercialization and communication at district and municipal level.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-39) Moderate Impact
	Demolition and removal of the infrastructure existing in the areas to be intervened	(-35) Moderate Impact
	Earth moving (Excavation and Fillings)	(-33) Moderate Impact
	Treatment of slopes	(+31) Mild or Irrelevant Impact
	Restoration of Vegetation Cover and Revegetation	(+34) Moderate Impact
Abandonment and Final Restoration	Final cleaning of the areas intervened	(+43) Moderate Impact
	Landscape Management	(+56) Severe Impact





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ENVIRONMENTAL ELEMENT: SOCIAL INFRASTRUCTURE
ENVIRONMENTAL IMPACT: CHANGE IN THE STATE OF ROAD INFRASTRUCTURE
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:
<p>The change in the state of road infrastructure is affected positively by the aspects of treatment of slopes, restoration of vegetation cover and revegetation, final cleaning of the areas intervened and landscape management, with a mild, moderate and severe environmental significance, respectively, considering that all these activities include actions of improvement of the road infrastructure of great incidence for the population given the current state of these roads. It would have a significant influence on mobility of the population. It is important to bear in mind that the relations that the territorial units have with the municipal head town and the exchange of social services and goods and services. The community is highly benefited by having better roads for its mobilization and, thus, transport of products from the rural area to the municipal head town, which decreases the transport costs.</p> <p>Currently, the roads of the territorial units are in a regular state of traffic. It is possible that for the activities inherent in the project national highways and unpaved roads shall be used, which can cause discomfort in the communities. Therefore, a negative modification of the road infrastructure with a moderate environmental significance shall be presented mainly due to the use of roads for the project in the activities of mobilization of building materials, supplies, machinery, equipment and staff; demolition and removal of the infrastructure existing in the areas to be intervened and earth moving (Excavation and Fillings).</p> <p>The vehicle flow generates alterations in the roads used by the communities for cultural, economic and political relations with the other territorial units, a situation that can be identified as a negative impact for the population present in the area. Nonetheless, for the communities not having access roads under favorable conditions, increase of the activities in the area can be positive bearing in mind that some of them require building or fitting of roads.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.95 Description of the Impact of Generation of Conflicts in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: COMMUNITY		
ENVIRONMENTAL IMPACT: GENERATION OF CONFLICTS		
It consists in mitigating the conflicts that may arise for the activities of the project, that is, during the stages of pre-building and building.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building	Negotiation of properties and easements	(-51) Moderate Impact
Pre- Building y Building	Hiring and training of the staff	(-30) Mild or Irrelevant Impact
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-28) Mild or Irrelevant Impact
	Acquisition of goods and services	(-28) Mild or Irrelevant Impact
	Catchment of surface water	(-24) Mild or Irrelevant Impact
	Generation of solid wastes by the project	(-24) Mild or Irrelevant Impact
	Generation of domestic and industrial liquid wastes by the project	(-24) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>The conflict is a situation that involves a problem, a difficulty between two or more parties, whose interests, values and thoughts have different and opposite positions. The conflict generates an exchange of opinions that support opposite interests about which there can be discussions or agreements between such parties.</p> <p>The foregoing is not disconnected with the pre-building activity during <i>negotiation of properties and easements</i>. Even though it is true that for the communities it is not easy to understand the dynamics of many projects in the country, it is not easy either for the national government to make immediate decisions to solve conflicts threatening integrity of people, who must be transferred to safe places in order to guarantee favorable life conditions such as housing, environment, infrastructure, among others.</p> <p>Likewise, it is important to clarify that negotiation of properties and easements shall not be the direct responsibility of the company conducting the Environmental Impact Assessment, for which it shall clarify the scope in the process. Nonetheless, for implementation</p>		





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ENVIRONMENT: SOCIOECONOMIC
ENVIRONMENTAL ELEMENT: COMMUNITY
ENVIRONMENTAL IMPACT: GENERATION OF CONFLICTS
<p>of the project, in general, if it is a conflict, it depends on the agreement with the owner of each property and the aforementioned guaranteed. Therefore, the impact is qualified as negative with a moderate importance value.</p> <p>As for <u>hiring and training of the staff</u>, the impact is qualified as negative with a mild or irrelevant importance level considering that during the pre-building and building stage, clear guidelines are established about the type of contract and work to be performed as to proceed with induction and training which shall be the last step to begin works. Nonetheless, it is not predictable that during performance of the activities conflicts are generated and can be solved immediately.</p> <p>The same applies to <u>mobilization of building materials, supplies, machinery, equipment and staff</u>, which is qualified as negative with a mild or irrelevant importance level since the company shall establish some measures of traffic and proper management that shall allow circulating more safely through roads shared with the community.</p> <p>In connection with <u>acquisition of goods and services</u>, the conflict with the communities is qualified as positive with a mild or irrelevant importance level since the communities shall seek, according to the needs of workers, to cover the supply, that is, lodging, food, laundry, among others. Nonetheless, a general concern may affect the community, arrival of people from other smaller territorial units with the purpose of establishing a stationary or mobile business unit that provides workers with other options or proposals of goods and services decreasing productive capacity and reducing income as livelihood for their families.</p> <p>Another conflict that can arise with the communities is the use and <u>catchment of surface water</u> for the building stage. It was qualified as mild or irrelevant because of clear and concise information to the communities of the area of influence by the company about the points of water catchment to be required for the project, especially for the building stage. Regularly, the communities have district aqueducts that are characterized in the study and are evidenced as important tributaries of domestic use for the communities. Even though it is true that the communities live from crops. The generally have some territorial irrigation units that cover the service of transitory crops for trade or consumption.</p> <p>As for <u>generation of solid wastes</u> and <u>generation of domestic and industrial liquid wastes by the project</u> at the building stage, the conflict with the communities was qualified negative with a mild or irrelevant importance level since the project contains proper disposal of wastes that are generated during such stage. The project does not intend to generate an increase in the pollution caused by communities in their daily lives. The purpose of the project is to have a good cohabitation with the neighboring communities.</p>

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.96 Description of the Impact of Generation of Expectations in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: COMMUNITY		
ENVIRONMENTAL IMPACT: GENERATION OF EXPECTATIONS		
It consists in assessing the expectations that can be generated in negotiation of properties and easements, as well as goods and services.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-Building	Negotiation of properties and easements	(-34) Moderate Impact
Building	Acquisition of goods and services	(-31) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
<p>Generally, the issue of <u>negotiation of properties and easement</u> generates expectations in the communities of the area of influence since negotiation of the value of the land shall be considered depending on the type of use, that is, if it is a property which is used for house or a business unit (store, miscellaneous services, hardware store, among others) or if it is exploited for subsistence crops or commercial crops. This impact was qualified negative with a moderate environmental significance at the pre-building stage due to the disinformation that occur for people not having clear the information with respect to the scopes of the project. The communities must be clear about the stages of development of the project, as well as the details of each one of them.</p> <p>As for <u>acquisition of goods and services</u> at the building stage, the impact was qualified as negative with a mild or irrelevant environmental significance due to the changes that can be generated in the social environment under the framework of development of the project activities. Generally, the communities see an opportunity to improve their economic conditions planning and implementing informal businesses (laundry, fast food, homemade food restaurants, drinks, etc.) which on many occasions do not require a high supply due to the guarantees offered by the project to the workers during development of the project.</p>		

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Source: GEOCOL CONSULTORES S.A., 2017.





Table 8.97 Description of the Impact of Change in Social Relations in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: COMMUNITY		
ENVIRONMENTAL IMPACT: CHANGE IN THE SOCIAL RELATIONS		
The social relations at district level are modified by the big projects. Such projects bring, in turn, a social management associated with the relations with community organizations which, when not having been affected by big works, lead such communities to seek training and internal strengthening to deal with these works.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-building	Outreach and information to the community and competent authorities	(+38) Moderate Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
Big projects are linked to a social management associated with the relations with community organizations which, when not having been affected by big works, lead such communities to seek training and internal strengthening to deal with these works. For this reason, it is evidenced that the activity shall have a positive impact on the environment in matters related to social relations. Its intensity and extension shall be medium and partial, respectively, since the area of influence of the Rumichaca – Pasto Divided Highway Project, San Juan – Pedregal Segment since there are some base organizations working for community development from the district level. Duration is temporary considering the time of duration of the works per each district and/or segment to be intervened. Periodicity is regular since the aspect shall only arise in specific cases. It shall also be irrecoverable since once the organizations have the experience of facing companies and executing works, they acquire expertise on the issue and this also leads to its irreversibility, which necessarily involves a direct effect of the activity on the impact. Finally, due to the interactions with other impacts, it is observed that it is synergic, but not cumulative because the change occurs only once in time. For all the reasons stated above, it is considered a moderate impact.		

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.98 Description of the Impact of Change in Values and Cultural Practices in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: CULTURE		
ENVIRONMENTAL IMPACT: CHANGE IN VALUES AND CULTURAL PRACTICES		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Pre-building and building	Hiring and training of the staff	(-24) Mild or Irrelevant Impact
Building	Installation and operation of camps	(-24) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
The activity of hiring and training of the staff involves a negative change on the values and cultural practices of the area to be intervened since it shall attract foreign staff which shall arrive with customs and cultural particularities that could be in conflict with the customs of the region. Thus, intensity of the impact is considered medium because even though it is very likely that the situation described above arises, the culture in Nariño is strongly uprooted and the level of alteration would not be so high. The extension is managed as partial since even though it is a project that shall go through several small territorial units, this impact shall not go beyond the district level. Duration is temporary and the moment is medium, according to duration of works in each one of them. Periodicity is irregular since it only arises at a specific moment. It shall also be recoverable, reversible and highly resilient since once the foreign staff returns to their places of origin, the area shall also go back to normal in less than 12 months. The effect is direct considering that alteration necessarily answers to the activity, but since it does not interact with other impacts, it is neither cumulative nor synergic. Therefore, it is considered a mild impact.		
Additionally, installation and operation of camps has a negative impact on the values and cultural practices of the regions since it entails installation not only of infrastructure but foreign staff in these camps with customs and values other than the ones of the regions and daily life of families shall be affected by the new social stakeholder in the territory. Nonetheless, its intensity is medium and duration is temporary since, being a transitory activity, the effect shall not be serious. Its extension is partial because the impact would only occur in small territory units where they are installed. It is irregular since it is expected to occur only once. It is also		

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ENVIRONMENT: SOCIOECONOMIC
ENVIRONMENTAL ELEMENT: CULTURE
ENVIRONMENTAL IMPACT: CHANGE IN VALUES AND CULTURAL PRACTICES
recoverable and reversible since the environment can go back to normal once the activity ends. The moment is medium term considering the activity does not exceed three months. Its effect is direct since the impact is generated by execution of the activity, but with a high resilience because once it has ended, the environment recovers in less than two years. Finally, it is not observed that it interacts with other impacts. Therefore, it is not cumulative or synergic. It is thus a mild impact.

Source: GEOCOL CONSULTORES S.A., 2017.

Table 8.99 Description of the Impact of Change in the Health State of the Population in the Scenario with the Project

ENVIRONMENT: SOCIOECONOMIC		
ENVIRONMENTAL ELEMENT: HEALTH		
ENVIRONMENTAL IMPACT: CHANGE IN THE HEALTH STATE OF THE POPULATION		
Any variability caused in the health of the population by any activity associated with the project.		
PHASE	ACTIVITY	VALUE OF ENVIRONMENTAL IMPORTANCE
Building	Mobilization of building materials, supplies, machinery, equipment and staff	(-17) Mild or Irrelevant Impact
DESCRIPTION OF THE IMPACT ON THE GENERATING ACTIVITIES:		
This activity represents a negative effect on health of the population considering that constant circulation of vehicles causes particulate material that can have an incidence on health of the population near the project. Nonetheless, the intensity is minimal with a brief duration if it is considered that exposure shall not be constant. The extension is punctual since the health issues shall arise in the family environment. Periodicity is irregular considering that the impact is unpredictable. It is recoverable and reversible since its effects disappear in less than 12 months once the generating activity stops. The moment is immediate since the period for the impact to appear is short, but with a direct effect since health issues can be easily associated with passing of vehicles. Resilience is high when considering that upon conclusion of the activity, health issues associated with dust shall decrease in a short term. It is not cumulative or synergic since it does not interact with other impacts. For all these reasons, it is considered a mild or irrelevant impact.		

Source: GEOCOL CONSULTORES S.A., 2017.





8.3.6 Level of Global Negative Intervention (NIGN) (Scenario with the Project)

For calculation of the level of global negative intervention the methodology described in section 8.1 **DESCRIPTION OF THE METHODOLOGY FOR IMPACT** – Level of Global Negative Intervention (NIGN) was followed.

The maximum and minimum levels of intervention for the scenario without the project are -19900 and -2786, respectively, considering that the maximum possible value calculated for impact in the methodology of Vicente Conesa Fernández corresponds to a maximum of -100 and a minimum of -14. Additionally, 199 interactions that had negative impacts for the activities of interest of this study were identified in the scenario without the project (Total impacts 252).

Once the impacts were assessed, the sum of the results of the environmental assessment of negative impacts was -7154. Accordingly, the following was obtained:

$$NIGN = 100\% - \frac{(19900 - 7154) * 100\%}{(19900 - 2786)} = 25.5\%$$

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The value of the level of global intervention of the activities that must be compared with the values contained in **Table 8.3**. With the foregoing, it can be established that the negative Level of Global Intervention is under the medium category since the high intervention in the area for anthropogenic activities. For this reason most of the impacts are moderate or mild. Nonetheless, severe impacts (corresponding to 12%) must be subject to constant assessment for application of the environmental impact measures in order to prevent, mitigate, correct them or compensate them.

8.4 ANALYSIS OF CUMULATIVE, SYNERGIC AND RESIDUAL IMPACTS

For the analysis of cumulative and synergic, the assessment made in the scenario without the project was considered since some of the adverse effects caused by the activities currently with development of the project can have a major environmental significance affecting even more the deteriorated environmental element.

The analysis of these impacts is based on the evaluation made with the methodology of Vicente Conesa Fernández-Vitora, considering that this methodology uses evaluation criteria as synergy, accumulation and recoverability.

A cumulative impact is understood as the impact increased progressively after execution of the activity when the generating action persists in a continued or reiterated manner.⁸

By synergic impacts, we refer to the union of several impacts that generate bigger effects than the ones generated if they acted independently.⁹

As for residual impacts, they refer to continuity of the environmental impact after implementation of environmental management measure.¹⁰

It is worth highlighting that the scope of this analysis is identifying the environmental elements most likely to have impacts with cumulative, synergic or residual behavior, showing the no-project and scenario with the projects, as well as the activities that would cause evolution of the impacts as to establish measures for appropriate management of these activities and their corresponding sub-activities.

8.4.1 Cumulative and Synergic

· Scenario without the Project

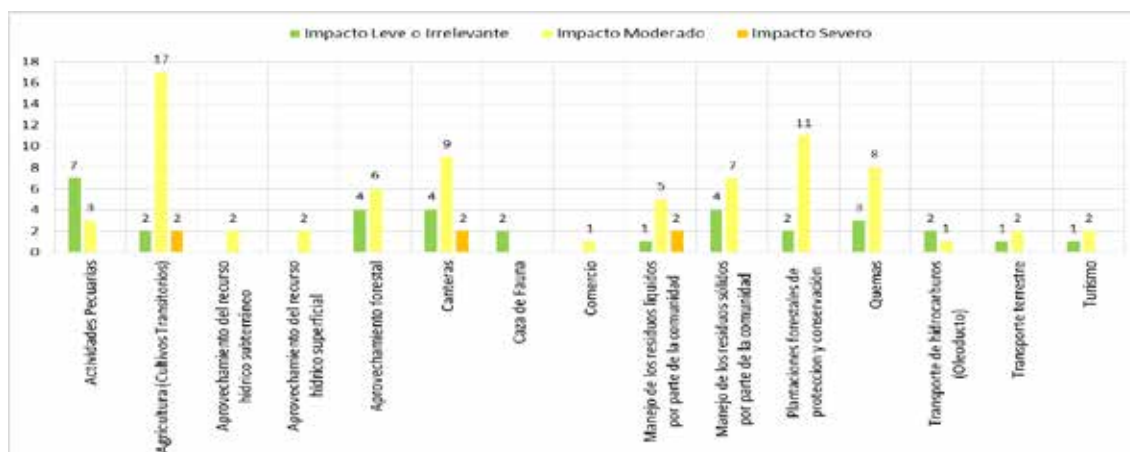
Figure 8.17 and **Figure 8.18** show the activities that can be causing cumulative and synergic impacts currently. **Figure 8.17** shows that the activities with the highest number of cumulative impacts are agriculture (Transitory Crops) (2 mild or irrelevant impacts, 17 moderate impacts and 2 severe impacts) for a total of 21 impacts, followed by the activity of quarries (4 mild or irrelevant impacts, 9 moderate impacts and 2 severe impacts) for a total of 15 impacts.

⁸ Vicente Conesa Fernández-Vitora. Guía metodológica para la evaluación del Impacto Ambiental. Editorial Mundi-Prensa, España. 2009.

⁹ IBID.

¹⁰ IBID

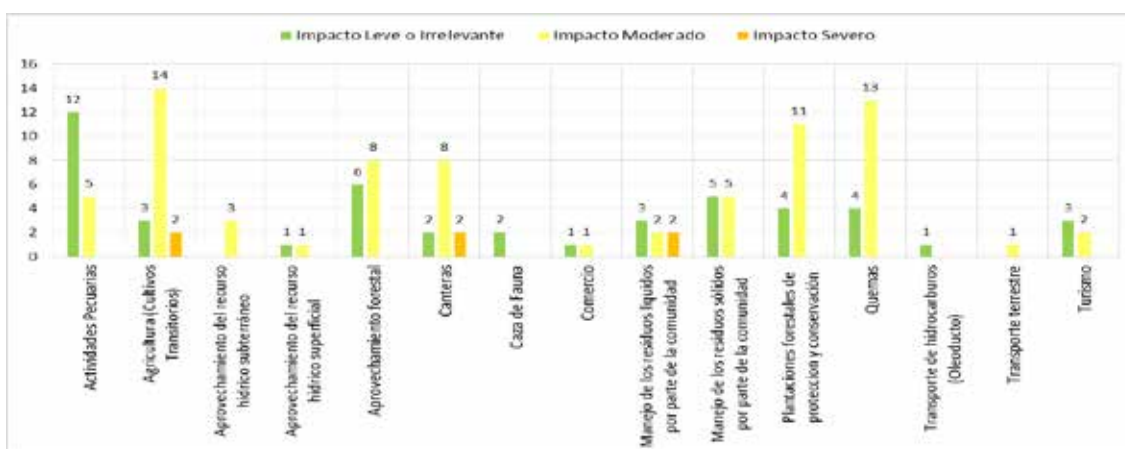
Figure 8.17 Activities Generating Cumulative Impacts in the Scenario without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

As for the synergic impacts, the activity of Agriculture (Transitory Crops) has the highest number of impacts (3 mild or irrelevant impacts, 14 moderate impacts and 2 severe impacts for a total of 19 impacts), followed by farming activities with 17 impacts (12 mild or irrelevant impacts and 5 moderate impacts) and with the same number of impacts there is burning with 17 impacts (4 mild or irrelevant impacts and 13 moderate impacts) (See Figure 8.18).

Figure 8.18 Activities Generating Synergic Impacts in the Scenario without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

As for the cumulative impacts, 66% of them are moderate, 29% are mild or irrelevant impacts, followed by 5% of severe impacts. From the foregoing, it is understood that the moderate and severe impacts must be

controlled in a more regulated manner as to avoid that accumulation of impacts generates a critical scenario, See **Figure 8.19**. As for synergic impacts, there is a situation similar to the situation of cumulative impacts with 58% of moderate impacts, followed by the mild impacts with 37% and the severe impacts with 5%. Although the percentage of impacts with high significance is lower, they must have a bigger control by the community since the combination of synergic impacts can aggravate alterations in the environment (See **Figure 8.20**). Considering that the anthropogenic of the area have a high synergy and accumulation is punctual, it is worth indicating that the alteration of the area currently has the highest levels if they are combined with bad practices of the project with the highest probability of alteration of the area.

Figure 8.19 Percentage Characterization of the Cumulative Impacts

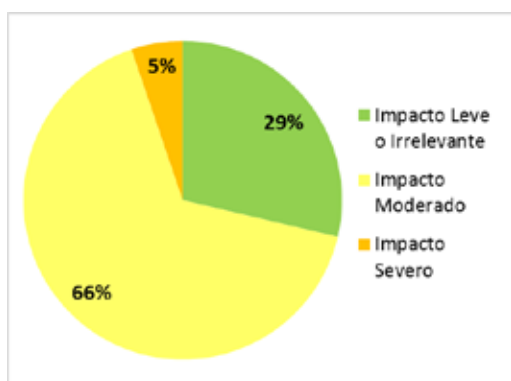
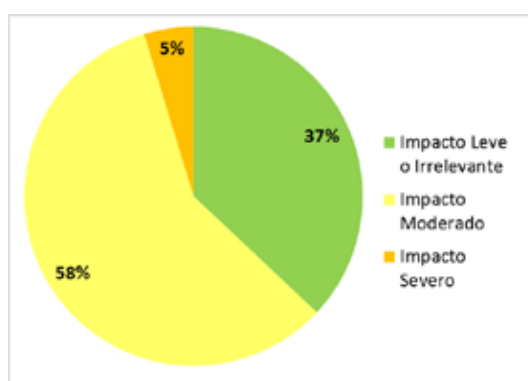


Figure 8.20 Percentage Characterization of Synergic Impacts

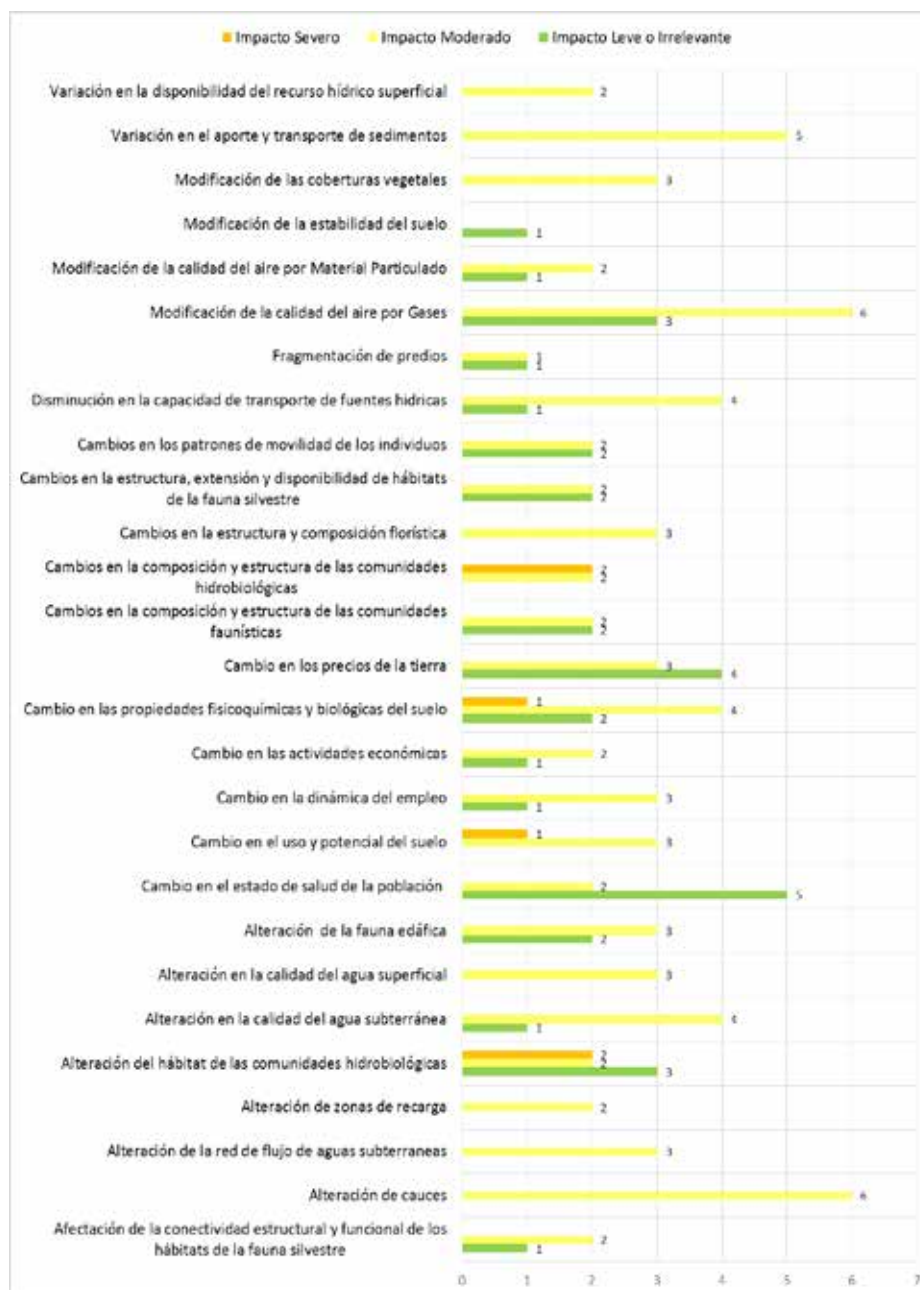


Source: GEOCOL CONSULTORES S.A., 2017.

Figure 8.21 and

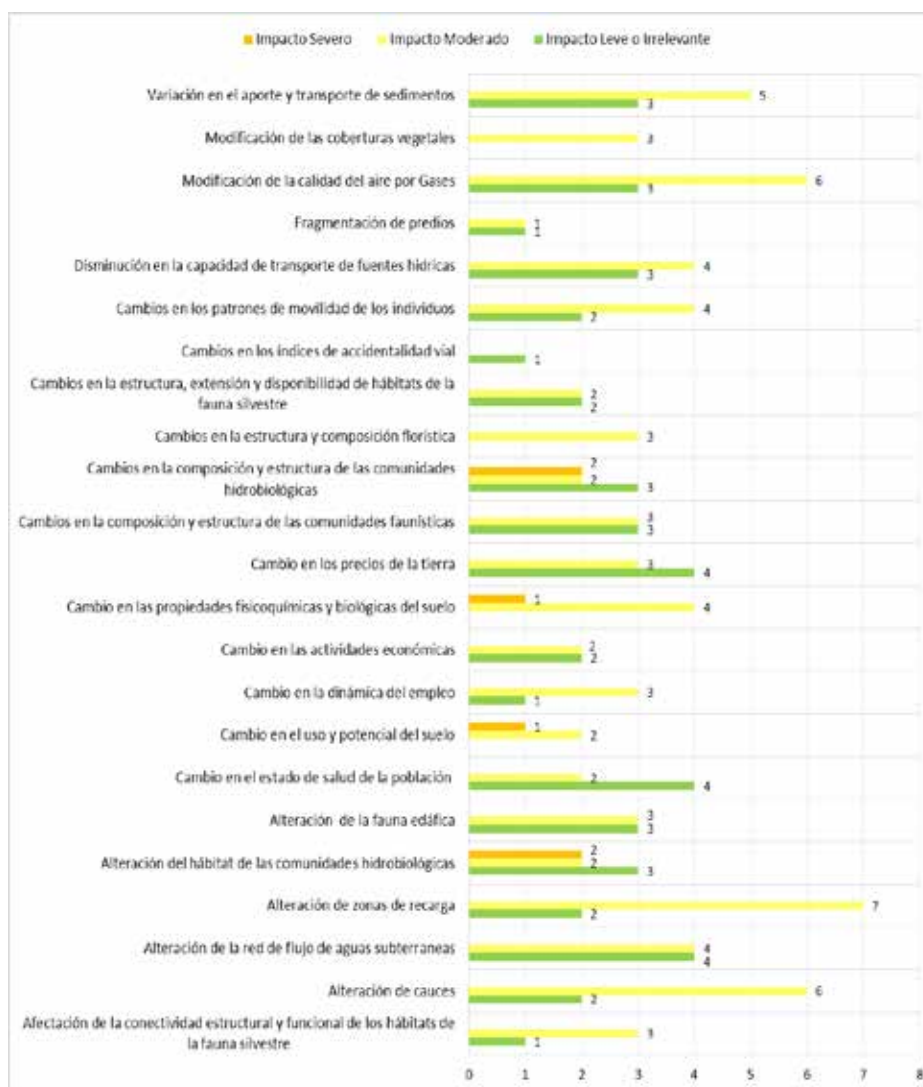
Figure 8.22 show the environmental impacts generated by the activities in the scenario without the project. They can behave in a cumulative and synergic manner. For the scenario without the project, the most recurrent cumulative impacts are alteration of the habitat of hydrobiological communities with 7 interactions (3 mild or irrelevant impacts, 2 moderate impacts and 2 severe impacts), and with the same number of impacts there is the change in the physicochemical and biological properties of the soil (2 mild or irrelevant impacts, 4 moderate impacts and 1 severe impact). For synergic impacts the most significant impact is alteration of the recharge areas with 9 interactions (2 mild or irrelevant impacts and 7 moderate impacts) and with the same number of impacts but with less significance there is modification of the air quality for gases (3 mild or irrelevant impacts and 6 moderate impacts).

Figure 8.21 Cumulative Impacts and their Significance in the Scenario without the Project



Source: GEOCOL CONSULTORES S.A., 2017.

Figure 8.22 Synergic Impacts and their Significance in the Scenario without the Project



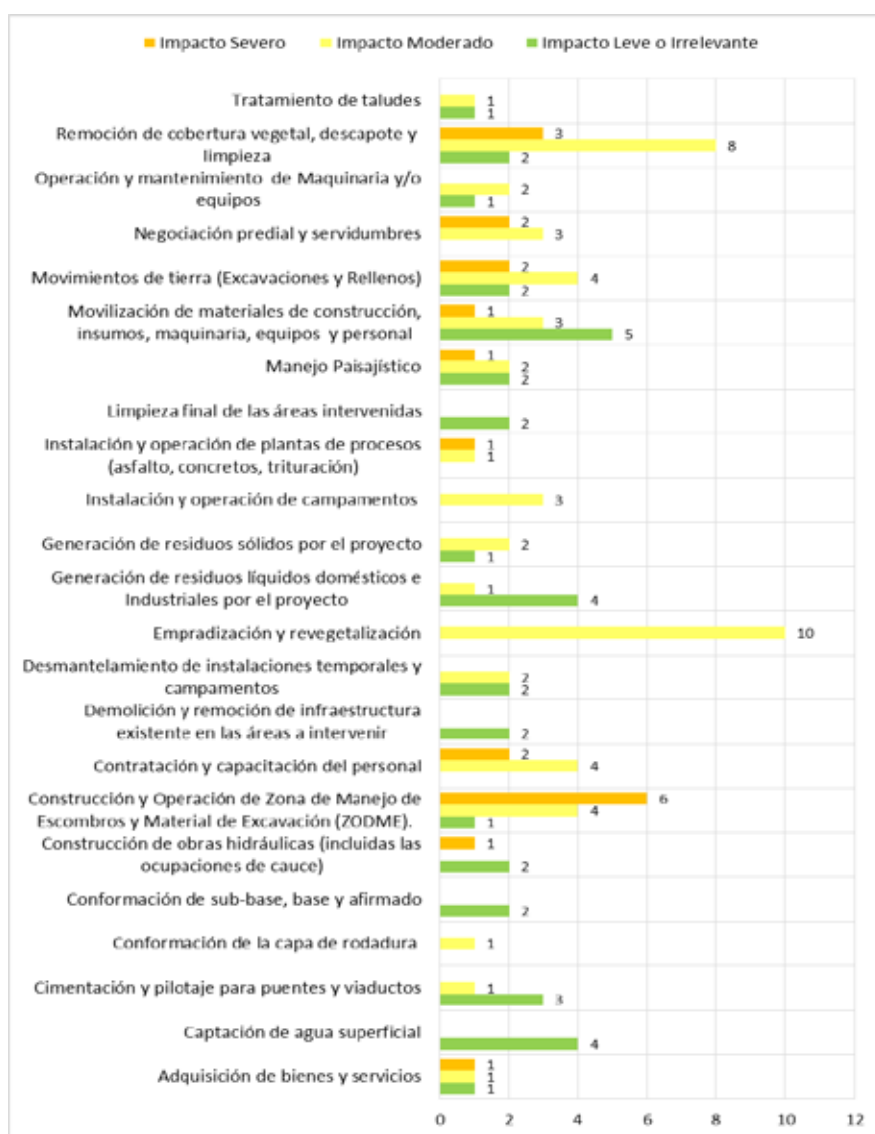
Source: GEOCOL CONSULTORES S.A., 2017.

Scenario with the Project

Figure 8.23 and Figure 8.24 show the activities that can generate cumulative and synergic impacts currently. Figure 8.23 shows that the activities with highest number of cumulative impacts are removal of vegetation cover, stripping and cleaning in the areas to be intervened (2 mild or irrelevant impacts, 8 moderate impacts

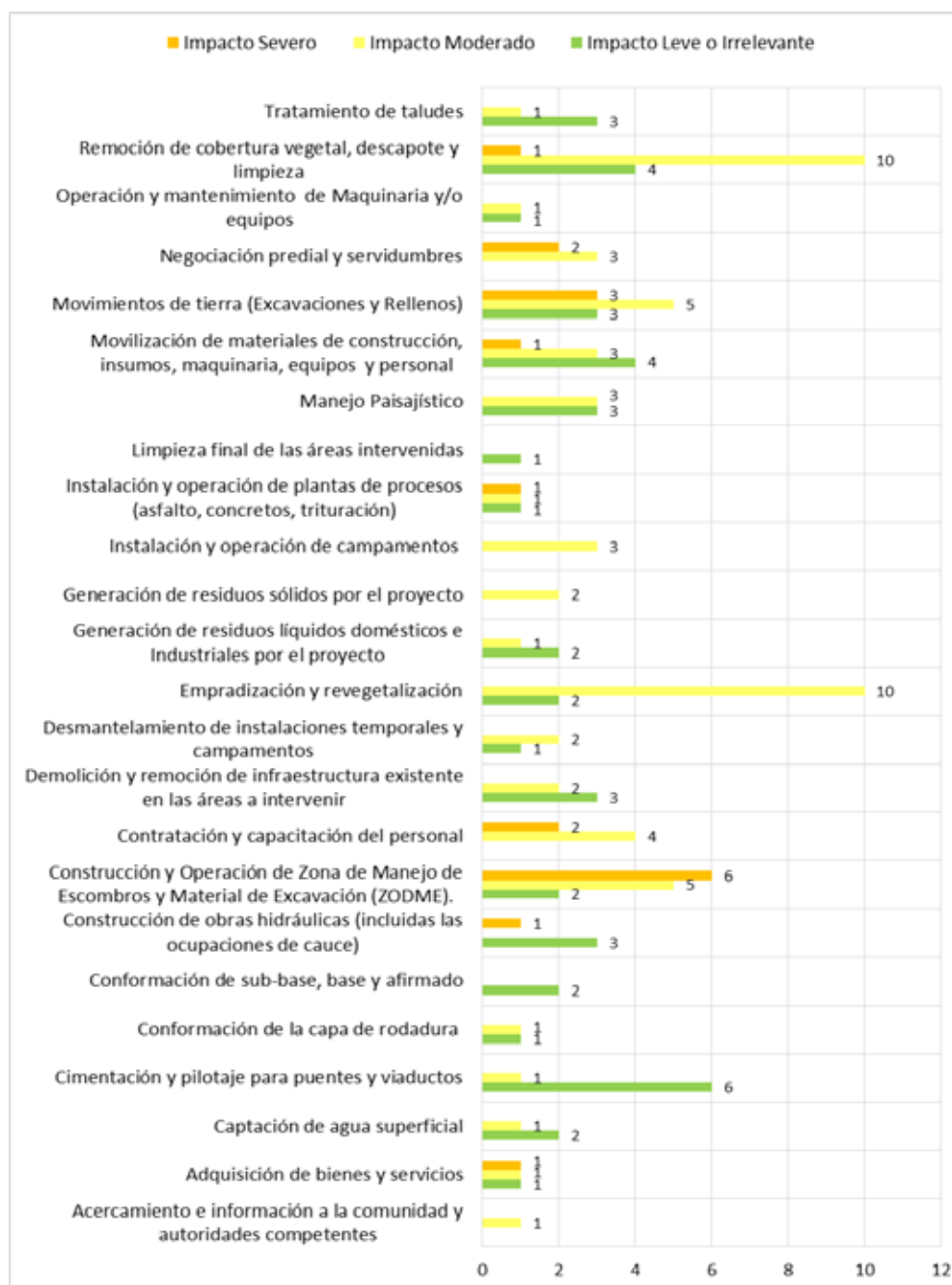
and 3 severe impacts) for a total of 13 impacts, followed by the activity of building and operation of areas of management of debris and excavation material (ZODME) with 11 impacts (1 mild or irrelevant impacts, 4 moderate impacts and 6 severe impacts). **Figure 8.24** shows the activities with the highest number of synergic impacts. The activity of removal of vegetation cover, stripping and cleaning in the areas to be intervened has more impacts (4 mild or irrelevant impacts, 10 moderate impacts, and 1 severe impact), in second place there is the activity of building and operation of areas of management of debris and excavation material (ZODME) with 13 impacts (2 mild or irrelevant impacts, 5 moderate impacts and 6 severe impacts).





Figure 8.23 Activities Generating Cumulative Impacts in the Scenario with the Project



Source: GEOCOL CONSULTORES S.A., 2017.

Figure 8.24 Activities Generating Synergic Impacts in the Scenario with the Project



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Source: GEOCOL CONSULTORES S.A., 2017.

Cumulative and synergic impacts for the projects scenario, as well as in the scenario without the project, are mainly moderate. It is worth mentioning that the severe impacts increase their percentage participation. It is evidenced that about 50 percent if the impacts both cumulative and synergic are of moderate importance. Therefore, it is considered that the impacts do not generate a greater alteration to the environment they affect (See Figure 8.25 and Figure 8.26).

Figure 8.25 Percentage Characterization of the Cumulative Impacts

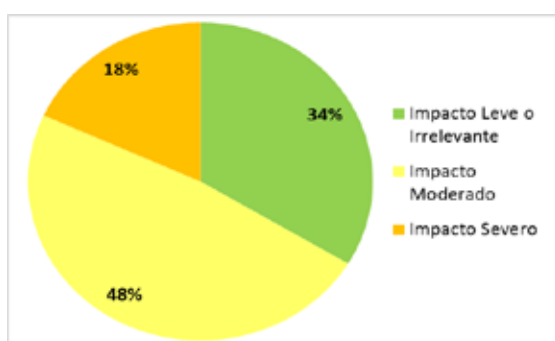
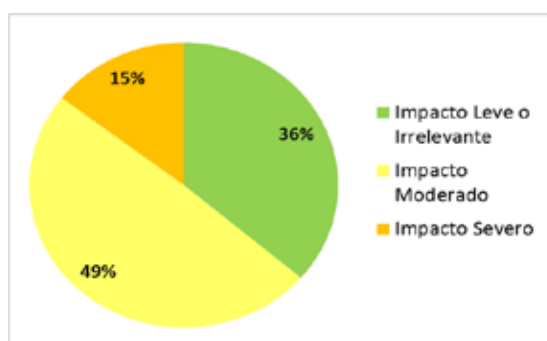


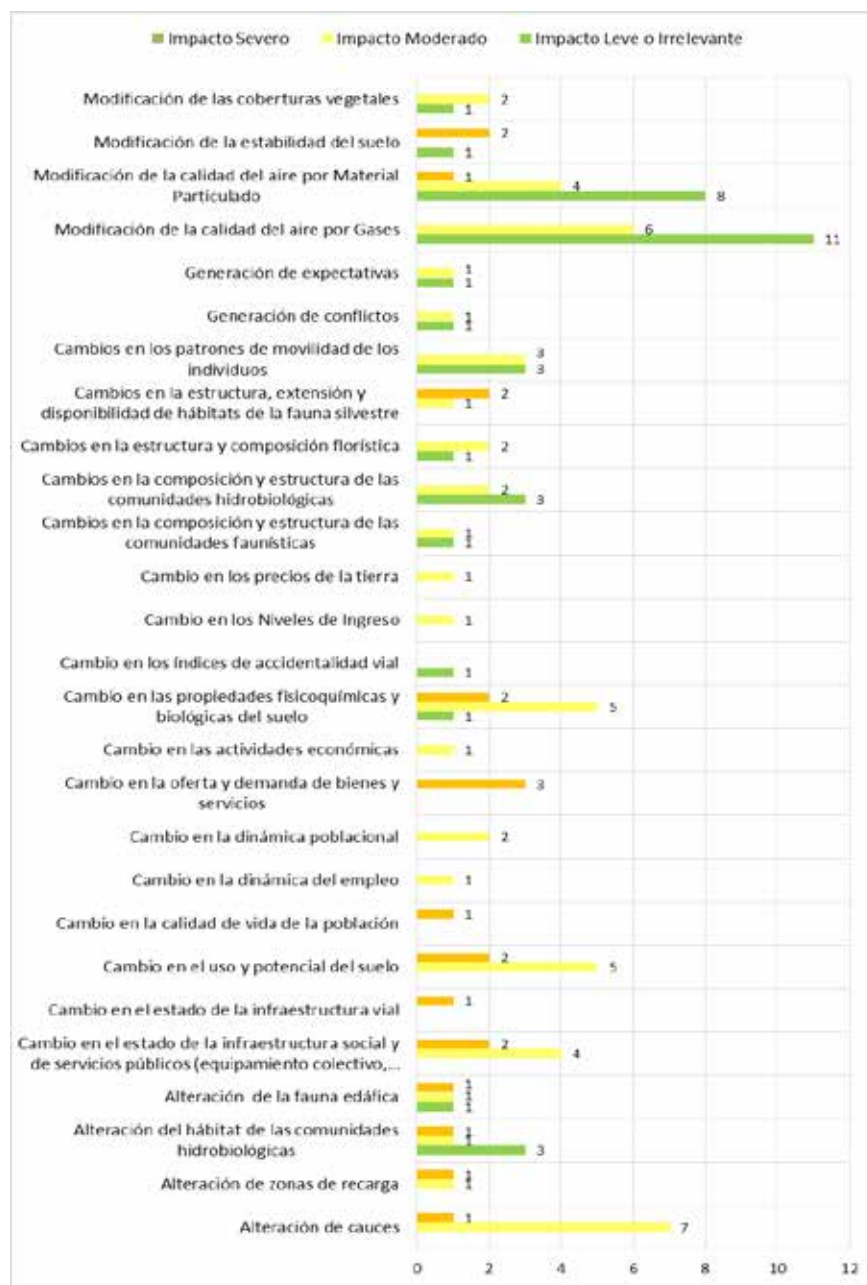
Figure 8.26 Percentage Characterization of the Synergic Impacts



Source: GEOCOL CONSULTORES S.A., 2017.

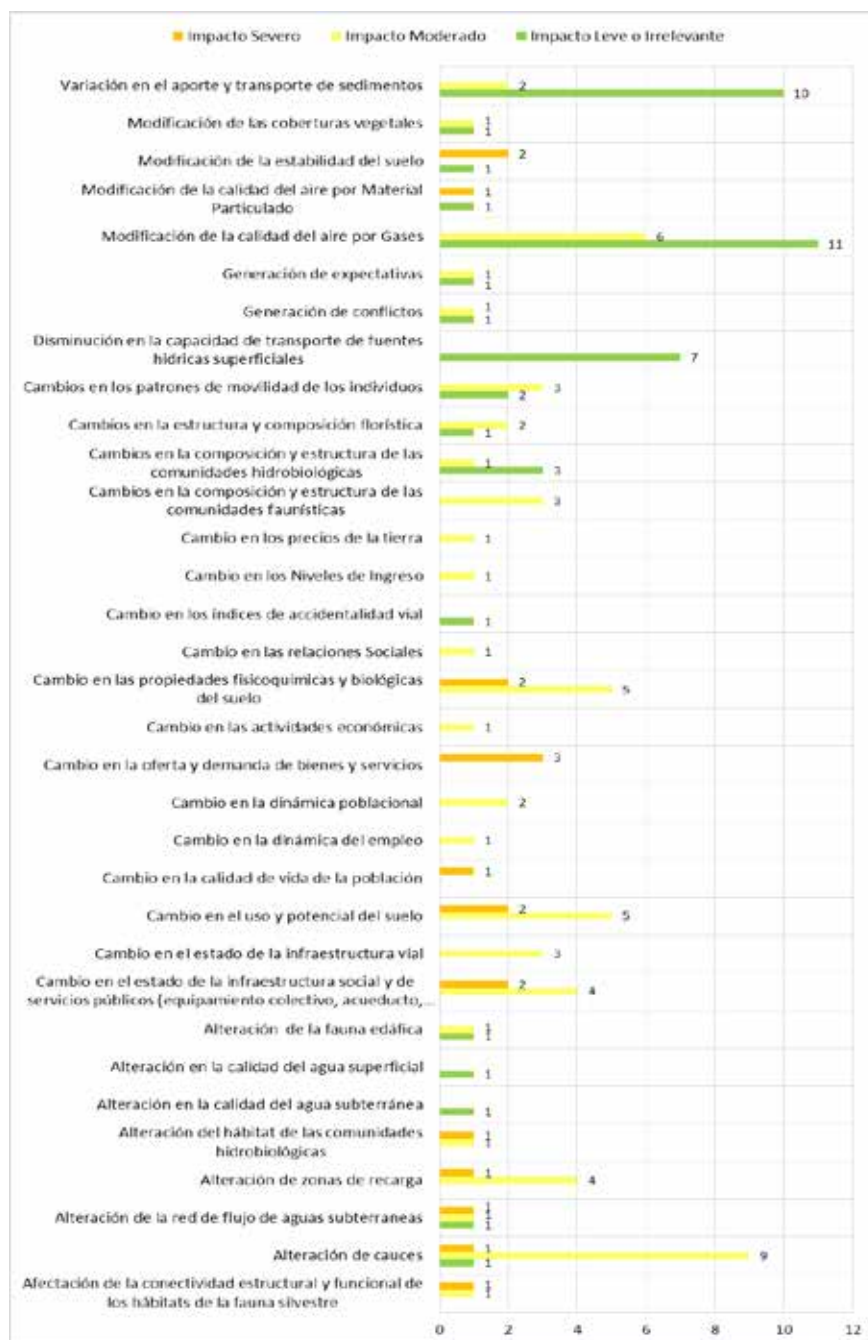
Figure 8.27 and Figure 8.28 show the environmental impacts assessed for the project that can behave in a cumulative and synergic manner. For the scenario with the project, the most recurrent cumulative impacts are modification of the air quality by Gases with 17 interactions (11 mild or irrelevant impacts and 6 moderate impacts), followed by modification of the air quality by particulate material with 13 interactions (8 mild or irrelevant impacts, 4 moderate impacts and 1 severe impact), followed by the impact of alteration of riverbeds with 8 interactions (7 moderate impacts and 1 severe impact). For the synergic impacts, the biggest impact is also modification of the air quality by gases with 17 interactions (11 mild or irrelevant impacts and 6 moderate impacts), followed by the variation in the amount and transport of sediments with 12 interactions (10 mild or irrelevant impacts and 2 moderate impacts).

Figure 8.27 Cumulative Impacts and their Significance in the Scenario with the Project



Source: GEOCOL CONSULTORES S.A., 2017.

Figure 8.28 Synergic Impacts and their Significance in the Scenario with the Project



Source: GEOCOL CONSULTORES S.A., 2017.

8.4.2 Residual Impacts

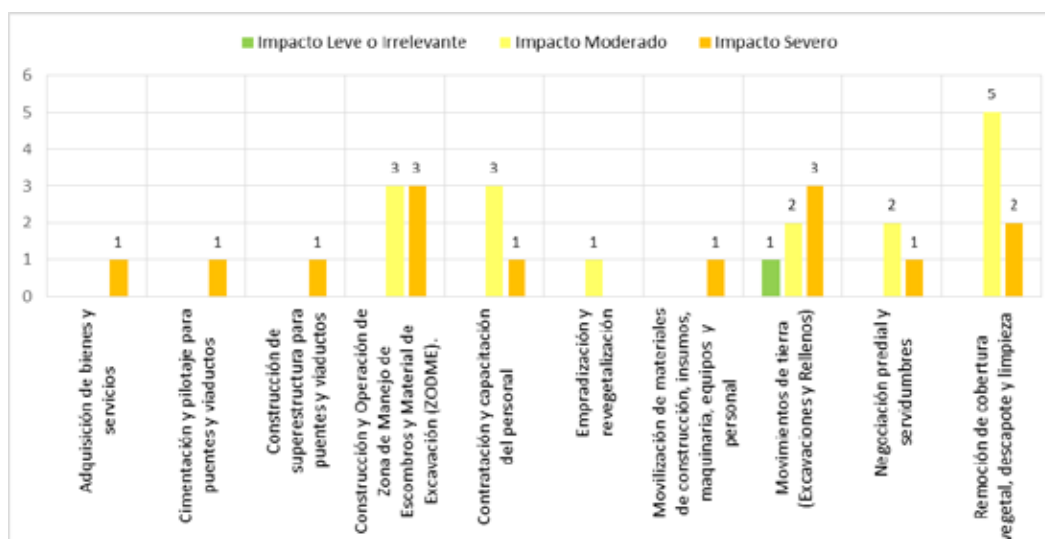
Residual impacts are the ones that have effects that shall persist in the environment after implementation of the prevention, minimization and mitigation measures. For this reason, compensatory measures shall be implemented.

Accordingly, in the assessment methodology they were identified based on the impacts assessed as irrecoverable, where it was considered that in spite of implementation of measures to address the impacts, they cannot be controlled and shall remain in the environment.

Out of 252 interactions that can generate environmental impacts, 31 were assessed as irrecoverable, which corresponds to 12.3%. In **Figure 8.29** the 10 activities that have residual impacts are presented. Most of them occur in building and operation of the ZODMEs with 6 impacts (3 moderate impacts and 3 severe impacts), earth moving also with 6 impacts (3 severe impacts, 2 moderate impacts and 1 mild or irrelevant impact) and removal of vegetation cover, stripping and cleaning with 7 impacts (2 severe impacts and 5 moderate impacts).

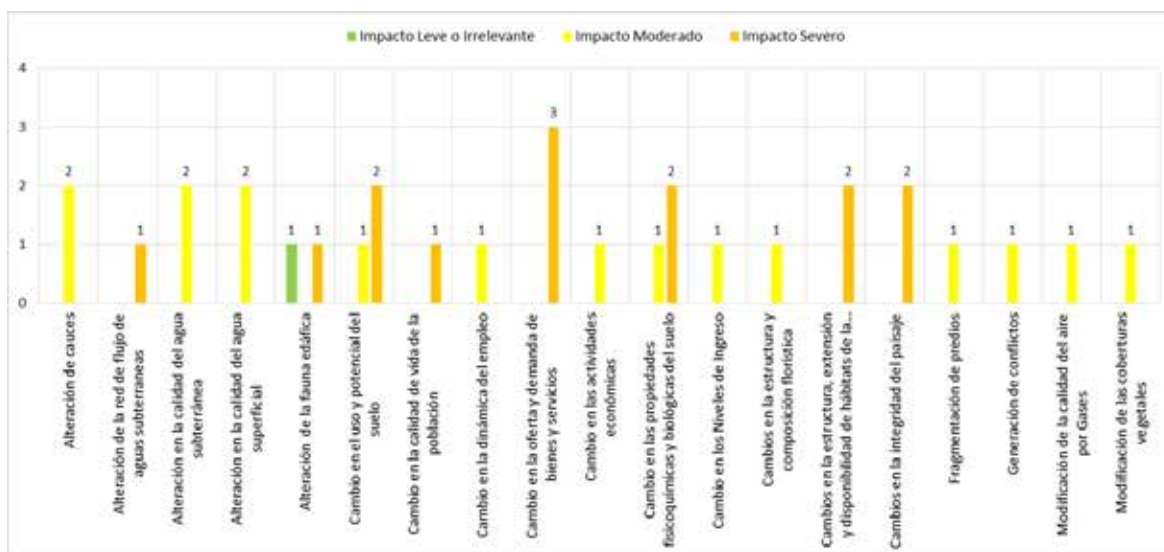
As for the impacts, there were 19 impacts with 31 interactions that cause residual impacts. The greatest impacts are change in the use and potential of soil; change of the physicochemical and biological properties of the soil; and change in the supply and demand of goods and services (See **Figure 8.30**).

Figure 8.29 Activities Generating Residual Impacts



Source: GEOCOL CONSULTORES S.A., 2017.





Figure 8.30 Residual Impacts Generated by the Project



Source: GEOCOL CONSULTORES S.A., 2017.





8.5 CONCLUSIONS

- In the area of influence of the highway project, there is a complex environmental problem because of the strong pressure on the natural resources by the anthropogenic activities developed by the community which occur due to the cultural tradition and the associated economic activities.
- In the scenario without the project, the activities generating more negative impacts are burning (22 negative impacts), farming activities (22 negative impacts) and agriculture of transitory crops (21 negative impacts). The activities that generate the highest number of positive impacts are forest plantations for protection and conservation (19 positive impacts). It is evident that there is a percentage difference between the negative impacts generated by the community with 84% versus the positive impacts with 16%. The most affected environmental element is the surface waters with 37 impacts, while the most benefited environmental element is the economic and productive structure with 12 impacts.
- The activities generated in the scenario without the project that affect negatively the environment to the greatest extent, according to the global weighing, are agriculture, burning and quarries, while the most damaged environmental element is surface water.
- In the scenario with the project, the activities that generate more negative impacts are removal of vegetation cover, stripping and cleaning with 24 negative impacts, followed by building and operation of areas of management of debris and excavation material (ZODME) with 22 impacts and, lastly, earth moving (excavation and fillings) with 19 impacts. The activities that generate the highest number of positive impacts are restoration of vegetation cover and revegetation with 17 impacts, followed by landscape management with 8 impacts and treatment of slopes with 7 impacts. It is evident that there is a percentage difference between the negative impacts generated with 79% versus the positive impacts

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with 21%, such different being higher than the difference in the scenario without the project. The most affected environmental element is the air with 49 impacts, while the most benefited environmental element is surface water with 11 impacts directly associated with the activity of restoration of vegetation cover and revegetation and treatment of slopes.





- The activities developed in the scenario with the project that affect negatively the environment to the greatest extent, according to the global weighing, are building and operation of the Areas of Management of Debris and Excavation Material (ZODME), removal of vegetation cover, stripping and cleaning and earth moving (Excavation and Fillings), while the most damaged environmental element is landscape due to changes in its integrity.
- The activities developed in the scenario without the project have generated changes in the socio-environmental field. According to the Global Level of Negative Intervention (NIGN), for the scenario without the project there is 23.87% corresponding to the category of low intervention. Based on the current conservation state, the project would generate a NIGN of 25.5% which is a medium intervention level. Such value can be reduced with the implementation of environmental management measures, given that, as established by the environmental authority, the project must be assessed without considering implementation of such measures.

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