CONTENTS

11. PLANS AND PROGRAMS _____ 1

11.2 OTHER PLANS AND PROGRAMS _____ 1

11.2.1 1% Investment Plan _____ 1

11.2.1.1 Legislative Framework _____ 1

11.2.1.2 Objectives _____ 3

11.2.1.3 Scope of the Actions to be Undertaken _____ 3

11.2.1.4 Methodology _____ 3

11.2.1.5 Tentative Location of the Area where the Investment is Planned _____ 4

11.2.1.6 Proposal for Works or Activities to Execute _____ 8

11.2.1.7 Amount of the 1% Investment Broken Down by Activities _____ 9

11.2.1.8 Schedule for Execution _____ 10

11.2.1.9 Budget for Developing each Activity Selected _____ 11

11.2.2 Compensation Plan for Biodiversity Loss _____ 15

11.2.2.1 Stage 1: Analysis of Early Warnings _____ 16

11.2.2.2 Stage 2: Compensations Manual _____ 20

11.2.2.2.1 Residual Impacts Generated by the Project on the Biotic Environment _____ 20

11.2.2.2.2 Ecosystems Present in the Area of Intervention of the Highway Project _____ 21

11.2.2.2.3 Estimate of Compensation Factors _____ 25

11.2.2.2.4 Compensation Factors and Area to Compensate _____ 27

11.2.2.2.5 Proposals for Compensation for Biodiversity Loss _____ 31

LIST OF TABLES

Table 11.1 Intake Points Requested for the Rumichaca – Pasto Dual Carriageway Project, San Juan – Pedregal Segment. 4

Table 11.2 Hierarchy for the Hydrographic Network of the Basins where the Intake Points will be Located that were Requested for the Rumichaca – Pasto Dual Carriageway Project, San Juan – Pedregal Segment. 4

Table 11.3 Lines of Intervention applicable to the 1% Investment 6

Table 11.4 Amount of the 1% Investment Broken Down by Activities 10

Table 11.5 Schedule for Execution of the Reforestation Activities 10

Table 11.6 Schedule for the Execution of the Riparian Buffer Zone Fencing Activities 10

Table 11.7 Schedule for Execution of the Purchase of Properties 11

Table 11.8 Schedule for the Execution of the Activities related to Incentives for Property Owners 11

Table 11.9 Budget for Reforestation per Hectare for the 1% Investment Plan 11

Table 11.10 Number of Hectares to be Reforested in the 1% Investment Plan 12

Table 11.11 Budget for Fencing off Riparian Buffer Zones per Hectare for the 1% Investment Plan 13

Table 11.12 Number of Hectares to be Fenced off in the 1% Investment Plan 14

Table 11.13 Budget for the Purchase of Properties per Hectare for the 1% Investment Plan 14

Table 11.14 Budget for the Activity related to Incentives for Property Owners who Replant and Engage in Conservation, per Hectare of the 1% Investment Plan 14

Table 11.15 Residual Impacts generated in the Area of Intervention of the Highway Project 21

Table 11.16 Compensation Factors by Ecosystem Unit in the Area of Intervention of the Rumichaca – Pasto Divided Highway Project, San Juan - Pedregal Segment. 27

Table 11.17 Maximum Area to Intervened in the Natural Land Cover for the Development of the Highway Project 30

Table 11.18 Maximum Area to Compensate according to the type of Ecosystem 30

Table 11.19 Number and Size of the Fragments Impacted by Project Development according to the Ma.F.E. v.2.0. Tool 32

Table 11.20 Result of the Search for Equivalencies for the Natural Forests of the Middle Andean Orobiome 33

Table 11.21 Result of the Search for Equivalencies for the High Secondary Vegetation of the Middle Andean Orobiome 33

Table 11.22 Result of the Search for Equivalencies for the Low Secondary Vegetation of the Middle Andean Orobiome 34

Table 11.23 Result of the Search for Equivalencies for the Natural Forests of the High Andean Orobiome35

Table 11.24 Result of the Search for Equivalencies for the High Secondary Vegetation of the High Andean Orobiome 36

Table 11.25 Result of the Search for Equivalencies for the Low Secondary Vegetation of the Middle Andean Orobiome 37

Table 11.26 Areas Available for Compensation – Summary 39

Table 11.27 Compensation Actions Proposed according to the Type of Ecosystem Impacted 40

Table 11.28 Menu of Proposed Facilitating Mechanisms for Supporting Conservation Agreements 45

Table 11.29 Form for Recording Survival and Growth of Plants in the Field 48

Table 11.30 Form for Recording Survival of Seedlings 49

Table 11.31 General Schedule for Implementation 49

Table 11.32 Estimated Overall Costs for the Development of the Project 50

Table 11.33 Risk Assessment and Contingency Measures for the Implementation of the Plan for Compensation for Biodiversity Loss 51

LIST OF FIGURES

Figure 11.1. Tentative Areas for the Investment of 1%. 8

Figure 11.2 Location of the Rumichaca – Pasto Divided Highway Project, San Juan - Pedregal Segment. 15

Figure 11.3 Stages of Sector Planning for the Compensation for Biodiversity Loss 16

Figure 11.4 Compensation Factors for the Ecosystems Affected in the Region where the Highway Project Intervention Area is located, according to the Tremarctos Colombia 3.0 Tool. 17

Figure 11.5 Distribution Areas for Sensitive Species in the Region of the Highway Project's Intervention Area, according to the Tremarctos Colombia 3.0 Tool 18

Figure 11.6 Priority Zones for Conservation near the Highway Project's Intervention Area according to the Early Warnings Analysis 19

Figure 11.7 Protected Areas near the Highway Project Intervention Area according to the Early Warnings Analysis 20

Figure 11.8 Biogeographic Districts present in the Area of Intervention of the Highway Project 22

Figure 11.9 Biomes present in the Area of Intervention of the Highway Project 23

Figure 11.10 Ecosystems present in the Area of Intervention of the Highway Project and its Area of Influence 24

Figure 11.11 Natural Ecosystems present in the Area of Intervention of the Highway Project and its Area of Influence _____ 25

Figure 11.12 Compensation Factors Calculated by type of Ecosystem _____ 29

Figure 11.13 Results produced by the Consultation with SIAC on Protected Areas and Priority Zones for Conservation in the Highway Project's Area of Influence _____ 38

11. PLANS AND PROGRAMS

11.2 OTHER PLANS AND PROGRAMS

11.2.1 1% Investment Plan

INTRODUCTION

This document contains the proposal for investing 1% of the resources corresponding to the construction activities for the Rumichaca – Pasto Highway Project, San Juan – Pedregal Segment, in compliance with article 43 of Law 99 of 1993 and its regulatory decrees.

In the national arena, the Ministry of the Environment and Sustainable Development, with its policies for the Comprehensive Management of Water Resources (GIRH for the Spanish acronym) seeks to guide public policy in the area of water resources through a combination of economic and social development and the protection of ecosystems. The GIRH is defined as "a process that promotes coordinated management and use of water resources, land, and related natural resources, in order to maximize social and economic welfare in an equitable manner without compromising the sustainability of vital ecosystems (MINAMBIENTE, 2017).

At the local level, the municipalities, as members of the National Environmental System, must develop general and sector plans, programs, and projects for the comprehensive management of water resources that are coordinated with regional and national development plans. They can dictate legal provisions, subject to laws that are higher in the hierarchy of laws, for the control and preservation of water resources. In addition, they co-finance and/or, in coordination with other public institutions, execute works or projects for removing pollution, hydraulic works, irrigation projects, actions to prevent floods, and the regulation of watercourses and water currents, to thus contribute to the management of water basins and micro-basins (Ministry of the Environment, Housing, and Regional Development, now the Ministry of the Environment and Sustainable Development, 2010).

The environmental authorities at the regional level, with support from regional institutions and the community living in the watershed areas, formulate the plans for managing those areas. In this sense, the Autonomous Regional Corporation of Nariño, CORPONARIÑO, in the year 2011 formulated plans for the development and management of water resources (PORH for the Spanish acronym) for the Boquerón, Sapuyes and Guaítara Rivers, which form a part of the eleven water sources that will provide the water resources used for this project.

So this plan identifies and prioritizes projects contained in the PORH that have activities that can be coordinated with this investment, with its respective proposed timelines, areas to intervene and budgets, in order to contribute to the availability of water resources in terms of quality and quantity from the sources of water of which the project makes use.

11.2.1.1 Legislative Framework

Article 43 of Law 99 of 1993

All projects that in their execution involve the use of water taken directly from natural sources, either for human consumption, recreation, irrigation, or any other industrial or agricultural activity, should allocate no

less than 1% of the total investment to the recovery, preservation, and monitoring of the hydrographic basin that nourishes the respective water source. The project owner must invest this 1% in the works and actions for the recovery, preservation, and conservation of the basin determined in the project's environmental license.

Decree 1729 of August 6, 2002

Article 1, definition of hydrographic basin. "A hydrographic basin or watershed area is understood to be the surface or underground water that drains into a natural network with one or several natural watercourses, with either continuous or intermittent flow, that then flow into a larger watercourse that, in turn, can flow into a main river, a natural deposit of water, a marsh, or directly into the sea.

Law 812 of 26/06/2003

To approve the National Development Plan 2003-2006, Toward a Community State, in its article 89, which modifies article 16 of Law 373 of 1997, which will now read as follows: "Article 16. The preparation and presentation of the program must specify that páramos, cloud forests, and areas of influence of the headwaters of aquifers and *estrellas fluviales* (a point that is the source of several rivers that flow out in different directions), must be acquired or protected as a priority of the environmental authorities and regional institutions in the corresponding jurisdiction, which shall do the studies necessary to establish their true capacity to provide environmental goods and services, in order to initiate a process for their recovery, protection, and conservation.

Decree 1900 of 2006

Article 1 once again specifies the field of application, as follows: "All projects whose execution involves the use of water taken directly from natural sources and that are subject to obtaining an environmental license, must allocate 1% of the total investment to the recovery, conservation, preservation, and monitoring of the hydrographic basin that feeds the respective source of water, in conformance with the paragraph of article 43 of Law 99 of 1993." That same decree defined in its article 2 that the projects that are required to make this forced investment of 1% are those that meet all of the following conditions: The water must be taken directly from a natural source, either on the surface or underground. The Project must require an environmental license. The Project, work, or activity must use the water in its execution stage, with this being understood to be the activities corresponding to construction processes and the operation. The water taken must be used for one of the following uses: human consumption, recreation, irrigation, or any other industrial or agricultural activity. "

Decree 2099 of 2016. "To modify the Sole Regulatory Decree of the Environment and Sustainable Development Sector, Decree number 1076 of 2015, relative to the "Forced Investment for the use of water taken directly from natural sources" and to make other determinations."

Chapter 3, Forced Investment of 1%, Section 1: Article 2.2.9.3.1.1 Field of Application. All projects that require an environmental license and whose execution involves the use of water taken directly from natural sources for any activity must allocate no less than 1% of the total investment in the recovery, conservation, preservation, and monitoring of the hydrographic basin that nourishes the respective source of water, in conformance with paragraph 1 of article 43 of Law 99 of 1993.

Article 2.2.9.3.1.4. Geographic arena for the forced investment of no less than 1%. The holder of the environmental license may make the investment described in Article 2.2.9.3.1.1 of this chapter, based on the following geographic arena and order of priority: a) The hydrographic basin in which the project is developed; b) The hydrographic zone in which the project is developed. Paragraph 1: The selection of the hydrographic

zone must be supported on technical conditions that justify giving it priority. Paragraph 2: As long as its execution is compatible with the uses defined for the respective management category, the forced investment of no less than 1% may be made in the areas of the National System of Protected Areas (SINAP for the Spanish acronym) that are identified inside of the geographic area given priority. Paragraph 3: The forced investment of no less than 1% generated by the execution of linear projects may be executed in one or several hydrographic sub zones or zones that cross the project, seeking to maximize the benefits of the measures to be implemented and giving priority to the areas that have ecological importance for the supply and maintenance of water resources.

11.2.1.2 Objectives

- **Overall Objective**

To establish a program for the investment of 1% from the Rumichaca- Pasto Highway Project, San Juan - Pedregal segment in actions and activities in favor of the recovery, conservation, preservation, and monitoring of the hydrographic basin supplying the water used.

- **Specific Objectives:**

o To define works and actions to undertake in compliance with Article 43 of Law 99 of 1993.

o To establish tentative areas for the allocation of the resources from the 1% investment.

o To establish the amount of the 1% investment and tentative budgets for each prioritized work or activity.

11.2.1.3 Scope of the Actions to be Undertaken

Once the project's area of influence is characterized and the sources of the water resources are defined from which the water will be taken, a technical and economic proposal will be presented for the investment of the 1%, in accordance with current laws. Therefore the following scopes are proposed:

Coordinate the activities proposed in this plan with the environmental authorities, local authorities, and companies in charge of the protection and conservation of the water resource from which water is being obtained.

In order to comply with the actions and activities in favor of the recovery, conservation, preservation, and monitoring of the defined hydrographic basin, the resources will be invested according to prioritized activities, defined amounts, and tentative areas and times.

11.2.1.4 Methodology

The plan to invest the 1% will be formulated in three phases, beginning with the identification of the hydrographic basin where the water will be obtained. For this purpose, the intake points were used that are proposed in Chapter 7 of this study, with the categorization of the corresponding basins, along with a review of the secondary information on the same. The purpose was to identify the lines of intervention applicable to the 1% investment that are contained in the water resource development and management plans, leading to the tentative location of areas where it is proposed the investment will be made.

The second phase is related to the proposal for the works or activities to execute, taking current laws into account.

The third phase includes the formulation of tentative budgets and schedules for the execution of said actions.

11.2.1.5 Tentative Location of the Area where the Investment is Planned

· **Intake points requested**

In accordance with the characterization done in this study, there are 11 intake points for water resources. This resource will be used in the construction stage of the highway construction project.

Table 11.1 Intake Points Requested for the Rumichaca – Pasto Dual Carriageway Project, San Juan – Pedregal Segment.

INTAKE	SOURCE	MAGNAS SIRGAS COORDINATES ORIGIN WEST		SEASON	FLOW (L/s)		RANGE OF MOBILITY
		EAST	NORTH		Domestic use	Industrial use	
1	Guáitara River	948503	590762	All year		1.5	A range of mobility of up to 200 m is requested, 100 m upriver and 100 m downriver from the points proposed.
2	Boquerón River	948589	590972	All year	0.45	1.5	
3	La Humeadora Creek	955074	597201	Rainy Season	0.45	1.5	
4	Moledores Creek	956019	598991	Rainy Season	0.45	1.5	
5	San Francisco 2 Creek	953962	601557	Rainy Season	0.45	1.5	
6	El Macal Creek	954870	603721	Rainy Season		1.5	
7	Sapuyes River	954844	605090	All year	0.45	1.5	
8	Yamurayán Creek	949128	592258	Rainy Season		1.5	
9	San Francisco Creek	949976	593121	Rainy Season		1.5	
10	Culantro Creek	950642	594577	Rainy Season		1.5	
11	El Manzano Creek	951631	595174	Rainy Season		1.5	

Source: GEOCOL CONSULTORES S.A., 2017.

· **Establishing the Hierarchy and Description of Hydrographic Basins**

The intake points requested are in the basin of the Guáitara River, which runs from south to north between the Western and Central ranges of the Andes, and flows into the Patía River, one of the main water sources in the Department, belonging to the geographic area of the Pacific region. There are 3 sub basins, which are: The Guaítara River basin, the Sapuyes River basin and the Boquerón River basin, which include the micro watershed areas of the Creeks where intake is going to take place (see **Table 11.2**)

Table 11.2 Hierarchy for the Hydrographic Network of the Basins where the Intake Points will be Located that were Requested for the Rumichaca – Pasto Dual Carriageway Project, San Juan – Pedregal Segment.

GEOGRAPHIC AREA	STREAM ORDER			
	HYDROGRAPHIC ZONE	BASIN	SUBBASIN	MICRO BASIN
	ORDER 1	ORDER 2	ORDER 3	ORDER 4
Pacifico	Patía River	Guáitara River	Boquerón River	Creek La Humeadora

GEOGRAPHIC AREA	STREAM ORDER			
	HYDROGRAPHIC ZONE	BASIN	SUBBASIN	MICRO BASIN
	ORDER 1	ORDER 2	ORDER 3	ORDER 4
			Sapuyes River	El Manzano Creek
			Guáitara River	Moledores Creek
				San Francisco 2 Creek
				San Francisco Creek

Source: GEOCOL CONSULTORES S.A., 2017.

- Guáitara River Sub basin: The Guáitara River is the main watercourse that collects all of the water in the south zone. The sub basin of the Guáitara River forms a part of the Guáitara River basin. The Guáitara River is the orographic border for several municipalities in the south of the Department of Nariño. It has steep areas with little potential for agriculture. The following micro-basins belong to the Guáitara River Sub basin: Los Moledores Creek, San Javier Creek, El Manzano Creek and the San Francisco Creek. The runoff areas of Los Arrayanes, La Chorrera Negra, El Tablón, and Pan de Azúcar are located there. These water sources occupy an area of 4,166.76 ha. Inside the Guaítara River sub basin we find:

  - The Moledores Creek micro-basin, which is part of the townships of Tablón Bajo, San Javier, Alto del Rey and Urbano, with an area of influence over the rural districts of Iscuazán, Tamburán, Loma Alta, Urbano and La Esperanza. This micro-basin occupies an area of 874.12 ha. The main channel is called the Los Moledores Creek and it feeds directly into the Guaítara River. The tributaries forming the micro-basin network are: The La Chorrera Chiquita Creek, the La Llave Creek and 19 tributaries without a name. The Los Moledores Creek micro-basin has serious environmental problems, especially high levels of pollution from the direct discharge of waste water into the main flow and the tributaries by local inhabitants. Deforestation has been produced mainly by the expansion of agriculture to plant miscellaneous crops and pasture for raising cattle.
  - The El Manzano Creek micro-basin is part of the townships of Alto del Rey and Urbano. Its main channel and its tributaries cross the villages of Iscuazán, Alto del Rey and Urbano; this micro-basin occupies an area of 418.63 ha. The main channel is called El Manzano and it feeds directly into the Sapuyes River, which in turn feeds into the Guaítara River. The El Manzano Creek micro-basin has problems with deforestation due to the establishment of pastures for cattle ranching, in addition to pollution from livestock activities, and all of these are aggravated by the lack of conscience on the part of the zone's inhabitants when they engage in uncontrolled field burning.
  - The San Francisco Creek micro-basin forms a part of the Tablón Bajo Township. The water sources that make up the micro-basin cross sectors of the rural districts of Tablón Alto and Capulí; this micro-basin occupies an area of 876.36 ha. The main channel is called the San Francisco Creek. Its main tributary is the San Francisco Creek, and the micro-basin feeds directly into the Guaítara River. This micro-basin has problems with deforestation from obtaining firewood for use by families, the establishment of pastures for cattle, and the expansion of the agricultural frontier to plant miscellaneous crops. Water pollution from agricultural and livestock activities has an impact on the quality of the water.

- Sapuyes River sub basin: The micro-basins belonging to the Sapuyes River sub basin occupy an area of 3,437.47 ha, which represents 40.83% of the total municipality of Iles. The micro-basins of Guingal Creek and La Chorrera Negra Creek, each with its respective tributaries, belong to the Sapuyes River sub basin. The Water Management Units that belong to this sub basin are San Lorenzo, Loma Guingal, El Cedral and Loma Rosales, with their respective water networks. The above micro-basin and runoff areas occupy an area of 5,081.88 ha (Municipality of Iles, 2003-2012) (Municipio de Iles, 2003-2012).
- Boquerón River Sub basin: On the border of the El Contadero municipality, it is joined by the Boyacá Creek and then the Cutipaz Creek, to finally discharge its water into the Guaítara River. This sub basin is formed by two Water Management Units in the jurisdiction of the municipality of El Contadero that correspond to the Boyacá Water Management Unit (UMH for the acronym in Spanish), the La Humeadora UMH, and the Cutipaz UMH, in addition to two direct runoff areas (Municipality of Contadero, 2001-2003). (Municipio de Contadero, 2001- 2003).
- La Humeadora Creek Water Management Unit springs up at a height of 3100 m.a.s.l. in the sector near Cerro Iscuazán. It runs from west to east for 48.5 km, and discharges its water into the Guáitara River at the altitude of 2000 m.a.s.l. Its main tributaries are the El Manzano Creek and the Los Arrayanes Creek and small waterways. The UMH includes the rural districts of Iscuazán (16.9%), San Andrés (3.9%), El Manzano (27.8%), Quisnamues (47.9%) and El Juncal (7.5%), covering a total area of 362.1 hectares that represent 8.6% of the municipality of Contadero. The vegetation is 341.7 ha of crops that represent 94.3% of the UNH and 20.4 ha of stubble that represent 5.7% of the UMH. According to its particular characteristics derived from the slopes, topography, and forest cover, its management must focus on protective and productive reforestation with native species and the protection of embankments.

· **Lines of Intervention applicable to the 1% Investment**

After reviewing the water resource development and management plans for the Boquerón, Sapuyes and Guaítara Rivers, in whose basins are located the 11 intake points for the water resources for the project, nine lines of intervention were selected that could be selected according to Article 2.2.9.3.1.9 of Decree 2099 if 2016. They are shown in **Table 11.3.**

Table 11.3 Lines of Intervention applicable to the 1% Investment

BASIN	PLAN	PROJECT	DESCRIPTION	Corresponding letter of Article 2.2.9.3.1.9. of Decree 2099 of 2016
Boquerón River	Remediation and recovery of the quality of the water resource.	Construction of a waste water treatment plant, Norte Ipiales Collector Operator.	Design and construction of a secondary treatment system for the domestic discharges coming from the sewage network in the north sector of the municipality of Ipiales.	b) Recovery actions through the construction of interceptors and domestic wastewater treatment plants in municipalities in categories 4, 5, and 6. This action may only be proposed when the works are owned by the regional institutions, and when they in turn guarantee the resources for the operation and maintenance of these structures.
Boquerón River	Remediation and recovery of the	Construction of a wastewater treatment	Design and construction of the preliminary and	b) Recovery actions through the construction of

BASIN	PLAN	PROJECT	DESCRIPTION	Corresponding letter of Article 2.2.9.3.1.9. of Decree 2099 of 2016
	quality of the water resource.	plant for the specific discharges from Contadero.	primary treatment system for domestic wastewater from the specific discharges of the municipality of Contadero.	interceptors and domestic wastewater treatment plants in municipalities in categories 4, 5, and 6. This action may only be proposed when the works are owned by the regional institutions, and when they in turn guarantee the resources for the operation and maintenance of these structures.
Boquerón River	Protection and conservation of the quality of the Boquerón River.	Recovery of the topsoil in the buffer area around the upper Totoral Creek.	Purchase and/or acquisition of properties, acquisition of topsoil, planting, maintenance, follow-up, and monitoring.	a) Protection, conservation, and preservation activities through ecological restoration, rehabilitation, and recovery.
Sapuyes River	Remediation and recovery of the quality of the water resource.	Optimization of the preliminary system for domestic discharges from Santa Ana.	Optimization of the preliminary treatment, design, and construction of the primary treatment system for the domestic wastewater coming from the discharge from Santa Ana in the municipality of Imués.	b) Recovery actions through the construction of interceptors and domestic wastewater treatment plants in municipalities in categories 4, 5, and 6. This action may only be proposed when the works are owned by the regional institutions, and when they in turn guarantee the resources for the operation and maintenance of these structures.
Sapuyes River	Protection and conservation of the quality of the Sapuyes River. .	Recovery of the buffer zone for the Sapuyes River. (Project 1)	Recovery of the buffer zone around the river through reforestation with native species and/or usufruct of forest products in exchange for financial incentives.	a) Protection, conservation, and preservation activities through ecological restoration, rehabilitation, and recovery.
Sapuyes River	Protection and conservation of the quality of the Sapuyes River. .	Recovery of the buffer zone for the Sapuyes River. (Project 2)	Reforestation of a total of 100 ha in properties located in the area of influence	a) Protection, conservation, and preservation activities through ecological restoration, rehabilitation, and recovery.
Sapuyes River	Protection and conservation of the quality of the Sapuyes River. .	Reforestation with native species on the banks of the Sapuyes River 1 km above and below the Sapuyes Bridge.	Reforestation with native species on the banks of the Sapuyes River 1 km above and below the Sapuyes Bridge.	a) Protection, conservation, and preservation activities through ecological restoration, rehabilitation, and recovery.
Guáitara River	Protection and conservation of the quality of the Guaítara River.	Recovery of buffer zone 3 on the Guaítara River.	Recovery of the buffer zone around the river through reforestation with species for the usufruct of forest products.	a) Protection, conservation, and preservation activities through ecological restoration, rehabilitation, and recovery.

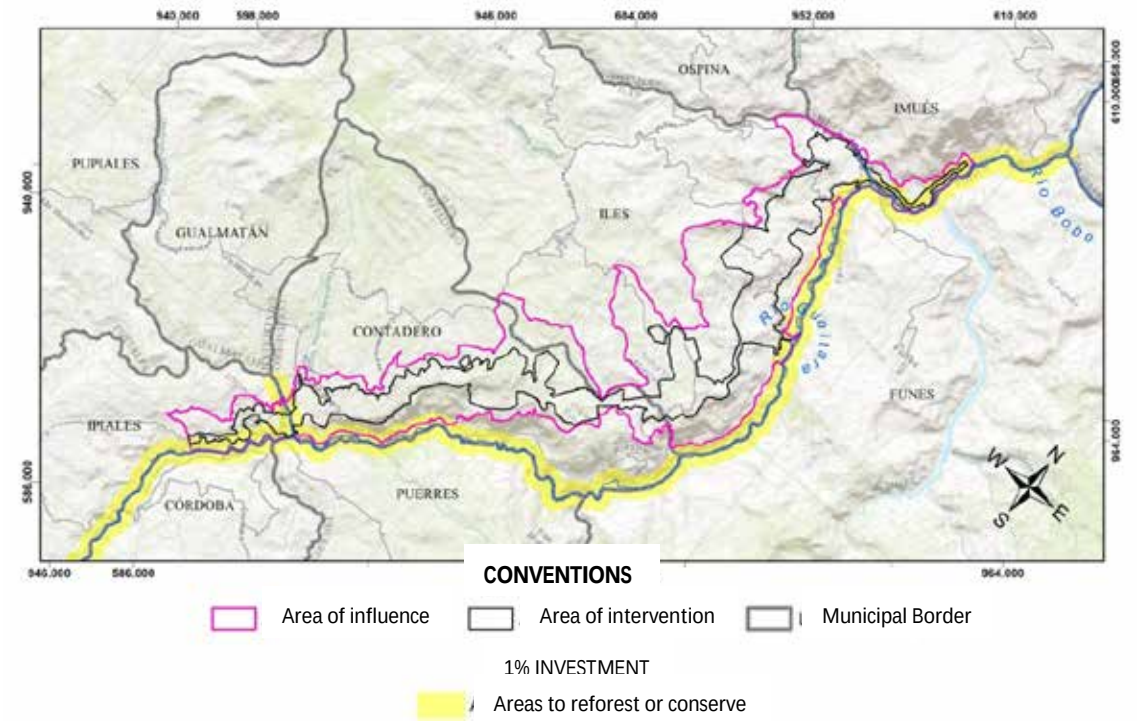
Source: PORH RIO BOQUERON, 2011, PORH RIO SAPUYES, 2011, PORH RIO GUAITARA, 2011, Edited by GEOCOL CONSULTORES S.A., 2017

According to the above and based on what is established in Decrees 2099 of 2016 and 1900 of 2006, five of the nine projects applicable to the 1% investment were selected. The ones related to remediation and recovery of the quality of the water resource were discarded, based on the fact that letter b) of article 2.2.9.3.1.9 of Decree 2099 of 2016, conditions the investment of resources on cases in which the works are owned by the regional institutions, and that the regional institutions in turn guarantee the resources for the operation and maintenance of these structures, a commitment that has not been made.

Given this, and bearing in mind the project baseline, where a high level of deforestation is evident along with the reduced area of natural land cover, the choice was made for projects that favor protection, conservation, and preservation through ecological restoration, rehabilitation, and recovery.

Based on these determinations, some tentative areas were defined for the execution of the works or activities proposed, as can be seen in **Figure 11.1.**

Figure 11.1. Tentative Areas for the Investment of 1%.



Source: GEOCOL CONSULTORES S.A., 2017.

11.2.1.6 Proposal for Works or Activities to Execute

In accordance with the above, the activities to undertake in the tentative areas for the protection and conservation of water resources are:

Reforestation: this activity has the purpose of conserving and protecting the water resource, and in this manner recovering the riparian buffer strip through reforestation with native species and/or forest product usufruct. To be able to engage in this activity, properties suitable to that end must be identified, along with the purchase of topsoil and inputs, planting, maintenance, follow-up, and monitoring.

Fencing off riparian buffer zones: Areas that are reforested and replanted, properties with plant cover to be conserved, and riparian buffer zones will be fenced off. To do this it is necessary to purchase materials and inputs, build the fences, and maintain, follow-up, and monitor them.

Purchase of properties: This activity will be done in order to do the reforestation, with the purpose of protecting and conserving the riparian buffer zones for the identified basins. To do that the following must be done: prioritization of areas, contact made with the owners of properties, and the legal process to acquire the same. The properties acquired will remain at the disposition of the local environmental authorities.

Incentives for the owners of properties that engage in replanting and conservation: This activity will be done to benefit the owners of properties that are willing to implement reforestation programs on their properties in exchange for financial incentives. To do that, the users will be identified, priorities will be assigned, the beneficiaries will be selected, and the incentives will be awarded.

11.2.1.7 Amount of the 1% Investment Broken Down by Activities

The calculation of the amount of the 1% investment was done based on Decree 1900 of 2016, which in its article 3 states, "-CALCULATION OF THE INVESTMENT. The calculation of the 1% investment established in article 1 of this decree, shall be made based on the following costs:

A) Acquisition of land and real estate

b) Civil Works

c) Acquisition and rental of machinery and equipment used in civil works.

d) Constitution of easements."

According to the above, the Rumichaca Pasto Highway Project, San Juan – Pedregal Segment, contemplates costs in its construction phase of seven hundred and seventy-eight billion two hundred and twenty-three million seven hundred and thirteen thousand one hundred and six Colombian pesos ($778,223,713,106).

One percent of this amount is seven billion seven hundred and eighty-two million two hundred and thirty-seven thousand one hundred and thirty-on Colombian pesos ($7,782,237,131), which will be distributed among the different works or activities proposed as shown below. (See **Table 11.4**)

Table 11.4 Amount of the 1% Investment Broken Down by Activities

ACTIVITY	PERCENTAGE TO INVEST	AMOUNT
Reforestation	50%	$ 3,891,118,566
Fencing off riparian buffer zones	10%	$ 778,223,713
Purchase of properties	20%	$ 1,556,447,426
Incentives for the owners of properties who engage in replanting and conservation	20%	$ 1,556,447,426
Total	**100%**	**$ 7,782,237,131**

Source: GEOCOL CONSULTORES S.A., 2017.

11.2.1.8 Schedule for Execution

The tables below show the schedules suggested for the execution of the resources from the investment of 1% for each of the activities given priority.

Table 11.5 Schedule for Execution of the Reforestation Activities

ACTIVITY	MONTH												MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Identification of properties																								
Purchase of plant material and inputs																								
Planting																								
Maintenance																								
Follow-up and Monitoring																								

Source: GEOCOL CONSULTORES S.A., 2017.

Table 11.6 Schedule for the Execution of the Riparian Buffer Zone Fencing Activities

ACTIVITY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
Delimiting and marking areas												
Purchase of materials and inputs												
Fencing off												
Maintenance												
Follow-up and Monitoring												

Source: GEOCOL CONSULTORES S.A., 2017.

Table 11.7 Schedule for Execution of the Purchase of Properties

ACTIVITY	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
Prioritization and selection of areas												
Contact with property owners												
Legal process for the acquisition												
Purchase												
Delivery												

Source: GEOCOL CONSULTORES S.A., 2017.

Table 11.8 Schedule for the Execution of the Activities related to Incentives for Property Owners

ACTIVITY	MONTH												MONTH												MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Identification and selection of users																																				
Verification of properties																																				
Signing agreements																																				
Awarding of incentives																																				

Source: GEOCOL CONSULTORES S.A., 2017.

11.2.1.9 Budget for Developing each Activity Selected

Reforestation: The budget for this activity was determined for each hectare to re-forest. Maintenance, follow-up, and monitoring will be done of these areas. The list below shows the cost of these activities.

Table 11.9 Budget for Reforestation per Hectare for the 1% Investment Plan

ITEM	UNIT	QTY	TIME (DAYS)	UNIT VALUE	TOTAL VALUE
Labor					
Unskilled labor	Day	5	7	35,000	1,225,000
Skilled Labor	Day	1	7	150,000	1,050,000
Subtotal Labor					**2,275,000**
Inputs					
Plant material (native species tree seedlings)	Unit	1111	N/A	2,000	2,222,000
Fertilizer (organic)	bag	8	N/A	60,000	480,000
Subtotal Inputs					**2,702,000**
Transportation					

ITEM	UNIT	QTY	TIME (DAYS)	UNIT VALUE	TOTAL VALUE
Minor transportation		8	N/A	100,000	800,000
Major transportation	Freight	3	N/A	500,000	1,500,000
Subtotal Transportation					**2,300,000**
Total Reforestation X Ha					**7,277,000**
Maintenance					
Labor					
Unskilled labor	Day	2	7	35,000	980,000
Skilled Labor	Day	1	7	150,000	600,000
Subtotal Labor					**1,580,000**
Inputs					
Plant material (10% of total plant material used)	Unit	112	N/A	2,000	224,000
Fertilizer (organic)	bag	1,5	N/A	60,000	90,000
Subtotal Inputs					**314,000**
Total Maintenance					**1,894,000**
Monitoring and Follow-up					
Unskilled labor	Day	2	7	35,000	980,000
Skilled Labor	Day	1	7	150,000	600,000
Subtotal Labor					**1,580,000**
Total Cost Reforestation per Ha					**10,751,000**

Source: GEOCOL CONSULTORES S.A., 2016.

To obtain the number of hectares to be reforested, the total amount of the investment in the activity was divided by the total cost to re-forest one hectare, as shown in **Table 11.10**

Table 11.10 Number of Hectares to be Reforested in the 1% Investment Plan

TOTAL AMOUNT OF INVESTMENT	TOTAL COST REFORESTATION PER HA	NO. HECTARES TO REFOREST
3,891,118,566	10,751,000	361.9

Source: GEOCOL CONSULTORES S.A., 2017.

Fencing off riparian buffer zones: The cost of this activity was determined per hectare as can be observed in **Table 11.11.**

Table 11.11 Budget for Fencing off Riparian Buffer Zones per Hectare for the 1% Investment Plan

ITEM	UNIT	QTY.	TIME (DAYS)	UNIT VALUE	TOTAL VALUE
Labor					
Unskilled labor	Day	12	1	35,000	420,000
Skilled Labor	Day	1	1	150,000	150,000
Subtotal Labor					**570,000**
Inputs					
Barbed wire No. 12 x 380m	Roll	3	N/A	150,000	450,000
Wooden posts	Unit	160	N/A	15,000	2,400,000
Staples x 400 g	Box	10	N/A	5,000	50,000
Subtotal Inputs					**2,900,000**
Total Fencing					**3,470,000**
Maintenance					
Labor					
Unskilled labor	Day	2	7	35,000	980,000
Skilled Labor	Day	1	7	150,000	600,000
Subtotal Labor					**1,580,000**
Inputs					
Posts (10% of total posts used)	Unit	16	N/A	15,000	240,000
Barbed wire No. 12 x 380m	Roll	0.5	N/A	150,000	75,000
Staples x 400 g	Box	1		5000	5000
Subtotal Inputs					**320,000**
Total Maintenance					**1,900,000**
Monitoring and Follow-up					
Unskilled labor	Day	2	7	35,000	980,000
Skilled Labor	Day	1	7	150,000	600,000
Subtotal Labor					**1,580,000**
Total Cost Fencing per Ha					**6,950,000**

Source: GEOCOL CONSULTORES S.A.S, 2017.

To determine the number of hectares to be fenced off, the total amount of the investment in the activity was divided by the total cost to fence off a hectare, as shown in **Table 11.12**

Table 11.12 Number of Hectares to be Fenced off in the 1% Investment Plan

TOTAL AMOUNT OF INVESTMENT	TOTAL COST FENCING PER HA	NO. HECTARES TO BE FENCED OFF
778,223,713	6,950,000	111.9

Source: GEOCOL CONSULTORES S.A., 2017.

Purchase of properties: The budget for this activity was determined per hectare. It should be highlighted that the labor used in the cost of the properties is subject to modification depending on the zone in which said activity will take place.

Table 11.13 Budget for the Purchase of Properties per Hectare for the 1% Investment Plan

ITEM	UNIT	QTY	UNIT VALUE	TOTAL VALUE
Labor				
Unskilled labor	month	2	850,000	1,700,000
Skilled Labor	month	4	3,500,000	14,000,000
Subtotal Labor				15,700,000
Purchase of land				
Lot and/or terrain	Ha	1	40,000,000	40,000,000
Subtotal Purchase of Land				**40,000,000**
Total Cost Purchase of Property				**55,700,000**

Source: GEOCOL CONSULTORES S.A., 2017.

Incentives for the owners of properties that engage in replanting and conservation: The budget for this activity is subject to the identification of program beneficiaries, for which reason a detailed budget is not developed with line items for this activity. Only the labor is presented that is required for this purpose on one hectare (see **Table 11.14**).

Table 11.14 Budget for the Activity related to Incentives for Property Owners who Replant and Engage in Conservation, per Hectare of the 1% Investment Plan

ITEM	UNIT	QTY	UNIT VALUE	TOTAL VALUE
Labor				
Unskilled labor	month	2	850,000	1,700,000
Skilled Labor	month	4	3,500,000	14,000,000
Total Labor				15,700,000

Source: GEOCOL CONSULTORES S.A., 2017.

11.2.2 Compensation Plan for Biodiversity Loss

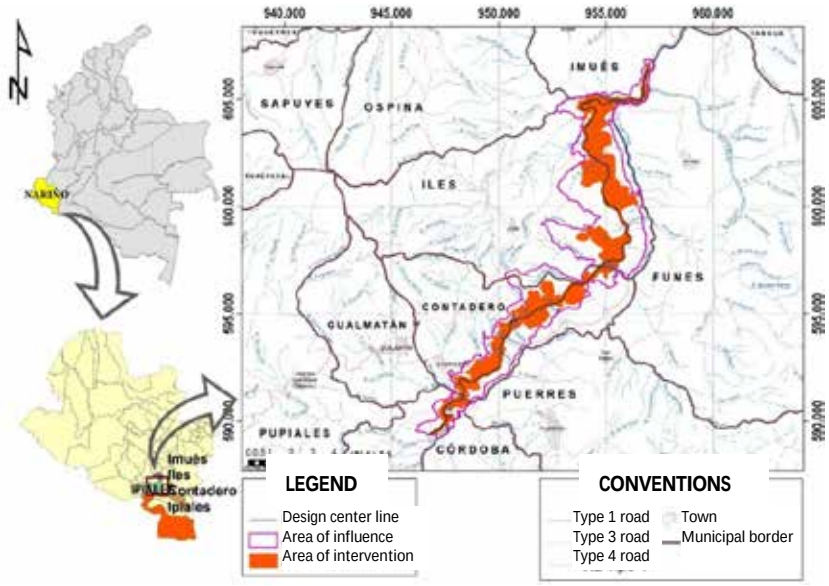
Environmental compensations are a fundamental instrument for making sure the residual impacts caused by development projects can be remedied through the implementation of actions for restoration, enrichment, or conservation of ecosystems equivalent to those affected (Sarmiento *et al*., 2015).

Compensation for loss of biodiversity for the Rumichaca – Pasto Divided Highway Project, San Juan - Pedregal Segment was defined based on the criteria established in the Manual for the Assignment of Compensations for Biodiversity Loss, adopted by means of Resolution 1517 of 2012 by the Ministry of the Environment and Sustainable Development (MADS for the Acronym in Spanish), as well as the Terms of Reference for the preparation of the Environmental Impact Study for highway and/or tunnel projects, adopted by MADS through Resolution 0751 on March 26, 2015.

The Manual establishes the compensations necessary for loss of biodiversity in natural terrestrial continental ecosystems, as well as the secondary vegetation, and permits those who generate impacts on biodiversity, subject to environmental licenses, to identify where, how much, and how to compensate. The area to be compensated will be determined by means of a total compensation factor based on four criteria: How representative the ecosystem is in the National System of Protected Areas, its rarity, its remnant status, and its annual rate of transformation. The application of said compensation factor seeks to recover ecosystems that are considered to be priority for the country (Sarmiento *et al*., 2015).

The Rumichaca – Pasto Divided Highway Project, San Juan - Pedregal Segment, is located in the Department of Nariño, under the jurisdiction of the municipalities of Imúes, Iles, Contadero and Ipiales (**Figure 11.2**), and has an area of intervention of 1897.65 ha.

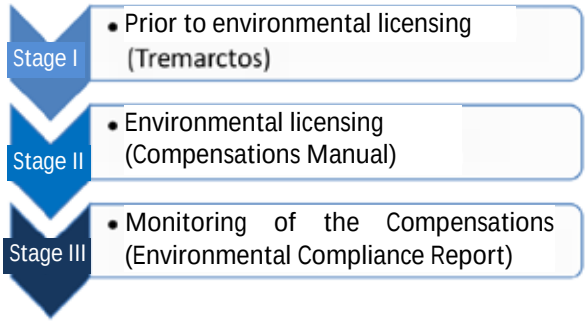
Figure 11.2 Location of the Rumichaca – Pasto Divided Highway Project, San Juan - Pedregal Segment.



Source: GEOCOL CONSULTORES S.A., 2017.

Compensation for biodiversity loss includes three stages in its planning. The first consists in a temporary phase in which use is made of the TREMARCTOS-COLOMBIA tool, established as a system of early warnings. It makes a preliminary evaluation of the impacts on the biodiversity produced by the project activities and provides recommendations regarding the possible compensations that would have to be assumed. The second takes place when the environmental licensing process occurs and proposes the compensation actions. The third takes into account each one of the monitoring and follow-up activities, with the purpose of making a comparison with the baseline and avoiding a net loss of biodiversity. In application of the manual, this document deals with the first two stages (**Figure 11.3**).

Figure 11.3 Stages of Sector Planning for the Compensation for Biodiversity Loss

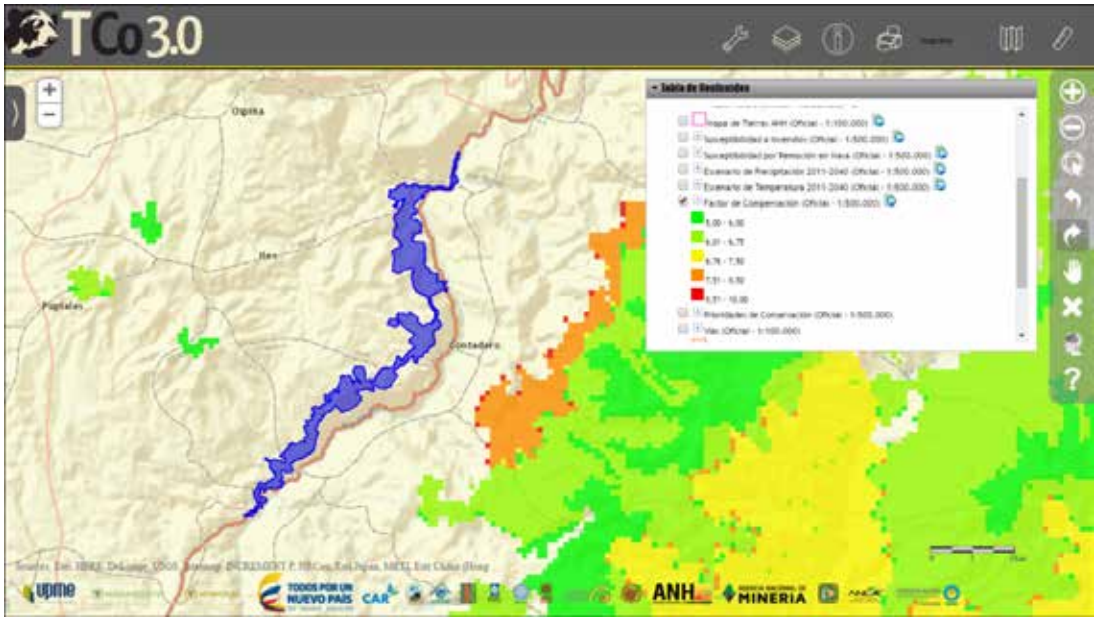


Source: MADS, 2012.

11.2.2.1 Stage 1: Analysis of Early Warnings

Relative to the compensation factors for biodiversity loss from the Rumichaca - Pasto Divided Highway Project, San Juan - Pedregal Segment, the TREMARCTOS COLOMBIA 3.0 tool determines no values for the compensation within the project's area of intervention (**Figure 11.4**). This is possibly because this is a highly intervened zone where crops and pasture predominate and forest remnants and other natural ecosystems are scarce. Nevertheless, the information produced by Tremarctos must be compared with the scale of the work for the project, since we have land cover determined in detail by means of the Corine Land Cover methodology, which permits more specific information on the ecosystems in the study area.

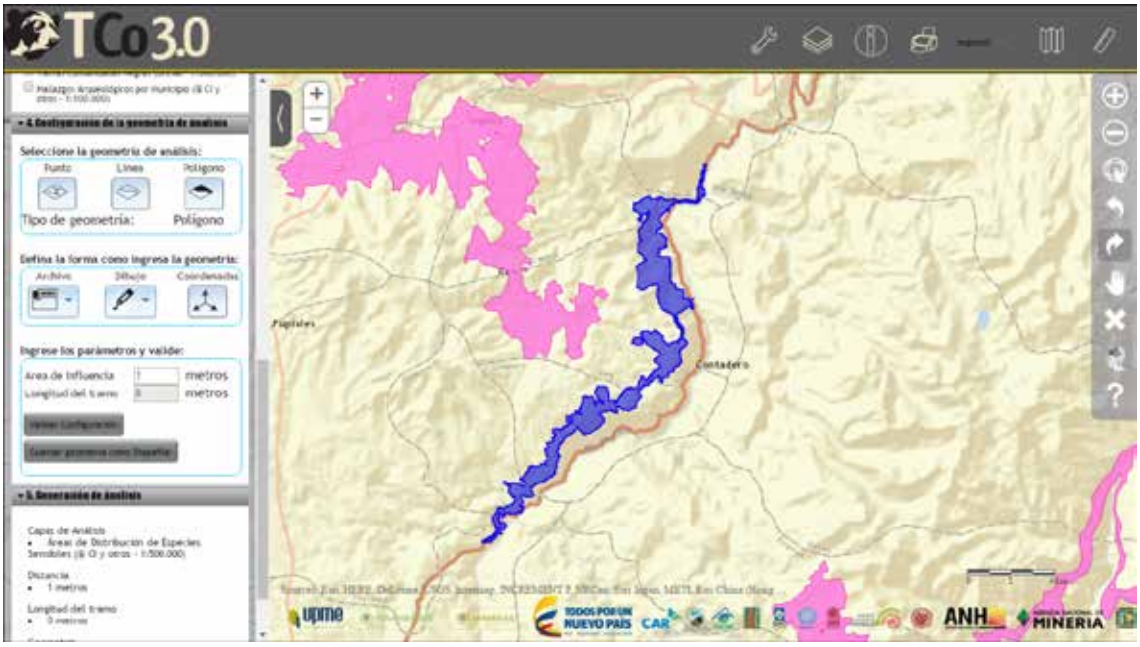
Figure 11.4 Compensation Factors for the Ecosystems Affected in the Region where the Highway Project Intervention Area is located, according to the Tremarctos Colombia 3.0 Tool.



Source: Tremarctos Colombia, 2015.

Through consultation with the TREMARCTOS COLOMBIA 3.0 tool, a preliminary evaluation was done to determine sensitive zones according to the variables of ecosystem representativeness, the presence of protected areas, and sensitive plants and wildlife. As seen in **Figure 11.5**, there is no overlapping of the highway project's area of intervention with the distribution zone for sensitive species. This contrasts with the results obtained during the characterization done in the project's area of influence, where some species were recorded in the categories of threatened, endemism, or with migratory behavior.

Figure 11.5 Distribution Areas for Sensitive Species in the Region of the Highway Project's Intervention Area, according to the Tremarctos Colombia 3.0 Tool



Source: Tremarctos Colombia, 2015.

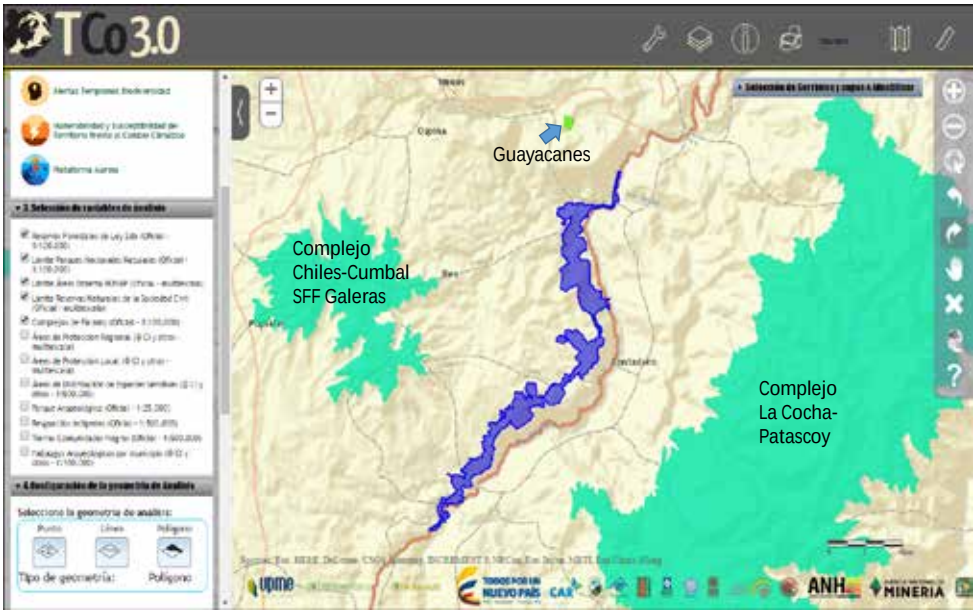
Relative to possible sites for carrying out the compensation, the TREMARCTOS tool shows that there are also no areas that are national priorities for conservation that are near the area of intervention of the highway project (**Figure 11.6**).

Figure 11.6 Priority Zones for Conservation near the Highway Project's Intervention Area according to the Early Warnings Analysis

Source: Tremarctos Colombia, 2015.

Moreover, the TREMARCTOS COLOMBIA 3.0 tool shows that the area of intervention of the highway project does not overlap with national, regional, or local protected areas, forest reserves under Law 2, or natural reserves held by civil society. The closest protected area to the study area, according to this tool, corresponds to the Natural Preserve of the Guayacanes Civil Society, located in the municipality of Imués (**Figure 11.7**). Another area nearby corresponds to the Galeras plant and animal sanctuary, that forms a part of the Chiles-Cumbal paramo complex.

Figure 11.7 Protected Areas near the Highway Project Intervention Area according to the Early Warnings Analysis



Source: Tremarctos Colombia, 2015.

The results produced by the TREMARCTOS COLOMBIA 3.0 tool are taken as reference information for the development of the compensation plan for biodiversity loss, since based on the scale of the map this tool manages (1:100.000 to 1:500.000) the information in the environmental impact study is more accurate, which has the primary information obtained in the field and more detailed maps (1:25.000).

11.2.2.2 Stage 2: Compensations Manual

11.2.2.2.1 Residual Impacts Generated by the Project on the Biotic Environment

Environmental compensations are based on the concept of the hierarchy of mitigation, which establishes that environmental compensation should only be done when prevention and mitigation actions fail to deal with the impacts of the development project. Compensation is the final step in the hierarchy, which establishes that before compensation it must be demonstrated that actions were taken to avoid, minimize, and repair or restore the residual impacts generated by the development project. Damage that cannot be avoided, minimized, repaired or restored is what is called a residual impact. It is precisely these damages that must be compensated (Sarmiento *et al*., 2015).

The analysis of possible residual impacts on the biotic environment shows that, despite the measures proposed in the environmental management plan, in some of the project's activities there is a percentage of residual impact for several of the impacts, and therefore it will be necessary to apply compensation measures to manage them.

As seen in **Table 11.15**, the modification of plant cover, changes in the structure and composition of plant life, alteration of the soil fauna, and changes in the structure, extension, and availability of wildlife habitat are the residual impacts on the biotic environment which, despite applying prevention, protection, mitigation, or control measures, present a remaining effect that does not permit a return to the original conditions prior to the intervention of the ecosystem. These are therefore the ones that must be compensated through the actions proposed by the plan for compensation for biodiversity loss.

Table 11.15 Residual Impacts generated in the Area of Intervention of the Highway Project

IMPACT	ACTIVITY THAT GENERATES THE IMPACT			DATA SHEET THAT COVERS IT	COVERAGE BY THE PLAN FOR COMPENSATION FOR BIODIVERSITY LOSS
	REMOVAL OF PLANT COVER, TOPSOIL STRIPPING, AND LAND CLEARING	CONSTRUCTION AND OPERATION OF ZONE FOR HANDLING RUBBLE AND EXCAVATION MATERIAL (ZODME).	EARTH MOVEMENT (EXCAVATIONS AND FILL)		
Modification of the land cover	X			Managing stripping the topsoil and the land cover/Managing for compensation for impacts on land cover and wildlife	YES
Changes in the structure and composition of plant life	X			Protection of plant life	YES
Alteration of soil fauna	X		X	Topsoil stripping and land cover management	YES
Changes in the structure, extension, and availability of wildlife habitats	X	X		Protection of fauna/ Management for compensation for impacts on land cover and wildlife	YES

Source: GEOCOL CONSULTORES S.A., 2017.

11.2.2.2.2 Ecosystems Present in the Area of Intervention of the Highway Project

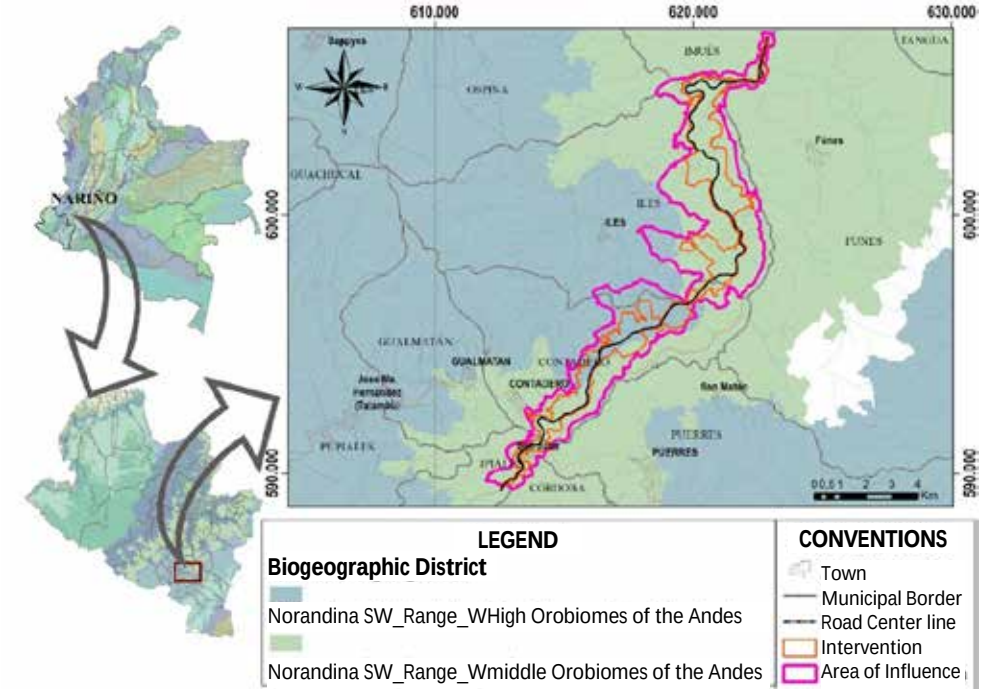
One of the fundamental aspects for developing compensation measures for biodiversity loss is the identification of the biogeographic districts and ecosystems of which the project area forms a part. The document on Biodiversity and Compensation in National Natural Parks (Latorre, 2005) was used as a reference, which uses the guidelines described by Hernández (1992), which recognize and describe nine (9) large provinces distributed throughout the country, made up of 100 biogeographic districts.

According to the classification proposed by Hernández *et al*. (1992), the project's area of influence is located in the Norandina Biogeographic Province, which groups together a set of biogeographic units corresponding to the three mountain ranges and the inter-Andean valleys in the Great Andes Mountains in Colombian territory. All the isothermal zones are represented here, and the mountain's biota is derived basically from elements coming from the low Amazon lands, which progressively began processes of adaptation and

speciation (Latorre, 2005). There are 45 biogeographic districts in this province. In the specific case of the project, it is in the Andean Forest West Range Nariño District (**Figure 11.8**).

This district is made up of the ecosystems at an altitude between 1800 masl and 3600 masl, in soils with abundant organic material and wooded plant formations, present in conditions of permanent high humidity due to the influence of fog. They are called montane forests and they are differentiated according to the altitude in the orobiome of the High Andean Forest and the Orobiome of the Middle Andean Forest (CORPONARIÑO, 2011).

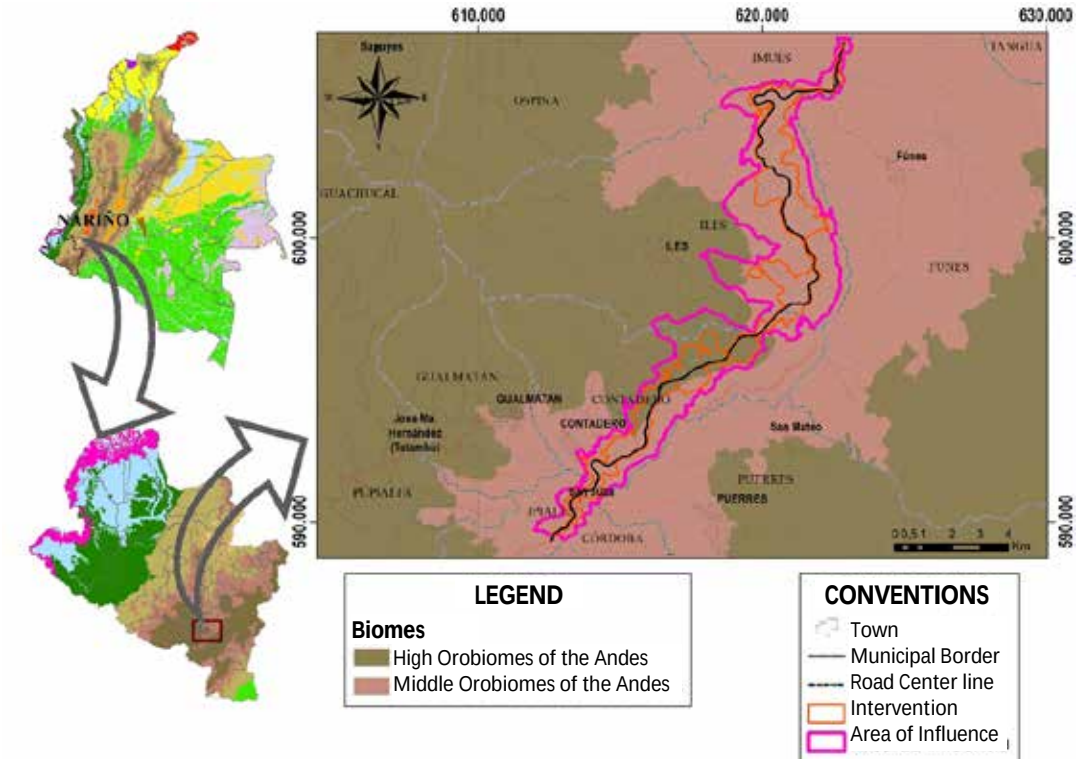
Figure 11.8 Biogeographic Districts present in the Area of Intervention of the Highway Project



Source: GEOCOL CONSULTORES S.A., 2017.

In turn, according to the map of the continental, coastal, and marine ecosystems of Colombia (IDEAM *et al*., 2015), the highway project's intervention area belongs to the Great Biome of wet Tropical forest, specifically in the Middle Orobiome of the Andes and the High Orobiome of the Andes (**Figure 11.9**). Taking into account the high level of anthropogenic intervention in the zone, the ecosystems have not conserved their natural characteristics. The forests have been intervened, and the agricultural frontier has been growing with greater strength, and the natural vegetation has been replaced by areas dedicated to pasture and agriculture.

Figure 11.9 Biomes present in the Area of Intervention of the Highway Project

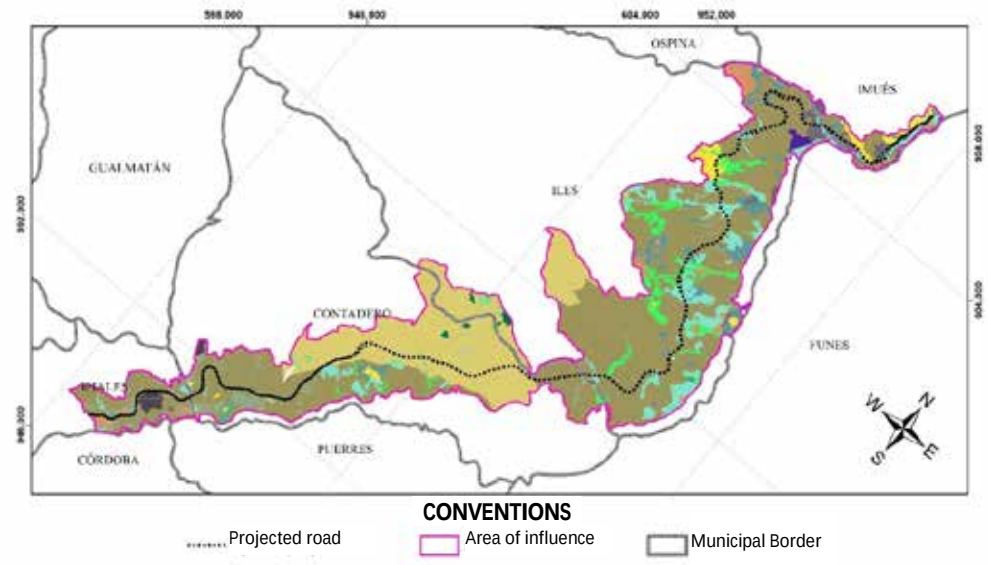


Source: GEOCOL CONSULTORES S.A., 2017.

With the purpose of identifying the ecosystems that make up the project's area of intervention, the land cover was updated, and the information was captured on a scale of 1:25.000. The final classification of the natural ecosystems had three levels of integration that followed the criteria established by Hernández and Sánchez (1992, Biomas de Colombia) and Hernández *et al*. (1992, Unidades biogeográficas de Colombia). Therefore its structure follows the following hierarchy: biogeographic district, biome, and ecosystem.

In total, 21 land cover units were identified for the area of intervention of the highway project and its area of influence according to the Corine Land Cover Methodology adapted to Colombia, which were associated with the official cartography of the continental, coastal, and marine ecosystems of Colombia (2015). **Figure 11.10** presents the distribution of each one of the ecosystems that make up the area of intervention of the highway project and its area of influence with respect to the middle orobiome of the Andes and the high orobiome of the Andes in the biogeographic district of the Andean Forest West Range Nariño.

Figure 11.10 Ecosystems present in the Area of Intervention of the Highway Project and its Area of Influence



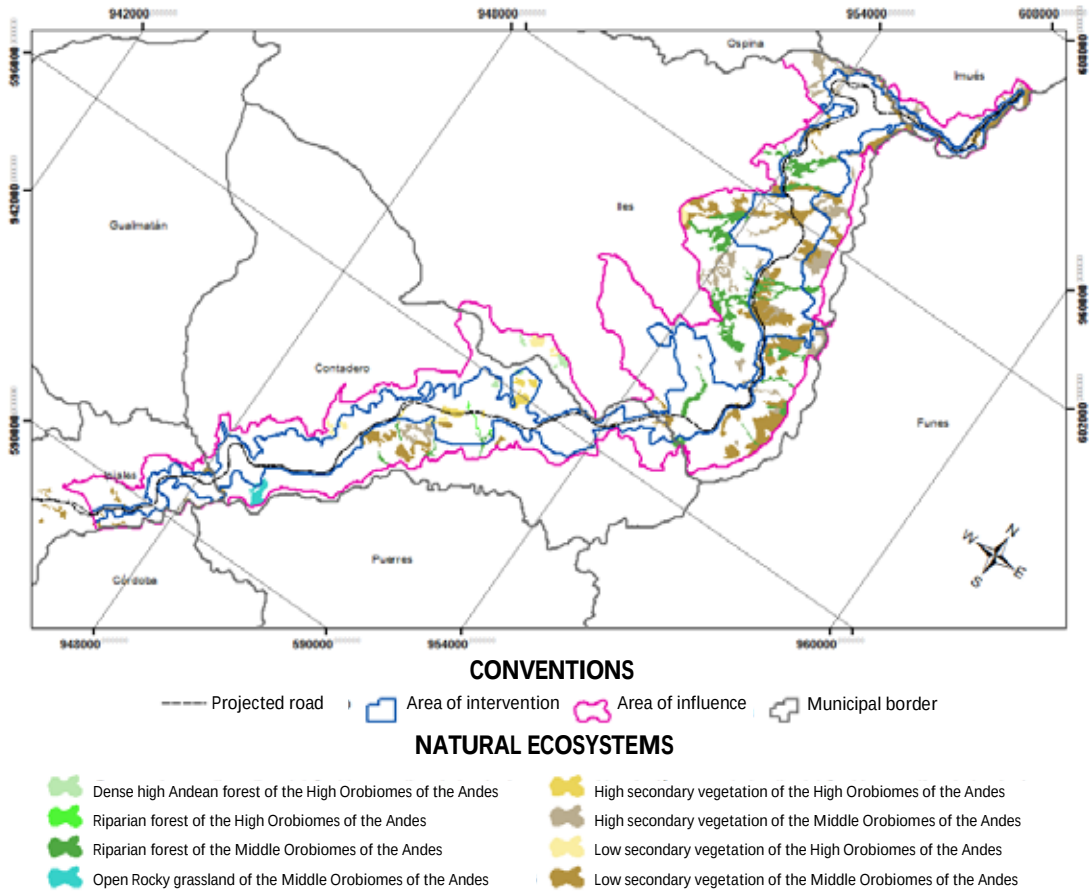
ECOSYSTEMS

- Dense high Andean forest in NorAndina SW Range W High Orobiomes of the Andes
- Riparian forest in NorAndina SW Range W High Orobiomes of the Andes
- Riparian forest in NorAndina SW Range W Middle Orobiomes of the Andes
- Extraction of construction materials in NorAndina SW Range W Middle Orobiomes of the Andes
- Open rocky grasslands in NorAndina SW Range W Middle Orobiomes of the Andes
- Mosaic of crops in NorAndina SW Range W Middle Orobiomes of the Andes
- Mosaic of pastures and crops in NorAndina SW Range W Middle Orobiomes of the Andes
- Managed pastures in NorAndina SW Range W High Orobiomes of the Andes
- Managed pastures in NorAndina SW Range W Middle Orobiomes of the Andes
- Forest plantation in NorAndina SW Range W High Orobiomes of the Andes
- Forest plantation in NorAndina SW Range W Middle Orobiomes of the Andes
- Road network and associated land in NorAndina SW Range W Middle Orobiomes of the Andes
- Forest plantation in NorAndina SW Range W High Orobiomes of the Andes
- Rivers in NorAndina SW Range W Middle Orobiomes of the Andes
- Continuous urban fabric in NorAndina SW Range W Middle Orobiomes of the Andes
- Discontinuous urban fabric in NorAndina SW Range W High Orobiomes of the Andes
- Discontinuous urban fabric in NorAndina SW Range W Middle Orobiomes of the Andes
- High secondary vegetation in NorAndina SW Range W High Orobiomes of the Andes
- High secondary vegetation in NorAndina SW Range W Middle Orobiomes of the Andes
- Low secondary vegetation in NorAndina SW Range W High Orobiomes of the Andes
- Low secondary vegetation in NorAndina SW Range W Middle Orobiomes of the Andes

Source: GEOCOL CONSULTORES S.A., 2017.

Nevertheless, the application of the Manual for the Assignment of Compensations for Biodiversity Loss contemplates compensation only for those natural terrestrial ecosystems and secondary vegetation, and therefore **Figure 11.11** shows the natural ecosystems described in said manual that are found in the area of intervention of the highway project. They include riparian forest, dense high Andean forest, open rocky grassland, high secondary vegetation, and low secondary vegetation (in the respective biomes), that occupy a moderate fraction of the area.

Figure 11.11 Natural Ecosystems present in the Area of Intervention of the Highway Project and its Area of Influence



Source: GEOCOL CONSULTORES S.A., 2017.

11.2.2.2.3 Estimate of Compensation Factors

Bearing in mind the aspects mentioned above, the compensation factors were calculated as indicated in the manual for the assignment of compensations for biodiversity loss. Therefore, each one of the components developed in this stage is based on the national list of compensation factors, which are presented in the Manual for the Assignment of Compensations for Biodiversity Loss - Appendix: National List of Compensation Factors. The following are the results for the calculation of the compensation factor by ecosystem unit in the area of intervention of the Rumichaca - Pasto Divided Highway Project, San Juan - Pedregal Segment, taking into account aspects such as representativeness, rarity, remnant status, and the transformation rate for each of the natural ecosystems.

In the case of the secondary vegetation (high and low), the reference ecosystem for the assignment of the compensation factors was the natural forests in the middle or high orobiome of the Andes in the Andean Forest West Range Nariño, bearing in mind that the national list of compensation factors does not assign

points to secondary vegetation, but the compensation factor is calculated with the formulas for secondary vegetation of less than 15 years and that is older than that age, as will be seen below.

· **Representativeness of Ecosystems**

The representativeness of ecosystems is defined as the minimum percentage necessary for a unit of analysis, to ensure its representation in the National System of Protected Areas - SINAP, in terms of the conservation goal. Within the area of intervention of the highway project, values of 2.0 (high insufficiency) are recorded for the biome-ecosystems and priority biogeographic districts for the natural forests (riparian forest) and the grasslands of the middle orobiome of the Andes. This indicates that, despite having some of its territories as protected areas, they total only 10% of the conservation goal. The natural forests (riparian forest and high Andean Forest) of the high orobiome of the Andes have a value of 1.25 (low insufficiency). In other words, they are units of analysis whose territories in protected areas reach up to 99.9% of the proposed conservation goal.

· **Rarity of Ecosystems**

Rarity is defined as the particularity of each of the ecosystems-biomes/ biogeographic districts in the study area, associated with high levels of endemism of species. According to the information on the country's biomes and biogeographic districts and those found for the project, the indication is that in the area of intervention of the highway project, the natural forests of the middle orobiome of the Andes have values of 1.25 (broadly distributed), while the grasslands in this biome and the natural forests of the high orobiome of the Andes have values of 2 (very restricted distribution).

· **Remnant Status of Ecosystems**

Remnant ecosystems are the smallest areas in the ecosystem. The remnant status factor is one of the most important indicators relative to the extinction of species, because the permanence of ecosystems is a critical factor for the survival of any individual and in many cases important decisions can be made when formulating the compensation for biodiversity loss.

In this case, the remnant area of natural ecosystems was determined and the total area of the biome/ biogeographic district, finding an mid-range remnant status (<70%>50%) for the natural forests and grasslands of the middle orobiome of the Andes, indicating a compensation value of 1, while for the natural forests of the high orobiome of the Andes the remnant status is low (<30%), with a compensation factor of 3.

· **Annual Ecosystem Transformation Rate**

The annual transformation rate refers to the annual rate of loss of natural plant cover of an ecosystem – biome district, provoked by anthropogenic and/or natural actions. In the case of the area of intervention of the highway project, a medium-range annual rate of transformation is recorded (<20% >10%) in the natural forests of the middle orobiome of the Andes, which translates into a compensation factor of 1.5. For the grasslands in this biome the annual transformation rate is very low (<0.05%), with a compensation factor of 1.0; and for the natural forests of the high orobiome of the Andes the annual transformation rate is high (<50% >20%), represented with a compensation factor of 1.75.

Table 11.16 Compensation Factors by Ecosystem Unit in the Area of Intervention of the Rumichaca – Pasto Divided Highway Project, San Juan - Pedregal Segment.

BIOME	UNIT OF LAND COVER IN NATURAL STATE	ECOSYSTEM	DISTRICT	ASSOCIATED LAND COVER	SYMBOL	REPRESENTATIVENESS	RARITY	POTENTIAL TRANSFORMATION	REMNANT STATUS	SUM OF COMPENSATION FACTORS
Middle Andean Orobiome	Natural Forests	Natural forests of the Middle Andean Orobiome	Norandina SW W Range	Riparian forest	Br	2	1.25	1.5	1	5.75
				High secondary vegetation (more than 15 years)	Vsa	2	1.25	1.5	1	5.75
				Low secondary vegetation (less than 15 years)	Vsb	1	0.625	0.75	0.5	2.875
	Grasslands	Grasslands of the middle Andean orobiome	Norandina SW W Range	Open rocky grassland	Har	2	2	1	1	6
High Andean Orobiome	Natural Forests	Natural forests of the middle Andean orobiome	Norandina SWW Range	Dense high Andean forest	Bda	1.25	2	1.75	3	8
				Riparian forest	Br	1.25	2	1.75	3	8
				High secondary vegetation (more than 15 years)	Vsa	1.25	2	1.75	3	8
				Low secondary vegetation (less than 15 years)	Vsb	0.625	1	0.625	1.5	4

Source: Manual for the Assignment of Compensation for Loss of Biodiversity, 2012 – Adapted by GEOCOL CONSULTORES S.A., 2017.

11.2.2.2.4 Compensation Factors and Area to Compensate

Based on the variables mentioned previously and the classification of the ecosystems that overlap with the area of intervention of the highway project, the total compensation factors were determined for the natural ecosystems and the secondary vegetation based on summing up the individual compensation factors (**Table 11.16**), while the areas to compensate were established using the following formulas:

· **Natural Forests and Grasslands**

To determine the total area to compensate for loss of biodiversity in each one of the natural terrestrial ecosystems, in this case the natural forests (riparian and dense high Andean) and grasslands, the following formula has been established:

$$Ac = Ai \times \Sigma Fc$$

Where,

Ac = the area to compensate in natural ecosystems

Ai= the area impacted by the development of the project

Σ Fc= Sum of the compensation factors

· **Secondary Vegetation of More than 15 years (High Secondary Vegetation)**

The manual for the assignment of compensations for biodiversity loss establishes that: "To calculate the area to compensate in the case of secondary vegetation of more than fifteen (15) years of development, the same formula will be applied as for THE area to compensate for biodiversity loss in natural terrestrial ecosystems." (MADS, 2012).

Therefore, the formula that was used to determine the compensation factor for the high secondary vegetation in the project's area of intervention was the following:

$$Acvs = Ai \times \Sigma Fc$$

Where,

Acvs= Area to compensate in secondary vegetation

Ai= the area impacted by the development of the project

Σ Fc= Sum of the compensation factors

· **Secondary Vegetation of Less than 15 years (Low Secondary Vegetation)**

In this case, the manual for the assignment of compensations for biodiversity loss determines that the following formula should be used:

$$Acvs = Ai \times (\Sigma Fc/2)$$

Where,

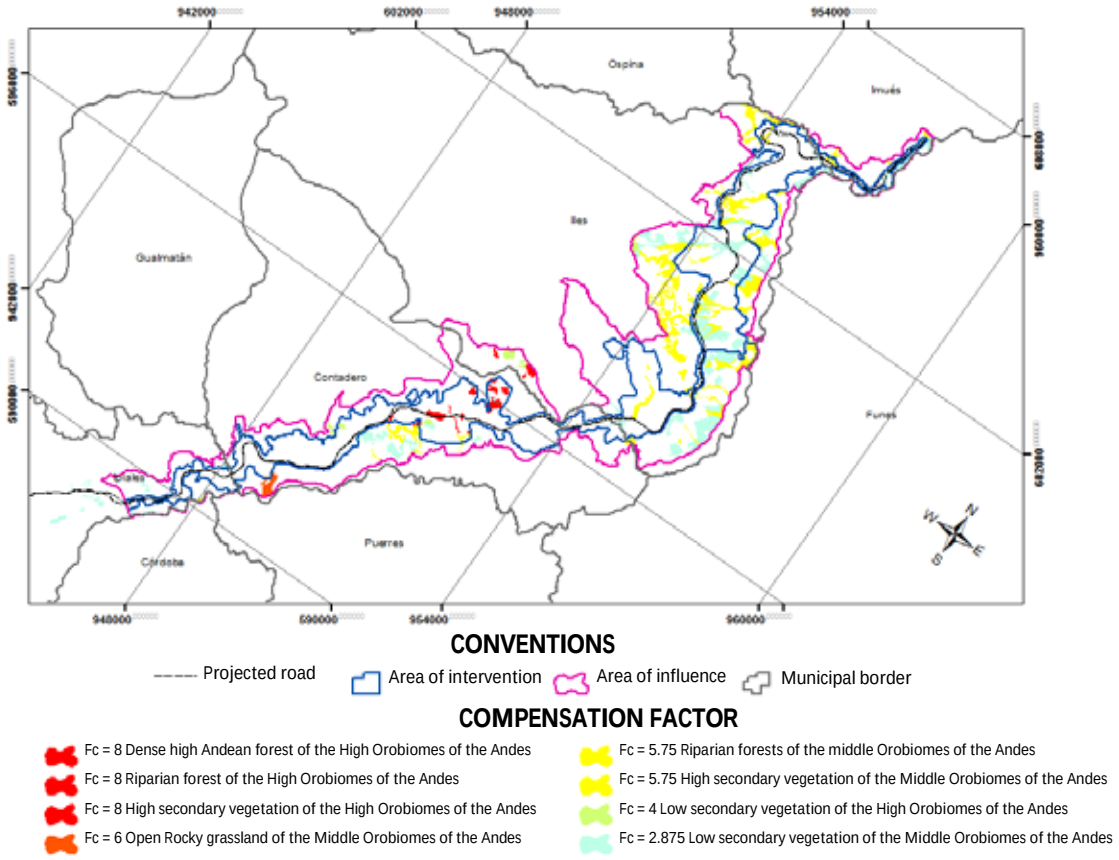
Acvs= Area to compensate in secondary vegetation

Ai= the area impacted by the development of the project

Σ Fc= Sum of the compensation factors

According to **Figure 11.12**, the sums of the compensation factors for the natural terrestrial ecosystems that overlap with the area of intervention of the highway project have differentiating values. In the case of the ecosystems of the middle Andean orobiome the values obtained were 5.75 for riparian forests and high secondary vegetation, 2.875 for low secondary vegetation, and 6 for open rocky grassland. Relative to the High Andean Orobiome, values were obtained of 8 for the Riparian forest, the dense high Andean forest and the high secondary vegetation, and 4 for the low secondary vegetation.

Figure 11.12 Compensation Factors Calculated by type of Ecosystem



Source: GEOCOL CONSULTORES S.A., 2017.

The development of the highway project requires the intervention of a total of 1,897.65 ha, of which 219.86 correspond to natural ecosystems and secondary vegetation. Due to the fact that the compensation plan only applies to natural land covers and secondary vegetation, other types of land cover were not taken into account. Their compensation will be done according to the management for the compensation of impacts on land cover and wildlife presented in **Data sheet 20** Management for Compensation for Impacts on Land Cover and Wildlife. **Table 11.17** presents the estimated area of intervention in each one of the natural ecosystems and secondary vegetation for the development of the highway project.

Table 11.17 Maximum Area to be Intervened in the Natural Land Cover for the Development of the Highway Project

BIOME	LAND COVER	MAXIMUM AREA TO INTERVENE (HA)
Middle Andean Orobiome	Riparian forest	48.47
	High secondary vegetation (more than 15 years)	27.11
	Low secondary vegetation (less than 15 years)	113.04
	Open rocky grassland	0.83
High Andean Orobiome	Riparian forest	2.22
	Dense high Andean forest	3.10
	High secondary vegetation (more than 15 years)	21.18
	Low secondary vegetation (less than 15 years)	3.90
	TOTAL	219,86

Source: GEOCOL CONSULTORES S.A., 2017.

Based on the compensation factors for each ecosystem and the area of intervention required, the formula was used to calculate the compensation area according to the activities and the type of ecosystem to intervene. **Table 11.18** presents the maximum area to compensate for each type of ecosystem/ biome/ biogeographic district that are subject to intervention for the development of the project.

Table 11.18 Maximum Area to Compensate according to the type of Ecosystem

BIOME	BIOGEOGRAPHIC DISTRICT	ECOSYSTEM	EQUIVALENT LAND COVER	TOTAL COMPENSATION FACTOR	AREA TO INTERVENE (HA)	TOTAL AREA TO COMPENSATE (HA)
Middle Andean Orobiome	Norandina SWW Range	Natural Forests	Riparian forest	5.75	48.47	278.70
		Secondary Vegetation of More than 15 years	High secondary vegetation	5.75	27.11	155.88
		Secondary Vegetation of Less than 15 years	Low secondary vegetation	2.875	113.04	324.99
		Grasslands	Open rocky grassland	6	0.83	4.98
High Andean Orobiome	Norandina SW W Range	Natural Forests	Dense high Andean forest	8	3.10	24.8
			Riparian forest	8	2.22	17.76

BIOME	BIOGEOGRAPHIC DISTRICT	ECOSYSTEM	EQUIVALENT LAND COVER	TOTAL COMPENSATION FACTOR	AREA TO INTERVENE (HA)	TOTAL AREA TO COMPENSATE (HA)
		Secondary Vegetation of More than 15 years	High secondary vegetation	8	21.18	169.44
		Secondary Vegetation of Less than 15 years	Low secondary vegetation	4	3.90	15.6

Source: GEOCOL CONSULTORES S.A., 2017.

11.2.2.2.5 Proposals for Compensation for Biodiversity Loss

· **Where to Compensate**

To know where to compensate, areas are proposed that are ecologically equivalent to those affected. As far as possible they should form a part of the project's area of influence and present opportunities for effective conservation. To identify these areas, the determining criteria were followed that are proposed in the manual for the assignment of compensation for biodiversity loss:

a) They should be the same type of natural ecosystem affected.
b) The size of the area to compensate should be equivalent to the fragment of ecosystem impacted.
c) They should have equal or better conditions and landscape context than the fragment of ecosystem impacted.
d) There should be an equal or greater wealth of species than the fragment of ecosystem impacted.
e) They should be located in the project's area of influence.
f) If the above is not possible, the area to compensate should be located in the same hydrologic subzone where the project is located, as close as possible to the area impacted.
g) If an ecologically equivalent area is not found in the same hydrologic subzone where the project is located, the surrounding hydrologic subzones can be used, as close as possible to the area impacted.
h) As possible, ecologically equivalent areas will be given priority in the municipality where the project is located.
i) If sufficient ecologically equivalent areas are not found, ecological restoration activities should be done that may include tools for landscape management (silvopastoral, agroforestry, silvicultural, etc.), until the area to be compensated is completed. These areas will be given priority in accordance with what is established in the National Restoration Plan.
j) The current areas protected in the National System of Protected Areas – SINAP may be the object of compensation if they meet criteria a), b), c) and d) described above, and if they require activities of property improvement or expansion, as long as they include measures for ecological restoration or prevention of deforestation and degradation.

To evaluate these criteria, the Ma.F.E v2.0 tool was used to map areas with ecosystems equivalent to those found in the highway project's area of intervention. In addition, the virtual platform was consulted of the Environmental Information System of Colombia to identify areas with some type of national, regional, or local protection, as well as areas that have priority for conservation, which overlap or are found within the hydrographic zone or subzone in the project's area of influence. The following are the results obtained.

o Ecologically equivalent areas

Making use of the Ma.F.E v2.0 tool – mapping of Equivalent Formulas, equivalence was sought for the natural terrestrial ecosystems present in the study area belonging to Biogeographic District of Andean Forest West Range Nariño in the middle Andean orobiome and the high Andean orobiome. Bearing in mind that the ecosystems to be intervened are inside the area marked out for project intervention, equivalent areas were sought for the compensation in the biotic area of influence and the hydrographic subzone in which the ecosystems to be compensated are located.

Table 11.19 presents the information produced by the Ma.F.E v2.0 tool relative to the number of fragments impacted, the average size, and the maximum number of fragments that would be affected by project development, which permits defining criteria for looking for equivalent fragments. As can be seen, the fragments impacted are not very large for the different ecosystems, and it is the low secondary vegetation from the middle Andean orobiome that has the fragments with the largest size and at the same time the greatest number of them. Therefore, that would be the ecosystem that requires a greater size of areas with ecological equivalence.

Table 11.19 Number and Size of the Fragments Impacted by Project Development according to the Ma.F.E. v.2.0. Tool

BIOME	BIOGEOGRAPHIC DISTRICT	ECOSYSTEM	EQUIVALENT LAND COVER	FRAGMENTS IMPACTED	AVERAGE AREA IMPACTED	MAXIMUM AREA IMPACTED
Middle Andean Orobiome	Norandina SW W Range	Natural Forests	Riparian forest	8	1.3	1.9
		Secondary Vegetation of More than 15 years	High secondary vegetation	18	1.5	4.7
		Secondary Vegetation of Less than 15 years	Low secondary vegetation	33	3.4	25.4
		Grasslands	Open rocky grassland	1	0.8	0.8
High Andean Orobiome	Norandina SW W Range	Natural Forests	Dense high Andean forest	4	1.3	1.9
			Riparian forest			
		Secondary Vegetation of More than 15 years	High secondary vegetation	7	3	7.4
		Secondary Vegetation of Less than 15 years	Low secondary vegetation	4	3.4	25.4

Source: M.a.F.E. v.2.0. Adapted by GEOCOL CONSULTORES S.A., 2017.

The following describes the results produced by the Ma.F.E. 2.0 tool with respect to looking for equivalencies in each one of the natural ecosystems and secondary vegetation.

- **Natural forests of the Middle Andean Orobiome**

This ecosystem includes the riparian forest, which has a projected area of intervention of 27.1 ha, and for which compensation is required of 278.7 ha. Using the Ma.F.E. v2.0 tool, no equivalent fragments of this size

were found, with the maximum size being 6.32 ha, with an availability of 9 fragments and a total of 18.739 ha (**Table 11.20**).

Table 11.20 Result of the Search for Equivalencies for the Natural Forests of the Middle Andean Orobiome

ECOSYSTEM	NATURAL FORESTS OF THE MIDDLE ANDEAN OROBIOME IN NORANDINA SW W RANGE MIDDLE ANDEAN OROBIOMES
Compensation Factor	From the table: 5.75
	Entered by the user: 5.75
Minimum Landscape Context	Applied to the search: 0.1161
	From the summary of impacts: 0.0132
Minimum Area	Applied to the search: 8 Ha
	From the summary of impacts: 48.469 Ha
Landscape Context	Minimum: 0.163
	Maximum: 0.436
	Average: 0.273
	Deviation: 0.103
# Fragments	9
Area	Total: 18.739 ha
	Minimum: 0.117 ha
	Maximum: 6.322 ha
	Average: 2.082 Ha
	Deviation: 1.968 ha
Threat	Min: 1 - Max: 1 - avg: 1 - Dev:
Wealth	Min: 1 - Max: 1 - avg: 1 - Dev: 0

Source: Ma.F.E. v.2.0.

· **Secondary Vegetation of more than 15 years in the Middle Andean Orobiome**

This ecosystem corresponds to high secondary vegetation, which has a projected area of intervention of 48.47 ha, and for which compensation is required of 155.9 ha. Using the Ma.F.E. v2.0 tool, no equivalent fragments of this size were found, with the maximum size being 14.89 ha, with an availability of 9 fragments and a total of 25.4 ha (**Table 11.21**).

Table 11.21 Result of the Search for Equivalencies for the High Secondary Vegetation of the Middle Andean Orobiome

ECOSYSTEM	HIGH SECONDARY VEGETATION OF THE MIDDLE ANDEAN OROBIOME IN NORANDINA SW W RANGE MIDDLE ANDEAN OROBIOMES
Compensation Factor	From the table: 5.75
	Entered by the user: 5.75
Minimum Landscape Context	Applied to the search: 0.1605

ECOSYSTEM	HIGH SECONDARY VEGETATION OF THE MIDDLE ANDEAN OROBIOME IN NORANDINA SW W RANGE MIDDLE ANDEAN OROBIOMES
	From the summary of impacts: 0.0111
Minimum Area	Applied to the search: 8 Ha
	From the summary of impacts: 27.107 ha
Landscape Context	Minimum: 0.161
	Maximum: 0.484
	Average: 0.255
	Deviation: 0.1
# Fragments	9
Area	Total: 25.399 ha
	Minimum: 0.161 ha
	Maximum: 14.894 ha
	Average: 2.822 ha
	Deviation: 4.585 ha
Threat	Min: 1 - Max: 1 - Avg: 1 - Dev:
Wealth	Min: 1 - Max: 1 - Avg: 1 - Dev: 0

Source: Ma.F.E. v.2.0.

· **Secondary Vegetation of less than 15 years in the Middle Andean Orobiome**

This ecosystem corresponds to low secondary vegetation, which has a projected area of intervention of 113.04 ha, and for which compensation is required of 324.99 ha. Using the Ma.F.E. v2.0 tool, no equivalent fragments of this size were found, or with the size of the largest fragment impacted (25.5 ha), with the maximum size being 21.687 ha with an availability of 12 fragments and a total of 62.24 ha (**Table 11.22**).

Table 11.22 Result of the Search for Equivalencies for the Low Secondary Vegetation of the Middle Andean Orobiome

ECOSYSTEM	LOW SECONDARY VEGETATION OF THE MIDDLE ANDEAN OROBIOME IN NORANDINA SW W RANGE MIDDLE ANDEAN OROBIOMES
Compensation Factor	From the table:
	Entered by the user: 2.875
Minimum Landscape Context	Applied to the search: 0.1161 0.1769
	From the summary of impacts: 0.000
Minimum Area	Applied to the search: 8 Ha
	From the summary of impacts: 113.046 ha
Landscape Context	Minimum: 0.178
	Maximum: 0.508
	Average: 0.271
	Deviation: 0.099
# Fragments	12

Area	Total: 62.238 ha
	Minimum: 0.297 ha
	Maximum: 21.687 ha
	Average: 5.186 ha
	Deviation: 7.384 ha
Threat	Min: 1 - Max: 1 - Avg: 1 - Dev:
Wealth	Min: 1 - Max: 1 - Avg: 1 - Dev: 0

Source: Ma.F.E. v.2.0.

· **Grasslands of the Middle Andean Orobiome**

This ecosystem corresponds to open Rocky grassland, which is present in the project's entire area of influence as a single fragment of 0.28 ha, which will be intervened in 0.83 ha and must be compensated in 4.98 ha. The Ma.F.E. v2.0 tool does not come up with any equivalent areas for this ecosystem, possibly due to the presence of a single fragment, part of which will be intervened.

· **Natural forests of the High Andean Orobiome**

This ecosystem includes the riparian forest and the dense high Andean forest, with a projected area of intervention of 2.22 ha for the first and 3.10 ha for the second, for which compensation will be required of up to 42.6 ha as a group. Using the Ma.F.E. v2.0 tool, no equivalent fragments of this size were found, with the maximum size being 1.75 ha, with an availability of 3 fragments, and a total of 2.966 ha (**Table 11.23**).

Table 11.23 Result of the Search for Equivalencies for the Natural Forests of the High Andean Orobiome

ECOSYSTEM	NATURAL FORESTS OF THE HIGH ANDEAN OROBIOME IN NORANDINA SW W RANGE HIGH ANDEAN OROBIOMES
Compensation Factor	From the table: 8.00
	Entered by the user: 8.00
Minimum Landscape Context	Applied to the search: 0.0884
	From the summary of impacts: 0.000
Minimum Area	Applied to the search: 8 Ha
	From the summary of impacts: 5.320 ha
Landscape Context	Minimum: 0.088
	Maximum: 0.205
	Average: 0.133
	Deviation: 0.063
# Fragments	3
Area	Total: 2.966 ha
	Minimum: 0.573 ha
	Maximum: 1.749 ha
	Average: 0.989 ha
	Deviation: 0.659 ha

Threat	Min: 1 - Max: 1 - Avg: 1 - Dev:
Wealth	Min: 1 - Max: 1 - Avg: 1 - Dev: 0

Source: Ma.F.E. v.2.0.

· **Secondary Vegetation of more than 15 years in the High Andean Orobiome**

This ecosystem corresponds to high secondary vegetation, which has a projected area of intervention of 21.18 ha, and for which compensation is required of 169.44 ha. Using the Ma.F.E. v2.0 tool, no equivalent fragments of this size were found, even with the size of the largest fragment impacted of 7.4 ha, with the maximum size of an equivalent area being 0.83 ha, with an availability of 3 fragments, and a total of 1.01 ha (**Table 11.21**).

Table 11.24 Result of the Search for Equivalencies for the High Secondary Vegetation of the High Andean Orobiome

ECOSYSTEM	HIGH SECONDARY VEGETATION OF THE HIGH ANDEAN OROBIOME IN NORANDINA SW W RANGE HIGH ANDEAN OROBIOMES
Compensation Factor	From the table:
	Entered by the user: 8
Minimum Landscape Context	Applied to the search: 0.0399
	From the summary of impacts: 0.0399
Minimum Area	Applied to the search: 6 ha
	From the summary of impacts: 21.183 ha
Landscape Context	Minimum: 0.073
	Maximum: 0.104
	Average: 0.083
	Deviation: 0.018
# Fragments	3
Area	Total: 1.01 ha
	Minimum: 0.032 ha
	Maximum: 0.83 ha
	Average: 0.337 ha
	Deviation: 0.432 ha
Threat	Min: 1 - Max: 1 - Avg: 1 - Dev:
Wealth	Min: 1 - Max: 1 - Avg: 1 - Dev: 0

Source: Ma.F.E. v.2.0.

· **Secondary Vegetation of less than 15 years in the High Andean Orobiome**

This ecosystem corresponds to low secondary vegetation, which has a projected area of intervention of 3.90 ha, and for which compensation is required of 15.6 ha. Using the Ma.F.E. v2.0 tool, no equivalent fragments of this size were found, with the maximum size being 0.365 ha with an availability of 1 fragment (**Table 11.25**).

Table 11.25 Result of the Search for Equivalencies for the Low Secondary Vegetation of the Middle Andean Orobiome

ECOSYSTEM	LOW SECONDARY VEGETATION OF THE MIDDLE ANDEAN OROBIOME IN NORANDINA SW W RANGE MIDDLE ANDEAN OROBIOMES
Compensation Factor	From the table:
	Entered by the user: 4
Minimum Landscape Context	Applied to the search: 0.1780
	From the summary of impacts: 0.0305
Minimum Area	Applied to the search: 4 ha
	From the summary of impacts: 3.904 ha
Landscape Context	Minimum: 0.281
	Maximum: 0.281
	Average: 0.281
	Deviation: 0
# Fragments	1
Area	Total: 0.365 ha
	Minimum: 0.365 ha
	Maximum: 0.365 ha
	Average: 0.365 ha
	Deviation: 0
Threat	Min: 1 - Max: 1 - Avg: 1 - Dev:
Wealth	Min: 1 - Max: 1 - Avg: 1 - Dev: 0

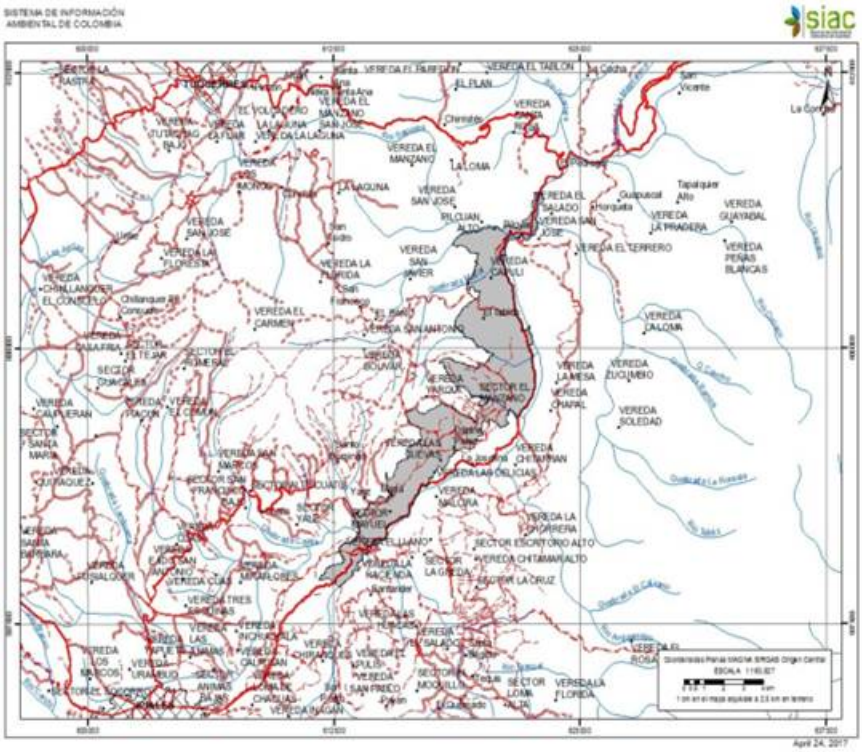
Source: Ma.F.E. v.2.0.

According to the results obtained using the Ma.F.E. v.2.0 tool in the project's area of influence and in the hydrographic subzone, sufficient sized areas are not found to comply with the compensation factors by means of conservation activities. It will therefore be necessary to engage in ecological restoration activities until the areas required are attained.

o Priority Areas for Conservation

To identify the presence of strategic ecosystems, protected areas, or areas given conservation priority in the area of influence and the hydrographic sub zone of the highway project, the database was consulted of the National Environmental System (SIAC for the acronym in Spanish), which is run by the MADS in coordination with environmental research institutions (IDEAM, SINCHI, HUMBOLDT, IIAP and INVEMAR), the regional environmental authorities (Regional Autonomous Corporations and sustainable development corporations) and local authorities, the academic community, the different sectors, and in general the different providers and users of environmental information. This produced the result that in the project's area of influence there are no protected areas declared at the national, regional, or local level, nor are there are zones marked out as priority areas for conservation.

Figure 11.13 Results produced by the Consultation with SIAC on Protected Areas and Priority Zones for Conservation in the Highway Project's Area of Influence



SOURCE	NAME OF THE LAYER
NATURAL PARKS	RECREATION AREAS – NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	SOIL CONSERVATION DISTRICT – NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	REGIONAL DISTRICT FOR INTEGRATED MANAGEMENT – NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	NATIONAL NATURAL PARKS _2.5 KM – NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	REGIONAL NATURAL PARKS – NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	NATIONAL CONSERVATION PRIORITIES CONPES 3680 - NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	PROPOSAL FOR NEW AREAS AND EXPANSION OF NATIONAL NATURAL PARKS – NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	NATIONAL PROTECTIVE FOREST RESERVE – NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	REGIONAL PROTECTIVE FOREST RESERVE - NO INTERSECTION IN THE CONSULTATION
NATURAL PARKS	NATURAL RESERVES OF CIVIL SOCIETY – NO INTERSECTION IN THE CONSULTATION

Source: Environmental Information System – SIAC, Consulted: April 24, 2017

The Natural Reserve of the Guayacanes del Llano Verde Civil Society, located in the municipality of Imués, will be the only nearby protected area with ecological equivalence for carrying out any compensation activity.

There are only 4 ha of forest available, however, because despite having a size of 22 ha, most of it is covered with grasses and its use is agricultural (Resolution 114 of 2002).

In the case of the Santuario de Fauna y Flora Galeras (or SFF Galeras, the Galeras Plant and Wildlife Sanctuary), located near the project's area of influence and belonging to the Guáitara River basin, it could be an ecosystem with ecological equivalence for compensating the natural forests and the high secondary vegetation of the High Andean Orobiome in the high Andes portion of the sanctuary (López *et al.*, 2015), because its páramo zone does not correspond to any of the biomes that intersect with the project's area of intervention. This protected area, however, does not form a part of any of the municipalities that cross the project's area of influence, which creates difficulties for doing the compensation activities.

o Summary of the Search for Equivalent Areas

According to the results of the search for equivalent areas using the Ma.F.E. v.2.0. tool and consulting the environmental information system, there is a deficit of areas where compensation can be done by means of conservation activities. So it will be necessary to undertake activities for ecological restoration, and use landscape management tools (criteria i) (**Table 11.26**). In the case of the High Andean Orobiome ecosystems, a good option is conservation in the SFF Galeras, which has an area available for natural forests and high secondary vegetation, although in this case, criteria h would not be met regarding giving priority to areas in the municipalities where the project takes place.

Table 11.26 Areas Available for Compensation – Summary

BIOME	BIOGEOGRAPHIC DISTRICT	ECOSYSTEM	AREA REQUIRED (HECTARES)	AREA AVAILABLE (HECTARES)	
				Ma.F.E. v.2.0	SIAC
Middle Andean Orobiome	Norandina SW W Range	Natural Forests	278.70	18,739	4
		Secondary Vegetation of More than 15 years	155.88	25,399	0
		Secondary Vegetation of Less than 15 years	324.99	62,328	0
		Grasslands	4.98	0	0
TOTAL			764.55	106.46	4
High Andean Orobiome	Norandina SW W Range	Natural Forests	42.56	2.966	3938.5*
		Secondary Vegetation of More than 15 years	169.44	1.01	465.56*
		Secondary Vegetation of Less than 15 years	15.6	0.365	0
TOTAL			227.6	4.341	4404.06*
*Corresponding to SFF Galeras (outside of the area of influence and the municipalities where the project will be developed).					

Source: GEOCOL CONSULTORES S.A., 2017; Ma.F.E. v.2.0; SIAC, 2017.

· **How to Compensate and Types of Actions to Take**

The measures for compensation for biodiversity loss seek to increase and guarantee the provision of ecosystem services, recover the ecological integrity of ecosystems, and protect the compensation zones. In this sense, the actions proposed seek not only to compensate the loss of biodiversity from the point of view of plants, but also in terms of generating or maintaining the structure and connectivity of the characteristic habitats of the region and of the associated fauna, including species with some degree of sensitivity that are

present in the land cover units that may be affected by the project, and also to maintain the functionality of the ecosystem.

Because sufficient equivalent areas were not found for compensation inside the biotic area of influence and the hydrographic sub zone, use must be made of the determinant criteria i), which indicates the execution of ecological restoration activities that can include the use of landscape management tools.

Based on this consideration, the following is a general proposal for compensation for biodiversity loss for the Rumichaca – Pasto Divided Highway Project, San Juan - Pedregal Segment, which will focus on implementing landscape management tools in accordance with the system that should be compensated, as shown in **Table 11.27**.

Table 11.27 Compensation Actions Proposed according to the Type of Ecosystem Impacted

BIOME	BIOGEOGRAPHIC DISTRICT	ECOSYSTEM	Landscape Management Tools					
			Enrichment or reforestation actions	Living fences	Enrichment of secondary vegetation	Enrichment of riparian strips and forest fragments	Enclosures (passive restoration)	Creation of corridors
Middle Andean Orobiome	Norandina SW W Range	Natural Forests						
		Secondary Vegetation of More than 15 years						
		Secondary Vegetation of Less than 15 years						
		Grasslands						
High Andean Orobiome	Norandina SW W Range	Natural Forests						
		Secondary Vegetation of More than 15 years						
		Secondary Vegetation of Less than 15 years						

Source: GEOCOL CONSULTORES S.A., 2017.

Once usufruct has been made of the forest products for the construction of the divided Highway, ZODMEs, and their access roads, and the total area to be compensated has been defined, the definitive compensation project will be presented in detail to the environmental authority for its evaluation and approval.

o Landscape Management Tools and Ecological Restoration Activities

The implementation of landscape management tools promotes community participation in favor of the conservation of natural elements throughout the landscape that favor connectivity in rural areas, where not only are a high diversity of species concentrated, but they also engage in processes related to movement or dispersion. Executing these tools implies reaching a consensus and negotiating in relation to private lands, so it must incorporate the concept of property planning, which has the goal of reorganization of the properties involved to permit establishing the elements to be conserved or introduced (Lozano-Zambrano *et al.*, 2009).

Moreover, according to Apfelbaum and Chapman, 1997 (Cited by MADS, 2015) restoration can be defined as "a practical management strategy that reestablishes ecological processes to maintain the composition,

structure, and function of the ecosystem in different landscape units and on different scales, through the development of participatory strategies." For a long time it was said that the final objective of restoration is to reestablish conditions to move toward a reference ecosystem, but taking into account the current scenarios for ecosystems, "restoration should be considered to be an adaptive type management strategy, whose approach is not only based on a reference ecosystem but also on the real context, in which the possible scenarios are broadened toward which the restoration might be directed." (MADS, 2015).

Bearing in mind that there is a protected area (SFF Galeras) in the region where the highway project will be developed, close to its area of influence, which has ecological attributes of a high diversity of species and a great variety of ecosystem services, but in turn has lost connectivity with the fragments of forest and secondary vegetation that concentrate most of the diversity that is still conserved throughout the agricultural territories that surround this protected area, there is a need to reconnect these areas to facilitate ecological processes and increase the capacity of the species to acquire different resources and engage in reproductive processes throughout their area of distribution.

· **Objective**

To restore structural connectivity of forest and secondary vegetation fragments in the Andean and sub Andean belts (middle and high Andean orobiome) in a corridor of conservation that connects SFF Galeras with the natural elements of the landscape in the rural zone of the area of influence of the highway project.

· **Goals**

- Reach a consensus on the project and define areas that have the greatest priority for conservation with the community in the area of influence and the environmental authority (CORPONARIÑO).
- Generate structural and functional conditions that permit increasing productivity and/or the number of ecosystem services.
- Reestablish ecosystem attributes that benefit the greatest number of species of plants and animals.
- Increase the community's interest in protecting and recovering the natural ecosystems in their territory.

· **Identification of the Areas with greatest Priority**

Identifying the areas with greatest priority for connection will take the following criteria into account:

1) They should represent the ecosystems units that are the object of compensation.
2) Most of them should be located in the biotic area of influence.
3) They should represent areas with high ecological importance or high interest to the community.

Different resources will be used to identify them, including satellite images, visits to the zone, and information provided by local inhabitants.

Once the compensation is going to be made, it should be established in which of the areas selected the project will be done, bearing in mind the agreement reached with the community and the environmental authority, as well as the technical viability, which should be assessed by competent professionals.

· **Scope of the Project**

A corridor should be planned that is made up of different landscape management tools whose size is equivalent to the area to be compensated according to the compensation factor of the ecosystems that are the object of intervention for the development of the highway project, which will be defined as the activities are executed to remove land cover to build the divided highway, and form Zodmes and their access.

There must be an evaluation regarding whether properties must be purchased to establish the area to be compensated via that mechanism, or whether to pay ecological easements to protect the area selected.

· **Operating Plan for the Project**

There will be five stages for the development of the project, which are described below.

o Stage 0: Recognition of the rural territory

To guarantee a participatory process that redounds in the sustainability of the conservation strategy, it will be necessary to approach recognition of the territory in three dimensions (Aristizábal *et al.*, 2009):

1) *Reviewing the information:* This is oriented toward recognizing other groups doing similar or complementary work in the zone (identification and classification of actors). This permits identifying not only the institutional and social actors that interact in the region and that become strategic partners for the process, but also the existing initiatives for the conservation of biodiversity, instruments for institutional work, scenarios for local and regional action for conservation, and information generated, among other things.
2) *Presenting the process:* The arenas for public presentation of the process provide an entry into each one of the pilot zones for the work. They focus on a technical presentation regarding the proposal for the conservation of biodiversity in rural landscapes to regional and local entities (e.g. officials at the Regional Autonomous Corporations). In those arenas the proposal is presented for the methodological and conceptual aspects of the work, along with the objectives and results expected.
3) *Generating and formalizing local and regional alliances:* Once the actors are characterized, the type of relationship required with each one is defined, which may be cooperation, coordination, negotiation, or communication. It is important to mention that there may be different types of relationships with the same actor. The instruments include:

    - Framework agreements for cooperation or goodwill: These are signed between public and/or private institutions and are oriented toward formalizing alliances to cooperate on a specific matter. This type of agreement should be signed between the entity executing the project with the institutional actors classified as first level (Corponariño and municipal mayors, for example), in such a way that it generates appropriation by those actors, so that, when the executing entity withdraws from the zone, this will be an element that contributes to the sustainability of the conservation strategy.

    - Specific agreements to develop activities: These are formalized by signing agreements oriented toward joining efforts, both economic and technical, to develop concrete activities around the establishment of areas set aside for the conservation of biodiversity in rural landscapes; in other words, one of the main characteristics of this type of agreement is that it involves the execution of financial resources.

    - Conservation agreements: This is a document to formalize the implementation of areas allocated for conservation on private property. They are signed by at least two parties involved in the implementation process, where one of them necessarily is the owner of the property; the other parties that can participate in signing a conservation agreement are the institution executing the project, Corponariño, or the municipality.

o Stage I: Identification of opportunities for conservation in the rural landscape

This is one of the most important stages, and its final objective is to identify the elements of the rural landscape that have the greatest opportunity for conservation of biodiversity. It is developed by means of a series of three steps (Lozano-Zambrano *et al.*, 2009):

1) *Biological characterization of the area of interest:* When studying fragmented landscapes, where the area for the different landscape elements is very small, a methodology must be generated to characterize communities. The methodology must not only be quick, it must be efficient in permitting an approximation to the composition and general structure of the different land covers that make up the landscape of transformed areas. This characterization of communities will generate the baseline for prioritizing sites (identification of conservation opportunities), based on the distribution, abundance, and wealth of the communities present in the different elements of the landscape (Lozano-Zambrano *et al.*, 2009).
   Bearing in mind that there detailed information exists in the baseline of the highway project, that information will be analyzed in order to generate an index for conservation for the elements of the landscape that will be incorporated in the conservation corridor. Therefore two steps will be taken (Lozano-Zambrano *et al.*, 2009):

   a) Identification of the elements of the rural landscape that have conservation value: Priority sites must be identified for the conservation of biodiversity in rural landscapes, because this will permit targeting the efforts for habitat recovery based on technical criteria produced by scientific research in the field. It also offers focused and efficient information for designing and implementing the area to be conserved.
   b) Definition of the value index for the conservation of the landscape: This generates a set of priorities that can be used to identify the sites that host the greatest number of species that are of interest for conservation, highlighting them and focusing the conservation efforts on them. The criteria taken into account are closely related to the alpha diversity: 1. Total wealth of species per sample of the landscape element for each target group; 2. Number of endemic species from each target group found in each sample of the landscape elements and, 3. Number of threatened species from each target group present in each sample of landscape element. In the case of species that are threatened and endemic, these are considered in both criteria. The value index for landscape conservation is built by adding together the information from the target biological groups used in the investigation (Lozano-Zambrano *et al*., 2009).

2) *Evaluation of the socioeconomic viability of rural properties:* With the information gathered and analyzed, at this stage discussion starts about the "sustainability" of the landscape elements that persist in the midst of a rural landscape and the ecosystem conditions to be conserved. To do that, a socioeconomic characterization is done of the rural properties, and based on the results of that characterization, an indicator of "socioeconomic viability" is built. The indicator seeks to predict the possibility a piece of rural property has, based on private decisions, to maintain the current biodiversity (elements of the landscape given priority) or to engage in conservation actions (Lozano-Zambrano *et al.*, 2009).
   a) *Socioeconomic characterization:* This is done via semi-structured perception surveys conducted with the property owners or decision-makers for the properties that contain biologically characterized elements.

      The survey gathers information to identify opportunities for biodiversity conservation at each site (properties with landscape elements), with high, medium, and low values of conservation. Nevertheless, it also gathers useful information for designing the conservation strategy, and for the implementation of conservation areas and the facilitating mechanisms in the negotiation, establishment, and maintenance phases.

The survey consists of seven sections: General information, decision-making, a sketch of the property, information about land use and productive use, use of the natural resources, management of natural resources, and scenarios.

b) Indicator of the socioeconomic viability: The use of an indicator is proposed to determine the socioeconomic viability of the sites prioritized biologically, relative to the possibilities of establishing land management tools. This is described in detail in Lozano-Zambrano *et al.*, 2005.

3) Identification of opportunities for conservation: This seeks to integrate biological and socioeconomic information with the purpose of prioritizing sites (elements of landscape or rural properties) where the establishment of conservation actions will most efficiently contribute to improving the conservation status of the biodiversity present in the different transformed landscapes (see Lozano-Zambrano *et al*., 2005 for details).

The final results obtained in this step of the methodology should be graphically reflected on the map of land cover and properties in the rural landscape, in such a way that there is a spatial identification of where these conservation opportunities are and their level of priority.

o Stage II: Design of the conservation strategy for rural landscapes

The conservation strategy designed in this phase has the goal of laying the foundations for establishing the land management tools that will permit maintaining the biodiversity through increasing the quality of native habitats for fauna, native land cover, and the connectivity of the elements of the rural landscape that represent opportunities for conservation. This stage will have two moments (Renjifo *et al.*, 2009):

1) *Selection of the landscape management tools:* Remnants of natural habitat are the ones that have the greatest potential to maintain wildlife, plants, and the original microorganisms of a region. These remnants can be of diverse types such as forests, wetlands, savannas, etc. Nevertheless, in this case we're looking for fragments of riparian forest, dense high Andean forest, High secondary vegetation and Low secondary vegetation since these are the land covers that need to be compensated.

Among the landscape management tools that can be used to meet the goals of compensation, are the following:

- *Diversification and enrichment of reforestation:* This is done in order to increase the diversity of species of plants and animals, the structural complexity, and the management of pastures in the plantations, and is also done to produce resources for the rural properties, like wood or some type of fodder or fruits.
- *Living fences:* This includes the improvement of existing fences or the conversion of dead fences in living fences. This process uses native species that grow quickly; some of them must produce resources for wildlife.
- *Enrichment of secondary vegetation:* The enrichment of these ecosystems requires great attention, given that the process uses exclusively native species, especially from advanced and intermediate stages of succession. The type of species is determined in accordance with the composition of the forests in the same area and the conditions of the site to be enriched. On average a hectare of secondary vegetation can be enriched with 10 individuals per species, usually from 10 to 20 species per hectare.
- *Enrichment of riparian buffer strips and forest fragments:* This seeks to incorporate strips of riparian forest and fragments of dense forest into the corridor, which in some cases will be improved in their

composition while in others will be expanded or connected by means of enclosures or assisted regeneration processes.

- *Enclosures* (passive restoration): In some sections of the corridor where the land use is cattle ranching, enclosures will be made using fences to eliminate the disturbance factor (cattle) and begin the process of natural regeneration.
- *Creation of corridors (includes active restoration and assisted regeneration activities):* These help connect population groups and help sustain populations of plants and animals that live in fragmented habitat, as in the case of rural landscapes. The main sources of plant matter for the establishment of a biological corridor are seedlings produced in greenhouses from seeds collected in forests or from remnant trees in the zone; seedlings rescued from under remnant trees in pastures or forests; and small trees naturally regenerated inside forest plantations or on the edges of highways that will eventually be eliminated.

For the activities for enrichment, expansion of forest strips and fragments, active restoration and assisted regeneration, the selection of plant species must be taken into account, according to the composition and structure of the remnant forests (reference ecosystems):

- *Species for forest enrichment:* This should consider the incorporation of species with conservation value, including threatened and endemic species, and species producing fine woods. Due to the fact that many of these species are restricted to advanced stages of succession or mature forests, which are only present in small and isolated fragments, their dispersion has difficulties given that the majority of their seeds are depredated under the trees before they have a chance to reach other sites and germinate, and therefore managing them in a greenhouse is the only alternative for conservation, either using seeds or seedlings that will be taken once again to the forest, to restored areas, or to fragments that form a part of the corridor.
- *Key species as sources of resources for fauna:* Two main types of plants are required in this type of a process, those capable of generating habitat in short time thanks to their high growth rates, adaptation, and competence, and those that produce abundant resources for fauna, such as abundant fruit of good quality. Therefore these attributes are evaluated based on a list of species during the characterization of plants for their selection.

2) Design of the facilitating mechanisms for the implementation of conservation agreements: These are actions directed toward fomenting behavior that is favorable to conservation and the sustainable use of the biodiversity, in a determined arena and time in the process of planning the rural landscape. **Table 11.28** shows a menu of mechanisms, which is merely indicative, because others may arise or these ones can be adapted to particular conditions.

Table 11.28 Menu of Proposed Facilitating Mechanisms for Supporting Conservation Agreements

NATURE	MECHANISM	SCALE	OBJECTIVE	RECIPIENT
Economic - Financial	Property tax exemptions	Property	Compensate property transaction costs	Rural private properties
	Financing compensation actions	Property	Compensate productive opportunity costs	Properties involved in the project
	Financing the establishment of areas set aside for landscape management tools	Property	Zero cost to establish	Properties involved in the project

NATURE	MECHANISM	SCALE	OBJECTIVE	RECIPIENT
Regulatory – legal	Commitment agreements	Property	Formalize the investment in the conservation areas and the management they should receive.	Properties involved in the project and the mayor or the autonomous regional Corporation
	Ecological easements	Property	Formalize the investment in the conservation areas and the management they should receive.	Properties involved in the project and the mayor or the autonomous regional corporation
Institutional	Inter-institutional discussion table	Local, regional	Sustainability: Definition of the management of the conservation areas and the participation of the different interested actors	Local and regional actors with competencies and interest in conservation actions
Educational and raising awareness	Trips to exchange information	local, regional	Raising awareness and sharing information about progress made in the process	Municipality and other regional actors
	Alternative communication media	Local, regional	Raising awareness and sharing information about progress made in the process	Municipality
	Mass media	Local, regional	Raising awareness and sharing information about progress made in the process	Municipality
Technical	Establishment and operation of native species greenhouse	Local		Local
	Technical assistance in establishment and maintenance phases	Property		
	Management plan for areas of interest	Property		

Source: Adapted from Renjifo *et al*., 2009.

o Stage III: Mechanism for implementation and administration

Bearing in mind that the plan for compensation for biodiversity loss will be executed in rural landscapes, which implies a process of reaching a consensus and negotiating private lands, the concept of property planning should be incorporated. This process should start with the current situation of a rural property by recognizing, in addition to the interest in the establishment of landscape management tools, the problems and needs, the intrinsic characteristics of the property, and above all, the individual expectations that should be incorporated in the work, to formulate the rural property plan, with objectives and activities, to attain the proposed goals. The property planning process should generate a document built with the property owner that includes the planning elements that have been agreed on (Vargas *et al.*, 2009):

- A general description of the property, expressing the biophysical characteristics and their regional context.
- A detailed description of the menu of restoration actions to be implemented on the rural property, indicating the type of tool, the dimensions, the number of trees, the planting dates, the species to be used, the objective of each activity, and the management schedule, among other things.
- A geographic representation of the property, in other words, a map indicating the property's land cover, productive systems, and the geo-referenced location of the areas to be rehabilitated.

- The management guidelines, detailing the implementation and maintenance activities, when necessary, that should take place on the property. This schedule of activities must clearly define the responsibilities and the seasonality for the actions.

The following steps will be taken to implement the project and meet the established goals:

1) Prepare the restoration proposal by prioritized property: Identify all of the properties involved in the layout of the restoration corridor on a landscape-scale that involves the property that has opportunities for conservation. It should be designed on the property scale (in area, species, densities, and costs) according to the landscape elements the property has.
2) Contact the owners of rural properties to share information about the project. The methodology used to present the project is participatory construction. The starting point is the knowledge they have of the local biodiversity, and the identification and prioritization made by the property holders of the problems with loss of natural resources on their properties and in the zone.
3) Define the menu of landscape management tools to establish on the property: Based on the proposed menu of landscape management tools and the contact made with the property owner, tour the property in order to verify in the field the information on land cover. Learn about the property owner's expectations regarding changes in land use – while he learns about the scope of the project and the strategic location and environmental importance of his property – and begin reaching a consensus on the landscape management tools.
4) Reaching a consensus on the landscape management tools and their financing: The costs of the landscape management tools should be estimated for the property and the compensation actions (costs of establishment). With this information, the possibilities of the project are analyzed for covering the entire demand of the landscape according to the number of rural properties with opportunities for conservation. In another meeting or meetings with the property owner the final proposal is negotiated for the restoration actions and compensation actions, the legal mechanism chosen to formalize the investments made in the property, and the commitments regarding financing and management of the landscape management tools.
5) Sign the commitment documents: which could be a commitment agreement, or an ecological easement, among others, and with this, the arrangements for managing the landscape management tools are delivered.

o Stage IV: Monitoring and Follow-up Plan

In this stage it is very important to take actions that permit verifying compliance with the objectives of the planning process, in other words, improve the conditions in the habitats, increase connectivity, and contribute to the conservation of biodiversity in the rural landscape. The development of the process for follow-up and evaluation in the rural landscape is an opportunity for feedback for the conservation strategy. For that reason it is suggested that this component be incorporated in the evaluation of the biological and socioeconomic dimensions (Vargas *et al.*, 2009).

1) *Evaluation of the biological efficacy of the conservation activities:* A program of biological follow-up can be supported by the use of biological communities that respond quickly to environmental changes. Biological follow-up on conservation actions in fragmented landscapes should cover two ecological scales over time and in space that include the different existing disturbance gradients: (1) follow-up on a particular biological community, (2) species that indicate progress resulting from conservation actions, and the final conditions that are sought. One of the best options corresponds to following up on bird assemblages and/or groups of indicator plant species.

- *Identification of indicator avian assemblages and evaluation of the efficacy of landscape management tools:* In this case umbrella species will be selected, which demand greater habitat requirements. Their presence indicates that the site has the conditions necessary to maintain them and, together with them, species that are not affected so drastically by fragmentation. The following characteristics will be taken into account for their selection:

ü Their presence is associated with large fragments.

ü They show a low capacity for dispersion in the landscape.

ü In some cases, they show habitat specificity.

The groups of umbrella species of birds for the evaluation of landscape management tools can be different depending on the landscape management tools and the context of the landscape.

- *Evaluation and follow-up on vegetation in restored areas:* The evaluation of the restoration strategies requires the selection of groups or species that serve to indicate advances in the process. One of these key groups could be the lauraceae or other families that are intolerant of fragmentation.

- *Follow-up on planting:* This includes the follow-up on plants planted in the field for a period of time. This follow-up on the plants focuses on two aspects: their survival and their height. Aspects related to their phytosanitary condition, adaptation, relations, among other things, should be reported as part of the follow-up.

  In general, follow-up is done on a sampling of individuals (50 individuals is an appropriate number) of each species defined as key or as the object of evaluation. Data is kept as of the moment of their definitive planting in the field. A good form for this purpose must include the following information (**Table 11.29**).

Table 11.29 Form for Recording Survival and Growth of Plants in the Field

SPECIES	INDIVIDUALS	SITE	PLANTING DATE	INITIAL HEIGHT	CURRENT HEIGHT	COMMENTS

Source: Vargas *et al.*, 2009.

- *Follow-up on seedlings:* The seedlings planted in the restoration phases should be evaluated relative to their capacity to adapt, and data on survival and development should be kept. Evaluations each semester during the first year and subsequently annually until the fifth year should provide sufficient information. Aspects should be evaluated in the greenhouse such as survival and the development of the seedlings rescued from the field. The suggestion is to mark and follow at least one sample of each species (**Table 11.30**).

Table 11.30 Form for Recording Survival of Seedlings

SPECIES	INDIVIDUALS	DATE	HEIGHT	DBH	PHENOLOGY			COMMENTS
					FLOWERS	FRUIT	NONE	

Source: Vargas *et al.*, 2009.

- *Socioeconomic Evaluation and Follow-up:* seeks to evaluate the impact of the establishment of the landscape management tools on the socioeconomic conditions and the financial performance of the adoptive properties. In other words, it's an evaluation from the perspective of the property owner-producer, a private evaluation. The results of this evaluation will be compared with the results of a qualitative assessment of the social and economic impact of the project on the property owners (Vargas *et al.,* 2009).

· **Schedule for Implementation and Investment Plan**

The schedule and the project costs will be specified once the total area has been defined that should be compensated according to the execution of the activities for the construction of the divided highway. This information will be delivered in a timely manner to the environmental authorities. The following is a schedule that includes the main activities of the compensation project (**Table 11.31**).

Table 11.31 General Schedule for Implementation

ACTIVITY	YEAR 1	YEAR 2	YEAR 3	AÑO 4	YEAR 5	YEAR 6
STAGE 0: RECOGNITION OF THE RURAL TERRITORY						
Review the information						
Present the process						
Generate and formalize local and regional alliances						
STAGE I: IDENTIFICATION OF OPPORTUNITIES FOR CONSERVATION IN THE RURAL LANDSCAPE						
Biological characterization of the area of interest						
Evaluation of the socioeconomic viability of rural properties						
Identification of opportunities for conservation						
STAGE II: DESIGN OF THE CONSERVATION STRATEGY FOR RURAL LANDSCAPES						
Selection of the landscape management tools						
Design of the conservation corridor						
Design of the facilitating mechanisms for implementation						
Presentation of the project to the environmental authorities						
STAGE III: APPLICATION OF THE MECHANISM FOR IMPLEMENTATION AND ADMINISTRATION						
Preparation of the restoration proposal by prioritized property						
Contact with property owners to share information about the project						

ACTIVITY	YEAR 1	YEAR 2	YEAR 3	AÑO 4	YEAR 5	YEAR 6
Definition of the menu of landscape management tools for the properties						
Reaching a consensus on the landscape management tools and their financing						
Sign the commitment documents						
Development of the restoration and implementation activities of the landscape management tools						
Maintenance						
Sharing results and final delivery						
STAGE IV: MONITORING AND FOLLOW-UP PLAN						
Selection of monitoring sites						
Selection of indicator species (birds and plants)						
Preparation of detailed monitoring plan						
Monitoring of species at the sites						
Evaluation of results and adjustments to the process						

Source: GEOCOL CONSULTORES S.A., 2017.

Table 11.32 presents a general estimate of the costs per hectare associated with the development of this alternative for compensation. These costs, however, will vary according to the total area that should be compensated and the specific activities that should be executed to implement the landscape management tools.

Table 11.32 Estimated Overall Costs for the Development of the Project

ACTIVITY	AMOUNT PER HA
Recognition of the rural territory	$ 2,000,000
Identification of opportunities for conservation (biological and socioeconomic characterization)	$ 3,000,000
Payment for ecological easements and other facilitating mechanisms	$ 5,000,000
Application of restoration actions and landscape management tools	$ 5,000,000
Maintenance	$ 3,000,000
Follow-up and evaluation	$ 2,000,000
Total	**$ 20,000,000**

Source: GEOCOL CONSULTORES S.A., 2017.

- **Evaluation of Potential Risks in the Implementation and Measures to Minimize Them**

In order to ensure the viability of the compensation actions, it is necessary to identify all of the associated risks and the corresponding contingency measures. **Table 11.33** presents the risks identified for the compensation project according to the actions proposed, and the control or contingency measures.

Table 11.33 Risk Assessment and Contingency Measures for the Implementation of the Plan for Compensation for Biodiversity Loss

TYPE OF RISK	STAGE IN WHICH IT OCCURS	DESCRIPTION	MAIN CONSEQUENCE	LIKELIHOOD	LEVEL OF IMPACT	CONTROL OR CONTINGENCY MEASURE	RESPONSIBLE
Technical	Stage 0	Delay in reaching a consensus on the compensation strategy and the proposed sites with the environmental authority	Failure to meet the Schedule	Medium	Medium	Organize a discussion table between the environmental authorities and local and regional actors	Entity executing the project – environmental authorities – local actors
Technical	Stage 0	Disapproval of the process by the local community	Development of the project in the region not viable	Low	High	Develop a strategy for participatory negotiation that shows the benefits of developing the project	Entity executing the project
Technical	Stage I	Insufficient number of properties interested in developing the project	Failure to meet the objectives and compensation factor	Medium	High	Formulation of negotiating strategies that permit property owners to recognize the advantages of the project and its benefits in the short and long-term	Entity executing the project
Technical	Stage II	Discrepancy between the best design for the corridor/ landscape management tools and the properties with the best socioeconomic viability	Failure to meet objectives and conservation goals	Medium	High	Complete identification of interested actors, proper socioeconomic assessment, and rigorous design of different options that maximize connectivity and support for biodiversity	Entity executing the project
Financial	Stage III	Costs of implementation higher than the available investment costs	Failure to meet the objectives and compensation factor	Medium	High	Proper design of the investment plan based on experiences in other sites – Adaptation of goals and objectives during project development	Entity executing the project

TYPE OF RISK	STAGE IN WHICH IT OCCURS	DESCRIPTION	MAIN CONSEQUENCE	LIKELIHOOD	LEVEL OF IMPACT	CONTROL OR CONTINGENCY MEASURE	RESPONSIBLE
Technical	Stage III	Change of interest among property owners in developing the project during its execution	Need to change the design of the corridor – delay in advance on the project	Medium	High	Continuous follow-up on the process and following through on commitments acquired	Entity executing the project – property owners
Technical	Stage III	Insufficient sources of seeds, seedlings, and green houses in the locations where the project is executed	Difficulty in developing the activities – delay in the schedule – failure to meet goals and objectives	Medium	Medium	Identification of donating fragments at the local and regional level – promotion of the development of green houses in the community – identification of priority species for the community that have good conditions for restoration	Entity executing the project
Technical	Stage III	Deterioration in the restored or intervened areas	Failure to meet objectives and conservation goals	Medium	High	Development of monitoring and maintenance at the established times	Entity executing the project – property owners

Source: GEOCOL CONSULTORES S.A., 2017.