CONTENTS

TABLES

ILLUSTRATIONS

4.4 ENVIRONMENTAL ZONING

Environmental zoning is highly important for the development and planning of the areas to be used by "El Pescado" project. It is important to find harmony between the physical, biotic and socio-economic components in the area in order to carry out the decision-making process on possible actions in the area, seeking sustainable development.

For the elaboration of the environmental zoning, the GIS tool (ArcGIS) was used, with which the cartographic modeling was established to determine each of the zoning units.

Therefore, the information used refers to the delimitation of the following units (See Table 4.4-1).

Table 4.4-1. Environmental components considered for zoning.

PHYSIC/ABIOTIC	BIOTIC	SOCIO-ECONOMIC AND CULTURAL
Geotechnical	Vegetable soil coverings	Community Organization
Soil aptitude (Potential use)	Ecosystem fragmentation and connectivity.	Presence of states and other organizations
Hydrogeology		Property Size
Hydrology		Land use and destination
Surface aquifers		Availability of public and social services
		Population concentration
		Ecosystem services unit
		Accessibility
		Archaeological potential
		Presence of ethnic groups.

Source: ECOPETROL, 2016.

Once each of the categories to be evaluated were defined, it proceeded to characterize them according to their level of sensitivity and importance, as well as other factors of high importance in order to intercept them and obtain as main result, the environmental zoning categories and recommended uses.

4.4.1 Abiotic Environment Zoning

For the analysis of the abiotic environment, it is related the use of different physical elements that are important for the categorization of sensitivity and importance, such as geotechnics, soil aptitude, hydrogeology and hydrology (Scarcity index).

4.4.1.1 Geotechnical Stability

Geotechnical stability refers to the land balance in reference to any occurrence of mass removal phenomena, evaluated through various physical and biotic variables (lithology, geomorphology, slope of the land, vegetation cover, precipitation, tectonics, seismicity, among others).

4.4.1.1.1 Environmental sensitivity and importance (Geotechnical stability).

For the evaluation of environmental sensitivity, areas with greater sensitivity will be considered because they present some degree of geotechnical threat, which will be directly proportional to the susceptibility of the soil if it is altered or modified in its structure and/or functioning by external actions or conditions.

The importance lies in the capacity of the terrain to support the project infrastructure under current conditions, evaluating its sensitivity, according to the parameters established in Table 4.4-2.

Table 4.4-2. Environmental sensitivity and importance in the geotechnical stability of soils.

LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
VERY HIGH	5	5	It corresponds to very low geotechnical stability terrain, where all soil conditions are very likely to generate Mass Removal Phenomena - MRF. Corresponds to tectonically active areas, where predominantly shaly rocks and colluvial deposits emerge, with a high density of faults and arranged on slopes of steep to very steep slopes, with very high relative relief. Current use includes bare or degraded land.
HIGH	4	4	Corresponds to areas with low geotechnical stability, where most ground conditions are prone to generate MRF. The lithology consists of rocks that are interspersed with hard and soft lithologies or are metamorphic of low grade, with high density of faults and drainage, with a relatively high relief.
MEDIUM	3	3	Represented by terrain in zones with moderate geotechnical stability, where the terrain presents some conditions to generate MRF, such as landslides, rock falls and overturns others. The rocks have moderate competition, in areas with failure density and moderate drainage, with inclined slopes and intermediate relief.
LOW	2	2	It groups together areas of high geotechnical stability where terrain conditions do not present major risks of MRF generation. They are competent rocks or localized deposits such as alluvial terraces, with flat slopes to slightly inclined, without the influence of faults and with low drainage density, soft relative relief.
VERY LOW	1	1	Due to the terrain conditions it corresponds to areas with very high geotechnical stability, where MRF is not present. It belongs to areas where rocks are competent or deposits where the slope is flat and there is no relief contrast, there are no failures, the drainage density is very low and there is no relief contrast.

Source: ECOPETROL, 2014.

According to the classification previously carried out and according to the project scenarios in terms of susceptibility (directly related to the threat), this area is classified as follows. It is important to note that the rating for sensitivity and importance has the same value:

Table 4.4-3. Relationship between susceptibility and geotechnical stability.

GEOTECHNICAL SUSCEPTIBILITY	VALUE RANGE	GEOTECHNICAL STABILITY
Low	0 – 20	High
Medium	21 – 40	Moderate
High	>40	Low

Source: ECOPETROL, 2014

Table 4.4-4. Environmental sensitivity and importance of soil geotechnical stability.

ABIOTIC SENSITIVITY AND IMPORTANCE				
GEOTECHNICAL STABILITY				
SUSCEPTIBILITY UNIT	SENSITIVITY	IMPORTANCE	DESCRIPTION GEOTECHNICAL STABILITY	
LOW	2	2	Steady	It groups areas of high and low frequency geotechnical stability for mass formation phenomena, generally stable due to their low slope conditions, which makes it qualify with a low to zero potential for the occurrence of mass movements. It corresponds to an area where the topography is very smooth as are the alluvial terraces. In this area there are few denotative processes, however it is necessary to maintain the current balance that exists.
MEDIUM	3	3	volatile	Represented by land in areas with moderate geotechnical stability, due to the possible occurrence of mass movement events, mostly depending on the intensity of precipitation on these sectors and drastic changes in land use. This area is usually found in areas of undulating morphology, where erosive processes such as terraces, laminar erosion and old scars of mass movements occur. The area does not present a large number of erosion processes; however, it is necessary to maintain the equilibrium, preserving native vegetation cover and undertaking environmental protection campaigns.
HIGH	4	4	Very Volatile	Corresponds to areas with low geotechnical stability, where it is directly related to the active mass movements in the study area, these are associated along the unstable margins of some streams of El Pescado ravine and agricultural malpractice (erosive processes). Within this group are the area's most susceptible to physical soil imbalances. These areas are usually located in the parts where the mining project's infrastructure is located.

Source: INGEX, 2016.

In addition to the classification described above, cartography is linked as an input for the preliminary mapping of the abiotic component, which clearly describes each of the categories defined for the stability and importance of Geotechnics (See Illustration 4.4-1).

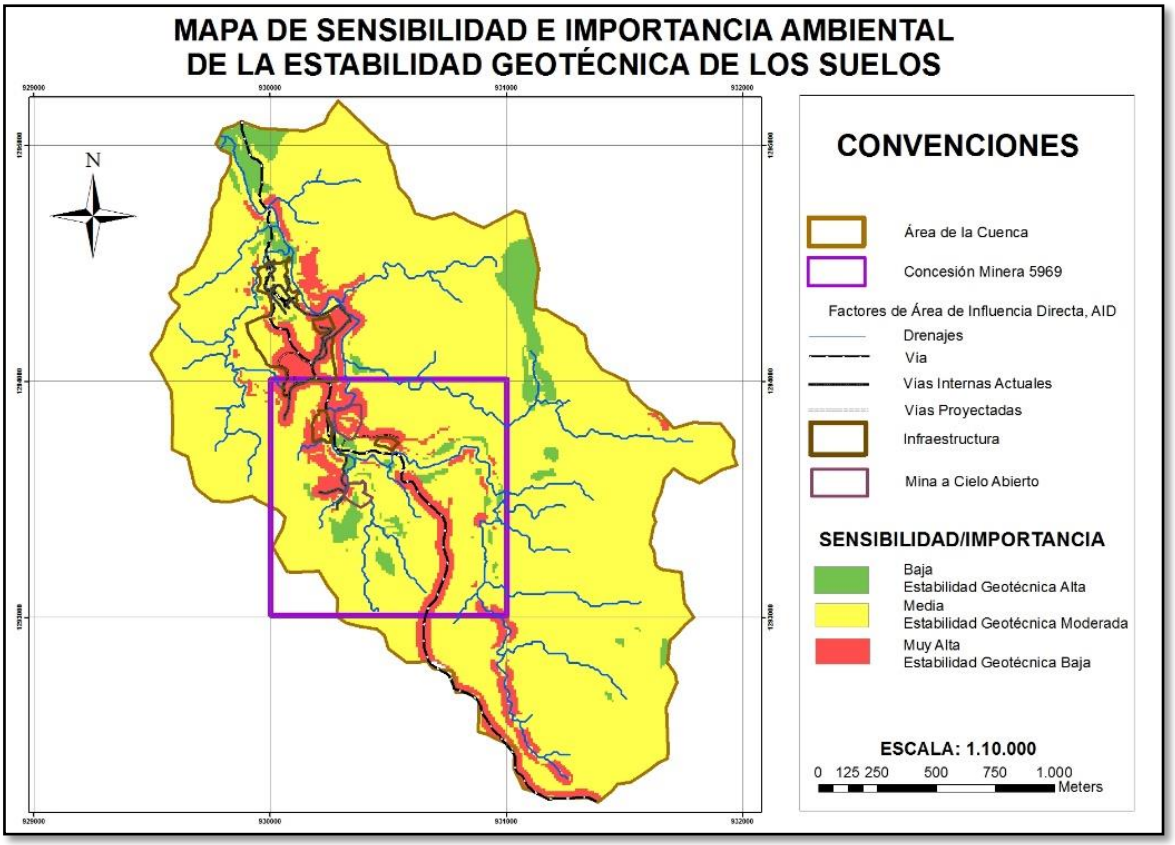

Illustration 4.4-1. Map of environmental sensitivity and importance of soil geotechnical stability.
Source: INGEX, 2016.

4.4.1.2 Potential Soil Use (Use capacity)

Soils also suffer changes, especially when they are under different climatic, relief, geological and use conditions, which is why they present characteristics that can be susceptible at the time of developing the project (as demonstrated by environmental sensitivity). For environmental importance, the impact on soil capacity is related to the supply of environmental goods and services.

According to the methodology used by Ecopetrol (2014), the agro-logical classification of land is used to evaluate both sensitivity and importance, based mainly on the analysis of characteristics which limit land use and therefore generate some risk of degradation or loss of the resource.

4.4.1.2.1 Sensitivity (soil use potential).

In order to establish the soil sensitivity range, the values presented in Table 4.4-5 are considered.

Table 4.4-5. Levels of environmental sensitivity in potential land use.

SENSITIVITY LEVEL		DESCRIPTION	RATING
Very high	Soils with a very low ability to return to their original state before an intervention. Low resistance to change by recovering in the long term through restoration and compensation actions.	Agrological class: VIII (IGAC). Land destined for the conservation and protection of nature, strategic ecosystems for the provision of environmental goods and services.	Very high (5)
High	Soils with a low ability to return to their original state before an intervention and with low resistance to change, recovering in the long term through the implementation of mitigation actions	Agrological class VII and VI in the subclass (s: limitations or deficiencies only in edaphic e: soil and susceptibility to erosion p: slope: h: natural drainage) Forest lands with mixed use possibilities of the forest.	High (4)
Medium	Soils that have an average capacity to return to their original state before an intervention and have a medium resistance to change, recovering in the medium term through the implementation of mitigation actions.	Agrological class: (IV) and (V) in the subclass (s: limitations or deficiencies only in edaphic soil; e: susceptibility to erosion; p: slope: h: natural drainage) Land for livestock with improved pasture, permanent crops, agroforestry systems and/or reforestation, soil conservation practices and water management.	Medium (3)
Low	Soils that have a high ability to return to their original state before an intervention and have a good resistance to change so that their recovery naturally occurs in the short term.	Agrological class: (I), (II) and (III) in the subclass (s: limitations or deficiencies only edaphic; e: susceptibility to erosion). Arable land, with restrictions on crop selection, with intensive soil conservation and water management practices.	Low (2)
Very Low	Soils that have a very high capacity to return in the short term to their original state before an intervention and therefore have a high resistance to change.	Agrological class: (I) and (II) in the subclass (s: limitations or deficiencies only edaphic). Arable land, with capacity for any type of cultivation, with light to moderate practices of soil conservation and water management.	Very Low (1)

Source: ECOPETROL, 2014.

According to the classification carried out in the soil study adapted by the Augustín Codazzi Geographical Institute, the agrological classes II, IV and VI are presented in the area under study. This classification system is structured so that, the higher the agrological class, the lower the possibility of agricultural use, decreasing the ability to plant a variety of crops, while increasing management and conservation practices (Guerra, 2014).

Based on the above and the classification for the sensitivity determination, the following results were obtained:

Table 4.4-6. Levels of environmental sensitivity in potential land use.

SENSIBILITY LEVEL		DESCRIPTION	RATING
High	Soils with a low capacity to return to their original state before an intervention and with low resistance to change, recovering in the long term through the implementation of mitigation actions.	Agrological class VI in the subclass (strong slopes (>25%). With low nutritional contents for plants, pH moderately acidic. Low natural fertility. Soil texture A, FA and FArA.) Forest land with possibilities of mixed use of the forest. The main uses in the project's area of influence are production-protection forestry with timber plantations on slopes of less than 45%, and protection on slopes of more than 45%, where native forest is present. Agroforestry with special pasture management.	High (4)
Medium	Soils that have an average capacity to return to their original state before an intervention and have a medium resistance to change, recovering in the medium term through the implementation of mitigation actions.	Agrological class: (IV) in the subclass (strong slopes (12-25%). With a mixture of different types of materials, by man's action, which have given rise to the Tecnosol soil type. Soils with low nutritional content for plants. Livestock lands with improved pasture, permanent crops, agroforestry systems and/or reforestation, soil conservation practices and water management. For the project's area of influence, its uses are forestry with protective plantations and small-scale agriculture of perennial crops such as cocoa, banana, cassava and citrus.	Medium (3)
Very Low	Soils that have a very high capacity to return in the short term to their original state before an intervention and therefore have a high resistance to change.	Agrological class: (II) in the subclass (Terraces, slightly flat-tilting (0-7%), with alluvial deposit parent material and slope; soil with effective depth of surface (30-56cm), texture A and FA, with low nutritional content, moderately acid pH). Arable land, with capacity for any type of cultivation, with light to moderate practices of soil conservation and water management. Within the area of influence, current uses are livestock, alluvial mining and forest strips.	Very Low (1)

Source: INGEX, 2016.

4.4.1.2.2 Environmental importance (potential use).

When referring to ecosystem services, the provision of the resource for the livelihoods of populations is related. Soil provides great services, aimed at supporting the development of organisms responsible for various processes that reduce the release of greenhouse-effect gases.

The importance of this is determined by the evaluation of the characteristics that enhance or limit the productivity of the area's goods and services. From the productive point of view, the lands with the greatest aptitude for agricultural development are high importance (class 2), while the lands with

no productive vocation (of conservation and protection) are low in importance (class 8) (ECOPETROL, 2014), as shown in the following table:

Table 4.4-7. Levels of environmental importance of potential land use.

IMPORTANCE LEVEL		DESCRIPTION	RATING
Very High	Soils with very high capacity to generate social and environmental goods and/or services.	Organic carbon: Very high. Effective depth: 100 - 150 cm. Natural Drainage: Very fast to excessively well drained. Texture: Medium Limiters: Non-rocky outcrops, stony, hard layers or other.	Very High (5)
High	Soils with a high capacity for generating environmental and/or social goods and/or services in the area of influence.	Organic carbon: High Effective Depth: >150 cm. Natural Drainage: Fast to imperfectly drain. Texture: Medium Moderately fine. Limiters: 25% with rocky outcrops, stony, hard layers or others.	High (4)
Medium	Soils that have an average capacity to generate environmental and/or social goods and/or services in the area of influence.	Organic carbon: Medium. Effective depth: 50 - 100 cm. Natural Drainage: Moderately well drained. Texture: Moderately medium to fine. Boundary: 50% with rocky outcrops, stony, hard layers or others.	Medium (3)
Low	Soils that have a low capacity to generate environmental and/or social goods and/or services in the area of influence.	Low	Low (2)
Very Low	Soils that have a very low capacity to generate environmental and/or social goods and/or services in the area of influence.	Organic Carbon: Very Low. Effective depth: <25 cm. Natural Drainage: Very poorly drained. Texture: Fine. Limiters: >75% with rocky outcrops, stony, hard layers or others.	Very low (1)

Source: ECOPETROL, 2014.

For the mining project "El Pescado", the following classification was carried out according to the potential land use, taking into account the biophysical supply expressed by capacity of use and current use (soil demand). Likewise, the activities carried out by man over the resource considered. Table 4.4-8, describes the level of importance of potential land use.

Table 4.4-8. Levels of importance of potential land use.

IMPORTANCE LEVEL		DESCRIPTION	RATING
Medium	Soils that have an average capacity for the generation of environmental and/or social goods and/or services such as: Conservation of water resources, flora and fauna, both in the area of direct and indirect influence (Subclass IIs - LVAOT).	Soil formed with parental material of alluvial deposit in the bottom and deposit of slope in the superior part. Originating from rocks like Granodiorite or Quartz Diorite, warm climate, with an effective superficial depth, between 30-56 cm, well drained, are constituted by horizons Ap-Bw-2C. The humidity regime is udic, temperature regime of the isothermal soil, with good natural drainage, no epipedons were observed; current use in pastures, and alluvial mining, evidence of superficial erosion by cattle trampling.	Medium (3)
Low	Soils that have a low capacity for generating environmental and/or social goods and/or services in the area of direct and indirect influence, such as transient or perennial crops (Subclass IIs - LVAD).	This soil does not form a structure; therefore, it corresponds to an alluvial and slope deposit, with a mixture of materials provided by the water bodies and the slope. This alluvial deposit is located in the Terrace fluvial (Ft) geoform at 190 masl, with grass vegetation, used in pasture land, slope of 3% (slightly flat). The material comes from soil transported from terrace, wetness regime of the soil, surface depth (40cm), good natural drainage, without epipedon, no evidence of erosion, organic carbon recorded values between 0.15 - 0.71% (Subclass IIs - LVAD). Soil originating from granodiorite rock, with a warm climate, effective surface depth of 40 cm, made up of horizons A and B. The humidity regime is udic, and the soil temperature regime is isothermal, with good natural drainage; epipedons and subsurface horizons were not observed, current use in pasture, evidence of erosion and compaction due to cattle grazing trampling. The pH is moderately acidic, unsuitable for plant growth, with aluminum exchangeable in low quantities. Organic carbon is 1.58 - 0.57% (Subclasses VI - LCOT).	Low (2)
Very Low	Soils that have a very low capacity to generate environmental and/or social goods and/or services in the area of influence, such as: gold mining on steep slopes that could favor erosive processes (Subclass IVs-LCT).	It is presented at a height of 231 meters above sea level, the soil humidity regime and the soil temperature regime are isothermal; the effective depth is very superficial (20 cm), erosion is severe by mining, good natural drainage, geomorphological belongs to the loins area (Dl), vegetation is stubble without use, the slope is steep (20-25%). Organic carbon ranges from 1.32 - 0.40% (Subclass IVs-LCT).	Very Low (1)

Source: INGEX, 2016.

Once the classification of sensitivity and importance of potential land use has been carried out, the homogeneous variables are superimposed, as shown in Table 4.4-9 and Illustration 4.4-2.

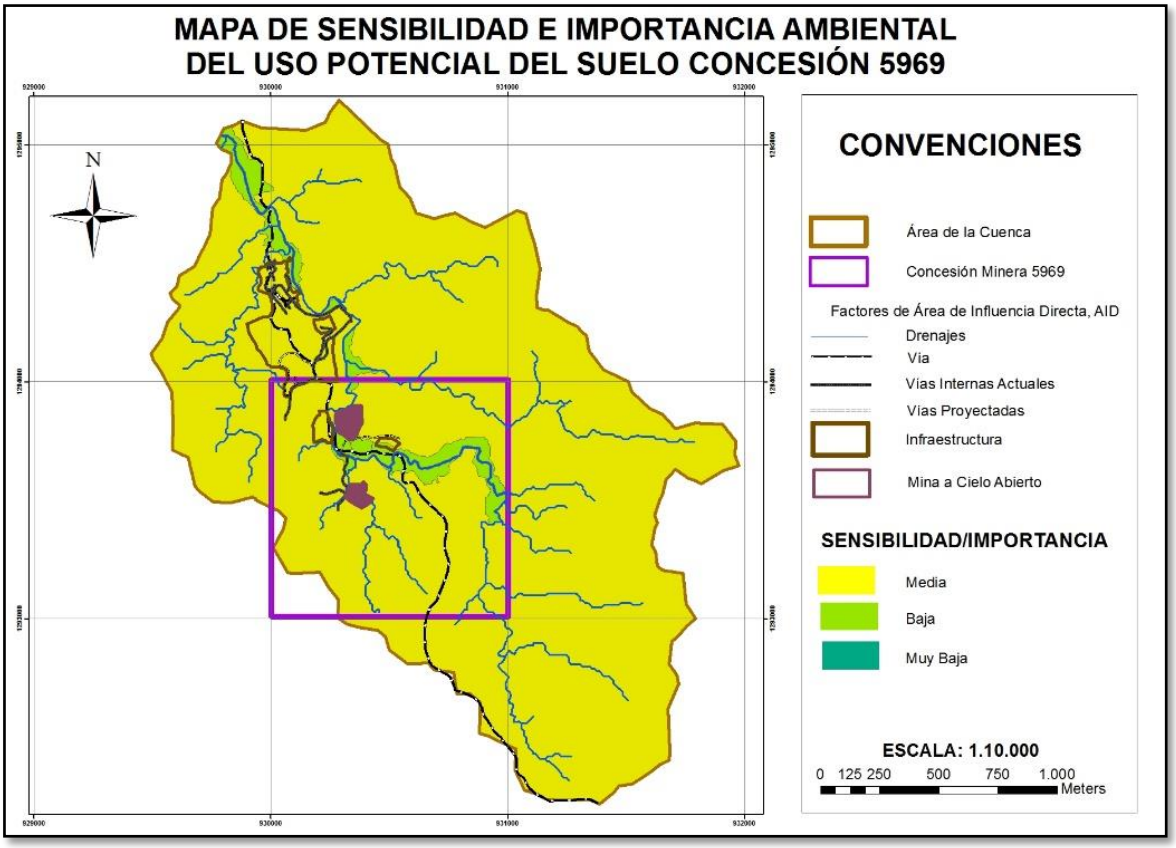

Illustration 4.4-2. Map of environmental sensitivity and importance of land use (Concession 5969).
Source: INGEX, 2016.

Table 4.4-9. Environmental sensitivity/importance (S/I) interaction matrix.

	SENSITIVITY LEVEL	Very High	High	Medium	Low	Very Low
IMPORTANCE LEVEL	Value	5	4	3	2	1
Very high	5					
High	4					
Medium	3					LOW (2,0)
Low	2		MEDIUM (3,0)			VERY LOW (1,5)
Very Low	1			LOW (2,0)		

Source INGEX, 2016.

4.4.1.3 Hydrogeology

The development of this zoning is mainly based on the analysis of the upper aquifer level.

4.4.1.3.1 Environmental sensibility

Environmental sensitivity is mainly based on the susceptibility of the aquifer to a contaminating condition or element. Sensitivity evaluation is based primarily on surface aquifers, since they are the most susceptible to pollution load affectation, with the possibility of altering deeper horizons.

In accordance with the methodology used by Ecopetrol (2014), sensitivity is considered in terms of vulnerability to aquifer contamination, using the DRASTIC and GOD methodology.

The DRASTIC methodology is the acronym for an index of vulnerability to aquifer pollution involving seven (7) parameters or variables:

D (depth to water): Depth of the water level;
R (net recharge): Net recharge;
A (aquifer media): Geological formation that constitutes the aquifer;
S (soil medium): Edaphic roof below the surface of the land;
T (topography): Slope of the terrain;
I (impact of vadose zone): Type of geological material in the unsaturated zone;
C (hydraulic conductivity): Hydraulic conductivity of the aquifer.

According to the variables considered, a numerical value is determined for each site or area with homogeneous characteristics. Using the following additive model and the weighting factors and ranges of variables (Table 4.4-10. Table ***4.4-11***):

$$CP = (Dw \cdot Dr) + (Rw \cdot Rr) + (Aw + Ar) + (Sw \cdot Sr) + (Tw \cdot Tr) + (Iw \cdot Ir) + (Cw \cdot Cr)$$

Table 4.4-10. Weighting factors and ranges of the variables Drastic method

PARAMETER	WEIGHTING FACTORS (W)	RANGE (r) (according to natural condition)
D - Depth of water level	5	1 – 10
R - Net recharge	4	1 – 9
A - Nature of the aquifer	3	1 – 10
S - Nature of the soil	2	1 – 10
T - Topography	1	1 – 10
I - Impact of the unsaturated zone	5	1 – 10
C – Permeability	3	1 – 10

Source: ECOPETROL, 2014.

Table 4.4-11. Vulnerability ranges according to DRASTIC methodology

RANGE	AQUIFER VULNERABILITY RANGE
<100	Negligible vulnerability
101 – 119	Very low vulnerability
120 - 139	Low vulnerability
140 – 159	Moderate vulnerability
160 – 179	High vulnerability
180 – 199	Very high vulnerability
>200	Extreme vulnerability

Source: ECOPETROL, 2014.

The GOD methodology estimates vulnerability to aquifer contamination, taking into consideration three important variables, where the index obtained may vary from 0 - 1, using the following equation:

$$V_{GOD}: G \times O \times D$$

G (Groundwater occurrence): Type of aquifer (Free semi-confined or confined).
O (Overlying lithology): Unsaturated zone lithology.
D (DepthtoGroundwater): Depth to groundwater.

The following table shows the degree of vulnerability, according to GOD data:

Table 4.4-12. Vulnerability ranges according to the GOD methodology.

VULNERABILITY	RANGE
Negligible (Very low)	< 0,1
Low	0,1 – 0,3
Medium (Moderate)	0,3 – 0,5
High	0,5 – 0,7
Extreme	> 0,7

Source: ECOPETROL, 2014.

For the mining project El Pescado and according to the study carried out for the abiotic component (hydrogeology) and the inventories of water points, hydrogeological units, infiltration analysis, geophysics, conceptual hydrogeological model, hydro-geochemical model, intrinsic vulnerability, hydraulic parameters, numerical hydrogeological model and monitoring well systems; it was found that regional aquifer systems are not identified in this area, due to the low hydrogeological potential of the region identified in macro studies, developed by the Colombian Geological Service (hereinafter SGC) and IDEAM (See Illustration 4.4-3)

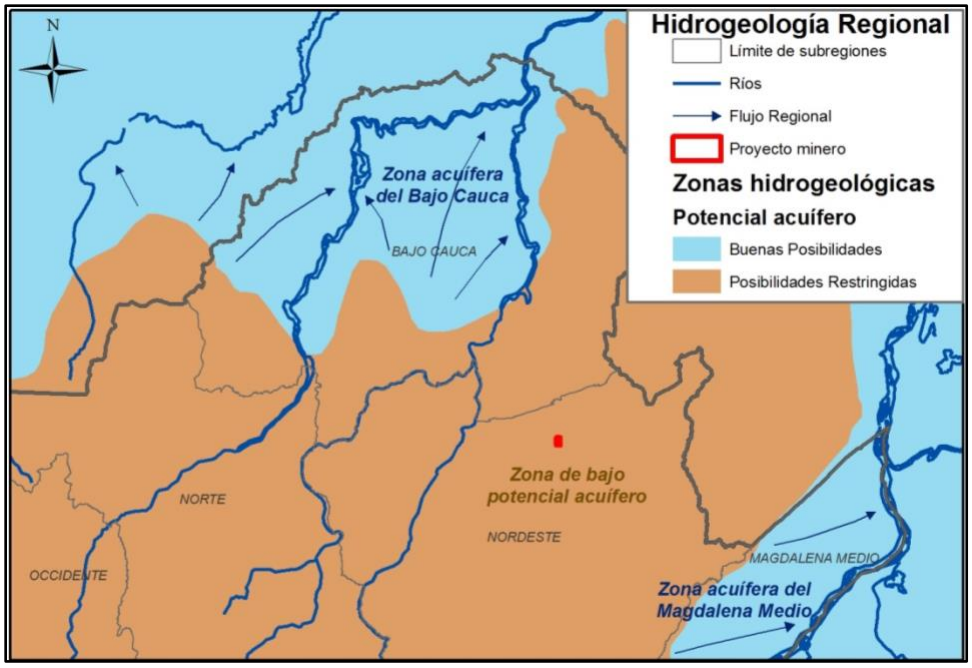

Illustration 4.4-3. Map of homogeneous hydrogeological zones in Antioquia.
Source: IDEAM, 2002.

Illustration ***4.4-3*** shows the study area in a zone of low aquifer potential and the regional flow of groundwater in the aquifer zones Low Cauca and Magdalena Medium, schematically arranged with arrows indicating the preferential direction towards the main surface water currents where groundwater is finally discharged to maintain the base flow of these currents.

Therefore, the methodologies previously described for environmental zoning could not be implemented due to the lithological characteristics, exhibiting a low or restricted hydrogeological potential, which means, with little or no possibility of finding important groundwater producing aquifers, or the water associated with these units is so scarce that it is not economically profitable to make use of the resource.

For being found on igneous rocks whose primary porosity is null and therefore framed within an area of low groundwater potential in the northeastern Antioquia sub region (See Illustration 4.4-3) and as stipulated in chapter 4.1.9. It is impossible to quantify environmental sensitivity and importance.

4.4.1.4 Hydrology (scarcity index).

The water scarcity index is the percentage relation between the potential demand for social water and economic activities with the available water supply, after applying reduction factors based on low water levels and fragile sources (IDEAM, 2008). In addition, it is a primary tool when evaluating if the water resource in the area is enough in space and time; it is important for sustainable resource

planning efforts to know the amount of available water offered by the source, demand levels and use restrictions necessary to maintain the health of the source provider.

Taking these definitions into account, the rate of scarcity is established as the following relationship:

$$I_e = \frac{D}{O_n}\ x\ 100\%$$

Where: I_e- scarcity index [%], D - water demand [m^3], O_n- Net surface water supply [m^3].

Considering the parameters proposed in the ECOPETROL methodology (2014) it is estimated that the degree or level of water sensitivity is an area is directly proportional to environmental importance, because, the higher the demand or scarcity, the supply of this liquid becomes more important. The degrees of sensitivity and water importance are grouped as follows:

Table 4.4-13. Water degree of sensitivity according to the scarcity index.

DEGREE	RANGE	SCARCITY INDEX	SENSIBILITY/IMPORTANCE
High	>50%	High demand	Very High
Medium High	21 – 50%	Significant demand	High
Medium	11 – 20%	Low demand	Medium
Minimum	1 – 10%	Very low demand	Low
Not significant	<1%	Non-significant Demand	Very Low

Source: ECOPETROL, 2014.

The data obtained for the mining project El Pescado are listed in the following table:

Table 4.4-14. Water supply of the currents under study, mining project "El Pescado".

CORRENT	AVERAGE FLOW (m^3/s)	MEDIUM FLOW (m^3/s) (0.8 * CAUDAL MEDIO)	Q97.5% (m^3/s)	OFFER (m^3/day)	DEMAND (m^3/day)	SCARCITY INDEX
SN #1	0,248	0,198	0,100	8132,335	55.259	0.7
SN # 9	0,193	0,154	0,078	6331,721	54.190	0.9
SN #2	0,026	0,021	0,011	867,449	11.812	1.4
SN #3	0,001	0,001	0,001	167.575	1.06	0.6
SN #4	0,020	0,016	0,008	657,158	17.876	2.7
SN #5	0,042	0,033	0,017	1373,461	5.652	0.4
SN # 8	0.119	0.095	0.048	3903.521	18.705	0.5
SN #6	0.022	0.018	0.009	722.874	2.870	0.4
SN #7	0.005	0.004	0.002	167.575	4.470	2.7

Source: INGEX, 2016.

According to the results obtained for the index scarcity of each of the basins analyzed, it is evidenced that they are all below 3%, which determines the absence of significant pressure on the water resource.

According to each of the zoning requirements, the basins and/or streams are classified as follows:

Table 4.4-15. Classification of water sensitivity according to the scarcity index.

CORREN	SCARCITY INDEX	DEGREE	RANGE	DESCRIPTION	SENSIBILITY/IMPORTANCE
SN #1	0.7	Not significant	<1%	Non-significant Demand	Very low
SN # 9	0.9	Not significant	<1%	Non-significant Demand	Very low
SN #2	1.4	Minimum	1 – 10%	Very low demand	Low
SN #3	0.6	Not significant	<1%	Non-significant Demand	Very low
SN #4	2.7	Minimum	1 – 10%	Very low demand	Low
SN #5	0.4	Not significant	<1%	Non-significant Demand	Very low
SN # 8	0.5	Not significant	<1%	Non-significant Demand	Very low
SN #6	0.4	Not significant	<1%	Non-significant Demand	Very low
SN #7	2.7	Minimum	1 – 10%	Very low demand	Low

Source: INGEX, 2016.

As a final result, the water sensitivity/importance map was obtained according to the scarcity index, as shown in Illustration 4.4-4.

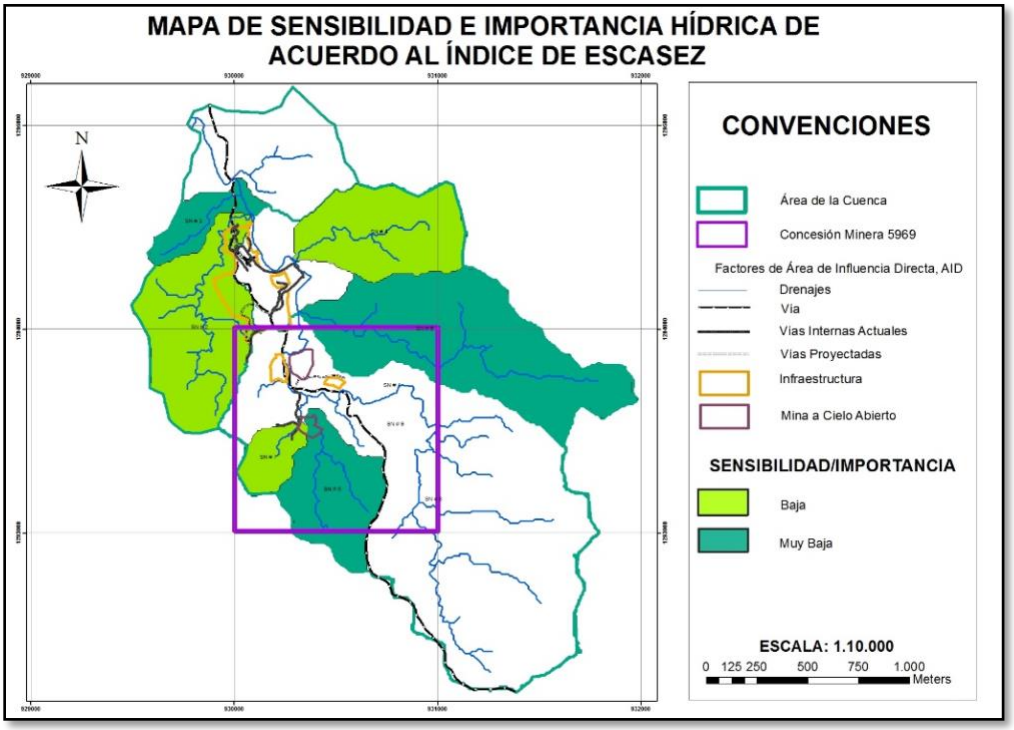

Illustration 4.4-4. Water Sensitivity/Importance map according to the scarcity index (Mining Concession 5969).
Source: INGEX, 2016

4.4.1.5 Surface aquifers.

In order to measure the sensitivity of surface aquifers and/or water bodies (lotic systems) each of the geographical conditions of the area will be taken into account, which means that to higher or lower degrees is covered with water (swamps, lakes, rivers, streams, etc.).

The importance is associated with the quantity of environmental services it provides, such as the supply or provision of the resource, water and climate regulation, preventing flooding. The levels of sensitivity and importance of the water resource are listed in Table 4.4-16.

Table 4.4-16. Environmental Sensitivity and Importance of Surface Aquifers.

LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
VERY HIGH	5	5	Wetland systems and zones of very high and high susceptibility to flooding, as well as areas with very good presence of the resource in lotic systems represented in water densities ranging from 2.0 to 2.5 km/km2, with very high capacity to provide water supply and regulation services.
HIGH	4	4	Areas with high susceptibility to flooding with moderate presence of the resource in lotic systems represented in water densities that vary between 1.9 and 1.5 km/km2, with high capacity to provide water supply and regulation services.
MEDIUM	3	3	Areas with a low presence of the resource in lotic systems represented in water densities that vary between 1.4 and 1.0 km/km2, with a moderate capacity to provide water supply and regulation services.
LOW	2	2	Areas with little presence of the resource in lotic systems represented in hydric densities between 0.9 and 0.5 km/km2. With a low supply of water supply and regulation services.
VERY LOW NULE	1	1	Areas with very little presence of the resource in lotic systems represented in hydric densities less than 0.5 km/km2, so that the water supply is very low or null in both supply and flow regulation.

Source: ECOPETROL, 2014.

According to the study conducted by Londoño (2001) (Conceptual bases, characterization, planning, administration), the basins can be classified according to Strhaler (1957); in Lima, W., (1986), in low drainage density (less than 5 km/km2), medium drainage density (5 - 13.7 km/km2), high drainage density (13.7 - 155.3 km/km2) and very high drainage density (>155.3 km/km2).

For both the conditions of the area of direct and indirect influence, this methodology was used as a reference since the values presented are of high ranks, as evidenced in Table 4.4-17.

Table 4.4-17. Water density values.

CORRENT	TOTAL LENGTH (km)	TOTAL AREA(km^2)	DRAINAGE DENSITY (km/km^2)	PENDING (%)	OFFER (m^3/day)
SN #1	464,41	3,91	118,77	45,30	8132,335
SN # 9	362,52	3,05	118,68	56,35	6331,721
SN #2	49,22	0,41	120,05	58,11	867,449

SN #3	8,92	0,073	122,19	46,70	167.575
SN #4	37,54	0,31	121,09	67,36	657,158
SN #5	79,10	0,66	119,85	57,93	1373,461
SN # 8	223,04	1,90	117,39	44,37	3903.521
SN #6	37,54	0,31	107,26	67,36	722.874
SN #7	9,66	0,081	119,26	45,99	167.575
TOTAL	1271,95	10,704	118,83		

Source: INGEX, 2016.

Bearing in mind that the basins with the highest drainage density are made up of erodible materials, impermeable soils, steep slopes and scarce vegetation cover; the basin is located at the next level (see Table 4.4-18).

Table 4.4-18. Sensitivity and environmental importance of surface aquifers in the Mining project "El Pescado".

LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
HIGH	4	4	Areas with currents that are found in the area of direct and indirect influence, which are located in the upper part of the basin, where the valleys are cannoned and where there are no flood plains, the risk of such events is very low. In addition, there are no major infrastructure works in this area susceptible to flood damage. Moderate presence of the resource in lotic systems represented in hydric densities that vary between 13.7 - 155.3 km/km2, with high capacity to provide water supply and regulation services. In the basin there are two dominant geomorphological types: waterfalls and wells, and rapid and wells; these results show that the basin as such does not present deposition zones, therefore in the long term it is expected that all sediments produced by erosive processes in the basin will be evacuated from it. It should be taken into account that, within the estimate carried out, no important processes were considered in the sediment production, such as the formation of gullies and furrows in the upper parts of the basin, erosion in the banks of the riverbeds and mass removal. The yield in the watersheds of the currents in the study area is around 63 l/s/km2, which is important in terms of availability of the resource, because the water used will be quickly recovered by the production of the watershed.

Source: INGEX, 2016.

According to the evaluation carried out for the sensitivity/importance of the drains, was obtained the thematic map shown in Illustration 4.4-5.

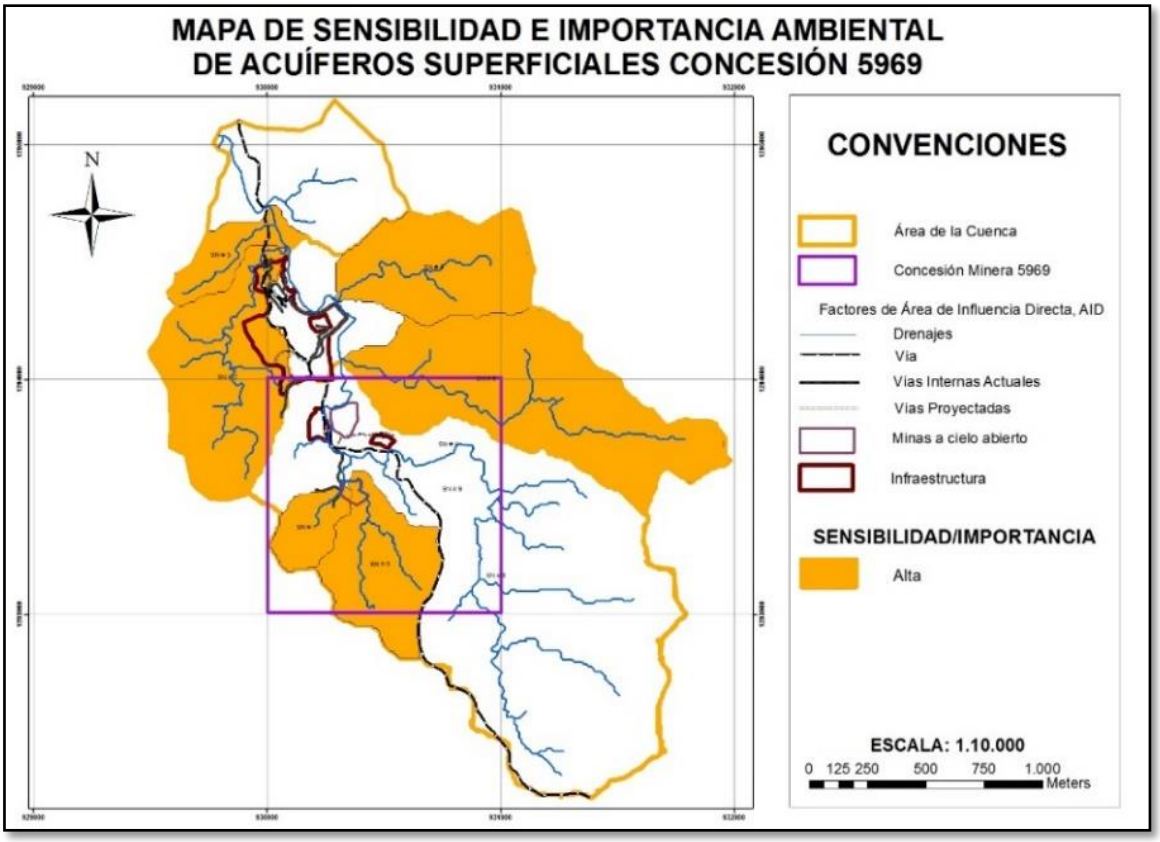

Illustration 4.4-5. Sensitivity map/environmental importance of surface aquifers (Mining concession 5969)
Source: INGEX, 2016.

4.4.1.6 Map of physical sensitivity/importance

As a result of the qualification or qualification of the environmental sensitivity and importance of the different defined areas, based on each of the components of the physical environment and previously analyzed (geotechnics stability, hydrogeology, hydrology, index of scarcity and potential land use), a localization is obtained that is reflected in the intermediate map of the physical environment, given by the relationship established between environmental sensitivity and importance based on the weighting carried out among its different categories or levels, as shown in Table 4.4-19 and Illustration 4.4-6 .

Table 4.4-19. *Sensitivity/environmental importance of the physical component*.

SENSIBILITY/IMPORTANCE
Very High
High
Medium
Low
Very Low

Source: ECOPETROL, 2014.

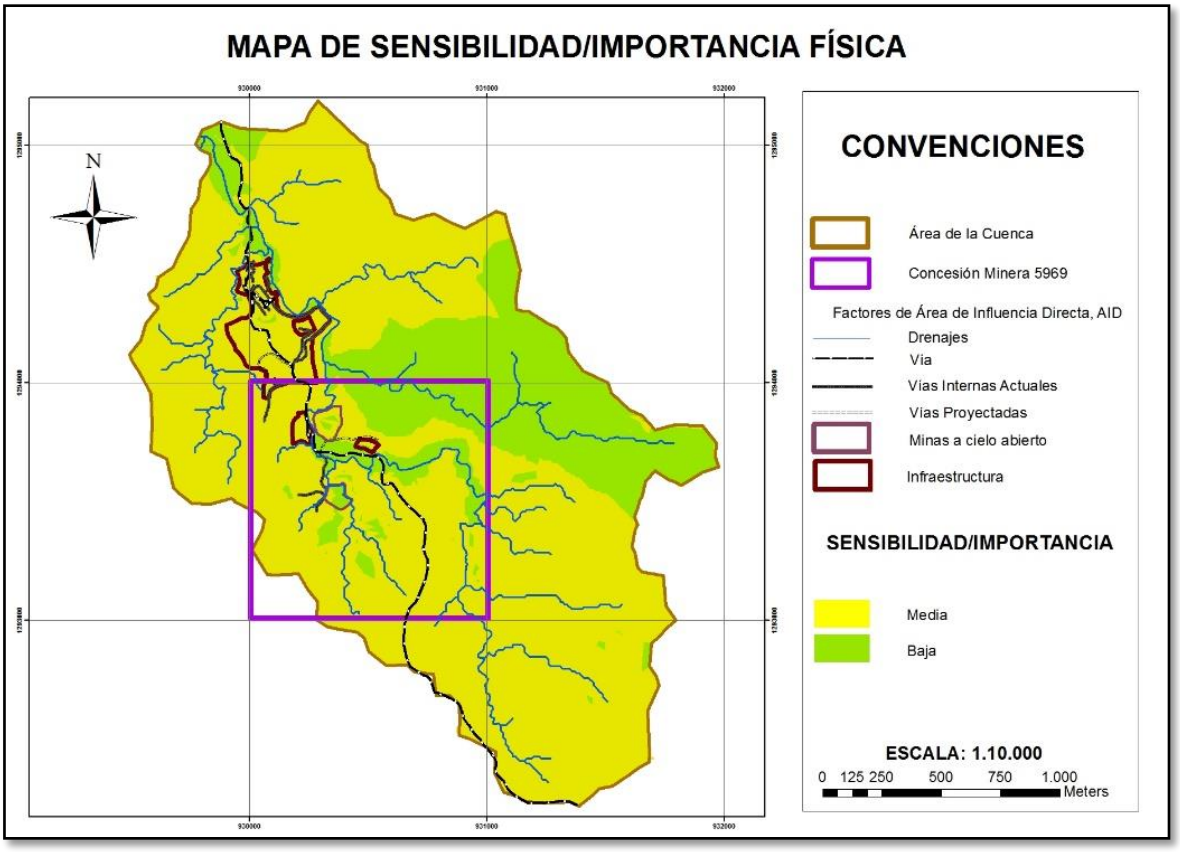

Illustration 4.4-6. Intermediate map of the physical environment.
Source: INGEX, 2016.

This map shows the category with the greatest abundance in the area, is average and some of its sectors refer to the low category, so it may be concluded that the basin is moderately susceptible of being modified by different factors, although its recovery is destined for the medium term and almost naturally. Similarly, it is important to clarify that its capacity to provide services is from low to moderate, which is why its operation would not be at risk, because it does not jeopardize its supply capacity.

4.4.2 Biotic environment zoning

Environmental zoning depends mainly on two important components, such as plant cover and wildlife. Being the first one based on land cover localization, using the Corine Land Cover methodology adapted for Colombia (2010), and the fauna component, focused on the degree of fragmentation of ecosystems and their connectivity in relation to indicator species (ECOPETROL, 2014).

Based on the above, it is important to evaluate each one of the necessary elements and characteristics in a detailed manner, according to the project conditions.

4.4.2.1 Land covers

Plant coverings were determined according to Ortofoto (2012) and updating through field trips (2016), evaluating the interaction of multiple biotic and abiotic factors, both natural and anthropic, using the methodology of Corine Land Cover adapted for Colombia by the Institute of Hydrology, Meteorology and Environmental Studies (IHME) and the Ministry of Environment, Housing and Territorial Development (MEHTD), currently the Ministry of Environment and Sustainable Development (MESD).

4.4.2.1.1 Coverage environmental sensitivity

According to ECOPETROL (2014), in its methodology for the elaboration of environmental zoning, zoning is considered to be the environmental sensitivity of land cover based on the intrinsic capacity of each type of cover that makes it more or less susceptible to being altered or modified in its structure and/or operation by external actions or conditions. Coverage that is altered with a slight intervention or modification is more sensitive, presenting greater difficulties in recovering or returning to its original state. In the same way, they propose levels of environmental sensitivity as those presented in Table 4.4-20

Table 4.4-20. Description of environmental sensitivity levels of land cover.

SENSIBILITY LEVEL	DESCRIPTION
VERY HIGH	Coverages very susceptible to being altered or modified in their structure and/or functioning by actions or relatively mild external conditions. They are very intolerant to disturbance with very little or no resilience in the long term.
HIGH	Coverages susceptible to being altered or modified in their structure and/or functioning by relatively mild external actions or conditions. They are intolerant of disturbance with low resilience in the long term, where management measures must be adopted.
MEDIUM	Coverages moderately susceptible to being altered or modified in their structure and/or functioning by relatively mild external actions or conditions. They are moderately tolerant of disturbance with resilience in the medium term, through the adoption of management measures.
LOW	Coverages not susceptible to being altered or modified in their structure and/or functioning by actions or relatively strong external conditions. They are disturbance tolerant with good resilience in the medium term naturally.
VERY LOW	Coverages which are very unlikely to be altered or modified in their structure and/or functioning by very strong external actions or conditions. They are very tolerant to disturbance with good resilience in the short term naturally.

Source: ECOPETROL, 2016.

The following table shows the rating and/or weighting for the valuation of the land cover at sensitivity level in the project "El Pescado" (See Table 4.4-21)

Table 4.4-21. Land covers types and their respective sensitivity level.

LAND COVER TYPES				
Land cover units with vegetation				
Forests	BOSQUE DENSO	Low dense forest	Underground dense forest.	HIGH
Herbal and/or shrub vegetation	SECONDARY VEGETATION OR IN TRANSITION	Lower secondary vegetation		MEDIUM
Agricultural Territories	PERMANENT CROPS	Permanent tree cultivation		LOW
		Permanent herbaceous crop		
	PASTURES	Clean Grasses		LOW
Artificialized Territories	URBAN FABRIC	Urban discontinuous fabric		VERY LOW

Source: INGEX, 2016.

4.4.2.1.2 Environmental importance of the coverages

The environmental importance is given by the capacity of land cover in providing social, economic, cultural and environmental services to the environment in which it is located; in order to evaluate this criterion, the following classification of the ECOPETROL methodology (2014) is proposed (See Table 4.4-22)

Table 4.4-22. Description of the levels of environmental importance of land cover.

IMPORTANCE LEVEL	DESCRIPTION
VERY HIGH	Coverages with very high capacity to generate and offer environmental goods or services to the surrounding environment (habitat of wild fauna and flora species, water regulator, soil protection, conservation of the landscape, etc.) due to their high degree of conservation, which in the event of any alteration lose their supply capacity in the short term. e. g. dense forests and water-related coverings such as swamps, marshes, wetlands.
HIGH	Coverages with a low degree of intervention and therefore a high capacity to generate and offer social and/or environmental goods or services to the surrounding environment (habitat of wild fauna and flora species, water regulator, soil protection, landscape conservation, etc.), which in the medium term may lose its supply capacity due to any alteration. e. g. open or fragmented forests and coverages related to succession processes such as upper secondary vegetation or forests planted for protection purposes.
MEDIUM	Coverages with a moderate degree of intervention, which generates a moderate capacity to produce and offer social and/or environmental goods or services to the surrounding environment (habitat of wild fauna and flora species, water regulator, soil protection, landscape conservation, etc.), which, faced with relatively significant alterations, lose part of their supply capacity in the medium term. e. g. land grasslands, low secondary vegetation, etc.
LOW	Altered coverages with low capacity to generate and offer social and/or environmental goods or services to the surrounding environment (habitat of wild fauna and flora species, water regulator, soil protection, landscape conservation, etc.), so that in the event of severe alterations its supply capacity is not altered in the short term. e. g. wooded or weeded grasses and some types of crops.
VERY LOW	Highly altered coverages with very low capacity to generate or offer social and/or environmental goods or services to the surrounding environment (habitat of wild fauna and flora species, water

	regulator, soil protection, conservation of the landscape, etc.), so that in the event of very severe alterations, there is no longer any variation in their potential to provide services.

Source: ECOPETROL, 2014.

In accordance with the aforementioned parameters, the weighting for each one of the land cover at importance level is carried out according to the vegetation and the services offered, as illustrated in Table 4.4-28 and Illustration 4.4-7.

Table 4.4-23. Land covers types and their respective level of importance.

LAND COVER TYPES				
Land cover units with vegetation				
Forest	DENSE FOREST	Low dense forest	Underground dense forest.	HIGH
Herbal and/or shrub vegetation	SECONDARY VEGETATION OR IN TRANSITION	Low secondary vegetation		MEDIUM
Agricultural Territories	PERMANENT CROPS	Permanent tree cultivation		LOW
		Permanent herbaceous crop		
	PASTURES	Clean pastures		LOW
Artificial Territories	URBAN FABRIC	Urban discontinuous fabric		VERY LOW

Source: INGEX, 2016.

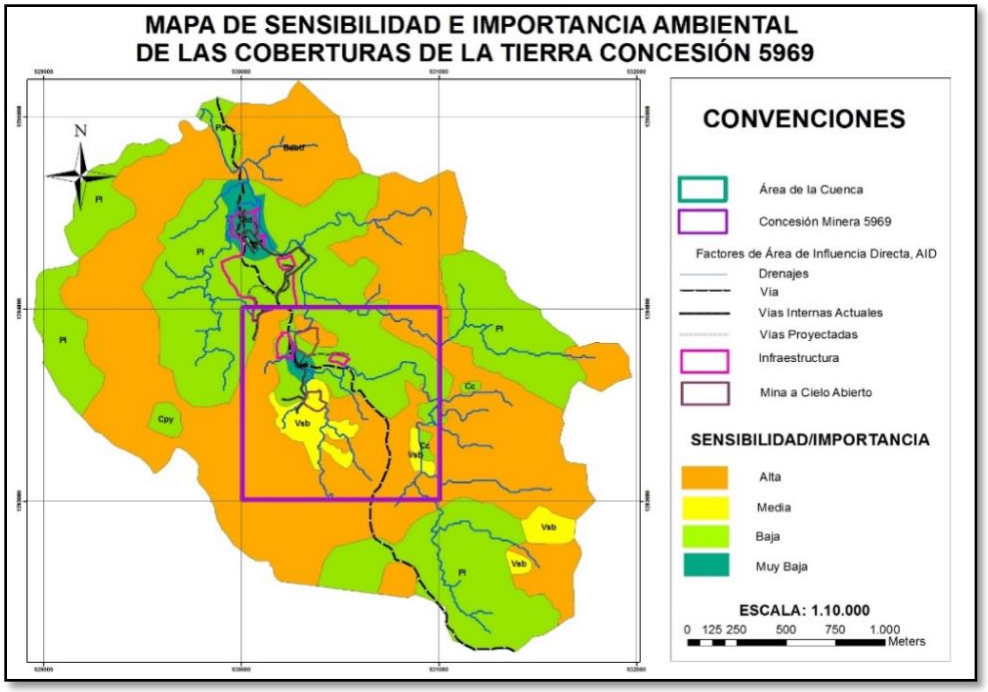

Illustration 4.4-7. Environmental Sensitivity/Importance of Land Cover (Mining title 5969).
Source: INGEX, 2016

4.4.2.2 Fragmentation and connectivity of ecosystems

The vision and interpretation of connectivity is developed from the ecology of the landscape and is based on an approach that is both structural-morphological and functional; in other words, it analyses the structural and morphological characteristics that make up a territory and its ecosystems at a given moment and/or their evolution over time or as a result of a transformation, while at the same time inferring their impact in terms of ecological functionality (Forman & Godron, 1986).

In accordance with the methodology used by ECOPETROL (2014), fragmentation means a rapid decrease in biodiversity and the size of many populations (flora and fauna), modifying the structure of ecosystems, limiting the exchange between populations.

In order to meet the objective of establishing the relationship between connectivity and the provision of ecosystem services, the composition of flora and fauna species presented in the baseline is integrated in an integral manner into each patch (availability of habitat) in structural terms, and in relation to functionality is estimated using a connectivity model.

The composition of the patches in terms of richness, rarity and diversity, together with their configuration or spatial distribution, are aspects that help to define the structural capacity of connectivity, as shown in Table 4.4-24:

Table 4.4-24. Number of patches and area per type of coverage.

Type of Coverage	Number of patches	Area per type of coverage m2
Underground dense forest (Bdbtf)	6	1.795.488,65
Cocoa Crops (Cc)	2	12.975,13
Wooded grasses (Pa)	1	27.549,64
Clean pastures (Pl)	4	1.800.069,65
Urban discontinuous territory (Tud)	2	95.958,32
Lower secondary vegetation (Vsb)	4	167.520,17
Total landscape area	-	3.899.561,5

Source: Renaturar, 2016.

This type of quantitative data should be analyzed in its context: although the Bdbtf is one of the two largest coverages, it is also the type with the greatest number of patches, which does not necessarily make it a fragmented coverage. Understanding fragmentation as "Dynamic process by which a given habitat is reduced to smaller patches or islands, more or less connected to each other in a habitat matrix different from the original" (Forman, 1995).

In the map of resistance or lower cost for functional connectivity of the landscape, the lowest costs were found around forest coverings, secondary vegetation and agroforestry crops (cocoa) with moderate slopes. The greatest cost that prevents movement was found in clean pastures, with high slopes, near roads and discontinuous urban fabric.

The connectivity of the landscape is mainly due to the presence of forest cover, structure and habitat, which facilitates the movement and dispersion of species, genetic exchange and other ecological flows. Although the cost of friction in the landscape does not directly alter the forest cover in the area, it is possible that the effect on the availability and quality of the water resource (by the confluence of ravines) may affect the quality of the habitat in some way.

This is why the importance of connectivity in each fragment is given according to the areas of vital domain or daily travel distances of the wildlife groups that have been recorded in the area. The methodology used proposes the following qualification levels (sensitivity and importance).

Table 4.4-25. Levels of sensitivity and importance of fragmentation of forest ecosystems.

LEVEL	SENSIBILITY	IMPORTANCE
VERY HIGH	Forest cover with a high degree of intervention and a very low number of remaining fragments, of very small sizes, irregular shapes, very distant, with very low connectivity. Areas with fragmentation category in transition and patch, where due to the decrease in density with values? 0.4, they allow to detect less connectivity, with a difference in the probability of connectivity dPC =0.02	Because of the very high level of intervention and its very high degree of fragmentation, the importance of these remaining coverages is very high, as they become almost unique relics that must be conserved in order to guarantee the supply of ecological services they provide.
HIGH	Very intervened forest coverings with a low number of fragments remaining, small, irregularly shaped, distant with low connectivity. Areas with edge fragmentation category, where the density is greater than 0.6 and the difference between density and connectivity is less than zero and a difference in the probability of connectivity, dPC =0.03	Given the intervention suffered, there is little connectivity of these remaining forest coverings; the importance is high since the fragments harboring a significant diversity of species, which has a direct impact on the conservation of the ecological services offered.
MEDIUM	Wooded coverings with a moderate number of remaining fragments, with regular shapes, medium sizes and some connectivity between patches. Areas with perforated fragmentation category, where changes in shape, detection of clearances or disturbances have density greater than 0.6 and the difference between density and connectivity is greater than zero and a difference in the probability of connectivity, dPC =0.05	Moderately intervened forest coverings, whose remaining fragments present an intrinsic species composition, with a diversity of medium species that provide some importance for the conservation and supply of ecological services.
LOW	Wooded coverings with little intervention and a few fragments of great size, of more regular shapes, with a high connectivity. Inner areas whose density decreases its value to 0.9 and maintains connectivity equal to 1.0 and a difference in the probability of connectivity dPC =0.1	Remaining forest cover with low fragmentation as a result of moderate to low intervention, which means the importance of the species is low, given that a large part of the forest species and ecosystems are still conserved.

VERY LOW	Well preserved forest cover with very few fragments given the very little intervention, fragments of considerable size and high connectivity. Very low fragmentation with nuclear 22 areas identified with the highest values of density and connectivity, equal to 1.0 and a difference in the probability of connectivity dPC =0.8.	Forests with very low fragmentation, due to little intervention, which makes the relictual importance of species and ecosystems very low since it is important to protect the environment. Very well conserve the representative species of these forest ecosystems.

Source: ECOPETROL, 2014.

Based on the data obtained in the ecological connectivity and taking into account the results for each of the coverage patches present on the area, in addition to the functionality and structure of each of them, the following classification is obtained (See Table 4.4-26).

Table 4.4-26. Levels of sensitivity and importance of fragmentation of forest ecosystems.

LEVEL	SENSIBILITY	IMPORTANCE
MEDIUM	The forest cover of this area still has characteristics that allow forest species to live in this place, as it has a border density a little higher than the other coverages, allowing an ecotone of it to exist with the matrix. When a patch has irregular shapes, they are more in line with the forms of ecosystems and habitats, making the abiotic factors change less wild; therefore, the forest cover has a higher index, for other coverings this index is very similar.	This coverage is moderately affected by mining activities, extensive livestock farming, agriculture and so on, which has been causing the extension of managed and/or clean pastures to be the coverage with the greatest area extension, which hinders the mobility of forest animals that are more demanding in their ecological requirements, thus facilitating the presence of generalist species (Forman & Godron, 1986; Forman, 1995). According to the baseline studies, forest cover is in a good state of conservation, which gives importance to the availability of ecosystem services such as water regulation, soil protection, conservation of fauna and flora species. It can be inferred from this that deforestation rates will continue to increase fragmentation and disadvantage the connectivity and delivery of ecosystem services.

Source: Renaturar, 2016.

Once the sensitivity and importance of ecological connectivity at the location was known and qualified, the result was the following map.

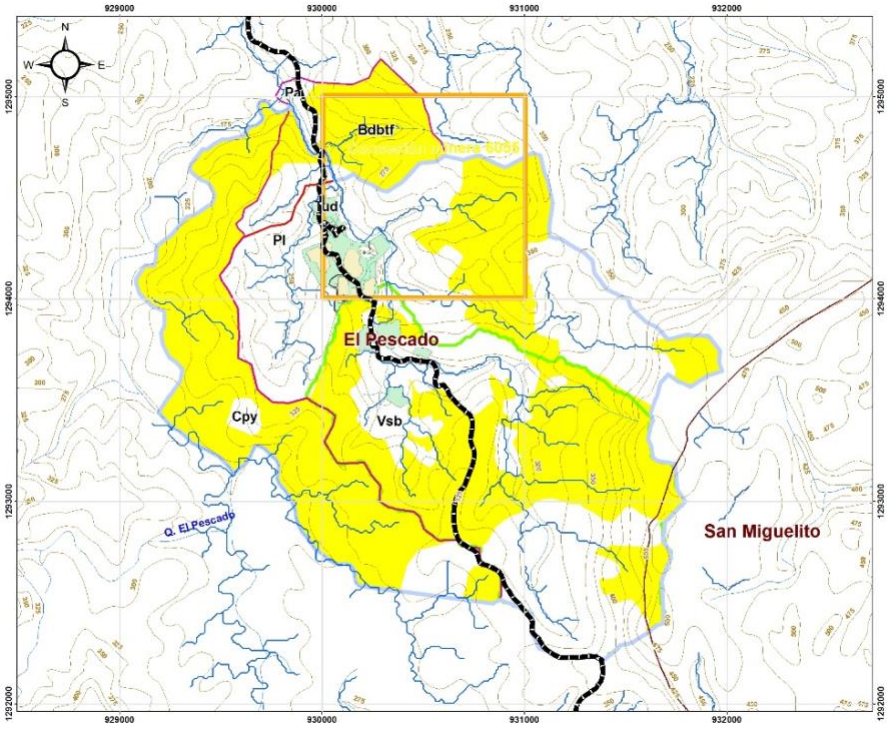

Illustration 4.4-8. Sensitivity/Importance ecological connectivity.
Source: INGEX, 2016.

Once the maps for the biotic environment have been made, they are indexed in order to know their final qualification and/or classification as shown in the following illustration (Illustration 4.4-9).

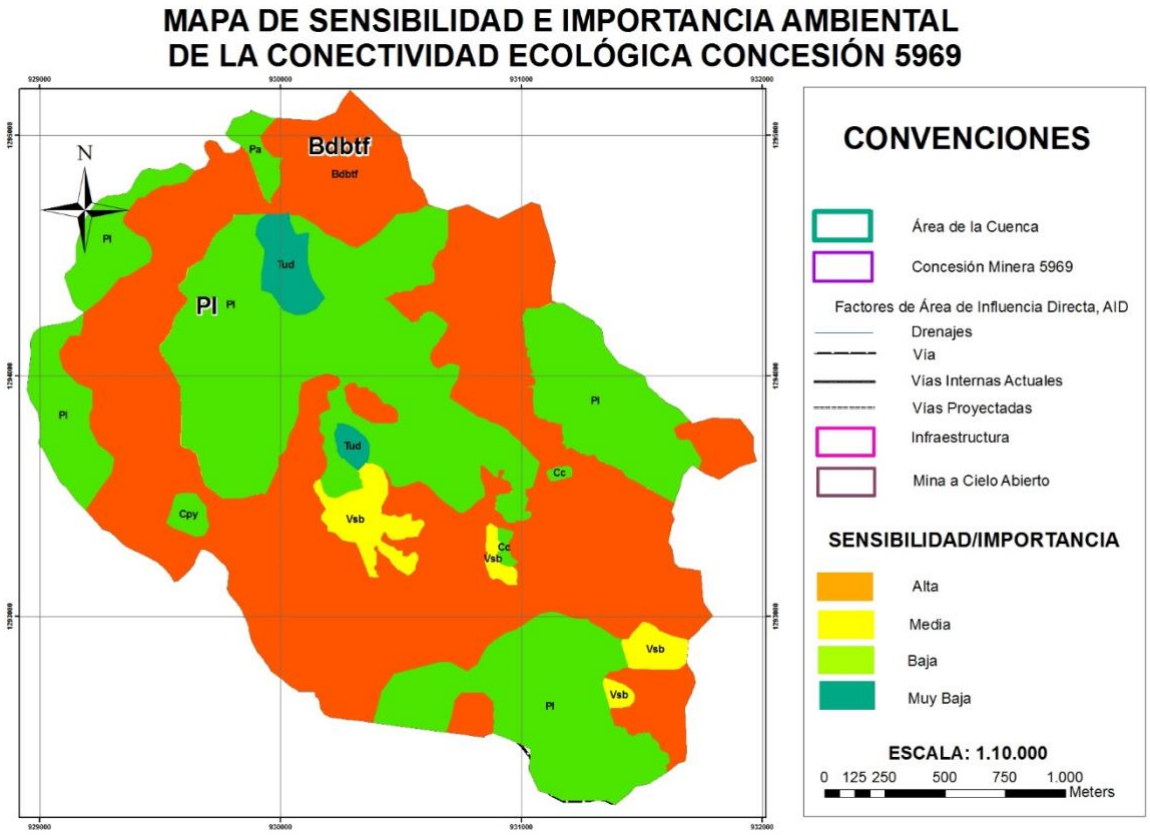

Illustration 4.4-9. Environmental Sensitivity and Importance for Ecological Connectivity.
Source: INGEX, 2016

4.4.3 Zoning of the socio-economic and cultural environment

Socio-economic zoning allows knowing the current state of the communities, taking into account both the sensitivity and importance of these communities to any alteration in their current conditions, as well as being a technical instrument for characterizing the territory. In this sense, it is important to know the Territorial Planning, since it enables to identify and analyze the social and economic dynamics, change in land use, population, among other aspects (Ministry of the Environment Republic of Peru, 2015).

Zoning does not establish uses but proposes several alternatives that lead to managing the impact that some activities can generate, making them more profitable and reducing conflicts.

For the location of each of the social, economic and cultural variables for "El Pescado" mining project, the following variables will be taken into account:

4.4.3.1 Political-administrative division

4.4.3.1.1 Community organization and areas of participation

Community organization is the structure given to a group of people to function according to a common goal, a common interest or problem that requires unity in achieving it (Food and Agriculture Organization of the United Nations-FAO, 2008). In order to carry out the proper zoning, non-profit organizations that carry out activities and / or management necessary for the specific interests of the community will be considered (ECOPETROL, 2014)

One of the best- known forms of community organization is the Communal Action Board approved by Law 743, 2002, issued by the Congress of the Republic, based on article 38 of the Colombian Constitution, which states*: "The right of free association is guaranteed for the development of the different activities that people carry out in society".*

That is why the Ministry of the Interior and Justice considered these as a mechanism for citizen participation. These organizations even become community representatives in areas where there are no Community Action Groups.

In accordance with the methodology used by ECOPETROL (2014) the sensitivity of a community is given by the existence or ease of organizing itself to conceive and develop common goals, generate social fabric, as well as by the capacity to manage programs or projects, both internally and with other actors or institutions. The importance is inversely proportional to the levels of sensitivity that communities present, from an organizational point of view, communities with a low level of community organization (high sensitivity) present a very low capacity to provide goods or services to their environment or the project itself (Table 4.4-27).

Table 4.4-27. Levels of sensitivity and importance by community organization.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
TOTAL ABSENCE OF SOCIAL ORGANIZATIONS (JAC, NGOs, associations)	VERY HIGH	VERY LOW	Inexistence of any social organization, there is disarticulation among the members of the community and lack of management before other social or institutional actors, whether public or private. Given the absence of organization, it is highly unlikely that it can provide a social, environmental, economic or cultural good or service.
ABSENCE OF REPRESENTATIVE SOCIAL ORGANIZATION (JAC, NGOs, associations)	HIGH	LOW	Little or no social organization presents difficulties in the organization, drawing common goals, there is disarticulation among members of the community and lack of management before other social actors or public or private institutions.

			Given the lack of organization, it is unlikely that it can provide a social, environmental, economic or cultural good or service.
BASIC ORGANIZATIONS (presence of JACs)	MEDIUM	MEDIUM	There is at least one JAC legally recognized as community representatives; there is no evidence of networking with other organizations and their management capacity is weak. They present a moderate capacity to provide goods or services to the project, environment or region.
COMMUNITIES INCIPIENTLY ORGANIZED (JAC, NGOs, associations)	LOW	HIGH	The functioning and representation of the JAC (s) is evidenced, along with one or two (2) associations that interact with state or private institutions. In some cases, they may present incipient social networking organizations working on issues of territorial and/or community interest. They have a high capacity to provide goods or services to the project, environment or region, based on the articulation of its members, its management and organizational potential.
HIGHLY ORGANIZED COMMUNITIES (HIGHLY ORGANIZED COMMUNITIES (JAC, NGO' s, associations)	VERY LOW	VERY HIGH	The functioning and representation of the JAC (s) is evidenced, along with more than two (2) associations or associations that interact with state or private institutions. Presents organizations with social networks that work on topics of interest to their community and/or territory. They have a very high capacity to provide goods or services to the project, environment or region, based on the articulation of its members, its management and organizational potential.

Source: ECOPETROL, 2014

In accordance with the established methodology and the social study that was advanced in El Pescado Mining Project, it was determined that the El Pescado sidewalk currently does not have a Communal Action Board (JAC by its initials in Spanish) duly formed because, according to some inhabitants' version, it is in the process of organization because it has been considered unnecessary and due to difficulties and disinterest of the inhabitants of the village. The closest trails to El Pescado with JAC are Laureles and San Miguel. These have developed activities and actions by the communities, which have included the inhabitants of El Pescado. There have also been joint efforts by community initiative, such as the improvement of access roads, links and processing of State services, activities and procedures before the Secretariat of Mines and requests to officials of the Municipal Unit for Agricultural Technical Assistance (UMATA).

This behavior has become a kind of "social code of conduct" that influences decisions at all levels and the precarious levels and demotivation of social and community organization. In essence, People see with little interest the scenarios of organization and management, in many cases, results or access to immediate resources. An additional factor is the armed conflict that has generated demotivation and

even fear among the communities because sometimes, according to local narratives, it is not well seen by armed conflict actors that communities organize themselves and leaders are often considered threats to the interests of the conflict participants.

Therefore, and according to the results obtained, during the workshops and socializations, the area was classified as follows:

Table 4.4-28. Sensitivity and importance by community organization.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
TOTAL ABSENCE OF SOCIAL ORGANIZATIONS (JAC, NGOs, associations)	VERY HIGH	VERY LOW	The trails El Pescado and Cuturú Abajo, currently does not have a Community Action Board (JAC) duly formed because, according to some inhabitants' version, is in the process of organization because it has been considered unnecessary and due to difficulties and disinterest of the inhabitants of the trail. Given the absence of organization, it is highly unlikely that it can provide a social, environmental, economic or cultural good or service.
BASIC ORGANIZATIONS (presence of JACs)	MEDIUM	MEDIUM	There is at least one JAC, which is constituted in Laureles, where community representatives are legally recognized. In the same way, activities and actions have been developed on the part of the communities, which have included the inhabitants of El Pescado and Lower Cuturú, as well as projects on the community's own initiative.
ORGANIZED INCIPIENT COMMUNITIES (JAC, NGOs, associations)	LOW	HIGH	There is evidence of the functioning and representation of the Community Action Board, in addition to the Corporation for the development of Machuca, Association of Afro-descendants. Fraguas is the closest population center to the project's operating area. It is located on the side of the road that connects the municipalities of Segovia and Zaragoza and a local pantry of products and some services.
HIGHLY ORGANIZED COMMUNITIES (JAC, NGOs, associations)	VERY LOW	VERY HIGH	In the municipality of Segovia, the presence of the main private organizations is evident, among them are those belonging to the mining guild (mentioned in the cultural dimension), trade unions (those that belong to SINTRAMIENERGETICA) and the organization that brings together the different JACs of the municipality called ASOCOMUNAL, ASOGROPO: Promotion of agriculture and clean production management in agricultural processes in the municipality of Segovia, JUME by its initial in Spanish. Municipal Board of Education and Visitors of the Sisben. As a central aspect to be highlighted in the different forms of organization and their concrete expressions, the following characteristics and characteristics are identified: cojunctural character and orientation to private or union interests, high dependency on the main leaders, low management capacity,

			informality in their internal dynamics, low capacity to influence policies, scarce generation of resources for their associates or general coverage benefits.

Source: INGEX, 2016.

Finally, as a distinctive feature of community participation and decision-making processes, there is an almost total absence of development planning processes for communities and territories and formal management processes before the authorities. Instead, it is typical to look for administration officials on the days of attention set aside to make usually verbal requests or requests for resource management or problem-solving, as related in the chapter 4.3.2.5.1.3 and 4.3.2.5.2.3 of the socioeconomic environment. Illustration 4.4-10 shows clearly the relationship between the sensitivity and importance of community organization in this region, according to the weighting of its qualifications, as well as evaluating its existence and legalization.

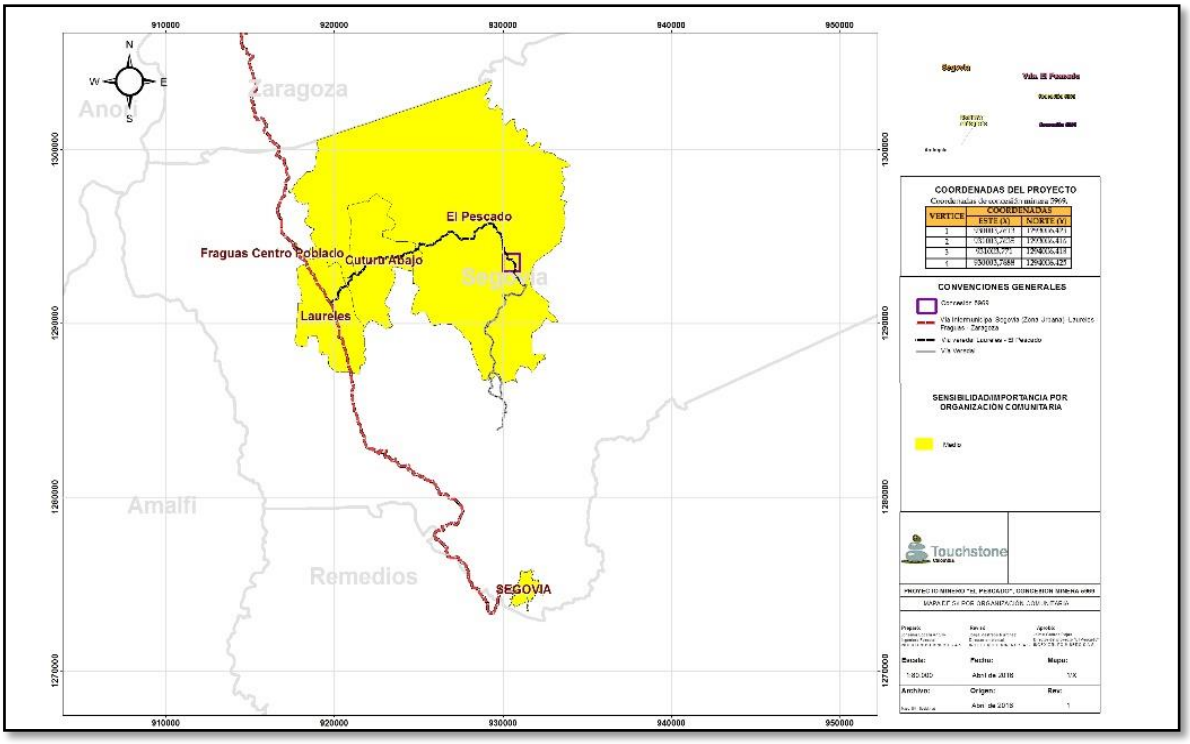

Illustration 4.4-10. Community Organization Map.
Source: INGEX, 2016.

4.4.3.1.2 State presence and other organizations

The presence of public and/or private institutions is of great importance to guarantee the rights of the inhabitants, in addition to providing basic services such as health services, education, culture, recreation, environmental protection, housing, disaster prevention and care, among other dependencies.

The sensitivity of a community is based on the intervention of the State and/or other organizations that support development, in such a way that the greater the presence of the State, the less the community's sensitivity to the changes that may be generated. Conversely, the socio-economic and cultural importance of a community is inversely proportional to that of sensitivity. The greater the sensitivity, the less importance or capacity there will be to provide goods and services to the community or its environment (ECOPETROL, 2014).

Table 4.4-29. Levels of Sensitivity/Importance by presence of the State and other organizations.

DEGREE/LEVEL	SENSIBILITY	IMPORTANCE	DETERMINANT
TOTAL ABSENCE	VERY HIGH	VERY LOW	State and non-governmental institutions have not taken any action in the territory, which is evidenced by the lack, inoperativeness or deterioration of community facilities, roads and service networks. The ability to provide socio-economic goods and services is virtually non-existent.
PRESENCE INCIPIENT	HIGH	LOW	State and non-governmental institutions have carried out incipient actions in the territory, which is evidenced by the lack, ineffectiveness or deterioration of community facilities, roads and service networks. The capacity to provide socio-economic goods and services is low.
BASIC PRESENCE	MEDIUM	MEDIUM	State and non-governmental institutions have been involved in some basic actions for the provision of public services, education and health. This is evidenced by the characteristics of community facilities, roads and service networks. This community has a moderate capacity to provide socioeconomic goods and services to both its regional environment and the project itself.
GOOD PRESENCE	LOW	HIGH	There is normal evidence of the actions of state institutions in the territory, through the execution of projects that guarantee the welfare of the community, have the appropriate participation of non-governmental organizations, resulting in the development and progress of the community. This community has a good capacity to provide socioeconomic goods and services, both to its regional environment and to the project itself.
GREAT PRESENCE	VERY LOW	VERY HIGH	The constant action of state institutions in the territory is evidenced by the execution of projects that guarantee the well-being of the community. There are quite a number of programs and projects carried out in the territory by non-governmental organizations or corporate social responsibility of private companies. This community has a very good capacity to provide socioeconomic goods and services, both to its regional environment and to the project itself.

Source: ECOPETROL, 2014.

Therefore, it was possible to identify that the area of direct influence (Laureles, Fraguas and El Pescado), the institutional presence in the sidewalks of AID, is given by coverage of the services

offered in the municipal capital or in the town center Fraguas. Occasionally, it is known that vaccination days are held for children, health brigades, and care of some government departments such as UMATA to provide technical advice to farmers. Finally, as a distinctive feature of community participation and decision-making processes, there is an almost total absence of development planning processes for communities and territories and formal management processes before the authorities.

For the Indirect area of influence, as a central aspect to be highlighted in the different forms of organization and their concrete expressions, the following characteristics and traits are identified: cojunctural character and orientation to private or union interests, high dependence on the main leaders, scarce management capacity, informality in their internal dynamics, low capacity to influence policies, scarce generation of resources for their associates or general coverage benefits.

According to the information gathered in the field and following the guidelines of the methodology mentioned above, the following assessment was given for both the AID and the IIA (See Table 4.4-30 and Illustration 4.4-21).

Table 4.4-30. Levels of sensitivity and importance due to the presence of the State and other organizations.

DEGREE/LEVEL	SENSIBILITY	IMPORTANCE	DETERMINANT
INCIPIENT PRESENCE	HIGH	LOW	The institutional presence in the villages of AID, is given by coverage of services offered in the municipal capital or in the town center Fraguas. Vaccination days for children, health brigades, and care of some government agencies such as UMATA to provide technical advice to farmers are also known. There is no record of public organizations other than JACs in the AID. Private organizations include churches and religious services.
BASIC PRESENCE	MEDIUM	MEDIUM	Among the organizations identified in the town center Fraguas include the Corporation for the development of Machuca, Association of Afro-descendants. For Segovia, in addition to those already mentioned, we count ASOGROPO: Promotion of agriculture and clean production management in agricultural processes in the municipality of Segovia, JUME. Municipal Board of Education and Visitors of the Sisben.
GOOD PRECENSE	LOW	HIGH	The government of Antioquia and the mayor's office of Segovia develop activities, programs, plans and projects of benefit to the communities with two identified origins: those that are projected in the local development plans and that have budgetary allocations or that have resources for transfers from the state at the departmental or national level. The other origin is cojunctural and it is due to the urgency or necessity of giving a punctual response to the situations that arise in the locality. Among the main private organizations are those belonging to the mining guild (of which mention was made in the cultural

			dimension), trade unions (those that belong to SINTRAMIENERGETICA).

Source: INGEX, 2016.

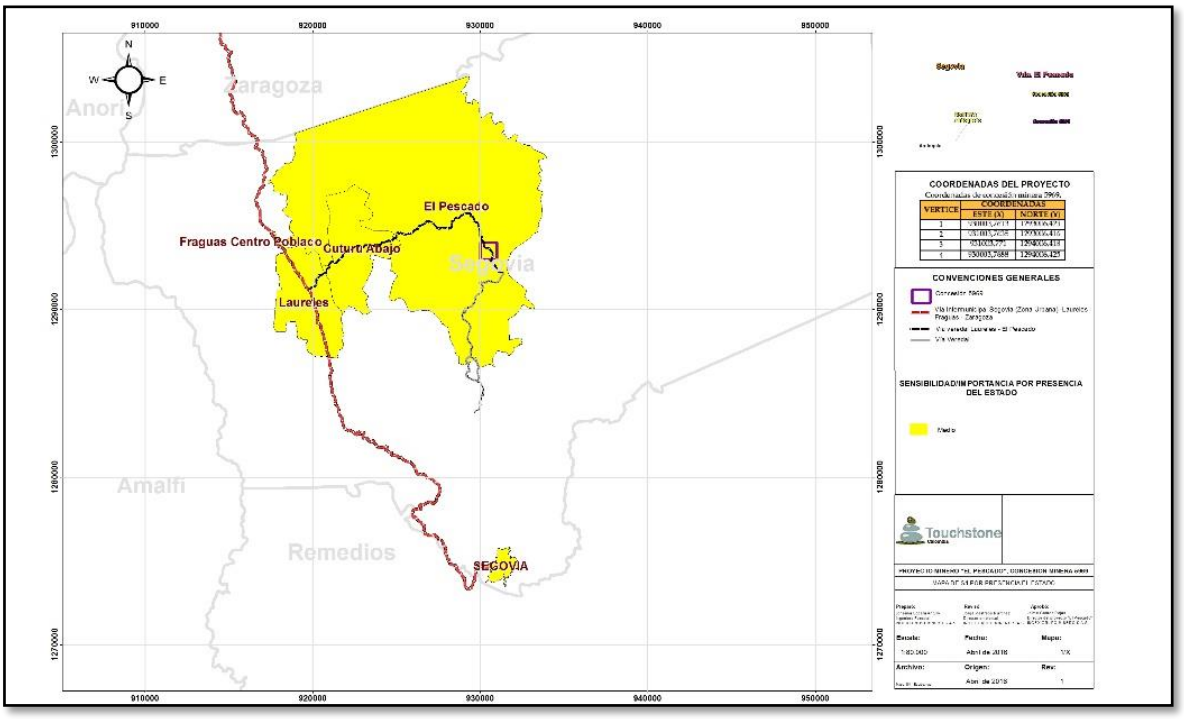

Illustration 4.4-11. Map of Sensitivity and Importance due to the presence of the State and other entities.
Source: INGEX, 2016.

4.4.3.2 Economic Dimension

The economic dimension assesses the various ways of meeting human needs and assessing each of the aspects that are part of them, in addition to the resources available. Similarly, primary, secondary and tertiary production systems are part of this system.

4.4.3.2.1 Economic use and destination of the land

This component refers mainly to the actions, activities and interventions that people undertake on a given type of surface to produce modify or maintain it (FAO/UNEP, 1999).

According to the methodology proposed by ECOPETROL (2014) the social sensitivity of communities to the generation of an alteration or change is given by the intensity of use of the territories, being more sensitive to those that present a more intensive use than those that by their characteristics or type of tenure present an extensive use. The social importance is also directly proportional to the

intensity of land use, so that it is more important in soils with a high level of use. In Table 4.4-31, the values to be weighed are presented.

Table 4.4-31. Level of Sensitivity/Importance by use Economic destination of the soil.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
USE SUPERINTENSIVO	VERY HIGH	VERY HIGH	Areas with a very high use or demand for land use, generally associated with a higher population concentration, dedicated to housing, industrial production, *(urban areas, agricultural areas of bread cog, agro-industrial areas)* They present a high capacity for the provision of social goods and services, given the level of use they show.
INTENSIVE USE	HIGH	HIGH	Areas with a high use or demand for land use, generally associated with higher productivity of soils or market demand, dedicated to agro-industrial, agricultural or livestock production in an intensive or technical manner. *Agricultural areas of bread catch, agro-industrial zones - agroforestry.* They have a high capacity to supply social goods and services, given the level of productivity they show.
NORMAL USE	MEDIUM	MEDIUM	Areas with a moderate degree of land use or demand, generally associated with a moderate productivity of the soil or market demand, dedicated to agricultural or livestock production in a semi-intensive manner. *Agricultural and livestock areas of normal use.* They have a moderate capacity to provide social goods and services, given the level of productivity they show
SEMI-INTENSIVE USE	LOW	LOW	Areas with a low degree of land use or demand generally associated with low productivity soils, mainly dedicated to livestock or forest production. They have a low capacity to provide social, economic or cultural goods and services, given the level of productivity they show
EXCESSIVE USE	VERY LOW	VERY LOW	Areas with very low levels of land use or demand, generally associated with low accessibility, low productivity, abandoned or dedicated to conservation (forests, stubbles, abandoned areas, and bare areas). From a socio-economic and cultural point of view, they have a very low capacity for the provision of social goods and services, given the level of productivity they show.

Source: ECOPETROL, 2014.

According to the IIA and AID study, the northeast is the second largest gold-producing sub region in Antioquia (after Low Cauca). However, this activity is characterized by adding little value by being purely extractive and by the high degree of informality. In the agricultural sector, livestock farming and cocoa production stand out, which to date has enjoyed a great boom in the region due to the

impetus and promotion it has received from state agencies and transformation companies seeking to expand the national offer (See Table 4.4-32 and Illustration 4.4-12).

Table 4.4-32. Level of Sensitivity/Importance by economic use of the land.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
SEMI-INTENSIVE USE	LOW	LOW	The AID for the present SDA presents a subsistence economy, with high levels of precariousness, NBI and poverty, lack of infrastructure and generally low productivity. The productive activities of the AID premises are of a basic nature, without any degree of specialization. No production of processed or processed goods or products for marketing was recorded. The main activities of the area are agriculture (Agriculture, livestock), as well as crops such as banana, cassava, corn, rice, pineapple, cocoa and citron. The main economic activity is artisanal mining.
NORMAL USE	MEDIUM	MEDIUM	The vocation of the municipality of Segovia is oriented towards the primary sector. The characteristics of this sector at the IIA level are the low level of technification and the low level of incorporation of value into productive processes and the precariousness of skills of the workforce other than those engaged in mining. The only company in the primary sector that has significant weight in local and regional GDP is the Zandor Capital, dedicated to mining. Other entrepreneurial initiatives do not have a significant weight and in most cases, are directly related to the agricultural sector, on a small scale and with incipient levels of investment and development.

Source: INGEX, 2016.

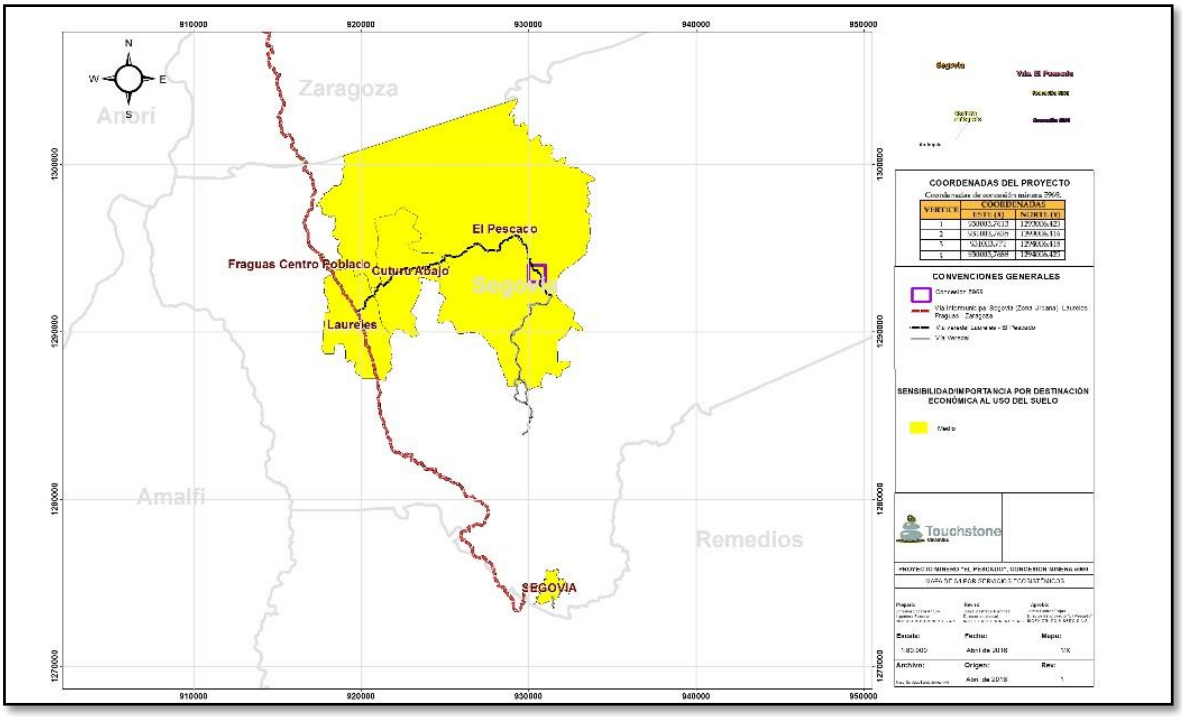

Illustration 4.4-12. Map of Sensitivity/Importance by use to the economic destination of the land.
Source: INGEX, 2016

4.4.3.2.2 Property Size

Depending on land titling and the extent of land ownership, it is possible to determine the socio-economic characteristics of a region. For this purpose, the classification determined by UFA's (Family Agricultural Units – UFA by its initials in Spanish) is taken into account. The Family Agricultural Units, as stipulated by resolution 1133 of 2013, is defined as a unit of economic measure translated into the necessary hectares, so that, in a given place, a rural family has the income necessary to obtain a dignified life and the sustainability of their productive activity. In the following table, day units are written for two regions of the country (Table 4.4-33)

Table 4.4-33. Family Agricultural Units applied to two different regions.

TYPE OF PROPERTY	NUMBER OF (UAF)	MOUNTAIN RANGE AREA (Has)	IN ELEVATED AREAS (Has)
Small rural producer	2	<156	<234
Medium rural producer	2 a 5	156 a 290	234 a 585
Large rural producer	>5	>290	>585

Source: ECOPETROL, 2014.

In accordance with the guidelines proposed by the ECOPETROL zoning methodology (2014), the following levels or categories will be considered, according to the size of the properties (See Table 4.4-34)

Table 4.4-34. Levels and sensitivity and importance by property size.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
VERY SMALL PROPERTY	VERY HIGH	VERY HIGH	Properties not larger than one (1) extension or area of the Family Agricultural Units - FAU, depending on the department and municipality where it is located (See Resolution 041, 1996). Smaller plots of land are more important for the subsistence of the community that inhabits them, and this is vital for them.
SMALL PROPERTY	HIGH	HIGH	Properties within 1-2 extensions or areas of Family Agricultural Units - FAU, depending on the department and municipality where it is located (See Resolution 041, 1996). The properties are of great importance given the service they normally provide for the subsistence of the community that inhabits them.
MEDIUM PROPERTY	MEDIUM	MEDIUM	Properties between 2 and 5 areas or extensions of FAUs, depending on the department and municipality where they are located (See Resolution 041, 1996). The properties are of moderate importance given the service they normally render to the community that inhabits them.
LARGE PROPIEDAD	LOW	LOW	Properties within 5-10 areas or extensions of FAUs, depending on the department and municipality where the property is located, as provided in resolution 041, 1996. The properties are of low importance since the service they normally provide is not so significant for the community that inhabits them.
EXTENSIVE PROPERTY	VERY LOW	VERY LOW	Properties exceeding 10 areas or extensions of the FAU, depending on the department and municipality where it is located (see resolution 041, 1996). The properties have very little importance given the service they normally provide is not significant the community that lives there.

Source: ECOPETROL, 2014.

As stipulated in Resolution 041, 1996, the municipality of Segovia, is located in the homogeneous zone of No. 7 of the Department of Antioquia, where the Family Farming Unit according to the potential of mixed farming 23-31 has and livestock 39-53 has. Therefore, this region is located in the FAU (2 - Small rural producer), which is why the following classification is carried out. (Table 4.4-35) and it is obtained the map of Illustration 4.4-13.

Table 4.4-35. Levels of sensitivity and importance by property size

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
SMALL PROPERTY	HIGH	HIGH	Properties comprised between 1-2 extensions or areas of the Family Agricultural Units - FAU, depending on the department and municipality where it is located (See resolution 041, 1996). Both AID and IIA, ownership structure is given by the possession of small tracts of land, productive processes with low incorporation of technologies and investment in knowledge, and

			productive processes lack product or service transformation activities. In the case of Fraguas and the urban center of Segovia, among its inhabitants there are an indeterminate number of inhabitants dedicated to agricultural and livestock activities that only use the populated centers as a dwelling place and probably own properties in rural areas near the headwaters. This subsistence character is related to an underdeveloped and underperforming activity, judging by characteristics such as: 1) low incorporation of adequate techniques for production in poor soils that require constant investment for acceptable levels of productivity, 2) high utilization of labour with simple labor that ensures the subsistence of farmers but does not generate surpluses to improve or modernize production, and 3) deficient commercialization of agricultural products by a precarious regional road network at secondary and tertiary levels.

Source: INGEX, 2016.

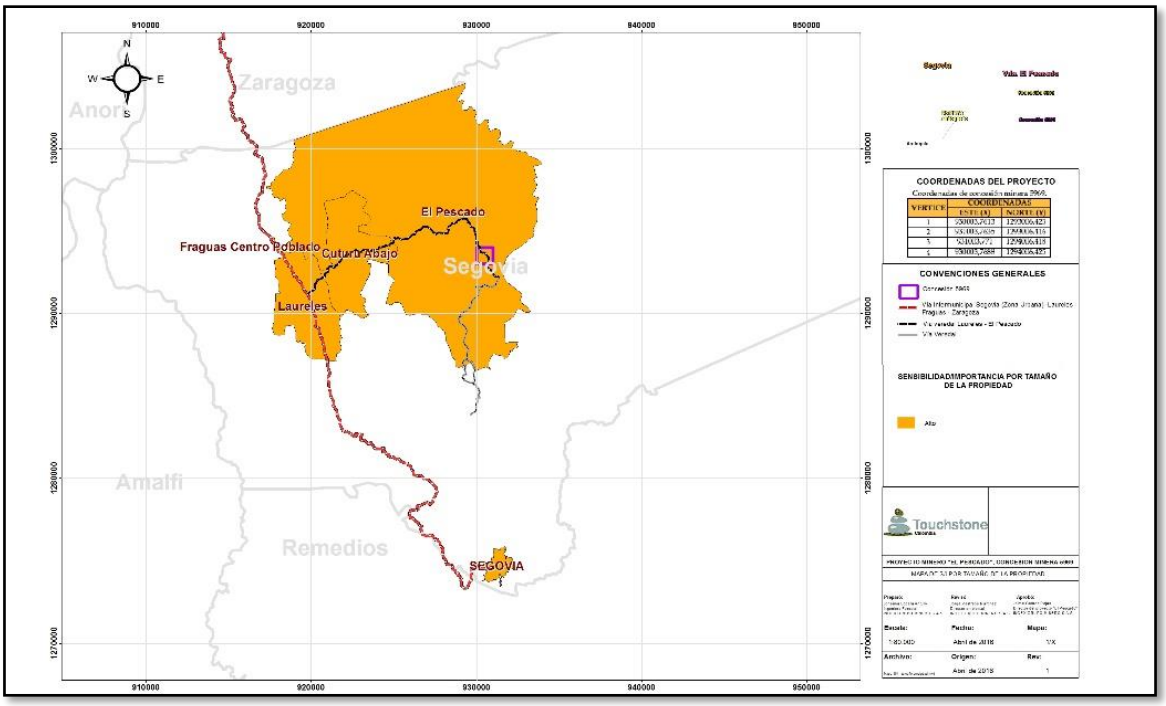

Illustration 4.4-13. Sensitivity and Importance Map according to property size.
Source: INGEX, 2016.

4.4.3.3 Spatial Dimension

This dimension groups together those zoning indicators, such as coverage of public and social services in the area, infrastructure, ecosystem services and the demand for quality of life presented by IIA and AID residents.

4.4.3.3.1 Availability to public and social services

Public services are considered to be those that are developed by a public and/or private institution in order to satisfy a specific social need and play an essential role in economic and social development (gas, electricity, sewerage, aqueduct); in addition to social infrastructure (health, education and community).

Within public services, aqueducts (vital element), followed by energy, sewerage and gas, are considered of greater importance. In social services, those related to health are considered of greater importance, followed by education and communication.

The sensitivity and importance levels are presented below, taking into account the importance of these services (See Table 4.4-36).

Table 4.4-36. Levels of sensitivity/importance of the availability of public and social services.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	SECTOR CHARACTERISTICS
WITHOUT PUBLIC OR SOCIAL SERVICES	VERY HIGH	VERY LOW	In the sector there is no evidence of public or social services in the area or sector. Generally associated with heavily neglected areas that do not have the capacity to provide socioeconomic goods or services.
PRECARIOUS PUBLIC AND SOCIAL SERVICES	HIGH	LOW	In the sector, there is at least one aqueduct with coverage (< 20%). Likewise, health and education services with low coverage. It is of low importance given the low capacity to provide socio-economic goods and services.
BASIC PUBLIC AND SOCIAL SERVICES	MEDIUM	MEDIUM	The sector has electric energy and aqueduct or sewerage coverage between 20-50%. Good coverage in health and education. Moderate capacity to provide socio-economic goods and services.
ADEQUATE PUBLIC AND SOCIAL SERVICES	LOW	HIGH	The sector has electric energy and aqueduct or sewerage with coverage between 50-75% of homes. Good coverage in health, education and community services. Good capacity to provide socio-economic goods and services.
PUBLIC AND SOCIAL SERVICES OPTIMUM	VERY LOW	VERY HIGH	All basic public services are available in the sector, with coverage greater than 75% of homes. They have an excellent network of social services. Very high capacity to supply socio-economic goods and services

Source: ECOPETROL, 2014.

According to the social study carried out in the area of direct influence (Village El Pescado, Laureles and Cuturú Abajo) and indirect (Municipal Head of Segovia and village of Fraguas), regarding the coverage of public and social services and was given the following qualification (Table 4.4-37), in addition to the map shown in the Illustration 4.4-14:

Table 4.4-37. Sensitivity/Importance of the availability of public and social services.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	SECTOR CHARACTERISTICS
PRECARIOUS PUBLIC AND SOCIAL SERVICES	HIGH	LOW	Electricity coverage is universal in AIDs, according to data collected in the field and the implementation of the Antioquia Illuminated program. The greater quantity of houses is supplied with water for the consumption of births that are found on the land and constitutes one of the greatest advantages for the inhabitants, given that it does not represent costs for the service, except the maintenance that is made of the particular distribution networks. Similarly, there are no adequate sanitary facilities and solid waste is burnt or disposed of in open fields, which generates greater air and soil pollution. Finally, the population has partial coverage of mobile telephony, without fixed telephony and internet. For AID trails, access to health services is provided in the urban area of Segovia, where there are two first-class hospitals that cover the demand for services. The population also goes to the municipality of Remedios in search of health services. Attendance at schools is very limited, as the child population is scarce. The closest schools are the schools of Lower Cuturú and Mid Cuturú. For El Pescado, according to local data, the community is in the process of managing a lot for the construction of a school. In the village of Laureles there is Fray Martín de Porras School.
BASIC PUBLIC AND SOCIAL SERVICES	MEDIUM	MEDIUM	Fraguas has availability and coverage of basic services. One of the critical aspects of the population center is the scarce sewerage coverage and the way in which this waste is released to water sources without any treatment and intervention. There is no drinking water available for any inhabitant. This is an equally critical situation given that, as noted above, access to drinking water is a citizen's' right. Citizens also have the right to adequate leisure and leisure facilities and mobility. Public space is scarce.
ADEQUATE PUBLIC AND SOCIAL SERVICES	LOW	HIGH	According to the Segovia 2014-2015 Development Plan, 89% of the urban population consumes treated water, but does not meet all the requirements to be consumed without restriction. Eleven percent of the urban population consumes water without any treatment. The urban sewage system has sanitary and sanitary networks of PVC and concrete rainwater. The municipality partially has waste treatment plants and it is practically obsolete; the consequence of this deficiency in the sewerage service translates into coverage of 14.1%.

			As far as the toilet service is concerned, 78% is covered and according to unconfirmed data, it is reported that a considerable amount of homes dumps their waste in water sources. The IIA areas in general have mobile phone coverage from operators, which has helped to improve communications especially in rural areas, while in fixed telephony and broadband internet, Edatel, part of the UNE - EPM Telecommunications business group, is the service provider. For the header, as shown in the table above, the coverage is 100% and for the rest, 93% coverage is available. For social services such as health, it is acceptable the level of coverage and the availability of resources for the attention of the population, the total school enrolment rate is 89%, which implies an acceptable level of educational provision and that the population has resources available for access to education, in addition to having radio stations, equipment and sports, recreation and culture and has optimal conditions in its tracks.

Source: INGEX, 2016.

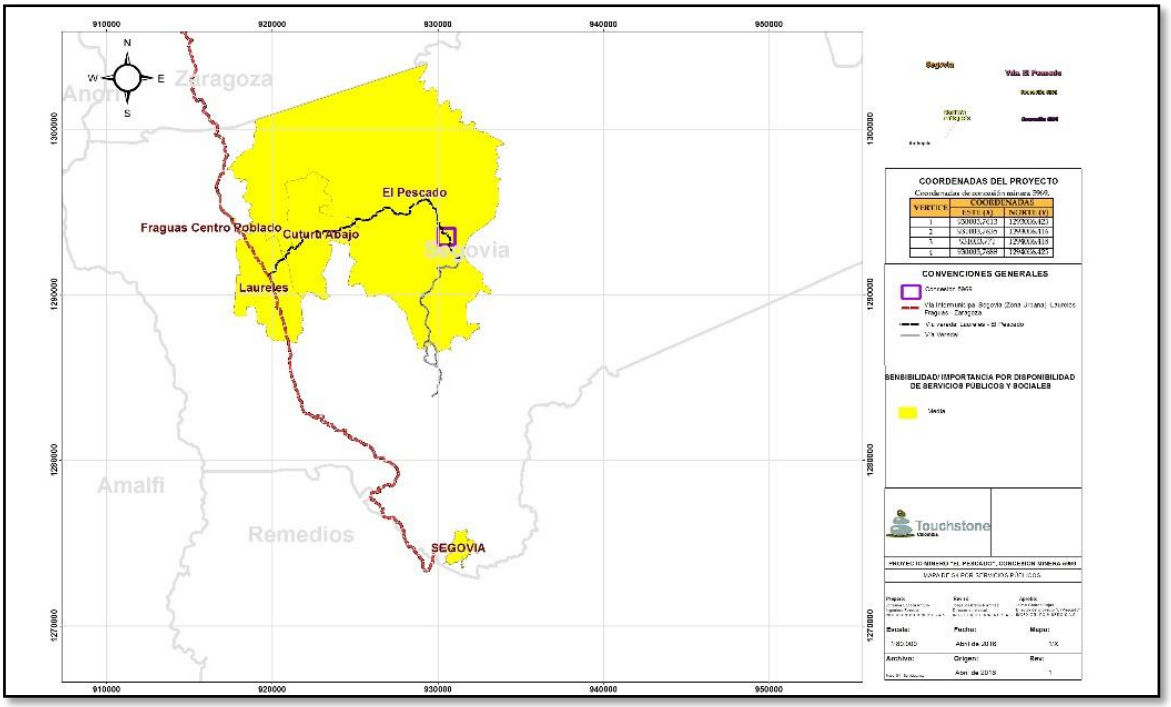

Illustration 4.4-14. Map of Sensitivity and Importance for public and social services.
Source: INGEX, 2016.

4.4.3.3.2 Dependence on ecosystem services

Ecosystem services offer to diverse communities' support and/or provisioning (water, wood, sand, wood, timber, agriculture, livestock, fishing, water, among others), as well as intangible or regulating services (air, erosion, water purification) and cultural services such as religious, recreation, tourism, among others, which are of great importance.

For this reason, it is important to identify the population's dependence on these services, through the levels of sensitivity and importance proposed (Table 4.4-38)

Table 4.4-38. Levels of sensitivity and social importance for dependence on ecosystem services.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
TOTAL DEPENDENCE	VERY HIGH	VERY LOW	In the sector there is total dependence for its subsistence on ecosystem services, whether by water supply, firewood, fishing, hunting or tourism among others. These communities would not be able to provide social goods or services, given their degree of dependence on ecosystem supply.
HIGH DEPENDENCIA	HIGH	LOW	In the sector, there is high dependence on ecosystem services for their livelihoods, whether through water supply, firewood, fishing, hunting or tourism, among others. These communities have a low capacity to provide social goods or services, given the degree of dependence on ecosystem supply.
MEDIUM DEPENDENCE	MEDIUM	MEDIUM	In the sector, there is partial dependence on ecosystem services for their sustenance, whether through water supply, firewood, fishing, hunting or tourism, among others. These communities have a moderate capacity to provide social goods or services.
LOW DEPENDENCE	LOW	HIGH	In the sector, there is little dependence on ecosystem services for their livelihoods, whether through water supply, firewood, fishing, hunting or tourism, among others. These communities have a high capacity to provide social goods or services.
INDEPENDENT	VERY LOW	VERY HIGH	In the sector, there is no dependence on ecosystem services for their livelihoods. These communities have a very high capacity to provide social goods or services.

Source: ECOPETROL, 2014.

According to the data obtained during the social study, both in the area of direct and indirect influence, through surveys and socialization workshops, the following results were achieved (See Table 4.4-39 and Illustration 4.4-15).

Table 4.4-39. Levels of sensitivity and social importance for dependence on ecosystem services.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
TOTAL DEPENDENCE	VERY HIGH	VERY LOW	The area of direct influence (AID), the community depends entirely on ecosystem services for its daily sustenance, from the construction of homes, water for domestic and labor activities,

			agriculture, livestock, landscape, air, soil, in addition to firewood extraction and hunting, obtaining firewood for domestic activities (fuel).
MEDIUM DEPENDENCE	MEDIUM	MEDIUM	In the area of indirect influence (IIA), partial use is made of ecosystem services, especially for consumption and regulation (water, air, landscape), in addition to the provision of food (agriculture, livestock, hunting) and construction and some of their homes.

Source: INGEX, 2016.

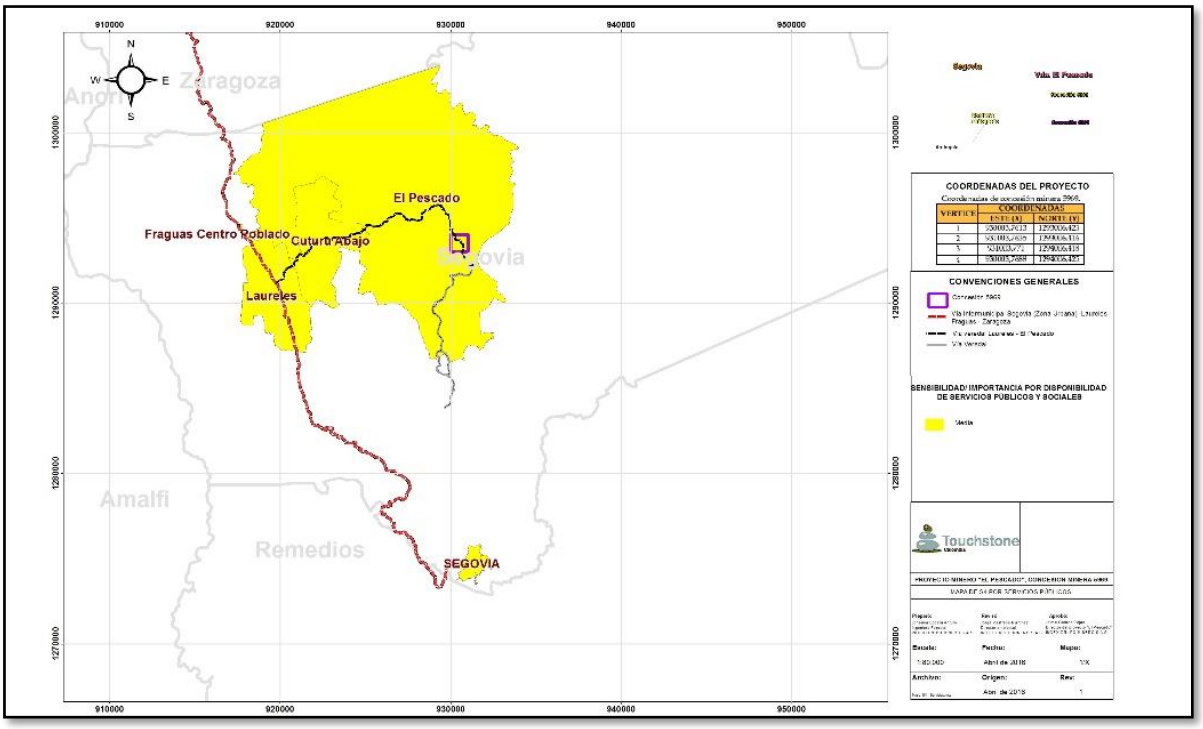

Illustration 4.4-15. Sensitivity/Importance Map for Dependency to Ecosystem Services.
Source: INGEX, 2016.

4.4.3.3.3 Accessibility

The state of access roads to the areas of direct and indirect influence are key to determining the ability of these areas to provide services or their access lines to extract their products and ensure access to services goods and rapid communication determined by the ranges proposed in Table 4.4-40.

Table 4.4-40. Levels of sensitivity and importance for accessibility.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
INACCESSIBLE	VERY HIGH	VERY HIGH	Territorial units or areas that are not crossed by any means. They only have roads in adjacent areas. These bordering roads are important because they are the only means of communication available to them.
NON- ACCESSIBLE	HIGH	HIGH	Territorial units or areas that are crossed by a pathway, usually in poor condition or with very low territorial unit coverage. This route is of great importance because it is the only means of communication available to them.
ACCESSIBLE	MEDIUM	MEDIUM	Territorial units or areas that are crossed by more than one access road, some of them in poor condition or with a coverage or coverage of the moderate territorial unit. Individually, these routes provide a service of moderate importance, given that there are communication alternatives that make them not dependent on a single medium.
GOOD ACCESSIBILITY	LOW	LOW	Territorial units or areas that are crossed by more than one access road, most of them in good condition, with good coverage or coverage of the territorial unit. These routes provide a low importance service, given the possibility of using communication alternatives that make them not dependent on a single medium.
EXCELLENT ACCESSIBILITY	VERY LOW	VERY LOW	Territorial units or areas that are crossed by more than one access road, all in good condition, with full coverage or coverage of the territorial unit. These routes provide a service of very low importance, given the possibility of using communication alternatives that make them not dependent on a single medium.

Source: ECOPETROL, 2014.

According to the route taken in the field and taking into account the conditions of the road network of the areas of influence, the following levels are established:

Table 4.4-41. Levels of sensitivity and importance for accessibility.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
NON-ACCESSIBLE	HIGH	HIGH	The most commonly used means of transport in DAI are horse and mule, motorcycle and to a lesser extent motor vehicle. The travel time between the operation sites is variable depending on the state of the access road and the means of transport used. The urban roads remain in an acceptable state, with the characteristic that there are sections with high slopes due to the topography.
ACCESSIBLE	MEDIUM	MEDIUM	The north-western axis connects the urban capital with the sidewalks of this area through the road that goes to the municipality of Zaragoza, as the village of Fraguas and the village Laureles. Urban roads remain in an acceptable state, with the characteristic that there are sections with high slopes due to the topography and that the settlement that gave rise to the urban capital is located mainly on top of hills that extend in different directions.
EXCELLENT ACCESSIBILITY	VERY LOW	VERY LOW	The urban capital of Segovia is located 227 km from Medellin, from the capital is the one that includes the route through the so-called main road of the Northeast, which crosses the municipalities of Bello, Barbosa, Corregimiento Porcesito, Cisneros, Yolombo, Yali, Vegachi, the towns of El Tigre de Vegachi and Santa Isabel and Otu, Remedios, the village of La Cruzada de Remedios and Segovia. The current track conditions are optimal because it was significantly improved with asphalt and concrete. Thus, the length of the route was reduced from 8 and up to 10 hours at the time this road was uncovered, to 4 hours at the most today. Another route that allows access to the municipality is the one that leads to Cisneros, San José del Nus, Maceo, Yalí, Vegachí, Santa Isabel, Otú, Remedios, La Cruzada and Segovia. The transport service is provided by the companies Flota Nordeste and Transportes Segovia.

Source: INGEX, 2016.

Once each of the categories for the municipality's sensitivity and importance for accessibility were determined, the following map was obtained, showing each of the levels described above for both AID and IIA.

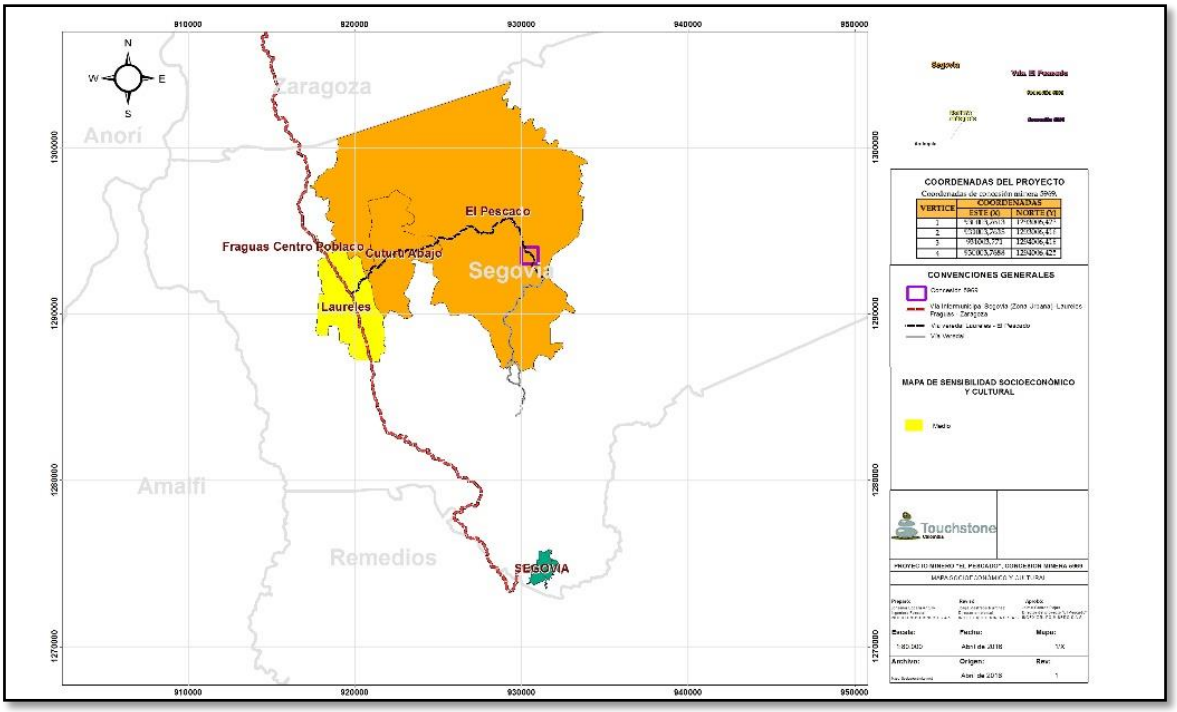

Illustration 4.4-16. Sensitivity/Importance map to the accessibility of the area.
Source: INGEX, 2016.

4.4.3.4 Demographic Dimension

This dimension was drawn up on the basis of data collected in the field and, where possible and necessary, complemented or compared with official data in order to provide greater depth in the quantitative and qualitative analysis of the different social variables and in order to have a clear picture of the current conditions of the territory and to assess more accurately the possible transformations that may arise from the implementation of the different stages of the El Pescado project, in order to learn more about the possible transformations that may arise from the different stages of the project.

4.4.3.4.1 Population concentration.

Population concentration refers to the action or tendency to increase the population of larger towns at the expense of smaller towns, especially in rural areas, in addition to determining the degree of population concentration in a given area.

Therefore, and in order to identify the values of sensitivity/importance in terms of population density, according to the levels proposed in the ECOPETROL methodology (2014), as illustrated in the following Table 4.4-42.

Table 4.4-42. Levels of sensitivity and importance for population concentration.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
MUNICIPAL CAPITAL	VERY HIGH	VERY HIGH	Geographical area defined by an urban perimeter, whose limits are established by agreements of the Municipal Council. Corresponds to the place where the administrative headquarters of a municipality is located. It has a very high capacity to offer socioeconomic goods and services.
POPULATION CENTER	HIGH	HIGH	Concentration of at least twenty (20) contiguous, neighboring or semi-detached dwellings located in the rural area of a municipality or a departmental borough. This concentration has urban characteristics such as the delimitation of vehicular and pedestrian roads. It has a high capacity to offer socioeconomic goods and services.
HOUSING	MEDIUM	MEDIUM	A conglomerate of dwellings, commonly located next to a main road and which has no civil authority. The census limit is defined by the same dwellings that constitute it. Moderate capacity to provide socio-economic goods and services.
HIGH DENSITY RURAL AREA	LOW	LOW	It is characterized by a relatively dispersed disposition of housing and farms, with a high population density. It does not have a layout or nomenclature of streets, roads, avenues, and so on. It does not generally have public services and other facilities in urban areas. It has low capacity to offer socio-economic goods and services.
LOW DENSITY RURAL AREA	VERY LOW	VERY LOW	Very dispersed disposition of housing and farms, with a very low population density. It does not generally have public services and other facilities in urban areas. It has low capacity to offer socio-economic goods and services.

Source: ECOPETROL, 2014.

According to the results obtained in each of the tours and information provided by the municipal administration, the dynamics of occupation and the current population distribution in both the IIA and the AID is reflected in the following manner (See Table 4.4-43 and Illustration 4.4-17).

Table 4.4-43. Sensitivity/Importance in population concentration.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
MUNICIPAL CAPITAL	VERY HIGH	VERY HIGH	Segovia is the second largest municipality in the Northeast after Remedios and has a total population of 37,572 inhabitants, 33,595 of whom are part of the IIA, as noted above, since the largest number of inhabitants of the municipality resides and works in the urban capital. The density of Segovia's urban headquarter is high considering that the urban layout and topography are irregular, so that not all areas of the headquarters are occupied for housing construction.
POPULATION CENTER	HIGH	HIGH	Fraguas, instead, is a road port that in the past was also a center of commerce and location of population in an intermediate site between Remedios, Segovia and Zaragoza. This settlement to date is catalogued as a village and its jurisdiction is not defined in the official cartography, beyond the town center. Other official documents designate El Cenizo, Fraguas, Laureles and Mata as the jurisdiction of the municipality. Its current population is characterized by being mostly dedicated to mining, as labor from farms dedicated to livestock, as farmers and temporary employees of companies that are present in the area (Ecopetrol and mining exploration companies).
LOW DENSITY RURAL AREA	VERY LOW	VERY LOW	Population density is low in Laureles, Cuturú below and Pescado and settlements are scattered rural type. The distances between the houses on the sidewalk are between 1.5 and 3 kilometers. As an illustration, the distance in a straight line between the exploitation area and the nearest dwelling is approximately 2 kilometers. In the meantime, it can be said that the living conditions of dependent people are stable, and coverage of basic services is acceptable.

Source: INGEX, 2016.

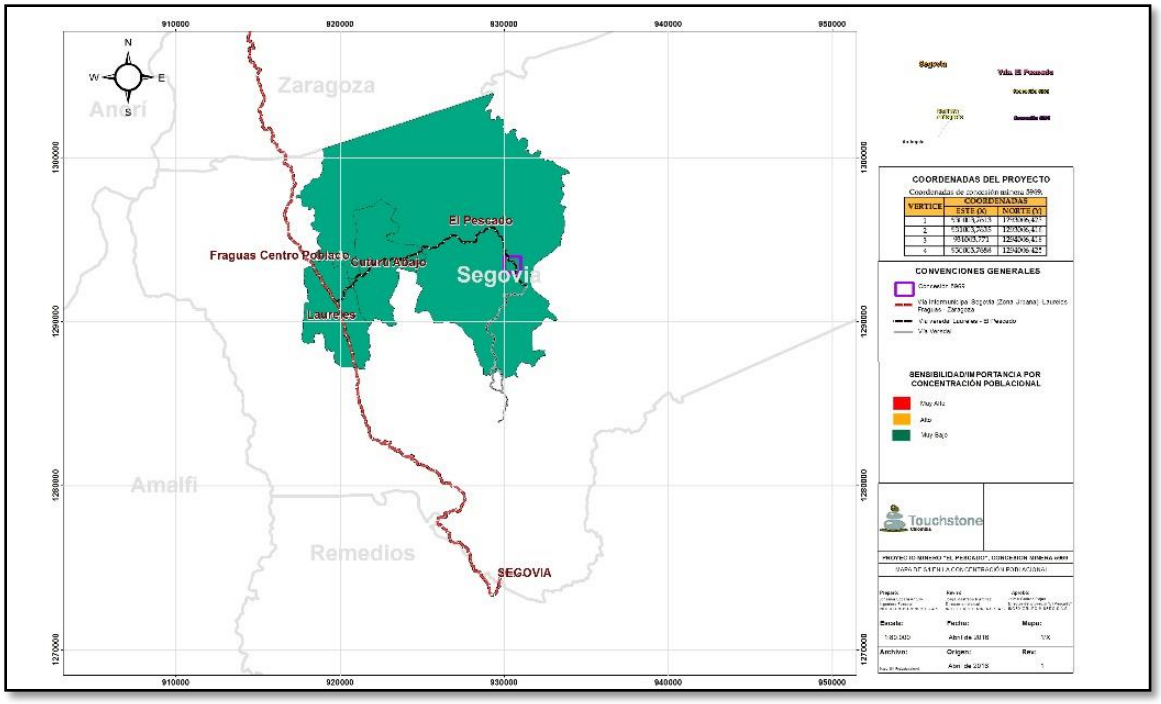

Illustration 4.4-17. Sensitivity and Importance by population concentration.
Source: INGEX, 2016.

4.4.3.5 Cultural Dimension

Within the cultural dimension, it will be very important to assess both regional archaeology and the presence of ethnic groups in IIA and AID.

4.4.3.5.1 Archeological and cultural potential

The preventive archaeology program consists of an archaeological survey and prospecting in the zone of direct intervention of the polygon, in order to identify whether archaeological properties are found on the ground, their importance and the correct way to prevent or mitigate their destruction or deterioration. Archaeological properties are protected in Colombia under a special regime of protection, by article 72 and articles 4 and 6 of Law 397, 1997, modified by articles 1 and 3, respectively, of Law 1185, 2008 of the National Constitution.

The archaeological and/or cultural potential of the study area in a given region is determined by the levels of sensitivity and importance listed below:

Table 4.4-44. Levels of sensitivity and importance due to archaeological and cultural potential.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
HISTORICAL AND/OR CULTURAL ARCHAEOLOGICAL INTEREST	HIGH	HIGH	Areas with high potential for the effective presence of sites, pieces or collections of archaeological, historical and/or cultural value or interest for the community at the national level (meeting, recreation or high potential landscape sites). Places with a very high capacity to contribute archaeological, historical or cultural values.
HISTORICAL AND/OR CULTURAL ARCHAEOLOGICAL INTEREST	MEDIUM	MEDIUM	Areas where the environment allows assuming with moderate probability, the existence of sites, pieces or collections of archaeological value or interest, there may be decontextualized archaeological evidence and / or not stratified. With the presence of sites of cultural value for the community at the departmental level (meeting, recreation or high landscape value sites). Sectors with a moderate capacity to contribute archaeological, historical or cultural values.
HISTORICAL AND/OR CULTURAL ARCHAEOLOGICAL INTEREST	LOW	LOW	Areas without archaeological evidence or where the characteristics of the environment (soil acidity, high water table, among others) do not facilitate the preservation of the same. Areas with sites of cultural value for the community at the municipal level (meeting, recreation or high landscape value sites). With low capacity to contribute archaeological, historical or cultural values.

Source: ECOPETROL, 2014.

According to the archaeology study, the area of study is crossed by the Pescado Creek and its tributaries, its main tributary is the El Bagre river, as the main basin is the Cauca river; tributaries that influence the continuous formation of the environment, in this case it is taken as an element of relevance in the areas chosen by the ancient inhabitants of the area for occupation and exploitation of resources. Water sources also offer water, flora and fauna resources special for subsistence. It is possible to register cultural materials that may indicate some type of ceramic style or lithic material that can be associated with those already known, therefore Illustration ***4.4-18***, shows the importance of this factor in the area.

Table 4.4-45. Levels of sensitivity and importance due to archaeological and cultural potential.

DEGREE OR LEVEL	SENCIBILITY	IMPORTANCE	DESCRIPTION
NO REPORTED PRESENCE	MEDIUM	MEDIUM	According to information gathered for the IIA and AID, the community in each of the socializations reported archaeological material that it possesses, for example, a late period pre-Hispanic hoe, a hand of grinding from the same period, a vinyl chisel and gold nostrils. Within the AID of the project, surveys were conducted every 25 meters, but no archaeological elements were found.

Source: INGEX, 2016.

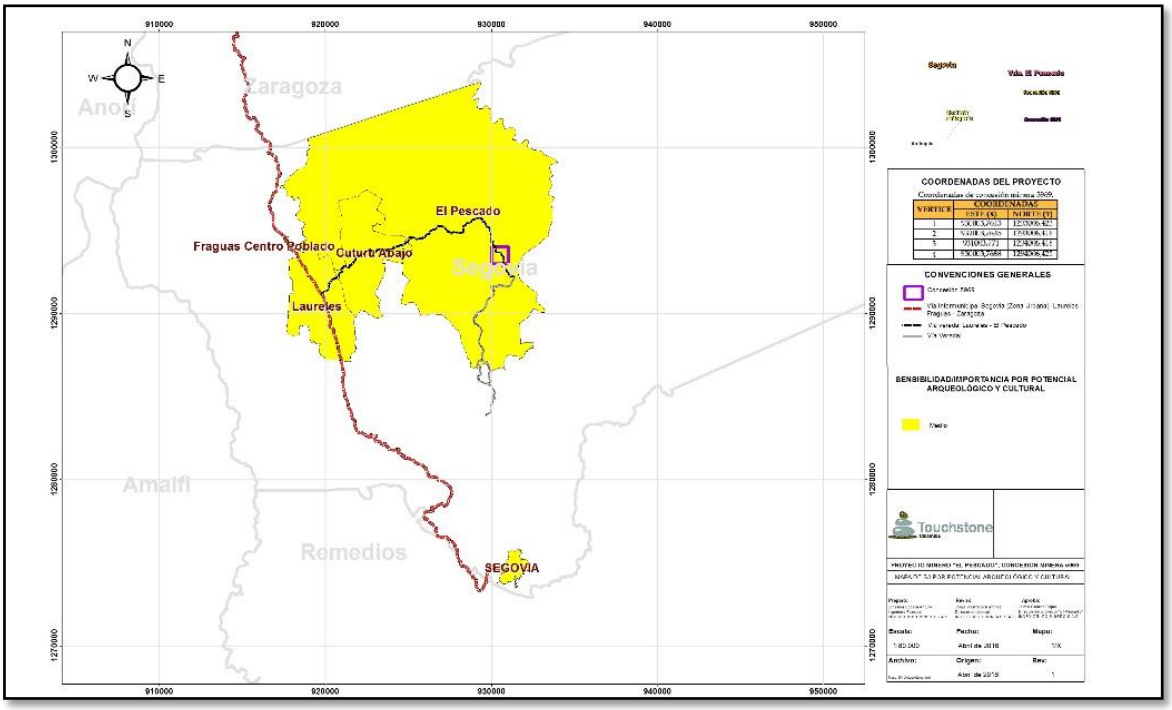

Illustration 4.4-18. Map of Sensitivity and Importance for Archaeology and Cultural Heritage.
Source: INGEX, 2016.

4.4.3.5.2 Presence of ethnic groups

Ethnic groups or minorities, Afro-Colombian communities, may have a presence within the areas of influence and it is therefore necessary to determine their influence and existence on the site, since regardless of the environmental zoning obtained in the previous consultation, it is important to consider territories of communities that have not yet been recognized, in order to determine their cultural sensitivity and importance. This is why the following levels of sensitivity and importance are defined.

Table 4.4-46. Levels of sensitivity and importance due to the presence of ethnic groups.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
LEGALLY CONSTITUTED GUARDS AND TOWN COUNCILS	HIGH	HIGH	Areas with shelters or councils legally constituted by the Ministry of the Interior. High capacity for the provision of cultural goods and services, especially due to the need for pre-consultation.
RECOGNISED OR IN THE PROCESS OF RECOGNITION	MEDIUM	MEDIUM	Areas or sectors with legitimate or recognized councils or in the process of being recognized by the territorial entities or the Ministry of the Interior. Moderate capacity to provide cultural goods and services, given that they do not need to be consulted and their cultural ancestors are yet to be proven.
NO REPORTED PRESENCE	LOW	LOW	Areas or sectors outside ethnic minority territories.

Source: ECOPETROL, 2014.

According to the application filed for certificate of existence of ethnic territories in the area of direct and indirect influence of the project, the Colombian Institute of Rural Development (INCODER by its initials in Spanish), with established numbers 20151148323, cites (20152146027), 20151148324, cites (20152146025), dated 26 June 2015 and 20151178067, cites (20152179590), dated 23 September 2015. He points out that: "the polygon delimited by the coordinates that correspond to the area of direct and indirect influence of the project, does not intersect with territories legally entitled of indigenous reservations or belonging to black communities". Therefore, the following classification was carried out and the map shown below was obtained.

Table 4.4-47. Levels of sensitivity and importance due to the presence of ethnic groups.

DEGREE OR LEVEL	SENSIBILITY	IMPORTANCE	DESCRIPTION
NO REPORTED PRESENCE	LOW	LOW	According to information gathered for the IIA and AID, the population in the Northeastern Antioquia sub region is mainly determined by three aspects: gold mining as the determining factor, the phenomenon of violence and armed conflict since the mid-20th century and the new economic processes associated with agro-industry and infrastructure works. In its resolution, the Internal Ministry certifies that in its databases "there is no record of constituted reservations, nor ethnic communities in the polygon bounded by the coordinates that correspond to the area of direct and indirect influence of the project".

			Under these conditions, to date no process of participation and rapprochement with this type of communities has been developed or planned within this study, in compliance with article 330 of the Political Constitution, article 7 of Law 21, 1991, article 76 of Law 99, 1993, Decree 1320, 1998, by means of official letter number OFI11-2840-GFP-0201.

Source: INGEX, 2016.

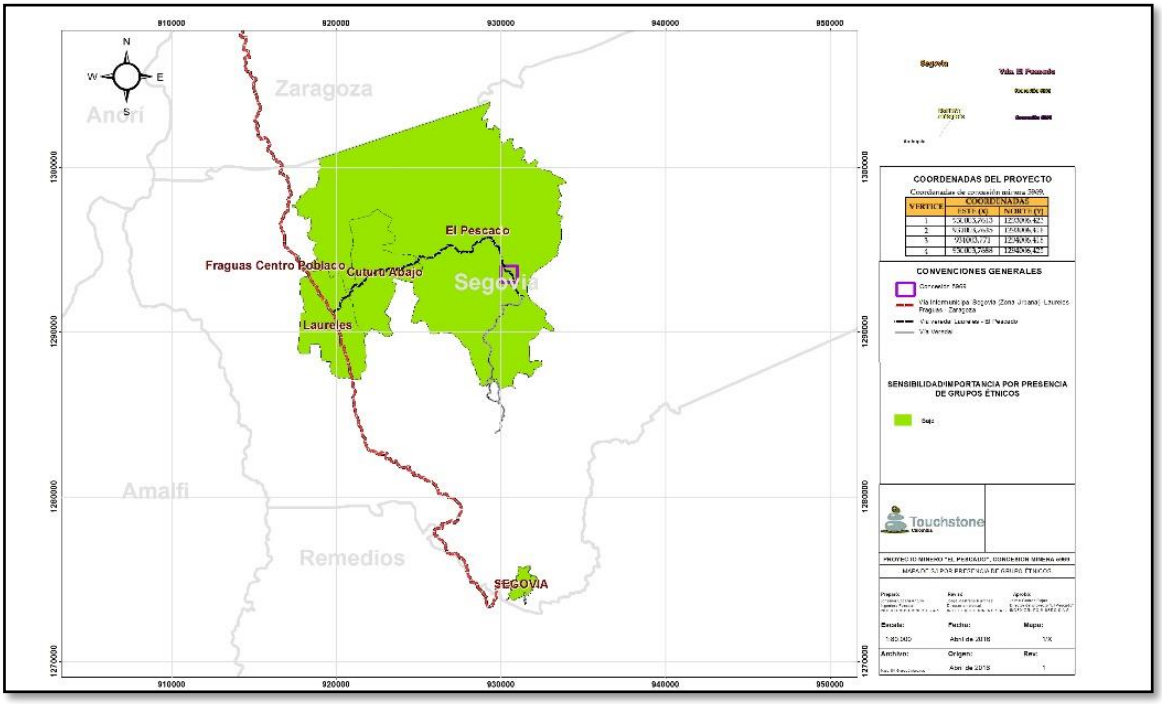

Illustration 4.4-19. Map of Sensitivity and Importance for Ethnic Groups presence.
Source: INGEX, 2016.

Finally, once each one of the maps of the social area has been obtained, the indexation of each one of them is carried out, based on the definition of homogeneous areas and with the help of the ArcGIS 10.3 software, in order to superimpose or join each of the maps, in addition to a weighted one where the intermediate zoning of the socioeconomic and cultural environment is obtained as a result. As a result of this procedure, the following map is obtained:

As the map shows, the socio-economic and cultural milieu in both its AID and IIA is categorized as a milieu, i.e. the community and its surrounding environment is moderately susceptible to being altered by any factor external to it and its resilience is medium-term, in accordance with the management and/or mitigation measures applied.

Similarly, its capacity to provide social/cultural services is moderate, which is why any agent that alters its equilibrium can endanger the ecosystem and its interaction.

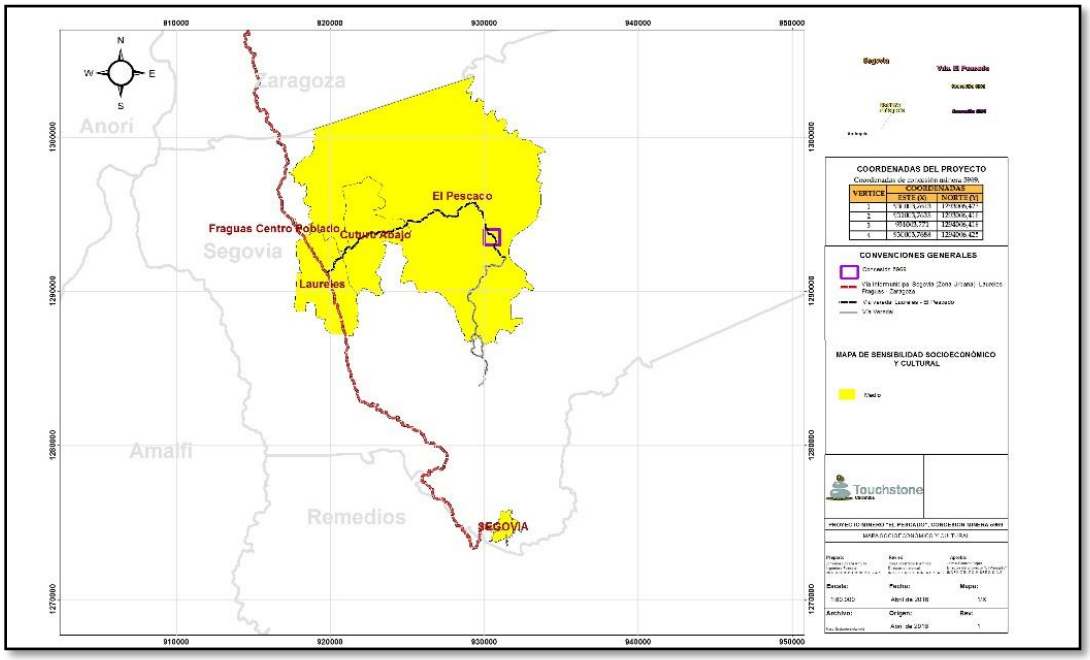

Illustration 4.4-20. Intermediate map of the socio-economic and cultural component.
Source: INGEX, 2016.

4.4.4 Final environmental zoning.

As a final product, after crossing each of the final maps by component (Abiotic, Biotic and Socio-Economic), the final product and/or sensitivity/importance map of the project's area of influence is presented, which represents the definitive environmental zoning and establishes the sites with restriction, exclusion, minor restriction and without restriction. Due to the differences between the areas of influence of the project, two final maps will be established, one for the physical and environmental component and the other for the social component.

The zoning presents the basin established as a unit of study and as an integrated temporal space entity in which ecological processes and the functioning of the landscape are incorporated into physiographic analysis, as established in the framework of structural and functional connectivity.

According to the complexity of the zone and the available information layers, multivariate statistical methods can be incorporated in zoning to consider and analyze the natural environment as a multidimensional system; thus, a first criterion to define would be that the diversity analyses carried out by type of coverage in the baseline, should reflect the similarities and differences between structural units of the landscape such as a forest and a grassland, in the basin as a study area, which is part of the large ecosystem.

In general terms, zoning limits are established based on the analysis of discontinuities or the potential for interrelationships between spatial patterns of the natural environment such as vegetation cover, in addition to considering legal aspects of protection. This is why the proposed zoning and the result of the interpolation of each one of the maps, suggests an indicated use of the soils, to avoid their degradation, and to sustain the interrelationships that favor the resilience of the ecosystem.

In Illustration ***4.4-21***, each of the areas for environmental zoning, taking into account each of the values previously obtained in terms of sensitivity and importance for the biotic and abiotic component; the social component was evaluated independently of the magnitude of its areas of direct, specific and local influence.

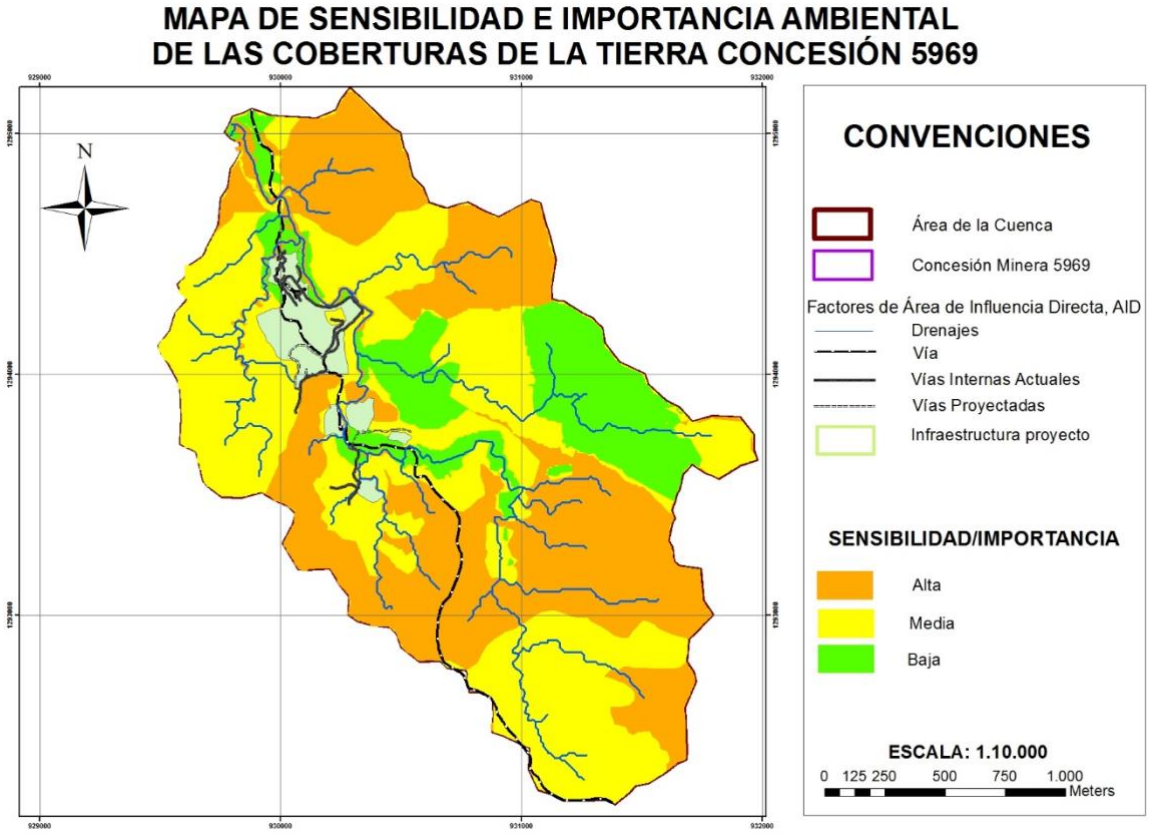

Illustration 4.4-21. Environmental Zoning for sensitivity and importance mining title 5969.
Source: INGEX, 2016.

The areas of low environmental sensitivity correspond to 16.05% of the basin and are those areas where part of the project's infrastructure is located and the coverage of clean pastures, specifically those areas with the lowest slopes (between 5 - 10%), made up of soils with alluvial deposit and slope parental material; soil with effective surface depth (30-56cm), texture A and FA, with low nutritional content, pH moderately acidic. Arable land, with capacity for any type of cultivation, with light to moderate practices of soil conservation and water management.

Within the area of influence, current uses are livestock, alluvial mining and forest strips. On this terrain, the high and low frequency geotechnical stability for the formation of mass phenomena is generally stable due to its low slope conditions, which makes it qualify as having a low to zero potential for the occurrence of mass movements. It corresponds to an area where the topography is very smooth as are the alluvial terraces. In this area there are few denotative processes, however, it is necessary to maintain the current balance that exists.

45.36% of the project area is in medium environmental sensitivity, corresponding to the slope zones between 5 - 10% and greater, groups together the areas where the births of each of the tributaries of the ravine el Pescado, with vegetable coverings of clean pastures (Pl) and low secondary vegetation (Vsb), which also serve mainly as passageways or corridors for bird species since they are highly mobile, in some cases generalist and in most cases the richness of these are found in disturbed sites or vegetation in transition; similarly eventually for mammals such as primate troops, some carnivores and ungulates.

The soils in this area are made up of different types of materials, by man's action, which have given rise to the technosol soil type. Soils with low nutritional content for plants. Livestock lands with improved pasture, permanent crops, agroforestry systems and/or reforestation, soil conservation practices and water management. For the project's area of influence, its uses are forestry with protective plantations and small-scale agriculture of perennial crops such as cocoa, banana, and yucca, citrus, with rocky outcrops, hard layers or others.

The 38.57% of the project area is categorized in high sensitivity and corresponds to those areas where the dense forest cover is located, which serves as a regulator of water sources and shelter for the associated wildlife such as the umbrella species like the Panther *honca* (Jaguar) and which is key in terms of connectivity, while exerting a profound influence on the structure and composition of the ecosystem (Payán et al., 2011). The connectivity of the landscape is mainly due to the presence of forest cover, since given the structure and habitat it possesses, it facilitates the movement and dispersion of species, genetic exchange and other ecological flows.

In this area, the soils are for forest use with possibilities of mixed use of the forest. The main uses in the project's area of influence are production-protection forestry with timber plantations on slopes of less than 45%, and protection on slopes of more than 45%, where native forest is present. Agroforestry livestock farming with special pasture management and rapid drainage to imperfectly drain.

In the same way, it is important to clarify that it was estimated that the flooding clumps of the main currents associated to a flow with a return period of 100 years or what is equal with a probability of occurrence of 0.01 and 30mts of withdrawal from the gullies were established. In addition, there are

no major infrastructure works in this area susceptible to flood damage. Moderate presence of the resource in static systems represented in water densities ranging from 13.7 - 155.3 km/km2, with high capacity to provide water supply and regulation services.

In the basin there are two dominant geomorphological types: jumps and wells, and rapids and wells; these results show that the basin as such does not present deposition zones, therefore in the long term it is expected that all sediments produced by erosive processes in the basin will be evacuated from it. It should be noted that, according to the estimate, no significant sediment production processes were considered, such as the formation of gullies and furrows in the upper parts of the basin, bank erosion and mass removal.

This is important in terms of resource availability because the water used will be quickly recovered by the basin's production. For the case of the area of social influence, it was estimated that the final sensitivity is average, since all the evaluation criteria pointed to this classification, as it is related in the Illustration 4.4-22.

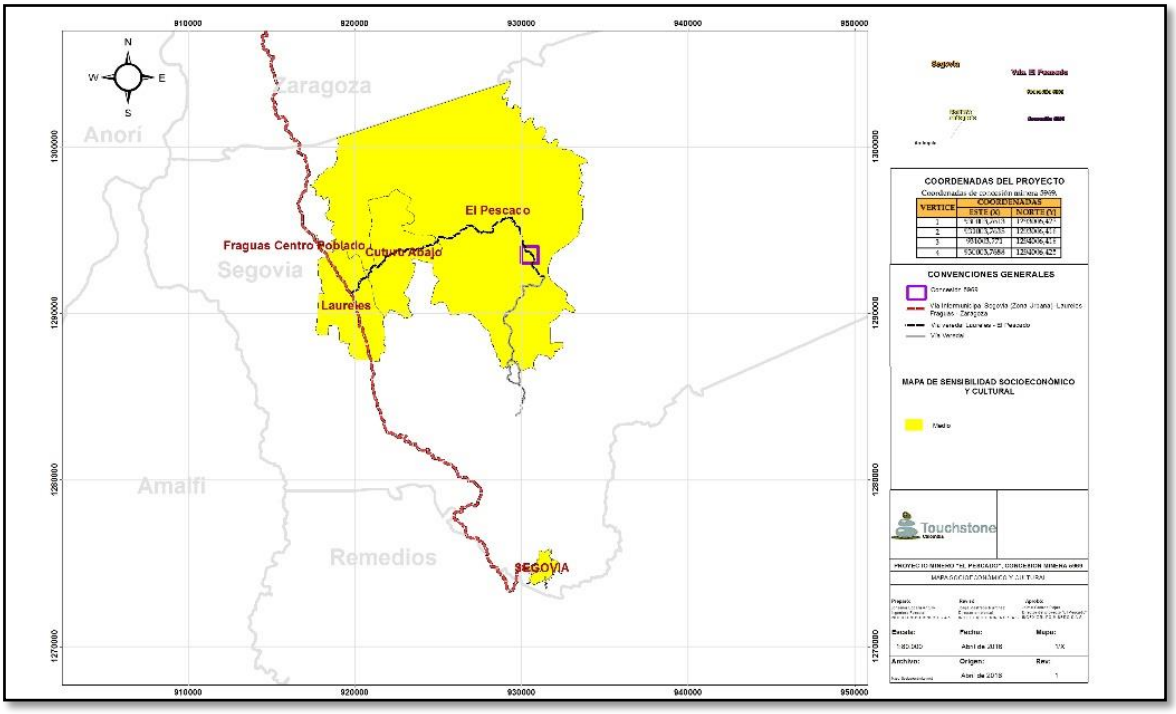

Illustration 4.4-22. Environmental Zoning for sensitivity and importance mining title 5969.
Source: INGEX, 2016.

According to information gathered in the field, the population in the Northeast Antioquia sub region is determined mainly by three aspects: gold mining as the determining factor, the phenomenon of violence and armed conflict since the mid-20th century and the new economic processes associated with agribusiness activities and infrastructure works. Urban roads remain in an acceptable state, with

the characteristic that there are sections with high slopes due to the topography and that the settlement that gave rise to the urban capital is located mainly on top of hills that extend in different directions.

The vocation of the municipality of Segovia is oriented towards the primary sector. The characteristics of this sector at the IIA level are the low level of technification and the low level of incorporation of value into productive processes and the precariousness of skills of the workforce other than those engaged in mining.

The only company in the primary sector that has significant weight in local and regional GDP is the Zandor Capital, dedicated to mining. Other entrepreneurial initiatives do not have a significant weight and in most cases, are directly related to the agricultural sector, on a small scale and with incipient levels of investment and development.

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