ENVIRONMENTAL IMPACT STUDY FOR THE RUMICHACA - PASTO TWO-LANE ROADWAY PEDREGAL – CATAMBUCO ROAD SECTION, UF. 4 AND UF. 5.1 CONCESSION CONTRACT UNDER PUBLIC PRIVATE PARTNERSHIP (PPP) SCHEME NR. 15 OF 2015

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CHAPTER 11.1.2 Abiotic Environment Follow-up and Monitoring Plan

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11.1.2. ABIOTIC ENVIRONMENT – ENVIRONMENTAL FOLLOW-UP PLAN

This Environmental Follow-up and Monitoring Plan aims to ensure environmental variables likely to be affected by the execution of works and activities related to the construction and operation of the Rumichaca - Pasto two-lane roadway Pedregal – Catambuco road section.

The Follow-up and Monitoring Plan (PSM Spanish acronym) provides programs, which purpose is to study the validity and reliability of the application of environmental measures proposed in the Environmental Management Plan (PMA Spanish acronym) for the construction phase. In this regard, it seeks to monitor and verify the necessary information to establish the performance, efficiency and effectiveness of measures and controls implemented and identify insufficiencies and inconsistencies in the project enabling the implementation of any adjustment required, if needed.

This plan intends to achieve the purposes set in the programs outlined in the PMA, which will allow adjusting them to any new condition as it appears during construction works and project operation. Follow-up and monitoring programs for each environmental media to be executed by the concessionaire's personnel involved in the PMA with the support of certified laboratories, were designed.

As mentioned, this plan involves environmental media mainly affected according to the analysis of impacts conducted and the assessment of the actual intensity of changes that will occur because of the project. For this purpose, the following aspects were considered:

- Initial environmental conditions of the Area of Influence.
- Compliance with environmental standards.
- Components to be monitored, specifying sampling sites, parameters to measure, frequency and number of samples.

Each data sheet of the follow-up and monitoring program contains: Purposes, environmental components to be monitored, impacts to be controlled, location, type of control measure, description of the measure, frequency and sampling period, duration, analysis and interpretation of results , type and reporting period.

11.1.2.1. PURPOSES

- Check the evolution of expected impacts and ensure the effectiveness of the management measures proposed.
- Verify that corrective measures proposed are effective and that the extent is reduced to a minimum.
- Allow the assessment of programs in compliance with the provisions of the management plan

11.1.2.2. PLAN STRUCTURE

The follow-up and monitoring plan for this study is divided as follows:

- Follow-up and monitoring to programs
- Follow-up and monitoring to environment trend

- ***Follow-up and Monitoring to Programs***

Measures to implement the environmental management plan need to be monitored to verify compliance thereof, and compliance with applicable environmental regulations in force. Based on this, this follow-up and monitoring program includes relevant aspects for abiotic environment.

The follow-up and monitoring measures to be implemented are directed to actions proposed to be taken for the abiotic environment because of access adaptation, and adaptation and operation of camps activities (catchment, air emissions, treatment and waste disposal), among other.

The following describes the aspects addressed in the contents of the programs for environmental management of the Rumichaca – Pasto, two-lane roadway Pedregal – Catambuco road section.

- **Actions to be taken:** Refers to actions taking place during project execution to meet the purposes and goals of the program.
- **Schedule for execution:** Describes the progress of actions to be executed during the term of the project execution.
- **Stages to be implemented:** The time is specified in the project duration, when the management measures developed by the program will be executed.
- **Program Identification:** Consecutive code expressed with letters and numbers, identifying each subprogram in a simplified manner.
- **Follow-up and monitoring indicators:** Includes the definition of follow-up and monitoring indicators for the execution of activities previously detailed in the program, their description, frequency of assessment, and record of compliance.
- **Application site:** Identifies the site or sites where the measure will be applied.
- **Participatory mechanisms and strategies**: Points out strategies to involve the community in the development of management measures.
- **Name of program and subprogram:** Corresponds to the denomination of each project, established according to the component to which it refers.
- **Purposes:** Outlines the results expected to be obtained upon completion of the actions contemplated within the program.
- **Target population:** The population that will benefit with the development of measures that will allow the reduction of negative impacts.
- **Type of measurement to be executed:** Corresponds to the classification of the measures that will allow reducing the negative impacts and increasing the positive ones during the project execution. These may be prevention, correction, mitigation and / or compensation measures.

- **Personnel required:** Refers to the human resources necessary for the carrying out of the activities contained in each program.
- **Responsible for Execution:** It records the organizations, companies or positions within the company with the responsibility for the implementation of programs.

The Error! Reference source not found. It presents the structure of the abiotic components monitoring plan for the area of influence of the new lane corridor Rumichaca – Pasto, Pedregal – Catambuco road section, prepared in accordance with the Project Management Plan for the same components.

Table 11.1.2. 1. Structure of Follow-up and Monitoring Program to Plans and Programs

ENVIRONMENT	PROGRAM	CODE	PROJECTS
ABIOTIC	SOIL RESOURCE MANAGEMENT FOLLOW-UP PROGRAM SMRS	SMRS-1	Follow-up to the disposal of debris and excavation material
		SMRS-2	Monitoring and control of erosion processes or other phenomena caused or triggered by the project
		SMRS-3	Follow-up to the handling of material and construction equipment
		SMRS-4	Follow-up to the management of domestic, industrial and hazardous waste
		SMRS - 5	Follow-up to the handling of explosives
		SMRS - 6	Follow-up to fuel storage and handling
	WATER RESOURCE MANAGEMENT FOLLOW-UP PROGRAM	SMRH-1	Follow-up to catchment management
		SMRH-2	Follow-up to water bodies crossing management
		SMRH-3	Follow-up to runoff management
		SMRH-4	Follow up to domestic liquid waste management

ENVIRONMENT	PROGRAM	CODE	PROJECTS
	FOLLOW –UP TO AIR RESOURCE MANAGEMENT	SMRA-1	Follow-up to the management and control of noise sources
		SMRA-2	Follow – up to the management and control of emission sources
		SMRA	Follow-up to the management and control of process plants
	FOLLOW-UP TO LANDSCAPE MANAGEMENT	SMP-1	Follow-up to landscape management
	FOLLOW-UP AND MONITORING TO THE ENVIRONMENT TREND	SMTMA	Follow-up and monitoring the trend of abiotic environment components

Follow-up and monitoring of each of the activities proposed will be performed through visual inspections, where one can get photographic or film records to prove the veracity of each activity.

Supports (purchase of materials, delivery of waste, laboratory) and records are a tool to assess the activities and works for each component over time. Data sources for measuring indicators will be reviewed since it will allow to take appropriate measures or make adjustments to management plans in order to provide preventive, corrective, mitigation or compensation response to project impacts.

Herein below, the follow-up programs for the abiotic environment:

Soil resources follow-up (SMRS)

- *Final disposal of debris and excavation material*

Table 11.1.2. 2Follow-up on the disposal of debris and excavation materials

SMRS-1	**ABIOTIC ENVIRONMENT**
	SOIL RESOURCE MANAGEMENT
	Follow-up to the disposal of debris and excavation material

PURPOSE

Follow-up the storage and disposal of surplus excavation materials that may primarily affect water and soil resources, in addition to the visual or aesthetic landscape conditions.

ACTIONS TO BE TAKEN

- The Builder, the Construction Compliance Supervision, supervisors and assurance teams of the Rumichaca – Pasto road project Pedregal - Catambuco road section, will permanently examine that socio-environmental management measures proposed for each ZODME be applied as well as for handling of debris and excavation material, land clearing and other removals along the corridor and specific disposal sites.
- The compliance to be verified by the Builder, the Construction Compliance Supervision, supervisors and assurance teams of the project- as part of the follow-up program – are the legal provisions such as the provisions of the Code of Natural Resources, National Health Code, Act 99 of 1993, Decree 1541 of 1978, Decree 541 of 1994, Decree 838 of 2015, Decree 1076 of 2015 and other regulations in force.
- Follow-up to ZODME site intervention ensuring that the necessary management measures in relation to water courses and water points and protection against action of winds, landscape degradation, terrain instabilities, altered natural drainage and other potential environmental alteration are established, especially if they appear unexpectedly or create risks or impacts not previously established.
- The Construction Compliance Supervision will generate a specific and detailed format to document the follow-up and monitoring of ZODME (hereinafter " ZODME follow-up formats"), in which all elements of the environment and evaluation of water, geotechnical, biotic, social and landscape variables, among others, are included.
- Once the managerial or technical decision to intervene any ZODME is made, the “ZODME follow-up formats” will be applied, including prior detailed assessment of any physical intervention to the land and inspect the consistency with the ZODME design and creation plan.
- Based on the actual involvement of each site or ZODME, the Construction Compliance Supervision will apply the “follow-up format” each week. These formats will be reported to the environmental authority in the environmental compliance reports.

	ABIOTIC ENVIRONMENT
SMRS-1	**SOIL RESOURCE MANAGEMENT**
	Follow-up to the disposal of debris and excavation material

- Follow-up to ZODME will be done with a comprehensive approach. That is, applying the observations, follow-up and monitoring of other components and subcomponents. For instance, verify the non-involvement and conformance of neighbors and communities near the ZODME, compliance with management actions for slopes, conservation of organic soils, attention to Risk Management Plan and attention to Mobility and Signaling Plan, among others.
- The Builder and the Construction Compliance Supervision will perform a documented follow-up to the order and cleanliness of the sites where excavation and / or construction materials are stored.
- Vehicles transporting material to be disposed of, will be covered and will comply with the security measures for transporting heavy loads.
- It will verified that quarry materials required, coming from third parties, count on the corresponding mining title, not be involved in any sanction process and have the environmental license for the use and exploitation of material sources, taking into account the priority of local sources which comply with the specifications above and the required technical specifications.
- Check conditions and ZODME delivery certificate.
- Confirm that waste generated in front of the worksites are not disposed of in the ZODME.
- Check the use of PPE for operation and inspection activities in the area.
- Keep daily records of all activities and volumes of excavation and backfill.
- Daily Record of volumes unloaded in the materials disposal zone.
- Careful monitoring of the disposal process and implementation of drainage measures.

MEASUREMENT CRITERIA

Indicators were developed based on the volume of excavation material and debris generated to verify proper disposal thereof.

The amount of waste - no longer disposed of- in relation to the ones generated allows us to evidence the results of the actions taken.

SMRS-1	**ABIOTIC ENVIRONMENT**
	SOIL RESOURCE MANAGEMENT
	Follow-up to the disposal of debris and excavation material

MEASUREMENT FREQUENCY
The verification of proper disposal of excavation materials will be made monthly, in order to check and measure the actions applied. Those residuals are disposed in the appropriate places without generating impact to the environment.
PROOF OF INDICATOR OF REPRESENTATIVENESS
As basis for the follow-up, the indicator uses the volume of waste generated, each demolition and excavation activity will be recorded by means of photographs and reports of waste generated. The volume is estimated according to the means of transport used to reach the ZODME areas.

- *Management of Slopes, Hillsides and Erosion Control.*

Table 11.1.2. 3: Follow-up to the Management of Slopes, Hillsides and Erosion Control

SMRS-2	**ABIOTIC ENVIRONMENT**
	FOLLOW-UP TO SOIL RESOURCES
	Monitoring and control to erosion processes or other phenomena caused or triggered by the project
PURPOSES	
- Apply control stability actions in the areas of project intervention. - Verify the effectiveness of the stabilization and protection works proposed in the design studies. - Implement observation, screening, and follow-up tasks to cutting and filling conditions along the road, natural slopes, bridges and structures. The foregoing in order to identify sites with erosional or instability processes or requiring maintenance. - Implement and monitor degree of erosion and ground movements in areas where the carrying out of large earthworks and / or excavations related activities (cuts and fills in the road corridor) were projected.	
ACTIONS TO BE TAKEN	
Monitoring and control tasks Monitoring activities will be focused on the periodic inspection of control erosion operation and interventions: **1. Inspection of drainage works and erosion control status:** Verify drainage and runoff water channelization to prevent the occurrence or increase of erosion processes and landslides. Include the verification of drainage works associated with earthmoving, construction of temporary adequate stake fences to prevent the sliding of materials. Progress in placing geotextiles, geo-membrane and drains proposed in the PMA. Check that the operation of ditches, perimeter drain and tailings is not obstructed. **2. Verification of land clearing areas** It aims to control the limits of land clearing areas to prevent erosive effects generated by the clearance of vegetation in the project construction activities because of soil, wind and water exposure.	

	ABIOTIC ENVIRONMENT
SMRS-2	**FOLLOW-UP TO SOIL RESOURCES**
	Monitoring and control to erosion processes or other phenomena caused or triggered by the project

3. Inspect the conditions of containment works

Inspect the conditions and operation of permanent containment works located in potentially unstable areas. The following activities must be performed: Check the conditions of built structures such as: viaducts, bridges, tolls, weighing stations, retaining walls, etc. Check the condition and behavior of stabilization works and slope protection.

4. Instrumentation work

In order to advance on works monitoring / specific areas, instruments for measuring parameters showing changes in the initial conditions of the works following the construction, must be installed. Instrumentation and control measures will include:

a) Visual inspection and field control

Intended to collect information in a periodic manner, to identify, assess and predict the behavior of earth materials from the point of view of stability, and also verify the effectiveness of the works built. Based on this information, actions to mitigate negative impacts, if any, will be planned, reformulated and verified.

These tasks will be performed from the beginning of the construction stage through visual inspection recordings with biweekly frequency, at least. However, it is important that these inspections (like instruments reading) are carried out after the occurrence of seismic events and rains classified as torrential. During the operational stage, inspections can be performed every 2 months.

Based on visual inspection, the mapping of geomorphological processes must be updated; particularly those associated with landslide and erosion processes. That is, follow-up to existing processes must be carried out in order to detect new evidence such as cracks, areas with water, land subsidence, movements of trees, detachment of materials, generation of erosion (laminar or gullies or rills) , block falls, etc. As a result of the foregoing, it must obtain the execution or update of process data sheet.

	ABIOTIC ENVIRONMENT
SMRS-2	**FOLLOW-UP TO SOIL RESOURCES**
	Monitoring and control to erosion processes or other phenomena caused or triggered by the project

In the event of malfunctions of any work, this must be reported to plan the respective maintenance. Considering the foregoing, it is important that observations tasks are performed by a geotechnical engineer or geologist, who will verify the stability conditions of the works or interventions in the project. The activities to highlight during inspections will be:

- Check operation of penetration drains.
- Check that ditches, perimeter drains and tailings are not obstructed.
- Check sites of materials detachment in excavation or cutting areas.
- Check the condition of structures built such as: viaducts, bridges, tolls, weighing station, retaining walls, etc.
- Verify whether re-vegetation or reforestation processes are in line with projected growth.
- Check the condition and behavior of stabilization works and slope protection.

At worksites and specific areas in accordance with technical and engineering studies, a monitoring report on the conditions, will be generated, if required.

b) Road maintenance

Road maintenance is the set of activities required to be immediately done, when a deterioration or failure of any part or road structure is detected, and which must be performed within the shortest-term since detection. In order to detect such inconsistencies, it is proposed to carry out a "routine maintenance", which corresponds to the work of screening, observation and inspection along the road, seeking immediate correction. Additionally, “a regular maintenance" consisting of works or corrections or scheduled maintenance, which cannot be performed immediately and can affect the road operation, will be carried out.

Herein below, the main routine and periodic maintenance tasks:

	ABIOTIC ENVIRONMENT
SMRS-2	**FOLLOW-UP TO SOIL RESOURCES**
	Monitoring and control to erosion processes or other phenomena caused or triggered by the project

Clearing of road, berms and hydraulic structures

It consists of the removal of all alien material from the road, berms and hydraulic structures using hand tools, so that they remain free of obstacles, debris and other falling objects and / or thrown objects.
The purpose is to keep the road, berms, ditches, perimeter drains, tailings, penetration drainage, etc., free of loose materials which would be harmful to both the road operation and the stability of cut slopes, embankments or berms. These works will be performed on a daily basis with special priority during the rainy season

Removal and clearing of slipped material

Consists of removal, clearing and transport of material produced by slides, and obstructing the road, berms, ditches, culverts, overflow channel, or any other element of the road.

The purpose is to keep the road and its elements free of landslides caused by detachment of cutting materials or by natural terrain, affecting the free flow of traffic and putting the road users at accident risk.

These works are to be executed as soon as possible after the occurrence of the slide.

c) Reconstruction, repair and reinforcement of geo-technical works

If during inspection and monitoring, inconsistencies in geotechnical works constructed are detected and no periodic maintenance activities can be applied, it is necessary, at first, to restrict the transit near the site or worksite presenting any flaw or instability. Subsequently, the situation must be jointly assessed by the Contractor's personnel and the Construction Compliance Supervision (including geotechnical engineers), and a decision will be made concerning the action to be taken, which can be: reconstruction, repair or reinforcement.

MEASUREMENT CRITERIA

ABIOTIC ENVIRONMENT	
	FOLLOW-UP TO SOIL RESOURCES
SMRS-2	Monitoring and control to erosion processes or other phenomena caused or triggered by the project

Actions	Indicator / Formula
Visual periodic Inspection of monitored sites.	Number of sites monitored / total number of sites intervened.
Follow-up to monitoring compliance.	Number of monitoring performed/ number of monitoring scheduled

MEASUREMENT FREQUENCY

Since the proposed activities are performed in step-by-step processes, this measurement will be done every 4 weeks but follow-up and on site verification must be performed permanently on-site.

PROOF OF INDICATOR OF REPRESENTATIVENESS

The obtaining of slopes to be shaped will be taken from engineering designs as a basis to verify the execution proposed; in turn, monthly reports and photographic records, such as inspection visits are the tools to verify meadowed areas.

The information gathered allows including the evaluation of all measures taken. The areas shaped as well as all the slope areas are the final result of the purpose and goal proposed in the management plan to minimize the impact generated by soil removal, and establish a visual harmony with the landscape.

- *Follow-up to the Handling of Material and Construction Equipment*

Table 11.1.2. 4: Follow –up to the handling of materials and construction equipment

SMRS-3	**ABIOTIC ENVIRONMENT**
	FOLLOW-UP TO SOIL RESOURCES
	Follow-up to the handling of materials and construction equipment
PURPOSE	
-Follow up to construction materials by preventing or minimizing the deterioration of environmental conditions in the area. - Follow - up to environmental management actions for the use of construction equipment at the worksites and temporary storage yards.	
ACTIONS TO BE TAKEN	
Material handling: The follow-up will be aimed at meeting the conditions mentioned below: · Comply with the regulations set out in the Management and Disposal of Surplus Excavation Materials and in accordance with the provisions of Resolution 541 of 1994. · Check permissions of materials sources from third parties, which must have environmental permits required for its operation. · Check traffic management measures and signaling through visual inspection and photographic record. **Materials Storage** · Verify that material storage does not generate obstruction. · Control emissions of particulate matter into the atmosphere by natural causes. · Check the use of PPE. · Indicate the sites ready for preparing alloys or blends. · Follow-up to the experience and relevant documentation of machinery and equipment operator personnel. · Check lowboy conditions and use thereof. Laboratory measurements are the tool to verify the limits of particulate matter generated by movement of materials.	

	ABIOTIC ENVIRONMENT
SMRS-3	**FOLLOW-UP TO SOIL RESOURCES**
	Follow-up to the handling of materials and construction equipment

Keep daily records of all activities.
- Inventory of machinery, equipment and vehicles transporting materials.
- Inspection of preventive and corrective maintenance performed on vehicles and work equipment.
- Inspection of the loading of dump trucks transporting materials to worksites and to areas

- Prior to the start of the construction activities, last maintenance logs of all machinery, vehicles and equipment entering the project worksite to work will be required.
- The environmental manager will keep control to verify routine, preventive and corrective maintenance of equipment, machinery and vehicles on the worksite.

Pre-operational inspections (daily) will be conducted to all machinery, equipment and vehicles assigned to project development in order to check the correct operation of:
- Control equipment located in dashboards /panels (gauges, tachometers, speedometer, voltmeters, etc.).
- Machine, equipment and vehicles, detecting leaks and pieces or conduits in bad conditions; water, air, fuel, lubricants, brake fluids, hydraulic leaks, etc.
- Tires in terms of pressure and cuts.
- Windscreens, mirrors and rear-view mirrors removing anything that might hinder visibility before starting the machine, equipment and vehicles.
- Engine, free from all kinds of alien elements.
- Oil, water and fuel levels.
- Operation of lights and reverse whistle.
- Multipurpose fire extinguishers properly charged and valid.
- Driver's cabin free of objects (tools, for instance).

In addition, pre-operational inspections (weekly) will be carried out to all machinery, equipment and vehicles assigned to the project development, checking:

- General cleaning and washing.
- Examine the condition and tension of belts.
- Cleaning of air filters.
- Cleaning of battery terminals and checking of battery electrolyte levels.
- Check brake fluid levels.

SMRS-3	**ABIOTIC ENVIRONMENT**
	FOLLOW-UP TO SOIL RESOURCES
	Follow-up to the handling of materials and construction equipment

Check the condition and pressure of tires
- Lubrication
- keep control of daily and weekly maintenance
- carry out periodic inspections, as recommended in service manuals from manufacturers of machines and equipment, with preventive purpose including downtime scheduling for changing certain pieces and elements.
- Perform maintenance to vehicles in front of the worksite - except for reasons of force majeure – is prohibited.

All the foregoing applies to each operating unit of plants installed at camps.

MEASUREMENT CRITERIA

Measures taken to control particulate matter because of the movement of materials are verified according to the measurement of particulate matter generated that should be within permissible limits. This measurement indicator will diminish over time and allow to verify the effectiveness and thoroughness of measures established.

The proper operation of the machinery generates multiple benefits for the project because it will allow the compliance with all the activities without causing any delay in their progress.

MEASUREMENT FREQUENCY

Environmental pollution measurements will be carried out semiannually or with the periodicity the environmental authority indicates.

In turn, the verification of maintenance and inspection of machinery is semiannual with the purpose of ensuring proper operation of machinery and equipment.

PROOF OF INDICATOR OF REPRESENTATIVENESS

Laboratory records, photographic records and monthly maintenance logs are the tools and sources of information for measuring the indicators proposed. These indicators allow to assess the activities proposed and provide a healthy environment in the community by ensuring the condition of equipment and machinery that facilitates the compliance with schedules and reports and measures to be taken during project development.

- *Management of Domestic, Industrial and Hazardous Waste*

Table 11.1.2. 5: Follow up to the management of solid, domestic, industrial and hazardous waste

ABIOTIC ENVIRONMENT	
SMRS-4	FOLLOW-UP TO SOIL RESOURCES
	Follow-up to the management of solid, domestic, industrial, special and hazardous waste
PURPOSE	
· Determine the necessary follow-up measures to carry on proper management of solid waste generated during construction activities and operation of the project in order to avoid adverse effects on the environment. · Comply fully with the provisions of environmental regulations in force and projections regarding the handling and disposal of waste, during the activities developed in the project.	
ACTIONS TO BE TAKEN	
During all project stages, the implementation of management measures outlined in the data sheets of the Environmental Management Plan (Solid and Special Waste Management) for the construction and operation of the project in the areas of temporary disposal and management of waste generated, will be verified The following must be verified: - the prevention and minimization of hazardous waste generation - development of permanent education and training programs in order to conduct a comprehensive waste management **Follow-up to the management of domestic and industrial waste** · Verify the carrying out of adequate classification at the source of the waste according to its origin, and management factsheet (Solid and Special Waste Management) · Verify the reuse of building elements in the works. · Check that the waste is being disposed of at suitable locations and by authorized third parties. · Ratify that different collection sites, worksites and camps are provided with suitable storage sites (weather protected and with enclosure). · Confirm that collection sites comply with storage conditions and that regular waste disposal takes place.	

ABIOTIC ENVIRONMENT	
SMRS-4	FOLLOW-UP TO SOIL RESOURCES
	Follow-up to the management of solid, domestic, industrial, special and hazardous waste

- Validate that routes and frequencies established are proper and necessary for effective waste disposal.
- Check conditions of transporting vehicles and compliance with the provisions of Decree 1609 of 2002 or other administrative actions that replace or modify it.
- Check storage conditions of containers, due labeling and tagging.
- Confirm that records of final disposal correspond to volumes generated.
- Keep a tight control of the volume of each type of waste generated, especially recyclable materials, to be able to verify compliance with the separation and minimization at the source, and in turn, to be used to take corrective action, if necessary.

Follow-up to the management of hazardous solid waste, the following must be verified:

- Not mix with any other kind of residue given its hazardous characteristics
- Stored in a maximum of thirty days and then, immediately transferred to sites authorized by the environmental authorities to be treated or incinerated
- Transfer and handling will take place in high density polypropylene disposable bags, red color, grade greater than 1.8.
- The transporting vehicle failed to compact waste bags. It must have been properly identified and storage completely covered preventing waste from being lost along the way.
- Check that people handling waste or hazardous waste are properly trained for this activity.
- Confirm that oily solid waste from cleaning of equipment, piping, fuel storage area, etc., are collected and properly stored in appropriate containers.

ABIOTIC ENVIRONMENT	
SMRS-4	FOLLOW-UP TO SOIL RESOURCES
	Follow-up to the management of solid, domestic, industrial, special and hazardous waste

- Confirm that no incineration of materials such as tires, plastics, banned under environmental legislation in force, is done.
- Confirm that used batteries are being stored in appropriate collection sites (weather protected, waterproof soils, etc.) and that their final disposal meets the current legal permits for handling.
- Confirm that paint containers or packing, resulting from main pipe maintenance, are stored apart in sealed cans.

Separation and management

- Perform daily inspections at various separation sites authorized within the project to ensure that waste is properly separated at the source according to color code established and that appropriate corrective actions are taken in the event of inadequate handling.
- Perform bimonthly inspections of temporary storage sites in order to verify the effectiveness of environmental measures proposed in the management plan and the need for adjustments.

Collection, transport and final disposal

- The Environmental Supervision will carry out the follow-up to transport and disposal of waste. The exit of waste to treatment and / or disposal sites will be registered on a Collection Record Sheet containing waste type, origin, quantity, weight in Kg, date and final destination. In the event of hazardous waste, the environmental supervision will require contractor companies the certifications of disposal of such waste.
- Each time a company for handling and / or disposal of waste is hired, the permits required by the environmental authorities for the development of these activities, will be required.
- Check delivery supports (return) of hazardous / special waste to specialized suppliers duly authorized by the environmental authority.
- Environmental Compliance Reports will indicate the records or proof of delivery and receipt of solid waste, including delivery date, volumes and types of waste delivered each

ABIOTIC ENVIRONMENT	
SMRS-4	FOLLOW-UP TO SOIL RESOURCES
	Follow-up to the management of solid, domestic, industrial, special and hazardous waste

time the service is requested.

- Conduct inspections on storage and final disposal sites.

MEASUREMENT CRITERIA

Separation and proper storage of waste are the basis for the measurement and follow-up to activities proposed. Weight is the measurement unit that allows to assess - as a whole- separation, storage and delivery of waste to select and authorized centers.

MEASUREMENT FREQUENCY

To avoid the accumulation of waste in the camps, this measurement and delivery is estimated to be bimonthly, if possible, or sooner if the amount of waste generated requires it.

PROOF OF INDICATOR OF REPRESENTATIVENESS

Weight control on-site by the collection company is the main tool to evaluate behavior at the time of waste separation and storage. Weekly inspection of the condition of collection points and volume of ordinary waste weekly delivered to the sanitation and collection company that cannot be weighed, are the mission of the environmental management accomplished. Hazardous and usable waste are measures to assess the impact of campaigns and the clarity of measures applied to waste separation according to their material or production sources.

Table 11.1.2. 6 Tracking handling explosives

ABIOTIC ENVIRONMENT	
SMRS-5	**Follow-up to handling of explosives**
PURPOSE	
Check the follow-up to actions proposed for the safe handling of explosives	
ACTIONS TO BE TAKEN	
To carry out the follow-up to the program, the following periodic inspections to verify the measures, will be made: - Use explosives identification tags according to their classification: primary and secondary. - Identify obstruction aspects that fail to prevent adequate air circulation in the powder store. - Order and cleanliness of the powder store. - Prohibition of storage of other substances in the powder store. - Transporting vehicles in good mechanical and electrical conditions. - Do not carry more weight than the indicated. - Keep record of explosives received. - Submit permission from the Brigade for storing explosives. - Make sure that the surroundings of the powder stores are properly signaled with red flags and no combustible materials within a radius not less than 50 meters. - Extinguishers in good condition. - Access to the powder magazine must be free of obstacles. At the time of handling and use of explosives, verify the following - Use of substances proper for ignition of explosives. - Inspect the design and earthworks. - Inform the surrounding community about the works to be performed. - Take measures to ward off wildlife present in the area to be detonated. - No unauthorized personnel in detonation areas.	

ABIOTIC ENVIRONMENT	
SMRS-5	**Follow-up to handling of explosives**
Damaged or expired explosives to be delivered or destroyed by the Military Forces of Colombia	
MEASUREMENT CRITERIA	
The indicators were developed in order to measure the number of potential accidents by bad handling explosives.	
MEASUREMENT FREQUENCY	
Verification of each action above should be done fortnightly; measurements should be done quarterly for the follow-up to indicators proposed.	
PROOF OF INDICATOR OF REPRESENTATIVENESS	
The indicators proposed are based on the number of accidents that occur in the handling of explosives and the complaints filed by the community.	

Table 11.1.2. 7: Follow to fuel handling and storage

ABIOTIC ENVIRONMENT	
SMRS-6	**Follow-up to fuel handling and storage program**
PURPOSE	
Follow-up to compliance with the measures established for fuel storage and handling of fuel in camp areas.	
ACTIONS TO BE TAKEN	
- Check the environmental and operation documentation (Certificate) of the fuel supplier which must meet the requirements of the Ministry of Mines and Energy. - Analyze fuel consumption records with filling authorizations. - Check the number of spills, the handling of the accident, and the disposal of soil and contaminated material. - Keep an anti-spill with the necessary input. - In the event of accidental fuel spills on the ground, the operator doing the manipulation must notify the person in charge or the supervisor of construction contingencies and should	

ABIOTIC ENVIRONMENT	
SMRS-6	**Follow-up to fuel handling and storage program**
deal with the incident by removing the spill immediately. If the volume spilled is greater than 5 gallons, the soil removed must be moved to special treatment site, and the affected area should be restored immediately. - Do not exceed the volume of fuel allowed for storing. - Transport on appropriate vehicles clearly marked according to NFP standards. - Tank cars must comply with all safety measures, carry fire extinguishers, and anti-spill kit	
MEASUREMENT CRITERIA	
Indicators were developed from spills and work accidents during fuel handling and storage. The number of accidents occurring and their handling is an indicator that measures proposed are being executed.	
MEASUREMENT FREQUENCY	
The inspection must be daily and every time out supply activities are carried out. The measurement of the indicators will be on a quarterly basis for follow-up and taking of corrective actions required.	
PROOF OF INDICATOR OF REPRESENTATIVENESS	
The number of accidents and / or spills occurring during fuel supply, fuel provision and storage thereof is a follow-up measure to identify that actions proposed are being executed.	

Catchment Management

Table 11.1.2. 8: Follow-up to Catchment Management

ABIOTIC ENVIRONMENT	
SMRH-1	FOLLOW-UP TO WATER RESOURCE MANAGEMENT PROGRAM
	Follow-up to catchment management

PURPOSE

Establish adequate follow-up measures at authorized catchment sites, perform it efficiently and keep natural conditions of the sites intended for this purpose.

ACTIONS TO BE TAKEN

Based on the number of catchments in the various water sources described in chapter 7 Use and Exploitation of Resources, Section: General requirements for water bodies catchment:

- Water monitoring will be conducted and carried out according to parameters set out in the table below

Parameters to be measured in water sampling during catchment

KIND	PARAMETER
PHYSICAL	Temperature
	Conductivity
	Total Suspended Solids
CHEMICALS	ph
	Fats and oils
	DQ0
	DBO5

- Verify that catchments for this activity are carried out in water bodies authorized and under the coordinates and conditions approved.
- This will be made with the following frequency: One time, before carrying out the catchment in each surface drainage established for this purpose, and one time after the catchment on each drainage.

ABIOTIC ENVIRONMENT	
SMRH-1	FOLLOW-UP TO WATER RESOURCE MANAGEMENT PROGRAM
	Follow-up to catchment management

- Check that catchment strategy is clear and operators are familiar with it in order to prevent environmental and personal accidents.
- Records of volumes captured are tools to verify that the amount of concession water does not exceed the amount authorized by the environmental authority.

MEASUREMENT CRITERIA

Not exceeding the authorized catchment for each volume is the main measure to verify compliance with the proposal. Considering that the volume collected is not for household purposes, it should not meet water treatment parameters.

MEASUREMENT FREQUENCY

Follow-ups and monitoring will be conducted as the competent environmental authority indicates through the records of water resources catchment and the amount of resource reaching and stored at the camp. During catchment, photographic records should be taken to verify the compliance with measures established.

FOLLOW UP AND MONITORING INDICATORS

PROOF OF INDICATOR OF REPRESENTATIVENESS

The volume collected is the measure that allows verify compliance with the permitted volume; flowmeter registration and storage capacity are the required registration to obtain the entire volume collected

Management of Water Bodies Crossing

Table 11.1.2. 9: Follow-up to the management of water bodies crossing

ABIOTIC ENVIRONMENT	
SMRH-2	**FOLLOW THE WATER RESOURCE MANAGEMENT**
	Follow-up to the management of water bodies crossing
PURPOSE	
Verify compliance with the construction activities of water bodies crossing structures.	
ACTIONS TO BE TAKEN	
- Check the delimitation of the area to be intervened by works on water courses. - Confirm that the works do not alter the stability of water banks intervened. - Provide that sources of materials have environmental clearance for extraction. - Verify the adequacy of crosswalks with boards to prevent or restrict the passage of workers through the watercourse. - Corroborate the construction of works of art, adaptation of transverse barriers in order to retain sediment and material slipping from the works. Barriers, which can be built temporarily are dikes with permissible height for water passage, sandbags barriers or stake fences, meshes, and others. - Check the reshaping and restoring of streams, returning them to their original course, cleaning the banks and the riverbed will be carried out, if required, and banks will be stabilized with sandbags and cement. - Confirm installation of structures for retaining fines (sedimentation) downstream from the crossing site, which will be removed during final reshaping works of the crossing, prior cleaning and proper disposal of fine material retained therein. - Confirm compliance with design works proposed in the ZODME, such as perimeter ditches around in order to collect runoff waters. Maintenance of ditches and sediment containment barriers will be made, ensuring that each structure fulfills its function (avoid excessive sedimentation); the filtered sediment will be disposed at the nearest ZODME.	
MEASUREMENT CRITERIA	
Each channel intersection must have a hydraulic work to allow adequate drainage structures; for this reason, structures planned as result of a design and engineering study are the basis for measurement.	

ABIOTIC ENVIRONMENT	
SMRH-2	FOLLOW THE WATER RESOURCE MANAGEMENT
	Follow-up to the management of water bodies crossing
MEASUREMENT FREQUENCY	
As the project progresses, the construction works to be assessed at the time the competent environmental authority provides, is carried out. During the inspection visits, photographic records must be taken and the amounts of works required must be examined.	
PROOF OF INDICATOR OF REPRESENTATIVENESS	
Reports made by Construction Compliance Supervision and the design follow-up log are the basis for measuring the indicators proposed. The number of structures built with respect to those designed and planned to be build is the measure of compliance since the fewer works built with respect to those programmed generate a negative impact on water bodies running through drainage.	

Runoff Management

Table 11.1.2. 10: Follow-up to runoff management

ABIOTIC ENVIRONMENT	
SMRH-3	FOLLOW-UP TO WATER RESOURCE MANAGEMENT PROGRAM
	Follow-up to runoff management
PURPOSE	
Verify that methods set out in the management measures provide the treatment of waters that may enter the runoff water natural drainage in the infrastructure project.	
ACTIONS TO BE TAKEN	
- Verify the implementation of additional works for rainwater and runoff water management. - Confirm that actions are carried out in areas where concentration of runoff flows or water ponding are identified. Verification of compliance with execution of construction works proposed such as: - Drains and construction works: side ditches and gutters for rainwater and runoff management with tailings in the direction of natural drains, will be carried out on the roads. These tailings will have energy dissipaters structures made of cement to prevent the erosion of slopes reaching the drains. - Measures to prevent contamination and deterioration of surface water - Check the conditions of each of the ditches built around temporary camps, work sites on ground or simple concrete in terms of cleanliness, and adaptation of the same - Confirm that rainwater gutters located on both sides of the road will remain free of debris or any material blocking the passage of water. Keep runoff records coming from the falling of phreatic level in the excavations: SST	
MEASUREMENT CRITERIA	
Both maintenance and construction of the structures required are necessary for measuring the efforts to channel rainwater, runoff flows and prevent water ponding.	
MEASUREMENT FREQUENCY	

ABIOTIC ENVIRONMENT	
SMRH-3	FOLLOW-UP TO WATER RESOURCE MANAGEMENT PROGRAM
	Follow-up to runoff management
Quarterly measurement of the proposed measures is the result of monthly inspections, which must verify the construction of structures built as the project development progresses, and the right runoff flow. This means that structures such as canals or ditches should not be obstructed.	
PROOF OF INDICATOR OF REPRESENTATIVENESS	
Maintenance follow-up logs and records of construction of structures are the sources for measurement of indicators. Assess the amount of structures built provides that water flows will be channeled and directed to their natural course. The maintenance of the structures protects flow continuity and prevents dragging of materials into water bodies, removing contamination from water bodies and generating a harmonious visual appearance.	

Table 11.1.2. 11 Follow-up to the management of liquid, domestic and industrial waste

ABIOTIC ENVIRONMENT	
SMRH-4	FOLLOW-UP TO WATER RESOURCES PROGRAM
	Follow-up to the management of liquid, domestic and industrial waste
PURPOSE	
Check the handling of liquid waste generated during the project development	
ACTIONS TO BE TAKEN	
According to the activities proposed for management of sewage, gray water and industrial waste, the following will be verified: - Use and disposal of portable medical units. - Ownership and validity of environmental and operation permits. - Proper functioning of wastewater treatment units. - Periodic maintenance of the treatment system proposed treatment - Odor generation	

	ABIOTIC ENVIRONMENT
SMRH-4	**FOLLOW-UP TO WATER RESOURCES PROGRAM**
	Follow-up to the management of liquid, domestic and industrial waste

- Water recirculation for the activities described (wetting and supply of processes)
- Handling and disposal of oily water.
- Compliance with design criteria for infiltration basin
- Percolation test results and phreatic level in compliance with Resolution 631 of 2015

Keep records of the quality and quantity of discharges:
- Flow generated in m3 / s
- Quality of water discharged
- Removal parameters

REFERENCIA	USUARIOS NUEVOS
PH	5 a 9 unidades
Temperatura	Menor o igual 40°C
Material flotante	Ausente
Grasa y Aceites	Remoción mayor igual 80% en carga
Sólidos Suspendidos	Remoción mayor igual 80% en carga

Regarding the handling of oily water, verify:
- That it counts on a system of collection and storage of used oils.
- Direct dumping on the floor of oils, greases or fuels is prohibited.
- Storage tanks with protection systems (dike) in the event of spills. The dike will have a capacity of 110% the volume of the storage tanks
- Storage of oil, grease or fuel will be in a properly signaled isolate area and will count on emergency containment kits.
- The storage area will be paved, preventing leaking to the subsoil.
- Work personnel will be trained on the proper handling of these substances.
- Washing, repairing and corrective maintenance of vehicles and machinery in the work should be avoided. This will be carried out at authorized centers.
- In case of accidental spills of oils, accelerants will be picked up quickly using synthetic absorbent, sawdust, sand, etc.
- A record of all spills, indicating date, place and corrective action applied, will be kept.

- When the supply of fuel for the machinery and / or equipment in the work front is required, it will be through the use of a tank truck - tank car meeting the NTC standard for transport of

ABIOTIC ENVIRONMENT	
	FOLLOW-UP TO WATER RESOURCES PROGRAM
SMRH-4	**Follow-up to the management of liquid, domestic and industrial waste**
hazardous substances and the provisions of the environmental regulations in force. - Dumping of waste oils and other materials directly on the ground is prohibited. If the work generates this type of waste, it will be delivered to authorized entities.	
MEASUREMENT CRITERIA	
Measuring the quality and characteristics of the dumping allows me to identify that all processes are in progress as established	
MEASUREMENT FREQUENCY	
The measurement will be semiannual or according to periodicity set by the environmental authority. Maintenance of the units will be performed monthly	
PROOF OF INDICATOR OF REPRESENTATIVENESS	
The measurement of the parameters indicated involve a series of actions for their compliance. Therefore, it is considered that having them into account is a way to assess all activities proposed.	

Air Resource Management Program

- *Follow-up and control of emission and noise sources*

Table 11.1.2. 12: Follow-up to the management of atmospheric emission sources

SMRA-1	**ABIOTIC ENVIRONMENT**
	AIR RESOURCE FOLLOW-UP PROGRAM
	Follow-up to the management and control of emission and noise sources
PURPOSE	
Follow-up and monitoring of measures in place to establish proper management of emissions of gases and particulate matter associated with the operation of machinery, equipment and vehicles during the construction of the Rumichaca – Pasto two-lane roadway project, Pedregal – Catambuco road section.	
GOAL	
Execute 100% of the measures provided for in this program, which apply for the project	
ACTIONS TO BE TAKEN	
To guarantee the compliance with the proposed measures and in order to comply with the provisions of the regulations, the following follow-up measures are established: - Inspect the frequency of maintenance performed on vehicles, equipment and machinery used in the project activities. - Verify compliance with automotive diagnostic certificate for each vehicle used for transporting people, materials or movement of materials. - Verify compliance with the provisions of Decree 948/95, Resolution 005/96 and Resolution 909/96 of the Ministry of Environment, Housing and Land Development MAVDT. - Through visual inspection and photographic record of Geotextile coverage of materials remaining in the camps to prevent the spread of materials. - The site supervisor must verify that dump trucks that make the transfer of materials have tarps to protect transported materials from wind. - According to operation manuals of each equipment used in the camps, schedule the maintenance thereof, and change bag filters, sprinklers, exhaust hoods as required by each equipment. - Comply with yearly air quality monitoring or air quality monitoring at such intervals as determined by the environmental authority. Once the laboratory results are delivered, make the respective analysis results to apply corrective measures, if necessary.	

ABIOTIC ENVIRONMENT	
	AIR RESOURCE FOLLOW-UP PROGRAM
SMRA-1	**Follow-up to the management and control of emission and noise sources**

- Follow-up the roadway wetting to avoid suspension of particles that contribute to pollution. This wetting must be a responsible process of industrial wastewater recirculation.
- No open-air burning of any residue in front of the worksite and camps.
- Transit speed in front of the worksite will be 20 km / h.
- Vehicles, machinery and equipment using gasoline or ACPM will be started only the strictly necessary. • A format recording dry days requiring wetting will be designed.
- Periodic maintenance will be made to vehicles, machinery and equipment, considering the perfect combustion of engines, the adjustment of mechanical components, and tires balancing and calibration.
- Synthetic or polyethylene tarps will be placed on storage areas of debris, avoiding particle dispersion because of the wind.
- Semiannual assessment of air quality.

MEASUREMENT CRITERIA

Compliance with Colombian environmental legislation on air quality is the basis for measuring the conservation of air quality for the community, and the control of stationary and fixed emission sources through compliance with the applicable parameters to be measured.

MEASUREMENT FREQUENCY

Verification of compliance of parameters for both stationary and mobile sources -depending on their classification - are made semiannually or according to the periodicity the environmental authority provides.

PROOF OF INDICATOR OF REPRESENTATIVENESS

Measurement of parameters established by the environmental legislation on air quality - depending on their source of emission - must be performed and enforced to ensure the quality of air in the community and not contribute to atmospheric pollution as an act of environmental responsibility.

SMRA-1	**ABIOTIC ENVIRONMENT**
	AIR RESOURCE FOLLOW-UP PROGRAM
	Follow-up to the management and control of emission and noise sources
Measurements will be made by authorized laboratories or diagnostic centers to ensure compliance with the permissible limits. This data sheet takes into account the use of technology that controls emissions such as exhaust hoods, baghouse filters and wetting activities.	

Table 11.1.2. 13 Follow-up to the management and control of process plant emissions

SMRH-4	**ABIOTIC ENVIRONMENT**
	AIR RESOURCE FOLLOW-UP PROGRAM
	Follow-up to the management and control of process plant emissions
PURPOSE	
Examine the performance of plants and emission control units installed	
ACTIONS TO BE TAKEN	
Control to the proper functioning of the systems installed will be carried out as follows: - Plants must have filters with holding capacity according to size and production. - Ventilation system - Gas emissions control devices - Periodic maintenance of equipment The semiannual air quality monitoring should be done to assess the following parameters: particulate matter, gases (CO, SOx, NOx). This should be done every six months or according to the periodicity established by the environmental authority.	
MEASUREMENT CRITERIA	
Measurement parameters and compliance with these according to environmental regulations indicate that the measures are being implemented and the appropriate control equipment are being used.	
MEASUREMENT FREQUENCY	
The measurement will be semiannually or as otherwise provided by environmental authority through monitoring performed by a laboratory duly authorized by the IDEAM	

SMRH-4	**ABIOTIC ENVIRONMENT**
	AIR RESOURCE FOLLOW-UP PROGRAM
	Follow-up to the management and control of process plant emissions
PROOF OF INDICATOR OF REPRESENTATIVENESS	
The compliance with the provisions of environmental regulations indicates proper operation of the plant in terms of production and emissions control	

Table 11.1.2. 14: Follow-up the management and control of noise emission sources

SMRA-1	**ABIOTIC ENVIRONMENT**
	AIR RESOURCE FOLLOW-UP PROGRAM
	Follow-up to the management and control of noise sources
PURPOSE	
Follow-up and monitoring to measures in place to guarantee proper management of noise sources associated with the operation of machinery, equipment and vehicles during the construction of the Rumichaca – Pasto two-lane roadway, Pedregal – Catambuco road section.	
ACTIONS TO BE TAKEN	
- Check through organoleptic means, situations, and times and use frequency of cornets and horns by vehicles and machinery operators causing discomfort in this community. - Verify that speed of circulating vehicles is according to regulations or internal policies. - Confirm that engines have silencers that allow changing the sound frequency. - As far as possible, perform internal sound- measuring.	
MEASUREMENT CRITERIA	
Sound-measuring shows the decibel levels recorded during normal operations. These records must comply with established environmental regulations and not generate impacts on the community and surrounding wildlife habitats. Noise generation is perceived by human senses; therefore, complaints or suggestions from the community will be taken into account.	

SMRA-1	**ABIOTIC ENVIRONMENT**
	AIR RESOURCE FOLLOW-UP PROGRAM
	Follow-up to the management and control of noise sources
MEASUREMENT FREQUENCY	
Monitoring should be performed within the term provided by the environmental authority, the follow-up of complaints and suggestions filed by the community, as well as internal decibel measurement as an internal control mechanism.	
PROOF OF INDICATOR OF REPRESENTATIVENESS	
The perception of the community is essential because their usual conditions cannot be altered by the project. The internal measurement of decibel and follow-up to complaints and suggestions are control measures that are thought to minimize the impact to the community and adjacent wildlife. Sound-measuring reports are internal measures undertaken by the concessionaire's personnel, which seek to verify that no discomfort is generated by any machinery or equipment.	

- *Landscape Management*

Table 11.1.2. 15: Follow –up to landscape management

SMRS-4	**ABIOTIC ENVIRONMENT**
	FOLLOW-UP TO SOIL RESOURCES
	Follow-up to landscape management
PURPOSE	
Establish the follow-up measures necessary to guarantee compliance with management actions undertaken to minimize visual change because of adaptation and construction activities of the project in relation to the perception of the landscape	
ACTIONS TO BE TAKEN	
FOLLOW-UP TO MANAGEMENT MEASURES AND LANDSCAPE CLEARING · Identify whether the cleared areas are necessary and authorized · Verify that all equipment, machinery and other elements affecting the landscape are removed at the end of the activity. · Verify that reforestation or gardening processes are made with native species from the area. · Inspect the circulation paths of vehicles in order to ensure that they transit through authorized roads · Inspect proper dispersion and compaction of surplus excavation materials, and verify if they were taken to wasted dumps authorized and with environmental license in force.	

ABIOTIC ENVIRONMENT	
SMRS-4	FOLLOW-UP TO SOIL RESOURCES
	Follow-up to landscape management

- Corroborate that surfaces (rills, gullies, erosion processes) are restored.
- Check the final condition of the roads, to ensure their proper status upon completion of construction activities.
- Check that camp areas and temporary collection sites are recovered through re-vegetation, cleaning, grading and removal of all alien elements to the environment.
- Check that waste generated - independently from its generation source - are disposed of in established and authorized sites.

MEASUREMENT CRITERIA

Protective measures and protective barriers are critical for the development of the works because they create a visual impact and also a safety measure. Likewise, works must be in harmony with the environment so they must have landscape adaptation measures.

MEASUREMENT FREQUENCY

Monthly inspection measures are necessary to verify the use of visual protection measures such as using poly-mesh shade, and that landscape adaptation activities are performed according to the environment and measures proposed for landscape adaptation.

PROOF OF INDICATOR OF REPRESENTATIVENESS

Having measures to preserve landscape is critical for the project development. These measures should be consistent with the environment. The measures applied are assessed at the discretion of the supervisor and in compliance with designs and landscape adaptation measures because the relationship with society, mobility and tourism activities in the area is important. Conservation planning and landscape design are actions to minimize the negative visual perception of the public concerning the regular activities of the project.

- ***Follow-up and monitoring the trend of the Abiotic Environment.***

The following describes the issues addressed in the contents of the follow-up and monitoring plan to the trend of the abiotic environment of the Rumichaca – Pasto two-lane roadway, Pedregal – Catambuco road section.

- Purposes
- Environmental component to monitor
- Location of sampling sites
- Management measures that influence the trend
- Process
- Frequency and duration of monitoring
- Criteria for the analysis and interpretation of results
- Indicators

Monitoring conducted by laboratories will be with equipment and under the methodologies certified by the IDEAM.

Table 11.1.2. 16: Follow-up and monitoring of the Abiotic Environment Trend

FOLLOW-UP AND MONITORING TO THE ABIOTIC ENVIRONMENT TREND.					
PURPOSE					
Define the environmental quality of abiotic environment by analyzing water and atmospheric components trends, enabling to monitor the behavior and taking corrective actions, if necessary.					
ENVIRONMENTAL COMPONENT TO MONITOR					
Geospheric		water	X	Atmospheric	X

LOCATION OF SAMPLING SITES

water component

Locate the water quality monitoring stations along the road corridor of the project in the following municipalities:

MUNICIPALITY	VEREDA (SETTLEMENT)	SOURCE NAME	ELEVATION	MAGNA SIRGAS PLANE COORDINATES- ORIGIN: WEST	
				EAST	NORTH
Imués	El Pedregal	Guáitara	1741	958574	608089
Imués	Pilcuán	Guáitara	1704	957030	605405

FOLLOW-UP AND MONITORING TO THE ABIOTIC ENVIRONMENT TREND.

Yacuanquer	Inantas Bajo	Bobo	1799	960904	608425
Yacuanquer	Inantas Alto	Magdalena	2049	961200	610748
Tangua	El Tablón	Magdalena	1882	961152	609232
Tangua	Chávez	La Chaquita	2693	967144	614093
Tangua	El Cebadal	Magdalena	2648	965250	615213
Tangua	Los Ajos	La Marquesa	2999	968133	617098
Tangua	Los Ajos	La Marquesa	3003	968462	617078

Atmospheric component

The location of the monitoring stations are listed below:

MUNICIPALITY	VEREDA (SETTLEMENT)	NAME	ELEVATION	MAGNA SIRGAS PLANE COORDINATES - ORIGIN: WEST	
				EAST	NORTH
Imués	Pedregal	Point 6 - El Pedregal	1803	958439	608235
Tangua	Municipal capital	Point 7 - Tamgua	2417	964268	612785
Tangua	Chavez	Point 8 - Vereda Chavez	2733	966837	614411
Tangua	El Tambor	Point 9 - Vereda El Tambor	2912	967320	616111
Grass	Catambuco	Point 10 - Catambuco	2836	975477	620217

MANAGEMENT MEASURES AFFECTING THE TREND

Water component

- The use of portable sanitary units in the worksites, and a waste collection system (generally by vacuum suction) for disposal by the service company, will be hired. The use of this system does not allow discharge into water systems.

FOLLOW-UP AND MONITORING TO THE ABIOTIC ENVIRONMENT TREND.
- The process plant is located near La Chaquita, the Marqueza, La Magdalena water sources. The water left will be conducted to the recirculation system for the production of concrete in compliance with Article 500 - 07 of INVIAS (Quality Standard hydraulic concrete), number 500.2.1.2 - Water). - In foundation activities, where the use of sludge is necessary, a containment system for materials, allowing separation and drying thereof, and subsequent treatment as debris (final disposal at ZODME) will be implemented. - All management measures included in the "water bodies crossing" program of the PMA established for the project. - Under no circumstances, excavations material will be available near the drainage or runoff reaching water bodies, as it may block the channel with sediments or increased turbidity, and therefore, causing deterioration to aquatic resources populations. - Desanders, allowing the separation of particles carried by collected waters before discharging into natural drainage areas, are implemented. **Atmospheric component.** Implementation of management measures included in the Management of Emission and Noise Control Sources
PROCESS
Water component Due to the intervention of the Rumichaca – Pasto two-lane roadway project Pedregal – Catambuco road section on Quebrada La Magdalena (La Magdalena Stream) and Quebrada La Marqueza (La Marqueza Stream), the implementation of a monitoring system to assess the water source trend is considered while the construction activities crossing such water bodies are in progress. During the construction process of the Rumichaca-Pasto roadway, water quality monitoring (one for each climate period) must be made in order to describe the quality of the resource.

FOLLOW-UP AND MONITORING TO THE ABIOTIC ENVIRONMENT TREND.

The parameters analyzed are as follows:

Turbidity	Total metals by ICP-MS Ba
Alkalinity	Total metals by ICP-MS Cd
Acidity	Total metals by ICP-MS Cu
True Color	Total metals by ICP-MS Cr
DBO5	Total metals by ICP-MS Hg
DQO	Total metals by ICP-MS Ni
Total nitrogen	Total metals by ICP-MS Ag
Calcium hardness	Total metals by ICP-MS Pb
Total hardness	Total metals by ICP-MS is
Total phosphorous	Total metals by ICP-MS As
Total phenolic	total coliforms
Total Suspended Solids	E. coli

Resolution 1575 of 2007

Monitoring should be carried out by a laboratory certified by IDEAM.

Atmospheric component.

In order carry out the follow-up and monitoring of air quality, a follow-up and monitoring plan will be designed in accordance with national environmental regulations, as well as methods referenced by the US EPA, in order to meet all standard conditions for taking and analysis of samples (monitoring will be contracted with an IDEAM certified laboratory for taking and analysis of samples).

The assessment of quality of the atmospheric component will be done through the implementation of a monitoring system according to the protocol for follow-up and monitoring of air quality issued by the Ministry of Environment and Land Development, 2010 (number 5.7 SVCAI. - Industrial Air Quality Surveillance System)

Monitoring was conducted by installing simultaneous monitoring stations for 18 days. Parameters to be monitored are PM10, SOx, NOx (five stations)

FOLLOW-UP AND MONITORING TO THE ABIOTIC ENVIRONMENT TREND.

The stations will be located according to the inventory of emissions and dispersion model and monitoring campaign that was developed to describe the project baseline. Through the dispersion model the location of the monitoring stations were identified; they are listed herein below

AIR QUALITY					
MUNICIPALITY	VEREDA (SETTLEMENT)	NAME	ELEVATION	COOR_X	COOR_Y
Imués	Pedregal	El Pedregal	1803	958439	608235
Tangua	Municipal capital	Tangua	2417	964268	612785
Tangua	Chavez	Vereda Chavez	2733	966837	614411
Tangua	El Tambor	Vereda El Tambor	2912	967320	616111
Grass	Catambuco	Catambuco	2836	975477	620217

ENVIRONMENTAL NOISE					
MUNICIPALITY	VEREDA (SETTLEMENT)	NAME	ELEVATION	COOR_X	COOR_Y
Imués	Pedregal	El Pedregal	1803	958421	608240
Tangua	Municipal capital	Tangua	2417	964250	612790
Tangua	Chavez	Vereda Chavez	2731	966819	614417
Tangua	El Tambor	Vereda El Tambor	2912	967301	616117
Grass	Catambuco	Catambuco	2836	975459	620222

In order to perform the monitoring, equipment and methodologies from laboratories certified by the IDEAM, were used:

- Three high volume samplers for PM10
- Three "RAC" gas samplers with calibration kit
- Glass fiber filter paper for PM10
- Portable weather station

FREQUENCY AND DURATION OF MONITORING

FOLLOW-UP AND MONITORING TO THE ABIOTIC ENVIRONMENT TREND.								
Component	Follow-up monitoring plan	Frequency	Duration					
			year 1	year 2	year 3	year 4	year 5	year 6
water	Monitoring of Water (water sources Guáitara, Bobo, Magdalena, La Chaquita, La Marqueza)	Two monitoring per year, 1 in each climate period	Project duration					
Atmospheric	Monitoring air quality: PM10, SOx, NOx (three stations)	Two monitoring per year, 1 in each climate period	Project duration					

CRITERIA FOR ANALYSIS AND INTERPRETATION OF RESULTS
The analysis of the monitoring is founded on parameters defining the quality of the component to be described. The interpretation will be made based on the maximum levels permitted by the regulation.

INDICATORS			
COMPONENT	**INDICATOR**	**TYPE**	**SPECIFICATION**
water	Analysis of current water quality vs analysis of water quality from prior year	Qualitative	This qualitative indicator allows to establish changes in current water quality in relation to the analysis from previous years

FOLLOW-UP AND MONITORING TO THE ABIOTIC ENVIRONMENT TREND.			
	Number of measurement parameters that meet the maximum values permitted by legislation / Number of total parameters monitored Resolution 1575 of 2007	Quantitative	This indicator can establish compliance with the maximum levels permitted according to water quality standard.
Atmospheric	Analysis of current air quality vs analysis of air quality from previous year	Qualitative	This qualitative indicator allows to establish changes in current air quality in the area most affected by project emissions (areas associated with the location of process plants) in relation to the quality from the previous year.
	Number of measurement parameters that meet the maximum values permitted by legislation /total number of parameters monitored Resolution 610 of 2010	Quantitative	This indicator can establish compliance with maximum levels permitted according to air quality standard (resolution 610 of 2010).