Pöyry Tecnologia Ltda.
Av. Alfredo Egídio de Souza Aranha, 100
Bloco B - 5º Andar
04726-170 - São Paulo-SP
Tel. (11) 3472 6955
Fax (11) 3472 6980
E-mail: contato.br@poyry.com
www.poyry.com.br

ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

Date 31.07.2021

Reference N. 109002841-001-0000-E-1500
Page 1

PARACEL

EUCALYPTUS PLANTATION
Departments of Concepción and Amambay – Paraguay

VOLUME I – Description of Project

Content

Annexes

Distribution	
PARACEL	E
PÖYRY	-

Orig.	31/07/21– kxh	31/07/21 – bvv	31/07/21 – hfw	31/07/21 – hfw	For information
Rev.	Date/Author	Date/Verified	Date/Aproved	Date/Authorized	Observacion
a	20/08/21– kxh	20/08/21 – bvv	20/08/21 – hfw	20/08/21 – hfw	For information

SUMMARY

FIGURE LIST

TABLE LIST

1 INTRODUCTION

1.1 Background

This document is an Environmental and Social Impact Assessment (ESIA) of the forest component of the PARACEL project in line with IFC EHS Guidelines for Perennial Crop Production and what is established by the Performance Standards (PS) of the IFC, in order to form, together with the ESIA of the industrial component, the Study of Comprehensive Environmental Impact of the Project that the IFC-PS1 presupposes.

PARACEL, was established by the independent entrepreneurs Copetrol (Paraguay) and Girindus Investments (Sweden), and its industrial project is a implementation of a pulp mill with a capacity of 1,5 million tons per year of bleached pulp for paper, to be located in Concepción, Department of Concepción, Paraguay.

The forest and industrial project will use the best resources available in terms of technologies (BAT – Best Available Techniques) and environmental management (BPEM – Best Practices of Environmental Management).

It is expected that the construction phase of the mill will begin in the first half of 2021, and that its operation will take place in the first half of 2023. In its operational phase, it will be supplied with eucalyptus wood from sustainable forest plantations, that is objective of the present study. Plantations will be certified to Forest Stewardship Council (FSC) and other environment global sustainability standards such as General EHS Guidelines.

According to PARACEL, the forest project will acquire 19 estancias, or ranches for plantations, with a total area of approximately 190,000 ha, mostly located in the department of Concepción; approximately 130 km from the prospected industrial site.

Considering the overall project land area, 53% will be destinated to eucalyptus plantations and 47% to protected areas. This will satisfy around 80% of the demand required for the operation of the plant and the other 20% will be provided by external producers to the company (small local producers).

During the first 6 years, a supply of wood from Brazil, Argentina and from forestations located in the country is foreseen, which will be transported by land and river to "Puerto PARACEL". It is worth mentioning that the mobilization of trucks with rolls from own plantations is estimated as of the fourth year of the project.

It is estimated that the forestry area will generate approximately 3 thousand jobs, between own contractions and outsourcing, during all the steps of the project – feasibility, construction/implementation, implementation and pre-operation, operation-learning curve and operation.

The development and content of this Environmental and Social Impact Assessment (ESIA) is in accordance with the Constitution of the Republic of Paraguay (1992), articles 4th to 8th, which determine the right to protection of human life and the to a healthy environment.

Guidelines established by Law 294/1993 and Decree 453/2013, which establish and regulate the process of environmental impact study, were also complied with, in addition to the analysis of other laws, decrees, resolutions, regulations and guidelines of the Ministry of the Environment and Sustainable Development - MADES.

In addition to the legal requirements, the ESIA was developed to be aligned with IFC Performance Standards (2012) and applicable EHS Guidelines.

The IFC Performance Standards include:

- IFC PS 1 on "Evaluation and management of environmental and social risks and impacts";
- IFC PS 2 on “Labor and working conditions”;
- IFC PS 3 regarding resource efficiency and pollution prevention, including pest management activities and use of chemical pesticides evaluation;
- IFC PS 4 on “Community Health and Safety”;
- IFC PS 5 on “Land Acquisition and Involuntary Resettlement”;
- IFC PS 6 regarding biodiversity conservation and sustainable management of living natural resources, including the Critical Habitat concept;
- IFC PS 7 regarding the Indigenous People;
- IFC PS 8 on Cultural Heritage.

The main objective of this Environmental and Social Impact Assessment (ESIA) is to declare the environmental feasibility of the PARACEL forest component, through the characterization of the project, the knowledge and analysis of the current situation of the areas that will suffer modifications due to its implementation and operation - the designated areas of influence, for the subsequent comparative study between the current situation and the future situation.

This analysis is carried out by identifying and evaluating the possible environmental impacts resulting from implementation and the operation of PARACEL forest component. This study considers the proposal of actions to mitigate impacts, in order to minimize and/or eliminate negative changes, and increase the benefits provided by the implementation of PARACEL forest component.

1.2 Nature of the Project

The project foresees the reforestation with Eucalyptus varieties (*Eucalyptus urograndis, E. grandis, E. dunnii, and E. saligna*) in 114,000 ha to produce wood to supply the group pulp mill located in Concepción, Department of Concepción, Paraguay.

The project will acquire 19 estancias, or ranches for plantations, with a total area of approximately 190,000[1] ha located on a range between 30 km and 150 km from the mill site. The eucalyptus varieties that PARACEL will use require 6 years of growth prior to harvest (a 6-year “rotation”).

PARACEL plans to gradually initiate planting eucalyptus on their owned plantations, but it will be six or more years before these plantations can begin to supply fiber to the mill, which is expected this will begin in 2027.

The properties are reportedly on average 47% of Quite Natural Area (i.e. non-plantable) and 53 % of Modified Area (i.e. potentially plantable). Reportedly, that mainly pasturelands will be used as plantations, and the native forest and riparian areas will be

[1] PARACEL has purchased approximately 170,000 ha of former estancias, but plans to purchase additional land to reach a total of approximately 190,000 ha.

retained and protected, which will amount to roughly 90 thousand hectares of conservation areas.

Once in full production the PARACEL owned plantations are expected to provide around 80 percent of the PARACEL mill's raw material needs, while the other 20 percent will come from local out-growers in Paraguay.

1.3 Project Proponent, Operators and Contractors

1.3.1 Project Proponent

Company name	PARACEL S.A.
Company registry data	80106417-1
Address	Facundo Machaín 6426 - Villa Aurelia – Asunción - Distrito Capital
ZIP CODE	001419
Contact person	Eng. Cyro Croce Launy
Telephone	+595 2153 7445 ext. 550
Legal Representative	Nils Grafstrom

PARACEL is a Paraguayan project that arises from the innovative vision of the Zapag family. This vision, together with the experience of the Swedish group Girindus Investments, achieves the endorsement of other Paraguayan and foreign investors to carry out the largest productive industrial undertaking and the largest private investment in the history of Paraguay.

The impulse and strength of this combination of enthusiasm, experience and capital in PARACEL, allows nowadays to consolidate the project of installing, supplying and operating a world class pulp mill, under the highest standards of environmental and social sustainability, and with the capacity to satisfy the most demanding international markets.

1.3.2 Operators and Contractors

1.3.2.1 Identification of Responsible Company by the ESIA

Company name	PÖYRY Tecnologia Ltda.
CNPJ (registry number)	50.648.468/0001-65
Address	Av. Alfredo Egídio de Souza Aranha, 100 – Bloco B – 5º Andar – Chácara Santo Antônio – São Paulo – SP
ZIP CODE	04726-170
Telephone	(+55 11) 3472-6955
Legal Representative	Fábio Belotti da Fonseca fabio.fonseca@poyry.com.br (+55 11) 3472-6955
Contact person or Technical Representative	Romualdo Hirata romualdo.hirata@poyry.com.br (+55 11) 3472-6955

1.3.2.2 Technical Personnel

The technical team prepared this Environmental and Social Impact Assessment (ESIA) to provide the necessary information to evaluate the environmental study process and define the conditions necessary for PARACEL to implement and operate in accordance with the premises of sustainability.

<u>Pöyry Tecnologia Staff – ESIA</u>

– Chemical Engineer Romualdo Hirata
  General Coordinator
  CREA 0600332092 SP

– Chemical Engineer Celso Tomio Tsutsumi
  Technical Coordinator
  CREA 5060443241/D SP

– Chemical Engineer Cristina Maria Colella
  Identification and assessment of impacts
  CREA 5061787977 SP

– Chemical Engineer Karen Harumy Freitas
  Environmental and Social Management Programs (ESMP)
  CREA 5063578289 SP

– Environment Engineer MSc. Rafael Lourenço Thomaz
  Environmental Diagnosis
  CREA 5062655712 SP

– Geologist Domingos Fernandes Pimenta Neto
  Environmental Diagnosis
  CREA 210875647-7

– Forestry Engineer Bruno Polli Domanowski
  Project Characterization

– Forestry Engineer Nathalia Rodrigues Moletta
  Project Characterization

– Forestry Engineer Murilo José Trento
  Project Characterization

<u>RBG Service Team</u>

– Forestry Engineer Mariangela Gerum

– Forestry Engineer Flavio Murillo Machado

<u>Environmental Diagnosis (Baseline Conditions)</u>

Physical Environment Team

– Geologist Domingos Fernandes Pimenta Neto
  CREA 210875647-7

– Environment Engineer MSc. Rafael Lourenço Thomaz
  CREA 5062655712 SP

- Isabela Alvarenga de Mattos Landim
  Map production
- TECNOAMBIENTAL – Inginiería y Consultoria
  Surface and groundwater analysis

Biotic Environment Team

- Msc. Engineer Lourdes González Soria
  General technical coordination and planning
- Alberto Yanosky Farran
  Natural Science Specialist conservation
- Juan Carlos Rudolf
  Advice and support
- Specialist María Vera Jiménez
  Flora and Natural Communities
- Biologist Alberto Yanosky
  Fauna leading specialist
- Engineer Lidia Pérez de Molas
  Fauna Leading Specialist
- Nicolás Cantero
  Assistant specialist – mammals
- Gloria González
  Assistant specialist – bats
- Engineer Rebeca Irala
  Assistant specialist – birds
- Msc. Diego Bueno
  Assistant specialist – amphibians and reptiles
- Jimmy Emhart V
  Assistant specialist – ictiofauna
- Biologist Eduardo Martins
  CRBio 26063/01-D
- Biologist Patrick Inácio Pina
  Fauna Specialist
  CRBio 72.450/01-D
- Biologist Renato Augusto Martins
  Fauna Specialist
  CRBio 82.226/01-D
- Biologist Gilce França Silva
  Flora Specialist
  CRBio 054.274/01-D

Socioeconomic Environment Team

- Caren Kremer - Direction
  Degree in Social Sciences # B4983D
- Social Work Specialist Fátima Enciso
  Title Number B6519D
- Civil Engineer Sonia Chávez – MSc. Impact Evaluation, Management and Environment Audit
  Title Number B3409H
- Market Specialist Frederic Gerard
  Title Number B6519D
- Archeologist Manuel Bragayrac
- Social Work Specialist Blasia Yrene Díaz Domínguez

Indigenous People

- Fundación Natán

Impact Assessment

- Chemical Engineer Cristina Maria Colella
  CREA 5061787977 SP
- Environment Engineer MSc Rafael Lourenço Thomaz Favery
  CREA 5062655712 SP

1.4 Project Justification

PARACEL pulp mill in Concepción will adopt *Kraft*[2] process, for pulp production. The justification for implementing the mill project is based on the premise that the current market for pulp and paper is expanding abroad. This can be seen through the projects to increase various industries in the productive sector, with the consequent expansion of their forestry bases, with South America standing out in recent years, with new pulp mills in Brazil, Uruguay and Chile.

PARACEL will use Eucalyptus wood from its land in order to satisfy 80% of the demand required for the operation of the plant; and the other 20% will be provided by external producers to the company (small local producers).

It is noteworthy that in the forestry operation of PARACEL will generate approximately 3 thousand jobs, between own contractions and outsourcing, during all the steps of the project. In addition, this activity fosters the local economy and generates tax revenues for the municipalities in the region and in the country as a whole.

Also, the environmental benefits provided by this cultivation are highlighted, such as maintaining soil with vegetation cover, preserving the legal reserve and APP and carbon sequestration, all guided by the environmental management system of PARACEL.

[2] *Kraft* pulp: Pulp produced by sulphate process

Considering the approach that forest management goes far beyond the simple production of products for supply to the processing chain, a comprehensive vision of the objectives of the PARACEL Forestry Project is established:

a) To comply with the 8 IFC Performance Standards;

b) To comply with the EHS General Guidelines of the IFC;

c) To comply with IFC's EHS Guidelines for Forest Harvesting Operations;

d) To comply with IFC's EHS Guidelines for Perennial Crop Production;

e) To comply with the FSC Principles and Criteria in the long term, appropriately to the intensity and risk scale of forest management, respecting the values and policies of FSC;

f) To manage natural forests in such a way that they are restored, maintained or improved as needed, removing the pressure of logging on them;

g) To develop forest plantations to obtain timber resources for the purpose of supplying the pulp mill of PARACEL;

h) To provide goods and services to local communities and the consumer, ensuring the right to forest values, ecosystem services and benefits from plantation forest management;

i) To develop human talents, with a focus on continuous improvement of the quality of services and professional performance;

j) To investigate and implement the best production practices with a view to mitigating negative environmental and social impacts and increasing positive ones;

k) To adopt the precautionary approach in the identification, evaluation and implementation of management measures for attributes and areas of High Conservation Value;

l) To maintain the processes of revision and improvement of the management plan, incorporating the concept of adaptive management under the scale, intensity and risk analysis of forestry operations.

1.5 Project Schedule

In general, the schedule of planting activities lasts approximately 7 years, starting with the acquisition of properties until the moment of harvest. Therefore, the main activities are presented below.

– Year 1
    - ✓ Land acquisition
    - ✓ Topographic survey
    - ✓ Physical register
    - ✓ Technical project (planning, roads, firebreaks, eucalyptus stands, preserved areas, effective planted area)

– Year 2
    - ✓ Land preparation (area cleaning, soil preparation, fertilization)

    - ✓ Sowing/Planting
- Year 3 to Year 7
    - ✓ Plantation maintenance
- Year 7
    - ✓ Harvest

1.6 Purpose of the ESIA

The purpose of the Environmental and Social Impact Assessment (ESIA) is to evaluate the environmental and social feasibility to install the forest component of the PARACEL project in Departments of Concepción and Amambay.

1.6.1 Summary of the ESIA

1.6.1.1 Scoping

The project foresees the reforestation with Eucalyptus varieties (*Eucalyptus urograndis, E. grandis, E. dunnii, and E. saligna*) in 114,000 ha to produce wood to supply the pulp mill located in Concepción, Department of Concepción, Paraguay.

The project will acquire 19 estancias, or ranches for plantations, with a total area of approximately 190,000 ha located on a range between 30 km and 150 km from the mill site. The eucalyptus varieties that PARACEL will use require 6 years of growth prior to harvest (a 6-year “rotation”).

1.6.1.2 Baseline Data Collection

This report is based primarily on the Preliminary Findings Report and the Estudio de Impacto Ambiental y Social del Componente Forestal – EICF (Environment Impact from Forestry Component), but also on information from a number of other Project documents and e-mails provided by PARACEL that has been incorporated, including Forestry Director Plan by InnovaTech, the Biodiversity Baseline Study developed by CSI, The Cerrado in Paraguay and Paracel Investment, by PhD Alberto Yanosky, water quality baseline study, reports related to Paraguayan requirements for consultation with Indigenous People groups performed by Fundación Natán, the social baseline for the plantation area, and a number of other reports, studies, politics, codes from PARACEL’s project.

1.6.1.3 Stakeholder Engagement Activities

Stakeholder engagement and consultation is quite important in any project, because initiate and sustain a constructive external relationship over time. Companies that start the process early and take a long-term strategic view are, in essence, developing their local “social license to operate.”

In order to access the necessary information for social studies prior to the implementation of the project, it is of special interest to know some elements for the characterization of the area of influence and the perception regarding the project. For this purpose, PARACEL conducted interviews with key actors at the community and institutional level, such as: health, education, social organizations, productive committees and those responsible or in charge of the establishments that will be assigned to forest plantations.

These social researches were developed sequentially, each stage began with the formation of an interdisciplinary team in charge of the survey and analysis of information obtained through secondary and primary sources. This process required the use of various data collection techniques; and, despite the complications arising from the sociopolitical context and sanitary restrictions, it was sought at all times to generate participatory spaces and direct contact with the population, especially, referents of the institutional and community environment of the areas involved in the project.

Beyond this survey carried out for the licensing process, stakeholder engagement and consultation are considered core for PARACEL activities and, therefore, a Stakeholder Management Plan was set aiming to:

- Strengthen the relationship and trust with PARACEL´s different stakeholders;
- Carry out a transparent, effective and close communication about PARACEL's values and purpose;
- Ensure the constant flow of information, creating, enabling and feeding the communication channels that allow the effective exchange of information;
- Contribute to the strengthening of the organizational culture and the pride of belonging to PARACEL from the information on achievements and impacts of the organization.

The Stakeholder Management Plan is presented in the Annex 1.5 of the Health, Safety, Environment and Social Management System Manual.

1.6.1.4 Impact Assessment

Currently, there are several methodological lines developed for environmental impact assessment: spontaneous methodologies (Ad hoc), checklists, interaction matrices, interaction networks, quantitative methodologies, simulation models, overlay maps, scenario projection, among others.

PÖYRY has a multidisciplinary team with extensive experience and has conducted numerous environmental studies in various segments, and especially in the paper and pulp sector including eucalyptus forestry. Thus, over the years, through the accumulation of experience and the increase in the repertoire of technical and scientific works, PÖYRY has developed its own methodology for the identification and evaluation of impacts.

This methodology is based on the development of a checklist (which in turn already includes interaction matrices), in which the factors generating impacts (activities) and the aspects leading to impacts on the environmental components are listed in the various project phases.

The impact assessment methodology was also based on legal provisions such as Law no. 294/93 and therefore presupposes temporal and spatial scales of impacts. In this study, the planning, implantation and operation phases were used as the temporal scales, and for the spatial scales the area directly affected, the area of direct influence and the area of indirect influence were used. The evaluation was consolidated through discussion among the members of the multidisciplinary technical team.

Thus, impacts were evaluated, qualifying them according to their specification and indicating their spatial magnitude (qualitative measure) and degree of importance depending on how long they remain in the environment.

In this methodology, the mitigation measures, in the case of negative impacts, or the strengthening of positive impacts are already predicted and related, and their degree of resolution (high, medium or low) is evaluated after implementation.

From the measurement of the impact and the resolution of the proposed measure it was possible to define the degree of importance of the impact, taking into account the environmental situation before the implementation of the company.

In the case of positive (beneficial) impacts, measures must be taken to make the most of the benefits generated; these are the so-called enhancing or compatible measures. And in the case of impacts that are partially mitigated or not possible to mitigate, compensatory measures are proposed.

Other than that, the quantitative evaluation of the impacts was carried out through analyses of the magnitude associated with the area of spatial coverage, probability of occurrence and duration of the actions and the importance of the impacts on the environmental factors associated with the action, temporality/duration and degree of reversibility of the action. Therefore, the greater the impact, the higher the assessment. The assessment uses 1 to 3 following the methodology of Leopold et. (1971) so that even the least significant impact was considered in the assessment.

1.6.2 ESIA Methodology

The Environmental and Social Impact Assessment (ESIA) methodology consists to evaluate the environmental feasibility to install the forest component of the PARACEL project.

This assessment performed a systemic approach of the forest component, taking into account its main characteristics, as well as the physical, biotic and socioeconomic environment at its areas of influence. Later, in the analysis of the environmental impacts, the possible impacts, at the same environments, resulting from the implementation and operation of the forest plantation were pointed out, as well as their respective mitigation and enhancement measures.

1.6.3 Structure of the ESIA Report

The structure of the ESIA is as follows:

- Volume I – Description of Project
- Volume II – Baseline Conditions
  - Part I – Physical Environment
  - Part II – Biotic Environment
  - Part III – Socioeconomic Environment
- Volume III – Impact Identification and Analysis

2 LEGAL ASPECTS

2.1 National and Local Laws and Regulations

2.1.1 Principles of Environmental Law

It is necessary to mention the main bases of environmental law in Paraguay. In other words, it will be about the fundamental bases that have created the environmental normative framework and consequently the Science of Environmental Law in Paraguay, which are the guides for the interpretation and application of the laws for the PARACEL project.

When referring to principles, these precedents in Environmental Law are considered to be the normative, legislative, jurisprudential and administrative bases themselves. The initial documents exposing the Principles of Environmental Law are: the Stockholm Declaration on the Human Environment of 1972; the World Charter for Nature of the General Assembly of the United Nations of 1982 and the Rio Declaration on Environment and Development of 1992.

In the field of Environmental Law the principles constitute an interpretative, informing and guiding instrumental force more powerful than in any other field or science.

Principle of Sustainable Development: Jurists have called it "the principle of principles" of Environmental Law today: the dominant paradigm in the field of Environmental Law is structured on this principle, which is inserted in the basic universal norms, or its cogens at an international level, and which has been constitutionalized in most of the constitutional orders of the world and without doubt in the constitutional order in Paraguay. This principle is the result of a synthesis between environmental conservation and economic development which pressured and polarized policies and the interpretation of environmental norms from their very origin. It assumes an integration of these two interests or purposes, at a higher level of human, socio-cultural and legal projection. It must be stated that sustainable development constitutes a principle, since one of its characteristics is that it is formulated as an axiom.

The principle of sustainable development has been deeply influenced by the weight of international negotiations and environmental policy formulation through consensus.

The Brundtland Report (1987) states that: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is clear that this formulation responds to an anthropocentric perspective, although it synthesizes and integrates environmental conservation and economic activity in decision-making processes.

Solidarity: This principle is based on the Modern State, which considers the environmental legal good located in the social sphere; that is, the necessary coordination of interests and legal spheres is imposed, coordination in accordance with the Objectives of Sustainable Development (ODS). The principle of solidarity has projections in a long spectrum, as it is combined in an intergenerational and intragenerational dimension.

From the first perspective, the rights and duties of compensation for the sacrifices that arise for specific groups or individuals from the effective application of environmental protection, and from the second perspective, the rights and duties of safeguarding the capacity of future generations to obtain from other species and from natural resources, sufficient means for the maintenance of the human project in the balance of ecosystems.

The principle of solidarity is implicit in the principle of sustainable development and in the cooperation of government and society. It is present in the Johannesburg Declaration - Point 17: States committing themselves to sustainable development show that they are aware of how important solidarity between people and cooperation between society are.

Prevention: Principle related especially to environmental protection policies. This principle is fundamental when there is a potential for non-redress of environmental damage resulting from activities with environmental risk to third parties. For example, there may be irreversible environmental damage such as extinction of species, radioactivity, destruction of flora, desertification of rural areas, etc. when Prevention is not used to avoid environmental damage. Environmental impact study is a mechanism to implement this principle.

Precaution: also called the precautionary principle (Rio Declaration, Principle 15), it is stated that "in order to protect the environment, States should apply the precautionary approach according to their capabilities. That is, in cases of serious danger or irreversible damage, the absence of scientific knowledge and certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation". Nor can the absence of certainty be invoked as a justification for the development of an activity, the impact and effect of which on the environment is not sufficiently known.

This principle also brings others that are derived from it, such as the principle of a high level of protection or the principle of "stand still" (no degradation), which impose, as a maximum and respectively, the preference for the adoption of the highest possible level of protection provided by environmental measures and the commitment not to lower or reverse these levels of protection in projects that generate impacts.

Liability (polluter-pays): Principle 13 of the Rio Declaration proclaims "the duty of States to develop national law concerning liability and compensation for victims of pollution and other environmental damage". To this criterion, effectiveness is an objective of Environmental Law declared by Principle 11 of the Rio Declaration, which proclaims "the duty of States to enact effective laws on the environment". Also called user-payer, it brings the characteristic of retribution for the use of non-renewable natural resources.

Cooperation: this principle has the great objective of "establishing a new and equitable global partnership by creating new levels of cooperation between States, key sectors of societies and individuals". It is most explicit in Principle 7, which establishes the duty of States to cooperate to conserve, protect and restore the health and integrity of the ecosystem.

Common but differentiated responsibilities: The Rio Declaration states "Since they have contributed in varying degrees to the degradation of the global environment, States have common but differentiated responsibilities. Developed countries recognize their responsibility in the international pursuit of sustainable development, in view of the pressures on their societies from the environment and the technologies and financial resources at their disposal". The Climate Change Treaty (UNFCCC) is an example of common but differentiated responsibility.

2.1.2 Legal Considerations

PARACEL recognizes the environmental laws and regulations that govern its planning and activity, so it will be respectful of compliance with the legal aspects of environmental protection, human health and land use regulation.

Paraguay created by means of Law 1,561/2000 the National System of the Environment integrated by a group of public entities of the national, departmental and district governments with environmental competence.

Article 1. The purpose of this law is to create and regulate the operation of the agencies responsible for the elaboration, standardization, coordination, execution and control of the national environmental policy and management.

These regulations also created the National Council for the Environment (CONAM), which has the following functions:

a) to define, monitor and evaluate national environmental policy;

b) to propose norms, criteria, guidelines and standards in the matters submitted to its consideration by the Secretariat of the Environment;

c) cooperate with the Executive Secretary of the Secretariat for the compliance with this law and its regulations; and

d) the others that correspond to it in accordance with the law.

Paraguay has a National Environmental Policy (PAN).

The national environmental Policy (PAN, in Spanish) brings together the set of objectives, principles, criteria and general guidelines for the protection of the environment and society, in order to guarantee sustainability for current and future generations, as established in the legal framework.

It is based on the following foundations:

- The environment is a common heritage of society; on its quality depend the life and development possibilities of the communities of Paraguay;
- The sustainability of the country's development is strongly linked to the use and adequate management of its natural resources and to sustainable production, improvement of the quality of life of the population, achievement of equity and full participation in socioeconomic development;
- The preservation, conservation and recovery of the natural and cultural heritage are crucial for the sustainability and improvement of the quality of life of the communities. Socio-economic development needs environmental sustainability;
- Environmental and cultural issues of a regional or transboundary nature are a priority. Regional integration initiatives based on sustainable management, conservation of shared ecosystems and recognition of cultural identities will be promoted.

The principles of PAN are the following:

- Sustainability: present generations are responsible for environmental protection and should ensure the appropriate use and enjoyment of the natural heritage that will be passed on to future generations;

- Precaution: where there are threats of serious or irreversible damage, lack of information or scientific certainty should not be used as a reason for postponing effective action;
- Integrity is understood as the need to agree on sectoral policies and to adjust the national, departmental and municipal legal framework, making the regulations that provide greater protection to the environment prevail;
- Graduality: is assumed as the capacity of continuous adaptation and improvement;
- Responsibility: the person who has caused damage to the environment must repair the damage and restore the affected conditions;
- Subsidiarity: environmental management will be organized in such a way as to achieve the maximum social protagonism in decision making, efficiency in the use of resources and in obtaining results, guaranteeing that decision making is as close as possible to the citizen.

The National Environmental Policy has as its general objective:

- To preserve and adapt the use of Paraguay's natural and cultural heritage to guarantee the sustainability of development, the equitable distribution of its benefits, environmental justice and the quality of life of the present and future population.

The National Environmental Policy has the following specific objectives:

- To generate conditions for the well-being and improvement of the quality of life of people, preventing the degradation of habitats;
- Prevent environmental deterioration, restore degraded ecosystems, recover and improve the quality of natural and cultural heritage resources, mitigate and compensate for environmental impacts on the population and ecosystems;
- Apply the precautionary principle in the face of environmental risks that could affect human health;
- Optimize the use of natural resources in production processes;
- To promote and articulate projects for the conservation and sustainable use of water, air, soil and biodiversity resources;
- Make the economy dynamic by gradually reconverting production processes, introducing the principles of sustainability in the production and service sectors and promoting pollution prevention;
- Promote the increase of efficiency in the productive processes through the sustainable use of soil, water, energy and other inputs, encouraging their reuse, recovery and recycling with the adoption of good environmental management practices;
- To promote the rights and human development of indigenous peoples, in a way that is compatible with the conservation of biodiversity in their territories and to harmonize traditional life systems with their current socio-cultural needs.

- To promote and coordinate public policies for the sustainable use of environmental opportunities in accordance with social demand, equity and justice;
- To actively involve citizens in decision making and environmental management;
- Strengthen environmental institutions at all levels, especially at the departmental and municipal levels, in an orderly and decentralized process, to achieve their full integration into the National Environmental System (SISNAM);
- To promote coordination and stimulate intersectoral alliances;
- To promote compensation and access to justice when, due to environmental restrictions for the common benefit, the heritage of individuals is affected;
- To update environmental law in order to develop efficient management instruments;
- To follow up and make effective international conventions, agreements and treaties;
- Disseminate environmental information, facilitate and encourage the formation of public awareness about the conservation and sustainable use of natural resources.

2.1.3 Environmental Law

Paraguay National Constitution – 1992

The Constitution, which has been in force since 1992, contains provisions relating to the environment. The most significant provisions and their most relevant content related to the PARACEL Project are indicated below:

> "Article 6: Of the Quality of Life
>
> The quality of life shall be promoted by the State through plans and policies that recognize conditioning factors, such as extreme poverty and the impediments of disability or of age.
>
> The State shall also promote research on the factors of population and their links with socioeconomic development, with the preservation of the environment and with the quality of life of the inhabitants.
>
> Article 7: Of the Right to a Healthy Environment Everyone has the right to live in a healthy and ecologically balanced environment.
>
> The preservation, the conservation the re-composition and the improvement of the environment, as well as its conciliation with the complete [integral] human development, constitute priority objectives of social interest. These purposes orient the legislation and the pertinent governmental policy.

> Article 8: Of Environmental Protection The law will regulate the activities susceptible of producing [an] environmental alteration. In the same way, it may restrict or prohibit those activities that it qualifies as dangerous."

What happens is that the State, through MADES, establishes the process of environmental licensing to protect diffuse rights such as ensuring the protection of the environment. The ESIA is the appropriate instrument to investigate environmental factors and the alterations suffered by the natural (physical, biotic) and socioeconomic (landscape ecology, socioeconomic dynamics, employment generation, etc.) environment.

The process of impact evaluation guarantees the preservation of the environment and social and economic development. The change in the quality of life and environmental condition in the project's area of influence is evaluated by the Independent Consultancy and approved by MADES' technical team.

The impact of changes in the quality of life must be evaluated, as the interest of the population in the PARACEL project's Area of Influence is protected.

With respect to the right to a healthy environment, it is clear that Paraguayan citizens have the right to live in an ecologically balanced environment.

The preservation, conservation, compensation and improvement of the natural environment is a priority for developing countries (e.g. Paraguay).

The environmental licensing process before MADES aims at reconciling economic development with environmental protection. This becomes the principle of sustainable development.

For this reason, article 8 of the National Constitution of Paraguay establishes that the law will regulate the activities that can produce environmental impacts (alteration, transformation or modification of the environment).

Law 1,561/2000 – National Environmental System, The National Environmental Council and the Secretariat of the Environment

The secretariat is an autarkic, autonomous entity with legal personality under public law, its own assets and indefinite duration (Article 7). The national environmental policy is formulated, executed and its control is the responsibility of the secretariat.

Thus, considering those legal competences, this entity has authority and is responsible for applying the following laws:

Law 294/1993 - Environmental Impact Study (modified by Law 345/1994 and regulatory decree and all those legal provisions (laws, decrees, international agreements, ordinances, resolutions and regulations affecting the environment).

Law n. 6,123/2018 - elevates the Secretariat of the Environment to the rank of Ministry and changes its name to the Ministry of the Environment and Sustainable Development

It should be reported that the national environmental system was recently altered, changing SEAM to the Ministry of Environment and Sustainable Development.

In other words, the environmental law whose text has been passed in this work mentions SEAM. For reasons of accuracy and loyalty to the original text, the term "SEAM" was not changed to "MADES", preserving the faithful text as originally published in the Official Press.

> Art. 1. The Secretariat of the Environment, which depends on the Presidency of the Republic, shall be promoted to the rank of Ministry and shall be called the Ministry of the Environment and Sustainable Development. It shall have the objective of designing, establishing, supervising, controlling and evaluating the National Environmental Policy, in order to comply with the constitutional precepts that guarantee national development based on the right to a healthy environment and environmental protection.
>
> The Ministry of the Environment and Sustainable Development shall be governed by the provisions of Law n. 1561/00 "which creates the national system of the environment, the national council of the environment and the secretariat of the environment", in the relevant part which are not repealed and do not contravene the provisions of this Law.
>
> (PARAGUAY, 2018)

Law n. 294/1993, Environmental Impact Study

As it was said, this law declares the Environmental Impact Study (section 1) mandatory when an activity or undertaking may generate an environmental impact. Environmental impact is legally defined as *"any modification of the environment brought about by human works or activities which have a positive direct or indirect effect on life in general, on biodiversity, on the quality or significant quantity of natural or environmental resources and their exploitation, on well-being, on health, on personal safety, on habits and customs, on the cultural heritage or on legitimate livelihoods".*

Article 78 declares:

> Article 7: An Environmental Impact Study shall be required for the following works projects or public or private activities:
>
> (…)
>
> b) Agricultural, livestock, forestry and farming exploitation;

Thus, it is clear that the implementation of a Eucalyptus forest is included among the activities to be presented in the Environmental and Social Impact Assessment.

Law 3,001/06 – Valuation and remuneration of environmental services

The main objective of this law is to promote the conservation, protection, recovery and sustainable development of the country's biological diversity and natural resources, through the fair, timely and adequate valuation and remuneration of environmental services.

Article 2 - “Environmental services” are understood to be those generated by human activities for the management, conservation and recovery of ecosystem functions that directly or indirectly benefit the populations:

a) Environmental services related to the mitigation of greenhouse gas emissions: fixation, reduction, sequestration, storage and absorption of carbon and other greenhouse gases. The activities to be compensated or financed by this service include protection and management of: forests, reforestation projects, urban arborization, forestry component of agroforestry projects or systems, reforestation of riverbanks and springs, palm groves, regardless of the size or magnitude of the project concerned;

b) Environmental services for the protection of water resources for different modes of use (energy, industrial, tourism, domestic, irrigation, etc.) and their related elements (aquifers, springs, water sources in general, wetlands, protection and recovery of basins and micro-basins, trees, etc.);

c) environmental services related to the protection and sustainable use of biodiversity: protection of species, ecosystems and forms of life; access to elements of biodiversity for scientific and commercial purposes;

d) environmental services of scenic beauty derived from the presence of forests and natural landscapes and the existence of elements of biodiversity and protected wild areas, whether state or private, duly declared as such; and,

e) environmental services for the protection and recovery of soils, and for mitigating damage caused by natural phenomena.

Law 836/80 – Sanitation Code

When it comes to the issues of environmental sanitation, soil contamination and pollution, and surface or groundwater, the Health Code must be addressed. The Environmental Impact Study deals with the impacts related to water, air and soil quality.

The main objective is to limit the actions of the venture with respect to the following:

Article 66: It is forbidden any action that deteriorates the natural environment, diminishing its quality and turning it into a risk for health.

Article 67: The Ministry shall determine the tolerance limits for the emission or discharge of pollutants in the atmosphere, water and soil and shall establish the rules that the labor, industrial, commercial and transportation activities must follow in order to preserve the environment from deterioration.

> Article 68: The Ministry shall promote programs aimed at the prevention and control of environmental pollution and contamination and shall provide measures for its preservation, having to carry out periodic controls of the environment to detect any element that causes or may cause deterioration of the atmosphere, soil, water and food.

The water will be obtained from small dams (deposits with water accumulation used in cattle rising) and, in some cases, from artesian wells.

Law 123/1991 – Adopt new forms of phytosanitary protection

This law adopt the following phytosanitary protection standards, without prejudice to the Sanitation Code, as well as the other laws and their respective regulations:

a) Establish and control the phytosanitary conditions that must gather plant products and any other means capable of spread pests for their entry into the country, temporary or permanent under any hospitalization regime;

b) Arrange for the application of disinfection treatments and disinfestation of products, means of transport, packaging and local, adequate to human and environmental health standards ambient;

c) Order the destruction of plants, merchandise or products contaminated vegetables, when they pose a risk to spread of pests in the country;

d) Establish general, regional, quarantine regimes, permanent or temporary, preventive or treatment;

e) Establish quarantine, disinfection, disinfestation of plant products, means of transport and packing;

f) Prohibit the commercialization of any type of products plants when they constitute means of dissemination of pests; and,

g) Prohibit the operation of packing plants, processing of vegetable products, maintenance of means of transport whose operating conditions constitute a risk to the spread of pests or to conservation of quality and health conditions in post-harvest.

> Article 7. Every owner or occupant of a real estate, whatever their title, or holder of plants or plant products, containers or objects containing or carrying a production pest plant, is obliged to combat and destroy it.

During the first 6 years, a supply of wood from Brazil and Argentina is foreseen by PARACEL. Law 123/1991 also provides for the following for the import of wood products into the country:

> Article 14. For importation, temporary admission, warehouses in free zones or transit of vegetable products must have the prior import authorization granted by the competent body.
>
> Article 15. In the event that a phytosanitary problem is detected, according to its nature and / or potential risk, the Enforcement Authority shall prohibit their entry or order

their re-export, disinfection, disinfestation or subjecting it to a post-admission quarantine regime. The expenses required for the execution of these measures are in charge of the corresponding importers.

Article 17. For the entry into the national territory of vegetable products, must have a phytosanitary certificate issued by the competent authorities of the country of origin.

Article 19. The Enforcement Authority may proceed to confiscate and destroy of vegetable products that enter the country by any means and under any regime, without phytosanitary import permit and the phytosanitary certificate from the country of origin.

Resolution 50/06 – National Water Resources Management

By which the regulations for the management of the water resources of Paraguay are established in accordance with Article 25 of Law 1,561/00, which creates the National System of the Environment, the National Council of the Environment and the Ministry of the Environment.

Article 1 - Violations of the rules for the rational use of surface and underground water resources:

– Non-compliance with Article 1898 of the Paraguayan Civil Code and its amendments;
– The failure to: Law 350/94, Law 1195/86, Law 177/69, Law 4/92, Law 836/80, the Rural Code, Law 1248, Law 1614/00, SEAM Res. 222/02, Law 389/73, Law 433/73. In the criminal field, Articles 197 and 200 of the Criminal Code, criminalization of water pollution and alteration, illegal processing of waste and Law 716; and
– The failure to comply with laws 422/73, 42/90, 112/91, 232/93, 251/93 and all the provisions of Law N. 294/93 also constitute infringements for the preservation of water resources.

Law 3,239/2007 – Paraguay Water Resources

The purpose of this law is to regulate the sustainable and integral management of all waters and the territories that produce them, regardless of their location, physical state, or their natural occurrence within Paraguayan territory (article 1).

Article 3°- The integral and sustainable management of Paraguay's water resources shall be governed by the following Principles:

a) Water, whether surface or underground, is the public property of the State and its ownership is inalienable and imprescriptible.
b) Access to water for the satisfaction of basic needs is a human right and must be guaranteed by the State, in adequate quantity and quality

c) Water resources have multiple uses and functions and this characteristic must be adequately addressed, respecting the hydrological cycle and always favoring, in the first place, the use for consumption by the human population.

d) The river basin is the basic unit for water resources management

e) Water is a natural good that conditions the survival of all living beings and the ecosystems that shelter them.

f) Water resources are a finite and vulnerable good.

g) Water resources have a social, environmental and economic value.

h) Water resources management should be carried out within the framework of sustainable development, and should be decentralized, participatory and gender-sensitive.

i) The Paraguayan State possesses the non-transferable and non-delegable function of property and guardianship of national water resources.

Priority will be given to the use and development of surface and groundwater resources for human consumption. Other uses and developments shall be prioritized as follows (Article 18):

> (…)
>
> d) Use and exploitation for energy generation.
>
> e) Use and exploitation for industrial activities.
>
> (...)

It is important to observe the location of the project on the margins adjacent to the water courses. In this specific case, it was defined by law that a water source protection zone 100 (one hundred) meters wide on both banks must be protected, in which the use of the soil and the activities carried out there will be conditioned, according to what is established by environmental legal regulations. The protection zone shall not include the public use zone and shall be adjacent to it.

National Law 3,239/2007 defines in Article 28 the following:

> Article 28: Prior to its execution, all works or activities related to the use of water resources shall be submitted to the Environmental Impact Study procedure provided for by Law n. 294/93 "Environmental Impact Study" and its regulations. Excepted from this obligation are the uses related to the exercise of the right provided for in Article 15 of the present Law.

PARACEL has complied with the law and regulations concerning environmental impact study: Law 294/1993 (art. 7) defines which of the works and activities require Environmental Impact Study.

Thus, in the same way the law of water resources also establishes rules to obtain permits for the use of water resources.

It is not unknown that in the present project PARACEL will be the holder of a water use permit in precarious title, although not the domain or any other property right over the same. Thus, it is understood that the permit is revocable, so that its suspension or revocation will not give rise to any compensation when there is a justified cause.

As from this Law, the use of Water Resources or their channels is prohibited without a permit or a Concession granted by the Water Resources Authority.

PARACEL will be aware of the fact that prior to the granting of the Environmental Impact Statement by MADES, the Water Resources authority will issue a certificate of water resources availability.

This certificate of availability is a proof to guarantee that the priority uses will not be damaged. Therefore, PARACEL will subsequently obtain the permit to manage water resources in its production process.

It is also relevant to observe the law that deals with the protection of forests that protect watercourses.

Therefore, it is necessary to evaluate the technical and legal conditions of the site: location of the project, type of vegetation on the margin of the Paraguay River, need to implement access or infrastructure etc.

The institution that regulates and defines the level of protection to the forests is the National Forest Institute - INFONA, but this is evaluated jointly with the General Direction of Control of the Environmental Quality and Natural Resources (DGCCARN) in the structure of the Ministry of the Environment.

Law n. 4,241/2010 - Restoration of Protective Forests of Watercourses within the National Territory

This law is regulated by Decree 9824/12, which establishes the necessary guidelines for compliance with the aforementioned law, and regulates aspects related to the width of forests that protect watercourses, as well as the establishment of a Program for the Restoration of Forests that Protect Watercourses for those properties whose surface contains watercourses that do not have the minimum width of protective forests.

Article 5. Establish the minimum parameters to be restored according to the width of the waterway and the particularities of the area of influence of these, which constitute the basis for planning the waterway protective forest areas for the Eastern Region, according to the following table.

Channel Width	Minimum width of protective forest on each border (m)
More than or equal to 100 m	100
50 to 90 m	60
20 to 49 m	40
5 to 19 m	30
1.5 to 4.9 m	20
Less than 1.5 m	10
Water fountain	Minimum 30 m to be preserved

With respect to the management of forests and native vegetation it will be necessary to evaluate before the Ministry (MADES) the fulfillment of retribution of environmental services or substitution by a project of compensation and new plantations of the native vegetation.

Resolution SEAM 222/2002 – States the standard of quality of the waters in the national territory is established

This resolution establishes the classification of the waters of the national territory according to the use made of them; and in turn, it establishes the quality standards for each of the types of water. Article 1 establishes the classification of the waters of the national territory. Articles 2, 3, 4 and 5 establish the limits and/or conditions for waters of class 1, 2, 3 and 4 respectively.

Article 6 establishes the quality parameters for waters intended for recreational use. While Article 7 establishes the limits of effluent quality to be discharged into water bodies. Article 7 establishes that effluents from any polluting source may only be directly or indirectly discharged into bodies of water in accordance with the conditions, standards and criteria established in the classification of the water body.

In the case of PARACEL, it is necessary to comply with the effluent emission parameters, which are established in Resolution SEAM 222/2002.

> Art. 8 The dissolution of industrial effluent with unpolluted water is not permitted.
>
> (…)
>
> Art. 15 In class I waters, the discharge of domestic and industrial waste water as well as of any potentially toxic substance will not be tolerated.

Considering that the Paraguay River is a Class 2 water body, therefore, the standards defined by these regulations must be complied with..

> Art. 1: They are classified, according to their predominant uses, in 4 classes of the National Territory.
>
> (…)
>
> Class 2 – Water destination:
>
> (a) For domestic supply after conventional treatment
>
> (b) For the protection of aquatic communities
>
> c) For primary contact recreation (water skiing, swimming)
>
> (d) Irrigation of vegetables that are consumed raw, fruits that grow in the soil and are grafted raw without removal of the film.
>
> (e) Natural and/or intensive breeding (aquaculture) of species intended for human consumption.

Thus, Resolution 222/2002 establishes the legal limits for this river classification.

> Art. 3° For Class 2 waters, the same limits are established under Class 1 conditions, with the exception of the following conditions:

a) No artificial coloring shall be permitted unless it is removed by conventional coagulation, sedimentation and filtration

b) Coliforms for primary contact recreation use shall be complied with Art. 6 of this resolution. For other uses, the limit of 1000 coliforms per 100 ml shall not be exceeded by 80 % or more of at least 5 samples per month,

c) Colour: up to 75 Pt/l

d) Turbidity: up to 100 UNT

e) BOD 5d 20° C up to 5 mg/l

f) OD, in any sample: not less than 5 mg/l O_2

g) Total Phosphorus or Total Nitrogen: respectively up to 0,05 mg/l and 0,6 mg/l

In addition, regarding the limits of effluent quality to be discharged into water bodies, it should be noted that the PARACEL project is based on international standards, such as 'Effluent Guidelines for Pulp and Paper Facilities – Bleached Kraft Pulp, Integrated' by IFC, as shown in the table below.

Effluent Guidelines for Pulp and Paper Facilities - Bleached Kraft Pulp, Integrated		
Parameter	**Units**	**Guideline**
Flow [a]	m^3/ADt	50
pH	-	6 - 9
TSS	kg/ADt	1.5
COD	kg/ADt	20
BOD_5	kg/ADt	1
AOX	kg/ADt	0.25
Total N	kg/ADt	0.2[b]
Total P	kg/ADt	0.03

a Cooling water and other clean water are discharged separately and are not included.
b Any nitrogen discharge associated with the use of complexing agents should be added to the figure of tot -N.

Resolution SEAM 255/06 – Establishing the Classification of Waters of the Republic of Paraguay

This Resolution states, in a preventive manner, the classification of all waters in Paraguay in Class 2, in accordance with the provisions of SEAM Resolution 222/02.

This is due to the need to anticipate more effective preventive instruments and more efficient mitigating or compensatory measures, in order to reduce environmental risks and prevent water quality degradation.

Law 3,956/09 – Integral Solid Waste Management in the Republic of Paraguay

The purpose of these regulations is to establish and apply a legal regime for the generation and responsible management of solid waste, whose regulatory content and practical usefulness should lead to the reduction of such waste to a minimum and avoid situations of risk to human health and environmental quality (article 1).

<u>Municipalities and their relationship with Solid Waste:</u>

> Article 9.- Municipal Competence. The municipalities are responsible for environmental protection and cooperation with environmental sanitation, especially with regard to urban and domestic cleaning services, including all phases of integrated solid waste management.
>
> Article 23.- Recycling. The solid residues, whose characteristics allow it, shall be used by means of its use or reincorporation to the productive process as secondary matter, without representing risks to the health and the environment.

It should be noted that the following are considered as "recovery systems": recycling, recovery, reduction, composting and others that the technology develops and is authorized by the competent authorities.

> Article 4.- Classification. Solid waste will be classified according to its origin and composition, in accordance with the technical criteria established in this Law and its regulations.

Article 8 decree 7,391/2017 (law regulation):

> Art. 8 - Classification of Solid Waste
>
> The Authority of Application will group and subclassify the hazardous, solid urban and special management waste in categories, with the purpose of preparing the corresponding inventories, and guide the decision making based on risk criteria and management.

The decree classifies the waste in:

> l. Municipal solid waste, as defined in Article 4, and
>
> II. Special handling wastes considered as non-hazardous, including the following
>
> a) Waste from health services, generated by establishments that carry out medical-care activities for human or animal populations, research centers, development or experimentation in the area of pharmacology and health, with the exception of biological-infectious waste, as defined

in Law 3361107 on Waste generated in Health and Related Establishments.

b) Industrial waste: that generated in production processes and industrial and commercial facilities, not assimilated to solid urban waste and not included in Law 567/95

(c) Those generated by agricultural, fishing, forestry and livestock activities, including waste from inputs used in those activities.

d) Those generated by transport services, as a result of the activities carried out in transport terminals such as ports, airports, customs terminals, bus and railway terminals.

e) Civil construction waste, generated in the construction, maintenance, alteration, repair and demolition of civil engineering works in general, including waste resulting from the preparation and excavation of land for civil engineering works

f) Technological waste from the computer industry, manufacturers of electronic products or motor vehicles and others which, at the end of their useful life, require specific handling

(g) Dehydrated sludge or sludge from the treatment of waste water

h) Used tires, furniture, large-volume household goods, plastics and other slowly degrading materials

i) Those from industrial, chemical, biological, production or research laboratories

j) Mining and hydrocarbon waste: generated in the activity of exploration, extraction or benefit of minerals.

k) The others that are determined by Decree of the Executive Power or by the Authority of Application in agreement with the governments and municipalities, which thus agree to facilitate their comprehensive management.

III. Hazardous wastes provided for in Law 567/95 and its regulations

PARACEL and Solid Waste matters:

Article 3.- Principles. This Law is based on the following principles:

a) a) Principle of Co-responsibility. The generator of waste or the cause of any current or future degrading effect on the environment is responsible, together with the relevant authorities, for the cost of preventive or corrective recomposition actions.

Article 13.- Rights of individuals. In the process of solid waste management, the following will be considered as people's rights

a. access to temporary or final solid waste deposits, structured in accordance with the provisions of this Law and its regulations;

b. obtaining computerized data from the Ministry of Public Health and Social Welfare, the Secretariat of the Environment and the Technical Secretariat for Planning and Development, especially in relation to carrying out the stages in solid waste management; and,

c. the protection of health and the environment from risks or damage that may occur during all stages of solid waste management.

Article 14 - Duties of individuals. In the process of solid waste management, the following will be considered as people's duties

a) pay, in a timely manner, the services provided by the municipality, cancel the penalties and other charges applied by the mentioned agency;

b) comply with the standards and technical recommendations that have been established by the competent authorities;

c) store solid waste and residues subject to sanitary and environmental regulations, to avoid damage to third parties and to facilitate their collection, as established in this Law and its regulations.

Article 15 - Minimization. The generator shall adopt measures to minimize solid waste, through technologically viable production processes, subject to the determination of the competent authority and the provisions of this Law and its regulations. The municipal authorities and the generators shall agree on the elaboration of projects and development of programs of minimization of the same, in the conditions and within the term determined by the competent environmental and sanitary authority.

Article 17.- Initial provision. The generation of the solid waste implies obligations in the generator; therefore, it must make the previous storage in containers adapted to its volume, handling and particular characteristics, in order to avoid its dispersion.

Article 18.- Of the containers. The containers and recipients used for the temporary storage of the solid residues must fulfill the following minimum requirements:

a. Be reusable;

b. Be properly located and covered;

c. Have the capacity to store the volume of solid waste generated, taking into account the frequency of collection;

d. Be hermetically sealed;

e. Be built with waterproof materials and with the necessary resistance for the use to which they are destined;

f. To have an adequate sanitary maintenance;

g. To Have the identification related to the use and types of solid waste; and

h. Any other that the municipality considers, according to the technical criteria existing in the Local Plan for Solid Waste.

Law 3,742/2009 – Control of phytosanitary products for agricultural use

Forest plantations such as those that will be implemented by PARACEL usually need to carry out Integrated Pest Management (IPM) by which it seeks to make use of the association of techniques applicable to the management of the populations of the main crop pests, in order to achieve coexistence with harmful agents, without causing damage to the forest.

The application of phytosanitary pesticides is one of the stages of this integrated management and the control of these products as well as the correct procedure for the disposal of empty packages are established by law 3,741 / 2009, specifically in the following articles:

> Article 1. This Law establishes the legal regime for the registration and control of all phytosanitary products for agricultural use as of their entry into the national territory, as well as: synthesis, formulation, fractionation, transportation, storage, labeling, marketing, advertising, application and elimination of waste and final disposal of empty containers and expired pesticides, in order to protect human, animal, and plant health, and the environment.
>
> Article 46.- The containers and packaging of phytosanitary products must never be used to contain water or food destined for human or animal consumption.
>
> Article 49.- The commercialization and distribution entities must indicate in their sales invoices the places of return of the containers of phytosanitary products already used by the producer or user.
>
> Article 51.- It will be the responsibility of the producers or users to carry out the triple washing or pressure washing of the containers, immediately after emptying the container during the preparation of the broth or mixture, in addition to

piercing the base and returning the empty containers to the centers or mini-collection centers indicated in the sales invoice of the product issued by the marketer or distributor of the same. In addition, they must have a place for the temporary storage of empty containers, where they will remain until they are actually returned.

Article 64.- The applicators of phytosanitary products for agricultural use by air and land, whether mechanized or costal, are obliged to keep the records of applications, which will have the character of a sworn statement, where the operations carried out must be recorded.

Article 67.- Every person involved in the handling and application of phytosanitary products for agricultural use, must have the appropriate protective equipment, in order to avoid poisoning.

Article 68.- The supply and cleaning of the application equipment must be carried out away from water courses or sources, in order to avoid possible contamination.

Article 69.- People involved in the aerial or terrestrial application of phytosanitary products for agricultural use, must know: trade names, technical names, their effects, risks, safety precautions and first aid measures, of the products to be used.

Law 1,100/1997 - Prevention of noise pollution

That law sets the maximum permissible noise levels. For PARACEL's pulp mill and forest operations, the limits comply with those of Article 9 and 10.

Scope	**Night 20:00 to 07:00**	**Day 07:00 to 20:00 14:00 to 19:00**	**Day (Occasional peak) 07:00 to 12:00**
	Measured in decibels "A". Db(a) 20 to 40		
Residential areas of specific use, public spaces: recreation areas, parks, squares and public roads.	45	60	80
Mixed areas, transition zones, urban centers, specific programs, service zones and public buildings	55	70	85
Industrial area	60	75	90

Source: Law 1.100/1997

In addition, it should be noted that the PARACEL project is based on international standards, such as noise level guidelines from the General EHS Guidelines of IFC, as shown in the table below.

Receptor	**Day 07:00 to 22:00**	**Nightime 22:00 to 07:00**
	One Hour $L_{Aeq\ (dBA)}$	
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Source: General EHS Guidelines: Environmental - Noise Management by IFC, 2007.

Occasional peaks refer to discontinuous noises and sounds that exceed the permitted levels in the corresponding area and that occasionally occur during the day, with a maximum of twenty peaks per hour. This noise and sound level will only be permitted during the following hours: from 7.00 to 12.00 and from 14.00 to 19.00.

The maximum levels may not be exceeded within any neighboring property or on the public highway. Measurements are taken with an automatic recording device, calibrated and sealed by the municipalities, using the "A" compensation scale and in an impulse response, with the observer preferably located in front of an open side of the affected property or on the public highway.

The device must be at least 1.2 meters away from any obstacle and covered, in order to avoid the potential wind effect.

Resolution SEAM 259/15 – States the permissible air quality parameters (according to Law 5,211/14 Air Quality)

PARACEL must be vigilant for industrial emission controls.

Although Paraguay has no standards for industrial air emissions, PARACEL must comply with air quality parameter.

It is not permitted for emissions to the environment to generate odors or aromas that may cause discomfort, or for solvents and other chemical products to be released that are harmful or injurious to human health (Article 1).

Parameters	**Annual Average**	**Average in 24h**	**Average in 8h**	**Average in 1h**
$PM_{2,5}$	*15 µg/m³*	*30 µg/m³*		
PM_{10}		*150 µg/m³*		
O_3			*120 µg/m³*	
NO_2	*40 µg/m³*			*200 µg/m³*
SO_2		*20 µg/m³*		
CO			*10 µg/m³*	

Therefore, PARACEL shall use the best available technologies and best environmental practices. Thus, collection and absorption devices will be adopted to prevent the dispersion of pollutants in the atmosphere, which will be purified before their final disposal.

It was not possible to find specific regulations for the Municipality of Concepción, but it is understood that it is necessary to comply with air quality regulations in order to establish a legal standard for PARACEL. In addition, it should be noted that the PARACEL project is based on international standards, such as the guidelines from the 'Emission Guidelines for Pulp and Paper Facilities' by IFC, as shown in the table below.

Emission Guidelines for Pulp and Paper Facilities			
Parameter	**Type of Mill**	**Units**	**Guideline Value**
TSP	Kraft, bleached	kg/ADt	0.5
	Kraft, unbleached—Integrated	kg/ADt	0.5
	Sulfite, integrated and non-integrated	kg/ADt	0.15
SO_2 as S	Kraft, bleached	kg/ADt	0.4
	Kraft, unbleached—Integrated	kg/ADt	0.4
	Sulfite, integrated and non-integrated	kg/ADt	1.0
NO_x as NO_2	Kraft, bleached	kg/ADt	1.5 for hardwood pulp 2.0 for softwood pulp
	Kraft, unbleached—Integrated	kg/ADt	1.5 for hardwood pulp 2.0 for softwood pulp
	Sulfite, integrated and non-integrated	kg/ADt	2.0
TRS as S	Kraft, bleached	kg/ADt	0.2
	Kraft, unbleached—Integrated	kg/ADt	0.2

Source: Environmental, Health, and Safety Guidelines: Pulp and Paper Mills by IFC, 2007.
Notes:
TSP - Total Suspended particulates; SO_2 - Sulfur dioxide; S – Sulfur; NO_2 - Nitrogen dioxide; TRS - Total reduced sulfur compounds; kg/ADt - kilograms pf pollutant per 1,000 kg of air dry pulp.

2.1.4 Forestry Law

Law 422/1973 – Forestry Law

That law sets principles for use and rational management of forests and forest lands of the country, as well as the renewable natural resources that are included in the regime of this law. Likewise, it is declared of public interest and mandatory protection, conservation, improvement and enhancement of forest resources.

> Article 2. The fundamental objectives of this Law are:
>
> a. The protection, conservation, increase, renewal and sustainable and rational use of the country's forest resources;

b. The incorporation into the national economy of those lands that can maintain vegetation forestry;

c. Soil erosion control;

d. The protection of hydrographic basins and springs;

e. The promotion of afforestation, reforestation, crop protection, defense and beautification roads, public health and tourism areas;

f. Coordination with the Ministry of Public Works and Communications in the construction of the communication routes for economic access to forest production areas;

g. The conservation and increase of the natural resources of hunting and river and lake fishing with the object of obtaining the maximum social benefit;

h. The study, research and dissemination of forest products; and

i. Cooperation with national defense.

This law also creates the National Forest Service, dependent on the Ministry of Agriculture and Livestock, with specific powers and attributions: to manage, promote and develop the country's forest resources, in terms of their defense, improvement, expansion and rational use.

For PARACEL the following articles matter:

> Article 24. The use of forests will start with prior authorization from the National Forest Service for which purpose the respective application will be submitted accompanied by the corresponding Plan of Forest Management.
>
> Article 25. When the forest production is used in an irrational way, the Forestry authority will encourage the owner to comply with the authorized plan, being able to arrange the suspension of work and cancellation of the permit and apply the corresponding sanctions if the former does not comply with the formulated requirement.
>
> Article 26. The transport and commercialization of wood and other forest products may not be done without the corresponding guides issued by the National Forest Service. These guides will specify: quantity, species, weight or volume, origin and destination of the transported product.
>
> Article 27. Any natural or legal person that is dedicated to the exploitation, industrialization, trade in forest products and reforestation for production purposes, should register in the registries that the National Forest Service will set up for this purpose.

Article 28. The natural or legal persons that carry out forest exploitation must notify the National Forest Service, at the end of each year, the forest area that has been harvested and the volume or weight of the species extracted.

Article 42. All rural properties of more than twenty hectares in forest areas must keep 25 percent of its natural forest area. In case you don't have this minimum percentage, the owner must reforest an area equivalent to five percent of the surface of the property.

Article 43. Cultivated forest areas established on forest lands are declared exempt of the real estate tax under the conditions established by the respective regulations.

Law 3,464/2008 - Creates INFONA

This Law creates the National Forestry Institute, which constitutes the body for the application of the rules established by the Forestry Law and by the Law to promote afforestation and reforestation and also determines that INFONA will have as a general objective the administration, promotion and sustainable development of the country's forest resources, in terms of their defense, improvement, expansion and rational use.

The main functions of INFONA include the following:

a) Formulate and implement forest policy in accordance with rural government economic and development policies;

b) Promote and encourage forestry development through the planning, execution and supervision of plans, programs and projects, aimed at fulfilling the aims and objectives of the regulations forestry;

c) Monitor and control the extraction, industrialization and commercialization of timber products and non-timber trees from the use of the forest until the first transformation of the themselves;

d) Establish, when appropriate, on a permanent or temporary basis, special regimes of management and protection, with respect to certain areas or forest resources;

e) Promote and implement education, dissemination and knowledge transfer plans in the forestry disciplines;

f) Promote public and private investment in activities within the scope of its competence so that increase production, productivity, commercialization, diversification, industrialization of resources forestry, ecotourism and other environmental services;

g) Set and collect fees and charges for forest use, technical studies, expert opinions and others services;

h) Manage the forest fund, as well as the goods and facilities that constitute its patrimony;

i) Design and promote foresting and reforestation plans, forest management, systems agrosilvopastoral, forest restoration and others, which may be financed with own resources or private, national or foreign;

j) Other attributions that correspond to it, in accordance with Laws No. 422/73 "FOREST" and 536/95 "FOR THE PROMOTION OF FORESTATION AND REFORESTATION";

k) Prepare the internal regulations of the institution and the matters within its competence;

l) INFONA will present its budget project annually to the Ministry of Finance, and it will be governed by the laws of State Administration. The Institute will report annually to the Ministry of Agriculture and Livestock on the implementation of forest policy, plans, programs and projects executed as also future projections.

Law 6,676/2020 – Prohibition in the Eastern Region of processing activities and conversion of areas with forest cover

The PARACEL forestry project does not provide for planting in areas in the Eastern region of Paraguay, however the company is aware of the prohibition on the conversion of forest areas determined by this law in its article 4º:

> Article 4. a) The realization in the Eastern Region of transformation activities or conversion of areas with forest cover, to areas destined to the agricultural use in any of its forms; or to surfaces intended for human settlements; as well as the production, transportation and commercialization of wood, firewood, charcoal and any forest by-product originated dismounting not allowed.

Resolution SFN 76/1992 – About forest management plans

This regulates the preparation of the forest use and management plans and in it's 1st article establish the following limits of forest extension for the elaboration of forest management plans:

a) The use plans will be drawn up for wooded areas of up to a maximum of 500 hectares.

b) The management plans will be mandatory for areas greater than 500 hectares and optional for smaller areas.

<u>Article 6</u> - The Forest Use and Management Plans will contain:

a) Name and address of the applicant.

b) Registration number in the Public Forest Registry.

c) Location and area of the property.

d) Types of forests and area by stratum and total.

e) Type of sampling and work methodology.

f) Total volume per plot for all species with specimens of 10 and more cm. of DAP and its statistical analysis.

g) Tables of results of the inventory of two entries, classifying trees, basal area and standing commercial volume (up to crown base), referred to the hectare as a unit of surface.

h) Tables of estimated values of the volume of usable rolls with a diameter equal to or greater than 40 cm., according to species and referred to the hectare.

i) Cutting plan indicating the maximum volume of cutting per species and annual total, classifying according to diameter classes, per hectare, and for the entire forest.

j) Inventory field sheets.

k) Plan of the property and forest area on a topographic chart in scale 1: 50,000.

l) All the submitted plan sheets must be numbered, stamped and signed by the professional responsible for their preparation.

Law 536/1995 – Encouraging Foresting and Reforesting

This law determines that the State will promote the action of foresting and reforestation in priority forest soils, based on a forest management plan and with some incentives.

These incentives are described in the following:

> Article 7. The State will discount by 75% (seventy-five percent) and only once for each foresting or reforested area, the direct costs of the implementation incurred by individuals or legal of any nature and that are carried out in rural properties, whose soils are classified as forest priority.
>
> In the same way, 75% (seventy-five percent) of the direct costs derived from the maintenance of foresting and reforestation during the first 3 (three) years will be reduced, provided that it has been carried out in accordance with the approved Forest Management Plan.

Law 352/1994 and 96/1992 – About protected wild areas and Wild Life

The different properties involved in the Project are located in different ecoregions according to the different visions recognized, for example most of the properties are in the Cerrado while others are found in the Paranaense Province and a small portion of one of the properties in the Chacoan Province.

Concepcion Cerrados are part of the Paraguay Important Bird Area (IBA) 13 and its conservation needs have been highlighted internationally, site that holds different protected areas, neighboring or in the proximity of the properties considered by PARACEL, such as “Serranías San Luis”, “Paso Bravo”, “Parque Nacional Cerro Corá”, “Parque Nacional Bella Vista”, “Arroyo Blanco”, “Cerrado del Rio Apa”, “Guayacan I II II” and “Tagatiyá”.

These areas, as well as their fauna and flora, are part of the National System of Protected Wild Areas and their protection is determined by article 16 of law 352/1994 and by article 4 of law 86/1992:

> Article 16.- It will be a permanent objective of the National System of Protected Wild Areas the environmental preservation of extensions of the territory that contain representative samples of landscapes and different biogeographic and ecological regions of the country, in order to maintain biological diversity, ensuring the balance

and continuity of processes evolutionary and ecological, conserve flow and genetic materials and restore degraded systems; are also main objectives:

a. The management of these areas and their corresponding zones of damping adjusted to the criterion of socio-economic development sustainable;

b. The preservation and management of hydrographic basins and wetlands; control of erosion and sedimentation;

c. The protection and management of forest resources, flora and fauna wild;

d. The protection of cultural heritage, its physical supports, its accesses and its surroundings, as well as the activities promoted by tourism ecological in the right places;

e. The study, research and ecological dissemination, the development of appropriate technology and environmental education; and

f. The promotion and encouragement of the interest of society in the preservation and in the management of the Wild Areas representative of the heritage environmental of the country.

Article 4.- The protection, management and conservation of wild life of the country is declared of social interest and public utility, as well as its incorporation into the economy national. All inhabitants have a duty to protect the wildlife of our country.

Law 4,014/2010 - About fire prevention and control

Fires are a risk factor for forest areas and it is necessary to adopt correct measures for the prevention of this.

Article 1. The purpose of this Law is to establish suitable norms to prevent and control rural, forest, vegetation and interface fires; Therefore, the uncontrolled burning of grasslands, forests, bushes, fallows, natural fields, sawdust or any other cereal, legumes or type of flammable organic material that could generate any of the fires defined in this Law is prohibited. The only form of burning authorized for the purposes of this Law is Prescribed Burning.

Article 4.- Created the "Paraguayan Fire Prevention, Monitoring and Control Network" with the following functions:

c. Establish a National Fire Use Plan and update a public database that will record the variables that make up the sources of fires;

2.1.5 Others

Law 1.183/1985, Civil Code.

The main legal provision applicable to this project concerns the harmful use of property and pollution.

> Article 2000 - The proprietor is bound, in the exercise of his right, to abstain from any excess to the detriment of the property of the neighbors. In particular, smoke or soot emissions, harmful and disturbing emanations, noises, vibrations with a harmful effect and exceeding the limits of tolerance due to the local use, the situation and the nature of the buildings are prohibited. The owner, tenant or usufructuary of a property has the right to prevent that the bad use of the neighboring property can harm the security, the peace and the health of the inhabitants.
>
> Depending on the circumstances of the case, the judge may order the cessation of such nuisances and the compensation of damages, even if administrative authorization is required.
>
> (PARAGUAY, Civil Code - 1985)

It is clear that PARACEL must employ mitigation measures to avoid contamination of the Paraguay River.

Law 716/1996 establishes the Ecological Crime and protects the environment against anyone who orders, or through his power authorizes, activity that threatens the balance of the economic system, the support of natural resources or the quality of life. It refers in its articles 7 and 8 to the pollution of the atmosphere and water resources respectively.

The ESIA complies with the legal requirements and principles of Environmental Law, especially the Precautionary Principle.

Law n. 3,966/2010 – Municipal Organizational Law

Article 12 - Duties:

In the field of planning, urbanism and territorial ordering:

a) The planning of the municipality, through the Sustainable Development Plan of the Municipality and the Urban and Territorial Planning Plan

Environment issues:

a) The preservation, conservation, recomposition and enhancement of significant natural resources
b) The regulation and supervision of standards and patterns that guarantee the environmental quality of the municipality; and,

c) The control of the compliance with national environmental regulations, prior agreement with the competent national authorities.

d) The normative conditions established by the Municipal Development Plan according to the federal law are made explicit.

e) In this study and research no specific Municipal Organic Law of the municipality of Concepción was found.

f) But it is relevant to mention that the next topic covers the Municipal Development Plan of Concepción (Period 2016-2021).

Municipal Development Plan of Concepción (2016 - 2021)

On the website of the Information and Resources Center for Development - CIRD, it is possible to locate the Municipal Development Plan of Concepción mentioned. This document was elaborated from the coordination between authorities and officials of the Departmental and National Governments, with the support of volunteer citizens.

Article 177 of the National Constitution states: "The national development plans shall be indicative for the private sector and mandatory for the public sector".

Thus, there is a context for Sustainable Development Plan of the Municipality that is provided for in Article 225 of the Municipal Organic Law (according to national law n. 3966/2010). This plan must be understood as an instrument of government for local transformation, in a manner consistent with the National Development Plan.

The Municipal Development Plan of Concepción (PDM in Spanish) is a perfectible, dynamic plan that will be updated and improved according to the decisions taken by the Municipal Development Council (formed on June 9, 2016, composed of 29 people).

The PDM points out relevant information that should be evaluated by the PARACEL entrepreneur, especially indicating the population numbers (men and women), educational institutions (urban and rural), health and police establishments, as well as the municipal diagnosis under the social, economic and environmental axes.

Thus, the PDM allows for a diagnosis of Strengths, Opportunities, Weaknesses and Threats in the social, economic and environmental axes.

The Municipal Development objectives include strategies on all three axes:

- social;
- economic; and,
- environment friendly.

The PDM is based on National Constitution, National Development Plan, Law n. 3966/2010 (Municipal Organizational Law) and other legal matters.

However, this document is indicative for private entrepreneurs, PARACEL must comply with the Municipal Development Plan of Concepción, as well as employ the best environmental practices and best available technologies, and all environmental regulations relevant to the preservation, conservation, recomposition and improvement of natural resources. It must also comply with the law that governs the standards and patterns that guarantee the environmental quality of the municipality of Concepción.

The entrepreneur is subject to the Municipal Development Plan and the Organic Law of Concepción. The relationship between PARACEL and the Municipality of Concepción must be subject to the norms on construction and installations, independently of the requirements of the Environmental Impact Study.

This project is subject to all planning and land use regulations of the municipality of Concepción.

Indigenous Protection Regulations

Article 177 of the National Constitution states that "National development plans shall be indicative for the private sector and mandatory for the public sector".

The National Development Plan (PND) was approved by Executive Decree n. 2794/2014, to be applied as a guide in the various tasks that fall under the jurisdiction of the public administration. Based on the aforementioned regulations, the Technical Secretariat for Planning approved a Guide for the elaboration of a Municipal Development Plan that the Municipality of Concepción has respected.

In this context, the Sustainable Development Plan of Concepción (PDM) provided for in Article 225 of Law 3,966/10 "Organic Municipal", shall be interpreted as an instrument of government for change of local reality, in a manner consistent with the vision and objectives of the National Development Plan; since it forms part of a national planning system, by constitutional provision it is governed by the basic guidelines of the same, although nothing prevents it from being strengthened and complemented with other elements that are compatible.

The Constitution of Paraguay (1992) recognizes indigenous peoples and defines them as "groups of culture prior to the formation and organization of the Paraguayan State" (art. 62).

Thus, the Constitution guarantees to indigenous peoples (art. 63) the application of their systems of political, social, economic, cultural and religious organization, as well as their voluntary submission to their customary rules for the regulation of internal coexistence, provided that they do not infringe upon fundamental rights.

Paraguay has adopted national and international standards to protect the fundamental rights of indigenous individuals and communities and provides a framework for the needs and requirements of the administration in the area of access to justice.

In an international, more macro perspective, it is important to cite the main instruments:

- ILO Convention 169; ratified by Law 234/1993;
- United Nations Declaration on the Rights of Indigenous Peoples (2007);
- International Convention on the Elimination of All Forms of Racial Discrimination; in force under law 2,128/2003;
- OAS Declaration on the Rights of Indigenous Peoples (2016).

The same is true at the national level through special laws on indigenous communities. They are as follows:

- Law 904/1981 "Statute of the Indigenous Communities" (modified and extended by Law 919/1996 in articles 30, 31, 62, 63 Inc. d, and 71);
- Law 1,286/2000 "Code of Criminal Procedure", Title VI, articles 432 to 448;

- Law 1,863/2002 "Establishing the Agrarian Statute";
- Act 3231/2007, establishing the General Directorate for Indigenous School Education;
- Law 4,251/2010 "Law on Languages";
- Law 5,469/2015 "On Indigenous Health".

The most important aspect to be considered in this ESIA and for the whole operation of PARACEL is that the indigenous peoples are recognized as groups of culture prior to the formation and organization of the Paraguayan State.

Thus, the Constitution of Paraguay guarantees the right to preserve and develop their ethnic identity and especially to preserve it in their habitat. This means that systems of cultural, social, economic, political and religious organization prevail over systems and jurisdictions legally created by non-indigenous people.

With regard to land ownership, the Magna Carta guarantees sufficient extension and quality to develop their particular way of life.

PARACEL must observe that the removal or relocation of their habitat is prohibited without the express consent of the indigenous peoples and communities. Article 63 states: "The right of indigenous peoples to preserve and develop their ethnic identity in their respective habitat is recognized and guaranteed. They also have the right to freely apply their systems of political, social, economic, cultural and religious organization, as well as to voluntarily submit to their customary rules for the regulation of internal coexistence, provided that they do not violate the fundamental rights established in this Constitution. In jurisdictional disputes, indigenous customary law shall be taken into account".

Therefore, PARACEL must consider indigenous protection in its decision-making, as well as assess the social and environmental impacts that may eventually occur in indigenous communities or peoples, guaranteeing their protection and participation.

2.2 International Standards

2.2.1 Historic Background

In Paraguay according to Decreet 954/13 art 1° (with reference to art 2°.b-2) it is mandatory to perform an ESIA to get the government permit for the forest plantation areas, and PARACEL with Pöyry performed this study based on Article 1 to 4 of Law 294/13, which establishes that an Environmental Impact Study is needed for all potential polluted ventures. The impact evaluation investigates the changes in the environment caused by works and/or human activities that have a positive or negative, direct or indirect consequence, affecting life in general, biodiversity, the quality or a significant quantity of natural or environmental resources and their use, welfare, health, personal safety, habits and customs, cultural heritage, legitimate livelihoods.

Thus, the ESIA aims to meet the Financing Institutions of the Project and also that the requirements of the Environmental and social requirements for FSC Certification are fully aligned with IFC's Performance Standards (PS), its EHS Guidelines and the application of best available practices and techniques.

Man's interest in the environment and the issue surrounding it is a matter that goes back many centuries. However, in the second half of the last century, a special global emphasis has been placed on the issue of environment and development, and it is in this way that the main global, regional and national forums have inevitably turned their attention to seeking appropriate responses and effective solutions, with the aim of "ensuring sustainable human progress and survival".

In 1948, the Constituent Congress of the International Union for the Conservation of Nature, IUCN, was held in Fountainebleau, France, after an international conference of UNESCO.

Later, in 1968, the General Assembly of the United Nations convened a world conference and, as a precedent to this, a meeting of experts was scheduled in Switzerland, which concluded that the quality of life and also life itself was deteriorating in the Third World. These experts formed the so-called Club of Rome, which was originally composed of a multidisciplinary group of economists, politicians and scientists, under the leadership of Dennis Meadows.

The Club of Rome produced a study that caused a great sensation at the time and awoke planetary concern to relate the scarcity of natural resources to the intense exploitation of nature.

The document called "The Limits to Growth" (1972) integrated variables into a global analysis model, presenting conclusions that the environment was threatened by the progressive increase in demand and increase in world population directly related to the decrease in the supply of natural resources (non-renewable resources).

In short, this publication indicates that the decrease in supply is directly related to environmental pollution.

Then, in 1972, the United Nations Conference on Environment and Development met in Stockholm, resulting in the publication of the United Nations Environment Program. The 1972 Stockholm Declaration on the Human Environment supported the Founex Report, and at the same time affirmed the possibility of planning social and economic development without causing irreversible damage to the environment.

Later, in 1987, the Report of the World Commission on the Environment - Our Common Future - presented long-term considerations and strategies for achieving sustainable development and environmental protection. It cannot fail to refer to the Earth Summit (1992, in Brazil) in which the integral and independent nature of the planet was proclaimed and recognized, and which offered a very promising outcome called The Rio Commitments.

These are the main environmental events that consolidated International Environmental Law, which was incorporated by various countries, the same thing happening in Paraguay which assimilated the principles of general application in the discipline of environmental law.

2.2.2 International Treaties and Conventions

Sustainable Development Goals – SDG

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future.

At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

The private sector has an essential role in this process as a great holder of economic power, a propeller of innovations and technologies that influences and engages the most diverse audiences - governments, suppliers, employees and consumers.

Forest Stewardship Council - FSC

Founded in 1994 in response to concerns about global deforestation, the FSC is a pioneering forum, to define what is an environmentally appropriate, socially beneficial, and economically viable management forest management, and to identify tools and resources that promote a positive and lasting change in forests and the peoples that inhabit them.

Through its certification system, the FSC seal recognizes the responsible production of forest products, allowing consumers and companies to make conscious purchasing decisions, benefiting people and the environment, as well as adding value to the business.

The FSC Principles and Criteria are the rules for an environmentally appropriate, socially beneficial, and economically viable management forest management. They form the basis of the FSC certification system and, together with the Preamble and Glossary of Terms, form the core of a comprehensive policy package. There is no hierarchy between the Principles and Criteria, and they are at the center of the FSC standards structure, and should be applied in conjunction with other interconnected documents.

The Principles and Criteria are immutable around the world. Indicators and Verifiers are adapted to each national context and consolidated in National Forest Management Standards. They are used by certifiers to ensure compliance and compliance with P&C.

The 10 principles and the main criteria for PARACEL forestry project are:

- Principle 1 - Compliance with laws: The Organization shall comply with all applicable laws, regulations and nationally-ratified international treaties, conventions and agreements.
- Principle 2 - Workers' rights and employment conditions: The Organization shall maintain or enhance the social and economic well-being of workers.
- Principle 3 - Indigenous peoples' rights: The Organization shall identify and uphold indigenous peoples' legal and customary rights of ownership, use and management of land, territories and resources affected by management activities.
- Principle 4 - Community relations: The Organization shall contribute to maintaining or enhancing the social and economic well-being of local communities.
- Principle 5 - Benefits from the forest: The Organization shall efficiently manage the range of multiple products and services of the Management Unit to maintain or enhance long term economic viability and the range of environmental and social benefits.

    5.1 The Organization shall identify, produce, or enable the production of, diversified benefits and/or products, based on the range of resources and ecosystem services existing in the Management Unit in order to strengthen and diversify the local economy proportionate to the scale and intensity of management activities.

    5.2 The Organization shall normally harvest products and services from the Management Unit at or below a level which can be permanently sustained.

    5.3 The Organization shall demonstrate that the positive and negative externalities of operation are included in the management plan.

    5.4 The Organization shall use local processing, local services, and local value adding to meet the requirements of The Organization where these are available, proportionate to scale, intensity and risk.

    5.5 The Organization shall demonstrate through its planning and expenditures proportionate to scale, intensity and risk, its commitment to long-term economic viability.

- Principle 6 - Environmental values and impact: The Organization shall maintain, conserve and/or restore ecosystem services and environmental values of the Management Unit, and shall avoid, repair or mitigate negative environmental impacts.

    6.1 The Organization shall assess environmental values in the Management Unit and those values outside the Management Unit potentially affected by management activities. This assessment shall be undertaken with a level of detail, scale and frequency that is proportionate to the scale, intensity and risk of management activities, and is sufficient for the purpose of deciding the necessary conservation measures, and for detecting and monitoring possible negative impacts of those activities.

6.2 Prior to the start of site-disturbing activities, The Organization shall identify and assess the scale, intensity and risk of potential impacts of management activities on the identified environmental values.

6.3 The Organization shall identify and implement effective actions to prevent negative impacts of management activities on the environmental values, and to mitigate and repair those that occur, proportionate to the scale, intensity and risk of these impacts.

6.4 The Organization shall protect rare species and threatened species and their habitats in the Management Unit through conservation zones, protection areas, connectivity and/or (where necessary) other direct measures for their survival and viability. These measures shall be proportionate to the scale, intensity and risk of management activities and to the conservation status and ecological requirements of the rare and threatened species. The Organization shall take into account the geographic range and ecological requirements of rare and threatened species beyond the boundary of the Management Unit, when determining the measures to be taken inside the Management Unit.

6.5 The Organization shall identify and protect representative sample areas of native ecosystems and/or restore them to more natural conditions. Where representative sample areas do not exist or are insufficient, The Organization shall restore a proportion of the Management Unit to more natural conditions. The size of the areas and the measures taken for their protection or restoration, including within plantations, shall be proportionate to the conservation status and value of the ecosystems at the landscape level, and the scale, intensity and risk of management activities.

6.6 The Organization shall effectively maintain the continued existence of naturally occurring native species and genotypes, and prevent losses of biological diversity, especially through habitat management in the Management Unit. The Organization shall demonstrate that effective measures are in place to manage and control hunting, fishing, trapping and collecting.

6.7 The Organization shall protect or restore natural water courses, water bodies, riparian zones and their connectivity. The Organization shall avoid negative impacts on water quality and quantity and mitigate and remedy those that occur.

6.8 The Organization shall manage the landscape in the Management Unit to maintain and/or restore a varying mosaic of species, sizes, ages, spatial scales and regeneration cycles appropriate for the landscape values in that region, and for enhancing environmental and economic resilience.

6.9 The Organization shall not convert natural forest to plantations, nor natural forests or plantations on sites directly converted from natural forest to non-forest land use, except when the conversion:

a. affects a very limited portion of the area of the Management Unit, and

b. will produce clear, substantial, additional, secure long-term conservation benefits in the Management Unit, and

c. does not damage or threaten High Conservation Values, nor any sites or resources necessary to maintain or enhance those High Conservation Values.

6.10 Management Units containing plantations that were established on areas converted from natural forest after November 1994 shall not qualify for certification, except where:

a. clear and sufficient evidence is provided that The Organization was not directly or indirectly responsible for the conversion, or

b. the conversion affected a very limited portion of the area of the Management Unit and is producing clear, substantial, additional, secure long term conservation benefits in the Management Unit.

- Principle 7 - Management planning: The Organization shall have a management plan consistent with its policies and objectives and proportionate to scale, intensity and risks of its management activities.
- The management plan shall be implemented and kept up to date based on monitoring information in order to promote adaptive management. The associated planning and procedural documentation shall be sufficient to guide staff, inform affected stakeholders and interested stakeholders and to justify management decisions.

7.1 The Organization shall, proportionate to scale, intensity and risk of its management activities, set policies (visions and values) and objectives for management, which environmentally appropriate, socially beneficial, and economically viable. Summaries of these policies and objectives shall be incorporated into the management plan, and publicized.

7.2 The Organization shall have and implement a management plan for the Management Unit which is fully consistent with the policies and objectives as established according to Criterion 7.1.

The management plan shall describe the natural resources that exist in the Management Unit and explain how the plan will meet the FSC certification requirements. The management plan shall cover forest management planning and social management planning proportionate to scale, intensity and risk of the planned activities.

7.3 The management plan shall include verifiable targets by which progress towards each of the prescribed management objectives can be assessed.

7.4 The Organization shall update and revise periodically the management planning and procedural documentation to incorporate the results of monitoring and evaluation, stakeholder engagement or new scientific and technical information, as well as to respond to changing environmental, social and economic circumstances.

7.5 The Organization shall make publicly available a summary of the management plan free of charge. Excluding confidential information, other relevant components of the management plan shall be made available to affected stakeholders on request, and at cost of reproduction and handling.

7.6 The Organization shall, proportionate to scale, intensity and risk of management activities, proactively and transparently engage affected stakeholders in its management planning and monitoring processes, and shall engage interested stakeholders on request.

- Principle 8 - Monitoring and assessment: The Organization shall demonstrate that progress towards achieving the management objectives, the impacts of management activities and the condition of the Management Unit, are monitored and evaluated proportionate to the scale, intensity and risk of management activities, in order to implement adaptive management.
- Principle 9 - High conservation values: The Organization shall maintain and/or enhance the high conservation values in the Management Unit through applying the precautionary approach.
- Principle 10 - Implementation of management activities: Management activities conducted by or for the Organization for the Management Unit shall be selected and implemented consistent with the Organization's economic, environmental and social policies and objectives, and in compliance with the Principles and Criteria collectively

FSC also has a certificate of Controlled Wood. This standard specifies basic requirements applicable at the forest management unit (FMU) level for forest management enterprises to demonstrate to a company or third party certification body that wood supplied is controlled.

It allows forest management projects to provide evidence that the wood they supply has been controlled to avoid wood that is illegally harvested, harvested in violation of traditional and civil rights, harvested in forest management units in which high conservation values are threatened by management activities, harvested in areas in which forests are being converted to plantations or nonforest use or harvested from forests in which genetically modified tress are planted:

- 1.4. The Forest Management Enterprise shall include the following information on all invoices issued for sales of FSC Controlled Wood products:
  a. the name and address of the buyer;
  b. the date on which the invoice was issued;
  c. description of the product;
  d. the quantity of the products sold;
  e. reference to the product's batch and/or to related shipping documentation,
  f. sufficient to link the invoice to the goods received by the customer;
  g. the certification code issued by an FSC accredited Certification Body.

- 1.5. Invoices and shipping documents for sale of controlled wood shall always include the claim “FSC Controlled Wood”. Where sale or transport documents cover a consignment of both controlled and uncontrolled wood it shall specify which products are sold or transported as “FSC Controlled Wood”.
- 1.6. The Forest Management Enterprise shall ensure that claims in relation to FSC Controlled Wood meet the requirements specified in appendix 3 of this standard.
- 2.1. The Forest Management Enterprise shall specify the Forest Management Units (FMUs) under its management.
- 2.2. The Forest Management Enterprise shall specify the FMUs to be included in the scope of evaluation for compliance with this standard.
- 2.3. Any FMU under the control of the Forest Management Enterprise is not included in the scope of evaluation for compliance with this standard, then the Forest Management Enterprise shall implement a tracking system to ensure wood from FMUs included in the scope of the standard to be reliably identified as such.

The HCS Approach Toolkit

Tropical natural forests hold large stores of carbon and biodiversity, and are critical for millions of indigenous and local peoples who depend on forests for their livelihoods. However, this carbon is released and biodiversity is lost when these forests are cleared – otherwise known as deforestation. The High Carbon Stock (HCS) Approach is a methodology that distinguishes forest areas for protection from degraded lands with low carbon and biodiversity values that may be developed. The methodology was developed with the aim to ensure a practical, transparent, robust, and scientifically credible approach that is widely accepted to implement commitments to halt deforestation in the tropics, while ensuring the rights and livelihoods of local peoples are respected.

The amount of carbon and biodiversity stored within an area of land varies according to the type of vegetative cover. The HCS Approach stratifies the vegetation in an area of land into six different classes using analyses of satellite data and ground survey measurements. These six classes are: High Density Forest, Medium Density Forest, Low Density Forest, Young Regenerating Forest, Scrub, and Cleared/ Open Land. The first four classes are considered potential High Carbon Stock forests.

The HCS Approach is a breakthrough for plantation companies and manufacturers who are committed to breaking the link between deforestation and land development in their operations and supply chains. The approach represents the first practical methodology that has been tested and developed in active concessions in Asia and Africa with input from a variety of stakeholders. It is a relatively simple tool that plantation companies can use for new developments while ensuring that forests are protected from conversion.

PARACEL’s forest project plans to use only pastureland as plantations and the wooded areas will be retained and protected.

Voluntary Principles on Security and Human Rights Security and Human Rights

The Voluntary Principles on Security and Human Rights were created in 2000 when the governments of the United States and the United Kingdom, companies, and NGOs engaged in a dialogue about security and human rights. Although originally developed for the extractive and energy sector, the principles are implemented by a variety of industries.

While the duty to protect human rights rests with governments, businesses have a responsibility to avoid harming people and to address adverse impacts with which they are involved. Companies often operate in complex environments with little guidance on the ground on how to observe their human rights responsibilities. The Voluntary Principles helps companies understand the environment they are operating in, identify security-related human rights risks, and take meaningful steps to address them.

Through dialogue and a collective effort, the participants have developed a set of voluntary principles that fall into three components:

- Risk Assessment: The ability to assess risks in a Company’s operating environment and impact to local communities is critical. The quality of risk assessment depends on the assembling of updated, credible information from a range of perspectives — governments, security firms, other companies, multilateral institutions, and civil society. Some of the factors that should be considered are:
  - ✓ Identification of risks associated with political, economic, civil or social factors.
  - ✓ Potential for violence.
  - ✓ Human rights records of public security forces, paramilitaries, law enforcement, and private security.
  - ✓ Local prosecuting authority and judiciary’s capacity to ensure accountability.
  - ✓ Conflict analysis with identification of the root causes of conflicts and level of adherence to human rights standards.
  - ✓ Risks associated with the transfer of lethal and non-lethal equipment to security providers.
- Interactions Between Companies and Public Security: Although governments have the primary role of maintaining law and order, companies have an interest in ensuring that actions taken by public security providers are consistent with the protection of human rights. Some of the principles that guide relationships between companies and public security providers are:
  - ✓ Companies should consult with governments and communities about the impact of their security arrangements.
  - ✓ The type of forces deployed should be proportional to the threat.
  - ✓ Individuals implicated in human rights abuses should not provide security services.
  - ✓ Force is used only when necessary.

  - ✓ Companies should hold frequent meetings with public security and other stakeholders.
  - ✓ Companies should provide human rights training.
  - ✓ Allegations of human rights abuses should be reported.
  - ✓ Information used for allegations of human rights abuses should be credible.
- – Interactions Between Companies and Private Security: The following represents some of the principles to guide private security conduct.
  - ✓ Private security should act consistently with the law and international guidelines. They should have policies regarding appropriate conduct and the use of force.
  - ✓ Allegations of human rights abuses should be investigated and monitored.
  - ✓ Only preventative and defensive services should be provided.
  - ✓ Individuals implicated in human rights abuses should not provide security services.
  - ✓ Private security should investigate and report incidents where physical force is used.
  - ✓ Companies should include the Voluntary Principles in their contract agreements with private security providers and ensure personnel is trained.
  - ✓ Companies should seek to employ private security providers from the local population.
  - ✓ Companies should exchange information with other stakeholders about abuses committed by private security

UN Guiding Principles on Business and Human Rights – UNGPs

These Guiding Principles are grounded in recognition of:

a) States' existing obligations to respect, protect and fulfil human rights and fundamental freedoms;

b) The role of business enterprises as specialized organs of society performing specialized functions, required to comply with all applicable laws and to respect human rights;

c) The need for rights and obligations to be matched to appropriate and effective remedies when breached.

These Guiding Principles apply to all States and to all business enterprises, both transnational and others, regardless of their size, sector, location, ownership and structure.

The UN Framework also addresses the human rights responsibilities of businesses. Business enterprises have the responsibility to respect human rights wherever they operate and whatever their size or industry. This responsibility means companies must know their actual or potential impacts, prevent and mitigate abuses, and address adverse impacts with which they are involved. In other words, companies must know—and show—that they respect human rights in all their operations.

The Guiding Principles contain three chapters, or pillars: protect, respect and remedy. Each defines concrete, actionable steps for governments and companies to meet their respective duties and responsibilities to prevent human rights abuses in company operations and provide remedies if such abuses take place.

- The State duty to protect human rights: States must protect against human rights abuse within their territory and/or jurisdiction by third parties, including business enterprises. This requires taking appropriate steps to prevent, investigate, punish and redress such abuse through effective policies, legislation, regulations and adjudication.

  States should set out clearly the expectation that all business enterprises domiciled in their territory and/or jurisdiction respect human rights throughout their operations.

- The corporate responsibility to respect human rights: Business enterprises should respect human rights. This means that they should avoid infringing on the human rights of others and should address adverse human rights impacts with which they are involved.

  The responsibility of business enterprises to respect human rights refers to internationally recognized human rights – understood, at a minimum, as those expressed in the International Bill of Human Rights and the principles concerning fundamental rights set out in the International Labour Organization's Declaration on Fundamental Principles and Rights at Work.

  The responsibility to respect human rights requires that business enterprises:

  a) Avoid causing or contributing to adverse human rights impacts through their own activities, and address such impacts when they occur;

  b) Seek to prevent or mitigate adverse human rights impacts that are directly linked to their operations, products or services by their business relationships, even if they have not contributed to those impacts.

  The responsibility of business enterprises to respect human rights applies to all enterprises regardless of their size, sector, operational context, ownership and structure. Nevertheless, the scale and complexity of the means through which enterprises meet that responsibility may vary according to these factors and with the severity of the enterprise's adverse human rights impacts.

  In order to meet their responsibility to respect human rights, business enterprises should have in place policies and processes appropriate to their size and circumstances, including:

  a) A policy commitment to meet their responsibility to respect human rights;

  b) A human rights due diligence process to identify, prevent, mitigate and account for how they address their impacts on human rights;

  c) Processes to enable the remediation of any adverse human rights impacts they cause or to which they contribute.

- Access to remedy: As part of their duty to protect against business-related human rights abuse, States must take appropriate steps to ensure, through judicial, administrative, legislative or other appropriate means, that when such abuses occur within their territory and/or jurisdiction those affected have access to effective remedy.

2.2.3 Detailed International Lender Standards

International Finance Corporation – IFC

IFC's Environmental and Social Performance Standards define IFC clients' responsibilities for managing their environmental and social risks.

The 2012 edition of IFC's Sustainability Framework, which includes the Performance Standards, applies to all investment and advisory clients whose projects go through IFC's initial credit review process after January 1, 2012.

IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation in order to achieve its overall development objectives. The Performance Standards may also be applied by other financial institutions.

2. Together, the eight Performance Standards establish standards that the client is to meet throughout the life of an investment by IFC:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts: underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders. Drawing on the elements of the established business management process of “plan, do, check, and act,” the ESMS entails a methodological approach to managing environmental and social risks and impacts in a structured way on an ongoing basis. A good ESMS appropriate to the nature and scale of the project promotes sound and sustainable environmental and social performance, and can lead to improved financial, social, and environmental outcomes
- Performance Standard 2: Labor and Working Conditions: recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. For any business, the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient in the sustainability of a company. Failure to establish and foster a sound worker-management relationship can undermine worker commitment and retention, and can jeopardize a project. Conversely, through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.
- Performance Standard 3: Resource Efficiency and Pollution Prevention: recognizes that increased economic activity and urbanization often generate

increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world. These are often implemented through continuous improvement methodologies similar to those used to enhance quality or productivity, which are generally well known to most industrial, agricultural, and service sector companies.

– Performance Standard 4: Community Health, Safety, and Security Performance: recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups.

– Standard 5: Land Acquisition and Involuntary Resettlement Performance: recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. Resettlement is considered involuntary when affected persons or communities do not have the right to refuse land acquisition or restrictions on land use that result in physical or economic displacement. This occurs in cases of (i) lawful expropriation or temporary or permanent restrictions on land use and (ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.

– Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources: recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity, which defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems."

– Performance Standard 7: Indigenous Peoples: recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also come under threat. As a consequence, Indigenous Peoples may be more vulnerable to the adverse impacts associated with project development than non-indigenous communities. This vulnerability may include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases.

- Performance Standard 8: Cultural Heritage: recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

Addressing Gender-Based Violence and Harassment: Emerging Good Practice for the Private Sector, EBRD, CDC, IFC

Jointly commissioned by IFC, the European Bank for Reconstruction and Development (EBRD), and CDC Group, Addressing Gender-Based Violence and Harassment: Emerging Good Practice for the Private Sector outlines emerging practices in addressing gender-based violence and harassment (GBVH) in operations and investments. These practices are drawn from recent experience in the private sector, as well as a larger body of work from the non-profit sector. The guidance provides an opportunity to engage with stakeholders to refine practices as those in the private sector collectively gain implementation experience.

The negative impacts of GBVH on both individual health and wellbeing and businesses can be severe. For companies and investors, GBVH can pose a range of risks, including costly litigation, loss of profits and damaged reputation.

The following principles need to underpin all efforts to assess, prevent, respond to and monitor GBVH.

- Survivor-centered: Prioritize the rights and needs of people who have experienced GBVH and listen to their wishes.
- Safe: Protect people who experience, witness or report GBVH, as well as those who seek to address it.
- Context-specific: Base all actions on a solid understanding of the local legal and social context.
- Collaborative: Work with internal and external stakeholders to identify risks, prevent GBVH and respond to reports.
- Inclusive: Address the heightened risk of GBVH for certain groups and provide access to independent, objective and nonjudgmental spaces to discuss concerns.
- Integrated: Address GBVH as part of an organization's existing processes and management systems.

- Non-discriminatory: Locate efforts to address GBVH as part of wider approaches to promote inclusive, diverse and effective businesses.
- Well-informed: Draw on expertise, including from GBVH, child protection and legal experts when needed, to help inform approaches and support responses.

It is important that companies and investors recognize that the stakes can be extremely high or even life-threatening for those who speak out against GBVH. Continuous thought, care and sensitivity are needed.

Investors and companies can take action to prevent GBVH and to be ready to respond to reports. It is often easier and more effective to integrate measures into existing systems by:

- strengthening leadership and company culture, so that GBVH risks are understood, clear and consistent messages are communicated, necessary partnerships are developed, inclusive organizational structures are developed, and adequate resources are invested
- developing and communicating policies and codes of conduct that define GBVH, set out prevention and response measures and outline behaviors that are not tolerated, with clear links to sanctions and disciplinary procedures
- establishing grievance mechanisms and investigation procedures that enable GBVH to be reported in a safe and confidential way, with effective channels at project level and for workers, service users and communities
- strengthening recruitment and performance assessments so that they address GBVH risks and enable fair and transparent decision-making on hiring, promotions and performance-related pay
- delivering training and awareness raising, both internally among workers and externally among communities and service users, providing essential information and enhanced training for those with specific responsibilities for GBVH prevention and response
- working with contractors and suppliers to address GBVH through procurement processes, contract selection and negotiation and regular engagement along the supply chain
- improving the physical design of worksites and service delivery locations, with safety assessments to identify potential GBVH hotspots for workers, service users and community members.

IFC’s Workers' Accommodation: Processes and Standards

This guidance note addresses the processes and standards that should be applied to the provision of workers’ accommodation in relation to projects funded by the European Bank for Reconstruction and Development (EBRD) or IFC. Applying appropriate standards to the construction and operation of worker housing falls within the performance requirements on labor issues expected of clients by both organizations.

There is a range of different types of workers’ accommodation that may be required by various projects and at different stages within projects, including temporary exploration camps, construction camps and permanent dormitories. Specific issues arise in relation to each of these.

The key standards that need to be taken into consideration, as a baseline, are those contained in national/local regulations. Although it is quite unusual to find regulations specifically covering workers' accommodation, there may well be general construction standards which will be relevant. These may include the following standards:

– Building construction: for example, quality of material, construction methods, resistance to earthquakes.

– Housing and public housing: in some countries regulations for housing and public housing contain requirements on issues such as the basic amenities, and standards of repair.

– General health, safety and security: requirements on health and safety are often an important part of building standards and might include provisions on occupation density, minimal air volumes, ventilation, the quality of the flooring (slip-resistant) or security against intrusion.

– Fire safety: requirements on fire safety are common and are likely to apply to housing facilities of any type. This can include provision on fire extinguishers, fire alarms, number and size of staircases and emergency exits, restrictions on the use of certain building materials.

– Electricity, plumbing, water and sanitation: national design and construction standards often include very detailed provisions on electricity or plumbing fixtures/fittings, water and sanitation connection/ equipment.

IFC Environmental, Health, and Safety Guidelines for Perennial Crop Production

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards.

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in plantations by existing technology at reasonable costs. Application of the EHS Guidelines to existing farming and forestry systems may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables— such as host country context, assimilative capacity of the environment, and other project factors—are taken into account.

Environmental issues in plantation crop production primarily include the following:

– Soil Conservation and Management

– Nutrient Management

– Crop Residue and Solid Waste Management

– Water Management

– Pest Management

- Use and Management of Pesticides
- Fertilizers
- Biodiversity and Ecosystems
- Genetically Modified Crops (GM Crops)
- Energy Use
- Air Quality
- Greenhouse Gas (GHG) Emissions

IFC Environmental, Health, and Safety Guidelines for Forest Harvesting Operations

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry specific examples of Good International Industry Practice (GIIP). These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors.

The EHS Guidelines for Forest Harvesting Operations include information relevant to the management of both plantation and natural forests, in temperate, boreal and tropical zones.

Market demands that forest products originate from sustainably managed natural and plantation forest operations have resulted in the creation of specific forest certification systems to demonstrate that internationally-acceptable standards of forest management are met.

These systems generally have formal standards, based on internationally-acceptable principles and criteria for sustainable forest management, and usually include the following:

- Compliance with relevant law;
- Respect for any customary land tenure and use rights of indigenous peoples respect for the rights of workers, and compliance with occupational health and safety measures;
- Measures for community and stakeholder engagement
- Conservation of biodiversity and protection of critical habitat;
- Maintenance of environmentally-sound multiple benefits from the forest;
- Prevention or minimization of adverse environmental and social impacts;
- Effective forest management planning;
- Active monitoring and assessment of relevant forest management areas.

Forest sector enterprises may be encouraged or required by regulatory bodies or financial institutions, to obtain such certification as a condition of operation, and such certification is also increasingly being viewed as necessary for access to international or national markets.

Environmental issues in forest harvesting operations primarily include the following:

- Habitat alteration and loss of biodiversity
- Water quality
- Soil productivity
- Hazardous materials management
- Visual impact

IDB Invest Environmental and Social Sustainability Policy

IDB Invest, the private sector institution of the Inter-American Development Bank (IDB) Group, is a multilateral development bank committed to supporting the private sector in Latin America and the Caribbean. It finances sustainable enterprises and projects to achieve financial results that maximize economic, social and environmental development for the region.

In addition to the policies approved by the IDB Invest Board, the Sustainability Policy requires clients to apply the IFC Performance Standards and the World Bank Group's EHS Guidelines. The Sustainability Policy highlights IDB Invest commitments in several areas, both environmental and social. Topics that are given increased emphasis include disaster risk management, human rights, stakeholder engagement, gender and diversity, and reprisals.

DFC's Environmental and Social Policies and Procedures - ESPP

U.S. International Development Finance Corporation (DFC) is America's development bank. DFC partners with the private sector to finance solutions to the most critical challenges facing the developing world today. DFC invests across sectors including energy, healthcare, critical infrastructure, and technology projects. DFC also provides financing for small businesses and women entrepreneurs in order to create jobs in emerging markets. DFC investments adhere to high standards and respect the environment, human rights, and worker rights.

The guiding environmental and social policies and procedures are based in large part on environmental and social impact assessment procedures applied by organizations such as the World Bank Group, the European Bank for Reconstruction and Development, the Inter-American Development Bank, and the U.S. Export Import Bank, among others.

DFC's business lines work closely with the Office of Development Policy to determine a project's eligibility for DFC support. Each potential project is subject to a full policy review. Thorough, accurate, and complete information in the application and supplemental materials, such as a business plan, help expedite DFC's project review.

All projects and Subprojects are categorized as Category A, B, C or D based on environmental and social factors. PARACEL's forest project is classified in Category A that are projects that may have significant adverse environmental and/or social impacts that are irreversible, sensitive, diverse, or unprecedented in the absence of adequate mitigation measures. Category A projects are considered high risk.

Companies must meet the requirements of the IFC's Performance Standards. Included within this requirement are the risk and impact identification requirements of Performance Standard 2, which requires (1) Identification of all relevant environmental and social risks of the Project including issues identified in Performance Standards through 8; (2) Identification of all factors that define the Project's Area of Influence; and (3) Identification of groups and communities that may be directly or indirectly affected by the Project (i.e., Project Affected People), including groups and communities that may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status. The process of identifying risks, impacts, Area of Influence and Project Affected People shall be adequate, accurate, objective and appropriate to the severity of Project risks and significance of Project impacts.

All projects involving timber extraction from Natural Forests, including all boreal, temperate, and plantation Forests must be, and remain, certified by an independent non-governmental organization.

Certifiers must be accredited by an international accreditation body (such as the Forest Stewardship Council that can hold the certifier accountable to a common set of environmental and social principles and procedural protocols, including periodic review and re-accreditation. The purpose of certification is to demonstrate that timber extraction activities are managed sustainably.

Any forest product labeling associated with a certified Forest must be guaranteed by a credible independent certification body that connects the labeled product to its certified forest- of-origin.

Equator Principles

As financiers and advisors, Equator Principles Financial Institutions (EPFIs) work in partnership with its clients to identify, assess and manage environmental and social risks and impacts in a structured way, and on an ongoing basis. Such collaboration promotes sustainable environmental and social performance and can lead to improved financial, environmental and social outcomes.

The Equator Principles are intended to serve as a common baseline and framework for financial institutions to identify, assess and manage environmental and social risks when financing Projects.

The Equator Principles apply globally and to all industry sectors. The principles are:

– Principle 1: Review and Categorization: When a Project is proposed for financing, the EPFI will, as part of its internal environmental and social review and due diligence, categorize the Project based on the magnitude of potential environmental and social risks and impacts, including those related to Human Rights, climate change, and biodiversity. Such categorization is based on the International Finance Corporation's (IFC) environmental and social categorization process. This categorization is the same of DFC's Environmental and Social Policies and Procedures – ESPP and PARACELS's forest project is classified as Category A.

– Principle 2: Environmental and Social Assessment: The EPFI will require the client to conduct an appropriate Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and scale of impacts of the proposed Project. The Assessment Documentation should propose measures to minimize, mitigate, and where residual impacts remain, to compensate/offset/remedy for risks and impacts to Workers, Affected

Communities, and the environment, in a manner relevant and appropriate to the nature and scale of the proposed Project.

- Principle 3: Applicable Environmental and Social Standards: The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan: For all Category A and Category B Projects the EPFI will require the client to develop and / or maintain an Environmental and Social Management System (ESMS).
- Principle 5: Stakeholder Engagement: For all Category A and Category B Projects the EPFI will require the client to demonstrate effective Stakeholder Engagement, as an ongoing process in a structured and culturally appropriate manner, with Affected Communities, Workers and, where relevant, Other Stakeholders.
- Principle 6: Grievance Mechanism: For all Category A the EPFI will require the client, as part of the ESMS, to establish effective grievance mechanisms which are designed for use by Affected Communities and Workers, as appropriate, to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.
- Principle 7: Independent Review: For all Category A an Independent Environmental and Social Consultant, will carry out an Independent Review of the Assessment process including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence and determination of Equator Principles compliance. The Independent Environmental and Social Consultant will also propose or opine on a suitable EPAP capable of bringing the Project into compliance with the Equator Principles, or indicate where there is a justified deviation from the applicable standards. The Independent Environmental and Social Consultant must be able to demonstrate expertise in evaluating the types of environmental and social risks and impacts relevant to the Project.
- Principle 8: Covenants: For all Projects, where a client is not in compliance with its environmental and social covenants, the EPFI will work with the client on remedial actions to bring the Project back into compliance. If the client fails to re-establish compliance within an agreed grace period, the EPFI reserves the right to exercise remedies, including calling an event of default, as considered appropriate.
- Principle 9: Independent Monitoring and Reporting: For all Category A in order to assess Project compliance with the Equator Principles after Financial Close and over the life of the loan, the EPFI will require independent monitoring and reporting. Monitoring and reporting should be provided by an Independent Environmental and Social Consultant.
- Principle 10: Reporting and Transparency: For all Category A:
    - ✓ The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online and that it includes a summary of Human Rights and climate change risks and impacts when relevant.

- ✓ The client will report publicly, on an annual basis, GHG emission levels (combined Scope 1 and Scope 2 Emissions, and, if appropriate, the GHG efficiency ratio12) during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually.
- ✓ The EPFI will encourage the client to share commercially non-sensitive Project-specific biodiversity data with the Global Biodiversity Information Facility13 (GBIF) and relevant national and global data repositories, using formats and conditions to enable such data to be accessed and re-used in future decisions and research applications.

3 DESCRIPTION OF PROJECT

3.1 Plantation Operations and Locations

PARACEL will acquire an area of approximately 190 thousand ha. The properties are reportedly on average 47% of Quite Natural Area (i.e. non-plantable) and 53 % of Modified Area (i.e. potentially plantable). Reportedly, that mainly pasturelands will be used as plantations, and the native forest and riparian areas will be retained and protected, which will amount to roughly 90 thousand hectares of conservation areas.

The PARACEL plantations range between 30 km and 150 km from the mill site.

The main purpose of these plantations is to provide wood to the pulp mill which is schedule to start operating in 2023.

The areas to be acquired by PARACEL will be managed by them and that are covered by this study are divided in 19 properties and are located on the regions of Concepción and Amambay, as per following figure and table.

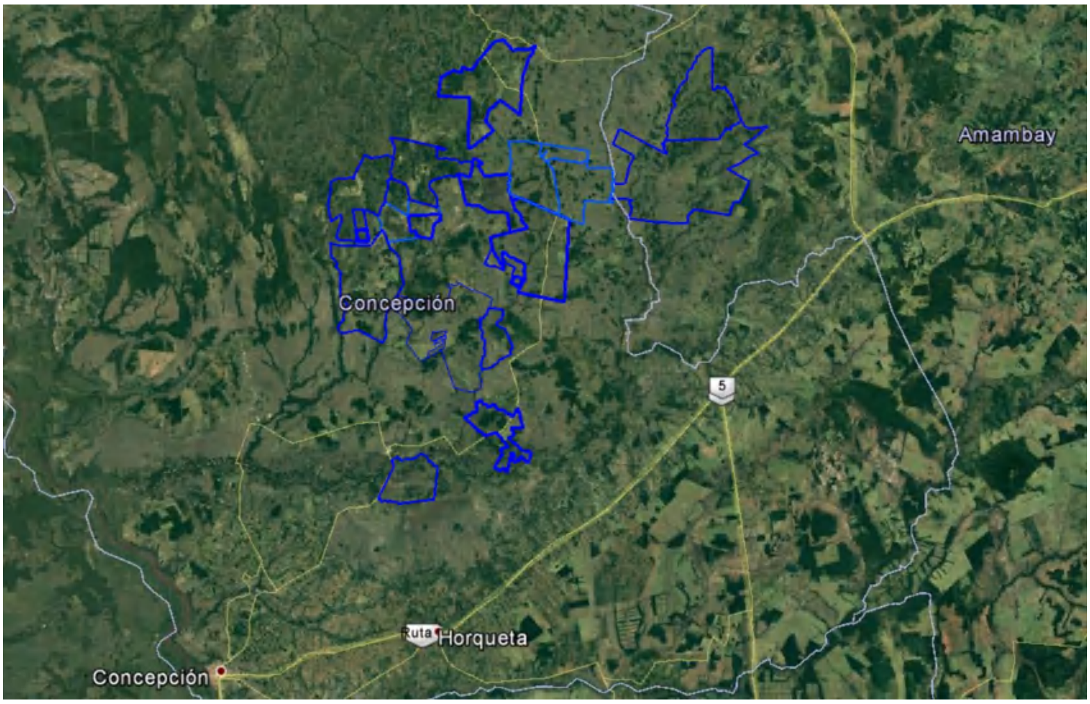


Figure 1 – Location of Forest Properties. Source: Google Earth, 2021.

Table 1 – Forest Properties

Abbrev.	Properties	Department	District	Surface (ha)
CR	Cristo Rey	Concepción	Loreto	6.747
GA	Gavilán	Concepción	Sgto. José Félix López	6.722
HE	Hermosa	Concepción	Sgto. José Félix López	14.978
IA	Isla Alta	Concepción	Concepción	556
LB	La Blanca	Concepción	Concepción	5.632
LP	La Paraguaya	Concepción	Sgto. José Félix López	4.221
MC	Machuca Cué	Concepción	Sgto. José Félix López	1.720
MN	Mandijú	Concepción	Concepción	4.074
RZ	Rancho Z	Concepción	Concepción	19.345
RO	Ronaldo	Concepción	Sgto. José Félix López	711
SL	San Liberato	Concepción	Sgto. José Félix López	18.502
ST	Santa Teresa	Amambay	Bella Vista	31.453
SI	Silva	Concepción	Concepción	1.210
SO	Soledad	Concepción	Sgto. José Félix López	10.115
TM	Trementina	Concepción	Sgto. José Félix López-Concepción	17.095
VS	Villa Sana	Concepción	Sgto. José Félix López-Concepción	17.179
WI	Willer	Concepción	Sgto. José Félix López	412
ZM	Zanja Moroti	Concepción	Sgto. José Félix López	11.213
ZA	Zapallo	Amambay	Bella Vista	12.889
TOTAL				**184.774**

Source: PARACEL, 2021.

3.2 History and status of the acquisition of the 20 estancias

Paracel's journey began with two companies, independent of each other, located on different continents, but sharing the same vision: to have a positive impact on society and to encourage an increase in demand for biodegradable products.

The Zapag group is a Paraguayan leader in the import and distribution of fuel. Always attentive to global and regional trends, the group saw an opportunity in the growth of products derived from pulp and decided to acquire land that was destined for forestation. The choice of these lands was made considering factors such as degraded land, soil suitability and good conditions for biological growth, logistics; and the possibility of providing work to thousands of people in the region.

Meanwhile, Girindus Investments is a group of companies based in Sweden, which has extensive experience in the research and development of the pulp business throughout its production chain: from sustainable forestation to producing pulp. In the search to expand the business in a competitive environment, Girindus was interested in participating in the development of a new project that met all criteria for a state-of-the-art sustainable pulp mill.

In this way, the combination of the vision of Zapag group and Girindus led to the creation of Paracel, a company that aims to build a world-class pulp mill in the Concepción region of Paraguay, through compliance with the highest sustainability standards and one of the most efficient logistics for regional and global markets.

Therefore, Paracel project was born with already some forest lands acquired. After that Paracel acquired some plantations areas from a company named EUCATEC S.A. In total 20 estancias were acquired, being 19 for eucalyptus plantation and 1 for the pulp mill site.

It should be noted that within Forestry Master Plan, Paracel counts with the land module which aims to allow the control of land acquisitions and leases made by the company. This includes stakeholders (broker, attorney, buyer, and sellers), payment control made individually for each of the sellers or lessees, and the control of the properties purchased or leased in each acquisition always prioritizing none people displacement.

3.3 Nurseries

PARACEL will contract nursery services to local producers, attending to the requirements of quality and technology in partnership with private nurseries. The PARACEL nursery project will be contracted in 2022. Currently, 100% of the seedlings used in the plantations are purchased from third parties. The purchase contract establishes the delivery standard for the seedlings.

3.4 Plantations

The eucalyptus varieties that PARACEL will require 6 years of growth prior to harvest (a 6-year rotation), with initial density varying from 1,200 to 2,300 seedlings per hectare. The ideal annual precipitation range is 1,000 – 1,400 millimeters (mm) with the precipitation occurring for eight months of the year.

Once in full production the PARACEL owned plantations are expected to provide around 80 percent of the PARACEL mill’s raw material needs, while 20 percent will come from local out-growers in Paraguay.

PARACEL plans to achieve FSC certification for all PARACEL owned plantations.

3.4.1 Soils

The forest project area and its direct influence zones are located according to the land use classification map below.

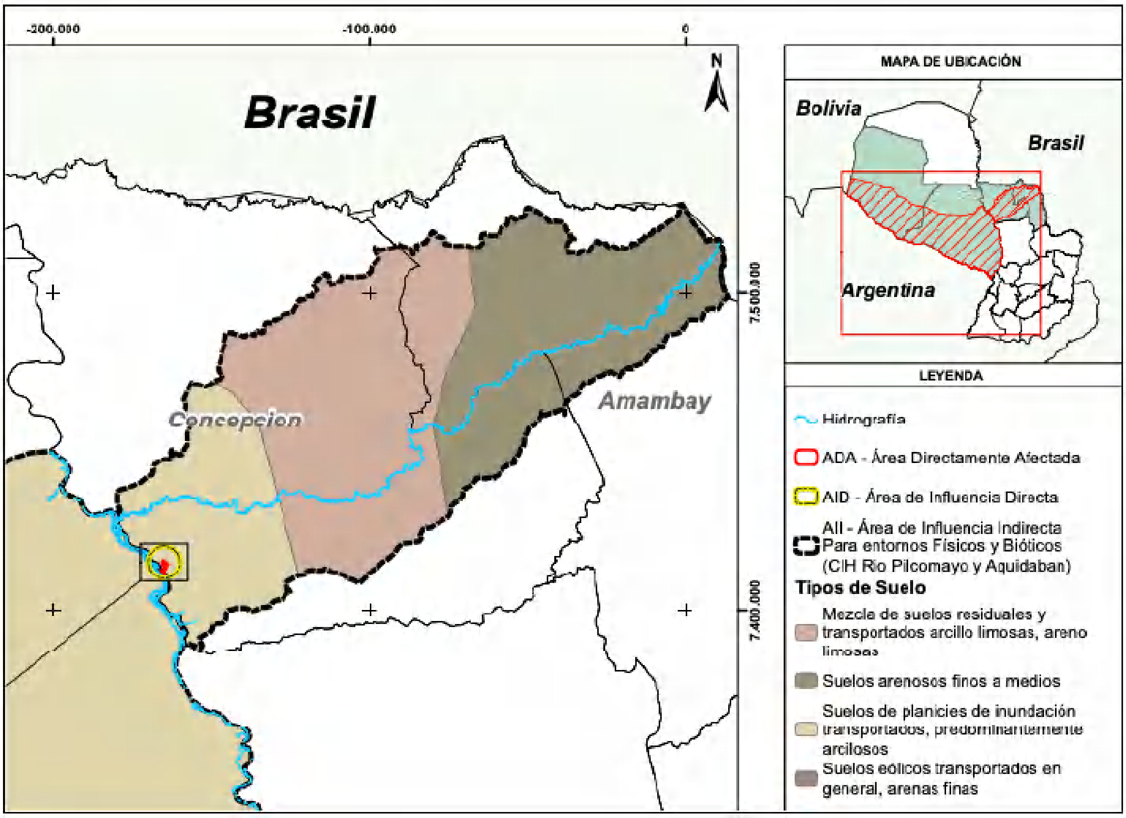


Figure 2 – Soil classification in the direct influence zone. Source: Pöyry

According to the classification of the land use capacity in Paraguay, PARACEL's forest areas are located in a region with predominance of Class VI soils (Figure 5).

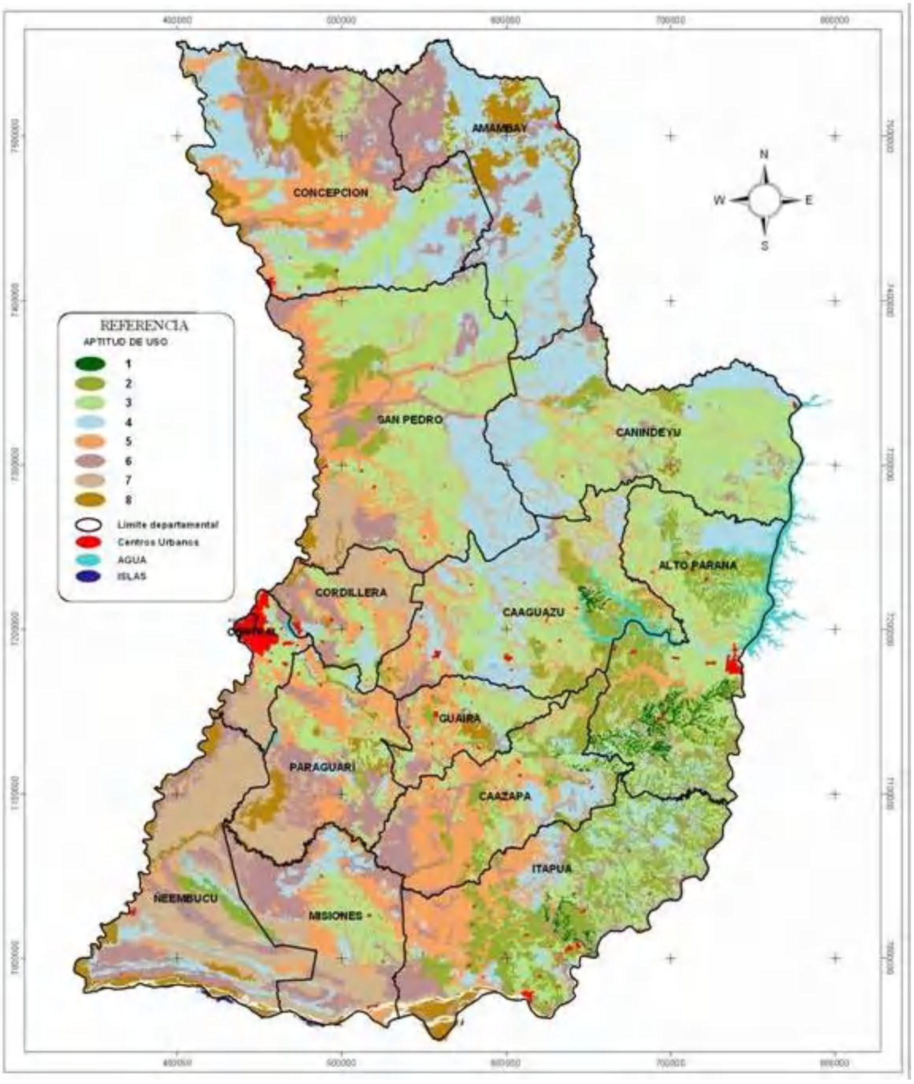


Figure 3 – Land use capacity in Paraguay. Source: Project of Rationalization of Land Use (PRUT)

These areas present inappropriate conditions to develop agricultural crops according to the department of soils from Paraguay. However, such areas are suited for forest plantations as forests are less demanding regard soils fertility and more resilient than agricultural crops.

3.4.1.1 Monitoring and Maintenance of Soil Fertility

Before each rotation, samples of the soil are taken to analyze the current deficiencies in terms of fertility. These results are used for the fertilization recommendations (quantities and time and sharing of application). With that, each soil unit has its own treatment.

For the first forest establishment, a first soil sampling must be carried out in order to identify the different types of soil in the farm. This activity happens only once, as the type of soil will not change over time, and this information will be used as an input to fertilization recommendation and management and conservation actions.

3.4.1.2 Erosion Control

The erosion management must be preventive, through soil conservation measures from the first establishment, aiming to avoid the start of erosive processes. Through this process, all soil preparation activities are reduced to a minimum, in order to avoid soil exposure. The preparation is done only on planting rows, and on steepest areas it is carried out perpendicular to the slope, seeking to avoid damages due to rainwater flow.

Erosion prevention actions must focus on the first years of plantation, when the soil is more exposed and susceptible to erosive processes. After a certain age, the canopy closes and helps reducing the impact of rainwater.

Some measures, however, must can be carried out during the whole planting cycle, in order to prevent the advance of erosive processes, particularly on internal roads. One of them is constructing small contour lines at specific spots on the roads, defined with the help of a topography team, to reduce the impact of rainwater flow. Those lines must be correctly positioned, perpendicular to the slope, with one or two water exits leading to the plantations.

The correct planning of roads can also minimize risk of damages to the soil. Road construction should, whenever possible, respect the slope of the terrain, in a way that the stands are divided in a fishbone shape. Road opening and maintenance should avoid

Other actions can be necessary depending on the area’s susceptibility to erosive processes, such as:

- Construction of roadside containment basins on the border of the stands;
- Long term monitoring, in order to identify and repair erosive processes while on initial stages;
- Identifying of water accumulation spots to construct contour lines;
- Identifying and repair silted contour lines;
- Identify and repair contour lines that have been damaged due to machinery traffic;
- Avoid compaction of contour lines to allow better water infiltration.

Monitoring of erosive processes must be carried out continuously, with the collaboration of all staff. All employees must be instructed to report any signs of damages to roads and stands and any other abnormalities that can lead to erosive processes. Such abnormalities must be registered in a specific document, as well as a schedule of actions to be taken, aiming at correcting the problem as fast as possible.

3.4.1.3 Maintenance of Organic Matter Cover

The maintenance of organic matter cover is important to avoid damages to rainwater impact and flow and to maintain the soil fertility. To maintain organic matter cover, is recommended that the maximum amount of forest residues be kept on the stands. This must be taken into account when planning the harvest operation, prioritizing harvesting systems such as cut-to-length.

Land preparation before each re-establishment must prioritize manual or mechanical sickle on planting row, leaving all vegetal remains in between the rows to protect the most sensitive areas and promote nutrient cycling. Harvesting residues can also be chipped and distributed evenly on the stand. Burning of residues should be avoided, as it removes the organic matter cover and reduces the soils fertility in the long term.

In case harvest residues are to be removed from the stands for commercialization or use as energy source, the fertilization recommendation must be revised.

3.4.1.4 Soil Contamination

All operations must be carried out in compliance with measures to prevent the risk of soil contamination.

Machinery fueling and maintenance in the field must attend to at least the following preventive measures:

- A distance of 100 meter from protected areas and water flows must be respected;
- Fueling must only be carried out over a containment structure with sawdust, aiming to avoid spilling of fuel on the soil;
- Before any activity of maintenance and fueling of machinery, the soil must be covered with an waterproof cover, to avoid the contact of oils and fuels with the soil.

Besides that, any container of chemical product that needs to be in the field, such as chainsaw oil, must be kept inside a containment structure to avoid contamination. Also, contaminated material such as gloves, tows and machinery parts must never be placed in direct contact with the soil.

Any kind of residues generated on field operations, especially hazardous residues, must be disposed of correctly.

In case of accidents that can result in soil contamination, such as leaks of fuels, oils and pesticides, the following steps must be carried out:

- Isolate the place;
- Report the accident to the headquarters;
- Locate the Emergency Kit;
- Contain the leaking by constructing barriers or ditches, stopping it from spreading and contaminating water bodies;
- Protect the soil by placing a canvas under the machinery or equipment;
- Scatter sawdust or sand through the affected place to absorb the leaking product;
- Remove the contaminated soil, using a shovel or hoe, and put it inside identified plastic bags or drums;
- Forward the contaminated material to a company specialized in the treatment of this kind of waste;
- Request external support from specialized company, if necessary;
- Evaluate the contamination of soil and water.

3.4.2 Water Usage

The water will be obtained from small dams (deposits with water accumulation used in cattle rising) and, in some cases, from artesian wells.

The location where those dams and wells will be located and the estimate water volume is still not defined, but Paracel will perform studies and get the duly authorizations not to cause impacts on the aquifer and its users.

It should be noted that there are already 14 wells for groundwater uses in the plantation. The current location of the wells are presented at the table below.

Table 2 – Existing wells

No.	Site	ID	Depth (m)	Coordinates (UTM WGS84 Zone 21K)	
				E (m)	S (m)
1	Trementina - Central	GW10	60	516254	7484946
2	Trementina – R. Michel	GW11	115	518643	7484801
3	Trementina – R.Laguna	GW12	65	516419	7478307
4	Trementina – R. San Juan	GW13	70	509767	7486076
5	Zanja Moroti	GW14	102	493064	7499176
6	Soledad	GW15	107	483316	7497562
7	Gavilán	GW16	97	505125	7498320
8	La Paraguaya	GW17	NDA (*)	489833	7492572
9	Zapallo	GW18	NDA	548201	7512128
10	Hermosa	GW19	NDA	512695	7515558
11	Santa Teresa	GW20	NDA	537999	7498476
12	Machuca Cue	GW21	NDA	495202	7489899
13	Silva Cue	GW22	NDA	509830	7484037
14	San Liberato	GW23	NDA	516367	7503054

Source: PARACEL, 2021. (*) NDA: No Data Available

Enclosed is water consumption estimate by age/operation activities. This estimate only refers to direct consumption according to the planned operations. Potential consumption related to fire control or nurseries are not included. According to this estimate:

- Year zero (plantation): 5.3 m^3/ha
- First year: 0.24 m^3/ha
- Second year: 0.24 m^3/ha
- Third to sixth year: no water consumption

3.4.3 Energy Usage

The afforestation activities will require electricity only for the domestic and administrative activities that will take place in the building infrastructure of the ranches. For this, the electrical energy available through the existing national network will be used. No new transmission or distribution lines will be required, or an increase in the power supplied.

3.4.4 Inputs, Agrochemicals, Fertilizers and Pesticides

In compliance with the FSC policy on use of Highly Hazardous Pesticides - HHP (SC-POL-30-001 V3-0), PARACEL will exclude the use of all hazardous pesticides that contain or main contain active ingredients listed as prohibited by the FSC.

The HHP listed by the FSC as highly restricted can be used when there's no viable alternative methods, evidenced by analysis of costs, risks and social and environmental impacts.

The HHP listed by the FSC as restricted can be used as an auxiliary method to non-chemical treatments, subject to exhaustive analysis of environmental and social risks for the active ingredient to be used.

At the operational level, at first, the highly hazardous pesticides are identified as prohibited, of highly restricted use or of restricted use, due to their hazardous level. When the integrated pest management identifies the necessity of using a chemical pesticide as the last resource, an evaluation of social and environmental risk must be carried out on different levels to identify the nature and level of risk, as well as to define mitigation measures and requirements for impact monitoring.

PARACEL's policy on the use of pesticides highlights the importance of repair and compensate the damages that have been potentially caused to environmental values and the human health, as well as the importance of monitoring the use of pesticides and the impact of the policy itself.

PARACEL will make efforts to investigate the products and control methods of weeds in order to diminish the use of HHP with a view to their complete eradication. Any HHP to be used will present legal registration with the competent authorities.

The general list of forest inputs is presented in the following table.

Year	Activity	Forest inputs	Unit	Dose	Surface 2021 (ha)	Total quantity
Year 0	Ants combat – pre plantation 1	Cebo - Formirex Plus	kg	2,5	18.000	45.000
Year 0	Post Emerging herbicidal application – total area	Glyphosate 79,2%	L	2,7	18.000	48.600
Year 0	Liming application – total area	Dolomitic agricultural lime	t	1,5	18.000	27.000
Year 0	Gypsum application – total area	Gypsum	t	0,5	18.000	9.000
Year 0	Base fertilization	NPK (12-20-16)	t	0,4	18.000	7.200
Year 0	Ants combat – pre plantation 2	Cebo - Formirex Plus	kg	2,5	18.000	45.000

Year	Activity	Forest inputs	Unit	Dose	Surface 2021 (ha)	Total quantity
Year 0	Pre-emergent herbicide application in line 1	Isoxaflutole	L	0,2	18.000	3.600
Year 0	pH regulatory adherent 1	Vegetable oil and pH regulators	L	0,35	18.000	6.300
Year 0	Planting with forest hydrogel	Stockosorb	kg	3,5	18.000	63.000
Year 0	Planting clone seedlings	Seedings	unit	1313	18.000	23.625.000
Year 0	Pre-emergent herbicide application in line 2	Isoxaflutole	L	0,2	18.000	3.600
Year 0	pH regulatory adherent 2	Vegetable oil and pH regulators	L	0,35	18.000	6.300
Year 0	Pre-emergent herbicide application in line 3	Isoxaflutole	L	0,2	18.000	3.600
Year 0	pH regulatory adherent 3	Vegetable oil and pH regulators	L	0,35	18.000	6.300
Year 0	Ants combat – post plantation 3	Cebo - Formirex Plus	kg	1,5	18.000	27.000
Year 0	Pre-emergent herbicide application between row	Glyphosate 79,2%	L	1,5	18.000	27.000
Year 1	Cover fertilization	NPK Cover 1 (10-00-30 + 4%S + 0,7%B)	t	0,23	18.000	4.140
Year 1	Ants combat – post plantation	Cebo - Formirex Plus	kg	1,5	18.000	27.000
Year 1	Cover fertilization	NPK Cover 2 (00-00-54 + 1%B)	t	0,18	18.000	3.240
Year 2	Ants combat – post plantation	Cebo - Formirex Plus	kg	1,5	18.000	27.000
Year 3	Ants combat – post plantation	Cebo - Formirex Plus	kg	1,5	18.000	27.000
Year 4	Ants combat – post plantation	Cebo - Formirex Plus	kg	1,5	18.000	27.000
Year 5	Ants combat – post plantation	Cebo - Formirex Plus	kg	1,5	18.000	27.000
Year 6	Ants combat – post plantation	Cebo - Formirex Plus	kg	1,5	18.000	27.000

Source: PARACEL, 2021.

Notes: 1) common name, active ingredient, type, use, WHO and FSC classification to be detailed; 2) Alternatives substitution of Glyphosate to be evaluated

3.4.4.1 PARACEL's Pesticide Policy

In alignment with FSC's pesticide policy, PARACEL has the following short term objectives:

- Promote the best practices in order to minimize risks to human health and the environment when using chemical pesticides;
- Reduce the volume and total number of pesticides in use;
- Eliminate the use of highly hazardous pesticides.

<u>In the long term, PARACEL aims at complete eliminating the use of chemical pesticides in its management units</u>.

This policy applies to all PARACEL's operation areas and to all organization, work groups and entities that provide services that can make use of pesticides inside PARACEL's management areas, aiming to protect the natural vegetation, the human health and the native species. It includes all facilities and surfaces:

- Located inside or adjacent to the areas under PARACEL's valid title or control, or operated by, or on behalf of PARACEL, in order to contribute to the management activities; and
- Located outside or in non-adjacent areas to those aforementioned areas, operated by PARACEL, or on behalf of PARACEL, in order to contribute to the management activities.

3.4.4.2 Integrated Pest Management

The integrated pest management must be based in a adequate monitoring system, allowing the identification of infestations, their geographic distribution and the pests population density. In a wider sense, the monitoring program must identify the variables of interest for identification of infestations and the actions to be taken for infestations control.

A pest control program consists on the application of ecologically acceptable measures, based on the monitoring results, such as biological, cultural, genetic and mechanical measures, aimed at eliminating or reducing the necessity of chemical control.

Silvicultural control actions are part of site preparation techniques aimed at removing weeds and residues that serve as shelter and feeding and reproduction sites for different kinds of pests. Also, post-planting silvicultural measures are also important, as keeping the seedlings and trees healthy reduces the susceptibility to pest attacks. Thus, good silvicultural practices such as weed control, residues management, soil preparation, correct planting, irrigation and fertilization, when correctly undertaken, help reducing the risks of infestation.

Genetic measures consist of planting genetic material that is resistant of pest attacks. Nowadays, there are several genetic improvement processes being carried out in view of increasing natural resistance. Paracel will accompany these processes in order to always select the best genetic material available taken into consideration the benefits for the Integrated Pest Management.

3.4.4.3 Training

- All workers involved with the use of agrochemicals, whether permanent, temporary and/or third-parties, must have the proper training;
- The training must cover basic and priority topics, such as: good practices for the use of agrochemicals; correct application and elimination of agrochemical residues; correct use of PPE; basic toxicological concepts; route of entry into the body, signals and symptoms of intoxication and first aid, etc.;
- The organization must keep records of all trainings in a spreadsheet intended for that use, with a copy attached to each trained employee.

3.4.4.4 Choice and Purchase of Pesticides

- PARACEL will use only pesticides recommended to the detected pest or weed, registered, approved and permitted by the competent authority (SENAVE), and in compliance with all ratified international conventions (Rotterdam, Stockholm, Montreal, etc.);
- The use of certain active ingredient, as well as the doses to be used, must be previously authorized by the forest manager, and must comply with the process of Environmental and Social Risk Assessment to be elaborated, following the FSC policy on the use of pesticides;
- The products to be used must be selective and have minimum impact on the population of beneficial organisms and aquatic life, as well as not be harmful to the ozone;
- It is recommended not to buy any products close to their expiration date, unless their immediate use is planned.

Paracel will also comply with WHO Recommended Classification of Pesticides and IFC Guidelines for Perennial Crop Production specifically:

- Will ensure that any pesticides used are manufactured, formulated, packaged, labeled, handled, stored, disposed of, and applied according to the FAO's International Code of Conduct on Pesticide Management;
- Will not purchase, store, use, or trade pesticides that fall under the World Health Organization's (WHO) Recommended Classification of Pesticides by Hazard Classes 1a (extremely hazardous) and 1b (highly hazardous), or Annexes A and B of the Stockholm Convention;
- Will not use pesticides listed in WHO Hazard Class II (moderately hazardous), unless the project has appropriate controls established with respect to the manufacture, procurement, or distribution and/or use of these chemicals. These chemicals will not be accessible to personnel without proper training, equipment, and facilities in which to handle, store, apply, and dispose of these products properly;
- Preferentially, Paracel will use selective pesticides, where appropriate, rather than broad-spectrum products to minimize impacts on non-target species.

3.4.4.5 Security Information for Purchases

- The supplier is responsible for complying with local regulations related to safety information and therefore for providing such information to the buyer;
- When buying/receiving a product, this product must contain the "Safety Sheet". If not provided by the supplier, the person responsible for the purchase must request the Safety Sheet of the product.;
- The company must keep records of all copies of the safety sheet of each product for use in the pesticide storage building. These copies will be kept for as long as the product is stored or in use.

3.4.4.6 Storage

- All storage facilities and containers intended for agrochemical storage will be used only for that purpose, and their basic characteristics will be in compliance with the recommendations from FAO and the competent authorities in Paraguay (SENAVE), other than being in line with WHO and Perennial crop production guidelines by IFC;
- The storage room must be kept in good conditions, protected from adverse climatic phenomena, the entry of animals and unauthorized people;
- The access to the storage room must be restricted. The door must be always locked, with key available only to authorized personnel;
- Signaling: the storage facility must be identified with the proper safety signs, indicating the storage of agrochemicals and the restricted access. The inside of the facility must contain signs indicating the prohibited activities (such as smoking, eating and drinking) and the obligation to wear PPE while inside. The location of safety elements such as absorbent materials and fire extinguishers must be marked;
- The labels of the products must be always visible to facilitate identification;
- Powders, granules and wettable powders must be stored in cardboard boxes, just like concentrated preparations;
- Maintain the stacking of boxes to a minimum, according to each product's specifications;
- Expired products must be stored separately from other products, in a visible and identified place, until their disposal, which will be carried out based on a plan of disposal of expired products. These products will be deleted from the inventory data only after their final disposal;
- The products should be maintained in their original package. In case of fractionation, the new container must be clearly identified, avoiding the use of containers that can lead to confusion, such as those from beverages, medicines or food;
- The following recommendations must be followed in order to avoid leaks or accidents: 1) Products stored in bags, drums and plastics must be stored on pallets, never in direct contact with the floor. 2) Liquid products must be stored separately from powdered products; if that's not possible, powdered products must be stored on the upper shelves and liquids on the lower shelves. 3) Products

with hard containers must always be in an upright position, with their lids or openings facing up;

- The storage facility must contain: 1) fire extinguisher in good conditions, located in visible and identified places, with easy access. The use of ABC dry chemical fire extinguishers is recommended. 2) Absorbent materials, in case of leaks, like sand or sawdust buckets in sufficient quantities, visible and marked, as well as elements to collect spilled product (broom, scoop and waste container);
- The quantity of stored agrochemical must be kept to a practical quantity, just enough to cover the demand peak. The products must be organized in a way that allow the oldest products to be used first, thus avoiding the expiration of the products;
- There must be a record of all stored products in a product inventory worksheet, allowing the following data to be identified: product identification (commercial name, common name, active ingredient), date of entry, expiration date, toxicological classification, quantity delivered and remaining quantity.

3.4.4.7 Local Transportation

- The contractors must specify a person who will be responsible for the removing the products from agrochemical warehouse and transport them to the places of application;
- Products must be transported exclusively, that is, they must not be transported with other products. The vehicle must have the driver’s cabin separated from the cargo area, which, in turn, must have adequate ventilation and containers for the storage of products;
- Products must be stacked in the vehicle in an orderly manner, making sure that fragile containers will not be crushed;
- The load must be distributed evenly in order to avoid displacement and/or bumps;
- The liquid products must be placed below those of powder or granules formulation;
- Liquid products must be transported with the top upwards and must not be submitted to excessive load pressure;
- Containers made of paper, cardboard or other water-soluble products must be protected from the rain or bad weather with a waterproof cover;
- Small containers must be placed inside bigger waterproof containers.

3.4.4.8 Application

- Before the application, check the availability of personal protection equipment, and if they are adequate for that use (gloves, filter masks, protective clothing, boots, aprons, goggles, etc.;
- The forestry coordinator and field assistants are responsible for supervising the preparation of mixtures according to the dosage, surface and products to be

applied. The indications issued by the technical manager must be recorded through Service Orders;

- Field workers must prepare and load the mixture into the sprayer tractor (uniport) or manual sprayers (backpack sprayer) very carefully. The workers responsible for making the mixtures must be trained for the job;
- Before dosing, the container label should be read carefully and the product manufacturer's instructions must be followed. The mixtures should be prepared outdoors, away from living areas. The containers must be opened carefully, avoiding splashes or spills on the body. Safety measures must be taken to prevent contamination of soil and water sources;
- The preparation of the mixtures must be carried out on a smooth, waterproof surface, not directly on the ground. In cases where there are no waterproof floors for the preparation, the mixtures must be carried out inside containers to avoid losses and small spills. All items used for the preparation must be used solely for this purpose;
- Before application, the operator must check the correct operation of the backpack sprayers, if the nozzles are clean and without obstructions and if there are any leaks in the hose. Nozzles must be cleaned with a suitable brush;
- Before, during and after the application, the person responsible for this task must adopt the necessary precautions for protection against intoxication risks, whether due to direct or indirect exposure. Likewise, precautions must be taken to avoid the contamination of soil, water and natural vegetation;
- Application must be carried out following the established use recommendations, respecting the direction and speed of the wind, as well as temperature and humidity. Unfavorable atmospheric conditions are: high temperature (above 32 ºC), relative humidity below 60% and wind speed above 10 km/h;
- A 100 meter protection range must be kept between the application area and all human settlements, educational centers, health units, squares, places of public attendance and all water courses;
- There must be no other people working in the area where application is being carried out;
- It is strictly forbidden to eat, drink or smoke while handling and/or applying the product;
- In cases where there is a surplus of the applied solution, the elimination must be carried out by applying it to fallow land, ensuring that the doses do not exceed what is allowed. Under normal circumstances there should be no surplus. If the application will continue the next day, the backpacks must be kept in a protected place.

3.4.4.9 Equipment Washing

- The equipment used for the application must be washed rigorously and immediately after use in the same area of application;

- The clothing for the application must be washed on piece at a time, separately from the rest of the personal clothing. Workers must not take contaminated clothing or PPE to their home;
- The water used to wash the equipment must be disposed of in authorized laundries at the PARACEL plant, in septic chambers with activated carbon filters. This water must never be disposed of near homes, corrals, sheds or in canals, streams or other water sources;
- All personnel involved in the dosage and application specifically with backpacks must shower at the end of the application day, using specific shower facilities intended for that use, with a sufficient supply of water.

3.4.4.10 Elimination of Pesticide Packaging

- The elimination of pesticide packaging must be carried out according to the waste management policy.

3.4.4.11 Personal Protection

- The use of protection equipment is mandatory for all personnel involved with agrochemical handling. These PPE must be provided to the workers by the employer. Records of the provision of such equipment must be kept at the disposal of each contractor. The use of PPE must be monitored;
- Each contractor must provide the necessary PPE in good condition, as well as training in PPE use. Those equipment must be renewed according to the necessity;
- It is mandatory for the personnel who handle agrochemicals to correctly use the PPE;
- PPE include work clothes, gloves, goggles, masks with activated carbon filters, safety shoes, etc. The use is exclusive for the activity, always respecting the indications for each product and activity;
- PPE must be kept clean and preferably hung up, in a ventilated, clean, cool and dry place, protected from heat and sunlight, and intended only for this purpose. PPE should not be stored in the agrochemical storage;
- Face shields or masks must be cleaned with a bactericidal agent. After cleaning, they must be stored in their original bags;
- The frequency of replacement of filters in respiratory protection equipment depends on the airborne concentration of the toxic agent (exposure). In case of repeated exposure, the filters must be replaced when the worker perceives resistance during inhaling or change in the color of the filter.

3.4.4.12 Emergency Actions

- In case of contact with agrochemicals, wash the affected area with plenty of water and soap. For products coded with toxicity grade II, seek medical assistance. Any accident related to the use and handling of agrochemicals must be reported to the health and safety manager, who will carry out the corresponding record and the pertinent actions;

- Emergency telephone numbers must always be available in a visible place, including the numbers of the nearest hospital, health centers, fire department and institutions from which to request assistance, such as SENAVE, poison control center, product suppliers.

3.4.4.13 Product Spills and Losses

- In case of spills or loss of products, the contaminated area must be isolated;
- PPE must be used before carrying out any decontamination actions;
- Sufficient absorbent material must always be available in identified containers, as well as cleaning materials (broom, shovel, etc.);
- The spilled product must be absorbed with recommended material (sawdust or sand). This action must follow the procedure for spilling in the product sheet;
- Solid products must be carefully swept, trying not to raise the product's dust, and mixed with sand to reduce the product's toxicity;
- The waste must be placed in containers intended for that use. The manufacturer must be contacted to enquire about the final destination of the product. In the meantime, it must be kept safely stored in the adequate storage facility;

3.4.4.14 Considerations on Fipronil Use

- In forest plantations, leafcutter ants are considered as one of the most damaging pests, particularly in South America, due to their resistance and adaptability to different ecosystems. Currently, the only known efficient way of dealing with leafcutter ants is the application of Fipronil based products;
- The use of Fipronil is permitted by local legislation and it's currently categorized as a Restricted Use product within the FSC Highly Hazardous Pesticide List. As so, its use is not prohibited;
- The product is applied only in a timely and localized manner, by backpack sprayers, at the beginning of forest plantation. Depending on the level of infestation, its dose is gradually reduced, being substituted by other products such as Sulfluramide;
- The impacts on the use of both Fipronil (in any of its formulations) and Sulfluramide will be fully evaluated in the environmental and social risk assessment, to be developed.

3.4.4.15 Quality Assurance

- Monthly verification of the status of the PPE used by all contractor personnel must be carried out, and the findings must be registered in the PPE Evaluation Record Sheet – Contractor Personnel;
- The agrochemical storage infrastructures, their handling and the proper management of empty containers must be subject of monthly verifications;

The following parameters are to be monitored:

- Verify that the agrochemical storage facilities are tidy, have drainage routes, waterproof floor, ventilation, pits for cases of spillage, cleaning equipment, septic chamber, fire extinguishers, sand/sawdust buckets, basins to contain spillage, emergency showers, changing rooms, first aid kits and antidotes;
- Verify that the empty container storage is tidy, has a waterproof floor and is ventilated;
- Control of empty containers that have gone through triple-rinsing and puncture process;
- Verify that other work tools, fire fighting equipment, fuels, oils and other products and equipment are not being stored in the agrochemical storage facility;
- Control of the registration of expiration date of products at the time of delivery and the updating of the stock sheet;
- Verification of fire extinguishers – location, expiration date, accessibility.

3.4.5 Labor Force, Worker Accommodations and Labor Structure

PARACEL is in the early stages of construction and pre-operation planning. It is estimated that the forestry area will generate approximately 3 thousand jobs, between own contractions and outsourcing, during all the steps of the project – feasibility, construction/implementation, implementation and pre-operation, operation-learning curve and operation.

PARACEL's policy on human resources prioritize the employment of local or national workforce as the first and second options respectively over foreign labor.

PARACEL's program on developing and hiring local workforce aims to provide job creation to the local community through hiring and training both qualified and unqualified workforce in the project's area of influence. One of the measures Paracel is undertaking to achieve that goal is the development of partnerships with education institutions related to the Ministry of Labor, in order to promote training and qualification courses to local communities.

Moreover, PARACEL's hiring policy aims to provide equal opportunities for men and women, promoting equality in hiring, remuneration and promotion.

Table 3 – Project's workforce

Source	Feasibility	Construction / Implementation	Implementation and Pre-Operation	Operation – Learning Curve	Operation
PARACEL	15	35	45	50	50
Outsourced / Third Party	255	1,300	2,500	2,700	3,000
Total	**270**	**1,335**	**2,545**	**2,750**	**3,050**

Source: PARACEL, 2021.

It is expected that the accommodations for forest workers will be temporary, modular structures that mobilize following project work fronts. The details about their location and the quantity of modular structures needed will take place with the plantation contractors. These structures will be designed to accommodate 50 to 100 worker. The design, construction, and maintenance of these worker accommodations would be responsibility of future plantation contractors, but PARACEL will supervise to assure the accommodations meet the Applicable Standards (including 'Workers' Accommodation: Processes and Standards, A Guidance Note' by IFC and the EBRD, 2009). Once details are confirmed, the plantation ESIAs' social baseline will reevaluate impacts related to worker influx and workers accommodations.

As a primary estimate, between 10 and 20 modular structures would be in place simultaneously during the initial planting period (6 years), an amount that may reach some 30 when the harvest period begins.

The detailed layout and design of the accommodation facilities will be the responsibility of each contractor, according to the following general criteria (as a minimum):

- Accommodations must be located to avoid flooding and other natural hazards, and the site must be adequately drained;
- Living facilities must be built with adequate materials, provided with adequate ventilation and illumination (both natural and artificial), kept in good repair and kept clean and free from rubbish and other refuse. Minimum density standard is 10 m^3/resident (volume) and 4 m^2/resident (surface). A separate bed (with mattress, pillow and cover) for each worker and separate sleeping areas for men and women must be provided;
- Facilities for the storage of personal belongings for workers must be provided;
- Cooking and canteen facilities must be provided, adequately furnished. Minimum density standard is 1 m^2/worker. Kitchen must be provided with facilities to maintain adequate personal hygiene including a sufficient number of washbasins designated for cleaning hands with clean, running water and materials for hygienic drying;
- Sanitary facilities must be located within the same buildings group, and must be kept clean and in good repair. Minimum density standard is 1 unit to 15 workers. Facilities must be provided separately for men and women;
- Adequate facilities for washing clothes must be provided. Work clothes used in contact with agrochemicals must be washed in special laundry facilities which could be provided by Paracel;
- Free potable water must be always available to workers. Drinking water quality must meet the National Standard *NP 24 001 80*;
- Facilities for waste discharge must be provided. Waste must be managed according to *PR-SA-F02 Comprehensive Waste Management Program*.

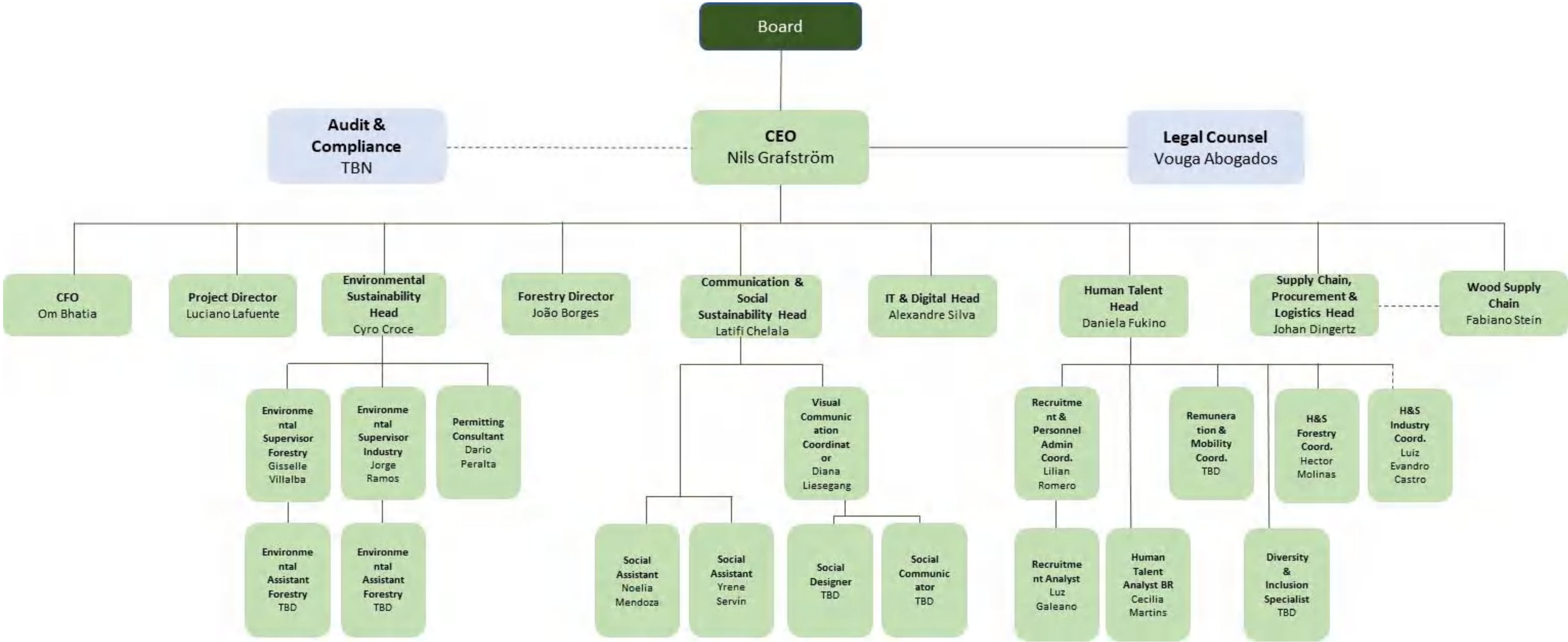


Figure 4 – PARACEL's labor structure. Source: PARACEL.

3.4.6 Species

The following Eucalyptus species will be prioritized by PARACEL for market purchase: E. urograndis, E. grandis, E. dunnii, and E. saligna. Other Eucalyptus species, such as E. camaldulensis and hybrids of E. urophylla, will be considered depending on the market availability.

For PARACEL's own plantations and third parties in Paraguay, hybrids of E. urophylla will be prioritized, especially E. urograndis.

As the area is a new frontier for Eucalyptus plantations, the selection of suitable species and genetic material will be based on a long term project, based on the species and genetic material that better adapt to edaphoclimatic environment and meet the mill requirements in terms of pulpwood supply.

The use of Eucalyptus species is justified by their high productivity, which is expected to be around 30-40 m^3/ha/year, according to data from similar regions in the state of Mato Grosso do Sul, Brazil. Eucalyptus plantations currently cover roughly 100 thousand hectares in Paraguay.

3.4.7 Land Preparation

3.4.7.1 Soil Preparation

The main objective of preparing the area and soil for planting forest species is to provide sufficient amounts of water and nutrients as quickly as possible for the establishment of seedlings, ensuring their fixation on the ground and avoiding future falls. In summary, the activities of soil preparation and its applied techniques, in addition to seeking the rapid growth of the root system from the overturning of the soil, facilitating the absorption of water and nutrients, also eliminate undesirable weeds, contributing to the management of weed competition (GATTO et.al., 2003).

Tillage is also a technique that contributes to increasing forest productivity, since most of the cultural residues are kept on the soil surface, ensuring the maintenance of organic matter on the soil, protecting it from the impact and speed of rainwater, conserving soil moisture and improving soil fertility and soil micro and mesofauna (PAES et.al., 2013).

Of all the different options and techniques used for soil preparation, subsoiling in the planting line has been one of the most consolidated ones in the forest environment, since it directly benefits the development of the root system of plants and also presents operational advantages due to greater work capacity, resulting in economic advantages due to its lower cost (PAES et.al., 2013 apud DEDECEK et.al., 2007).

In the case of the Concepción region, climatic variations are observed throughout the year, mainly rainfall, which alter the ideal humidity conditions for soil preparation, especially concerning the peak moments of deficit and water surplus. Soil preparation during periods of peak of water deficit may result in the formation of cracks and clumps, which generate an inadequate condition for planting due to the formation of air bags, empty spaces without soil. Those air bags impair the survival of seedlings right after planting and/or prevent the proper development of the root system. In the period of peak and excessive rainfall, the soil becomes soaked, which can hinder mechanized activities and produce inadequate soil preparation by only scratching the soil, since the subsoiler stem does not find enough strength to turn the soil.

To minimize the effects of drought and rain peaks throughout the year, it is recommended that soil preparation be carried out during the transition periods from rain to drought and vice versa, concentrating activities on the windows from February to August and enabling plantations throughout the year, in times of milder temperatures.

Due to the characteristics of the soil in the region, the structure and stages of soil preparation activities, the following sequence is recommended:

- 1st Harrowing: to revolve the layer of the superficial structure of the soil, reducing the sub-superficial and superficial compaction;
- 2nd Harrowing: when necessary, it has the function of removing soil clumps and leveling soil surface;
- Deep soil preparation: the activity begins with subsoiler or ripper, preparing the soil to depth of 50 to 60 cm, for subsoiler, and up to 1 m if the ripper is used. The ripper is recommended on soils that have a deep impediment layer, and its use is intended to help better anchor the roots in depth for better root development and tree stabilization.

Soil preparation activities are activities that establish planting spacing, that is, spacing between planting lines. In this sense, it is recommended to use machines equipped with GPS or similar equipment, also known as "automatic pilot" that guide the correct demarcation of the planting lines.

3.4.7.2 Fertilization

In addition to good preparation and establishment of planting and adequate choice of spacing, fertilization is yet another extremely important pillar in forest productivity, being responsible for significant gains in increasing the volume of wood (SANTANA et. Al., 2008).

The decision for any fertilization should always be based on economic and technical criteria. The strategy of a fertilization program consists of knowing the soil, its physical and morphological chemical characteristics, in short its pedology, as well as the characteristics of the growth curve of the genetic material to be planted, its potential productivity and nutritional demand to support the expected yields.

The knowledge of the growth phases and rainfall distribution are fundamental to determine the fertilization operations, since the use of the fertilizer by the plant depends on its nutritional demands, as well as the availability of water in the soil to make nutrients accessible to the seedlings, that is, soil conditions and their portion explored by the roots.

The knowledge of the nutrient balance is also essential for the sustainability of forest production, which reinforces the need for adequate long-term management strategies. Thus, it is necessary to have knowledge of the relationship between the amount of nutrients that are exported and the bioavailability of nutrients at the place of cultivation, in order to be able to apply techniques aimed at sustainable forest management for several rotations (SANTANA et. Al., 2008).

Fertilization in general has the basic NPK formulation, which represents the main primary macro nutrients: Nitrogen, Phosphorus and Potassium. The NPK formulation can contain different combinations of concentration of these 3 elements, in order to meet the needs of each plant, according to its stage of development and soil fertility.

Nitrogen (N) is the component of greatest importance for the initial growth, as it is present in the composition of the most important biomolecules, such as ATP, NADH, NADPH, chlorophyll, proteins and numerous enzymes (BREDEMEIER & MUNDSTOCK, 2000 apud MIFLIN & LEA, 1976; HARPER, 1994). This way, this is the most important nutrient for the first fertilization, carried out before planting. Phosphorus (P) is also essential for the initial growth, as it is directly related to energy storage and root formation. In turn, potassium (K) has direct responsibility for the development of plant tissue and assists in resisting water deficit by regulating the functions of opening and closing the stomata of the leaves, which in turn regulates the "loss" of water by plants.

Therefore, for the first fertilization, a higher dosage of N and P is recommended to guarantee the initial development of the plant, while in following fertilizations K becomes the key component in the growth and health of more adult plantations.

In general, the practice of fertilization depends on technical and economic factors, with the most important phase of fertilization occurring in the first phase of forest development. Fertilization needs constant technical and scientific development for its improvement and must be adjusted to the needs of the planted genetic materials taking into account the characteristics of the soil, the nutritional efficiency of the fertilizers, growth curve, potential productivity, the type of harvest and management waste.

Taking into account all the growth assumptions, the genetic materials available and the soils, which for the most part can be characterized as dystrophic, the fertilization specifications are shown below, as recommended by Innovatech. It is emphasized that the recommendation should be adjusted to the extent that more specific information on the soils of the properties is analyzed and known.

Table 4 – Fertilization recommendation

Type	Period	Product	Dose (kg/ha)	Application	Location	Observations
Liming	Up to 6 months before or after planting	Dolomitic Limestone (CaO24%, MgO12%, PN 70, PRNT=70)	1,500	Full area	Over the soil	
Gypsum application	Up to 6 months before or after planting	Gypsum	500	Continuous strip near plant canopy	Over the soil	
Plantation	Up to 5 days before planting	NPK 12:20:16 + 0.4% B; 0.4% ZN; 0.4% Cu	450	Continuous strip	8 to 12 cm below the seedling substrate	
12 months	11 to 13 months	NPK 10:00:30 + + 0.7% B	250	Full area or 2 continuous strips 80 - 120 cm	Over the soil	Alternating lines or airway total area

Type	Period	Product	Dose (kg/ha)	Application	Location	Observations
18 months	18 to 20 months	KCl + 1% B	180	Full area or 2 continuous strips 80 - 120 cm	Over the soil	Alternating lines or airway total area
24 months		Nutritional monitoring				
30 months		As recommended	As recommended	Full area or 2 continuous strips 80 - 120 cm	Over the soil	Alternating lines or airway total area

Source: PARACEL and Innovatech Gestão (2021)

PARACEL must install field tests for fertilization tests on different types of soils and genetic materials to optimize its fertilization strategy.

3.4.8 Sowing/Planting Plan

Once the soil is prepared and the NPK base fertilizer is applied, the areas are ready for the planting of Eucalyptus clonal seedlings to start.

Immediately preceding planting, it is necessary that the seedlings be immersed in a terminicide solution + MAP Monoammonic phosphate. This solution aims to prevent the attack of termites and improve the start and development of seedlings until the root system grows and can access the nutrients of the basic fertilization.

The seedlings must be planted in the planting line at a distance of 2.3 meters between plants. Immediately after planting it is recommended that a first irrigation be carried out and if the period is dry, with little rainfall, the irrigation should contain hydrogel based on polymers that absorb and accumulate water in order to better maintain the humidity around the seedlings, with the purpose of improving survival rate.

A second irrigation may be necessary depending on climatic conditions. After irrigation, the plants begin to establish themselves and, to guarantee operational quality, it is recommended to carry out a quality control operation to assess the survival rate. At this stage, according to the mortality percentage, it is important to assess the need for replanting. In regions in Brazil similar to Concepción, the mortality rate reaches an average of 5%, which represents an increase of 63 seedlings per hectare for PARACEL for the initial density of 1,250 trees per ha.

PARACEL plans to gradually initiate the plantation on their own areas, but it will take six or more years for these plantations to begin supplying wood to the mill.

The planting planning will follow the harvesting planning, since the production system is continuous, with re-planting or coppice taking place after clearcut, providing a sustainable source of raw material to supply the industry demands.

For example of the planting planning, **ANNEX I** presents the microplanification of San Liberato property. Same criteria of this microplanification will be used for the others PARACEL´s properties.

3.4.9 Plantation Maintenance

3.4.9.1 Weed Control

Cultural treatments consist of operations to combat and eliminate invasive plants to ensure better physical and biological conditions for the Eucalyptus seedlings to grow. Trees, especially in the early stages of growth, when they have not yet closed the canopy, can suffer significantly from competition for growth resources with weeds, such as nutrients, light and moisture. Thus, the control of invasive species in the initial planting phases is fundamental for the establishment and reach of the expected yields.

It is important to highlight the importance of interdependence between cultural treatments and their interrelated impacts.

The effectiveness of weed control actions significantly interferes with the results of fertilization processes. This is because, in an adequate soil preparation, the roots grow and develop beyond the planting line and are distributed forming a root plot. In the complementary fertilization, the fertilizers are applied to the soil surface and becomes available for the weeds. Therefore, the smaller the amount and distribution of weeds, the better the absorption of nutrients by the root system of the trees.

Cultural treatments start in pre-planting operations, with cleaning activities of pre-existing vegetation, such as grasses and broad leaves, with the application of post-emergent herbicide in total area, such as glyphosate, 15 to 30 days before planting, which will promote the desiccation of existing plants. When glyphosate is not effective, due to the presence of broadleaf weeds, specific emergent powders are used and when chemical control has not been effective, physical control, such as harrowing or mowing, can be performed. The important thing is to prevent competing plants from harming the seedlings.

After planting, there are several strategies that can be used to control overgrowth and the best decision will depend on control costs as well as other factors such as: level of infestation; type of weed; application technologies; climatic condition and quantity and qualification of the workforce.

Thus, competition control of weeds in the row and between the rows should occur before planting, after 60 and 120 days, and during the first year after planting, with intensities that will vary according to the degree of infestation of the weed species in each region.

In case of occurrence of more resistant invasive species that are not controllable with the use of the herbicides available on the market, manual or mechanical combat operations will be carried out at specific points. All of these operations aim to maintain a competition-free strip of at least 1.20 meters from the seedlings, with 60 cm on each side.

In good management conditions the Eucalyptus plantation should be established in 12 months, with the canopies developed enough to promote the shading of the soil and prevent the development of weeds due to lack of light.

Depending on local resources and conditions, two chemical managements stand out as the main strategies for weed control:

– Management 1: predominance of use of post-emergent herbicides in different control operations in the row and between the planting lines;

– Management 2: predominance of the use of pre-emergent herbicides in total area.

3.4.9.2 Pest Control

In forest cultures, especially in Eucalyptus plantations, one of the main challenges to be faced is the emergence of new pests and diseases in the field and in the nursery, which directly impacts wood productivity and quality. Based on these challenges, together with definitions of genetic materials and implantation techniques, phytosanitary management strategies have been of great importance for better identification of the problem and definition of combat and prevention methods (BERTI FILHO, 1980; VOMERO, 2018) .

In addition to the proper management of pests and diseases, it is essential to have a complete plan for monitoring the occurrence of these diseases and pests and their impacts, since the occurrence of each type of pest or disease is directly related to the period of the year, depending factors such as climate conditions and other abiotic factors that can cause stress to the plants.

For both control and monitoring, the first year after planting is always the most critical and requires greater investment in both monitoring and control activities, since the risk of mortality is greater.

In the context of pests, the ant is the main enemy and, therefore, requires systematic control. Among the species, leaf-cutting ants (genus Atta and Acromyrmex) directly affect the cultivation of eucalyptus in different regions.

Other pests include the psyllid (Glycaspis brimblecombei), the brown stink bug (Thaumastocoris peregrinus), the gall wasp (Leptocybe invas) and the costalimaita (Costalimaita ferruginea) (SANTANA, 2013; SOLIMAN, 2010; WILCKEN, 2010; ; ZANETTI et.al., 2003).

The main diseases in Eucalyptus plantations are eucalyptus rust, caused by the fungus Puccinia psidii and eucalyptus cancer, caused by Cryphonectria cubensis and Dothiorella sp. (WILCKEN et. Al., 2008).

Leaf-cutting ants directly affect the entire leaf coverage of plantations, impacting from newly planted seedlings to already established plantations, throughout the eucalyptus cycle (Figure 64). As a result of the reduction of leaf cover, the absorption of light and the photosynthetic process of the plant are impaired, reducing its growth capacity and volumetric increase, which affects the productivity of the forest.

The control of ants is done mainly in the dry period, by the use of granulated baits based on sulfluramid or fipronil, with two control methods: systemic combat, applying 1.5 to 8 kg / ha, according to the age of planting; and located combat, with the application of 5 to 10 g per anthill (WILCKEN et.al., 2008; ZANETTI et.al., 2003).

The application of pesticides for ant control in the pre-planting period is essential to maintain areas with a low level of ant infestation. For that, the baits must be applied in a localized and systematic way before planting. If necessary, the re-application of the product should be carried out, by means of identification and control of the anthills, to ensure that at the time of planting there is no infestation and damage the seedlings.

Considering the specific conditions in PARACEL’s areas, it is important to intensify monitoring and combat measures between April and October, which is the dry period.

3.4.10 Agroforestry Research and Laboratories

Genetic improvement refers to the set of activities that aim to produce individuals with desired qualities, such as improved growth, quality and resistance to pests and environmental conditions. PARACEL follows the FSC requirements concerning the non-use of genetic modified organisms in commercial plantations.

It is important to highlight that the PARACEL Research Program (Genetics, Soil Management and Nutrition, Forest Protection and Management) will be prepared in the 2nd Semester of 2021.

3.4.11 Plantation Health Monitoring and Natural Forest Monitoring

The plantation health monitoring includes all steps related to the monitoring and treatment of all factors that can affected the trees growth or result in mortality. This includes the following programs:

- Plantation establishment monitoring: annual check on the mortality of the seedlings after plantation;
- Weed monitoring: annual check on the presence and the damage caused by weeds to the forest plantations;
- Ant monitoring: annual check on the efficiency of ant control measures;
- Forest fires: annual check on the surface of forest areas affected by forest fires.

PARACEL has plan for the monitoring of natural areas, which comprehends field surveys to evaluate the integrity of the native forest remnants every three years, including a baseline study in the first year.

3.4.12 Products and By-Products

The forest management is focused on supplying the pulp industry with wood suitable for that purpose. Eucalyptus plantations are known as being a good source of wood for the production of short fiber pulp, which is used for the production of different kinds of paper and cardboard for packaging.

3.4.13 Harvest

The forest harvesting activity consists of the operation of cutting the trees, comprising the stages of felling, delimbing, debarking, tracing and stacking. The main harvesting systems are: Cut-to-Length (CTL) or Full Tree.

In the CTL system, the wood is cut in the forest, in sectioned logs according to the intended use, allowing high performance and an efficient logistic chain. In this system the group of machines is formed by two units: a harvester (cut, process, peel, measure, optimize and trace) and a forwarder (forwarding or transport of wood to the pile on the side of the road) (PONSSE, 2020).

The Full Tree system consists of four units: feller buncher fells and grabs the entire trees, the skidder drags the whole felled trees to the loading area beside the road, delimber removes the branches and prepares the wood for transport and slasher cut the trees. The residues from branches and tips are left at the edge of the field (PONSSE, 2020).

The CTL harvesting system has the following advantages: wood without bark; all stages of the harvest carried out by a single equipment within the forest, with the exception of the forwarding; maintenance of crop residue in the field, leaving leaves, branches and tips in the forest, favoring the physical protection of the soil and enrichment of the soil from the chemical point of view.

The CTL system also allows harvesting operations to be carried out with better uniformity and reliability. The smaller the number of machines, the easier it is to manage them by a small team. In addition, when the productivity rates between the different machines in the group are balanced, the productivity of the entire group is higher (PONSSE, 2020).

For these reasons, the CTL is the recommended harvesting system for PARACEL, composed of the Harvester machines and the Forwarder (Innovatech, 2021).

For this modality, the expected productivity varies according to the two operations, which present different factors that can impact the overall performance. For cutting, the average volume per tree is one of the main factors responsible for productivity. As for the forwarding activity, factors such as relief and average forwarding distance - DMB (referring to the forwarder's walk along the field) significantly interfere in productivity.

3.4.14 Waste Management

The waste management plant will aim to reduce the generation of waste to a minimum, through efficiency of the operations, application of the best available techniques, the best management practices and the sustainable production and consumption.

The focus of the actions of waste management will be prioritized as follows: re-utilization, recycling, energy recovery and other types of recovery. The final disposal will be considered only as the last resource.

The waste management will also guarantee that all the steps to the correct management will be executed through formal activities, assuring the compliance with current laws and regulations and the best environmental practices.

Crop Residue and Solid Waste Management will be in line with IFC Environmental, Health, and Safety Guidelines For Perennial Crop Production.

The main waste generated is presented in the following table.

Table 5 – Main wastes

Waste	Rough estimates (m^3/year)
Domestic waste (non-recyclable)	250
Recyclables (glass, paper and cardboard, plastic, metals)	50
Agrochemicals packaging (empty pesticide packages, empty fertilizer bags)	100
Hazardous (oil and oil contaminated materials, fluorescent lamps, batteries, waste from health services, paint packaging)	10

Source: PARACEL, 2021.

3.4.14.1 Segregation

The residues must be classified in the place of origin, between organic and inorganic, recyclable and non-recyclable, hazardous and non-hazardous, and stored separately in identified containers.

Third-parties will be instructed to do the same with their own residues and forward the containers to PARACEL.

All employees and third parties will be trained on the different types of residues, their classification and importance of the correct disposal.

3.4.14.2 Temporary Storage

Before being sent to the main waste storage room, the residues must be temporary stored in the place of origin, following the safety measures to avoid leaks, infiltration and odor.

The temporary storage room for hazardous residues must be closed and identified, with waterproof floor and structures to contain leaks, and with restricted access.

The containers for domestic residues must attend to the requirements of Decree 7391/2017:

- Re-usable;
- Adequately located and covered;
- Capacity to store all residues generated, taking into account the collection frequency;
- Constructed with waterproof material and with adequate resistance;
- Clear identification of the type of residue to which is destined.

The containers for temporary disposure of recyclable waste will be identified with the colors defined by the Resolution 548/96 from MSPBS and identified accordingly:

Table 6 – Identification for recyclable waste containers

Type of residue (identification)	Color
Glass	Green
Paper and cardboard (clean and dry)	Blue
Plastic	Red
Metal	Yellow

Containers for other residues will be identified with the following colors and identified accordingly:

Table 7 – Identification for non-recyclable waste containers

Type of residue (identification)	Color
General, mixed or non-recyclable	Black
Organic	Grey
Hazardous	Orange

3.4.14.3 Collection and Transportation

It will be defined the frequency of collection and the method of transportation for domestic residues from temporary storages. The recommended frequency for collection is of at least once a week, this way avoiding the proliferation of insects and odor in the sites.

3.4.14.4 Treatment

The different actions to minimize and/or valorize the waste before their final disposal can be: re-utilization, recycling, recuperation, composting and special incineration.

Non-hazardous waste, according to their type, can be destined to different methods such as re-utilization, recycling, composting, as foreseen in the temporary storage.

Hazardous waste must be treated with specific methods for each type, depending on their risk classification, and must send to third-parties authorized to handle such waste.

3.4.14.5 Domestic Waste

Organic and compostable domestic residues can be incorporated to the soil (buried or scattered) or used for animal feeding.

Recyclable clean waste (glass, paper and cardboard, plastic, metals) are separated in containers for each type to be later transported to PARACEL’s mill. While the corresponding infrastructure is not available in the industrial plant, those wastes may be removed by local collectors, after registration of delivery.

Non-recyclable waste, as well as mixed or dirty recyclable, are collected separately in the black containers specifically intended for this and are then suitably stored in the temporary storage area, until their transfer to the final destination.

3.4.14.6 Harvest Residues

Dispose of the biological residues originated in harvest activities in a way to:

- Facilitate the segregation and removal of usable material;
- Facilitate chipping and subsequent distribution of the residues on the stand.

The following actions are forbidden without written authorization by the forest manager:

- To burn harvest residues;
- Keep those residues stacked for a period longer than required to process them;
- Keep residues on the border of preservation areas, water flows, low-lying areas and roads.

3.4.14.7 Final Disposal

Most of Paraguay’s rural areas lack a proper service for collection and final disposal of waste, and for this reason the waste must be buried in the properties, adopting the basic health criteria.

- All residues that could not be recovered under any treatment, will be destined for the final disposal site, which may be sanitary landfill of PARACEL pulp mill

There will be no sanitary landfill destinated exclusively for forest activities, due mainly to the small amount of residues that is expected to be generated by the forest area;

- Third-parties must have their own site for final disposition in accordance with the requirements established by PARACEL;
- The monitoring system must guarantee that all final disposal sites are maintained in good conditions;
- It is prohibited the disposal, abandonment or burning of waste, whatever its origin, in the open, on roads, homes, camps and in the vicinity of water bodies (streams, rivers, lakes, estuaries, canals of drainage, etc.), or in any way that directly or indirectly affects groundwater.

3.4.14.8 Pesticides Packaging Management

PARACEL will carry out the management of pesticides packaging generated in its management units according to the current legislation and norms.

Overall, these procedures require the triple-rinsing of empty pesticide packaging. The water from the triple-rinsing must be re-used as dissolvent for the product in the tanks.

All packages must have their bottoms punctured after triple-rinsing, in order to guarantee they will not be re-used. Empty packages must not remain in field after use.

It is prohibited:

- To re-use the empty pesticide packages after washing for any purpose;
- To burn or to bury empty pesticide packages;
- To dispose of or store empty packages away from the storage facility intended for that use.

Washed and punctured packages must be temporary collected, including flexible materials in their original containers (cartons, polyethylene bags or big bags), in the temporary storage facility in the camps of each contractor. Once the storage is full, empty packages must be transferred to the collection are at the PARACEL headquarters, from where the collection of empty containers will be requested. The packages will be delivered to a recycling company, which must be authorized and registered by MADES and SENAVE as a recycling company for agrochemical containers.

In the note of receipt of the empty packages that the company will deliver, it must be clearly specified the quantity and type of containers and quantity of packages with triple-rinsing and puncturing, with the corresponding signature by the person in charge of the recycling company and the person in charge of gathering. This document must be filed in a folder provided for this purpose.

3.4.15 Prevention of Forest Fires

Forest fires are characterized by the occurrence of uncontrolled fire. These are the most critical occurrences within the scope of forest protection, with environmental and social economic impacts.

The fire risks in the first year of planting tend to be low, as it is an area without large concentrations of vegetation and combustible material. The more mature the forest, the more significant the economic losses are, whether due to the forest itself, or the risks of imbalances in the supply plan of a market or an industry.

In order to avoid fire and its consequent losses, all actions must be mainly aimed at its prevention and control. However, corrective measures must be considered and be at full capacity if they have to be put into practice.

The occurrence of the fire depends on at least two factors: cause and condition. Preventive measures aim to eliminate or minimize at least one of these factors and can be listed at:

– Eliminate or reduce the combustible materials around the plantations, by keeping firebreaks free of combustible materials such as vegetation and vegetal, in order to avoid the start and propagation of fires. The fire breaks must be more intensively managed the greater the potential risk of fire, that is, where there is a greater intensity of traffic of vehicles, machines and other vehicles not related to the forest operation. This practice must be incorporated into forestry activities;

– Monitoring of local climatic conditions, which allows estimating the probability of fire occurrence. The variables to be monitored are: temperature, relative humidity, wind and lightning occurrence. These indexes guide the preventive mobilization of contingency resources;

– Communication and education of local communities and neighbors on the importance of avoiding using fire as a practice for cleaning vegetation, as well as develop, together with the communities, a communication system to alert the occurrence fire outbreaks;

– Develop of an efficient internal communication system, in order to guarantee the quick activation of the combat team in case of fire outbreaks;

– Construction of fire lookout towers, with the objective of increasing the effectiveness of monitoring fire outbreaks. The observation of changes in the landscape can be made by human observation or with the use of more advanced technologies, such as high resolution cameras that automatically detect changes in the landscape, the presence of vehicles and other risk factors. The use of high-resolution cameras allows data to be communicated in real time to a control room that can immediately trigger firefighting brigades. In the case of human observation, binoculars and long-range visualization equipment help identifying fire outbreaks and risk factors, which are communicated via radio.

According to Venturi et.al., 2007, the implantation of a network of surveillance towers for the detection of forest fires requires studies of the topographic characteristics of the region, calculation of the visual range of the operators / cameras of the towers and analysis of maps of fire risk based on previous occurrence records. Therefore, it is important that the plots have climatology networks to assess humidity, temperature and wind speed, for the classification of potential risk areas.

Once preventive measures are taken, the likelihood of fire occurring decreases in the same proportion, but it is never possible to completely eliminate the risk of fire. In the event of a fire, the main measures to be taken are:

– Speed and effectiveness of the initial combat to the fire outbreak to prevent this outbreak from spreading and taking on large proportions. In order for the action time to be as short as possible, an efficient system for monitoring, detecting, communicating and mobilizing firefighting resources is necessary;

– Access conditions, this means that road and bridge conditions must not prevent combat resources from reaching the desired location quickly;

– Fire brigades, which consist of a water truck structure and pickup trucks with combat kits. It is recommended to have a structure of 1 (one) water truck and 1 (one) fire brigade for each 20 thousand hectares of forest plantation, for greater agility and effectiveness in combat;

– Annual training of the firefighting team, reviewing all combat concepts and techniques, such as the use of retardants, fire-fighting techniques, cleaning and opening fire breaks, safety during combat, the essential equipment for the activity and how to handle them, etc. When properly trained and well positioned, the combat team becomes able to quickly locate the outbreaks and effectively implement the communication and control measures, thus reducing the risk of fire propagation;

– Effective communication systems, as they guarantee the quick activation of the entire combat team and almost immediate action.

As recommended by Innovatech, the table presents the items considered for the composition of CAPEX for firefighting and prevention. The estimate of the items takes into account the condition of flat relief for the entire region of the project.

Table 8 – CAPEX for control and prevention of forest fires

Item	Unit	USD/unit	USD Total
Fire lookout tower with cameras	12.5	30,000	375,000
Water truck	5.0	62,000	310,000
Firefighting kit for pickups	5.0	500	2,500
Radio communication system		(*)	
Cellphone	20.0	375	7,500
Weather station	20.0	2,000	40,000
Tablet	20.0	375	7,500
Total	-	-	**742,500**

(*) Values considered in the budget of the Information Technology area.
Source: PARACEL and Innovatech (2021)

3.5 Sources and Volumes of Unrelated Airborne, Liquid and Solid Waste Unmitigated Discharge into the Environment

The type and quantities of residues generated may vary according to several factors, such as climate, number of workers and time of the year, as well as where does residues are generated. It is estimated that urban residues generation averages 1.2 kg/person/day.

To quantify the volume and types of residues generated, characterization studies will be carried out during the first year of forest operation, using the quartering method, aiming to adjust the best management practices for the following years.

The types of residues will be classified as hazardous and non-hazardous, based on the potential risk they present to the environment and to the worker's health and safety.

Non-hazardous residues include forest biomass generated in silviculture and harvest activities, residues from the employees domestic activities and all other residues not classified as hazardous.

Hazardous residues include:

- Empty packages of pesticides;
- Empty containers of fuels, oils, solvents, lubricants and paints;
- Contaminated material such as tows, gloves, filter and hoses;
- Used lubricants and tires;
- Batteries and lamps;
- First aid residues;
- Contaminated PPEs;
- Contaminated absorbent materials, such as sand and sawdust.

All employees and third parties will be trained on the risks of hazardous residues manipulation.

4 ALTERNATIVES ANALYSIS

Regarding to locational justifications, giving the 6-year period necessary for PARACEL's own forests to grow and start supplying the market, the early stages of the project will depend on wood bought from the market. This wood will be sourced from different producers in Brazil, Argentina and Paraguay. The wood supply from these countries will be 70%, 20% and 10%, respectively. It is important to emphasize that the locations of these plantations are the closest and that they are already in intense wood production.

After the first years of operation, PARACEL will use Eucalyptus wood from its land in order to satisfy 80% of the demand required for the operation of the plant; and the other 20% will be provided by external producers to the company (small local producers). The PARACEL owned plantations range between 30 km and 150 km from the pulp mill site, which can be considered very good in relation to similar activities. The properties are reportedly on average 47% of Quite Natural Area (i.e. non-plantable) and 53 % of Modified Area (i.e. potentially plantable). Reportedly, that mainly pasturelands will be used as plantations, and the native forest and riparian areas will be retained and protected, which will amount to roughly 90 thousand hectares of conservation areas.

Regarding to technical justifications, the project will prioritize the following Eucalyptus varieties: *Eucalyptus urograndis, E. grandis, E. dunnii, and E. saligna*. Other Eucalyptus species, such as E. camaldulensis and hybrids of E. urophylla, will be considered depending on the market availability.

As the area is a new frontier for Eucalyptus plantations, the selection of suitable species and genetic material will be based on a long term project, based on the species and genetic material that better adapt to edaphoclimatic environment and meet the mill requirements in terms of pulpwood supply.

The use of Eucalyptus species is justified by their high productivity, which is expected to be around 30-40 m^3/ha/year, according to data from similar regions in the state of Mato Grosso do Sul, Brazil. Eucalyptus plantations currently cover roughly 100 thousand hectares in Paraguay.

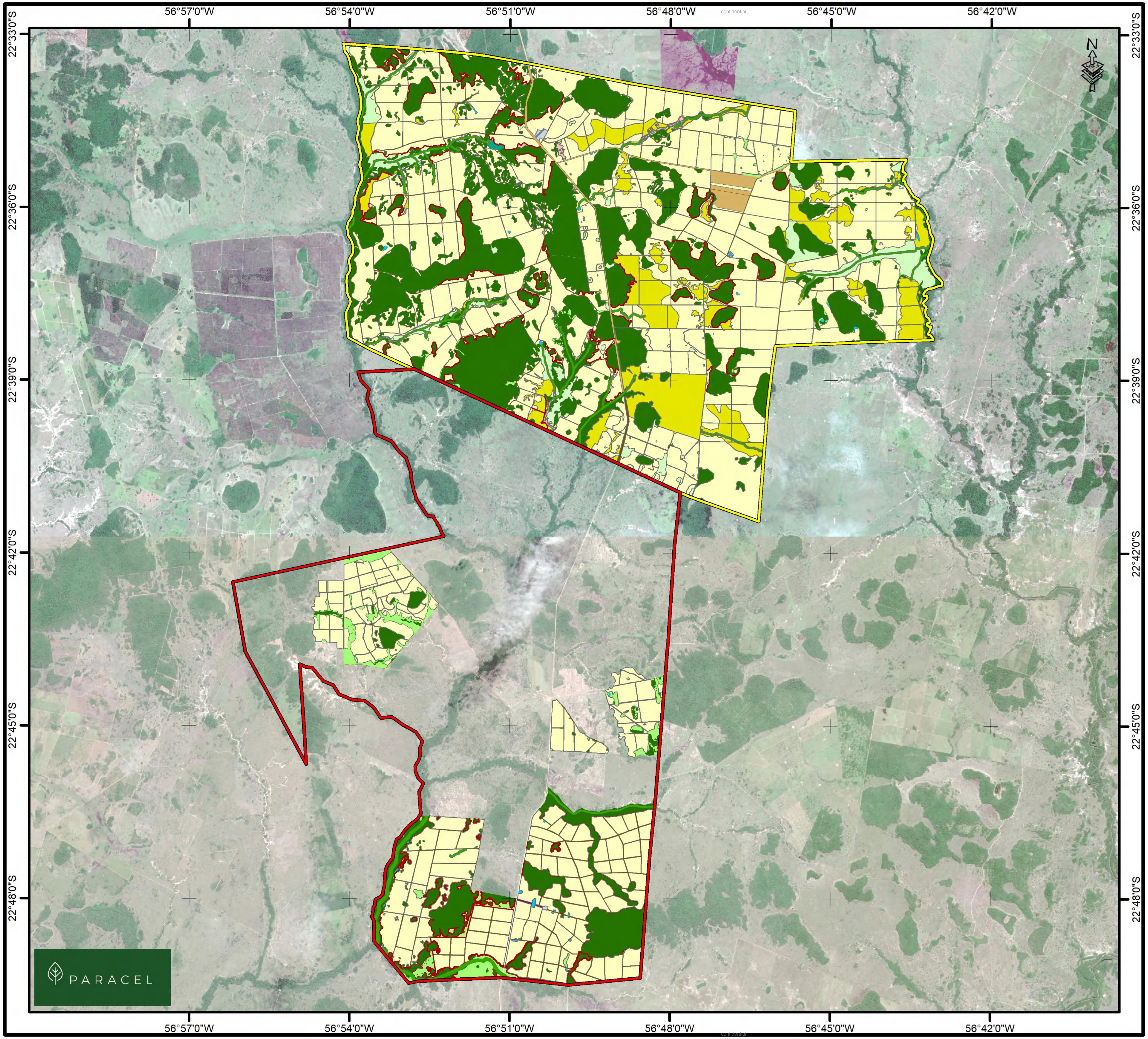
Genetic improvement refers to the set of activities that aim to produce individuals with desired qualities, such as improved growth, quality and resistance to pests and environmental conditions. PARACEL follows the FSC requirements concerning the non-use of genetic modified organisms in commercial plantations.

It is noteworthy that in the forestry operation of PARACEL will generate approximately 3 thousand jobs, between own contractions and outsourcing, during all the steps of the project. In addition, this activity fosters the local economy and generates tax revenues for the municipalities in the region and in the country as a whole.

Also, the environmental benefits provided by this cultivation are highlighted, such as maintaining soil with vegetation cover, preserving the legal reserve and APP and carbon sequestration, all guided by the environmental management system of PARACEL.

ANNEX I

MICROPLANIFICATION OF SAN LIBERATO PROPERTY



LOCALIZATION

TECHNICAL INFORMATION

Projected Coordinate System: UTM 21 Zone
Projection: Transverse Mercator
Geographic Coordinate System: GCS WGS 1984
Datum: WGS 1984
Prime Meridian: Greenwich
Angular Unit: Degree

SCALE

1 : 160.000

0 1 2 4
Km

REFERENCES - FORESTRY MICROPLANIFICATION

PARACEL Properties

- San Liberato
- Trementina

Land Cover

- Flooded / Wet land
- Native forest
- Natural grassland
- Restoration area
- Water bodies
- Watercourse Protection
- Apt land for planting
- Apt land for planting with restrictions*
- Erosion
- Existing plantations
- Firebreaks
- Headquarters
- Road
- Transmission lines area

Flooded/Wet land	545
Native forest	6.162
Natural grassland	412
Restoration area	9
Water bodies	23
Watercourse Protection	482
Subtotal	**7.634**
Apt land for planting	13.901
Apt land for planting with restrictions*	1.708
Erosion	64
Existing plantations	194
Firebreaks	218
Headquarters	11
Road	443
Transmission lines area	2
Subtotal	**16.541**

*Corresponds to the areas that it may be partially used depending on the type of soil preparation.

Pöyry Tecnologia Ltda.
Av. Alfredo Egídio de Souza Aranha, 100
Bloco B - 5º Andar
04726-170 - São Paulo-SP
Tel. (11) 3472 6955
Fax (11) 3472 6980
E-mail: contato.br@poyry.com
www.poyry.com.br

ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

Date 31.07.2021

Reference N. 109002841-001-0000-E-1500
Page 1

EUCALYPTUS PLANTATION
Departments of Concepción and Amambay – Paraguay

VOLUME II – BASELINE CONDITIONS

TOMO I – PHYSICAL ENVIRONMENT

Content

Annexes

Distribution
PARACEL
PÖYRY -

Orig.	31/07/21 – emf	31/07/21 – bvv	31/07/21 – hfw	31/07/21 – hfw	For information
Rev.	Date/Author	Date/Verified	Date/Aproved	Date/Authorized	Observacion
a	20/08/21 – emf	20/08/21 – hbo	20/08/21 – hfw	20/08/21 – hfw	For information

SUMMARY

FIGURE LIST

TABLE LIST

5 OUTCOME OF SCOPING

5.1 Spatial Scope

The Spatial Scope considered the influence areas of the PARACEL Eucalyptus Plantation, for the physical and biotic environment. This areas are divided into Indirect (IIA), Direct (DIA) and Directly Affected Area (DAA).

5.1.1 Indirect Influence Area (IIA)

It corresponds to a regional territorial share, which can advance to 100km from the edges of the premises. For the PARACEL Eucalyptus Plantation, considering that best management practices will have to be applied, it is estimated that the 100km range is sufficient to cover indirect impacts under knowledge and relative control.

The area considered is the same as that of the socioeconomic environment, since it covers the hydrographic basins where the properties are located. The hydrographic basins are related to the indirect bio-physical impacts of the project.

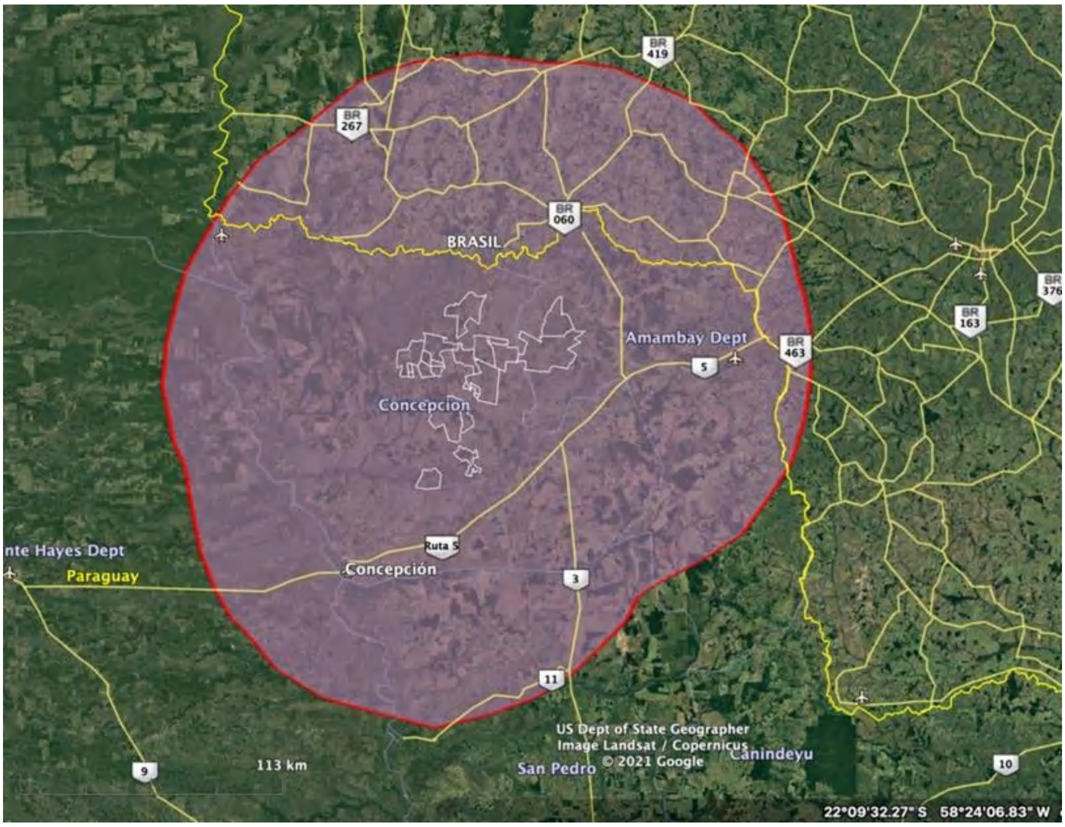


Figure 1 – Area of indirect bio-physical influence of the PARACEL Eucalyptus Plantation (buffer 100 km)

5.1.2 Direct Influence Area (DIA)

It corresponds to the nearest area of the boundaries or perimeters of the premises. The bio-physical dimensions and complexities of each property are the determining factors of its area of direct influence. However, it can be determined that the direct influence of plantation activities on the bio-physical environment generally is only 10 km away.

The area considered is the same as that of the socioeconomic environment, since it comprises the micro basins where the properties are located. The micro basins are related to the direct bio-physical impacts of the project.

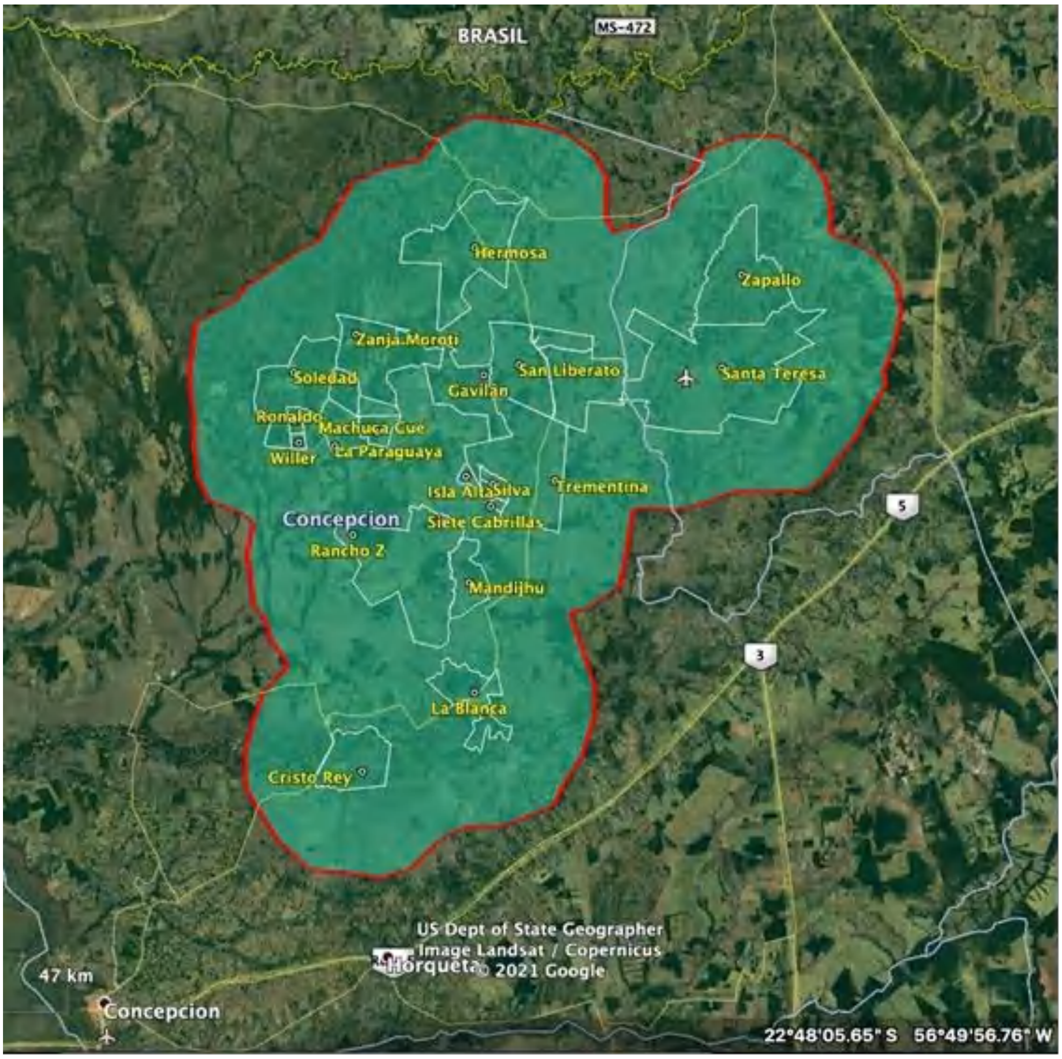


Figure 2 – Direct bio-physical influence of the PARACEL Eucalyptus Plantation (Buffer 10km)

5.1.3 Directly Affected Area (DAA)

It corresponds to the areas destined for PARACEL Eucalyptus Plantation, as illustrated below.

Figure 3 – Directly affected area of the PARACEL Eucalyptus Plantation

5.2 Temporal Scope

The Temporal Scope it was considered the entire period of operation of the evaluated ventures (in their different phases of planning, installation and operation).

5.3 Technical Scope

In the next topics, aspects related to the physical, biotic and socioeconomic aspects of the areas of influence of the PARACEL Eucalyptus Plantation will be evaluated.

6 BASELINE CONDITIONS

6.1 Physical Environment

The diagnosis of the physical environment allows us to observe the current states of climate, geology, geomorphology, topography, seismicity and hydrology (surface and underground water resources) of the areas of influence and thus obtain an adequate evaluation of the environmental impacts related to the PARACEL Eucalyptus Plantation.

For the compilation of primary and secondary data, the areas of influence were previously considered.

6.1.1 Climate

The climate type in Paraguay is tropical to subtropical, governed by tropical air mass and polar air mass, with hot and rainy summers and low and less rainy winters. The average annual temperature is 23°C and the average annual maximum is 29°C. There is a marked difference between the distribution of rainfall in the two regions into which the country is divided. In the Eastern Region, the average annual temperature ranges from 21°C to 23°C. In the Western Region, the average annual temperature is 24°C. The average recorded rainfall is 1,700 mm in the eastern region and 400 mm in the western region, near the border with Argentina and Bolivia (DGEEC, 2011).

According to Grassi et al. (2005), the Eastern Region, has an undulating and humid feature confined between the Paraguay and Paraná rivers, has a rugged topography with good drainage and a growing rainfall regime to the east and where the climate varies from humid sub-humid to humid, in the same orientation, giving rise to the large subtropical forests of the Atlantic basin.

According to this classification Pasten et al. (2011), the Eastern Region is defined with two types of climates:

- Tropical Shroud/Dry Winter (Aw): covers much of the department of Concepción and a small portion of northwest San Pedro;
- Temperate/No Dry Season/Hot Summer (Cfa) includes the departments of Amambay, Canindeyú, Central, Cordillera, Caaguazú, Alto Paraná, Paraguarí, Guairá, Ñeembucú, Misiones Itapúa and much of San Pedro.

The result of Köppen's climate classification, which can be seen in the Figure below, determined that in Paraguay there are three types of climate: tropical savannah with dry winter (Aw), semi-arid (Steppe) warm during all year (Bsh) and temperate climate, without dry season and hot summer (Cfa), this is the predominant climate in much of Paraguay (Pasten et al. 2011).

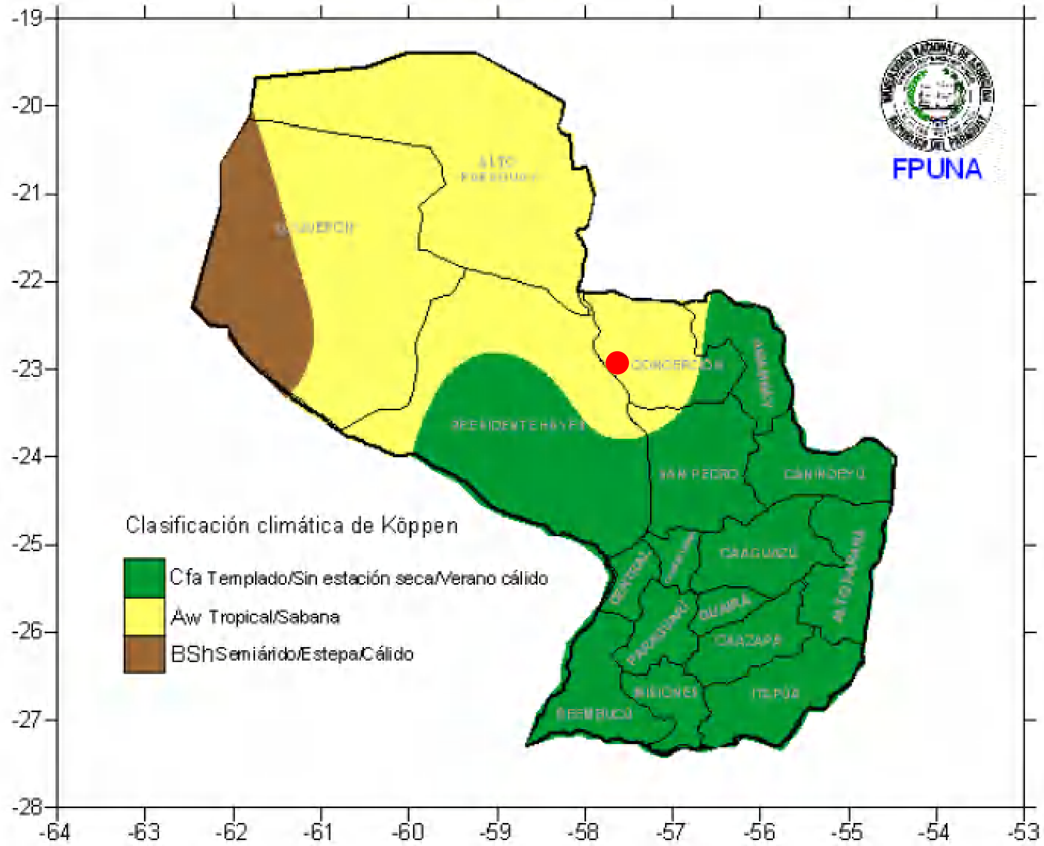


Figure 4 - Climate Classification of Köppen (1971-2010). Source: Pasten et al. (2011)

In the Figure below you can see the result of Thornthwaite's climate classification, where it's possible to observe the 5 different types of climate of Paraguay.

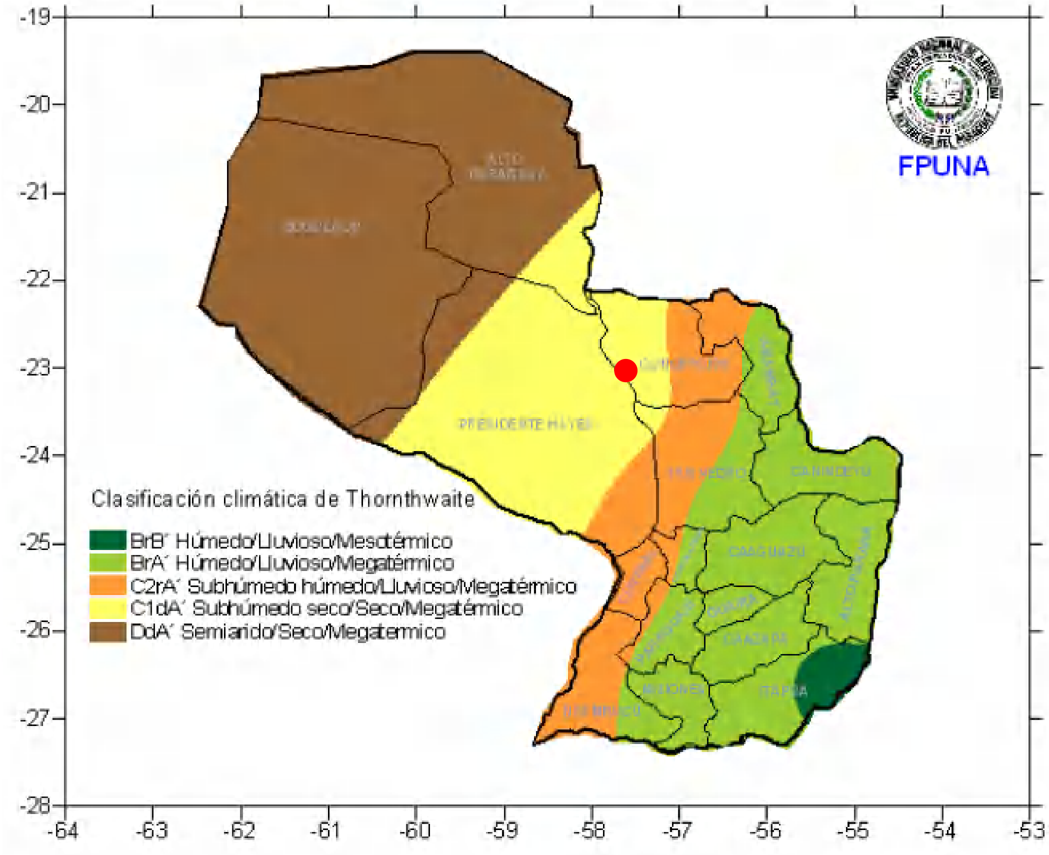


Figure 5 - Thornthwaite climate classification (1971-2010). Source: Pasten et al. (2011)

According to Pasten et al. (2011), the Western Region is defined considering four types of climate:

- Dry sub-humid/dry/megathermal (C1dA'): it includes the western part of the department of Concepción and a small portion of the department of San Pedro;
- Humid sub-humid/rainy/megathermal (C2rA'): covers the east of Concepción, a strip of San Pedro, Central department, west of Cordillera and west of Ñeembucú;
- Wet/Rain/Megathermal (BrA'): includes the departments of Canindeyú, Alto Paraná, Guairá, Caazapá, Misiones, east of Amambay, southeast of San Pedro, east of Cordillera, east of Ñeembucú and a large part of Itapúa;
- Wet/Rain/Mesothermal (BrB'): includes only a small part of Itapúa.

6.1.1.1 Methodology

The climatic characterization of the region where the PARACEL Eucalyptus Plantation is located considered the analysis of the following parameters: temperature, relative humidity, wind direction and speed, precipitation, solar radiation and water balance.

The meteorological and climatic information presented comes from the Climatological and Meteorological Study, carried out by the Company "CATAVENTO

AMBIENTALE METEOROLOGIA E MEIO AMBIENTE", the data were obtained by surface meteorological stations approved in the region of the company. The following information has been extracted from the Pulp Mill and Port Environmental Impact Study & Report (EIAp/RIMA): Book I - Environmental Diagnosis Of The Physical Environment (PÖYRY, 2020).

The data used for the study of the region's climate were obtained from the Integrated Surface Database (ISD), which can be consulted on the website of the National Oceanic and Atmospheric Administration (NOAA). Four surface weather stations were chosen for the analysis of climate conditions in the region, which were more representative of the project area, as shown below.

- Puerto Casado (USAF:860860/ICAO:SGLV), installed in the coordinates 22°16'58.80 "S / 57°55'58.80 "W. The data series examined is composed of 7 years (from 01/01/2013 to 31/12/2019);
- Pozo Colorado (USAF: 861280/ICAO: SGPC), at coordinates 23°30'0.00 "S / 58°46'58.80 "W. The data series examined is composed of 7 years (from 01/01/2013 to 31/12/2019);
- San Pedro (USAF: 861850/ICAO: SGSP), located at coordinates 24° 4'1.20 "S / 57° 4'58.80 "W The data series examined is composed of 7 years (from 01/01/2013 to 31/12/2019);
- Teniente Coronel Carmelo Peralta (USAF: 861340/ICAO: SGCO), used as a reference station for the region, located at coordinates 23°26'31.20 "S e 57°25'37.20 "W. The data series examined is composed of 10 years (from 01/01/2010 to 31/12/2019).

Figure 6 - Map of the location of the weather stations distant from the project. Source: Google Earth, 2020

6.1.1.2 Rainfall precipitation

No rainfall data are available in the database used for the study. Therefore, the study of rainfall precipitation was carried out by consulting the bibliography with information from previous studies of the region and the country.

Most of the country's rainfall is convective, produced by isolated storms or lines of instability that are frequent in spring and autumn. The average annual precipitation shows a great spatial variation. The greatest amplitude is towards the south of the country, varying zonally from 400 mm in the northwest of the Chaco to more than 1,800 mm in the Eastern Region.

The Paraná River basin is the wettest, with annual averages above 1800 mm, while the Paraguay River basin receives maximums of 1600 mm in the eastern region. Rainfall also shows great seasonal variability. They are lowest in July and August, and the average of the least rainy month usually does not reach 5% of the annual total. The highest volumes of precipitation occur during the months of October to April and are generally recorded in the form of storms or rainfall, as a result of atmospheric instability caused by strong warming of the lower layers of the atmosphere (Mayeregger and Romero 2017).

The highest precipitation rates in the region of Concepción occur in the summer. The month with the lowest rates is August, with an average of 28mm. In February and November, precipitation reaches its highest levels, between 128 and 152 mm on average. The average annual rainfall is approximately 1,190 mm[1].

[1] Source: https://es.weatherspark.com/

6.1.1.3 Atmospheric pressure

At the Puerto Casado station, the atmospheric pressure varied between 1,001.4 and 1,004.9 hPa, while the average for the period from 2013 to 2019 was 1,002.9 hPa.

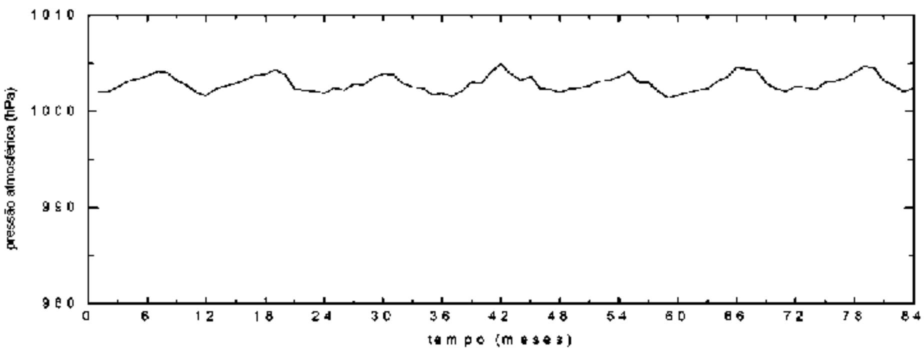


Figure 7 – Average monthly atmospheric pressure at the Puerto Casado station

At the Pozo Colorado station, the atmospheric pressure varied between 999.4 and 1,002.7 hPa, while the average for the period from 2013 to 2019 was 1,000.8 hPa.

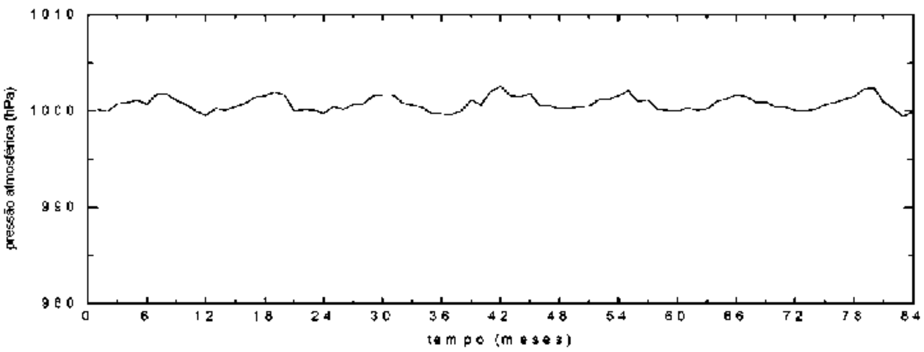


Figure 8 – Average monthly atmospheric pressure at the Pozo Colorado station

At the San Pedro station, the atmospheric pressure varied between 1,002.1 and 1,005.5 hPa, while the average for the period from 2013 to 2019 was 1,003.6 hPa.

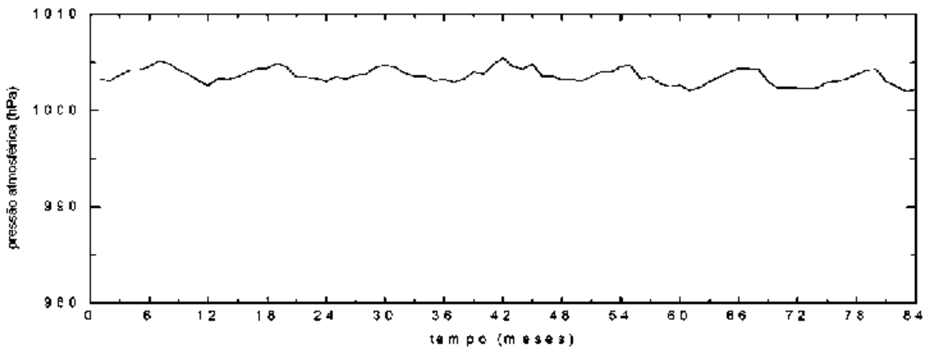


Figure 9 – Average monthly air pressure at San Pedro station

At the Lieutenant Colonel Carmelo Peralta station, the atmospheric pressure varied between 1,001.5 and 1,007.5 hPa, while the provisional average climate for the period from 2010 to 2019 was 1,003.9 hPa.

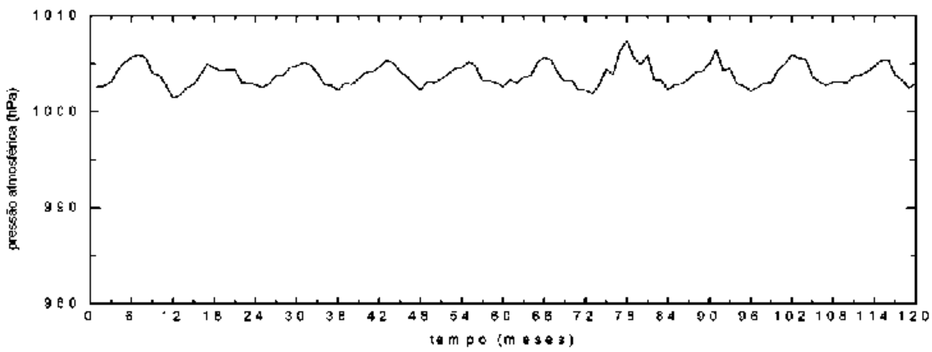


Figure 10 – Average monthly atmospheric pressure at the Teniente Coronel Carmelo Peralta station

Although the four weather stations cover a relatively large area and are separated by considerable distances, the atmospheric pressure behavior was similar in all stations and the average for the region was 1,002.8hPa.

6.1.1.4 Air temperature

At the Puerto Casado station, the average monthly temperature varied between 16.9˚C and 31˚C, while the average for the period from 2013 to 2019 was 25.7˚C.

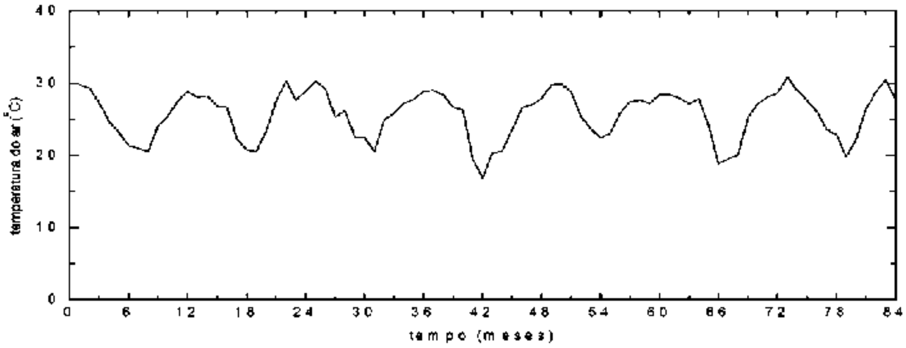


Figure 11 – Average monthly temperature at Puerto Casado station.

At Pozo Colorado station, the monthly average temperature varies between 15,5˚C and 31,2˚C, while the average for the period from 2013 to 2019 was 24.7˚C.

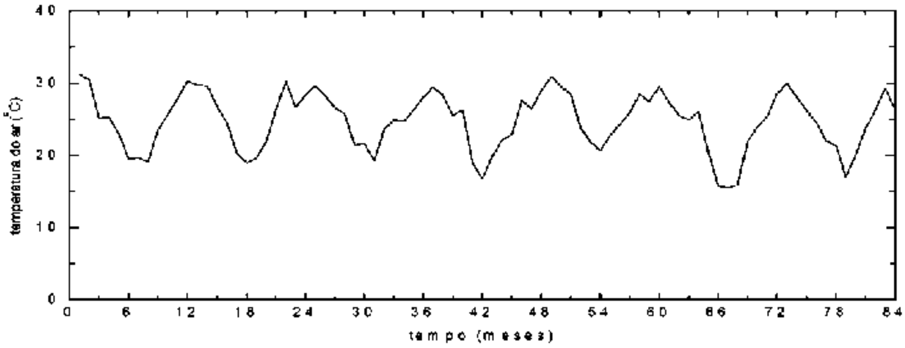


Figure 12 – Average monthly temperature at Pozo Colorado station

At the San Pedro station, the average monthly temperature varied between 16.5˚C and 30.5˚C, while the average climate for the period from 2013 to 2019 was 24.1˚C.

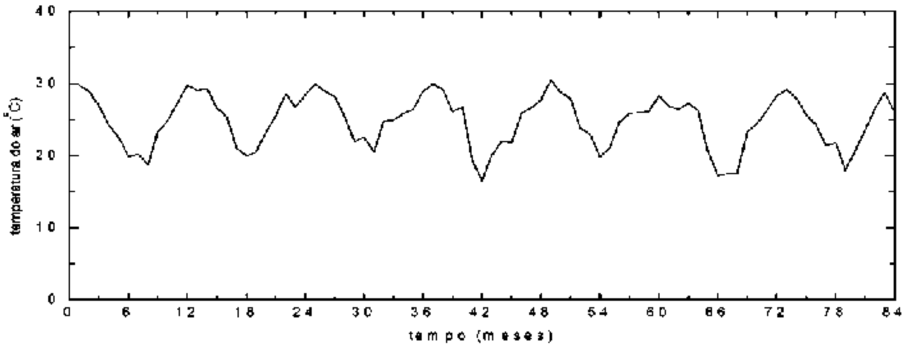


Figure 13 – Average monthly temperature at San Pedro station

At Teniente Coronel Carmelo Peralta station, the average monthly temperature varied between 15.5˚C and 29.6˚C, while the provisional average climate for the period from 2010 to 2019 was 24.3˚C.

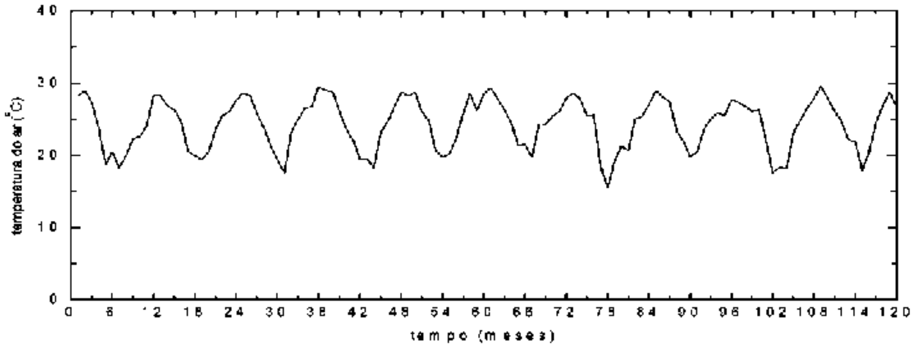


Figure 14 – Average monthly temperature at station Teniente Coronel Carmelo Peralta

The air temperature in the region is defined by the effect of continentality and topographic uniformity, presenting a great amplitude. In summer, as it is a tropical region, the maximum temperatures can exceed 30˚C, and in winter frost phenomena can be registered as a consequence of the entry of cold fronts.

The average temperatures are very similar in all the weather stations, from 24.1˚C in the San Pedro station, which is further south, to 25.7˚C in the Puerto Casado station, located further north. In the large region analyzed, the average temperature was 24.7˚C.

6.1.1.5 Relative humidity

At the Puerto Casado station, the monthly relative humidity varied between 46.7% and 79.6%, while the average for the period from 2013 to 2019 was 63%.

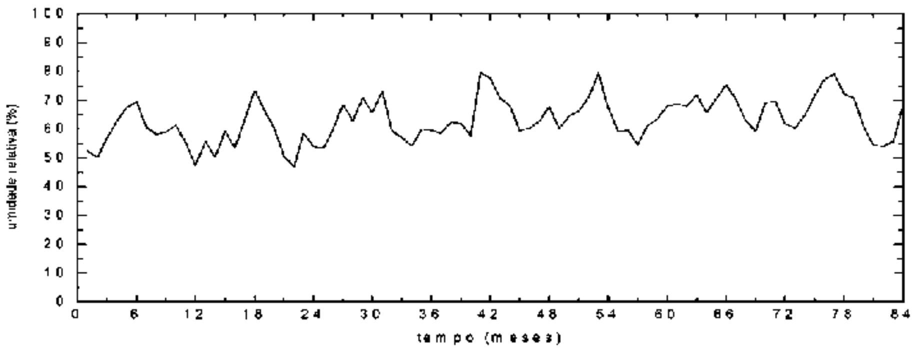


Figure 15 – Average monthly relative humidity at Puerto Casado station

At the Pozo Colorado station, the monthly relative humidity varied between 51.7% and 83.6%, while the average for the period from 2013 to 2019 was 70.2%.

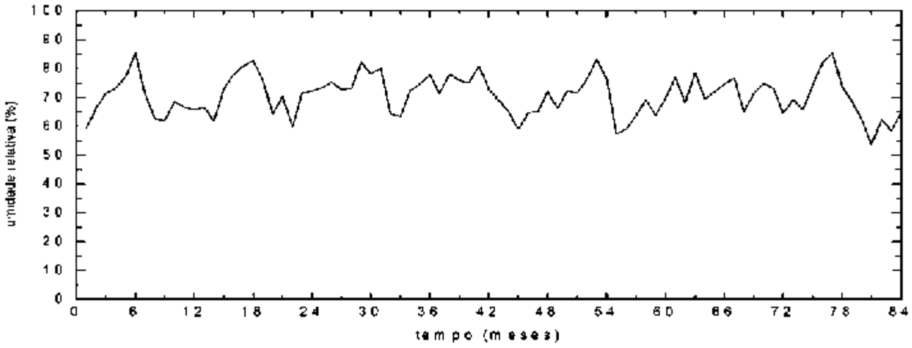


Figure 16 – Average monthly relative humidity at station Pozo Colorado

In the San Pedro station, the monthly relative humidity varied between 56.1% and 85.4%, while the average for the period from 2013 to 2019 was 70.5%.

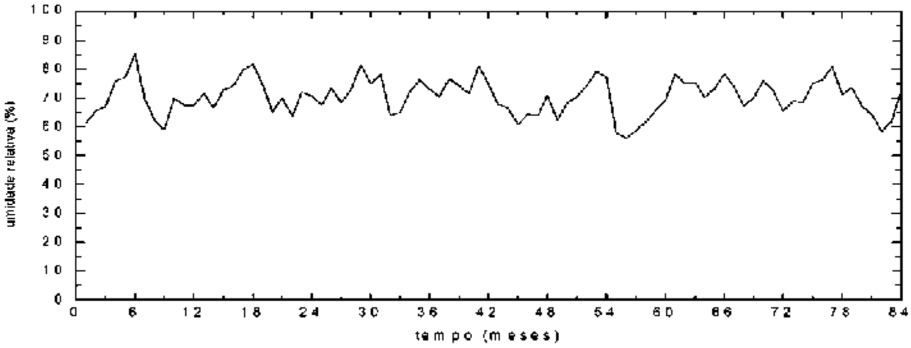


Figure 17 – Average monthly relative humidity at San Pedro station

At Teniente Coronel Carmelo Peralta station, the monthly relative humidity varied between 51.4% and 85.5%, while the provisional average for the period from 2010 to 2019 was 70.9%.

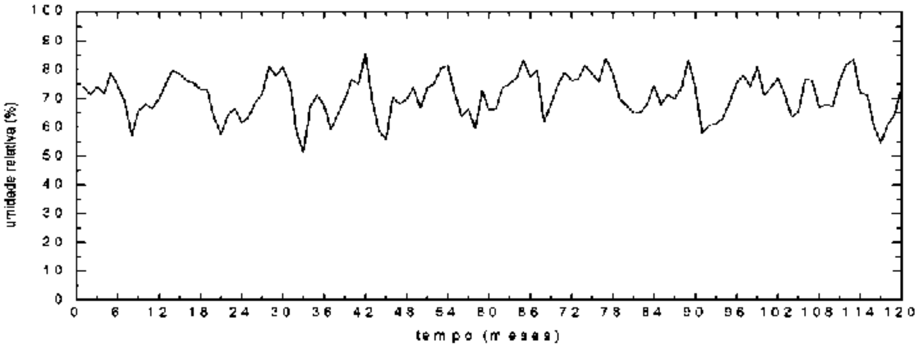


Figure 18 – Average monthly relative humidity at station Teniente Coronel Carmelo Peralta

The relative humidity at the Puerto Casado station, has an average relative humidity of 63%. The other regions presented values between 70.2% and 70.9%, the highest value being at the station of Lieutenant Colonel Carmelo Peralta. This difference is due to the variability of rainfall among the regions.

6.1.1.6 Wind

At the Puerto Casado station, the average monthly wind speed varied between 0.76 and 2.49 m/s, while the average for the period from 2013 to 2019 was 1.47 m/s. The wind rose generated with the data obtained at the Puerto Casado station proves the predominance of south and north winds.

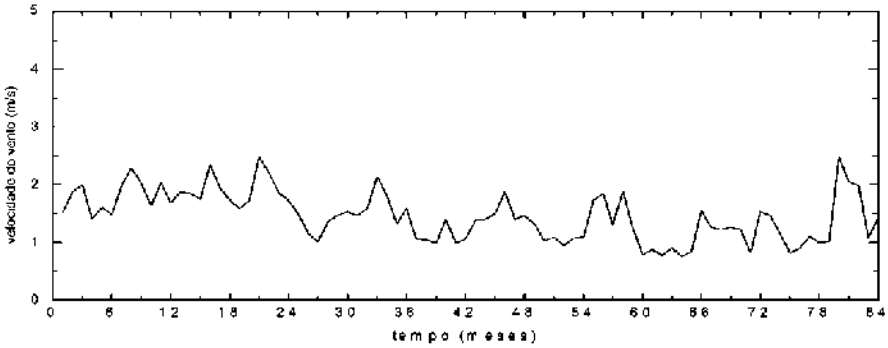


Figure 19 – Average wind speed at Puerto Casado station.

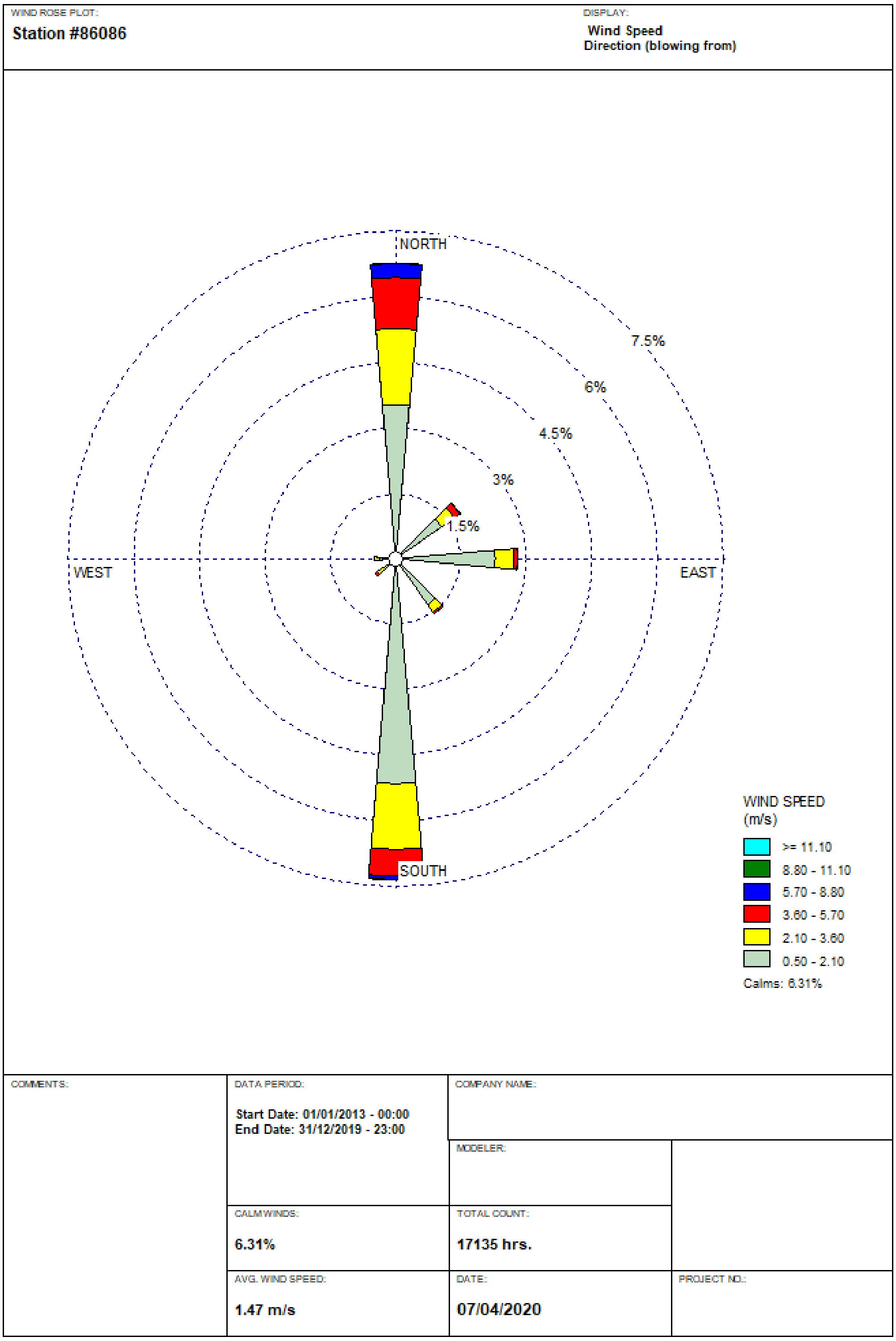


Figure 20 – Wind rose observed at the station Puerto Casado

At the Pozo Colorado station, the average monthly wind speed varied between 0.7 and 5.0 m/s, while the average for the period from 2013 to 2019 was 2.5 m/s. The wind rose generated with the data observed at the Pozo Colorado station proves the predominance of south and north winds, with important components from the northeast and east.

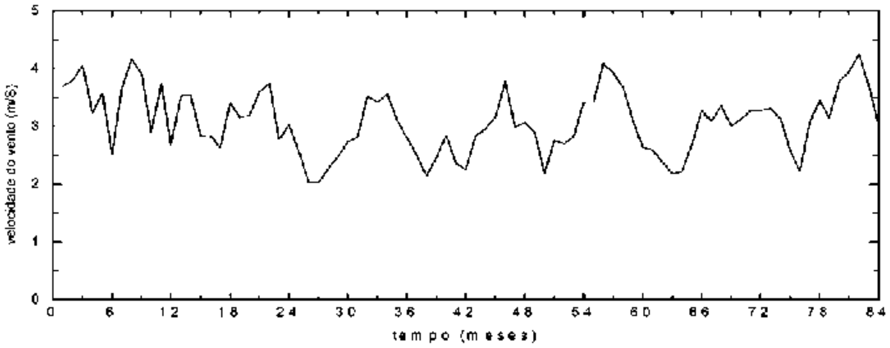


Figure 21 – Average wind speed at station Pozo Colorado

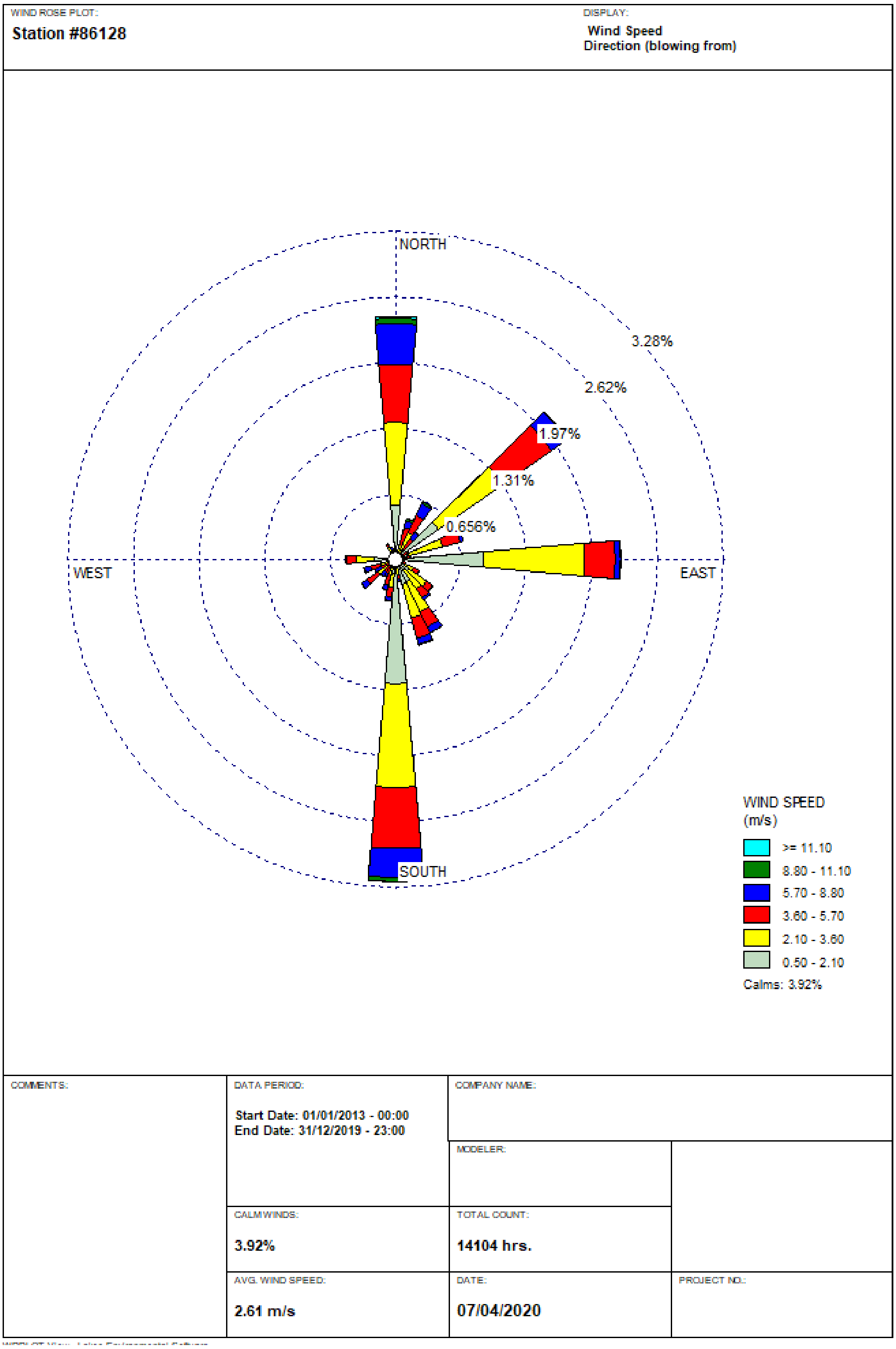


Figure 22 – Wind rose observed at Pozo Colorado station

At the San Pedro station, the average monthly wind speed varied between 0.5 and 3.7 m/s, while the average for the period from 2013 to 2019 was 1.9 m/s. The wind rose generated with the data observed at the San Pedro station proves the predominance of two winds from the south and north, followed by winds from the east.

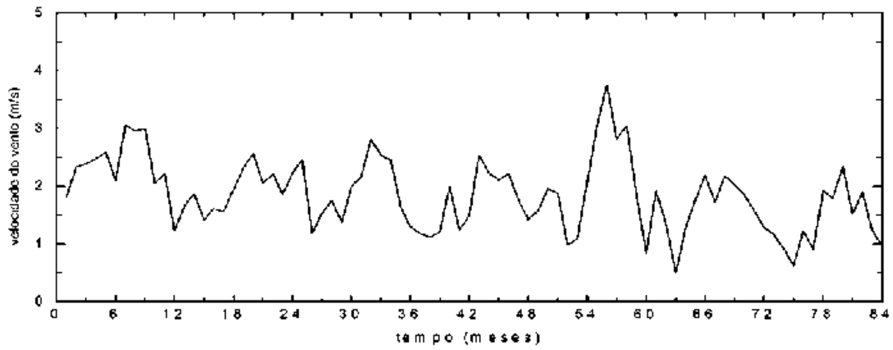


Figure 23 – Average wind speed at the station San Pedro

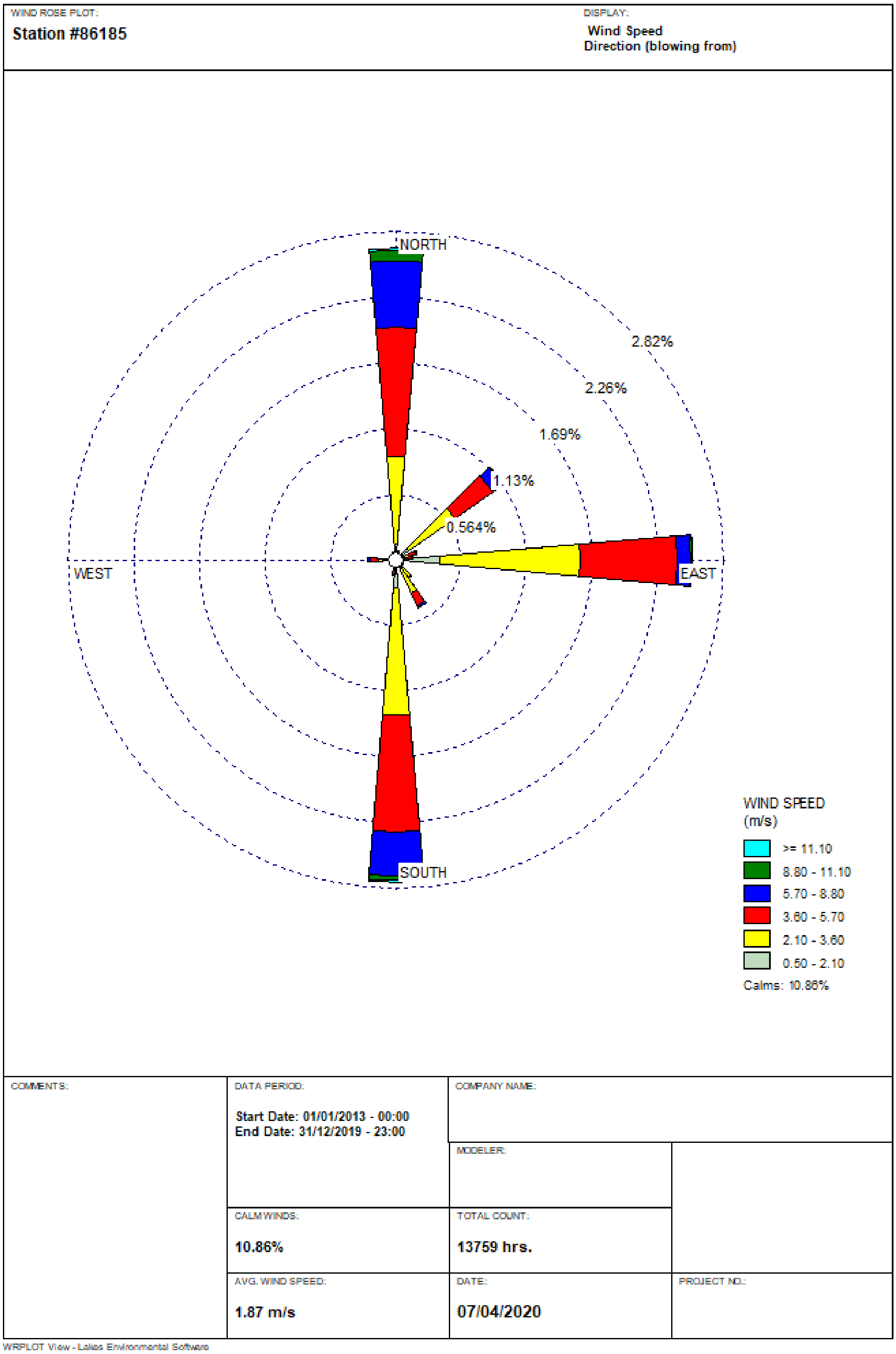


Figure 24 – Wind rose observed at the station San Pedro

At the Teniente Coronel Carmelo Peralta station, the average monthly wind speed varied between 1.8 and 4.9 m/s, while the provisional average for the period from 2010 to 2019 was 3.2 m/s.

The wind rose generated with the data observed at the Teniente Coronel Carmelo Peralta station proves the predominance of two winds from the south, followed by northeast and east, and with a less important component from the southeast.

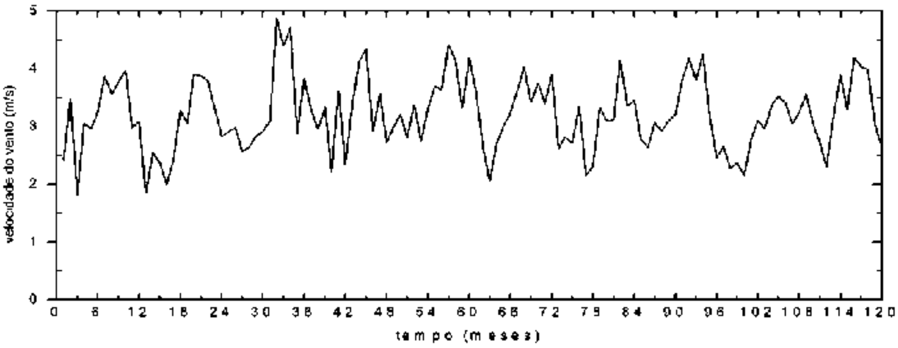


Figure 25 – Average wind speed at the station Teniente Coronel Carmelo Peralta

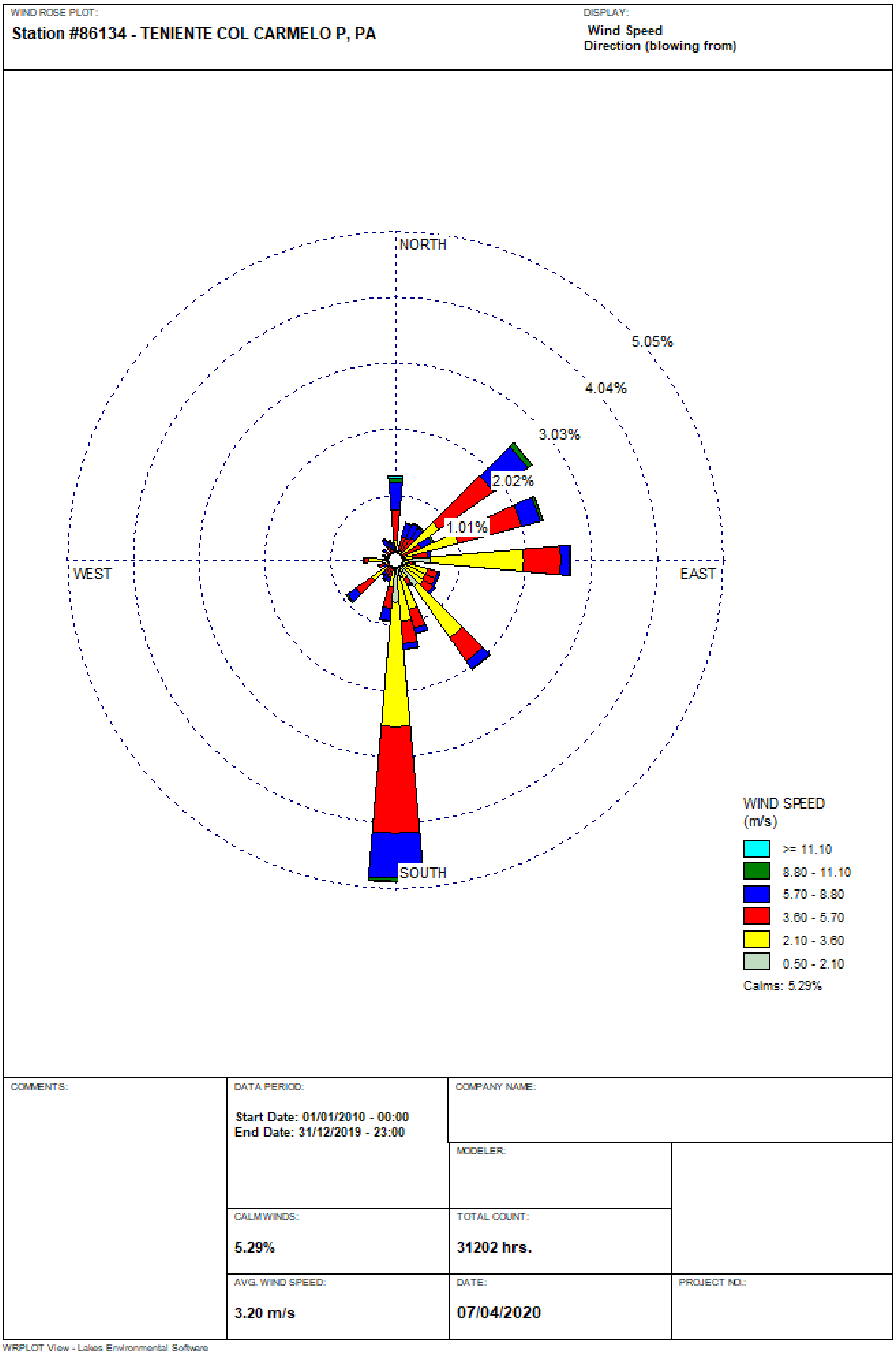


Figure 26 – Wind rose observed at the station Teniente Coronel Carmelo Peralta

The wind intensities in all regions are very similar and can be classified as weak winds, between 1.4 and 3.2 m/s. The highest wind speeds were registered at Teniente Coronel

Carmelo Peralta station. The predominant wind directions are north and south, followed by northeast and east winds.

6.1.2 Air Quality

This item presents the Air Quality Monitoring Report results of PARACEL pulp mill in the Municipality of Concepción, Department of Concepción, Paraguay, as reference, considering air quality should be similar in all area of the eucalyptus plantation.

The monitoring objective is to verify the air quality before the implementation and operation of the pulp mill (background).

The air quality monitoring was carried out through 2 campaigns, the first in the period from September 25 to October 16, 2019, and the second in the period from February 12 to March 4th, 2020.

This report was prepared using SEAM Resolution No. 259/2015, which establishes the air quality standard.

6.1.2.1 Collection points

Three different points were defined to evaluate the air quality in the region where the PARACEL factory is installed, which are:

– Point 01 – SENACSA/ Departmental Animal Health Commission

  Address: Calle Gral. Díaz c/ Rufino Spika – Concepción/Paraguay

  Coordinates: UTM 21K 0454572 - 7410810

– Point 02 – Loreto Municipality/ Paraguay

  Address: Av. Eusebio Ayala Y Centro Corá – Loreto/Paraguay

  Coordinates: UTM 21K 0466753 - 7426022

– Point 03 – National Police Station – Comisaría nº18 Col. Roberto L. Petit

  Address: Puesto Policial Nacional – Comisaría nº18 – Col. Roberto L. Petit – Concepción/Paraguay

  Coordinates: UTM 21K 0457325 – 7434506

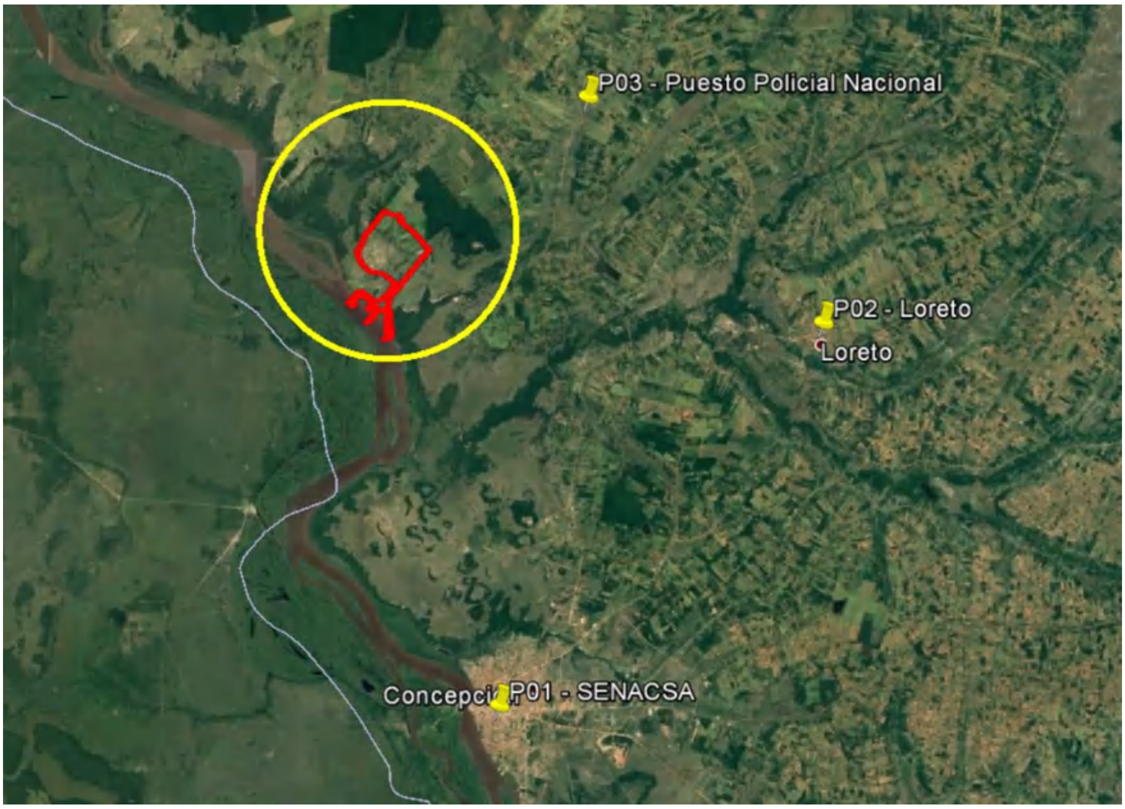


Figure 27 – Location of campaign monitoring points. Source: Pöyry Tecnologia (2020)

Figure 28 – Point P01. Source: Geoavaliar (2020)

Figure 29 – Point P02. Source: Geoavaliar (2020)

Figure 30 – Point P03. Source: Geoavaliar (2020)

6.1.2.2 Parameters

To monitor the current air conditions, the parameters were considered: Total Suspended Particles (TSP), Inhalable Particles (IP - PM_{10}), Respirable Particles (RP - $PM_{2.5}$), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Total Reduced Sulfur (TRS), Carbon Monoxide (CO), Ozone (O_3), Hydrogen Sulfide (H_2S) and Volatile Organic Compounds (VOC).

6.1.2.3 Methods

The samples were taken at 3 points, and 7 collections occurred at each of the sampling locations (points), with an approximate duration of 24 hours for the parameters Total Suspended Particles (TSP), Inhalable Particles (IP - PM_{10}), Respirable Particles (RP - $PM_{2.5}$), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Ozone (O_3), Hydrogen Sulfide (H_2S); approximately 1 hour for Total Reduced Sulfur (TRS) and Carbon Monoxide (CO) parameters; 20 minutes for Volatile Organic Compounds (VOC).

The references of the methodologies used are presented below.

- 40 CFR Appendix B to Part 50 - Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method);
- 40 CFR Appendix J to Part 50 - Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere;
- 40 CFR Appendix L to Part 50 - Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere;
- ISO 4220:1983 - Ambient air — Determination of a gaseous acid air pollution index — Titrimetric method with indicator or potentiometric end-point detection;
- US EPA METHOD Nº QN 1277:1977 - Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere/
- EQOA-0206-148 - Environment S.A Model O342M UV Photometric Ozone Analyzer;

- US EPA EMC Conditional Test Method (CTM-030) - Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers and Process Heaters Using Portable Analyzers;
- US EPA Method 16A - Total Reduced Sulfur – Impinger – Adapted Method for Air Quality Monitoring;
- US EPA Method 11 — Determination Of Hydrogen Sulfide Content Of Fuel Gas Streams In Petroleum Refineries – Adapted Method for Air Quality Monitoring;
- US EPA Method 18 - Volatile Organic Compounds by Gas Chromatography

In order to compare and assess the results registered, the limits stated by SEAM Resolution n. 259/2015 were considered and also the limits of the air quality standards presented by the US EPA - Environmental Protection Agency.

6.1.2.4 Results

The results are presented in the table below.

PÖYRY

Table 1 – Results of first air quality campaign

Resultados del Análisis

Concentración de Setiembre - Octubre/2019

Estación de Monitoreo	Colecta	Resultado del Monitoreo										En acuerdo con la Resolución SEAM nº 259 del 3 de júlio de 2015 (µg/m3)								CETESB	
		PTS (MP) µg/m³ (24 horas)	PI (PM10) µg/m³ (24 horas)	PI (PM2,5) µg/m³ (24 horas)	SO_2 µg/m³ (24 horas)	NO_2 µg/m³ (1 hora)	VOC µg/m³ (20 minutos)	O_3 µg/m³ (8 horas)	CO µg/m³ (8 horas)	TRS µg/m³ (1 hora)	H_2S µg/m³ (24 horas)	PTS	PI (PM10)	PI (PM2,5)	SO_2	NO_2	VOC	O_3	CO	TRS	H_2S
Punto 01 - Senacsa/ Comision Departamental de Salud Animal	1ª	69,37	42,39	31,96	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	2ª	136,99	70,90	56,31	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	3ª	201,09	93,51	65,84	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	4ª	150,55	78,23	58,41	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	5ª	113,27	53,59	42,82	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	6ª	130,91	64,34	52,52	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	7ª	178,64	63,88	50,36	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
Punto 02 - De Municipalidad de Loreto/ Paraguay	1ª	55,11	32,91	28,36	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	2ª	66,04	37,92	30,49	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	3ª	64,06	31,36	27,99	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	4ª	8,36	5,40	4,72	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.		150	30	20	200		120	10	6,55	6,55
	5ª	23,00	11,72	9,10	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	6ª	36,15	20,27	16,49	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	7ª	38,72	21,79	18,52	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
Punto 03 - Posto Policial Nacional - Comsaria nº18 Col. Roberto L. Petit	1ª	54,55	29,33	21,27	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	2ª	32,05	20,30	14,26	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	98,98										
	3ª	34,87	26,89	16,30	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	98,68										
	4ª	40,75	27,70	18,48	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	5ª	35,89	25,65	16,12	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	99,06										
	6ª	23,87	17,01	11,43	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	100,49										
	7ª	16,96	7,39	5,45	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	25,14										

Table 2 – Results of second air quality campaign

Resultados del Análisis Concentraciones de Febrero-Marzo/2020																					
Estación de Monitoreo	Colecta	Resultado del Monitoreo										En acuerdo con la Resolución SEAM nº 259 del 3 de július de 2015 (µg/m3)								CETESB	
		PTS (MP) µg/m³ (24 horas)	PI (PM10) µg/m³ (24 horas)	PI (PM2,5) µg/m³ (24 horas)	SO_2 µg/m³ (24 horas)	NO_2 µg/m³ (1 hora)	VOC µg/m³ (20 minutos)	O_3 µg/m³ (8 horas)	CO µg/m³ (8 horas)	TRS µg/m³ (1 hora)	H_2S µg/m³ (24 horas)	PTS	PI (PM10)	PI (PM2,5)	SO_2	NO_2	VOC	O_3	CO	TRS	H_2S
Punto 01 - Senacsa/ Comision Departamental de Salud Animal	1ª	59,93	34,35	23,95	17,63	1,09	N.D.	N.D.	N.D.	N.D.	N.D.										
	2ª	64,74	32,77	25,38	19,48	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	3ª	53,56	34,77	21,81	16,82	N.D.	0,18	N.D.	N.D.	N.D.	N.D.										
	4ª	48,89	29,94	19,18	13,28	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	5ª	49,91	27,52	16,79	12,46	N.D.	0,11	N.D.	N.D.	N.D.	N.D.										
	6ª	70,10	36,31	23,16	14,14	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	7ª	56,08	30,55	17,31	11,94	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
Punto 02 - De Municipalidad de Loreto/ Paraguay	1ª	42,31	25,48	19,54	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	2ª	70,43	38,33	29,94	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	3ª	67,22	27,47	30,34	N.D.	N.D.	0,15	N.D.	N.D.	N.D.	N.D.										
	4ª	76,89	43,09	35,94	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.		150	30	20	200	20	120	10	6,55	6,55
	5ª	40,11	26,30	20,66	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	6ª	59,36	26,96	20,74	N.D.	N.D.	0,38	N.D.	N.D.	N.D.	N.D.										
	7ª	60,93	30,70	23,28	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
Punto 03 - Estación de Policía Nacional - Comisária nº18 Col. Roberto L. Petit	1ª	107,18	38,13	27,37	N.D.	N.D.	0,01	N.D.	N.D.	N.D.	N.D.										
	2ª	83,68	29,73	20,09	N.D.	N.D.	0,21	N.D.	N.D.	N.D.	N.D.										
	3ª	165,03	58,49	44,16	N.D.	N.D.	0,18	N.D.	N.D.	N.D.	N.D.										
	4ª	103,01	42,58	25,62	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.										
	5ª	133,13	49,92	27,51	N.D.	N.D.	0,18	N.D.	N.D.	N.D.	N.D.										
	6ª	74,95	31,48	19,22	N.D.	N.D.	0,24	N.D.	N.D.	N.D.	N.D.										
	7ª	132,30	45,49	26,11	N.D.	N.D.	0,15	N.D.	N.D.	N.D.	N.D.										

Nota 1. Límite establecido por medio de la Resolución SEAM 259/2015
Nota 2. No Existe límite en establecido en la Resolución SEAM 259/2015 para Compuestos Orgánicos Volatiles (COV). Asimismo, empleose el límite de exposición fijados por base horaria (TWA) por la "American Conference of Governmental Industrial Hygienists (ACGIH)" para Tolueno, el COV identificado en el análisis.
Nota 3. No existe límite para comparación fijados por la Resolución SEAM n 259/2015, para los parámetros TRS e H_2S. Asimismo, se empleo el límite de percepción del olor para H_2S presente en la FISPQ del producto.

PTS - Total Suspended Particles

Considering Resolution n. 259/2015, there is no limit for Total Suspended Particles (TSP), being therefore in charge of the environmental body the interpretation of the reported results.

Inhalable Particles (IP - PM_{10})

Considering the limit established by Resolution n. 259/2015, whose maximum permitted 24-hour concentration of Inhalable Particles (PM_{10}) is 150 µg/m^3, after comparing the results obtained in the two monitoring campaigns, it was confirmed that in the monitored period all data collections were below the limit established in the regulations.

Respirable Particles (PR - $PM_{2.5}$)

Considering the limit established in Resolution n. 259/2015, whose maximum concentration in the 24-hour period of Respirable Particles ($PM_{2.5}$) is 30 µg/m^3, after comparing the data obtained in the two monitoring campaigns, it was revealed that all the collections of Point 01, and one collection of Point 02, presented concentrations above the regulations. It is possible that this is material associated with re-suspension of particulate matter from unpaved roads and emissions from vehicles running on diesel fuel. Other data obtained showed concentrations below the limit established by the aforementioned resolution in the monitoring period.

According to GEOAVALIAR, the difference observed in the premises has its origin in circumstances around Point 01, in Concepción, Paraguay. That monitoring point has unpaved public roads and is largely diesel-fueled vehicles. Thus, the phenomenon of re-suspension of particulates and vehicle emissions contribute by the addition in the analyses performed, since Points 02 and 03 are located respectively in a small jurisdiction and rural area and show little or no influence on the events verified.

SO_2 - Sulfur Dioxide

Considering the limit established by Resolution n. 259/2015, and the maximum permitted 24-hour concentration of Sulfur Dioxide (SO_2) of 20 µg/m^3, after comparing the results obtained in the two monitoring campaigns, the concentration below the regulatory limit was verified, because it was not detected.

NO_2 - Nitrogen Dioxide

Considering the limit established by Resolution n. 259/2015, and the maximum permitted 1 (one) hour concentration of Nitrogen Dioxide (NO_2) of 200 µg/m^3, after comparing the data obtained in the two monitoring campaigns, it was verified that all data collected were presented below the limit, once the parameter was not detected.

O_3 - Tropospheric Ozone

It is verified that the data obtained in the two monitoring campaigns presented data below the limit established in Resolution n. 259/2015 whose average concentration of 8 (eight) hours is 120 µg/m^3.

CO – Carbon Monoxide

The results obtained in the two monitoring campaigns were below the limit established by Resolution n. 259/2015, whose 8 (eight) hour average concentration is 10 µg/ m^3.

H_2S - Total Reduced Sulfur and Hydrogen Sulfide

There is no reference to emission limits for these parameters in the technical literature. Therefore, the control body must establish a comparison between the data obtained and international environmental regulations.

According to Geoavaliar, in Point 03 of the first campaign, possible sources of hydrogen sulfide pollutant emissions through lagoons and water wells containing vegetation in the process of eutrophication and putrefaction were verified in the location near the monitoring equipment and devices. From that consideration it's possible to consider the emission of hydrogen sulfide originated from the Anaerobic Digestion process (process of conversion of organic matter in conditions of absence of oxygen), are employed inorganic electron acceptors such as NO_3 (reduction of Nitrate), SO_4 (reduction of Sulfate) or methane formation (CH_4). Anaerobic digestion can be considered as an ecosystem of different groups of microorganisms that are in interaction to convert complex organic matter into methane, carbon gas, water, hydrogen sulphide and ammonia gas, and other new bacterial cells. It should be noted that the results obtained are expressed in micrograms per cubic meter of air collected, and any source of contribution in the vicinity is capable of significantly altering the results.

In the second campaign, it was observed that the contaminants Hydrogen Sulfide and Total Reduced Sulfur are below the odor perception limit for H_2S by the IFCS (6.55 $\mu g/m^3$).

VOCs - Volatile Organic Compounds

The results obtained are significantly below the American Conference of Governmental Industrial Hygienists (ACGIH) average daily value for toluene exposure of 20 ppm. The comparative value was adopted since Resolution n. 259/2015 does not state a standard for that contaminant.

6.1.3 Noise

PARACEL will carry out a Noise Monitoring for the area surrounding the plantations, in order to verify the environmental sound pressure level present in the area, prior to the project implementation and operation (background levels).

The sound pressure level will be compared with the limits established by the Law for the Prevention of Noise Pollution (Law n. 1,100/97).

Law n. 1,100/1997 aims to prevent noise pollution on public roads, squares, parks, sidewalks, exhibition halls, meeting centers, sports and social clubs and in all public and private activities that produce noise pollution in Paraguay.

Article 9th of the aforementioned law establishes the noise limits, according to the type of environment, as shown in the table below.

Table 3 – Noise limits established by Law 1100/97 (in decibel "A" dB (A))

Environment	Night (20:00 – 07:00)	Day (07:00 – 20:00)	Day (Occasional peak) (07:00 – 12:00 / 14:00 – 19:00)
Residential areas, specific use, public spaces: recreation areas, parks, squares and public roads	45	60	80
Hybrid areas, transition areas, city center areas, specific programs, service areas and public buildings	55	70	85
Industrial area	60	75	90

In addition, it should be noted that the PARACEL project will be based on international standards, such as noise level guidelines from the General EHS Guidelines of IFC, as shown in the table below.

Receptor	Day 07:00 to 22:00	Nightime 22:00 to 07:00
	One Hour L_{Aeq} (dBA)	
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Source: General EHS Guidelines: Environmental - Noise Management by IFC, 2007.

6.1.4 Geology

From a geological point of view, Paraguay is located on two different formations: the Brazilian shield and the Andean Depression, which largely correspond to the regions already mentioned. The eastern region is more diverse in its origin, with formations originating in the Mesozoic, Paleozoic and even the Agnostozoic, one of the oldest formations, while the whole of the Chaco territory, with few exceptions, corresponds to Tertiary layers, with relatively recent geological ages between two and 65 million years (DBEnvironnement, 1999).

The following figure presents a synthesis of the geology of Paraguay and the stratigraphic column of the geology of Paraguay. The regional geological characterization and the areas of influence of PARACEL Eucalyptus Plantation are presented below, with data from the website of the Vice-Ministry of Mines and Energy.

The following information has been extracted from the Pulp Mill and Port Environmental Impact Study & Report (EIAp/RIMA): Book I - Environmental Diagnosis Of The Physical Environment (PÖYRY, 2020).

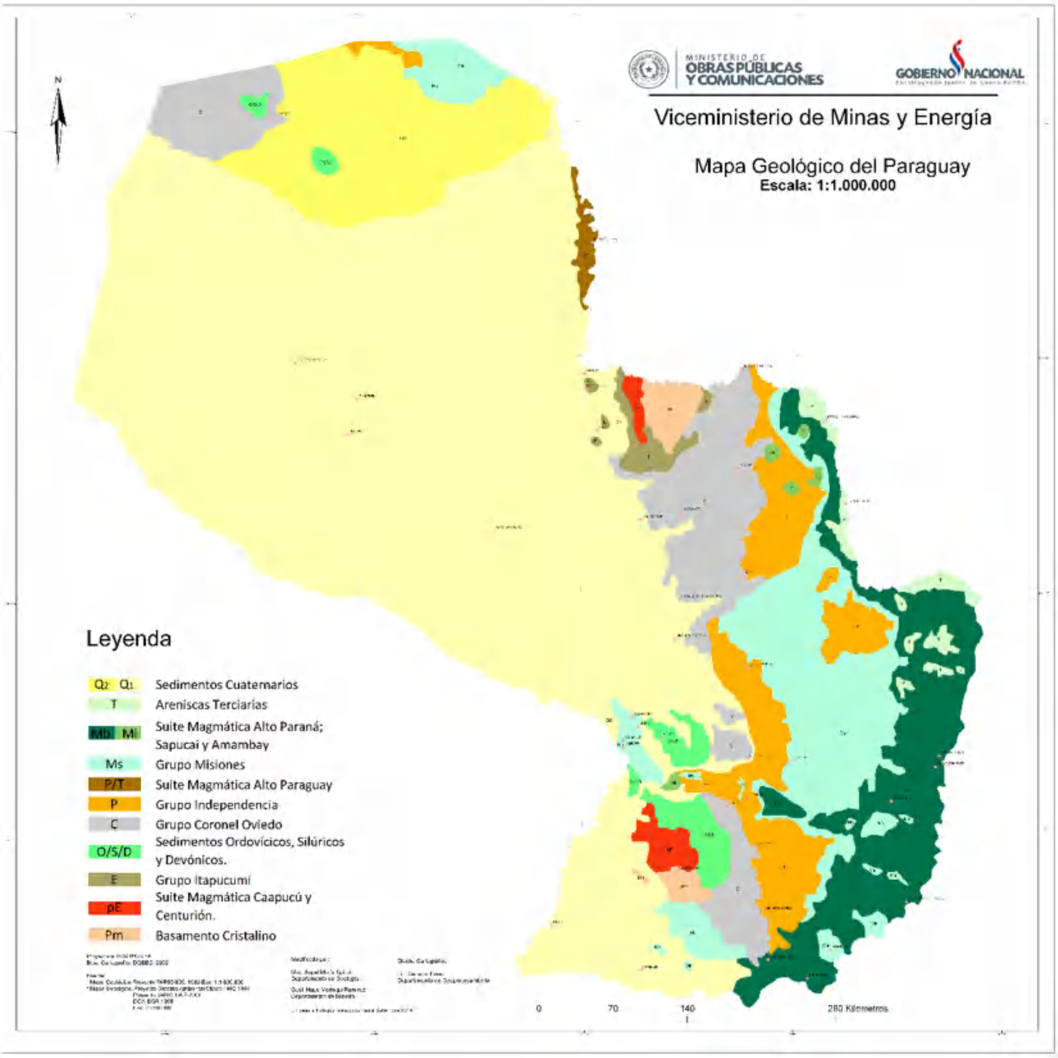


Figure 31 – Synthesis of the Geology of Paraguay. Source: González, 2000

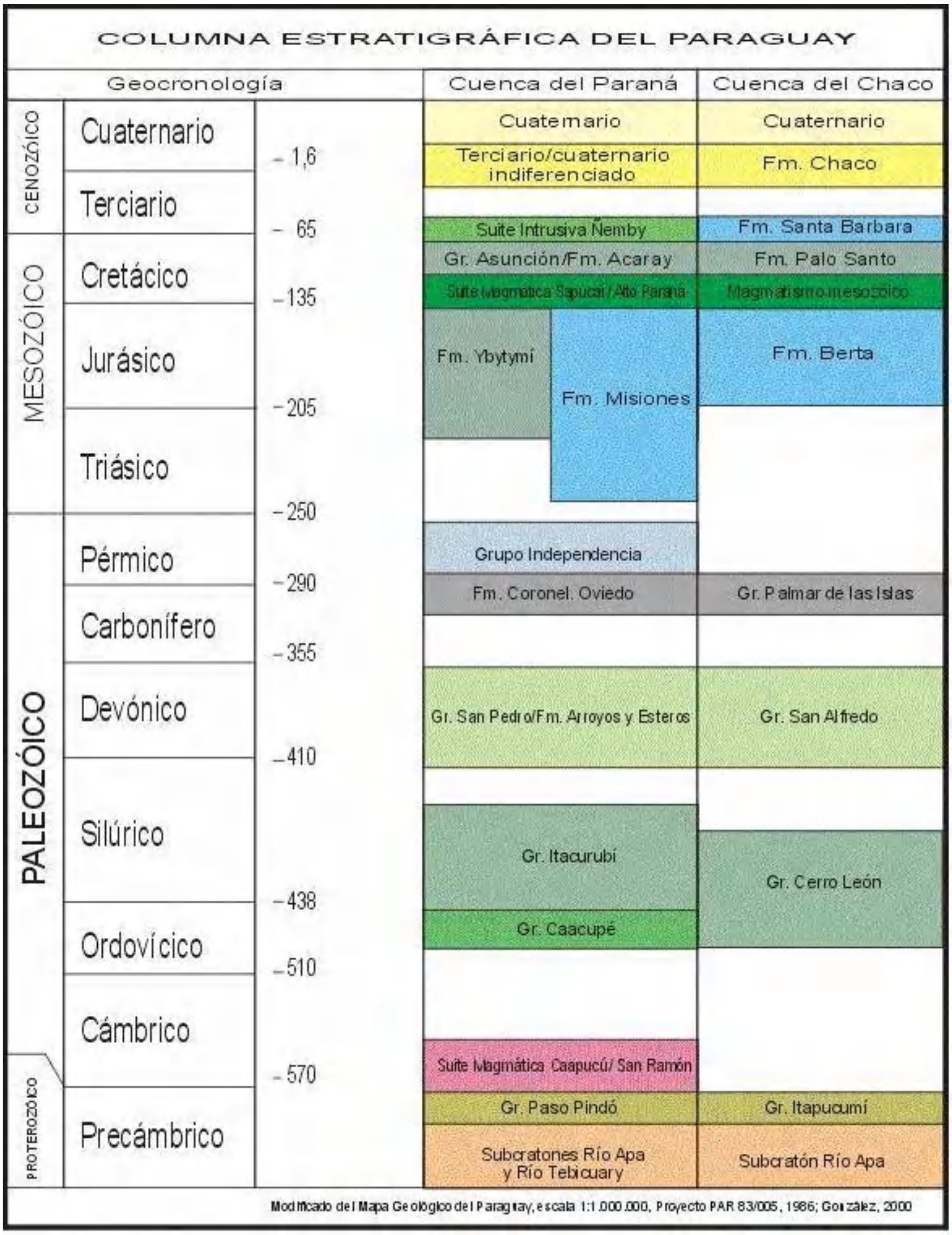


Figure 32 – Tectonic-Stratigraphic Column of Paraguay. Source: González, 2000

6.1.4.1 Regional Characterization (IIA)

6.1.4.1.1 Chratonical Provinces

The Chrathonic Provinces of Paraguay are located mainly in the Eastern Region and occur in two distinct areas. One to the north in the border area with Brazil, called the Province of Rio Apa and the other, the Province of Rio Tebicuary in the Central-South.

Both provinces are formed by chronic blocks that include the oldest units with Paleoproterozoic ages, Meso Proterozoic Folded Belts and Neoproterozoic-Eocambrian platform units.

The Apa River Block is made up of the homonymous complex and is represented mainly by gneiss, mafic and leukocratic, granite-gneiss, metasediments and granitic-pegmatic intrusives of Lower to Middle Proterozoic age and the Centurion Magmatic Suit corresponding to thick granite-type plutonic-volcanic rocks, sometimes porphyritic and acidic to intermediate pyroclastic metavolcanic rocks, of Middle Proterozoic age (K/Ar 1,650 ± 63 Ma).

The Apa River Complex is disproportionately covered by carstic metasedimentites of the San Luis Group, in its western portion, while in the eastern part it is superimposed by carbonate-classic rocks of the Itapucumi Group of Vendian age. Both units, in turn, are intruded by plutonic igneous and intermediate acidic volcanic rocks called San Ramon Magmatic Suites. This last magmatism is considered a non-detectonic event of the Brasiliano Cycle.

The Province of Rio Apa is mainly a producer of limestone, calcite, dolomitic and marble. It also presents anomalies of metallic minerals such as Ag-Pb-Zn and tin; in addition, there are quartz veins, pegmatites carrying large sheets of muscovite and other pegmatites carrying tourmaline and beryl.

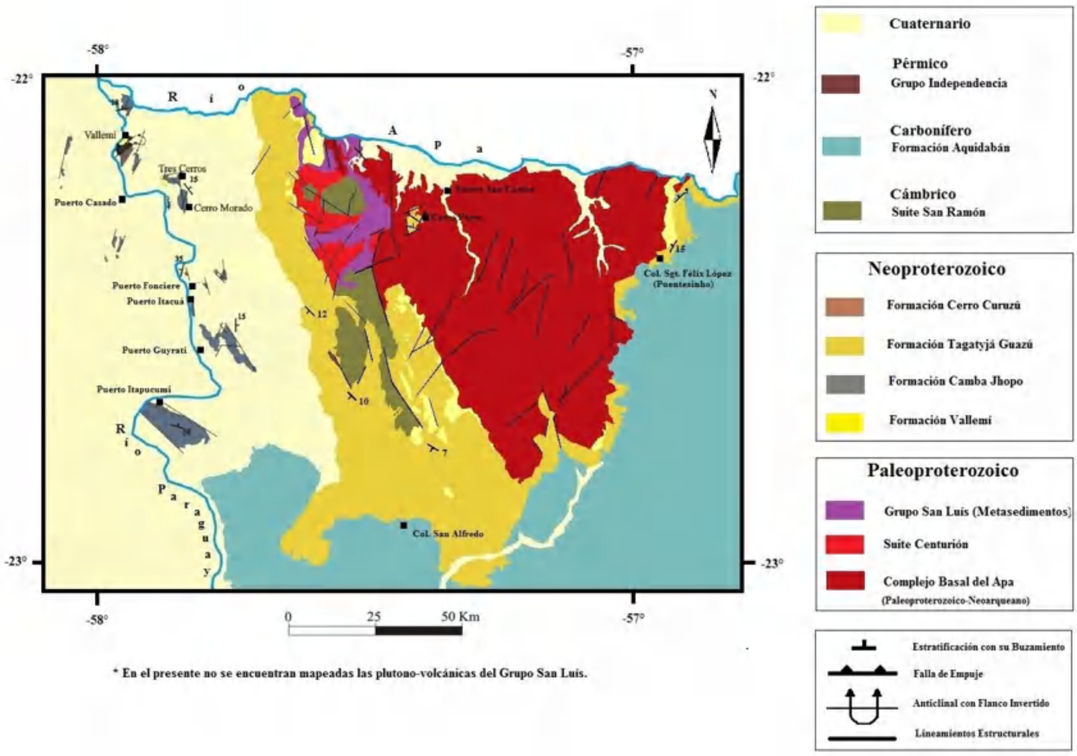


Figure 33 – Craton of Apa river. Source: website Geología del Paraguay

The Rio Tebicuary Block located southeast of Asuncion is represented by three lithostratigraphic units: Rio Tebicuary Complex, Paso Pindó Group and the Caapucu Magmatic Suite.

The Tebicuary River Complex includes two units: the Villa Florida Metamorphic Suite and the Centu-Cué Granodiorite. The first one gathers a set of crystalline rocks affected by regional metamorphism of medium to high degree, within the amphibolite and granulite facies, of Lower Proterozoic age, Transamazonian Cycle (2,000 ± 200 Ma).

Lithologically, this unit is constituted by paragneis and orthogneis, associated with quartzite, chalcosilicate, marble, amphibolite and ultrabasic rocks, transformed into talc shale and serpentinite. On the other hand, the second unit is represented by intruded porphyritic acid rock in the gneisses. This last event evidences intense deformations during the synthetodetectonic phase of the Trans-Amazonian Cycle, generating folding, migmatization and fracturing.

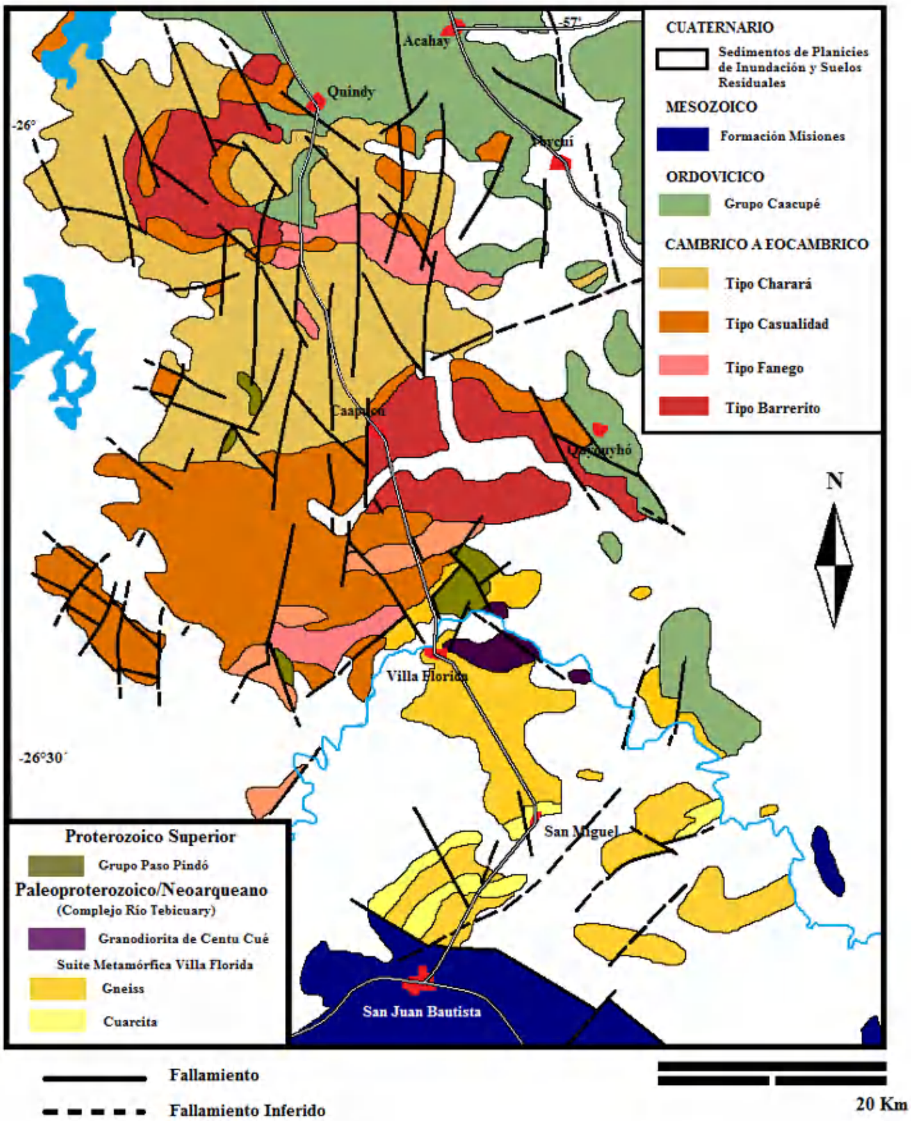


Figure 34 – Craton of Tebicuary river. Source: website Geología del Paraguay

The Paso Pindó Group takes a divergent position on the Tebicuary River Complex. This unit, made up of silica sediments and volcanic-clastic sediments, has been affected by a low grade metamorphism (easy from green shales), during the Brasiliano Cycle, in the Upper Proterozoic (± 600Ma).

The Caapucu Magmatic Suite intrudes in the post-tectonic phase of the Brasiliano Cycle to the Tebicuary River Complex and the Paso Pindó Group. This acidic magmatic event is constituted by rocks with several emplacement levels (plutonic, hypoabyssal and effusive), mainly from coarse to porphyritic granites, granite/rhyolite porphyry and rhyolite, of Rb/Sr 531 ± 5 age (Cubas et al. 1997).

Small isolated occurrences of granitic rocks in the Caapucu Magmatic Suite, occur in the center of the Eastern Region, associated with the structuring of the Asuncion Rift.

With regard to tectonics, the Tebicuary River Block can be divided into two main events: the Trans-Amazonian Cycle (Tebicuary River Complex) and the Brazilian Cycle (Paso Pindó Group and Caapucú Magmatic Suite).

6.1.4.1.2 Phanerozoic Basin

The Phanerozoic in Paraguay is represented by two large basins: Chaco Basin and Parana Basin. In them, sedimentary sequences of ages: Ordovisic/silurian constitute the deposition base, in the marginal zone of the Paleo-Pacific Plate, before the subduction with the Gondwana continent.

6.1.4.1.2.1 Paraná Basin

The Paraná River Basin covers a vast area of the South American continent, approximately 1,500,000 km^2, occupying parts of southern Brazil, northeastern Argentina, eastern Paraguay and northern Uruguay. With its major axis oriented in the NNE-SSW direction and its structural depocenter located along the Paraná River, with a record of sedimentary and volcanic rocks, whose total thickness exceeds 7,000 meters.

In Eastern Paraguay, six wide-scale sedimentary sequences or super sequences are recognized, separated from each other by regionally discordant surfaces (MILANI, 1997).

The first super sequence of Ordovician/Silurian age is found in discordant contact on the crystalline basement, observed east of Asunción, in the Acahay Valley and bordering the northeast of the Tebicuary River Block. This is a group of sedimentary rocks deposited in a continental environment that is morphologically abrupt, in lateral contact with a transgressive sea, which reaches the maximum flooding in the Lower Silurian. In its coastal environment it deposits conglomerates, interspersed with conglomerate sandstones, which gradually turn into sandstones, forming a group of thick clastic rocks called the Caacupé Group. Concurrently, the sequence continues with clastic rocks of the Itacurubi Group, mainly made up of fine sandstones, shales and claystones, highly fossiliferous, constituting the geochronological supports of the sequence, with the inferior Silurian llandover age.

Devonian-age rocks are arranged in discordance with the previous one, in continental and marine deposits. Rocks of marine origin were not directly observed in the field, being identified only in the Asunción 1 and 2 exploratory wells (PECTEN, 1982), in which about 450 meters of these sediments were described. Those of continental origin rest in erosive discordance on the Silurian fossiliferous units. These have been first identified in wells and called Santa Elena Formation (GONZÁLEZ ET AL., 1994), later geological mapping works defined coarse sandstones as belonging to this unit, calling them Arroyos and Esteros Formation (DIONISI, 1999).

The deposition of the Devonian sequence is interrupted by continental readjustment tectonism (Eoherceric Orogenia). This event is responsible for the restructuring of the basin in the Lower Carboniferous, with sedimentation resuming from the Upper Carboniferous (Stephaniano), as the third Carboniferous/Permian super sequence. It is environmentally influenced by very varied climatic conditions, beginning under glacial and periglacial dominance, depositing the Aquidaban and Coronel Oviedo formations, as a succession of continental and marine clastic sediments. The Permian deposits, in regional agreement, sediments of continental wind and fluvial, coastal and marine environments, which in a lithologic point of view are characterized by sandstones, siltstones, claystones and limestones, which agglutinate in the Independencia Group.

The continentalization of the Paraná Basin from the Upper Permian, in the Triassic, deposited continental fluvial and eolian sandstones, called Misiones Formation. This group is distributed in a north-south strip, deposited in discordance on carboniferous/Permian rocks.

The Misiones Formation windsand sandstones are characteristically quartz sandstone, homogeneous, with little clayey material as a matrix, little cemented, friable, saccharine and locally silicified. Overlying and interspersed with the aeolian sandstones there are intrusions and extrusions of basaltic rocks of the Upper Parana Magmatic Suite. These are presented as lava spills, sills and dikes in sediments of the pre-existing units, in preferential northwest-southeast directions. Petrographically the basaltic rocks show a subophytic texture, joint crystallization of pyroxene and plagioclase, of age between 127 and 108 million years. The upper divergent contact of the suite is deposited sandstones of the Acaray Formation and/or quaternary sediments.

6.1.4.1.2.2 Del Chaco Basin

The Chaco Basin is bounded on the west by the Andes Mountains and on the east and northeast by the Brazilian shield; it occupies an area of 246,725 km^2, in the Western Region of Paraguay. It is a pericratonic basin, formed by several depocenters or sub-basins separated by structural highs, each one of them with a unique tectonic-sedimentary record. To the NW the Curupayty and Carandayty sub-basins are accommodated, both representing areas with well-developed Paleozoic sequences. On the other hand, Mesozoic-Cenozoic subsidence areas occur mainly in the Pirity and Pilar sub-basins. The tectonic style of the Chaco Basin is characterized by the presence of NW and NE structural guidelines of Brazilian age. Later reactivations of these structures, during the Paleozoic, result in the characterization of four subsidence cycles: Lower Paleozoic, Upper Paleozoic, Upper Mesozoic and Cenozoic. The phases are separated by erosive discordances or absence of sedimentation.

The sedimentary cycle of the Lower Paleozoic is represented by continental and marine clastic deposits of Ordovician, Silurian and Devonian ages. The Ordovician-age sediments (Cerro León Group) are preserved in depth in the Carandayty sub-basin. In contrast, occurrences of sedimentary rocks attributed to the Silurian and Devonian are presented in the northwestern portion, associated with high structures (Cerro León and San Alfredo Range).

The sedimentary cycle of the Upper Paleozoic, carboniferous/permian sequence, constitutes the Group "Palmar de las Islas", mainly composed of deposits in the Carandayty and Curupayty sub-basins, as well as some outcrops in the northern portion of the Chaco, associated with the Alto de Lagerenza. The Carboniferous age sediments are composed of two units, a lower one or San José Formation, made up of sandstones combined with claystones, sticks and diamictites. The upper unit or Cabrera Formation, starts with local conglomerates and mainly sandstones, with higher levels of clay and oolitic limestone.

The Mesozoic/Cenozoic unit, called the Adria Jara formation, is composed of sandstones with conglomerate levels and claystone, found mainly in the Curupayty sub-basin, in erosive discordance on carboniferous sediments.

On the other hand, the Mesozoic-Cenozoic sediments in the Pirity sub-basin comprise three formations: Berta, Palo Santo and Santa Barbara. The first is made up of sandstones interspersed with claystone, the second is made up of intercalations of conglomerate sandstones, sandstones, claystones, marls and evaporites; finally, the Santa Bárbara Formation consists of sandstones, siltstones, claystones, evaporites and calcareous.

In the Pirity sub-basin there are magmatic rocks of basaltic composition of Lower Cretaceous age (128 ±5 Ma).

During the Lower to Middle Eocene, between 500 and 1,000 meters of continental sediments were deposited in several depots of the Chaco Basin, in marine parts, called Chaco Formation. In general, this formation consists of alternating sandstones, silts and claystones.

The Quaternary period in the Chaco Basin is a continuity of the Chaco Formation sedimentation, with heterogeneous continental deposits.

6.1.4.1.3 Alkaline Magmatism

The alkaline rocks of Paraguay occur in various parts of Eastern Paraguay distributed in six provinces: Alto Paraguay, Rio Apa, Amambay, Central, Asuncion and Misiones, these rocks are tectonically associated with extensional structures (continental rifts, intersection of structural lines and lines in areas of chronic margins), which affected the western portion of the Parana Basin in the Mesozoic. The alkaline provinces of Paraguay differ from each other in their petrographic, chemical, geochronological and tectonic characteristics.

The petrographic composition of these rocks presents great variation, with greater predominance of alkaline silica rocks, unlike carbonatite rocks which are restricted to only one province (Amambay Province). Chemically, the silicatic lithologies vary from ultrabasic to acidic and in general represent differentiated petrographic terms. As for the Na/K ratio they can be differentiated in sodium alkaline provinces and potassium alkaline provinces.

Evidence from geology and geophysics indicates that the conditions of alkaline rocks in Paraguay are strongly controlled by a distensional tectonics developed during the Mesozoic, related to the fragmentation of the Gondwana and opening of the South Atlantic

In terms of geochronology, these rocks cover a wide age spectrum extending from 255 million years to 39 million years.

In general, alkaline rocks are associated with Paleozoic-Mesozoic sediments and are covered by recent alluvial deposits.

The mode of occurrence is also quite diversified and varies from province to province. The intrusive forms appear as annular complexes (Alkaline-Carbonate Complex) and stocks. The extrusive forms include lavas, domes and plug and the hypoabyssal forms generally in the form of embankments or swarms of embankments.

6.1.4.2 Local Characterization (DIA)

The PARACEL Eucalyptus Plantation is inserted in 4 different groups, which are E – Itapacumi Group, Pc – Caacupé Group, C - Coronel Oviedo and Q1 - Quaternary Sediments

6.1.4.2.1 E- Itapacumi Group

The group rests on the previous units in strong angular unconformity. In Cerro Paiva, near the San Luís stay, it is located directly over the Basal Complex and has continuity towards the E under the youngest sedimentary cover, of Permo-Carboniferous age (Aquidabán Formation), as can be seen to the W of the Santa Luisa Ranch. on the Bella Vista - San Carlos Route. It occupies an area of 2,075 km^2 in the eastern region of the country and 45 km^2 in the western part, in isolated outcrops near the Paraguay River.

The group begins with a shallow basal conglomerate, progressing to an arcosic and sandy sequence. However, it is predominantly made up of calcareous with oolitic layers, finely laminated layers, clay banks and probable stromatolytic and marble levels (Wiens, 1982). Locally there are brecciated layers whose fragments are made up of the limestone itself. Wiens (1986) calls this sequence "Itapucumi Group" from the Itapucumi series.

The age of the Itapucumi Group is from the Upper Proterozoic (Vendian) to the Lower Cambrian (Zaine and Firchild, 1985) according to determinations made on the fossil content in the northern part of Brazil (Corumbá Group).

6.1.4.2.2 Pc – Caacupé Group

It outcrops NE of Asunción, in the Cordillera de los Altos, from the Ypacaraí valley to the homonymous city. To the south of Asunción there is an extensive band of outcrop, from Roque González de Santa Cruz to Quiindy, Quyquyhó and Mbuyapey. The group is divided into three formations: Fm.Paraguarí, Fm.Cerro Jhú and Fm.Tobatí and its deposition probably begins in the Upper Ordovician.

6.1.4.2.3 C – Coronel Oviedo Group (Independencia Group)

The group is made up of the San Miguel and Tacuary formations, of Permian age, which emerge in Eastern Paraguay in an area of 7,996 km^2. The name Independencia Serie was used by Harrington (1980), to designate the sedimentary layers of the upper Permian. In 1956, the same author designated the same unit of the Independencia Formation, (ECKEL, 1959) he again used the denomination Independencia Series in a Gondwana or Santa Catarina system. Putzer (1962) called the Permian age layers the Passa Dois Serie.

In the description of the geology of grid 41, Coronel Oviedo (ANONYMOUS, 1966), the lower and middle Permian-age layers are called the Ybytyruzú Series, divided into the Pañetey and Independencia Formations. Wiens (1982) proposes for the Permian the division into San Miguel, Tacuary, Tapytá and Cabacuá formations. In the preliminary adaptation of the stratigraphic column of Paraguay, for the PAR-83/005 Project, these formations were gathered in the Independencia Group. In this explanatory text the Independencia Group is divided into the San Miguel and Tacuary formations with the elimination of the Tapytá and Cabacuá formations which, in reality, belong to the base of the Triassic/Jurassic age unit.

The group emerges maintaining the direction of the so-called Gondwanic layers, N-S/NNW-SSE, with dipping towards the E, in areas that are frequently faulty. North of the Jejuí/Aguaray Guazú Fault zone, in the Alto Apa, the Group is absent due to erosion in the Lower Triassic. The formations of the group are correlated with the units of the groups Guatá and Passa Dois, in the Paraná Basin, in Brazil.

6.1.4.2.4 Q1 – Quaternary Sediments

The accumulated sediments are grouped here, near the area of the Paraguay River and its tributaries, which are at a lower elevation of 70 meters, in the eastern region of the country. It covers an area of 60,782 km^2. It is made up of a light creamy sandstone, of medium to coarse granulation with scattered gravel, interspersed with shales. The sandstones, in contact with these shales, present clay clasts. There are also layers of clayey sandstones up to 1.5 metres thick. The sedimentation environment is essentially water-based (fluvial).

In Candú Creek, on the property of Señor Virgilio Larrea, there are vertebrate fossils that were described by Presser and Crosa (1984). These fossils found in the described place, in the locality of Ytororó, are contained in a sedimentary succession described by the mentioned authors as:

- Blue-green sediments, with good selection, predominance of medium-grained sands, apparently solid, associated with clay sheets;
- Poorly selected sediments with a predominance of medium to thick sand and secondary layers of clay. They present levels with fossils in contact with the previous sequence and;
- Spotted sediments, with good selection, with medium grain sands and subordinate fine sands and clay. Apparently massive.

According to the same authors, the fossils found are typical of a Pleistocene fauna and present three species of Glyptodonts, two of Lestodontes and one of Megatherion associated with other vertebrates not clearly systematized.

The name San Antonio formation is formally proposed for the lithostratigraphic designation of these sediments, based on a proposal by Palmieri and Velazquez (1982). In the valleys of the current drainage network of Eastern Paraguay, from the Apa River in the north to the Paraná River in the south and east, and the Paraguay River in the west, there is an extensive deposition of Holocene age sediments.

6.1.5 Geomorphology and Topography

The Paraguay River divides the country into two distinct regions: the Gran Chaco or Western Region in the west and the Jungle or Eastern Region in the east, which is considerably mountainous. The Gran Chaco is part - except for the western end - of an alluvial plain that extends from Paraguay to the bordering countries and is covered with grasslands, swamps and bushes. The jungle is formed mainly by the southern portion of the Paraná plateau, at an elevation of 305 to 610 m, which constitutes a basin where numerous tributaries of the Paraguay and Paraná rivers originate; and by the gentle mountain ranges that are part of the Brazilian system that penetrate this area, creating wild valleys.

To the west, the plain drops precipitously into a region of hills covered with fertile pastureland that ends at the Paraguay River. The main mountain system is made up of the Amambay, Mbaracayú and Caaguazú mountain ranges, which have altitudes that rarely exceed 800 meters. Another secondary mountain system, located in the center of the country, is formed by the Cordillera de los Altos, Ybytypanema and the so-called Cordillerita. Among the most outstanding peaks are the Tres Kandú (842 m), Capii (816 m) and Peró (815 m) mountains, all in the department of Guairá. Some authors consider, however, that Paraguayan territory is structured in three regions: the aforementioned

Chaco and Selva regions, and the region known as Campo, which extends through the most depressed sector of the Paraguayan valley and the final stretch of the river courses that drain into it, that is, the central and southern area of the country.

The following is a geomorphological characterization of the influence areas of the PARACEL Eucalyptus Plantation. The following information has been extracted from the Pulp Mill and Port Environmental Impact Study & Report (EIAp/RIMA): Book I - Environmental Diagnosis Of The Physical Environment (PÖYRY, 2020).

6.1.5.1 Regional Characterization (IIA)

Most of the Eastern region has a slightly undulating topography, with an elevation that varies between 50 and 750 meters above sea level. Its major orographic systems are the Amambay, Mbaracayú, Ybytyrusú and Caaguazú mountain ranges. The highest point is Cerro Pero (Cerro Tres Kandu), with 842 meters, located in the IV Department of Guairá.

The following figure shows the topography map of Paraguay, highlighting the points of highest elevation.

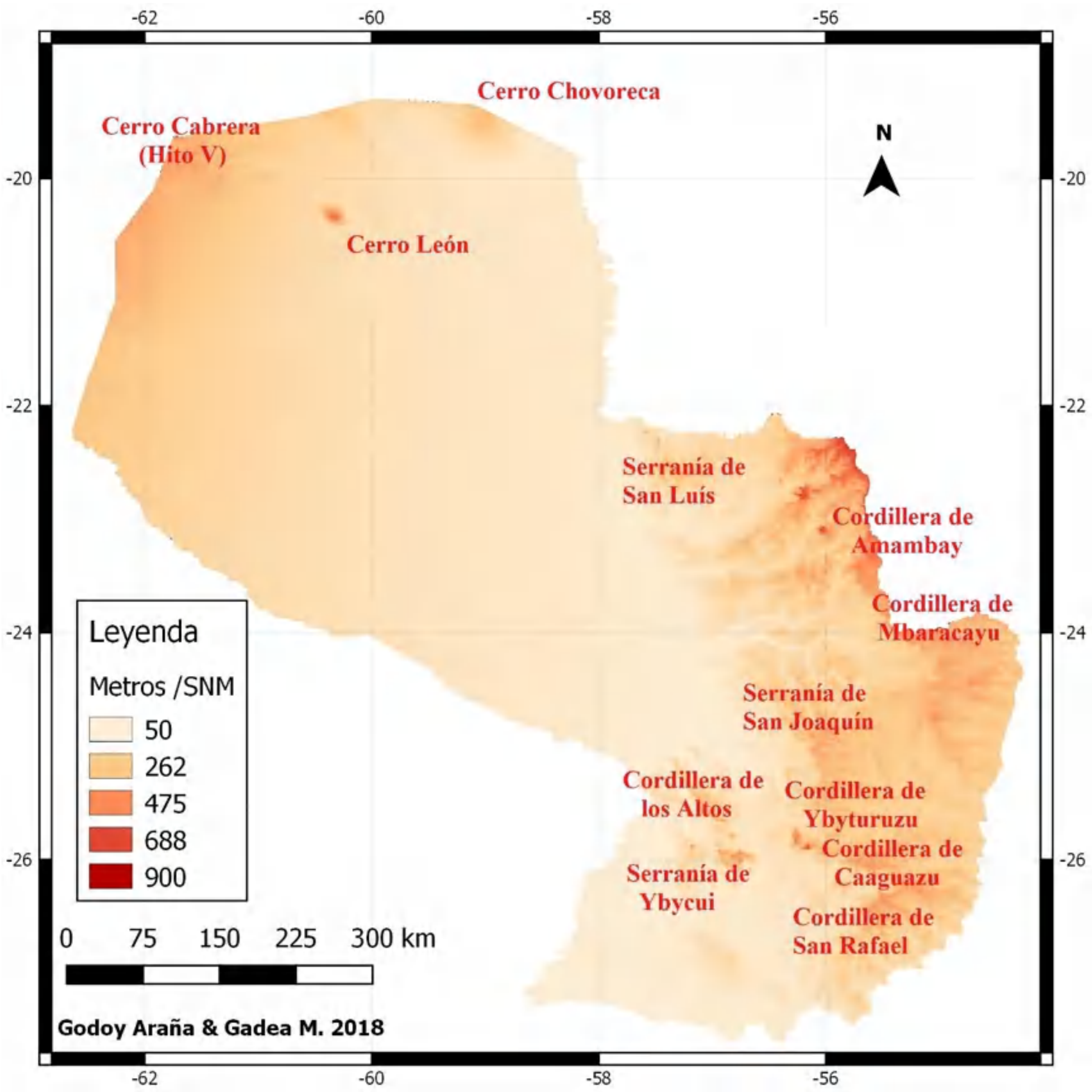


Figure 35 – Map of Topography and Orography of Paraguay. Source: Godoy Araña & Gadea (2018)

6.1.5.2 Local Characterization (DIA and DAA)

The topography of the areas of influence of the PARACEL Eucalyptus Plantation has plateaus and valleys, which are flat to almost flat lands that receive the drainage water from the high places, which are the hills and mountains.

The valley is flanked by higher places and is narrower than it is long, while the plain, also called the "llanura", is a large area both wide and long (flatlands), further away from the high places.

According to the Geology of Paraguay site, in the Departments of Concepción and Amambay, you can see Cerro Memby, Vallemi, Aceite, Akangue, Alambique, Guazu, Muralla and Sarambi.which geomorphologically, according to its characteristics, would be assigned the name of Butte (isolated hills with cliffs). It is constituted essentially by red sandstones of the Triassic - Jurassic known as the sandstones of the Misiones Formation. To acquire this form, an intense material removal (erosion) had to have occurred in the course of geological time.

6.1.6 Seismicity

Paraguay, located in the south-central part of the South American Plate between the Andean Orogen and the Paraná Basin, presents low to moderate seismicity, compared to the countries of the Andean region.

Knowledge of the seismic activity of Paraguay is in its initial stages, not having a bibliographic and / or reference documentary base on the subject, as an initial activity a data bank has been organized resorting to the compilation of isolated information of macrosisms in the files found in the written press from the 1950s that refer to "tremors" felt in the country and with seismic data provided by news agencies in neighboring countries.

Reliable data on seismic activity in Paraguay began to be compiled in 1979 with the installation around Lake Itaipu, on the border between Paraguay and Brazil, a seismic network composed of eight seismographs to cover an area of 14,500 km^2 to monitor the seismicity of the mega dam built between the two countries.

At the beginning of the nineties, through a scientific and technological cooperation agreement between the Government of Paraguay and that of the United States of America, one of the seismic stations of the Global Telemetered Seismographic Network was installed in the national territory, (GTSN), a three-component primary seismic station that provides data on local and regional seismic events, helping to improve knowledge of Paraguay's seismicity.

During the last years the continuous monitoring of seismic events has evidenced the occurrence of earthquakes with magnitudes ranging between 2.5 to 5.6 mb. The Paraguay River represents a North-South orientation fault, which separates the western block (Chaco Basin) with a higher occurrence of seismic activity than the more stable eastern block (Parana Basin) from the seismic point of view of the country.

The analysis of the Catalog of seismic events and distribution of the epicenters in the geological-structural map of Paraguay, suggests a correlation with the geological and tectonic characteristics of the region.

The seismic activity in Paraguay is related to two seismogenic zones: (Berrocal, J., and Fernández, C., 1991) the seismic activity that occurs in the western block related to the subduction of the Nazca Plate with the South American Plate and earthquakes occurring in the eastern region related to shallow intraplate events, probably caused by rearrangement of local geological structures.

Finally, although Paraguay is located in a region not prone to earthquakes, with a moderate to low seismicity that should not be ignored, considering the historical seismicity data. The figure below shows that within the catalog of seismic events available in Paraguay, there were no events within influence areas of the PARACEL Eucalyptus Plantation.

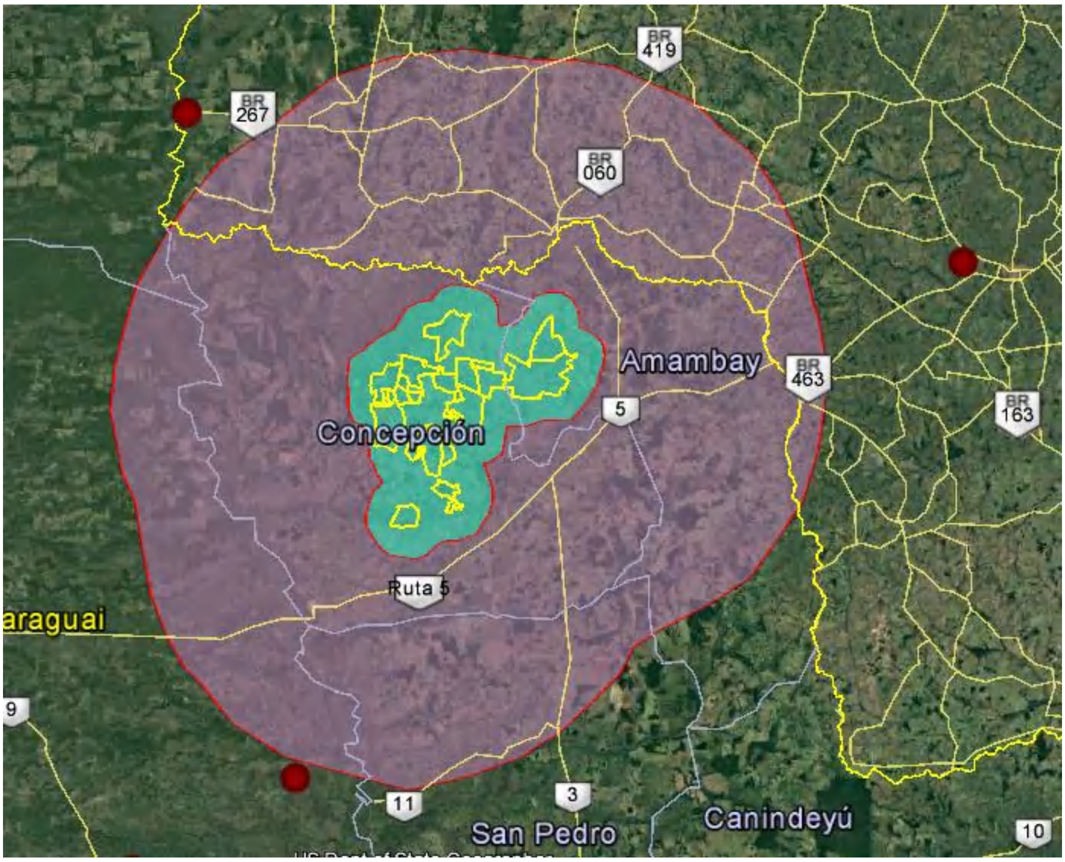


Figure 36 – Epicenters of nearby seismic events in PARACELs influence areas of Eucalyptus Plantation. Source: Berrocal, J., and Fernández, C., 1991

6.1.7 Current use of soil/land use

Although about a fifth of Paraguay's total area is suitable for intensive cultivation, only a small part of it is used constantly, and practically everything is in the Eastern Region (BRITANNICA, 2021).

The western region over the centuries was a sparsely populated area, representing 60% of the territorial area and with only 2% of the population (MOLINAS et al, 1995). From 1995 onwards, a more intense territorial occupation started by cattle ranchers for meat production (COSTA; MORETTI, 2016), which is still their main land use until today. However, the main economic activities in the country occur in the eastern region of Paraguay, including agricultural and forestry activities (GOROSTIAGA et al, 1995).

Agriculture occupies approximately 34% of the territory, as shown in the table below.

Table 4 – Distribution of land use types in Paraguay

Types of use	Surface (km²)	%
Native Forest	36,834	23.5
Agriculture	53,113	33.9
Pasture	19,745	12.6
Flooded Area	39,832	25.4
Others	7.275	4.6
Total	**156,799**	**100.0**

Official information on Paraguay's land use dates back to 1995 and with incipient information about land use for planted forests. No specific surveys were found for the influence areas of the PARACEL Eucalyptus Plantation.

6.1.8 Hydrology

Paraguayan territory belongs entirely to the great basin of the River Plate, one of the largest rivers in the American hemisphere, as well as in the whole world, due to the extension, the flows it produces, and its natural resources (PMCIC, 2014).

The basin of the Plata is, by its geographical extension and the flow of its rivers, one of the most important in the world. Its importance also lies in the fact that it is a territory shared by five countries (CIC, 2020).

With its 3.1 million square kilometers, the Plata Basin occupies one fifth of South America, including territories of Argentina, Bolivia, Brazil, Paraguay and Uruguay, as seen in the following figure (CIC, 2020).

The waters of two large rivers converge in the Río de la Plata: the Paraná and the Uruguay, both of which, by their turn, collect the flow of other very important rivers, such as the Paraguay, the Bermejo, the Pilcomayo and the Iguazú, among many others (CIC, 2020).

Through its wide estuary in the Atlantic Ocean, the Plata Basin delivers a flow of 25,000 m^3/s to the sea.

Figure 37 – Basin of the Plata by country. Source: CIC (2020)

Water resources management

Thus, in Paraguay, there is concern about water resources highlighted by the extensive legal framework, among which are SEAM Resolution n. 222/2002 (Standard of Water Quality in the Entire National Territory), SEAM Resolution n. 50/2006 (National Water Resources Management), SEAM Resolution n. 255/2006 (Classification of All Waters of Paraguay in Class 2) and Law n. 3239/2007 (Water Resources of Paraguay).

In accordance with Law n. 3239/2007, the integrated and sustainable management of Paraguay's water resources is governed by the following principles:

a) Water, whether surface or underground, is the public property of the State and its ownership will not be subject to any form of limitation.

b) Access to water for the satisfaction of basic needs is a human right and must be guaranteed by the State, in adequate supply and with appropriate quality

c) Water resources have multiple uses and functions and this characteristic must be adequately addressed, respecting the hydrological cycle and always favoring, in the first place, the use for consumption by the human population.

d) The hydrographic unit is the basic unit for water resources management.

e) Water is a natural good that conditions the survival of all living beings and the ecosystems that shelter them.

f) Water resources are a finite and vulnerable good.

g) Water resources have a social, environmental and economic value.

h) Water resources management should be carried out within the framework of sustainable development, and should be decentralized, participatory and gender-sensitive.

i) The Paraguayan State possesses the non-transferable and non-delegable function of property and guardianship of national water resources.

The management of water resources in Paraguay occurs through the hydrographic units, which are the basic management units, according to Law n. 3239/2007.

In Paraguay, there are 19 Hydrographic Units (Figure above) classified in two regions: the Western Region and the Eastern Region, according to Resolution n. 376/2012.

.

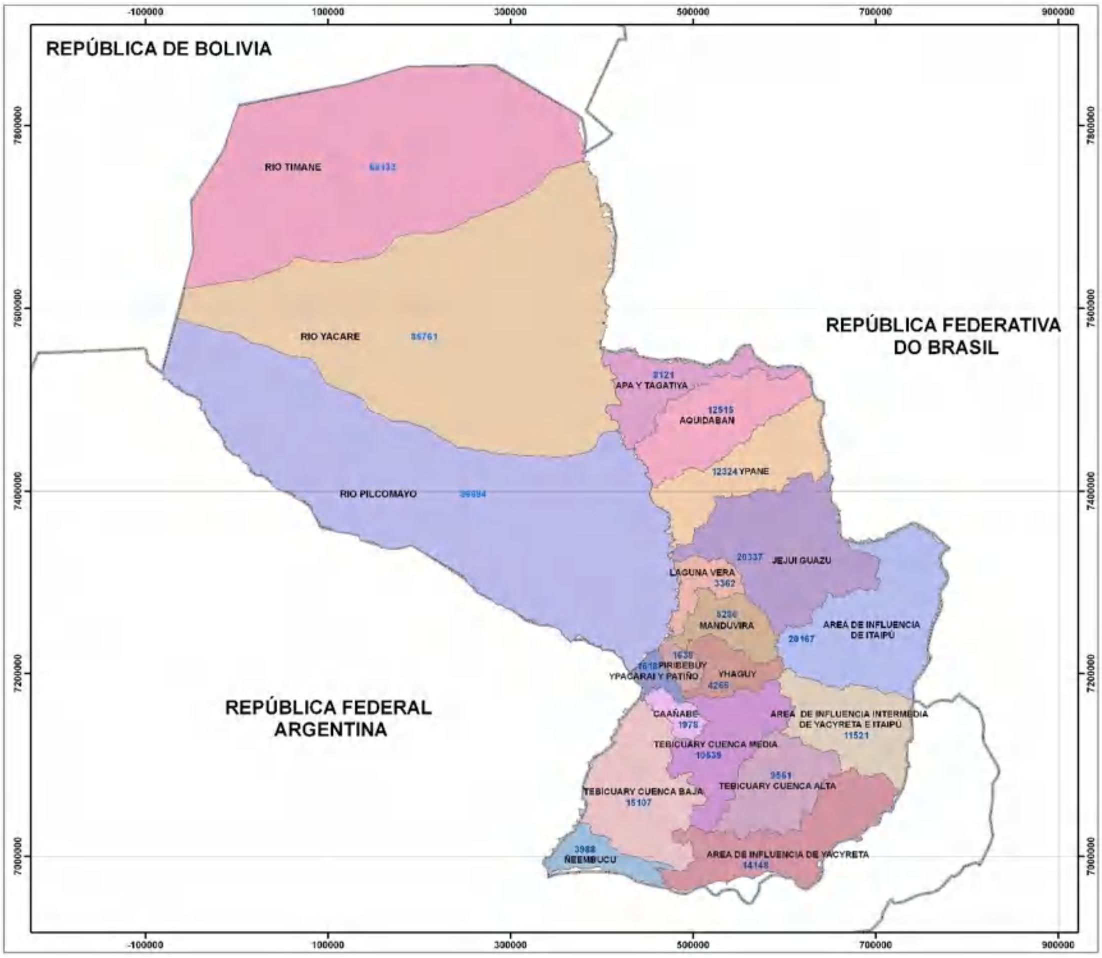


Figure 38 – Hydrographic Units of Paraguay. Source: MADES (2020)

The following table presents the characteristics (region, name and area) of the Hydrographic Units of Paraguay.

Table 5 – Hydrographic Units of Paraguay

Region	Name	Area (km²)
Eastern	Apa and Tagatiya	8,121
	Aquidabán	12,515
	Area of Intermediate Influence of Yacyreta and Itaipu	11,521
	Influence Area of Itaipu	20,167
	Influence Area of Yacyreta	14,148
	Caanabe	1,978
	Jeiui Guazu	20,337
	Laguna Vera	3,362
	Oriental Manduvirá	~ 5,286
	Neembucú	~ 3,988
	Piribebuy	1,638
	Tebicuary Cuenca Alta	9,561
	Tebicuary Cuenca Baja	15,107
	Tebicuary Cuenca Media	10,539
	Yhaguy	4,266
	Ypacaraí and Patinc	1,618
	Ypané	12,324
Western	Rio Pilcomayo	86,694
	Rio Yacaré	85,761
	Rio Timme	68,133

Source: Resolution SEAM n. 376/2012.

The influence areas of the PARACEL Eucalyptus Plantation encompass the Aquidabán Hydrographic Basin. Thus, these hydrographic unit will be addressed in this chapter on water resources.

The following information has been extracted from the Pulp Mill and Port Environmental Impact Study & Report (EIAp/RIMA): Book I - Environmental Diagnosis Of The Physical Environment (PÖYRY, 2020).

6.1.8.1 Aquidabán Hydrographic Basin

The Aquidabán River basin has an area of approximately 1,254,812 ha (SEAM & DIGESA, 2006), within the departments of Amambay and Concepción, and flows into the Paraguay River north of the city of Concepción, as illustrated in the figure below.

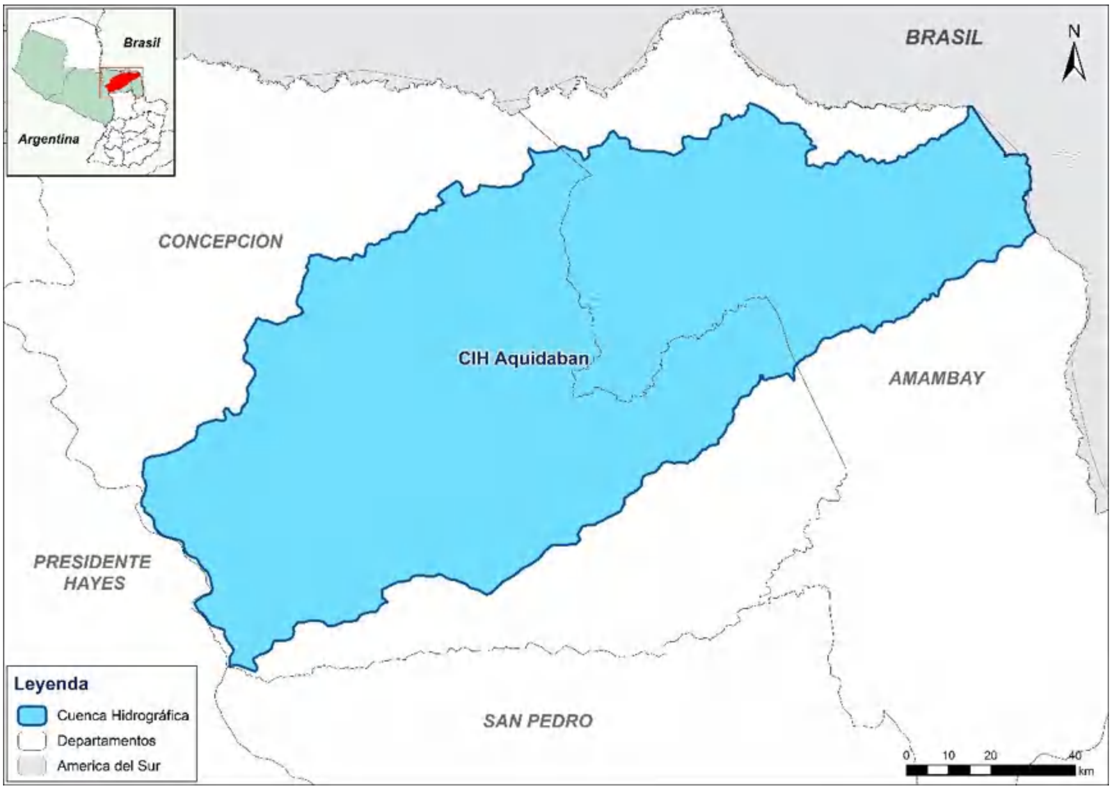


Figure 39 – Map of the Hydrographic Basin of Aquidabán

The basin is 59.3% occupied by cattle and 28.6% by forest, which includes approximately 87.9% of the entire basin area. Small rural producers occupy 7.6% of the basin area, mechanized cultivation 2.6%, flooded areas 1.6% and water and city occupy approximately 0.1%, as presented in the following table.

With respect to pollution loads, there are three districts with a total population of 36,150 inhabitants, of which 19% reside in urban areas, which constitutes the potential contributor to sanitation loads. The diffuse load from agricultural areas is 2 to 10 times higher than the sanitary load. With regard to industrial loads, there are no significant sources in this basin (SEAM & DIGESA, 2006).

Table 6 – Aquidabán River Basin Occupations

Mechanized cultivation	Cattle raising	Forest	Water	Small area ranchers	Flood	City	Total
32,408	744,261	359,133	1,810	95,613	20,042	1,810	1.254,812
2.6%	59.3%	28.6%	0.1%	7.6%	1.6%	0.1%	100.0%

Source: SEAM & DIGESA (2006).

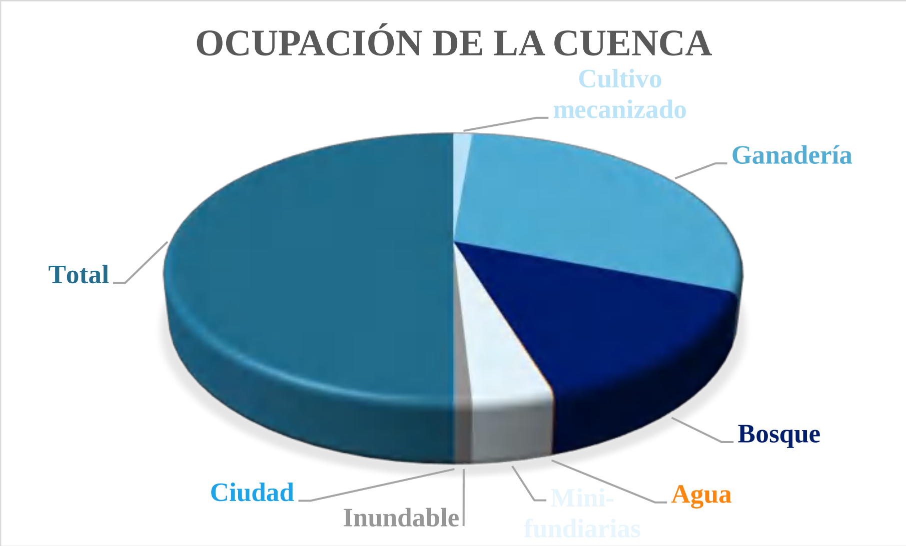


Figure 40 – Aquidabán River Basin Occupations

The Aquidabán River rises in the Amambay mountain range after traveling approximately 250 km through the departments of Amambay and Concepción, in an east-west direction. This river is a tributary of the Paraguay River and its mouth occurs north of the city of Concepción, 35 km from the central region. Its main tributaries are the Trementina and Negla Rivers.

The Aquidabán River as well as all surface water resources in Paraguay are classified as a Class 2 river, according to SEAM Resolution n. 255/2006.

The relevant characteristic of this river's water is the relatively high concentration of total and dissolved solids, depending on the time of collection, and the presence of significant nutrient contents. The cause of the high solids value can be attributed, mainly, to the recurrent diffuse loads of agricultural activities, also carrying nitrogen and phosphorus that are components of chemical fertilizers. The variation in concentration, especially of solids, is closely correlated to the recorded precipitation (SEAM & DIGESA, 2006).

6.1.8.2 Paraguay River

Paraguay has a very important and extensive hydrographic network throughout its territory. In fact, the Paraguay river separates and limits two natural regions with very different natural and socioeconomic characteristics (MADES, 2020).

The hydrography of the River Plate Basin is made up of three large water systems: the Paraná, Paraguay and Uruguay, in addition to the River Plate itself, into which some smaller rivers flow. Paraguay is a tributary of the Paraná, while the latter joins with Uruguay to form the Plata river. The drainage areas of each of them form the main sub-basins of the system (CIC, 2020).

The Paraguay River Basin has an area of 1,095,000 km², which covers about 35% of the entire area of the Plata Basin, which is 3,100,000 km², as illustrated in the figure below.

Figure 41 – The Plata Basin by sub-basin. Source: CIC (2020)

The Paraná and Paraguay rivers run from north to south and form an axis that divides the Basin into two parts: to the east there is a dense river network with abundant rivers, while to the west the contributions are from flatlands with low flow (CIC, 2020).

One third of the basin of the Paraguay river corresponds to Brazil (370,000 km²), another third to Paraguay (355,000 km²) and the rest is divided between Argentina (165,000 km²) and Bolivia (205,000 km²) as illustrated in the figure below. Almost all of it extends over a vast alluvial plain, with very little slope and extensive flood plains (CIC, 2020).

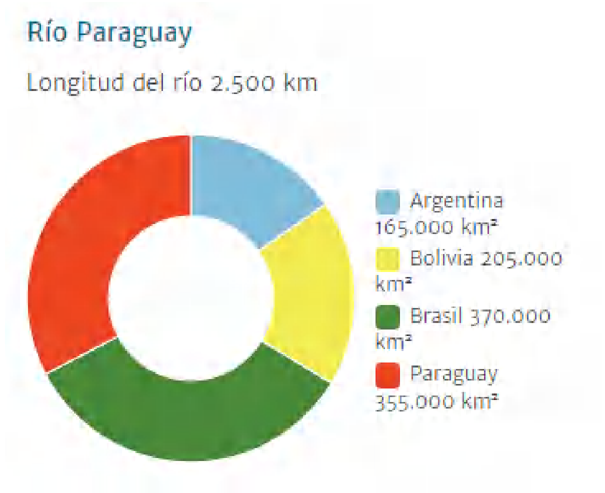


Figure 42 – Distribution of Paraguay river basin among the countries. Source: CIC (2020)

The Plata Basin can be subdivided into 7 sub-basins, among which the Upper Paraguay sub-basin and the Middle and Lower Paraguay (where are located the influence areas of the PARACEL Eucalyptus Plantation sub-basin are located in Paraguay (CIC, 2017), as shown in the figure below.

Figure 43 – Map of Plata sub-basins. Source: CIC (2017)

The Middle and Lower Paraguay Sub-basin (Figure below) is defined from the estuary of the Apa river to the confluence with the Paraná river. The Paraguay river, in spite of the contributions it receives in its upper basin, would present a negative water balance in part of this section, if only its right bank tributaries were considered, since its overflows do not return to the main channel, recharging lateral depressions in which water is retained until it evaporates. However, its left bank tributaries - Aquidabán, Jejui, Aguaray and Tebicuary- generate important contributions. Along the main course of Paraguay, the city of Asunción is located in the sub-basin, affected by frequent flooding. This section is an important part of the Paraguay-Paraná Waterway and receives, on its right bank, two tributaries: the lower Pilcomayo and Bermejo rivers.

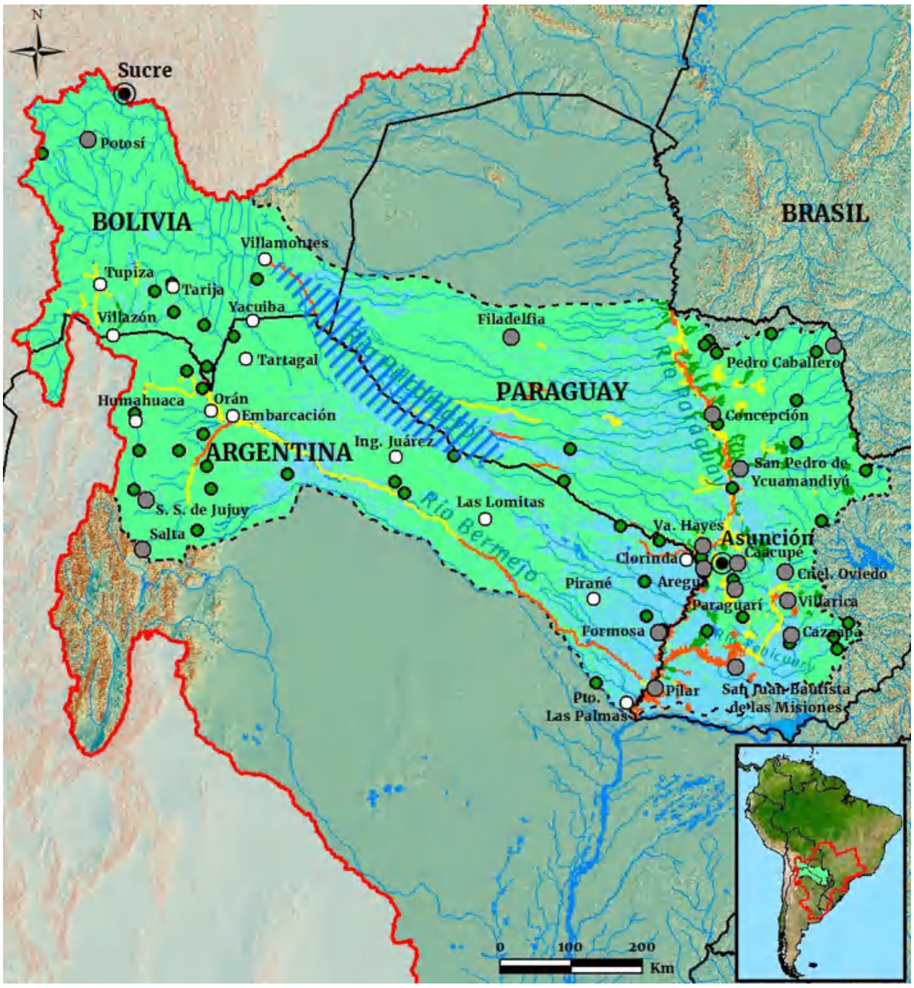


Figure 44 – Map of sub-basins of Middle and Lower Paraguay. Source: CIC (2017)

6.1.8.3 Surface Water Quality

This item presents the results of the First Monitoring Campaign of Surface and Groundwater Quality Monitoring, prepared by TECNOAMBIENTAL – Iniginería y Consultoría, in last February.

The purpose of this document is to establish a baseline of the surface quality int the project´s area of influence before the conversions to industrial zone and plantation forestry respectively occur.

The main objectives of the monitoring are the following:

- Obtain quantitative information of the River Paraguay´s water quality at 2 points located near the future industrial plant, before and after the treated effluents discharge point from the future factory located 20 km upstream port of the city of Concepción; and
- Obtain quantitative information of the surface water quality (streams and rivers running through the so-called "Farm Zone" in the Departments of Concepción and Amambay) at 18 monitoring stations.

The sampling take place in two campaigns covering the dry and rainy seasons. The preliminary results are presented here.

PARACEL selected and provided the monitoring points that correspond to sites of interest where land-use changes occur in the short term, mainly the transformations of pasture for livestock converted to and industrial zone or forest plantations as the case may be.

6.1.8.3.1 Monitoring Points

According to TECNOAMBIENTAL (2021), PARACEL provided the coordinates of the 20 monitoring point for the surface waters; 18 points are existing watercourses located in the so-called "Farm Zone" of the project´s and 2 points are on the River Paraguay. The number of samplings points is detailed below, according to the denominations given to the surface waters.

- One point, corresponds to the Hermosa stream, a tributary of the Apa River;
- One point corresponds to the Napegue stream, a tributary of the Negla steam;
- One point is on the Negla steam, a tributary of the Aquidaban River;
- Ten points are on the Trementina steam, a tributary of the Aquidaban River;
- One point is on an unnamed stream, a tributary of the Aquidaban River;
- Two point are on the Aquidaban River;
- One point corresponds to the Laguna Penayo stream;
- One point corresponds to the Pitanohaga steam;
- Two point are on the Paraguay River, at the future´s industrial plant.

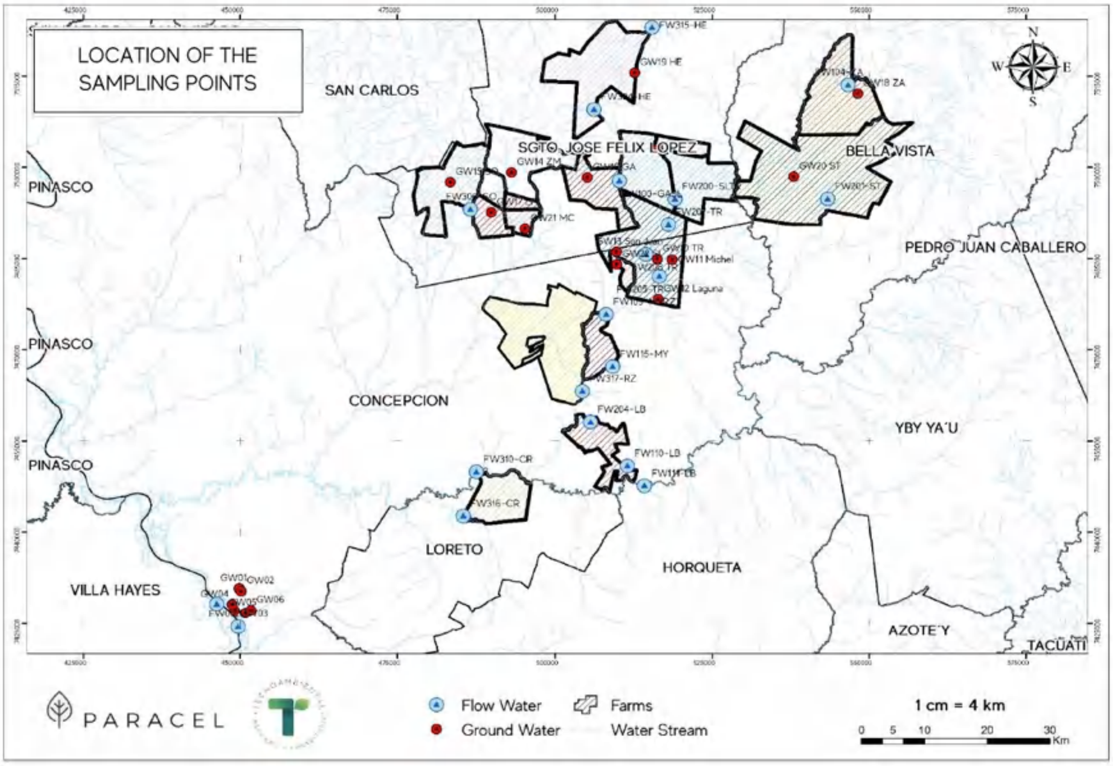


Figure 45 – Location of the sampling points. Source: TECNOAMBIENTAL (2021)

6.1.8.3.2 Results

Based in the document prepared by TECNOAMBIENTAL (2021), the main findings for surface water were:

- Of the 26 physicochemical and bacteriological parameters evaluated, 20 have limits established in the current regulations, and 6 do not have defined limits;
- Of the 20 parameters with defined limits, 11 (55%) do not show and deviation from the current regulations and 9 parameters (45%) show values above the maximum allowed at least one monitoring point;
- The parameters that do not show any deviation are pH, floating materials, Total Dissolved Solids (TDS), oils and fats, nitrites, hardness, sulphate, cyanides, sodium and copper;
- The parameters that show some degree of deviation are total phosphorus, total nitrogen, dissolved oxygen turbidity, BOD5, ammonia, soluble iron, faecal coliforms and total coliforms;
- The parameters that most frequently present deviations in the 19 point sampled are total phosphorus (52% of the points sampled), total coliforms (73%), faecal coliforms (84%), soluble iron (100%) and ammonia (100%).

The following table show a summary of the results obtained for each parameter analyzed in surface water, highlights the points that present some deviation and the percentage of monitoring points that complies with the SEAM n°222/02.

TABLE 9. SUMMARY OF SURFACE WATER QUALITY ANALYSIS

Nº	PARAMETER	AVERAGE	MONITORING POINTS WITH DEVIATIONS	COMPLY WITH THE LIMITS		BEYOND THE LIMITS	
				Nº	%	Nº	%
1	Temperature	24,5 ºc	No limits				
2	pH	6,9	FW317-RZ FW 11-LB	17	89,5%	**2**	**10,5%**
3	Electrical conductivity	121,9 µS/.cm	No limits				
4	Dissolved oxygen	5,8 mg O2/L	FW 207-TR FW 208-TR FW 115-MY FW 110-LB FW 109-MYRZ	14	73,7%	**5**	**26,3%**
5	Turbidity	147,1 NTU	FW 200-SLTR FW 205-TR FW 111-LB FW 310-CR	15	78,9%	**4**	**21,1%**
6	Floating materials	53,3	No limits				
7	Total dissolved solids (TDS)	164,5	All the points complies with the limits	19	100,0%	**0**	**0,0%**
8	Oil and grease	9,1 mg/L	No limits				
9	COD	77,2 mg O_2/L	No limits				
10	BOD5	3,1 mg O_2/L	FW 205-TR FW 310-TR FW 316-CR	16	84,2%	**3**	**15,8%**
11	Total phosphorus	0,1 mg/l	FW 315-HE FW 304-HE FW 207-TR FW205-TR FW 109-MYRZ FW 115-MY FW 110-LB FW 111-LB FW310-CR FW01	9	48%	**10**	**52%**
12	Total nitrogen	0,2 mg/l	FW 315-HE FW 208-TR FW 316-CR	16	84,2%	**3**	**15,8%**
13	Nitrates	2,1 mg/L	All the points complies with the limits	19	100,0%	**0**	**0,0%**
14	Ammonia	0,1 mg/L	All the points exceeds the maximum limits	0	0,0%	**19**	**100 %**
15	Nitrites	0,0 mg/L	All the points complies with the limits	19	100,0%	**0**	**0,0%**
16	Hardness	25,5 mg CaCO3/L	All the points complies with the limits	19	100,0%	**0**	**0,0%**
17	Sodium	7 mg/L	All the points complies with the limits	10	100%	**0**	**0,0%**
18	Sulphates	>2 mg/L	All the points are under the limits of quantification in water; therefore complies with the limits	19	100,0%	**0**	**0,0%**
19	Cyanides	>0,02 mg/L	All the points are under the limits of quantification in water; therefore complies with the limits	19	100,0%	**0**	**0,0%**
20	Copper	>0,02 mg/L	All the points are under the limits of quantification	19	100%	**0**	**0%**
21	Soluble iron	1,3 mg/L	All the points exceeds the maximum limits	0	0,0%	**19**	**100 %**

** Table refers to limits from SEAM n°222/02. There are no water quality limits stablished in IFC EHS Guidelines, only for effluents.*

TABLE 9. SUMMARY OF SURFACE WATER QUALITY ANALYSIS							
Nº	PARAMETER	AVERAGE	MONITORING POINTS WITH DEVIATIONS	COMPLY WITH THE LIMITS		BEYOND THE LIMITS	
				Nº	%	Nº	%
22	Fipronil	>LOQ	All the points are under the limits of quantification in water except for F.W315-HE **There are no limits for this parameter.**				
23	Faecal coliforms	3677,4 NMP/100 mL	Acorde en los puntos: FW 316-CR, FW01 y FW02. En todo los demás puntos de aguas superficiales, este parámetro se encuentra fuera del límite.	3	15,8%	**16**	**84,2%**
24	Total coliforms	9129,6 NMP/100 mL	FW104-ZA, FW315-HE, FW304-HE, FW200-SLTRE, FW207-TR, FW208-TR, FW205-TR, FW109-MYRZ, FW115-MY, FW317-RZ, FW204-LB, FW110-LB, FW310-CR	6	31,6%	**13**	**68,4%**

** Table refers to limits from SEAM n°222/02. There are no water quality limits stablished in IFC EHS Guidelines, only for effluents.*

Complete information about this campaign, as methodology and detailed results are presented in **ANNEX I**.

6.1.9 Hydrogeology

Paraguay not only has extensive natural surface water resources, but also a wealth of groundwater. Groundwater is the most important water resource in Paraguay, because of its easy access and availability in terms of quality and quantity (PMCIC, 2014).

Paraguay has great potential in terms of groundwater, which is contained in aquifers that are strategic for the country's socioeconomic development and for the social well-being of its inhabitants (PMCIC, 2014).

Paraguay's main aquifers are located in the subsoil of the country's two regions, the Eastern Region and the Western Region. Some of these aquifers are locally distributed and are restricted to the national territory, as is the case with the following aquifers: Patiño, Caacupé, Arroyos and Esteros, Itacurubí, while others, such as the Guaraní (Misiones aquifer), Yrendá, Independencia, Col. Oviedo, Alto Paraná, Pantanal and Acaray, are shared with neighbouring countries and have been classified as transboundary aquifers (PMCIC, 2014).

The Plata Basin is also rich in groundwater resources. It largely coincides with the Guarani Aquifer System (SAG in Spanish), one of the largest groundwater reservoirs in the world, with an area of 1,190,000 km². To the west of the Basin is the Yrendá-Toba-Tarijeño Aquifer System (SAYTT), which in the majority is located in the semi-arid zone of the Basin, the Gran Chaco American Biome, with an area of 410,000 km² (CIC, 2017).

The following figure shows the map of the transboundary aquifers of the Plata Basin.

Figure 46 – Map of the transboundary aquifers of the Plata Basin. Source: CIC (2017)

In the La Plata Basin, the natural development of urban and rural populations, associated with the strong increase in agricultural and industrial activities, has significantly increased the use of water resources, particularly those of underground origin. This growth, as expected, in addition to demographic parameters, is due to the intrinsic characteristics of the aquifers, such as the occurrence of potentially productive units and the quality of the groundwater (CIC, 2017).

In Paraguay, too, groundwater is widely used for human and industrial supply, as for example in the outskirts of its capital, Asunción. In other regions, it is mainly used for livestock and for public supply in dispersed locations (CIC, 2017).

The following figure shows the annual volumes of groundwater exploited in the Basin.

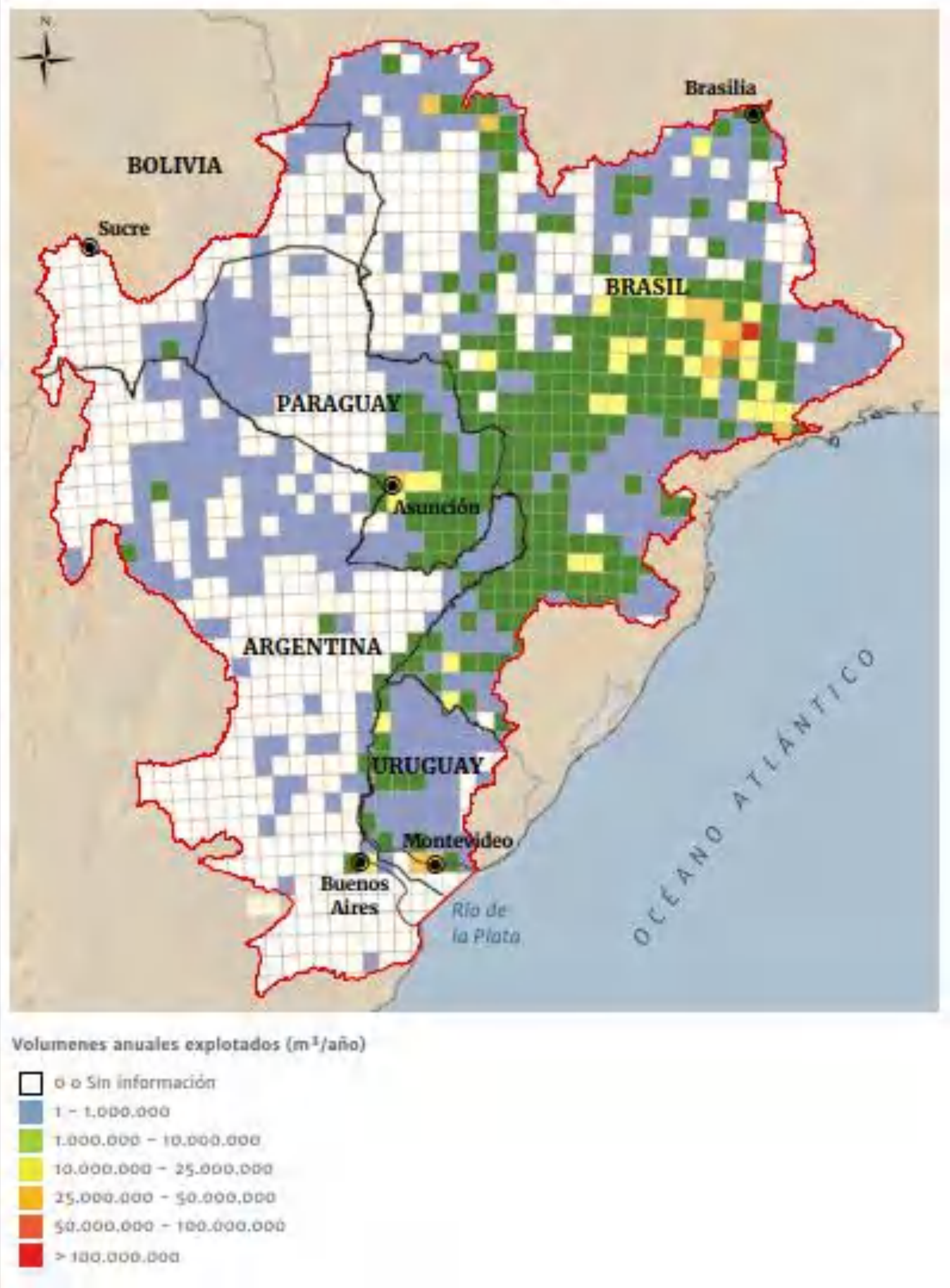


Figure 47 – Volumes of groundwater exploited annually. Source: CIC (2017)

The potability of the groundwater in the Basin was analyzed, in terms of salinity, taking into account the values of the electrical conductivities of the samples analyzed, given that they represent an approximation of the total dissolved salt content.

The concentrations of these salts, expressed in µS/cm were arranged in regular intervals distributed throughout the area of the Basin, and present the following results:

- 0 – 100 µS/cm – Registered only in the extreme North and Northeast regions of the Brazilian territory;
- 100 – 500 µS/cm – Widely predominant throughout the Basin, mainly in the Paraná Sub-basin in Brazil, and smaller portions in other countries;
- 500 – 1000 µS/cm – This interval occurs as strips aligned in a north-south direction, separating the Paraná Basin from those located further west in the region, also extending over part of Bolivian territory, the Brazilian Pantanal area and the eastern and western regions of Argentina;
- 1000 – 3000 µS/cm – This concentration interval, which marks the beginning of the occurrence of waters with inadequate quality for human health, is available in the Argentine and Paraguayan Chaco, in addition to the central and southern portion of Argentina;
- 3000 µS/cm – the area of occurrence of this interval of highly saline waters is restricted to a region of the Paraguayan and Argentine Chaco, corresponding to the fraction of the area of occurrence of the SAYTT Aquifer.

The following figure shows the geographical distribution of occurrence of these intervals.

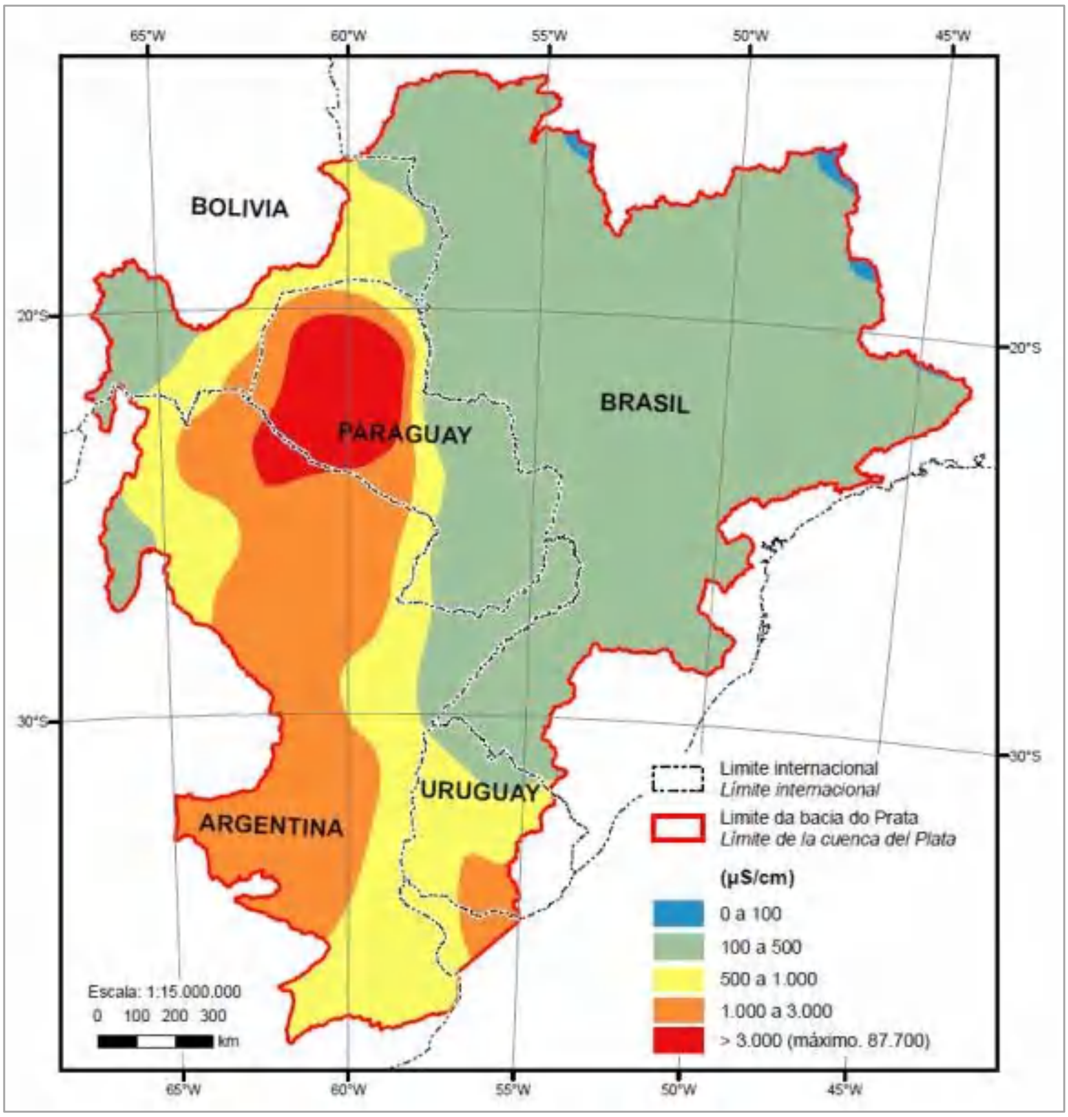


Figure 48 – Groundwater salinity distribution. Source: Diniz *et al.* (2015)

The natural vulnerability of groundwater is presented in the figure below. The lower regions or those with more dense drainage, such as the Chaco, Pantanal and the main drainage areas, present high to extreme vulnerabilities. The compartment represented by the Paraná Sedimentary Basin has medium to low vulnerability in relation to the others and high portions such as the Bolivian Andes present Low vulnerability index.

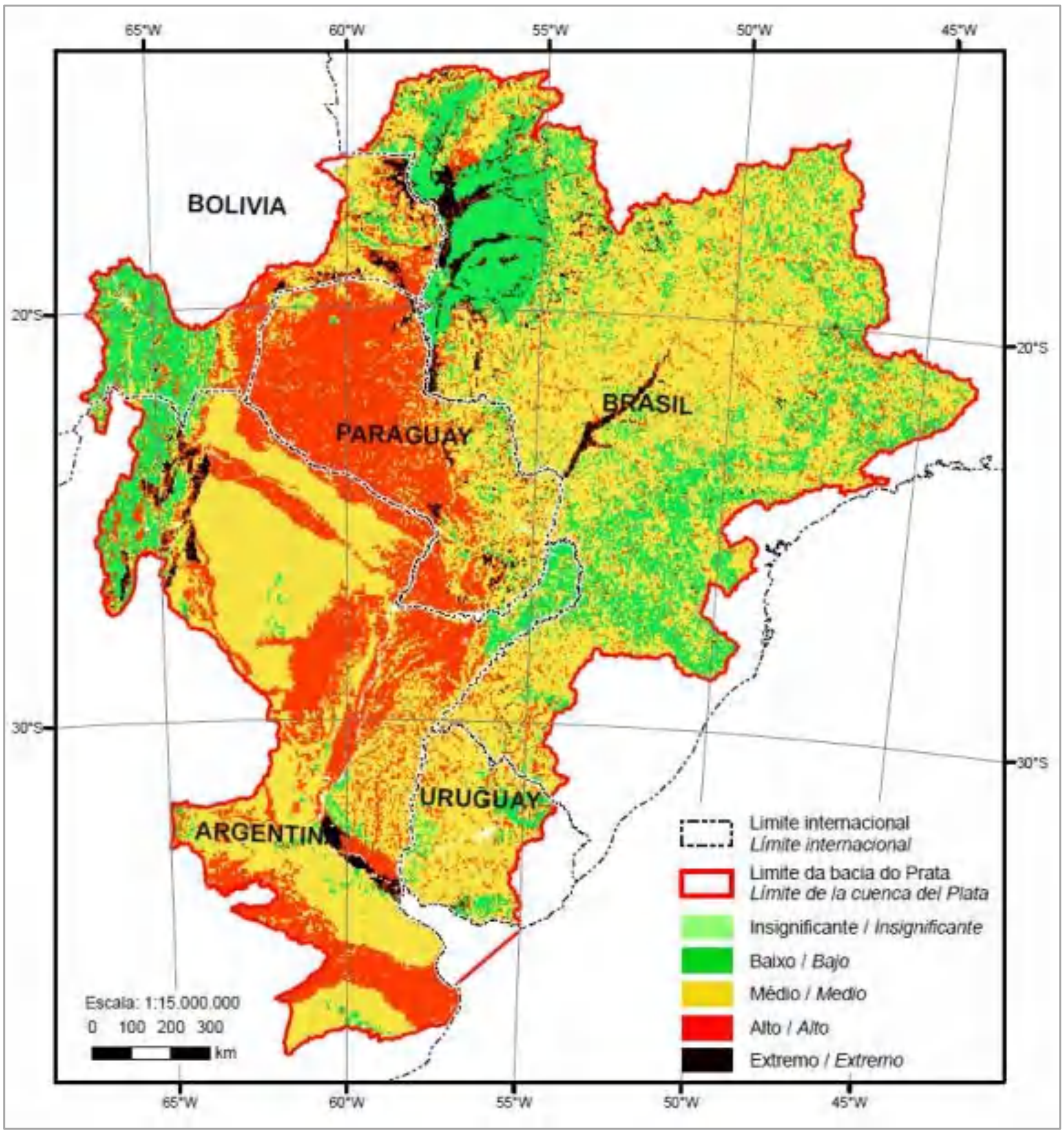


Figure 49 – Natural vulnerability of the groundwater of the Plata Basin. Source: Diniz *et al.* (2015)

The aquifers present in the influence areas of the PARACEL Eucalyptus Plantation will be addressed in this chapter on groundwater.

The following information has been extracted from the Pulp Mill and Port Environmental Impact Study & Report (EIAp/RIMA): Book I - Environmental Diagnosis Of The Physical Environment (PÖYRY, 2020).

6.1.9.1 Aquifer System Yrendá-Toba-Tarijeño - SAYTT

According to CIC (2015), the SAYTT is shared by the three countries of the South American Gran Chaco, which are Argentina, Bolivia and Paraguay. Each of the countries that contain the aquifer has given it a name to identify it within its territory. So we have to: Argentina: Acuífero Toba (T), Bolivia: Acuífero Tarijeño (T) and Paraguay: Acuífero Yrendá (Y).

The SAYTT is an aquifer system of great regional importance due to the existing expectations in a region with water shortage, semi-arid climate and with other aquifers where its supply is brackish or salt water, not suitable for human consumption or agricultural production. Its knowledge and subsequent sustainable management would favor a correct management of the soil, which, undeniably, the services provided by both natural resources are integrated for the development of the region.

The rocks assigned to the Quaternary that appear in the SAYTT region extend over some 521,904 km^2, distributed among the following countries in order of surface area: Argentina: 303,220 km^2 (58.1%), Paraguay: 196,988 km2 (37.7%) and Bolivia 21,696 km2 (4.2%) (GULISANO 2014).

In Paraguay the Yrendá Aquifer System is located in three departments (Boquerón, Pte. Hayes and Alto Paraguay).

The most important river in the SAYYT, in Paraguay, is the Pilcomayo river, with an area of 272,000 km^2 (approx. 8.4% of the Plata basin). It is the natural border between Argentina - Bolivia and Argentina - Paraguay. This river is characterized by its permanent wandering due to the large volume of sediments it carries. This has created through thousands of years a great continental delta, with apex in the triple border and its maximum opening on the Paraguay River from Bahía Negra in Paraguayan territory, to Route 81 in the province of Formosa, which has remained practically as a division of the Pilcomayo and Bermejo basins.

This gigantic alluvial fan could be divided into two types of morphology. To the north in Paraguayan territory, a dense network of deactivated-clogged paleo-catchment areas has been formed, which today constitutes one of the sources of water supply for human consumption. These paleo-channels present a direct recharge of rainwater and since a few decades ago the artificial recharge of this phreatic aquifer, superimposed on the SAY, has been carried out in the area. On the other hand, towards the south there is a series of streams and rivers that constitute the active network of paleo-catchment areas and new channels. All the watercourses finally discharge into the Paraguay River which is the great receiver of all the waters that descend from the Andes. The surface of this great continental paleo-delta is about 200,000 km^2, located almost entirely in Paraguayan territory.

According to CIC (2015), in Paraguay, the compilation of data from the Yrendá aquifer (SAY), in Paraguayan territory, presented 382 deep wells in Excel spreadsheets and 227 wells with less than 50 meters deep in SISAG origin sheets. A map of the location of the wells was presented where the quality of the water is defined according to its salinity (fresh, brackish and salty, as well as dry wells), in addition to a sheet with physical-chemical data of some wells.

Under the denomination of SAY, it is understood that confined and/or semi-confined aquifers extend throughout the Chaco at various levels and at different depths, constituting multi-layer systems, formerly called the Yrendá Aquifer Complex (GODOY, 1990), constituting at the regional level a single hydrogeological system, although differences in detail may occur at the local level, occupied by different groundwater flow systems. South of the 20th parallel, the SAY is below a depth of 50 m to the west, bordering Bolivia, and below 5 - 3 m to the east, in the Humid Chaco, even overcoming the phreatic level near the Paraguay River, causing the flow of the aquifers to be confined to the phreatic level. The piezometric levels range from 25 m to close to rising, in the channels that run in a west-east direction, tributaries of the Paraguay River.

In the area between the Bolivian Sub-Andean and the Parapetí River, the permeability (K) of the deep aquifers varies from 8.6 - 17.3 m/day; the transmissibility (T) from 1,075 - 2,150 m^2/day and the storage coefficient (S) from 5.10-4 - 6. 10-6; in the Bolivian-Paraguayan border area permeability varies from 6 to 8 m/day and transmissibility from 400 to 200 m^2/day and in the central Paraguayan Chaco permeability varies from 0.3 to 8.0 m/day and transmissibility from 50 to 100 m^2/day. The wells that capture these aquifers have specific flows that vary from 2.0 to 3.6 m^3/h/m. Their maximum total porosity is 40% and the effective porosity is between 7 and 10%. The actual underground flow rate varies from approximately 20 m/year to 46 m/year. (GODOY V. EUGENIO, 1990).

The large hydraulic load of the confined aquifers indicates that the recharge zone is at a much higher level than the land where the well is located, and as the area is semi-arid with a strong water deficit it is difficult for these aquifers to receive fresh water by direct infiltration of rainfall. As well, the isolated freatic aquifers are insufficient to feed the deep aquifers that contain large volumes of fresh water. It is strong to think that the recharge is produced by infiltration of rainfall and rivers in Bolivian territory, mainly along a strip of thick piedmont sediments about 15 to 20 km wide, which runs parallel to the sub-Andean mountain ranges, as well as by infiltration of the Pilcomayo River during floods through its alluvial fan. (GODOY V. EUGENIO, 1990).

In times of low water, the salinity of the surface courses and wetlands increases, indicating a subterranean source of water. The discharge zone is characterized by the occurrence of brackish to salty wetlands in the direction of underground flow. The formation of evaporative minerals in discharge areas produced by regional flow systems of mineralized (salt) groundwater is a characteristic of the area.

6.1.9.2 Guaraní Aquifer System (Sistema Aquifero Guarani – SAG, in Spanish)

According to CIC (2015), the transboundary Guarani Aquifer System (SAG) has an area of 1,087,879.15 km^2, extending over the Chaco - Paranaense sedimentary basin. It is the most important hydro-stratigraphic unit in the southern portion of the South American continent, and is associated with the siliciclastic rocks of the Plata Basin (Brazil and Paraguay), the Chaco - Paranaense Basin (Argentina) and the Northern Basin (Uruguay), which represent an evolutionary history common to the eastern portion of the Bolivian Chaco (FRANCA ET AL, 1995).

The regional climate in its area of occurrence is characterized as humid, with rainfall ranging from 1,200 to 1,500 mm/year.

Its waters are widely used for human and industrial supply and for thermal tourism, due to their thermal properties in the places where the aquifer is confined by the basalts of the Serra Geral formation.

The Guarani Aquifer System is formed by sandstones of the Jurassic period (Brazil), of the Tacuarembó formation (Uruguay), Misiones (Paraguay) and by the fluvio-lake sandstones of the Piramboia/Rosario do Sul formation (Brazil) and Rivera (Uruguay).

Outcrop zones occur in two bands located to the west and east of the zone of occurrence and correspond to approximately 10% of the total area of the aquifer, being confined to 90%.

The average thickness is 250 meters and the flows vary between 60 and 200 m^3/h in areas close to the outcropping zones and from 200 to 400 m_3/h in the confined areas. Locally it can present much lower values in the outcrop areas.

The waters are calcium and magnesium bicarbonate near the outcropping areas and sodium in the deeper areas. The pH is alkaline and dry residue values vary from 200 to 600 mg/l. The temperature varies from 18 to 63°C, depending on the depths of occurrence of the aquifer.

This aquifer system is of great importance at the regional and transnational level, representing a fundamental resource for socioeconomic development and in the operation and maintenance of associated ecosystems.

6.1.9.3 Groundwater water quality

This item presents the results of the First Monitoring Campaign of Surface and Groundwater Quality Monitoring, prepared by TECNOAMBIENTAL – Inginiería y Consultoría, in last February.

The purpose of this document is to establish a baseline of the groundwater quality int the project´s area of influence before the conversions to industrial zone and plantation forestry respectively occur.

The main objectives of the monitoring are the following:

- Measure the groundwater level and analyze the groundwater quality of 6 existing monitoring wells in the future BKP cellulose pulp manufacturing plant´s;
- Analyze and, where technically feasible, measure the groundwater level of 14 artesian wells distributed in the “Farm Zone” of the departments of Concepción and Amambay.

The sampling take place in two campaigns covering the dry and rainy seasons. The preliminary results are presented here.

PARACEL selected and provided the monitoring points that correspond to sites of interest where land-use changes occur in the short term, mainly the transformations of pasture for livestock converted to and industrial zone or forest plantations as the case may be.

6.1.9.3.1 Monitoring Points

According to TECNOAMBIENTAL (2021), PARACEL provided the coordinates of the 20 monitoring point for the groundwaters, detailed below:

- Fourteen points are deep tubular wells located in the “Farm Zone”, these wells are currently in service. Their waters are extracted with submersible pumps and are used to supply drinking water to the area´s human populations;

- Six points are located in the future industry and relate to deep tubular wells built exclusively for groundwater quality monitoring;

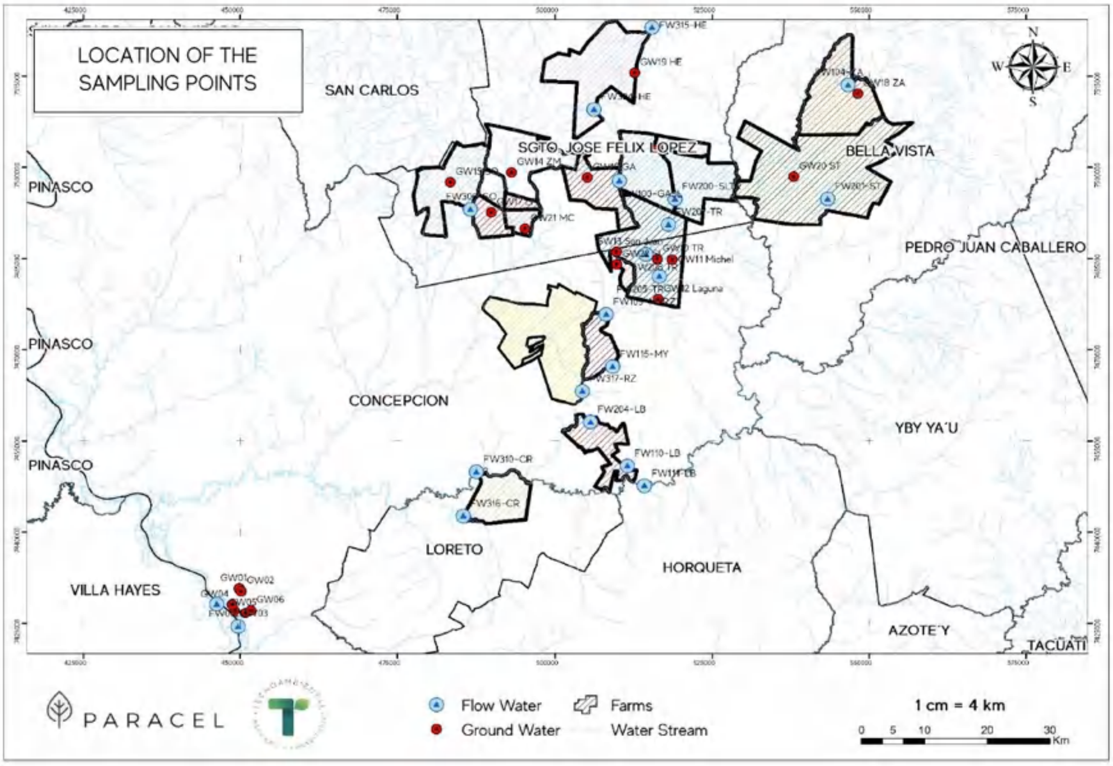


Figure 50 – Location of the sampling points. Source: TECNOAMBIENTAL (2021)

6.1.9.3.2 Results

Based in the document prepared by TECNOAMBIENTAL (2021), the main findings for groundwater were:

- Of the 23 physicochemical and bacteriological parameters evaluated, 18 have limits established in the current regulations, and 5 do not have defined limits;
- Of the 18 parameters with defined limits, 11 (61%) do not show and deviation regarding current regulations and 7 parameters (39%) show values above the maximum permitted in at least one monitoring point;
- The 11 parameters that do not show any deviation in the 14 wells evaluated are electrical conductivity, total dissolved solids, hardness, total nitrogen, chlorides, sulphates, sodium, potassium, calcium, magnesium, fluoride and E. coli;
- The parameters that show some degree of deviation are pH, total phosphorus, nitrates, alkalinity, fecal coliforms and total coliforms;
- The parameters that most frequently present deviations in the 14 sampled wells are Nitrates (42%), total phosphorus (71%), fecal coliforms (92%) and total coliforms (100%).

The following table show a summary of the results obtained for each parameter analyzed in groundwater, highlights the points that present some deviation and the percentage of monitoring points that complies with the SEAM n°222/02.

N°	PARAMETER	AVERAGE	MONITORING POINTS WITH LIMIT DEVIATIONS	COMPLY WITH THE LIMITS		BEYOND THE LIMITS	
				N°	%	N°	%
1	Temperature	24,5 °C	No limits				
2	pH	6.6	GW 20-ST GW 23-SL GW 11-MICHEL GW 22-SI	10	71%	**4**	**29%**
3	Electrical conductivity	257.8 µS/.cm	All groundwater points comply with the limits established by regulation NP 2400180	14	100%	**0**	**0%**
4	Dissolved solids	252.4 mg/L	GW 15-SO	13	93%	**1**	**7%**
5	Organic matter	0.67 mg O_2/L	No limits				
6	Hardness	49.12 mg $CaCO_3$/L	All groundwater points comply with the Regulation	14	100%	**0**	**0%**
7	Total phosphorus	0.2 mg/L	GW 18-10 GW 19-ST GW 23-SL GW 11-MICHEL GW 10-TR GW 13-SL GW 12-LAGUNA GW 14-ZM GW 15-SO GW 17-LP GW 21-MC	3	21%	**11**	**79%**
8	Total nitrogen	2 mg/L	GW 15-SO	13	93%	**0**	**0%**
9	Nitrates	34.5 mg/L	GW 13-SAN JUAN GW 22-SILVA GW 15-SO GW 17-LP	10	71%	**4**	**29%**
10	Chlorides	12.9 mg/L	All groundwater points comply with the Regulation	14	100%	**0**	**0%**
11	Alkalinity	82 mg $CaCO_3$/L	GW 15-SO	13	93%	**1**	**7%**
12	Bicarbonates	57.86 mg $CaCO_3$/L	No limits				
13	Carbonates	0 mg $CaCO_3$/L	No limits				
14	Sulphates	4.0 mg/L	All groundwater points comply with the Regulation	14	100%	**0**	**0%**
15	Sodium	32 mg/l	All groundwater points comply with the Regulation	14	100%	**0**	**0%**
16	Potassium	1.5 mg/l	All groundwater points comply with the Regulation	14	100%	**0**	**0%**
17	Calcium	13.0 mg/L	GW 15-SO	13	93%	**1**	**7%**
18	Magnesium	56.3 mg/L	All groundwater points comply with the Regulation	14	100%	**0**	**0%**
19	Fluorine	2.6 mg/L	No limits				
20	Boron	1.2 mg/l	All points complies with the Regulation	14	100%	**0**	**0%**
21	Faecal coliforms	15.9 NMP/100mL	Only GW16-GA comply with the Regulation	0	0%	**14**	**100%**
22	Total coliforms	>21 NMP/10mL	All points complies with the Regulation	0	0%	**14**	**100%**
23	*E Coli*	Absent	All points complies with the Regulation	14	100%	**0**	**0%**

Complete information about this campaign, as methodology and detailed results are presented in **ANNEX I**.

6.1.10 Natural disasters

Floods are the most common natural disasters that occur in areas of influence areas of the PARACEL Eucalyptus Plantation.

Fluvial Floods are natural phenomena due to the natural flooding of a river that conditions the formation of alluvial plains, close to periodically flooded water courses.

Rain floods are those that are produced by the accumulation of rainwater, snow or hail in areas of flat topography, which are normally dry, but which have reached their maximum degree of infiltration.

According to DOMECQ et al (2016), in Paraguay, these two types of floods occur: river-river floods, mainly due to the seasonal and extraordinary floods of the Paraná and Paraguay rivers.

The origin of these floods due to the Paraguay River, are actually presented as a consequence of the seasonal rainfall that accumulates in the Pantanal and that, due to the geographical characteristics of the area, it acts as a natural reservoir, where the water from the floods it accumulates slowly and progressively and then delivers them regularly to the Paraguay riverbed for six months (April to September), becoming a regulator of its hydraulic regime.

Floods of pluvial origin (urban) arise as a result of intense rainfall (severe storms) in cities and the alteration of the basin as a result of uncontrolled urbanization.

Ordinary floods occur in the summer months (February-March) and the dry season is centered in winter (July-August). However, extraordinary floods can occur at any time of the year, with all-time highs being recorded between May and July.

The hydrological region of the Paraguay River is characterized by a module of 3000m^3/s, with maximum flows of the order of 12000m^3/s and minimums of the order of 800m^3/s. The annual cycle presents extreme flood wave peaks between June and July, with minimums from December to February. The flows are associated with the variability of rainfall, increasing strongly with the occurrence of “El Niño”.

The figures below shows the hydrometric levels of annual maximums of the Paraguay River in Asunción from 1904 to 2015 and the chronological years of occurrence attending to the same maximum hydrometric levels of the Paraguay River corresponding to the estimated period of 1904-2015.

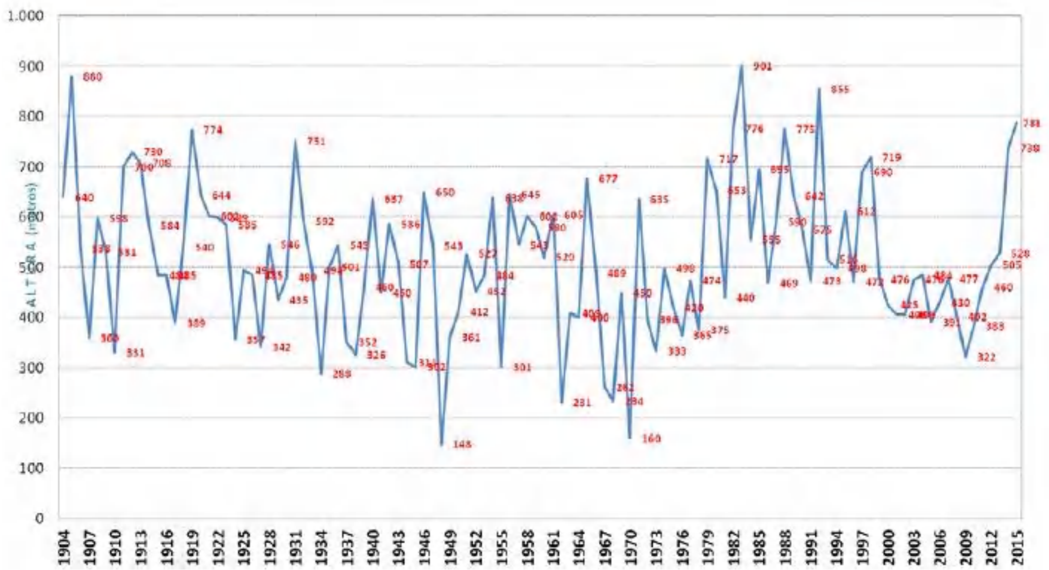


Figure 51 – Hydrometric levels of the Paraguay River 1904/2015 - Asunción - Annual Highs. Source: DOMECQ et al (2016)

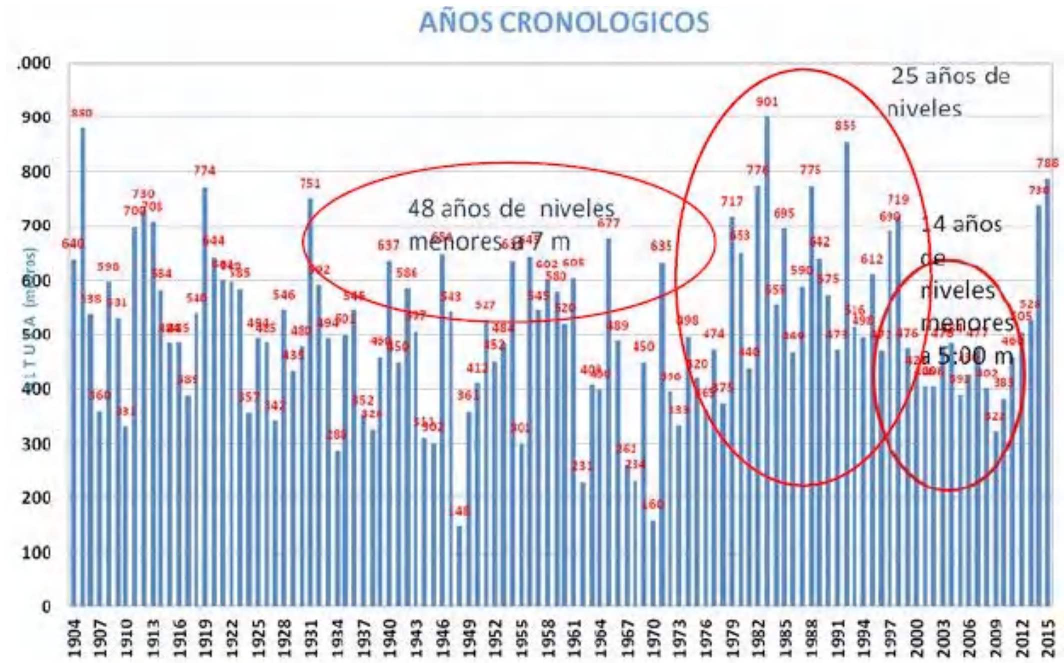


Figure 52 – Hydrometric levels of annual maximums of the Paraguay River - Asunción - 1904/2015 - Chronological years. Source: DOMECQ et al (2016)

6.1.10.1 River Floods and Urban Drainage

Floods in Paraguay acquired relevance in urban areas from the 70s, when the processes of land occupation related to the natural flood plains of rivers and banks of urban streams intensified. In the years 1982/83 this occupation of territory worsened in the country, associated with the climatic event "El Niño" when the Paraguay River reached extraordinary levels, with little recorded history to date. Considering this event, the riverside population occupies higher spaces almost always linked to water courses, with an impact on the entire city due to the occupation of public spaces, improvised shelters on public and private lands and the environmental and sanitary effects that this situation brings with it. .

The floods that occur in urban areas are not only consequences of the overflowing of rivers and streams, but are also linked to severe storms that normally occur in the months of October and April, this together with the concentration of population in the centers. urban areas and the weak rainwater evacuation infrastructure. The effects of this event are translated into the deterioration of the pavement that is systematically worn by the absence of rain drainage, absenteeism from work and school, stagnant waters that generate deterioration in the environment and in the health of people, among others. In this case, the streams become rainwater evacuators, which overflows from its natural channel dragging all kinds of solid waste that is finally deposited on the banks of the Paraguay River, causing an environmental impact on the body of water.

In Paraguay, to date, the construction of urban drainage infrastructures is insufficient and in some cases they are reduced to specific solutions in the main cities of the country. These refer to sanitary drainage (sewer network and storm drainage), which are conceived as independent systems.

In figure below, the area's most vulnerable to rain floods linked to urban drainage are presented. The department of Concepción and Amambay stands out, where they are located the influence areas of the PARACEL Eucalyptus Plantation.

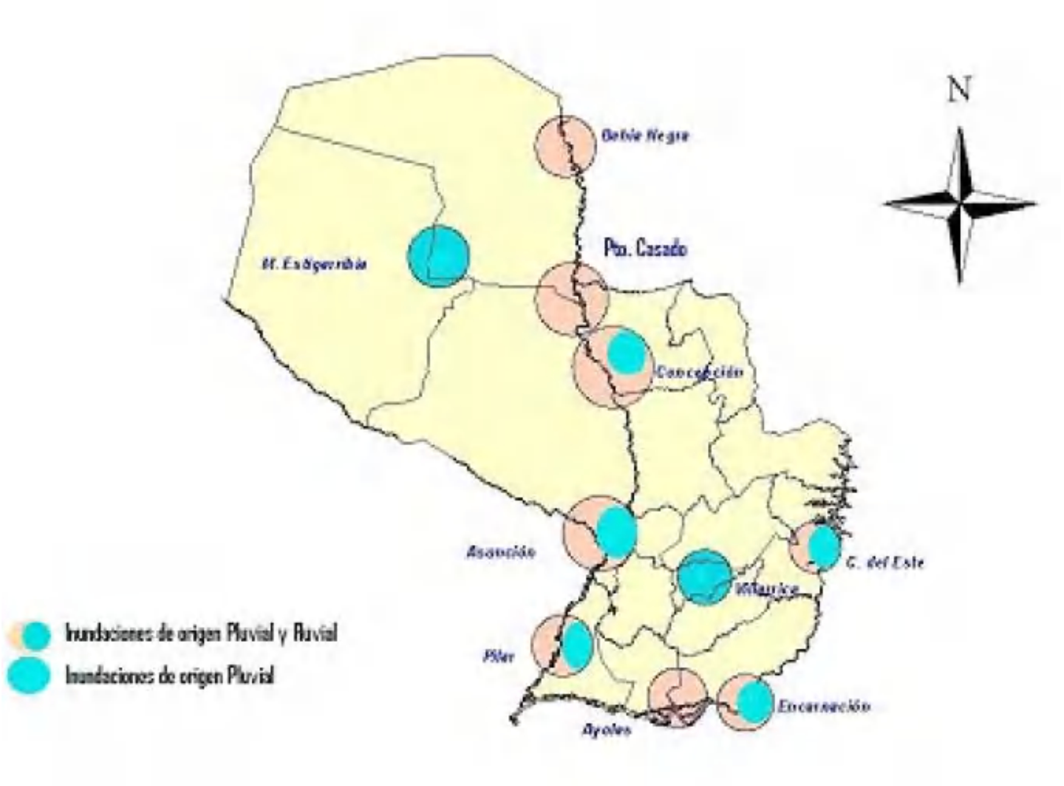


Figure 53 – Most vulnerable areas to flooding in urban centers. Source: DOMECQ et al (2016)

Urban drainage coverage in Paraguay has a deficit. The storm drain system in Asunción is installed in the downtown area and along a few other roads, which are connected to streams, this implies that rainwater runs through most of the road surfaces and obstructs the flow of traffic when Rains.

Rainwater runs off within 1 to 2 hours due to topographic undulations, however it tends to erode base course materials, an action that damages the pavement.

Regarding the sanitary sewer system, it is observed that 100% of the discharges are conducted to water channels, be they streams or the Paraguay River. As for the pluvial drainage in other cities, on the Paraguay River, the only cities on this river that have sanitary sewers are: Villeta and Pilar. On the Paraná River, Ciudad del Este and Encarnación lack storm sewers. Encarnación also has sanitary sewer lines.

6.1.10.2 Water Network of Paraguay

According to DOMECQ et al (2016), Paraguay is fully inserted in the Río de la Plata basin, two of the main tributaries of the basin are linked to Paraguayan territory, the Paraguay and Paraná rivers.

The Paraguay River is the most important tributary of the Paraná River, and is considered the second most important river system in South America, containing in its basin and system the largest wetland in the world, the Pantanal.

The Paraguay river basin covers 1,095,000 km^2, and in the national territory, this river has an extension of 1,250 km^2. Its banks are located in important urban centers such as: Concepción, Pilar and Asunción. The section of the same begins in Bahía Negra to Asunción, according to image below where the section of the Paraguay River is shown.

Figure 54 – Sections of the Paraguay River. Source: DOMECQ et al (2016)

REFERENCES

AGP - ASOCIACIÓN DE GEÓLOGOS DEL PARAGUAY. **Geología del Paraguay.** Disponible en: < http://www.geologiadelparaguay.com.py/GeoMain.htm>

BERROCAL, J. **Datos de la estación sismológica CPUP, Paraguay**. 1991.

CIC – COMITÉ INTERGUBERNAMENTAL COORDINADOR DE LOS PAÍSES DE LA CUENCA DEL PLATA. 2020. Disponible en: <https://cicplata.org/es/>.

CIC – COMITÉ INTERGUBERNAMENTAL COORDINADOR DE LOS PAÍSES DE LA CUENCA DEL PLATA. **Análisis Diagnóstico Transfronterizo de la Cuenca del Plata-ADT**. – 1ª ed. - Ciudad Autónoma de Buenos Aires : Comité Intergubernamental Coordinador de los Países de la Cuenca del Plata - CIC ; Estados Unidos : Organización de los Estados Americanos - OEA, 2017. Disponible en: <https://cicplata.org/wp-content/uploads/2017/09/analisis_diagnostico_transfronterizo_de_la_cuenca_del_plata.pdf>.

CIC – COMITÉ INTERGUBERNAMENTAL COORDINADOR DE LOS PAÍSES DE LA CUENCA DEL PLATA. **Informe Final – PMARCO-CIC/OEA – Componente: Navegación**. 2014. Disponible en: <https://cicplata.org/wp-content/uploads/2019/08/Navegaci%C3%B3n-Paraguay_Oscar-Ruben-Ferreira-Baez.pdf>.

CIC – COMITÉ INTERGUBERNAMENTAL COORDINADOR DE LOS PAÍSES DE LA CUENCA DEL PLATA. **Informe Final – PMARCO-CIC/OEA – Recursos Hídricos- Disponibilidad y Demanda de Agua**. 2015.

DOMECQ, R.M.; BAEZ, J.;ÁVILA, J.L. **Las inundaciones en el Paraguay.** Assunción: Revista de la Facultad de Ciencias y Tecnologías. N°7. 2016.

FÚLFARO, V.J. **Geología del Paraguay Oriental**. São Paulo: Edusp/Fapesp, 1996.

FUNDACIÓN MOISÉS BERTONI. **Biodiversidad del Paraguay, una aproximación a sus realidades.** 1ra ed.— Fundación Moisés Bertoni, USAID, GEF/BM. 2007.

GODOY, E; PAREDES, J.L. **Acuíferos Potenciales del Paraguay**. Filadelfia – Chaco/Paraguay: Casila de Coreo, 1995.

MADES – MINISTERIO DEL AMBIENTE Y DESARROLLO SOSTENIBLE, 2020. Disponible en: <http://www.mades.gov.py/areas-tematicas/recursos-hidricos/>.

MADES – MINISTERIO DEL AMBIENTE Y DESARROLLO SOSTENIBLE. **Áreas Tematicas – Recursos Hidricos**. 2020. Disponible en: < http://www.mades.gov.py/areas-tematicas/recursos-hidricos/>.

PONESSA, R.E.G. **Análisis de la variabilidad del clima en la región oriental del Paraguay en el período 1960-2012**. Tesis presentada a la Facultad de Ciencias Agrarias, Universidad Nacional de Asunción, como requisito para la obtención del título de Ingeniera Ambiental. San Lorenzo, Paraguay: 2017.

PÖYRY. **Environmental Impact Study and Report (EIAp/RIMA) – Pulp Mill and Port in Concepción – Paraguay. Book I – Enviromental Diagnosis of the Physical Environment.** Brazil: São Paulo, 2020.

SEAM & DIGESA. **Proyecto de " Control y Mejoramiento de la Calidad de las Aguas de la Cuenca Del Lago Ypacaraí y Río Paraguay**. 2006. Cooperación Técnica por la JICA – Informe Final. Disponible en: <http://chmparaguay.com.py/informaciones-ambientales/Agua/Informe%20AGUA%20JICA%20SEAM%20DIGESA.pdf>.

TECNOAMBIENTAL. **Surface and Groundwater Quality Monitoring.** 2021.

ANNEX I

FIRST WATER MONITORING CAMPAING REPORT

SURFACE AND GROUNDWATER QUALITY MONITORING

TECNOAMBIENTAL
•INGENIERÍA Y CONSULTORÍA•

1ST MONITORING CAMPAIGN REPORT

CONTRACTING COMPANY:	PARACEL SA.
DEPARTMENT:	CONCEPCIÓN AND AMAMBAY
DISTRICTS:	CONCEPCIÓN, SGTO. JOSÉ FELIX LÓPEZ, LORETO AND BELLA VIST
CONSULTANT:	TECNOAMBIENTAL S.R.L.
REPORTED PERIOD:	RAINY SEASON (JANUARY-FEBRUARY)

APRIL 2021

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

I. INTRODUCTION

The terms of reference of the water quality monitoring consulting service prepared by PARACEL SA defines this report's guidelines. The firm is in charge of the project "Construction and operation of a plant for the manufacture of BKP cellulose pulp on the Paraguay River", which is developing approximately 15 km north of the city Concepción. This report also responds to the International Finance Corporation (IFC) environmental requirements, the financing entity, that requires a baseline of the environmental conditions before implementing the project to collect useful data to monitor potential changes resulting from the project's implementation.

The purpose of this document is to establish a baseline of the surface and groundwater quality in the project's direct area of influence (DAI) and indirect area of influence (IAI) before the conversions to industrial zone and plantation forestry respectively occur.

The main objectives of the monitoring are the following:

- Obtain quantitative information of the River Paraguay's water quality at 2 points located in DAI of the future Industrial plant, before and after the treated effluent's discharge point from the future factory located 20 km upstream port of the city of Concepción.
- Measure the groundwater level and analyse the groundwater quality of 6 existing monitoring wells in the future BKP cellulose pulp manufacturing plant's DAI.
- Obtain quantitative information of the surface water quality (streams and rivers running through the so-called "Farm Zone" in the Departments of Concepción and Amambay) at 18 monitoring stations.
- Analyse and, where technically feasible, measure the groundwater level of 14 artesian wells distributed in the "Farm Zone" of the Departments of Concepción and Amambay.

The samplings take place in two campaigns covering the dry and rainy seasons. The preliminary results presented in this report belong to the latter.

PARACEL SA selected and provided the monitoring points that correspond to sites of interest where land-use changes will occur in the short term, mainly the transformations of pastures for livestock converted to an industrial zone or forest plantations as the case may be.

A certified laboratory, the Multidisciplinary Centre for Technological Research (CEMIT) of the National University of Asunción (UNA), analysed the samples. CEMIT's calibrated equipment and standardised procedures were used during sampling and transporting samples.

The National Accreditation Body (ONA), dependent on the National Council of Science and Technology (CONACYT), accredited the CEMIT's laboratory.

II. METHODOLOGY

2.1 General information about the study area

This section collects some data mentioned in the environmental impact assessment report of the future industry prepared by the consultancy POYRY in 2020 and aims to establish the hydrological and hydrogeological context in which the monitoring carries out.

The project's location is in the city of Concepción; therefore, the surface and groundwater monitored are part of the Aquidabán River Basin. This basin has an approximate area of 1,254,812 ha and flows into the River Paraguay to the north of Concepción. Its main tributaries are the Trementina and Negla streams, and it is characterised by its relatively high concentration of total and dissolved solids, depending on the time of collection and the presence of significant nutrient contents.

2.1.1 Surface water

The future factory's location is in the Middle and Lower Paraguay sub-basin, which is part of the hydrographic units mentioned above.

In the area of direct influence is the River Paraguay, from which raw water is to be collected and which is the main body of surface water to receive the wastewater treated and generated by the project, in a stretch of approximately 1 km, through a submarine wastewater discharge pipe.

Dispersion of treated effluents in the River Paraguay expects to occur very close to the discharge point between 0.37 and 0.42 m upstream of the factory's water intake.

In the AII is the Tinfunqué Ramsar site, which is 235 km from the future factory. Likewise, the Estero Milagro Ramsar site is 35 km away but outside the area of indirect influence.

Hydrographically, the most critical watercourses for the present study are the Trementina stream, Napegue stream, Negla stream, Hermosa stream, Pitanohaga stream, Aquidabán River and Paraguay River.

2.1.2. Groundwater

Regarding the hydrogeological characteristics, the factory is in the Aquidauana-Aquidabán Aquifer System.

This system is in the River Paraná basin, covering approximately 27,000 km^2, of which 12,300 km^2 are in Paraguay and the rest in Brazilian territory. It is used mainly for human and animal supply in both countries.

The aquifer is a semi-confined type, made up of glaciomarine sediments with significant facies variations, and has very dispersed flows rates with average values ranging between 10-20 m^3/h/ well.

The water's chemical characteristics are very variable also.

2.2 Location and details of monitoring points

There are 40 sampling points selected to monitor water quality in the DAI and IAI, 20 of which are surface watercourses and 20 are groundwater.

As for the political-administrative limits of the study area, 4 points are in the district of Bella Vista in the Department of Amambay and 36 points are distributed in the districts of Concepción, Sgt José Felix López and Loreto in the Department of Concepción.

PARACEL provided the coordinates of the 20 monitoring points for surface waters; 18 points are existing watercourses located in the so-called "Farm Zone" of the project's AII, and 2 points are on the River Paraguay in the DAI of the future industry. The number of sampling points is detailed below, according to the denominations given to the surface waters:

- One point corresponds to the Hermosa stream, a tributary of the Apa River.
- One point corresponds to the Napegue stream, a tributary of the Negla stream.
- One point is on the Negla stream, a tributary of the Aquidabán River.
- Ten points are on the Trementina stream, a tributary of the Aquidabán River.
- One point is on an unnamed stream, a tributary of the Aquidabán River.
- Two points are on the Aquidabán River.
- One point corresponds to the Laguna Penayo stream.
- One point corresponds to the Pitanohaga stream.
- Two points are on the Paraguay River at the DAI of the future's industrial plant.

Regarding groundwater monitoring points:

- Fourteen points are deep tubular wells located in the "Farm Zone", these wells are currently in service. Their waters are extracted with submersible pumps and are used to supply drinking water to the area's human populations.
- Six points are located in the future industry's DAI and relate to deep tubular wells built exclusively for groundwater quality monitoring.

In the existing properties in the so-called "Farm Zone", the land use is changing from cattle pasture to *Eucalyptus sp.* plantation while in the DAI from floodplain pasture to an industrial zone.

The 40 monitoring points were selected to verify the existing surface, and groundwater quality in the DAI and the "Farm Zone" (IAI) before land-use conversions occur due to project implementation.

The following map shows the properties' boundaries and the spatial distribution of the monitoring points, classifying between surface water and groundwater points. The hydrography layer of the study area is also displayed.

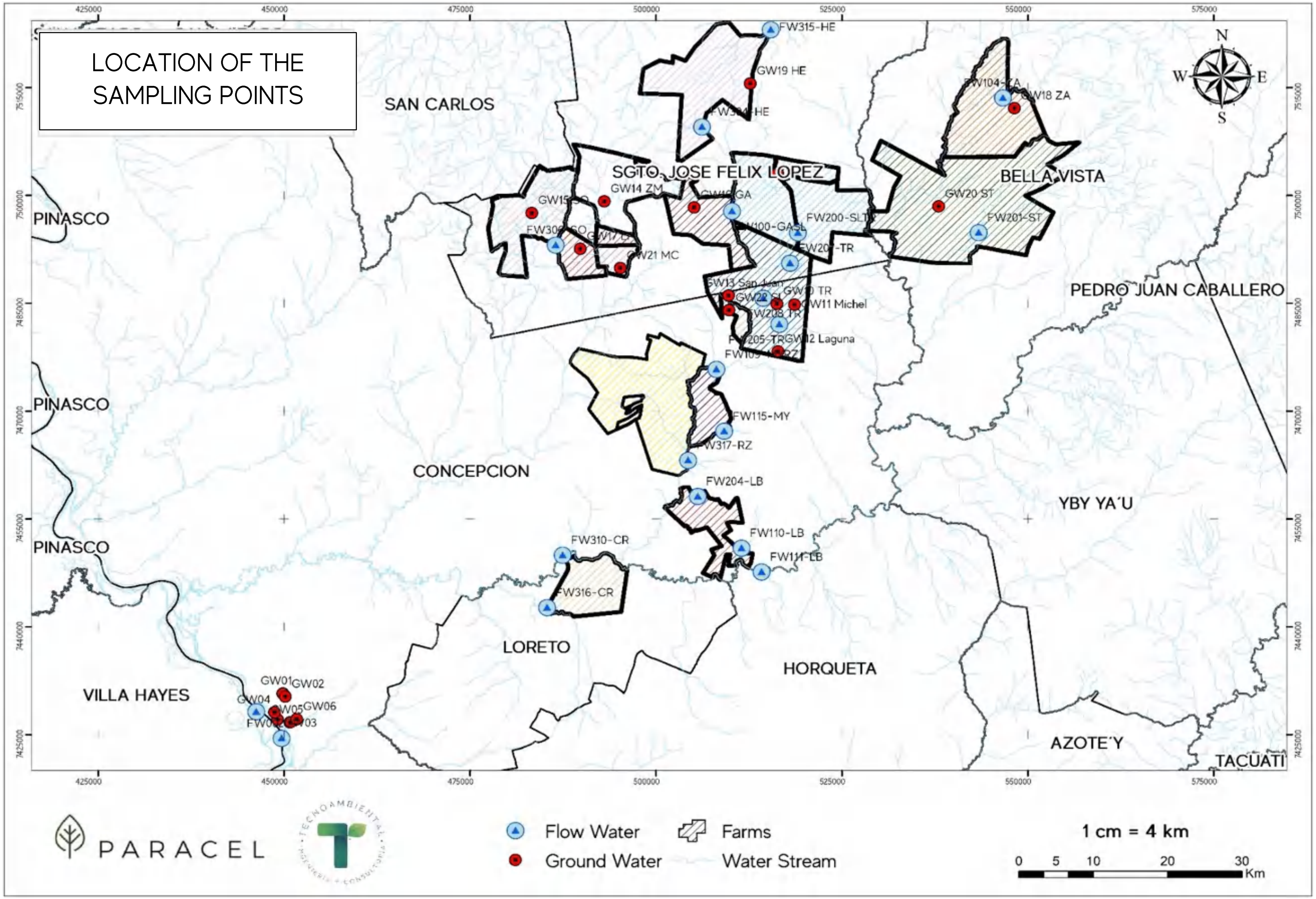

LOCATION OF THE SAMPLING POINTS
SAN CARLOS
SGTO. JOSE FELIX LOPEZ
BELLA VISTA
PINASCO
PEDRO JUAN CABALLERO
CONCEPCION
YBY YA´U
LORETO
HORQUETA
VILLA HAYES
AZOTE´Y
TACUATI
FW315-HE
GW19 HE
GW18 ZA
GW14 ZM
GW20 ST
FW200-SLT
FW201-ST
GW21 MC
GW11 Michel
FW115-MY
FW204-LB
FW110-LB
FW310-CR
FW316-CR
GW01
GW02
GW04
GW06
PARACEL
Flow Water
Ground Water
Farms
Water Stream
1 cm = 4 km
0 5 10 20 30 Km

TABLE 1. SAMPLING POINTS						
	Nº	**CODE**	**UTM COORDINATES**	**TYPE OF SAMPLE**	**MONITORED PARAMETERS**	**LOCATION, DESCRIPTION, OBJECTIVES**
NEGLA STREAM MICRO-WATERSHED	1	FW 104 - ZA	21K 546639,23 mE 7513553,82 mS	F.W.	Described in Table 2	Negla stream – Upper part of the micro-watershed – Determine the surface water quality of the Farm "Zapallo".
	2	G.W. 18-ZA	21K 548201.00 mE 7512128.00 mS	G.W.	Described in Table 3	Headquarters of the "Zapallo" farm – Deep tubular well used for water drinking supply – Determine the groundwater quality of Farm "Zapallo".
	3	F.W. 201-ST	21K 543911.54 mE 7497910.60 mS	F.W.	Described in Table 2	Napague stream - Upper middle part of the Negla stream micro-watershed - Determine Farm "Santa Teresa's surface water quality.
	4	G.W. 20-ST	21K 537999.00 mE 7498476.00 mS	G.W.	Described in Table 3	Headquarters of the "Santa Teresa" farm - Deep tubular well used for drinking water supply - Determine the groundwater quality of Farm "Santa Teresa".
HERMOSA STREAM MICRO-BASIN	5	FW 315-HE	21K 515424,99 mE 7523026,00 mS	F.W.	Described in Table 2	"Hermosa" stream - Upper watershed of the "Hermosa" creek micro-watershed - Determine the surface water quality at the outlet of Farm "Hermosa".
TREMENTINA. STREAM MICRO-WATERSHED	6	GW 19-HE	21K 512695.00 mE 7515558.00 mS	G.W.	Described in Table 3	Headquarters of the "Hermosa" farm - Deep tubular well for drinking water supply – Determine the current groundwater quality of Farm "Hermosa".
	7	FW 304-HE	21K 506172,99 mE 7509505,00 mS	F.W.	Described in 2	Trementina stream – Upper watershed of the Trementina stream micro-watershed – Determine surface water quality at the outlet of Farm "Hermosa."
	8	G.W. 23-SL	21K 516367.00 mE 7503054.00 mS	G.W.	Described in 3	Headquarters of the "San Liberato" farm – Deep tubular well for water provision for human consumption – Determine groundwater's current quality in the "San Liberato" farm.
	9	G.W. 16-GA	21K 505125.00 m E 7498320.00 m S	G.W.	Described in 3	Headquarters of the "San Gavilán" farm at 200 metres from *Eucalyptus sp.* plantations – Deep tubular well to provide water for human consumption – Determine the current groundwater quality of the "Gavilán" farm.
	10	FW 100-GASL	21K 510205.03 mE 7497780.65 mS	F.W.	Described in 2	Trementina stream – Middle/upper catchment of the Trementina stream micro-watershed runs through approximately 7 km of *Eucalyptus sp.* plantations – Determine the surface water quality at the plantation's exit.
TREMENTINA STREAM MICRO-WATERSHED	11	FW 200-SL	21K 519072.00 mE 7494784.00 mS	F.W.	Described in 2	Tributary of the Trementina stream at the southeast of the headquarters of the "San Liberato" farm – middle catchment of the Trementina stream – Determine surface water quality at the outlet of Farm "San Liberato".
	12	F.W. 207-TR	21K 518004.00 mE 7490567.00 mS	F.W.	Described in 2	Tributary of the Trementina stream, 5 km at the north of the headquarters of the "Trementina" farm – middle catchment of the Trementina stream – Determine the current surface water quality of the property.
	13	F.W. 208-TR	21K 514416.00 mE 7485700.00 mS	F.W.	Described in 2	Trementina stream, 2 km northwest of the Trementina farm's headquarters – Middle catchment of the Trementina stream – Determine the property's current surface water quality.
	14	GW 11-MICHEL	21K	GW	Described in 3	Deep tubular wells located in new plantations of *Eucalyptus sp* – Middle basin

TABLE 1. SAMPLING POINTS						
	Nº	CODE	UTM COORDINATES	TYPE OF SAMPLE	MONITORED PARAMETERS	LOCATION, DESCRIPTION, OBJECTIVES
			518643.00 mE 7484801.00 mS			of the Trementina stream – Well for water for human consumption.
	15	G.W. 10-TR	21K 516254.00 mE 7484946.00 mS	G.W.	Described in 3	Trementina farm headquarters –Middle basin of the Trementina stream, dairy farm and corrals within 200 metres of the All of the well, use for drinking water supply – Determine current groundwater quality.
	16	G.W. 13-SAN JUAN	21K 509767.00 mE 7486076.00 mS	G.W.	Described in 3	"San Juan" farm, the middle basin of the Trementina stream – Well for drinking water supply – Determine the "San Juan" farm's current groundwater quality.
	17	G.W. 22-SILVA	21K 509830.00 m E 7484037.00 m S	G.W.	Described in 3	"Silva" farm, the middle basin of the Trementina stream – Well for drinking water supply – Determine current groundwater quality of the "Silva" farm.
	18	F.W. 205-TR	21K 516574.00 mE 7482061.00 mS	F.W.	Described in 2	Trementina stream, 2.7 km east of the Trementina farm headquarters, middle catchment of the Trementina stream micro-catchment – Determine the property's current surface water quality.
	19	G.W. 12-Laguna	21K 516419.00 mE 7478307.00 mS	G.W.	Described in 3	"Laguna" farm, the middle basin of the Trementina stream micro-basin – Well for drinking water supply and irrigation of seedlings, currently developing a forest nursery and plantation of new crops of *Eucalyptus sp* – Determine the current quality of groundwater in the "Laguna" farm.
TREMENTINA STREAM MICRO-WATERSHED.	20	F.W. 109-MYRZ	21K 508110.00 mE 7475784.00 mS	F.W.	Described in 2	Trementina stream, point located between the "Mandyju" and "Rancho Z" property boundaries – middle catchment of the "Trementina" stream micro-watershed – Determine the current surface water quality of the property.
	21	F.W. 115-MANDYJU	21K 509155.00 mE 7467194.00 mS	F.W.	Described in 2	Trementina stream, a point located 11 km southeast of the "Rancho Z" forest plantations – middle catchment of the Trementina stream micro-watershed – Determine Mandyju's ranch current surface water quality.
	22	F.W. 317-RZ	21K 503324.00 mE 7459243.00 mS	F.W.	Described in 2	Trementina stream – lower catchment of the Trementina stream micro-catchment – Determine the current surface water quality at the exit of "Rancho Z".
	23	F.W. 204-LB	21K 498840.00 mE 7451514.00 mS	F.W.	Described in 2	Trementina stream point located 5 km upstream of the outflow point of the Trementina stream to the Aquidabán River – The lower watershed of the "Trementina" stream micro-watershed – Representative point of the quality of water discharging from the Trementina stream into the Aquidabán River.
REPRESENTATIVE POINTS OF THE RIVER AQUIDABÁN	24	FW 110-LB	21K 511487.00 mE 7450940.00 mS	F.W.	Described in 2	Unnamed Stream – Tributary of the Aquidabán River – Determine surface water quality.
	25	F.W. 111-LB	21 K 514185.37 mE 7447625.56 mS	F.W.	Described in 2	Aquidabán River – Lower-middle basin of the Aquidabán River catchment – Determine the current surface water quality.
	26	F.W. 310-CR	21 K 487444.00 mE 7449950.00 mS	F.W.	Described in 2	Aquidabán River – Lower basin of the Aquidabán River catchment – Determine the current Surface water quality in the All of the "Cristo Rey" farm.

TABLE 1. SAMPLING POINTS						
	Nº	CODE	UTM COORDINATES	TYPE OF SAMPLE	MONITORED PARAMETERS	LOCATION, DESCRIPTION, OBJECTIVES
	27	F.W. 316-CR	21K 485341.00 mE 7442662.00 mS	F.W.	Described in 2	"Laguna Penayo" stream – Lower basin of the Aquidabán River – Determine the "Soledad" farm's surface water quality.
PITANOHAGA STREAM MICRO-WATERSHED	28	G.W. 14-ZM	21K 493064.00 mE 7499176.00 mS	G.W.	Described in 3	Headquarters of the "Zanja Morotĩ" farm – Deep tubular well for drinking water supply – Determine the current groundwater quality of the "Zanja Morotĩ" farm.
	29	G.W. 15-SO	21K 483316.00 mE 7497562.00 mS	G.W.	Described in 3	Headquarters of the "Soledad" farm - Deep tubular well for drinking water supply – Determine the current quality of the groundwater of the "Soledad" farm.
MICROCUENCA DEL AO PITANOHAGA	30	FW 306 -SO	21K 486496.00 mE 7493077.00 mS	FW	Described in 2	Tributary of the Pitanohaga stream– Upper catchment of the Pitanohaga stream micro-watershed – Determine the surface water quality of the Soledad farm.
	31	G.W. 17-LP	21K 489833.00 mE 7492572.00 mS	G.W.	Described in 3	Headquarters of "La Paraguaya" farm – Deep tubular well for water provision for human consumption – Determine the current quality of the farm's groundwater.
	32	G.W. 21-MC	21K 495202.00 mE 7489899.00 mS	G.W.	Described in 3	Headquarters of the "Machuca-cue" farm – Deep tubular well for drinking water supply – Determine the farm's groundwater's current quality.
ADA	33	GW 01	21K 449839.00 mE 7430729.00 mS	GW	Described in 3	The directly affected area by the future PARACEL industry, currently a floodable grassland area – Deep tubular wells built exclusively for the periodic and systematic monitoring of the groundwater quality of the aquifer, to detect possible chemical alterations of the water as a consequence of the implementation and operation of the industrial plant.
	34	GW 02	21K 450165.00 mE 7430301.00 mS			
	35	GW 03	21K 449136.00 mE 7427123.00 mS			
	36	GW 04	21K 448716.00 mE 7428109.00 mS			
	37	GW 05	21K 450803.00 mE 7426714.00 mS			
	38	GW 06	21K 451708.00 mE 7427153.00 mS			
	39	F.W. 01	21K 446252.08 mE 7428199.87 mS	F.W.	Described in 4	Paraguay River – Project's ADA – To monitor a point located 2.5 km upstream before the effluent discharge point.
	40	F.W. 02	21K 449651.97 mE 7424489.86 mS			Paraguay River – Project's ADA – To monitor point located 2.5 km downstream of the effluent discharge point.

2.3 Monitored parameters determined by sample type

The table below shows the monitored parameters for each sample or monitoring points according to terms of reference. It was analysed 67 parameters (physicochemical, agrochemical, hydrobiological and bacteriological) for 18 surface water points.

TABLE 2. MONITORED PARAMETERS FOR SURFACE WATER	
IN SITU MONITORING PARAMETERS	
1- Water temperature	4- Dissolved oxygen
2- Hydrogen potential	5- Turbidity
3- Electrical conductivity	

PHYSICO-CHEMICAL ANALYTICAL DETERMINATIONS			
PARAMETERS INCLUDED IN THIS REPORT		PARAMETERS THAT INCLUDES THE FINAL REPORT OF THE FIRST CAMPAIGN	
6- Suspended sediments	14- Ammonia	22- Aluminium	30- Selenium
7-Total dissolved solids	15- Nitrites	23- Cadmium	31- Zinc
8- Oil and grease	16- Hardness	24- Hexavalent chromium	32- Arsenic
9- COD (oxygen demand chemical)	17- Sodium	25- Trivalent chromium	33- Barium
10- BOD5 (oxygen demand biochemical)	18- Sulphates	26- Tin	34- Total mercury
11- Total phosphorus	19- Cyanides	27- Nickel	
12- Total nitrogen	20- Copper	28- Manganese	
13- Nitrates	21- Soluble iron	29- Lead	
AGROCHEMICALS			
35- Glyphosate	43- DDE	51- 2,4-D	59- Imidacloprid
36- AMPA	44- DDD	52- Lambda-cyhalothrin*	60- Methyl-paraoxon
37- Aldrin	45- Atrazine	53- Bifenthrin	61- Thiamethoxam*
38- Endrin	46- Simazine	54- Cypermethrin	62- Sulfluramide*
39- Dieldrin	47- Carbaryl	55- Chlorpyrifos	63- Fipronil*
40- Lindane	48- Carbofuran	56- Dichlorvos	
41- Chlordane	49- Heptachlor	57- Methamidophos	
42- DDT	50- Methomyl	58- Tebuconazole	
*Notes: This document does not report the following parameters: Lambda-cyhalothrin, Thiamethoxam, and Sulfluramide.			
HYDROBIOLOGICAL PARAMETERS			
64- Phytoplankton diversity: ▪ Genus ▪ Species composition ▪ Dominance		65- Zooplankton diversity: ▪ Genus ▪ Species composition ▪ Dominance	
BACTERIOLOGICAL PARAMETERS			
66- Faecal coliforms		67- Total coliforms	

TABLE 3. PARAMETERS DETERMINED FOR GROUNDWATER		
IN SITU MONITORING PARAMETERS		
1- Water temperature		3- Electrical conductivity.
2- Hydrogen potential		
PHYSICO-CHEMICAL ANALYTICAL DETERMINATIONS		
4- Total dissolved solids	10- Bicarbonates	16- Total phosphorus
5- Organic matter	11- Carbonates	17- Total nitrogen
6- Hardness	12- Sulphates	18- Sodium
7- Nitrates	13- Calcium	19- Potassium
8- Chlorides	14- Magnesium	20- Boron
9- Alkalinity	15- Fluorine	
BACTERIOLOGICAL PARAMETERS		
21- Faecal coliforms	21- Total coliforms	23- *Escherichia coli*

Table 3 shows the parameters analysed for groundwater monitoring that are 23 determinations for the twenty samples extracted from the artesian and monitoring wells.

The two sampling points on the Paraguay River are crucial monitoring points for the PARACEL's future industry. According to POYRY's environmental impact assessment report (2020), this river will work as a waterway to transport raw materials, chemical inputs, and products.

The future industry's port will be on the Paraguay River (AII). At the same time, raw water will be extracted from this river for treatment and use in the industrial processes and will also be the receiving body for the treated effluents generated at the paper mill.
Given the particular importance of the points on the River Paraguay, 68 analytical determinations, including a broader range of agrochemicals and halogenated organic compounds (AOX), were carry out in points F.W01 and F.W02. Table 4 shows in detail the parameters determined for these points.

TABLE 4. PARAMETERS DETERMINED FOR THE PARAGUAY RIVER
IN SITU MONITORING PARAMETERS

1- Water temperature		4- Dissolved oxygen	
2- Hydrogen potential		5- Turbidity	
3- Electrical conductivity			
PHYSICO-CHEMICAL ANALYTICAL DETERMINATIONS			
PARAMETERS INCLUDED IN THIS REPORT		**PARAMETERS THAT INCLUDES IN THE FINAL REPORT OF THE FIRST CAMPAIGN**	
6- Floating materials	16- Hardness	25- Aluminium	34- Zinc
7- Total dissolved solids	17- Sodium	26- Cadmium	35- Arsenic
8- Oil and grease	18- Sulphates	27- Hexavalent chromium	36- Barium
9- COD (oxygen demand chemical))	19- Cyanides	28- Trivalent chromium	37- Total mercury
10- BOD5 (oxygen demand biochemical	20- Copper	29- Trivalent chromium	
11- Total phosphorus	21- Soluble iron	30- Tin	
12- Total nitrogen	22- Colour	31- Manganese	
13- Nitrates	23- Phenols index	32- Lead	
14- Ammonia	24-PCBs (Polychlorinated Biphenyls)	33- Selenium	
15- Nitrites			
AGROCHEMICALS			
38- Glyphosate	46- DDE	54- 2,4-D	62- Imidacloprid
39- AMPA	47- DDD	55- Lambda-cyhalothrin*	63- Methyl-paraoxon
40- Aldrin	48- Atrazine	56- Bifenthrin	64- Thiamethoxam*
41- Endrin	49- Simazine	57- Cypermethrin	65- Sulfluramide*
42- Dieldrin	50- Carbaryl	58- Chlorpyrifos	66- Fipronil*
43- Lindane	51- Carbofuran	59- Dichlorvos	
44- Chlordane	52- Heptachlor	60- Methamidophos	
45- DDT	53- Methomyl	61- Tebuconazole	
*Notes: This document does not report the following parameters: Lambda-cyhalothrin, Thiamethoxam, and Sulfluramide.			
BATERIOLOGICAL PARAMETERS			
67- Faecal coliforms		68- Total coliforms	

2.4. Sample collection procedures

2.4.1 Surface water (FW.)

In situ measurements were performed (pH, temperature, conductivity and dissolved oxygen) and were collected samples for the rest parameters to be analysed in the laboratory (Tables 1 and 3) by immersing plastic containers to a depth of 30 cm below the surface of the water. For bacteriological sampling, a sterile sampling cup was submerged to a depth of 30 cm, fill it with water and closing it tightly underwater to avoid external contamination.

The cups, duly identified, were placed in coolers with ice to avoid altering the samples' composition before analysis. The surface sampling procedure and the preservation of the samples until they arrived at the laboratory (Table 5), for each point, was based on the Standard Methods 22nd. Ed. For surface water (Tables 6, 7 and 8).

2.4.2 Groundwater (GW.)

Groundwater samples were taken to determine physicochemical and bacteriological parameters in the laboratory (Table 2). On the other hand, parameters as pH, temperature and conductivity were measured on-site.

2.4.3 Sample containers and preservatives

Table 5 details all the parameters, sample containers, volumes and preservatives applied according to the parameter's analysis method.

TABLE 5. FLASKS AND PRESERVATIVES PER SAMPLE TYPE						
SAMPLE CONTAINER	**MATERIAL**	**VOLUME**	**PRESERVATIVE**	**PARAMETERS**	**FW**	**GW**
Bacteriology	Plastic	100 mL	s/p	Total coliforms Faecal coliforms *Escherichia coli*	✓	✓
BOD5	Plastic	1L	s/p	COD, BOD5	✓	
CF	Plastic	2L	s/p	Solids, Turbidity, Alkalinity, Nitrite, Nitrate, Colour, Chloride, Magnesium, Calcium, Sulphate	✓	✓
Phenols	Plastic	1L	H_2SO_4 1+1, up to pH<2	Phenols, Cr^{+6}	✓F W PY	
Metals	Plastic	1L	HNO_3 1+1, up to pH<2	CrT, Hg, Zn, Cd, Pb, Se, Sn, Al, Cu, Mn, Ni	✓	✓
NTK	Plastic	1L	H_2SO_4 1+1, hasta pH<2	P.T., NTK, N-NH_3	✓	✓
Iron	Plastic	250 mL	HCl 1+1, up to pH<2	Iron, sodium, potassium	✓	
Sulphides	Plastic	500 mL	Zn acetate + NaOH up to pH>9	Sulphur	✓	
Multi-waste	Amber glass	1L	s/p	Multi-waste	✓	
Sulphuramid and lambda-cyhalothrin	Amber glass	1L	s/p	Sulphuramid and Lambda-cyhalothrin	✓	
Bifenthrin y Thiamethoxam	Plastic	1L	s/p	Bifenthrin y Thiamethoxam	✓	
Glyphosate and AMPA	Plastic	1L	s/p	Glyphosate and AMPA	✓	
Fipronil	Amber glass	1L	s/p	Fipronil	✓	
PCBs	Amber glass	1L	s/p	PCBs	✓ FW PY	
FITO	Plastic	250 mL	Lugol	Phytoplankton	✓*	
ZOO	Plastic	100 L	Formaldehyde 10%	Zooplankton	✓*	

Sample collection and preservation conditions. Ref.: s/p (Without preservative), BOD5 (Biochemical Oxygen Demand); COD (Chemical Oxygen Demand); FQ (Some Physicochemical parameters); NTK (Total Nitrogen Kjeldahl); CrT (Total Chromium) and AMPA (α-Amino-3-hydroxy-5-methyl-4-isoxazole propionic acid), FITO (Phytoplankton) y ZOO (Zooplankton).

2.5 Applied analytical methods

The tables below detail the analytical methods applied for the determination of each parameter.

TABLE 6. METHODS FOR HYDROBIOLOGICAL-BACTERIOLOGICAL PARAMETERS			
HYDROBIOLOGICAL			
PARAMETERS	**METHODS**	**LIMITS OF QUANTIFICATION IN WATER**	**PERMISSIBLE LIMITS AS PER SEAM REGULATION 222/02 CLASS 2**
Phytoplankton	Phytoplankton counting techniques - SM 10200 F	<100 Cells	No limits

Zooplankton	Zooplankton counting techniques – SM 10200 G	Not applicable	No limits
MICROBIOLOGICAL PARAMETERS - GROUNDWATER			
PARAMETERS	**METHODS**	**LIMITS OF QUANTIFICATION IN WATER**	**PERMISSIBLE LIMITS AS PER NP REGULATION 2400180**
Total coliforms	Standard fermentation technique for Total coliforms SM 9221 B Bacterial density estimation SM 9221 C	>23 NMP/100mL	<1,1 NMP/100mL
Faecal coliforms	Standard fermentation technique for Total coliforms SM 9221 B Bacterial density estimation SM 9221 C	>23 NMP/100mL	<1,1 NMP/100mL
E. coli	Escherichia coli SM 9260 F	Presence/100mL	Absence/100mL
MICROBIOLOGICAL PARAMETERS – SURFACE WATER			
PARAMETERS	**METHODS**	**LIMITS OF QUANTIFICATION IN WATER**	**PERMISSIBLE LIMITS AS PER SEAM REGULATION 222/02 CLASS 2**
Faecal coliforms	Standard fermentation technique for Total coliforms SM 9221 B Bacterial density estimation SM 9221 C	>160.000 NMP/100mL	≤ 1.000 NMP/100mL
Total coliforms	Standard fermentation technique for Total coliforms SM 9221 B Bacterial density estimation SM 9221 C	>160.000 NMP/100mL	Not applicable

TABLE 7. METHODS APPLIED TO PHYSICO-CHEMICAL PARAMETERS				
PARAMETERS	**METHODS**	**MONITORING EQUIPMENT**	**LIMITS OF QUANTIFICATION IN WATER**	**PERMISSIBLE LIMITS AS PER SEAM REGULATION 222/02 CLASS 2**
Water temperature	Laboratory and field methods SM-2550 B	Conductimeter/Oximeter/pHmeter WTW MULTI 350	Not applicable	No limits
Dissolved oxygen	Membrane electrode method SM-4500-O G	Conductimeter/Oximeter/pHmeter WTW MULTI 350	0,10 mg O2/L	No less than 5 $mg.L^{-1}$
pH	Electrometric method SM-4500 - H^+	Conductimeter/Oximeter/pHmeter WTW MULTI 350	0 a 14	6 a 9
Conductivity	Laboratory method SM-2510 -B	Conductimeter/Oximeter/pHmeter WTW MULTI 350	0 a 199,9 mS/cm	No limits
Alkalinity	Titration method SM-2320 B	Current calibrated glass material	1,0 $mg.L^{-1}$	No limits
Turbidity	Nephelometric method SM-2130 B	THERMO ORION AQ 4500 Turbidimeter	0,10 NTU	100 NTU
Floating materials	Visual	Not applicable	Not applicable	Visually absent
Oil and grease	Method SM 5520-B	QUIMIS 01317M-53 stove and rotary evaporator EYELA SB1000	0,020 $mg.L^{-1}$	Visually absent
Total phosphorus	Ascorbic acid method SM-4500-P E	Schimadzu - UV Spectrophotometer 1700	0,025 mg $PO4^{-3}.L^{-1}$	0,05 $mg.L^{-1}$
NTK	Macro-Kjeldahl SM-4500-N B; phenate method SM-4500 F	Gerhardt Turbosog/ Schimadzu Digester - UV Spectrophotometer 1700	0,025 mg $N.L^{-1}$	0,6 $mg.L^{-1}$
Nitrate nitrogen	AOAC Official Method 973.50 Brucine Colorimetric Method	Schimadzu - UV Spectrophotometer 1700	0,10 mg $N(NO3^-).L^{-1}$	10 $mg.L^{-1}$
Nitrite nitrogen	Colorimetric method SM-4500 ($NO2^-$) B	Schimadzu - UV Spectrophotometer 1700	0,0025 mg $N\text{-}NO2^-.L^{-1}$	1,0 $mg.L^{-1}$
Ammonia nitrogen	Phenol salt method SM-4500 (NH3) F	Schimadzu - UV Spectrophotometer 1700	0,015 mg $N\text{-}NH3.L^{-1}$	0,02 $mg.L^{-1}$
BOD5	5-day BOD test - SM-5210 B	WTW OXI 3310 Oximeter	0,10 mg $O2.L^{-1}$	5 $mg.L^{-1}$
COD	Closed reflux, colorimetric method - SM-5220 D	Schimadzu - UV Spectrophotometer 1700	5,0 $mgO2.L^{-1}$	SLE
Dissolved solids totals	Gravimetric method SM-2540 C	Sartorius Analytical Balance / Stove QUIMIS 0317M-S3	2,0 $mg.L^{-1}$	500 $mg.L^{-1}$
Colour	Visual comparison method SM-2120 B	Schimadzu - UV Spectrophotometer 1700	5 mg $Pt.L^{-1}$	75 $mgPt.L^{-1}$
Trivalent chromium	Calculation method (Total chromium – Hexavalent chromium)	Not applicable	0,05 $mg.L^{-1}$	0,5 $mg.L^{-1}$
Hexavalent chromium	Colorimetric method (SM-3500-Cr B)	Schimadzu - UV Spectrophotometer 1700	0,05 $mg.L^{-1}$	0,05 $mg.L^{-1}$
Copper	AAS-Air-Acetylene Flame (SM-3111-B)/GFA (SM-3113)	AA-7000 Shimadzu / GFA -7000	0,05 $mg.L^{-1}$	1,0 $mg.L^{-1}$
Arsenic	Colorimetric method (SM-3500-As B)	Schimadzu - UV Spectrophotometer 1700	<0,01 $mg.L^{-1}$	0,01 $mg.L^{-1}$
Boron	Colorimetric method (SM-4500-B C)	Schimadzu - UV Spectrophotometer 1700	1,0 $mg.L^{-1}$	No limits
Manganese	AAS- Air-Acetylene Flame (SM-3111-B)/GFA (SM-3113)	AA-7000 Shimadzu	0,05 $mg.L^{-1}$	0,1 $mg.L^{-1}$
Nickel	AAS- Air-Acetylene Flame (SM-3111-B)/GFA (SM-3113)	AA-7000 Shimadzu	0,010 $mg.L^{-1}$	0,025 $mg.L^{-1}$
Zinc	AAS- Air-Acetylene Flame (SM-3111-B)	AA-7000 Shimadzu	0,05 $mg.L^{-1}$	3,0 $mg.L^{-1}$
Cadmium	AAS-GFA (SM-3113)	AA-7000 Shimadzu / GFA -7000	0,0008 $mg.L^{-1}$	0,001 $mg.L^{-1}$
Lead	AAS-GFA (SM-3113)	AA-7000 Shimadzu / GFA -7000	0,002 $mg.L^{-1}$	0,01 $mg.L^{-1}$
Selenium	AAS-GFA (SM-3113)	AA-7000 Shimadzu / GFA -7000	0,005 $mg.L^{-1}$	0,01 $mg.L^{-1}$
Tin	AAS-GFA (SM-3113)	AA-7000 Shimadzu / GFA -7000	1,0 $mg.L^{-1}$	2,0 $mg.L^{-1}$
Aluminium	AAS-GFA (SM-3113)	AA-7000 Shimadzu / GFA -7000	0,10 $mg.L^{-1}$	0,2 $mg.L^{-1}$

TABLE 7. METHODS APPLIED TO PHYSICO-CHEMICAL PARAMETERS				
PARAMETERS	**METHODS**	**MONITORING EQUIPMENT**	**LIMITS OF QUANTIFICATION IN WATER**	**PERMISSIBLE LIMITS AS PER SEAM REGULATION 222/02 CLASS 2**
Fluorine	Method SM 4500 F C Ion-selective electrode	Multiparameter with selective fluoride electrode OAKTON	0,05 $mg.L^{-1}$	No limits
Phenols	Direct photometric method SM-5530 D	Schimadzu - UV Multiparameter with selective fluoride electrode OAKTON 1700	0,04 $mg.L^{-1}$	No limits
Total hardness	EDTA titrimetric method - SM-2340 C	Current calibrated glass material	1,0 $mg.L^{-1}$	300 $mgCa.L^{-1}$
Chlorides	Argentometric SM-4500 -Cl^- B	Current calibrated glass material	0,5 mg $Cl^-.L^{-1}$	No limits
Magnesium	Calculation method SM-3500 B	Not applicable	0,2 mg $Mg.L^{-1}$	No limits
Calcium	EDTA titrimetric method SM-3500 B	Current calibrated glass material	0,4 $mg.L^{-1}$	No limits
Potassium	AAS-Flame nitrous oxide-acetylene (SM-3111-D)/GFA (SM- 3113)	AA-7000 Shimadzu	0,25 $mg.L^{-1}$	No limits
Sodium	AAS-Air-acetylene flame (SM-3111-B)	AA-7000 Shimadzu	0,25 $mg.L^{-1}$	200 $mg.L^{-1}$
Soluble iron	Phenanthroline method SM-3500-Fe B	Schimadzu - UV Spectrophotometer 1700	0,05 mg $Fe.L^{-1}$	No limits
Sulphates	Turbidimetric method SM-4500 - $SO4^{-2}$ E	THERMO ORION AQ 4500 Turbidimeter	1,0 mg $SO4^{-2}.L^{-1}$	250 $mg.L^{-1}$
Cyanides	SM 4500-CN E – Standard method – Standard methods used to analyse drinking and wastewater, 17th Edition (APHA-AWWA-WPCF).	Thermo Scientific Evolution 60S UV-Visible Spectrophotometer	0,02 mg. L^{-1}	0,07 mg. L^{-1}
PCB	Determination of PCBs residues in an aqueous matrix by GC-ECD *Gas Chromatography - Electron Capture Detector*	Gas Chromatography	0,2237 mg. L^{-1}	0 (zero)
Total mercury	Method ICP/MES *"Inductively Coupled Plasma Mass Spectrometry"*	Spectrophotometer.	0,05 mg. L-1	No limits
Barium	Method icp/mes *"inductively coupled plasma mass spectrometry"*	Spectrophotometer.	<0,001 mg. L-1	2 mg. L^-

TABLE 8. APPLIED METHODS FOR THE DETERMINATION OF AGROCHEMICALS			
AGROCHEMICALS			
PARAMETERS	**METHODS**	**LIMITS OF QUANTIFICATION IN WATER**	**PERMISSIBLE LIMITS AS PER REGULATION 222/02 SEAM CLASS 2**
OC- Aldrin	Extraction US-EPA 8081B and 3510 with modifications. Quantification by EPA 608.1 with modifications - GC-MS/MS	<1,00	No limits
OC-Endrin		<1,25	2
OC-Dieldrin		<1,50	No limits
2,4-D		<2,50	30
Atrazine		<2,00	3
Carbaryl		<3,50	No limits
Carbofuran		<3,00	40
Cypermethrin		<1,20	No limits
Chlordane		<0,9	0
Chlorpyrifos		<5,00	No limits
DDD		<2,00	No limits
DDE	Extraction US-EPA 8081B and 3510 with modifications. Quantifications by EPA 608.1 with modifications - GC-MS/MS	<2,00	No limits
DDT		<2,00	2
Dichlorvos		<10,0	10
Heptachlor		<1,50	0
Imidacloprid		<5,00	No limits
Lindane		<0,200	0,2
Methamidophos		<25,0	No limits
Methylparaoxon		<25,0	No limits
Methomyl		<25,0	No limits
Simazine		<2,50	4
Tebuconazole		<2,00	No limits
Sulfluramid	*		No limits
Lambdacyalothrin	*		No limits
Lambdacyalothrin	*		No limits
Thiamethoxam	*		No limits
Glyphosate/AMPA in water	Extraction: In-house method (According to Amarante, J. et al; 2002) Quantification by HPLC/FLD	0,3 µg/L	0,7
Fipronil	Method: LC-MS/MS *Liquid Chromatography Mass Spectrometry*	0,0100 mg. L^{-1}	

Notes: Due to the pandemic, the suppliers of the reagents and laboratory chemicals necessary to determine Sulfluramid, Lambdacyalothrin, Lambdacyalothrin and Thiamethoxam, have not yet been delivered causing delays in the determination of these agrochemicals (Appendix E. Supplier's note).

2.6 Data quality control

As established in the National Water Quality Standard (Regulation SEAM No. 222/02 – Art. 13), the sampling techniques and respective analysis were carried out according to the internationally recognised methodology: The Standard Methods – To examine water and wastewater – APHA – AWWA – WPCF. Tables 6, 7 and 8 show the methods and equipment used for each parameter's analytical determination.

A team of technicians from the CEMIT's laboratory and TECNOAMBIENTAL performed the field sampling. The samples were taken according to the methodology previously described, ensuring the correct application of procedures, flasks, preservatives and cold chain maintenance from the sampling site to the laboratories.

Using a "field blank" eliminates the possibility that the flasks are a source of contamination. Field blanks are containers filled with deionised water free of the analyte in question and are preserved and analysed in the same wat as any other sample for the same determination.

If the analytical determinations made on the field blanks show results close to zero (0), the flasks did not contaminate during the trip, and the samples are representative of the points analysed.

The CEMIT Water Quality Laboratory, which belongs to the National University of Asunción (UNA), has been accredited since 2015 by the Paraguay National Accreditation Body (ONA). The professional responsible for the processing and analysis of the results is the chemist Claudia Ávalos de Enciso.

Other laboratories also accredited by the ONA analysed the following parameters; Total mercury, Barium, Cyanides, Fipronil and PCBs.

ANALITICA SA tested Total mercury and Barium. This laboratory is also accredited by the ONA, according to Standard NP-ISO/EIC 17025:2018.

The Water Quality Laboratory of the Faculty of Exact and Natural Sciences of the National University of Asunción (FACEN-UNA) analysed Cyanides.

Eco Natura laboratory, which is part of the MULTI LAB group, analysed FIpronil and PCBs. This institute is accredited according to NO-ISO/EIC 17025:2018 by the ONA.

2.7 Data interpretation models

The steps followed for the presentation and interpretation of the results of the analytical determinations are the following:

- Processing the results and comparing with the limits established in Regulation SEAM No. 222/02 "By which the water quality standard is established in the national territory" for Class 2, a category in which all surface waters are classified.
- The series of determinations at the different sampling points are shown on graphs and descriptive statistics for each parameter. The sampling point's parameters that are out of range are reported.
- For each point, the percentage of parameters that complies and does not comply with Regulation SEAM No. 222/02 was determined.

III. RESULTS

3.1 General performance of surface water's parameters

Table 9 shows a summary of the results obtained for each parameter analysed in surface water; it also highlights the points that present some deviation and the percentage of monitoring points that complies with Regulation SEAM No. 222/02 "Establishing the water quality standard in the national territory" and those beyond the permissible limits.

TABLE 9. SUMMARY OF SURFACE WATER QUALITY ANALYSIS

Nº	PARAMETER	AVERAGE	MONITORING POINTS WITH DEVIATIONS	COMPLY WITH THE LIMITS		BEYOND THE LIMITS	
				Nº	%	Nº	%
1	Temperature	24,5 ºc	No limits				
2	pH	6,87	FW317-RZ, FW 11-LB	18	90%	2	10%
3	Electrical conductivity	130,50 µS/.cm	No limits				
4	Dissolved oxygen	5,7 mg O2/L	FW 207-TR, FW 208-TR, FW 115-MY, FW 110-LB FW 109-MYRZ	15	75%	5	25%
5	Turbidity	140,154 NTU	FW 200-SLTR, FW 205-TR FW 111-LB, FW 310-CR	16	80%	4	20%
6	Floating materials	51,36	No limits				
7	Total dissolved solids (TDS)	161,7	All the points complies with the limits	20	100%	0	0%
8	Oil and grease	8,78 mg/L	No limits				
9	COD	78,2 mg O_2/L	No limits				
10	BOD5	3,15 mg O_2/L	FW 205-TR, FW 310-TR, FW 316-CR	16		3	
11	Total phosphorus	0,07 mg/L	FW 315-HE, FW 304-HE, FW 207-TR, FW205-TR, FW 109-MYRZ, FW 115-MY FW 110-LB, FW 111-LB FW310-CR, FW01	9	45%	11	55%
12	Total nitrogen	0,77 mg/L	FW 315-HE, FW 208-TR FW 316-CR	16	80%	4	20%
13	Nitrates	2,7 mg/L	All the points complies with the limits	20	100%	0	0%
14	Ammonia	0,12 mg/L	All the points exceeds the maximum limits	0	0%	20	100%
15	Nitrites	0,12 mg/L	All the points complies with the limits	20	100%	0	0%
16	Hardness	30,70 mg CaCO3/L	All the points complies with the limits	20	100%	0	0%
17	Sulphates	>2 mg/L	All the points complies with the limits	20	100%	0	0%
18	Sodium	7,42 mg/L	All the points are under the limits of quantification in water; therefore complies with the limits	20	100%	0	0%
19	Aluminium	--	All the points are under the limits of quantification (LOQ=0,1)	20	100%	0	0
20	Cadmium	---	All the points are under the limits of quantification (LOQ=0,0008)	20	100%	0	0
21	Hexavalent chromium	--	All the points are under the limits of quantification (LOQ=0,0500)	20	100%	0	0%
22	Trivalent chromium	--	All the points are under the limits of quantification (LOQ=0,0500)	20	100%	0	0%
23	Copper	--	All the points are under the limits of quantification	20	100%	0	0%
24	Tin		All the points are under the limits of quantification (LOQ=1)	20	100%	0	0

TABLE 9. SUMMARY OF SURFACE WATER QUALITY ANALYSIS							
Nº	**PARAMETER**	**AVERAGE**	**MONITORING POINTS WITH DEVIATIONS**	**COMPLY WITH THE LIMITS**		**BEYOND THE LIMITS**	
				Nº	**%**	**Nº**	**%**
25	Nickel	0,098 mg/L	18 points under the limits of quantification and only 2 determinations beyond the limits	18	90%	2	10%
26	Manganese	0,207 mg/L	FW315-HE, FW205-TR FW110-LB, FW111-LB FW310-CR, FW01, FW02	13	65%	7	35%
27	Lead	0,0118 mg/L	FW317-RZ, FW316-CR FW306-SO	17	85%	3	15%
28	Selenium	--	All the points are under the limits of quantification (LOQ=1)	20	100%	0	0
29	Zinc	0,14 mg/L	-	20	100%	0	0%
30	Arsenic	--	-	20	100%	0	0%
31	Soluble iron	1,3 mg/L	All the surface water sampling points exceeds the maximum limits	0	0%	20	100%
32	Total mercury	--	All the points are under the limits of quantification (LOQ=0,001)	20	100%	0	0%
33	Barium	0,139 mg/L	All the points are under the limits of quantification	20	100%	0	0%
34	Cyanides	>0,02 mg/L	All the points complies with the limits and are under the limits of quantification	20	100%	0	0%
35	Faecal coliforms	3677,4 NMP/100 mL	All points are beyond the limits except FW 316-CR, FW01 and FW02.	4	20%	16	80%
36	Total coliforms	9129,6 NMP/100 mL	FW104-ZA, FW315-HE, FW304-HE, FW200-SLTRE, FW207-TR, FW208-TR, FW205-TR, FW109-MYRZ, FW115-MY, FW317-RZ, FW204-LB, FW110-LB, FW310-CR	6	30%	14	70%

3.2 Analysis and interpretation of results

The next graphs show each parameter's behaviour determined at the 19 monitoring points, contrasting them with limits established by Regulation SEAM No. 222/02, according to the objectives.

Details per sampling point are in Appendix C.

3.2.1 Water temperature

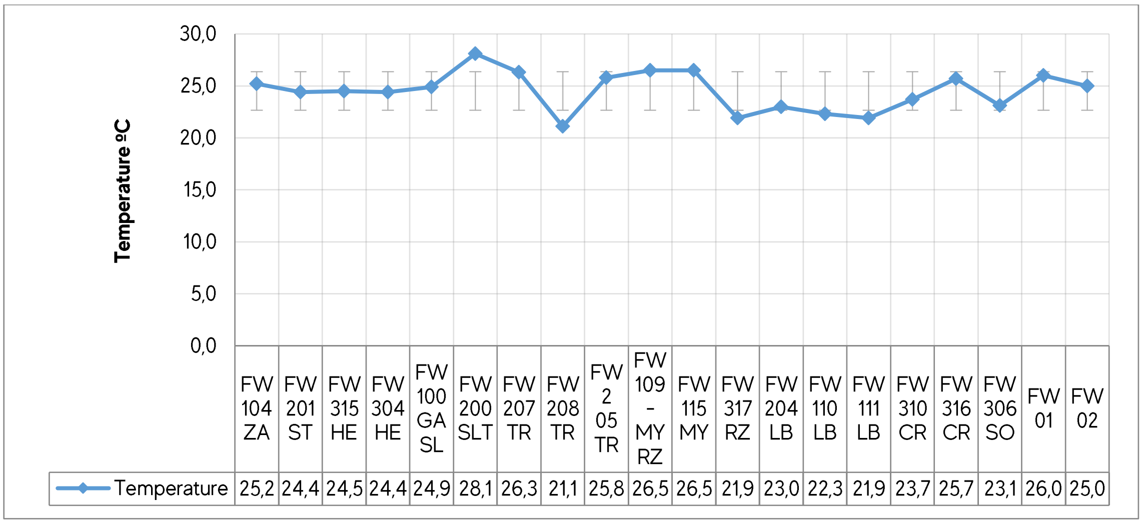


Figure 1. Comparative analysis of water temperature at monitoring points

SEAM Regulation No. 222/02 does not establish limit values for the temperature of Class water 2; only for effluents discharge to water bodies, whose limit value is 40 ºC. The average water temperature recorded in the first campaign was 24.5 ºC. The maximum value was measure at the point FW200-SLTR (28.1 ºC) and the minimum at FW208-TR (21.1 ºC).

3.2.2 Hydrogen potential (pH)

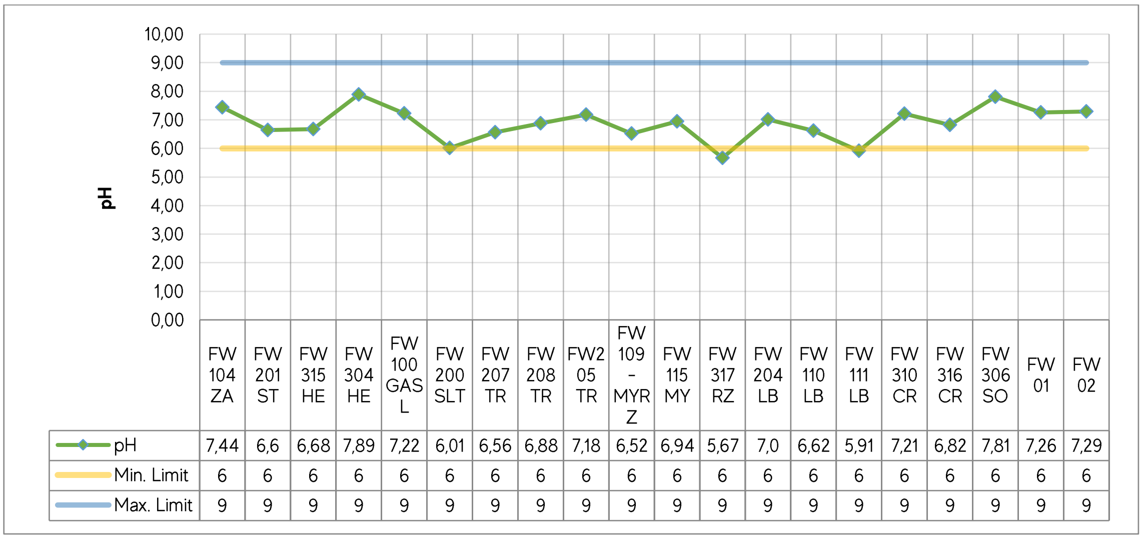
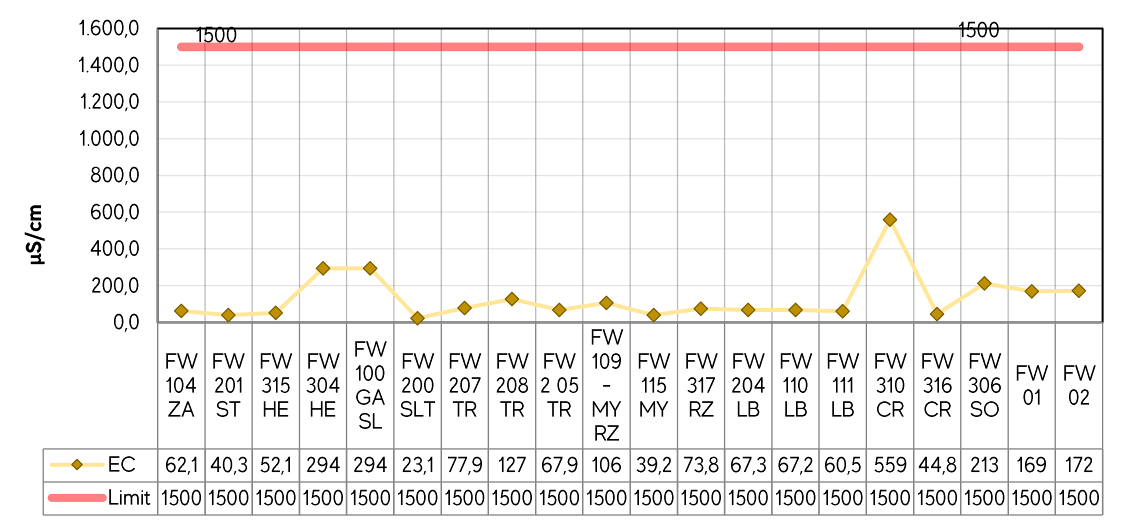


Figure 2. Comparative analysis of pH values at different monitoring points

The SEAM Regulation No. 222/02 establishes a minimum and maximum limit of 6 and 9. Figure 2 shows that none point exceeds the upper limit; as for the lowest, points FW317-RZ and FW111-LB show slightly acid pH values.

The 90% of the points comply with Regulation 222/02. The average pH magnitude in the first campaign is 6.8 which is very close to the ideal value of 7.

3.2.3 Electrical conductivity



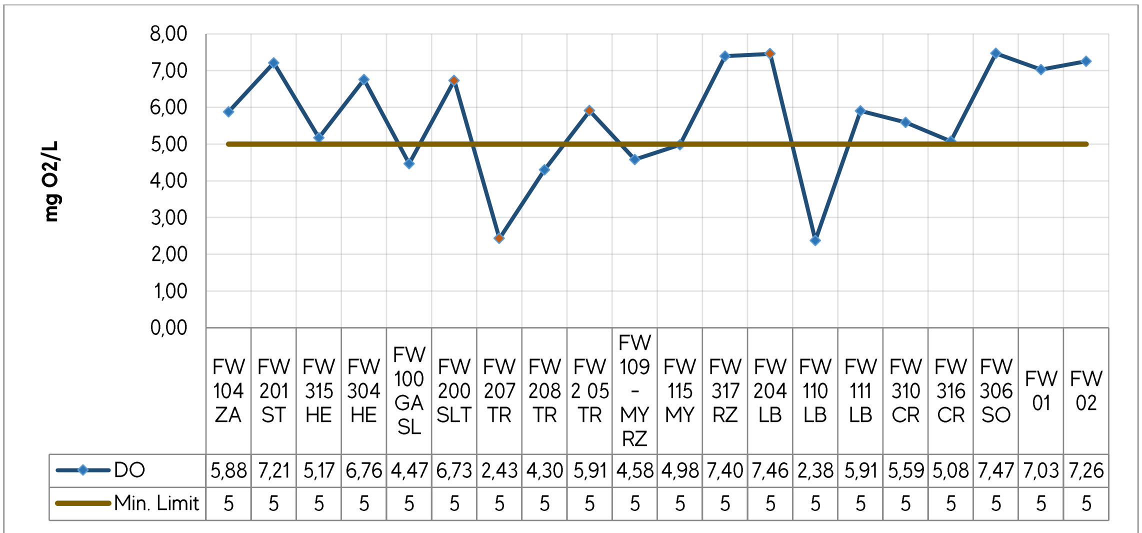
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
EC	62,1	40,3	52,1	294	294	23,1	77,9	127	67,9	106	39,2	73,8	67,3	67,2	60,5	559	44,8	213	169	172
Limit	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500

Figure 3. Comparative analysis of electrical conductivity values at different monitoring points

Regulation 222/02 does not set any limit for the electrical conductivity parameter for Class 2 water. The limit of 1500 µS/cm established in the regulation NP 24 001 80 "General requirements for drinking water" is taken as a reference. None determination carried out exceeds the mentioned number.

The average value of the parameter evaluated in the first campaign was 130,5 µS/cm. The point FW316-CR has the maximum value which is at the "Laguna Penayo" stream.

3.2.4 Dissolved oxygen



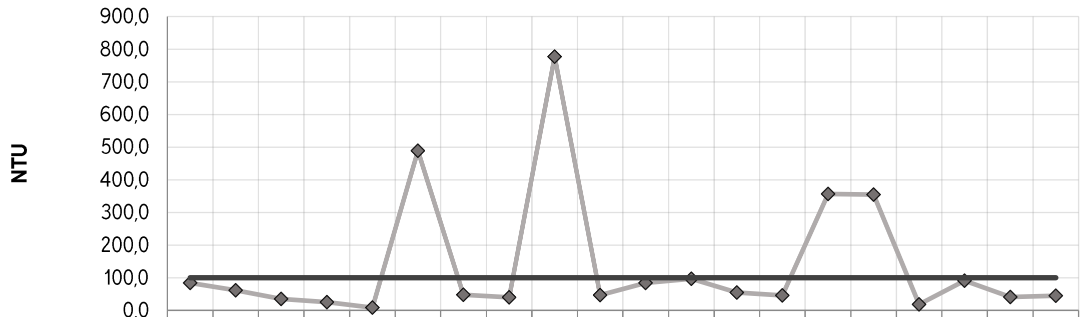
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
DO	5,88	7,21	5,17	6,76	4,47	6,73	2,43	4,30	5,91	4,58	4,98	7,40	7,46	2,38	5,91	5,59	5,08	7,47	7,03	7,26
Min. Limit	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Figure 4. Comparative analysis of dissolved oxygen at different monitoring points

According to Regulation 222/02, dissolved oxygen of waters classify as Class 2 should not be less than five (5 mg O_2/l). At points FW207-TR, FW208-TR, FW115-MY, FW110-LB and FW109-MYRZ, the value is lower.

The 74% of the 19 points comply with the regulation. The average DO in the first campaign is 5.8 mg O_2/l.

3.2.5 Turbidity



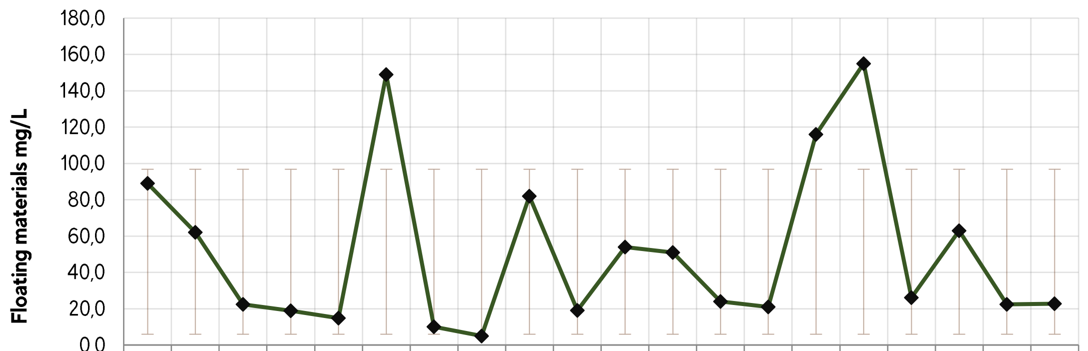
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Turbidity	84,0	61,6	35,0	25,6	8,48	489	47,4	40,3	777	46,6	83,6	96,4	54,7	46,2	357	355	18,6	90,8	41,2	44,6
Limit	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Figure 5. Comparative analysis of turbidity at different monitoring points

The maximum value established in Regulation 222/02 for Class 2 watercourse's NTU is 100. The results of the points FW200-SLTR, FW205-TR, FW111-LB and FW316-CR exceed the permissible limit.

The presence of chlorophyll and sediments may influence high turbidity values; the average value measured for this parameter in the first campaign is 140,154 NTU.

3.2.6 Floating materials



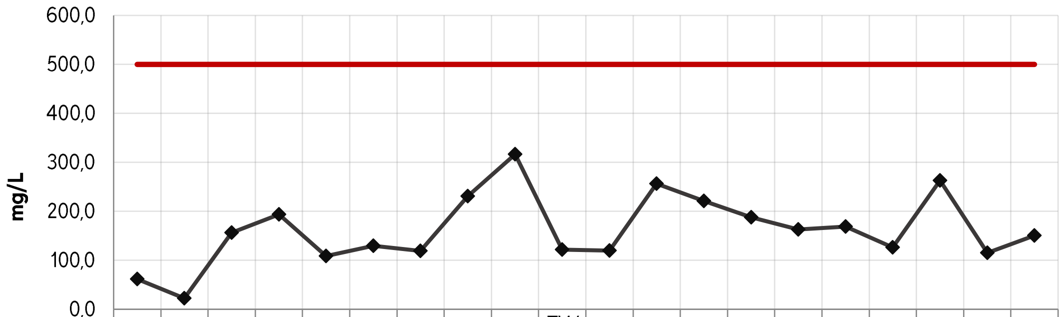
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
F.M	89,0	62,0	22,4	18,8	14,8	149	10,0	5,00	82,0	19,0	54,0	51,0	24,0	21,0	116	155	26,0	63,0	22,4	22,8

Figure 6. Comparative analysis of the presence of floating materials at different monitoring points

The national Regulation 222/02 does not set limits for this parameter but indicates that it should be virtually absent.

According to the results, the parameter's average is 51,36 mg/l. The points FW200 SL-TR, FW111-LB and FW310-CR show values higher than the mean's standard deviation even without established limits. The presence of floating material may be influence by the principal livestock activity in the area.

3.2.7 Total dissolved solids

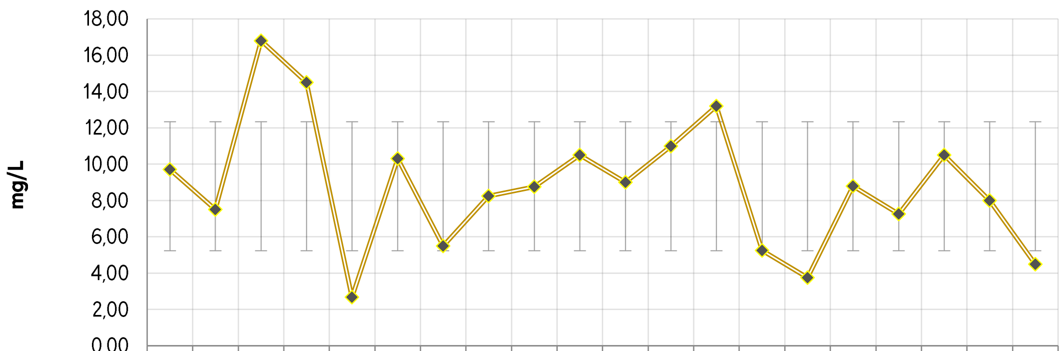


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
TDS	62,0	22,5	157	194	109	130	120	231	317	122	120	257	221	188	163	169	127	263	115	151
Limit	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500

Figure 7. Comparative analysis of total dissolved solids (TDS) at different monitoring points

The permissible limit established in the national regulation is 500 mg/l which none monitoring point exceeded in this campaign. The average TDS value is 161,7 mg/l.

3.2.8 Oil and grease



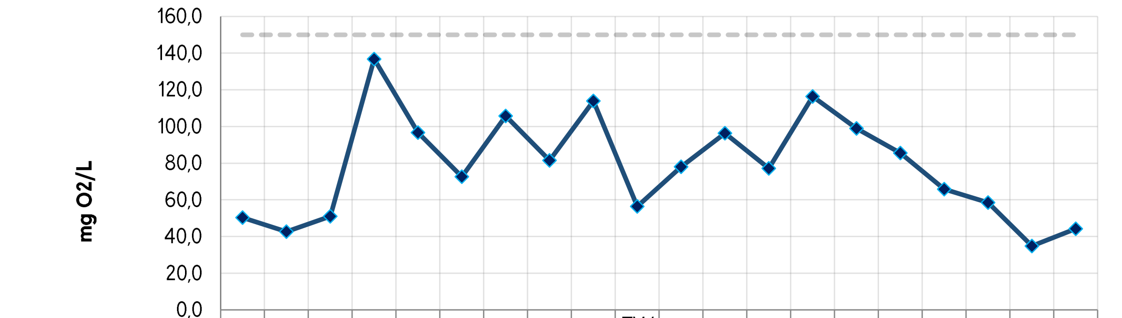
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
O and G	9,70	7,50	16,8	14,5	2,67	10,3	5,50	8,25	8,75	10,5	9,00	11,0	13,2	5,25	3,75	8,80	7,25	10,5	8,00	4,50

Figure 8. Comparative analysis of oil and grease at different monitoring points

For waters Class 2, the national regulation does not establish a limit; it only indicates that it must be virtually absent. For effluent discharges to water bodies, the maximum limits are 20 mg/l for mineral oils and grease and 50 mg/l for animal or vegetable oils and grease.

The average parameter in the first campaign is 8,7 mg/l. The value indicated in FW315-HE is the maximum value measured with 16.8 mg/l. This point's location is close to the departmental route D001 which can be related the higher value.

3.2.9 Chemical oxygen demand

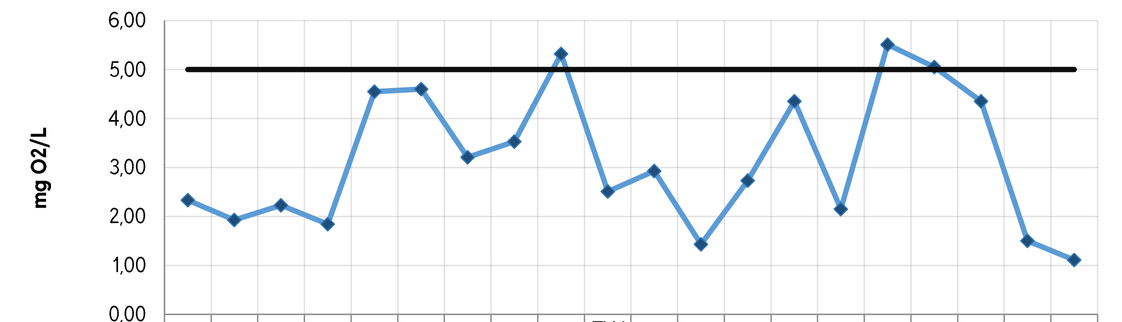


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
COD	50,4	42,6	51,1	137	96,6	72,6	106	81,6	114	56,4	78,0	96,4	77,2	116	99,0	85,5	65,9	58,6	34,9	44,3
Reference	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

Figure 9. Comparative analysis of COD at different monitoring points

Regulation 222/02 does not establish a permissible limit for water classified as Class 2. It is only defined in Art. 7 a maximum value of 150 mg O_2/l for effluents discharge in water bodies. The average COD measured is equivalent to 78,19 mg O_2/l.

3.2.10 Biological oxygen demand

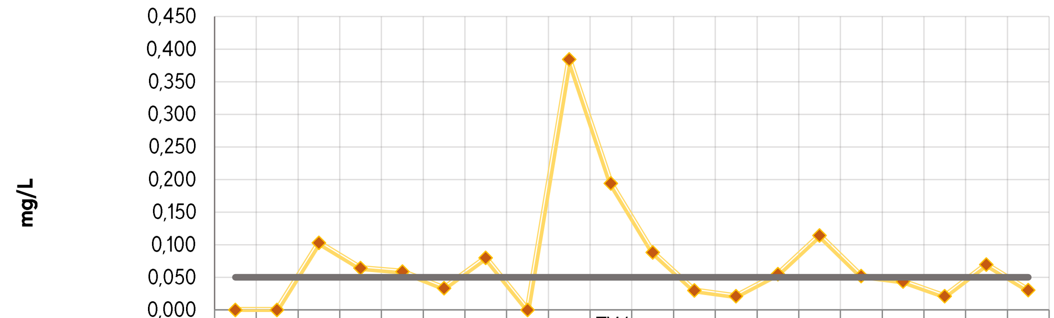


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
BOD5	2,33	1,93	2,23	1,84	4,55	4,60	3,21	3,53	5,32	2,51	2,93	1,43	2,73	4,35	2,15	5,51	5,05	4,35	1,50	1,11
Limit	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Figure 10. Comparative analysis of BOD5 at different monitoring points

Regulation 222/02 sets a maximum of 5 mg O_2/l for the BOD5 parameter. A percentage of 84 of the monitored points comply with the limits, and the 3 points that slightly exceed it are FW205-TR, FW310-CR and FW316-CR. The BOD5 average in the first campaign is 3,158 mg O_2/l.

3.2.11 Total phosphorus



	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Total phosphorus	0,00	0,00	0,10	0,06	0,05	0,03	0,07	0,00	0,38	0,19	0,08	0,02	0,02	0,05	0,11	0,05	0,04	0,02	0,07	0,03
Limit	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05

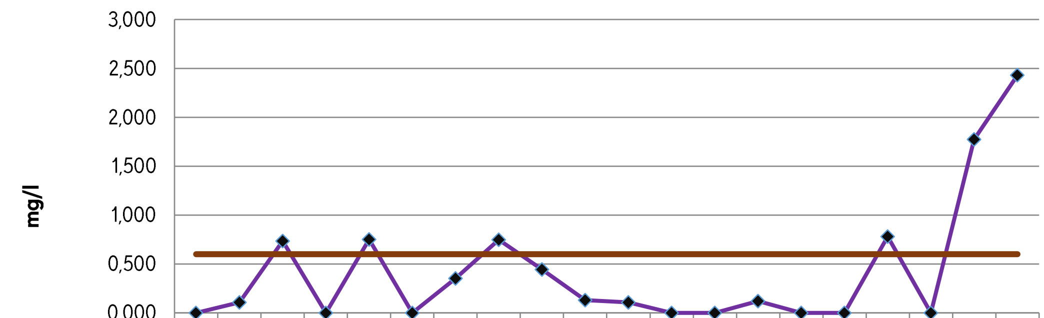
Figure 11. Comparative analysis of total phosphorus at different monitoring points

The presence of phosphorus in water is usually related to the use of organic or synthetic fertilisers. When excesses in the application of fertilisers or agrochemicals happen, it is usual that a fraction that the vegetation doesn't absorb infiltrates into the soil, reaching groundwater and surface water.

The legislation of reference establishes the presence of phosphorus in water to a maximum of 0.05 mg/L.

As shown in figure 11, this parameter's levels exceeded the limit at points FW 315-HE, FW 304-HE, FW 207-TR, FW 205-TR, FW 109-MYRZ, FW 115-MY, FW 110-LB, FW11-LB, FW 310-CR and FW01.

3.2.12 Total nitrogen



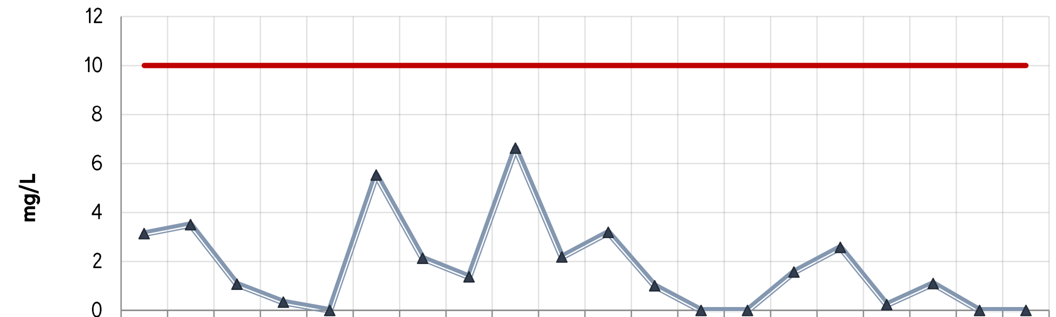
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Total nitrogen	0,00	0,10	0,73	0,00	0,75	0,00	0,35	0,74	0,44	0,13	0,10	0,00	0,00	0,12	0,00	0,00	0,77	0,00	1,77	2,43
Limit	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6

Figure 12. Comparative analysis of total nitrogen at different monitoring points

The limit set by the national water standard for total nitrogen is 0.6 mg/l; the points exceeding the maximum are FW 315-HE, FW 100-GASL, FW 208-TR and FW 316-CR.

The median for this parameter is 0.7 mg/L. A percentage of 70% of the monitoring points shows values under the range.

3.2.13 Nitrate



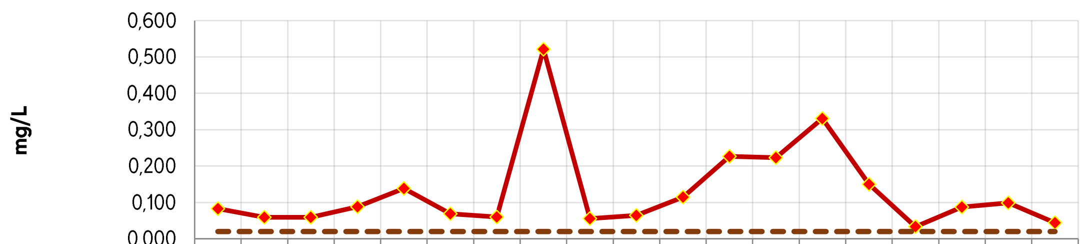
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Nitrate	3,14	3,50	1,07	0,33	0,00	5,52	2,13	1,37	6,63	2,18	3,18	1,01	0,00	0,00	1,56	2,58	0,23	1,10	0,00	0,00
Limit	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Figure 13. Comparative analysis of nitrate levels at different monitoring points

The legislation established a maximum of 10 mg/l for nitrates. None of the points exceeds this value except for point FW205-TR that reaches the maximum result with 6.63 mg/l.

The nitrate's results average is 2.7 mg/l, far below the limit.

3.2.14 Ammonia



	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Ammonia	0,08	0,05	0,05	0,08	0,13	0,06	0,06	0,52	0,05	0,06	0,11	0,22	0,22	0,33	0,15	0,03	0,08	0,1	0,04
Limit	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02

Figure 14. Comparative analysis of ammonia levels at monitoring points

The ammonia levels exceed at all the points with an average value of 0.12 mg/l, which is five times higher than the maximum reference value.

In water bodies that don't receive industrial effluents and are in agro livestock's areas, the primary source of ammonia comes from the degradation of organic matter, specifically the decomposition of faecal matter which can explain the values obtained.

3.2.15 Nitrite

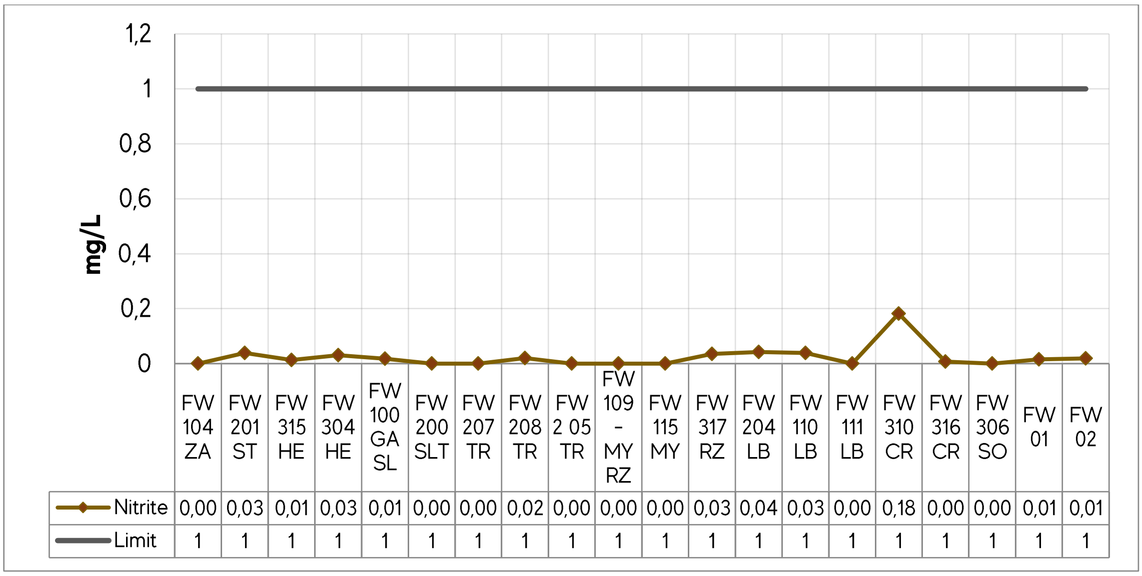


Figure 15. Comparative analysis of nitrite levels at monitoring points

For nitrate levels, the maximum established by Regulation 222/02 is 1 mg/l. All monitored points comply with the permissible limit with an average result of 0.024 mg/l.

3.2.16 Hardness

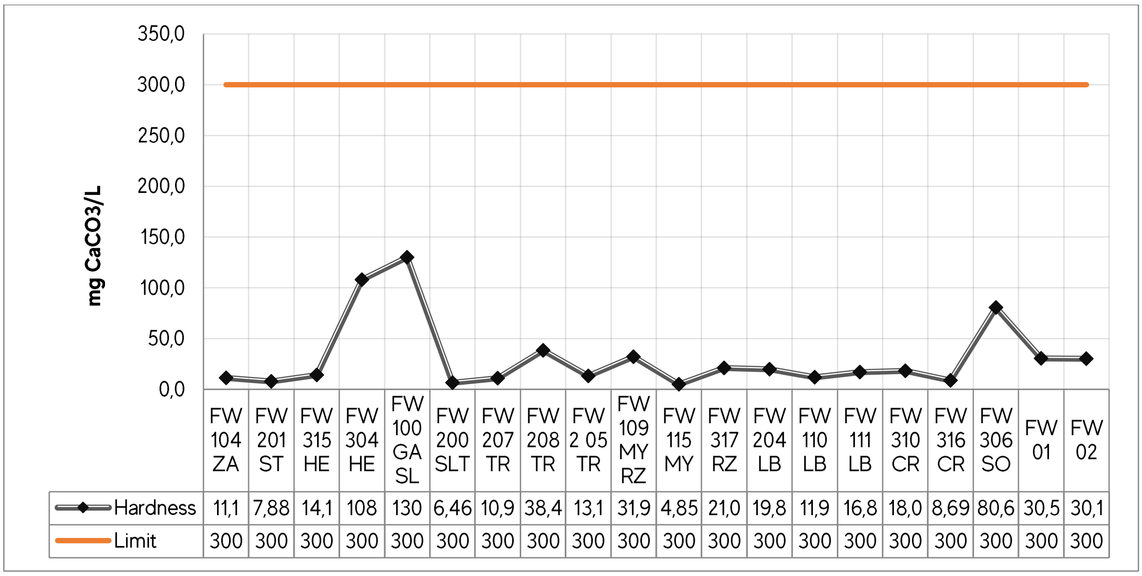
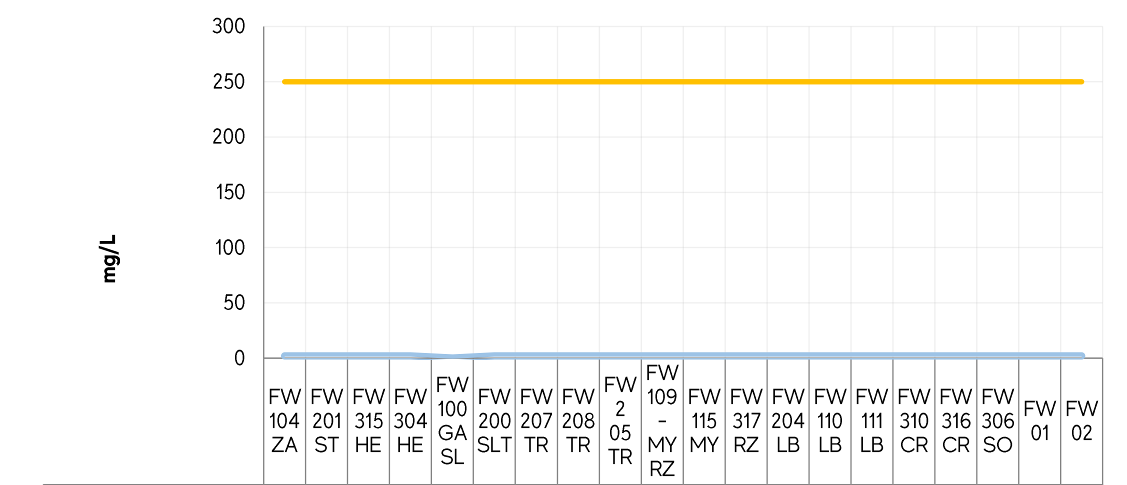


Figure 16. Comparative analysis of hardness levels at monitoring points

Hardness is a water quality parameter mainly influence by the geological formations of the hydrological area in which a given watercourse is located. Regulation 222/02 stipulates a maximum level of 300 mg/l for this parameter; none result yielded a value higher than limits. The average result in the first campaign is 30.7 mg $CaCO_3$/l.

3.2.17 Sulphates

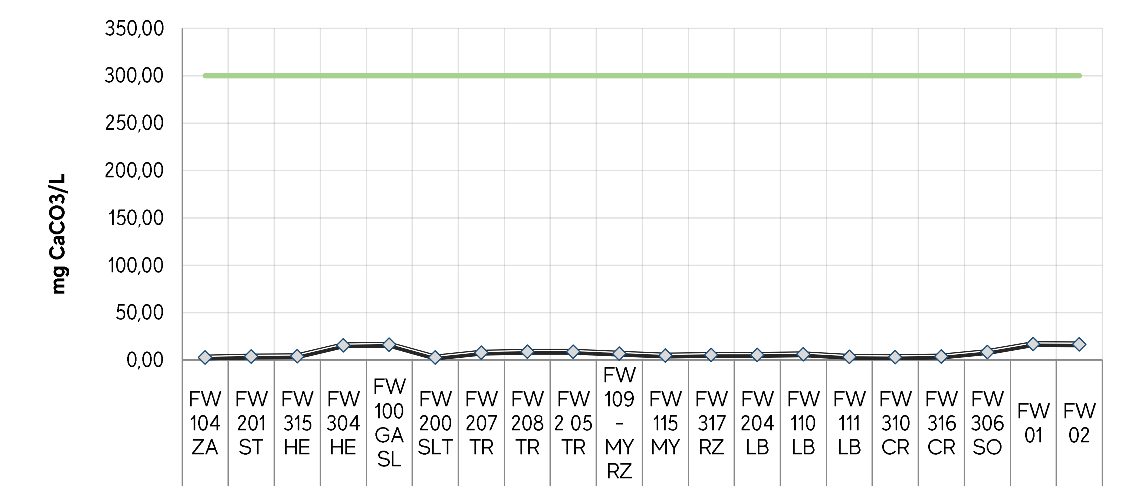


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Sulphates (LOQ)	2	2	2	2	0,10	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Limit	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250

Figure 17. Comparative analysis of sulphates levels at monitoring points

All the 19 samples were below the detection limit of the turbidimetric method SM-4500, equal to 2 mg/l. Figure 17 shows a flat line with no points exceeding the permissible limit defined in Regulation 222/02, up to 250 mg/l.

3.2.18 Sodium



	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Sodium	2,53	3,52	4,00	15,6	16,1	2,77	7,53	8,84	8,52	6,66	4,53	5,35	5,19	5,94	3,32	2,94	3,50	8,36	16,7	16,6
Limit	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300

Figure 18. Comparative analysis of sodium levels at monitoring points

The highest values of sodium are measured at FW 304-HE ("Hermosa" stream), FW 100-GASL ("Trementina stream") and at the points of the Paraguay River (FW01 and FW02). Even the points with the highest concentrations are less than the limit established by Regulation 222/02.

3.2.19 Aluminium

	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Aluminium (LOQ)	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10
Limit	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2

Figure 19. Comparative analysis of aluminium levels at monitoring points

Aluminium levels was measured with AAS-GFA method (SM-3113). The limit of quantification (LOQ) of this method is 0.2 mg/l. According to Regulation 222/02 the permissible limits of aluminium in surface water is 0.1 mg/l.

Figure 19 shows that at all monitoring points the aluminium levels are below the LOQ. In conclusion, all the points comply with the water standard limits for this parameter.

3.2.20 Cadmium

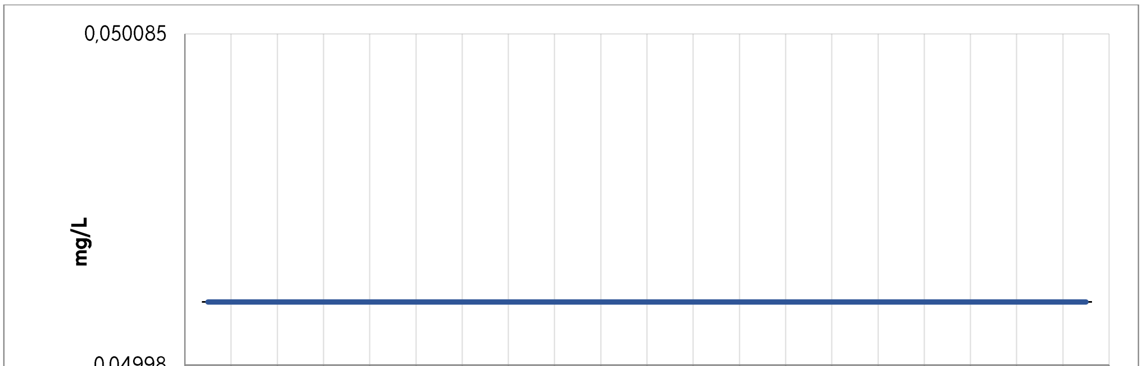
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Cadmium (LOQ)	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80
Limit	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Figure 20. Comparative analysis of cadmium levels at monitoring points

Cadmium levels was measured with AAS-GFA method (SM-3113). The limit of quantification (LOQ) of this method is 0.8 µg/ for cadmium. According to Regulation 222/02 the permissible limits of aluminium in surface water is 1 µg/L

All monitoring points have levels of aluminium below the LOQ. In conclusion, all the points comply with the water standard limits for this parameter.

3.2.21 Hexavalent chromium



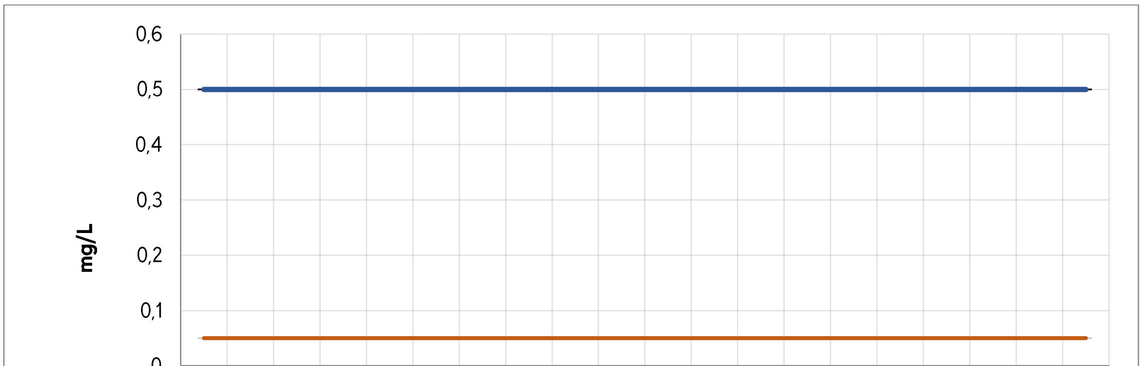
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Cr (VI)	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05
Limit	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05

Figure 21. Comparative analysis of hexavalent chromium levels at monitoring points

The colorimetric method (SM-3500-Cr B) was used to determine the levels of this parameter. The limit of quantification (LOQ) in aqueous matrix is 0.05 mg/l. The hexavalent chromium at all sampling points was below the LOQ.

Under those circumstances, all the points are in accordance with the water standard limits for this parameter.

3.2.22 Trivalent chromium



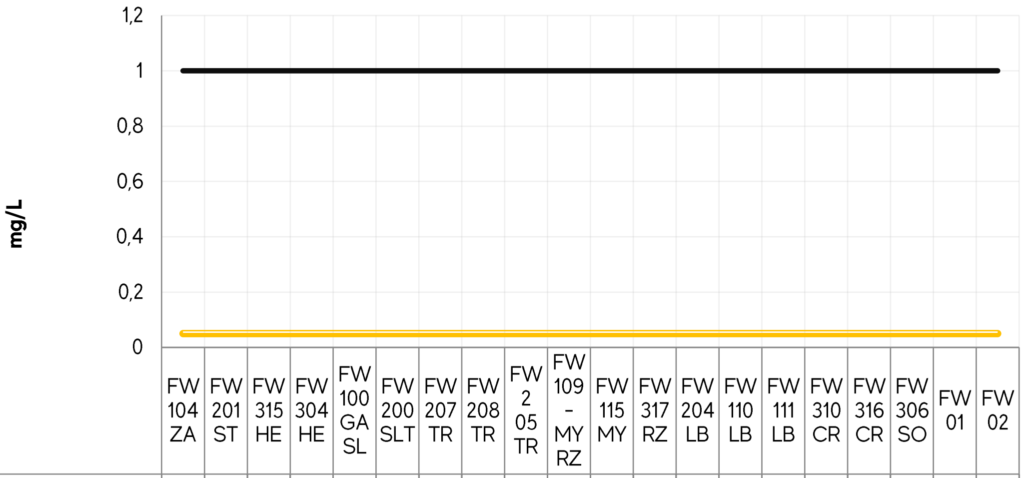
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Cr (III)	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05
Limit	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5

Figure 22. Comparative analysis of trivalent chromium levels at monitoring points

For this determination, the calculation method (Total Chromium - Hexavalent Chromium) was used. The limit of quantification (LOQ) is 0.05 mg/l. The flat line on the graph shows that the 20 points analysed are below the LOQ.

It is important to note that the maximum permissible value according to the national water standard is 10 times higher than the limit of quantification.

3.2.23 Copper



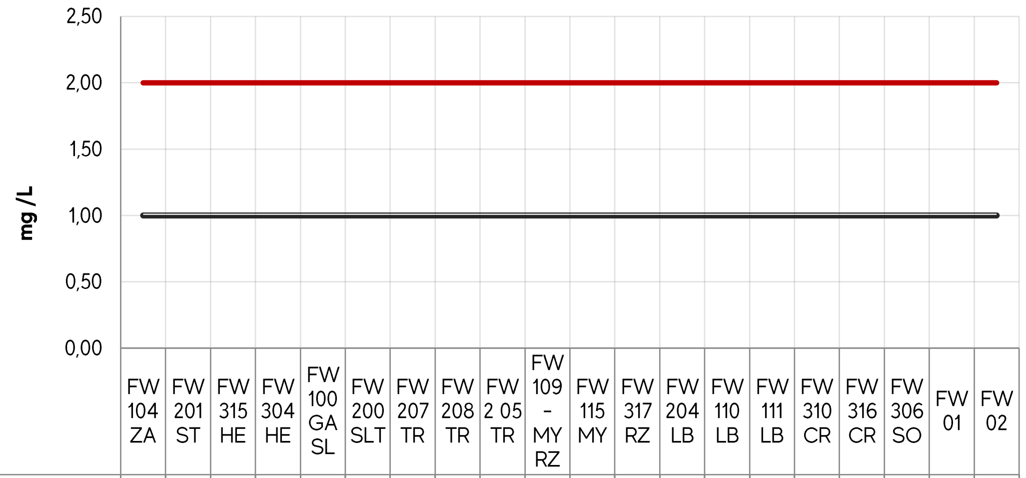
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Copper (LOQ)	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05
Limit	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Figure 23. Comparative analysis of copper levels at monitoring points

The copper determinations method is AAS-Air-Acetylene Flame (SM-3111-B)/GFA (SM-3113), which has a sensitivity or limit of quantification in the water of 0.05 mg/l. For this parameter, there are no detectable and quantifiable copper concentrations in any of the 20 samples.

The fact that all samples were below the detection limit explains the flat line in figure 23; 100% of the monitored points are within the range for this parameter.

3.2.24 Tin

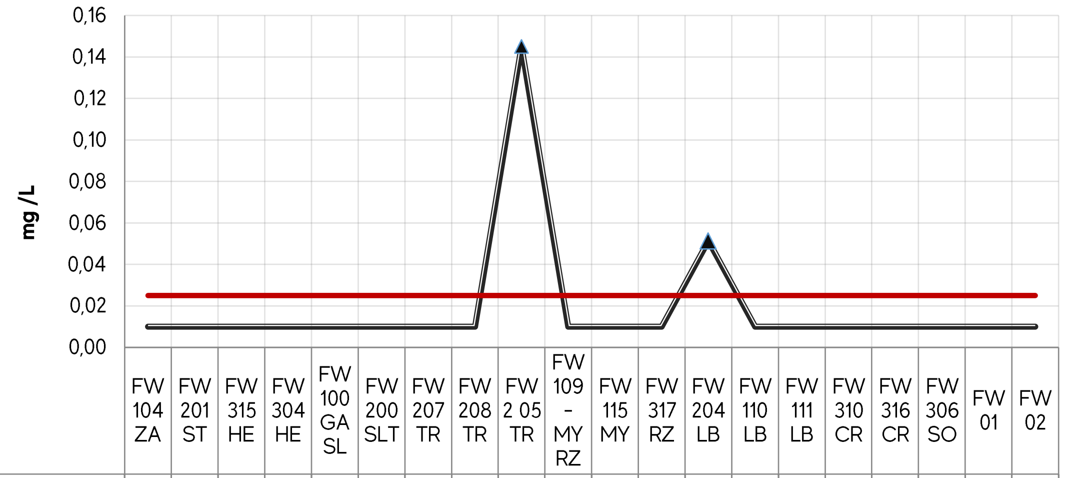


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Tin (LOQ)	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Limit	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 24. Comparative analysis of tin levels at monitoring points

At all points the concentrations of tin were below the limit of quantification. Since the LOQ (1 mg/l) is lower than the maximum allowed by the water standard regulation (2 mg/l), it is deducted that all the monitoring points comply with the regulation's limits.

3.2.25 Nickel

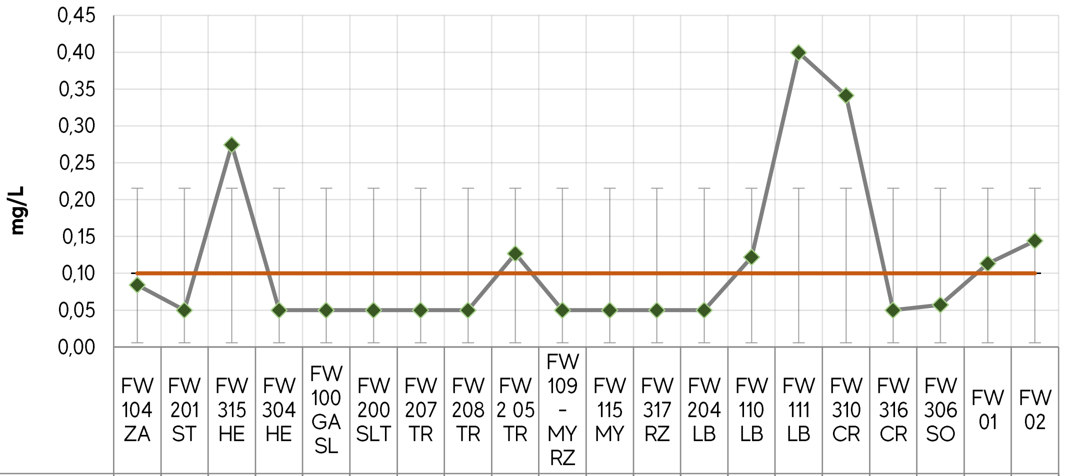


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Nickel	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,15	0,01	0,01	0,01	0,05	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Limit	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02

Figure 25. Comparative analysis of nickel levels at monitoring points

The results of nickel at 18 monitoring points are below the limit of quantification (LOQ= 0.01 mg/L). However, in FW 208-TR and FW 204-LB the values are higher than the limit established by the water standard regulation, which is 0.025 mg/L.

3.2.26 Manganese

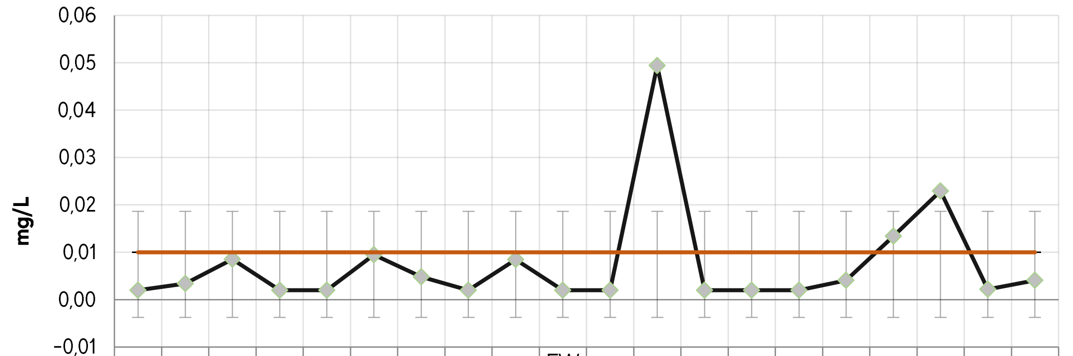


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Mn	0,08	0,05	0,27	0,05	0,05	0,05	0,05	0,05	0,12	0,05	0,05	0,05	0,05	0,12	0,40	0,34	0,05	0,05	0,11	0,14
Limit	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1

Figure 26. Comparative analysis of manganese levels at monitoring points

The graph shows that points FW 315-HE, FW 205-TR, FW 110 LB, FW 111 LB, FW 310 CR and the two points on the Paraguay River (FW 01 and FW 02) have higher values than the maximum established for waters classify as Class II by the Regulation. The maximum permissible value for this element is 0.1 mg/L and the limit of quantification (LOQ) of the method used to measure is 0.05 mg/L.

3.2.27 Lead



	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Lead	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,01	0,02	0,00	0,00
Limit	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Figure 27. Comparative analysis of lead levels at monitoring points

The method used to determine lead levels is AAS-GFA (SM-3113). The limit of quantification (LOQ) is 0.002 mg/l. The figure 27 reveals that in 9 points the levels were below the LOQ but in 3 points with quantifiable values, the values exceed the water standard limits (0.01 mg/L).

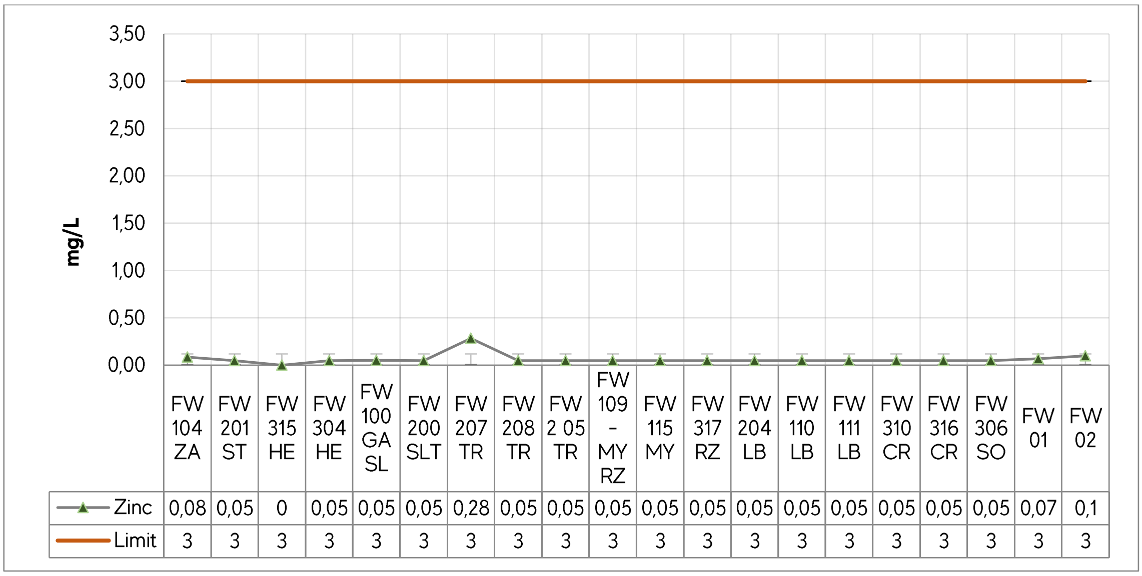
3.2.28 Selenium

	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Selenium (LOQ)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Limit	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Figure 28. Comparative analysis of selenium levels at monitoring points

At all sampling points selenium concentrations were below the limit of quantification (LOQ= 5 µg/L). According to Regulation 222/02 the maximum permissible level is 10 µg/L. Therefore, it can be deduced that all points are in accordance with the reference legislation.

3.2.29 Zinc

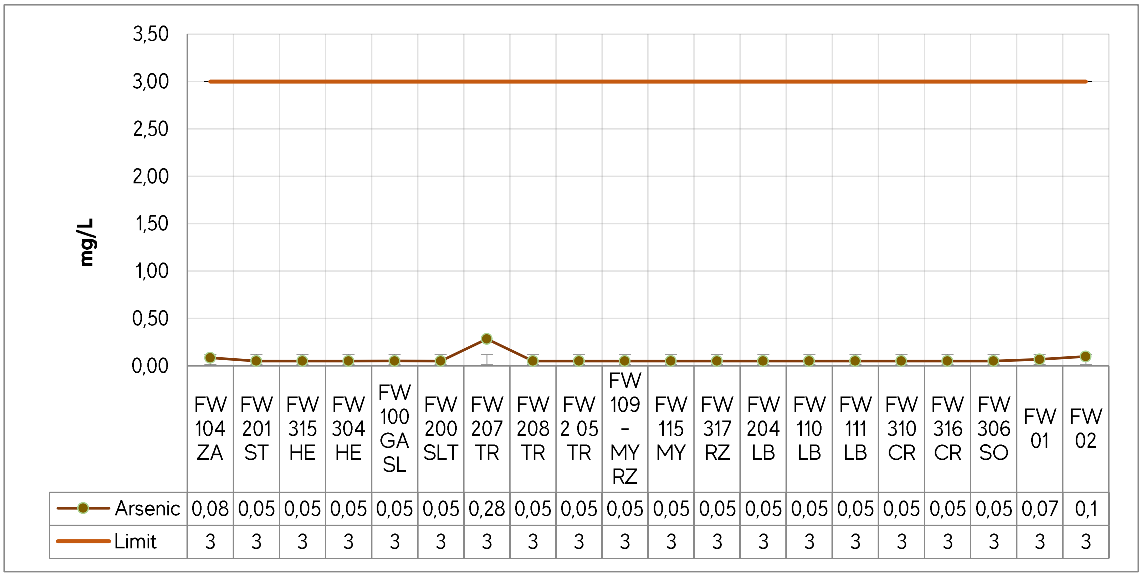


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Zinc	0,08	0,05	0	0,05	0,05	0,05	0,28	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,07	0,1
Limit	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Figure 29. Comparative analysis of zinc levels at monitoring points

Zinc concentrations are below the maximum limit established in the water regulation at all points. Even in 75% of the sampled points the zinc levels were under the limit of quantification (LOQ=0.05).

3.2.30 Arsenic

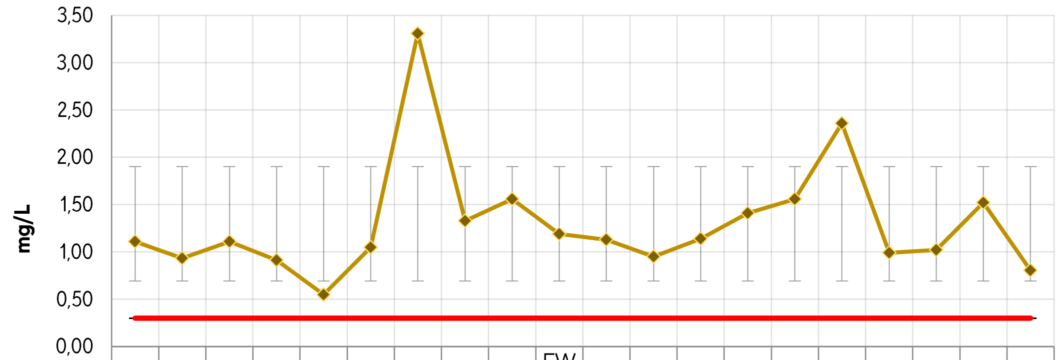


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Arsenic	0,08	0,05	0,05	0,05	0,05	0,05	0,28	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,07	0,1
Limit	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Figure 30. Comparative analysis of zinc levels at monitoring points

As figure 30 illustrates, the arsenic concentrations in all the points are below the maximum defined by the national regulation. In 85% of them, the values are not detectable by the method used to measure; which is LOQ=0.05.

3.2.31 Soluble iron



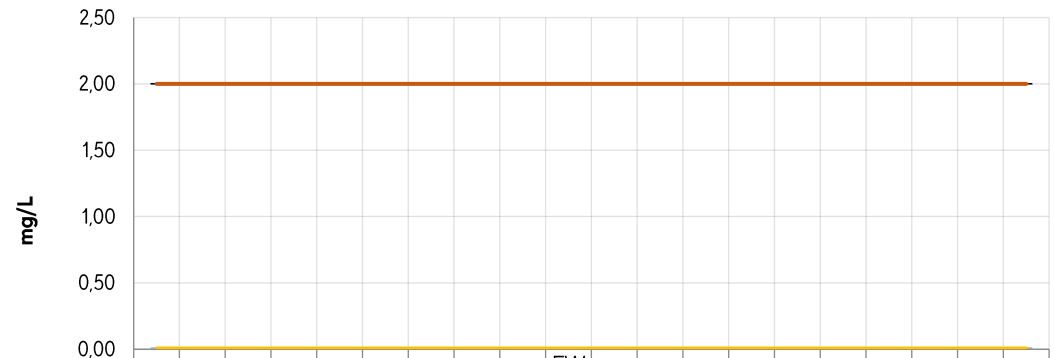
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Fe++	1,11	0,93	1,11	0,91	0,55	1,05	3,31	1,33	1,56	1,19	1,13	0,95	1,14	1,41	1,56	2,36	0,99	1,02	1,52	0,8
Limit	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3

Figure 31. Comparative analysis of soluble iron levels at monitoring points

The geological formations of a river basin determine the presence of iron in the water. Regulation 222/02 determines a maximum level of 0.3 mg/l for this element.

In the first monitoring campaign, all 20 points reach levels higher than the maximum permissible for waters classify as Class 2 according to the regulation. The average value is up to 1.3 mg/l which is four times higher than the limit.

3.2.32 Total mercury

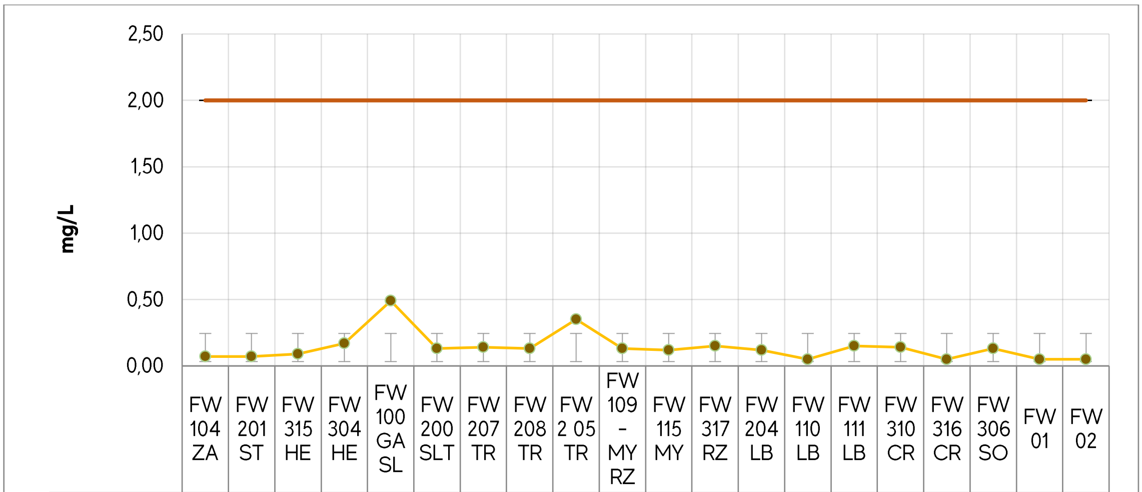


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Mercury	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Limit	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 32. Comparative analysis of total mercury levels at monitoring points

Levels of mercury were not detected at any of the 20 points. The national water regulation establishes a limit of 2 mg/l for this parameter. Regarding to the limit of quantification for the method used to analyse the samples is 0.01 mg/l.

3.2.33 Barium

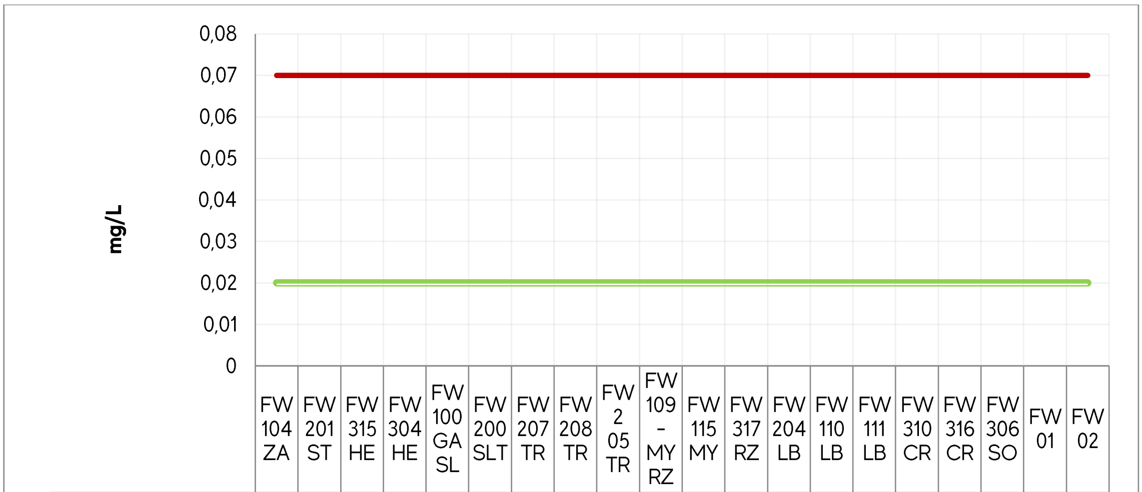


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Barium	0,07	0,07	0,09	0,17	0,49	0,13	0,14	0,13	0,35	0,13	0,12	0,15	0,12	0,05	0,15	0,14	0,05	0,13	0,05	0,05
Limit	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 33. Comparative analysis of barium levels at monitoring points

All the values measured are within the permissible limit established by the Regulation 222/02. The highest value recorded belongs to the point FW 100 GASL and it is approximately 4 times lower than the maximum defined by the mentioned legislation.

3.2.34 Cyanide

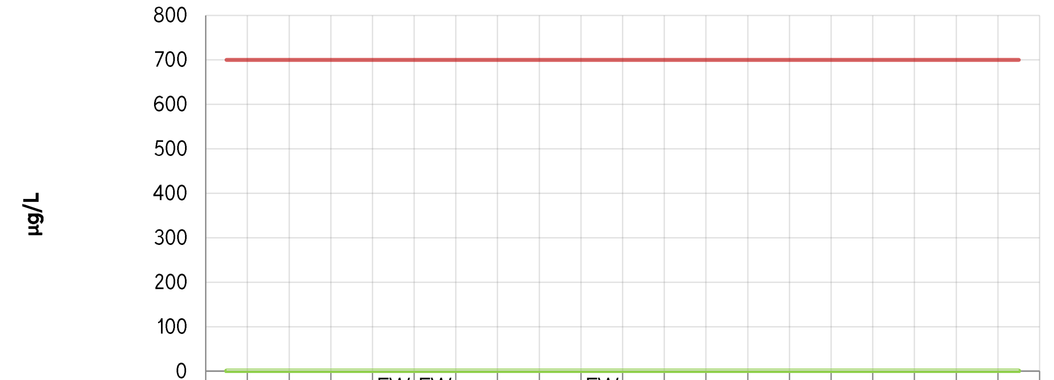


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Cyanide (LOQ)	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
Limit	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07

Figure 34. Comparative analysis of cyanides levels at monitoring points

The SM 4500 CN E method used for cyanides determinations has a limit of quantification (LOQ) equal to 0.02 mg/l, which was not detected in all the sampling points. The regulation establishes a limit 3.5 times higher than LOQ; therefore, it is inferred that the 20 samples comply with the reference regulation.

3.2.35 Glyphosate



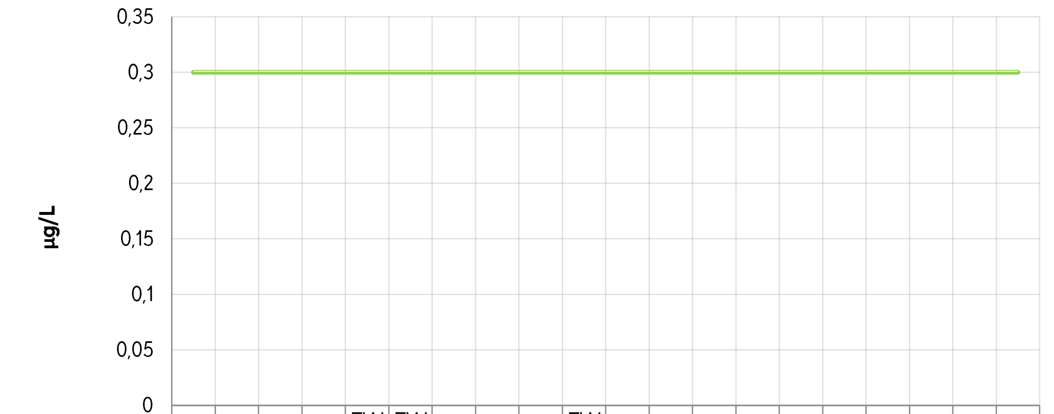
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Glyphisate (LOQ)	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
Limit	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700

Figure 35. Comparative analysis of glyphosate levels at monitoring points

Glyphosate is a systemic herbicide ($C_3H_8NO_6P$) marketed under the name Round-up, widely used in agricultural and forestry activities.

The water regulation establishes a limit up to 700 µg/l for this substance. The limit of quantification in aqueous matrix is 0.3 µg/l which is not detected in any of the surface water sampling points.

3.2.36 AMPA



	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
AMPA (LOQ)	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3

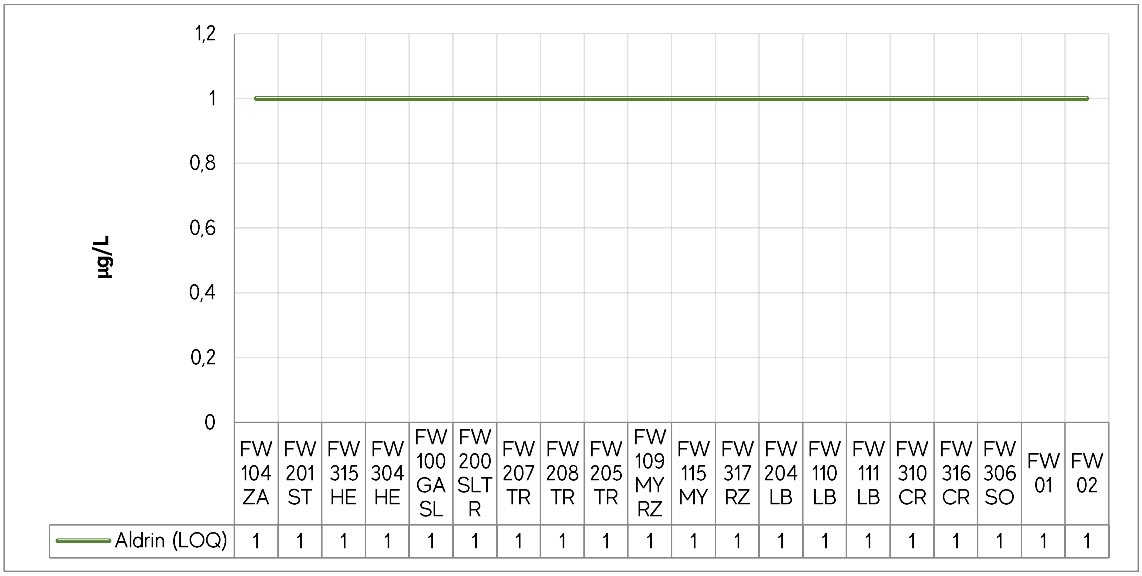
Figure 36. Comparative analysis of AMPA levels at monitoring points

The main metabolite of glyphosate is AMPA (amino-methyl phosphoric acid), which, due to its high solubility, can contaminate surface water.

The national water regulation does not establish limits for this substance.

The limit of quantification of the method used to determine this parameter is 0.3 µg/l. In any of the sampling points were detected levels of AMPA during the first campaign.

3.2.37 Aldrin

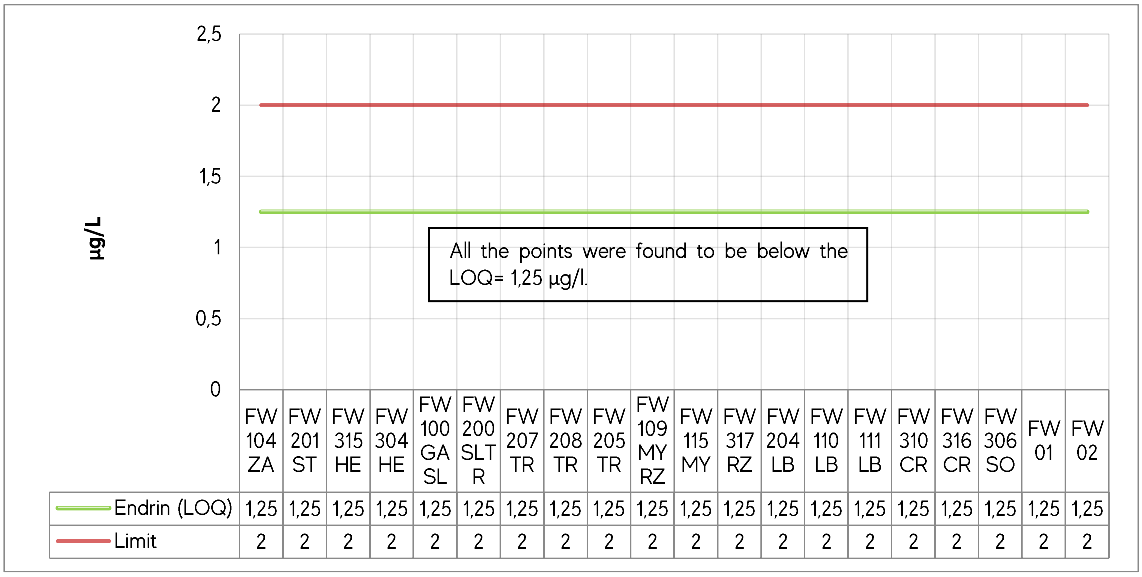


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Aldrin (LOQ)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Figure 37. Comparative analysis of Aldrin levels at monitoring points

Aldrin is a non-systemic insecticide which has no maximum limit established by the national water regulation. At none of the samples were was detected levels of this substance. The limit of quantification of the method used to measure this parameter is 1 µg/L.

3.2.38 Endrin



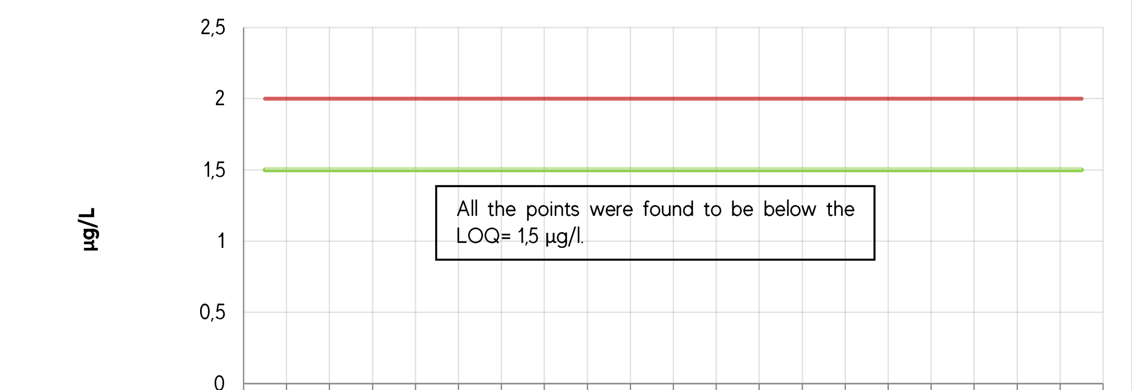
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Endrin (LOQ)	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25	1,25
Limit	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 38. Comparative analysis of Endrin levels at monitoring points

Endrin (C12H8Cl6O) is an insecticide and rodenticide. Regulation 222/02 establishes a maximum admissible value for waters Class II up to 2 µg/L. The limit of quantification of the method used to measure this parameter is 1.25 µg/L.

There were not detected levels of Endrin in the samples analysed.

3.2.39 Dieldrin



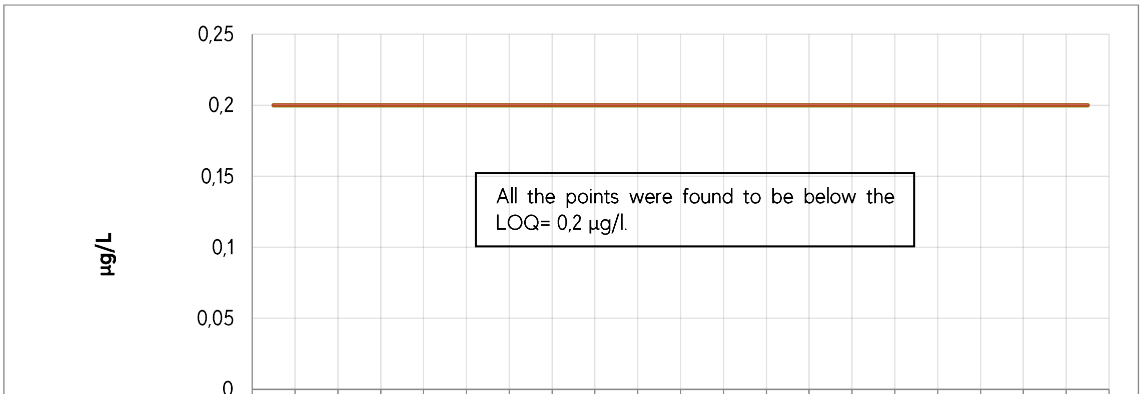
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Dieldrín (LOQ)	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
Limit	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 39. Comparative analysis of Dieldrin levels at monitoring points

Dieldrin (C12H8Cl6O) is an insecticide. The national water regulation sets a maximum limit for this substance of 2 µg/l.

The method's limit of quantification is 1.5 µg/L. It was not detected this agrochemical at any of the sampling points.

3.2.40 Lindane

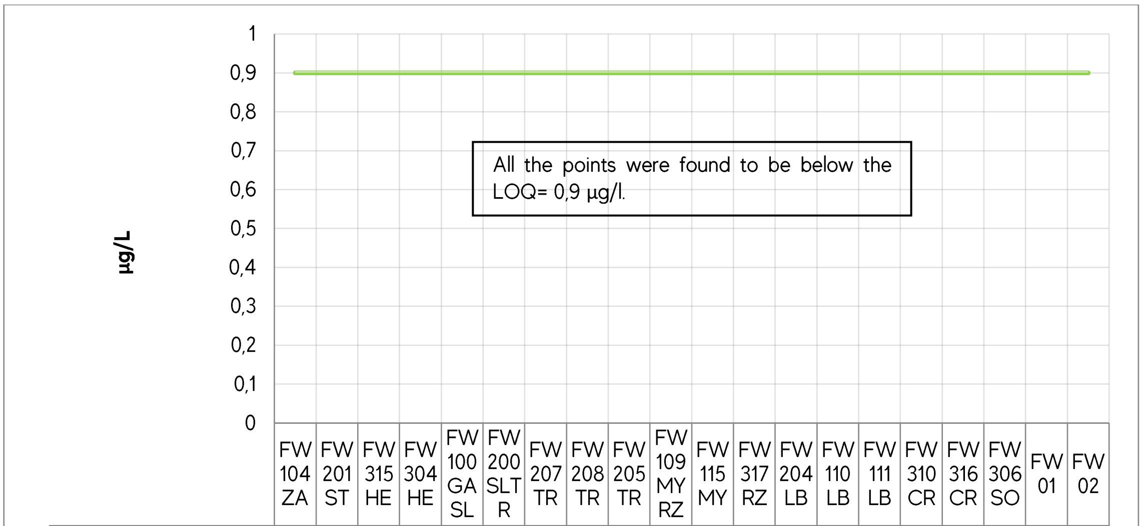


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Lindane (LOQ)	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
Limit	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2

Figure 40. Comparative analysis of Lindane levels at monitoring points

Lindane (C6H6CL6) is an insecticide distributed under the trade name Gamexane. Both the permissible limit established by the water regulation and method's LOQ sets a value of 0.2 µg/l. Lindane was not detected at the sampling points.

3.2.41 Chlordane

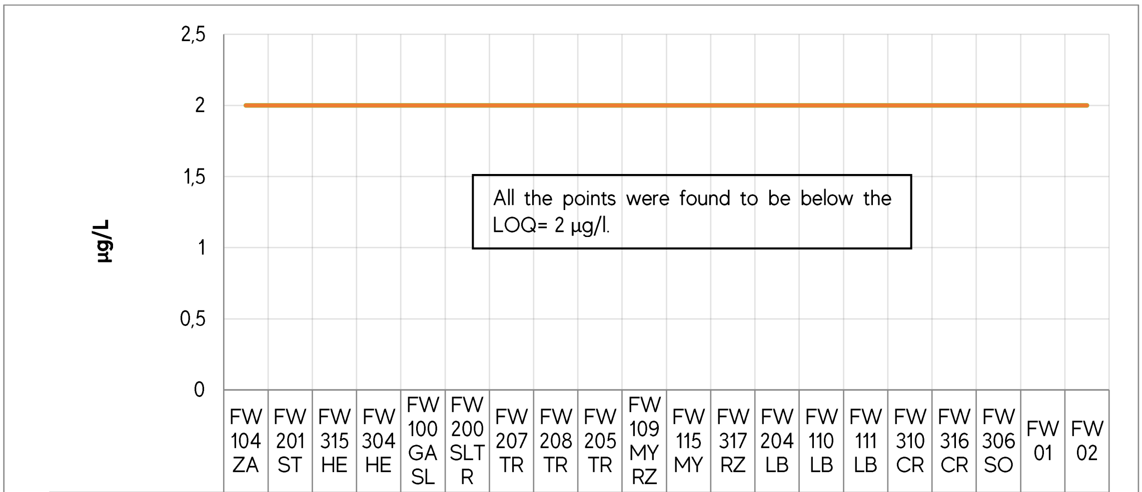


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLTR	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Chlordane (LOQ)	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9

Figure 41. Comparative analysis of chlordane levels at monitoring points

Chlordane ($C_{10}H_6Cl_8$) is an insecticide with no limit established in the national water regulation. The limit of quantification of this parameter is 0.9 µg/L. At all sampling points, chlordane levels was below the LOQ.

3.2.42 DDT



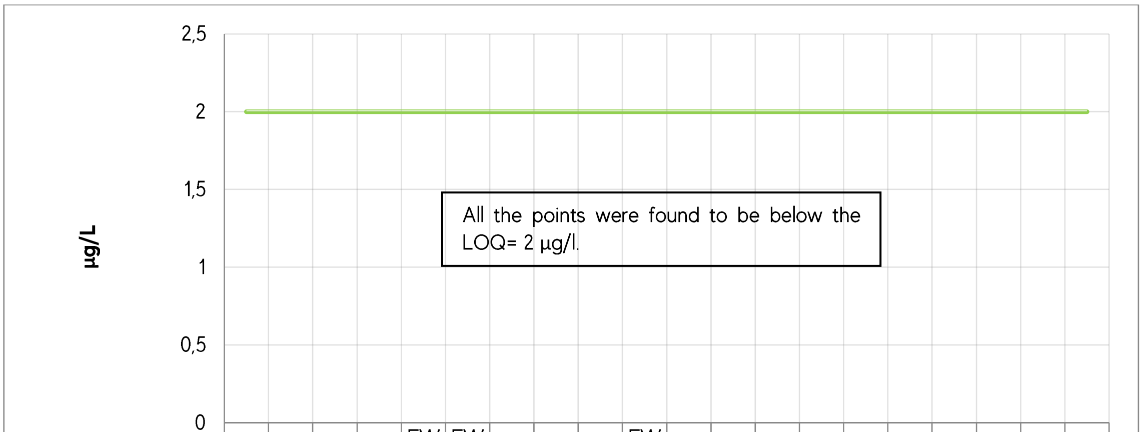
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLTR	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
DDT (LOQ)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Limit	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 42. Comparative analysis of DDT levels at monitoring points

DDT ($C_{14}H_9Cl_5$) is an insecticide. According to the national water regulation, the maximum permissible concentration in Class II surface water is 2 µg/L.

The limit of quantification of this parameter is 2 µg/L. DDT levels were below LOQ at all the 20 monitoring points.

3.2.43 DDE



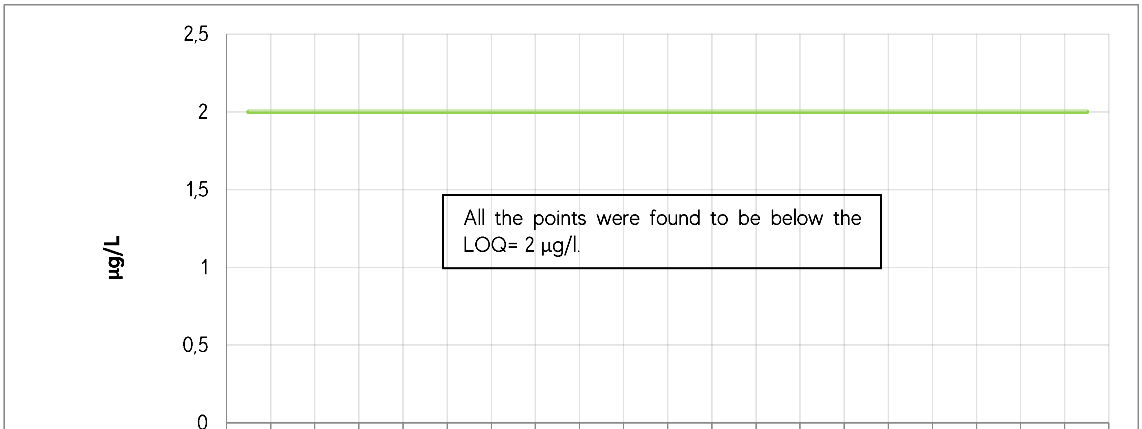
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
DDE (LOQ)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 43. Comparative analysis of DDE levels at monitoring points

Likewise, other pesticides, no evidence of DDE was found in surface water. In all cases the DDE concentrations were below the method's limit of quantification which is LOQ= 2 µg/l.

The national water regulation does not establish maximum limits for this substance.

3.2.44 DDD



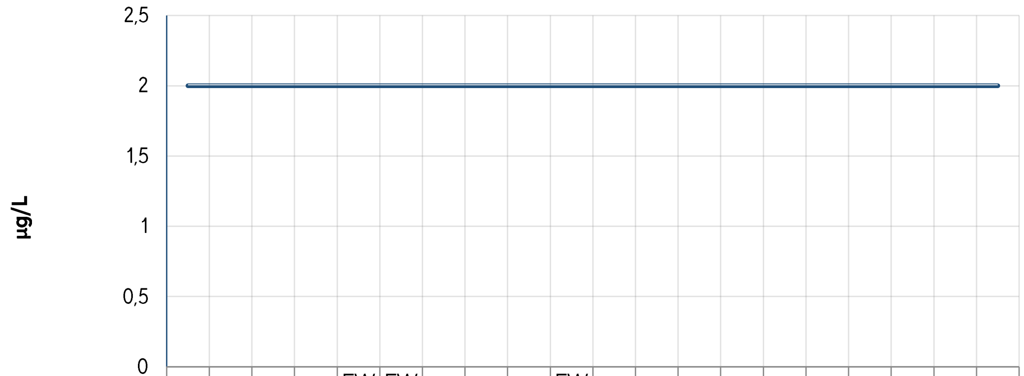
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
DDD (LOQ)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 44. Comparative analysis of DDD levels at monitoring points

DDD is a metabolite resulting from the degradation of the insecticide DDT. The national water regulation does not establish a maximum limit for this parameter.

There is no evidence of DDD in the samples analysed during the first campaign. The method's limit of quantification is 2 µg/ which is not exceeded at any sampling point.

3.2.45 Atrazine



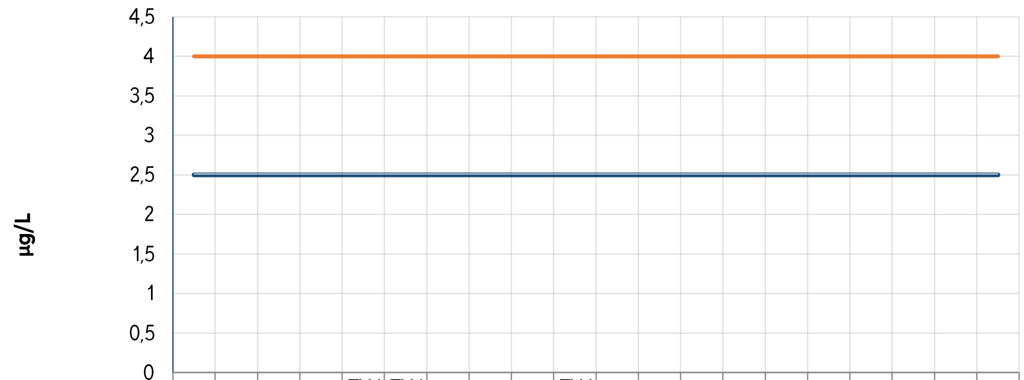
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Atrazine (LOQ)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure 45. Comparative analysis of atrazine levels at monitoring points

Atrazine ($C_8H_{14}ClN_5$) is an herbicide distributed under the trade names Atramyl or Atraplex. The water standard regulation does not establish limits for this substance.

During the first monitoring campaign, there was no evidence of atrazine in surface waters. The limit of quantification is LOQ= 2 µg/L. None of the 20 samples exceeded this value.

3.2.47 Simazine



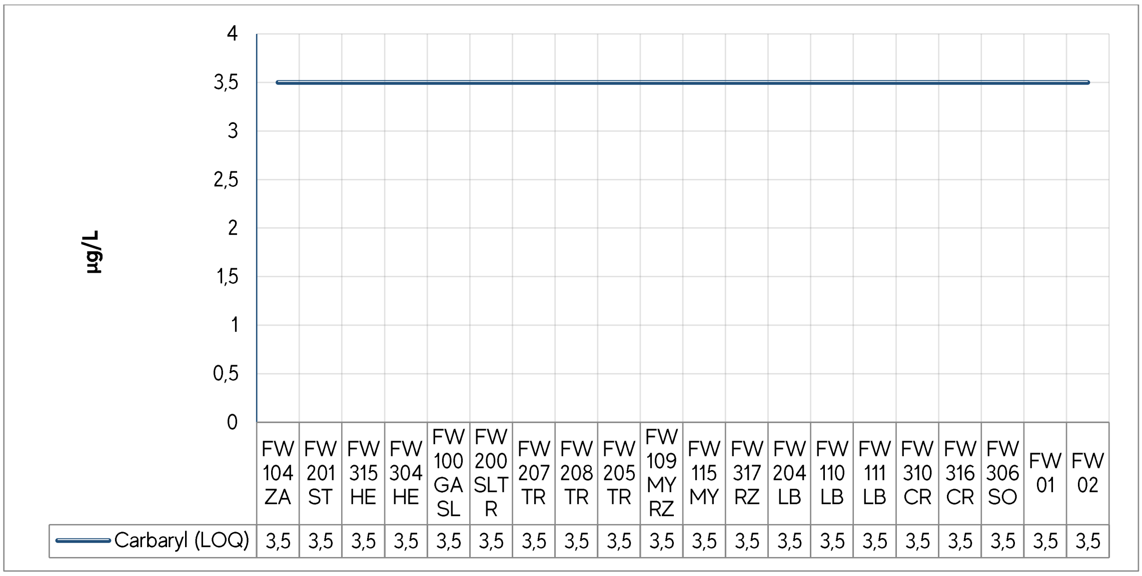
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Simazine (LOQ)	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Limit	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Figure 46. Comparative analysis of simazine levels at monitoring points

Simazine ($C_7H_{12}ClN_5$) is an herbicide distributed under the trade name SIMAPLEX. Regulation 222/02 establishes a maximum of 4 µg/l for this substance.

The analytical method used has a limit of quantification equal to 2.5 µg/l which none of the samples reached. All the monitoring points comply with the established limits.

3.2.48 Carbaryl



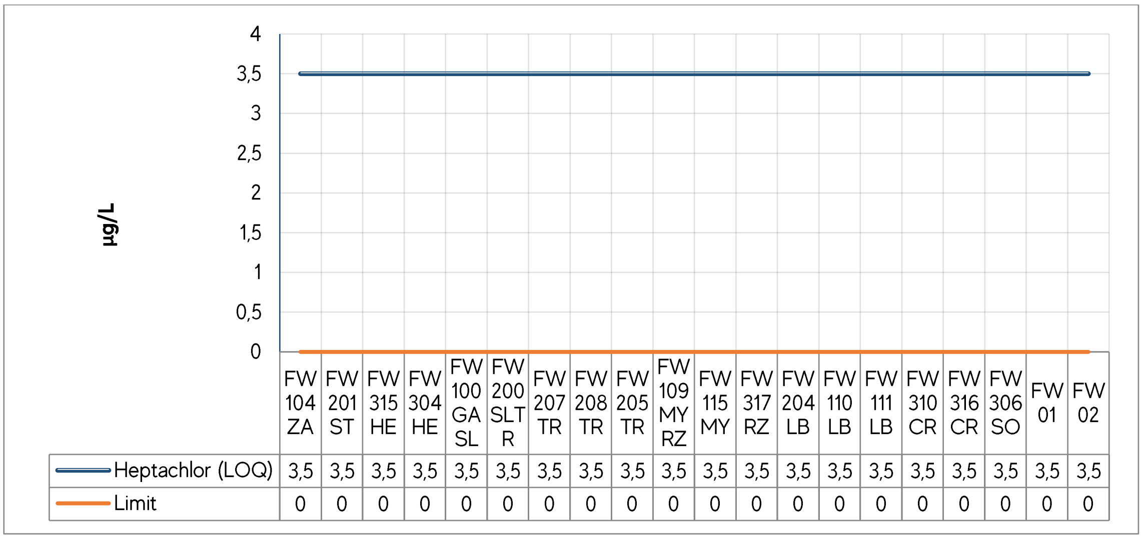
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Carbaryl (LOQ)	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5

Figure 47. Comparative analysis of Carbaryl levels at monitoring points

Carbaryl ($C_{12}H_{11}NO_2$) is an insecticide used to control insects and ectoparasites. It is distributed under the trade names HORTEVI and CARBARYL.

The analytical method used has a limit of quantification equal to 3.5 µg/L. It was not detected quantifiable levels at any of the points.

3.2.49 Heptachlor



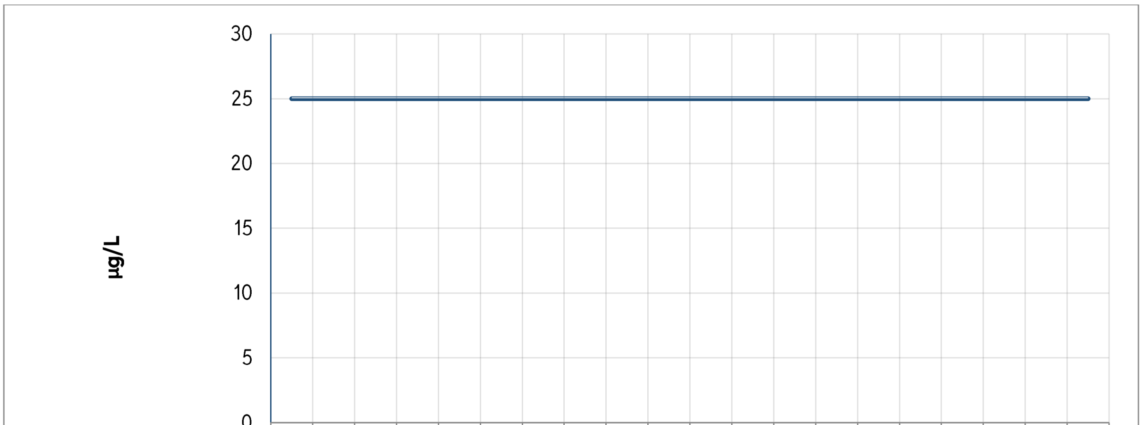
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Heptachlor (LOQ)	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5
Limit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 48. Comparative analysis of heptachlor levels at monitoring points

Heptachlor ($C_{10}H_5Cl_7$) is an insecticide used to control ants and termites. The national water regulation establishes that the concentration of this substance in the aqueous matrix must be 0 µg/L (zero).

The limit of quantification is higher than the maximum permissible by the water regulation (LOQ = 3.5 µg / L), which is why none of the points are within the limits but it is not detected quantifiable values of Heptachlor.

3.2.50 Methomyl



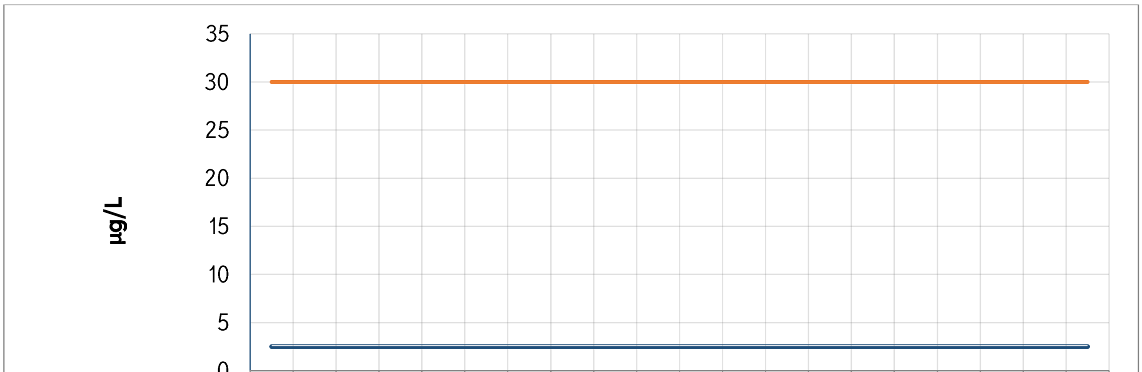
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Methomyl (LOQ)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Figure 49. Comparative analysis of Methomyl levels at monitoring points

Methomyl ($C_5H_{10}N_2O_2S$) is an insecticide marketed under the name Lannate®BR. The national water regulation does not establish limits for this pesticide.

The limit of quantification is 25 µg/L and none of the samples exceeded this value.

3.2.51 2,4 D



	FW 104 ZA	FW 201 ST	FW 315 HE	FW 30 4 HE	FW 100 GA SL	FW 200 SL TR	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 20 4 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 30 6 SO	FW 01	FW 02
2,4 D (LOQ)	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Limit	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Figure 50. Comparative analysis of 2,4 D levels at monitoring points

2,4 D ($C_8H_6Cl_2O_3$) is an herbicide distributed under the trade names DMA® 6 and Cleanspray (among others). According to Regulation 222/02, the concentration of this herbicide in surface water must not exceed 30 µg/L.

The analytical method used has a limit of quantification of 2.5 µg/L None of the samples exceeds this threshold; therefore, all samples are within the limit established by the water regulation.

3.2.52 Cypermethrin

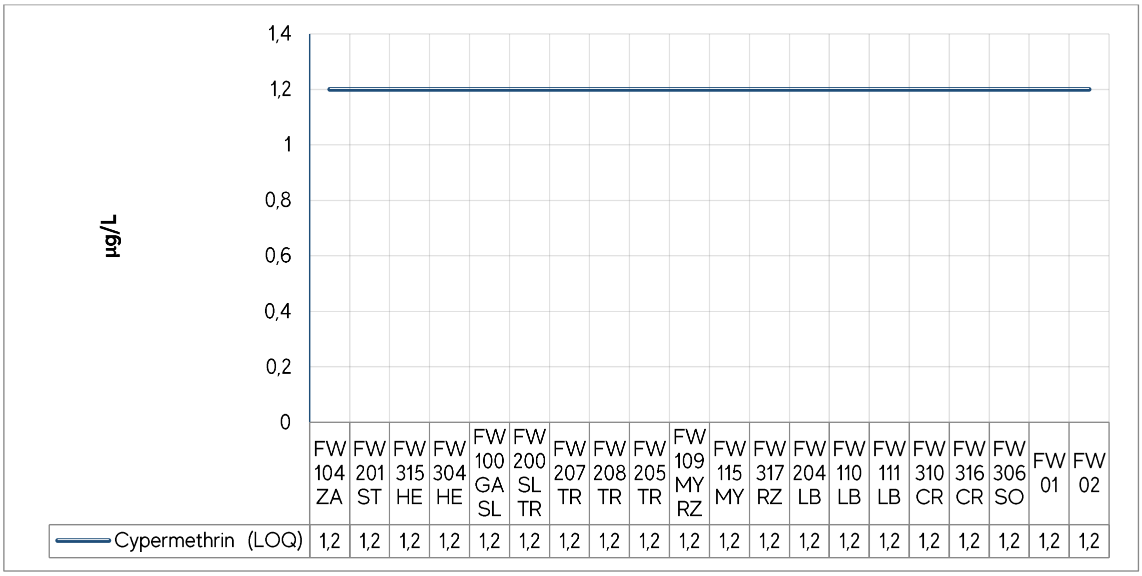


Figure 51. Comparative analysis of Cypermethrin levels at monitoring points

Cypermethrin ($C_{22}H_{19}Cl_2NO_3$) is an insecticide and acaricide distributed in the market under the trade names Trine-aktra and SUPERMYL among others. The water regulation does not establish limits for this pesticide.

As for the analytical results obtained, no quantifiable levels of Cypermethrin were detected in any sample. The limit of quantification is 1.2 µg/L.

3.2.53 Chlorpyrifos

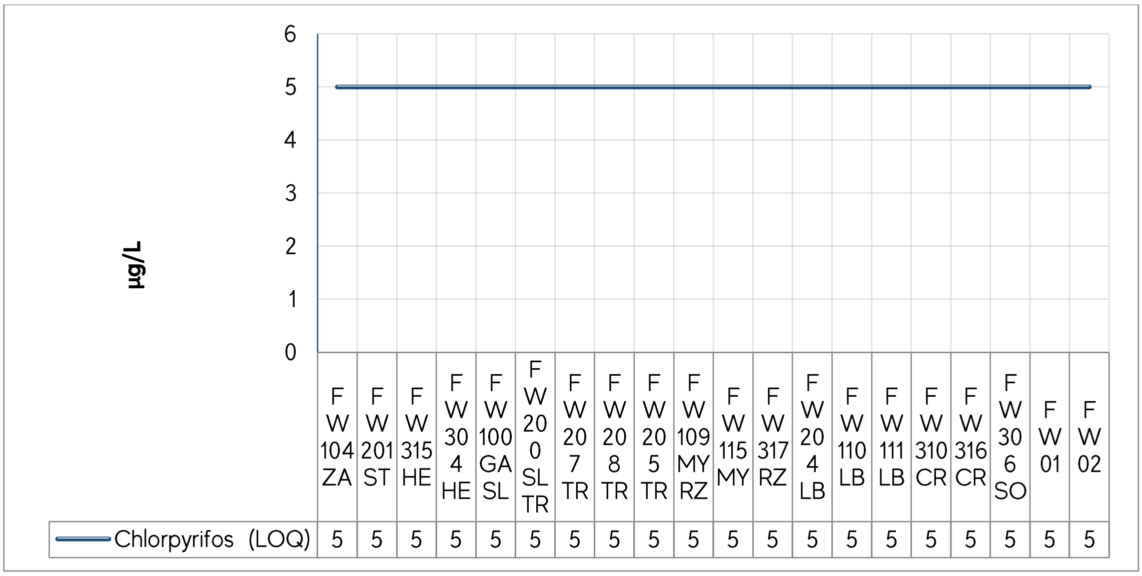
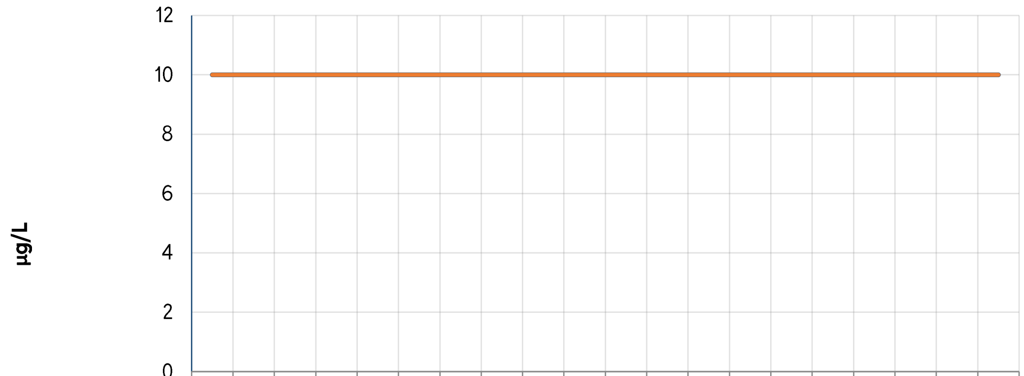


Figure 52. Comparative analysis of Chlorpyrifos levels at monitoring points

Chlorpyrifos ($C_9H_{11}Cl_3NO_3PS$) is an insecticide commonly called CLORFOS and BRONCO®. The national water regulation does not establish a limit for this pesticide.

In none of the samples taken during the first campaign are quantifiable levels of Chlorpyrifos. The limit of quantification of the method used to analyse is 5 µg/L.

3.2.54 Dichlorvos



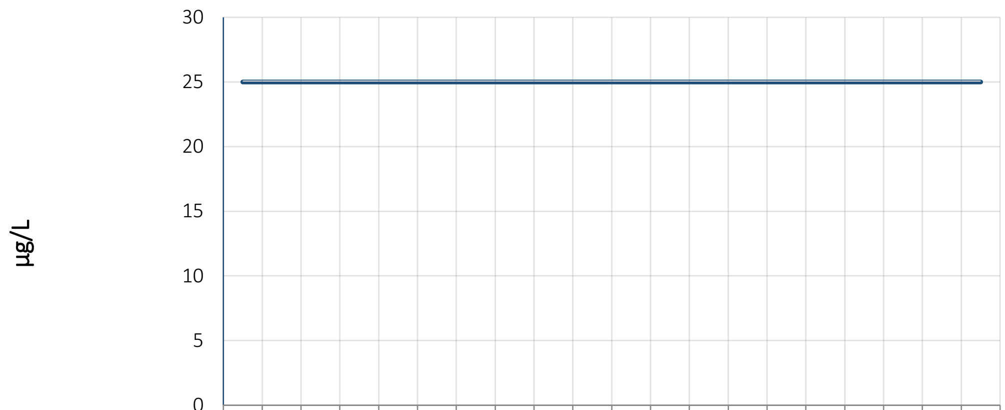
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Dichlorvos (LOQ)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Limit	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Figure 53. Comparative analysis of Dichlorvos levels at monitoring points

Dichlorvos ($C_4H_7Cl_2O_4P$) is an insecticide and arachnicide trade under commercial names such as Diclovan. According to the national surface water regulation, the maximum concentration allowed for this pesticide is 10 µg/L.

The limit of quantification of the method used to analyse the samples is 10 µg/L (equal to the maximum permissible). No quantifiable levels of Dichlorvos are detected in any sample.

3.2.55 Methamidophos



	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SL TR	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Methamidophos (LOQ)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Figure 54. Comparative analysis of Methamidophos levels at monitoring points

Methamidophos ($C_2H_8NO_2PS$) is an insecticide and acaricide. This pesticide does not have limits established in the national water regulation.

The method's limit of quantification is 25 µg/L and none of the samples exceeds this value.

3.2.56 Tebuconazole

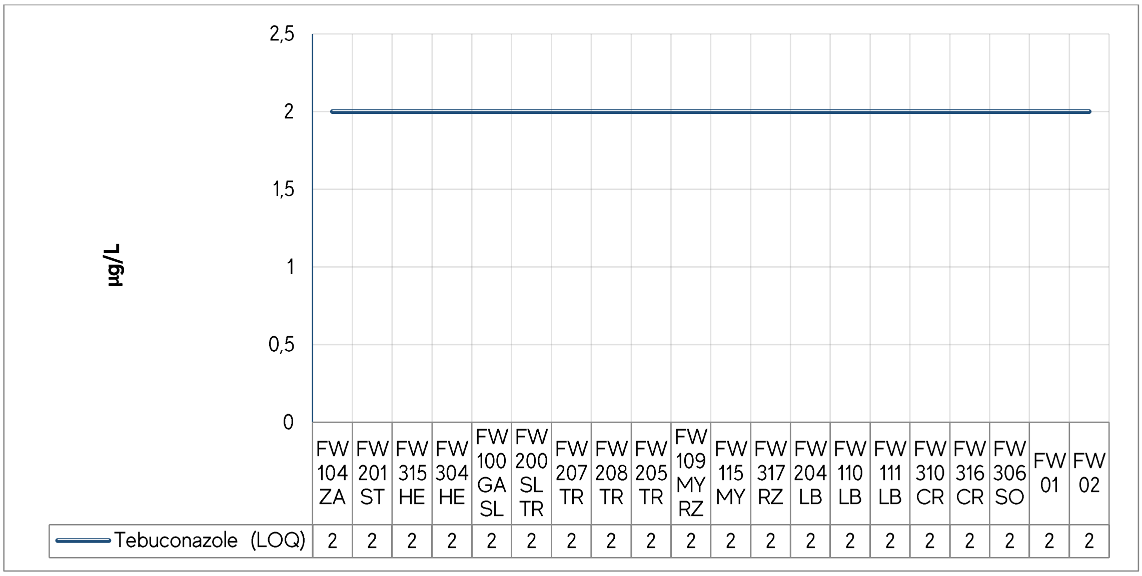


Figure 55. Comparative analysis of Tebuconazole levels at monitoring points

Tebuconazole ($C_{16}H_{22}ClN_3O$) is a fungicide trade under the name Folitra Max among others. It is use mainly in the prevention and eradication of fungi that attack horticultural crops. The water standard regulation does not establish a limit for this parameter.

As for the results, there is no evidence of Tebuconazole in surface waters of the area of study. The limit of quantification is 2 µg/L which no sample exceeds.

3.2.57 Imidacloprid

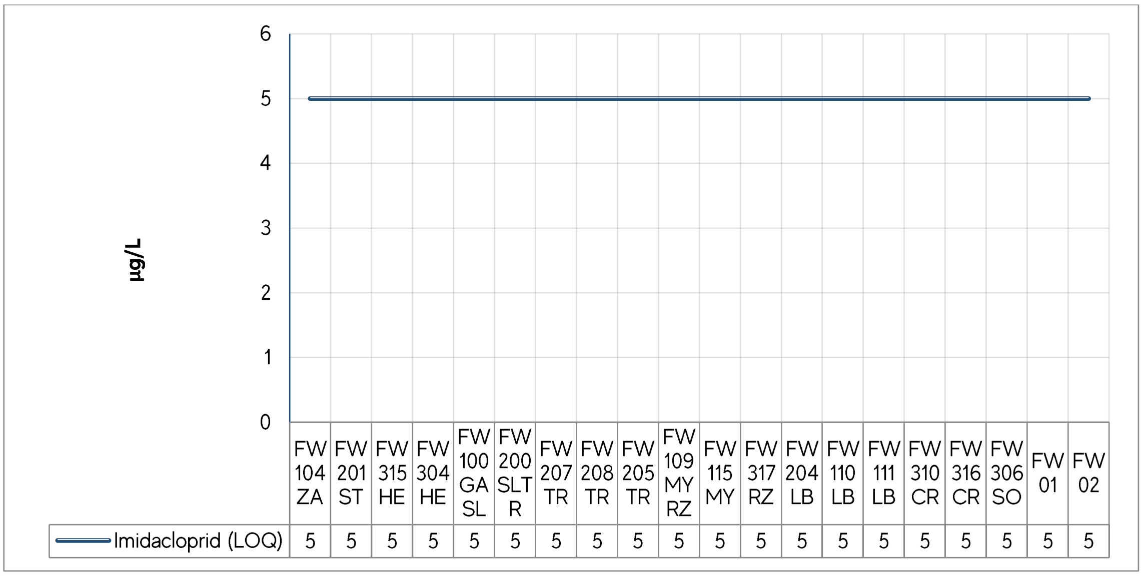
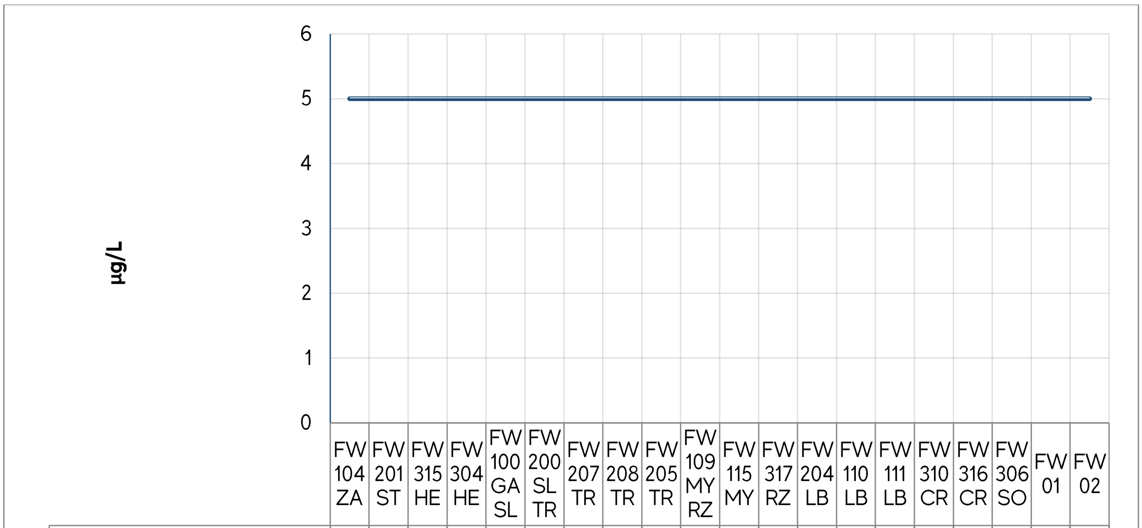


Figure 56. Comparative analysis of Imidacloprid levels at monitoring points

Imidacloprid ($C_9H_{10}ClN_5O_2$) is a systemic insecticide used to control insects, aphids and thrips in various crops. Its commercial name is Dagger or Hephaestus among others.

This pesticide is not detected in any of the points. The limit of quantification is 5 µg/L, and the national regulation does not establish a maximum permissible level for this parameter.

3.2.58 Methyl paraoxon



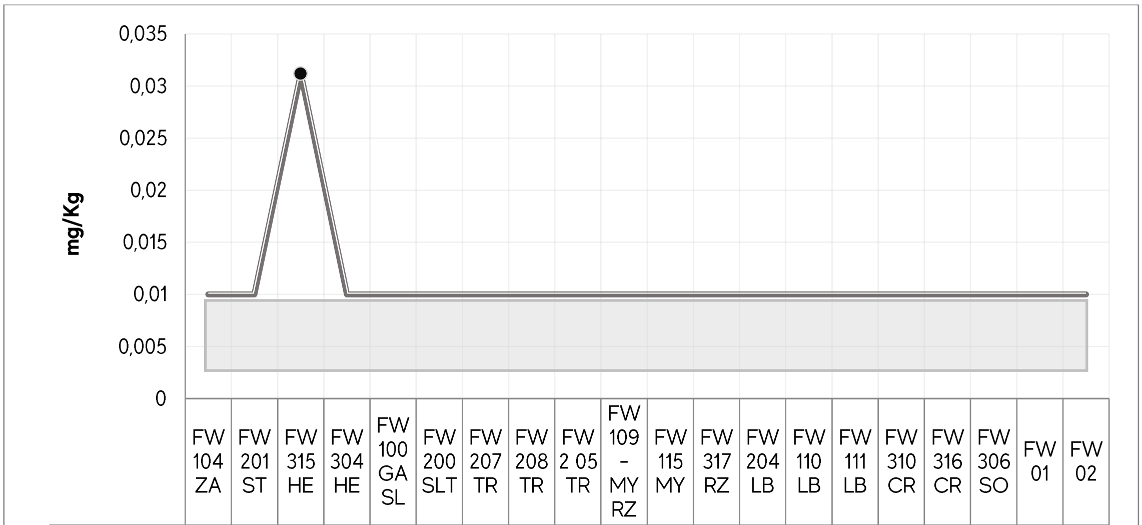
	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SL TR	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Methyl paraoxon (LOQ)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Figure 57. Comparative analysis of methyl paraoxon levels at monitoring points

Methyl Paraoxon ($C_8H_{10}NO_6P$) is a non-systemic and broad-spectrum insecticide. The national water regulation does not establish limits for this pesticide.

No quantifiable levels of this substance is found in any sample. The limit of quantification of the method used is 5 µg/L.

3.2.58 Fipronil

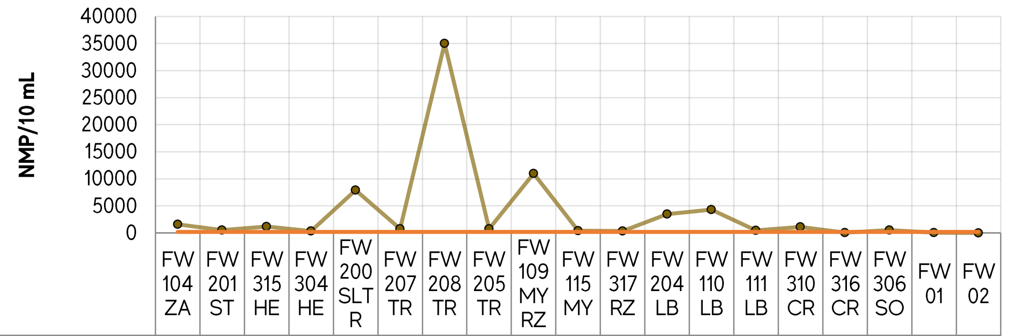


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT	FW 207 TR	FW 208 TR	FW 2 05 TR	FW 109 - MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Fipronil	0,01	0,01	0,03	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Figure 58. Comparative analysis of Fipronil levels at monitoring points

Regulation 222/02 does not establish a limit for Fipronil concentrations in surface water. The method used to determine Fipronil has a limit of quantification (LOQ) up to 0.01 mg/kg that is not detected in any sample points but FW 315-HE with 0.03113 mg/kg.

3.2.59 Faecal coliforms



	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 200 SLTR	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Faecal coliforms	1600	540	1200	330	7900	790	3500	780	1100	390	330	3500	4300	490	1100	46	540	33	2
Limit	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200

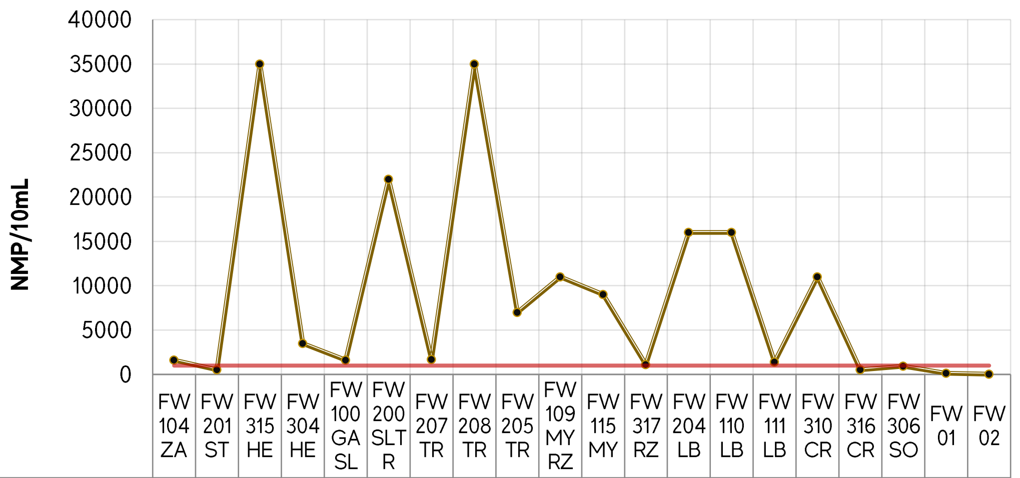
Figure 59. Comparative analysis of faecal coliforms levels at monitoring points

According to the water regulation, in those classify as Class 2, the presence of faecal coliforms must be less than 200 NMP/100ml.

All samples values are beyond the established limits except from the Paraguay River monitoring points (FW01 and FW02) and FW316-CR ("Laguna Penayo" stream).

A percentage of 84% of the samples have values above the maximum permissible. The average for this parameter is 3677 NMP/100ml.

3.2.60 Total coliforms

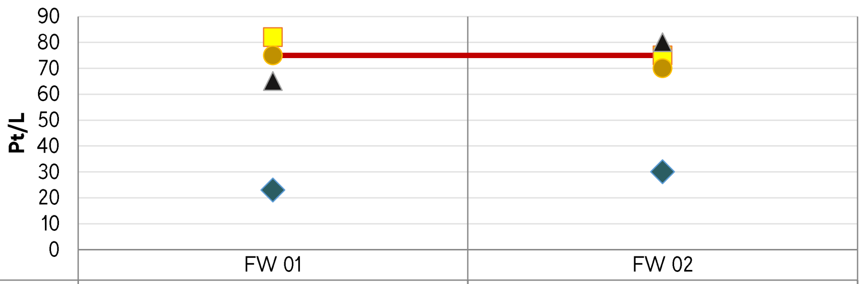


	FW 104 ZA	FW 201 ST	FW 315 HE	FW 304 HE	FW 100 GA SL	FW 200 SLT R	FW 207 TR	FW 208 TR	FW 205 TR	FW 109 MY RZ	FW 115 MY	FW 317 RZ	FW 204 LB	FW 110 LB	FW 111 LB	FW 310 CR	FW 316 CR	FW 306 SO	FW 01	FW 02
Total coliforms	1600	540	3500	3500	1600	2200	1700	3500	7000	1100	9000	1100	1600	1600	1400	1100	540	920	130	33
Limit	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Figure 60. Comparative analysis of total coliforms levels at monitoring points

According to the water regulation, the permissible limit for this parameter is 1000 NMP/ml. Figure 60 shows that only 5 points are under this value while 75% of the points exceeds.

3.2.61 Colour



	FW 01	FW 02
Colour	23	30
3º campaign PYORY	82	75
2º campaign PYORY	65	80
1º campaign PYORY	75	70
Limit	75	75

Figure 61. Comparative analysis of colour at two points of the Paraguay River and three previous monitoring campaigns

Comparing to the values obtained in previous campaigns performed by POYRY (2020) for the project's environmental impact assessment, in the current campaign, the colour is within the range recommended by Regulation 222/02; in comparison with the background results that were close to or exceeded the limit of 75Pt/l.

The colour variations depend on the flow and sediment dragging variations, which relates to climate's conditions. In this case, the values are representative of the rainy season.

3.2.62 Phenols index

	TABLE 10. COMPARATIVE ANALYSIS OF PHENOLS INDEX AT DIFFERENT SAMPLING POINTS	
	PHENOLS INDEX (mg/L)	
	FW01	**FW02**
Current campaign	<0,0005 ND	<0,0005 ND
3° Campaign PYORY	<0,024 ND	<0,024 ND
2° Campaign PYORY	<0,024 ND	<0,024 ND
1° Campaign PYORY	<0,024 ND	<0,024 ND

In all campaigns, phenol at both points is below the limit of quantification (LOQ) therefore not detected. It is essential to mention that the current method is more sensitive than the ones used by POYRY.

The maximum value established by the national water regulation is 0.05 mg/L. None of the 2 points nor the 4 monitoring campaigns exceeds this limit.

3.2.63 PCBs

	TABLE 11. COMPARATIVE ANALYSIS OF PCBs INDEX AT DIFFERENT SAMPLING POINTS	
	PCB (µg/L /L)	
	FW01	**FW02**
Current campaign	<10 µg/L ND	<10µg/L ND
3° Campaign PYORY	<0,2 µg/L ND	<0,2 µg/L ND
2° Campaign PYORY	<0,2 µg/LND	<0,2 µg/L ND
1° Campaign PYORY	<0,2 µg/L ND	<0,2 µg/L ND

The method used during the first, second and third campaigns is more sensitive than the current one. Nevertheless, in all campaigns, PCB levels is below the limit of quantification (LOQ) and so, not detected.

According to Regulation 222/02, the presence of PCBs in waters classified as Class 2 should be zero.

3.3 General performance of groundwater parameters

Table 12 summarises the results obtained for each parameter analysed in groundwater; it also highlights the points that are beyond the established limits and the percentage of monitoring points that comply with regulations.

Regulation 222/02 "Establishing the water quality standard in the national territory" and NP 2400180 established the limits of the analysed parameters and were used to compare the results.

Nº	PARAMETER	AVERAGE	WITHIN THE LIMITS		BEYOND THE LIMITS	
			Nº	%	Nº	%
1	Temperature	23,58 ºC				
2	pH	6,72	15	79%	**4**	**21%**
3	Electrical conductivity	640,1 µS/.cm	17	89%	**2**	**11%**
4	Dissolved solids	422,31 mg/L	16	84%	**3**	**16%**
5	Organic matter	1,7 mg O_2/L				
6	Hardness	100.5 mg $CaCO_3$/L	14	73%	**5**	**27%**
7	Total phosphorus	0,908 mg/L	4	21%	**15**	**79%**
8	Total nitrogen	1,335 mg/L	16	84%	**3**	**26%**
9	Nitrates	37,2 mg/L	15	79%	**4**	**21%**
10	Chlorides	60,82 mg/L	17	89%	**2**	**11%**
11	Alkalinity	109.12 mg $CaCO_3$/L	16	84%	**3**	**16%**
12	Bicarbonates	53,17 mg $CaCO_3$/L				
13	Carbonates	0 mg $CaCO_3$/L				
14	Sulphates	44,53 mg/L	18	94%	**1**	**6%**
15	Sodium	67,9 mg/L	17	89%	**2**	**11%**
16	Potassium	3,66 mg/L	18	94%	**1**	**6%**
17	Calcium	26,3 mg/L	18	94%	**1**	**6%**
18	Magnesium	10,1 mg/L	18	94%	**1**	**6%**
19	Fluorine	0,52 mg/L				
20	Boron	1,84 mg/L	19	100%	**0**	**0%**
21	Faecal coliforms	15,9 NMP/100mL	1	7%	**13**	**93%**
22	Total coliforms	>21 NMP/10mL	2	10%	**17**	**90%**
23	*E Coli*		14	73%	**5**	**27%**

3.4 Comparative analysis of the groundwater's parameters

The following graphs provide each parameter's results determined in the 19 wells sampled on the first monitoring campaign.

3.4.1 Temperature

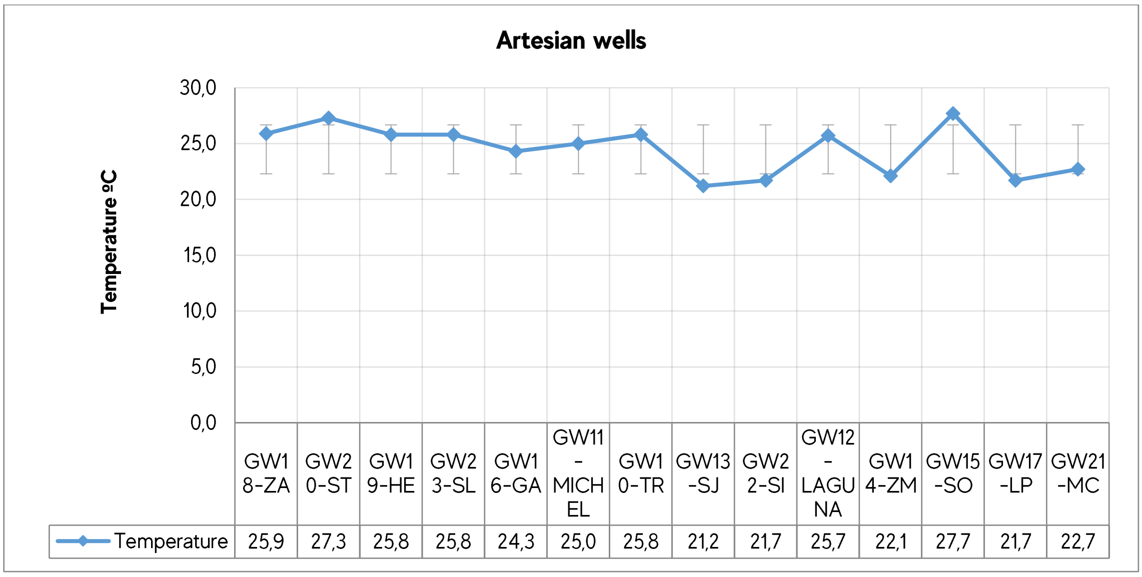


Figure 62. Comparative analysis of temperature measured in artesian wells at the forest plantation area

The artesian wells that provide drinking water to the local population of the "Farm zone" are the monitored points in which the average temperature is 24.5 ºC. The regulations do not establish a limit to analyse this parameter.

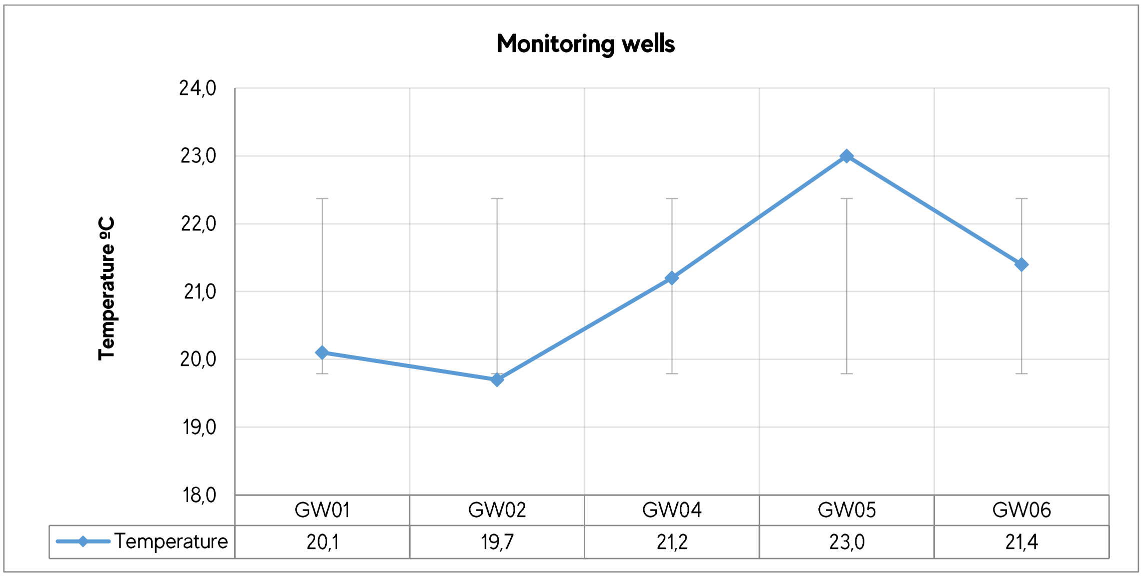
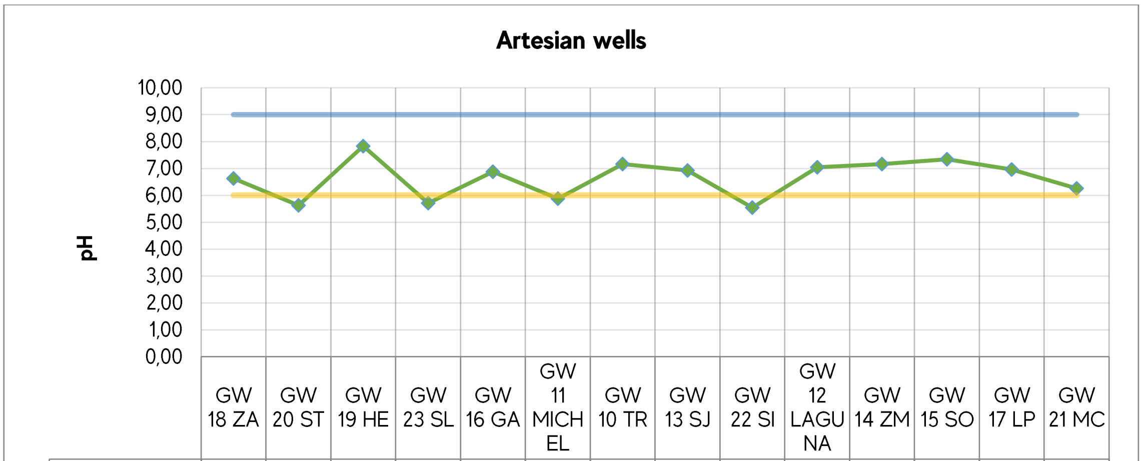


Figure 63. Comparative analysis of temperature measured in monitoring wells at the DAI

The average temperature of the water extracted from the monitoring wells located in the AID of the future industrial plant is 21.08 ºC.

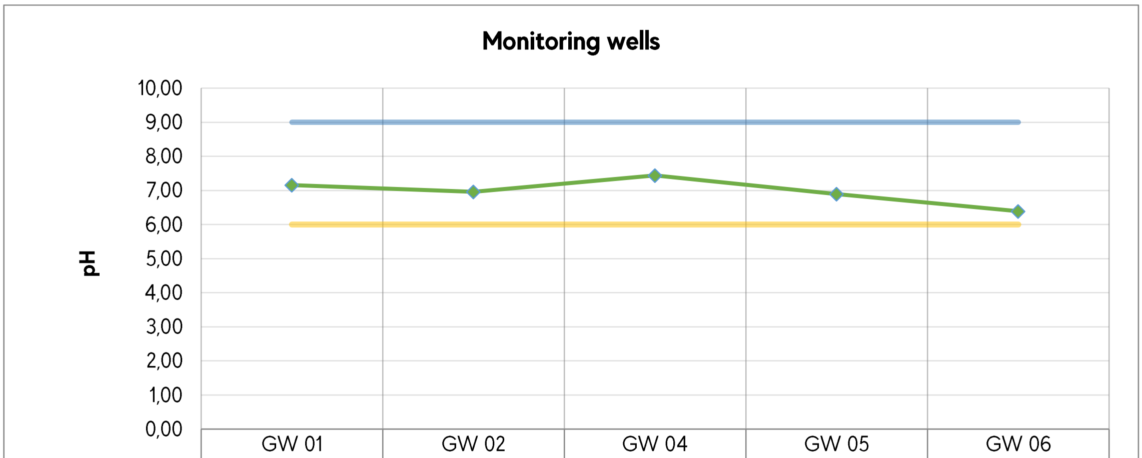
3.4.2 Hydrogen potential



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
pH	6,63	5,63	7,83	5,71	6,87	5,87	7,16	6,92	5,54	7,04	7,16	7,34	6,96	6,26
Limit inf	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Limit sup	9	9	9	9	9	9	9	9	9	9	9	9	9	9

Figure 64. Comparative analysis of pH measured in artesian wells at the forest plantation area

The pH parameter was measured in situ. Regulation 222/02 establishes a limit of range between 6 and 9. Figure 64 shows that none of the points exceeds the upper limit; as for the lower limit, GW20-ST, GW23-SL, GW11-MICHEL and GW22-SILVA show slightly acid pH values.



	GW 01	GW 02	GW 04	GW 05	GW 06
pH	7,16	6,96	7,44	6,89	6,39
Limit inf	6	6	6	6	6
Limit sup	9	9	9	9	9

Figure 65. Comparative analysis of pH measured in monitoring wells at the DAI

In the DAI's monitoring wells, all pH values are within the range established in the water regulation.

3.4.3 Electrical conductivity

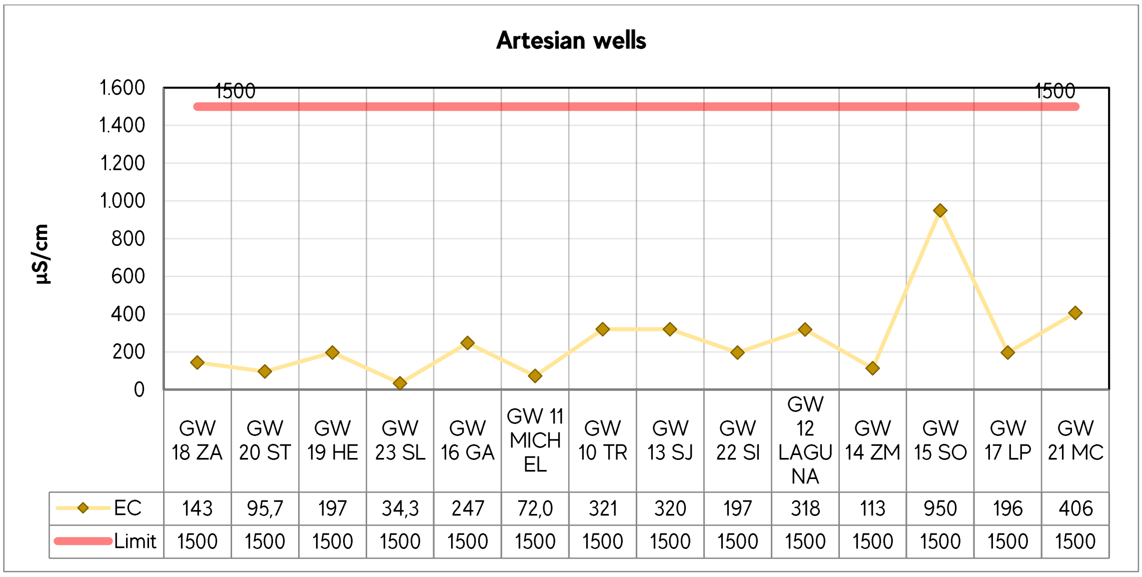


Figure 66. Comparative analysis of EC measured in artesian wells at the forest plantation area

For Class 2 water, Regulation 222/02 does not set any limit for the electrical conductivity. The limit of 1500 µS/.cm established in NP 2400180 “General Requirements for drinking water” is taken as a reference. None determination carried out exceeds the limit mentioned.

The average value is 257.8 µS/cm for the forestry area. The maximum value measured belongs to GW15-SW which represents to the farm “Soledad”.

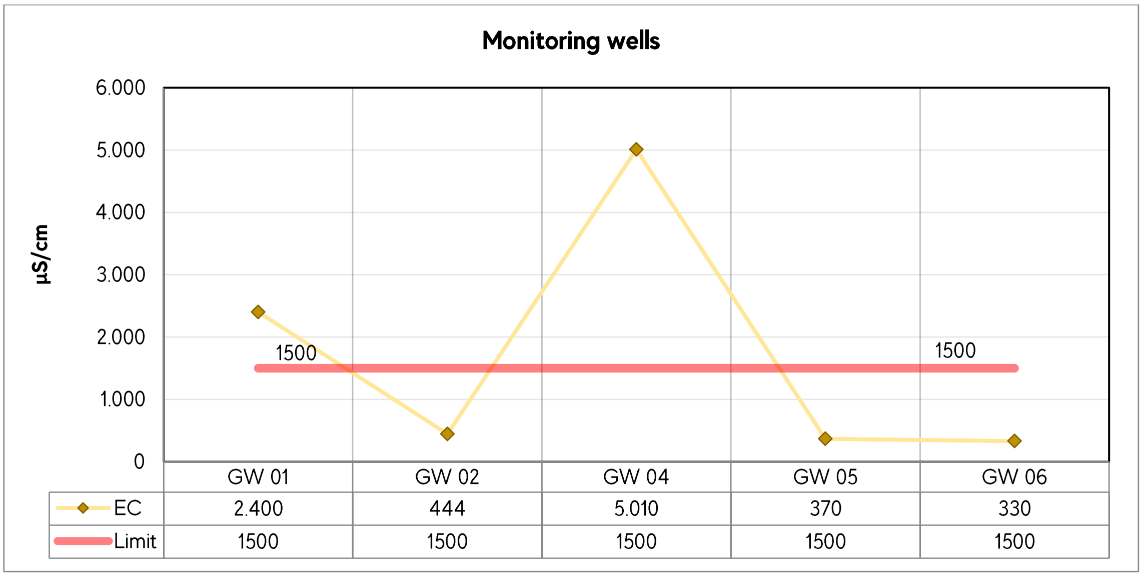
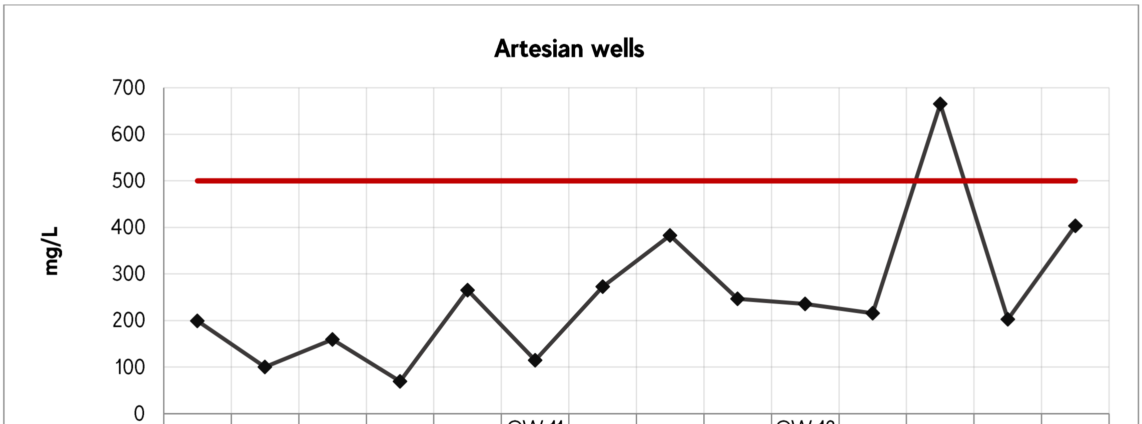


Figure 67. Comparative analysis of EC measured in monitoring wells at the DAI

Compared to the forest plantation zone, higher electrical conductivity values are recorded in the DAI zone. The average EC value from the monitoring wells is 1710 µS/cm and the points GW01 and GW04 exceed the maximum values.

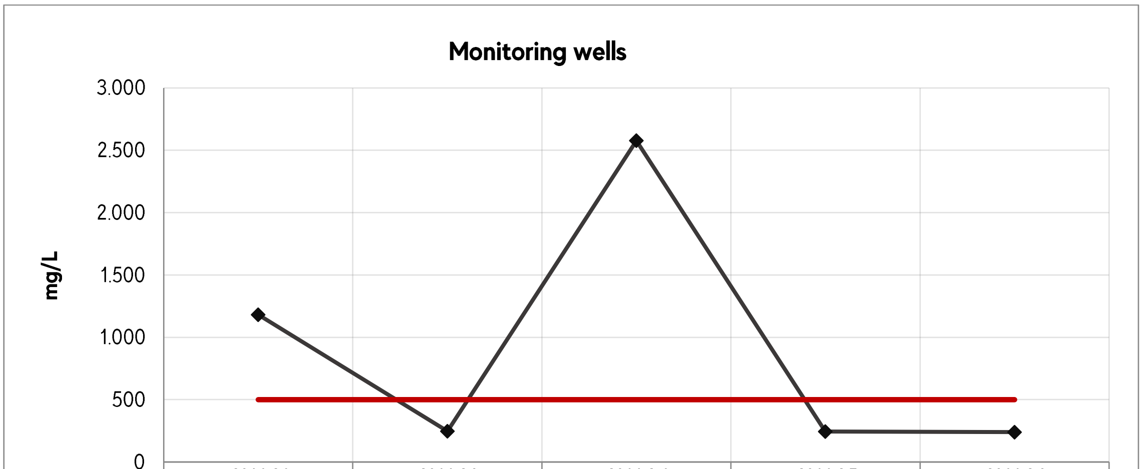
3.4.4 Total dissolved solids (TDS)



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
TDS	200	100	160	69,5	266	115	273	383	247	236	216	665	203	404
Limit	500	500	500	500	500	500	500	500	500	500	500	500	500	500

Figure 68. Comparative analysis of TDS measured in artesian wells at the forest plantation area

The national water regulation establishes a limit of 500 mg/l for this parameter. In the first monitoring campaign, the average TDS value is 252.4 mg/l where only GW 15-SW exceeds the limit.



	GW 01	GW 02	GW 04	GW 05	GW 06
TDS	1.181	248	2.577	245	240
Limit	500	500	500	500	500

Figure 69. Comparative analysis of TDS measured in monitoring wells at the DAI

The average TDS value is 898.2 mg/l in the DAI zone, which is considerably higher compared to the TDS in the forest plantation area.

3.4.5 Organic matter

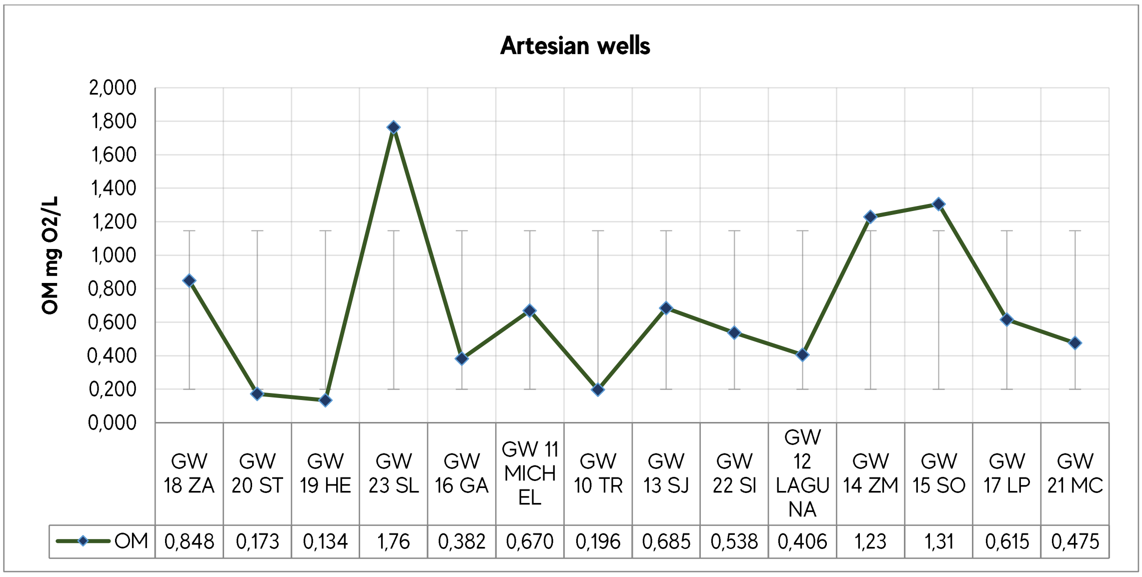


Figure 70. Comparative analysis of OM measured in artesian wells at the forest plantation area

Regulation 222/02 does not determine a maximum concentration for organic matter. The average result is 0.7 mg O_2/l. But, GW23-SL, GW14-ZM and GW15-SO shows values above the standard deviation.

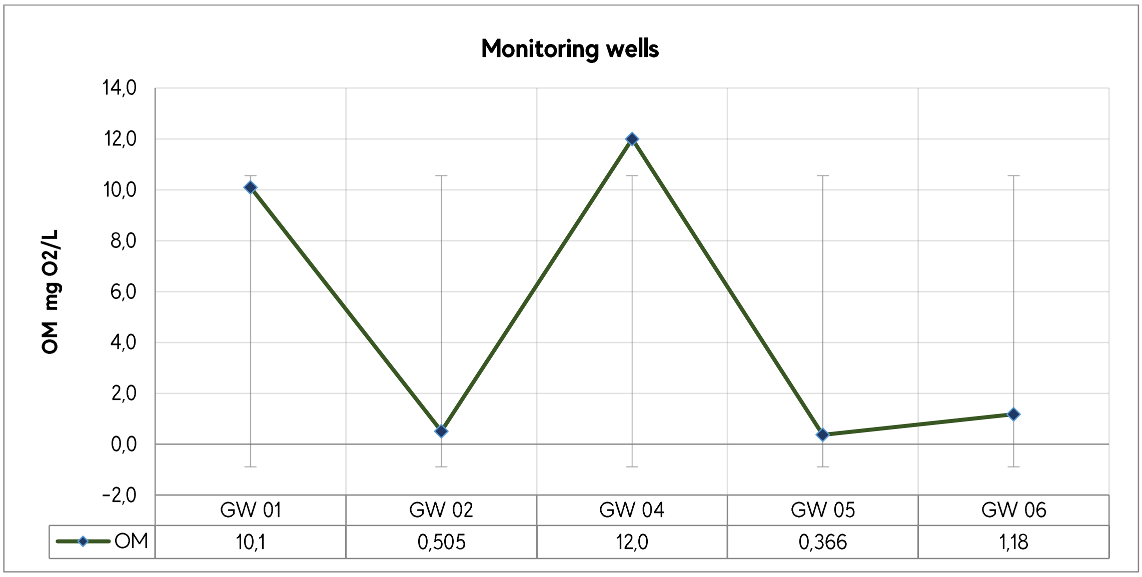
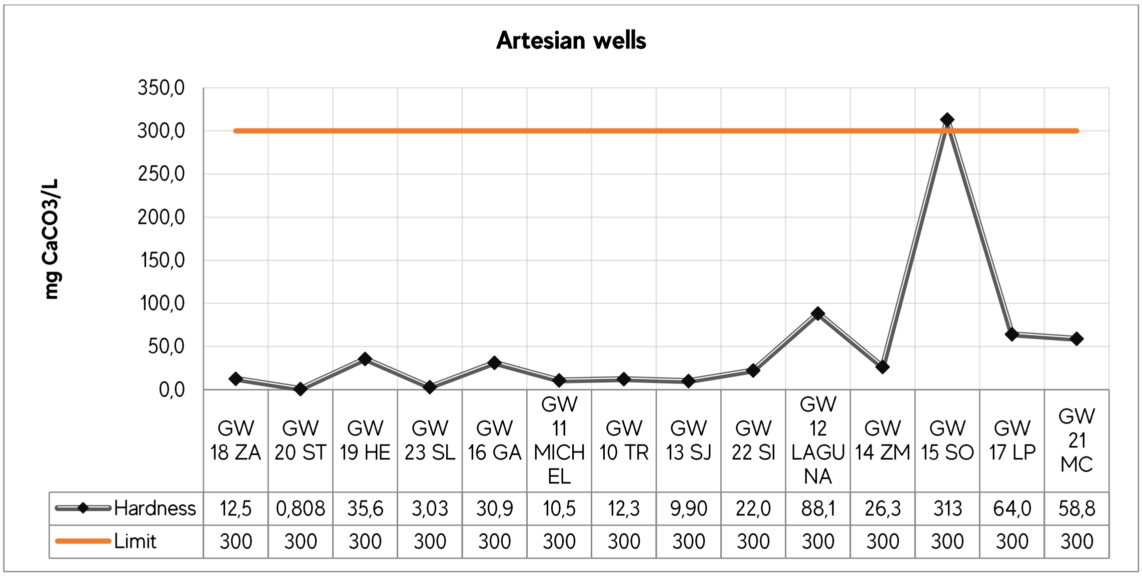


Figure 71. Comparative analysis of OM measured in monitoring wells at the DAI

The average value of OM at the DAI area is 4.8 mg O2/l, which is significantly higher than the average obtained in the forest plantation zone.

3.4.6 Hardness

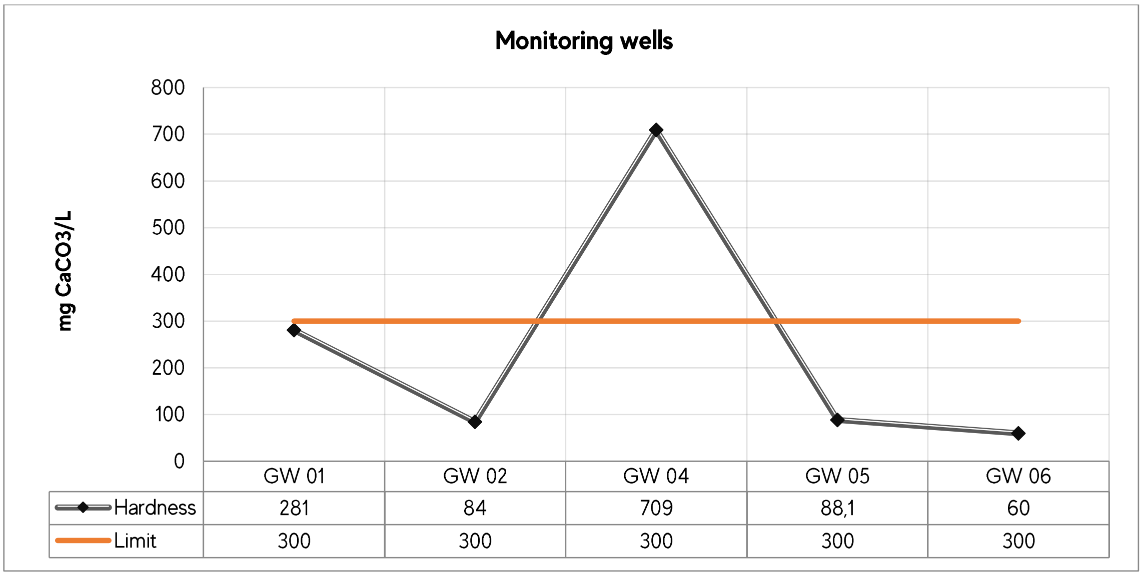


	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Hardness	12,5	0,808	35,6	3,03	30,9	10,5	12,3	9,90	22,0	88,1	26,3	313	64,0	58,8
Limit	300	300	300	300	300	300	300	300	300	300	300	300	300	300

Figure 72. Comparative analysis of hardness levels measured in artesian wells at the forest plantation area

Hardness is a water quality parameter influenced by the hydrological area's geological formations in which a well is located. Regulation 222/02 stipulates a maximum of 300 mg/l for this parameter.

The average hardness value in this first campaign is 49.1 mg $CaCO_3$/l. In the forest plantation area, only GW15-SO has a higher result than the permissible limit.

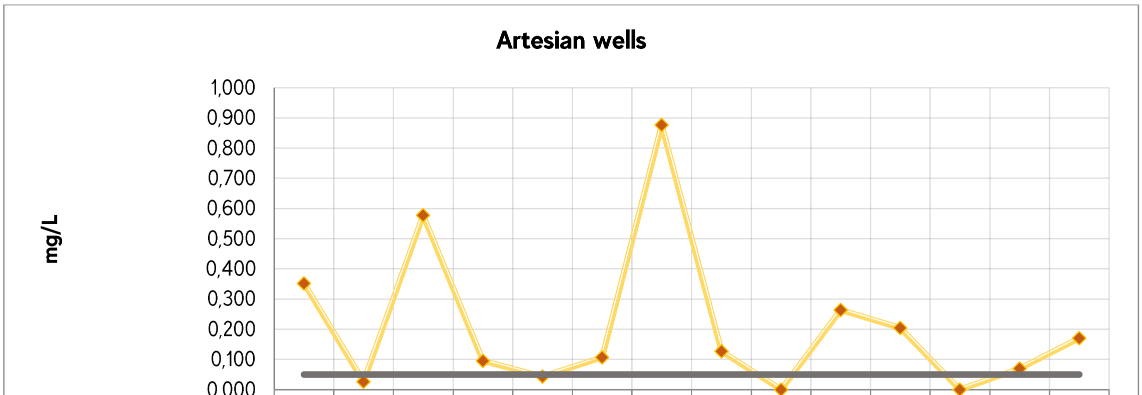


	GW 01	GW 02	GW 04	GW 05	GW 06
Hardness	281	84	709	88,1	60
Limit	300	300	300	300	300

Figure 73. Comparative analysis of hardness levels measured in monitoring wells at the DAI

In the DAI zone, the average hardness value is 244.46 mg CaCO3/l. Only the value measured at the monitoring well GW04 is above the limit.

3.4.7 Total phosphorus

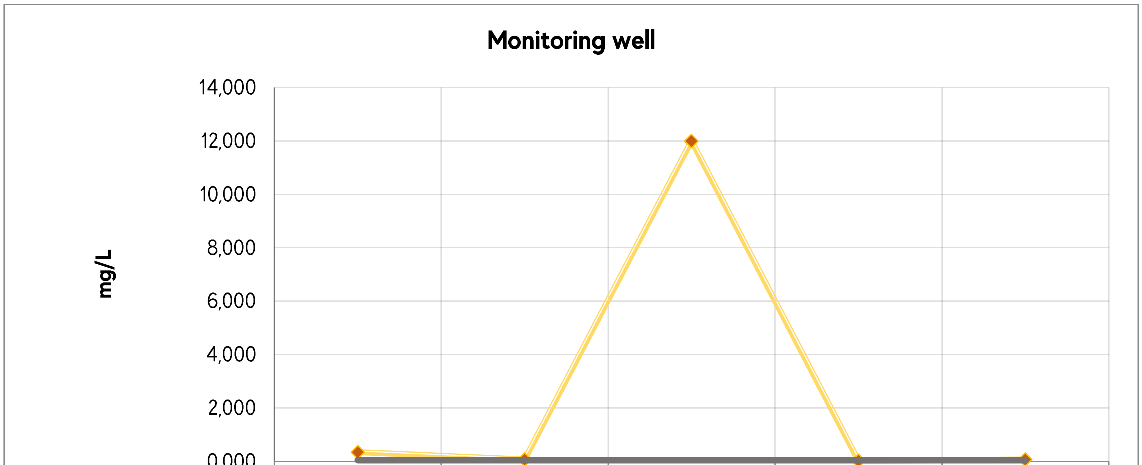


	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Total phosphorus	0,352	0,0263	0,577	0,0947	0,0431	0,107	0,876	0,127	0,000	0,264	0,204	0,000	0,0699	0,170
Limit	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05

Figure 74. Comparative analysis of total phosphorus levels measured in artesian wells at the forest plantation area

Over-fertilisation causes that a fraction of phosphorus not assimilated by the vegetation to infiltrate into the soils and reach groundwater or surface water, which can explain the high phosphorus concentrations.

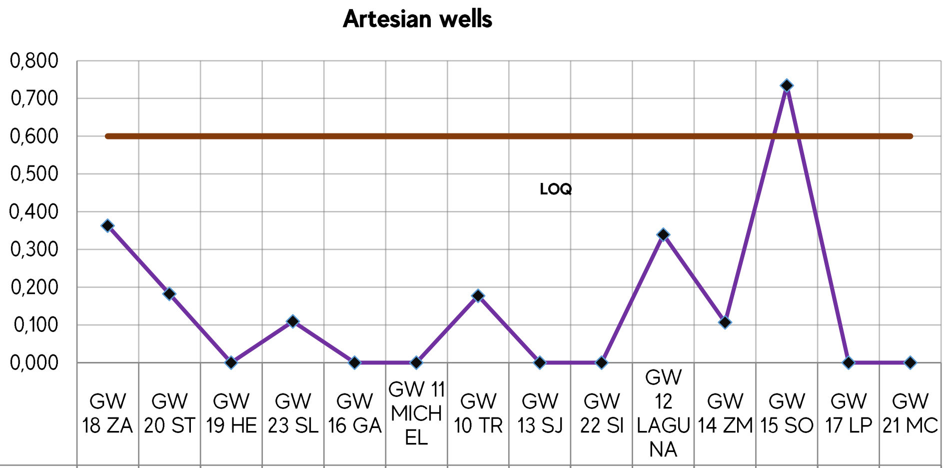
Figure 74 shows that only 4 wells of the forestry area comply with the regulation's established limit. In the remaining 10 wells, the limits exceed up to 17 times the maximum recommended by the national water regulation (0.05 mg/L).



	GW 01	GW 02	GW 04	GW 05	GW 06
Total phosphorus	0,356	0,0776	12,0	0,0212	0,0723
Limit	0,05	0,05	0,05	0,05	0,05

Figure 75. Comparative analysis of total phosphorus levels measured in monitoring wells at the DAI

3.4.8 Total nitrogen

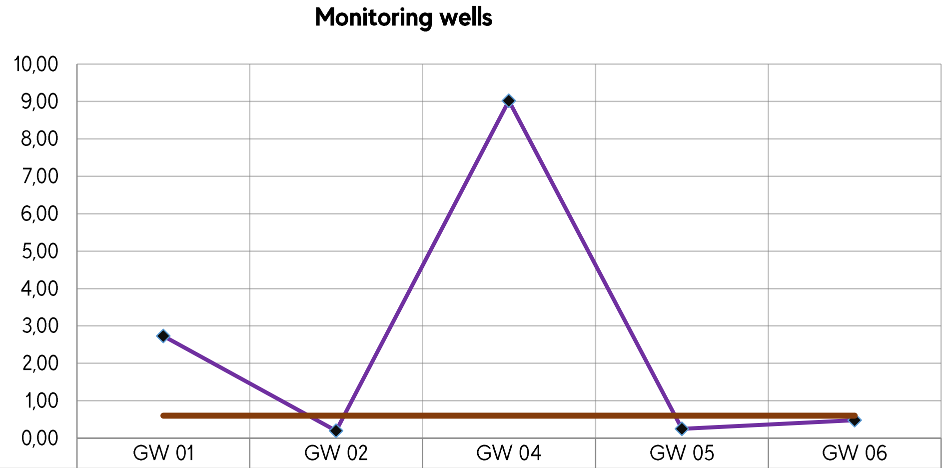


	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Total nitrogen	0,363	0,182	0,000	0,109	0,000	0,000	0,177	0,000	0,000	0,339	0,107	0,734	0,000	0,000
Limit	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6

Figure 76. Comparative analysis of total nitrogen levels measured in artesian wells at the forest plantation area

Figure 76 shows that the limit of quantification (LOQ) for total nitrogen equals 1 mg/l. At points, GW 19-HE, GW 16-GA, GW 11-MICHEL, GW 13-SAN JUAN, GW 22-SILVA, GW 14-ZM, GW 17-LP and GW 21-MC, the concentrations of total nitrogen are lower than the LOQ.

GW 15-SO is the only point that exceeds LOQ with a value of 0.734 mg/l.

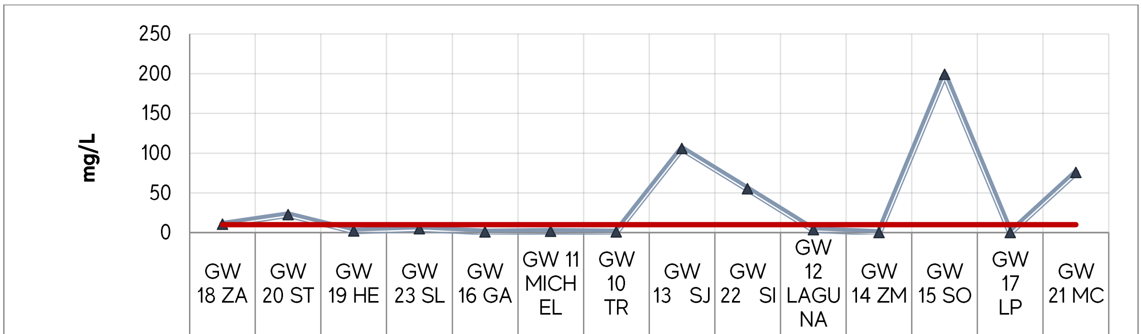


	GW 01	GW 02	GW 04	GW 05	GW 06
Total nitrogen	2,73	0,196	9,02	0,245	0,483
Limit	0,6	0,6	0,6	0,6	0,6

Figure 77. Comparative analysis of total nitrogen levels measured in monitoring wells at the DAI

GW01 and are the two monitoring wells in the DAI with values above the limit. The average value of nitrogen in groundwater future industrial plant zone is 2.5 mg/L.

3.4.9 Nitrates

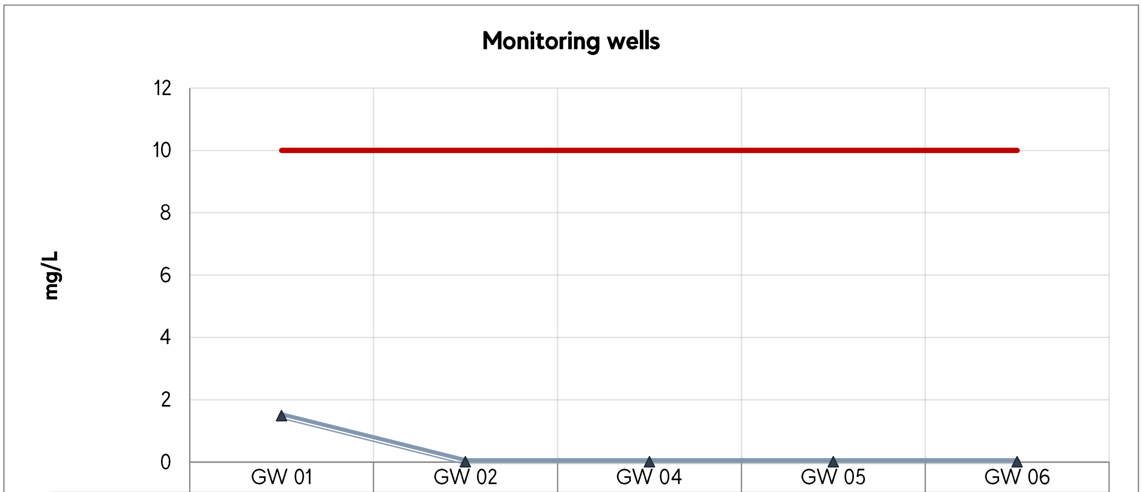


	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICH EL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGU NA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Nitrates	10,5	22,8	1,93	5,08	0,899	1,80	0,818	106	55,2	3,70	0,20	199	0,20	75,5
Limit	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Figure 78. Comparative analysis of nitrate levels measured in artesian wells at the forest plantation area

For nitrates, the maximum level established by the legislation is 10 mg/l. GW 18-ZA. GW 20-ST, GW-13 San Juan, GW 22-Silva, GW 15-SO and GW 21- MC exceed the maximum limit.

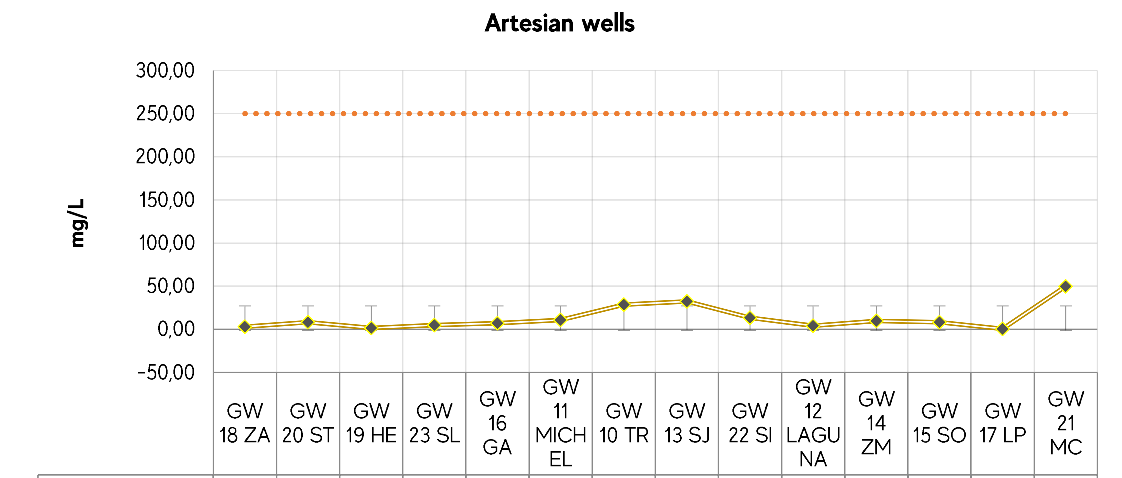
Statistically, 79% of wells are within the range while 21% are beyond the limits. The average value of nitrates is 37.2 mg/l.



	GW 01	GW 02	GW 04	GW 05	GW 06
Nitrates	1,49	0,02	0,02	0,02	0,02
Limit	10	10	10	10	10

Figure 79. Comparative analysis of nitrate levels measured in monitoring wells at the DAI

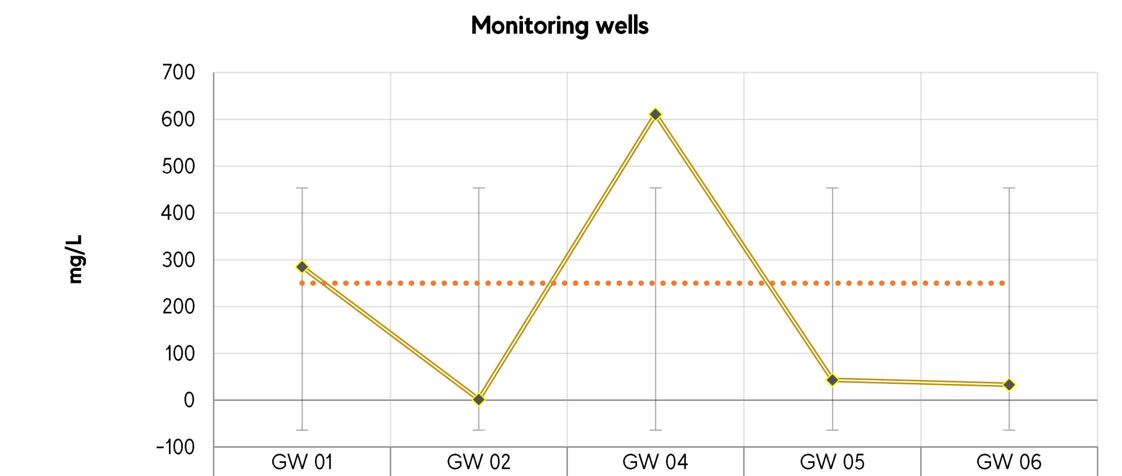
3.4.8 Chlorides



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Chlorides	3,09	8,08	1,43	4,75	6,89	10,9	28,5	32,3	13,3	4,28	9,50	8,31	0,475	49,9
Limit	250	250	250	250	250	250	250	250	250	250	250	250	250	250

Figure 80. Comparative analysis of chloride levels measured in artesian wells at the forest plantation area

According to Law 1614/2000, Chloride's permissible limit is 250 mg/l. None well exceeds this maximum limit. The average chloride value is 12.9 mg/l.

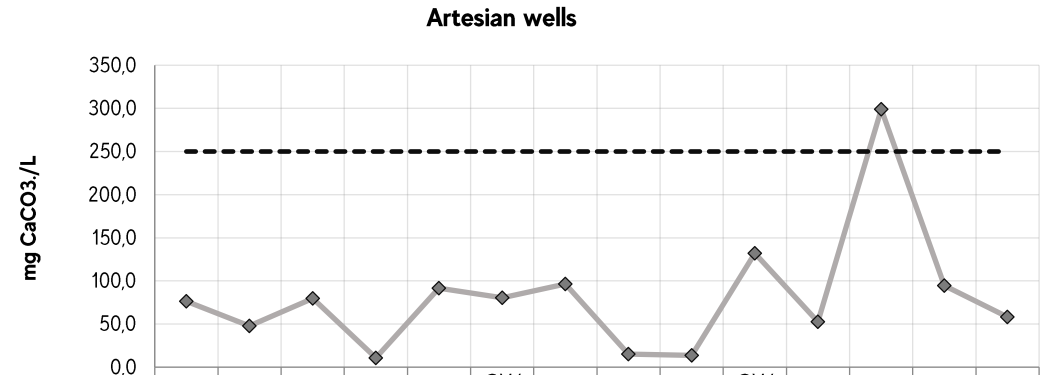


	GW 01	GW 02	GW 04	GW 05	GW 06
Chlorides	285	1,59	611	43,1	33,3
Limit	250	250	250	250	250

Figure 81. Comparative analysis of chloride levels measured in monitoring wells at the DAI

In the DAI, the monitoring wells GW01 and GW04 show values above the established limit. The average result of the parameter is 194.7 mg/l.

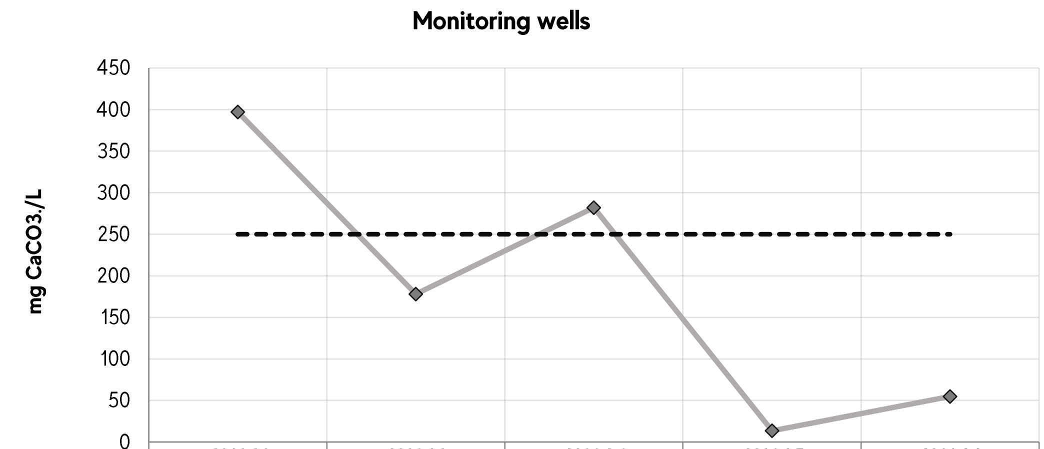
3.4.9 Alkalinity



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Alkalinity	76,2	47,9	79,7	10,8	91,5	80,4	96,5	15,2	13,8	132	52,6	299	94,5	58,1
Limit	250	250	250	250	250	250	250	250	250	250	250	250	250	250

Figure 82. Comparative analysis of alkalinity levels measured in artesian wells at the forest plantation area

The Law 1614/2000 establishes a maximum value of 250 mg $CaCO_3$/l. Figure 82 shows that only well GW15-SO exceeds the limit. The average alkalinity concentration is 82 mg $CaCO_3$/l.



	GW 01	GW 02	GW 04	GW 05	GW 06
Alkalinity	397	178	282	13,5	54,6
Limit	250	250	250	250	250

Figure 83. Comparative analysis of alkalinity levels measured in monitoring wells at the DAI

In the DAI, monitoring wells GW01 and GW04 have concentrations above the limit. The average is 185.02 mg CaCo3/l.

3.4.10 Bicarbonates

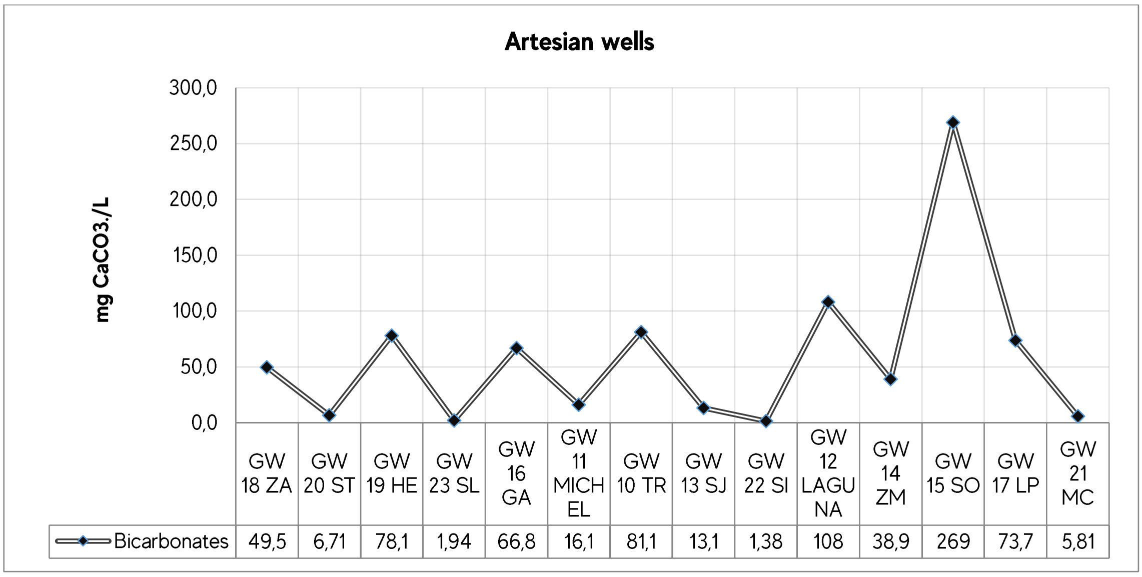


Figure 84. Comparative analysis of bicarbonate levels measured in artesian wells at the forest plantation area

Bicarbonate is a water quality parameter with no set limit. The types of minerals in the geological formation where the wells are, influence the concentrations of this parameter. The average value of bicarbonates is 57.9 mg CaCO3/l.

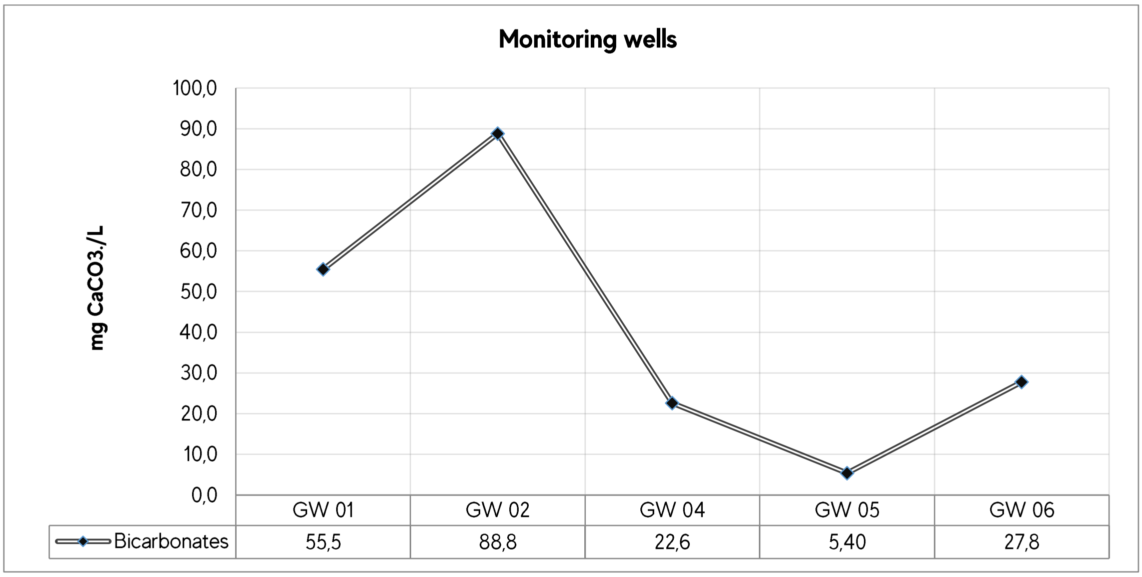


Figure 85. Comparative analysis of bicarbonate levels measured in monitoring wells at the DAI

In the DAI zone, the average bicarbonate concentration is 40.02 mg CaCo3/l.

3.4.11 Carbonates

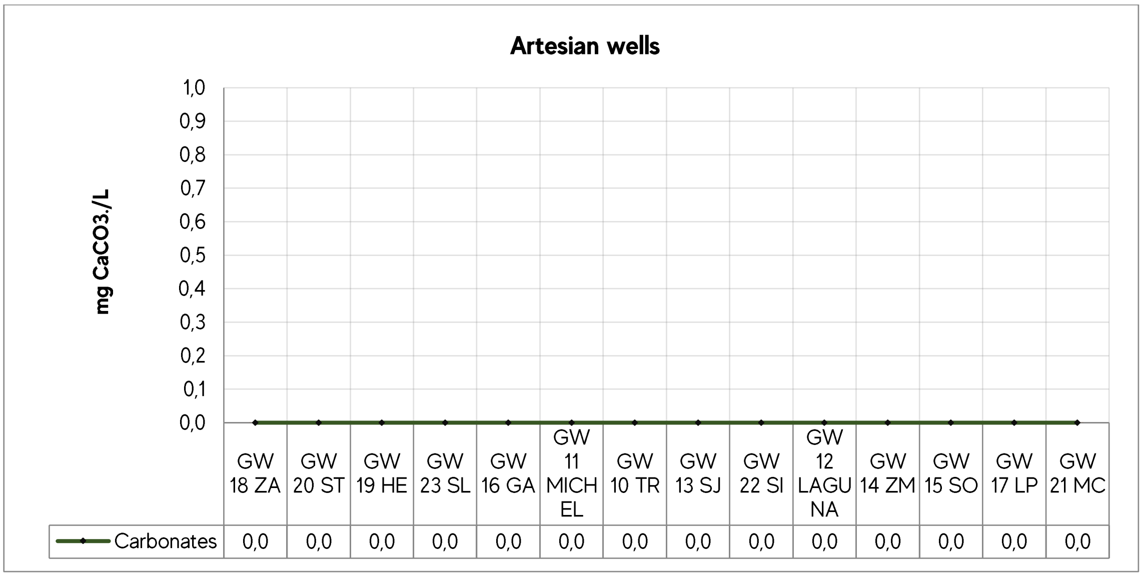


Figure 86. Comparative analysis of carbonate levels measured in artesian wells at the forest plantation area

Carbonate is a water quality parameter with no set limit. According to the laboratory results, there is no presence of this parameter in any sample.

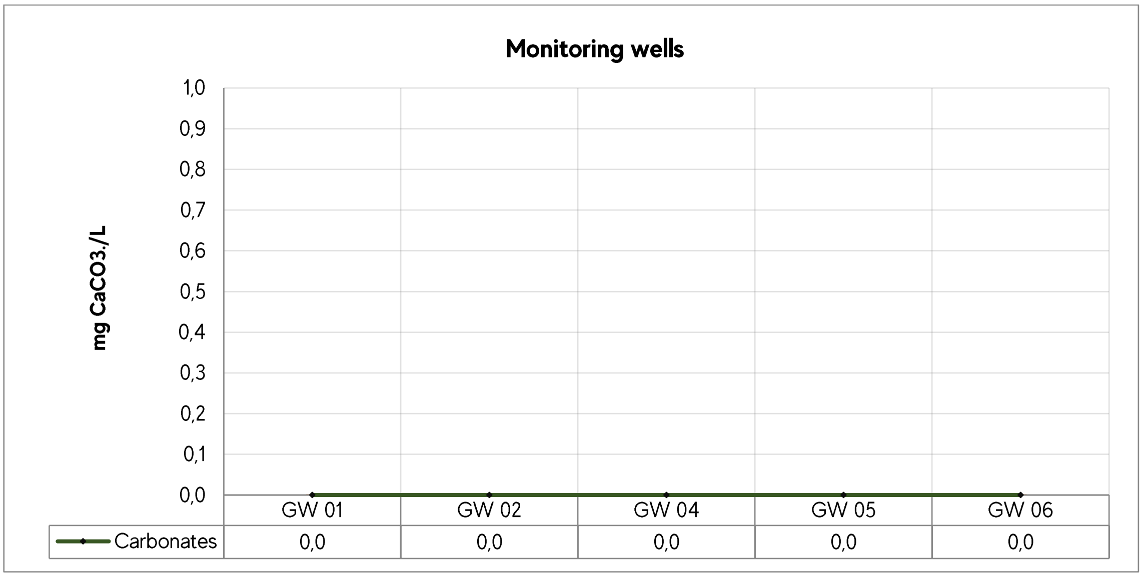
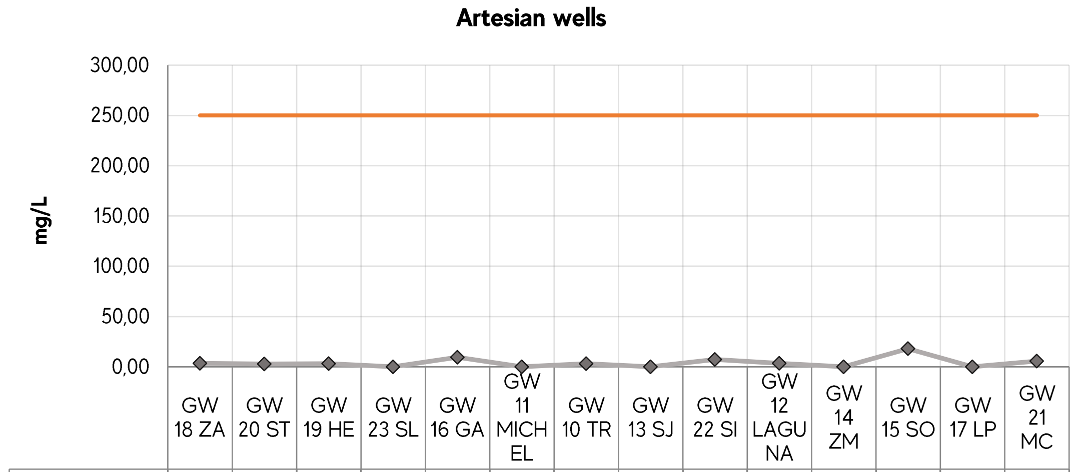


Figure 87. Comparative analysis of carbonate levels measured in monitoring wells at the DAI

As the artesian well's results, the monitoring well's values in the DAI are equal to zero.

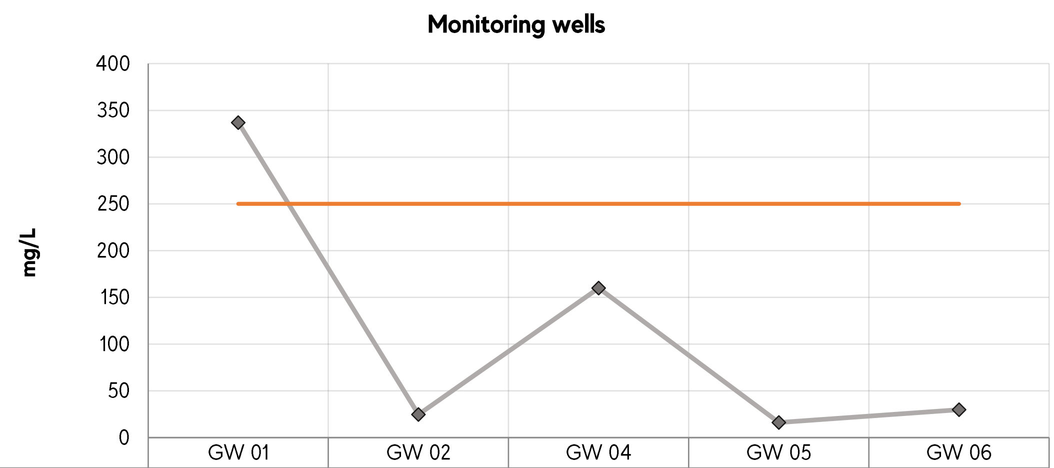
3.4.12 Sulphates



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Sulphates	3,31	2,66	2,96	0	9,50	0	3,21	0	7,37	3,46	0	17,9	0	5,79
Limit	250	250	250	250	250	250	250	250	250	250	250	250	250	250

Figure 88. Comparative analysis of sulphate levels measured in artesian wells at the forest plantation area

In contrast to surface water, all the artesian well's monitored points show sulphate concentrations. Regulation 222/02 defines a maximum of 250 mg/l for this parameter, and the highest determination is 17.9 mg/l at point GW18-SO. All the samples are within the range, and the average sulphate value is 4 mg/l.

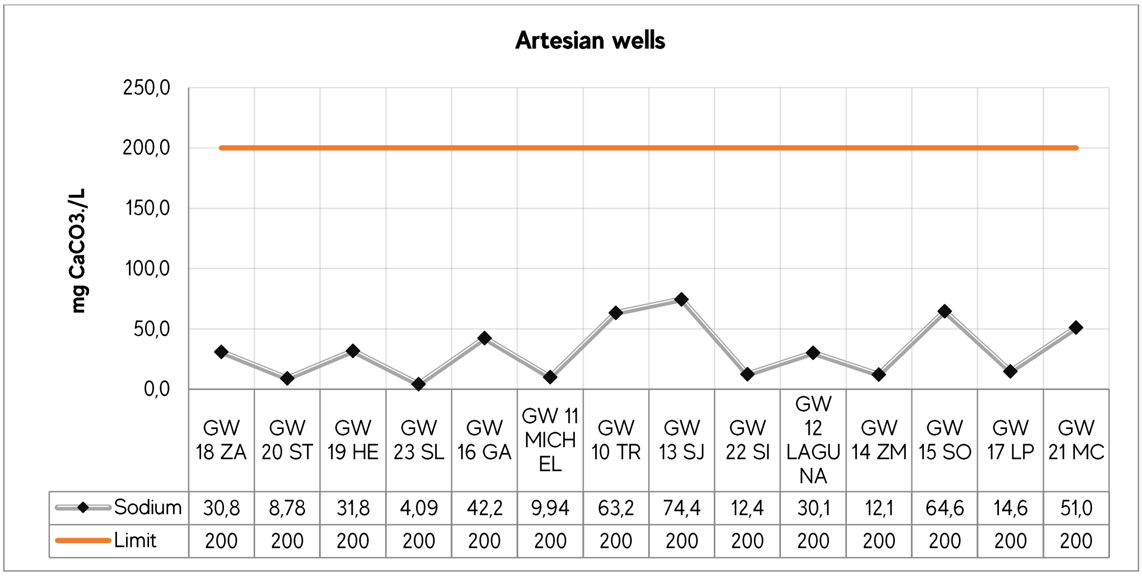


	GW 01	GW 02	GW 04	GW 05	GW 06
Sulphates	337	24,5	160	16,1	29,7
Limit	250	250	250	250	250

Figure 89. Comparative analysis of sulphate levels measured in monitoring wells at the DAI

In the DAI zone, the only well that exceeds the limit is GW01 with 337 mg/L. The average value of sulphates is 113.46 mg/L.

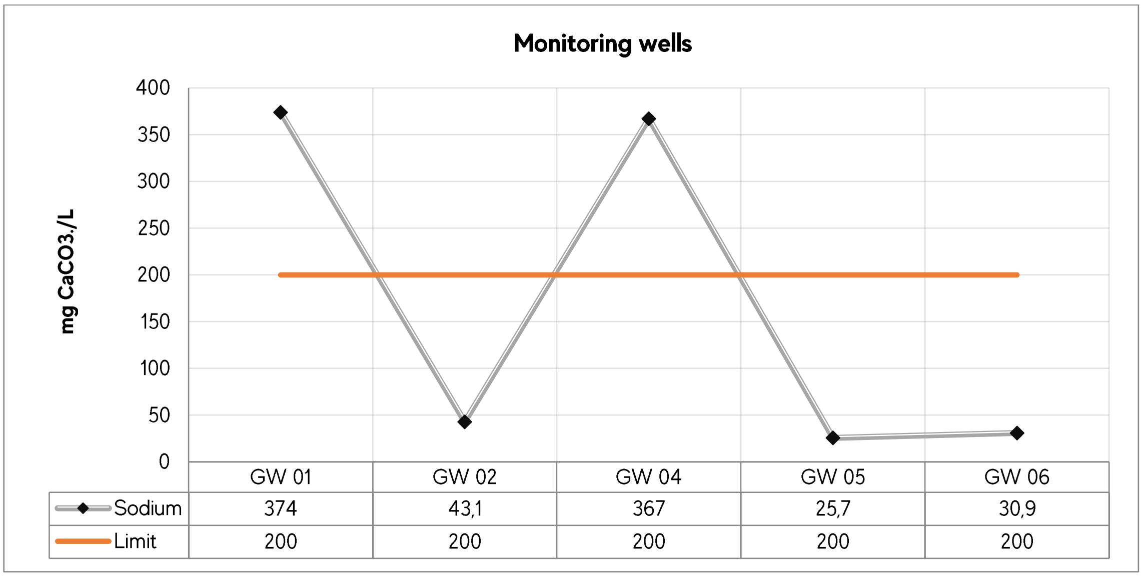
3.4.13 Sodium



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Sodium	30,8	8,78	31,8	4,09	42,2	9,94	63,2	74,4	12,4	30,1	12,1	64,6	14,6	51,0
Limit	200	200	200	200	200	200	200	200	200	200	200	200	200	200

Figure 90. Comparative analysis of sodium levels measured in artesian wells at the forest plantation area

In all the sampled wells, the sodium concentrations are lower than the maximum levels established in Regulation 222/02. Statistically, the average sodium concentration in groundwater is 32.14 mg/L.

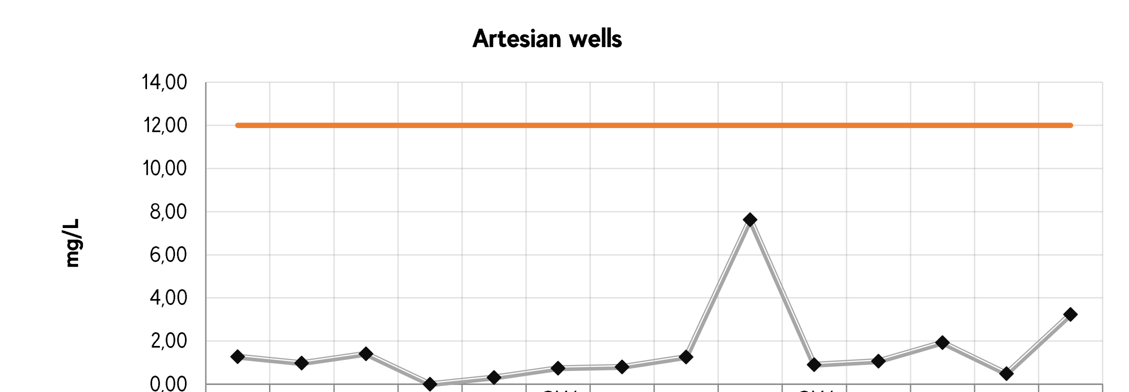


	GW 01	GW 02	GW 04	GW 05	GW 06
Sodium	374	43,1	367	25,7	30,9
Limit	200	200	200	200	200

Figure 91. Comparative analysis of sodium levels measured in monitoring wells at the DAI

In the DAI zone the average sodium concentration is 168.14 mg/l. Only wells GW01 and GW04 have values above the limit.

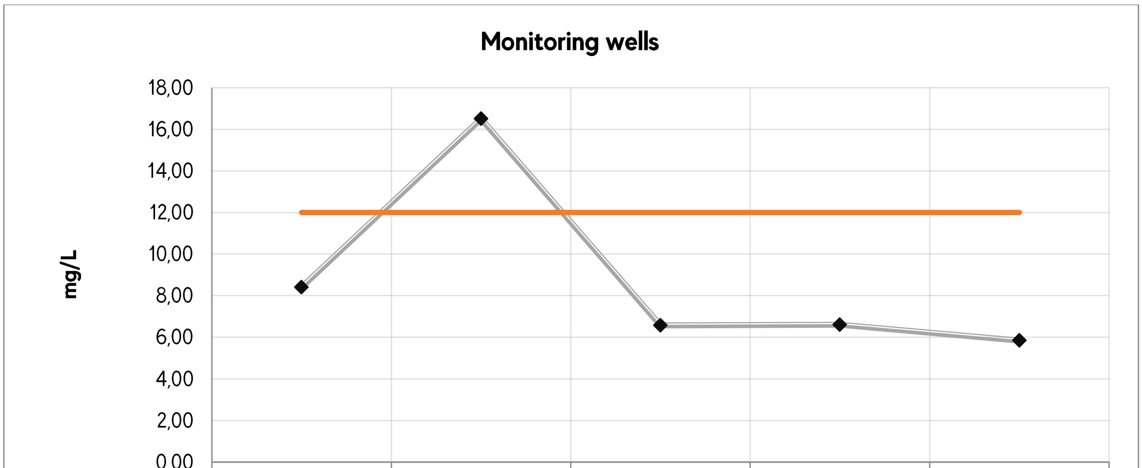
3.4.13 Potassium



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Potassium	1,27	0,982	1,41	0	0,311	0,737	0,804	1,26	7,63	0,906	1,07	1,93	0,486	3,23
Limit	12	12	12	12	12	12	12	12	12	12	12	12	12	12

Figure 92. Comparative analysis of potassium levels measured in artesian wells at the forest plantation area

The recommended sodium limits, in Law 1614/2000, is less than 12 mg/L. All the artesian well's results are within this range.

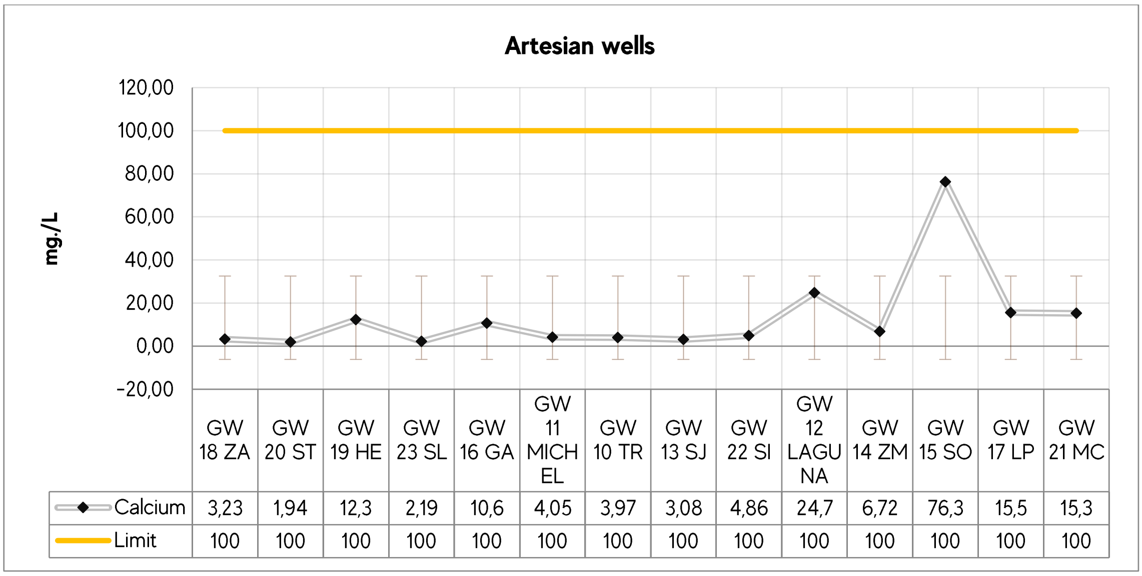


	GW 01	GW 02	GW 04	GW 05	GW 06
Potassium	8,40	16,5	6,57	6,60	5,84
Limit	12	12	12	12	12

Figure 93. Comparative analysis of potassium levels measured in monitoring wells at the DAI

In the DAI zone, monitoring well GW02 exceeds the value established in the reference regulation, the average potassium concentration in groundwater at the future industrial plant zone is 8.7 mg/l.

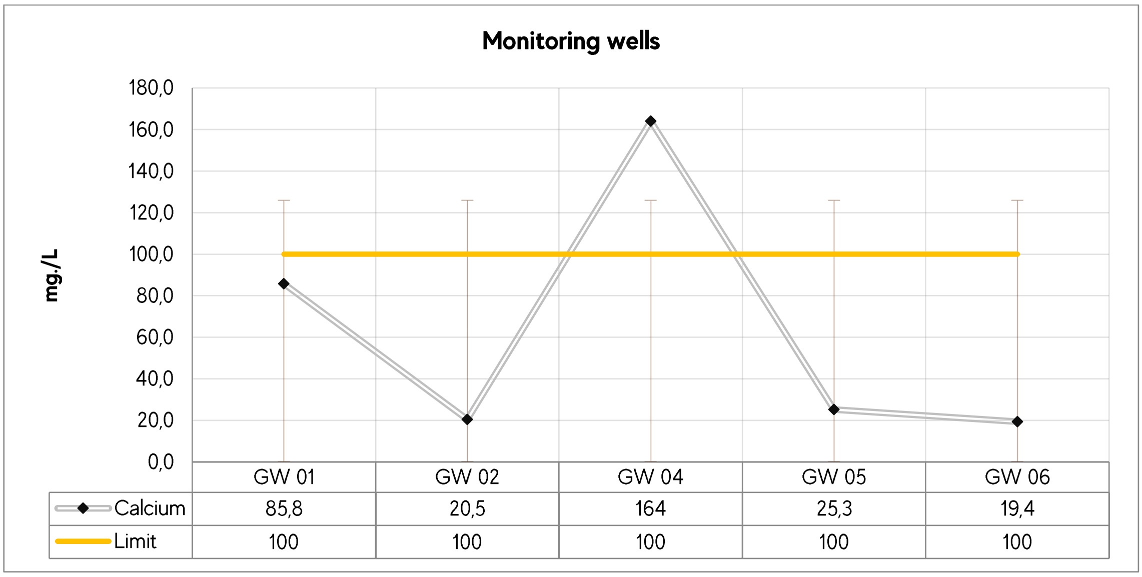
3.4.14 Calcium



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Calcium	3,23	1,94	12,3	2,19	10,6	4,05	3,97	3,08	4,86	24,7	6,72	76,3	15,5	15,3
Limit	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Figure 94. Comparative analysis of calcium levels measured in artesian wells at the forest plantation area

Regulation 222/02 does not establish a maximum value for this parameter; therefore, the limit value considered is 100 mg/l which is set by Law 1614/2000. Figure 94 shows that none points exceed this value. The average result is 13,19 mg/l.

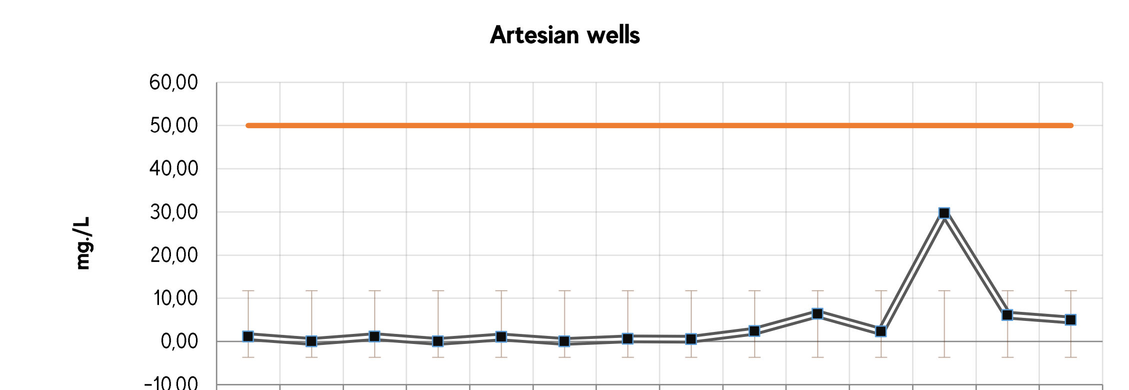


	GW 01	GW 02	GW 04	GW 05	GW 06
Calcium	85,8	20,5	164	25,3	19,4
Limit	100	100	100	100	100

Figure 95. Comparative analysis of calcium levels measured in monitoring wells at the DAI

Figure 95 illustrates that the highest concentrations are recorded in the DAI monitoring wells. GW04 is the only point that exceeds the established limit. The average calcium value in this area is 63 mg/l.

3.4.14 Magnesium

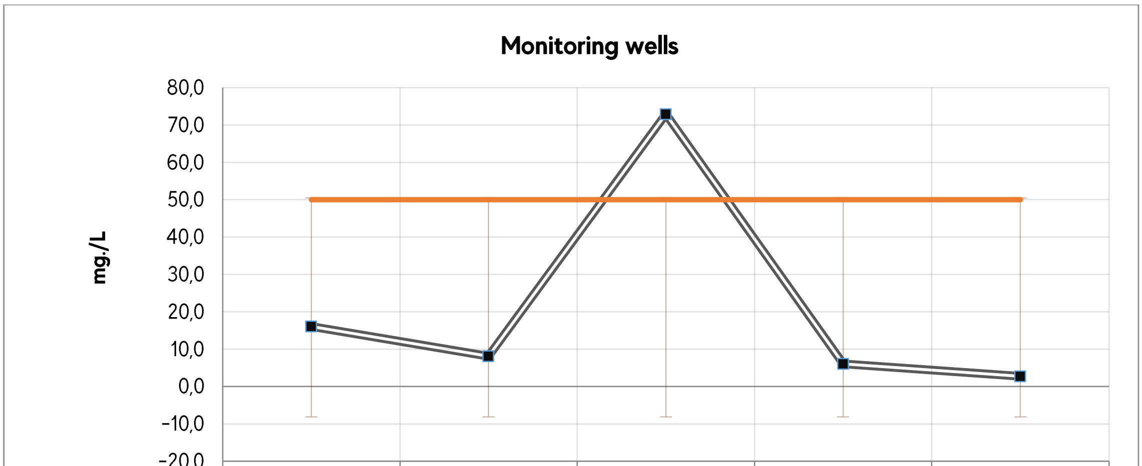


	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Magnesium	1,08	0,000	1,15	0,000	1,07	0,000	0,578	0,536	2,41	6,410	2,30	29,7	6,11	4,98
Limit	50	50	50	50	50	50	50	50	50	50	50	50	50	50

Figure 96. Comparative analysis of magnesium levels measured in artesian wells at the forest plantation area

The water standard for the national territory does not establish a maximum level for this parameter; thus, Law 1614/2000 is used as a reference and it establishes 50 mg/l for magnesium level.

None point exceeds the reference value in the forest plantation area. The average magnesium value at all points is 5.1 mg/l.



	GW 01	GW 02	GW 04	GW 05	GW 06
Magnesium	16,1	8,07	72,9	6,06	2,73
Limit	50	50	50	50	50

Figure 97. Comparative analysis of magnesium levels measured in monitoring wells at the DAI

In the DAI zone, point GW04 exceeds the limit value established by Law 1614/2000. The average magnesium value in this zone is 21.17 mg/l.

3.4.15 Fluoride

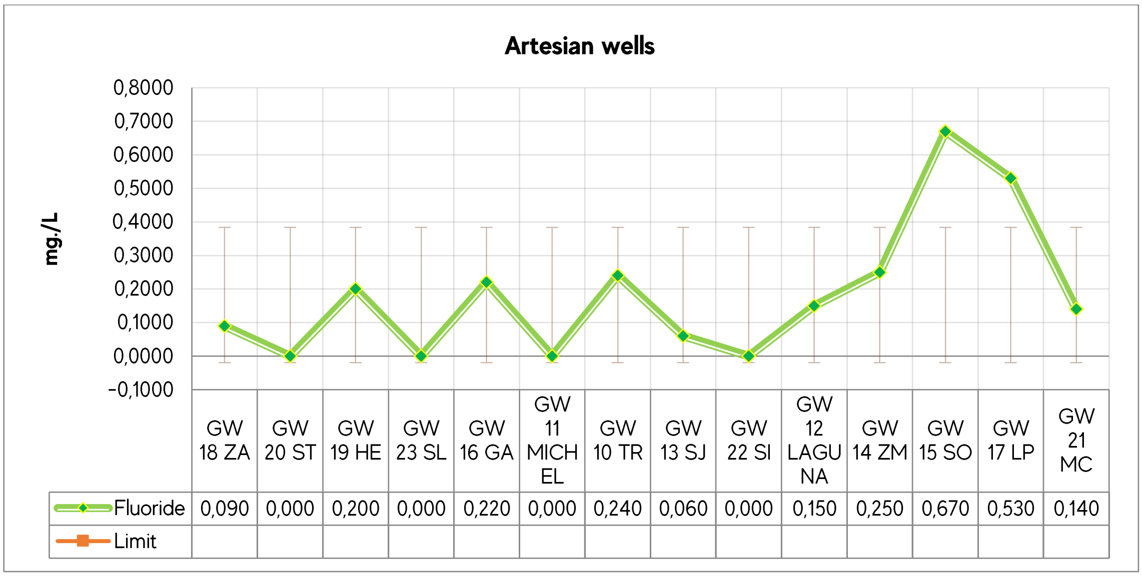


Figure 98. Comparative analysis of fluoride levels measured in artesian wells at the forest plantation area

Fluoride is a parameter with no established limits by the legislation.

The average fluoride value, in the forest plantation area, is 0.2 mg/l.

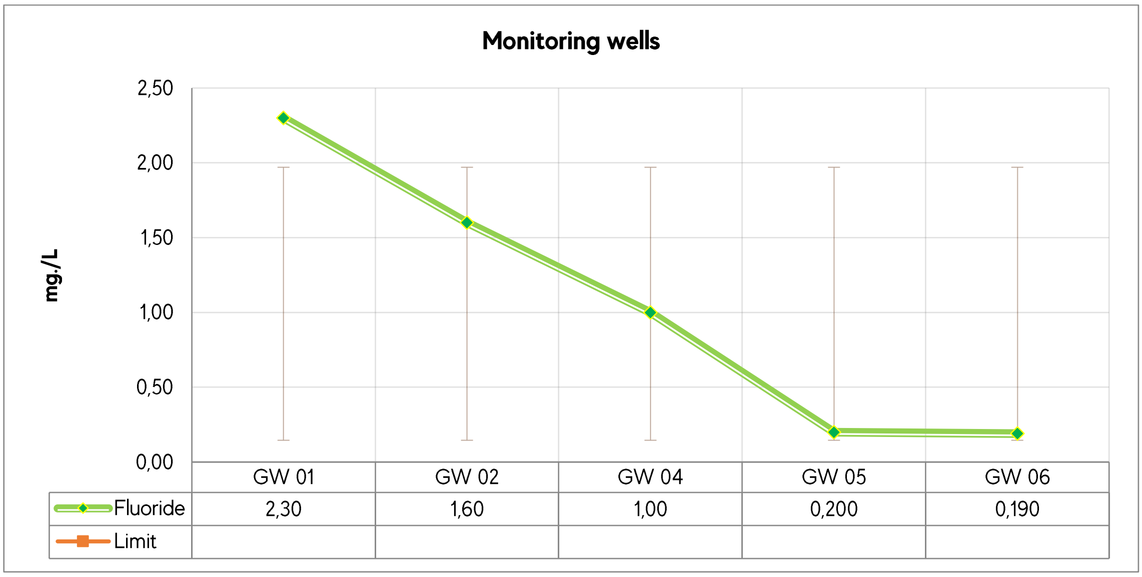
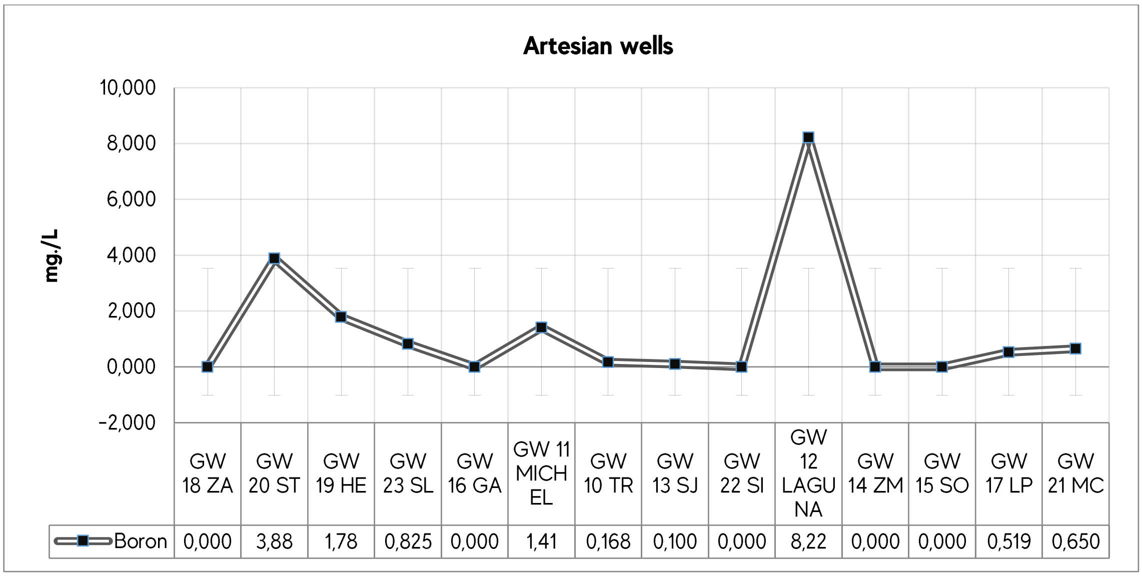


Figure 99. Comparative analysis of fluoride levels measured in monitoring wells at the DAI

In the DAI zone, fluoride has an average concentration of 1.05 mg/l. The highest determination recorded is in well GW01.

3.4.16 Boron

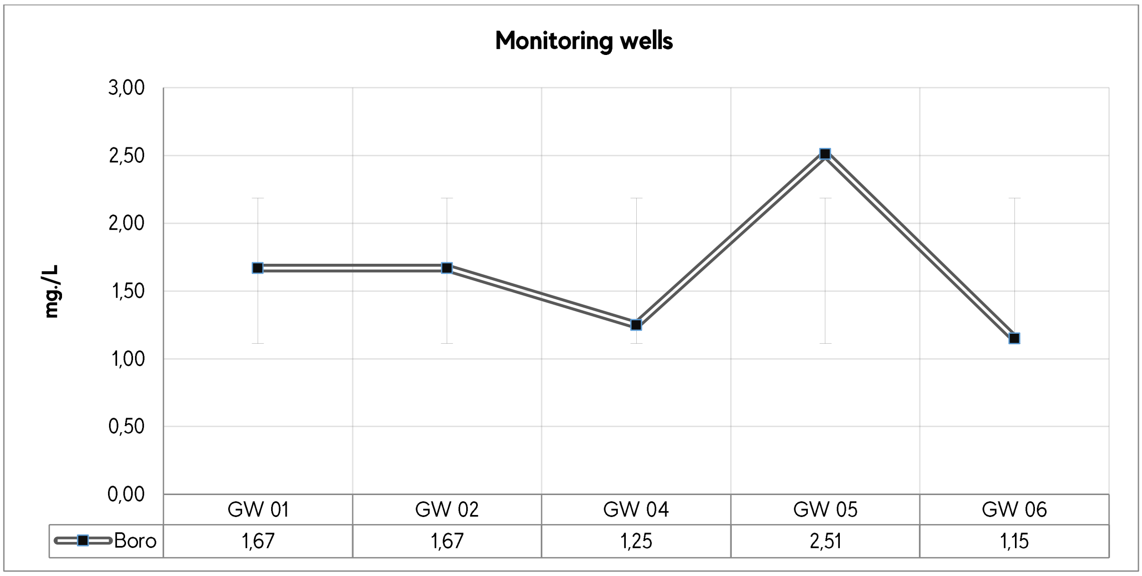


	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICHEL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGUNA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Boron	0,000	3,88	1,78	0,825	0,000	1,41	0,168	0,100	0,000	8,22	0,000	0,000	0,519	0,650

Figure 100. Comparative analysis of boron levels measured in artesian wells at the forest plantation area

In GW 18-ZA, GW 16-GA, GW 13-SJ, GW 22-SI, GW 14-ZM and GW 15-SO, the concentrations of boron are not detectable considering the analytical method's limit of quantification in the water which is 1 mg/L.

The highest result is in well GW 12-LAGUNA; however, this parameter does not have established limits. Statistically, the average boron value is 2 mg/l.

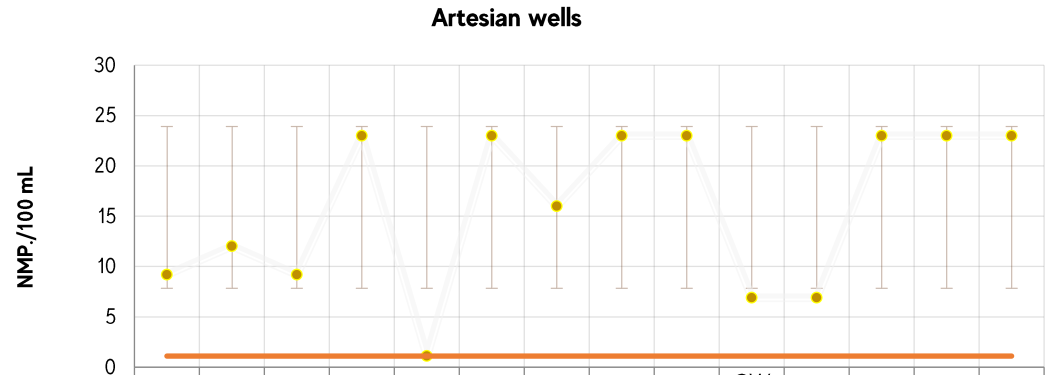


	GW 01	GW 02	GW 04	GW 05	GW 06
Boro	1,67	1,67	1,25	2,51	1,15

Figure 101. Comparative analysis of boron levels measured in monitoring wells at the DAI

In the DAI zone, Boron values obtained from the samples of the monitoring wells has an average value of 1.65 mg/L.

3.4.17 Faecal coliforms

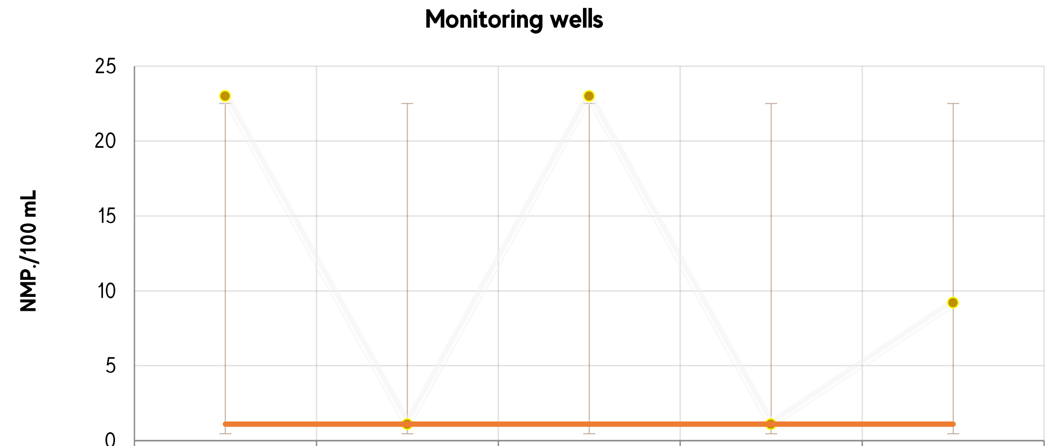


	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICH EL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGU NA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Faecal C	9,2	12	9,2	23	1,1	23	16	23	23	6,9	6,9	23	23	23
Limit	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1

Figure 102. Comparative analysis of faecal coliforms levels measured in artesian wells at the forest plantation area

Since the water of the artesian wells are for human consumption, the results are compared to the maximum limits set in NP 2400180 norm for faecal coliform.

All the wells located at the forest plantation area have concentrations above the established limit in this campaign. Only GW16-GA does not exceed the maximum value of 1.1 NMP/100ml.

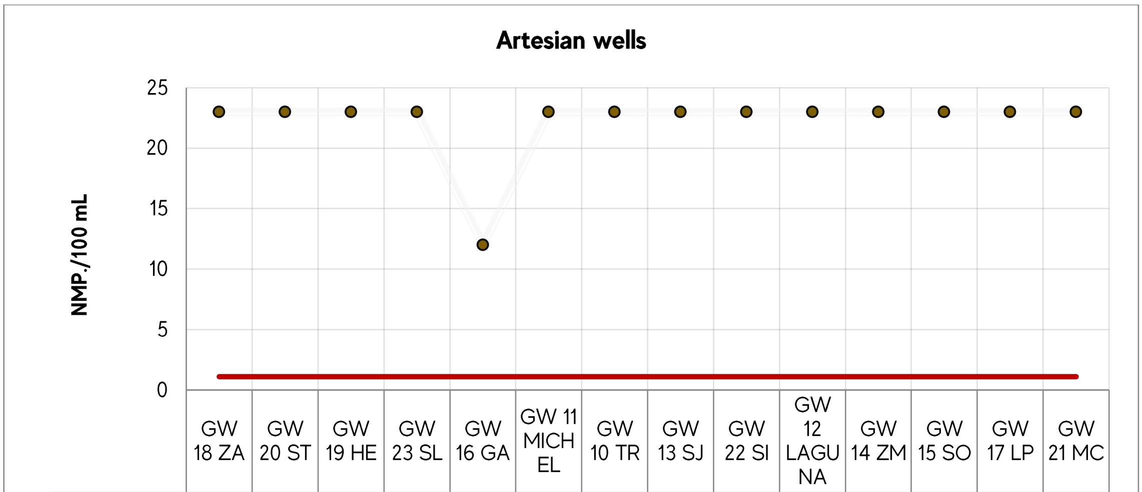


	GW 01	GW 02	GW 04	GW 05	GW 06
Feacal C	23	1,1	23	1,1	9,2
Limit	1,1	1,1	1,1	1,1	1,1

Figure 103. Comparative analysis of faecal coliforms levels measured in monitoring wells at the DAI

In the DAI zone, 3 of the monitoring wells, except GW02 and GW05, have faecal coliform concentrations above the limits.

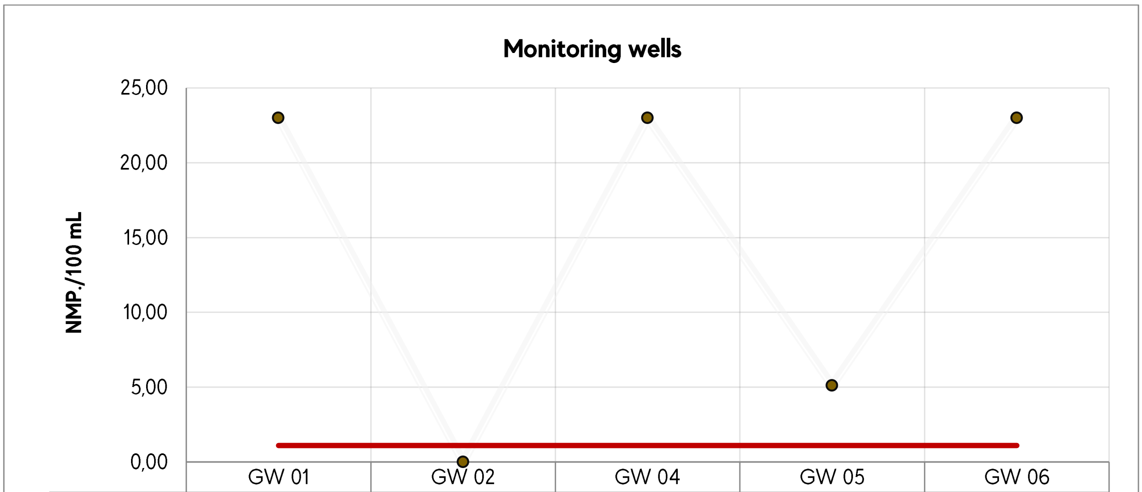
3.4.17 Total coliforms



	GW 18 ZA	GW 20 ST	GW 19 HE	GW 23 SL	GW 16 GA	GW 11 MICH EL	GW 10 TR	GW 13 SJ	GW 22 SI	GW 12 LAGU NA	GW 14 ZM	GW 15 SO	GW 17 LP	GW 21 MC
Total C	23	23	23	23	12	23	23	23	23	23	23	23	23	23
Limit	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1

Figure 104. Comparative analysis of total coliforms levels measured in artesian wells at the forest plantation area

Total coliforms values of artesian wells are compared with the limits set by NP 2400180 which establishes a maximum of 1.1 NMP/100ml in water used for human consumption. All the wells art the forest plantation zone exceeds this limit.



	GW 01	GW 02	GW 04	GW 05	GW 06
Total C	23,00	0	23,00	5,10	23,00
Limit	1,1	1,1	1,1	1,1	1,1

Figure 105. Comparative analysis of total coliforms levels measured in monitoring wells at the DAI

In the DAI zone, all monitoring wells except for GW02 shows concentrations of total coliforms above the established limit.

3.4.18 Escherichia coli

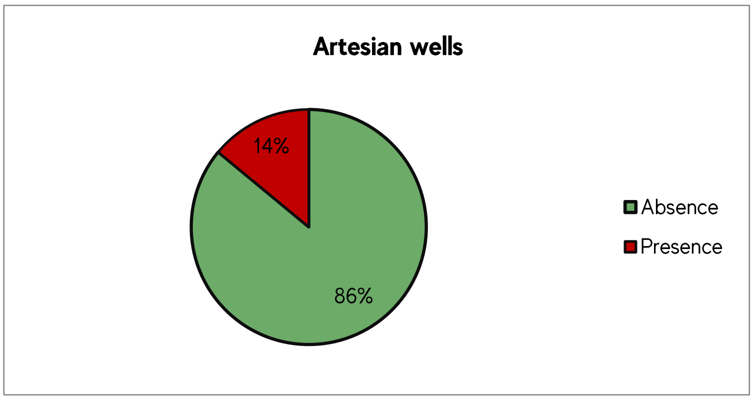


Figure 106. Presence-absence test of *E. coli* in artesian wells at the forest plantation area

According to NP 2400180, *Escherichia coli* bacteria must be absent from water for human consumption. In GW22-SILVA Y GW 23-SL it is found the presence of this bacteria.

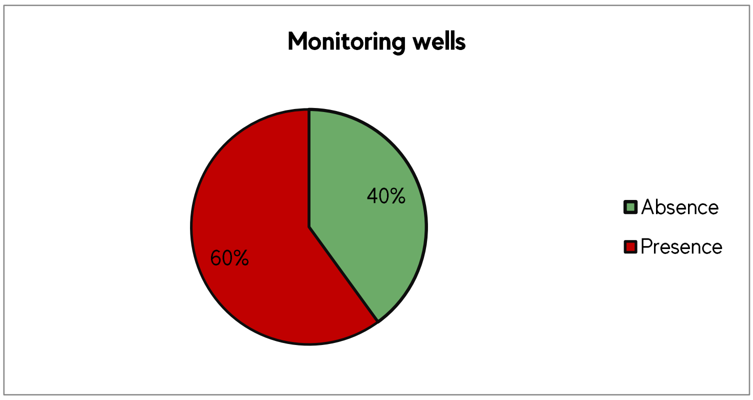


Figure 107. Presence-absence test of *E. coli* in monitoring wells at the DAI

Escherichia coli is found in the following DAI monitoring wells: GW01, GW04, and GW05.

IV. CONCLUSION

This report presents the direct area of influence and indirect area of influence's results of the first water monitoring campaign. According to the consultancy terms, it should be two campaigns to monitor groundwater and surface water quality, one in the rainy season and other in the dry season; the present report corresponds to the first one.

PARACEL provided the coordinates of 40 monitoring points, 20 for surface water and 20 for groundwater. Of the total number, 39 were sampled and analysed and only one monitoring well in the DAI was not sampled since it was not found water (Appendix D. Evidence).

In terms of the parameters defined, a 100% of the parameters for groundwater are reported in this document, as well as 63 of 67 of the parameters established for surface water. Sulfluramide, Bifenthrin, Thiamethoxam y Lambdacyalothrin are the 4 parameters that are not included since these determinations depend on reagents and chemical substances that were not possible to acquire until now due to pandemic (Appendix E. Suppliers note).

According to the terms of reference, Glyphosate, Sulfluramide, Lambdacyhalothrin, Bifenthrin, Thiamethoxam, Carbofuran, Lindane and Fipronil are the parameters to report for the 18 surface water points. However, 22 agrochemicals are included in addition (Table 4).

Laboratories certified by the ONA (National Accreditation Body) are the responsible of the results obtained by analytical determinations. The analysis and evaluation of the results are contrast with the following normative:

- Regulation SEAM Nº 222/02 "BY WHICH THE WATER QUALITY PADRON OF THE NATIONAL TERRITORY IS ESTABLISHED".
- Law 1614/200 - GENERAL LAW ON THE REGULATORY AND TARIFFING FRAMEWORK FOR THE DRINKING WATER AND SANITARY SEWERAGE SERVICE - ANNEX I.
- NP 24 001 80. DRINKING WATER: GENERAL REQUIREMENTS

Regarding the surface water results, the main findings are:

- Of the 63 parameters analysed (physicochemical, agrochemical and bacteriological), 44 have limits established in the regulations while 19 do not.
- Of the 44 parameters with defined limits, 31 (75%) do not show any deviation compared to the regulation's limits and 13 parameters (25%) show values above the maximum allowed in at least one monitoring point.
- During the first monitoring campaign no traces of agrochemicals were found in surface waters. Still, there are pendant determinations as Sulfluramide, Bifenthrin, Thiamethoxam and Lambdacyhalothrin and the only exception is Fipronil at point FW 315-HE.
- The physicochemical parameters that do not have any deviation are (20): floating materials, total dissolved solids (TDS), oils and fats, nitrates, nitrites, hardness, sulphate, sodium, aluminium, cadmium, trivalent chromium, hexavalent chromium, copper, tin, selenium, zinc, arsenic, mercury, barium, cyanide.
- The physicochemical parameters with deviations are (9): pH, Dissolved Oxygen, Turbidity, BOD5, Total Phosphorus, Total Nitrogen, Nickel, Manganese and Lead.

In the case of groundwater, specifically at forest plantation area, the main findings are:

- The 14 artesian wells located in the forest plantation area provides water for human consumption.
- Of the 23 physicochemical and bacteriological parameters evaluated, 18 have limits established in the current regulations, and 5 do not have defined limits.
- Of the 18 parameters with defined limits, 11 (61%) do not show any deviation regarding current regulations and 7 (39%) show values above the maximum permitted in at least one monitoring point.

- The 11 parameters that do not show any deviation in the 14 wells evaluated are electrical conductivity, total dissolved solids, hardness, total nitrogen, chlorides, sulphates, sodium, potassium, calcium, magnesium, fluoride and E coli.
- The parameters deviated from the established limits are pH, total phosphorus, nitrates, alkalinity, faecal coliforms and total coliforms.
- The parameters that most frequently show deviations in the 14 sampled wells are nitrates (42%), total phosphorus (71%), faecal coliforms (92%) and total coliforms (100%).

As for the monitoring wells placed at DAI zone of the future industry, the groundwater main findings are:

- A total of 5 monitoring wells located in the AID were analysed. Unlike the wells in the forest plantation area, these well's purposes are exclusively for monitoring groundwater quality.
- One of the monitoring wells did not have water.
- The parameters results were significantly higher in comparison with the values obtained in the forest plantation zone.

APPENDIX A:
SURFACE WATER
LABORATORY RESULTS

TABLE OF CONTENT

LIST OF TABLES

A.1 Analytical determinations of point FW104-ZA

TABLE 1. PARAMETERS MEASURED ON THE SITE – FW104-ZA			
FW 104-ZA			
SAMPLING POINT DATA			
Sampling time:	18:30	Air temperature:	28,5 ºC
Atmospheric conditions:	Cloudy skies, drizzle	Relative humidity:	60%
UTM coordinates:	21K 546639,23 mE; 7513553,82 mS	Elevation:	190 m

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation2 22/02	**Alternative reference standards** *
1	Water temperature	Tº	ºC	25,2	No limits	
2	Hydrogen potential	pH	---	7,44	6 - 9	
3	Electrical conductivity	σ	µS/cm	62,1	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	5,88	> 5 mg O_2/L	
5	Turbidity		m	84,0	100 NTU	

TABLE 2. PHYSICOCHEMICAL PARAMETERS – FW 104-ZA						
FW 104-ZA						
PHYSICOCHEMICAL PARAMETER						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards** *
6	Floating materials			**89,0**	Visually absent	
7	Total dissolved solids	TDS	mg/L	62,0	500	
8	Oil and grease		mg/L	**9,70**	Visually absent	
9	Chemical oxygen demand	COD	mg O_2/L	50,4	No limits	[1] <150
10	Biological oxygen demand	BOD5	mg O_2/L	2,33	5	
11	Total phosphorus	P	mg/L	<0,0200	0,05	
12	Total nitrogen	N	mg/L	<0,100	0,6	
13	Nitrates	NO_{3-}	mg/L	3,14	10	
14	Ammonia	NH_3	mg/L	**0,083**	0,02	
15	Nitrites	NO_{2-}	mg/L	<0,0025	1	
16	Hardness		mg $CaCO_3$/L	11,1	300	
17	Sodium	Na	mg/L	2,53	200	
18	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
19	Cyanides		mg/L	<0,02 LOQ	0,2	
20	Copper	Cu	mg/L	<0,0500	1	
21	Soluble iron	Fe^{++}	mg/L	**1,110**	0,3	
22	Aluminium	Al	mg/L	<0,100	0,2	
23	Cadmium	Cd	µg/L	<0,000800	0,001	
24	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
25	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
26	Tin	Sn	mg/L	<1,00	2	
27	Nickel	Ni	mg/L	0,0839	0,025	
28	Manganese	Mn	mg/L	0,0839	0,1	
29	Lead	Pb	mg/L	0,00200	0,01	

30	Selenium	Se	mg/L	0,00500	0,01	
31	Zinc	Zn	mg/L	0,0851	3	
32	Arsenic	As	mg/L	0,0143	0,5	
33	Mercury	Hg	mg/L	0,001	2	
34	Barium	Ba	mg/L	0,07	2	

TABLE 1. TABLE 3. AGROCHEMICAL IN SURFACE WATER – FW 104-ZA

FW 104-ZA							
AGROCHEMICAL							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards** *
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atrazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacyalothri n	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLEE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

TABLE 4. HYDROBIOLOGICAL AND BACTERIOLOGICAL PARAMETERS – FW104-ZA				
FW 104 – ZA – HYDROBIOLOGICAL PARAMETERS				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
C Y A N O B A C T E R I A **(805)**			**Cylindrospermum sp.**	805
Presence of organic material		+	TOTAL CELLS/mL	805
Presence of sediment		+++	Abundant/dominant organism	Cylindrospermum sp. 100%
Presence of bacteria		+++	Range of risk	Null
Presence of fungal hyphae		X		
CODES				
+(less than half of the field)		**++** (half of the field)	**+++** (whole field)	**X** (sporadically observed)
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(Nº 65) ZOOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
Absence of zooplankton.				
Plant remains		No	TOTAL CELLS /mL	Not applicable
Colour		Yellowish	Abundant/dominant organism	Not applicable
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation 222/02**
66	Total coliforms	NMP/100mL	1600	1000 NMP/100mL
67	Faecal coliforms	NMP/100mL	1600	200 NMP/100mL

A2 Analytical determinations of point FW 201-ST

TABLE 5. PARAMETERS MEASURED ON THE SITE – FW 201-ST			
FW 201-ST			
SAMPLING POINT DATA			
Sampling time	13:50	Air temperature	26 ºC
Atmospheric conditions	Cloudy sky, drizzle	Relative humidity	58%
UTM coordinates	21K 543911.54 m E 7497910.60 m S	Elevation	179

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards ***
1	Water temperature	Tº	ºC	24,4	No limits	
2	Hydrogen potential	pH	---	6,6	6 - 9	
3	Electrical conductivity	σ	µS/cm	40,3	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	7,21	> 5 mg O_2/L	
5	Turbidity		NTU	61,6	100 NTU	

TABLE 6. PHYSICOCHEMICAL PARAMETERS - FW201-ST						
FW 201-ST						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards ***
6	Floating materials			62,0	Visually absent	
7	Total dissolved solids	TDS	mg/L	22,5	500	
8	Oil and grease		mg/L	7,50	Visually absent	
9	Chemical oxygen demand	COD	mg O_2/L	42,6	No limits	[1] <150
10	Biological oxygen demand	BOD5	mg O_2/L	1,93	5	
11	Total phosphorus	P	mg/L	<0,0200	0,05	
12	Total nitrogen	N	mg/L	0,108	0,6	
13	Nitrates	NO_3^-	mg/L	3,5	10	
14	Ammonia	NH_3	mg/L	0,0594	0,02	
15	Nitrites	NO_2^-	mg/L	0,0388	1	
16	Hardness		mg $CaCO_3$/L	7,88	300	
17	Sodium	Na	mg/L	2,53	200	
18	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
19	Cyanides		mg/L	<0,02 LOQ	0,2	
20	Copper	Cu	mg/L	<0,0500	1	
21	Soluble iron	Fe^{++}	mg/L	0,935	0,3	
22	Aluminium	Al	mg/L	<0,100	0,2	
23	Cadmium	Cd	µg/L	<0,000800	0,001	
24	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
25	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
26	Tin	Sn	mg/L	<1,00	2	
27	Nickel	Ni	mg/L	<0,01	0,025	
28	Manganese	Mn	mg/L	<0,01	0,1	
29	Lead	Pb	mg/L	0,00337	0,01	

30	Selenium	Se	mg/L	<0,005	0,01	
31	Zinc	Zn	mg/L	<0,0500	3	
32	Arsenic	As	mg/L	0,0132	0,5	
33	Mercury	Hg	mg/L	0,001	2	
34	Barium	Ba	mg/L	0,07	2	

TABLE 7. AGROCHEMICALS IN SURFACE WATER – FW201-ST

FW 201-ST

AGROCHEMICAL

GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards** *
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atrazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacyalothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLEE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

TABLE 8. HYDROBIOLOGICAL AND BACTERIOLOGICAL PARAMETERS – FW201-ST

FW 201-ST – HYDROBIOLOGICAL PARAMETERS				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type		**Species**	**Measured value**	
C H L O R O P H Y T A (69)		*Ankistrodesmus sp.*	69	
B A C I L L A R I O P H Y T A (46)		*Pennate diatoms*	46	
E U G L E N O Z O A (184)		*Euglena sp.*	184	
Presence of organic material	+	TOTAL CELLS /mL	**299**	
Presence of sediment	+++	Abundant/dominant organism:	*Euglena sp.* 61,5%	
Presence of bacteria	+++	Range of risk:	Null	
Spicules	X			
CODES				
+(less than half of the field)	++ (half of the field)	+++ (whole field)	**X** (se observa en forma esporádica)	
Risk level (UNESCO)	Null until 10.000 Cel/mL	Alert I – between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL	
(Nº 65) ZOOPLANKTON DIVERSITY				
Type		**Species**	**Measured value**	
Absence of zooplankton.				
Plant remains	No	TOTAL CELLS /mL	Not applicable	
Colour	Yellowish	Abundant/dominant organism	Not applicable	
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Faecal coliforms	NMP/100mL	540	200 NMP/100mL
67	Total coliforms	NMP/100mL	540	1000 NMP/100mL

A3 Analytical determinations of point FW 315-HE

TABLE 9. PARAMETERS MEASURED ON THE SITE – FW315-HE						
FW 315-HE						
SAMPLING POINT DATA						
Sampling time	10:30		Air temperature	25 ºC		
Atmospheric conditions	Cloudy, rainy all-day		Relative humidity	78%		
UTM coordinates	21K 515424,99mE; 7523026,00 mS		Elevation	184		
IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards** *
1	Water temperature	Tº	ºC	24,5	No limits	
2	Hydrogen potential	pH	---	6,68	6 - 9	
3	Electrical conductivity	σ	µS/cm	52,1	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	5,17	> 5 mg O_2/L	
5	Turbidity		NTU	35,0	100 NTU	

TABLE 10. PHYSICOCHEMICAL PARAMETERS - FW 315-HE						
FW 315-HE						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards** *
6	Floating materials			22,4	Visually absent	
7	Total dissolved solids	TDS	mg/L	157	500	
8	Oil and grease		mg/L	16,8	Visually absent	
9	Chemical oxygen demand	COD	mg O_2/L	51,1	No limits	[1] <150
10	Biological oxygen demand	BOD5	mg O_2/L	2,23	5	
11	Total phosphorus	P	mg/L	0,103	0,05	
12	Total nitrogen	N	mg/L	0,734	0,6	
13	Nitrates	NO_3-	mg/L	1,07	10	
14	Ammonia	NH_3	mg/L	0,0587	0,02	
15	Nitrites	NO_2-	mg/L	0,0136	1	
16	Hardness		mg $CaCO_3$/L	14,1	300	
17	Sodium	Na	mg/L	4	200	
18	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
19	Cyanides		mg/L	<0,02	0,2	
20	Copper	Cu	mg/L	<0,0500	1	
21	Soluble iron	Fe^{++}	mg/L	1,11	0,3	
22	Aluminium	Al	mg/L	<0,1	0,2	
23	Cadmium	Cd	µg/L	<0,0080	0,001	
24	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
25	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
26	Tin	Sn	mg/L	<1,0	2	
27	Nickel	Ni	mg/L	<0,01	0,025	
28	Manganese	Mn	mg/L	0,274	0,1	
29	Lead	Pb	mg/L	0,0085	0,01	
30	Selenium	Se	mg/L	<0,005	0,01	

31	Zinc	Zn	mg/L	<0,0500	3	
32	Arsenic	As	mg/L	<0,0100	0,5	
33	Mercury	Hg	mg/L	0,001	2	
34	Barium	Ba	mg/L	0,09	2	

TABLE 11. AGROCHEMICALS IN SURFACE WATER – FW315-HE							
FW 315-HE							
AGROCHEMICAL							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atrazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacyalothri n	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLEE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	0,03	No limits	

TABLE 12. HYDROBIOLOGICAL AND BACTERIOLOGICAL PARAMETERS – FW 315-HE				
FW 315-HE – HYDROBIOLOGICAL PARAMETERS				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
C Y A N O B A C T E R I A **(395)**			*Pseudanabaena sp.1*	135
			Pseudanabaena sp.2	180
			Pseudanabaena sp.3	80
B A C I L L A R I O P H Y T A **(20)**			*Pennate diatoms*	20
E U G L E N O Z O A **(10)**			*Euglena sp.*	
Presence of organic material		+	TOTAL CELLS /mL	**425**
Presence of sediment		+++	Abundant/dominant organism	Pseudanabaena sp.2 38,9%
Mushroom spores		x	Range of risk	Null
CODES				
+(less than half of the field)		++ (half of the field)	+++ (whole field)	**X** (sporadically observed)
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(Nº 65) ZOOPLANKTON DIVERSITY				
Type			**Species**	**Measured value (Org/m³)**
COPEPODS			*Harpacticoida sp*	20
Plant remains			TOTAL CELLS /mL	20
Colour			Abundant/dominant organism	*Harpacticoida sp 100%*
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation 222/02**
66	Faecal coliforms	NMP/100mL	1200	200 NMP/100mL
67	Total coliforms	NMP/100mL	35000	1000 NMP/100mL

A4 Analytical determinations of point FW304-HE

TABLE 13. PARAMETERS MEASURED ON THE SITE – FW 304-HE.						
FW 304-HE						
SAMPLING POINT DATA						
Sampling time	11:30		Aire temperature		24 ºC	
Atmospheric conditions	Cloudy skies, light rain		Relative humidity		76%	
UTM coordinates	21K 506172,99 mE; 7509505,00 mS		Elevation		180	
IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards** *
1	Water temperature	Tº	ºC	24,4	No limits	
2	Hydrogen potential	pH	---	7,89	6 - 9	
3	Electrical conductivity	σ	µS/cm	294	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	6,76	> 5 mg O_2/L	
5	Turbidity		m	25,6	100 NTU	

TABLE 14. PHYSICOCHEMICAL PARAMETERS – FW304-HE						
FW 304-HE						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards** *
6	Floating materials			18,8	Visually absent	
7	Total dissolved solids	TDS	mg/L	194	500	
8	Oil and grease		mg/L	14,5	Visually absent	
9	Chemical oxygen demand	COD	mg O_2/L	137	No limits	[1] <150
10	Biological oxygen demand	BOD5	mg O_2/L	1,84	5	
11	Total phosphorus	P	mg/L	0,0639	0,05	
12	Total nitrogen	N	mg/L	<0,100	0,6	
13	Nitrates	NO_{3-}	mg/L	0,338	10	
14	Ammonia	NH_3	mg/L	0,0880	0,02	
15	Nitrites	NO_{2-}	mg/L	0,0306	1	
16	Hardness		mg $CaCO_3$/L	108	300	
17	Sodium	Na	mg/L	15,6	200	
18	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
19	Cyanides		mg/L	<0,02	0,2	
20	Copper	Cu	mg/L	<0,0500	1	
21	Soluble iron	Fe^{++}	mg/L	0,913	0,3	
22	Aluminium	Al	mg/L	<0,01	0,2	
23	Cadmium	Cd	µg/L	<0,008	0,001	
24	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
25	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
26	Tin	Sn	mg/L	<1	2	
27	Nickel	Ni	mg/L	<0,01	0,025	
28	Manganese	Mn	mg/L	<0,0500	0,1	
29	Lead	Pb	mg/L	<0,002	0,01	

30	Selenium	Se	mg/L	<0,005	0,01	
31	Zinc	Zn	mg/L	<0,0500	3	
32	Arsenic	As	mg/L	0,0616	0,5	
33	Mercury	Hg	mg/L	0,001	2	
34	Barium	Ba	mg/L	0,17	2	

TABLE 15. AGROCHEMICALS IN SURFACE WATER - FW 304-HE

FW 304-HE

AGROCHEMICAL

GROUP AOX	№	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atrazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacyalothri n	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLEE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

TABLE 16. HYDROBIOLOGICAL AND BACTERIOLOGICAL PARAMETERS – FW304-HE					
FW 304-HE – HYDROBIOLOGICAL PARAMETERS					
(Nº 64) PHYTOPLANKTON DIVERSITY					
Type			**Species**	**Measured value**	
C Y A N O B A C T E R I A **(120)**			*Phormidium sp.*	120	
B A C I L L A R I O P H Y T A **(15)**			*Gomphonema sp.*	15	
E U G L E N O Z O A **(25)**			*Euglena sp.*	25	
Presence of organic material		+	TOTAL CELLS /mL	**160**	
Presence of sediment		+	Abundant/dominant organism	*Phormidium sp.*	75,0%
			Range of risk	Null	
CODES					
+(less than half of the field)		++ (half of the field)	+++ (whole field)	**X** (sporadically observed)	
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I – between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL	
(Nº 65) ZOOPLANKTON DIVERSITY					
Type			**Species**	**Measured value**	
Absence of zooplankton.					
Plant remains		No	TOTAL CELLS /mL		
Colour		Yellowish	Abundant/dominant organism		
BACTERIOLOGICAL PARAMETERS					
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**	
66	Feacal coliforms	NMP/100mL	330	200 NMP/100mL	
67	Total coliforms	NMP/100mL	3500	1000 NMP/100mL	

.

A.5 Analytical determinations of point FW 100-GASL

TABLE 2. PARAMETERS MEASURED ON THE SITE – FW 100-GASL							
FW 100-GASL							
SAMPLING POINT DATA							
Sampling time				Air temperature			
Atmospheric conditions				Relative humidity			
UTM coordinates				Elevation			
IN SITU MEASUREMENTS							
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**		
					Regulation 222/02	**Alternative reference standards***	
1	Water temperature	T_{agua}	ºC	24,9	NO LIMITS		
2	Hydrogen potential	pH	---	7,22	6 - 9		
3	Electrical conductivity	σ	µS/cm	294	NO LIMITS	[2] <1500	
4	Dissolved oxygen	DO	mg O_2/L	**4,47**	> 5 mg O_2/L		
5	Turbidity		m	8,48	100 NTU		

TABLE 3. PHYSICOCHEMICAL PARAMETERS - FW 100-GASL						
FW 100-GASL						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			14,8	Visually absent..	
7	Total dissolved solids	TDS	mg/L	109	500	
8	Oil and grease		mg/L	2,67	Visually absent.	
9	Chemical oxygen demand	DQO	mg O_2/L	96,6	NO LIMITS	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	4,55	5	
11	Total phosphorus	P	mg/L	**0,0586**	0,05	
12	Total nitrogen	N	mg/L	**0,750**	0,6	
13	Nitrates	NO_{3-}	mg/L	<0,0200	10	
14	Ammonia	NH_3	mg/L	**0,0457**	0,02	
15	Nitrites	NO_{2-}	mg/L	0,0179	1	
16	Hardness		mg $CaCO_3$/L	130	300	
17	Sulphates	$SO_4^{2}-$	mg/L	0,102	250	
18	Sodium	Na	mg/L	16,1	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1	2	
25	Nickel	Ni	mg/L	<0,01	0,025	
26	Manganese	Mn	mg/L	<0,0500	0,1	

27	Lead	Pb	mg/L	<0,002	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	0,0518	3	
30	Arsenic	As	mg/L	0,913	0,5	
31	Soluble iron	Fe^{++}	mg/L	**0,550**	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,49	2	
34	Cyanides	CN^-	mg/L	<0,02	0,07	

TABLE 4. AGROCHEMICALS IN SURFACE WATER – FW 100-GASL							
AGROCHEMICAL							
GROUP AOX	**Nº**	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLEE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O	µg/L	<0,01	No limits	

TABLE 5. - HYDROBIOLOGICAL PARAMETERS - FW 100-GASL				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
Presence of organic material			TOTAL CELLS /mL	
Presence of sediment			Abundant/dominant organism	
			Range of risk	Null
CODES				
+(less than half of the field)		**++** (half of the field)	**+++** (whole field)	**X** (sporadically observed)
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(Nº65) ZOOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
Absence of zooplankton				
Plant remains			TOTAL CELLS /mL	
Colour			Abundant/dominant organism	
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Feacal coliforms	NMP/100mL	140	200 NMP/100mL
67	Total coliforms	NMP/100mL	1600	1000 NMP/100mL

A.6 Analytical determinations of point FW 200-SLTR

TABLE 6. PARAMETERS MEASURED ON THE SITE – FW 200-SLTR						
FW 200-SLTR						
SAMPLING POINT DATA						
Sampling time	14:30		Air temperature		28 ºC	
Atmospheric conditions	Cloudy, light rain		Relative humidity		83%	
UTM coordinates	21K 519072.00 m E; 7494784.00 m S		Elevation		173	
IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
1	Water temperature	T_{agua}	ºC	28,1	NO LIMITS	
2	Hydrogen potential	pH	---	6,01	6 - 9	
3	Electrical conductivity	σ	µS/cm	23,1	NO LIMITS	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	6,73	> 5 mg O_2/L	
5	Turbidity		m	489	100 NTU	

TABLE 7. PHYSICOCHEMICAL PARAMETERS - FW 200-SLTR						
FW 200-SLTR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			149	Visually absent	
7	Total dissolved solids	TDS	mg/L	130	500	
8	Oil and grease		mg/L	10,3	Visually absent	
9	Chemical oxygen demand	DQO	mg O_2/L	72,6	No limits	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	4,60	5	
11	Total phosphorus	P	mg/L	0,0334	0,05	
12	Total nitrogen	N	mg/L	<0,100	0,6	
13	Nitrates	NO_{3-}	mg/L	5,52	10	
14	Ammonia	NH_3	mg/L	0,138	0,02	
15	Nitrites	NO_{2-}	mg/L	<0,00250	1	
16	Hardness		mg $CaCO_3$/L	6,46	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	2,77	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1	2	
25	Nickel	Ni	mg/L	<0,01	0,025	
26	Manganese	Mn	mg/L	<0,0500	0,1	

TABLE 7. PHYSICOCHEMICAL PARAMETERS - FW 200-SLTR						
FW 200-SLTR						
PHYSICOCHEMICAL PARAMETERS						
№	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,00947	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	0,0536	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,05	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,13	2	
34	Cyanides	CN^{-}	mg/L	<0,02	0,07	

TABLE 8. AGROCHEMICALS IN SURFACE WATER – FW 200-SLTR							
AGROCHEMICALS							
GROUP AOX	№	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards.***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3P S	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	

TABLE 8. AGROCHEMICALS IN SURFACE WATER – FW 200-SLTR							
AGROCHEMICALS							
GROUP AOX	№	**Parameter**	**Chemical formula**	**Unit**	**Measured**	**Limits**	
PHENYLPYRAZOLES	63	Fipronil	$C_{12}H_4Cl_2F_6N_4O$.	µg/L	<0,01	No limits	

TABLE 9. HYDROBIOLOGICAL PARAMETERS - FW 200-SLTR				
(№ 64) PHYTOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
C Y A N O B A C T E R I A **(276)**			*Pseudanabaena sp.*	276
B A C I L L A R I O P H Y T A **(92)**			Diatomeas pennadas	92
E U G L E N O Z O A **(25)**			*Euglena sp.*	25
Presence of organic material		+	TOTAL CELLS /mL	**393**
Presence of sediment		+++	Abundant/dominant organism	*Pseudanabaena sp.* 70,2%
			Range of risk	Null
CODES				
+(less than half of the field)		++ (half of the field)	+++ (whole field)	**X** (sporadically observed)
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(№65) ZOOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
Absence of zooplankton				
Plant remains		No	TOTAL CELLS /mL	n/a
Colour		Yellowish	Abundant/dominant organism	n/a
BACTERIOLOGICAL PARAMETERS				
№	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Feacal coliforms	NMP/100mL	7900	200 NMP/100mL
67	Total coliforms	NMP/100mL	22000	1000 NMP/100mL

A.7 Analytical determinations of point FW 207-TR

TABLE 10. DATOS Y PARAMETERS TOMADOS EN CAMPO FW 207-TR.

FW 207-TR

SAMPLING POINT DATA

Sampling time	15:10	Air temperature	28 ºC
Atmospheric conditions	Cloudy, rainy	Relative humidity	76%
UTM coordinates	21K 518004.00 m E; 7490567.00 m S	Elevation	161

IN SITU MEASUREMENTS

Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
1	Water temperature	T_{agua}	ºC	26,3	No limits	
2	Hydrogen potential	pH	---	6,56	6 - 9	
3	Electrical conductivity	σ	µS/cm	77,9	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	**2,43**	> 5 mg O_2/L	
5	Turbidity		m	47,4	100 NTU	

TABLE 11. PHYSICOCHEMICAL PARAMETERS - FW 207-TR

FW 207-TR

PHYSICOCHEMICAL PARAMETERS

Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			10,0	Visually absent	
7	Total dissolved solids	TDS	mg/L	120	500	
8	Oil and grease		mg/L	5,50	Visually absent	
9	Chemical oxygen demand	DQO	mg O_2/L	106	No limits	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	3,21	5	
11	Total phosphorus	P	mg/L	0,0796	0,05	
12	Total nitrogen	N	mg/L	0,352	0,6	
13	Nitrates	NO_{3^-}	mg/L	2,13	10	
14	Ammonia	NH_3	mg/L	0,0687	0,02	
15	Nitrites	NO_{2^-}	mg/L	<0,00250	1	
16	Hardness		mg $CaCO_3$/L	10,9	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	7,53	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	<0,0500	0,1	

TABLE 11. PHYSICOCHEMICAL PARAMETERS - FW 207-TR						
FW 207-TR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,0048	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	0,284	3	
30	Arsenic	As	mg/L	0,0190	0,5	
31	Soluble iron	Fe^{++}	mg/L	3,31	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,14	2	
34	Cyanides	CN^{-}	mg/L	<0,02	0,07	

TABLE 12. AGROCHEMICALS IN SURFACE WATER – FW 207-TR							
FW 207 - TR							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3P S	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	

TABLE 12. AGROCHEMICALS IN SURFACE WATER – FW 207-TR							
FW 207 - TR							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical**	**Unit**	**Measured**	**Limits**	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

TABLE 13. HYDROBIOLOGICAL PARAMETERS - FW 207-TR				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type		**Species**		**Measured value**
C Y A N O B A C T E R I A **(1150)**		*Pseudanabaena sp.*		1150
C H L O R O P H Y T A **(322)**		*Chlorococcales coccoides*		322
B A C I L L A R I O P H Y T A **(161)**		*Diatomeas pennadas*		161
C R Y P T O P H Y T A **(23)**		*Cryptomonadales sp*		23
E U G L E N O Z O A **(184)**		*Phacus sp.*		115
		Trachelomonas sp.		69
Presence of organic material	+	TOTAL CELLS /mL		**1840**
Presence of sediment	+++	Abundant/dominant organism		*Pseudanabaena sp.* 62,5%
		Range of risk		Null
CODES				
+(less than half of the field)	++ (half of the field)	+++ (whole field)		**X** (sporadically observed)
Risk level (UNESCO)	Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL		Alert II More than 20.000 Cel/mL
(Nº65) ZOOPLANKTON DIVERSITY				
Type		**Species**		**Measured value**
Absence of zooplankton.				
Plant remains	No	TOTAL CELLS /mL		n/a
Colour	Yellowish	Abundant/dominant organism		n/a
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Feacal coliforms	NMP/100mL	790	200 NMP/100mL
67	Total coliforms	NMP/100mL	1700	1000 NMP/100mL

.

A.8 Analytical determinations of point FW 208-TR

TABLE 14. PARAMETERS MEASURED ON THE SITE - FW 208-TR			
FW 208-TR			
SAMPLING POINT DATA			
Sampling time	7:00	Air temperature	26 ºC
Atmospheric conditions	Sunny with some clouds	Relative humidity	60%
UTM coordinates	21K 514416.00 m E; 7485700.00 m S	Elevation	140

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
1	Water temperature	T_{agua}	ºC	21,1	No limits	
2	Hydrogen potential	pH	---	6,88	6 - 9	
3	Electrical conductivity	σ	µS/cm	127	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	**4,30**	> 5 mg O_2/L	
5	Turbidity		m	40,3	100 NTU	

TABLE 15. PHYSICOCHEMICAL PARAMETERS - FW 208-TR						
FW 208-TR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			5,00	Visually absent..	
7	Total dissolved solids	TDS	mg/L	231	500	
8	Oil and grease		mg/L	8,25	Visually absent.	
9	Chemical oxygen demand	DQO	mg O_2/L	81,6	NO LIMITS	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	3,53	5	
11	Total phosphorus	P	mg/L	<0,0200	0,05	
12	Total nitrogen	N	mg/L	0,748	0,6	
13	Nitrates	NO_{3-}	mg/L	1,37	10	
14	Ammonia	NH_3	mg/L	0,0603	0,02	
15	Nitrites	NO_{2-}	mg/L	0,0203	1	
16	Hardness		mg $CaCO_3$/L	38,4	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	8,84	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	

TABLE 15. PHYSICOCHEMICAL PARAMETERS - FW 208-TR						
FW 208-TR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
26	Manganese	Mn	mg/L	<0,0500	0,1	
27	Lead	Pb	mg/L	<0,002	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	0,0359	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,33	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,13	2	
34	Cyanides	CN^{-}	mg/L	<0,02	0,07	

TABLE 16. AGROCHEMICALS IN SURFACE WATER – FW 208 TR							
FW 208 TR							
AGROCHEMICALS							
AOX GROUP	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limites**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3P S	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	

	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

TABLE 17. HYDROBIOLOGICAL PARAMETERS - FW 208-TR			
(Nº 64) PHYTOPLANKTON DIVERSITY			
Type		**Species**	**Measured value**
C Y A N O B A C T E R I A **(135)**		*Pseudanabaena sp.*	135
C H L O R O P H Y T A **(50)**		*Monoraphidium sp.*	50
B A C I L L A R I O P H Y T A **(10)**		*Diatomeas pennadas*	10
C R Y P T O P H Y T A **(5)**		*Cryptomonadales sp*	5
Presence of organic material	+	TOTAL CELLS /mL	**200**
Presence of sediment	+++	Abundant/dominant organism	Pseudanabaena sp. 67,5%
		Range of risk	Null
CODES			
+(less than half of the field)	++ (half of the field)	+++ (whole field)	**X** (sporadically observed)
Risk level (UNESCO)	Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(Nº65) ZOOPLANKTON DIVERSITY			
Type		**Species**	**Measured value**
Absence of zooplankton.			
Plant remains	No	TOTAL CELLS /mL	
Colour	Yellowish	Abundant/dominant organism	

BACTERIOLÓGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Feacal coliforms	NMP/100mL	**35000**	200 NMP/100mL
67	Total coliforms	NMP/100mL	**35000**	1000 NMP/100mL

A.9 Analytical determination of point FW205-TR

TABLE 18. PARAMETERS MEASURED ON THE SITE - FW 205-TR.

FW 205-TR

SAMPLING POINT DATA

Sampling time	15:50	Air temperature	26 ºC
Atmospheric conditions	Cloudy, rainy	Relative humidity	80%
UTM coordinates	21K 516574.00 m E; 7482061.00 m S	Elevation	151

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Alternative reference standards*
1	Water temperature	T_{agua}	ºC	25,8	No limits	
2	Hydrogen potential	pH	---	7,18	6 - 9	
3	Electrical conductivity	σ	µS/cm	67,9	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	5,91	> 5 mg O_2/L	
5	Turbidity		m	77,7	100 NTU	

TABLE 19. PHYSICOCHEMICAL PARAMETERS - FW 205-TR

FW 205-TR

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Alternative reference standards*
6	Floating materials			82,0	Visually absent	
7	Total dissolved solids	TDS	mg/L	317	500	
8	Oil and grease		mg/L	8,75	Visually absent	
9	Chemical oxygen demand	DQO	mg O_2/L	114	NO LIMITS	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	5,32	5	
11	Total phosphorus	P	mg/L	0,384	0,05	
12	Total nitrogen	N	mg/L	0,443	0,6	
13	Nitrates	NO_{3-}	mg/L	6,63	10	
14	Ammonia	NH_3	mg/L	0,521	0,02	
15	Nitrites	NO_{2-}	mg/L	<0,00250	1	
16	Hardness		mg $CaCO_3$/L	13,1	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	8,52	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	0,145	0,025	
26	Manganese	Mn	mg/L	0,127	0,1	

TABLE 19. PHYSICOCHEMICAL PARAMETERS - FW 205-TR						
FW 205-TR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,0085	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	0,0360	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,56	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,35	2	
34	Cyanides	CN^{-}	mg/L	<0,02	0,07	

TABLE 20. AGROCHEMICALS IN SURFACE WATER – FW 205-TR							
FW 205-TR							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3P S	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	

TABLE 20. AGROCHEMICALS IN SURFACE WATER – FW 205-TR							
FW 205-TR							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured**	**Limits**	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

TABLE 21. HYDROBIOLOGICAL PARAMETERS - FW 205 TR				
FW 205-TR – HYDROBIOLOGICAL PARAMETERS				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
B A C I L L A R I O P H Y T A **(146)**			*Navicula sp.*	**146**
Presence of organic material		+	TOTAL CELLS /mL	**146**
Presence of sediment		+++	Abundant/dominant organism	*Navicula sp.* 100%
Insect remains		X	Range of risk	Null
CODES				
+(less than half of the field)		++ (half of the field)	+++ (whole field)	**X** (sporadically observed)
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(Nº65) ZOOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
ROTÍFERA **(20)**			*Bdelloidea*	20
Plant remains		No	TOTAL CELLS /mL	**20**
Colour		Yellowish	Abundant/dominant organism	*Bdelloidea* 100%
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Feacal coliforms	NMP/100mL	780	200 NMP/100mL
67	Total coliforms	NMP/100mL	7000	1000 NMP/100mL

A.10 Analytical determinations of point FW 109-MYRZ

TABLE 22. PARAMETERS MEASURED ON THE SITE - FW 109-MYRZ			
FW 109-MYRZ			
SAMPLING POINT DATA			
Sampling time	17:45	Air temperature	28ºC
Atmospheric conditions	Cloduy	Relative humidity	68%
UTM coordinates	21K 508110.00 m E; 7475784.00 m S	Elevation	130

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
1	Water temperature	T_{agua}	ºC	26,5	NO LIMITS	
2	Hydrogen potential	pH	---	6,52	6 - 9	
3	Electrical conductivity	σ	µS/cm	106	NO LIMITS	[2]<1250
4	Dissolved oxygen	DO	mg O_2/L	**4,58**	> 5 mg O_2/L	
5	Turbidity		m	46,6	100 NTU	

TABLE 23. PHYSICOCHEMICAL PARAMETERS - FW 109-MYRZ						
FW 109-MYRZ						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			19,0	Visually absent..	
7	Total dissolved solids	TDS	mg/L	122	500	
8	Oil and grease		mg/L	10,5	Visually absent.	
9	Chemical oxygen demand	DQO	mg O_2/L	56,4	NO LIMITS	[1]<150
10	Biological oxygen demand	DBO_5	mg O_2/L	2,51	5	
11	Total phosphorus	P	mg/L	0,194	0,05	
12	Total nitrogen	N	mg/L	0,132	0,6	
13	Nitrates	NO_{3-}	mg/L	2,18	10	
14	Ammonia	NH_3	mg/L	0,0554	0,02	
15	Nitrites	NO_{2-}	mg/L	<0,0025	1	
16	Hardness		mg $CaCO_3$/L	31,9	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	6,66	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	<0,0500	0,1	

TABLE 23. PHYSICOCHEMICAL PARAMETERS - FW 109-MYRZ						
FW 109-MYRZ						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	<0,002	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	<0,0100	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,19	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,13	2	
34	Cyanides	CN^-	mg/L	<0,02	0,07	

TABLE 24. AGROCHEMICALS IN SURFACE WATER – FW 109-MYRZ							
FW 109-MYRZ							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3P S	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	

TABLE 24. AGROCHEMICALS IN SURFACE WATER – FW 109-MYRZ							
FW 109-MYRZ							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured**	**Limits**	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

TABLE 25. HYDROBIOLOGICAL PARAMETERS - FW 109-MYRZ				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type		**Species**	**Measured value**	
C Y A N O B A C T E R I A **(322)**		*Pseudanabaena sp.*	322	
C H L O R O P H Y T A **(138)**		*Monoraphidium sp.*	138	
B A C I L L A R I O P H Y T A **(184)**		*Diatomeas pennadas*	**184**	
Presence of organic material	+	TOTAL CELLS /mL	**644**	
Presence of sediment	+	Abundant/dominant organism	*Pseudanabaena sp.* 50,0%	
Presence of bacterias	+++	Range of risk	Null	
CODES				
+(less than half of the field)	++ (half of the field)	+++ (whole field)	**X** (sporadically observed)	
Risk level (UNESCO)	Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL	
(Nº65) ZOOPLANKTON DIVERSITY				
Type		**Species**	**Measured value**	
Absence of zooplankton.				
Plant remains	No	TOTAL CELLS /mL	n/a.	
Colour	Yellowish	Abundant/dominant organism	n/a.	
BACTERIOLÓGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Feacal coliforms	NMP/100mL	11000	200 NMP/100mL
67	Total coliforms	NMP/100mL	11000	1000 NMP/100mL

.

A.11 Analytical determinations of point FW 115-MY

TABLE 26. PARAMETERS MEASURED ON THE SITE - FW 115-MY			
FW 115-MY			
SAMPLING POINT DATA			
Sampling time	18:40	Air temperature	28,6 ºC
Atmospheric conditions	Cloudy	Relative humidity	70%
UTM coordinates	21K 509155.00 m E; 7467194.00 m S	Eelevation	138

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
1	Water temperature	T_{agua}	ºC	26,5	No limits	
2	Hydrogen potential	pH	---	6,94	6 - 9	
3	Electrical conductivity	σ	µS/cm	39,2	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	**4,98**	>5 mg O_2/L	
5	Turbidity		m	83,6	100 NTU	

TABLE 27. PHYSICOCHEMICAL PARAMETERS - FW 115-MY						
FW 115-MY						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards** *
6	Floating materials			54,0	Visually absent	
7	Total dissolved solids	TDS	mg/L	120	500	
8	Oil and grease		mg/L	9,00	Visually absent	
9	Chemical oxygen demand	DQO	mg O_2/L	78,0	No limits	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	2,93	5	
11	Total phosphorus	P	mg/L	0,0882	0,05	
12	Total nitrogen	N	mg/L	0,106	0,6	
13	Nitrates	NO_3^-	mg/L	3,18	10	
14	Ammonia	NH_3	mg/L	0,065	0,02	
15	Nitrites	NO_2^-	mg/L	<0,00250	1	
16	Hardness		mg $CaCO_3$/L	4,85	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	4,53	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	

26	Manganese	Mn	mg/L	<0,0500	0,1	
27	Lead	Pb	mg/L	<0,002	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	<0,0100	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,13	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,12	2	
34	Cyanides	CN^-	mg/L	<0,02	0,07	

TABLE 28. AGROCHEMICALS IN SURFACE WATER – FW 115-MY

FW 115-MY

AGROCHEMICALS

GROUP AOX	№	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards** *
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3P S	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	No limits	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

<table>
<tr><td colspan="5">TABLE 29. HIDROBIOLÓGICAL PARAMETERS - FW 115-MY</td></tr>
<tr><td colspan="5">(Nº 64) PHYTOPLANKTON DIVERSITY</td></tr>
<tr><td colspan="3">Type</td><td>Species</td><td>Measured value</td></tr>
<tr><td colspan="3">C H L O R O P H Y T A (92)</td><td>Monoraphidium sp.</td><td>92</td></tr>
<tr><td colspan="3">B A C I L L A R I O P H Y T A (69)</td><td>Diatomeas pennadas</td><td>69</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Presence of organic material</td><td>+</td><td>TOTAL CELLS /mL</td><td>161</td></tr>
<tr><td colspan="2">Presence of sediment</td><td>+++</td><td>Abundant/dominant organism</td><td>Monoraphidium sp.
57,1%</td></tr>
<tr><td colspan="2">Insect remain</td><td>X</td><td>Range of risk</td><td></td></tr>
<tr><td colspan="5">CODES</td></tr>
<tr><td colspan="2">+(less than half of the field)</td><td>++ (half of the field)</td><td>+++ (whole field)</td><td>X (sporadically observed)</td></tr>
<tr><td colspan="2">Risk level (UNESCO)</td><td>Null until
10.000 Cel/mL</td><td>Alert I - between
10.000 to 20.000 Cel/mL</td><td>Alert II
More than 20.000 Cel/mL</td></tr>
<tr><td colspan="5">(Nº65) ZOOPLANKTON DIVERSITY</td></tr>
<tr><td colspan="3">Type</td><td>Species</td><td>Measured value</td></tr>
<tr><td colspan="5">Absence of zooplankton.</td></tr>
<tr><td colspan="2">Plant remains</td><td>No</td><td>TOTAL CELLS /mL</td><td>n/a.</td></tr>
<tr><td colspan="2">Colour</td><td>Yellowish</td><td>Abundant/dominant organism</td><td>n/a.</td></tr>
<tr><td colspan="5">BACTERIOLÓGICAL PARAMETERS</td></tr>
<tr><td>Nº</td><td>Parameters</td><td>Unit de Medida</td><td>Determinación</td><td>Regulation 222/02</td></tr>
<tr><td>66</td><td>Faecal coliforms</td><td>NMP/100mL</td><td>390</td><td>200 NMP/100mL</td></tr>
<tr><td>67</td><td>Total coliforms</td><td>NMP/100mL</td><td>9000</td><td>1000 NMP/100mL</td></tr>
</table>

.

A.12 Analytical determinations of point FW 317-RZ

TABLE 30. PARAMETERS MEASURED ON THE SITE - FW 317-RZ			
FW 317-RZ			
SAMPLING POINT DATA			
Sampling time	8:20	Air temperature	25,6 ºC
Atmospheric conditions	Partly cloudy	Relative humidity	65%
UTM coordinates	21K 503324.00 m E; 7459243.00 m S	Elevation	116

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limites	
					Regulation 222/02	**Alternative reference standards ***
1	Water temperature	T_{agua}	ºC	21,9	No limits	
2	Hydrogen potential	pH	---	5,67	6 - 9	
3	Electrical conductivity	σ	µS/cm	73,8	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	7,40	> 5 mg O_2/L	
5	Turbidity		m	96,4	100 NTU	

TABLE 31. PHYSICOCHEMICAL PARAMETERS - FW 317-RZ						
FW 317-RZ						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			51,0	Visually absent..	
7	Total dissolved solids	TDS	mg/L	257	500	
8	Oil and grease		mg/L	11,0	Visually absent.	
9	Chemical oxygen demand	DQO	mg O_2/L	96,4	NO LIMITS	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	1,43	5	
11	Total phosphorus	P	mg/L	0,0299	0,05	
12	Total nitrogen	N	mg/L	<0,100	0,6	
13	Nitrates	NO_{3-}	mg/L	1,01	10	
14	Ammonia	NH_3	mg/L	0,115	0,02	
15	Nitrites	NO_{2-}	mg/L	0,0351	1	
16	Hardness		mg $CaCO_3$/L	21,0	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	5,35	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	<0,0500	0,1	

TABLE 31. PHYSICOCHEMICAL PARAMETERS - FW 317-RZ						
FW 317-RZ						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,0494	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	0,0132	0,5	
31	Soluble iron	Fe^{++}	mg/L	0,951	0,3	
32	Mercurio	Hg	mg/L	0,001	2	
33	Mercury	Ba	mg/L	0,15	2	
34	Barium	CN^{-}	mg/L	<0,02	0,07	

TABLE 32. AGROCHEMICALS IN SURFACE WATER – FW 317-RZ							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O	µg/L	<0,01	No limits	

TABLE 33. HIDROBIOLÓGICAL PARAMETERS - FW 317-RZ				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
C Y A N O B A C T E R I A **(192)**			*Pseudanabaena sp.*	192
Presence of organic material		+	TOTAL CELLS /mL	**192**
Presence of sediment		+++	Abundant/dominant organism	*Pseudanabaena sp.* 100%
			Rango de riesgo	Null
CODES				
+(less than half of the field)		++ (half of the field)	+++ (whole field)	**X** (sporadically observed)
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(Nº65) ZOOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
Absence of zooplankton.				
Plant remains		No	TOTAL CELLS /mL	n/a.
Colour		Yellowish	Abundant/dominant organism	n/a.
BACTERIOLÓGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Faecal coliforms	NMP/100mL	**330**	200 NMP/100mL
67	Total coliforms	NMP/100mL	**1100**	1000 NMP/100mL

.

A.13 Analytical determinations of point FW 204-LB

TABLE 34. PARAMETERS MEASURED ON THE SITE – FW 204-LB

FW 204-LB			
SAMPLING POINT DATA			
Sampling time	9:30	Air temperature	28 ºC
Atmospheric conditions	Parcialmente nublado	Relative humidity	68%
UTM coordinates	21 K 498840.00 m E; 7451514.00 m S	Elevation	104

Nº	Parameter	Symbol	Unit	Measured value	Limites	
					Regulation 222/02	Alternative reference standards*
1	Water temperature	T_{agua}	ºC	23,0	NO LIMITS	
2	Hydrogen potential	pH	---	7,0	6 – 9	
3	Electrical conductivity	σ	µS/cm	67,3	NO LIMITS	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	7,46	>5 mg O_2/L	
5	Turbidity		m	54,7	100 NTU	

TABLE 35. PARAMETERS PHYSICOCHEMICAL FW 204-LB

FW 204-LB

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Alternative reference standards*
6	Floating materials			24,0	Visually absent	
7	Total dissolved solids	TDS	mg/L	221	500	
8	Oil and grease		mg/L	13,2	Visually absent	
9	Chemical oxygen demand	DQO	mg O_2/L	77,2	No limits	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	2,73	5	
11	Total phosphorus	P	mg/L	0,0211	0,05	
12	Total nitrogen	N	mg/L	<0,100	0,6	
13	Nitrates	NO_3^-	mg/L	<0,0200	10	
14	Ammonia	NH_3	mg/L	0,226	0,02	
15	Nitrites	NO_2^-	mg/L	0,0420	1	
16	Hardness		mg $CaCO_3$/L	19,8	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	5,19	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	0,0513	0,025	
26	Manganese	Mn	mg/L	<0,0500	0,1	

TABLE 35. PARAMETERS PHYSICOCHEMICAL FW 204-LB						
FW 204-LB						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	<0,002	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	0,0772	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,14	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,12	2	
34	Cyanides	CN^-	mg/L	<0,02	0,07	

TABLE 36. AGROCHEMICALS IN SURFACE WATER – FW 204-LB							
FW 204-LB							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	No limits	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	

TABLE 36. AGROCHEMICALS IN SURFACE WATER – FW 204-LB							
FW 204-LB							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured**	**Limits**	
PHENYLPYRAZOLES	63	Fipronil	$C_{12}H_4Cl_2F_6N_4O$.	µg/L	<0,01	No limits	

TABLE 37. HIDROBIOLÓGICAL PARAMETERS - FW 204-LB					
(Nº 64) PHYTOPLANKTON DIVERSITY					
Type			**Species**	**Measured value**	
B A C I L L A R I O P H Y T A **(391)**			*Diatomeas pennadas*	115	
			Gomphonema sp.	92	
			Navicula sp.	184	
E U G L E N O Z O A **(46)**			*Euglena sp.*		
Presence of organic material		+	TOTAL CELLS /mL	**437**	
Presence of sediment		+++	Abundant/dominant organism	*Navicula sp.* *42,1%*	
Presence of bacteria		+++	Range of risk	Null	
CODES					
+(less than half of the field)		++ (half of the field)	+++ (whole field)	**X** (sporadically observed)	
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL	
(Nº65) ZOOPLANKTON DIVERSITY					
Type			**Species**	**Measured value**	
Absence of zooplankton.					
Plant remains		No	TOTAL CELLS /mL	n/a.	
Colour		Yellowish	Abundant/dominant organism	n/a.	
BACTERIOLOGICAL PARAMETERS					
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**	
66	Faecal coliforms	NMP/100mL	**3500**	200 NMP/100mL	
67	Total coliforms	NMP/100mL	**16000**	1000 NMP/100mL	

A.14 Analytical determinations of point FW 110-LB

TABLE 38. PARAMETERS MEASURED ON THE SITE - FW 110-LB			
FW 110-LB			
SAMPLING POINT DATA			
Sampling time	6:50	Air temperature	23,6 ºC
Atmospheric conditions	Partly cloudy	Relative humidity	58%
UTM coordinates	21K 511487.00 m E; 7450940.00 m S	Elevation	122

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limites: Regulation 222/02	Limites: Alternative reference standards*
1	Water temperature	T_{agua}	ºC	22,3	No limits	
2	Hydrogen potential	pH	---	6,62	6 - 9	
3	Electrical conductivity	σ	µS/cm	67,2	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	2,38	>5 mg O_2/L	
5	Turbidity		m	46,2	100 NTU	

TABLE 39. PHYSICOCHEMICAL PARAMETERS - FW 110-LB						
FW 110-LB						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits: Regulation 222/02**	**Limits: Alternative reference standards***
6	Floating materials			21,0	Visually absent..	
7	Total dissolved solids	TDS	mg/L	188	500	
8	Oil and grease		mg/L	5,25	Visually absent.	
9	Chemical oxygen demand	DQO	mg O_2/L	116	NO LIMITS	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	4,35	5	
11	Total phosphorus	P	mg/L	0,0548	0,05	
12	Total nitrogen	N	mg/L	0,121	0,6	
13	Nitrates	NO_{3-}	mg/L	<0,0200	10	
14	Ammonia	NH_3	mg/L	0,224	0,02	
15	Nitrites	NO_{2-}	mg/L	0,0394	1	
16	Hardness		mg $CaCO_3$/L	11,9	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	5,94	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	0,122	0,1	

TABLE 39. PHYSICOCHEMICAL PARAMETERS - FW 110-LB						
FW 110-LB						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L		0,01	
28	Selenium	Se	mg/L		0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	<0,0100	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,41	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,05	2	
34	Cyanides	CN^-	mg/L	<0,02	0,07	

TABLE 40. AGROCHEMICALS IN SURFACE WATER – FW 110-LB							
FW 110-LB							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	

TABLE 40. AGROCHEMICALS IN SURFACE WATER – FW 110-LB						
FW 110-LB						
AGROCHEMICALS						
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured**	**Limits**
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O	µg/L	<0,01	No limits

TABLE 41. HIDROBIOLÓGICAL PARAMETERS - FW 110-LB				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
C Y A N O B A C T E R I A **(315)**			*Pseudanabaena sp.1*	65
			Pseudanabaena sp.2	250
B A C I L L A R I O P H Y T A **(15)**			*Diatomeas pennadas*	15
C R Y P T O P H Y T A **(15)**			*Cryptomonadales sp*	15
Presence of organic material		+	TOTAL CELLS /mL	350
Presence of sediment		+++	Abundant/dominant organism	*Pseudanabaena sp.2* 71,4%
Protists		X	Range of risk	Null.
Rizhopods		X		
CODES				
+(less than half of the field)		++ (half of the field)	+++ (whole field)	**X** (sporadically observed)
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(Nº65) ZOOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
Absence of zooplankton.				
Plant remains		No	TOTAL CELLS /mL	n/a.
Colour		Yellowish	Abundant/dominant organism	n/a.
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Faecal coliforms	NMP/100mL	**4300**	200 NMP/100mL
67	Total coliforms	NMP/100mL	**160000**	1000 NMP/100mL

A.15 Analytical determinations of point FW 111-LB

TABLE 42. PARAMETERS MEASURED ON THE SITE - FW 111-LB			
FW 111-LB			
SAMPLING POINT DATA			
Sampling time	6:00	Air temperature	
Atmospheric conditions	Cloudy	Relative humidity	
UTM coordinates	21 K 514185.37 m E; 7447625.56 m S	Elevation	121

IN SITU MEASUREMENTS						
№	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limites**	
					Regulation 222/02	**Alternative reference standards***
1	Water temperature	T_{agua}	ºC	21,9	No limits	
2	Hydrogen potential	pH	---	5,91	6 - 9	
3	Electrical conductivity	σ	µS/cm	60,5	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	5,91	>5 mg O_2/L	
5	Turbidity		m	35,7	100 NTU	

TABLE 43. PHYSICOCHEMICAL PARAMETERS - FW 111-LB						
FW 111-LB						
PHYSICOCHEMICAL PARAMETERS						
№	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			116	Visually absent	
7	Total dissolved solids	TDS	mg/L	163	500	
8	Oil and grease		mg/L	3,75	Visually absent	
9	Chemical oxygen demand	DQO	mg O_2/L	99,0	No limits	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	2,15	5	
11	Total phosphorus	P	mg/L	0,114	0,05	
12	Total nitrogen	N	mg/L	<0,100	0,6	
13	Nitrates	NO_{3-}	mg/L	1,56	10	
14	Ammonia	NH_3	mg/L	0,331	0,02	
15	Nitrites	NO_{2-}	mg/L	<0,00250	1	
16	Hardness		mg $CaCO_3$/L	16,8	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	3,32	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	0,400	0,1	

TABLE 43. PHYSICOCHEMICAL PARAMETERS - FW 111-LB						
FW 111-LB						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	<0,002	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	<0,0100	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,56	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,15	2	
34	Cyanides	CN^{-}	mg/L	<0,02	0,07	

TABLE 44. AGROCHEMICALS IN SURFACE WATER – FW 111-LB							
FW 111-LB							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	No limits	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	

TABLE 44. AGROCHEMICALS IN SURFACE WATER – FW 111-LB						
FW 111-LB						
AGROCHEMICALS						
GROUP AOX	Nº	**Parameter**	**Chemical f...**	**Unit**	**Measured**	**Limits**
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits

TABLE 45. HIDROBIOLÓGICAL PARAMETERS - FW 111-LB				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type		**Species**	**Measured value**	
B A C I L L A R I O P H Y T A (207)		*Diatomeas pennadas*	207	
Presence of organic material	+	TOTAL CELLS /mL	**207**	
Presence of sediment	+++	Abundant/dominant organism	*Diatomeas pennadas* 100%	
		Rango de riesgo	Null	
CODES				
+(less than half of the field)	++ (half of the field)	+++ (whole field)	**X** (sporadically observed)	
Risk level (UNESCO)	Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL	
(Nº65) ZOOPLANKTON DIVERSITY				
Type		**Species**	**Measured value**	
Absence of zooplankton.				
Plant remains	No	TOTAL CELLS /mL	N/a.	
Colour	Yellowish	Abundant/dominant organism	N/a.	
BACTERIOLÓGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Faecal coliforms	NMP/100mL	490	200 NMP/100mL
67	Total coliforms	NMP/100mL	1400	1000 NMP/100mL

A.16 Analytical determinations of point FW 310-CR

TABLE 46. PARAMETERS MEASURED ON THE SITE - FW 310-CR

FW 310-CR			
SAMPLING POINT DATA			
Sampling time	18:20	Air temperature	
Atmospheric conditions	Cloudy	Relative humidity	
UTM coordinates	21 K 487444.00 m E; 7449950.00 m S	Elevation	110

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limites	
					Regulation 222/02	Alternative reference standards *
1	Water temperature	T_{agua}	ºC	23,7	No limits	
2	Hydrogen potential	pH	---	7,21	6 - 9	
3	Electrical conductivity	σ	µS/cm	559	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	5,59	> 5 mg O_2/L	
5	Turbidity		m	355	100 NTU	

TABLE 47. PHYSICOCHEMICAL PARAMETERS FW 310-CR

FW 310-CR

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Alternative reference standards*
6	Floating materials			155	Visually absent	
7	Total dissolved solids	TDS	mg/L	169	500	
8	Oil and grease		mg/L	8,80	Visually absent	
9	Chemical oxygen demand	DQO	mg O_2/L	85,5	No limits	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	5,51	5	
11	Total phosphorus	P	mg/L	0,0518	0,05	
12	Total nitrogen	N	mg/L	<0,100	0,6	
13	Nitrates	NO_3^-	mg/L	2,58	10	
14	Ammonia	NH_3	mg/L	0,150	0,02	
15	Nitrites	NO_2^-	mg/L	0,182	1	
16	Hardness		mg $CaCO_3$/L	18,0	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	2,94	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,0	2	
25	Nickel	Ni	mg/L	<0,01	0,025	
26	Manganese	Mn	mg/L	0,341	0,1	

TABLE 47. PHYSICOCHEMICAL PARAMETERS FW 310-CR						
FW 310-CR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,00407	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	<0,0100	0,5	
31	Soluble iron	Fe^{++}	mg/L	2,36	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,14	2	
34	Cyanides	CN^{-}	mg/L	<0,02	0,07	

TABLE 48. AGROCHEMICALS IN SURFACE WATER – FW 310-CR							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards ***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3P S	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

<table>
<tr><td colspan="5">TABLE 49. HYDROBIOLOGICAL PARAMETERS - FW 310-CR</td></tr>
<tr><td colspan="5">(Nº 64) PHYTOPLANKTON DIVERSITY</td></tr>
<tr><td colspan="3">Type</td><td>Species</td><td>Measured value</td></tr>
<tr><td colspan="3">B A C I L L A R I O P H Y T A (184)</td><td>Synedra sp.</td><td>184</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Presence of organic material</td><td>+</td><td>TOTAL CELLS /mL</td><td>184</td></tr>
<tr><td colspan="2">Presence of sediment</td><td>+++</td><td>Abundant/dominant organism</td><td>Synedra sp.
100%</td></tr>
<tr><td colspan="3"></td><td>Range of risk</td><td>Null</td></tr>
<tr><td colspan="5">CODES</td></tr>
<tr><td colspan="2">+(less than half of the field)</td><td>++ (half of the field)</td><td>+++ (whole field)</td><td>X (sporadically observed)</td></tr>
<tr><td colspan="2">Risk level (UNESCO)</td><td>Null until
10.000 Cel/mL</td><td>Alert I - between
10.000 to 20.000 Cel/mL</td><td>Alert II
More than 20.000 Cel/mL</td></tr>
<tr><td colspan="5">(Nº65) ZOOPLANKTON DIVERSITY</td></tr>
<tr><td colspan="3">Type</td><td>Species</td><td>Measured value</td></tr>
<tr><td colspan="5">Absence of zooplankton.</td></tr>
<tr><td colspan="2">Plant remains</td><td>No</td><td>TOTAL CELLS /mL</td><td>n/a.</td></tr>
<tr><td colspan="2">Colour</td><td>Yellowish</td><td>Abundant/dominant organism</td><td>n/a.</td></tr>
<tr><td colspan="5">BACTERIOLÓGICAL PARAMETERS</td></tr>
<tr><td>Nº</td><td>Parameters</td><td>Unit</td><td>Measured value</td><td>Regulation 222/02</td></tr>
<tr><td>66</td><td>Faecal coliforms</td><td>NMP/100mL</td><td>11000</td><td>200 NMP/100mL</td></tr>
<tr><td>67</td><td>Total coliforms</td><td>NMP/100mL</td><td>11000</td><td>1000 NMP/100mL</td></tr>
</table>

.

A.17 Analytical determinations of point FW 316-CR

TABLE 50. PARAMETERS MEASURED ON THE SITE - FW 316-CR						
FW 316-CR						
SAMPLING POINT DATA						
Sampling time	18:50		Air temperature			
Atmospheric conditions	Rainy		Relative humidity			
UTM coordinates	21K 485341.00 m E; 7442662.00 m S		Topographical elevation		110	
IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limites**	
					Regulation 222/02	**Alternative reference standards***
1	Water temperature	T_{agua}	ºC	25,7	No limits	
2	Hydrogen potential	pH	---	6,82	6 - 9	
3	Electrical conductivity	σ	µS/cm	44,8	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	5,08	> 5 mg O_2/L	
5	Turbidity		m	18,6	100 NTU	

TABLE 51. PHYSICOCHEMICAL PARAMETERS - FW 316-CR						
FW 316-CR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			26,0	Visually absent..	
7	Total dissolved solids	TDS	mg/L	127	500	
8	Oil and grease		mg/L	7,25	Visually absent.	
9	Chemical oxygen demand	DQO	mg O_2/L	65,9	NO LIMITS	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	5,05	5	
11	Total phosphorus	P	mg/L	0,0435	0,05	
12	Total nitrogen	N	mg/L	0,779	0,6	
13	Nitrates	NO_3^-	mg/L	0,231	10	
14	Ammonia	NH_3	mg/L	0,0331	0,02	
15	Nitrites	NO_2^-	mg/L	0,00778	1	
16	Hardness		mg $CaCO_3$/L	8,69	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	3,50	200	
19	Aluminum	Al	mg/L	<01,00	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	<0,0500	0,1	

TABLE 51. PHYSICOCHEMICAL PARAMETERS - FW 316-CR						
FW 316-CR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,0134	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	<0,0100	0,5	
31	Soluble iron	Fe^{++}	mg/L	0,991	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,05	2	
34	Cyanides	CN^{-}	mg/L	<0,02	0,07	

TABLE 52. AGROCHEMICALS IN SURFACE WATER – FW 316-CR							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards ***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3P S	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	62	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

TABLE 53. HIDROBIOLÓGICAL PARAMETERS - FW 316-CR				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
C Y A N O B A C T E R I A **(50)**			*Pseudanabaena sp.*	50
C H L O R O P H Y T A **(35)**			*Monoraphidium sp.*	35
B A C I L L A R I O P H Y T A **(10)**			*Diatomeas pennadas*	10
C R Y P T O P H Y T A **(20)**			*Cryptomonadales*	20
Presence of organic material		+	TOTAL CELLS /mL	115
Presence of sediment		+++	Abundant/dominant organism	*Pseudanabaena sp.* 43,5%
Presence of nematodes		X	Range of risk	Null.
CODES				
+(less than half of the field)		++ (half of the field)	+++ (whole field)	**X** (sporadically observed)
Risk level (UNESCO)		Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL
(Nº65) ZOOPLANKTON DIVERSITY				
Type			**Species**	**Measured value**
Absence of zooplankton.				
Plant remains		No	TOTAL CELLS /mL	n/a.
Colour		Yellowish	Abundant/dominant organism	n/a.
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Faecal coliforms	NMP/100mL	46	200 NMP/100mL
67	Total coliforms	NMP/100mL	540	1000 NMP/100mL

A.18 Analytical determinations of point FW 306-SO

TABLE 54. PARAMETERS MEASURED ON THE SITE FW 306-SO			
FW 306-SO			
SAMPLING POINT DATA			
Sampling time	14:30	Air temperature	
Atmospheric conditions	Cloudy	Relative humidity	
UTM coordinates	21K 486496.00 m E, 7493077.00 m S	Elevation	176

IN SITU MEASUREMENTS						
					Limits	
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Regulation 222/02**	**Alternative reference standards** *
1	Water temperature	T_{agua}	ºC	23,1	No limits	
2	Hydrogen potential	pH	---	7,81	6 - 9	
3	Electrical conductivity	σ	µS/cm	213	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	7,47	> 5 mg O_2/L	
5	Turbidity		m	90,8	100 NTU	

TABLE 55. PHYSICOCHEMICAL PARAMETERS - FW 306-SO						
FW 306-SO						
PHYSICOCHEMICAL PARAMETERS						
					Limits	
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Regulation 222/02**	**Alternative reference standards** *
6	Floating materials			63,0	Visually absent..	
7	Total dissolved solids	TDS	mg/L	263	500	
8	Oil and grease		mg/L	10,5	Visually absent.	
9	Chemical oxygen demand	DQO	mg O_2/L	58,6	NO LIMITS	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	4,35	5	
11	Total phosphorus	P	mg/L	0,0208	0,05	
12	Total nitrogen	N	mg/L	<0,100	0,6	
13	Nitrates	NO_{3-}	mg/L	1,10	10	
14	Ammonia	NH_3	mg/L	0,0872	0,02	
15	Nitrites	NO_{2-}	mg/L	<0,00250	1	
16	Hardness		mg $CaCO_3$/L	80,6	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	8,36	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	0,0571	0,1	

TABLE 55. PHYSICOCHEMICAL PARAMETERS - FW 306-SO						
FW 306-SO						
PHYSICOCHEMICAL PARAMETERS						
№	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,0229	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	<0,0500	3	
30	Arsenic	As	mg/L	0,0539	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,02	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,13	2	
34	Cyanides	CN^{-}	mg/L	<0,02	0,07	

TABLE 56. AGROCHEMICALS IN SURFACE WATER – FW 306-SO							
FW 306-SO							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	35	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	36	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	37	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	38	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	39	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	40	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	41	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	42	DDT	C10H6Cl8	µg/L	<2,00	2	
	43	DDE	--	µg/L	<2,00	No limits	
	44	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	45	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	46	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	47	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	48	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	49	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	50	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	51	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	52	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	53	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	54	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	55	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	56	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	57	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	58	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	59	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	60	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	61	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	

TABLE 56. AGROCHEMICALS IN SURFACE WATER – FW 306-SO							
FW 306-SO							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured**	**Limits**	
FLUORATED	62	Sulfluramide	$C_{10}H_6F_{17}NO_2S$	µg/L	--	No limits	
PHENYLPYRAZOLES	63	Fipronil	$C_{12}H_4Cl_2F_6N_4O$.	µg/L	<0,01	No limits	

TABLE 57. HIDROBIOLÓGICAL PARAMETERS - FW 306-SO				
(Nº 64) PHYTOPLANKTON DIVERSITY				
Type		**Species**	**Measured value**	
C Y A N O B A C T E R I A (345)		*Pseudanabaena sp.*	345	
C H L O R O P H Y T A (184)		*Monoraphidium sp.*	184	
B A C I L L A R I O P H Y T A (230)		*Diatomeas pennadas*	230	
Presence of organic material	+	TOTAL CELLS /mL	759	
Presence of sediment	+++	Abundant/dominant organism	*Pseudanabaena sp.* 45,5%	
Fungal spores	X	Range of risk	Null.	
CODES				
+(less than half of the field)	++ (half of the field)	+++ (whole field)	**X** (sporadically observed)	
Risk level (UNESCO)	Null until 10.000 Cel/mL	Alert I - between 10.000 to 20.000 Cel/mL	Alert II More than 20.000 Cel/mL	
(Nº65) ZOOPLANKTON DIVERSITY				
Type		**Species**	**Measured value**	
Absence of zooplankton.				
Plant remains	No	TOTAL CELLS /mL	N/a.	
Colour	Yellowish	Abundant/dominant organism	N/a.	
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
66	Faecal coliforms	NMP/100mL	540	200 NMP/100mL
67	Total coliforms	NMP/100mL	920	1000 NMP/100mL

A.19 Analytical determinations of point FW 01

TABLE 58. PARAMETERS MEASURED ON THE SITE FW 01

FW 01 - PY

SAMPLING POINT DATA			
Sampling time	10:20	Air temperature	
Atmospheric conditions	Soleado	Relative humidity	
UTM coordinates	21K 446252.08 m E 7428199.87 m S	Elevation	85

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limites	
					Regulation 222/02	Alternative reference standards*
1	Water temperature	T_{agua}	ºC	26,0	No limits	
2	Hydrogen potential	pH	---	7,26	6 - 9	
3	Electrical conductivity	σ	µS/cm	169	No limits	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	7,03	>5 mg O_2/L	
5	Turbidity		m	41,2	100 NTU	

TABLE 59. PHYSICOCHEMICAL PARAMETERS FW 01

FW 01 - PY

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Alternative reference standards*
6	Floating materials			22,4	Visually absent	
7	Total dissolved solids	TDS	mg/L	115	500	
8	Oil and grease		mg/L	8,00	Visually absent	
9	Chemical oxygen demand	DQO	mg O_2/L	34,9	No limits	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	1,50	5	
11	Total phosphorus	P	mg/L	0,0694	0,05	
12	Total nitrogen	N	mg/L	1,77	0,6	
13	Nitrates	NO_{3-}	mg/L	<0,100	10	
14	Ammonia	NH_3	mg/L	0,0989	0,02	
15	Nitrites	NO_{2-}	mg/L	0,0153	1	
16	Hardness		mg $CaCO_3$/L	30,5	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	16,7	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	0,113	0,1	

TABLE 59. PHYSICOCHEMICAL PARAMETERS FW 01						
FW 01 - PY						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,00219	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	0,0694	3	
30	Arsenic	As	mg/L	<0,0100	0,5	
31	Soluble iron	Fe^{++}	mg/L	1,52	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,05	2	
34	Cyanides	CN^-	mg/L	<0,02	0,07	
ADDITIONAL PARAMETERS DETERMINED IN PARAGUAY RIVER						
35	Colour		Pt/L	23	75	
36	Phenols index		mg/L	<0,00500	0,5	
37	PCBs		mg/L	Not detected.	0	

BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
38	Faecal coliforms	NMP/100mL	33	200 NMP/100mL
39	Total coliforms	NMP/100mL	130	1000 NMP/100mL

TABLE 60. AGROCHEMICALS IN SURFACE WATER – FW PY 01							
FW PY 01							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	40	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	41	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	42	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	43	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	44	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	45	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	46	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	47	DDT	C10H6Cl8	µg/L	<2,00	2	
	48	DDE	--	µg/L	<2,00	No limits	
	49	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	50	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	51	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	52	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	53	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	54	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	55	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	56	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	57	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	
	58	Bifenthrin	C23H22	µg/L	--	No limits	

TABLE 60. AGROCHEMICALS IN SURFACE WATER – FW PY 01							
FW PY 01							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical f...**	**Unit**	**Measured**	**Limits**	
			ClF3NO2				
	59	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	60	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	61	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	62	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	63	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	64	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	65	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	66	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	67	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	68	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

A.20 Analytical determinations of point FW 02

TABLE 61. PARAMETERS MEASURED ON THE SITE - FW02						
FW 02 - PY						
SAMPLING POINT DATA						
Sampling time	9:30		Air temperature			
Atmospheric conditions	Sunny		Relative humidity			
UTM coordinates	21K 449651.97 m E 7424489.86 m S		Elevation	81		
IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limites**	
					Regulation 222/02	**Alternative reference standards***
1	Water temperature	T_{agua}	ºC	25,0	NO LIMITS	
2	Hydrogen potential	pH	---	7,29	6 - 9	
3	Electrical conductivity	σ	µS/cm	172	NO LIMITS	[2] <1500
4	Dissolved oxygen	DO	mg O_2/L	7,26	> 5mg O_2/L	
5	Turbidity		m	44,6	100 NTU	

.

TABLE 62. PHYSICOCHEMICAL PARAMETERS - FW 02						
FW 02 - PY						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Alternative reference standards***
6	Floating materials			22,8	Visually absent..	
7	Total dissolved solids	TDS	mg/L	151	500	
8	Oil and grease		mg/L	4,50	Visually absent.	
9	Chemical oxygen demand	DQO	mg O_2/L	44,3	NO LIMITS	[1] <150
10	Biological oxygen demand	DBO_5	mg O_2/L	1,11	5	
11	Total phosphorus	P	mg/L	0,0305	0,05	
12	Total nitrogen	N	mg/L	2,43	0,6	
13	Nitrates	NO_{3^-}	mg/L	<0,100	10	
14	Ammonia	NH_3	mg/L	0,0441	0,02	
15	Nitrites	NO_{2^-}	mg/L	0,0186	1	
16	Hardness		mg $CaCO_3$/L	30,1	300	
17	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
18	Sodium	Na	mg/L	16,6	200	
19	Aluminum	Al	mg/L	<0,01	0,2	
20	Cadmium	Cd	mg/L	<0,0008	2	
21	Hexavalent chromium	Cr (VI)	mg/L	<0,0500	0,05	
22	Trivalent chromium	Cr (III)	mg/L	<0,0500	0,5	
23	Copper	Cu	mg/L	<0,0500	1	
24	Tin	Sn	mg/L	<1,00	2	
25	Nickel	Ni	mg/L	<0,001	0,025	
26	Manganese	Mn	mg/L	0,144	0,1	

TABLE 62. PHYSICOCHEMICAL PARAMETERS – FW 02						
FW 02 - PY						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured**	**Limits**	
27	Lead	Pb	mg/L	0,0041	0,01	
28	Selenium	Se	mg/L	<0,005	0,01	
29	Zinc	Zn	mg/L	0,0983	3	
30	Arsenic	As	mg/L	<0,0100	0,5	
31	Soluble iron	Fe^{++}	mg/L	0,804	0,3	
32	Mercury	Hg	mg/L	0,001	2	
33	Barium	Ba	mg/L	0,05	2	
34	Cyanides	CN^-	mg/L	<0,02	0,07	

ADDITIONAL PARAMETERS DETERMINED IN PARAGUAY RIVER						
35	Colour	--	Pt/L	30,0	75	
36	Phenols index	--	mg/L	<0,00500	0,5	
37	PCBs	--	mg/L	Not detected.	0	

BACTERIOLOGICAL PARAMETERS				
Nº	**Parameters**	**Unit**	**Measured value**	**Regulation 222/02**
38	Faecal coliforms	NMP/100mL	2	200 NMP/100mL
39	Total coliforms	NMP/100mL	33	1000 NMP/100mL

TABLE 63. AGROCHEMICALS IN SURFACE WATER – FW 02 – PY							
FW 02 - PY							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured value**	**Limits**	
						Regulation 222/02	**Alternative reference standards***
PHOSPHOGLYCINE	40	Glyphosate	C3H8NO6P	µg/L	<0,300	0,7	
	41	AMPA	CH6NO3P	µg/L	<0,300	No limits	
CHLORDANE	42	Aldrin	C12H8Cl6	µg/L	<1,00	No limits	
	43	Endrin	C12H8Cl6O	µg/L	<1,25	2	
	44	Dieldrin	C12H8Cl6O	µg/L	<1,50	No limits	
	45	Lindane	C6H6Cl6	µg/L	<0,2	0,2	
	46	Chlordane	C10H6Cl8	µg/L	<0,90	No limits	
	47	DDT	C10H6Cl8	µg/L	<2,00	2	
	48	DDE	--	µg/L	<2,00	No limits	
	49	DDD	--	µg/L	<2,00	No limits	
TRIAZINE	50	Atriazine	C8H14ClN5	µg/L	<2,00	3	
	51	Simazine	C7H12ClN5	µg/L	<2,50	4	
CARBAMATE	52	Carbaryl	C12H11NO2	µg/L	<3,50	No limits	
	53	Carbofuran	C12H15NO3	µg/L	<3,00	4	
	54	Heptachlor	C10H5Cl7	µg/L	<1,50	0	
	55	Methomyl	C5H10N2O2S	µg/L	<25,0	No limits	
ALKYLCHLORO-PHENOXY	56	2,4 D	C8H6Cl2O3	µg/L	<2,50	30	
PYRETHROIDS	57	Lambdacialothrin	$C_{23}H_{19}ClF_3NO_3$	µg/L	--	No limits	

TABLE 63. AGROCHEMICALS IN SURFACE WATER – FW 02 – PY							
FW 02 - PY							
AGROCHEMICALS							
GROUP AOX	Nº	**Parameter**	**Chemical formula**	**Unit**	**Measured**	**Limits**	
	58	Bifenthrin	C23H22 ClF3NO2	µg/L	--	No limits	
	59	Cypermethrin	C22H19Cl2NO3	µg/L	<1,20	No limits	
	60	Chlorpyrifos	C9H11Cl3NO3PS	µg/L	<5,00	No limits	
	61	Dichlorvos	C4H7Cl2O4P	µg/L	<10,0	10	
	62	Methamidophos	C2H8NO2PS	µg/L	<25,0	No limits	
TRIAZOLE	63	Tebuconazole	C16H22ClN3O	µg/L	<2,00	1	
NEONICOTINOID	64	Imidacloprid	C9H10ClN5O2	µg/L	<5,00	No limits	
	65	Methylparaoxon	C8H10NO6P	µg/L	<25,0	No limits	
	66	Thiamethoxam	C10H6F17NO2S	µg/L	--	No limits	
FLUORATED	67	Sulfluramide	C10H6F17NO2S	µg/L	--	No limits	
PHENYLPYRAZOLES	68	Fipronil	C12H4Cl2F6N4O.	µg/L	<0,01	No limits	

*Alternative reference standards refers to other national water quality standards, such as Law 1614/200 and NP 24001/80, as well as IFC EHS Guidelines.

APPENDIX B
GROUNDWATER LABORATORY RESULTS

TABLE OF CONTENT

LIST OF TABLES

B1. Analytical determinations of the sampling point GW 18-ZA

TABLE 1. PARAMETERS MEASURED ON THE SITE - GW 18-ZA			
GW 18-ZA			
SAMPLING POINT DATA			
Sampling time	15:10	Air temperature	25,9 ºC
Atmospheric conditions	Cloudy, drizzle	Relative humidity	80%
UTM coordinates	21K 548201.00 m E; 7512128.00 m S	Elevation	211
Water level	No data	Water table	No data

IN SITU MEASUREMENT						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	Tº	ºC	25,9	No limits	
2	Hydrogen potential	pH		6,63	6-9	
3	Electrical conductivity	σ	µS/cm	143	-	1250

TABLE 2. PHYSICOCHEMICAL PARAMETERS - GW 18-ZA						
GW 18-ZA						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	200	500	
5	Organic matter	OM	mg O_2/L	0,848	No limits	
6	Hardness	---	mg $CaCO_3$/L	12,5	300	
7	Total phosphorus	P	mg/L	0,352	0,05	
8	Total nitrogen	N	mg/L	0,363	0,6	
9	Nitrates	NO_{3}-	mg/L	10,5	10	
10	Chlorides	Cl-	mg/L	3,09	-	250
11	Alkalinity	---	mg $CaCO_3$/L	76,2	-	250
12	Bicarbonates	---	mg $CaCO_3$/L	49,5	No limits	
13	Carbonates		mg $CaCO_3$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	3,31	250	
15	Sodium	Na	mg/L	30,8	200	
16	Potasium	K	mg/L	1,27	-	12
17	Calcium	Ca	mg/L	3,23	-	100
18	Magnesium	Mg	mg/L	1,08	-	50
19	Fluorine	F	mg/L	0,09	-	1,5
20	Boron	B	mg/L	<0,100	No limits	

TABLE 3. BACTERIOLOGICAL PARAMETERS				
GW 18-ZA				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	16	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B2. Analytical determinations of sampling point GW20-ST

TABLE 4. PARAMETERS MEASURED ON THE SITE - GW 20-ST			
GW 20-ST			
SAMPLING POINT DATA			
Sampling time	13:00	Air temperature	28,5 ºC
Atmospheric conditions	Nublado	Relative humidity	60%
UTM coordinates	21K 537999.00 m E; 7498476.00 m S	Elevation	186
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	Tº	ºC	27,3	No limits	
2	Hydrogen potential	pH	--	5,63	6-9	
3	Electrical conductivity	σ	µS/cm	95,7	-	1250

TABLE 5. PHYSICOCHEMICAL PARAMETERS - GW 20-ST						
GW 20-ST						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	100	500	
5	Organic matter	OM	mg O_2/L	0,173	No limits	
6	Hardness	---	mg $CaCO_3$/L	0,808	300	
7	Total phosphorus	P	mg/L	0,0263	0,05	
8	Total nitrogen	N	mg/L	0,182	0,6	
9	Nitrates	NO_{3-}	mg/L	22,8	10	
10	Chlorides	Cl-	mg/L	8,08	-	250
11	Alkalinity	---	mg $CaCO_3$./L	47,9	-	250
12	Bicarbonates	---	mg $CaCO_3$./L	6,71	No limits	
13	Carbonates		mg $CaCO_3$./L	0,00	No limits	
14	Sulphates	SO_4^{2}-	mg/L	2,66	250	
15	Sodium	Na	mg/L	8,78	200	
16	Potasium	K	mg/L	0,982	-	12
17	Calcium	Ca	mg/L	1,94	-	100
18	Magnesium	Mg	mg/L	<0,243	-	50
19	Fluorine	F	mg/L	<0,05	-	1,5
20	Boron	B	mg/L	3,88	No limits	

TABLE 6. BACTERIOLOGICAL PARAMETERS - GW 20-S				
GW 20-ST				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	12	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B3. Analytical determinations of sampling point GW 19-HE

TABLE 7. PARAMETERS MEASURED ON THE SITE - GW 19-HE

GW 19-HE			
SAMPLING POINT DATA			
Sampling time	12:20	Air temperature	28 ºC
Atmospheric conditions	Cloudy, drizzle	Relative humidity	76%
UTM coordinates	21K 512695.00 m E; 7515558.00 m S	Elevation	230
Water level	No data	Water table	No data

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
1	Water temperature	Tº	ºC	25,8	No limits	
2	Hydrogen potential	pH		7,83	6-9	
3	Electrical conductivity	σ	µS/cm	197	-	1250

TABLE 8. PHYSICOCHEMICAL PARAMETERS - GW 19-HE

GW 19-HE

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
4	Total dissolved solids	TDS	mg/L	160	500	
5	Organic matter	OM	mg O_2/L	0,134	No limits	
6	Hardness	---	mg $CaCO_3$/L	35,6	300	
7	Total phosphorus	P	mg/L	0,577	0,05	
8	Total nitrogen	N	mg/L	<0,100	0,6	
9	Nitrates	NO_3-	mg/L	1,93	10	
10	Chlorides	Cl-	mg/L	1,43	-	250
11	Alkalinity	---	mg $CaCO_3$./L	79,7	-	250
12	Bicarbonates	---	mg $CaCO_3$./L	78,1	No limits	
13	Carbonates		mg $CaCO_3$./L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	2,96	250	
15	Sodium	Na	mg/L	31,8	200	
16	Potasium	K	mg/L	1,41	-	12
17	Calcium	Ca	mg/L	12,3	-	100
18	Magnesium	Mg	mg/L	1,15	-	50
19	Fluorine	F	mg/L	0,20	-	1,5
20	Boron	B	mg/L	1,78	No limits	

TABLE 9. BACTERIOLOGICAL PARAMETERS - GW 19-HE

BACTERIOLOGICAL PARAMETERS - GW 19-HE

Nº	Parameter	Unit	Measured value	Regulation NP 2400180 limits
2	Faecal coliforms	NMP/100mL	9,2	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B4. Analytical determinations of sampling point GW 23-SL

TABLE 10. PARAMETERS MEASURED ON THE SITE - GW 23-S			
GW 23-SL			
SAMPLING POINT DATA			
Sampling time	13:00	Air temperature	28 ºC
Atmospheric conditions	Cloudy	Relative humidity	76%
UTM coordinates	21K 516367.00 m E; 7503054.00 m S	Elevation	205
Water level	19	Water table	186

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	Tº	ºC	25,8	No limits	
2	Hydrogen potential	pH		5,71	6-9	
3	Electrical conductivity	σ	µS/cm	34,3	-	1250

TABLE 11. PHYSICOCHEMICAL PARAMETERS - GW 23-SL						
GW 23-SL						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	69,5	500	
5	Organic matter	OM	mg O_2/L	1,76	No limits	
6	Hardness	---	mg $CaCO_3$/L	3,03	300	
7	Total phosphorus	P	mg/L	0,0947	0,05	
8	Total nitrogen	N	mg/L	0,109	0,6	
9	Nitrates	NO_3-	mg/L	5,08	10	
10	Chlorides	Cl-	mg/L	4,75	-	250
11	Alkalinity	---	mg $CaCO_3$./L	10,8	-	250
12	Bicarbonates	---	mg $CaCO_3$./L	1,94	No limits	
13	Carbonates		mg $CaCO_3$./L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
15	Sodium	Na	mg/L	4,09	200	
16	Potasium	K	mg/L	<0,250	-	12
17	Calcium	Ca	mg/L	2,19	-	100
18	Magnesium	Mg	mg/L	<0,243	-	50
19	Fluorine	F	mg/L	<0,05	-	1,5
20	Boron	B	mg/L	0,825	NO LIMITS	

TABLE 12. BACTERIOLOGICAL PARAMETERS - GW 23-SL				
GW 23-SL				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	23	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B5. Analytical determinations for sampling point GW 16-GA

TABLE 13. PARAMETERS MEASURED ON THE SITE - GW 16-GA			
GW 16-GA			
SAMPLING POINT DATA			
Sampling time	13:00	Air temperature	29,6ºC
Atmospheric conditions	Sunny	Relative humidity	65%
UTM coordinates	21K 505125.00 m E; 7498320.00 m S	Elevation	219
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	Tº	ºC	24,3	No limits	
2	Hydrogen potential	pH		6,87	6-9	
3	Electrical conductivity	σ	µS/cm	247	-	1250

TABLE 14. PHYSICOCHEMICAL PARAMETERS - GW 16-GA						
GW 16-GA						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	266	500	
5	Organic matter	OM	mg O_2/L	0,382	No limits	
6	Hardness	---	mg $CaCO_3$/L	30,9	300	
7	Total phosphorus	P	mg/L	0,0431	0,05	
8	Total nitrogen	N	mg/L	<0,100	0,6	
9	Nitrates	NO_{3-}	mg/L	0,899	10	
10	Chlorides	Cl-	mg/L	6,89	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	91,5	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	66,8	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	9,50	250	
15	Sodium	Na	mg/L	42,2	200	
16	Potasium	K	mg/L	0,311	-	12
17	Calcium	Ca	mg/L	10,6	-	100
18	Magnesium	Mg	mg/L	1,07	-	50
19	Fluorine	F	mg/L	0,22	-	1,5
20	Boron	B	mg/L	<0,100	No limits	

TABLE 15. BACTERIOLOGICAL PARAMETERS – GW 16-GA				
GW 16-GA				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	<1,1	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	12	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B6. Analytical determinations for sampling point GW 11-MICHEL

TABLE 16. PHYSICOCHEMICAL PARAMETERS - GW 11-MICHEL			
GW 11-MICHEL			
SAMPLING POINT DATA			
Sampling time	06:50	Air temperature	24,5 ºC
Atmospheric conditions	Cloudy, drizzle	Relative humidity	82%
UTM coordinates	21K 518643.00 m E; 7484801.00 m S	Elevation	182
Water level	No data	Water table	No data

IN SITU MEASUREMENTS

Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	Tº	ºC	25,0	No limits	
2	Hydrogen potential	pH		5,87	6-9	
3	Electrical conductivity	σ	µS/cm	72,0	-	1250

TABLE 17. PHYSICOCHEMICAL PARAMETERS - GW 11-MICHEL						
GW 11-MICHEL						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	115	500	
5	Organic matter	OM	mg O_2/L	0,670	No limits	
6	Hardness	---	mg $CaCO_3$/L	10,5	300	
7	Total phosphorus	P	mg/L	0,107	0,05	
8	Total nitrogen	N	mg/L	<0,100	0,6	
9	Nitrates	NO_{3-}	mg/L	1,80	10	
10	Chlorides	Cl-	mg/L	10,9	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	80,4	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	16,1	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
15	Sodium	Na	mg/L	9,94	200	
16	Potasium	K	mg/L	0,737	-	12
17	Calcium	Ca	mg/L	4,05	-	100
18	Magnesium	Mg	mg/L	<0,243	-	50
19	Fluorine	F	mg/L	<0,05	-	1,5
20	Boron	B	mg/L	1,41	No limits	

TABLE 18. BACTERIOLOGICAL PARAMETERS – GW11-MICHEL				
GW 11-MICHEL				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	>23	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B7. Analytical determinations for sampling point GW 10-TR

TABLE 19. PARAMETERS MEASURED ON THE SITE - GW 10-TR			
GW 10-TR			
SAMPLING POINT DATA			
Sampling time	7:20	Air temperature	25 ºC
Atmospheric conditions	Cloudy	Relative humidity	81%
UTM coordinates	21K 516254.00 m E 7484946.00 m S	Elevation	157
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	Tº	ºC	25,8	No limits	
2	Hydrogen potential	pH		7,16	6-9	
3	Electrical conductivity	σ	µS/cm	321	-	1500

TABLE 20. PHYSICOCHEMICAL PARAMETERS - GW 10-TR						
GW 10-TR						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	273	500	
5	Organic matter	OM	mg O_2/L	0,196	No limits	
6	Hardness	---	mg $CaCO_3$/L	12,3	300	
7	Total phosphorus	P	mg/L	0,876	0,05	
8	Total nitrogen	N	mg/L	0,177	0,6	
9	Nitrates	NO_{3-}	mg/L	0,818	1	
10	Chlorides	Cl-	mg/L	28,50	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	96,5	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	81,1	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	3,21	250	
15	Sodium	Na	mg/L	63,2	200	
16	Potasium	K	mg/L	0,804	-	12
17	Calcium	Ca	mg/L	3,97	-	100
18	Magnesium	Mg	mg/L	0,578	-	50
19	Fluorine	F	mg/L	0,24	-	1,5
20	Boron	B	mg/L	0,168	No limits	

TABLE 21. BACTERIOLOGICAL PARAMETERS - GW 10-TR				
GW 10-TR				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
22	Faecal coliforms	NMP/100mL	10	1,1 NMP/100mL
23	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
24	E. coli	NMP/100mL	Absent	Absent

B8. Analytical determinations for sampling point GW 13-San Juan

TABLE 22. PARAMETERS MEASURED ON THE SITE - GW 13-SAN JUAN

GW 13-San Juan

SAMPLING POINT DATA

Sampling time	8:20	Air temperature	26,5 ºC
Atmospheric conditions	Sunny, disperse clouds	Relative humidity	80%
UTM coordinates	21K 509767.00 m E; 7486076.00 m S	Elevation	184
Water level	No data	Water table	No data

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
1	Water temperature	Tº	ºC	21,2	No limits	
2	Hydrogen potential	pH		6,92	6-9	
3	Electrical conductivity	σ	µS/cm	320	-	1250

TABLE 23. PHYSICOCHEMICAL PARAMETERS - GW 13-SAN JUAN

GW 13-San Juan

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
4	Total dissolved solids	TDS	mg/L	383	500	
5	Organic matter	OM	mg O_2/L	0,685	No limits	
6	Hardness	---	mg $CaCO_3$/L	9,90	300	
7	Total phosphorus	P	mg/L	0,127	0,05	
8	Total nitrogen	N	mg/L	<0,100	0,6	
9	Nitrates	NO_{3-}	mg/L	106	10	
10	Chlorides	Cl-	mg/L	32,3	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	15,2	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	13,1	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
15	Sodium	Na	mg/L	74,4	200	
16	Potasium	K	mg/L	1,26	-	12
17	Calcium	Ca	mg/L	3,08	-	100
18	Magnesium	Mg	mg/L	0,536	-	50
19	Fluorine	F	mg/L	0,06	-	1,5
20	Boron	B	mg/L	0,100	No limits	

TABLE 24.BACTERIOLOGICAL PARAMETERS - GW 13-SAN JUAN

GW 13-San Juan

BACTERIOLOGICAL PARAMETERS

Nº	Parameter	Unit	Measured value	Regulation NP 2400180 limits
22	Faecal coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
24	E. coli	NMP/100mL	Absent	Absent

B9. Analytical determinations for sampling point GW 22-Silva

TABLE 25. PARAMETERS MEASURED ON THE SITE – GW22-SILVA

GW 22-Silva							
SAMPLING POINT DATA							
Sampling time	8:50			Air temperature		27 °C	
Atmospheric conditions	Sunny, disperse clouds			Relative humidity		80%	
UTM coordinates	21K 509830.00 m E; 7484037.00 m S			Elevation		179	
Water level	No data			Water table		No data	
IN SITU MEASUREMENTS							
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**		
					Regulation 222/02	**Annexe I Law 1614/2000.**	
1	Water temperature	Tº	ºC	21,7	No limits		
2	Hydrogen potential	pH		5,54	6-9		
3	Electrical conductivity	σ	µS/cm	197	-	1250	

TABLE 26. PHYSICOCHEMICAL PARAMETERS – GW 22-SILVA

GW 22-Silva						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	247	500	
5	Organic matter	OM	mg O_2/L	0,538	No limits	
6	Hardness	---	mg $CaCO_3$/L	22,0	300	
7	Total phosphorus	P	mg/L	<0,0200	0,05	
8	Total nitrogen	N	mg/L	<0,100	0,6	
9	Nitrates	NO_{3-}	mg/L	55,2	10	
10	Chlorides	Cl-	mg/L	13,3	-	250
11	Alkalinity	---	mg $CaCO_3$./L	13,8	-	250
12	Bicarbonates	---	mg $CaCO_3$./L	1,38	No limits	
13	Carbonates		mg $CaCO_3$./L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	7,37	250	
15	Sodium	Na	mg/L	12,4	200	
16	Potasium	K	mg/L	7,63	-	12
17	Calcium	Ca	mg/L	4,86	-	100
18	Magnesium	Mg	mg/L	2,41	-	50
19	Fluorine	F	mg/L	<0,05	-	1,5
20	Boron	B	mg/L	<0,100	No limits	

TABLE 27. BACTERIOLOGICAL PARAMETERS – GW 22-SILVA

GW 22-Silva				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	23	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B10. Analytical determinations for sampling point GW 12- Laguna

TABLE 28. PARAMETERS MEASURED ON THE SITE - GW 12-LAGUNA

GW 12- Laguna

SAMPLING POINT DATA

Sampling time	16:30	Air temperature	28,6 ºC
Atmospheric conditions	Cloudy	Relative humidity	79%
UTM coordinates	21K 516419.00 m E; 7478307.00 m S	Elevation	154
Water level	12,3	Water table	183,3

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
1	Water temperature	Tº	ºC	25,7	No limits	
2	Hydrogen potential	pH		7,04	6-9	
3	Electrical conductivity	σ	µS/cm	318	-	1250

TABLE 29. PHYSICOCHEMICAL PARAMETERS - GW 12-LAGUNA

GW 12- Laguna

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
4	Total dissolved solids	TDS	mg/L	236	500	
5	Organic matter	OM	mg O_2/L	0,406	No limits	
6	Hardness	---	mg $CaCO_3$/L	88,1	300	
7	Total phosphorus	P	mg/L	0,264	0,05	
8	Total nitrogen	N	mg/L	0,339	0,6	
9	Nitrates	NO_{3-}	mg/L	3,70	10	
10	Chlorides	Cl-	mg/L	4,28	-	250
11	Alkalinity	---	mg $CaCO_3$./L	132	-	250
12	Bicarbonates	---	mg $CaCO_3$./L	108	No limits	
13	Carbonates		mg $CaCO_3$./L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	3,46	250	
15	Sodium	Na	mg/L	30,1	200	
16	Potasium	K	mg/L	0,906	-	12
17	Calcium	Ca	mg/L	24,7	-	100
18	Magnesium	Mg	mg/L	6,410	-	50
19	Fluorine	F	mg/L	0,15	-	1,5
20	Boron	B	mg/L	8,22	No limits	

TABLE 30. BACTERIOLOGICAL PARAMETERS - GW 12-LAGUNA

GW 12- Laguna

BACTERIOLOGICAL PARAMETERS

Nº	Parameter	Unit	Measured value	Regulation NP 2400180 limits
21	Faecal coliforms	NMP/100mL	6,9	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Ausente	Ausencia

B11. Analytical determinations for sampling point GW 14-ZM

TABLE 31. PARAMETERS MEASURED ON THE SITE - GW 14-ZM			
GW 14-ZM			
SAMPLING POINT DATA			
Sampling time	13:40	Air temperature	29,5 º C
Atmospheric conditions	Cloudy, drizzle	Relative humidity	79%
UTM coordinates	21K 493064.00 m E; 7499176.00 m S	Elevation	212
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	Tº	ºC	22,1	No limits	
2	Hydrogen potential	pH		7,16	6-9	
3	Electrical conductivity	σ	µS/cm	113	-	1250

TABLE 32. PARÁMETROS FISICOQUÍMICOS GW 14-ZM						
GW 14-ZM						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	216	500	
5	Organic matter	OM	mg O_2/L	1,23	No limits	
6	Hardness	---	mg $CaCO_3$/L	26,3	300	
7	Total phosphorus	P	mg/L	0,204	0,05	
8	Total nitrogen	N	mg/L	0,107	0,6	
9	Nitrates	NO_{3-}	mg/L	<0,200	10	
10	Chlorides	Cl-	mg/L	9,50	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	52,6	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	38,9	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
15	Sodium	Na	mg/L	12,1	200	
16	Potasium	K	mg/L	1,07	-	12
17	Calcium	Ca	mg/L	6,72	-	100
18	Magnesium	Mg	mg/L	2,30	-	50
19	Fluorine	F	mg/L	0,25	-	1,5
20	Boron	B	mg/L	<0,100	No limits	

TABLE 33. BACTERIOLOGICAL PARAMETERS - GW 14-ZM				
GW 14-ZM				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
22	Faecal coliforms	NMP/100mL	6,9	1,1 NMP/100mL
23	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
24	E. coli	NMP/100mL	Absent	Absent

B12. Analytical determinations for sampling point GW 15-SO

TABLE 34. PARAMETERS MEASURED ON THE SITE - GW 15-SO

GW 15-SO			
DATOS DEL PUNTO DE MUESTREO			
Sampling time	12:10	Air temperature	24,8 ºC
Atmospheric conditions	Cloudy, rainy	Relative humidity	60%
UTM coordinates	21K 483316.00 m E, 7497562.00 m S	Elevation	290
Water level	No data	Water table	No data

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
1	Water temperature	Tº	ºC	27,7	No limits	
2	Hydrogen potential	pH		7,34	6-9	
3	Electrical conductivity	σ	µS/cm	950	-	1250

TABLE 35. PHYSICOCHEMICAL PARAMETERS - GW 15-SO

GW 15-SO

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
4	Total dissolved solids	TDS	mg/L	665	500	
5	Organic matter	OM	mg O_2/L	1,31	No limits	
6	Hardness	---	mg $CaCO_3$/L	313	300	
7	Total phosphorus	P	mg/L	<0,0200	0,05	
8	Total nitrogen	N	mg/L	0,734	0,6	
9	Nitrates	NO_{3-}	mg/L	199	10	
10	Chlorides	Cl-	mg/L	8,31	-	250
11	Alkalinity	---	mg $CaCO_3$/L	299	-	250
12	Bicarbonates	---	mg $CaCO_3$/L	269	No limits	
13	Carbonates		mg $CaCO_3$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	17,9	250	
15	Sodium	Na	mg/L	64,6	200	
16	Potasium	K	mg/L	1,93	-	12
17	Calcium	Ca	mg/L	76,3	-	100
18	Magnesium	Mg	mg/L	29,7	-	50
19	Fluorine	F	mg/L	0,67	-	1,5
20	Boron	B	mg/L	<0,100	No limits	

TABLE 36. BACTERIOLOGICAL PARAMETERS - GW 15-SO

GW 15-SO

BACTERIOLOGICAL PARAMETERS

Nº	Parameter	Unit	Measured value	Regulation NP 2400180 limits
22	Faecal coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
24	E. coli	NMP/100mL	Absent	Absent

B13. Analytical determinations for sampling point GW 17-LP

TABLE 37. PARAMETERS MEASURED ON THE SITE - GW 17-LP

GW 17-LP

SAMPLING POINT DATA

Sampling time	14: 50	Air temperature	26,8 ºC
Atmospheric conditions	Sunny, disperse clouds	Relative humidity	60%
UTM coordinates	21K 489833.00 m E, 7492572.00 m S	Elevation	215
Water level	No data	Water table	No data

IN SITU MEASUREMENTS

Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	Tº	ºC	21,7	No limits	
2	Hydrogen potential	pH		6,96	6-9	
3	Electrical conductivity	σ	µS/cm	196	-	1250

TABLE 38. PHYSICOCHEMICAL PARAMETERS - GW 17-LP

GW 17-LP

PHYSICOCHEMICAL PARAMETERS

Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	203	500	
5	Organic matter	OM	mg O_2/L	0,615	No limits	
6	Hardness	---	mg $CaCO_3$/L	64,0	300	
7	Total phosphorus	P	mg/L	0,0699	0,05	
8	Total nitrogen	N	mg/L	<0,100	0,6	
9	Nitrates	NO_3-	mg/L	<0,200	10	
10	Chlorides	Cl-	mg/L	0,475	-	250
11	Alkalinity	---	mg $CaCO_3$./L	94,5	-	250
12	Bicarbonates	---	mg $CaCO_3$./L	73,7	No limits	
13	Carbonates		mg $CaCO_3$./L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	<2,00	250	
15	Sodium	Na	mg/L	14,6	200	
16	Potasium	K	mg/L	0,486	-	12
17	Calcium	Ca	mg/L	15,5	-	100
18	Magnesium	Mg	mg/L	6,11	-	50
19	Fluorine	F	mg/L	0,53	-	1,5
20	Boron	B	mg/L	0,519	No limits	

TABLE 39. BACTERIOLOGICAL PARAMETERS - GW 17-LP

GW 17-LP

BACTERIOLOGICAL PARAMETERS

Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	>23	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B14. Analytical determinations for sampling point GW 21-MC

TABLE 40. PARAMETERS MEASURED ON THE SITE - GW 21-MC

GW 21-MC			
SAMPLING POINT DATA			
Sampling time	15:30	Air temperature	26,5 ºC
Atmospheric conditions	Cloudy	Relative humidity	63%
UTM coordinates	21K 495202.00 m E; 7489899.00 m S	Elevation	177
Water level	10,70	Water table	166,3

IN SITU MEASUREMENTS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
1	Water temperature	T_{agua}	ºC	22,7	NO LIMITS	
2	Hydrogen potential	pH		6,26	6-9	
3	Electrical conductivity	σ	µS/cm	406	-	1250

TABLE 41. PHYSICOCHEMICAL PARAMETERS - GW 21-MC

GW 21-MC

PHYSICOCHEMICAL PARAMETERS

Nº	Parameter	Symbol	Unit	Measured value	Limits	
					Regulation 222/02	Annexe I Law 1614/2000.
4	Total dissolved solids	TDS	mg/L	404	500	
5	Organic matter	OM	mg O_2/L	0,475	No limits	
6	Hardness	---	mg $CaCO_3$/L	58,8	300	
7	Total phosphorus	P	mg/L	0,170	0,05	
8	Total nitrogen	N	mg/L	<0,100	0,6	
9	Nitrates	NO_{3-}	mg/L	75,5	10	
10	Chlorides	Cl-	mg/L	49,9	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	58,1	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	5,81	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	5,79	250	
15	Sodium	Na	mg/L	51,0	200	
16	Potasium	K	mg/L	3,23	-	12
17	Calcium	Ca	mg/L	15,3	-	100
18	Magnesium	Mg	mg/L	4,98	-	50
19	Fluorine	F	mg/L	0,14	-	1,5
20	Boron	B	mg/L	0,650	No limits	

TABLE 42. BACTERIOLOGICAL PARAMETERS - GW 21-MC

GW 21-MC

BACTERIOLOGICAL PARAMETERS

Nº	Parameter	Unit	Measured value	Regulation NP 2400180 limits
21	Faecal coliforms	NMP/100mL	>23	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B15. Analytical determinations for sampling point GW 01

TABLE 43. PARAMETERS MEASURED ON THE SITE - GW 01			
GW 01			
SAMPLING POINT DATA			
Sampling time	11:40	Air temperature	29,7 ºC
Atmospheric conditions	Sunny	Relative humidity	64%
UTM coordinates	21K 449839.00 m E 7430729.00 m S	Elevation	123 m
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	T_{agua}	ºC	20,1	NO LIMITS	
2	Hydrogen potential	pH		7,16	6-9	
3	Electrical conductivity	σ	µS/cm	2.400	-	1250

TABLE 44. PHYSICOCHEMICAL PARAMETERS - GW 01						
GW 01						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	1.181	500	
5	Organic matter	OM	mg O_2/L	10,1	No limits	
6	Hardness	---	mg $CaCO_3$/L	281	300	
7	Total phosphorus	P	mg/L	0,356	0,05	
8	Total nitrogen	N	mg/L	2,73	0,6	
9	Nitrates	NO_{3-}	mg/L	1,49	10	
10	Chlorides	Cl-	mg/L	285	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	397	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	55,5	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	337	250	
15	Sodium	Na	mg/L	374	200	
16	Potasium	K	mg/L	8,40	-	12
17	Calcium	Ca	mg/L	85,8	-	100
18	Magnesium	Mg	mg/L	16,1	-	50
19	Fluorine	F	mg/L	2,30	-	1,5
20	Boron	B	mg/L	1,67	No limits	

TABLE 45. BACTERIOLOGICAL PARAMETERS - GW 01				
GW 01				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	>23	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	>23	1,1 NMP/100mL
23	E. coli	NMP/100mL	Present	Absent

B16. Analytical determinations for sampling point GW 02

TABLE 46. PARAMETERS MEASURED ON THE SITE - GW 02			
GW 02			
SAMPLING POINT DATA			
Sampling time	9:40	Air temperature	28,5 ºC
Atmospheric conditions	Sunny	Relative humidity	65%
UTM coordinates	21k 450165.00 m E 7430301.00 m S	Elevation	116 m
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	T_{agua}	ºC	19,7	NO LIMITS	
2	Hydrogen potential	pH		6,96	6-9	
3	Electrical conductivity	σ	µS/cm	444	-	1250

TABLE 47. PHYSICOCHEMICAL PARAMETERS - GW 02						
GW 02						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	248	500	
5	Organic matter	OM	mg O_2/L	0,505	No limits	
6	Hardness	---	mg $CaCO_3$/L	84	300	
7	Total phosphorus	P	mg/L	0,0776	0,05	
8	Total nitrogen	N	mg/L	0,196	0,6	
9	Nitrates	NO_{3-}	mg/L	<0,0200	10	
10	Chlorides	Cl-	mg/L	1,59	-	250
11	Alkalinity	---	mg $CaCO_3$./L	178	-	250
12	Bicarbonates	---	mg $CaCO_3$./L	88,8	No limits	
13	Carbonates		mg $CaCO_3$./L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	24,5	250	
15	Sodium	Na	mg/L	43,1	200	
16	Potasium	K	mg/L	16,5	-	12
17	Calcium	Ca	mg/L	20,5	-	100
18	Magnesium	Mg	mg/L	8,07	-	50
19	Fluorine	F	mg/L	1,60	-	1,5
20	Boron	B	mg/L	1,67	No limits	

TABLE 48. BACTERIOLOGICAL PARAMETERS - GW 02				
GW 02				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	<1,1	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	<1,1	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

B17. Analytical determinations for sampling point GW 03 (NO WATER)

TABLE 49. PARAMETERS MEASURED ON THE SITE – GW 03			
GW 03			
SAMPLING POINT DATA			
Sampling time	13:30	Air temperature	30,4 ºC
Atmospheric conditions	Sunny	Relative humidity	67%
UTM coordinates	21 k 449680.00 m E 7426904.00 m S	Elevation	83 m
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	T_{agua}	ºC	-	NO LIMITS	
2	Hydrogen potential	pH		-	6-9	
3	Electrical conductivity	σ	µS/cm	-	-	1250

TABLE 50. PHYSICOCHEMICAL PARAMETERS – GW 03						
GW 03						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	-	500	
5	Organic matter	OM	mg O_2/L	-	No limits	
6	Hardness	---	mg $CaCO_3$/L	-	300	
7	Total phosphorus	P	mg/L	-	0,05	
8	Total nitrogen	N	mg/L	-	0,6	
9	Nitrates	NO_{3-}	mg/L	-	10	
10	Chlorides	Cl-	mg/L	-	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	-	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	-	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	-	No limits	
14	Sulphates	SO_4^{2-}	mg/L	-	250	
15	Sodium	Na	mg/L	-	200	
16	Potasium	K	mg/L	-	-	12
17	Calcium	Ca	mg/L	-	-	100
18	Magnesium	Mg	mg/L	-	-	50
19	Fluorine	F	mg/L	-	-	1,5
20	Boron	B	mg/L	-	No limits	

TABLE 51. BACTERIOLOGICAL PARAMETERS – GW 03				
GW 03				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	-	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	-	1,1 NMP/100mL
23	E. coli	NMP/100mL	-	Absent

B18. Analytical determinations for sampling point GW 04

TABLE 52. PARAMETERS MEASURED ON THE SITE - GW 04						
GW 04						
SAMPLING POINT DATA						
Sampling time	10:00		Air temperature		29.7 ºC	
Atmospheric conditions	Sunny		Relative humidity		58 %	
UTM coordinates	21k 449136.00 m E 7427123.00 m S		Elevation		94 m	
Water level	No data		Water table		No data	
IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	T_{agua}	ºC	21,2	NO LIMITS	
2	Hydrogen potential	pH		7,44	6-9	
3	Electrical conductivity	σ	µS/cm	5.010	-	1250

TABLE 53. PHYSICOCHEMICAL PARAMETERS - GW 04						
GW 04						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	**2.577**	500	
5	Organic matter	OM	mg O_2/L	12,0	No limits	
6	Hardness	---	mg $CaCO_3$/L	**709**	300	
7	Total phosphorus	P	mg/L	12,0	0,05	
8	Total nitrogen	N	mg/L	9,02	0,6	
9	Nitrates	NO_{3-}	mg/L	<0,0200	10	
10	Chlorides	Cl-	mg/L	**611**	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	**282**	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	22,6	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	160	250	
15	Sodium	Na	mg/L	**367**	200	
16	Potasium	K	mg/L	6,57	-	12
17	Calcium	Ca	mg/L	**164**	-	100
18	Magnesium	Mg	mg/L	**72,9**	-	50
19	Fluorine	F	mg/L	1,00	-	1,5
20	Boron	B	mg/L	1,25	No limits	

TABLE 54. BACTERIOLOGICAL PARAMETERS - GW 04				
GW 04				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	**>23**	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	**>23**	1,1 NMP/100mL
23	E. coli	NMP/100mL	Present	Absent

B19. Analytical determinations for sampling point GW 05

TABLE 55. PARAMETERS MEASURED ON THE SITE - GW 05			
GW 05			
SAMPLING POINT DATA			
Sampling time	14:50	Air temperature	31,2 ºC
Atmospheric conditions	Sunny	Relative humidity	52 %
UTM coordinates	21K 450803.00 m E 7426714.00 m S	Elevation	91 m
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	T_{agua}	ºC	23,0	NO LIMITS	
2	Hydrogen potential	pH		6,89	6-9	
3	Electrical conductivity	σ	µS/cm	370	-	1250

TABLE 56. PHYSICOCHEMICAL PARAMETERS - GW 05						
GW 05						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	245	500	
5	Organic matter	OM	mg O_2/L	0,366	No limits	
6	Hardness	---	mg $CaCO_3$/L	88,1	300	
7	Total phosphorus	P	mg/L	0,0212	0,05	
8	Total nitrogen	N	mg/L	0,245	0,6	
9	Nitrates	NO_{3-}	mg/L	<0,0200	10	
10	Chlorides	Cl-	mg/L	43,1	-	250
11	Alkalinity	---	mg $CaCO_{3-}$/L	13,5	-	250
12	Bicarbonates	---	mg $CaCO_{3-}$/L	5,40	No limits	
13	Carbonates		mg $CaCO_{3-}$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	16,1	250	
15	Sodium	Na	mg/L	25,7	200	
16	Potasium	K	mg/L	6,60	-	12
17	Calcium	Ca	mg/L	25,3	-	100
18	Magnesium	Mg	mg/L	6,06	-	50
19	Fluorine	F	mg/L	0,200	-	1,5
20	Boron	B	mg/L	2,51	No limits	

TABLE 57. BACTERIOLOGICAL PARAMETERS - GW 05				
GW 05				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	**5,1**	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	**1,1**	1,1 NMP/100mL
23	E. coli	NMP/100mL	Present	Absent

B20. Analytical determinations for sampling point GW 06

TABLE 58. PARAMETERS MEASURED ON THE SITE - GW 06			
GW 06			
SAMPLING POINT DATA			
Sampling time	16:00	Air temperature	30,08 ºC
Atmospheric conditions	Sunny	Relative humidity	57 %
UTM coordinates	21k 451708.00 m E 7427153.00 m S	Elevation	90 m
Water level	No data	Water table	No data

IN SITU MEASUREMENTS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
1	Water temperature	T_{agua}	ºC	21,4	NO LIMITS	
2	Hydrogen potential	pH		6,39	6-9	
3	Electrical conductivity	σ	µS/cm	330	-	1250

TABLE 59. PHYSICOCHEMICAL PARAMETERS - GW 06						
GW 06						
PHYSICOCHEMICAL PARAMETERS						
Nº	**Parameter**	**Symbol**	**Unit**	**Measured value**	**Limits**	
					Regulation 222/02	**Annexe I Law 1614/2000.**
4	Total dissolved solids	TDS	mg/L	240	500	
5	Organic matter	OM	mg O_2/L	1,18	No limits	
6	Hardness	---	mg $CaCO_3$/L	60	300	
7	Total phosphorus	P	mg/L	0,0723	0,05	
8	Total nitrogen	N	mg/L	0,483	0,6	
9	Nitrates	NO_{3-}	mg/L	<0,0200	10	
10	Chlorides	Cl-	mg/L	33,3	-	250
11	Alkalinity	---	mg $CaCO_3$/L	54,6	-	250
12	Bicarbonates	---	mg $CaCO_3$/L	27,8	No limits	
13	Carbonates		mg $CaCO_3$/L	0,00	No limits	
14	Sulphates	SO_4^{2-}	mg/L	29,7	250	
15	Sodium	Na	mg/L	30,9	200	
16	Potasium	K	mg/L	5,84	-	12
17	Calcium	Ca	mg/L	19,4	-	100
18	Magnesium	Mg	mg/L	2,73	-	50
19	Fluorine	F	mg/L	0,190	-	1,5
20	Boron	B	mg/L	1,15	No limits	

TABLE 60. BACTERIOLOGICAL PARAMETERS - GW 06				
GW 06				
BACTERIOLOGICAL PARAMETERS				
Nº	**Parameter**	**Unit**	**Measured value**	**Regulation NP 2400180 limits**
21	Faecal coliforms	NMP/100mL	**>23**	1,1 NMP/100mL
22	Total coliforms	NMP/100mL	**9,2**	1,1 NMP/100mL
23	E. coli	NMP/100mL	Absent	Absent

APPENDIX C:
ANALYSIS OF THE RESULTS
PER POINT

TABLE OF CONTENT

LIST OF TABLES

C1 FW104-ZA - NEGLA STREAM – UPPER PART OF THE MICRO-WATERSHED

TABLE 1. OUT-OF-RANGE PARAMETERS – FW104-ZA				
COD: FW 104-ZA	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	40	**4**
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Ammonia	0,083 mg/L		0,02 mg/L	
Soluble iron	1,110 mg/L		0,3 mg/L	
Total coliforms	16000 NMP/100mL		1000 NMP/100mL	
Faecal coliforms	16000 NMP/100mL		200 NMP/100mL	

C2 GW18-ZA – HEADQUARTERS OF "ZAPALLLO" FARM – DEEP TUBULAR WELL USED FOR WATER DRINKING SUPPLY

TABLE 2. OUT-OF-RANGE PARAMETERS – GW18-ZA				
COD: GW 18-ZA	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	14	**4**
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total phosphorus	0,352 mg/L		0,05	
Nitrates	10,5 mg/L		10	
Faecal coliforms	16 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C3 FW201-ST – NAPAGUE STREAM – UPPER MIDDLE PART OF THE NEGLA STREAM MICRO-WATERSHED

TABLE 3. OUT-OF-RANGE PARAMETERS – FW201-ST				
COD: FW 201-ST	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	41	3
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Ammonia	0,0594 mg/L		0,02 mg/L	
Soluble iron	0,935 mg/L		0,3 mg/L	
Faecal coliforms	540 NMP/100mL		200 NMP/100mL	

C4 GW 20-ST - HEADQUARTERS OF THE "SANTA TERESA" FARM - DEEP TUBULAR WELL USED FOR DRINKING WATER SUPPLY

TABLE 4. OUT-OF-RANGE PARAMETERS – GW20-ST				
COD: GW 20-ST	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	14	4

OUT-OF-RANGE PARAMETER	LABORATORY RESULTS	REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS
pH	5,63	6-9
Nitrates	22,8 mg/L	10 mg/L
Faecal coliforms	12 NMP/100mL	1,1 NMP/100mL
Total coliforms	>23 NMP/100mL	1,1 NMP/100mL

C5 FW 315-HE - "HERMOSA" STREAM - UPPER WATERSHED OF THE "HERMOSA" CREEK MICRO-WATERSHED

TABLE 5. OUT-OF-RANGE PARAMETERS – FW315-HE				
COD: FW 315-HE	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	37	7
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Total phosphorus	0,103 mg/L		0,05 mg/L	
Total nitrogen	0,734 mg/L		0,6 mg/L	
Ammonia	0,0587 mg/L		0,02 mg/L	
Manganese	0,274 mg/L		0,1 mg/L	
Soluble iron	1,11 mg/L		0,3 mg/L	
Faecal coliforms	1200		200 NMP/100mL	
Total coliforms	35000		1000 NMP/100mL	

C6 GW 19-HE - HEADQUARTERS OF THE "HERMOSA" FARM - DEEP TUBULAR WELL FOR DRINKING WATER SUPPLY

TABLE 6. OUT-OF-RANGE PARAMETERS – GW19-HE				
COD: GW 19-HE	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	15	3
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total phosphorus	0,577 mg/L		0,05 mg/L	
Faecal coliforms	9,2 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C7 GW 304-HE - TREMENTINA STREAM – UPPER WATERSHED OF THE TREMENTINA STREAM MICRO-WATERSHED

TABLE 7. OUT-OF-RANGE PARAMETERS – GW304-HE				
COD: FW 304-HE	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	39	**5**
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Total phosphorus	0,0639 mg/L		0,05 mg/L	
Ammonia	0,0880 mg/L		0,02 mg/L	
Soluble iron	0,913 mg/L		0,3 mg/L	

Faecal coliforms	330 NMP/100mL	200 NMP/100mL
Total coliforms	3500 NMP/100mL	1000 NMP/100mL

C8 GW 23-SL - HEADQUARTERS OF THE "SAN LIBERATO" FARM – DEEP TUBULAR WELL FOR WATER PROVISION FOR HUMAN CONSUMPTION

TABLE 8. OUT-OF-RANGE PARAMETERS – GW23-SL				
COD: GW 23-SL	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	14	4
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
pH	5,71		6-9	
Total phosphorus	0,0947 mg/L		0,05 mg/L	
Faecal coliforms	23 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C9 GW 16-GA - HEADQUARTERS OF THE "SAN GAVILÁN" FARM AT 200 METRES FROM *EUCALYPTUS SP.* PLANTATIONS – DEEP TUBULAR WELL TO PROVIDE WATER FOR HUMAN CONSUMPTION

TABLE 9. OUT-OF-RANGE PARAMETERS – GW16-GA				
COD: GW 16-GA	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	17	1
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total coliforms	12 NMP/100mL		1,1 NMP/100mL	

C10 FW 100-GASL - TREMENTINA STREAM – MIDDLE/UPPER CATCHMENT OF THE TREMENTINA STREAM MICRO-WATERSHED RUNS THROUGH APPROXIMATELY 7 KM OF *EUCALYPTUS SP.* PLANTATIONS

TABLE 10. OUT-OF-RANGE PARAMETERS FW 100-GASL				
COD: FW 100-GASL	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	38	5
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02**	
Dissolved oxygen	4,47 mg/L		>5 mg/L	
Total phosphorus	0,0586mg/L		0,05 mg/L	
Total Nitrogen	0,750 mg/L		0,6 mg/L	
Ammonia	0,0457 mg/L		0,02 mg/L	
Soluble Iron	0,550 mg/L		0,3 mg/L	

C11 FW 200-SL - TRIBUTARY OF THE TREMENTINA STREAM AT THE SOUTHEAST OF THE HEADQUARTERS OF THE "SAN LIBERATO" FARM – MIDDLE CATCHMENT OF THE TREMENTINA STREAM

TABLE 11. OUT-OF-RANGE PARAMETERS – FW200-SL				
COD: FW 200-SL	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	39	5
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Turbidity	489 NTU		100NTU	
Ammonia	0,138 mg/L		0,02 mg/L	
Soluble iron	1,05 mg/L		0,3 mg/L	
Faecal coliforms	7900 NMP/100mL		200 NMP/100mL	
Total coliforms	22000 NMP/100mL		1000 NMP/100mL	

C12 FW 207-TR - TRIBUTARY OF THE TREMENTINA STREAM, 5 KM AT THE NORTH OF THE HEADQUARTERS OF THE "TREMENTINA" FARM – MIDDLE CATCHMENT OF THE TREMENTINA STREAM

TABLE 12. OUT-OF-RANGE PARAMETERS – FW207-TR				
COD: FW 207-TR	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	38	6
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Dissolved oxygen	2,43 mg O_2/L		> 5 mg O_2/L	
Total phosphorus	0,0796 mg/L		0,05 mg/L	
Ammonia	0,0687 mg/L		0,02 mg/L	
Soluble iron	3,31 mg/L		0,3 mg/L	
Faecal coliforms	790 NMP/100mL		200 NMP/100mL	
Total coliforms	1700 NMP/100mL		1000 NMP/100mL	

C13 FW 208-TR - TREMENTINA STREAM, 2 KM NORTHWEST OF THE TREMENTINA FARM'S HEADQUARTERS – MIDDLE CATCHMENT OF THE TREMENTINA STREAM

TABLE 13. OUT-OF-RANGE PARAMETERS – FW208-TR				
COD: FW 208-TR	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	38	6
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Dissolved oxygen	4,30 mg O_2/L		> 5 mg O_2/L	
Total nitrogen	0,748 mg/L		0,6 mg/L	
Amoniaco	0,0603 mg/L		0,02 mg/L	
Ammonia	1,33 mg/L		0,3 mg/L	
Soluble iron	35000 NMP/100mL		200 NMP/100mL	
Faecal coliforms	35000 NMP/100mL		1000 NMP/100mL	

C14 GW 11-MICHEL - DEEP TUBULAR WELLS LOCATED IN NEW PLANTATIONS OF *EUCALYPTUS SP* – MIDDLE BASIN OF THE TREMENTINA STREAM

TABLE 14. OUT-OF-RANGE PARAMETERS – GW11-MICHEL				
COD: GW 11-MICHEL	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	14	4
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
pH	5,87		6-9	
Total phosphorus	0,107 mg/L		0,05 mg/L	
Faecal coliforms	>23 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C15 GW 10-TR - TREMENTINA FARM HEADQUARTERS –MIDDLE BASIN OF THE TREMENTINA STREAM, DAIRY FARM AND CORRALS WITHIN 200 METRES OF THE AII OF THE WELL, USE FOR DRINKING WATER SUPPLY

TABLE 15. OUT-OF-RANGE PARAMETERS – GW10-TR				
COD: GW 10-TR	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	15	3
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total phosphorus	0,876 mg/L		0,05	
Faecal coliforms	10 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C16 GW 13-SAN JUAN - "SAN JUAN" FARM, THE MIDDLE BASIN OF THE TREMENTINA STREAM – WELL FOR DRINKING WATER SUPPLY

TABLE 16. OUT-OF-RANGE PARAMETERS – GW13-SAN JUAN				
COD: GW 13-SAN JUAN	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	26	6	16	4
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 LIMITS**	
Total phosphorus	0,127 mg/L		0,05 mg/L	
Nitrates	106 mg/L		10 mg/L	
Faecal coliforms	>23 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C17 GW 22-SILVA - "SILVA" FARM, THE MIDDLE BASIN OF THE TREMENTINA STREAM – WELL FOR DRINKING WATER SUPPLY

TABLE 17. OUT-OF-RANGE PARAMETERS – GW22-SILVA				
COD: GW 22-SILVA	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	14	4
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
pH	5,54		6-9	
Nitrates	55,2 mg/L		10 mg/L	
Faecal coliforms	23 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C18 FW 205-TR - TREMENTINA STREAM, 2.7 KM EAST OF THE TREMENTINA FARM HEADQUARTERS, MIDDLE CATCHMENT OF THE TREMENTINA STREAM MICRO-CATCHMENT

TABLE 18. OUT-OF-RANGE PARAMETERS – FW205-TR				
COD: FW 205-TR	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	36	8
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
BOD5	5,32 mg O_2/L		5 mg O_2/L	
Total phosphorus	0,384 mg/L		0,05 mg/L	
Ammonia	0,521 mg/L		0,02 mg/L	
Manganese	0,127 mg/L		0,1 mg/L	
Soluble iron	1,56 mg/L		0,3 mg/L	
Faecal coliforms	780 NMP/100mL		200 NMP/100mL	
Total coliforms	7000 NMP/100mL		1000 NMP/100mL	
Nickel	0,145 mg/L		0,025 mg/L	

C19 GW 12-LAGUNA - "LAGUNA" FARM, THE MIDDLE BASIN OF THE TREMENTINA STREAM MICRO-BASIN – WELL FOR DRINKING WATER SUPPLY AND IRRIGATION OF SEEDLINGS, CURRENTLY DEVELOPING A FOREST NURSERY AND PLANTATION OF NEW CROPS OF *EUCALYPTUS SP*

TABLE 19. OUT-OF-RANGE PARAMETERS – GW12-LAGUNA				
COD: GW 12-LAGUNA	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	15	3
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total phosphorus	0,264 mg/L		0,05 mg/L	
Faecal coliforms	6,9 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C20 FW 109-MYRZ - TREMENTINA STREAM, POINT LOCATED BETWEEN THE "MANDYJU" AND "RANCHO Z" PROPERTY BOUNDARIES – MIDDLE CATCHMENT OF THE "TREMENTINA" STREAM MICRO-WATERSHED

TABLE 20. OUT-OF-RANGE PARAMETERS – FW109-MYRZ				
COD: FW 109-MYRZ	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	38	6
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Dissolved oxygen	4,58 mg O_2/L		> 5 mg O_2/L	
Total phosphorus	0,194 mg/L		0,05 mg/L	
Ammonia	0,055 mg/L		0,02 mg/L	
Soluble iron	1,19 mg/L		0,3 mg/L	
Faecal coliforms	11000 NMP/100mL		200 NMP/100mL	
Total coliforms	11000 NMP/100mL		1000 NMP/100mL	

C21 FW 115-MANDYJU - TREMENTINA STREAM, A POINT LOCATED 11 KM SOUTHEAST OF THE "RANCHO Z" FOREST PLANTATIONS – MIDDLE CATCHMENT OF THE TREMENTINA STREAM MICRO-WATERSHED

TABLE 21. OUT-OF-RANGE PARAMETERS – FW115-MANDYJU				
COD: FW 115- MANDYJU	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	38	6
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Dissolved oxygen	4,98 mg O_2/L		>5 mg O_2/L	
Total phosphorus	0,0882 mg/L		0,05 mg/L	
Ammonia	0,065 mg/L		0,02 mg/L	
Soluble iron	1,13 mg/L		0,3 mg/L	
Faecal coliforms	390 NMP/100mL		200 NMP/100mL	
Total coliforms	9000 NMP/100mL		1000 NMP/100mL	

C22 FW 317-RZ - TREMENTINA STREAM – LOWER CATCHMENT OF THE TREMENTINA STREAM MICRO-CATCHMENT

TABLE 22. OUT-OF-RANGE PARAMETERS – FW317-RZ				
COD: FW 317-RZ	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	39	5
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Ammonia	0,115 mg/L		0,02 mg/L	
Soluble iron	0,951 mg/L		0,3 mg/L	
Faecal coliforms	330 NMP/100mL		200 NMP/100mL	
Total coliforms	1100 NMP/100mL		1000 NMP/100mL	
Lead	0,0494 mg/L		0,01 mg/L	

C23 FW 204-LB - TREMENTINA STREAM POINT LOCATED 5 KM UPSTREAM OF THE OUTFLOW POINT OF THE TREMENTINA STREAM TO THE AQUIDABÁN RIVER – THE LOWER WATERSHED OF THE "TREMENTINA" STREAM MICRO-WATERSHED

TABLE 23. OUT-OF-RANGE PARAMETERS – FW204-LB				
COD: FW 204-LB	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	39	5
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Ammonia	0,226 mg/L		0,02 mg/L	
Soluble iron	1,14 mg/L		0,3 mg/L	
Faecal coliforms	3500 NMP/100mL		200 NMP/100mL	
Total coliforms	16000 NMP/100mL		1000 NMP/100mL	
Nickel	0,0513 mg/L		0,025 mg/L	

C24 FW 110-LB - UNNAMED STREAM – TRIBUTARY OF THE AQUIDABÁN RIVER

TABLE 24. OUT-OF-RANGE PARAMETERS – FW110-LB				
COD: FW 110-LB	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	37	7
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Dissolved oxygen	2,38 mg O_2/L		>5 mg O_2/L	
Total phosphorus	0,0548 mg/L		0,05 mg/L	
Manganese	0,122 mg/L		0,1 mg/L	
Ammonia	0,224 mg/L		0,02 mg/L	
Soluble iron	1,41 mg/L		0,3 mg/L	
Faecal coliforms	4300 NMP/100mL		200 NMP/100mL	
Total coliforms	160000 NMP/100mL		1000 NMP/100mL	

C25 FW 111-LB - AQUIDABÁN RIVER – LOWER-MIDDLE BASIN OF THE AQUIDABÁN RIVER CATCHMENT

TABLE 25. OUT-OF-RANGE PARAMETERS – FW111-LB				
COD: FW 111-LB	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	37	7
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
pH	5,91		6 – 9	
Total phosphorus	0,114 mg/L		0,05 mg/L	
Ammonia	0,331 mg/L		0,02 mg/L	
Manganese	0,4 mg/L		0,1 mg/L	
Soluble iron	1,56 mg/L		0,3 mg/L	
Faecal coliforms	490 NMP/100mL		200 NMP/100mL	
Total coliforms	1400 NMP/100mL		1000 NMP/100mL	

C26 FW 310-CR - AQUIDABÁN RIVER - LOWER BASIN OF THE AQUIDABÁN RIVER CATCHMENT

TABLE 26. OUT-OF-RANGE PARAMETERS – FW310-CR				
COD: FW 310-CR	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	36	8
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Turbidity	355 NTU		100 NTU	
BOD5	5,51 mg O_2/L		5 mg O_2/L	
Total phosphorus	0,0518 mg/L		0,05 mg/L	
Ammonia	0,150 mg/L		0,02 mg/L	
Manganese	0,341 mg/L		0,1 mg/L	
Soluble iron	2,36 mg/L		0,3 mg/L	
Faecal coliforms	11000 NMP/100mL		200 NMP/100mL	
Total coliforms	11000 NMP/100mL		1000 NMP/100mL	

C27 FW 316-CR - "LAGUNA PENAYO" STREAM – LOWER BASIN OF THE AQUIDABÁN RIVER

TABLE 27. OUT-OF-RANGE PARAMETERS – FW316-CR				
COD: FW 316-CR	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	39	5
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
BOD5	5,05 mg O_2/L		5 mg O_2/L	
Total nitrogen	0,779 mg/L		0,6 mg/L	
Ammonia	0,0331 mg/L		0,02 mg/L	
Soluble iron	0,991 mg/L		0,3 mg/L	
Lead	0,0134 mg/L		0,01 mg/L	

C28 GW 14-ZM - HEADQUARTERS OF THE "ZANJA MOROTĨ" FARM - DEEP TUBULAR WELL FOR DRINKING WATER SUPPLY

TABLE 28. OUT-OF-RANGE PARAMETERS – GW14-ZM				
COD: GW 14-ZM	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	15	3
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total phosphorus	0,204 mg/L		0,05 mg/L	
Faecal coliforms	6,9 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C29 GW 15-SO - HEADQUARTERS OF THE "SOLEDAD" FARM - DEEP TUBULAR WELL FOR DRINKING WATER SUPPLY

TABLE 29. OUT-OF-RANGE PARAMETERS – GW15-SO				
COD: GW 15-SO	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	11	7
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total dissolved solids	665 mg/L		500 mg/L	
Hardness	313 mg $CaCO_3$/L		300 mg $CaCO_3$/L	
Total nitrogen	0,734 mg/L		0,6 mg/L	
Nitrates	199 mg/L		10 mg/L	
Alkalinity	299 mg $CaCO_3$./L		250 mg $CaCO_3$./L	
Faecal coliforms	>23 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C30 FW 306-SO - TRIBUTARY OF THE PITANOHAGA STREAM- UPPER CATCHMENT OF THE PITANOHAGA STREAM MICRO-WATERSHED

TABLE 30. OUT-OF-RANGE PARAMETERS – FW306-SO				
COD: FW 306-SO	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	63	19	39	5
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Amoniaco	0,0872 mg/L		0,02 mg/L	
Soluble iron	1,02 mg/L		0,3 mg/L	
Faecal coliforms	540 NMP/100mL		200 NMP/100mL	
Total coliforms	920 NMP/100mL		1000 NMP/100mL	
Lead	0,0229 mg/L		0,01 mg/L	

C31 GW 17-LP - HEADQUARTERS OF "LA PARAGUAYA" FARM - DEEP TUBULAR WELL FOR WATER PROVISION FOR HUMAN CONSUMPTION

TABLE 31. OUT-OF-RANGE PARAMETERS – GW17-LP				
COD: GW 17-LP	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	15	3
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total phosphorus	0,0699 mg/L		0,05 mg/L	
Faecal coliforms	>23 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C32 GW 21-MC - HEADQUARTERS OF THE "MACHUCA-CUE" FARM - DEEP TUBULAR WELL FOR DRINKING WATER SUPPLY

TABLE 32. OUT-OF-RANGE PARAMETERS – GW21-MC				
COD: GW 21-MC	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS	BEYOND THE LIMITS
	23	5	14	4
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS**	
Total phosphorus	0,170 mg/L		0,05 mg/L	
Nitrates	75,5 mg/L		10 mg/L	
Faecal coliforms	>23 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C.33 FW01 PARAGUAY RIVER – PROJECT'S ADA – POINT LOCATED 2.5 KM UPSTREAM BEFORE THE EFFLUENT DISCHARGE POINT.

TABLE 33. OUT-OF-RANGE PARAMETERS FW 01 – PARAGUAY RIVER				
COD: FW 01	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS.	BEYOND THE LIMITS
	64	15	44	5
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Total phosphorus	0,0694 mg/L		0,05 mg/L	
Ammonia	0,0989 mg/L		0,02 mg/L	
Nitrites	0,01533 mg/L		1 mg/L	
Manganese	0,113 mg/L		0,1 mg/L	
Soluble Iron	1,52 mg/L		0,3 mg/L	

C.34 **FW02 PARAGUAY RIVER – PROJECT'S ADA -POINT LOCATED 2.5 KM DOWNSTREAM OF THE EFFLUENT DISCHARGE POINT**.

TABLA 34. OUT-OF-RANGE PARAMETERS FW 02				
COD: FW 02	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS.	BEYOND THE LIMITS
	64	15	46	3
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 PERMISSIBLE LIMITS**	
Ammonia	0,0441 mg/L		0,02	
Manganese	0,144 mg/L		0,1 mg/L	
Soluble iron	0,804 mg/L		0,3 mg/L	

C.35 MONITORING WELL GW01 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

TABLA 35. OUT-OF-RANGE PARAMETERS GW 01	
COD:	PARAMETERS

GW 01	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS.	BEYOND THE LIMITS
	23	5	5	13
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80 PERMISSIBLE LIMITS**	
Electric conductivity	2400		1250	
Total dissolved solids	1.181		500	
Hardness	281		300	
Total phosphorus	0,356		0,05	
Total nitrogen	2,73		0,6	
Chlorides	285		250	
Alkalinity	397		250	
Sulfates	337		250	
Sodium	374		200	
Fluorine	2,30		1,5	
E Coli	Presence		Absent	
Fecal coliforms	>23 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

C.36 MONITORING WELL GW02 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

TABLA 36. OUT-OF-RANGE PARAMETERS GW 02				
COD: GW 02	PARAMETROS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS.	BEYOND THE LIMITS
	23	5	14	4
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80 PERMISSIBLE LIMITS**	
Hardness	84		300	
Total phosphorus	0,0776		0,05	
Potassium	16,5		12	
Fluorine	1,60		1,5	

C.37 MONITORING WELL GW04 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

TABLA 37. OUT-OF-RANGE PARAMETERS GW 04				
COD: GW 04	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS.	BEYOND THE LIMITS
	23	5	5	13
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**LÍMITS: REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80**	
Electric Conductivity	5.010		1250	
TDS	2.577		500	
Hardness	709		300	
Total phosphorus	12		0,05	
Total nitrogen	9,02		0,6	
Chlorides	611		250	
Alkalinity	282		250	
Sodium	367		200	
Calcium	164		100	

Magnesium	72,9	50
E Coli	Presence	Absent
Fecal coliforms	>23 NMP/100mL	1,1 NMP/100mL
Total coliforms	>23 NMP/100mL	1,1 NMP/100mL

C.38 MONITORING WELL GW05 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

TABLA 38. OUT-OF-RANGE PARAMETERS GW 05				
COD: GW 05	PARAMETERS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS.	BEYOND THE LIMITS
	23	5	14	4
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**LÍMITS REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80**	
Hardness	88,1		300	
E Coli	Presence		Absent	
Fecal coliforms	1,1 NMP/100mL		1,1 NMP/100mL	
Total coliforms	5,1 NMP/100mL		1,1 NMP/100mL	

C.39 MONITORING WELL GW06 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

TABLA 39. OUT-OF-RANGE PARAMETERS GW 06				
COD: GW 06	PARAMETROS			
	PARAMETER QUANTITY	NO LIMITS	COMPLY WITH THE LIMITS.	BEYOND THE LIMITS
	23	5	14	4
OUT-OF-RANGE PARAMETER	**LABORATORY RESULTS**		**LÍMITS: REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80**	
Total phosphorus	60 mg/L		0,05 mg/L	
Total nitrogen	0,073 mg/L		0,6 mg/L	
Fecal coliforms	9,2 NMP/100mL		1,1 NMP/100mL	
Total coliforms	>23 NMP/100mL		1,1 NMP/100mL	

APPENDIX D.
PHOTOGRAPHY GALLERY OF THE FIRST MONITORING CAMPAIGN

FW 104 - ZA

GW 18-ZA

FW 201-ST

GW 20-ST

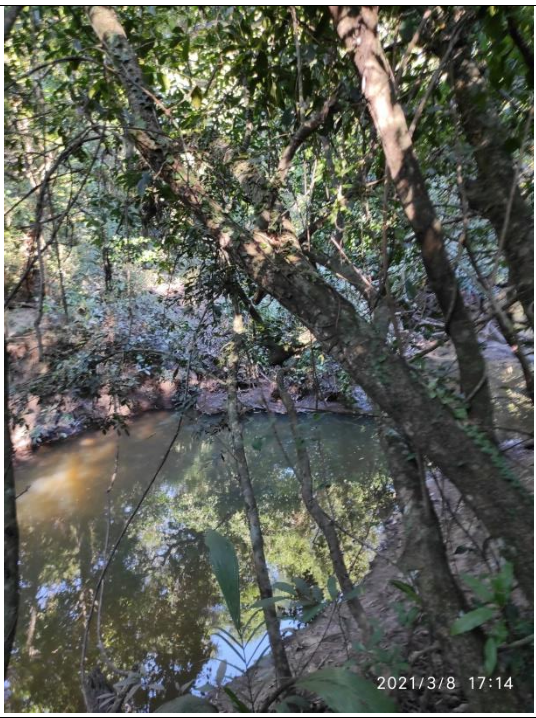
FW 315-HE	
	

GW 19-HE	
	

FW 304-HE	
	

GW 23-SL	
	

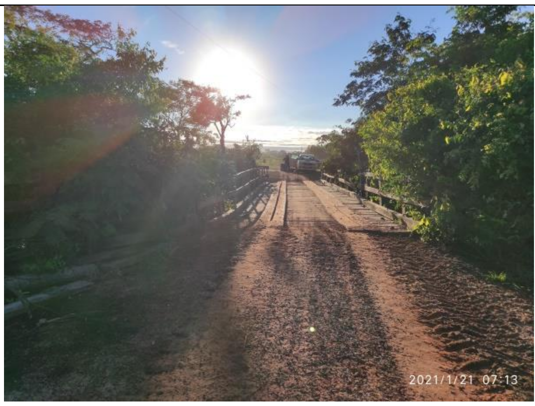
GW 16-GA	
	

FW 100-GASL	
	

FW 200-SL	
	

FW 207-TR

FW 208-TR



GW 11-MICHEL

GW 10-TR

GW 13-SAN JUAN

FW 205-TR

GW 12- Laguna

FW 109-MYRZ

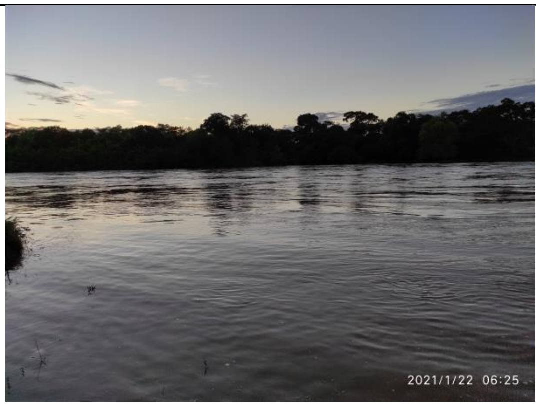
FW 115-MANDYJU

FW 317-RZ

FW 204-LB

FW 110-LB

FW 111-LB



FW 310-CR

FW 316-CR	
	

GW 14-ZM	
	

GW 15-SO	
	

FW 306 -SO	
	

GW 17-LP

GW 21-MC

FW 01

FW 02

GW 01

GW 02

GW 03

GW 04

GW 05

GW 06

APPENDIX E.
SUPPLIERS NOTE

Lasca

San Lorenzo, 20 de Abril de 2021

Dr. Gilberto Antonio Benitez
CEMIT.-
Presente.-

En relación los productos que fueron cotizados de la cartera **SIGMA ALDRICH** y que aún siguen pendientes de entrega, informamos que el motivo de la demora obedece a la crisis sanitaria actual, ya que los vuelos están supeditados a vuelos cargueros no comerciales (como es habitual), por lo que las fechas de embarque dependen exclusivamente de las informaciones que recibimos desde origen USA.

A la fecha seguimos aguardando confirmación de vuelo que estimamos sería dentro de este mes, de igual manera estamos duplicando esfuerzos para que estos tiempos logísticos demoren lo menos posible y podamos cumplir con sus necesidades

De nuestra mayor consideración.-

B.C. Rossana Vallejos.
Productos Químicos y Reactivos
Vicente Scavone & Cía. S.A.E

TRANSLATION

Note: texts between parenthesis and with different fonts are our comments and they describe certain particularities of the document, such as logos, and others.

(*There is a Logo:* **LASCA laboratory**)

San Lorenzo, 20th April, 2021

Dr. Gilberto Antonio López
CEMIT
Present:

Regarding to the products from SIGMA ALDRICH that are still pending delivery, we inform you that the reason for the delay is due to the current health crisis, since the flights depends on non-commercial cargo flights (as usual), so the shipment dates rest exclusively on the information we receive from the USA.

We are still awaiting confirmation of the flight, which we estimate will be within this month. We are also doubling our efforts so that these logistical issues can be solve as soon as possible so we can meet your needs.

Kind regards,

B.C. Rossana Vallejos
Reagents and chemical products
Vicente Scavone & Cía. S.A.E