Araguaia Níquel Metais LTDA

ENVIRONMENTAL IMPACT REPORT

(RELATÓRIO DE IMPACTO AMBIENTAL - RIMA)

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THE ENVIRONMENTAL IMPACT REPORT

This Environmental Impact Report *(Relatório de Impacto Ambiental - RIMA*) refers to the Araguaia Nickel North Project, a mineral project in the region of the municipality of Xinguara, in Pará state (PA), under the responsibility of Araguaia Níquel Metais LTDA, a subsidiary of the Horizonte Minerals Group.

The RIMA of the Araguaia Nickel North Project, as described below, systematizes, in accordance with the current environmental legislation, the results obtained in its Environmental Impact Study (*Estudo de Impacto Ambiental - EIA*), with an estimated life of mine of 24 years.

This Environmental Impact Assessment Report was prepared in a didactic manner, seeking to use clear and accessible language for all audiences that may be interested in the project.

The RIMA of the Araguaia Nickel North Project contains illustrations, figures, maps, tables, graphs and other communication techniques that aim to present the environmental impacts the project may cause in the proposed location and its area of influence, both positive and negative. It also presents mitigating measures for the negative environmental impacts, as well as the potential social and economic gains that the project may generate for the region.

This RIMA also contains the main characteristics of the Araguaia Nickel North Project, as well as the current environmental and social situation of the project location and its surroundings.

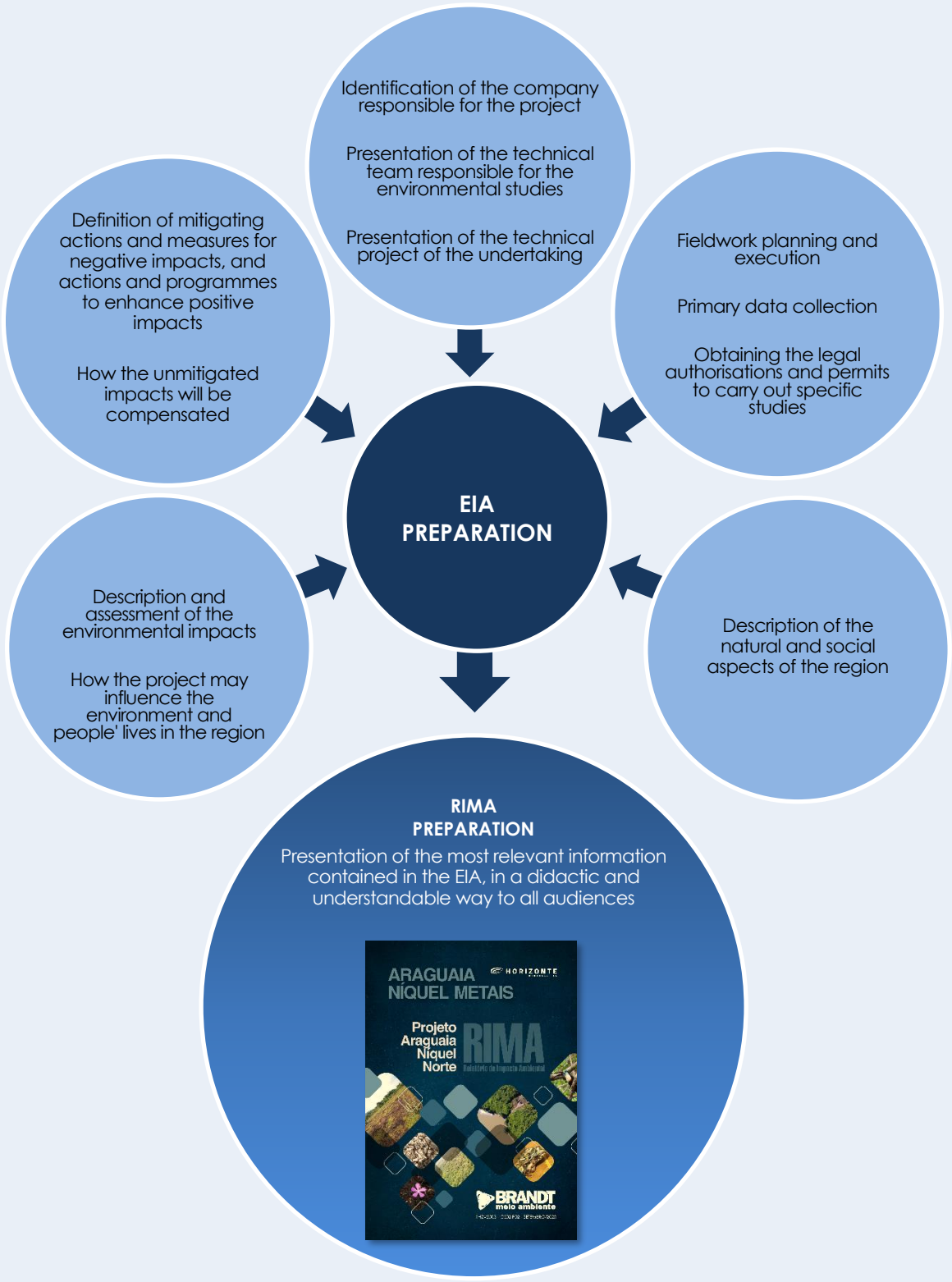
The figure below illustrates the main stages followed for the preparation of this RIMA, with information and data compiled from the project's Environmental Impact Study (EIA).

Environmental Impact Study *(Estudo de Impacto Ambiental - EIA)*

The Environmental Impact Study is a technical document that presents the assessments and environmental analyses that enable environmental agencies to decide on the environmental feasibility of a project. The environmental studies are prepared by professionals from several knowledge fields.

Environmental Impact Report *(Relatório de Impacto Ambiental - RIMA)*

The Environmental Impact Report is a public document, which presents the project under study, its characteristics, the environment where it is located and the positive and negative socioenvironmental impacts resulting from the project, in a didactic, clear and objective manner.


Identification of the company responsible for the project
Presentation of the technical team responsible for the environmental studies
Presentation of the technical project of the undertaking
Fieldwork planning and execution
Primary data collection
Obtaining the legal authorisations and permits to carry out specific studies
Description of the natural and social aspects of the region
Description and assessment of the environmental impacts
How the project may influence the environment and people' lives in the region
Definition of mitigating actions and measures for negative impacts, and actions and programmes to enhance positive impacts
How the unmitigated impacts will be compensated
EIA PREPARATION
RIMA PREPARATION
Presentation of the most relevant information contained in the EIA, in a didactic and understandable way to all audiences
ARAGUAIA NÍQUEL METAIS
HORIZONTE
Projeto Araguaia Níquel Norte
RIMA
BRANDT meio ambiente

UNDERSTANDING THE PROJECT

Location and importance

The Araguaia Nickel North Project is an undertaking from the company Araguaia Níquel Metais Ltda and basically consists of the exploration of a lateritic nickel deposit in the municipality of Xinguara, approximately 22 km from Vila São José do Araguaia, and 70 km east of the municipality's urban area. The following figure shows the Project location and the nearest communities and municipal headquarters.

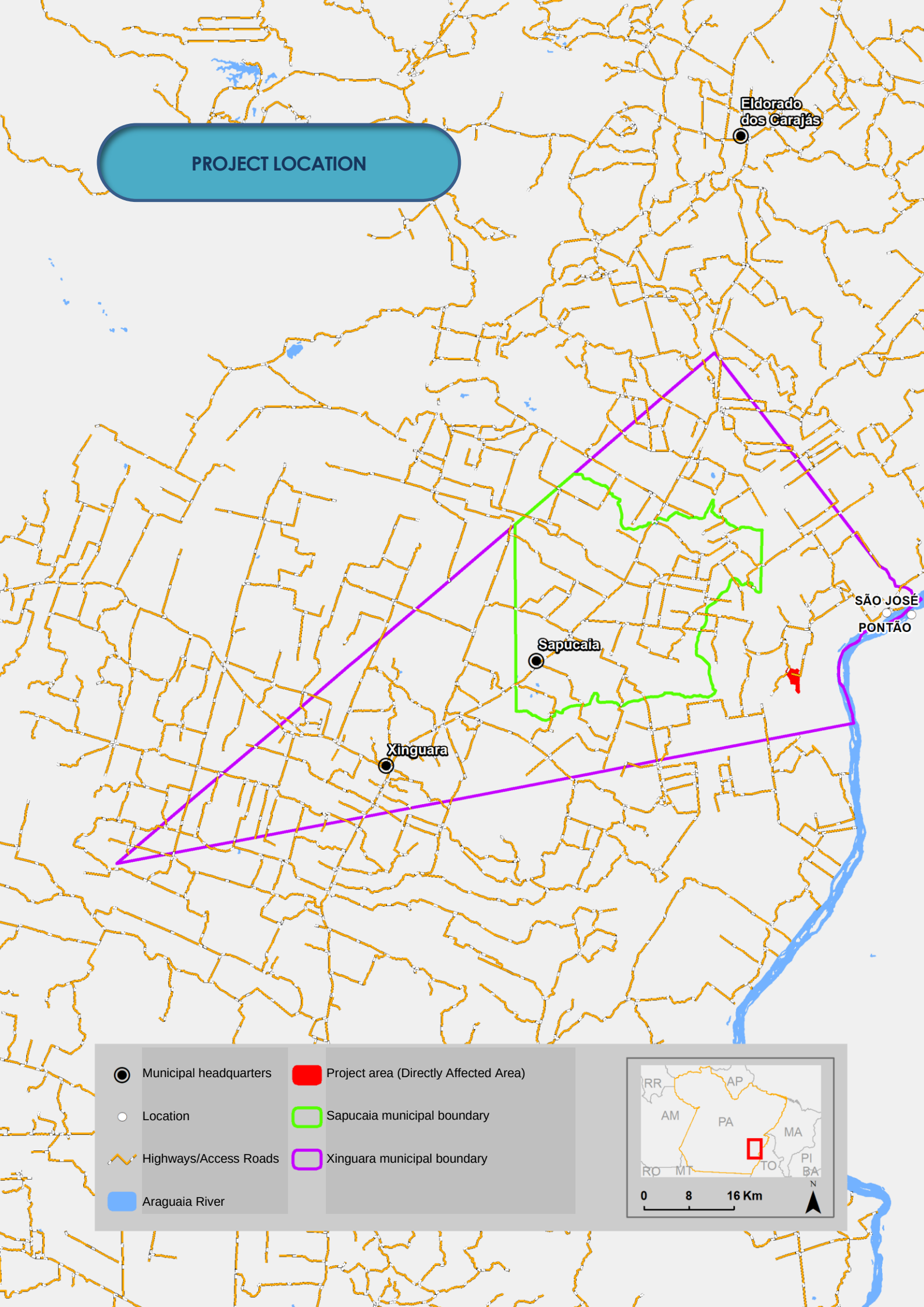
The nickel ore, to be extracted in open pit mine, will be stockpiled in the mine area and will be reclaimed on demand and transported by trucks to the facilities to process the ore and produce ferronickel. These facilities belong to the same company (Araguaia Níquel Metais Ltda) and are located in the municipality of Conceição do Araguaia, approximately 80 km from the mineral deposit.

Sample of nickel ore
Source: www.mgb.ba.gov.br

The socioeconomic study demonstrates that the Araguaia Nickel North Project may be important both due to the economic use of the ore, which will generate resources for the municipal, state and federal governments, from taxes and legal contributions, as well as due to the economic opportunities, income and jobs that the sustainable mining activity can offer to the Project region.

Did you know

Nickel is an essential metal to produce stainless steel, a metal alloy that is crucial for the food, chemical and oil industries. The stainless steel is also used in the production of household appliances and vehicles and in the construction industry.


PROJECT LOCATION
Eldorado dos Carajás
SÃO JOSÉ
PONTÃO
Sapucaia
Xinguara
Municipal headquarters
Location
Highways/Access Roads
Araguaia River
Project area (Directly Affected Area)
Sapucaia municipal boundary
Xinguara municipal boundary
RR
AP
AM
PA
MA
TO
PI
BA
RO
MT
0
8
16 Km
N

Location alternatives

Araguaia Níquel Metais Ltda has other mining rights in the south eastern region of Pará state. The Araguaia Nickel North Project, identified under ANM Case 850.493/2005 (*Agência Nacional de Mineração - ANM* is the Brazilian Mining Authority), comprises a nickel orebody that meets technical specifications in terms of quantity and quality to enable the company to operate in its integrated project, considering the processing, metallurgy and production of ferronickel.

Regarding the nickel ore, within the limits of the company's mining rights, extraction shall be carried out where the nickel grades make the extraction feasible.

Thus, the feasibility of mining and the use of the ore in industrial production are directly related to the locations where the ore naturally occurs and its easiness or difficulty to be extracted and handled. As a rule, as in this case, the location of the mining areas cannot be determined or alternatively selected by other criteria, such as environmental, for example, but by the mineral natural deposition criteria, that yields the grades that make its extraction economically feasible. This is called mineral deposits' locational rigidity, obviously preserving and respecting the social and environmental restrictions legally established by law.

Considering the restrictions associated with the mineral deposits' locational rigidity, as locational alternatives that can reduce negative environmental impacts from mining activities, what one should do is to analyse the environment and select alternatives for the location of the project's infrastructure facilities.

For the Araguaia Nickel North Project, the locations for the construction of roads, waste dumps and ore stockpiles were considered, which implied less vegetation suppression, and with it all other impacts resulting from this vegetation suppression on the animals that use it, and also other aspects such as sediment being produced and modifications in water and air. Priority was given to areas that had already been highly modified, such as pastureland, with no surface water resources, such as springs and streams or natural cavities.

Furthermore, when areas with vegetation were indispensable to use, the company has been diligent in using the structures already in place in these areas, such as using existing roads.

The distribution of the mine areas and structures associated with the project was defined as shown in the following image.

How will the nickel extraction process work?

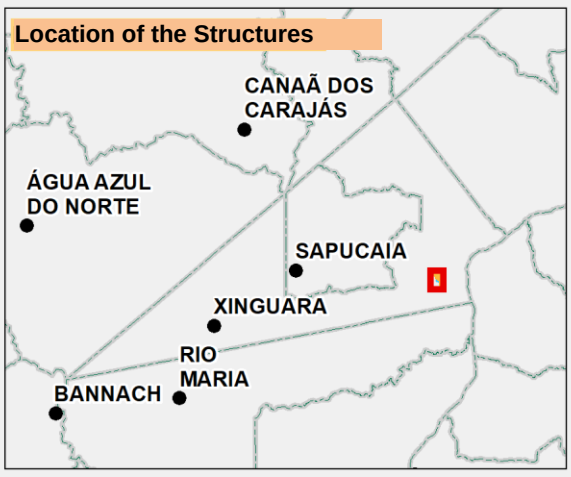
Vegetation and topsoil will be removed. The soil will be stored to be used in the recovery process of the areas occupied by the project.

The area to be suppressed is predominantly pasture and with the presence of low sized vegetation, composed of grasses and bushes, *juquira* or *capoeira*. Part of this vegetation resource will be preserved so that it can be used in the recovery of degraded areas.

This is when the digging of the ground begins to reach the ore. The ore explored in Araguaia Nickel North Project will be partly transported directly to the plant and partly stockpiled in the mine area, being reclaimed on demand and transported to the processing and metallurgy plant of the Araguaia Nickel South Project, in Conceição do Araguaia. The Araguaia South Project already has a Construction License issued by SEMAS (Pará State Secretariat for Environment and Sustainability).

The figure STAGES OF THE MINING PROCESS TO BE IMPLEMENTED shows, in a schematic way, these stages of the Araguaia Nickel North Project, which is the focus of this RIMA.

ARAGUAIA NICKEL PROJECT STRUCTURES

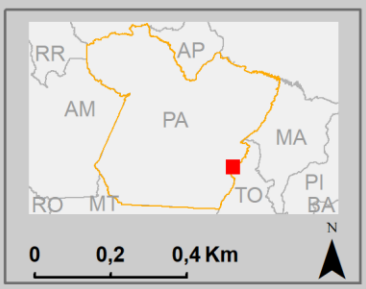


Locations

- Municipal headquarters
- Municipal boundary

Structures of the *Vale dos Sonhos* Project ARA North

- Dam
- Office Infrastructure
- Waste Piles
- Ore Piles
- Final Pit
- Dams' Drainage System
- Roads
- Topsoil Areas



STAGES OF THE MINING PROCESS TO BE IMPLEMENTED

Construction — Timescale: 6 months

1. Vegetation suppression using chainsaw
2. Opening accesses
3. Topsoil extraction
4. Installing support structures

Operation — Timescale: 16 years

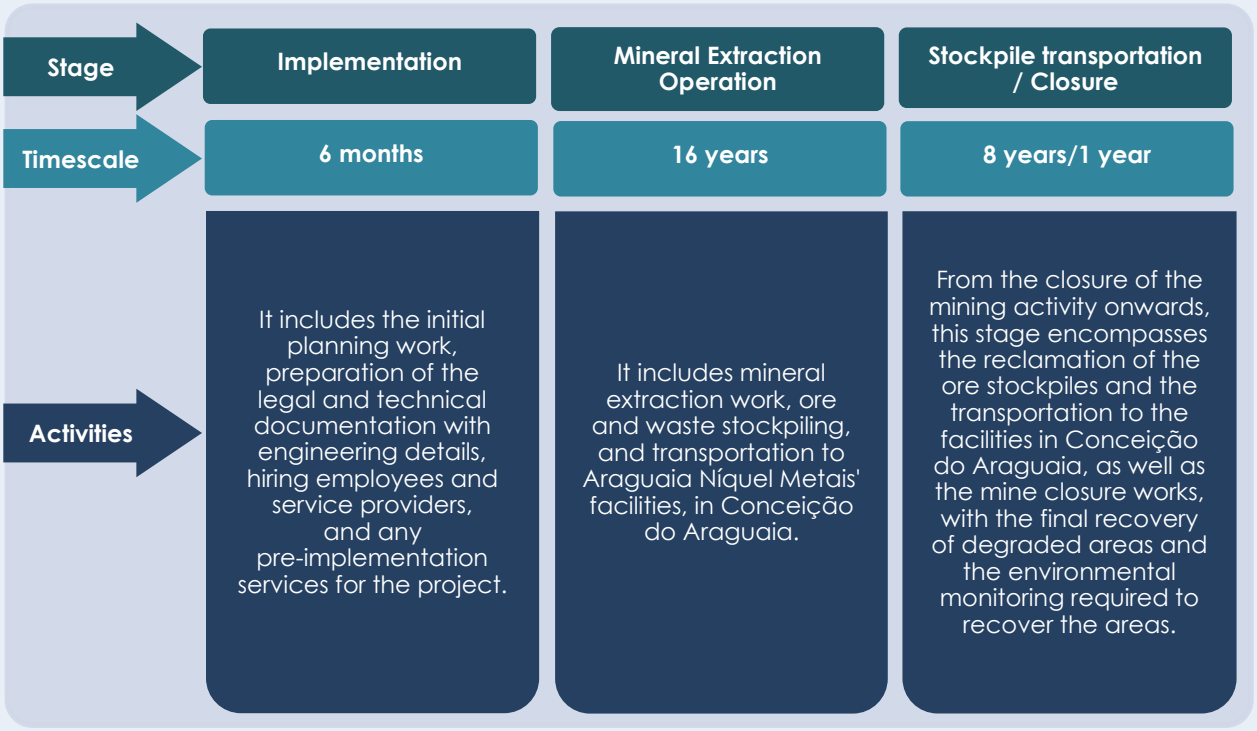
5. Ore extraction
6. Stocking
7. Truck loading
8. Ore transportation for processing

Closure — Timescale: 8 years

9. Equipment removal actions
10. Environmental recovery of the degraded areas

The stages of the project

The Araguaia Nickel North Project is divided into three stages: Implementation, Mineral Extraction Operation, Transport and Closure.



DEVELOPING THE ENVIRONMENTAL STUDIES

The territorial scope in which the environmental studies were developed is shown in the following figures.

This territorial scope, herein referred to as the Study Area, was established based on the project engineering that defined the operational limits required for the development of the mine and its infrastructure.

Did you know

The Project area is also referred to as the Directly Affected Area (*Área Diretamente Afetada - ADA*) and corresponds to the area where the project structures will be implemented, such as pits, ore stockpiles and waste disposal, as well as the areas necessary for the implementation of the mines' operational infrastructure, such as internal accesses, offices, workshops and other support and auxiliary structures.

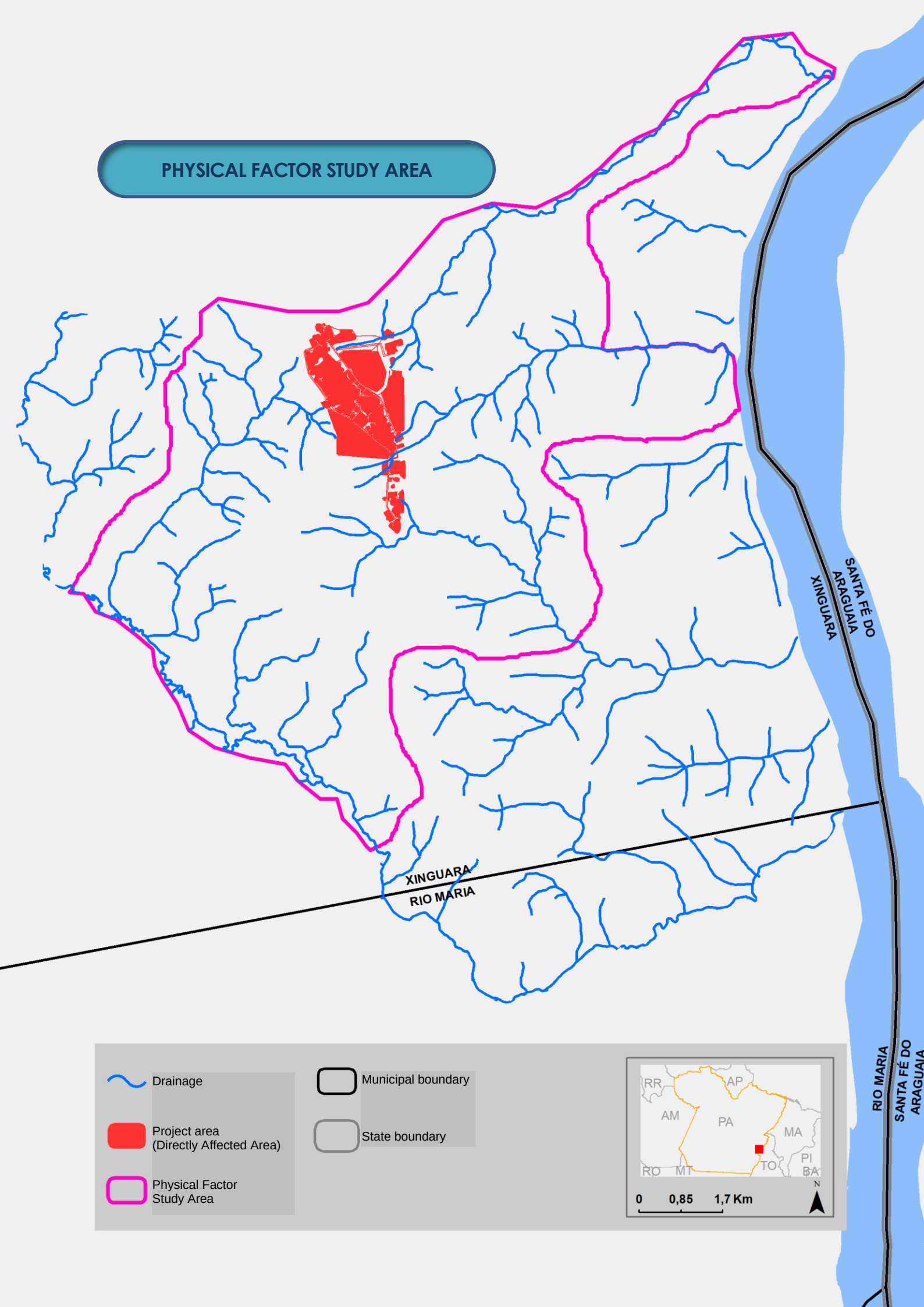
The Study Area about which the environmental assessment work was carried out was defined according to each factor separately: Physical, Biotic and Socioeconomic.

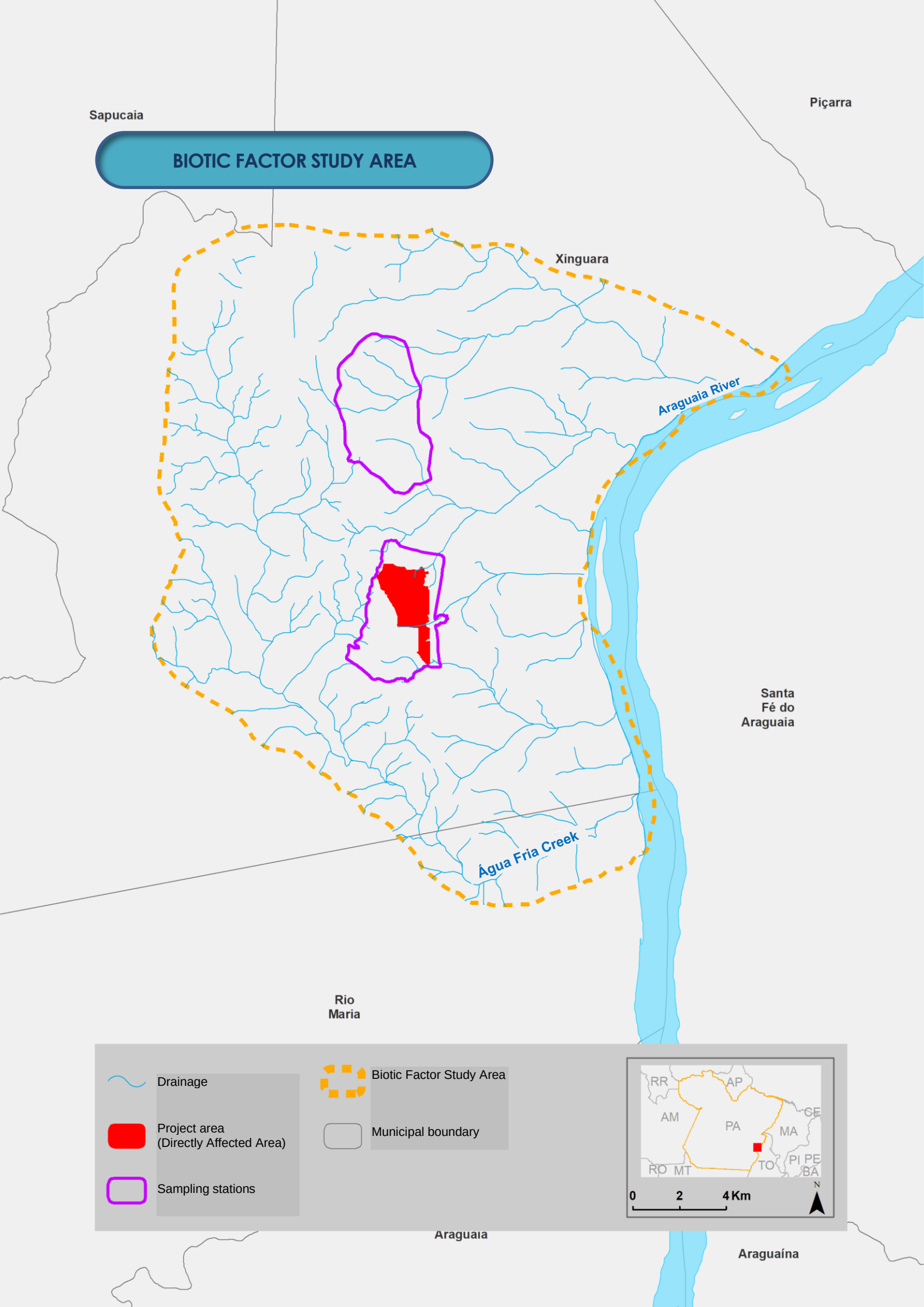
For the **Physical Factor**, the Study Area was defined based on the location of the micro-basins that drain the Project Area and characteristics such as topography and morphology of the land around the Project Area.

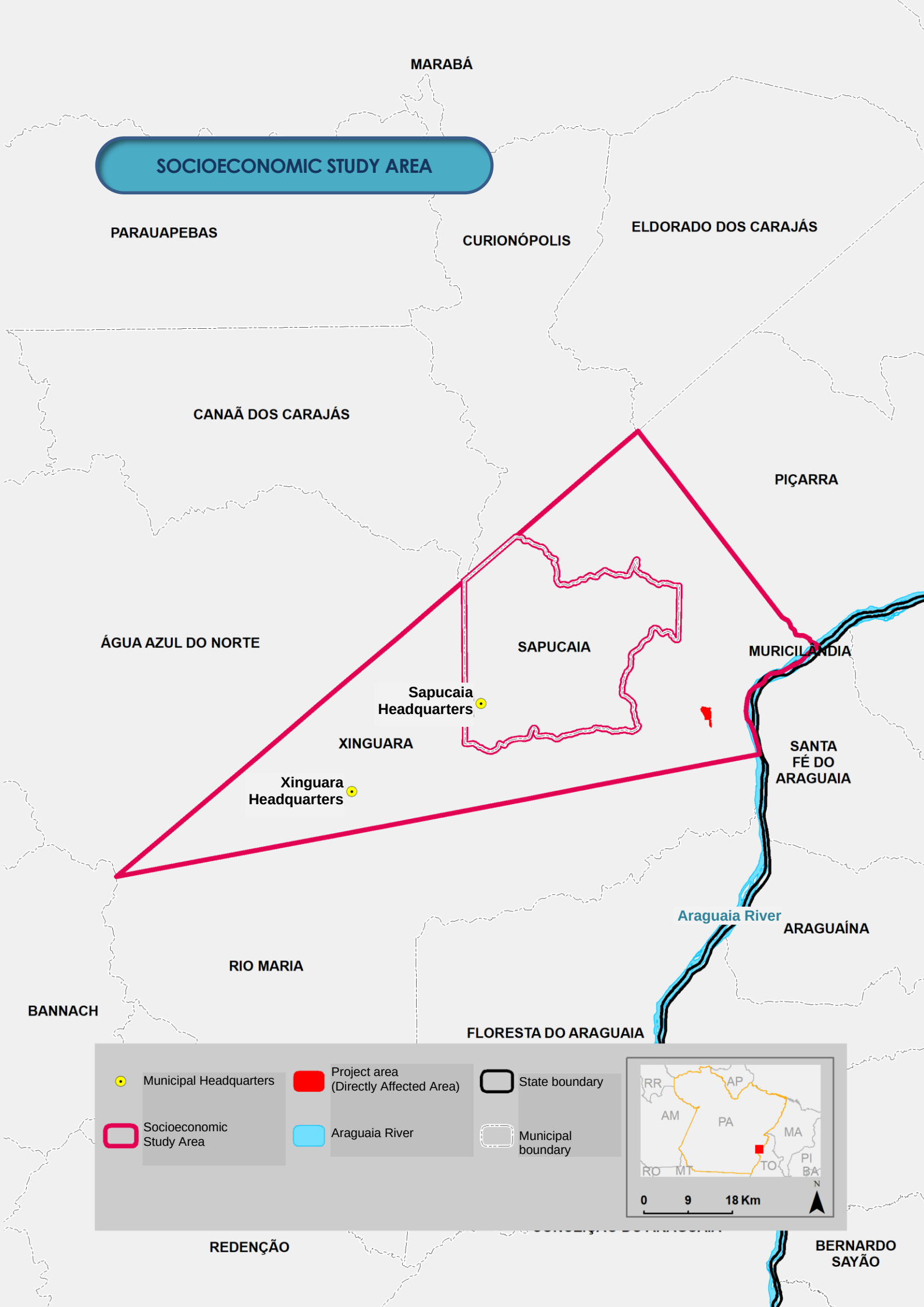
The **Biotic Factor** Study Area was also defined based on the same criteria of micro-basins, topography and land morphology, and other criteria were also considered related to altitude, vegetation and their correlations found in the region of the project.

The **Socioeconomic Factor** Study Area was defined considering the economic, land and cultural aspects of the municipality where the Project is located, as well as the presence of communities and houses around the Project Area, considering the municipalities of Xinguara and Sapucaia.

The Area of Influence of the Araguaia Nickel North Project and its main environmental attributes identified are presented in detail later in this RIMA.

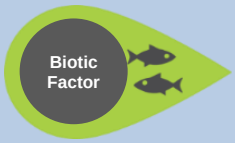

PHYSICAL FACTOR STUDY AREA
SANTA FÉ DO ARAGUAIA
XINGUARA
XINGUARA
RIO MARIA
RIO MARIA
SANTA FÉ DO ARAGUAIA
Drainage
Project area
(Directly Affected Area)
Physical Factor
Study Area
Municipal boundary
State boundary
RR
AP
AM
PA
MA
PI
BA
TO
MT
RO
N
0
0,85
1,7 Km


BIOTIC FACTOR STUDY AREA
Sapucaia
Piçarra
Xinguara
Araguaia River
Santa Fé do Araguaia
Água Fria Creek
Rio Maria
Araguaia
Araguaína
Drainage
Project area (Directly Affected Area)
Sampling stations
Biotic Factor Study Area
Municipal boundary
RR
AP
AM
PA
MA
CE
RO
MT
TO
PI
PE
BA
0
2
4 Km
N


SOCIOECONOMIC STUDY AREA
MARABÁ
PARAUAPEBAS
CURIONÓPOLIS
ELDORADO DOS CARAJÁS
CANAÃ DOS CARAJÁS
PIÇARRA
ÁGUA AZUL DO NORTE
SAPUCAIA
MURICILÂNDIA
Sapucaia Headquarters
XINGUARA
SANTA FÉ DO ARAGUAIA
Xinguara Headquarters
Araguaia River
ARAGUAÍNA
RIO MARIA
BANNACH
FLORESTA DO ARAGUAIA
REDENÇÃO
BERNARDO SAYÃO
Municipal Headquarters
Project area (Directly Affected Area)
State boundary
Socioeconomic Study Area
Araguaia River
Municipal boundary
RR
AP
AM
PA
MA
PI
BA
TO
MT
RO
N
0
9
18 Km

LEARNING ABOUT THE ENVIRONMENTAL ASPECTS

The following table summarises the environmental requirements and features adopted in the environmental assessment undertaken within the Project Study Area, which includes the Area of Influence of the Araguaia Nickel North Project.

	Study of the physical characteristics of a region based on aspects related to climate, soil and subsoil, relief, noise levels and running water on the ground surface (rivers, streams and others).
	Study of terrestrial and aquatic plants (Flora) and animals (Fauna) of a region, delving into the study of those that show whether the environment presents good levels of quality for their survival and for human life (bioindicator species), and pointing out which species of animals and plants are rare or threatened of extinction. The presence of environmental preservation areas, such as Conservation Units (*Unidades de Conservação - UCs*) and Permanent Preservation Areas (*Áreas de Preservação Permanente - APPs*), is also assessed in this factor.
	Study of aspects related to the historical formation of the region, population statistics, the population's standard of living, economic conditions, the municipal historical and cultural heritage, among others.

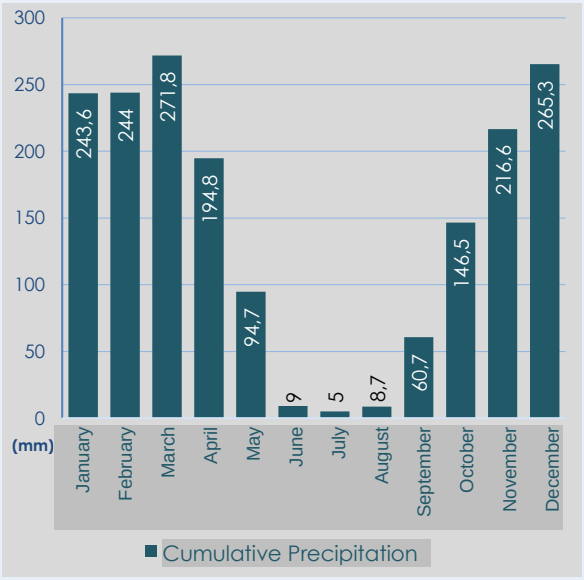
Physical Factor

It refers to non-living aspects that make up the environment, such as water, soil, relief, climate and rocks, among others. These aspects are necessary for the existence and maintenance of human, plant and animal life in a region.

Climate and Water Resources

The state of Pará, due to its vast territory, among other factors, presents various climatic types in its municipalities. The region of the project, located in the southeast of Pará, has an Equatorial Warm and Humid climate with average temperatures of approximately 20-21C° in the coldest months, reaching averages between 34°C and 37°C in the warmest months. With regard to the rainfall regime, the region's climate is marked by a period of intense rainfall, which lasts from November to April, and a short dry period, from June to September.

Rainfall regime, in mm, from 1981 to 2010



Hydrography

The Study Area is located in the Tocantins-Araguaia Hydrographic Region, which corresponds to 10.8% of Brazilian territory and involves six states: Goiás, Tocantins, Pará, Maranhão, Mato Grosso and the Federal District. The main consumptive use of water in the Tocantins-Araguaia Hydrographic Region is irrigation, which accounts for 62% of the total water demand in the region.

View of the Araguaia River at the section included in the Study Area. Source: Brandt

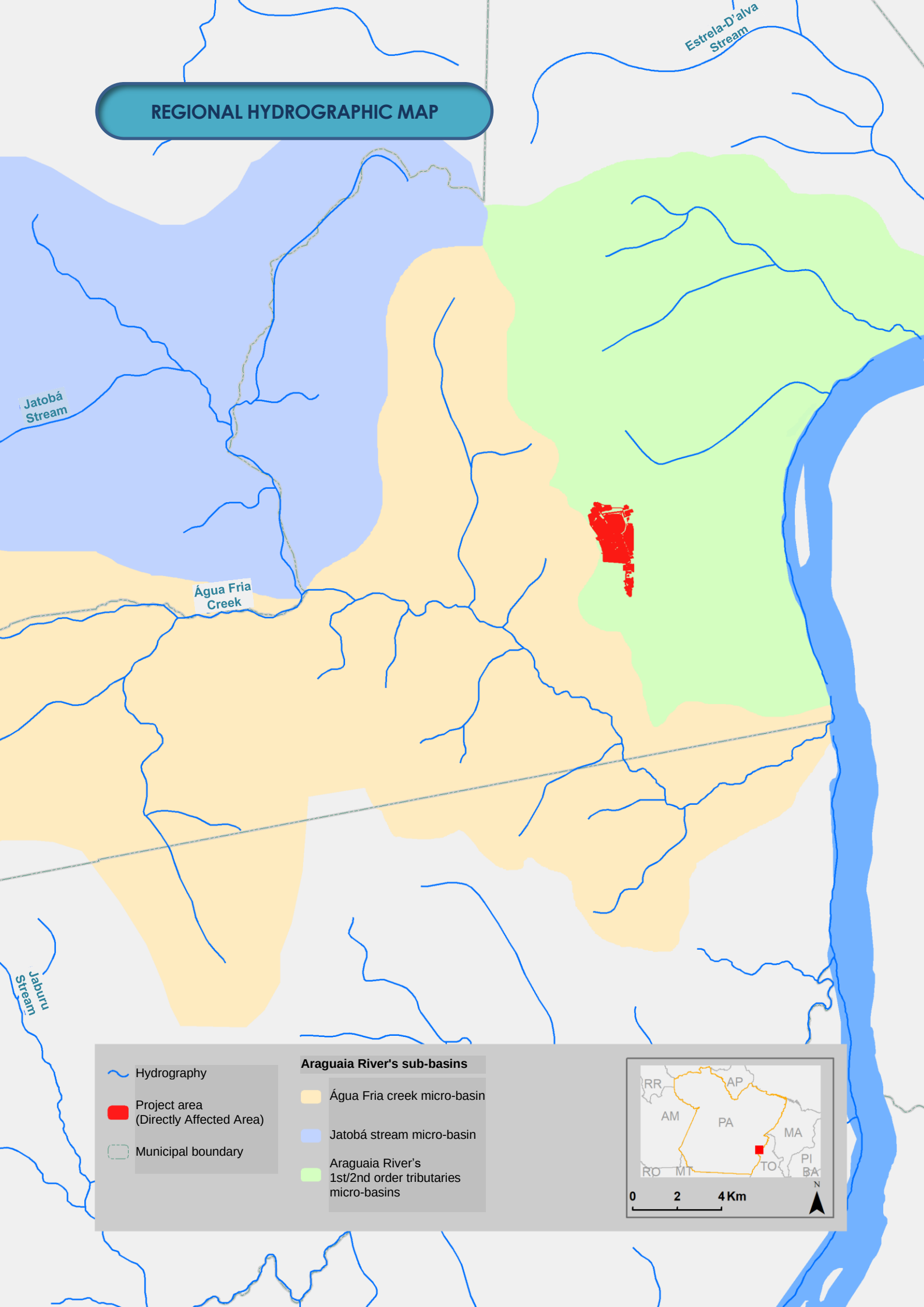
Did you know

To facilitate water resources management, the National Water Resources Council (*Conselho Nacional de Recursos Hídricos - CNRH*) defined 12 Hydrographic Regions in the Brazilian territory, taking into account the social, economic and environmental diversities of each region in the country.

The region is composed of a series of micro-basins and the ones that occupy the greatest extension are made up of five direct tributaries of the left bank of the Araguaia River. These are generally intermittent, i.e., they dry up at least near their springs during the dry season.

Drainage top *(cabeceira)* located in the Study Area in the dry season. Source: Brandt

REGIONAL HYDROGRAPHIC MAP



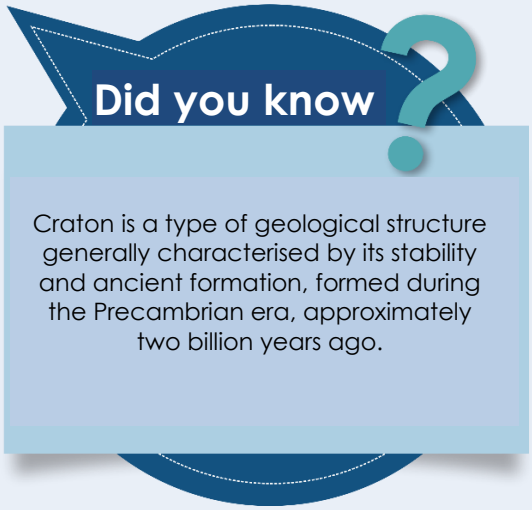
Air quality, noise and vibration

The current air quality in the Project region was assessed at 4 points located in the closest surrounding communities. Five parameters indicating air quality were assessed, in particular the concentration of particulate matter, which represents the main emission that the mineral extraction project will produce. When the measurements were taken, the air quality was in good condition, and the values of particulate matter in the air were considered typical of a rural area. It should be noted that air quality in the region can vary significantly due to the occurrence of wildfires, which are also observed in the Project region.

Regarding the noise and vibration levels currently observed in the project region, measurements were also taken in the same locations and communities where the air quality measurements were taken. Similarly, noise levels are typical of rural activities, arising from local fauna and the inhabitants' daily activities, and no perceptible levels of vibration were recorded.

Geology, geomorphology and soils

From a geological point of view, the project area is located in the Araguaia Belt *(Faixa do Cinturão Araguaia)*. This unit was formed during the Brasiliano Cycle, a series of orogenic events that occurred millions of years ago, during the Proterozoic Eon (about 1,000 to 541 million years ago). More specifically, the region is located in the Tocantins Orogenic System, formed as a result of the convergence of three continental blocks: São Francisco, Amazon and Paranapanema Cratons. Today it is located between the Amazonian and the São Francisco Craton.



The north, east and south of the Araguaia Belt are covered by sedimentary basins, respectively the Parnaíba Basin, Bananal Basin and Paraná Basin. Sedimentary basins are formed, in summary, by the accumulation of sediments from upper areas, carried by water or wind and deposited in a lower area over millions of years.

The area that will be used for the project is marked by the presence of metasedimentary, sedimentary and basic rocks, such as phyllites, slates, peridotites, silexites, gabbro, diabase and recent layers.

From the geomorphology point of view - the science that studies the origin and forms of the relief - the study area falls into two main units: the Depression of the Lower Araguaia River, where the highest altitudes correspond to the residual forms (*testemunhos* hills) and the River Plains and Terraces. In the Lower Araguaia Depression, the relief is flattened, with average altitudes of 200 m.

Thus, geomorphologically, the area is inserted in a complex of isolated hills and mountains, with the mountain and hill features concentrated in the western part, and the eastern part being marked by smooth and rounded relief.

Hilly relief close to the Project area.
Source: Brandt

Soft-rounded relief in the eastern part of the Project area. Source: Brandt

Four soil classes are found in the Project implementation area: Red-Yellow Argissolos, more spatially present in the Xinguara region; *Cambissolos Háplicos*, the second most prevalent class in the directly affected area; Litholic Neosols, present to a large extent in the area directly affected by the project; and Red-Yellow Latosols, occurring in an isolated form and not very representative in the study area.

Did you know

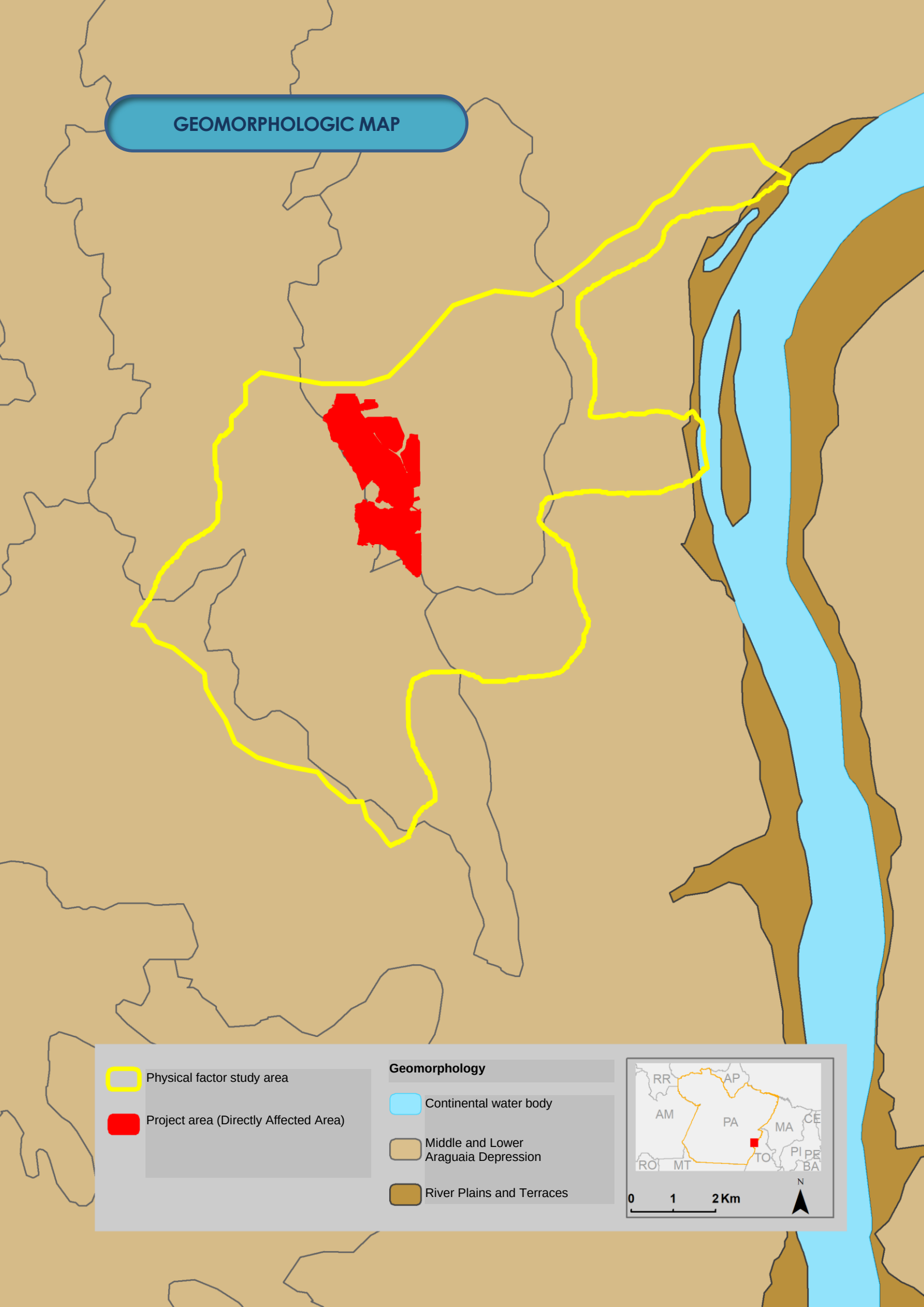
Pedology is the science that studies soil typologies, identifying, classifying and analysing the erosive potential that an area may develop.

Litholic Neosols, found in the area directly affected by the project, have a low degree of development, and may therefore develop a high erosive potential.

Litholic neosol in the area directly affected by the Project. Source: Brandt

***Cambissolos Háplicos* in the western part of the Project area.** Source: Brandt

GEOMORPHOLOGIC MAP



Water Resources

The Araguaia Nickel North Project is located in the Tocantins-Araguaia Hydrographic Region. The Jatobá Stream micro-basins, located within the project area, drain into the Araguaia river.

The quality of the water analysed, at various points in and around the Project area, presented natural characteristics with the presence of elements which are typical of the local geology.

Usual liquid effluents from the project include sediments which will be generated from water action in areas where soil and rock movement will occur, as a result of mining activities. Drainage and sediment containment systems were designed to control these effluents.

Sanitary and oily effluents will be produced as a consequence of human activities and cleaning and washing vehicles and machinery.

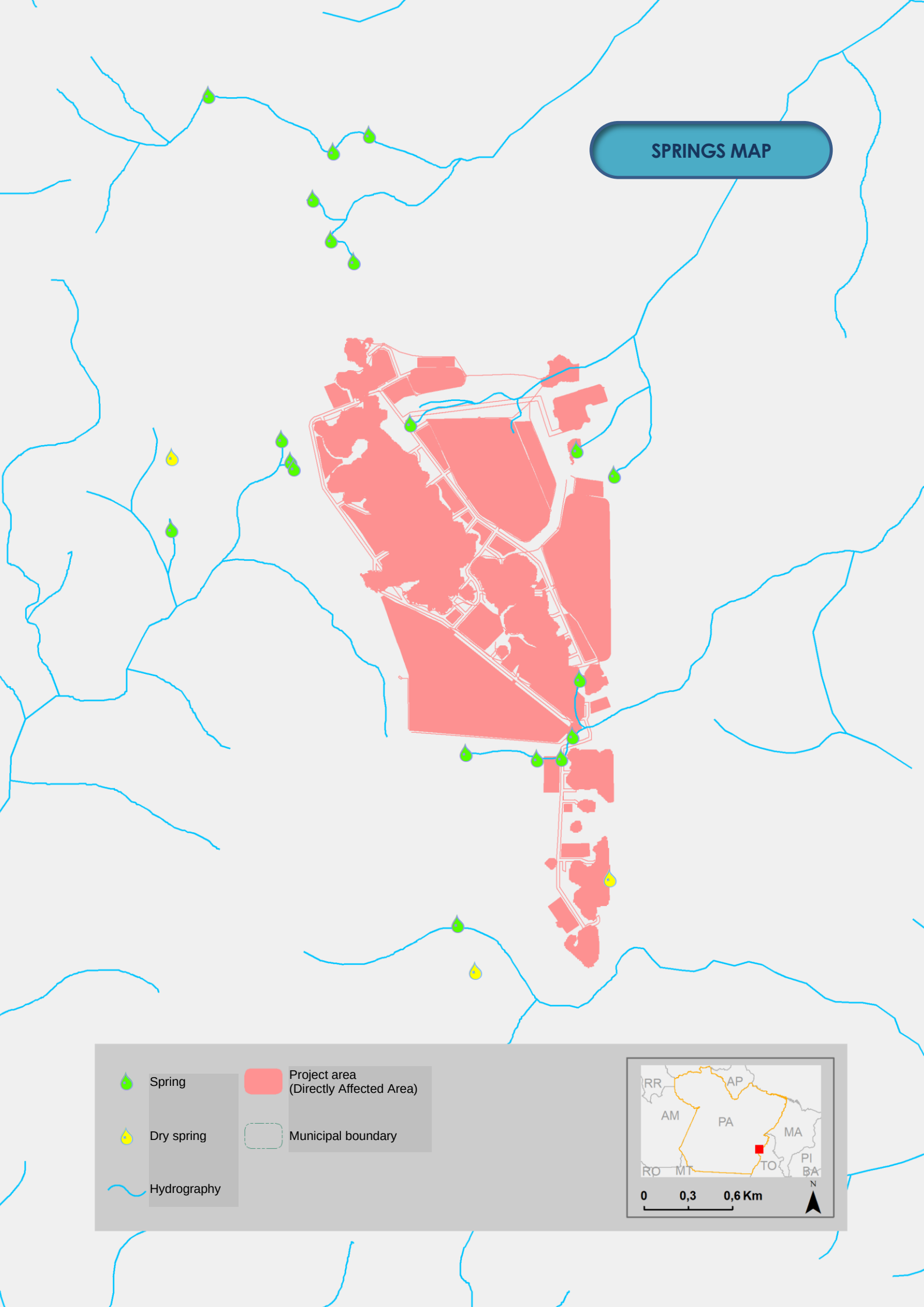
For sanitary effluents, septic tank and anaerobic filter integrated treatment systems are planned, with drains, so that sanitary effluents, although treated, will not be discharged into the natural drains around the Project.

The oily effluents will be treated in water and oil separating devices. The separated oil will be disposed of in accordance with the legislation and the final effluent will be recirculated as far as possible.

Wetland area in the project area. Source: Brandt

In 2016, Horizonte Minerals conducted a study to map the springs, in which 37 springs were identified, 17 of which are in the area surrounding the project. The following map shows the location of these springs.

SPRINGS MAP


Spring
Dry spring
Hydrography
Project area
(Directly Affected Area)
Municipal boundary
RR
AP
AM
PA
MA
PI
BA
TO
MT
RO
0
0,3
0,6 Km
N

Acid Drainage Assessment Study

Acid mine drainage mainly occurs when minerals containing iron sulphide are exposed to water and oxygen from the air, producing soluble iron and sulphuric acid.

There is no acid drainage process within the project area in its current condition, as well as there is no potential to generate acid drainage processes in the materials to be mined, either ore or waste. The presence of trace metals was observed in surface and groundwater, mostly below the detection limit.

Speleology

Using topography, geology, geography, biology, ecology, archaeology and palaeontology, among others, a study was carried out about the most likely areas to contain natural cavities, due to their characteristics. These were divided into categories of high speleological potential, medium potential, low potential, very low potential and unlikely potential (potential of containing natural cavities in each area).

The most spatially present categories in the Project area were those of unlikely and very low speleological potential. Four cavities were identified near the mining structures, located on the north eastern boundary of the Project area.

Cavity near the mining area.
Source: Brandt

Did you know

Speleology is the science that studies underground natural cavities, also known as caves.

Biotic Factor

The Biotic Factor mainly studies living beings, which means microorganisms, plants and animals as well as their habits of life, places where they live and all their diversity. Animals make up a group of living beings called fauna and plants make up the flora. Understanding the composition of the flora and fauna helps us understand how these beings depend on the place where they live and the consequences of modifications in these places.

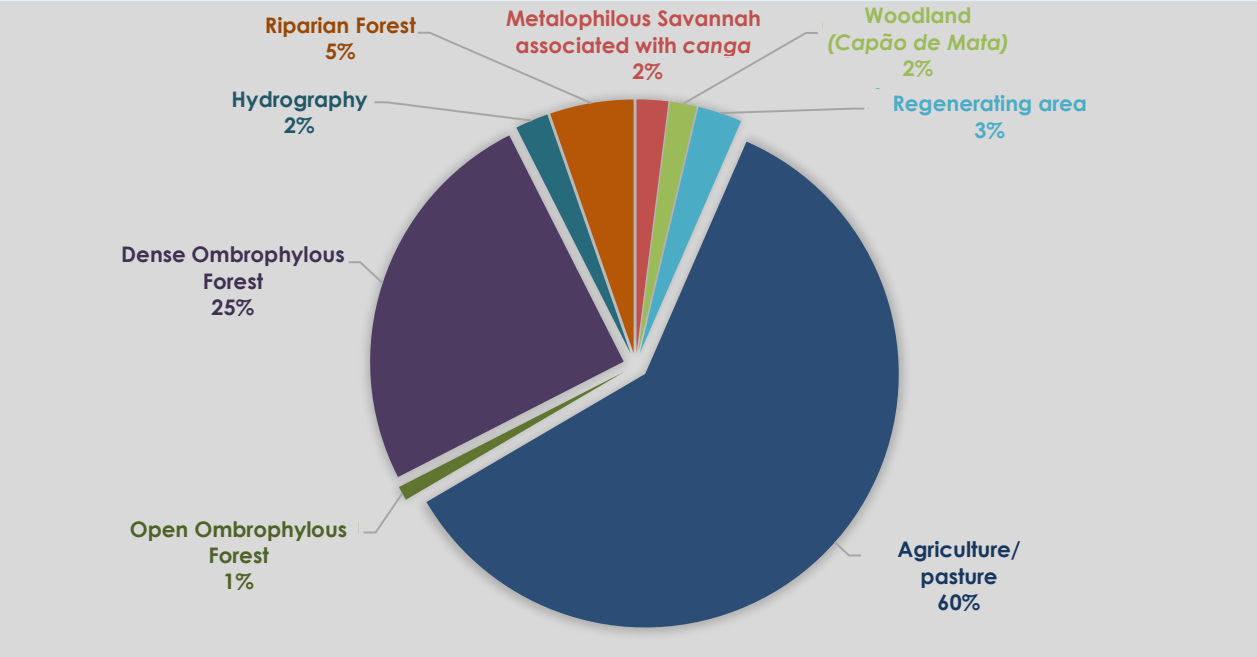
Land use and coverage

Land use and coverage refer to the ways in which the spaces of a given location are used and occupied. These kinds of use vary at each location depending on the type of soil, climate, vegetation and the human population present there. Twelve distinct land use and coverage classes have been classified in the study area. It is possible to observe natural and well-conserved environmental classes and areas with a marked presence of activities such as agriculture and livestock, which represents roughly 60% of the project area.

Among the most conserved areas, the most representative was the Dense Ombrophylous Forest, which accounts for approximately 25% of the project area. Among the human activities, the area devoted to agriculture and pasture stands out.

Soil uses with low representation were also recorded: roads (3%), anthropic areas (0.3%), dams (0.1%) and woodland *(Capão de Mata)* (2%).

Distribution of land use classes with natural origin



Ombrophylous Forest fragment.
Source: Brandt

Unpaved roads and pasture area.
Source: Brandt

Conservation Units *(Unidades de Conservação - UCs)*

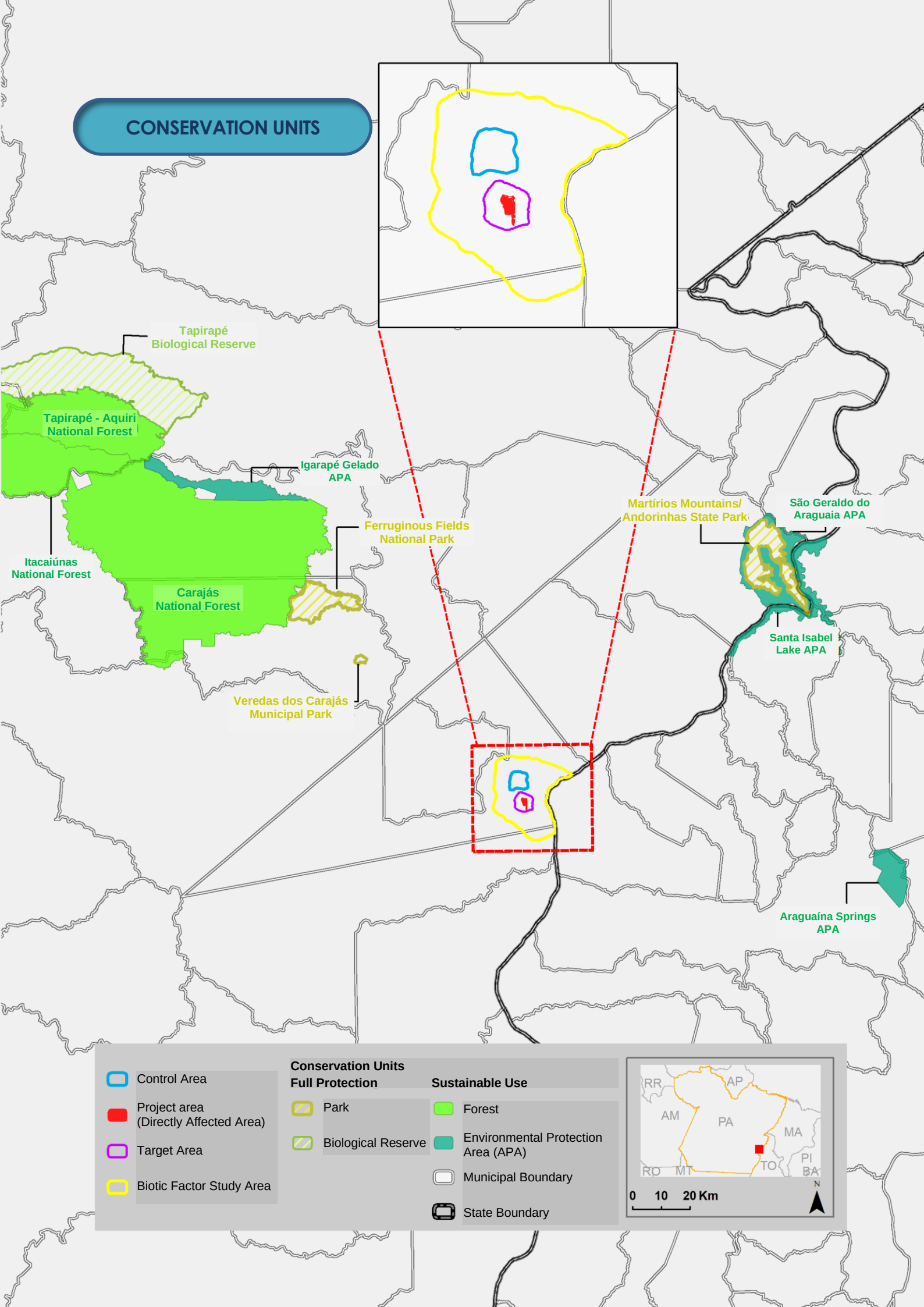
The Conservation Units (UCs) are protected areas that aim to preserve, protect, recover and enhance biodiversity, landscape, natural resources and traditional communities, such as indigenous peoples and *quilombolas*. The UCs also serve as an important resource for Environmental Education activities and scientific research.

There are two kinds of Conservation Units:

- ✓ **Full Protection:** this type of Conservation Unit has a more restricted use, where only scientific research, environmental education and visiting activities are allowed;
- ✓ **Sustainable Use:** it is possible to carry out scientific research, environmental education, visits and resource exploitation activities, as long as they are done in a sustainable manner, maintaining the conservation of biodiversity.

In the southeastern region of Pará State, which is the macro region where the Araguaia Nickel North Project is located, there are no environmental protection areas near the project. The following table shows the protection areas and their distance from the project.

Name	Municipality	Category	Distance from the study area
Carajás National Forest ***(Flona dos Carajás)***	Parauapebas/Flona de CARAJÁS/Pará - Canaã dos Carajás/PA	Sustainable Use	91 Km
Ferruginous Fields National Park ***(Parna dos Campos Ferruginosos)***	Parauapebas/Flona de CARAJÁS/Pará - Canaã dos Carajás/PA	Full Protection	71 Km
Tapirapé Aquiri National Forest ***(Flona Tapirapé - Aquiri)***	Marabá/PA	Sustainable Use	163 Km
Tapirapé Biological Reserve ***(REBIO do Tapirapé)***	Marabá/PA	Sustainable Use	166 Km
Itacaiúnas National Forest ***(Flona de Itacaiúnas)***	Marabá/PA	Sustainable Use	167 km
Igarapé Gelado Environmental Protection Area ***(APA do Igarapé Gelado)***	Parauapebas/PA	Sustainable Use	116 km
Veredas dos Carajás Municipal Natural Park ***(Parque Municipal Veredas dos Carajás)***	Canaã dos Carajás/PA	Sustainable Use	59 km
Araguaína Springs Environmental Protection Area ***(APA das Nascentes de Araguaína)***	Araguaína/PA	Sustainable Use	111 km
São Geraldo do Araguaia Environmental Protection Area ***(APA de São Geraldo do Araguaia)***	São Geraldo do Araguaia/PA	Sustainable Use	92 km
Santa Isabel Lake Environmental Protection Area ***(APA Lago de Santa Isabel)***	Ananás / Xambioá/PA	Sustainable Use	69 km
Martírios Mountains/ Andorinhas State Park ***(P.E. da Serra dos Martírios/Andorinhas)***	São Geraldo do Araguaia/PA	Full Protection	99 km


CONSERVATION UNITS
Tapirapé Biological Reserve
Tapirapé - Aquiri National Forest
Igarapé Gelado APA
Itacaiúnas National Forest
Carajás National Forest
Ferruginous Fields National Park
Martírios Mountains/ Andorinhas State Park
São Geraldo do Araguaia APA
Santa Isabel Lake APA
Veredas dos Carajás Municipal Park
Araguaína Springs APA
Control Area
Project area (Directly Affected Area)
Target Area
Biotic Factor Study Area
Conservation Units
Full Protection
Park
Biological Reserve
Sustainable Use
Forest
Environmental Protection Area (APA)
Municipal Boundary
State Boundary
RR
AP
AM
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Flora

Vegetation

The native vegetation of a place is a very important feature for the ecosystems of that place to be kept healthy and well-functioning.

The Araguaia Nickel North Project is located in Brazil's Legal Amazon in transition with the *Cerrado* biome.

The types of vegetation formations found in the project region are presented below. These data derive from studies carried out in the project location and its surroundings.

Ombrophylous Forest	Riparian Forest	*Campinarama*	Metalophilous Savannah
Composed of medium to tall trees, with the treetops merging, forming a canopy. The ombrophilous forests in the region of the Araguaia Nickel North Project are found in two forms: dense and open.	Those with some kind of association with watercourses and can be subdivided into two types: Gallery Forests and *Mata Ciliar*.	Areas where forest and Metalophilous Savannah meet, associated with aquatic formations, favouring the occurrence of species and microenvironment formations.	The rupestrian vegetation on *canga* is composed of a rare and highly adapted vegetation that grows on the ferruginous *canga*.
			

STUDY AREA FLORA	
Species	**Total number**
Endemic	38
Threatened	6
Economic and/or cultural interest	6
Scientific interest	7
Exotic	2
Aquatic macrophytes	26

***Sida urens* - Species found in the Study Area.**
Source: Brandt

***Buchnera carajasensis* - Species considered endemic found in the Study Area.**
Source: Brandt

***Turnera coerula* - Species found in the Study Area.** Source: Brandt

***Asclepias curassivaca* - Species considered invasive found in the Study Area.**
Source: Brandt

Fauna

The fauna study aims to provide information and promote discussion on the occurrence of representatives of seven major animal groups in the study area: Herpetofauna, Terrestrial Mastofauna, Flying Mastofauna, Avifauna, Entomofauna, Ichthyofauna and Hydrobiological communities.

The fauna study also considers information on threatened, rare and endemic species, species of economic and scientific interest and those indicative of environmental quality, when possible.

Herpetofauna

The herpetofauna is made up of two large groups: the amphibians (frogs, toads etc) and the reptiles (snakes, lizards, turtles etc).

Most amphibians are dependent on water at some stage of their lives. They feed on insects and other invertebrates, often working as pest controllers. Amphibians are also known as bio-indicator animals, i.e. their presence works as an indicator that the environment is in ecological balance.

Reptiles have their body covered by a dry and mostly impermeable skin that may have scales (snakes), plates (alligators, crocodiles) or shells (turtles, *jabutis*). Most of them are carnivorous animals; some species are herbivorous and others are omnivorous. The main threats to the herpetofauna species are agriculture, livestock and damming of water courses.

A total of 41 species of herpetofauna were identified in the Study Area, comprising 28 amphibians and 13 reptiles. Among these, *Pseudopaludicola canga* (*Rãzinha*) is of special interest because it is considered an indicator of environmental quality and classified as "Endangered" on Pará State's list of threatened species.

***Pseudopaludicola canga* - Species considered "endangered" found in the Study Area.** Source: Brandt

***Uranoscodon superciliosus* - Species of lizard found in the Study Area.** Source: Brandt

***Leptodeira annulata* - Snake species found in the Study Area.** Source: Brandt

***Rhinoclemmys punctularia* - Freshwater turtle species found in the Study Area.** Source: Brandt

Two other species found in the Study Area were considered to be of economic interest, namely: *Leptodactylus latrans*, known as butter frog (*rã manteiga*), which is used for food or as bait in fishing activities. And the *Teiú (Salvator merianae*), which is under hunting pressure due to the consumption of its meat and leather. No exotic and/or potentially harmful species of particular scientific interest have been identified, as well as annual or migratory species.

	STUDY AREA HERPETOFAUNA	
Species	**Amphibians**	**Reptiles**
Total species identified	28	13
Threatened species	1	0
Species of economic interest	1	1

Avifauna

The term avifauna refers to bird species found around the world, such as the ostrich, penguin, thrush, canary, chicken and duck, among many others. Birds are very diverse, and this diversity is an indication of the conservation status of the environment. Most birds are daytime birds and some are very demanding and require a greater quantity and quality of resources for food, nest building, shelter and protection.

Besides using different environments, the avifauna representatives are important for the maintenance of the local ecosystem, helping in the recovery of forest areas through seed dispersion, control of pest insects, such as caterpillars that devour crops, and serving as food for other animals.

A total of 268 bird species were found in the Study Area. Among the species recorded at the sampling points, seven are included in a category of threat of extinction, they are: *Tinamus tao (azulona), Penelope pileata (jacupiranga) Anodorhynchus hyacinthinus (arara-azul), Ramphastos vitellinus (tucano-de-bico-preto), Ramphastos tucanus (tucano-de-papo-branco), Hylexetastes brigidai (araçu-de-loro-cinza*), and *Tolmomyias assimilis paraensis (bico-chato-da-copa)*.

***Martim-pescador* (*Chloroceryle americana*) - Species identified in the study area.**
Source: Brandt

***Tucano-de-papo-branco* (*Ramphastus tucanus*) - Threatened of extinction species identified in the study area.** Source: Brandt

***Sicalis flaveola* (*Canário-da-terra)* - Species found in the study area considered to be of cultural interest due to intense capture.**
Source: Brandt

***Turdus leucomelas* (*Sabiá-branco*) - Species found in the study area considered to be of cultural interest due to intense capture.**
Source: Brandt

STUDY AREA AVIFAUNA	
Species	**Total number**
Threatened	7
Economic/cultural interest	19
Scientific interest	1
Migratory	2
Environmental quality indicators	5

Terrestrial and flying mastofauna

The mastofauna is composed of animals known as mammals. Mammals form a very diverse group and based on their habits and body size, they are divided into three distinct groups: flying mammals (bats), small mammals and medium and large mammals.

Bats are flying mammals with the greatest diversity among the mastofauna groups. The group of small mammals is composed mainly of marsupials and rodents that weigh less than 1 kg and are able to occupy a wide variety of environments. Medium and large mammals are mainly known for their predatory activity, working as natural controls for other species.

In the Study Area, 39 terrestrial mastofauna species were found, including individuals considered to be threatened of extinction, such as the jaguar (*Panthera onca*, known as *Onça-pintada*) and the little armadillo (*Dasypus beniensis*, known as *Tatu-galinha*), considered to be of great scientific interest.

***Cuíca* (*Marmosa murina*) - Small mammal species recorded in the study area.** Source: Brandt

Tapir (*Tapirus terrestris*) - Species of large mammal threatened of extinction recorded in the study area. Source: Brandt

Thorn rat (*Proechimys roberti*, known as *Rato-de-espinho*) - Mammal species recorded in the study area. Source: Brandt

Vampire bat (*Desmodus rotundus*) - Species of scientific interest identified in the study area.
Source: Brandt

Wild cat (*Herpailurus yagouaroundi*, known as *gato-mourisco*) - Mammal species recorded in the study area. Source: Brandt

TERRESTRIAL MASTOFAUNA	
Species	**Total number**
Threatened	8
Economic/cultural interest	20
Scientific interest	8

Regarding the flying mastofauna, 19 species of bats were identified in the Study Area, one of which is considered to be threatened of extinction. Species of scientific interest were also recorded, especially those that spread diseases, such as *Desmodus rotundus* (vampire bat), which is a potential vector of rabies.

Entomofauna

Entomofauna refers to animals known as insects, such as mosquitoes, bees and ants. Insects are essential for maintaining ecosystems' ecological balance. They fulfil important functions such as nutrient cycling, seed spreading and pollination, and can be found in almost all habitats, in fresh and brackish water, soil, plants and even as parasites of other animals.

STUDY AREA ENTOMOFAUNA		
	Bee	29 species
	Ant	71 species
	Mosquito	42 species

In general, a small number of insects (bees, ants and mosquitoes) was recorded in the Study Area, in comparison with the available data on the region. This fact is related to the high degree of degradation of the areas, as there are small fragments of native vegetation in a large region of pastures and monocultures.

Bee species typical of degraded environments, open areas and forest edges were recorded, such as: *Apis mellifera, Eulaema nigrita, Eulaema cingulata, Euglossa securigera* and *Tetragona clavipes*. The ant community, in turn, recorded the highest number of species. This fact may be justified by ants' great ability to adapt to man-made impacts. Among the mosquito groups, species of medical interest were recorded, such as *Anopheles nuneztovari* and *Anopheles fluminensis*, both vectors of malaria.

Did you know

Vector insects are those that can transmit diseases. Examples of vector insects are *Aedes aegypti* (dengue transmitter) and *Lutzomyia longipalpis* (leishmaniasis transmitter).

Ictiofauna

Ichthyofauna refers to a group of animals composed exclusively of fish. These animals are very important to maintain food chains, as they feed on micro-organisms, algae and other fish and are also food for other animals, such as for humans.

In addition, fish are important to tell us the quality of the water, as there are species that only exist in good quality water and others that are able to live in poor quality water, such as where there is sewage water. By knowing these different species, it is possible to understand the condition of a river, lake or stream, just by the presence of specific fish there.

In the Study Area, 100 species of fish were identified, distributed in 31 Families and 8 Orders, among which *Scobinancistrus pariolispos* (*Acari-da-pedra*) stands out, classified as "vulnerable" on the list of threatened species.

***Tucunaré* (*Cichla cf. kelberi*) Potentially endemic species found in the study area.** Source: Brandt

***Acari-da-pedra* (*Scobinancistrus pariolispos*) - Vulnerable species found in the study area.** Source: Brandt

STUDY AREA ICTIOFAUNA	
Species	**Total number**
Threatened	1
Endemic	20
Economic/cultural interest	41
Exotic	1
Environmental quality indicators	22

Hydrobiological Communities

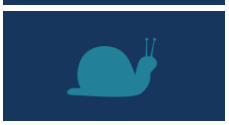
The group named Hydrobiological Communities is the collection of several species that inhabit aquatic environments. These living beings appeared millions of years ago and were essential for the development and maintenance of other species, since they are the base of the food chain and, specifically in the case of phytoplankton, they work as oxygen producers. This group is composed of phytoplankton, zooplankton and zoobenthos, which are very small or even microscopic living beings that live in the water or at the bottom of it, in the substrate.

These living organisms are important for the proper functioning of the aquatic ecosystem. They are the base of the food chain, serving as food for aquatic animals. Specifically in the case of phytoplankton, they contribute to the production of oxygen. In addition, some species are considered bioindicators, evidencing the water quality level in a particular water body. Thus, it is possible to understand, for example, the feasibility of using water from a certain location for human consumption.

Phytoplankton can be defined as a group of micro-organisms able to carry out photosynthesis and which floats on the water surface. The group consists of microscopic algae and cyanobacteria. The zooplankton group is made up of microscopic and heterotrophic organisms (which do not carry out photosynthesis). The main components of zooplankton are protozoa, worms, crustaceans and insect larvae. The benthic community is made up of organisms that live in association with the bottom of aquatic environments, living in it or depending on its resources. They can be fixed or floating in the environment, but do not actively swim in the water like fish and other animals.

The phytoplankton, zooplankton and zoobenthos communities were examined in this assessment, where 82 taxa for phytoplankton, 73 for zooplankton and 20 for zoobenthos were identified in the Study Area.

Regarding the bioindicators, from clean water organisms to polluted environment organisms were recorded, which suggests an environment with a certain degree of environmental quality, but with typical indications of anthropic changes. The physical-chemical data showed a strong carriage of iron, aluminium and manganese ions, which are associated with the carriage from environments with high level of soil degradation and reduced riparian forest. This result reflects the local land use and occupation, with areas devoted to agricultural activities where the aquatic environments are not preserved and their riparian forests are degraded.

STUDY AREA HYDROBIOLOGICAL COMMUNITIES		
	**Phytoplankton**	84 *taxa*
	**Zooplankton**	73 *taxa*
	**Zoobenton**	20 *taxa*

Socioeconomic Factor

This factor involves the study of people and their interrelationships, considering the historical background of the municipality where the structures of the Araguaia Nickel North Project are located and the surrounding regions, as well as aspects related to the characteristics of the local population, the economy at municipality level, quality of life and basic sanitation provided in each of the municipalities under study and cultural aspects of the region.

Population

Information related to the characteristics of the municipality of Xinguara, where the Project is located, is presented below, as well as for the municipality of Sapucaia, a district that was emancipated in 1997, which due to its proximity, is also considered as an area of influence of the Project in relation to the socioeconomic context.

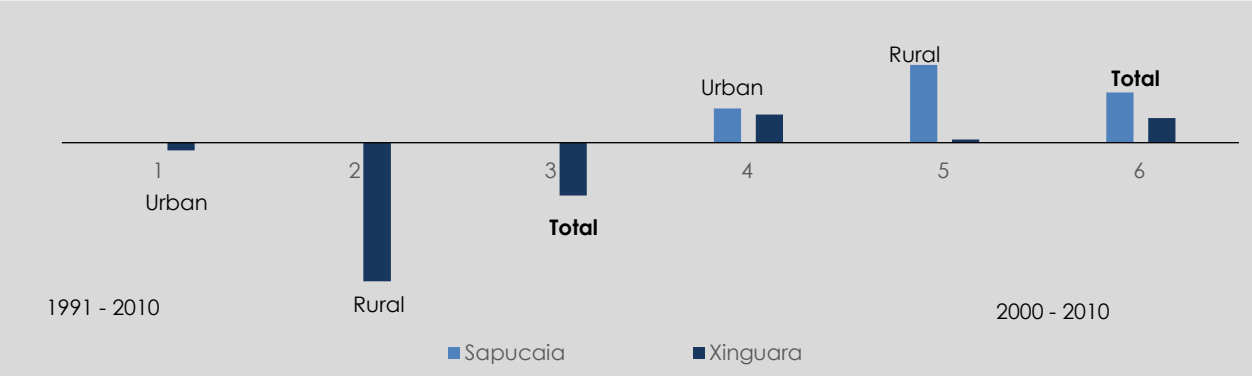
Sapucaia	
Immediate Region	Sapucaia
Population estimated in 2018	5,849
Demographic Census 2010 Population	5,047
Territorial size (Km²)	1,298.19
Number of Inhabitants per km²	4.51
Urban population in relation to total population (2010)	65.88%
Population projected for 2050	15,771

Xinguara	
Immediate Region	Xinguara
Population estimated in 2018	44,410
Demographic Census 2010 Population	40,573
Territorial size (Km²)	3,779.35
Number of Inhabitants per km²	11.75
Urban population in relation to total population (2010)	77.62%
Population projected for 2050	71,454

From 1991 to 2000, the total population of the municipality of Xinguara presented a decrease in the average annual growth of 3.39%, with 0.5% for the urban population and 8.9% for the the rural population per year. From 2000 to 2010, the urban population of Xinguara presented a higher percentage of growth than the rural population. The municipality of Sapucaia in this period followed the opposite trend, presenting a higher percentage of growth in the rural area (5.0%) than in the urban area (2.2%) and the total growth rate was 3.22%. This is due to urbanization processes and the emancipation of Sapucaia as a municipality in 1997.

A growth rate with is lower for the rural population than for the urban population indicates an urban densification process by intramunicipal migration (within the municipality). This is one of the central demographic characteristics of the municipality of Xinguara.

Average Annual Population Growth Rate for the Municipalities of Sapucaia and Xinguara (%)



Source: IBGE, 1991, 2000 and 2010. Prepared by Brandt Meio Ambiente, 2019.

Gross Domestic Product (GDP)

Understanding the productive, economic and service structure of a municipality and/or region is crucial to understanding the local socioeconomic context.

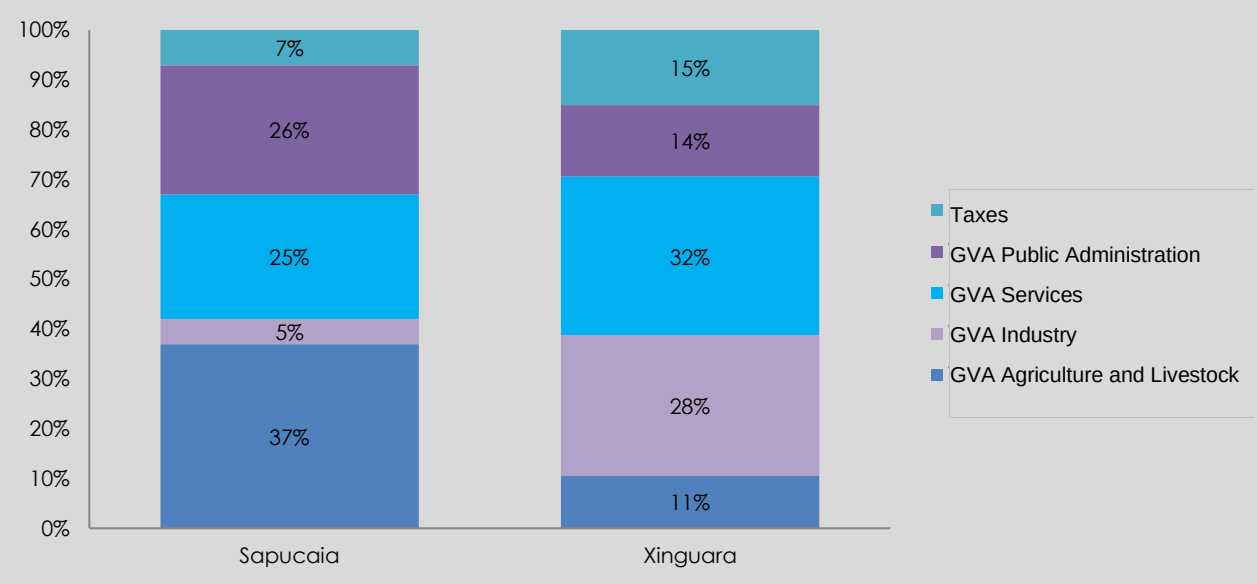
In the municipality of Sapucaia, the 'Agriculture and Livestock' sector is the largest contributor to the municipal wealth, followed by the economic sectors of 'Public Administration', 'Services' and 'Industry', which is the fourth (and last) in importance when calculating GDP.

In the municipality of Xinguara, the 'Services' sector is the largest contributor to the municipal GDP, followed by the 'Transformation Industry', 'Public Administration' and 'Agriculture and Livestock' sectors.

Did you know

GDP is the sum of all final goods and services produced by a country, state or city, usually in a year.

Participation in percentage of the economic sectors' Gross Value Added (GVA) in Sapucaia and Xinguara's Municipal GDP - 2016

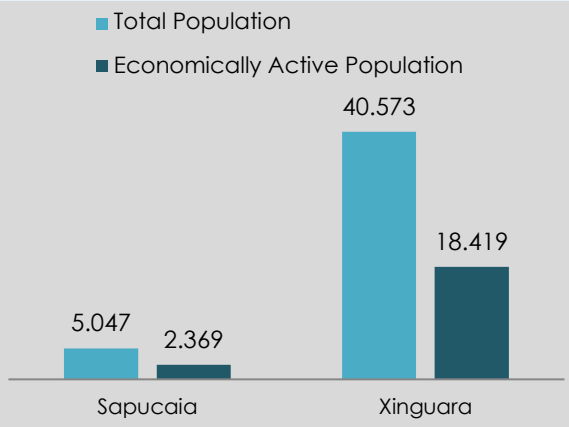


Standard of Living

Employment and Income

Characterisation of the occupational structure in a region, which may involve: the economically active population's composition, employability and income, the economic activity sectors of the municipality and/or aspects of the municipality's income distribution.

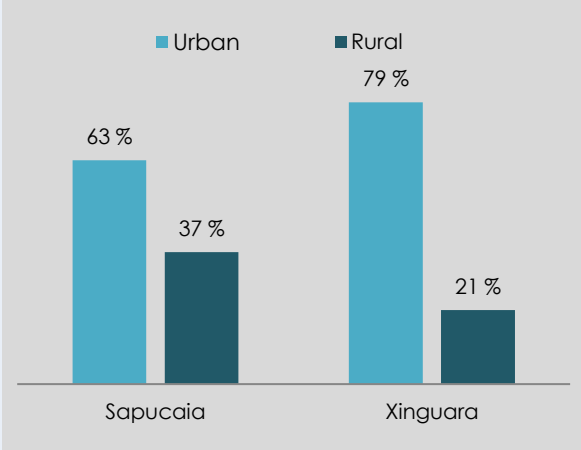
Economically Active Population, older than 10 years old, in the municipalities of Sapucaia and Xinguara - 2010



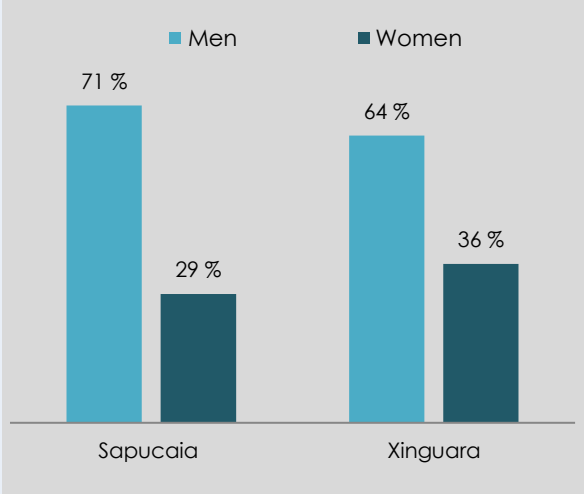
Did you know

The Economically Active Population of a municipality refers to the labour force that the productive sector of a locality can count on, including the region's employed and unemployed population.

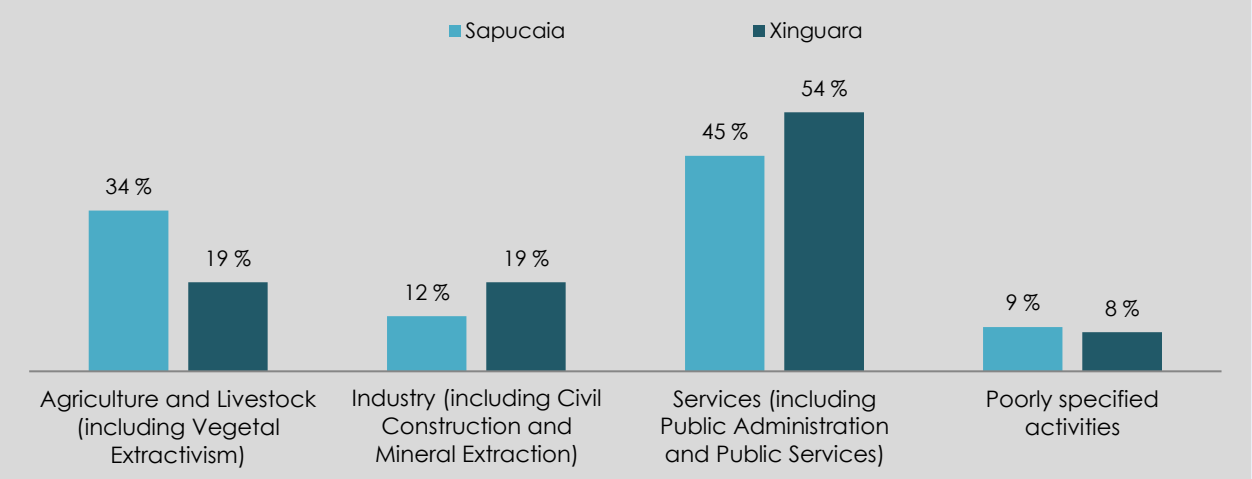
Economically Active Population, in Sapucaia and Xinguara, by place of residence - 2010



Economically Active Population, in Sapucaia and Xinguara, by gender - 2010



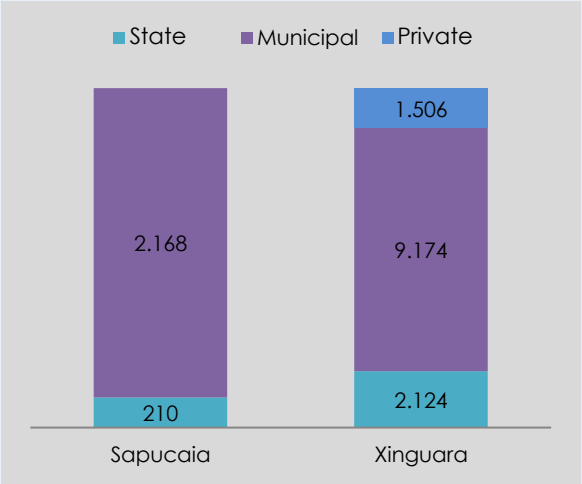
Employed Economically Active Population, in Sapucaia and Xinguara, by occupation in economic activity sectors - 2010



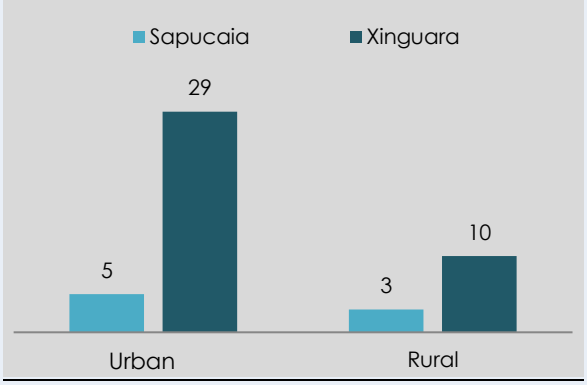
Education

The characterisation of the formal education system from a location can address: aspects of the Basic Education physical infrastructure, the demand and supply of vacancies in the education system, as well as population literacy data, among other aspects. At the municipalities of Sapucaia and Xinguara there were, in total, 47 formal educational facilities offering Basic Education in 2017, which is two (2) facilities above what was counted in 2010. The distribution of educational facilities in these municipalities is coherent with their population contingent. Although the educational level of the adult population of the municipalities under study generally improved between 2000 and 2010, they have not reached Pará state average values in all levels of schooling. In other words, the percentage of instruction of the population of the municipalities under study is systematically lower than that presented by Pará, in 2000 and 2010, denoting the continuing historical insufficiency in school attainment of their populations.

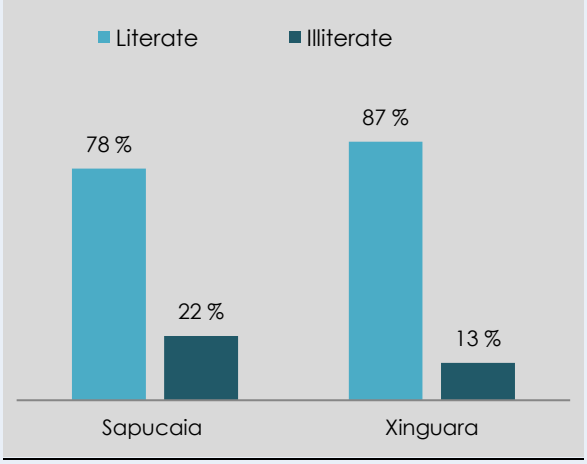
Primary Education Enrolment, by type of school - 2017



Basic Education Teaching Facilities, by location - 2017



Literate or Illiterate Population Aged 5 Years or Older - 2010



Health

The characterisation of a locality's health system can address: aspects of the health system's physical and human infrastructure, birth indicators, infant mortality, main occurrences of mortality and morbidity, among others. Xinguara presented a higher number of health care facilities when compared to Sapucaia, in 2018.

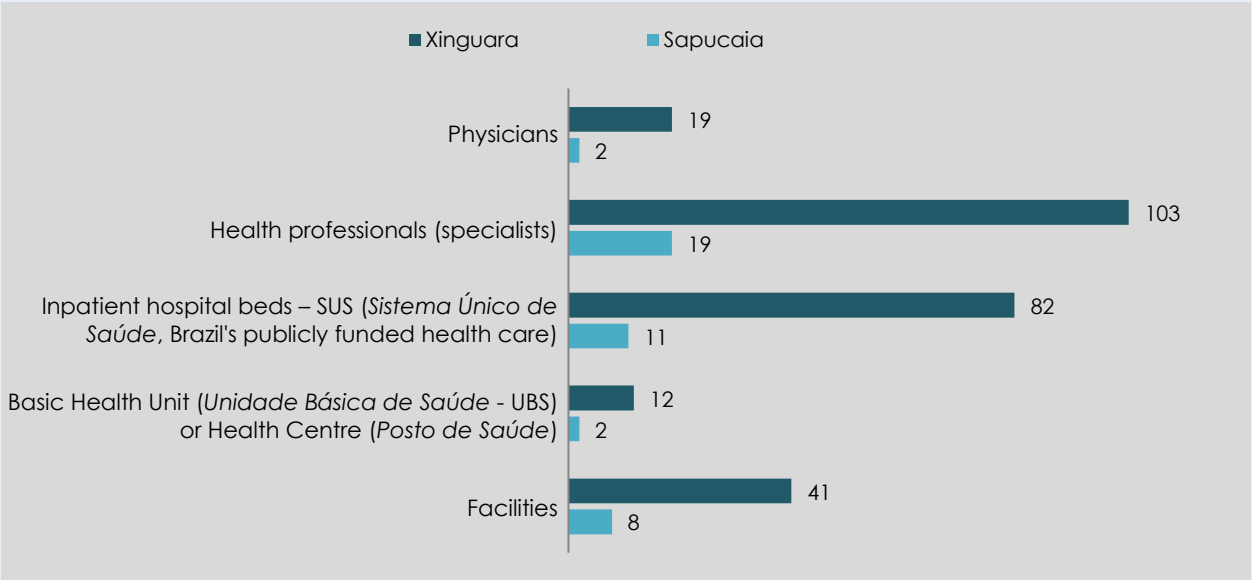
In that year, the municipalities under study accounted for a total of 49 facilities of this type, most of which are concentrated in the municipality of Xinguara, which accounts for 41 health care facilities, i.e. 84% of the total number.

In the same period (2018), the municipality of Sapucaia had 08 health care facilities, which represents 16% of the physical facilities providing health support to the population of the study area municipalities. Although Sapucaia presents a more incipient physical health structure, both municipalities under study are equipped with at least one general hospital.

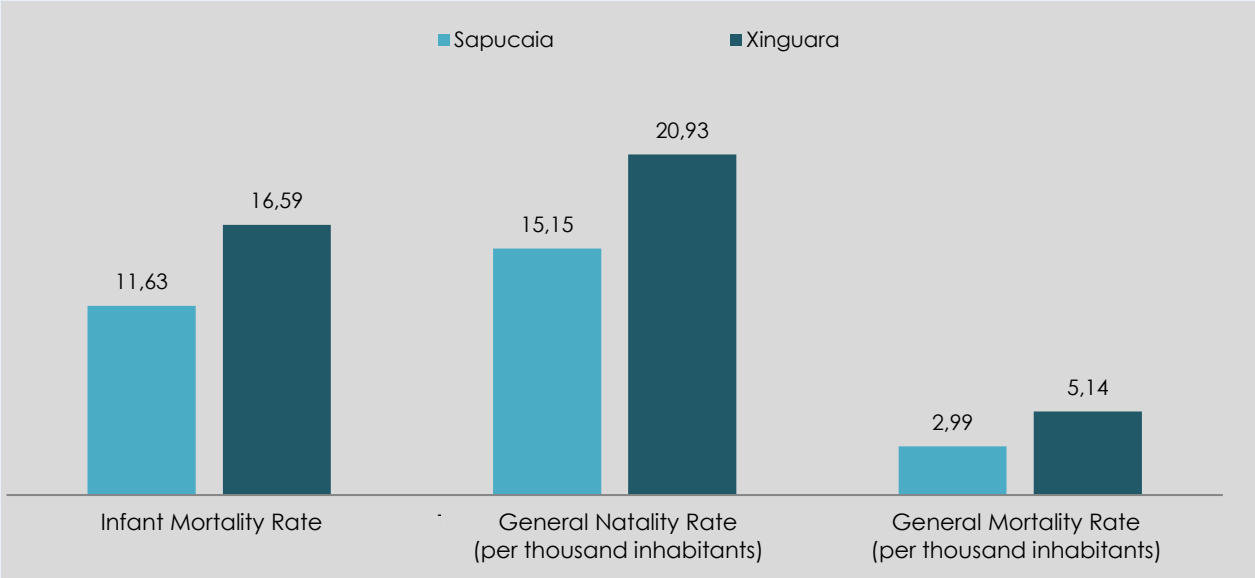
In general, it is possible to conclude that the municipality of Xinguara is better equipped to provide care and promote health than Sapucaia, as the latter has a very limited physical and health professional structures as well as significant rates of mortality and morbidity related to low conditions of basic sanitation, except for the mortality rates – which are higher in Xinguara.

In addition, the municipality of Sapucaia has a significantly smaller population than Xinguara, which also contributes to Xinguara having a health system with greater infrastructure.

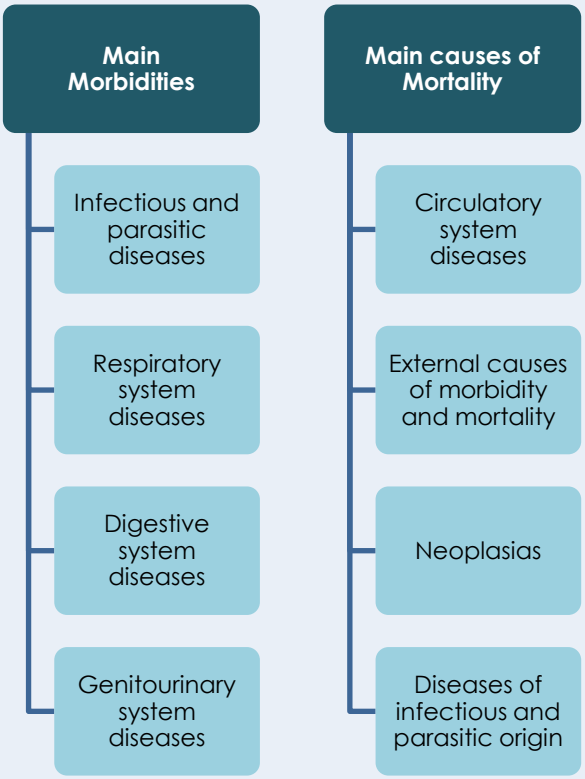
Physical and Human Resources of Sapucaia and Xinguara's Health System - Nov/2018 (Quantity)



Infant Mortality Rate, General Natality Rate and General Mortality Rate, in Sapucaia and Xinguara - 2016



Main causes of Morbidity and Mortality in Sapucaia and Xinguara, following ICD-10 chapters - 2016



Did you know

The International Classification of Diseases and Related Health Problems (also known as the International Classification of Diseases - ICD-10) is a publication of the World Health Organization (WHO) aimed at standardising the codes associated with diseases and other health-related problems.

Housing

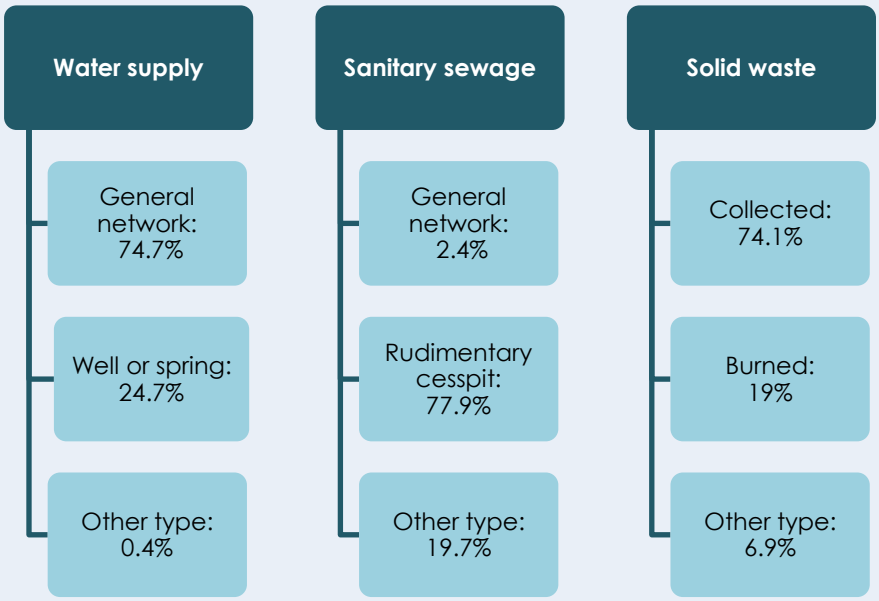
The characterisation of housing infrastructure addresses aspects related to the supply and quality in the provision of services essential to housing and maintaining good levels of quality of life in the regions under study.

In urban and rural areas, for essential services it is adopted the perspective of endowing public facilities aimed at providing infrastructure and services of electric power, water supply, sanitary sewage, collection and disposal of solid waste (basic sanitation), provision of telephone and television networks and internet access (communication), and easement and access to public transportation.

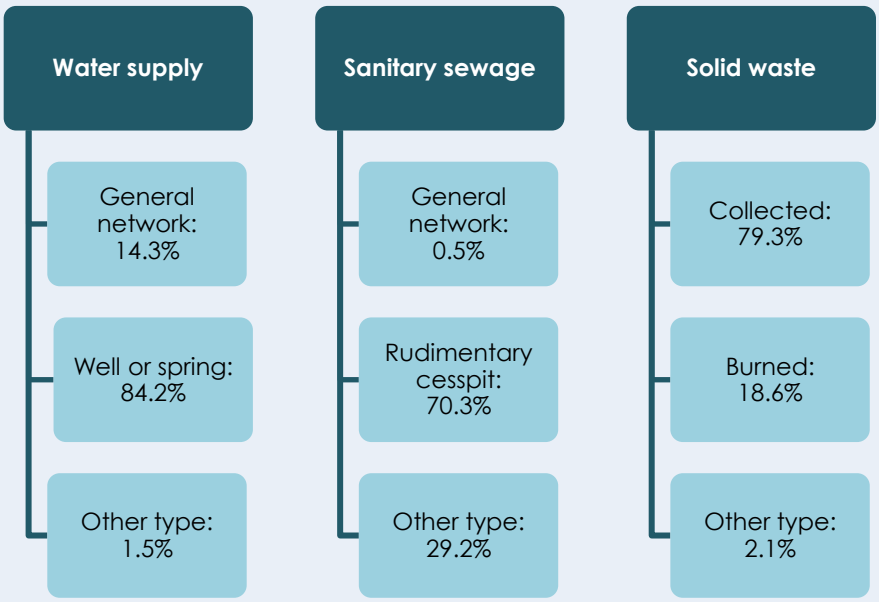
Basic Sanitation

In the municipalities of Sapucaia and Xinguara, water supply and sewage services are provided by the state-owned COSANPA (*Companhia de Saneamento do Pará*, the Pará state sanitation company).

Percentage of households in the municipality of Sapucaia, by type of water supply, sanitary sewage and solid waste - 2010



Percentage of households in the municipality of Xinguara, by type of water supply, sanitary sewage and solid waste - 2010



In the municipalities under study, the final waste disposal is carried out in dumps, as there are no sanitary landfills in Sapucaia and Xinguara.

With regard to electricity, there was a high percentage of urban households supplied with electricity in the municipalities under study in 2010. Such rate is close to the goal of 100% electrification in the country.

Regarding the supply of electric energy in rural households, the municipality of Xinguara is the closest one to the possibility of full rural electrification, with both municipalities presenting percentages of rural electrification above Pará State level.

Transportation Infrastructure

The road transportation infrastructure is mainly served by the federal and state road network connecting the municipalities under study and the region.

It consists of state highways and a federal highway, BR-155, which connects the municipalities of Redenção and Marabá, passing through Sapucaia and Xinguara.

Federal and State Road Network in the municipalities of Sapucaia and Xinguara - 2017

Municipalities	Main Federal and State Highways	
Sapucaia	BR-155	Connects Sapucaia to the municipality of Xinguara
Xinguara	BR-155	Connects Xinguara to the municipality of Sapucaia
	PA-279	Connects Xinguara to the municipality of Água Azul do Norte
	PA-160	It connects the municipality of Canaã dos Carajás to the junction with BR-155, which provides access to the municipalities of Sapucaia and Xinguara
	PA-477	Connects Xinguara to the municipality of Piçarra

Civil and Social Security

The characterisation of aspects inherent to a municipality's public security constitutes an important indicator of the social weaknesses affecting a specific region.

The municipalities under study are served by the 17th Military Police Battalion *(Batalhão da Polícia Milita - BPM*), with barracks in Xinguara and a deployment in Sapucaia. The Civil Police in the municipalities of Sapucaia and Xinguara reports to the Superintendency of the 14th Integrated Region of Public Security and Social Defence *(Região Integrada de Segurança Pública e Defesa Social - RISP)*, whose headquarters are in the municipality of São Félix do Xingu.

Since 2007, the municipalities of Sapucaia and Xinguara are served by the 10th Military Fire Brigade Group of Pará *(Grupamento de Bombeiros Militar - GBM)*, with headquarters in the municipality of Redenção. In relation to social security, there are social services facilities such as CRAS and CREAS in both municipalities under study: Sapucaia and Xinguara.

Only in the municipality of Xinguara there is a Shelter Unit, a structure provided by the Social Assistance Unified System (*Sistema Único de Assistência Social - SUAS*) which offers shelter to individuals abandoned and/or away from their families.

Regarding the existing and active legal infrastructure in the municipalities under study, there is a legal structure only in the municipality of Xinguara, which has specialised courts to serve its citizens and the demands of the region.

There are no childhood and youth courts in the municipalities under study, and the closest ones are located in the municipalities of Conceição do Araguaia and Redenção.

According to the Atlas of Violence 2018 (IPEA, 2018), the municipalities of Sapucaia and Xinguara are not among the municipalities that concentrate 75% of the homicides in Brazil.

Civil and Social Security Infrastructure in Xinguara and Sapucaia - 2018

Civil Defence

- Non-existent

Military Police

- 17th Military Police Battalion (*Batalhão de Polícia Militar - BPM)*

Civil Police

- 14th Public Security Integrated Region (*Região Integrada de Segurança Pública - RISP)*

Fire Brigade

- 10th Military Fire Brigade Group *(Grupamento de Bombeiros Militar - GBM)*

Social Security

- Sapucaia: 01 Welfare Reference Centre *(Centro de Referência de Assistência Social - CRAS)*; 01 Specialised Welfare Reference Centre *(Centro de Referência Especializado de Assistência Social - CREAS)*; 01 Guardianship Council
- Xinguara: 01 Welfare Reference Centre *(Centro de Referência de Assistência Social - CRAS)*; 01 Specialised Welfare Reference Centre *(Centro de Referência Especializado de Assistência Social - CREAS)*; 01 Shelter Unit *(Unidade de Acolhimento)*; 01 Guardianship Council

Leisure, Tourism, Culture and Religion

Characterisation of the socio-cultural activities carried out in the gathering and leisure spaces used by distinct social groups.

Located on the border of Xinguara, the Araguaia River beaches are one of the main places to hold cultural, leisure and tourism events in the rural area. Both in Xinguara and Sapucaia, the rural area is also characterised by cultural practices related to religious issues and agricultural production, which ultimately guide the festivities and traditional events in the region, especially in the villages and settlement projects.

Adão Pereira da Silva Cultural Centre - Municipality of Xinguara. Source: Brandt

Main Culture, Leisure and Tourism Venues

Sapucaia

- Indoor courts;
- Football stadium;
- Public squares;
- Lake (leisure centre under construction).

Xinguara

- Cultural Centre;
- Events Square;
- Sports courts;
- Exhibition Park;
- Public Gym (*Academia da Saúde*);
- Football stadium.

Football Pitch - Municipality of Sapucaia.
Source: Brandt

Main Cultural Events and Tourist Attractions

Sapucaia

- Day of the Evangelical People (September);
- June Party (schools and the town);
- Sapucaia Anniversary (April);
- Cultural Friday (fortnightly);
- Cultural Cinema (monthly);
- *CarnaFolia* (Carnival);
- Agriculture & Livestock Fair (September).

Xinguara

- Xinguara Anniversary Party (May);
- *Pontão* Beach (July);
- Agriculture & Livestock Fair (September);
- Patron Saint Joseph the Carpenter Celebration (May);
- Carnival.

Cultural Heritage

According to the survey carried out at the Institute for National Artistic and Historical Heritage *(Instituto do Patrimônio Histórico e Artístico Nacional - IPHAN)* and other secondary and primary sources, in the municipalities of Sapucaia and Xinguara there are no records of heritage listing, instruction process, registration or inventory of Tangible Heritage or Intangible Heritage, and the main records of these heritages are found at state level.

Did you know

Tangible cultural assets include architectural and urban structures, movable and integrated assets, archival collections, archaeological sites, natural sites and urban sets; while intangible assets include forms of expression, places, celebrations, Master Craftsmen, Professions and Ways of Doing.

***Carimbó* Dance**
Source: Portal Cultura Rede de Comunicação do Pará - 2019

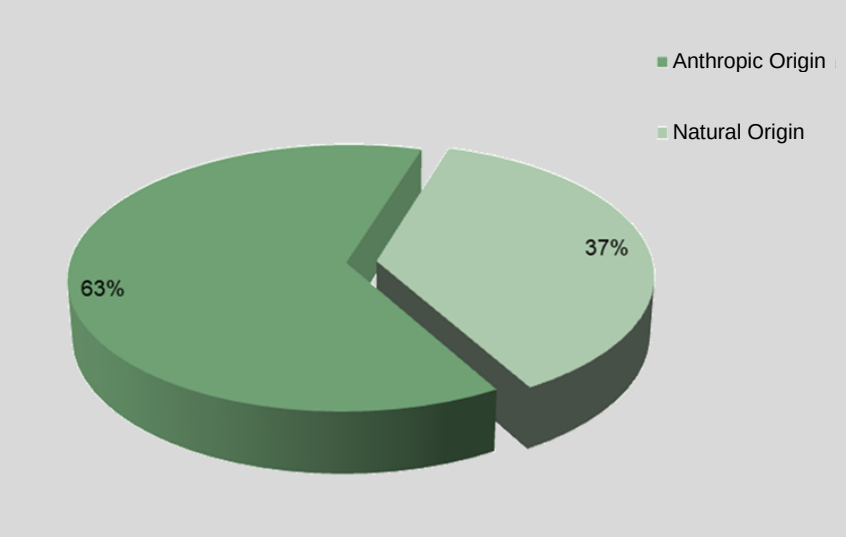
Way of Making *Cuia* (a type of bowl).
Source: Portal IPHAN - 2019

Integrated Environmental Assessment

In order to further understand the current levels of modification and conservation in the Study Area, the set of environmental classes was compared based on two distinct origins: classes of anthropic origin and classes of natural origin.

In this context, in the Study Area, which covers the Area of Influence of the Araguaia Nickel North Project, areas that have already undergone human-related processes prevail, representing approximately 63% of the use and coverage, against 37% of natural origin area.

Proportion between classes of anthropic and classes of natural origin in the study area



The natural functional units reveal situations of significant environmental relevance, which are detailed in the EIA flora and fauna assessments. On the plateaus, these include: ferruginous fields on rocky substrata, associated with environments of arboreal and shrubby vegetation in a metallophilic environment; humid environments, including temporary hydromorphic environments, as well as rocky outcrops.

In the forest areas, despite presenting diversity indices equivalent to other forests in the region, a certain degree of degradation is observed, probably as a result of timber extraction, especially where the morphology of the terrain is favourable to vegetal exploration.

In general, with regard to social vulnerability, it was possible to observe the lack of employment opportunities, the lack of promotion and investment in entrepreneurship, and the lack of local workforce qualification.

Regarding the socioeconomic development projects in place in the municipalities under study, most of them are linked to the implementation of federal and state government programmes.

The project target area for the mining activity is located essentially in a rural environment, far from the more consolidated urban centres. Thus, the surroundings of this area are of properties of rural origin and, therefore, have a peculiar way of life adapted to local conditions, with strong traces of the cultural identity of "cattle ranchers" *("pecuaristas")*.

It may be inferred that the condition of low preservation of the forest environments in the region – even though the land is used for vegetal extraction, pasture and livestock – still maintains an important diversity of the Amazonian fauna and flora.

ASSESSING ENVIRONMENTAL IMPACTS

Impact Assessment Criteria

The assessment of environmental impacts involves several criteria, namely: positive and negative effects, scope, significance, magnitude and reversibility of the impact, environmental loss or improvement, propensity of the impact to evolve or not, how it develops over time, direct or indirect effect or both, short or long term period of occurrence, permanence and duration of the environmental impact in each phase of the project, cumulative effect with other impacts, and finally, the presence of stakeholders who have expressed an opinion about the project. The compliance with the environmental legislation in force in the country was also considered as the main guide for impact assessments.

Summary of Environmental Impacts

Twenty-two environmental impacts were identified as a result of the project's activities, of which eight were classified as impacts on the physical factor, nine as impacts on the biotic factor, and five as impacts on the socioeconomic factor. These impacts unfold in the phases of implementation, mineral extraction operation, transportation and mine closure. In the likely condition, considering that the actions, plans and mitigation, control, monitoring and compensation programmes, including enhancement of positive impacts, will be implemented in the extent, scope and efficiency required to have an adequate control of the impact, a total of 49 distinct conditions of incidence of these 22 environmental impacts were assessed.

The following tables show the environmental impacts that have been identified and assessed, considering the mitigating, control and monitoring actions for the negative impacts, and the actions and programmes to enhance the project's positive impacts, as well as the planned environmental programmes.

Summary of the Characteristics Associated with the Impact of Modifications to Soil Physical Properties

Modifications to Soil Physical Properties	Stage		Implementation	Mine Operation	Environmental Programmes
	Magnitude of the Impact	***Potential***	**Medium**	**Medium**	
		Likely	**Medium**	**Medium**	
Impact Inducing Activities	Vegetation suppression, topsoil removal				
	Movement of machinery, equipment and vehicles for excavations, earthmoving and opening accesses; mineral exploration and waste disposal				
Environmental Aspects Associated with the Impact	Forming areas where the soil is exposed to the weather				
	Forming compacted soil				
Associated Environmental Impacts (Indirect)	Modifications in Erosion Dynamics				✓ Water Resources Management Programme (includes control and monitoring of effluents, surface and underground water) ✓ Degraded Areas Recovery Programme (DARP) ✓ Mine Closure Plan
	Silting up of Watercourses				
Mitigating and Control Actions and Measures	Execution of cut and fill activities following engineering best practices, in accordance with the project design				
	Building berms, if necessary, across the impacted slopes in order to reduce surface rainwater runoff				
	Continuous verification of critical points, carrying out recovery and isolating the area if necessary				
	Whenever possible, optimisation of vegetation suppression and earth movement (cutting and filling) in earthwork activities, during the implementation works and operation				
	Immediate recovery whenever possible as well as re-vegetation of the areas exposed to the weather				
	Inspection and control of vegetation suppression, earthworks and construction of drainage and retention systems				

Summary of the Characteristics Associated with the Impact of Modifications to Erosion Dynamics and Siltation of Watercourses

<table>
<tr><th rowspan="3">Modifications to Erosion Dynamics</th><th colspan="2">Stage</th><th>Implementation</th><th>Mineral Extraction Operation</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><th rowspan="2">Magnitude of the Impact</th><th>Potential</th><th>Medium</th><th>High</th></tr>
<tr><th>Likely</th><th>Medium</th><th>Medium</th></tr>
<tr><td>Impact Inducing Activities</td><td colspan="4">Vegetation suppression, topsoil removal;</td><td rowspan="7">✓ Solid Waste Management Programme (SWMP)

✓ Degraded Areas Recovery Programme (DARP)</td></tr>
<tr><td></td><td colspan="4">Movement of machinery, equipment and vehicles for excavations, earthmoving and opening accesses</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="4">Forming areas where the soil is exposed to the weather</td></tr>
<tr><td>Associated Environmental Impacts (Indirect)</td><td colspan="4">Silting up of Watercourses</td></tr>
<tr><td rowspan="4">Mitigating and Control Actions and Measures</td><td colspan="4">Release of rainwater effluent in line with the natural drainage flow regime</td></tr>
<tr><td colspan="4">Minimisation of vegetation suppression and earth movement (cutting and filling) in earthworks</td></tr>
<tr><td colspan="4">Recovery and re-vegetation of areas exposed to the weather</td></tr>
<tr><td colspan="4">Inspection and control of vegetation suppression, earthworks and construction of drainage and retention systems.</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Modifications to Surface Water Quality

Modifications to Surface Water Quality	Stage		Implementation	Mineral Extraction Operation	Reclamation of the Piles to be Transported and Mine Closure	Environmental Programmes
	Magnitude of the Impact	*Potential*	Medium	Medium	Medium	
		Likely	Low	Low	Medium	
Impact Inducing Activities	Vegetation suppression, topsoil removal					✓ Water Resources Management Programme (includes control and monitoring of effluents) ✓ Solid Waste Management Programme (SWMP) ✓ Degraded Areas Recovery Programme (DARP) ✓ Mine Closure Plan
	Places where hazardous products and waste are handled, stored and transported: oils, grease, fuels, paints, solvents and chemical products in general, including effluents					
	Fuelling, maintenance, repair, recovery and cleaning operations for equipment and installations using hazardous or non-inert products					
Environmental Aspects Associated with the Impact	Forming areas where the soil is exposed to the weather and chemical contaminations					
	Production of sanitary and industrial liquid effluents, and hazardous or non-inert waste					
Associated Environmental Impacts (Indirect)	Modifications to Surface Water Quality (Direct Incidence), due to potential soil carry-over, increased turbidity, total and dissolved solids					
	Modifications to Groundwater Quality (Infiltrated)					
Mitigating and Control Actions and Measures	Waterproofing and control of waste and effluents in warehouses and areas exposed to the weather					
	Inspection and control of vegetation suppression, earthworks, construction of waste deposits, treatment plants and retention and drainage facilities					
	Monitoring surface and groundwater					

Summary of the Characteristics Associated with the Impact of Modifications to Groundwater Quality

<table>
<tr><th rowspan="2">Modifications to Groundwater Quality</th><th colspan="2">Stage</th><th>Implementation</th><th>Mineral Extraction Operation</th><th rowspan="2">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>High</td><td>High</td></tr>
<tr><td>Likely</td><td>Medium</td><td>High</td></tr>
<tr><td rowspan="3">Impact Inducing Activities</td><td colspan="4">Vegetation suppression, topsoil removal</td><td rowspan="8">✓ Water Resources Management Programme (includes control and monitoring of effluents, surface and underground water)

✓ Solid Waste Management Programme (SWMP)

✓ Degraded Areas Recovery Programme (DARP)

✓ Mine Closure Plan</td></tr>
<tr><td colspan="4">Places where hazardous products and waste are handled, stored and transported: oils, grease, fuels, paints, solvents and chemical products in general, including effluents</td></tr>
<tr><td colspan="4">Fuelling, maintenance, repair, recovery and cleaning operations for equipment and installations using hazardous or non-inert products</td></tr>
<tr><td rowspan="2">Environmental Aspects Associated with the Impact</td><td colspan="4">Forming areas where the soil is exposed to the weather and chemical contaminations</td></tr>
<tr><td colspan="4">Production of sanitary and industrial liquid effluents, and hazardous or non-inert waste</td></tr>
<tr><td rowspan="2">Associated Environmental Impacts (Indirect)</td><td colspan="4">Modifications to Surface Water Quality (Direct Incidence)</td></tr>
<tr><td colspan="4">Modifications to Groundwater Quality (Infiltrated)</td></tr>
<tr><td rowspan="5">Mitigating and Control Actions and Measures</td><td colspan="4">Waterproofing and control of waste and effluents in warehouses and areas exposed to the weather</td></tr>
<tr><td colspan="4">Inspection and control of vegetation suppression, earthworks, construction of waste deposits, treatment plants and retention and drainage facilities</td></tr>
<tr><td colspan="4">Implementation of sewage treatment facilities</td></tr>
<tr><td colspan="4">Implementation of water & oil separating systems</td></tr>
<tr><td colspan="4">Monitoring surface and groundwater</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Modifications to Water Dynamics

Modifications to Water Dynamics	Stage		Implementation	Mineral Extraction Operation	Reclamation of the Piles to be Transported and Mine Closure	Environmental Programmes
	Magnitude of the Impact	*Potential*	High	High	High	
		Likely	Medium	High	High	
Impact Inducing Activities	Construction of solids retention sumps and directing the final effluent from the sumps into the downstream drains around the Directly Affected Area (ADA)					✓ Water Resources Management Programme ✓ Degraded Areas Recovery Programme (DARP) ✓ Mine Closure Plan
	Water catchment to feed the project's water supply					
	Lowering the water level for mineral extraction, in the operation stage					
	Release of liquid effluents, even if duly treated and within regulatory standards					
	Disruption of water catchment and pumping to lower the water level at the mine closure stage					
Environmental Aspects Associated with the Impact	Production of rainwater, sanitary and industrial liquid effluents					
Associated Environmental Impacts (Indirect)	Modifications to Erosion Dynamics and Silting of Watercourses					
	Modifications to Surface and Groundwater Quality					
Mitigating and Control Actions and Measures	The discharge must be made directly into the thalweg, which will be protected with mechanisms to avoid erosive processes in the natural drainage					
	Monitoring the flow rates of surface drainage in the surrounding area, springs and piezometers at the mine					
	Monitoring surface waters, with particular emphasis on turbidity and flow parameters					
	Optimising water use					

Summary of the Characteristics Associated with the Impact of Modifications to Noise and Vibration Levels

<table>
<tr><th rowspan="3">Modifications to Noise and Induced Vibration Levels</th><th colspan="2" rowspan="2">Stage</th><th>Implementation</th><th>Mineral Extraction Operation</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>High</td><td>High</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="5">Mineral extraction, truck traffic, with ore and waste, during the day</td><td rowspan="5">✓ Noise Monitoring Programme

✓ Speleological Management Programme

✓ Environmental Education Programme</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="5">Producing noise and vibration induced by operational activities</td></tr>
<tr><td>Associated Environmental Impacts (Indirect)</td><td colspan="5">Scaring some fauna species, which are susceptible to this type of impact</td></tr>
<tr><td rowspan="2">Mitigating and Control Actions and Measures</td><td colspan="5">Proper vehicle, machinery and equipment maintenance and regulation, and compliance with predefined maximum speed limits</td></tr>
<tr><td colspan="5">Monitoring of actual impacts by direct measurement of noise and vibration</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Modifications to Air Quality

Modifications to Air Quality	Stage		Implementation	Mineral Extraction Operation	Reclamation of the Piles to be Transported and Mine Closure	Environmental Programmes
	Magnitude of the Impact	***Potential***	**High**	**High**	**Medium**	
		Likely	**Medium**	**Medium**	**Medium**	
Impact Inducing Activities	Vehicle, machinery and equipment traffic on paved and unpaved roads					✓ Air Quality Management Programme ✓ Degraded Areas Recovery Programme (DARP)
	Operation of fossil fuel-powered vehicles, machinery and equipment					
	Ore extraction at Vale dos Sonhos target, building piles, stockyards and slopes exposed to the winds					
	Ore, waste and material transportation operations					
	Building and reclaiming piles, loading and unloading trucks					
Environmental Aspects Associated with the Impact	Forming areas, floors and yards with soil exposed to the weather and to vehicle movement					
Associated Environmental Impacts (Indirect)	Harm to photosynthesis and fauna activity in general					
Mitigating and Control Actions and Measures	Setting speed limits on unpaved traffic routes					
	Systematic inspection of vehicles' black smoke emissions					
	On unpaved roads, water should be sprayed by water trucks and a speed limit should be set					
	For emissions produced by equipment and vehicle engines combustion, carrying out preventive maintenance. Monitoring of vehicle emissions using the Ringelmann Scale as part of the Air Quality Management Programme					

Summary of the Characteristics Associated with the Impact of Modifications to Natural Cavities

<table>
<tr><th rowspan="2">Modifications to Natural Cavities</th><th colspan="2" rowspan="2">Stage</th><th>Implementation</th><th>Mineral Extraction Operation</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="2">Environmental Programmes</th></tr>
<tr><td>High</td><td>High</td><td>Medium</td></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>High</td><td>High</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td><td>Medium</td><td>Medium</td></tr>
<tr><td rowspan="5">Impact Inducing Activities</td><td colspan="5">Vehicle, machinery and equipment traffic on unpaved roads</td><td rowspan="10">✓ Speleological Heritage Management Programme

✓ Noise Monitoring Programme

✓ Water Resources Management Programme (includes effluent control and monitoring)

✓ Air Quality Management and Monitoring Programme</td></tr>
<tr><td colspan="5">Operation of fossil fuel-powered vehicles, machinery and equipment</td></tr>
<tr><td colspan="5">Opening mining pits, building piles, stockyards and slopes exposed to the winds</td></tr>
<tr><td colspan="5">Operations to transport materials</td></tr>
<tr><td colspan="5">Building and reclaiming piles, loading and unloading trucks</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="5">Forming areas, floors and yards with soil exposed to the weather and to vehicle movement</td></tr>
<tr><td>Associated Environmental Impacts (Indirect)</td><td colspan="5">Harm to fauna activity in general</td></tr>
<tr><td rowspan="4">Mitigating and Control Actions and Measures</td><td colspan="5">Setting speed limits on unpaved traffic routes</td></tr>
<tr><td colspan="5">Systematic inspection of vehicles' black smoke emissions</td></tr>
<tr><td colspan="5">On unpaved roads, water should be sprayed by water trucks and a speed limit should be set</td></tr>
<tr><td colspan="5">For emissions produced by equipment and vehicle engines combustion, carrying out preventive maintenance. Monitoring of vehicle emissions using the Ringelmann Scale as part of the Air Quality Management Programme</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Loss of Forest Individuals

Loss of Forest Individuals	Stage		Implementation	Mineral Extraction Operation	Environmental Programmes
	Magnitude of the Impact	***Potential***	**Medium**	**Medium**	
		Likely	**Medium**	**Medium**	
Impact Inducing Activities	Vegetation suppression, topsoil removal				✓ Erosive Processes Control and Monitoring Programme ✓ Environmental and Forest Compensation Programme ✓ Degraded Areas Recovery Programme (DARP) ✓ Vegetation Conservation and Management Programme - Plant Germplasm Rescue Subprogramme - Flora Monitoring Subprogramme - Vegetation Suppression Subprogramme ✓ Vector Monitoring and Nosological Control Programme
	Movement of machinery, equipment and vehicles for excavations, earthworks and opening accesses				
Environmental Aspects Associated with the Impact	Access to the ore and the mineral deposit				
	Forming compacted soil				
Associated Environmental Impacts (Indirect)	Reducing Vegetation Fragments				
	Reduction and Modification of Fauna Habitat				
	Loss of Fauna Individuals				
	Negative Interactions between Local Fauna and Workers				
Mitigating and Control Actions and Measures	Whenever possible, optimisation of vegetation suppression and earth movement (cutting and filling) in earthwork activities, during the implementation works and operation				
	Immediate recovery whenever possible as well as re-vegetation of the areas exposed to the weather				
	Inspection and control of vegetation suppression, earthworks and construction of retention systems				

Summary of the Characteristics Associated with the Impact of Reducing Fragments of Native Vegetation

<table>
<tr><th rowspan="3">Reducing Fragments of Native Vegetation</th><th colspan="2">Stage</th><th>Implementation</th><th>Mineral Extraction Operation</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td><td>Medium</td></tr>
<tr><td rowspan="2">Impact Inducing Activities</td><td colspan="4">Vegetation suppression, topsoil removal</td><td rowspan="9">✓ Environmental and Forest Compensation Programme
✓ Vegetation Conservation and Management Programme
- Plant Germplasm Rescue Subprogramme
- Vegetation Suppression Subprogramme</td></tr>
<tr><td colspan="4">Movement of machinery, equipment and vehicles for excavations, earthworks, mining and opening accesses</td></tr>
<tr><td rowspan="2">Environmental Aspects Associated with the Impact</td><td colspan="4">Ore extraction and waste disposal</td></tr>
<tr><td colspan="4">Forming compacted soil</td></tr>
<tr><td rowspan="4">Associated Environmental Impacts (Indirect)</td><td colspan="4">Loss of Forest Individuals</td></tr>
<tr><td colspan="4">Reduction and Modification of Fauna Habitat</td></tr>
<tr><td colspan="4">Loss of Fauna Individuals</td></tr>
<tr><td colspan="4">Negative Interactions between Local Fauna and Workers</td></tr>
<tr><td rowspan="3">Mitigating and Control Actions and Measures</td><td colspan="4">Whenever possible, optimisation of vegetation suppression and earth movement (cutting and filling), during the implementation works and operation</td></tr>
<tr><td colspan="4">Immediate recovery whenever possible as well as re-vegetation of the areas exposed to the weather</td></tr>
<tr><td colspan="4">Inspection and control of vegetation suppression, earthworks and construction of retention systems</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Reduction and Modification of Fauna Habitat

<table>
<tr><th rowspan="3">Reduction and Modification of Fauna Habitat</th><th colspan="2">Stage</th><th>Implementation</th><th>Operation</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="4">Vegetation suppression, topsoil removal</td><td rowspan="9">✓ Degraded Areas Recovery Programme (DARP)

✓ Operational Suppression Programme

✓ Fauna Monitoring Programme:

- Herpetofauna monitoring subprogramme

- Avifauna monitoring subprogramme

- Subprogramme for monitoring terrestrial mastofauna

- Subprogramme for monitoring winged mastofauna

- Entomofauna monitoring subprogramme

- Ichthyofauna monitoring subprogramme</td></tr>
<tr><td rowspan="2">Environmental Aspects Associated with the Impact</td><td colspan="4">Movement of machinery, equipment and vehicles for excavations, earthworks, mining and opening accesses</td></tr>
<tr><td colspan="4">Access to the ore and the mineral deposit</td></tr>
<tr><td colspan="4">Forming compacted soil</td></tr>
<tr><td rowspan="4">Associated Environmental Impacts (Indirect)</td><td colspan="4">Loss of Forest Individuals</td></tr>
<tr><td colspan="4">Reducing Fragments of Native Vegetation</td></tr>
<tr><td colspan="4">Loss of Fauna Individuals</td></tr>
<tr><td colspan="4">Negative Interactions between Local Fauna and Workers</td></tr>
<tr><td rowspan="3">Mitigating and Control Actions and Measures</td><td colspan="4">Whenever possible, optimisation of vegetation suppression and earth movement (cutting and filling) in earthwork activities, during the implementation works and operation</td></tr>
<tr><td colspan="4">Immediate recovery whenever possible as well as re-vegetation of the areas exposed to the weather</td></tr>
<tr><td colspan="4">Inspection and control of vegetation suppression, earthworks and construction of retention systems</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Loss of Fauna Individuals

<table>
<tr><th rowspan="3">Loss of Fauna Individuals</th><th colspan="2" rowspan="2">Stage</th><th>Implementation</th><th>Mineral Extraction Operation</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td>Medium</td><td>Medium</td></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="4">Vegetation suppression, topsoil removal</td><td rowspan="9">✓ Fauna Scaring and Rescue Programme

✓ Vector Monitoring and Nosological Control Programme</td></tr>
<tr><td></td><td colspan="4">Movement of machinery, equipment and vehicles for excavations, earthworks and opening accesses</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="4">Access to the ore and the mineral deposit</td></tr>
<tr><td></td><td colspan="4">Forming compacted soil</td></tr>
<tr><td rowspan="4">Associated Environmental Impacts (Indirect)</td><td colspan="4">Loss of Forest Individuals</td></tr>
<tr><td colspan="4">Reducing Fragments of Native Vegetation</td></tr>
<tr><td colspan="4">Loss of Fauna Individuals</td></tr>
<tr><td colspan="4">Negative Interactions between Local Fauna and Workers</td></tr>
<tr><td rowspan="3">Mitigating and Control Actions and Measures</td><td colspan="4">Whenever possible, optimisation of vegetation suppression and earth movement (cutting and filling) in earthwork activities, during the implementation works and operation</td></tr>
<tr><td colspan="4">Immediate recovery whenever possible as well as re-vegetation of the areas exposed to the weather</td></tr>
<tr><td colspan="4">Inspection and control of vegetation suppression, earthworks and construction of retention systems</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Negative Interactions between Local Fauna and Workers

<table>
<tr><th rowspan="3">Negative Interactions between Local Fauna and Workers</th><th colspan="2">Stage</th><th>Implementation</th><th>Mineral Extraction Operation</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><th rowspan="2">Magnitude of the Impact</th><th>Potential</th><th>Medium</th><th>Medium</th></tr>
<tr><th>Likely</th><th>Medium</th><th>Medium</th></tr>
<tr><td>Impact Inducing Activities</td><td colspan="4">Vegetation suppression</td><td rowspan="6">✓ Environmental Education Programme

✓ Fauna Monitoring Programme:

- Herpetofauna monitoring subprogramme

- Avifauna monitoring subprogramme

- Subprogramme for monitoring terrestrial mastofauna

- Subprogramme for monitoring winged mastofauna

- Entomofauna monitoring subprogramme</td></tr>
<tr><td></td><td colspan="4">Financial gain and livelihood/food provision; leisure</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="4">Labour force hiring and agglomeration</td></tr>
<tr><td></td><td colspan="4">Noise and Vibration</td></tr>
<tr><td>Associated Environmental Impacts (Indirect)</td><td colspan="4">Loss of Fauna Individuals</td></tr>
<tr><td>Mitigating and Control Actions and Measures</td><td colspan="4">Optimisation of vegetation suppression whenever possible

Education and awareness of the importance and hazards of contact with wild fauna

Inspection and control of vegetation suppression</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Modifications to the Ichthyofauna Community

Modifications to the Ichthyofauna Community	Stage		Implementation	Mineral Extraction Operation	Environmental Programmes
	Magnitude of the Impact	*Potential*	High	High	
		Likely	Medium	Medium	
Impact Inducing Activities	Vegetation suppression, topsoil removal				
	Movement of machinery, equipment and vehicles for excavations, earthworks and opening accesses				
Environmental Aspects Associated with the Impact	Forming Areas with Soil Exposed to the Weather				
	Forming Compacted Soil				
	Generation of Rainwater Liquid Effluents				
Associated Environmental Impacts (Indirect)	Modifications to Surface Water Quality (Direct Incidence)				✓ Water Resources Management Programme ✓ Sediment Management Programme ✓ Degraded Areas Recovery Programme (DARP) ✓ Ichthyofauna Monitoring Programme ✓ Surface and Groundwater Quality Monitoring Programme ✓ Management and Control of Liquid Effluents Programme ✓ Solid Waste Management Programme (SWMP)
	Modifications to the Chemical Properties of the Soil				
	Modifications to Erosion Dynamics				
	Silting up of Watercourses				
Mitigating and Control Actions and Measures	Protection ditches for cuts, landfill and steps to prevent the water coming from the upstream slopes from reaching the plateaus, avoiding erosion and slope instability. In areas with high slopes or heavy flow, these ditches will be designed in steps to enable energy reduction				
	Gutters (depressions that runs parallel to a road to collect rainwater; in Portuguese, *sarjeta*) for cutting and filling which should be excavated at the access roads and plateaus in primary lining				
	Water drains (*saídas d'água*): designed to enable the gutter to be drained by directing the runoff towards a waterfall				
	Construction of gratings to safely transfer water from one side of the access roads to the other				
	Construction of collecting tanks to receive water from ditches and gutters or collect water from waterfalls				
	Construction of energy dissipators at the end of ditches, gutters, tubular networks and waterfalls				
	Construction of stepped water drains: the purpose of these is to channel the drainage into another device or onto the natural terrain				

Summary of the Characteristics Associated with the Impact of Exposure to Disease Vectors

<table>
<tr><th rowspan="3">Exposure to Disease Vectors</th><th colspan="2" rowspan="2">Stage</th><th>Implementation</th><th>Mineral Extraction Operation</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="5">Vegetation suppression</td><td rowspan="5">✓ Environmental Education Programme

✓ Vector Entomofauna Monitoring Programme</td></tr>
<tr><td></td><td colspan="5">Exposing people to endemic areas</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="5">Labour force hiring and agglomeration</td></tr>
<tr><td rowspan="2">Associated Environmental Impacts (Indirect)</td><td colspan="5">Loss of Forest Individuals</td></tr>
<tr><td colspan="5">Reducing Fragments of Natural Vegetation</td></tr>
<tr><td>Mitigating and Control Actions and Measures</td><td colspan="5">Raising awareness of the risks and hazards of endemic diseases</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Natural Environment Recovery

<table>
<tr><th rowspan="3">Natural Environment Recovery and Fauna Attraction</th><th colspan="2">Stage</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="3">Degraded Areas Recovery</td><td rowspan="6">✓ Degraded Areas Recovery Programme (DARP)</td></tr>
<tr><td></td><td colspan="3">Stoppage of Mining Activities</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="3">Personnel Demobilisation, Halting of Noise, Vibrations, Atmospheric Emissions, Effluents and Waste</td></tr>
<tr><td rowspan="3">Associated Environmental Impacts (Indirect)</td><td colspan="3">Recovery of Forest Individuals and Vegetation Enhancement in Forest Fragments</td></tr>
<tr><td colspan="3">Increased Habitat for Fauna and Fauna Enhancement</td></tr>
<tr><td colspan="3">Reducing the Risk of Negative Interactions between Workers and Fauna</td></tr>
<tr><td></td><td colspan="3">Stopping activities that cause modifications to the substrate of surface waters due to the transportation of particulate material and interference on the ichthyofauna</td></tr>
<tr><td>Mitigating and Control Actions and Measures</td><td colspan="3">Inspection, Control and Monitoring of Environmental Recovery and Stability of Remaining Structures</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Fauna Attraction

<table>
<tr><th rowspan="2">Natural Environment Recovery and Fauna Attraction</th><th colspan="2">Stage</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="2">Environmental Programmes</th></tr>
<tr><th rowspan="2">Magnitude of the Impact</th><th>Potential</th><th>Medium</th></tr>
<tr><td>Impact Inducing Activities</td><td colspan="3">Degraded Areas Recovery</td><td rowspan="6">✓ Fauna Monitoring Programme</td></tr>
<tr><td></td><td colspan="2">Likely</td><td>Medium</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="4">Stoppage of Mining Activities</td></tr>
<tr><td>Associated Environmental Impacts (Indirect)</td><td colspan="4">Personnel Demobilisation, Halting of Noise, Vibrations, Atmospheric Emissions, Effluents and Waste</td></tr>
<tr><td></td><td colspan="4">Recovery of Forest Individuals and Vegetation Enhancement in Forest Fragments</td></tr>
<tr><td></td><td colspan="4">Increased Habitat for Fauna and Fauna Enhancement</td></tr>
<tr><td></td><td colspan="4">Reducing the Risk of Negative Interactions between Workers and Fauna</td></tr>
<tr><td></td><td colspan="4">Stopping activities that cause modifications to the substrate of surface waters due to the transportation of particulate material and interference on the ichthyofauna</td></tr>
<tr><td>Mitigating and Control Actions and Measures</td><td colspan="4">Inspection, Control and Monitoring of Environmental Recovery and Stability of Remaining Structures</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Raising Expectations

<table>
<tr><th rowspan="3">Raising Expectations</th><th colspan="2" rowspan="2">Stage</th><th colspan="2">Pre-Implementation and Implementation</th><th>Mineral Extraction Operation</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Medium</td></tr>
<tr><td rowspan="4">Impact Inducing Activities</td><td colspan="6">Project planning actions</td><td rowspan="8">✓ Social Communication Programme</td></tr>
<tr><td colspan="6">Construction work to install the project's structures in the region</td></tr>
<tr><td colspan="6">Project under operation</td></tr>
<tr><td colspan="6">Demobilisation of the project's structures</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="6">Movement of physical, human, financial and informational resources</td></tr>
<tr><td rowspan="2">Associated Environmental Impacts (Indirect)</td><td colspan="6">Concern from social, community and institutional stakeholders</td></tr>
<tr><td colspan="6">Emergence and spread of 'assumptions' and 'misunderstandings' about the project and its impacts</td></tr>
<tr><td>Mitigating and Control Actions and Measures</td><td colspan="6">Work on information and relational flows within and outside the organisational setting</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Increase in the Income Level, in the Wage Volume in Circulation and in Tax Payments

<table>
<tr><th rowspan="3">Increase in the Income Level, in the Wage Volume in Circulation and in Tax Payments</th><th colspan="2" rowspan="2">Stage</th><th>Pre-Implementation and Implementation</th><th>Mineral Extraction Operation</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td><td>High</td><td>High</td></tr>
<tr><td>Likely</td><td>Medium</td><td>High</td><td>High</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="5">Construction work to install the project's structures in the region</td><td rowspan="10">✓ Local Development Agenda

✓ Social Communication Programme</td></tr>
<tr><td></td><td colspan="5">Project in operation</td></tr>
<tr><td rowspan="4">Environmental Aspects Associated with the Impact</td><td colspan="5">Demand for inputs, goods, products and services</td></tr>
<tr><td colspan="5">Movement of physical, human and financial resources resulting from activities which are intrinsic to project implementation and operation</td></tr>
<tr><td colspan="5">Local employment</td></tr>
<tr><td colspan="5">Collection of taxes and charges at municipal level</td></tr>
<tr><td rowspan="4">Associated Environmental Impacts (Indirect)</td><td colspan="5">Collection of ISS, ICMS and CFEM at municipal level, among other taxes and duties</td></tr>
<tr><td colspan="5">Local employment, generating direct and indirect jobs, resulting in maintaining the salary volume through the payment of wages, charges and labour benefits</td></tr>
<tr><td colspan="5">Boosting the trade of goods and services and demand for inputs, goods, products and services</td></tr>
<tr><td colspan="5">Contribution towards boosting the economy at regional level, from the development of Araguaia Nickel Project (South and North) on the productive and socioeconomic structures of Conceição do Araguaia, Xinguara and Sapucaia</td></tr>
<tr><td rowspan="2">Mitigating and Control Actions and Measures</td><td colspan="5">Promotion of joint actions between the company and the local government, aiming at maximising the benefits to society and the local economy</td></tr>
<tr><td colspan="5">Prioritising local employment</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Causing Disturbance to the Local Lifestyle

<table>
<tr><th rowspan="3">Causing Disturbance to the Local Lifestyle</th><th colspan="2" rowspan="2">Stage</th><th>Pre-Implementation and Implementation</th><th>Mineral Extraction Operation</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Stage</td><td>Likely</td><td>Medium</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="5">Works (civil construction) of the Project structures
Project in operation</td><td rowspan="5">✓ Social Communication Programme
✓ Environmental Education Programme
✓ Access Maintenance and Trafficability Programme
✓ Erosive Processes Control and Monitoring Programme
✓ Water Resources Management Programme
✓ Noise Level Management and Monitoring Programme;
✓ Air Quality Management and Monitoring Programme</td></tr>
<tr><td>Environmental Aspects Associated with the Impact</td><td colspan="5">Disturbance caused by the modification of local physical aspects, such as increased noise levels, particulate matter in the air and exposure of the local community to the risk of accidents involving residents and animals
Presence of outsiders in the social life of local groups
Increased vehicle and machinery traffic on the project's access roads</td></tr>
<tr><td>Associated Environmental Impacts (Indirect)</td><td colspan="5">Modification to the local population's lifestyle</td></tr>
<tr><td>Ações e Medidas Mitigadoras e de Controle</td><td colspan="5">Actions aimed at ensuring the minimum conditions required for the continuity and permanence of the typical rural lifestyle of the local population
Educational and awareness-raising actions for the local population and workers</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Modifications to Local Landscape

<table>
<tr><th rowspan="3">Modifications to Local Landscape</th><th colspan="2">Stage</th><th>Implementation</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="3">Modification of the landscape as a result of the project implementation</td><td rowspan="7">✓ Social Communication Programme

✓ Local Development Agenda

✓ Degraded Areas Recovery Programme (DARP)

✓ Mine Closure Plan</td></tr>
<tr><td rowspan="2">Environmental Aspects Associated with the Impact</td><td colspan="3">Modifications to the original or already anthropised landscape from vegetal suppression and topsoil removal</td></tr>
<tr><td colspan="3">Movement of machinery, equipment and vehicles for excavations, earthworks and opening accesses</td></tr>
<tr><td rowspan="3">Associated Environmental Impacts (Indirect)</td><td colspan="3">Modification of the landscape's social function</td></tr>
<tr><td colspan="3">Alteration of the visual and perceptual aspect with modification or loss of visual, landscape, identity and spatial reference</td></tr>
<tr><td colspan="3">Modification to physical and biotic aspects in the region</td></tr>
<tr><td rowspan="3">Mitigating and Control Actions and Measures</td><td colspan="3">Raising awareness of new attitudes and practices, aimed at contributing to shaping a new socioenvironmental context</td></tr>
<tr><td colspan="3">Communication actions to share information about the company and the project</td></tr>
<tr><td colspan="3">Actions to promote the environmental recovery of the landscape</td></tr>
</table>

Summary of the Characteristics Associated with the Impact of Reduction in the Income Level, in the Wage Volume in Circulation and in Tax Payments

<table>
<tr><th rowspan="3">Reduction in the Income Level, in the Wage Volume in Circulation and in Tax Payments</th><th colspan="2">Stage</th><th>Reclamation of the Piles to be Transported and Mine Closure</th><th rowspan="3">Environmental Programmes</th></tr>
<tr><td rowspan="2">Magnitude of the Impact</td><td>Potential</td><td>Medium</td></tr>
<tr><td>Likely</td><td>Medium</td></tr>
<tr><td>Impact Inducing Activities</td><td colspan="3">Demobilisation of the project's structures</td><td rowspan="8">✓ Social Communication Programme

✓ Environmental Education Programme

✓ Local Development Agenda</td></tr>
<tr><td></td><td colspan="3">Modification and slowdown in the municipality's economic dynamics, resulting from the Project's closure phase</td></tr>
<tr><td rowspan="3">Environmental Aspects Associated with the Impact</td><td colspan="3">Progressive reduction in the procurement of inputs, goods, products and services</td></tr>
<tr><td colspan="3">Progressive reduction in the collection of taxes and duties</td></tr>
<tr><td colspan="3">Reduction of local labour employability</td></tr>
<tr><td rowspan="3">Associated Environmental Impacts (Indirect)</td><td colspan="3">Decline in employability</td></tr>
<tr><td colspan="3">Decrease in capital in circulation</td></tr>
<tr><td colspan="3">Slowdown in the trade of goods, products and services</td></tr>
<tr><td>Mitigating and Control Actions and Measures</td><td colspan="3">Measures to support and promote the local economy</td></tr>
<tr><td></td><td colspan="3">Upfront planning of alternatives to be developed in collaboration between public institutions, rural villages and the company</td></tr>
</table>

Considerations on the Environmental Impacts

The main findings from the environmental impact assessment are below:

- ✓ 18 impacts are classified as negative, mainly those associated with modifications to the physical and biotic factors during the implementation and operational phases; 3 impacts are classified as positive, such as impacts associated with an increase in the level of income, in the wage volume in circulation and tax collection during the whole life of mine, including during the closure phase, and also the recovery of natural environments and the attraction of fauna to these areas as a result of the recovery of degraded areas; and 1 impact is classified with a double effect, which can be positive and negative, in this case, the impact of reduction in the level of income, in the wage volume in circulation and in tax collection. In this regard, the adoption of the recommended programmes to diversify the economy could facilitate a reduction in the adverse effects from the closure of the mining activity in the region. It is worth noting that considering the 18 impacts classified as negative, virtually all of them ceased to exist when the activity was discontinued;
- ✓ Most of the impacts have a direct incidence, resulting from the actions directly related to the implementation, operation and closing of the project; however, the impacts with the potential to unfold into other impacts, classified as indirect or second order impacts, are also important. Therefore, the mitigation, control and monitoring of direct or first order impacts must be a permanent guideline to manage the environmental impacts;
- ✓ The majority of the impacts are of immediate and medium-term occurrence, demonstrating the importance of the environmental management for their control and mitigation;
- ✓ Most impacts continuously occur throughout the phase they are associated with, demonstrating the importance of measures to control and monitor their evolution until the closure phase, when they should cease;
- ✓ Half of the assessed conditions refer to impacts restricted to the project's Directly Affected Area (*Área Diretamente Afetada, ADA*). However, in one third of the assessed conditions, the impacts are not restricted to the ADA, reaching the Area of Direct Influence (*Área de Influência Direta, AID*) and Area of Indirect Influence (*Área de Influência Indireta, AII*);
- ✓ Three quarters of the assessed conditions indicate reversible impacts, and the quarter considered irreversible must be compensated in light of the current environmental legislation;
- ✓ Over 80% of the assessed conditions suggest a propensity for the impact to diminish or remain stable over the life of mine. The conditions that indicate an increase over the life of mine should be subject to intensified control and monitoring measures;
- ✓ About 70% of the assessed conditions represent accumulation and synergy with other impacts, indicating the need for joint actions in the environmental programmes to be detailed, in order to make these joint actions more effective;
- ✓ No environmental damage or improvement was observed that posed a loss or improvement capable of completely modifying the original environment;
- ✓ Perceptible and measurable losses make up more than half of the conditions assessed, indicating the possibility of efficiently controlling most environmental impacts.

Finally, as a result of the assessment, under the conditions in which it was carried out, no environmental impact was identified that could completely modify the physical-biological environment and/or the socioeconomic and cultural structures in the areas of influence, and consequently the biotic and/or social life in the areas of influence. Overall, these impacts correspond to medium magnitude, mainly associated with the implementation and operation phases of the project, which, despite having a high capacity to qualitatively and quantitatively modify the physical-biological environment and/or the socioeconomic and/or cultural structures in the areas of influence, correspond to identifiable impacts, and therefore controllable, manageable and largely reversible. In other words, after the closure of the activities, the project area will be recovered as of its conditions prior to the project, with the exception of the pit area, which will form small lakes.

ENVIRONMENTAL PROGRAMMES

The following Environmental Programmes are planned, aimed at mitigating, controlling and monitoring the negative impacts and enhancing the positive ones:

Erosive Processes Control and Monitoring Programme

Its main objective is to prevent, reduce and control the start of erosion processes, especially during project implementation works. Measures are planned to protect and stabilise the most sensitive environments.

Water Resources Management Programme

Its main objective is to ensure the quality and quantity of surface and groundwater around the Project. Water quality and quantity monitoring will be carried out, as well as controlling rain, sanitary and oily liquid effluents.

Air Quality Management and Monitoring Programme

Its main objective is to monitor the air quality indicator parameters, due to the modifying potential arising mainly from atmospheric emissions from mining activities, handling and transport of ore and waste.

Noise Level Management and Monitoring Programme

The programme aims to ensure that the levels of noise and vibration generated from the operations meet the current standards and legislation.

Degraded Areas Recovery Programme (DARP)

Its objective is to recover the areas degraded by the mining activity, by implementing procedures since the beginning of the operations, using the organic soil and ensuring the terrain stability and revegetation.

Mine Closure Plan

Its main purpose is to enable a positive and lasting legacy for the communities involved in the Project and to ensure environmental quality, safety/security and public health in the areas modified by the Project.

Speleological Management Programme

Aims to ensure the correct management of the cavities identified in the Area of Direct Influence of the project. Specific studies and monitoring will be carried out.

Road Access Restoration Programme

The aim is to keep the infrastructure of the roads used during the construction work in good condition, as well as to ensure appropriate and safe traffic circulation in the project area.

Fauna Scaring and Rescue Programme

This programme seeks to scare away and rescue fauna that has difficulty moving, before and during the vegetation suppression activities, to areas with environmental similarities that will not be affected by the project.

Fauna Monitoring Programme

The programme aims to monitor the fauna groups potentially affected by the project, such as herpetofauna, avifauna, mastofauna, flying mastofauna, entomofauna, ichthyofauna and hydrobiological communities.

Vector Monitoring and Nosological Control Programme

Its purpose is to obtain a history of the occurrence of entomological vectors that cause diseases, in the area of influence of the project. Entomofauna campaigns will be carried out in order to register the places where vectors have been identified, and to implement actions to prevent disease outbreaks.

Vegetation Conservation and Management Programme

The programme aims to preserve germplasm and woody resources. This will be achieved by carrying out flora rescue and monitoring programmes, optimisation and control of vegetal suppression activities, and recovery of degraded areas.

Environmental and Forest Compensation Programme

Guiding environmental compensation measures with regard to unmitigated environmental impacts, vegetation suppression and also the compensations defined in the legislation.

Social Communication Programme

The programme aims to promote understanding, involvement and dialogue between the Project's stakeholders on issues of mutual interest (company/target audiences).

Environmental Education Programme

Its objective is the development of educational actions with the target audiences, aimed at increasing their understanding of the socioenvironmental aspects of the Project and strengthening their critical socioenvironmental perception with a focus on the promotion of sustainable development.

Local Development Agenda

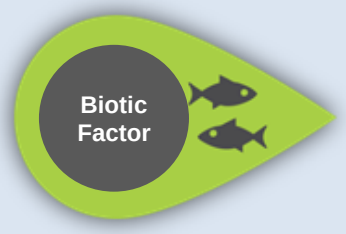
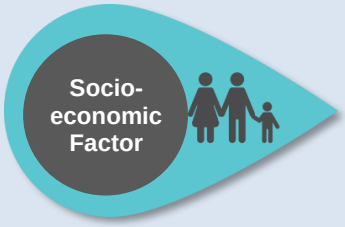
It aims to offer specialised technical support to the public administration of the municipalities of Xinguara and Sapucaia, contributing to the best use of financial resources, economic development of rural regions and employment opportunities from project implementation.

DEFINING THE AREA OF INFLUENCE

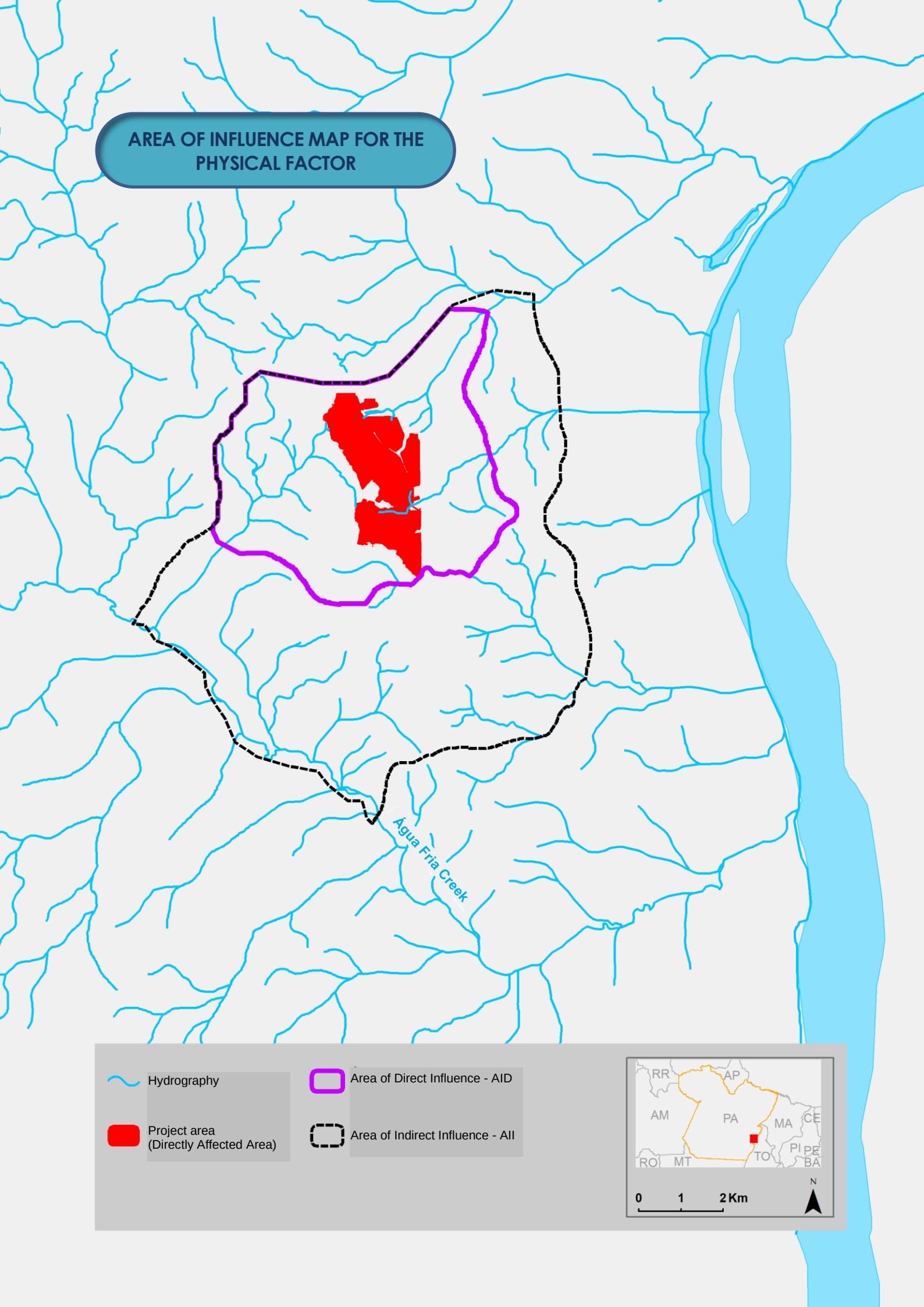
The Project's Area of Influence is defined as the geographical area to be directly or indirectly affected by the environmental impacts (CONAMA Resolution 01/86). To facilitate understanding and assessment of the environmental impacts, the Area of Influence is divided into an Area of Direct Influence *(Área de Influência Direta - AID)* and Area of Indirect Influence (*Área de Influência Indireta - AII*), as shown in the following boxes.

For a better understanding of the scope of the environmental impacts, the AID and AII were divided according to the impacts on the Physical, Biotic and Socioeconomic factors.

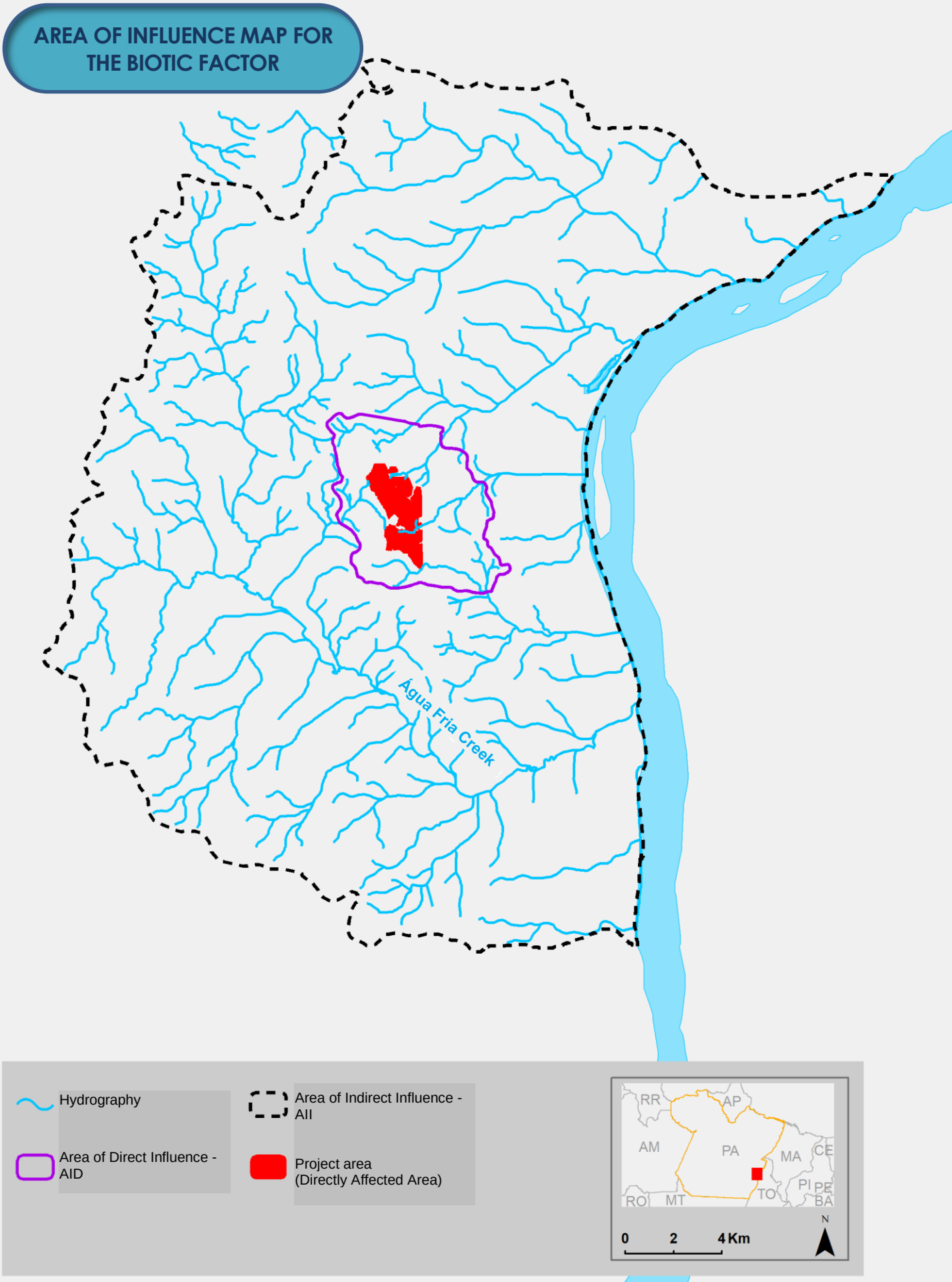
Directly Affected Area *(Área Diretamente Afetada)*	**Area of Direct Influence *(Área de Influência Direta)***	**Area of Indirect Influence *(Área de Influência Indireta)***
ADA	**AID**	**AII**
Area where the project is located or developed, i.e., the physical area on which the activities will take place, or also, the surface of the ground effectively occupied and modified by the project.	Area subject to direct impacts from the project's activities. Therefore, its boundaries should be defined according to the social, economic, physical and biological characteristics of the systems to be studied and the specificities of the direct impacts resulting from the project.	Area subject to the indirect impacts from the project's activities. For each factor considered, there will be an AII. The sum of all these areas indicates the AII of the project. Therefore, its definition should be based on the social, economic, physical and biological characteristics of the systems to be studied and on the specificities of the indirect impacts resulting from the project.

Factors	Area of Direct Influence	Area of Indirect Influence
	AID	AII
	The boundaries of the Area of Direct Influence of the physical factor mainly considered the boundaries of the project's drainages, as one of the main impacts is related to the potential carriage of sediments into the nearby streams.	The Area of Indirect Influence defined for the physical factor follows the AID defined for this project up to the Água Fria creek becoming a tributary of the Araguaia River.
	To delineate the Area of Direct Influence of the biotic factor, we primarily evaluated the extent of the impacts on flora and fauna, and the most susceptible ecosystems to impacts, such as native vegetation areas and waterways.	The Area of Indirect Influence of the biotic factor was defined mainly considering the criterion of hydrographic basins, covering all the watercourses that suffer direct and indirect effects from the project.
	For the socioeconomic factor, the Area of Direct Influence was considered to be the municipalities near the project that will be subject to the negative or positive effects of direct incidence impacts.	The Area of Indirect Influence was delineated taking into account the municipalities in the region of the project that will be indirectly affected by the positive or negative impacts from the project.

AREA OF INFLUENCE MAP FOR THE PHYSICAL FACTOR

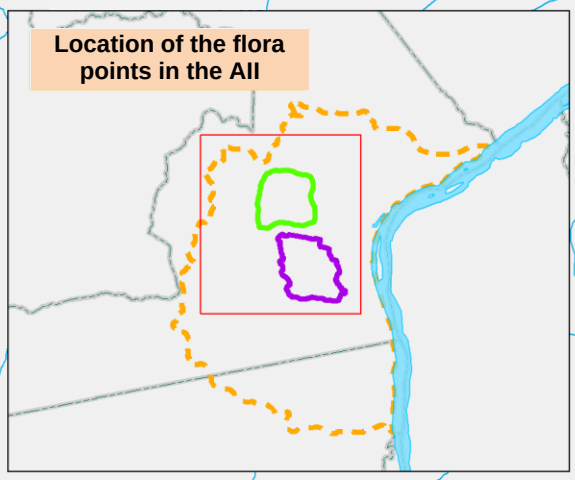


AREA OF INFLUENCE MAP FOR THE BIOTIC FACTOR



FLORA SAMPLING POINTS

Água Fria Creek



Flora sampling points

Drainage

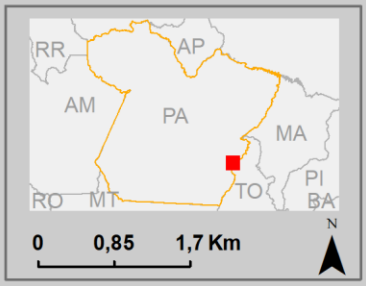
Municipal boundary

Control Area

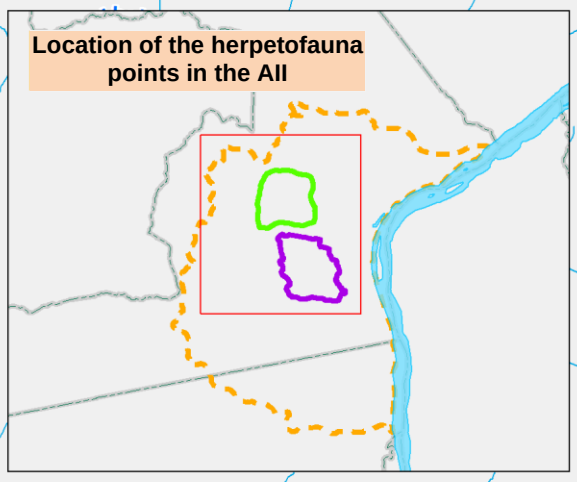
Project area (Directly Affected Area)

Area of Direct Influence - AID

Area of Indirect Influence - AII



HERPETOFAUNA SAMPLING POINTS



Herpetofauna sampling points

Drainage

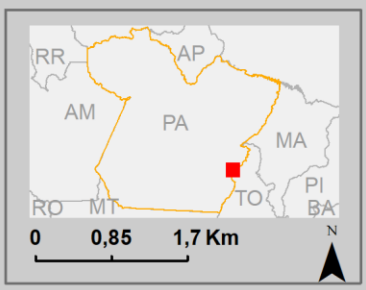
Municipal boundary

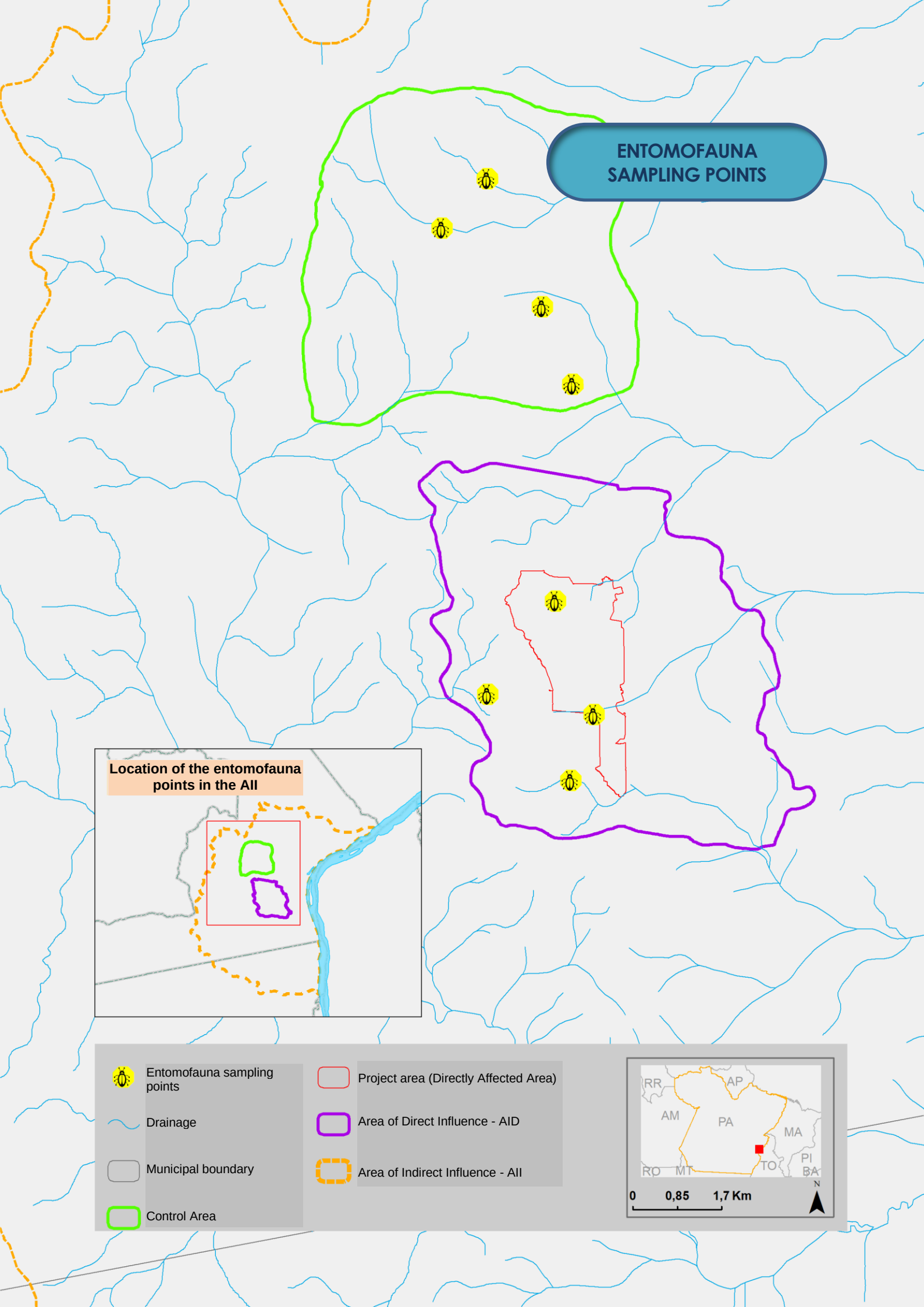
Control Area

Project area (Directly Affected Area)

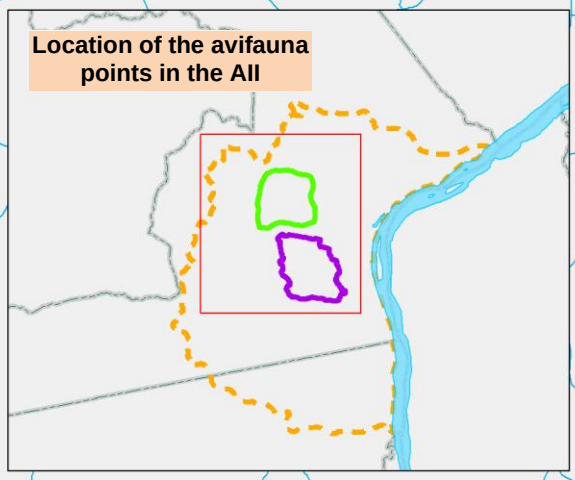
Area of Direct Influence - AID

Area of Indirect Influence - AII




ENTOMOFAUNA
SAMPLING POINTS
Location of the entomofauna points in the AII
Entomofauna sampling points
Drainage
Municipal boundary
Control Area
Project area (Directly Affected Area)
Area of Direct Influence - AID
Area of Indirect Influence - AII
RR
AP
AM
PA
MA
RO
MT
TO
PI
BA
0
0,85
1,7 Km
N

AVIFAUNA SAMPLING POINTS



Avifauna sampling points

Drainage

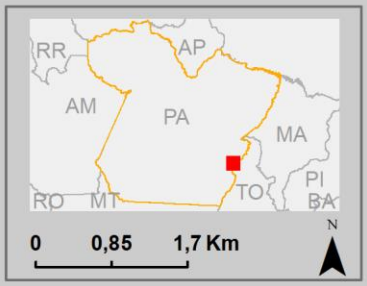
Municipal boundary

Control Area

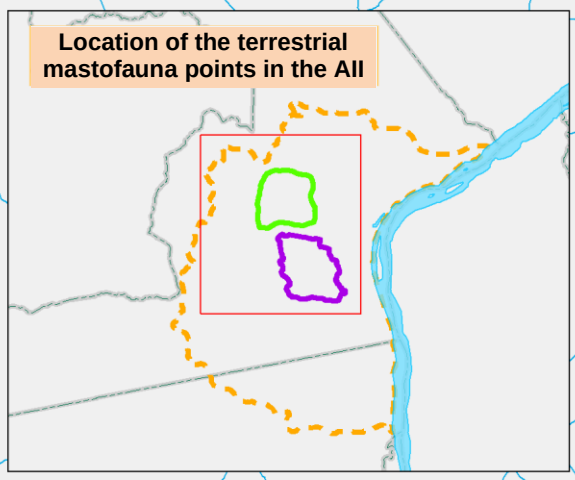
Project area (Directly Affected Area)

Area of Direct Influence - AID

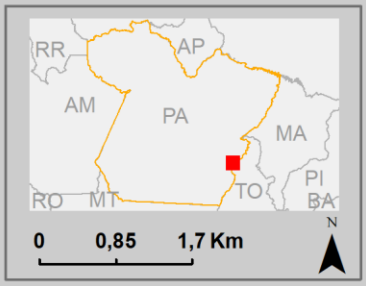
Area of Indirect Influence - AII



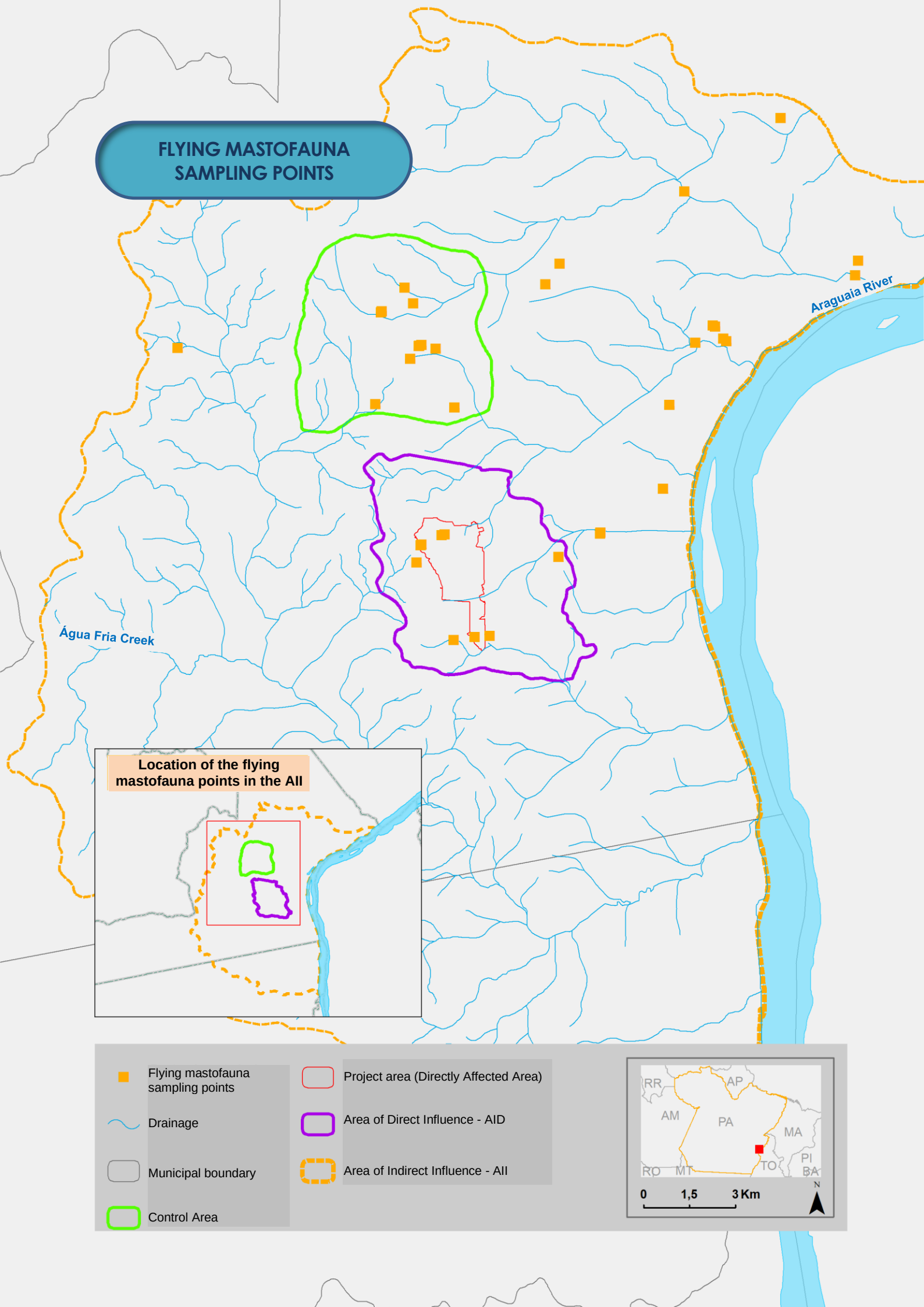
TERRESTRIAL MASTOFAUNA SAMPLING POINTS

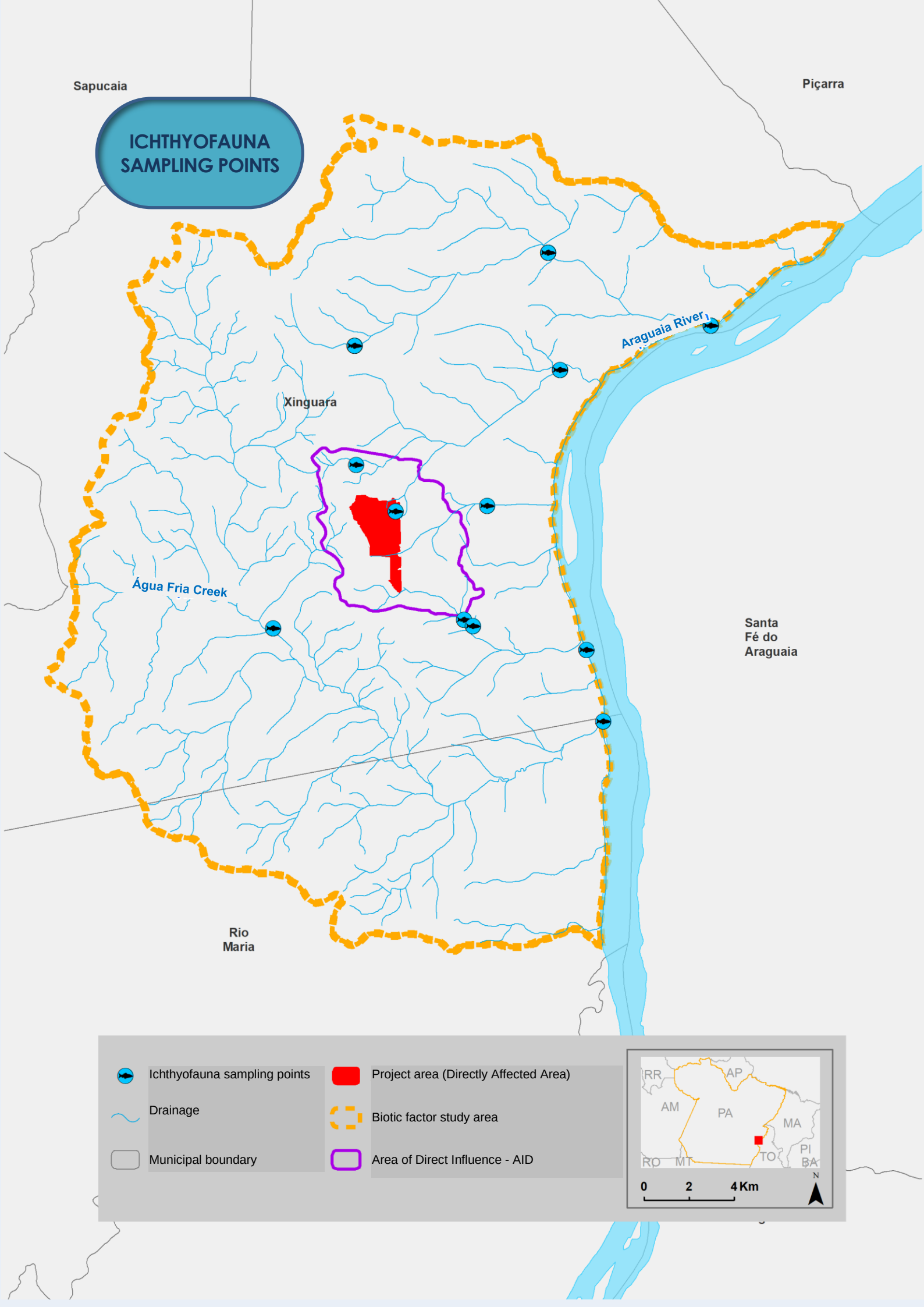


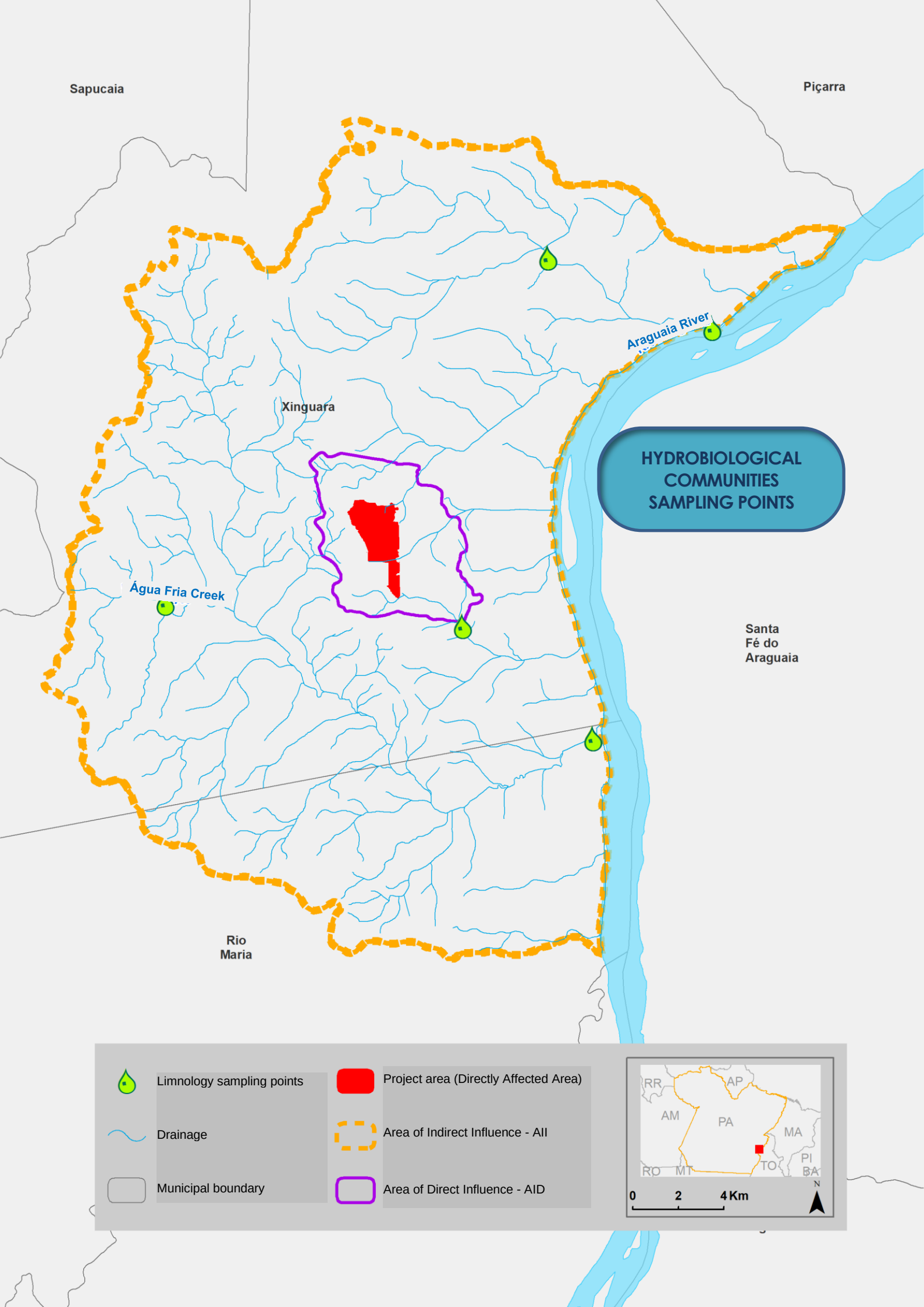
- Terrestrial mastofauna sampling points
- Drainage
- Municipal boundary
- Control Area
- Project area (Directly Affected Area)
- Area of Direct Influence - AID
- Area of Indirect Influence - AII

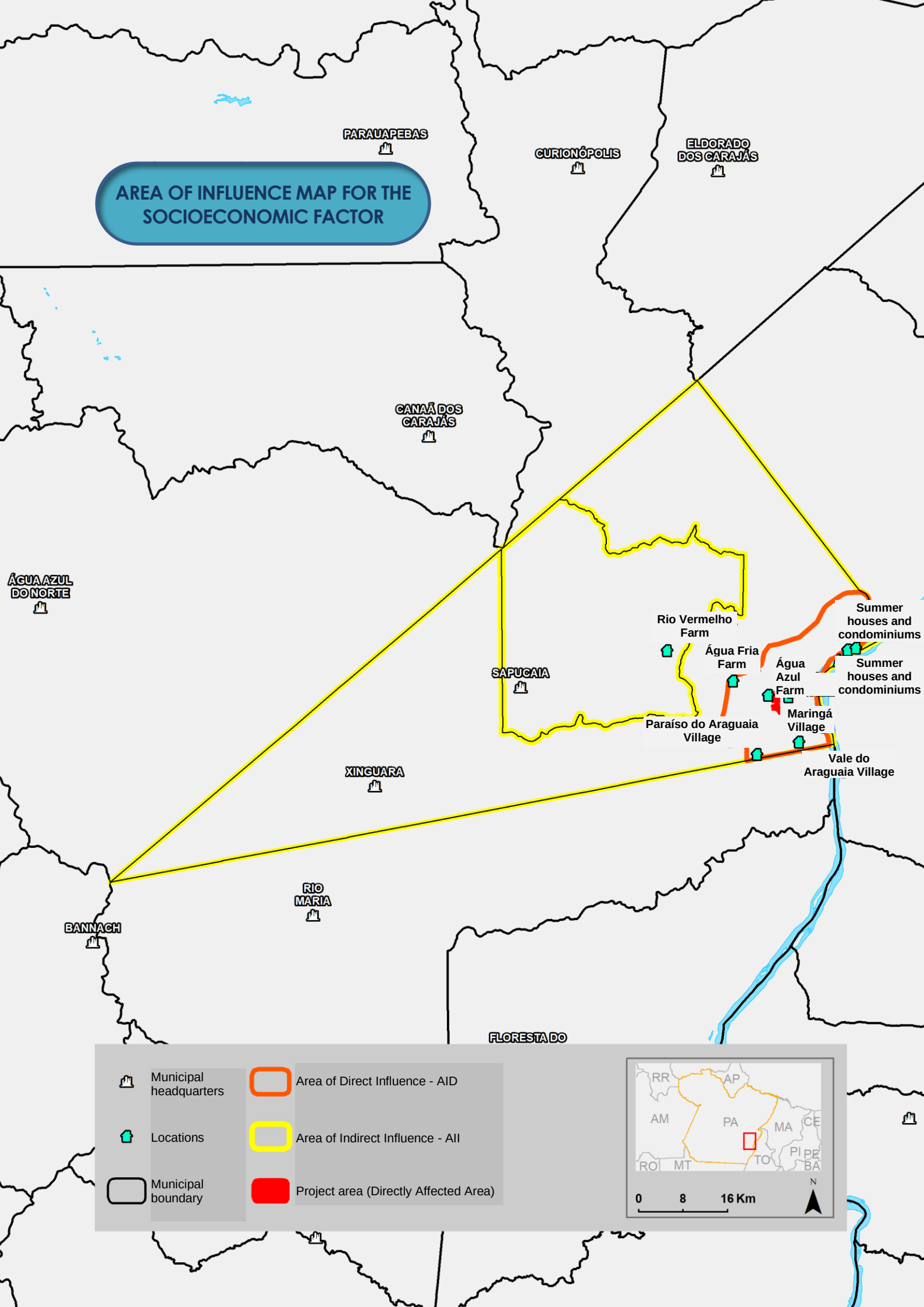


FLYING MASTOFAUNA SAMPLING POINTS




ICHTHYOFAUNA SAMPLING POINTS
Sapucaia
Piçarra
Araguaia River
Xinguara
Água Fria Creek
Santa Fé do Araguaia
Rio Maria
Ichthyofauna sampling points
Drainage
Municipal boundary
Project area (Directly Affected Area)
Biotic factor study area
Area of Direct Influence - AID
RR
AP
AM
PA
MA
PI
BA
TO
MT
RO
0
2
4 Km
N


Sapucaia
Piçarra
Araguaia River
Xinguara
HYDROBIOLOGICAL COMMUNITIES SAMPLING POINTS
Água Fria Creek
Santa Fé do Araguaia
Rio Maria
Limnology sampling points
Drainage
Municipal boundary
Project area (Directly Affected Area)
Area of Indirect Influence - AII
Area of Direct Influence - AID
RR
AP
AM
PA
MA
PI
BA
TO
MT
RO
0
2
4 Km
N


AREA OF INFLUENCE MAP FOR THE SOCIOECONOMIC FACTOR
PARAUAPEBAS
CURIONÓPOLIS
ELDORADO DOS CARAJÁS
CANAÃ DOS CARAJÁS
ÁGUA AZUL DO NORTE
SAPUCAIA
XINGUARA
RIO MARIA
BANNACH
FLORESTA DO
Rio Vermelho Farm
Água Fria Farm
Água Azul Farm
Paraíso do Araguaia Village
Maringá Village
Vale do Araguaia Village
Summer houses and condominiums
Summer houses and condominiums
Municipal headquarters
Locations
Municipal boundary
Area of Direct Influence - AID
Area of Indirect Influence - AII
Project area (Directly Affected Area)
RR
AP
AM
PA
MA
CE
PI
PE
BA
TO
MT
RO
0
8
16 Km
N

Summary of the Environmental Characteristics of the Areas of Influence

Once the areas of direct influence (AID) and indirect influence (AII) have been defined, based on the assessment of the environmental impacts directly and indirectly associated with the project, as designed and in the planned location, a summary of the main socioenvironmental characteristics observed and within these limits is presented below, in a comparative manner and when possible, qualifying and quantifying the main differences between the ADA, the AID and the AII.

Main environmental characteristics that enable a differentiation between the ADA, AID and AII in a qualitative-quantitative manner

For the Physical Factor	Water Resources and Permanent Preservation Areas (APPs)
For the Biotic Factor	Vegetation Conservation Status and Land Use and Coverage
For the Socioeconomic Factor	Land use and Occupation

Permanent Preservation Areas *(Áreas de Preservação Permanente - APPs)*: The Permanent Preservation Areas considered were: springs and watercourses, slopes and hilltops. The table below shows the number of hectares of APPs within the ADA, AID and AII, compared to the number of hectares outside the APPs.

Quantity of APP in the areas of influence of the physical factor

Areas of influence of the physical factor	INSIDE APP (ha)			Outside APP (ha)	Total (ha)
	Watercourse and spring	Slope	Hilltop		
ADA	19.39	0.00	0.00	492.17	511.56
Area of Direct Influence - AID	194.04	41.59	35.07	2,396.17	2,666.87
Area of Indirect Influence - AII	405.53	96.69	54.39	4,681.47	5,238.07
Total	**618.96**	**138.27**	**89.45**	**7,569.81**	**8,416.49**

Water Resources and Water Quality: for the study, 89 parameters for surface water were analysed as well as 90 parameters for groundwater. The results, both for surface water and groundwater, aim to identify the natural baseline for the area, given that the project has not been installed yet. In other words, the results represent the environmental quality characteristic of its natural condition without intervention, but with the presence of the existing mineralisation (groundwater) and local soils (surface water). The results therefore reflect the background of the area.

Vegetation Conservation Status: It was possible to identify eleven land use and coverage classes in the project's ADA (Table on the next page), with agricultural/pasture cultivation being the most representative class, which indicates that the ADA is primarily anthropised. Regarding forest formations, the presence of Ombrophylous Forest and Ferruginous *Canga* is notable, with these formations showing the transition between the Amazon and Cerrado biomes. The forest areas are inserted mainly in pasture lands, hindering the formation of ecological corridors in the surrounding region of the ADA.

The *canga* areas are subjected to, as well as the surrounding anthropised regions, the treading by animals moving between the formations.

The fragments, in general, were preserved and it was possible to observe healthy arboreal individuals in some points.

Land Use and Coverage: it was possible to identify eleven land use and coverage classes in the project's ADA, with agricultural/pasture cultivation being the most representative class, which indicates that the ADA is primarily anthropised.

Regarding forest formations, the presence of Ombrophylous Forest and Ferruginous *Canga* is notable, with these formations showing the transition between the Amazon and Cerrado biomes. Out of the 511.56 ha of the ADA, 19.39 ha are located in APPs, while 492.17 ha are outside APPs.

Regarding the AID (Area of Direct Influence) it is noteworthy that, similarly to the ADA, the most representative class of land use and coverage is the agricultural/pasture cultivation. Within the limits of the AID, water courses and springs stand out, totalling 242.95 ha. Out of the 3,360.92 ha of the AID, 321.15 ha are in APPs, while 3,039.77 ha are located outside of APPs, as shown in the table below. The overall sum of the ADA and AID amounts to 3,872.49 ha.

Types of Land Coverage and Quantity (hectares) of APP in the ADA and AID of the biotic factor

Land Coverage	ADA		AID				Total
	Inside APP	Outside APP	Inside APP			Outside APP	
	Watercourse and spring		Watercourse and spring	Slope	Hilltop		
Open Ombrophylous Forest	0.10	28.68	19.59	4.49		290.09	342.94
Dense Ombrophylous Forest	0.01	2.23	48.72	55.23	16.88	679.93	802.99
Rock outcrop / Ferruginous *Canga*	2.27	32.71	8.47	0.78	0.15	86.23	130.62
Woodland *(Capão de Mata)*	0.66	0.33	1.38	0.00	0.00	1.17	3.54
Swampy area	4.95	5.83	6.65	0.00	0.00	2.43	19.87
Regenerating area		32.99	9.90	0.07	0.00	415.16	458.13
Agriculture/ pasture	5.70	377.02	78.63	0.61	0.00	1,496.60	1,958.55
Roads		2.70	0.33	0.00	0.00	4.77	7.81
Dam	0.19	0.09	9.12	0.00	0.00	7.65	17.05
Houses	0.07	0.95	0.01	0.00	0.00	5.19	6.23
Riparian Forest	5.44	8.64	60.14	0.00	0.00	50.54	124.75
Total	**19.39**	**492.17**	**242.95**	**61.17**	**17.03**	**3,039.77**	**3,872.49**

In the AII (Area of Indirect Influence), similarly to the ADA and AID, the anthropised area is the most representative with a total of 47,858.35 ha, out of which 44,445.83 ha are outside the APP and 3,412.52 ha are in APPs. Although the AII is mostly made up of anthropised areas, the presence of forest fragments is noteworthy (19,067.92 ha), out of which 16,236.38 ha are outside of APPs and 10.00 ha are in APPs (Table below).

Types of Land Coverage and Quantity (hectares) of APP in the AII of the biotic factor

Land Coverage (AII)	Inside APP			Outside APP	Total
	Watercourse and spring	Slope	Hilltop		
Forest formation	1,897.27	465.31	468.97	16,236.38	19,067.92
Non-forest formation	4.90	4.93	0.17	416.62	426.63
Anthropised area	3,332.57	76.73	3.22	44,445.83	47,858.35
Built up area	34.88	0.00	0.00	60.44	95.32
Water	119.55	0.00	0.00	81.56	201.11
Total	**5,389.17**	**546.97**	**472.36**	**61,240.83**	**67,649.33**

Flora: considering the main phytophysiognomies found in these areas (Ombrophylous Forest, Ferruginous *Canga*, Riparian Forest and *Campinarana*), 326 species were recorded in the sampling campaigns, 38 of which are considered endemic. Out of the 38 endemic species, 19 were found in the ADA, 4 species in the AID and 8 species were found in the AII. Still within this context, 6 endemic species had their individuals identified in the ADA and AII; finally, one species was identified in the AID and AII.

Fauna: Regarding the fauna group, sampling points were defined in the project's ADA, AID and AII, taking into account the aforementioned characteristics such as preserved vegetation and water bodies. The areas of influence of the project take into account, in general, the mobility of fauna, especially the terrestrial fauna. In the Area of Indirect Influence, the preserved vegetation fragments stand out among the extensive anthropised areas.

Land Use and Occupation: The ADA of the Araguaia Nickel North Project is located on a property owned by the company, named Água Azul Farm and which has 511.56 hectares, located entirely within the municipality of Xinguara - PA. According to the IBGE (2010), the census segment where the farm is located is considered, within the IBGE parameters, to be a rural area, in a situation of exclusively rural agglomeration.

The prevailing land use is agricultural cultivation and pasture, which covers 382.7 ha of the area. The forest formations (Open Ombrophylous Forest, Dense Ombrophylous Forest, *Capão de Mata* and Riparian Forest) correspond to 46.1 ha, characterizing the second main type of land use identified in the ADA, followed by the rocky outcrops/ferruginous *canga* (about 35 ha) and regenerating area (about 33 ha). Regarding housing, this type of land use and occupation is restricted to one hectare, where a residential building is located.

ANALYSING THE ENVIRONMENTAL SCENARIOS

What will the Project Area look like without the project? If the project is to be implemented, what will the Project Area look like after the project is decommissioned?

These potential scenarios are presented below.

Scenario in the event of Non-Implementation of the Project

If the project is not implemented, the areas modified by agriculture and livestock activity will probably remain within the immediate limits and surroundings of the area, and the impacts on local fauna and flora are not likely to be mitigated, as the process of urban occupation in the medium term does not require the recovery of these environments.

In addition, if the project is not implemented, the potential negative effects, such as modification of the landscape, potential disturbance and modifications to the local routine related to the implementation and operation of the Project, traffic of vehicles and foreign people in the areas close to the project, as well as the potential positive effects, such as an increase in employability, in the level of income, in the volume of wages in circulation and in tax collection, urban development in the areas close to the project and the economic dynamism of the municipalities will be cancelled.

If there are no new projects in the region, the social and economic situation of the municipalities is likely to remain the same.

Scenario After the Decommissioning of the Project

Regarding the physical and biotic factors, the mining activities cause topographic and landscape modifications, due to the techniques used for extraction, and that, therefore, follow specific criteria related to the landscape, the rain water drainage system, the geotechnical and geomorphologic rules, the presence of fauna and flora, among other issues related to the environment and also the environmental risks.

Thus, on mine closure, physical and biological stabilisation of disturbed areas should be ensured as far as possible. After mine closure, the environmental programmes for the physical and biotic factors aim to recover the areas as close as possible to the previous condition. As from the implementation of the Closure Plan designed by Araguaia Níquel Metais, it is expected that the degraded areas will be recovered through re-vegetation with native flora species.

Along with this flora recovery, there should be the recovery of fauna populations in the recovered areas. Regarding the socioeconomic aspects, it is expected that an economic dynamic will coexist with regard to the generation of taxes and jobs from the socioenvironmental programmes aimed at the sustainable development of the region, including the realistic possibility of opening new fronts, given the mining potential of the region.

CONCLUSION

The Araguaia Nickel North Project is a strategic mining project for the success of Araguaia Níquel Metais Ltda, which has already been carrying out its activities in the southeastern region of Pará, with important investments for the region.

The Project represents the certainty of ore supply to ensure the technical and economic viability of the company's operations in Conceição do Araguaia.

The Project's expected life of mine is 24 years, with mineral extraction taking place over 16 years. In the final eight years, operations will basically consist of ore reclaiming from the stockpiles and transportation to the processing plant in Conceição do Araguaia.

The deposit will be mined with conventional mechanical breakage equipment, without the use of explosives, based on the excavator, loader and truck system.

Ore transportation is not part of the environmental impact assessment described in this EIA.

As an environmental factor restricting mining, the presence of four cavities near the pits was registered, and the assessment of their relevance is in progress. It was considered as a prerequisite in the LI (construction license) stage that the boundaries of the pits, waste piles and topsoil are checked so that they do not interfere in the protection radius according to the relevance of the cavities.

In general, the Project's area is marked by anthropic disturbances related to human occupation in rural areas and non-urbanised areas of villages, and the agricultural and livestock use of the land.

Regarding environmental impacts, 18 impacts are classified as negative, associated with the modifications to the physical and biotic factors during the implementation and operation phases; 3 impacts are classified as positive, such as the impacts of increase in the level of income, in the wage volume in circulation and in tax collection throughout the life of mine of the project, including the closure phase, and also the recovery of natural environments and the attraction of fauna to these locations following the recovery of degraded areas; and 1 impact is classified as having a double effect, which can be positive and negative, in this case, the impact of reduction in the level of income, in the wage volume in circulation and in tax collection, where the adoption of the recommended programmes to diversify the economy can reduce the adverse effects from the closure of the activity in the region. It is worth noting that out of the 18 impacts classified as negative, pretty much all of them ceased to exist with the closure of the activity;

Half of the assessed conditions refer to impacts restricted to the project's ADA. For about one-third of the conditions assessed, the impacts go beyond the ADA, reaching the AID and AII. Three-quarters of the assessed conditions indicate reversible impacts, and the quarter considered irreversible must be compensated in light of the current environmental legislation.

As a result of the assessment, considering the conditions under which they were carried out, no environmental impact was identified that could completely modify the physical-biological environment and/or the socioeconomic and cultural structures in the areas of influence, and consequently the biotic and/or social life in the areas of influence. These are exclusively impacts of medium magnitude, mainly associated with the implementation and operation phases of the project, which, despite having a high potential to qualitatively and quantitatively modify the physical-biological environment and/or the socio-economic and/or cultural structures in the areas of influence, they are identifiable impacts, and therefore controllable, manageable and largely reversible.

Regarding the land use and occupation, the implementation of the project does not prevent the continuity of the agricultural and livestock activities prevailing in the region, but it may reflect on the lifestyle and social routine in the region.

The ore processing will not be carried out in the mining facilities, and the ore will be stockpiled and reclaimed on demand, and transported to the company's processing plant in Conceição do Araguaia.

This is a project with a reduced number of employees and equipment, which should operate during the months with low rainfall when weather conditions are favourable. There is no mineral processing activity associated with the project, and it is considered a small project in relation to mining projects in general.

It is considered that the project does not cause environmental impacts outside the current legal framework, and the negative impacts identified may cease upon its closure, and the positive impacts may be enhanced during its life of mine. The unmitigated impacts may be compensated for under the terms of the current environmental legislation.

Thus, due to the company's ability to generate technical and financial resources for the effective control and mitigation of the negative environmental impacts and the possibility of economic, environmental and social gains enhanced by socioenvironmental and compensation programmes, it is considered that the implementation of the Araguaia Nickel North Project, as designed, in the planned location, has the necessary characteristics to have its socioenvironmental viability confirmed.

GLOSSARY

- **Anthropic** - Everything that refers to or has had its natural condition modified by human beings.
- **Archaeological site** - Place where traces of human occupation have been found.
- **Avifauna** - Birds.
- **Biodiversity** - Refers to the diversity of plant and animal communities that are inter-related and coexist in a common space, which may be an ecosystem or a biome (Glossário IBAMA, 2003).
- **Bioindicator** - Animal or vegetable whose presence in a specific environment indicates the existence of biological, physical or chemical modifications. Some bioindicators are bioaccumulators as they reveal the presence of toxic substances by accumulating them.
- **Biome** - A group of life (plant and animal) defined by the grouping of contiguous and identifiable vegetation types on a regional scale, with similar geoclimatic conditions and shared history of change, resulting in a biological diversity of their own. Biomes are the large 'living landscapes' existing on the planet, generally defined based on the prevailing type of vegetation. *Caatinga, Cerrado* and Atlantic Rainforest are examples of biomes.
- ***Canga*** - Concrete or ferruginous crust formed by limonitised rock mixed with clay and sand.
- ***Capoeira*** - Forest in a natural process of vegetation regeneration.
- **Catchment** - Structure built next to a body of water, which enables the diversion, controlled or not, of a certain volume, with the purpose of meeting one or more water uses.
- **Clay soil (Pedology)** - Soil that contains a large amount of clay, or soil that has properties similar to clay.
- **Community** - A group of people or living beings, part of a larger society, who live in a specific area and maintain some common interests and characteristics.
- **Complex** - Term used in regional mapping to indicate and map an association of rocks of different classes and whose structural and stratigraphic relationship is not completely defined yet.
- **Conservation** - The rational use of renewable natural resources (air, water, soil, flora and fauna) and obtaining maximum return from non-renewable resources (mineral deposits), so as to produce the greatest sustained benefit for current generations, while maintaining their potential to satisfy the needs of future generations. It is not synonymous with preservation because it is focused on the human use of nature, on a sustainable basis, while preservation aims at the long-term protection of species, habitats and ecosystems.
- **Conservation units** - Portions of the national territory with characteristics of relevant ecological and landscaping value, of public or private ownership, legally established by the public power with defined boundaries under special administration regimes, to which appropriate protection guarantees apply. Example: National Parks, Biological Reserves, Ecological Stations.
- **Containment dike** - A structure developed to contain the ore tailings.
- **Drainage** - This is usually defined as the area in which water is channeled to a main river and its tributaries due to geographical and topographical features.
- **Dry season** - Time of the year that is marked by a significant decrease or absence of rainfall.
- **Ecosystem** - An integrated system consisting of interactions of biotic and abiotic elements, whose dimensions may significantly vary.
- **Effluent** - Any type of water or liquid that flows from a collection or transport system, such as pipes, channels, reservoirs and pumping stations, or from a treatment or final disposal system, with treatment plants and receiving water bodies.
- **Endemic** - A biological entity (usually a species) found only in a certain region, a

species native to a certain area and restricted to it.

- **Cyanobacteria** - Photosynthesising prokaryotic organisms.
- **Entomofauna** - Insects, such as mosquitoes, bees and ants.
- **Environment** - The set of physical, chemical and biological agents and social factors capable of having a direct or even indirect effect, either immediate or long term, on all living beings, including human beings.
- **Erosion** - It is the process of disintegration and transportation of solid particles from the soil, subsoil and rock by the action of river waters (fluvial erosion), rain waters (pluvial erosion), wind (wind erosion), melting (glacial erosion) or sea currents and waves (marine erosion). Human action can directly or indirectly accelerate the natural process of erosion, which mainly depends on soil properties, climate, vegetation, topography and other conditions. The vegetation coverage influences runoff and erosion rates more than any other single physical factor.
- **Exotic species** - Animal or plant species that settle in places where they are not naturally found.
- **Germplasm** - Genetic material originated from plants and animals, which aims at conserving samples.
- **Habitat** - A restricted geographical environment in which a society and/or organism can live.
- **Herpetofauna** - Amphibians (frogs, toads etc) and reptiles (snakes, lizards, turtles etc).
- **Hydrobiological community** - Set of several species living in aquatic environments.
- **Hydrographic basin** - It is the territorial unit for planning and managing water. It is the set of lands delimited by water dividers and drained by a main river, its tributaries and sub-tributaries. The hydrographic basin shows the hierarchy of rivers, in other words, the natural organisation in order of smaller volume (springs and streams) to the more abundant ones (rivers), flowing from the highest to the lowest points.
- **Hydrography** - The study and mapping of the continental and oceanic waters on the Earth's surface, focusing on the measurement and description of the physical characteristics such as water depth, speed and direction of the currents in the oceans, seas, lakes and rivers.
- **Ichthyofauna** - Fishes.
- ***Juquira*** - Vegetation that grows in a pasture environment.
- **Land occupation** - Physical occupation of the soil to develop a specific productive activity or of any kind, related to the existence of a social group in a particular time and geographic area.
- **Layer (Sedimentology)** - A tabular rock body that lies in a position essentially parallel to the surface on which it was formed.
- **Macrophytes** - Aquatic plants.
- **Mammals** - Homeothermic (warm-blooded) tetrapods covered with hair, with mammary glands and two occipital condyles. The teeth are divided into canines, incisors and molars.
- **Mastofauna** - Mammals.
- **Micro-basin** - Regarding the physical aspect, the micro-basin is not different from the definition of hydrographic basin, and it can even be classified as a small basin. This concept emerged due to the difficulty of planning the intervention in hydrographic basins with all their complexity and countless socioeconomic and environmental variables. Thus, the micro-basin is adopted to carry out programmes and studies, as opposed to the enormous size of a basin.
- **Mineral** - A naturally occurring chemical element or compound that occurs as a product of inorganic processes.
- **Mitigation measures** - Measures that aim to minimise the environmental impacts caused by a project.
- **Nickel** - Silver-white coloured metal.
- **Parameter** - Each one of the monitored characteristics which, due to its properties and variation, enables analysing the behaviour of a certain object.
- **Permanent Preservation Area *(Área de Preservação Permanente - APP)*** - A protected area, covered or not by native vegetation, with the environmental function

of preserving water resources, the landscape, geological stability, biodiversity, the genetic flow of fauna and flora, protecting the soil and ensuring the well-being of human populations.

- **Phytophysiognomy** - Aspects of the vegetation from a certain location.
- **Phytoplankton** - A group of microscopic organisms that float in freshwater and ocean environments.
- **Population** - A group of individuals, whether human or animal, in a constant process of modification by growth (birth, immigration) or loss (death, emigration) living in the same area. In a natural condition population, this process is limited by food availability and other environmental factors. Human populations are, however, affected by social practices controlling reproduction and by modern civilization's techniques that reduce mortality and extend life span.
- **Population density** - The ratio between the number of inhabitants and the area of the spatial or political-administrative unit in which they live, measured in inhabitants per hectare or per square kilometre.
- **Population dynamics** - The functional study of population characteristics such as growth, dispersion, changes in composition, and in relation to the factors that determine them.
- **Processing** - Set of ore concentration operations carried out immediately after mining. The concentration operations use physical processes for size reduction, classification by size (crushing, screening) and chemical processes (flotation, leaching).
- **Rainy season** - Term used to describe the heavy rainy season, which is preceded and followed by a dry season.
- **Region** - A continuous and homogeneous portion of territory in relation to certain criteria, by which it is differentiated from neighbouring regions. Regions have their boundaries defined based on the coherence and homogeneity of certain factors, while an area has its limits decided according to convenience.
- **Ringelmann Scale** - This is a graphical scale for calorimetric assessment of smoke density.
- **Sanitation** - The control of all factors in a human's physical environment which have a harmful effect on their physical, mental or social well-being.
- **Shrub** - Woody stem of variable size, but not exceeding 6 m in height.
- **Soil** - In general, it can be defined as the unconsolidated material of the Earth's surface originating from rock weathering. For geologists and engineers, soil is used as a synonym for regolith and comprises both surface material and subsoil formed by decomposed rock. For agronomists and geographers, who are more interested in soil from the point of view of its ability to support life, especially plant life, soil is better defined as the mineral or organic unconsolidated material that covers the surface of the planet and serves as the natural environment for terrestrial plant growth. Between soil and the material from which it is derived, there are notable differences from a physical, chemical, biological and morphological point of view.
- **Soil class** - Group of soils that present a defined variation in specific properties and that are distinguished from any other class by differences in these properties.
- **Species** - Basic unit of classification for living beings. It refers to populations of beings with common genetic characteristics, which under natural conditions reproduce and generate fertile and viable offspring. Although there may be considerable morphological variation among individuals of the same species, in general, the external characteristics of a species are reasonably constant, enabling the species to be recognised and distinguished from one another by their morphology.
- **Specimen** - Individual.
- **Speleology** - The integrated scientific study of underground natural cavities regarding their origin and evolution, including the systematisation of their morphology, geological and hydrological features, geochemistry, biology and palaeontology.
- **Spring** - Place where a water course begins; where a river starts.
- **Suppression** - Cutting, removal of vegetation.

- **Surface waters** - The waters that run off or accumulate on the surface of the Earth, such as rivers, streams, lakes, ponds, wetlands etc.
- **Surroundings** - Area in which a territory is situated.
- **Threatened species** - An animal or plant species that is in danger of extinction, its survival being uncertain if the factors that cause this threat continue.
- **Tributary** - The watercourse that flows into a main river or lake.
- **Urban infrastructure** - Set of works that support the functioning of the cities and that enable the urban use of the soil, i.e., the set of basic conduction and distribution networks, road network, drinking water, sewage networks, electric power, gas, telephone, among others, which enable people' mobility, supply and discharge, supply of basic fuels, water transportation, drainage and removal of urban waste.
- **Vectors** - Animals able to transmit diseases.
- **Waste** - Material extracted from the pit that has no commercial value for the project.
- **Water body** - General name for any water source; watercourse, stretch of river, artificial or natural reservoir, lake, pond or underground aquifer.
- **Water resources** - Any group of surface or underground water that is available and can be collected for human use.
- **Zoobenthos** - Microscopic heterotrophic organisms living in the water substrate.
- **Zooplankton** - Microscopic heterotrophic organisms living in a scattered manner in the water column.

TECHNICAL TEAM

Company responsible for the Environmental Impact Study	
Legal name	BRANDT MEIO AMBIENTE LTDA.
CNPJ	71.061.162/0001-88
Website	www.brandt.com.br
Mail address	Alameda do Ingá, 89 - Vale do Sereno - 34 000 000 - Nova Lima - MG.
Phone	(031) 3071-7000 / 3071-7002
Director and General Legal Representative	Diego Lara CPF: 064 754 196 30

BRANDT MEIO AMBIENTE TECHNICAL TEAM		
This team participated in the preparation of this RIMA and is technically responsible for their respective areas		
Technician	**Education / Professional Registration**	**Project responsibility**
Sérgio Avelar	Metallurgical Engineer CREA: 38077-D	Managing the Contract
Alessandro Dornelas	Biologist CRBio 62469/04-D CTF 1565891 CTDAM 7938	General coordination of the environmental studies
Gabriel Rago Cordeiro	Biologist CRBio 117546/04-P	Preparation of the Environmental Impact Report
Ingrid Roxane Damascena Batista	Environmental Technical Assistant	Support in the Preparation of the Environmental Impact Report
Carolina Aparecida Vieira de Almeida	Environmental Assistant	Support in the Preparation of the Environmental Impact Report
Carolina Araújo	Physical Factor Internship	Support in the preparation of the physical factor assessment for the Environmental Impact Report
Dayanne Miranda de Souza	Environmental Technical Assistant	Support in the preparation of the socioeconomic factor assessment for the Environmental Impact Report
Ana Carolina Caetano	Environmental Technician	Preparation of maps
Eli Lemos	Advertiser	Design, illustrations and editing