



**BRAZILIAN
NICKEL**

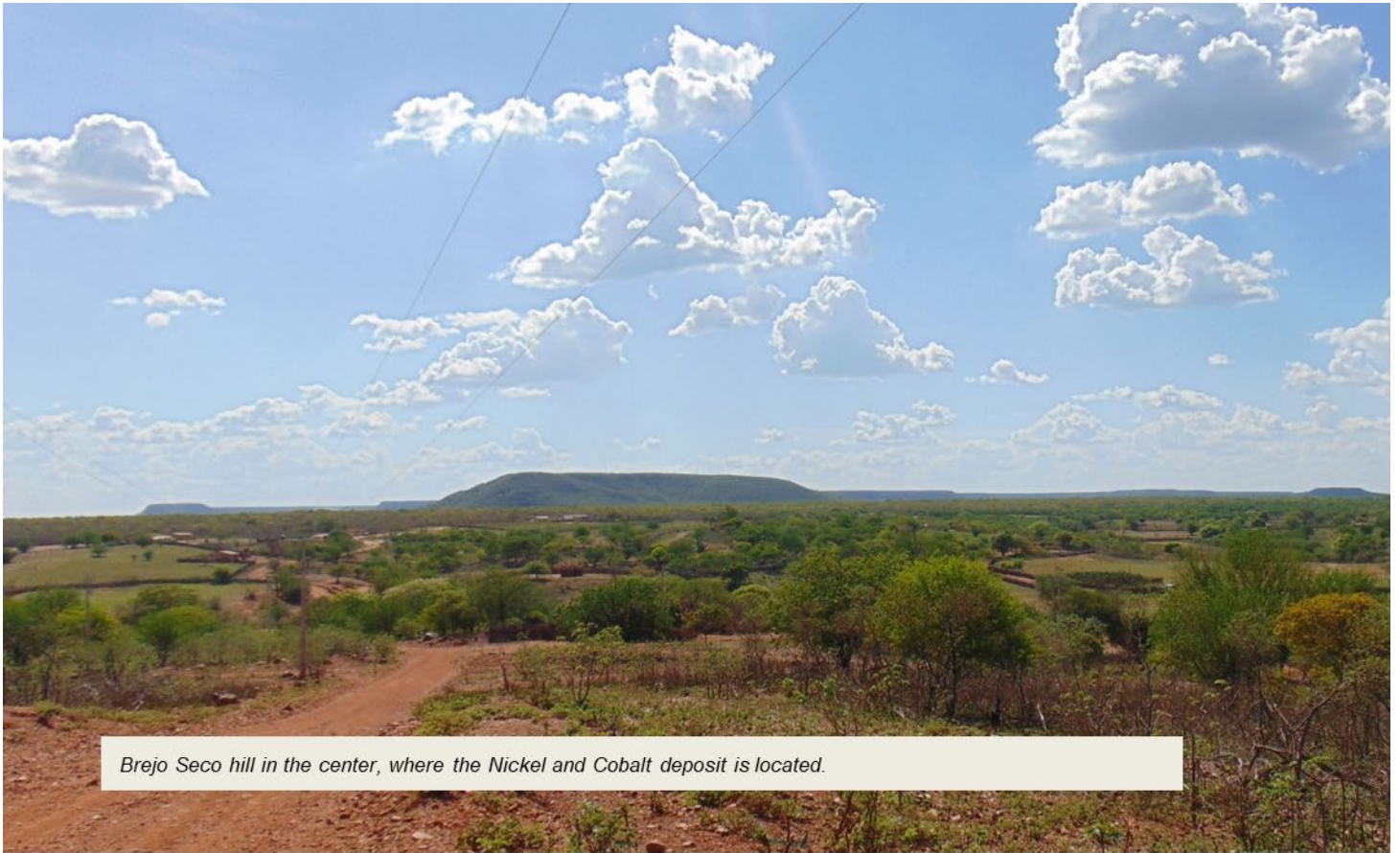
ESIA Summary

Environmental and Social Impact Assessment Summary Report

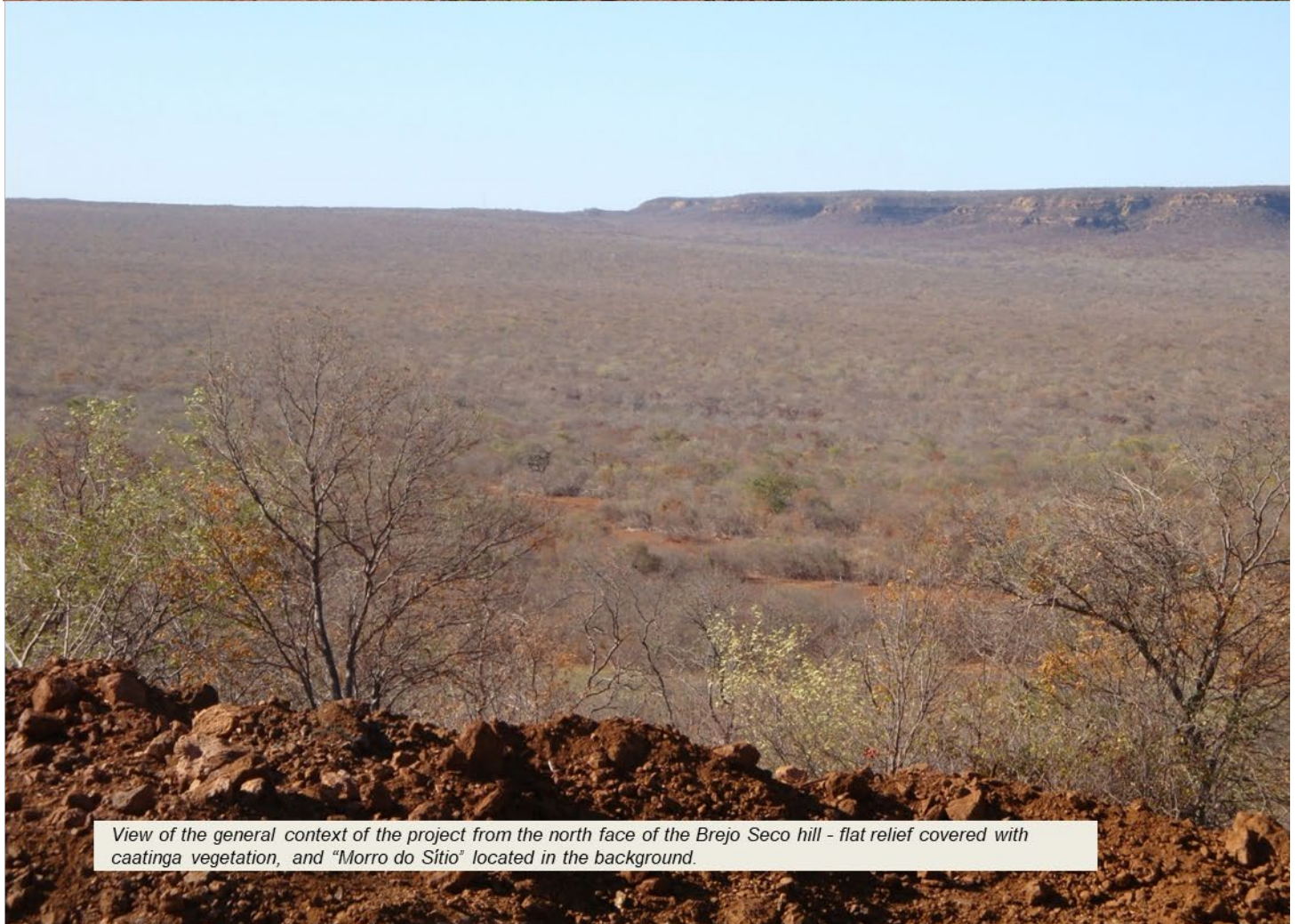
The PNP1000



PIAUI NIQUEL METAIS S.A



Brejo Seco hill in the center, where the Nickel and Cobalt deposit is located.



View of the general context of the project from the north face of the Brejo Seco hill - flat relief covered with caatinga vegetation, and "Morro do Sitio" located in the background.






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1 INTRODUCTION

The company, Brazilian Nickel PLC, through its subsidiary, Piauí Níquel Metais SA (PNM), intends to develop a full-scale nickel and cobalt mining and processing operation at the “Piauí Nickel Project” (PNP) to produce some 25,000 tonnes per year of nickel and 900 tonnes per year of cobalt. PNP is to be implemented in the rural area known as Brejo Seco in the municipality of Capitão Gervásio Oliveira, within Piauí State in north-eastern Brazil.



Figure 1-1 PNP1000 Project Location



The Environmental and Social Impact Assessment for this full-scale project is presented in separate documentation which was independently prepared by Arcadis SA in Brazil (PNP full-scale ESIA, Dec. 2017).

This ESIA Summary is focused on the PNP1000 project which is a small-scale expansion of the existing Demonstration Plant located at the project and has been designed to further develop and optimise the technology planned for the full-scale, and to build a customer base for the full-scale project.

Nickel is predominantly used in combination with other metals to make "alloys", of which the main alloy is stainless steel, the manufacture of which utilises about 70% of the world's nickel production. Nickel is also used in other steel alloys, some copper-nickel alloys and in batteries, and is expected to be increasingly

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sought after by the rechargeable battery market for the rapidly expanding electric vehicles industry, and the associated environmental, social and economic benefits they bring to society. Cobalt is also used in some batteries as well as for a variety of industrial applications such as permanent magnets, and in paints and dyes.

PNP1000 will entail the mining of nickel laterite ore at a rate of 120,000 dry tonnes per year at a grade of 1.81% nickel and 0.058% cobalt. This ore will be processed using a heap leaching process which involves the irrigation of the ore with dilute acidic solutions to leach out the contained nickel, cobalt, and other elements. The resulting solution is purified through a two stage process to produce 1,400 tonnes per year of nickel contained within a nickel hydroxide product and 35 tonnes per year of cobalt, also as a hydroxide product. PNP1000 will employ an estimated 120 direct employees and 25 contractors over a period of up to 10 years, or until the full-scale project is implemented.

PNM, using the environmental and social studies developed for the existing Demonstration Plant, and by Arcadis SA for the full-scale Piauí Nickel Project, carried out a further detailed Environmental and Social Impact Assessment (ESIA) of the smaller PNP1000 project from its conception to its operation and eventual closure.

This PNP1000 ESIA has been used by PNM to refine the design of the PNP1000 operation to ensure that environmental and social risk, impacts and opportunities are taken account of, and to inform the revision of PNM's Environmental and Social Management System. This ESIA Summary report presents the key findings of the ESIA and its conclusions. The objective is, through this summary and its illustrations to allow the general public to easily understand the concept, objectives and stages of the project, as well as foreseeable environmental, social and economic risks and opportunities for the region throughout its construction, operation and closure.

The existing Operating licence nº 547/17 of the Demonstration Plant awarded by SEMAR (Piauí State Secretariat for the Environment and Water Resources) allows PNM to retrofit and install the necessary structures for the PNP1000 and does not require any additional permitting process with SEMAR for its implementation and future operation. The deforestation permits for all project areas are also already awarded. During PNP1000 construction one additional groundwater use permit will be requested for project operation.

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2 THE PROJECT PROPONENT

Brazilian Nickel PLC (BRN) was established in the United Kingdom in 2013 to commercialise the application of nickel laterite heap leaching. BRN operates in Brazil through its 100% owned subsidiary Piauí Níquel Metais SA (PNM).

2.1 SUSTAINABILITY POLICY STATEMENT

The BRN team recognises that our success as a Group depends on our ability to develop, operate, and close, operations in a manner that provides long-term social, environmental, and economic benefits. As a result, we are committed to continuous improvements in health, safety, and environmental performance at our operations, and to sharing the benefits of our activities with our suppliers, business partners, customers and the communities within which we operate.

Our objective is to leave behind a positive legacy of stronger, more sustainable communities once mining activities cease. By maintaining high standards for protecting human health and the environment, and working in cooperation with our host communities and governments, we endeavour to create sustainable, long-term economic and social opportunities.

To support us in the sustainable management of our operations, we are guided by four key principles:



- The benefits of economic activity must be considered in relation to their respective social and environmental consequences
- In using resources, we must use these sustainably and consider the needs and expectations of future generations
- We must act together with government and other stakeholders to balance the benefits and consequences of our activities
- Corporate governance contributes to sustainable economic development by enhancing the performance of the Group and increasing our access to resources and capital

2.2 SUSTAINABILITY MANAGEMENT SYSTEM

Based on these principals, BRN implemented a Sustainability Management System (SMS) which includes BRN's high level policies for Health, Safety, Environment, Community Relations, Ethics and Working Conditions, as well as detailed outline procedures for the operations envisaged in Brazil. Sustainability can be defined as "meeting the needs of the current generation without compromising the needs of future generations" or in other words Responsible Business Practice.

Sustainability covers

- Safety
- Community and Social Engagement
- Environmental Management
- Occupational Health
- Labour relations & employment practices
- Business Ethics

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The need for a focus on Sustainability arises from a number of drivers such as licensing and permitting needs, shareholder desires, and earning a 'Social Licence to Operate'. More broadly a focus on Sustainability stems from common sense, and good and ethical business practice, as well as the 'business case' that can be made from *inter alia* improved efficiencies (at and among operations – no wheel re-invention), access to finance, and product differentiation and competitive positioning

Thus, BRN has adopted Sustainability as a core company value, meaning that Sustainability is integrated from the very beginning into BRN's business processes. BRN aims to lead its contemporaries in this area and maximise the benefits of its Sustainability advantage through effective communication and advocacy.

2.3 HEALTH, SAFETY, ENVIRONMENT AND COMMUNITY RELATIONS POLICY

BRN aims to achieve the highest standards of health, safety and environmental performance and the protection of workers, the general public, and local communities in areas where we operate. BRN will aim for zero harm to people and the environment. The Directors and Executive Management of BRN consider that their primary responsibilities in all areas of Group operations are as follows:-

- Adherence to the national laws and regulations of where we operate, together with relevant industry best practice standards where these are more stringent
- The protection of the health and the safety of everyone we encounter during our operations; be they employee, contractors, suppliers or other visitors to its sites, or members of the public, individually or collectively
- The conservation and, where possible, the enhancement of the natural environment at and in the vicinity of our operations
- To provide adequate resources to meet the objectives and improve HSEC performance
- To establish measurable objectives and targets to drive continuous HSEC improvement
- The avoidance of loss or damage to assets of our host communities as a result of the Group's operations
- The development of positive relationships with local communities and supporting their sustainable development
- The protection of the Group's human, intellectual, technological, physical, and financial assets



In order to implement these responsibilities the following policies are to be observed at all times and by all staff:-

- This HSEC Policy will never be compromised for the sake of operational convenience, productivity, costs, or profitability
- The safe management of all activities following the systematic identification and control of all hazards and risks is to be our fundamental method of operation - only in this way can safe operations be assured
- Appropriate HSEC standards must be defined, made clear to all employees and contractors, and adhered to. Managers must be trained and competent to ensure this is done

ALL incidents, accidents, injuries, excursions, environmental degradation, or community loss have an adverse impact on the Group and its operations. Therefore, all activities will be subject to appropriate loss control processes, in which safety considerations will be paramount.

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The Board of Directors and the Executive Management expect all employees, consultants, and contractors to act at all times in full compliance with these policies and to exercise effective leadership through their personal example. We also expect the full and enthusiastic participation in and compliance with these policies and principles from all our team.

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3 PROJECT HISTORY



Piauí Níquel Metais SA (PNM) acquired the Piauí Nickel Project in 2014. PNM then began extensive test work to demonstrate the use of its heap leaching technology at the project. This entailed adjustment and refurbishment of a pilot plant installed by the previous project owner to create the Demonstration Plant. This Demonstration Plant was then used to develop and optimise the ore treatment processes, and to produce an initial batch of a nickel and cobalt product.

The technical results of the tests achieved so far have been very positive, in particular, demonstrating that the technology developed is technically feasible, scalable, and has a low environmental impact. The Demonstration Plant also produced the necessary data for the preparation of the detailed engineering studies required for the full-scale stage of the project, as well as to demonstrate its feasibility and thus attract future investors to allow its implementation on a fully commercial scale.

Around 67 direct jobs were created by the Demonstration Plant, with the vast majority (92%) of employees being hired locally in the municipalities of Capitão Gervásio Oliveira, Campo Alegre do Fidalgo and São João do Piauí. These employees were trained to work with the process and given the skills to operate within a complex industrial environment. This important socio-economic benefit to the region will be continued, and built on, with the implementation of the PNP1000, as presented in this document.

Figure 3-1 The Demonstration Plant, site of the future PNP1000



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4 PROJECT DESCRIPTION

The PNP1000 (or the Project) is to be a continuously operating further demonstration of the extraction and processing of nickel ore for the production of a Nickel Hydroxide Product (NHP) and a separate Cobalt product.

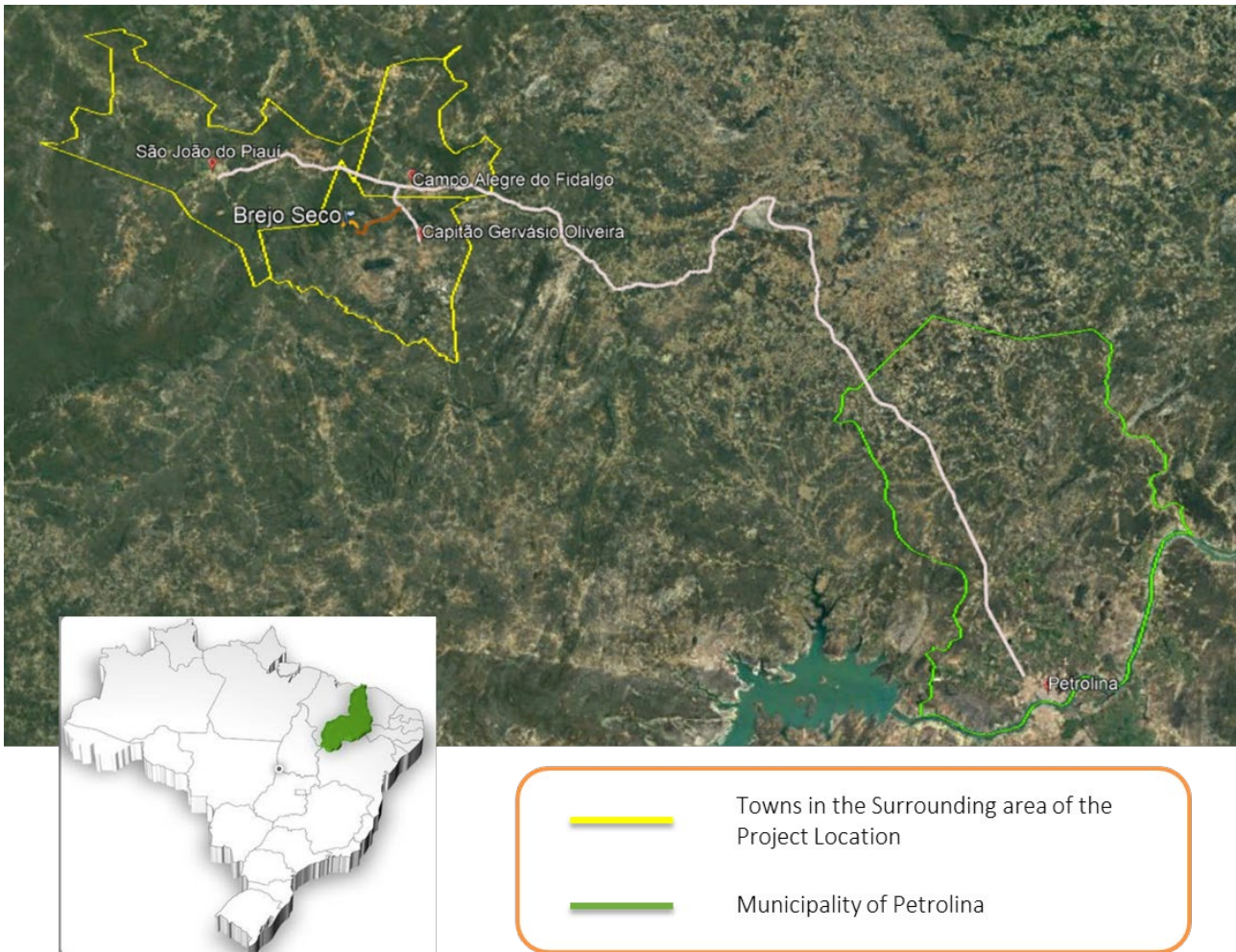
The Project consists of a Processing Plant and Nickel Mine (collectively the Brejo Seco Complex) and use of a series of existing services (power and water supply) as well existing access routes.



The process plant will be constructed as an expansion of the current Demonstration Plant.

4.1 LOCATION AND ACCESS

The Project is located in north-eastern Brazil in the State of Piauí in the rural area of Brejo Seco which is within the municipal area of Capitão Gervásio Oliveira.

Figure 4-1 PNP1000 Project Location



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The project area is some 275 km from Petrolina (Pernambuco State) where the nearest commercial airport is located. It is 55 km from São João do Piauí, 25 km from Campo Alegre do Fidalgo and 22 km from Capitão Gervásio Oliveira; these being the main towns in the area where workers, contractors and basic construction equipment will be sourced, as well as diesel, food and other general supplies. The majority of the current Demonstration Plant workforce is provided by these towns.

Access to the PNP1000 project is by road given the absence of rail lines and the low use of the airport located in the municipality of São Raimundo Nonato. The state capital Teresina is located circa 560 km to the north. Alternatively the Project can be accessed from Petrolina (and its airport) which is a city located circa 250 km away in the southernmost point of the neighboring state of Pernambuco. The export of nickel and cobalt products is expected to be through the port at Recife which is circa 1,000 km to the east. All roads are sealed and in good to reasonable condition, the final access to the project is along circa 20 km of an existing unpaved road which connects the Demonstration Plant to the PI-465 highway, and there are additional unsealed back roads connecting with the Project’s camp and to access Capitão Gervásio Oliveira (see Figure 4-3, and Figure 4-4).

The roads in the project region are characterized by the frequent presence of animals, especially cattle, goats, and donkeys (see Figure 4-2). These are often encountered on the margins of highways and roads, crossing them, or walking along them, and as such represent a very serious risk to road users, and is a risk factor taken account of in PNM’s traffic management plan for the Project.

Figure 4-2 Typical Local Roads



Animals on the BR-020 highway, near the city of Nova Santa Rita.



Donkey on the highway PI-465, near Campo Alegre do Fidalgo.



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Figure 4-3 PNP local context



Figure 4-4 Local access roads in the immediate PNP area



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4.2 MAIN PROJECT ELEMENTS

PNP1000 will be implemented next to the Brejo Seco Hill (see Figure 4-5). The mining area will be on the eastern flank of the hill, from where ore for the Demonstration Plant has been previously excavated, and the processing plant will be to its west (where the existing Demonstration Plant is located). These are connected by an existing unsealed non-public road running to the north of the hill. Topsoil, overburden and low grade stockpiles will be stored in dedicated areas adjacent to the mining area.

All supplies and reagents will be procured from Brazilian suppliers and transported by truck from origin to the Project using appropriately licenced and approved vehicles and packing.

Sulfuric acid, is an important input and will be purchased from existing Brazilian producers and transported in specialized vehicles by an authorized transportation company, as was the case during the Demonstration Plant operation.

The demand for electricity will be met by the substation from Equatorial Energia, located in São João do Piauí, through an existing low voltage distribution line. The current plant sub-station will be upgraded to match the additional PNP1000 power requirements. There is no requirement to upgrade the existing low voltage distribution line for the Project.

The capture and pumping of raw water necessary for the production process will be from the two existing (and permitted) groundwater wells. These wells will be complemented by a new third well to be installed within the vicinity of the project location (less than 3 km away).

Finally, all Project process plant residues will be filtered to a solid state so that they can be stacked in a specific and protected area at the Demonstration Plant, bringing operational and socio-environmental security and without the need for a tailings dam.

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Figure 4-5 Main Project Elements

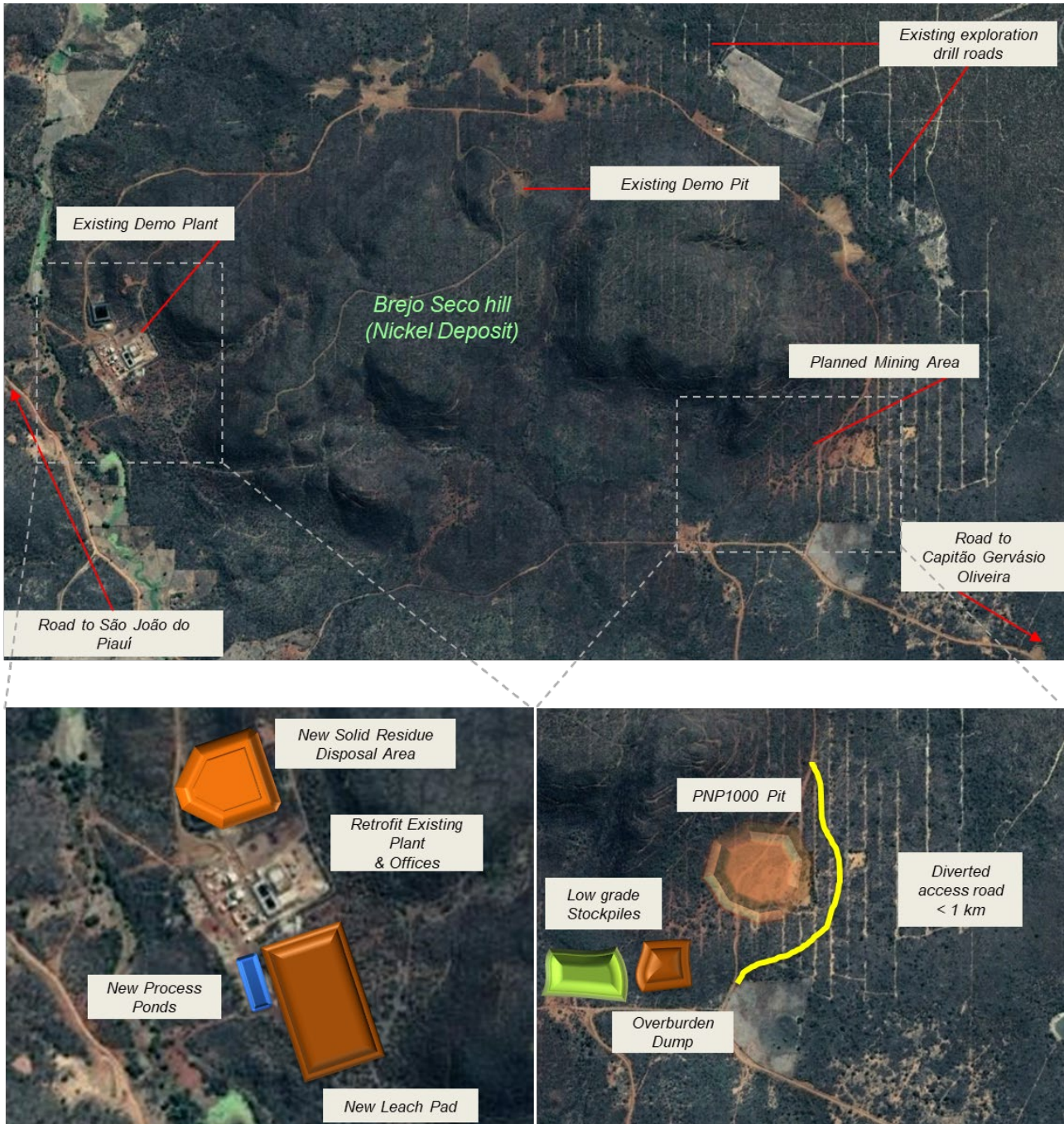
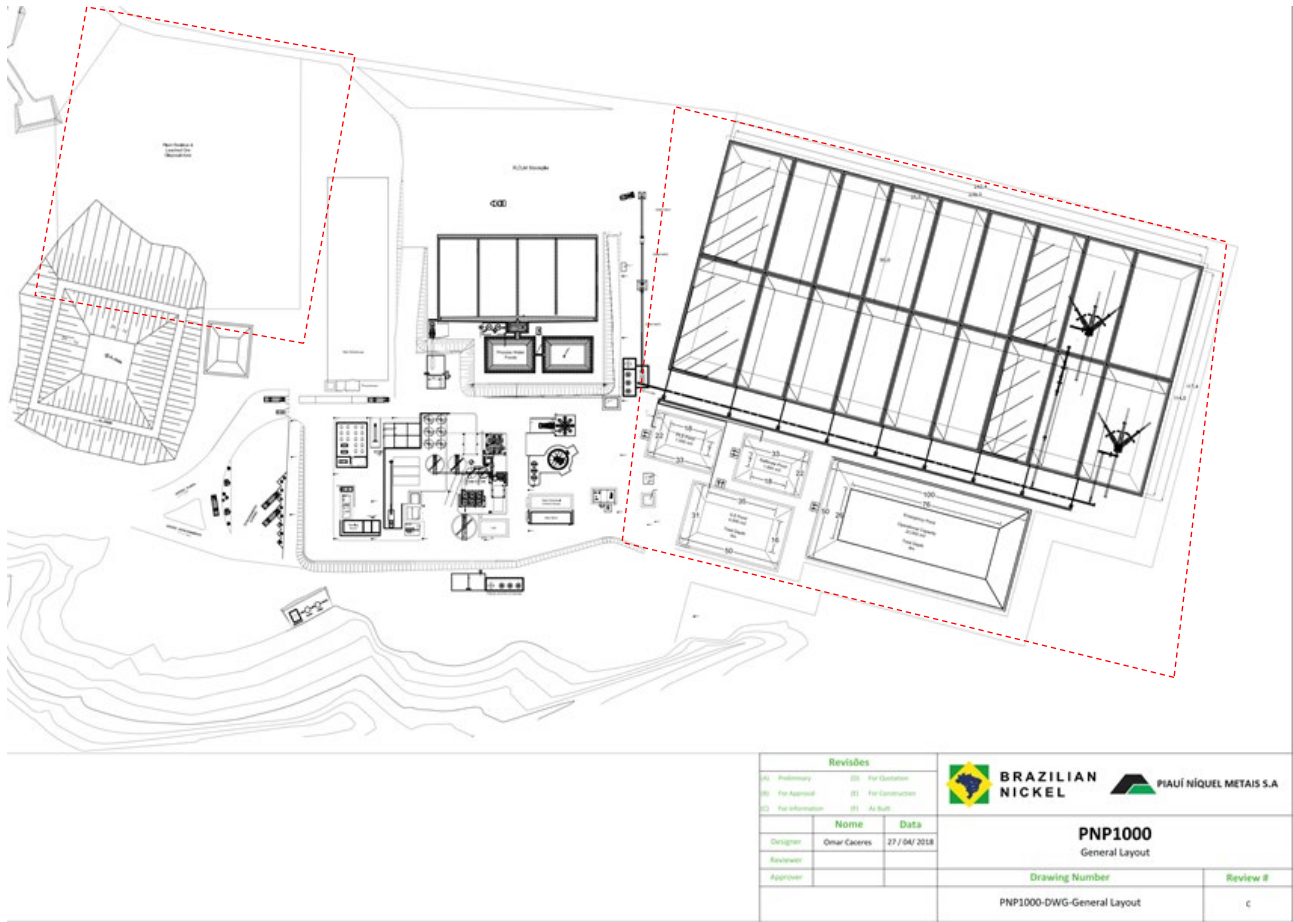


Figure 4-5 shows the major project elements of the PNP1000 project.

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Figure 4-6 PNP1000 Heap Leach Pads & Downstream Processing Plant



Highlighted by the red dotted lines; new leach pads and ponds area to the right and solid residue deposit to the left, to be built as an expansion of the current Demonstration Plant.

The proposed layout of the new heap leach pad and solutions ponds area and the downstream processing plant which will be an extension of the existing and permitted demonstration plant are illustrated above in Figure 4-6. Figure 4-7 illustrates this layout on the satellite map.

All the areas to be used for the main elements of the PNP1000 have been selected based on using and expanding on previously disturbed areas. The Land Access Agreements are already in place with landowners and the three deforestation permits to enable site clearance were awarded by the Environmental Authority (SEMAR) and are valid until August 2020, May 2021, and October 2021, and if required can be renewed as need if the areas have not been cleared by these dates.


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Figure 4-7 Satellite Image of the Existing Demo Plant and Highlighted New Leach Pad & Pond Area



Key: Pond areas (green and light pink), pads (yellow green) and conveyor (pink).



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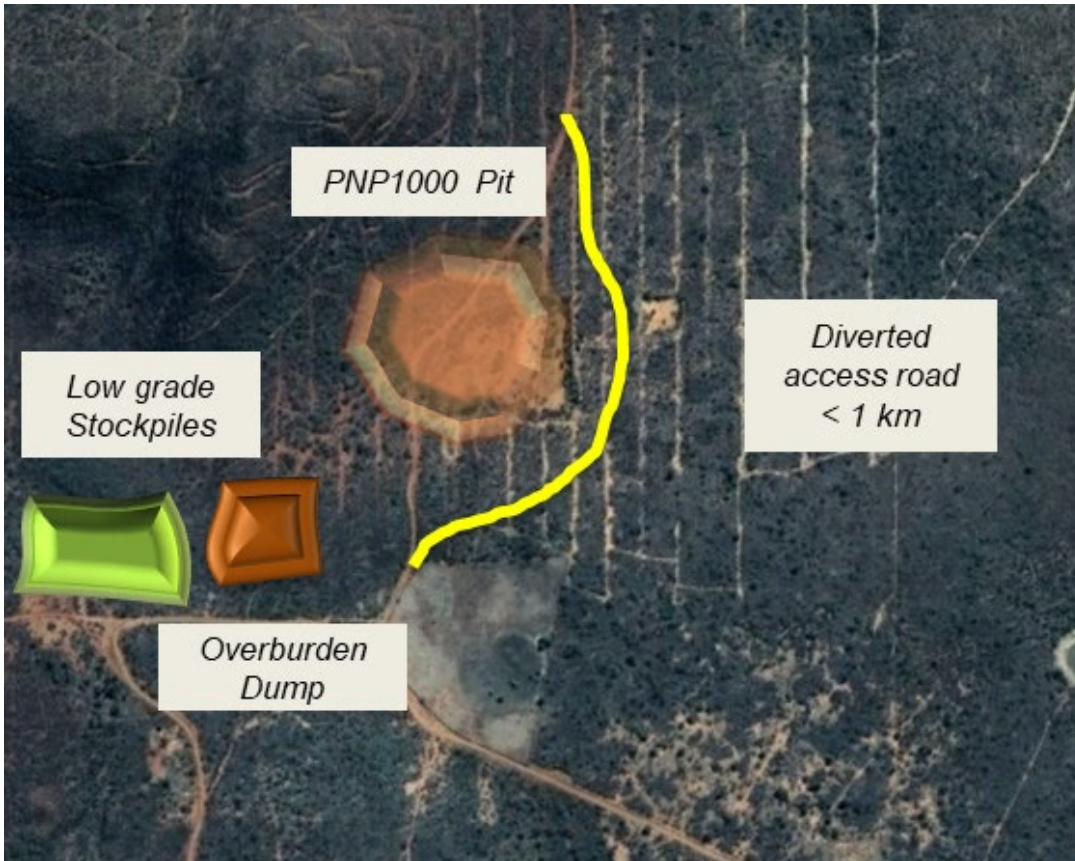
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Figure 4-8 PNP1000 future mine area layout, and context






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Figure 4-8 presents a satellite image and photograph of the planned mining area for the PNP1000. The selected area provides the Project with a high nickel grade pit on the low slope of the deposit, and utilizes a previously disturbed area. The mining location has Land Access Agreements in place with landowners and the Deforestation Permit was awarded by the Environmental Authority (SEMAR).

The main features of the PNP1000 are summarized as follow:

Table 4-1 PNP1000 Principal Features

| Technical aspects (PNP1000) | Quantities |
|--|---------------------------------------|
| Mineral resource to be mined | 1.2 Mt at 1.81% Ni & 0.058% Co |
| Project life | 10 years |
| Ore processing capacity | 120,000 metric tonnes per annum (tpa) |
| Production of Nickel in Nickel Hydroxide Product (NHP) | 1,400 metric tonnes per annum (tpa) |
| Production of Cobalt in the Cobalt Product | 40 metric tonnes per annum (tpa) |
| Sulfuric acid consumption | 380 kg per tonne of ore |
| Power Consumption (MWh) | 1.5 MWh/year |
| Limestone consumption (tpa) | 9,400 tpa |
| Industrial water use | 15 m ³ /h |
| Total occupied land area (mine and plant) | 35 hectares |

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4.3 ALTERNATIVES ASSESSMENT

4.3.1 TECHNOLOGY SELECTION

The following technological alternatives exist for the processing of nickel:

- Smelting of ferronickel
- High Pressure Acid Leaching (HPAL)
- Nickel Pig Iron (NPI)
- Atmospheric tank leaching (AL)
- Heap Leaching

Based on a review of the available technologies, the most suitable technology for the processing of the ore type, quantity, and concentration of nickel present in Brejo Seco, is considered to be heap leaching using sulfuric acid. The alternative technologies would require significantly larger inputs of energy, raw materials, infrastructure, and capital, which would not be feasible for a deposit with these characteristics.

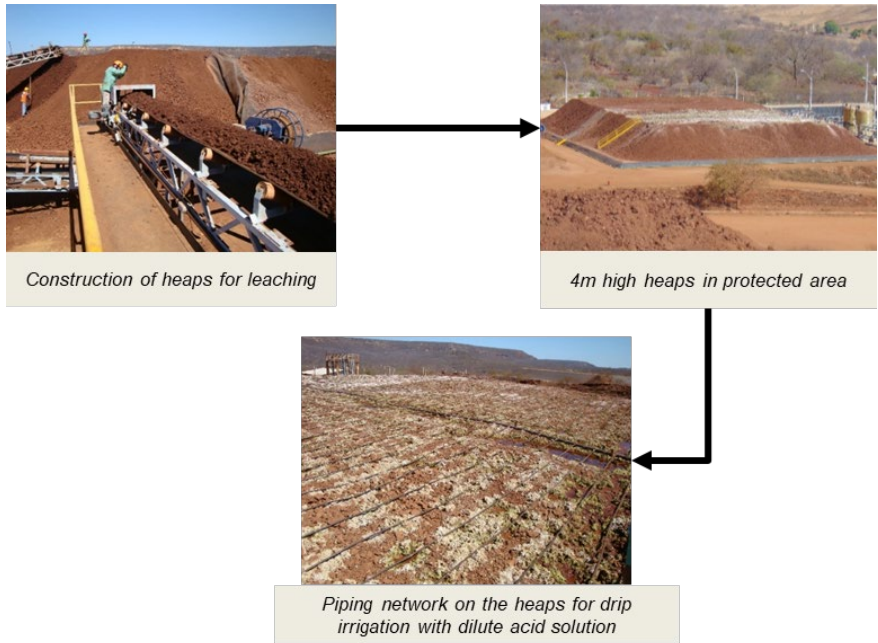
PNP1000 will use the same technology as the full-scale project, and has the following advantages in relation to other processing approaches:

- i) High ore resource utilisation
- ii) Lower consumption of water
- iii) Low energy requirement, and improved limestone and sulfuric acid use
- iv) Use of solid residue disposal, instead of the conventional solid/liquid tailings dam (which has a larger footprint, and greater operational and socio-environmental risks)
- v) Smaller footprint and therefore reduced vegetation clearance and impact on the Caatinga areas

Figure 4-9 and Figure 4-10 show photographs of the operations at the Demonstration Plant, and illustrate the process that will be used in the PNP1000.

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Figure 4-9 Photographs of the Existing Demonstration Plant





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Figure 4-10 PNP1000 Heap Leaching Process



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4.3.2 LOCATION OPTIONS

For mineral exploitation, there can be no other option for the location of mining other than where the ore to be exploited exists. The specific pit location for the resources dedicated to PNP1000 was selected based on the higher nickel grade that is accessible with the simplest mining method (i.e. no blasting will be required).



For the PNP1000 plant area, the natural location is at the existing Demonstration Plant. Some expansion though is required and for this, the already disturbed Caatinga area to the south of the existing Demonstration Plant fence line was selected.

The supplementary groundwater well location will be defined during the Project’s construction phase and is anticipated to be within a radius of less than 3 km. The exact location will be selected based on hydrogeological considerations, and avoidance of impacts on local biodiversity from the well or pipeline, or on the groundwater resources of any existing users in the area. The existing groundwater wells will provide the water required for the construction activities and for the process start up.

PNP1000 will make use of the existing roads used for the Demonstration Plant, these roads are essentially the most effective routes, the alternative of installing Project specific access roads has been dismissed as this would have required significant impact on the local communities and biodiversity. A detailed improvement plan will be implemented to minimize the impact on neighboring settlements and broader communities from Project traffic (trucks, buses, cars etc.), with the objective of minimizing potential impacts from dust, noise and vibration. The improvement plan will also increase the comfort to the local population of using the road (which is subject to significant degradation in the wet season) and increase road safety. PNM’s traffic management plan will include detailed procedures to reduce risks of Project induced road accidents, and risks of collisions with animals - especially goats, sheep and donkeys which roam freely in the region.


Figure 4-11 BRN’s Piauí Nickel Demonstration plant



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The benefits of utilising the existing PNP1000 location are

- Limited increase in existing footprint
- Allows effective use of and further optimisation of the production process
- Continuity of existing workforce regime, commuting, training, and delivering on local community employment desires.

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4.4 IMPLEMENTATION PHASE

The implementation phase of the PNP1000 consists of modifications to the existing Demonstration Plant facilities, the construction of new processing facilities, and the development of the selected mining area.

The construction period for the new operational and support elements of the Project is estimated to last about 12 months. All required permits and land use agreements are in place and the construction works can start as soon as PNM secures the funds and authorizes the project initiation.

The work plan comprises the following stages:

- Mobilization of construction team and contractors
- Site preparation (vegetation clearing, topsoil removal and earthworks)
- Construction of new processing facilities and supporting infrastructure
- Retrofit of the existing Demonstration Plant facilities
- Development of the mining area
- Demobilization of construction team and contractors

4.4.1 SITE PREPARATION

Works required to prepare the site for the planned construction activities are summarized below.

4.4.1.1 VEGETATION CLEARING



This activity will cover the mining area and the new leach pad and ponds area. The Project has been awarded the three required deforestation permits by SEMAR, and this clearance will be managed in accordance with best practice, and with the objective of only removing vegetation that is necessary for the works within the authorized areas, and in a manner that minimizes environmental impacts, and in accordance with PNM's Biodiversity Management Plan.

4.4.1.2 TOPSOIL REMOVAL AND STORAGE

After vegetation clearance, the areas where the Project elements will be installed will be scraped to remove topsoil. The topsoil will be stored in the areas adjacent to those planned for future ore stockpiles in preparation for use later in the environmental restoration program. These works will be undertaken in accordance with PNM's topsoil management procedure.

4.4.1.3 EARTHWORKS

Earthmoving operations will aim to make work areas level for the construction of structures such as the ponds. The Project will seek to make the best use of the volumes of cut and fill in order not to need further areas for additional fill or to store cut materials.

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4.4.2 SUPPORT ELEMENTS

4.4.2.1 CONSTRUCTION SITE

Given the presence of the Demonstration Plant, the PNP1000 implementation will not require a dedicated construction site (offices, construction site and temporary accommodation, access roads, energy distribution network, etc.). PNM’s intention is to utilize local and regional contractors to execute all Project activities, and they will use the current available infrastructure at the project and in the surrounding towns.

4.4.2.2 ACCESS ROADS

PNP1000 will use the existing roads and only small diversions will be required in the mine and project areas to accommodate the new facilities. These diversions will be engineered unsealed roads.

4.4.2.3 ACCOMMODATION



All housing requirements generated by the PNP1000 will be covered by the existing infrastructure in both Capitão Gervásio de Oliveira and Campo Alegre do Fidalgo, and at PNM’s existing camp which is located off the main road between these two towns. The camp has accommodation for 15 people, all in single rooms with en-suite toilet, basin and shower facilities, bed, chair, desk and storage, with no shared rooms or beds.

Figure 4-12 PNM’s Existing Camp



The camp is only used for non-local employees and certain contractors, consultants, and visitors. Non-local employees are typically employed on a fly-in/fly-out basis. The camp will be expanded to accommodate an additional 15 people as part of the PNP1000 implementation plan, with all of the expansion remaining within the existing fence line.

The camp is located in an area free of natural hazards (such as flooding), and is within 30 minute traveling time of the PNP1000 site. PNM will provide transport between the camp and the Project, which will utilise modern vehicles fitted with all safety features, and be provided free to employees.

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The existing and expansion accommodation etc. will follow the IFC/EBRD Worker Accommodation Processes and Standards guidance note (2009), there being no national regulatory standards in this regard. Camp procedures will ensure that the camp is at all times kept in good repair, and kept clean and free from rubbish and other refuse, and wastes recycled as appropriate. As per the current room designs, the expanded camp will have, adequate ventilation, air conditioning, mosquito screens and light systems, and will continue to be regularly cleaned and controlled for pests.

Services at the camp include free laundry for clothes and bedding, potable water, free meals from the camp's kitchen, a games/TV room and social area, and free internet as well as access to local cell phone networks. Wastewater is controlled by septic tanks which, during the camp expansion, will be enhanced to comply with World Bank standards. As part of the planned expansion emergency lighting and a back-up generator will be installed.

The camp is fenced with on-site security and is currently managed by locally recruited PNM employees, and as part of the planned expansion, these will be supplemented by a full-time Camp Manager.

4.4.2.4 CONSTRUCTION PHASE SUPPLIES

Key supplies utilised during the construction phase comprise the following:

- Fuel to supply the fixed and mobile machine fleet and vehicles. The diesel consumption for the construction phase (light vehicles and machinery) is estimated to be 150,000 litres
- Concrete, with a small concrete batch plant planned within the Brejo Seco Complex
- Civil construction materials including aggregates such as sand, gravel, and cement, supplied by local contractors
- Electric power from the existing distribution network that currently powers the Demonstration Plant
- Water supplied by existing groundwater wells and one new well

4.4.2.5 MANPOWER DURING CONSTRUCTION

The construction phase is anticipated to require up to 150 workers (peak of works). The intention is that at least 60% of this labor will be hired locally, the final number will depend on the availability of interested people having the minimum technical qualifications necessary to meet the demands of construction works. PNM will track the local content and gender of workers used by contractors, and also the utilisation of local sub-contractors and suppliers. All contractors, and their sub-contractors and suppliers will be required to follow PNM's human resource policies and procedures.



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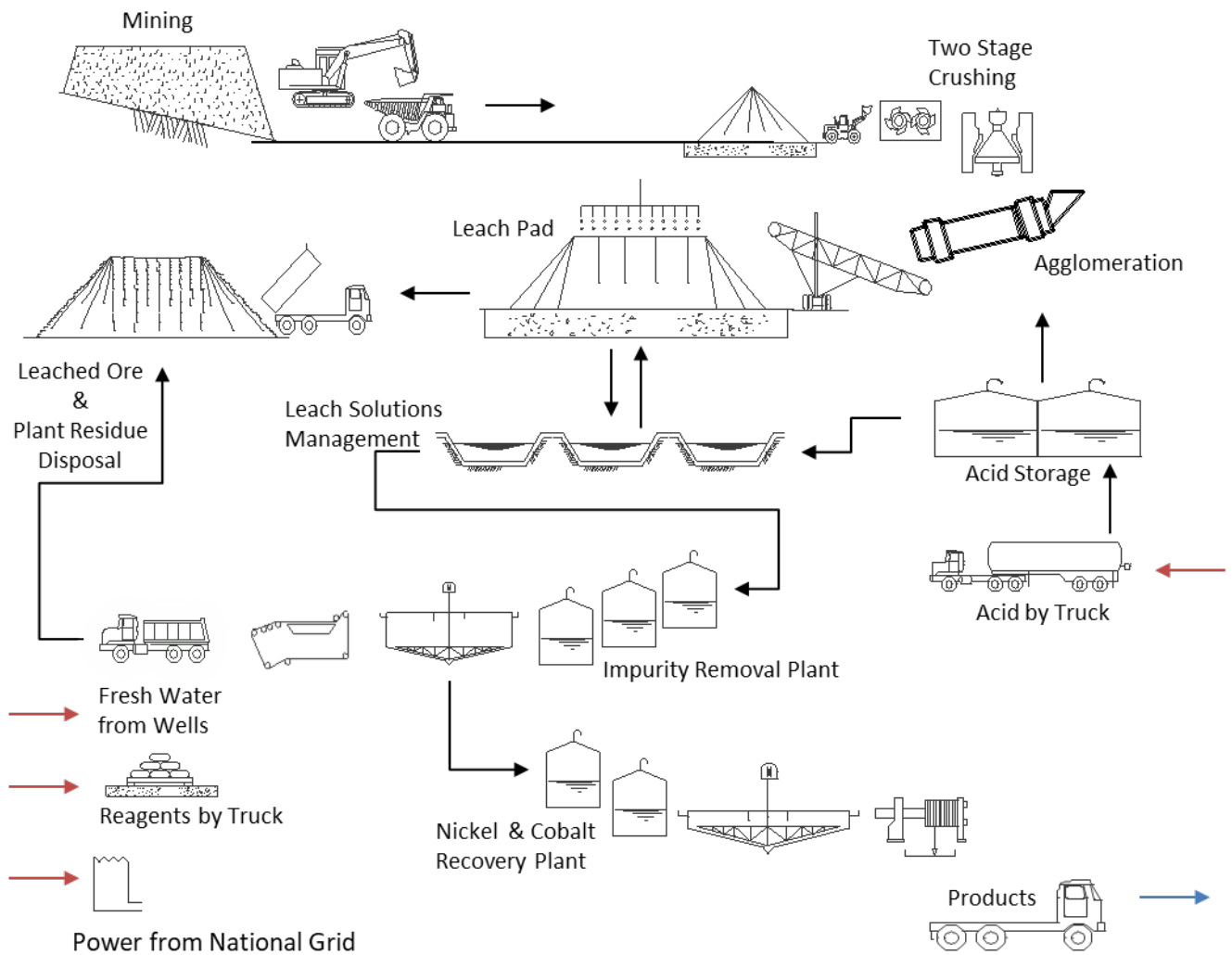




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4.5 OPERATIONAL PHASE

The operation of the PNP1000 foresees the extraction of 120,000 dry metric tonnes of ore per year, for the production of around 1,400 dry metric tonnes per year of nickel contained in NHP and 35 dry metric tonnes per year of cobalt contained in cobalt hydroxide product.

Figure 4-13 Summary of the main activities and structures of the Piauí Nickel Project



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4.5.1 ORE MINING

An open pit mine will be set up with benches and the ore will be mined by mechanical digging (excavators). Given the physical nature of the ore, current plans do not involve the use of blasting. The pit is to be excavated to a maximum depth of 14 metres and is expected to remain above the current groundwater level.

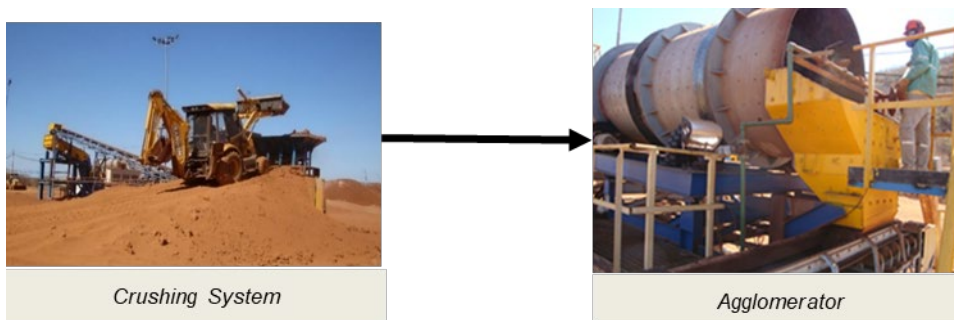
The material extracted at the mine will be transported by dump trucks, along the existing private road, to be stacked in the storage areas at the process plant in preparation for crushing.

The “overburden” material or waste rock generated by the PNP1000 mining activities is estimated to be in the order of 130,000 tonnes per year and will be trucked to a permanent storage area less than 200 meters from the planned PNP1000 pit and outside the mineable area for the full-scale project, off. The waste rock at the Piauí Nickel Deposit have been classified as Non-Acid Generating rocks (NAG) so the waste rock dump will not require a special design for this aspect. Nevertheless, the waste rock storage area will be designed and built to avoid interferences with natural drainage systems and to properly manage rainwater, especially focused on preventing the release of fine particles into the ground water systems.

4.5.2 CRUSHING AND AGGLOMERATION

The next step of the process is the crushing of the ore by passing it through two crushers to reduce the size of the ore to the predefined size for the agglomerator. The crushed ore passes through the agglomerator where it is moistened with process water and sulfuric acid (resulting in the agglomeration of the fine particles). This generates a material suitable for stacking on to the heap leaching pads.

Figure 4-14 *Crushing and Agglomeration at the Demonstration Plant*



4.5.3 HEAP LEACHING

The crushed and agglomerated ore is staked into 4m high heaps located over an impermeable liner (heavy duty plastic) upon which a system of buried tubes is placed to collect the leached solution. A piping/irrigation system is installed on top of the heaps to irrigate them with a sulfuric acid solution diluted with water for the leaching process. Once assembled the heap leach system is fed slowly (dripped) from the ponds, and the solution irrigates the ore by gravity, the leachate is collected and the leaching process repeated until the concentration of the final solution is rich in nickel and cobalt.


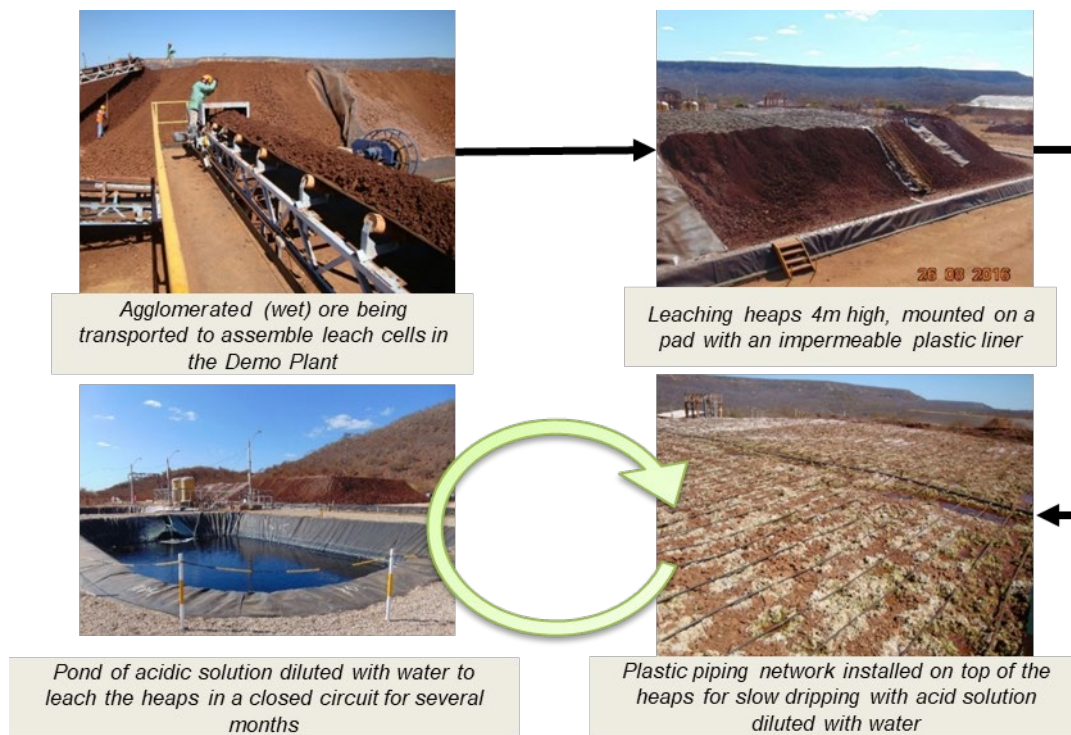
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Figure 4-15 PNM's Heap Leaching Process



4.5.4 DOWNSTREAM PRECIPITATION PLANT

The mineral-rich solution resulting from the leaching step (known as Pregnant Leach Solution or PLS), is then pumped to the precipitation plant which separates the nickel and cobalt from other unwanted minerals (iron, aluminum, chromium). The resulting slurries are then filtered to produce the solid waste and products. The four key steps are as follows:

1. **Iron Precipitation:** the PLS solution is first pumped to tanks where limestone is added which results in the precipitation and removal of unwanted metals from the solution (iron, chromium, aluminum). The resulting precipitates are then separated from the solution containing nickel and cobalt in a thickener, using flocculants to help sedimentation. This iron precipitate is then transferred to the filtration area (see step 4 below).
2. **Ion Exchange Unit:** The nickel and cobalt solution is transferred from the iron precipitation unit into the ion exchange unit. This unit contains a resin which separates the nickel from cobalt and from the solution. Magnesium oxide (or Sodium carbonate) is then added to these separate solutions to precipitate the products as Nickel and Cobalt Hydroxide Products (NHP and CHP). These precipitates also then proceed to filtration (see step 4 below) while the solution proceeds to step 3.
3. **Bleed Neutralisation:** Magnesium sulphate slowly builds up over time in the solutions coming from the ion exchange unit. To remove this magnesium, hydrated lime is added to precipitate solid magnesium hydroxide and gypsum. These precipitates also then proceed to filtration (see step 4 next) while the remaining process water proceeds to the agglomeration area for re-use.
4. **Filtration:** Both the impurity precipitates, and separately, the Nickel and Cobalt hydroxide products, are passed over belt filters to remove as much water as possible from the precipitates and produce

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a solid residue “cake” either as “Iron Filter Cake” (IFC), “Bleed Filter Cake” (BFC) or the desired solid nickel and cobalt products. The nickel and cobalt products are then bagged and stockpiled for later sale, and the IFC and BFC are dispatched to a specific lined area where they are stored.

Figure 4-16 *Precipitation Plant*

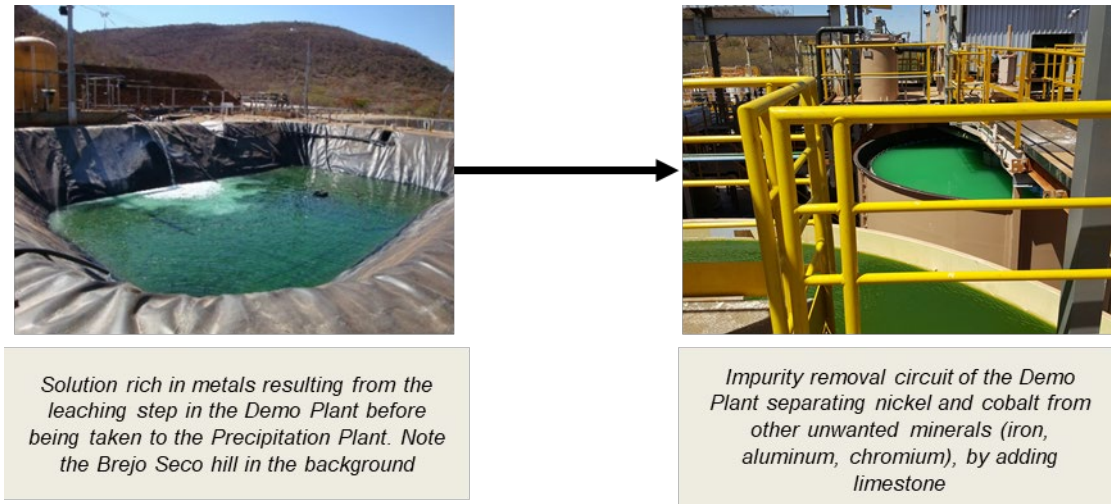
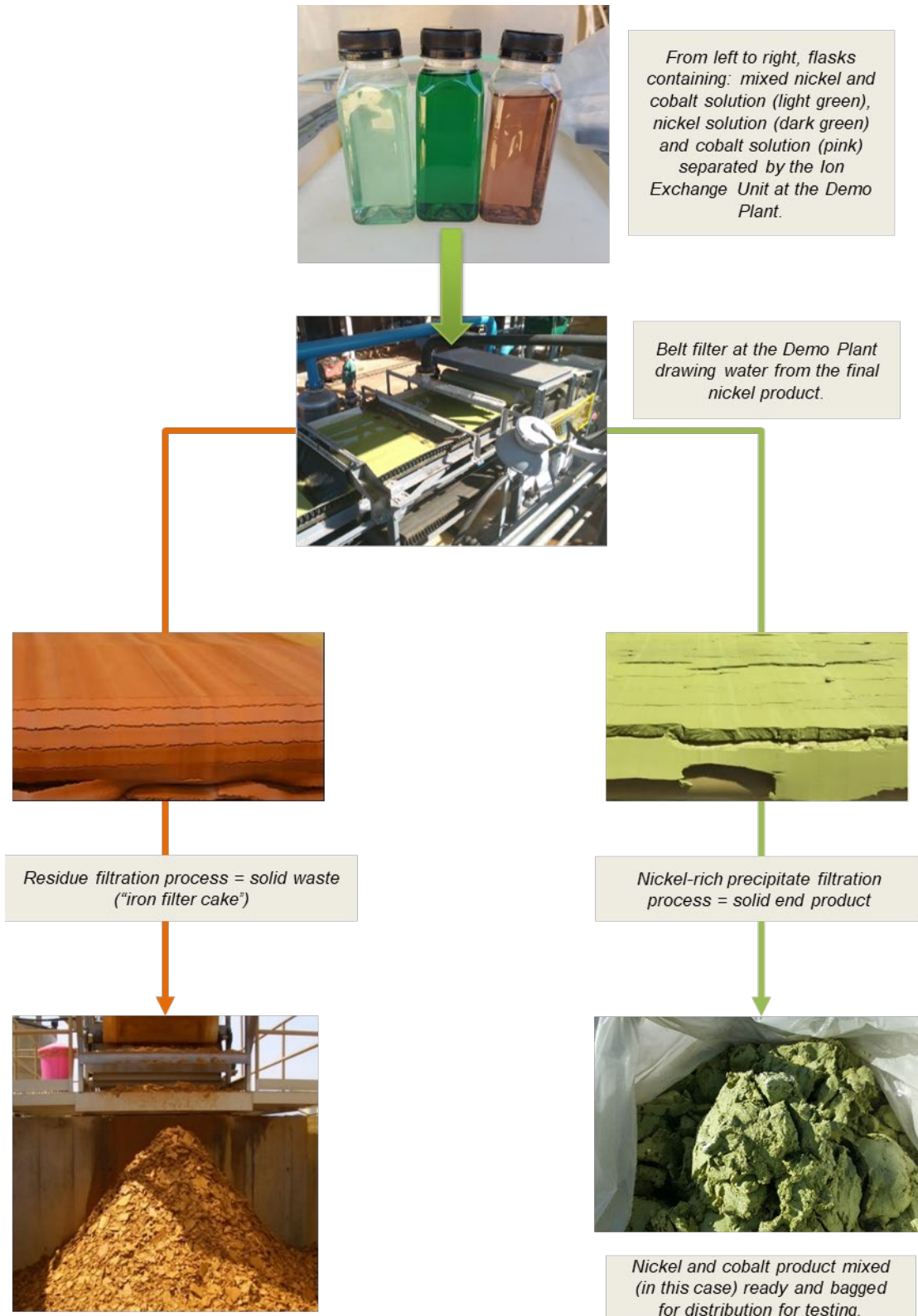





Figure 4-17 Filtration Process to produce solid residues and products



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4.5.5 MAIN PROJECT INPUTS

4.5.5.1 LIMESTONE SUPPLY

- Demand of 9,400 tonnes / year of limestone for the nickel production process
- The limestone will be supplied by a third party. Existing options have been shortlisted and long-term contracts will be negotiated during the construction phase

4.5.5.2 SULFURIC ACID SUPPLY

- Consumption of 42,500 tonnes / year of sulfuric acid for the leaching process
- The concentrated sulfuric acid will be supplied by a third party. Existing options have been identified (including the ones used during the demonstration plant operation) and long-term contracts will be negotiated during the construction phase



4.5.5.3 OTHER REAGENTS AND LOGISTICS

- Fuel and lubricants for the entire fleet of vehicles and equipment – 720,000 liters of diesel approximately per year of operations
- Magnesium oxide (MgO) for nickel and cobalt precipitation process – some 1,400 tonnes / year
- Hydrated Lime for the magnesium removal precipitation process – some 12,500 tonnes / year
- Flocculants: for the process of sedimentation of precipitates in thickeners and to improve filtration

Table 4-2 shows details of the proposed reagent supply chain, all by road and trucks.

Table 4-2 Principal reagent usage and required logistics

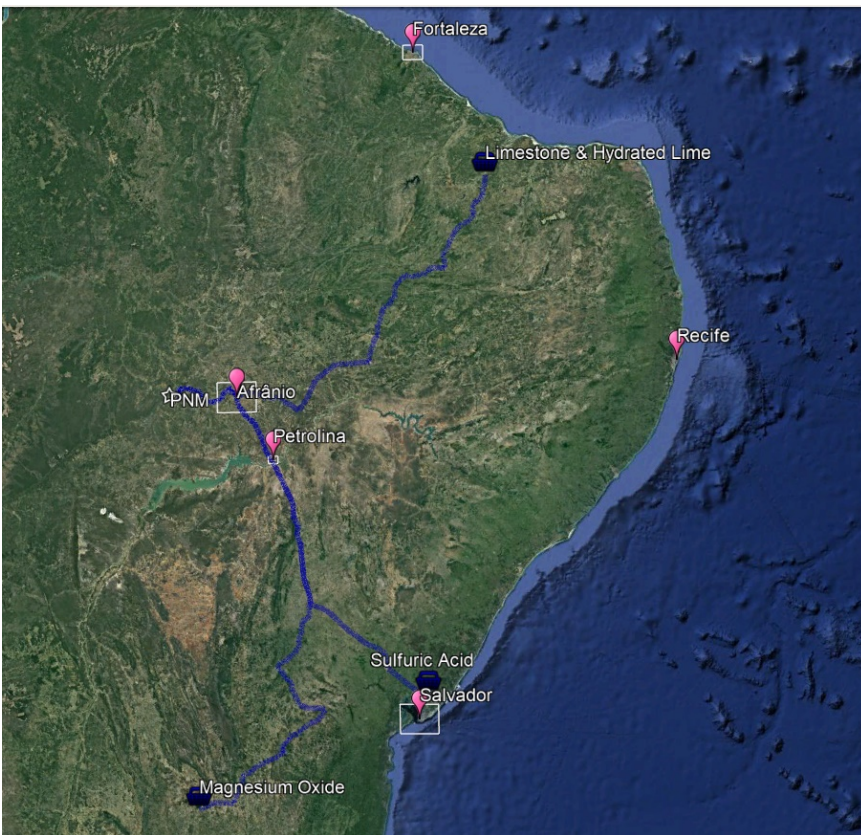
| Reagent | Operational Requirement at full capacity Tonnes per Day | Frequency of Deliveries | Location | Distance to Project Site |
|-----------------|---|-------------------------|---|--------------------------|
| Sulfuric Acid | 118 | 4 truckloads per day | Dias d'Avila, Camacari, Bahia State | 760 km |
| Limestone | 30 | 1 truckload per day | Governador Dix-Sept Rosado, Rio Grande do Norte State | 835 km |
| Magnesium Oxide | 4 | 1 truckload per week | Salvador, Bahia | 1,050 km |
| Hydrated Lime | 34 | 1 truckload per day | Governador Dix-Sept Rosado, Rio Grande do Norte State | 835 km |
| Flocculant | 0.6 | 1 truckload per month | Sao Paulo, SP State | 2,450 km |

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All suppliers are currently in the market supplying other customers and all of them have enough installed capacity to meet the PNP1000 reagent demand.

Once selected, detailed logistics plans and delivery schedules will be developed with each supplier to guarantee the continuity of our operations. (The pre-selected supplier list is subject to a price update and final terms and conditions negotiations, if required other alternative suppliers are available). All transportation will be done via existing state and national roads which are noted to be well maintained and in good condition.

Figure 4-18 PNP1000 supply logistics network



4.5.5.4 FRESH WATER SUPPLY

- Demand of 15 m³/h of water for the entire production process
- Supply from two existing wells (permitted for operation) will cover 1/3 of this demand (enough for the construction and start-up stages)

These two boreholes, which were installed by the previous owner of the Project, are located within a crystalline rock / fractured geological formation, which has a generally low groundwater potential (fracture flow with low storage and therefore can only sustain low pumping rates).

Borehole 1 is located 250 m south west of the existing Demonstration Plant and Borehole 2 is located 320 m north west. Water is pumped from the wells by pipeline to the water storage tanks located at the Demonstration Plant.



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Figure 4-19 Location of existing process water boreholes



For the additional water supply required for the PNP1000, PNM contracted MDGEO, a hydrogeology consulting company, to research the closest and most prominent location to drill a borehole to extract up to 30 m³/h of water. MDGEO confirmed in its April 2018 report that a nearby sedimentary rock formation, which contains the large and abundant Serra Grande Aquifer that provides underground water for the city of São João do Piauí and surroundings, was suitable to supply the Project's water demands. MDGEO also produced a register of the existing wells in the region (based on secondary data and field work), their location, depth and flow (from the information available). In order to define the exact and best location of the future water well, MDGEO recommended undertaking a geophysics study in the most prominent and closest area of the aquifer to the Demonstration Plant and positioned so as to avoid impacts on other users. This geophysical study will be followed by the drilling of a pilot borehole (with technical specifications defined), and also carrying out some pumping tests on existing boreholes within the target area (such as the ones in the Várzea's and Veredas' settlements) to confirm the aquifer capacity in the area. These activities will be undertaken with the PNP1000 construction schedule and budget (see section 7.1.6 for further discussion of local groundwater conditions).

As part of their studies MDGEO identified the target area for drilling the Project's additional well and the most probable location for the new borehole (number 3) is shown in Figure 4-20. The estimated pipeline length is 3.9 km, which will mainly follow the road, which facilitates its installation and eliminates any need for significant impacts to agricultural lands or natural flora.



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Figure 4-20 Existing and planned additional process water boreholes



4.5.5.5 POWER SUPPLY

There is an existing power connection with national grid available and in operation, and no new power line infrastructure is required. However, the project substation is to be upgraded to satisfy onsite demand requirements.

The existing transformer has a capacity of 500 kVA. PNM will commission a detailed power demand estimate based on final equipment selection to determine the size of an additional transformer or the replacement of the existing one. This is a trade-off to be completed by an expert consultant within the first three months after project kick-off. The current installed capacity is enough to start the project ramp-up with the crushing, agglomeration and stacking of the first three leach modules, therefore the time to implement the substation upgrade is 12 months and is not part of the critical path. The new transformer (additional or replacement) is readily available in the Brazilian market.

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4.5.6 MANPOWER

When fully operational, the entire project is expected to generate about 120 direct jobs, with 8% managerial positions, 17% supervisors and 75% operational workers.

PNM is committed to giving priority to the recruitment and hiring of local labor, aiming to offer equal opportunities employment which will provide income and sustainable development for the region. The target is to hire 100 (83%) from the Capitão Gervásio Oliveira and Campo Alegre do Fidalgo areas and a further 9 (7%) from the north east region (The Demonstration Plant’s workforce comprised 92% local labor). No expatriates are planned to be hired for the PNP1000 operation..



Figure 4-21 Local Labor at the Demo Plant



4.5.7 MACHINES AND EQUIPMENT

Hydraulic excavators, rear unloading dump trucks, tracked bulldozers, wheeled dozers, wheel loaders, motor graders, water tank trucks and lubrication lorries, among others, will be required for mining activities.

At the plant area, for the crushing units, equipment such as crushers, conveyor belts, screens and silos will be used, and the processing plant will utilize various equipment for pumping, separation (thickeners) dewatering (filters), and tanks.

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4.6 INVESTMENT AND SCHEDULE

An estimated investment of approximately US\$ 20-25 million will be necessary to build the PNP1000 (in 12 months) and start up its operations.

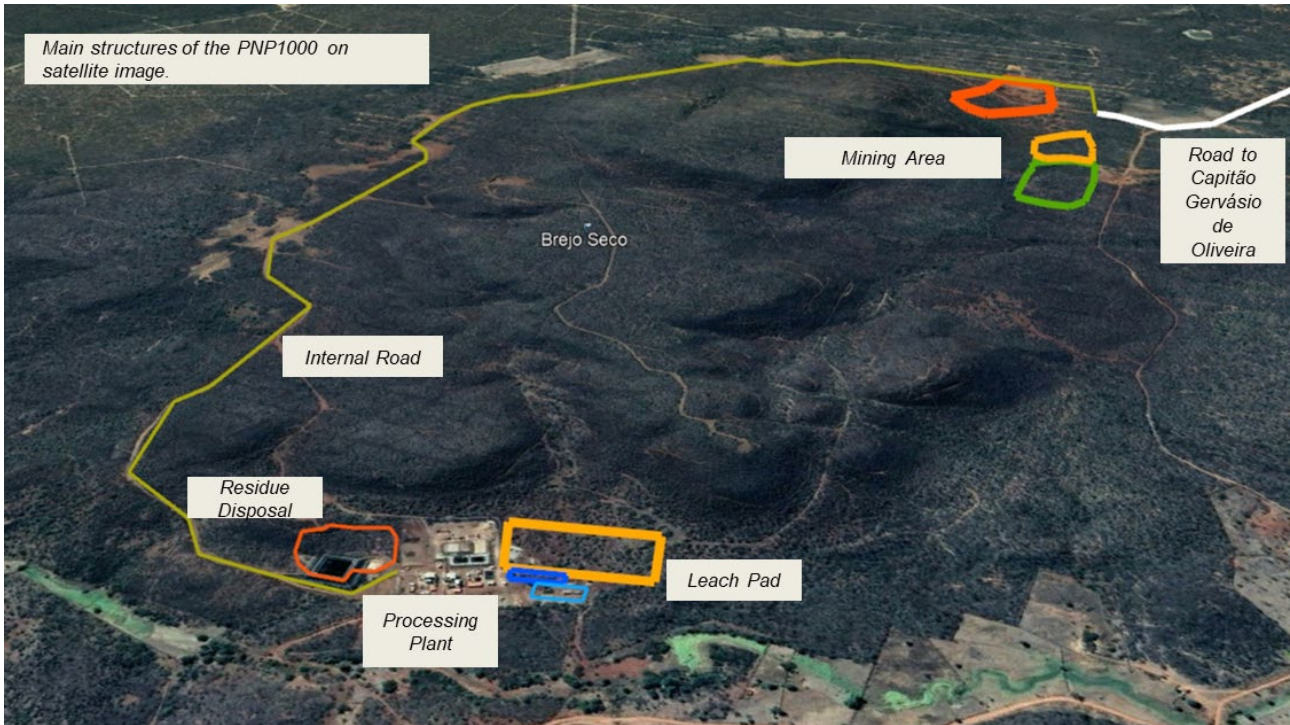
The project implementation schedule is summarized below.



Figure 4-22 PNP1000 Project Schedule

| Milestone | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|--|---|---|---|---|---|---|---|---|---|----|----|----|----|----|
| Project Kick Off | | | | | | | | | | | | | | |
| Drilling & Mine Planning | | | | | | | | | | | | | | |
| Detailed Engineering for the Final Equipment Selection | | | | | | | | | | | | | | |
| Earthworks & Civil Engineering | | | | | | | | | | | | | | |
| Fresh Water (New Bore Hole) Available | | | | | | | | | | | | | | |
| First Acid Delivery | | | | | | | | | | | | | | |
| Leach Pad construction | | | | | | | | | | | | | | |
| First Ore from the Mine | | | | | | | | | | | | | | |
| Module 1 Stacking | | | | | | | | | | | | | | |
| Downstream Processing Plant Construction | | | | | | | | | | | | | | |
| First PLS to the Plant | | | | | | | | | | | | | | |
| First NHP | | | | | | | | | | | | | | |

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Figure 4-23 Satellite of the main project elements



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4.7 GREENHOUSE GAS (GHG) EMISSIONS

The GHG Protocol Corporate Standard has been used to develop BRN’s internal GHG emissions. This standard utilises the concept of “scope” to help delineate direct and indirect emission sources, improve transparency, and provide utility for different types of organizations and different types of climate policies and business goals, three “scopes” (scope 1, scope 2, and scope 3) are defined for GHG.

Scope 1: Direct GHG emissions

Direct GHG emissions occur from sources that are owned or controlled by PNM, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment.

Scope 2: Electricity indirect GHG emissions

Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by PNM. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

Scope 3: Other indirect GHG emissions

Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by PNM. Some examples of Scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

BRN GHG emissions

BRN has calculated Scope 1 and 2 CO₂ for the PNP1000 project as a standalone project. Scope 1 and 2 are complete Scope 3 is a work in progress which will be looked at in detail once the project is operational. The power used for the PNP1000 in this part of Brazil is most likely to be form hydropower with either solar or wind renewable energies feeding the grid in this area if it is not hydropower, as such the CO₂ emissions for both scopes are the same. The calculated CO₂ emissions for both Scope 1 & 2 (as the power element in scope 2 is considered zero) for the PNP1000 project are 6,856 t CO₂ per annum or 4.77 t CO₂/t Ni produced.


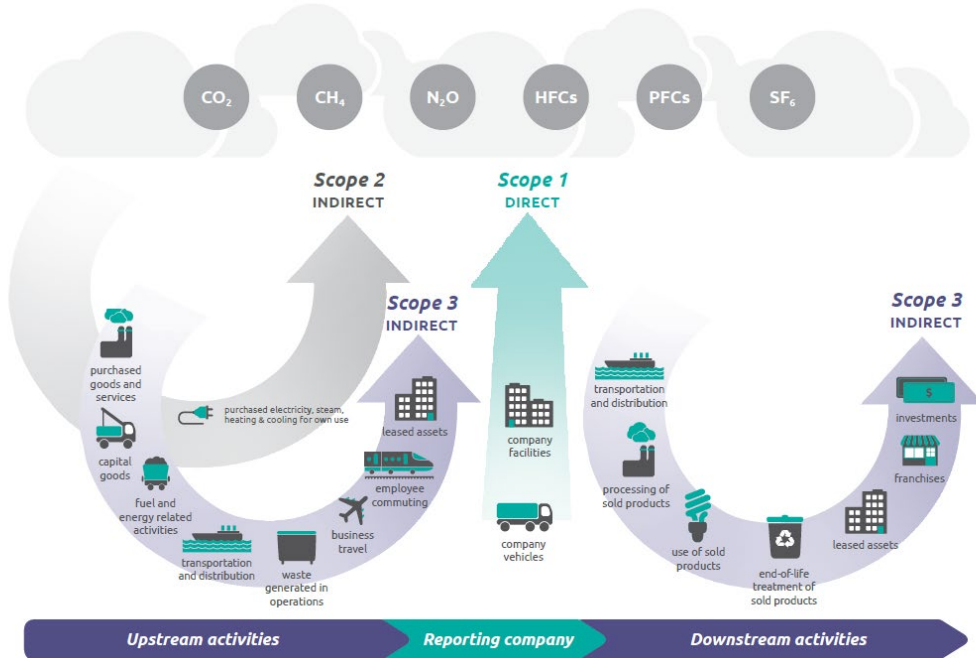
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Figure 4-24 Overview of the GHG Protocol Scopes and Emissions across the Value Chain



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4.8 ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM HIGHLIGHTS

An Environmental & Social Management System is a set of mechanisms or operations that are designed to control and reduce negative impacts on the environment and the local communities, which may occur during the construction and / or operation of the project. The following highlights are some of the mechanisms provided for in the PNP1000 Project design to avoid or mitigate potential environmental and social impacts (full details in section 9 below).

4.8.1 LIQUID EFFLUENTS AND SURFACE WATER

Management of liquid effluents and surface water will be improved by the Project through the following investments/activities:

- Refurbishment of a septic tank system and
- Refurbishment of the oil water separator system
- Installation of an efficient rainwater drainage system to guide rainwater and manage non-contact rainwater from operational areas
- Installation with the solid residue storage (IFC, BFC, spent ore) of a containment pond for water which will be reused in the production process
- Installation of inspection boxes and an emergency pond in the area of the leach solution ponds to assist management of the leachate effectively



4.8.2 SEDIMENTS

Construction and operation of sediment control structures to minimize and capture sediment erosion during the wet season around the various Project elements (especially during the construction phase). This will be combined with planned restoration/replanting of areas where feasible.

4.8.3 AIR QUALITY, DUST AND OTHER PARTICULAR EMISSIONS

Management of air quality will be improved by the Project through the following investments/activities:

- Use of water sprinkling on unpaved roads in the project area and parts of the access road by water trucks
- Control of vehicle speed and fleet management (to reduce dust generation and also reduce the risk of traffic accidents)
- Covering trucks transporting materials such as sand and cement
- Enhancement or replanting of vegetation cover over exposed areas, when feasible

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4.8.4 SOLID RESIDUES AND MINE WASTE ROCK

Management of potential risks from the solid residues and waste rock generated by the Project will be through the following investments/activities:

- Installation of an impermeably lined area for storage of leached (spent) ore and plant solid residues (IFC and BFC) associated with a containment pond
- Designing waste management plans and procedures for the selective collection of recyclable and hazardous waste, and appropriate final destination/disposal
- Deposit of unusable mineral material (overburden) in controlled and monitored waste heaps, and management of their stabilization and restoration

Figure 4-25 Disposal in an Impermeable Residue Storage Area of Solid Demonstration Plant Residues





4.8.5 NOISE AND VIBRATION

Management of potential impacts from noise and vibration will include implementing the following investments/activities:

1. Preventative and corrective maintenance of vehicles, machines and equipment used during the construction and operation stage, and vehicle traffic management
2. Restricting mining activities to daytime only. Transportation of reagents will be planned and optimized with the aim of minimizing disturbance to the surrounding communities

Further details of all the planned PNP1000 Environmental and Social Management Systems are provided in section 9.

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5 LEGAL AND ENVIRONMENTAL FRAMEWORK

5.1 NATIONAL AND STATE LEGISLATION

Within Brazil, all ores and the subsoil are considered to be federal assets, as explained in item IX, article 20, of the Federal Constitution. All mining projects therefore require government authorization both at national level and state level.

At the national level, the authorized authority the National Mining Agency (*Agência Nacional de Mineração, ANM*) evaluates and can issue permissions to mine; mining licenses or *concessão de lavra*.

There is also a National Environmental Policy (PNMA), established by Law No. 6,938 of August 31, 1981, and accepted in its main points by the Federal Constitution of 1988. The law subordinates public and private policies in all other sectors to its instruments and forms of control, under articles 170 and 225 of the Federal Constitution, emphasizing the protection of the environment as a public good and to address the challenge of seeking a sustainable development model to conserve natural resources for current and future generations

At the state level, the competent authority is SEMAR, *Secretaria Estadual de Meio Ambiente e Recursos Hídricos* do Piauí (State Secretariat of the Environment and Water Resources) which is under CONSEMA - State Council for the Environment and Urban Development. SEMAR can issue licenses for industrial projects (under article 12 of CONAMA Resolution 237/97) at three levels;



1. Preliminary License (*Licença Previa, LP*), in the preliminary phase of activity planning, via which the official State awards permission for the project to proceed provided certain conditions are met. Such conditions may relate to the gathering of additional environmental or social baseline data and/or certain required impact mitigation measures, other than those already predicted in the ESIA which is prepared and presented to start the permitting process
2. Installation License (*Licença do Instalação, LI*), authorizing the beginning of construction, according to the specifications contained in the approved Executive Project, and
3. Operation License (*Licença de Operação LO*), authorizing, after the necessary checks, the beginning of the licensed activity and the operation of its pollution control equipment, in accordance with the provisions of the preliminary and installation licenses

There are also a number of Federal, State and Municipal constitutional articles, decrees, laws, resolutions and decisions with which the project must comply (see full-scale ESIA sections 3.5 to 3.7).

5.2 ENVIRONMENTAL STANDARDS

According to the IFC, projects can be categorized as follows:

Category A – Projects with potentially significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented;

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Category B – Projects with potentially limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and

Category C – Projects with minimal or no adverse environmental and social risks and/or impacts.

The full-scale PNP project is categorized as Category A and while it might be argued that the activities envisaged, and therefore potential impacts, of the PNP1000 project are significantly more limited, it was decided by the project proponent that the PNP1000 should be approached in a similarly rigorous manner. As such, the PNP1000 will be developed in accordance with international best practice and following relevant World Bank and WHO guidelines including:

4. IFC – Performance Standards (2012)
5. World Bank - EHS General Guidelines (2007)
6. World Bank - EHS Guidelines for Mining (2007)
7. IFC/EBRD – Workers’ Accommodation Process and Standards Guidance Note (2009)

5.3 ENDANGERED SPECIES LISTS

Current Brazilian legislation, with the official lists of flora and fauna endangered species, remain the same as the ones described in the PNP full scale ESIA of November 2017. The main legislation in these areas are the *Portarias* from the Environmental Ministry MMA nºs 443, 444, and 445 from December 17th, 2014.

The IUCN red list was checked against the flora and fauna species lists presented in the PNP full scale ESIA, and the results remained the same for the PNP1000 in 2020.

As assessed by Arcadis in the PNP full scale ESIA, the PNP full scale implementation won’t (therefore neither will the PNP1000) affect the survival of any flora and fauna species populations, including the ones considered with some level of threat both by the IUCN and the Brazilian official lists. For PNP1000 this is therefore also the case considering that PNP1000 only requires the deforesting of some 25.5 ha of already degraded open Caatinga, located in the surroundings of the Demo Plant and Brejo Seco hill. The PNP1000 clearance represents about 2.8% of the predicted 1,121 ha of Caatinga clearing for the PNP full scale (which itself represents some 0.001% of the region’s total Caatinga 845,000 km² coverage). The clearance of these areas has been approved through the three deforestation permits awarded by SEMAR, and PNM will follow best practices to reduce environmental impacts.

5.4 CURRENT STATUS OF THE PNP1000

5.4.1 MINING RIGHTS

PNM is the holder of a current mining license at the project (“*concessão de lavra*” number 804.290/1970 as defined under the Brazilian Mining Code and National Mining Authority) as well as three exploration licenses (“*alvarás de pesquisa*” numbers 803.109/2017, 803.110/2017 and 803.111/2017). The mining license covers the area to be mined during the PNP1000 operation (see Figure 5-1 and Figure 5-2).


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Figure 5-1 Mineral Rights and Site Access Map

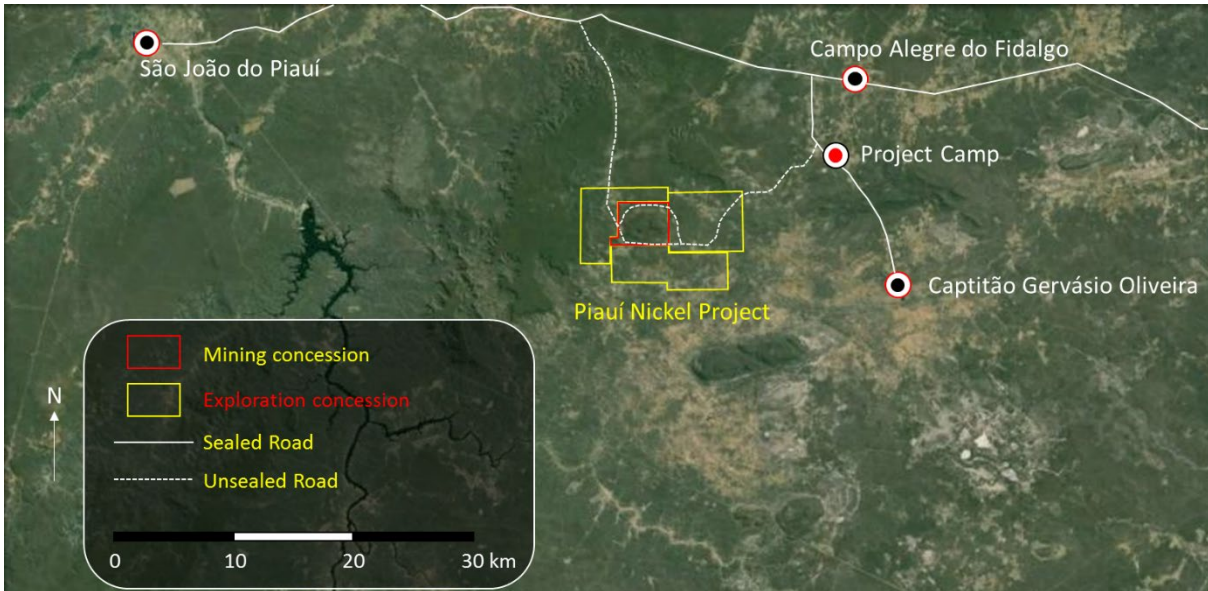
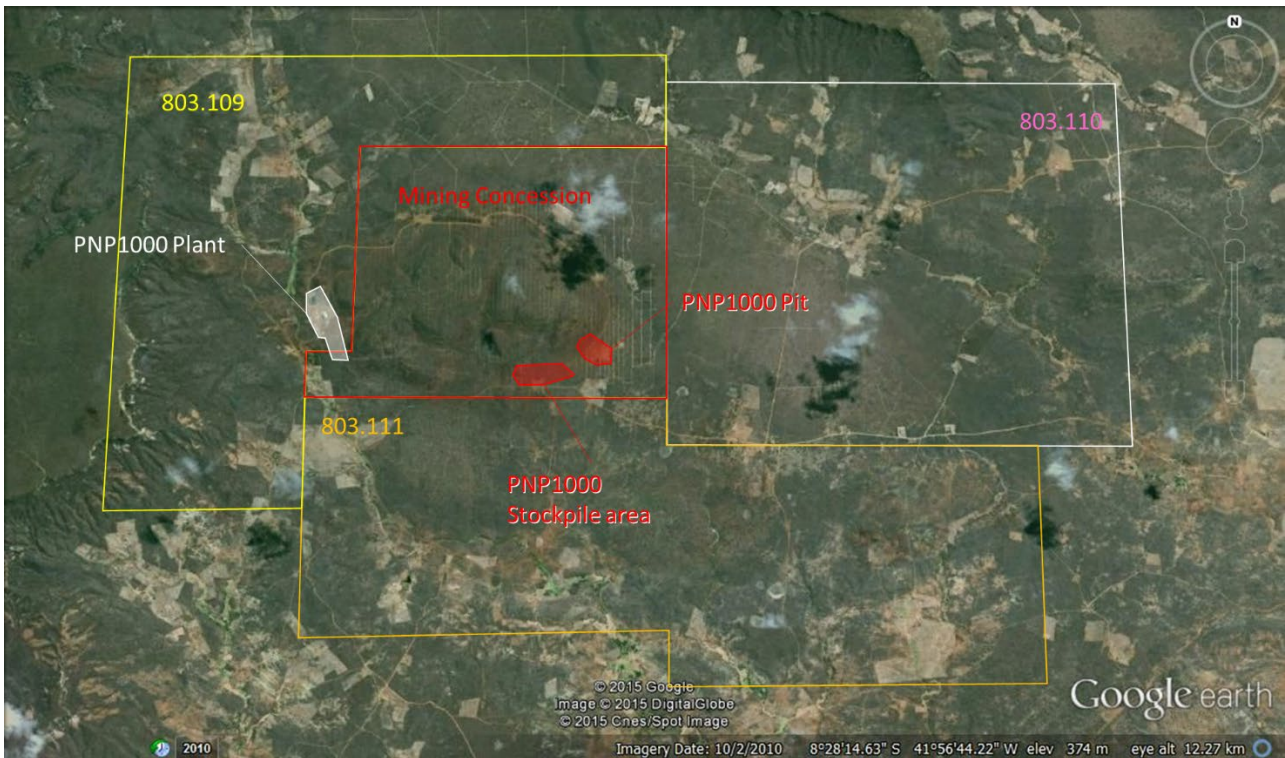



Figure 5-2 PNP1000 areas and mineral licences



The mining license is valid in perpetuity while the exploration licenses are valid until October 2020 and renewable for a further 3 years.

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5.4.2 OPERATING PERMIT

The PNP Demonstration Plant has an existing and valid Operating Permit (*Licença de Operação LO 547/17*) under which the PNP1000 will also operate as agreed with SEMAR.


5.4.3 OTHER PERMITS

PNM also has permits for vegetation removal for the PNP1000 construction activities as well as other permits and legal obligations for safe operations at the project, including disposal of solid waste residues, transportation allowance for controlled materials among others. The full permit list is shown in Table 5-1 below.



For final PNP1000 implementation a groundwater well permit for borehole number 3 (see section 4.5.5.4) is required, the request for authorization to drill the borehole will be made during the construction phase, and the request for authorization to use the well will be made following drilling and testing of the borehole.

Table 5-1 Current PNP Permit List

| Permit / Approval | Institution | Required for: | Status | Main Legal Reference |
|--|-------------|---|-----------------|---|
| Licença de Operação - LO | SEMAR | Licence for project operation | Awarded | Federal: Resolução CONAMA 01/86 |
| Autorização de Desmate | SEMAR | Licence for deforestation | Awarded | State: RESOLUÇÃO CONSEMA N° 010 de 25 de novembro de 2009 |
| Autorização de Desmate | SEMAR | Licence for deforestation | Awarded | State: RESOLUÇÃO CONSEMA N° 010 de 25 de novembro de 2009 |
| Autorização de Desmate | SEMAR | Licence for deforestation | Awarded | State: RESOLUÇÃO CONSEMA N° 010 de 25 de novembro de 2009 |
| Outorga poços captação de água - Preventiva | SEMAR | Authorization for drilling new water borehole | To be requested | State: PORTARIA GAB. N° 0101/15 |
| Outorga poços captação de água - Uso | SEMAR | Authorization for pumping water from new borehole | To be requested | State: PORTARIA GAB. N° 0101/15 |
| CTF IBAMA | IBAMA | Mining activity registration in IBAMA database - non operational | Awarded | Federal: Instrução Normativa nº 6, de 15 de março de 2013 |
| CTF IBAMA | IBAMA | Mining activity registration in IBAMA database - operational. payment of fee every 3 months | To be requested | Federal: Instrução Normativa nº 6, de 15 de março de 2013 |
| Portaria de Lavra - processo Níquel 804.290/1970 | ANM (DNPM) | Mining Licence (ANM Process 804.290/1970) | Awarded | Federal: Decreto-lei 227, de 28 fevereiro de 1967 (Código de Mineração) |

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| Permit / Approval | Institution | Required for: | Status | Main Legal Reference |
|---|--------------------------------|---|-------------------------------|--|
| Uso e transporte de produtos controlados | Exército Brasileiro DNPM | Licence for transportation and use of controlled materials (as defined by the National Army) | To be requested | Federal: DECRETO Nº 3.665, DE 20 DE NOVEMBRO DE 2000 (R-105) A Portaria nº 05-DLog, de 02 de março de 2005, (Pub BE de 18 Março de 2005) |
| CIPAMIM - Comissão Interna de Prevenção de Acidentes na Mineração | Labour Ministry | Maintaining safety regulation standards | To be renewed | Federal: Labour standard: NR22; NR05 |
| PCMSO/PGR | Labour Ministry | Approval of Health and Safety Action Programs for mining operation | To be renewed | Federal: Labour standard: NR07;NR22 |
| AVCB - Auto de Vistoria do Corpo de Bombeiros | Fire Department - Piauí | Fire safety licence for Project | To be requested/ submitted | Instrução Técnica do Corpo de bombeiros |
| CAI - Certificado de Aprovação de Instalações | Labour Ministry | Labour safety licence for Project | To be requested/ submitted | Federal: Labour standard: NR02 |
| Alvarás de funcionamento - cozinhas, refeitório, ambulatório médico (planta + alojamento) | Prefeitura CGO | Kitchen Licence both at the camp and Demo Plant | Awarded | Food & Environmental Hygiene within the health dept. |
| Alvará de funcionamento Planta Piloto | Prefeitura CGO | Operational Licence for Demonstration Plant (issued by the municipality) | Awarded | Taxes secretariat |
| Autorização de uso de ácido, soda-ash, HCL | Polícia Federal | Authorization for use, transport and storage of Sulphuric acid, Soda-ash, HCL | To be renewed | Law 10.357/2001 |
| Registro Junta comercial | Juntas comerciais MG e PI | Legal registration of company and affiliates. | Awarded | |
| Alvará de funcionamento novo escritório | Belo Horizonte | Office licence for running a headquarters office | To be requested/ submitted | Taxes secretariat |
| Rental or Access Rights, and indemnification Agreements | Land owners over project areas | Rental and indemnification for impacts caused over properties | Awarded | "Federal: Decreto-lei 227, de 28 fevereiro de 1967 (Código de Mineração)" |
| Trespassing/Connecting Authorizations | Public infrastructure entities | Construction of structures crossing, impacting on, or connecting to public infrastructures such as roads and transmission lines | To be requested/ submitted | |



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5.4.4 PROTOCOL OF INTENT

On May 26th 2017, PNM signed a “Protocol of Intent” with the State of Piauí concerning implementation of the PNP.

In this mutually cooperative agreement, PNM committed to maximize local job creation via priority assessment of worker availability, with sufficient skills, in the municipalities of the Areas of Direct and Indirect Influence, their surrounding communities, and regionally. PNM also committed to focus on developing a local and regional supply chain, embracing a culture to develop and foster local business (services and goods providers). In addition PNM also committed to certain other actions including that all company owned vehicles would be registered in Piauí State and that it would develop training programs for the local workforce.

In return the State committed to seek to improve local roads and Infrastructure (health, public safety, water supply, landfill, sewage treatment) and provide timely administrative decisions and procedures as well as to provide PNM preferential State value added tax (ICMS) treatment on local purchases.

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6 AREA OF INFLUENCE

An area of influence is the area where the environmental and social impacts resulting from the implementation of the project could occur. They are used to define the scope of necessary actions to address impacts and are defined based on the characteristics of the project and the region in which it is located.

The following areas of influence are defined for the Project, and are aligned with the definitions required under the Brazilian ESIA appraisal system:

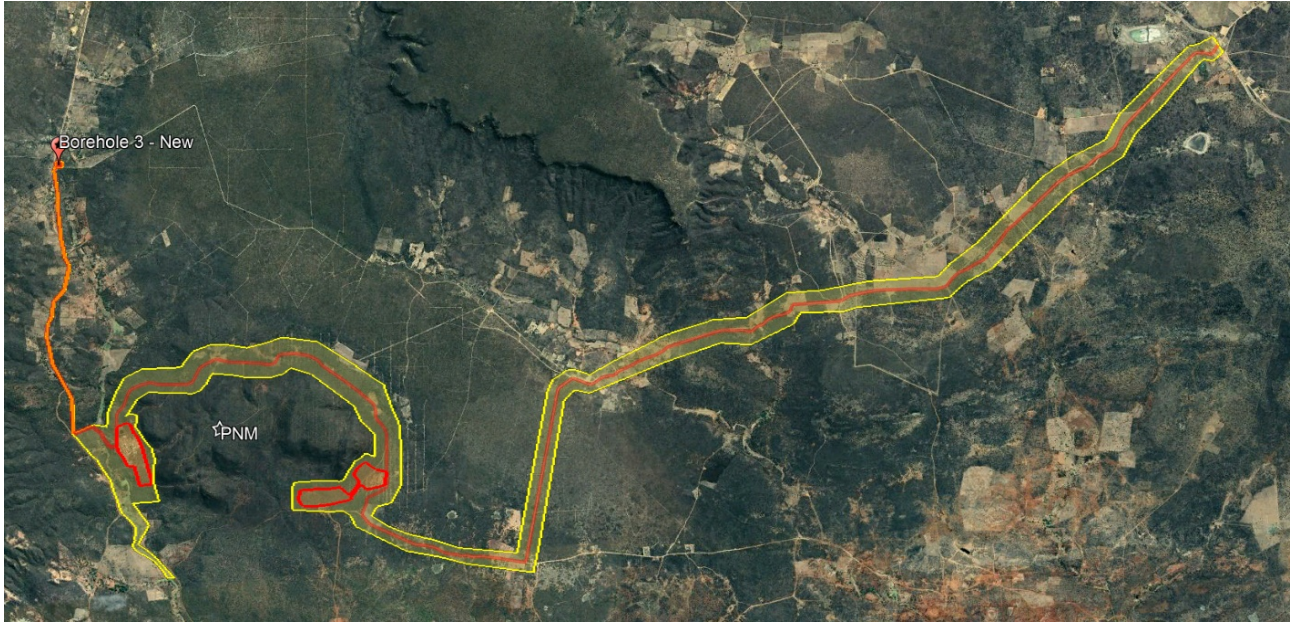
Directly Affected Area (DAA): corresponds to the places where the necessary actions / interventions for the construction of all elements and operation of the project will take place. It is the same area for all the studied environments; physical, biotic, or social.

Area of Direct Influence (ADI): the geographical area surrounding the DAA that can be affected by the significant impacts, positive or negative, *directly* resulting from the implementation, operation and/or closure of the project. The ADI of the physical and biotic environment for the PNP1000 was based on geographical factors such as hydrological basins and topographic features for the specific elements, and included a 150 m strip of land on each side of the new linear elements i.e. a *buffer zone* along access roads, water pipeline, etc. The socio-economic environment ADI differs from the geographical area in that it also considers the municipalities where the DAA operates: Capitão Gervásio Oliveira, São João do Piauí, and Campo Alegre do Fidalgo.

Area of Indirect Influence (AI): the area that involves the ADI, plus areas that may suffer any indirect impacts from the implementation and operation of the project, whether positive or negative. For the physical and biotic environments it comprises a broader buffer area compared to the ADI limits, and for the socio-economic environment it also includes the municipality of Petrolina/PE, where some of the more specialized services for the project will come from.

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Figure 6-1 Areas Directly Affected and of Direct Influence for the Physical and Biotic Environment



Directly Affected Area (DAA) in red, Area of Direct Influence (ADI) in yellow


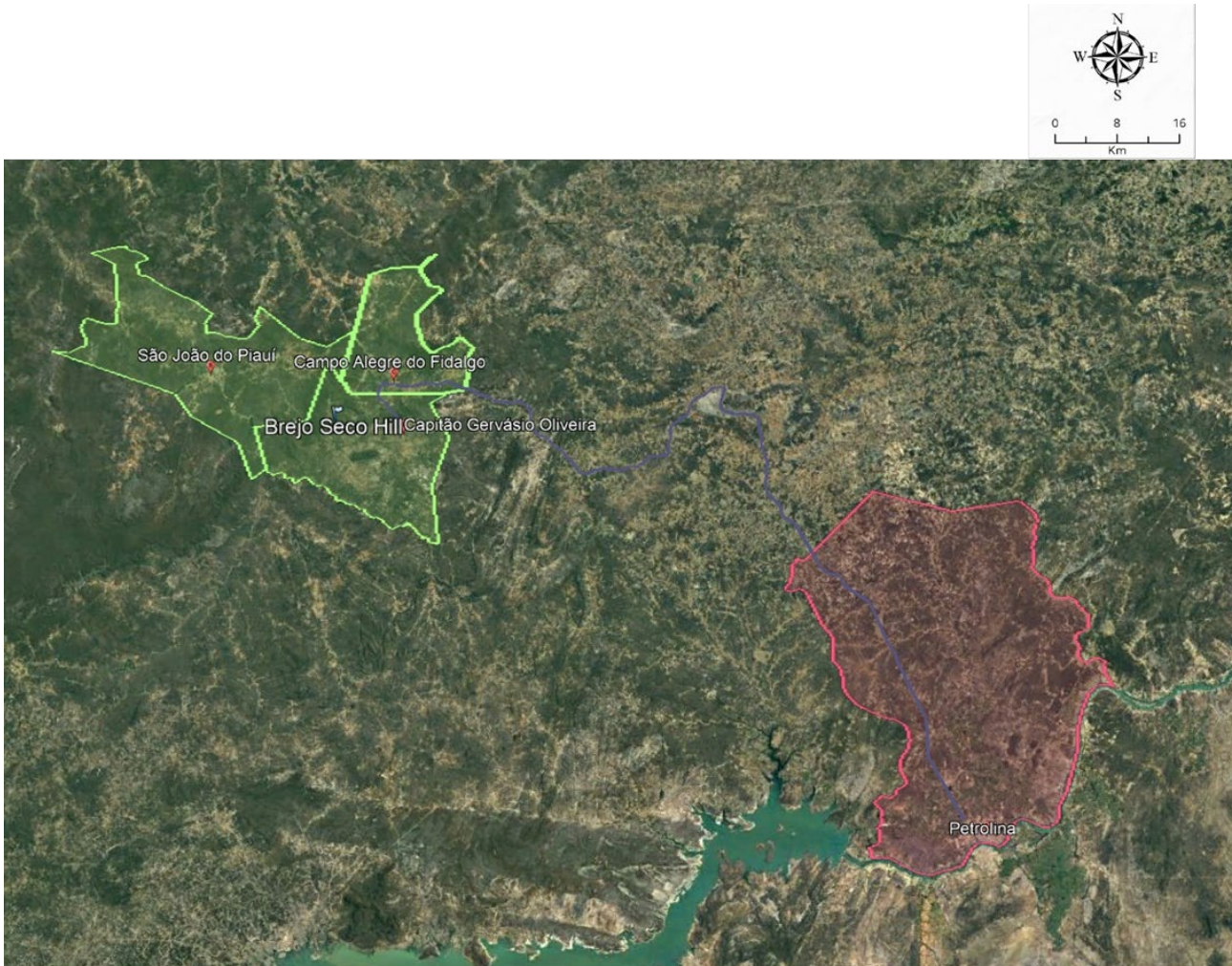


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Figure 6-2 Areas of Influence for the Socio-economic Environment



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7 ENVIRONMENTAL BASELINE

The ESIA for the Project describes the baseline environmental physical and biotic conditions within the areas of influence of the Project. It represents the baseline conditions in the region before the implementation of the PNP1000 (but after the Demonstration Plant which was constructed before the ESIA was undertaken), and considers the following elements:

Physical Environment

The physical environment baseline includes studies of the climate, air quality, noise and vibration, soils, topography, geology, hydrology (surface waters), hydrogeology (groundwaters), and caves, among others.



Biotic Environment

The biotic environment baseline studies fauna (terrestrial and aquatic animals) and flora (plants), highlighting the species, or habitats which are indicative of environmental quality, of scientific and economic value, and those which are rare or threatened with extinction. In addition, the assessment took account of any Permanent Preservation Areas (APPs) and Conservation Units (CUs) within the ADI or All.



Socio-Economic & Cultural

The socio-economic baseline studies assessed the local communities, including their socio-economic conditions, including work and income, education, health, housing and security, and the services and infrastructure offered by the respective municipalities. It also included the historical and archaeological characteristics of the region, and the cultural aspects of the communities. The stakeholder engagement for this was structured so as to enable the perspectives of all of the levels of the communities and other stakeholders, accounting for amongst other attributes gender, age, and vulnerability.



The baseline studies also included interviews with representatives of society and local communities to assess their environmental perceptions about the conditions of the existing natural resources, and how they evaluate the arrival of the Project and their perception of the potential consequences and benefits.

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7.1 PHYSICAL ENVIRONMENT

7.1.1 CLIMATE

The region where the PNP1000 will be implemented is part of the Caatinga biome, which is characterized by a semi-arid hot tropical climate, with a long dry season and four months of short concentrated rainfall episodes.

Figure 7-1 PNP1000 in context of the Caatinga Biome



Caatinga Biome

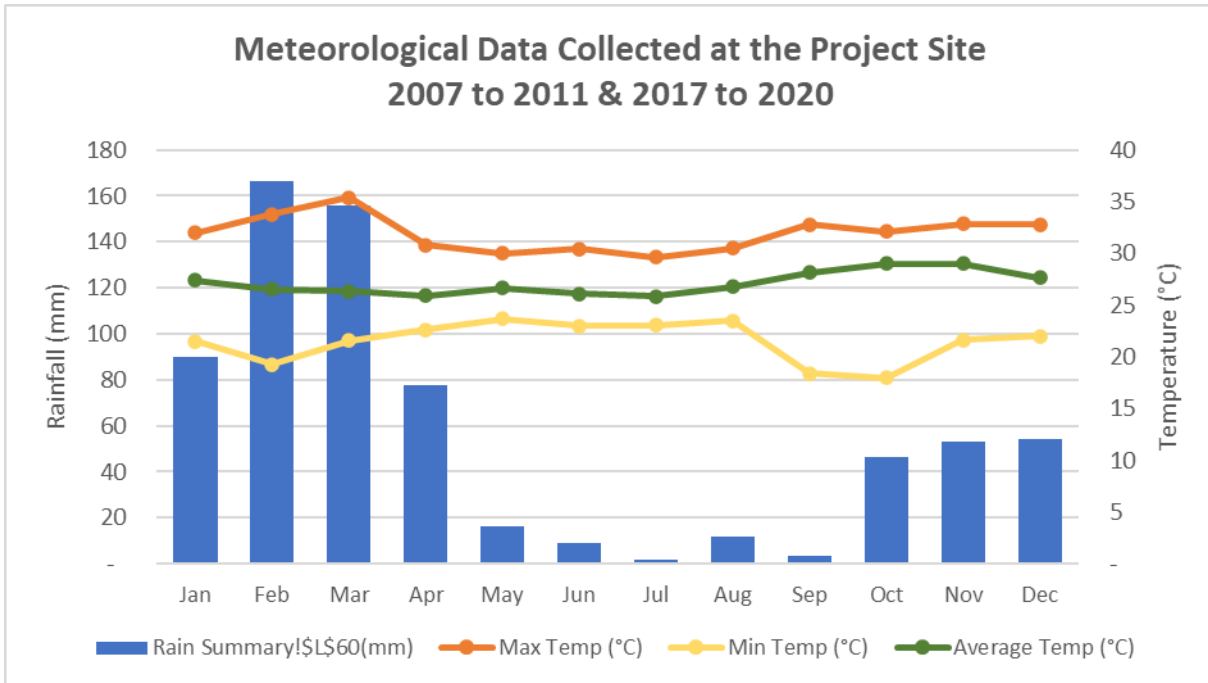


Brejo Seco Hill - Directly Affected Area – DAA

The temperature ranges from 18°C to 35°C with an average of 27°C. The average annual rainfall is 685 mm per year and is concentrated between the months of December and March.

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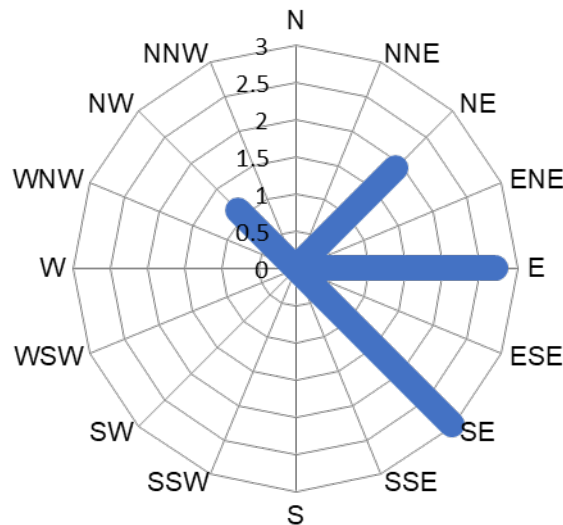
Figure 7-2 Project Site Meteorological Data





Source: Project Site Local Weather Station, 2020. Prepared by: PNM, 2020.

In the region of the Project, as well as in the entire northeast of Brazil, the winds are directly influenced by the air masses coming from the Atlantic Ocean and the intertropical convergence zone. The graph below indicates the predominance of winds from the east and southeast directions.

Figure 7-3 Project Wind Data



Source: INMET, 1992. Prepared by: Arcadis, 2017.

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7.1.2 GEOLOGY


The study region is divided between two types of rocks: sedimentary in the north, metamorphic and crystalline in the south. The sedimentary rocks, due to their porosity and permeability, are able to store significant volumes of water and form regionally extensive and important aquifers.

The metamorphic rocks in the region are those that have undergone transformations during their formation caused by high temperatures and/or pressures which has altered the shape and mineral composition of the rock. It is these metamorphic rocks which became the ore of the Piauí Nickel Project following extensive weathering.

Figure 7-4 Banded metamorphic rock with mineral veins



The rocks comprising the nickel ore and the over-lying “overburden” were oxidized by the weathering process and as such have no propensity to generate any acid rock drainage.

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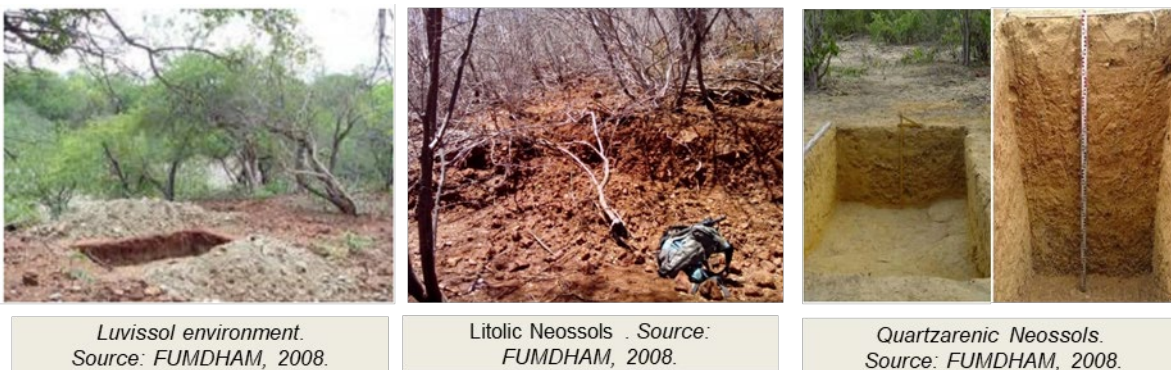
7.1.3 SOILS

There are three main types of soil are identified in the project area: Litolic Neossols, Quartzarenic Neossols, and, Luvisols, the characteristics of these are summarized and illustrated in the table and figures below.

Table 7-1 Main Soil Types

| Soil | Characteristics | Location |
|-----------------------|---|--------------------------------------|
| Litolic Neossols | Low agricultural potential. Shallow and rocky making it difficult for water to circulate within the soil. Can be used for grazing, as well as for borrow material and to preserve water springs and native vegetation | Steep slopes and rocky outcrops |
| Quartzarenic Neossols | Used as a substrate for irrigated agriculture and as a source of sand for civil construction. This type of soil is well drained and retains little water or nutrients making it fragile and highly dependent on agricultural conservation practices | Undulating to flat topographic areas |
| Luvisols | Shallow soil typical of a semi-arid environment, rich in bases and with high activity clay. Used for rain fed agriculture, pasture, livestock and environmental preservation | flat topographic areas |

Figure 7-5 Examples of the 3 Soil Environments




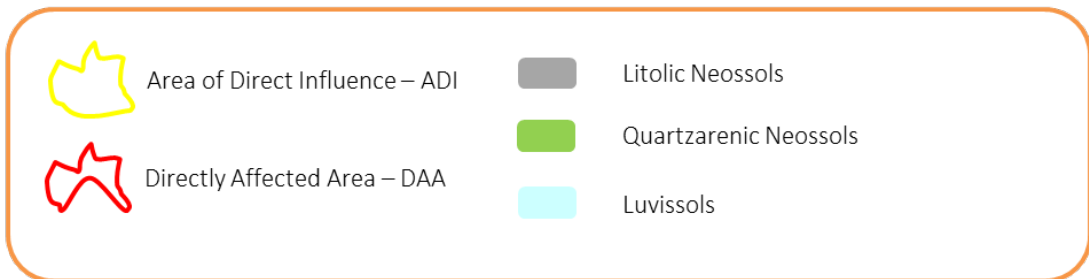
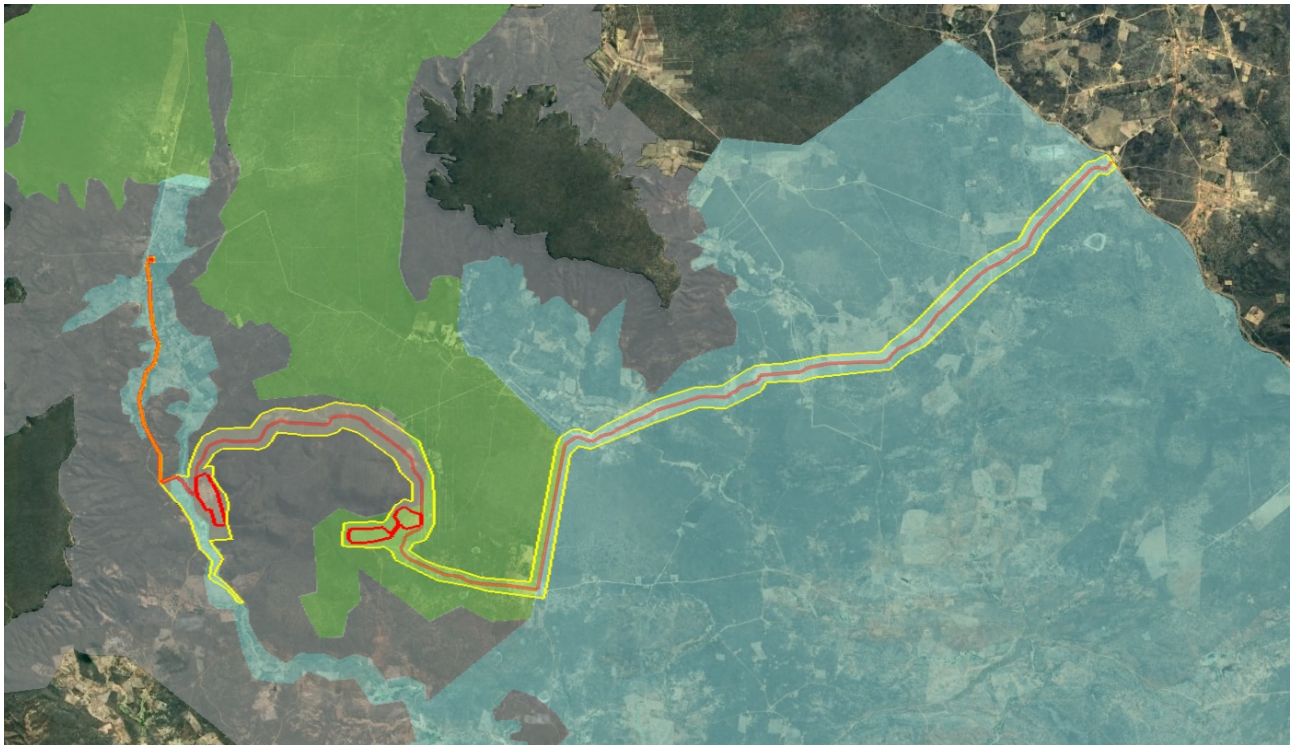


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Figure 7-6 Types of Soils in the ADI



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7.1.4 TOPOGRAPHY & LANDSCAPE

The study region is located within two geomorphological domains: the Sertaneja Depression and the Parnaíba Basin. The immediate region around the Project is typically made up of small hills with low slopes, with some more prominent hills with steeper slopes, including the plateaus which are typified by steep sides and wide and flat tops.

Figure 7-7 Typical Topography around the project



7.1.4.1 EROSION SUSCEPTIBILITY

The potential for erosive processes to occur from wind, rain, sun, temperature changes, and human interference, depend on the surface cover and steepness of the slopes. As part of the baseline studies, a classification of the areas in relation to their fragility due to erosion processes was carried out in the region where the PNP1000 will be implemented (see Figure 7-8). The PNP1000 mining area is on a flat or low slope part of the orebody and thus is an area considered to be of low susceptibility to erosion, whereas the process plant is located within an area classified as having a high erosion susceptibility. For both areas PNM will design and implement appropriate surface water run-off controls to minimize the potential for erosion and incorporate these into the design of key features such as the overburden stockpiles.


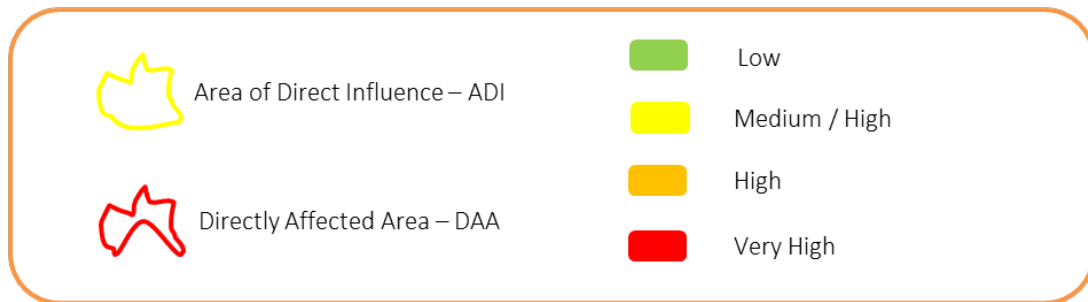
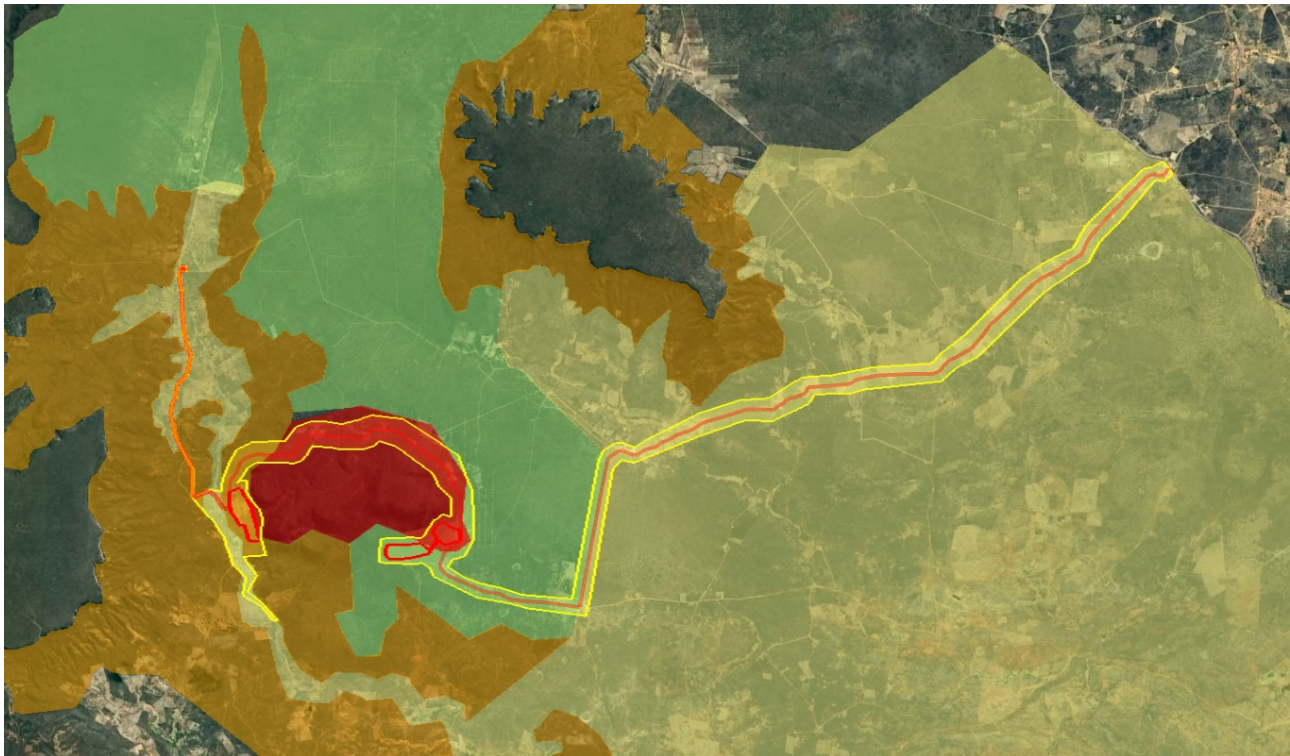
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Figure 7-8 Susceptibility to Erosive Processes in the ADI



7.1.5 SURFACE WATER

The rivers of the PNP1000 area are within the Middle Parnaíba basin (designated as sub-basin 5, Piauí / Canindé). The Middle Parnaíba accounts for 99% of the drainage network of the State of Piauí, and has an area of 333,056 km². This network supplies water to important cities in the State of Piauí, such as Teresina, Parnaíba, and Picos, as well as to 217 other towns.

The rivers and streams that flow in the Project Area of Influence are ephemeral due to the climatic characteristics of the location, and its short irregular and often low rainfall season, and mainly only flow during periods of high rainfall. The PNP1000 Project site is within the catchment of the Várzea stream which flows south in the valley 150 m to the west of the process plant (and within which the Project’s two boreholes are located). This flows south and is a tributary of the Gameleira stream which in turn flows into the Piauí River and ultimately the Janipapo reservoir.

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7.1.5.1 SURFACE WATER QUALITY

The baseline surface water monitoring is based on water samples collected during three different field campaigns carried out in February, March, and May 2008. This monitoring indicated the presence of elevated organic material, high levels of turbidity, low oxygenation, as well as bacteria of fecal origin. This reflects the seasonal nature of the river flows, the flushing of the land of faecal material from animals and the erosion of the soils in the area. It is also noted that the Project is in a region that does not have adequate basic sanitation. According to the surface water quality assessment, results do not meet the minimum requirements (for rivers Class 2 type) set by Brazilian legislation for human use. These very poor surface water conditions also have an impact on the aquatic life in the rivers and other water bodies such as retention ponds and semi-permanent pools in the rivers (see section 7.2.3.4)

Figure 7-9 Photographs of Surface Water in the Project Vicinity



Resident collecting water, Várzea Reservoir (3rd campaign).



Animal watering in a weir in Várzea stream (upstream Brejo Seco deposit, 1st campaign)



Gameleira Stream (2^a campaign).



Water with high turbidity (Várzea stream, downstream of the Brejo Seco hill, 2nd campaign)


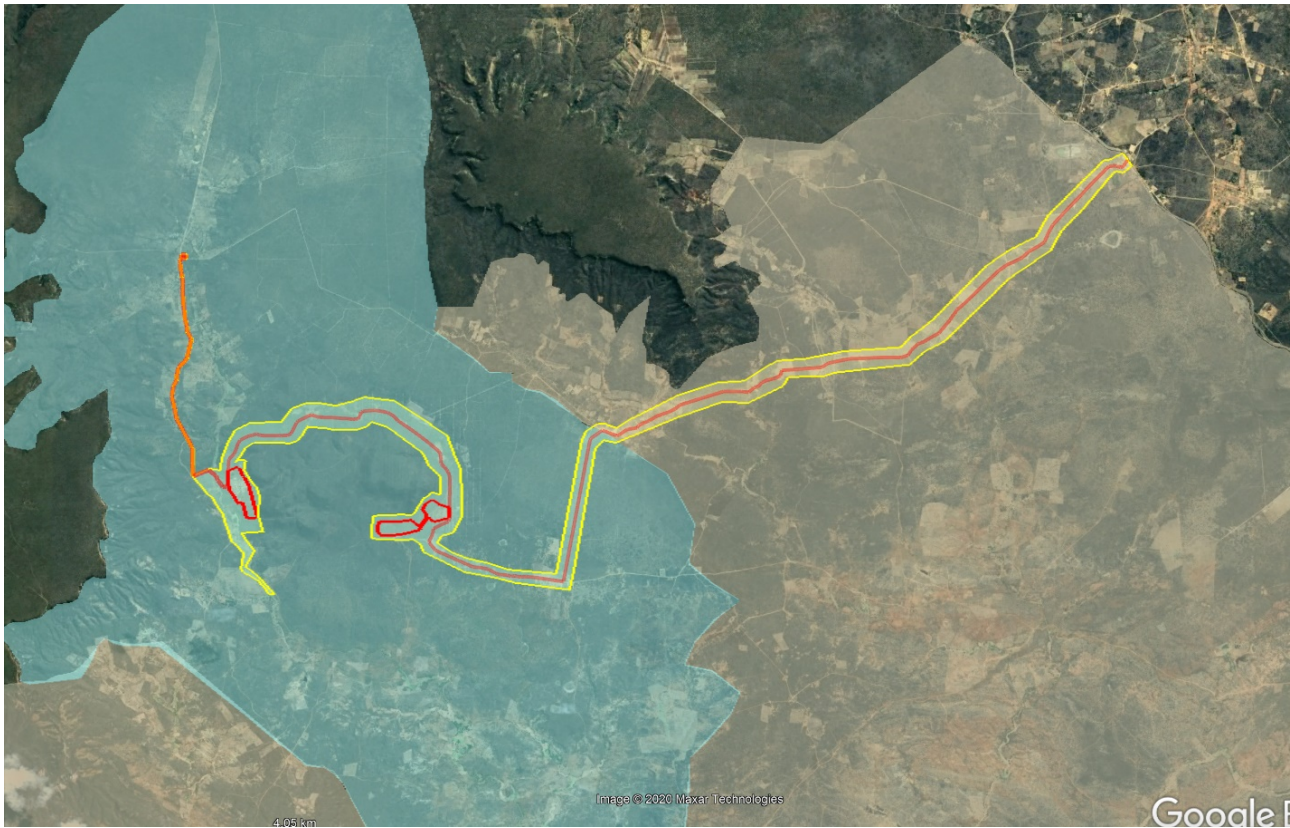
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Figure 7-10 Surface Water in the ADI



7.1.6 GROUNDWATER

There are two main aquifer systems found in the Project area; one is characterized by crystalline rocks, with limited fracture flow, and the other by sedimentary rocks of the Parnaíba Sedimentary Basin. The sedimentary rocks which form the Serra Grande Aquifer form the main aquifer in the region and are located to the north of the Project in the DAA (Directly Affected Area). These sedimentary rocks are up-hydraulic gradient from the area of PNP1000 mining or processing, and therefore will not be impacted by the PNP1000 Project other than through the proposed water supply boreholes which is intended to target this aquifer.

The Serra Grande Aquifer has great potential for water supply and is one of the largest and most important in the region. Studies carried out in 2008 identified that it had the capacity to pump 200 m³/h (or more) of water from deep wells installed in it.


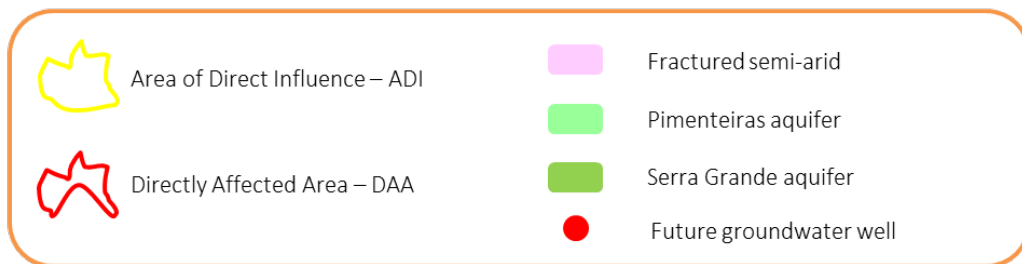
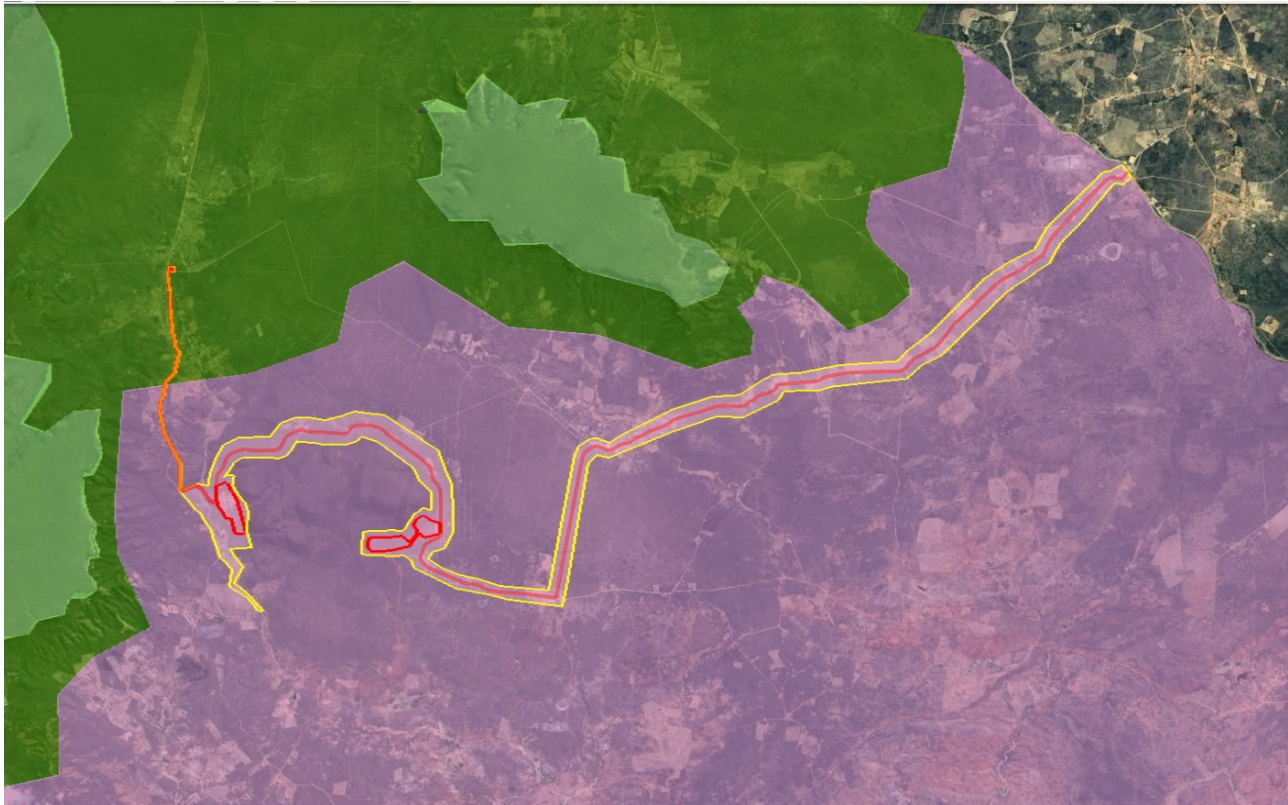
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Figure 7-11 Aquifers in the ADI



Based on the inferred hydrogeological characteristics this aquifer has been identified as having the ability to supply the groundwater requirements of the PNP1000 Project. To evaluate the additional water supply options, PNM contracted MDGEO, a hydrogeology consulting company, in 2018 to research the closest and most prominent location to drill a borehole to extract up to 30m³/h of water. From the results presented in the MDGEO 2018 study, no groundwater use conflicts are expected. There are only a few boreholes which exist in the area (see Figure 7-12) and those that are functioning have low pumping volumes reflecting the limited domestic demand and potentially the low borehole yield (see Table 7-2). This study illustrated the very low density of potential users in this rural area, and the fact that the relative low volume required for the new borehole (up to 30m³/h) will not have any measurable impact on the significant groundwater abundance and capacity of the Serra Grande Aquifer in the region.

Since completion of the 2018 study, it is PNM’s understanding that there have been no changes to local underground water demand and therefore the outcomes of the study remain valid.


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Figure 7-12 Current and proposed new borehole locations

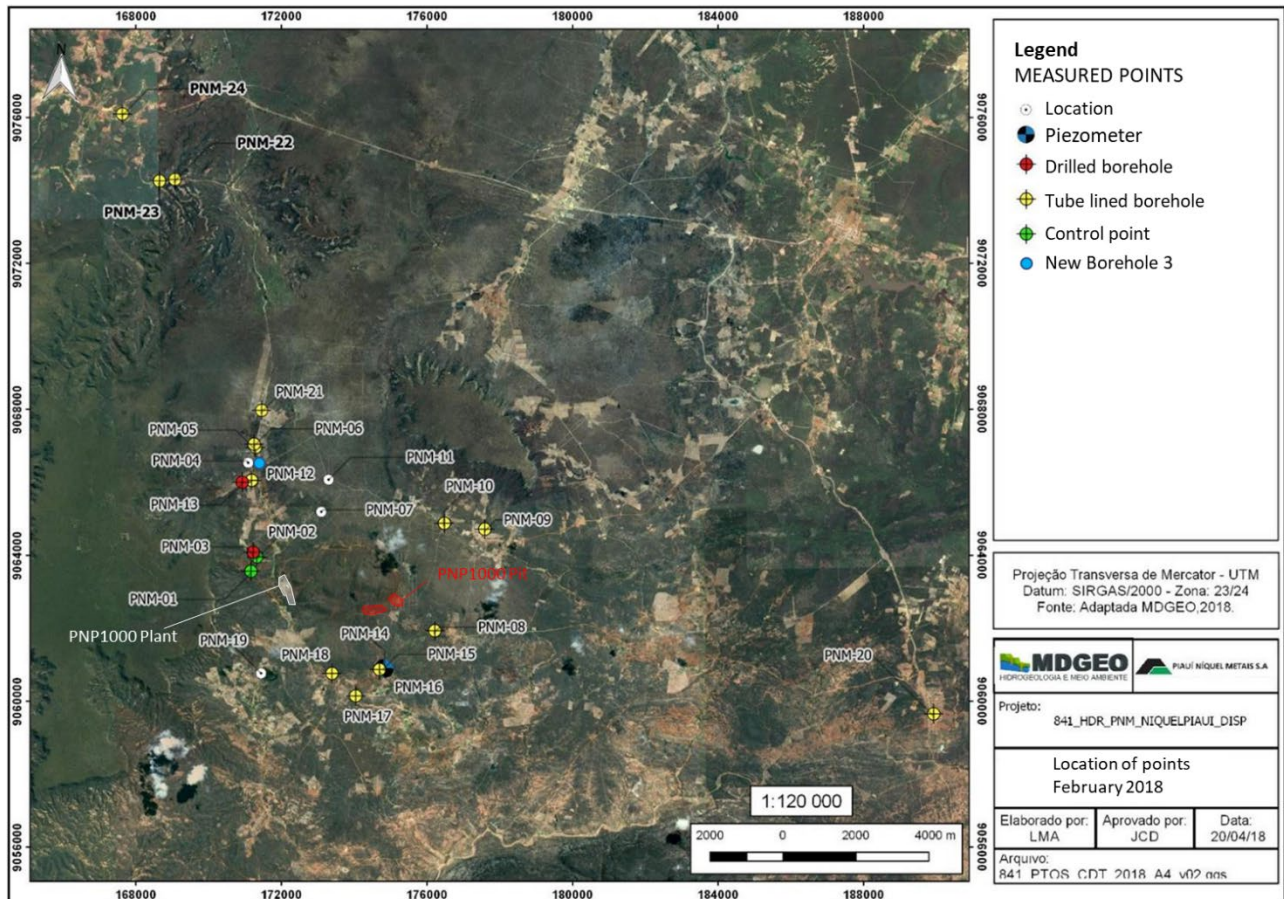


Table 7-2 Existing water borehole characteristics

| ID | Type | Depth | Flow m ³ /h | Field info |
|--------|---------------|-------|------------------------|--|
| PNM-01 | Control Point | - | - | Ridge start, schists |
| PNM-02 | Control Point | - | - | Road, downhill from swamp. Evaluate potential. |
| PNM-03 | Dug well | - | - | Mr. Horacio's weir. Dug in schist. Water is not being used currently. No water available during dry season according to owner. |
| PNM-04 | Control point | - | - | Sandstones at the surface, may be near a fracture. |
| PNM-05 | Drilled well | 120.0 | - | Well at Varzea Settlement, drilled in 2003. Crystalline rocks. Currently not used (bad water quality). 8" PVC tube (protected) |
| PNM-06 | Drilled well | 84.0 | 4 | Varzea Settlement. well not functioning due to pump problems. 8" PVC tube |
| PNM-07 | Control point | - | - | Sandy soil |
| PNM-08 | Drilled well | 83.5 | - | |
| PNM-09 | Drilled well | 56.0 | 10 | Drilled by the National health foundation (FUNASA) |
| PNM-10 | Dug well | - | 5 | Flow informed, with 3,000l water tank |



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| ID | Type | Depth | Flow m ³ /h | Field info |
|------------|---------------|--------|---------------------------|--|
| PNM-11 | Control point | - | - | Sandy surface with no potential |
| PNM-12 | Drilled well | 125.0 | - | Vereda Settlement. 6" protected tube within schists. 10,000l water tank. Without energy to operate. |
| PNM-13 | Dug well | 20.0 | - | Over schists. 2 m3/h pump |
| PNM-14 | piezometer | 6.6 | - | Drilled in July 2008 by BVP. Ultramafic rock |
| PNM-15 | piezometer | - | - | Clogged up. Ultramafic rock. |
| PNM-16 | Drilled well | 64.0 | 1 | Owner Flaldeni. 8" PCV tube up to 6m, over ultramafic rock. Keeps flow for 19min and then turns off. Turns on again after 40min. |
| PNM-17 | Drilled well | 60.0 | 3 | 8" PCV tube up to 6m. Higher elevation terrain. Drilled in August 2017. over ultramafic rock. |
| PNM-18 | Drilled well | 80.0 | - | Well shut down. Over ultramafic rock. Drilled in 2016 |
| PNM-19 | Control point | - | - | Fractured region over ultramafic rocks. |
| PNM-20 | Drilled well | 180.0 | 20 | Well from Capitão Gervásio Oliveira municipality. Drilled in Jan.2018, water entrance at 70m. |
| PNM-21 | Drilled well | 80.0 | 10 | Water well at Carnaíba Settlement. 5,000l water tank. |
| PNM-22 | Drilled well | 80.0 | 1 | Chiqueirinho community. |
| PNM-23 | Drilled well | 70.0 | 1 | Chiqueirinho community. |
| PNM-24 | Drilled well | 150.0 | 15 | Eugênio Settlement. |
| NIP-PE-014 | Dug well | 10.37 | - | Vereda de Baixo Community |
| NIP-PT-015 | Drilled well | - | - | Barra do Fraça. Crystalline rock. |
| NIP-PT-016 | Drilled well | 95.00 | - | Morro Branco. Crystalline rock |
| NIP-PT-017 | Drilled well | 120.00 | 5 | Vereda Settlement. Sandstones. |
| NIP-PT-076 | Drilled well | 100.00 | 2.8 | Demo Plant. Crystalline rock |
| NIP-PT-077 | Drilled well | 100.00 | 2.9 | Demo Plant. Crystalline rock |

As part of the infrastructure upgrades for the PNP1000, the water storage tank will have a new level control system installed that will activate the groundwater pumps only when water is required, and therefore maintain a safe operating level inside the tank, and regulate the pumping regime.

Water for mining activities and road maintenance/dust control will be supplied by tankers that will be filled at the water storage tank located in the PNP1000 processing plant.

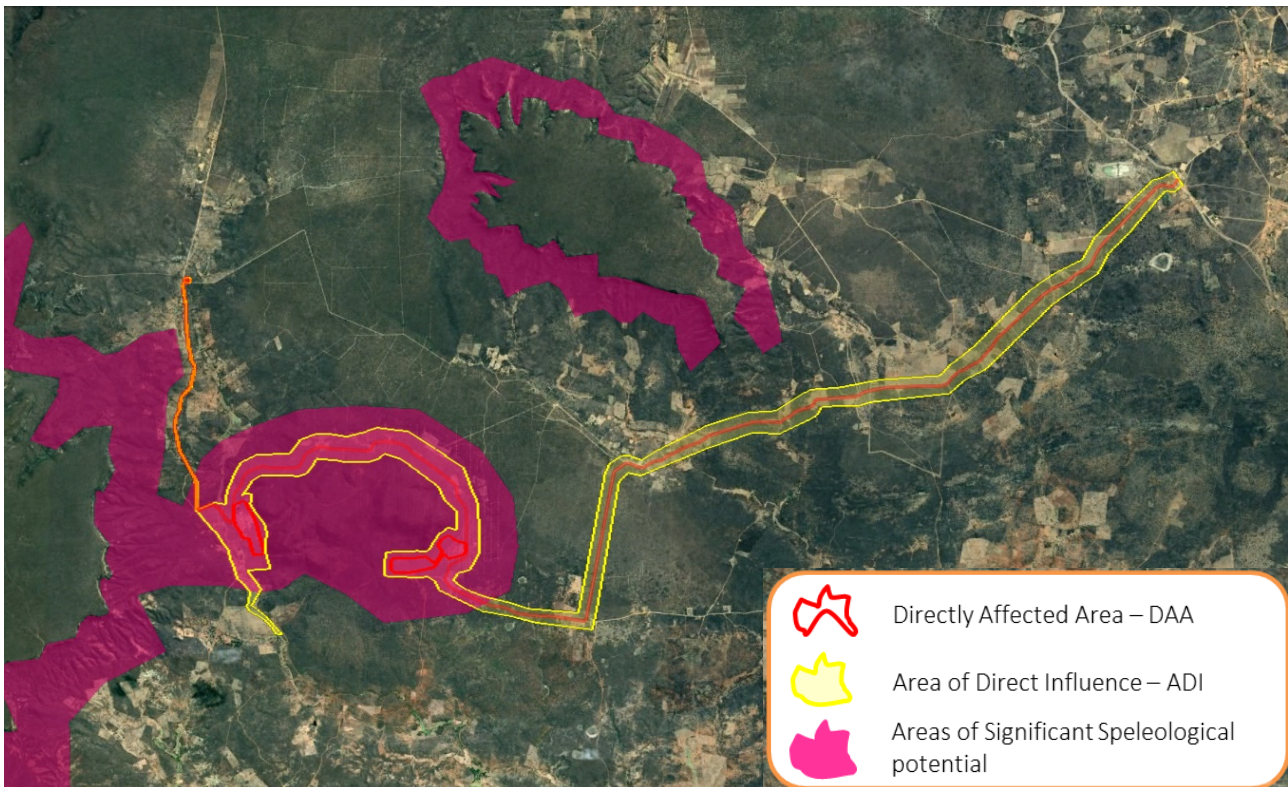
7.1.7 NATURAL CAVITIES/CAVES

Baseline studies during the ESIA were undertaken to assess the presence of cavities and caves in the area, and whether the implementation of the full-scale operation could cause interference with natural underground cavities (caves and small shelters). The first stage of this comprised extensive baseline and field work, covering all areas of the full-scale project (thus also the PNP1000 Project footprint), including a search distance of 250 m from the boundary of the planned elements (*buffer area*), to confirm and define the areas potentially containing caves that could be affected by the project (Target Areas).

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The second stage of the studies comprised a focused, denser field search (prospecting), in defined target areas. This included the entire Brejo Seco hill, which encompasses the proposed PNP1000 mining area. The nature of the geology is such that natural caves will not form, and cavities would only have the potential to form where there were rocky outcrops. The survey found no cavities in that area, and thus it is concluded that PNP1000 will not impact any natural cavities during its construction or operation.

Figure 7-13 Natural Cavities in the ADI



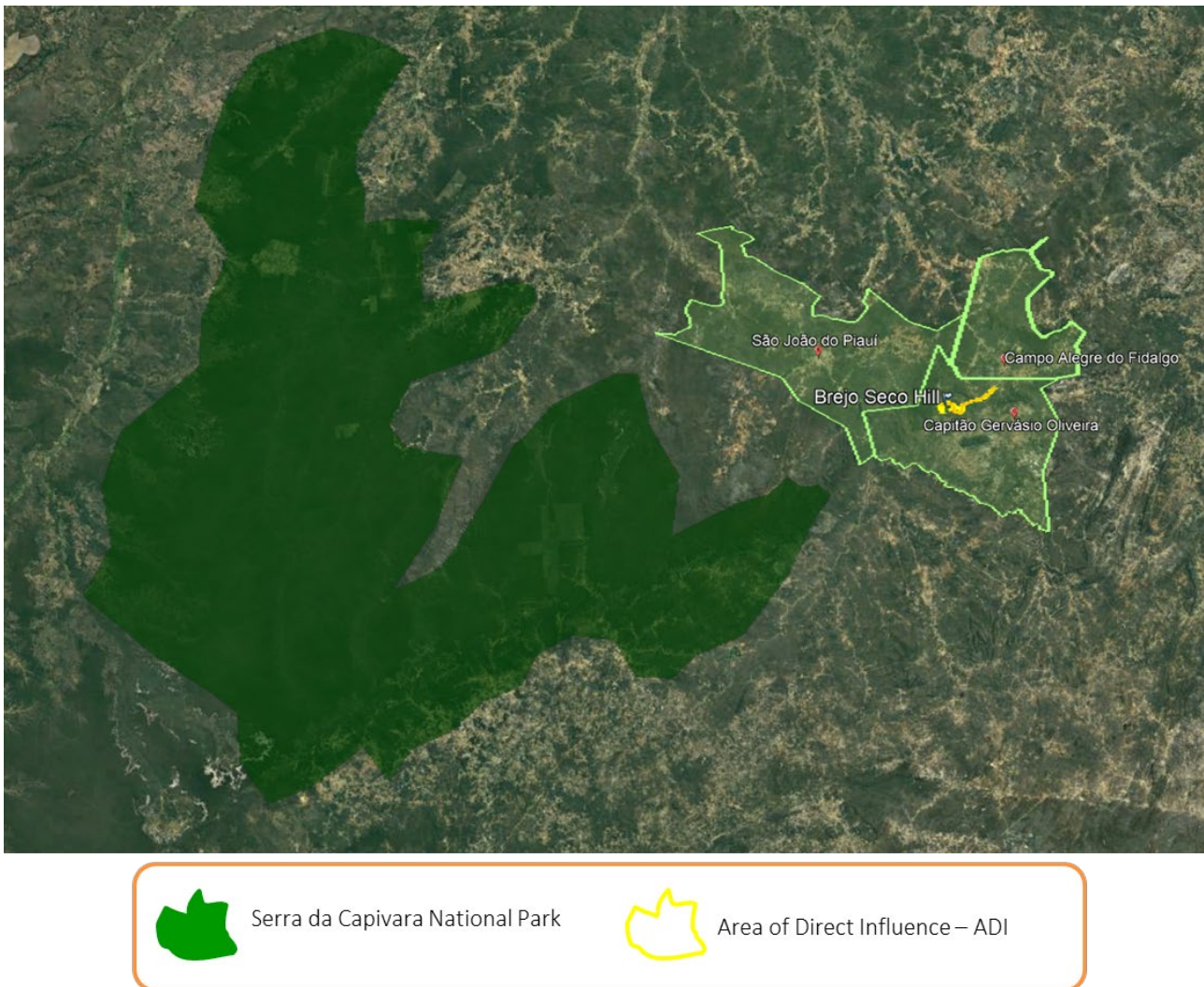
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7.2 BIOTIC ENVIRONMENT

7.2.1 CONSERVATION UNITS

Conservation Units (CU's) are areas protected by law with characteristics and natural resources considered to be very important. The PNP1000 is located outside and distant from any Conservation Unit. The closest CU to the Project is the Serra da Capivara National Park located approximately 41 km away from the PNP1000 nickel mine and plant, and within a different water catchment. Therefore, the PNP1000 will not cause interference with or impact on any CU's.

Figure 7-14 Closest Existing Conservation Unit to the Project Layout (DAA)



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7.2.2 FLORA

The natural vegetation present in the Project area is fully contained in the Northeastern *Caatinga* domain, which can be considered as an area of thorn forests that covers an approximate area of 845,000 km² in north-eastern Brazil (IBGE). This vegetation is considered to be, whilst in large part degraded, classified as natural habitat as per IFC PS6, and PNM's biodiversity management plans take account of this classification as well as the baseline findings.

This domain has extreme conditions, with a high exposure to sunlight and high temperatures, low relative humidity and little rain (which, as mentioned previously, occurs in a short period of the year, between December and March). These characteristics have a significant influence on the animal and plant life of this biome.

Land use and vegetation mapping with satellite imaging and field surveys (done for PNP Full scale ADI) shows that the PNP1000 Project's ADI is covered mainly by *Caatinga* vegetation (some 20,500 ha). Three types of *Caatinga* were recorded during the baseline surveys;

- Dense** Arboreal-shrubbery *Caatinga*;
- Open** Arboreal-shrubbery *Caatinga*, and
- Sparse** Arboreal-shrubbery *Caatinga*.

The total area of *Caatinga* vegetation approved for clearance by the environmental authority (SEMAR) as part of the PNP1000 implementation is up to 31 hectares. Under Brazilian legislation, areas surrounding water courses, water springs, steep slopes that are legally protected are classified as Permanent Preservation Areas (or APPs), no APPs will be affected by PNP1000 implementation.

A biodiversity assessment was undertaken for the full-scale project ADI (i.e. including the PNP1000 ADI), and this identified 226 plant species classified in 49 botanical families, including trees, shrubs, herbs, vines, and aquatic plants. Only one of the species, the "ipê-cascudo" - *Handroanthus spongiosus* is considered threatened (categorized as "In Danger") according to the official Brazilian lists of threatened species.

Currently, there is high degradation of the existing native (i.e. *Caatinga*) vegetation caused by livestock herds roaming freely in the region (including through the PNP1000 ADI), especially the goats that selectively consume the seedlings of many native species, altering the natural regeneration processes of the local vegetation.


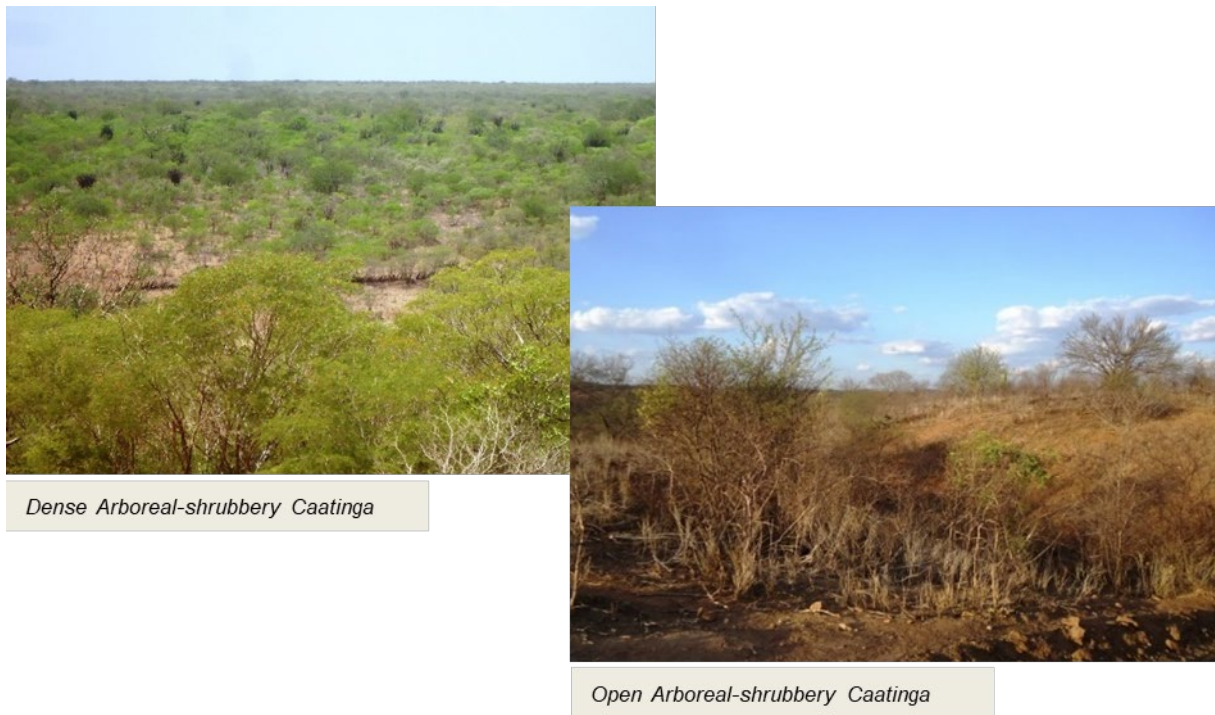
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Figure 7-15 Typical Vegetation in the Project Area

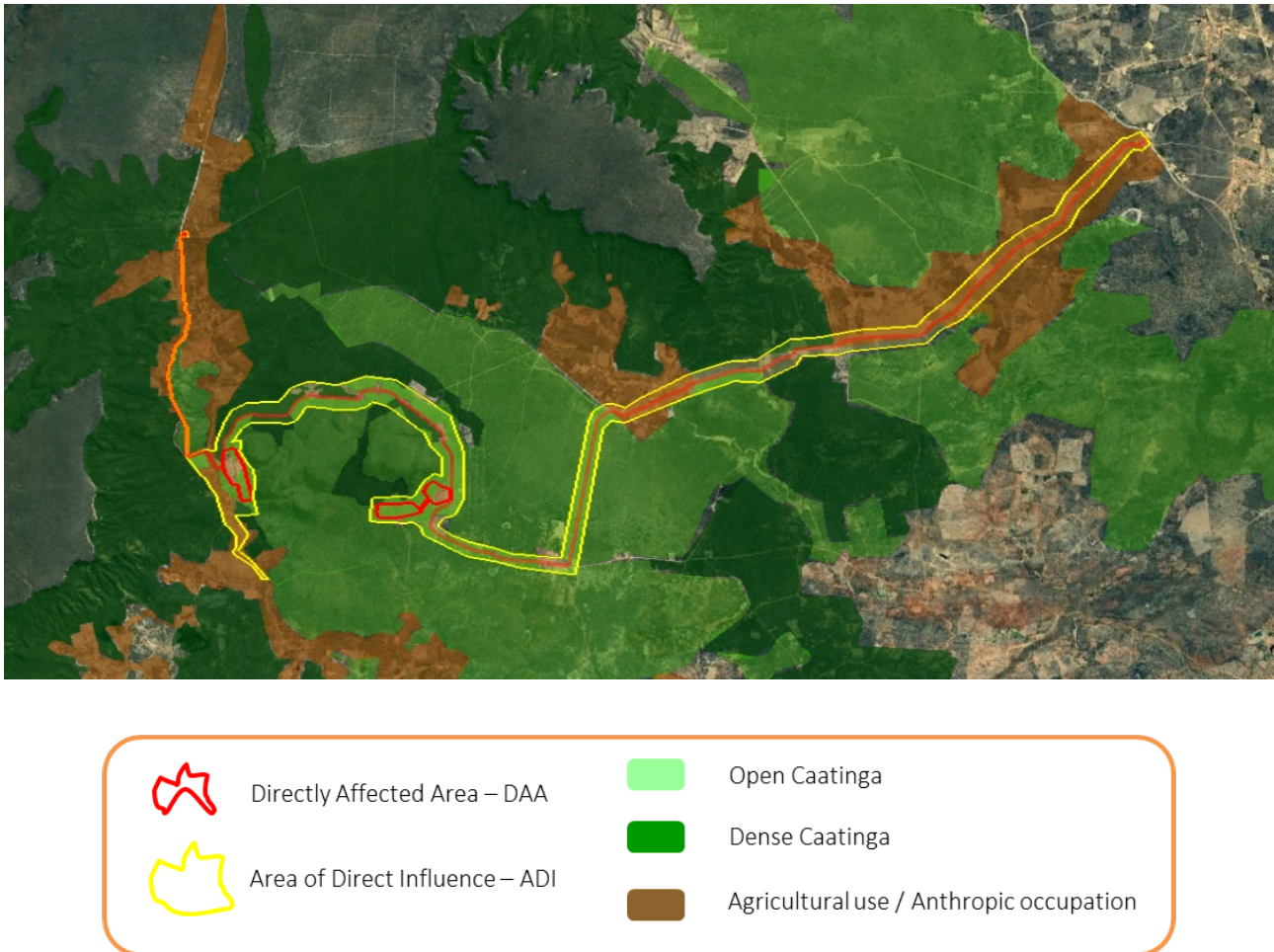


The expansion of the Demonstration Plant site, mining area and other infrastructure, will require the clearance of Caatinga. Based on the classifications of the Caatinga in the full-scale ESIA, the PNP1000 areas are classified as follows:

Table 7-3 Summary of land type by vegetation type

| Project Area | Estimated Area by type of Caatinga (hectares) | | | Exposed Soil / In Use | Total (ha) |
|-------------------------------|---|-------------|--------|-----------------------|-------------|
| | Dense | Open | Sparse | | |
| Open pit | -- | 4.8 | -- | 3.2 | 8.0 |
| Low-grade ore stockpile | -- | 3.0 | -- | -- | 3.0 |
| Mine Overburden | -- | 6.0 | -- | -- | 6.0 |
| Access Roads & Facilities | -- | 2.5 | -- | 0.5 | 3.0 |
| Leach Pad, ponds & Roads | -- | 6.0 | -- | -- | 6.0 |
| Processing Plant & Facilities | -- | -- | -- | 4.8 | 4.8 |
| Residue Disposal Facility | -- | 1.2 | -- | 1.0 | 2.2 |
| Plant Overburden | -- | 2.0 | -- | -- | 2.0 |
| Totals | -- | 25.5 | -- | 9.5 | 35.0 |

Figure 7-16 Vegetation Mapping in the ADI




7.2.3 FAUNA

7.2.3.1 TERRESTRIAL MAMMALS

The baseline surveys for terrestrial mammals assessed the presence of 21 mammal species (see Table 7-4 Mammal species registry below).

Table 7-4 Mammal species registry

| Order | Family | Taxon | Popular Name | Size | Method | Threat category | | |
|-----------------|-------------|------------------------------|--------------|------|--------|-----------------|---------------|-------------|
| | | | | | | Federal | International | |
| | | | | | | MMA nº 444/2014 | IUCN, 2016 | CITES, 2016 |
| Didelphimorphia | Didelphidae | <i>Didelphis albiventris</i> | gambá | S | I | - | LC | - |
| | | <i>Gracilinanus agilis</i> | guíca | S | P | - | LC | - |



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| Order | Family | Taxon | Popular Name | Size | Method | Threat category | | |
|-----------|-----------------|-------------------------------|------------------|------|---------------|-----------------|---------------|-------------|
| | | | | | | Federal | International | |
| | | | | | | MMA nº 444/2014 | IUCN, 2016 | CITES, 2016 |
| Rodentia | Echimyidae | <i>Thrichomys apereoides</i> | rabudo | S | AR | - | LC | - |
| Cingulata | Dasypodidae | <i>Dasyus novemcinctus</i> | tatu galinha | M | I | - | LC | - |
| | | <i>Dasyus septemcinctus</i> | tatuí | M | I, AF, AR | - | LC | - |
| | | <i>Euphractus sexcinctus</i> | tatu peba | M | I, IR, AF, AD | - | LC | - |
| | | <i>Tolypeutes tricinctus</i> | tatu-bola | M | I | EN | VU | - |
| Pilosa | Myrmecophagidae | <i>Tamandua tetradactyla</i> | tamanduá mirim | M | I | - | LC | - |
| Primates | Callithrichidae | <i>Callithrix jacchus</i> | sagüi | M | I | - | LC | - |
| Carnívora | Canidae | <i>Cerdocyon thous</i> | cachorro do mato | M | I, AF, AD | - | LC | II |
| | Felidae | <i>Puma yagouaroundi</i> | jaguarundi | M | I | - | LC | II |
| | | <i>Leopardus tigrinus</i> | gato do mato | M | I | - | VU | I |
| | | <i>Leopardus wiedii</i> | gato maracajá | M | I | VU | NT | I |
| | | <i>Puma concolor</i> | suçuarana | L | I | VU | LC | I |
| | Mustelidae | <i>Conepatus semistriatus</i> | cangambá | M | I | - | LC | - |
| | | <i>Eira barbara</i> | irara | M | I | - | LC | - |
| | | <i>Galictis</i> sp. | furão | M | I | - | - | - |
| | Procyonidae | <i>Procyon cancrivorus</i> | guaxinim | M | I | - | LC | - |
| Rodentia | Caviidae | <i>Kerodon rupestris</i> | mocó | M | I, IR, AD | VU | LC | - |
| | | <i>Galea spixii</i> | preá | M | I | - | LC | - |
| | Dasyproctidae | <i>Dasyprocta prymnolopha</i> | cutia | M | I, AF, AD | - | LC | - |

Preparation: Arcadis, 2017 from primary data for the full-scale Directly Affected Area (DAA), Area of Direct Influence (ADI) and Indirect Influence (AII), with respective sampling methods and respective threat categories (see notes below)

Methods: Interview (I); Living containment trap (AR); Camera Trap (AF); Indirect Register (IR); Direct sighting (AD).

Threat Categories: Least Concern (LC); Near Threatened (NT); Vulnerable (VU); Endangered (EN); and Critically Endangered (CR). CITES: Appendix I - Lists the most endangered species. International trade is prohibited; Appendix II - Lists species at risk of becoming threatened with extinction if international trade is not controlled; and Appendix III - Lists species with partially regulated international trade, but which needs the cooperation of countries to avoid overexploitation.

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In general, the registered species have generalist habits, of low environmental demand and with great resistance to anthropic pressures, such as extensive cattle breeding and hunting.

Based on field observations and interviews with residents, it is believed that the low number of species and records in the field survey is mainly related to local environmental variables and the characteristics of the region's mammal fauna, which are present at low abundance because of human pressure.

Among all species of terrestrial mammals registered to have been proven to occur during field surveys at the full scale project's ADI, two are worth further consideration.

The “tatu-bola” or three-banded armadillo (*Tolypeutes tricinctus*) is considered as endangered by the Brazilian Federal authorities (vulnerable according to IUCN). Its presence in the full-scale project’s areas was from an interview with a local inhabitant but was not confirmed by traps or direct observation, and therefore its presence is considered to be questionable, however, PNM are taking the conservative approach and assuming it may be present.

The “mocó” or Rock cavy (*Kerodon rupestris*) is considered threatened with extinction (as “vulnerable”) according to the official list (Portaria MMA 444/14), in addition to being endemic and rare in the Caatinga. The IUCN conservation status for this species is of ‘Least Concern’.

The full-scale biodiversity studies concluded that the full scale PNP project will not affect the survival of any species of terrestrial mammal in the region, and the impacts of the lower intensity activities of the PNP1000, would therefore be anticipated to have an even lesser impact. Nevertheless, and in particular with regard to the tau-bola/three banded armadillo, the project team will carefully monitor for evidence of any endangered or vulnerable species and implement the specific policies described in sections 8.7 and 9.10.2 below.

Figure 7-17 Wood fox individual (*Cerdocyon thous*) photographed by the camera trap





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Figure 7-18 Photographic record of an agouti individual (*Dasyprocta prymnolopha*) in a caatinga area.



Figure 7-19 Goats registered by the camera trap



7.2.3.2 BATS

The baseline survey of bat species utilized data from previous studies (Golder Associates, 2005) and the field campaign conducted in 2008, with the combined results compiled for the full-scale project ESIA.

The field survey identified six bat species, indicating a low species diversity which is to be expected for the region based on the complementary studies done in the project area in 2005 (Golder Associates). No species threatened with extinction according to official lists were identified.


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Table 7-5 Bat species registry

| Order | Family | Taxon | Method | Threat category | | |
|------------|----------------|--------------------------------|--------|-----------------|---------------|-------------|
| | | | | Federal | International | |
| | | | | MMA nº 444/2014 | IUCN, 2016 | CITES, 2016 |
| Chiroptera | Emballonuridae | <i>Peropteryx macrotis</i> | BA | - | LC | - |
| | Mormoopidae | <i>Pteronotus parnelli</i> | MN | - | LC | - |
| | Phyllostomidae | <i>Artibeus planirostris</i> | MN | - | LC | - |
| | | <i>Trachops cirrhosus</i> | BA | - | LC | - |
| | | <i>Micronycteris sanborni</i> | MN | - | DD | - |
| | | <i>Micronycteris megalotis</i> | BA | - | LC | - |

Preparation: Arcadis, 2017 recorded using primary data for the full-scale Directly Affected Area (DAA), Area of Direct Influence (ADI) and Indirect Influence (AII), with respective sampling methods and respective threat categories.

Methods: Active search for shelter (BA); mist net (MN).

Threat categories: Least Concern (LC); deficient data (DD). CITES: Appendix I - Lists the most endangered species. International trade is prohibited; Appendix II - Lists species at risk of becoming threatened with extinction if international trade is not controlled; and Appendix III - Lists species with partially regulated international trade, but which needs the cooperation of countries to avoid overexploitation

The species identified are characterized as having wide range of eating habits, and some of which are characteristic of environments with rocky outcrops.

The baseline studies (combined with the lack of caves in the area), concluded that the full-scale project will not affect the survival of any species of bat in the region and this same conclusion applies to the much more limited PNP1000 footprint.

Figure 7-20 Shelter in a rock crevice used by the species *Peropteryx macrotis* in the project's ADI.





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Figure 7-21 Individual of the species *Pteronotus parnellii* captured in a mist net



Figure 7-22 Individual of the species *Micronycteris megalotis* captured in an abandoned house near the Jenipapo Dam



7.2.3.3 BIRDS

The field surveys carried out for the full-scale ESIA identified the presence of 107 bird species in the project region. The species composition is characteristic of the types of local environment, and 11 of the species (i.e. 10% of the species identified in the full scale project area) are considered endemic to the Caatinga (i.e. they only occur in this type of vegetation).

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Table 7-6 Avifauna endemic to the Caatinga

| Taxon | Popular Name | Sensitivity to anthropogenic change | | Threat category | | |
|----------------------------------|-----------------------|-------------------------------------|--------|-----------------|---------------|-------------|
| | | Low | Medium | Federal | International | |
| | | | | MMA nº 444/2014 | IUCN, 2016 | CITES, 2016 |
| <i>Eupsittula cactorum</i> | periquito-da-caatinga | | X | - | LC | - |
| <i>Picumnus pygmaeus</i> | pica-pau-anão-pintado | | X | - | LC | - |
| <i>Sakesphorus cristatus</i> | choca-do-nordeste | | X | - | LC | - |
| <i>Hylopezus ochroleucus</i> | torom-do-nordeste | | X | - | NT | - |
| <i>Gyalophylax hellmayri</i> | joão-chique-chique | | X | - | NT | - |
| <i>Pseudoseisura cristata</i> | casaca-de-couro | | X | - | LC | - |
| <i>Cyanocorax cyanopogon</i> | gralha-cancã | | X | - | LC | - |
| <i>Sporophila albogularis</i> | golinho | | X | - | LC | - |
| <i>Paroaria dominicana</i> | cardeal-do-nordeste | X | | - | LC | - |
| <i>Icterus jamacaii</i> | corrupião | X | | - | LC | - |
| <i>Agelaioides fringillarius</i> | asa-de-telha-pálido | X | | - | - | - |

Preparation: Arcadis, 2017.

Threat Categories: Threat Categories: Least Concern (LC); Near Threatened (NT); Vulnerable (VU); Endangered; and Critically Endangered (CR). CITES: Appendix I - Lists the most endangered species. International trade is prohibited; Appendix II - Lists species at risk of becoming threatened with extinction if international trade is not controlled; and Appendix III - Lists species with partially regulated international trade, but which needs the cooperation of countries to avoid overexploitation

None of the species found is considered threatened with extinction according to official lists, and none are considered threatened by the full-scale project or therefore the PNP1000.



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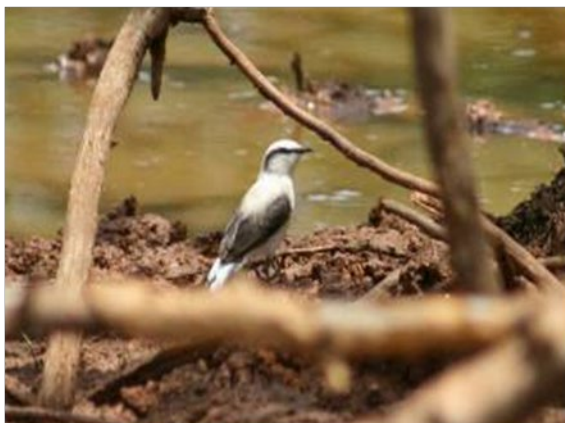
Figure 7-23 Birds found in the Project ADI



Cliff flycatcher (Hirundinea ferruginea).



Researcher in observation activity.



Masked water tyrant (Fluvicola nengeta).





Masked water tyrant nest (Fluvicola nengeta).

7.2.3.4 AQUATIC COMMUNITIES

Aquatic communities (algae, microorganisms, bacteria, and insects) are very important in the functioning processes of rivers, lakes, dams and wetlands. The nature of and location of the PNP1000 Project means that it has no direct impact on aquatic communities, other than through the management of run-off during the wet season.

The streams in the PNP1000 area, like many in the region, are ephemeral with their bed exposed (without water) for several months during the year. This ephemeral nature of the stream results in radical and periodic changes in the composition and quantity of both plants and animals that inhabit this ecosystem.

With the arrival of the rains there is an accumulation of organic matter (including a significant volume of faeces from domestic animals) and solids (soil from erosive processes) in the bed of the small streams, which then flow to the larger rivers. As a consequence the permanent rivers and also those regulated by dams become recipients of this polluting load, as is the case for the Jenipapo dam, some 40 km downstream of the PNP1000 location.

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This pollutant load can lead to the growth of cyanobacteria which can produce toxins that pose a risk to human and animal health. In the study area, the Jenipapo dam has been identified as having considerably high densities of the cyanobacterium *Cylindrospermopsis raciborskii*.

Figure 7-24 Várzea stream, sampling point 05, 3rd field campaign, full-scale ESIA.



7.2.3.5 FISH

During field surveys carried out in the full-scale project's ADI, 46 species of fish were recorded. The fish species identified have a generalist habit with low diversity and the proportion between the different taxonomic groups does not differ from the expected pattern for the region. It is also noted that the Jenipapo dam is not fitted with any fish transposition mechanisms (e.g. a fish ladder), and this may be linked to an impoverishment in the diversity of fish upstream of the dam (including the Project area).

The areas ephemeral rivers are recolonized each rainy season by fish that survive in the remaining water (puddles, ponds, or muds), and by fish from perennial sections of the rivers which are spring fed or downstream (possibly in the headwaters of the Jenipapo dam). None of the registered species is considered to be threatened with extinction according to official lists.



Figure 7-25 Examples of Surface Water sampled in the full-scale ADI



Reservoir arm of Jenipapo (São João do Piauí)



Sampling site 6, view of the spillway of the Jenipapo Dam, Piauí river.

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7.2.3.6 REPTILES & AMPHIBIANS

During the field survey carried out for the full-scale project, 14 species of amphibians and 19 species of reptiles (twelve lizards, six snakes and one turtle) were recorded.

None of the registered amphibian and reptile species appears on the lists of endangered species, however species that were considered rare or of restricted distribution were detected, such as the Caatinga horned frog (*Ceratophrys joazeirensis* - classed as data deficient by IUCN) and the lizards *Procellosaurinus erythrocerus* (classed as of least concern by IUCN).

The baseline study concluded that the full-scale project will not affect the survival of any species of reptile or amphibian in the region and this was therefore also concluded to be the case for the PNP1000.

Figure 7-26 Examples of Reptiles & Amphibians found in the full-scale ADI



Ceratophrys joazeirensis



Procellosaurinus erythrocerus

7.2.3.7 INSECTS

The insects survey for the full-scale covered only the main groups considered as vectors of diseases of interest to public health, that are, mosquitoes and bedbugs from the group of so-called kissing bugs.

During that study, collection efforts were concentrated in the vicinity of the nickel mine area. In addition to these points, other collections were carried out near the roads and access roads, and in the municipality of Capitão Gervásio Oliveira. Of these, only the nickel mine area is relevant for the PNP1000.



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Figure 7-27 *Collection of immature mosquitoes in a small dam with entomological shell.*



Figure 7-28 *Sampling of immature mosquitoes made at the breeding site*



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7.3 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

7.3.1 REGIONAL HISTORY

The municipalities considered as within the Area of Direct Influence of the full-scale project are the same for the PNP1000, except for Dom Inocêncio which is not part of the PNP1000's ADI or All.


The city of São João do Piauí had its origin in the 17th century as one of the cattle farms, donated by Domingos Afonso Mafrense, to the Jesuits based in Bahia, called Malhada do Jatobá, in 1711 (IBGE Cidades). In the 19th century (1871/72). São João became an emancipated and separate municipality from São Raimundo Nonato, becoming head of the district in 1874 and, finally, receiving the title of city in 1906.

With an economy based on livestock activity at its origin, agriculture and extraction in the last two centuries, the municipality has been inhabited, since its colonial origins, mainly by Bahian and Pernambuco families (Sesmaria supporters, tenants and squatters) and, more recently, by countless families from Ceará forced to migrate due to drought.

The municipalities Campo Alegre do Fidalgo and Capitão Gervásio Oliveira are more recent and were created from the division of São João do Piauí, and have the same development history as the original city.

Figure 7-29 Local Municipalities of the Project's ADI



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7.3.2 POPULATION

The municipalities in the project's Area of Direct Influence (ADI) are characterized by low population levels, with the municipality of São João do Piauí being the most populous.

Table 7-7 Total, Urban and Rural Population, Territorial Area and Demographic Density of the municipalities of the ADI and Piauí State.

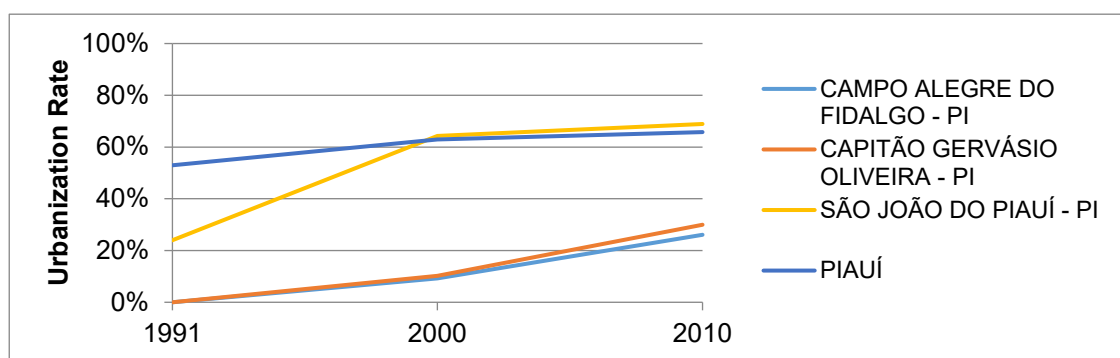
| Municipality | Territorial extension (km ²) | Total Population | | Urban Population | Rural Population | Demographic Density (People/ km ²) | |
|---------------------------|--|-------------------------|-----------|------------------|------------------|--|-------|
| | | 2016 | 2010 | 2010 | 2010 | 2016 | 2010 |
| | | Campo Alegre do Fidalgo | 658 | 4,935 | 4,693 | 1,224 | 3,469 |
| Capitão Gervásio Oliveira | 1,134 | 4,021 | 3,878 | 1,162 | 2,716 | 3.5 | 3.4 |
| São João do Piauí | 1,528 | 20,206 | 19,548 | 13,470 | 6,078 | 13.2 | 12.8 |
| Piauí State | 251,612 | 3,212,180 | 3,118,360 | 2,051,074 | 1,067,286 | 12.8 | 12.4 |

Source: Brazilian National Institute of Statistics (IBGE), 2010 e 2016. Prepared by: Arcadis, 2016.

Except for São João do Piauí, which has just under 70% of its population being urban, ADI municipalities had urbanization rates well below the average for the state of Piauí.

In 2010, the average urbanization rate for the state of Piauí was 65.8%, while the urbanization rate of ADI municipalities varied between 20 and 30% of the population.


Figure 7-30 Evolution of the Urbanization Rate of the Municipalities of ADI and Piauí State from 1991 to 2010



Source: Brazilian National Institute of Statistics (IBGE), 2010 e 2016. Prepared by: Arcadis, 2016.

As for the population composition of the ADI, there is a predominance of younger people, with most people between 5 and 19 years of age (IBGE, 2010). Although it has a relatively young population, evaluating the variation between the years 2000 and 2010, the municipalities of the ADI and the state of Piauí showed a very similar evolution, with a growing trend towards a more elderly population.

Regarding the division by sex the smaller municipalities of Campo Alegre do Fidalgo and Capitão Gervásio Oliveira present a slight predominance of the males up to 70 years old, whereas for older than 70 the

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situation is reversed with female being in the majority in these municipalities. In São João do Piauí and in the state of Piauí the situation is different, with the female population being the majority in almost all age groups (IBGE, 2010).

The PNP1000 will overlay only 3 rural properties that are currently used for seasonal livestock grazing (cattle and goats) and are covered by degraded Caatinga. The properties owners concerned do not live on the land parcels and have already settled amicable rental agreements with the company for its use. As presented in the PNP full scale ESIA Volume II section 5.3.6.2, the families of the surrounding communities have low socio-economic conditions since, according to the interviewed residents, a large part of them depend on resources from pensions or the federal government; the “*Bolsa Família*” income assistance program, with few exceptions. The settlements, that are close to PNP1000 (Veredas and Várzea) were formed by families that organized themselves through associations to enroll in the Program to Combat Rural Poverty (PCPR) of the state, and thus have acquired the land through collective financing from the so called “Land Bank”. The houses of the families of the settlements are arranged in village-type clusters, as closely spaced houses, with little land around each dwelling, and were built using federal government housing programs.

In the area immediate to the PNP1000 DAA, the table below describes the salient characteristics of the projects nearest neighbors.

Table 7-8 Characteristics of settlements in the close vicinity of the PNP1000

| Community | Nº of families (approx.) | Infrastructure and Public Services |
|-------------------|--------------------------|--|
| Varzea settlement | 16 | Settlement linked to the Federal Land Associations (Banco de Terras), total area of 546 hectares divided into 16 small properties. Access to water: houses have piped water captured in wells, suitable for human consumption including. Education: There is a school, but inactive. Students go to the Cacimba da Areia school with transport provided by the Municipality. High school is provided in Capitão Gervásio Oliveira. Health: There is no local service. The inhabitants use the basic health unit at the Cacimba da Areia community, available once a week, or they seek medical care directly at in Capitão Gervásio Oliveira or São João do Piauí facilities. There is no Family Health Programme available. |

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| Community | Nº of families (approx.) | Infrastructure and Public Services |
|--------------------|--------------------------|---|
| Veredas settlement | 18 | <p>Settlement linked to the Federal Land Associations (Banco de Terras),</p> <p>Access to water: houses have piped water captured in wells, which is suitable for human consumption.</p> <p>Education: There is no school. Students go to Cacimba da Areia school with transport provided by the Municipality. High school is provided in Capitão Gervásio Oliveira.</p> <p>Health: There is no local service. Use is made of the basic health service unit at the Cacimba da Areia community, available once a week, or they seek medical care directly in Capitão Gervásio Oliveira or São João do Piauí. There is no Family Health Programme available.</p> <p>Culture: a religious celebration is held on the festival of Saint Antony, between June 01 and 03.</p> |
| Veredas Community | 50 | <p>Some residences have lower quality construction standard.</p> <p>Access to water: local water trucks service only.</p> <p>Education: No school available. Students go to school in Capitão Gervásio Oliveira with transport provided the by municipality.</p> <p>Health: There is no local service. Inhabitants source medical care directly in Capitão Gervásio Oliveira. There is no Family Health Programme available..</p> |

No direct impacts by the PNP1000 on these communities in terms of impacts to water availability or grazing lands is anticipated considering the very small footprint of PNP1000 which is limited to the areas surrounding the Brejo Seco hill and does not overlay these communities. They will though be potentially impacted by the anticipated increase in vehicle movement/traffic over the municipal unpaved roads and through the passage of a small water pipeline from the new borehole to pump groundwater to the project.



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Figure 7-31 Road between PNM's Camp and Demonstration Plant




PNM has invested in improvement in traffic safety along the road between PNM's Camp and the Demonstration Plant for the surrounding communities. This has included the installation of speed limits and signs along the road and four speed bumps close to the communities of Vereda, Veredão Lagoa Funda and Salãozinho, all of these investments were authorized in advance by the municipality of Capitão Gervásio Oliveira.

Figure 7-32 Road close to the communities of Vereda, Veredão and Salãozinho.



As presented in the PNP full scale ESIA Volume II section 5.3.5.7, a survey of indigenous and traditional communities (such as *quilombolas*) was performed in accordance to current regulations, and it was

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confirmed that the project does not overlay nor is it near any indigenous or traditional communities. Therefore the Project also does not trigger PS7 of the IFC Performance Standards.

7.3.3 REGIONAL CONTEXT

The PNP1000 is located in the territory of Capitão Gervásio Oliveira, in the south-eastern portion of the state of Piauí close to the border with the states of Pernambuco and Bahia.

According to the territorial organization officially adopted by the government of the State of Piauí, the municipalities in the project's Direct Area of Influence are part of the Serra da Capivara Development Territory.

7.3.4 LAND COVERAGE AND USE

The current land coverage use for the Direct Affected Area (DAA) of the PNP1000 is degraded Open Caatinga. There are no agricultural activities in areas where the project is going to implement its operations.

PNP1000 plant is based on the expansion of the existing Demonstration Plant and will use the existing unsealed access road. The additional areas required for the Project are covered by existing long-term land access agreements (Landowners 2, 4, 5, 6 and 7 in Table 7-9 below). The agreements required for the additional facilities, the mining area and the overburden stockpiles and the leach pad, were signed in 2018 (with Landowners 1 and 3); those agreements allow the industrial use of the land and account for all compensation according to the Brazilian Mining Code. These agreements were a prerequisite to the application for the deforestation permits and the deforestation permits were granted in July 2018 and remain valid. For the new water borehole and pipeline to be built, new rental and right-of-way agreements will be settled with the other 5 or 6 landowners (depending on the exact location).

The implementation of the PNP1000 project does not involve any community displacement, relocation, or compensation due to the absence of settlements in the directly affected area.

Table 7-9 shows additional details regarding the land that will be used to implement the PNP1000 project.

Table 7-9 PNP1000 Land Coverage and Use Assessment

| Project Area | Landowners / users | Property information and agreements | Communities or settlements to be displaced | Land coverage of the impacted area |
|------------------|--------------------|---|--|--|
| Mining Area | 1 | This property is 195 ha, PNM has signed a rental agreement for 100 ha and is planning to use 20 ha. Project use is 40% in relation to the contracted area and 10% in relation to the actual area to be used by the project. | None | Degraded Open Caatinga. |
| Processing Plant | 2 | This property is 200 ha and 25 ha are under contract for the Demonstration Plant and PNP1000 expansion area. No new agreements are required. | None | Downstream Processing Plant and buffer area. |
| | 3 | This property is 60 ha, PNM signed a rental agreement for 50 ha and is planning to use around 2 ha for storage of the vegetation removed from the leach pad and as a buffer | None | Degraded Open Caatinga. |



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| Project Area | Landowners / users | Property information and agreements | Communities or settlements to be displaced | Land coverage of the impacted area |
|---|--------------------|--|--|--|
| | | zone. PNP1000 use will be 83% in relation to the contracted area and 4% in relation with the actual area to be used by the project. | | |
| Road between Mining Area and Processing Plant | 4 | This property is 350 ha and 1 ha is currently under a right-of-way contract to allow the use of the road between the public road and the Demonstration Plant (the same that will be used for PNP1000). Use will be less than 0.6% being the area occupied by the road. This same agreement granted permission to develop a test pit during the Demonstration Plant stage. | None | Access road to the Demonstration Plant |
| | 5 and 7 | These properties are 51 ha and 0.7 ha are currently under a right-of-way contract to allow the use of the road between the public road and the Demonstration Plant (the same that will be used for PNP1000). Use will be less than 0.5% occupied by the road. | None | |
| | 6 | This property is 37 ha and 0.3 ha are currently under right-of-way contract to allow the use of the road between the public road and the demonstration plant (the same that will be used for PNP1000). Project use less than 0.2% for the road. | None | |



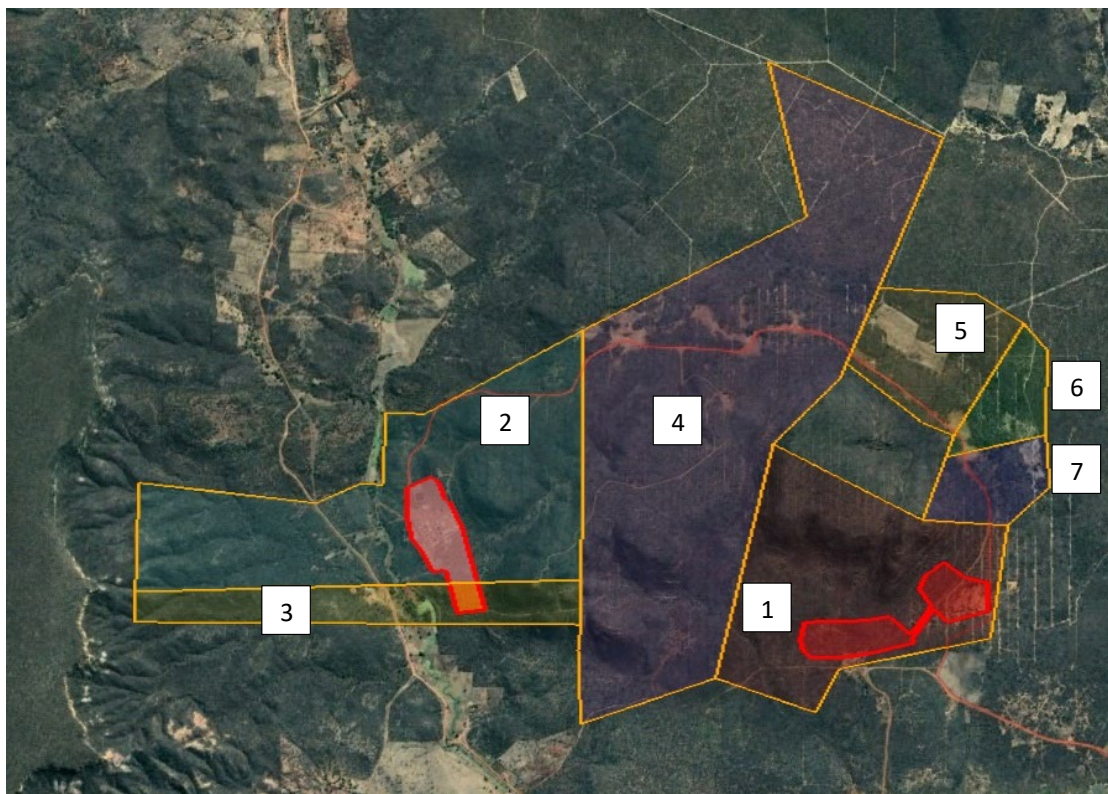
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Figure 7-33 PNP1000 Land use and land parcels



The PNP1000 DAA is shown in Red.



7.3.5 ECONOMY

According to the survey carried out by IBGE, in 2013 the GDPs (Gross Domestic Product) of the smaller municipalities of the ADI ranged from R\$ 27.7 million to R\$ 25.4 million for Campo Alegre do Fidalgo and Capitão Gervásio Oliveira respectively; and the larger São João do Piauí with a larger more thriving economy had a GDP of R\$ 172 million (representing 0.5% of the State's GDP).

There is a dependence of the public administration sector in the municipalities of Campo Alegre do Fidalgo and Capitão Gervásio Oliveira, with the sector contributing 70% to the Added Value (VA) of their economies, in 2013. By comparison in São João do Piauí although public administration is also the sector with the highest weight in the VA, it has less economic importance represented 46% of the total VA in 2013, practically the same weight as the service sector that contributed 45% of the VA.

7.3.5.1 PUBLIC FINANCES

The strength of public finances provides an indicator of the level of spending available to the municipalities. The municipality of São João do Piauí, due to its larger population and economic size, has the highest budget revenue among the municipalities of the ADI at R\$ 38.9 million. The other municipalities of the ADI are smaller, with revenues of R\$ 13.2 million in Campo Alegre do Fidalgo and R\$ 11.3 million in Capitão Gervásio Oliveira.

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Income from tax revenues by the municipalities as a proportion of their budgets is very low ranging from Campo Alegre do Fidalgo with 3.3% of its revenues coming from its own collection to 5.2% from São João do Piauí. Additional funds come from federal transfers such as the Municipality Participation Fund (MPF), whose final value for each municipality is mainly determined by its population size. This transfer represented the largest source of income for the municipalities of the ADI, being 29.3% in São João do Piauí, 43.2% in Campo Alegre do Fidalgo and 53.2% in Capitão Gervásio Oliveira.

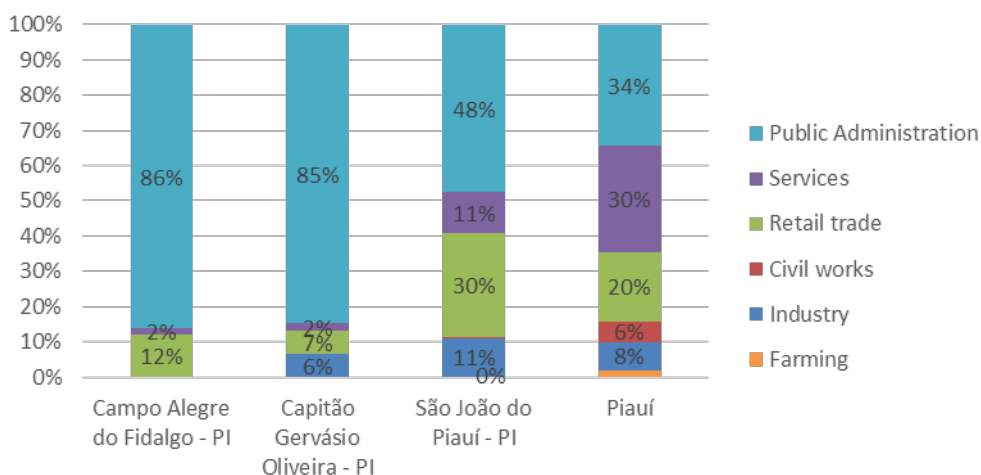
7.3.5.2 JOBS & INCOME

Within the employment market, formal employment relationships are those for workers hired according to the CLT (Brazilian Consolidation of Labor Laws), statutory workers, workers governed by temporary contracts, for a fixed term, and individual employees, when hired by unions (IBGE, 2010). In 2015 the formal job employment rate was 22% in Campo Alegre do Fidalgo, 18% in both Capitão Gervásio Oliveira and São João do Piauí, all well below the average 37% for the State of Piauí.

For the agricultural sector in the municipalities of the ADI, a complete degree of informality was observed in the working relations in the year 2015 (i.e. they were not counted as formally employed workers). No impact on agricultural activities are envisaged from the PNP1000 which will not be located on any agricultural lands.



The graph below shows the distribution of formal jobs in the ADI, in the major sectors of the economy.

Figure 7-34 Formal Employment by Major Sectors - Municipalities of the ADI and Piauí State- 2015.



Source: National Labor Department (MTE), 2016. Prepared by: Arcadis, 2016.

The average monthly income (wages) of formal workers in the municipalities of the ADI, in 2015, ranged between R\$ 1,453 (São João do Piauí) and R\$ 1,898 (Campo Alegre do Fidalgo). These average income values are below the average for the state of Piauí, which in 2015 was R\$ 1,952.

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7.3.6 EDUCATION

In the municipalities of the ADI there was a reduction in the illiteracy rate between 1991 and 2010 in all age groups, which followed the overall trend in the state of Piauí. The largest reduction in illiteracy rates was in the 15 to 17 age group, which had lowest illiteracy rate of all groups at just over 4%.

In 2010 in the municipalities of Campo Alegre do Fidalgo and Capitão Gervásio Oliveira, less than 30% of the population completed one of the formal education levels. In São João do Piauí this number was more than double (65%), although still slightly below the average for the state of Piauí, which was 67%. These education and literacy levels will be taken account of by PNM in its stakeholder engagement programs, to ensure all stakeholders and other affected parties are engaged and aware of their rights and duties.

The schools in the ADI municipalities provide three levels of basic education (pre-school, elementary and high school), so students from the municipalities do not need to travel to other areas in search of education at these levels. Education provision has been improving and between 2005 and 2015, according to data from IBGE, the ratio of students to each teacher was reduced in all the ADI municipalities (the one exception was pre-school education in Capitão Gervásio Oliveira where the ratio worsened).

School transportation is offered to students who live far from schools, even in rural areas of the municipalities. However, it was noted that students from more distant areas spend a lot of time commuting which ends up hampering the students' learning process.

The municipality of Campo Alegre do Fidalgo has technical education offered by the state government. As the municipality of São João do Piauí is classed as a local hub, it has a campus of the Federal Institute of Piauí which offers technical level courses.



Figure 7-35 IFPI campus at São João do Piauí



7.3.7 HEALTH

The municipalities of Campo Alegre do Fidalgo and Capitão Gervásio Oliveira, are considered to have a very weak health service which provides only primary care or emergency services (Ministry of Health, 2016). In these municipalities, all health equipment available to the population is public.

In São João do Piauí, the service network is broader, making it the center of first referral for municipalities in the region, including Campo Alegre do Fidalgo and Capitão Gervásio Oliveira. Facilities include a regional hospital, which is run by the state government, a maternity hospital, a dental service center, and two units

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of the Mobile Emergency Service - SAMU. In addition there are also some private initiatives (doctor's offices, diagnostic unit and specialized clinic).

Overall while there is an adequate level of overall health service (as per Ministry of Health recommendations 2012) with a family health UBS (first aid medical center) for up to 12,000 inhabitants in urban centers. Some aspects are weak and the recommendation to have one doctor for every 1,000 inhabitants, is not met and in Campo Alegre do Fidalgo there is only one doctor to serve the entire population.

One of the main strategies for preventive health is the Family Health Program - FHP, which targets a more dynamic and closer service to the population. In São João do Piauí, according to the interviews carried out in 2016, the FHP is successful with enough teams serving both urban and rural areas, however in the municipality of Capitão Gervásio Oliveira, the FHP has only two teams, which is insufficient to serve the entire population, especially given its rural nature.

Figure 7-36 Regional Hospital in São João do Piauí.



During the Environmental Baseline insect studies (section 7.2.3.7) of the mosquitoes captured, five types of epidemiological importance were identified with the potential to cause disease and two causing discomfort due to their bite.

The study also revealed the presence of two important disease vector insect species "kissing barbers" with high potential to settle in rural poor-quality households that can transmit Chagas disease. However, at the time of the surveys, none of the groups evaluated were at high risk of causing problems on a large scale to the population surrounding the project.

Among the groups of insects and others like those that offers risks to humans, it is worth mentioning the presence in the region of beetles known as *Potó* that cause burns by contact, and the yellow scorpion that may cause problems when stinging children and the elderly.

The baseline studies also identified other disease vectors including some mollusks hosting parasites found in the Jenipapo dam.

The local population is identified as being vulnerable to these water-related diseases, either through direct drinking of water or through contact activities, such as housework, personal hygiene or recreation among others.



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Figure 7-37 Female adult of *Triatoma brasiliensis* (kissing barber) collected during field research



7.3.8 BASIC SANITATION INFRASTRUCTURE

7.3.8.1 SEWAGE

There is inadequate sanitary infrastructure, and according to data from IBGE (2010), only 4% of the households of Capitão Gervásio Oliveira and São João do Piauí have an adequate sewage network (i.e septic tanks). While in Campo Alegre do Fidalgo, this system was identified in only two households. Therefore, based on this data it appears that practically all sewage from the ADI households is improperly disposed of, typically through the use of rudimentary pits. Rudimentary pits are used by 46% of the population in Campo Alegre do Fidalgo, 40% in Capitão Gervásio Oliveira, and 74% in São João do Piauí. In rural areas, disposal in ditches and streams is more prevalent, and many households are without access to bathrooms or toilets.


7.3.8.2 WATER SUPPLY

Water supply services are very poor for the households in the municipalities of the ADI, except for São João do Piauí, where 78% of households are supplied via a reticulated water network (IBGE, 2010). Households with access to a reticulated water network are low in Campo Alegre do Fidalgo only 27%, and 34% in Capitão Gervásio Oliveira. In these towns, most households are supplied by wells and water trucks.

It is also noted that even where there is a reticulated water supply, according to the field survey interviews, there are often problems, and there is a routine lack of water for supply.

7.3.8.3 GARBAGE COLLECTION

The percentage of households in the municipalities of the ADI with garbage collection is low, 26% in Campo Alegre do Fidalgo, 31% in Capitão Gervásio Oliveira and 66% in São João do Piauí (IBGE 2010). In the rural areas there is practically no garbage collection services available, with 70 to 80% of households burning their own waste within the properties, and the rest being disposed of in other inappropriate ways (e.g. buried, dumped in countryside, thrown into the river).

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7.3.9 ELECTRICITY SUPPLY

According to data from the 2010 Census, the municipalities of the ADI, with the exception of São João do Piauí, had a high proportion of households without electricity; 32% in Campo Alegre do Fidalgo and 54% in Capitão Gervásio Oliveira, which is well above the state average of 6.9%. In São João do Piauí only 4.1% of households did not have an electricity connection.

7.3.10 PUBLIC SECURITY

Public security is provided by the police, within the smaller municipalities such as Capitão Gervásio Oliveira the number of police officers is small, and they only have one vehicle, which, considering the rural characteristics of the municipality, is inadequate. In São João do Piauí, the secretariat interviewed reported there were no significant problems. Theft is the main type of crime in the municipality.

7.3.11 LIFE CONDITIONS

The indicator used to assess the quality of life of the population of the ADI was the Municipal Human Development Index (MHDI).

The MHDI was created by the United Nations Development Program (UNDP) in 1990 with the aim of classifying human development in different countries. Regarding the evaluation of Brazilian municipalities, the UNDP, the Institute of Applied Economic Research (IPEA) and the João Pinheiro Foundation (FJP) adapted the global MHDI methodology to the Brazilian context, considering the availability of national indicators, which resulted in the MHDI, based on the variables of longevity, education and income. The MHDI considers a numerical range from 0 (zero) to 1 (one), and the closer to 1, the better the population's quality of life is, as shown in the figure below.

Figure 7-38 The Municipal Human Development Index (MHDI)

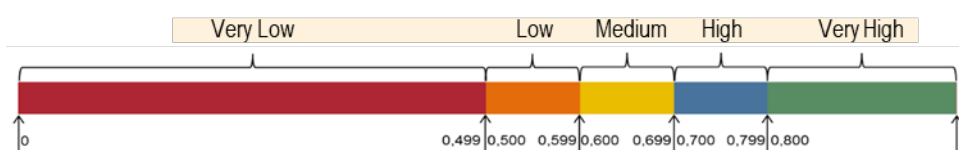




Figure 7-39 Municipal Human Development Index (MHDI) in the Municipalities of the ADI, 1991-2010.



Source: Atlas of Human Development in Brazil 2013 – PNUD, IPEA e FJP. Prepared by: Arcadis, 2016.

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The main component responsible for the increase in the MHDI score in the municipalities was improvements to education. However, despite this evolution, the municipalities are still considered to be at a very low level of development with regard to the education and other components.

The 5 communities surrounding the Project are essentially made up of small groups of small rural producers, based on subsistence agriculture. However, due to the prolonged drought in the last five years, agriculture has been little used (especially due to the lack of access to water), with extensive livestock farming being prioritized, especially goats and sheep, with poultry and cattle at a smaller scale.

Figure 7-40 PNP1000 Surrounding Communities



| | | | |
|---|---------------------------|---|--------------------------------|
|  | Communities & Settlements |  | Area of Direct Influence – ADI |
|---|---------------------------|---|--------------------------------|

Houses of the communities surrounding the Project are mostly of simple design, built of block masonry and covered with clay tiles. Electricity is provided in all communities, and in those with the highest concentration of homes, public lighting is provided.

It is important to note that the PNP1000 does not envisage any overlap with residential units of the neighboring communities.



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Figure 7-41 Photographs of the Surrounding Communities



Residences in the Várzea settlement in Capitão Gervásio Oliveira.



Interview with residents of the Veredas settlement in the municipal area Capitão Gervásio Oliveira.



Road to north from the PNP1000 area towards the Várzea settlement.





Road that connects the Demo Plant (and PNP1000) to the PI-465 (east), being repaired by municipality.



PNM supporting signaling improvements in the ADI's local road.



Engagement and communication with residents of the Brejo Seco community.

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7.3.12 ENVIRONMENTAL PERCEPTION SURVEY

An environmental perception survey was conducted with the aim of verifying how the local communities see, judge and qualify the environment in the region where they live; how they relate to environmental issues and what their impressions were of the project's implementation and operation plans. Bespoke questionnaires were developed around these themes. The interviews focused on representatives of public institutions and social organizations and the residents of the communities surrounding the project.

Highlights from the survey can be summarized as follows:

- Most respondents consider the region to be good. The main problems pointed out referred to the lack of basic sanitation services, few options for leisure and culture, and public safety. Positive aspects highlighted included the tranquility of the place, the welcoming population and the quality of the lands (considered to be fertile).
- The survey showed that the Piauí Nickel Project is well known in the region, with over 90% of respondents reporting having knowledge about it.
- Approximately 90% of the interviewees considered the implementation of the project to be "good" or "excellent". The positive aspects mentioned was the anticipated generation of jobs. As possible negative aspects, environmental degradation was mentioned, especially related to deforestation.

PNM will use the feedback from this perception study in their stakeholder engagement program for the PNP1000 Project, and use this to demonstrate the job creation opportunities, and present the environmental and social impact mitigation measures in action.

Figure 7-42 Interview conducted at the Union of Rural Workers of the Municipality of Dom Inocêncio




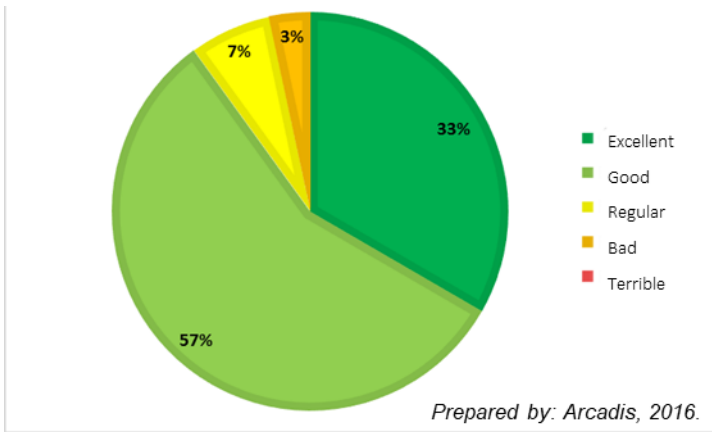
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Figure 7-43 Evaluation on the Possibility of Implementation of the Piauí Nickel Project




7.3.13 CULTURAL AND ARCHAEOLOGICAL HERITAGE

The baseline archaeological heritage studies related to the environmental permitting process for the full-scale project were initiated in 2008 when the project was still owned by Vale do Rio Doce Company, with archaeological surveys carried out by the Museum of American Man Foundation (FUMDHAM), which carried out archaeological prospecting and rescue throughout the entire project's area of influence.

With the resumption of the project by PNM, FUMDHAM was then again hired to carry out a survey to update the situation at the archaeological sites identified and rescued in 2008. They prepared a technical report that was submitted for evaluation by the National Historical and Artistic Heritage Institute (IPHAN). IPHAN has approved the reports and work plan developed, as such both the full-scale project and the PNP1000 have complied with the legal requirements in relation to the studies and actions necessary to ensure the preservation of archaeological heritage.

Figure 7-44 Archaeological Survey and Findings

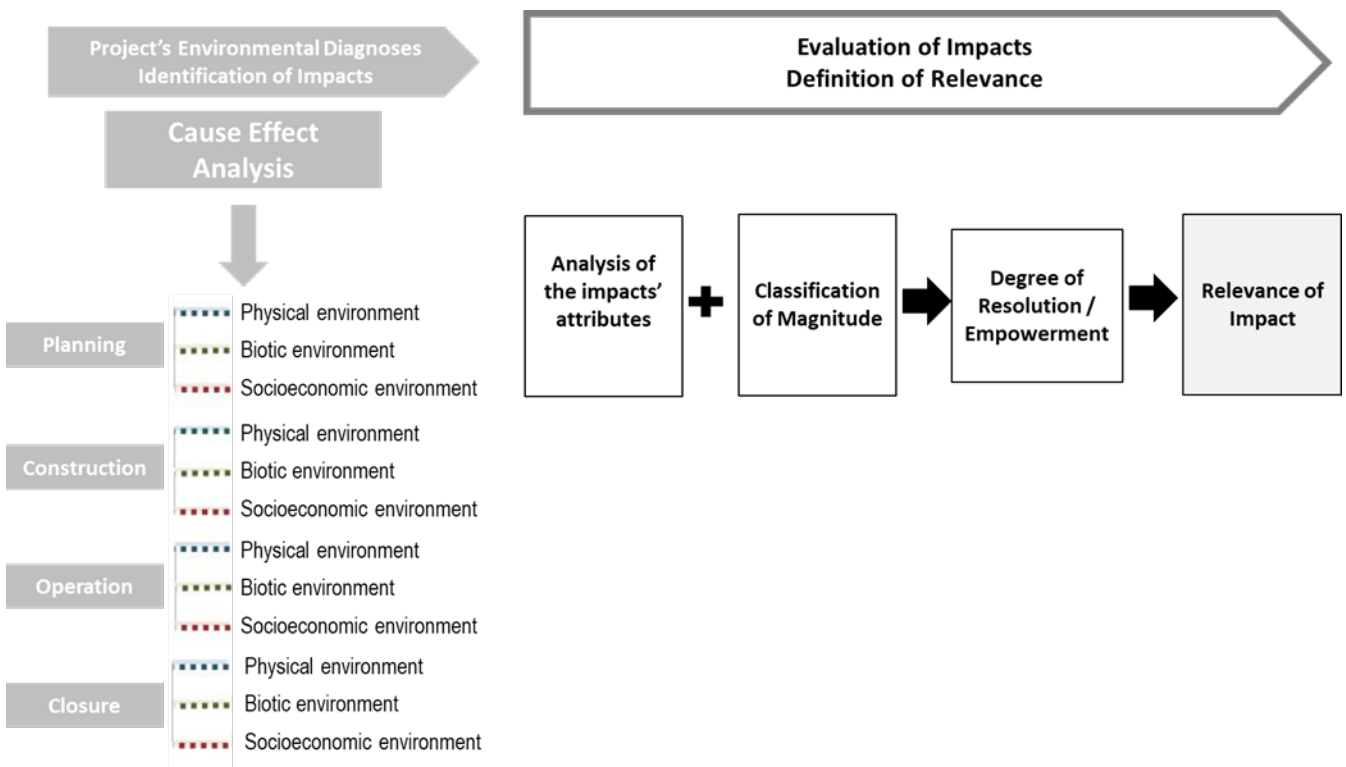


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8 IMPACT ASSESSMENT


Based on the baseline studies, PNM has undertaken an assessment of the potential socio-environmental impacts which may arise from the Project. This has been undertaken in accordance with Brazilian environmental legislation which provides the methodology for determining the identification of impacts in the various phases of the project: planning (to define where and how the project will be), construction (building of the project), operation (period when the project will be operating) and closure (when the project no longer produces and its activities cease). This is presented in Figure 8-1, and is considered to be in accordance with international good practice.

Figure 8-1 Synthesis of the Environmental Impact Assessment Methodology



The degree of relevance for each potential PNP1000 impact was calculated based on the approach, methodology, and data of the PNP full-scale ESIA. Thus the assessment considered the following elements during impact assessment:

- Activities of the project; in construction, operation, and closure
- Potential impacts of these activities
- The attributes of any impact
 - whether positive or negative
 - the probability of an impact occurring
 - the term of the impact (which could be immediate, medium, or long depending upon the lag between an activity and generation of the impact)
 - duration of a potential impact (permanent or only temporary)

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- spatial extent of the potential impact (localised or broader)
- whether an impact is reversible or irreversible
- whether an impact is directly created by the project or whether the project intensifies an existing impact
- From the above, a qualitative assessment was made as to the magnitude of any potential impact (small, medium, or large)
- Based on the potential impact attributes and magnitude certain measures were proposed and these were assessed according to their degrees of resolution/mitigation likely for the potential impact (assuming implementation of the relevant control programs), and thus a final relevance for each impact risk was assigned


Finally, in each case, the relevant Socio-Environmental Control Programs (section 9) are cross-referenced to each potential impact.

Table 8-1 shows the socio-environmental impacts of the PNP1000. In total there are 12 impacts of which 9 are of a low relevance negative nature, 1 is of a medium relevance negative nature and 2 are medium relevance of positive. These are then each considered in the following sections.

Table 8-1 PNP1000 Socio-Environmental Impacts

| Impacts | Nature | Environment | Relevance Degree | Phases |
|---|--------|----------------|------------------|------------|
| Groundwater Quality – possibly effected by contaminating substances (effluents, waste) | N | Physical | L | Co, Op, Cl |
| Soil Quality – degradation and erosion processes from land clearing and earth works, and possibly affected by contaminating substances (effluents, waste) | N | Physical | L | Co, Op, Cl |
| Air Quality – deterioration from dust generation and emission of air pollutants | N | Physical | L | Co, Op, Cl |
| Surface Water Quality – possible degradation due to the potential receiving of sediments and contaminating substances | N | Physical | L | Co, Op, Cl |
| Greenhouse Gas (GHG) Emissions – increase | N | Physical | L | Co, Op, Cl |
| Habitats – loss of vegetation coverage | N | Biotic | L | Co |
| Flora - loss of specimens from vegetation removal | N | Biotic | L | Co |
| Terrestrial fauna – dispersion and potential loss of specimens from land clearing | N | Biotic | L | Co, Op |
| Aquatic habitats – possibly effected by sediments and contaminating substances | N | Biotic | L | Co, Op, Cl |
| Government revenues – increase in many levels | P | Socio-economic | M | Co, Op |
| Community Impacts – from inward migration, noise, dust, traffic accidents | N | Socio-economic | M | Co, Op, Cl |
| Jobs, income and economic activity – increase in many areas | P | Socio-economic | M | Co, Op |

N = Negative; P = Positive L = Low; M = Medium Co = Construction; Op = Operation; Cl = Closure

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8.1 GROUNDWATER QUALITY

The degradation of the groundwater quality may occur due to the presence of contaminating substances which if released onto or into the ground may migrate into the underlying aquifer. This impact could occur during construction, operation, and closure from the following PNP1000 activities:

- Implementation of construction sites and accommodation expansion
- Access route improvements and use of machinery
- Construction of operational structures
- Operation of the ore processing plant
- Deposition of process wastes (such as IFC and spent ore)
- Supply, maintenance and washing of machines and equipment
- Storage and / or use of reagents and hazardous products
- During closure, decommissioning of structures, cleaning the area

These activities may results in the following:

- Generation of liquid effluents
- Acidic effluent generation
- Generation of solid waste
- Leak of contaminating substances


Considering the compact footprint of PNP1000 activities, the low vulnerability to groundwater contamination in the area and the specific control systems provided (e.g.septic tank system, drainage systems, impermeable workshop floors, inspection boxes, containment ponds, oil and water separators and lined residue storage) the impact was assessed as follows:

Table 8-2 Groundwater Quality Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|------------|
| Nature | Negative | Type | Direct |
| Occurance - Probability | Probable | Reversibility | Reversible |
| Occurance - Term | Medium | Form of interference | Caused |
| Occurance - Spatiality | Localized | Duration | Temporary |
| Magnitude | | | |
| Qualitative | Medium | | |

Additional mitigation measures proposed include, but are not limited to:

- Inspection and performance of systematic maintenance in oil storage and use areas (including use of oil and water separators)

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- Inspection and systematic maintenance (preventive and corrective) for all vehicles
- Implementation of relevant control programs (see below)
- Disposal of mine rock waste and dry process waste (spent ore and IFC) according to applicable standards
- Conducting periodic monitoring of rock waste and dry waste storage areas in accordance with applicable standards

The proposed mitigation measures are detailed in the Groundwater Monitoring Program (9.9), Solid Waste Management Program (9.3) and Effluent Monitoring Program (9.4). In the future, when developing the Risk Management Program and Emergency Response Plan (9.15), additional measures may be recommended.

Table 8-3 Ground Water Quality Impact Degree of Relevance

| Degree of Resolution and Relevance | |
|---|-------------|
| Degree of Resolution of Measures | High |
| Relevance Degree of the Impact | Low |


8.2 SOIL QUALITY

The soils of the PNP1000 area are generally poor quality and susceptible to impact. The soil may be degraded due to contamination, the loss of its biodiversity or ability to support life, or loss through erosion processes from the following activities and/or due to the presence or leaks of contaminating substances (effluents and waste from the following PNP1000 activities:

- Vegetation removal (both during construction and mine operations)
- Soil stripping and storage (as above)
- Earthworks and excavations in construction
- Construction of operational structures
- Mine operations and mineral extraction
- Operational activities of waste deposits and ore stocks
- Operational activities of the leach cells
- Operation of the plant
- Operational activity of dry tailings deposits
- Implementation of construction sites and accommodation expansion
- Access route improvements/maintenance

These activities may results in the following:

- Contamination of the soil

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- Degradation of stored soil quality through compaction, alteration of permeability, salinization
- Degradation of stored soil quality (loss of structure, humic content etc.) and its ability to be used for the restoration program
- Loss of soil resource through erosive processes (wind, rain, etc.)
- Generation of liquid effluents
- Acidic effluent generation
- Generation of solid waste
- Leak of contaminating substances



Considering the compact footprint of PNP1000, the low to medium susceptibility to erosive processes and specific control systems provided (e.g. drainage systems, run off water containment ponds, land clearing procedures, impermeable workshops floors, inspection boxes, oil and water separators and lined residue storage), the impact of the activities and potential results were assessed as follows:

Table 8-4 Soil Quality Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|---|-----------------------------|------------------------|
| Nature | Negative | Type | Direct |
| Occurance - Probability | Certain | Reversibility | Reversible |
| Occurance - Term | Short | Form of interference | Caused and Intensified |
| Occurance - Spatiality | Localized | Duration | Permanent/Temporary |
| Magnitude | | | |
| Qualitative | Medium (construction), Small (operation) and Small (closure), | | |

Proposed mitigation measures include, but are not limited to:

- Limiting the removal of vegetation to the areas strictly necessary
- Schedule project activities to be both compatible with later recovery actions and to minimize the time that soil and slopes are exposed to erosive agents
- Where possible, schedule construction earthmoving to be carried out outside the rainy season
- Shaping of slopes in affected areas to reduce erosion potential
- Promote systematic preventive and corrective actions in order to minimize possible environmental degradation as a result of the intensification of surface processes
- If necessary, carry out automated monitoring with relevant instruments (geotechnical monitoring)
- Recover the areas degraded by the project
- Adoption of constructive soil protection techniques
- Monitoring and control of erosion processes, mass movement and other processes of land instability.

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- Protect piles of excess material from erosive action
- Maintenance of drainage systems and accessory structures
- Management and storage of surplus material, including topsoil

The set of actions that encompass these practices mentioned above are found in the Degraded Areas Recovery Program (9.10.3), Prevention and Control of Erosion Processes (9.6), Surface Run-off Control Program (9.8), Solid Waste Management Program (9.3) and Effluent Monitoring Program (9.4).

Table 8-5 Soil Quality Impact Degree of Relevance

| Degree of Resolution and Relevance | |
|------------------------------------|-------------|
| Degree of Resolution of Measures | High |
| Relevance Degree of the Impact | Low |

8.3 AIR QUALITY

Air quality degradation can occur due to the (re)suspension of particulates in air and the emission of air pollutants which will arise from the following activities:

- Vegetation removal
- Land clearing and preparation
- Landscaping
- Implementation of support and operational elements
- Transport of personnel, supplies and equipment
- Mining operations (excavators, loaders, etc.)
- Crushing and ore handling at the process plant

These activities can result in generation of particulate matter in the air (including dust and particles from fossil fuel combustion) and gases including oxides of carbon (CO and CO₂), nitrogen oxides (NO_x), sulfur oxides (SO_x) and hydrocarbons from fuel burning. The assessment of the project's greenhouse gas emissions is covered in section 0.

Although PNP1000 is of small scale, it will still demand truck and vehicle movement during all project phases (more continuous and intense during operation) to access the site along the existing unpaved road that has some residents alongside it. Therefore, the intensification of the current traffic will increase dust and particulate matter generation for these receivers. Considering the procedures and preventive actions already in place in the Demonstration Plant to control this impact, it was assessed as follows:


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Table 8-6 Air Quality Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|------------------------|
| Nature | Negative | Order | Direct |
| Occurance - Probability | Certain | Reversibility | Reversible |
| Occurance - Term | Short | Form of interference | Intensified and Caused |
| Occurance - Spotality | Dispersed | Duration | Temporary |
| Magnitude | | | |
| Qualitative | Medium | | |



Proposed mitigation measures include, but are not limited to:

- Establishment of vehicle speed limits, since the main factors that contribute to the increase in dust generation associated with vehicle traffic are weight and speed
- Sprinkling water in the source areas with the greatest potential for generating particulate material and with the largest number of receivers
- Prohibit the transport without packaging of materials that may provide the suspension of solid particles, in this way the loads and bodies of trucks must be properly covered in order to minimize the emission of particulates
- Surface coverage of provisional stacks of unconsolidated materials
- Vegetation cover of exposed areas as soon as practicable
- Inspection and preventive maintenance of vehicles, machines and equipment, in order to detect any abnormalities in the operation of the combustion engines and also to minimize the emission of gases and black smoke
- Monitoring and measurement of emissions from contractors' and own vehicles, machines and equipment
- Use of new vehicles / equipment or in good condition, regulated according to the manufacturer's instructions

These actions are detailed within the Air Quality Monitoring Program (9.7) and Traffic Management Program (9.5).

Table 8-7 Air Quality Impact Degree of Relevance

| Mitigating Measures and Degree of Relevance | |
|---|-------------|
| Degree of resolution of measures | High |
| Degree of relevance of the impact | Low |

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8.4 SURFACE WATER QUALITY

Surface water may be affected due to the generation and transport of sediments (and silting of water streams) or due to the generation of liquid and oily effluents and solid waste (that can contaminate the waters), and these impacts could occur during construction, operation and closure from the following PNP1000 activities:

- Vegetation removal
- Soil stripping and storage
- Earthworks
- Opening of access routes
- Supply of machinery and equipment
- Maintenance of machinery and equipment
- Machine shop operation and equipment washing
- Movement of vehicles
- Construction, operation, and closure of the project's infrastructure
- Recovering of pits, stockpiles, and deposits

The sensitivity of, and potential for, surface water impacts is strongly influenced by whether the activities are being undertaken in the rainy months, however these activities may result in the following:

- Generation of solid wastes entering surface water bodies
- Soil erosion and loss into surface water bodies
- Alteration of the characteristics of water bodies
- Generation of liquid and oily effluents in surface water bodies
- Leak of contaminating substances migrating to surface water bodies

Considering the compact footprint of PNP1000, that the project has no elements over water streams (or in Permanent Preservation Areas – APPs), that the surrounding water streams are dry most of the year, the low to medium susceptibility to erosive processes, the low surface water quality already existing in the region, and the specific control systems provided (e.g. drainage systems, run off water containment ponds, land clearing procedures, oil and water separators and lined residue storage), this impact was assessed as follows:


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Table 8-8 Surface Water Quality Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|-------------|
| Nature | Negative | Order | Direct |
| Occurance - Probability | Probable | Reversibility | Reversible |
| Occurance - Term | Short | Form of interference | Intensified |
| Occurance - Spatiality | Dispersed | Duration | Temporary |
| Magnitude | | | |
| Qualitative | Small | | |

Proposed mitigation measures include, but are not limited to:

- Promote systematic preventive and corrective actions in order to minimize possible environmental degradation due to the intensification of erosion processes
- Adoption of constructive soil protection techniques (containment, drainage, and other systems)
- Monitoring and controlling the processes of surface dynamics triggered in the area (especially erosive processes, and mass movements)
- Conducting periodic visual inspections and maintenance of the rain drainage system, in addition to systematic observations on the general appearance of the water bodies, registering eventual presence of debris and concentration of solids
- Implementation of retention ponds or smaller solids retention devices, such as decantation boxes as needed during the rainy season to settle out sediment
- Cleaning and maintenance of the drainage system, removing the sediment accumulated in the decantation boxes, clearing channels, ditches, and manholes that may become silted
- Transportation only in trucks covered with tarpaulins, where appropriate, avoiding any falling or spreading of particulate material
- All machines, equipment and vehicles used shall undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential leaks of oils, greases, and fuels
- Use of containment boxes and impermeable floors around tanks and other fuel and lubricant storage devices
- Inspect and carry out systematic maintenance of the storage for lubricating oils, greases, and / or chemical products of any nature

The set of actions that encompass these practices are found in: Degraded Areas Recovery Program (9.10.3), Prevention and Control of Erosion Processes (9.6), Surface Run-off Control Program (9.8), Solid Waste Management Program (9.3) and Effluent Monitoring Program (9.4).


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Table 8-9 Surface Water Impact Degree of Relevance

| Degree of Resolution and Relevance | |
|------------------------------------|------|
| Degree of Resolution of Measures | High |
| Relevance Degree of the Impact | Low |

8.5 HABITATS

The loss of habitats may occur during construction activities from the following PNP1000 activities:

- Opening of access roads
- Removal of vegetation

Habit loss will occur to a very limited degree from the removal of already degraded Open Caatinga vegetation for the construction of project infrastructure and from the mining and waste rock storage activities. As presented in the previous sections, only some 25.5ha is predicted to be deforested, which is almost irrelevant considering the overall Caatinga matrix existing in the project region. This impact was therefore assessed as follows:

Table 8-10 Habitats Impact Magnitude Assessment

| Attributes | | | |
|-------------------------|-----------|----------------------|-------------|
| Nature | Negative | Order | Direct |
| Occurance - Probability | Certain | Reversibility | Reversible |
| Occurance - Term | Short | Form of interference | Intensified |
| Occurance - Spatiality | Localized | Duration | Permanent |
| Magnitude | | | |
| Qualitative | Small | | |

Proposed mitigation measures include, but are not limited to:

- Avoid removing unnecessary areas
- Promote, whenever possible, the collection of plant material of species for use in the rehabilitation of areas
- Topsoil storage for later use in areas to be recovered

These measures will be adopted in the Flora Removal Control Program and the Recovery of Degraded Areas Program.


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Table 8-11 Habitats Impact Degree of Relevance

| Degree of Resolution and Relevance | |
|------------------------------------|--------|
| Degree of Resolution of Measures | Medium |
| Relevance Degree of the Impact | Low |

8.6 FLORA

The loss of specimens from the native flora may occur during PNP1000 construction activities:

- Opening of access roads
- Removal of vegetation

As assessed by Arcadis in the PNP full scale ESIA, the Caatinga flora biodiversity in the project's region is already strongly affected by livestock herds roaming freely (including through the PNP1000 ADI), especially goats that selectively consume the seedlings of many native species, altering therefore the natural regeneration processes of the local vegetation. It was also concluded that the PNP full-scale implementation will not affect the survival of any flora and fauna species populations, including the ones considered to have some level of threat, both by the IUCN 'Red list' and the Brazilian official lists of threatened species. For PNP1000 this is therefore also the case as it will impact a much smaller area deforesting only 25.5ha of already degraded Open Caatinga. This impact was therefore assessed as follows:


Table 8-12 Flora Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|-------------|
| Nature | Negative | Order | Direct |
| Occurance - Probability | Certain | Reversibility | Reversible |
| Occurance - Term | Short | Form of interference | Intensified |
| Occurance - Spatiality | Localized | Duration | Permanent |
| Magnitude | | | |
| Qualitative | Small | | |

As vegetation is a renewable natural resource, the adoption of measures that make it possible to rescue propagules and to revegetate areas mitigates, to a large extent, these losses. This genetic material, used in vegetation recovery actions, allows the maintenance of species richness and genetic variability.

Proposed mitigation measures include, but are not limited to:

- Avoid unnecessary removal of vegetation
- Promote, whenever possible, the collection of plant material of species for use in the rehabilitation

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of areas (especially from the “ipê-cascudo” - *Handroanthus spongiosus* tree species, which is the only plant species considered “In Danger” according to the official Brazilian list of threatened species).

- Carry out revegetation actions on degraded areas, whenever feasible, or assure protection of other areas with Caatinga coverage
- Train workers on the prohibition on illegal vegetation cutting, emphasizing the importance in the maintenance and sustainability of natural environments

These measures will be adopted in the Flora Removal Control Program and in the Recovery of Degraded Areas Program.

Table 8-13 Flora Impact Degree of Relevance

| Degree of Resolution and Relevance | |
|------------------------------------|--------|
| Degree of Resolution of Measures | Medium |
| Relevance Degree of the Impact | Low |


8.7 TERRESTRIAL FAUNA

Terrestrial fauna specimens may be dispersed or lost during construction and operational activities from the following PNP1000 activities:

- Removal of vegetation
- Construction of access roads
- Movement of vehicles and people
- Construction of buildings
- Construction of operational structures
- Compressor operation
- Operation of machinery and equipment
- Mobilization of labor
- Mining
- Ore extraction
- Crushing

These activities may result in the following:

- Noise generation
- Generation of terrain vibrations
- Running over of fauna
- Increased hunting pressure
- Collision of fauna with structures of the project

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The loss or injury of fauna specimens (both wild and domesticated) may occur during removal of native vegetation and due to intensification of vehicle and equipment traffic (running over events), especially to those specimens with low escape capacity such as some representatives of the herpetofauna. Illegal hunting may also increase with the presence of more people in the area, and intensive noise and vibration may also promote changes in behavior pattern of fauna specimens (eg. increase aggressive interactions and competition levels).

However, as assessed by Arcadis in the PNP full scale ESIA, the fauna biodiversity in the project's region is already affected by current anthropic actions and the implementation of PNP full-scale will not affect the survival of any flora and fauna species populations, including the ones considered to have some level of threat both by the IUCN 'Red list' and the Brazilian official lists of threatened species. For PNP1000 this is therefore also the case as it will impact a much smaller area deforesting only up to 25.5ha of already degraded Open Caatinga and vehicle traffic will be much less intense than for the full-scale project. This impact was therefore assessed as follows:

Table 8-14 Terrestrial Fauna Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|--------------|
| Nature | Negative | Order | Direct |
| Occurance - Probability | Certain | Reversibility | Irreversible |
| Occurance - Term | Short | Form of interference | Intensified |
| Occurance - Spatiality | Dispersed | Duration | Permanent |
| Magnitude | | | |
| Qualitative | Medium | | |

In order to minimize the occurrence of this impact due to trampling and removal of vegetation, the following actions will be taken:

- Chase away and translocation of fauna specimens, concomitant with the operation of the machines and equipment used during the cutting and removal of vegetation, in order to avoid death by being run over
- Actions to control the speed of vehicles and equipment through signaling on site and the discouragement of driving at night
- Guidance for drivers and pedestrians regarding the necessary precautions for safe traffic
- Periodic maintenance of equipment and vehicles
- Train workers on the prohibition on hunting wild animals, emphasizing their importance in the maintenance and sustainability of natural environments, and
- Demystify issues related to snakes and other wild animals, guiding workers on ways to avoid encountering potentially dangerous species and enabling them to take the right actions in the event of chance encounters

These actions are detailed in the Bio-diversity Management Plan and Traffic Management Program.


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Table 8-15 Terrestrial Fauna Impact Degree of Relevance

| Degree of Resolution and Relevance | |
|---|-------------|
| Degree of Resolution of Measures | High |
| Relevance Degree of the Impact | Low |

8.8 AQUATIC HABITAT

The aquatic habitats around the Project are currently heavily impacted by local grazing and surrounding settlements, and the objective of PNM is to avoid further impacts and where feasible improve the quality of the aquatic habitat. The potential impacts are may occur due to the generation and transport of sediments or due to the generation of liquid and oily effluents and solid waste and could occur during construction, operation and closure from the following PNP1000 activities:

- Vegetation removal
- Soil stripping and storage
- Earthworks
- Opening of access routes
- Supply of machinery and equipment
- Maintenance of machinery and equipment
- Machine shop operation and equipment washing
- Movement of vehicles
- Construction, operation and closure of the project's infrastructure
- Recovering of pits, stockpiles and deposits

These activities may results in the following:

- Flow of solid wastes into the aquatic environment
- Loss of soil/sediment to the aquatic environment increasing turbidity and blanketing the river bed
- Alteration of the characteristics of water bodies through changes to the flow regimes
- Flow of liquid and oily effluents into the aquatic environment from spills or leak of contaminating substances

Considering the compact footprint of PNP1000, that the project will not occur in Permanent Preservation Areas – APPs (away from streams), the low to medium susceptibility to erosive, that the surrounding water courses are dry most of the year (which also affects the fauna community biodiversity), and the specific control systems provided (e.g. drainage systems, run off water containment ponds, land clearing procedures, impermeable workshop floors, inspection boxes, oil and water separators, waste management and lined residue storage) the impact was assessed as follows:


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Table 8-16 Aquatic Habitats Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|-------------|
| Nature | Negative | Order | Direct |
| Occurance - Probability | Probable | Reversibility | Reversible |
| Occurance - Term | Short | Form of interference | Intensified |
| Occurance - Spatiality | Dispersed | Duration | Temporary |
| Magnitude | | | |
| Qualitative | Small | | |


Additional mitigation measures proposed include, but are not limited to:

- Promote systematic preventive, corrective and monitoring actions to minimize erosive processes
- Adoption of constructive soil protection techniques (containment, drainage, and other systems)
- Conducting periodic visual inspections, cleaning and maintenance of the rain drainage systems, in addition to systematic observations on the general appearance of the water bodies, registering eventual presence of debris and concentration of solids
- Inspect and carry out systematic cleaning and maintenance of the storage structures for lubricating oils, greases and / or chemical products of any nature
- Transportation in trucks covered with tarpaulins, avoiding the falling and spreading of particulate material
- All machines, equipment and vehicles used must undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential leaks of oils, greases and fuels. In this sense, workshops and maintenance places must be equipped with environmental control devices

The set of actions that encompass these practices are detailed in the: Degraded Areas Recovery Program (9.10.3), Prevention and Control of Erosion Processes (9.6), Surface Run-off Control Program (9.8), Solid Waste Management Program (9.3) and Effluent Monitoring Program (9.4).

Table 8-17 Aquatic Habitat Impact Degree of Relevance

| Degree of Resolution and Relevance | |
|---|-------------|
| Degree of Resolution of Measures | High |
| Relevance Degree of the Impact | Low |

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8.9 GOVERNMENT REVENUE

Increase in government revenue will occur during construction and operation stages from the following PNP1000 activities:

- Acquisition of goods, supplies and services from companies in the municipalities and broader Brazilian economy
- Employment and training of workers generating income taxes and adding spending to their spending power in the local

PNP1000 implementation will generate increased income taxes for the surrounding municipalities (Tax on Services of Any Nature – ISSQN), on a state level (Tax on Circulation of Goods and Services – ICMS) and at federal level (Financial Compensation for the Exploration of Mineral Resources - CFEM). Considering also the municipalities of the ADI have a low current volume for their own local tax collection (with a high dependence on federal transfers), and that the CFEM will be applied at a rate of 2% on PNM's revenue; that 65% of this revenue is due to the local municipalities, 23% to the state of Piauí and the remaining 12% to the federal government, this impact was assessed as follows:


Table 8-18 Government Revenues Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|------------|
| Nature | Positive | Order | Direct |
| Occurance - Probability | Certain | Reversibility | Reversible |
| Occurance - Term | Medium | Form of interference | Caused |
| Occurance - Spatiality | Localized | Duration | Temporary |
| Magnitude | | | |
| Qualitative | Medium | | |

As the main potentiation measure for this positive impact, the company is committed to hire as many local service providers as possible to increase even more the income taxes for the ADI municipalities.

Table 8-19 Government Revenues Impact Degree of Relevance

| Degree of Empowerment and Relevance | |
|---|---------------|
| Degree of Potentiation of Measures | Medium |
| Relevance Degree of the Impact | Medium |

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8.10 COMMUNITY IMPACTS


The local community will be impacted with during construction, operation, and closure from the following PNP1000 activities:

- Circulation of vehicles (cargo, passengers, etc.)
- Construction of buildings
- Construction and operation of the project's infrastructure
- Maintenance of machines / equipment
- Operation of machines / equipment
- Earthworks
- Storage of hazardous and polluting substances
- Mining
- Ore extraction
- Crushing
- Operation of administration structures
- Landfill (sanitary and civil)
- Operation of the ore stockyard
- Effluent treatment and discharge
- Inward migration of new PNM employees
- Demobilization of the project

These activities have the potential to result in the following:

- Degradation of air quality through the generation of particulate material
- Degradation of air quality through the generation of gaseous pollutants
- Disturbance through noise generation
- Risks to community safety from the increased traffic generated by the Project (vehicles / machines)
- Disturbance through the generation of terrain vibrations
- Pressure on local services, or conflict with local communities through inward migration of opportunist jobseekers
- Interference with other economic activities through transfer of workers to PNM operations
- Availability and circulation of information
- Generation of unemployment upon closure if poorly planned

All these project activities may cause disturbance to local communities, especially those surrounding the operational site and access roads. Although PNP1000 is of small scale and this is an intensified impact (from the Demo Plant operation), it will still demand truck and vehicle movement during all project phases (more continuous and intense during operation) to access the site along the existing unpaved road that has some residents alongside it. Therefore, the intensification of the current traffic will increase dust, fumes, noise, vibration, and the risk of road accidents to these close receivers.

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The project is committed to giving priority to the recruitment and hiring of local labor, but there will still be some “outsiders” during construction (approximately 60 people during construction peak), and during operations, (around 20), not to mention some workers from limited outside service suppliers for short periods (especially during construction). Although these numbers are considered small in relation to the total population of the surrounding municipalities, that the migrants will be of higher education level type of workers, and that the local residents have already gone through this situation (both from the Demo Plant operation and also from more recent outside service providers present for the implementation of other large renewable energy projects in the region), social conflicts may still arise locally due to their presence.

This impact was therefore assessed as follows:

Table 8-20 Community Impacts Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|--------------------|
| Nature | Negative | Order | Direct |
| Occurance - Probability | Certain | Reversibility | Reversible |
| Occurance - Term | Medium | Form of interference | Caused/Intensified |
| Occurance - Spatiality | Localized | Duration | Temporary |
| Magnitude | | | |
| Qualitative | Medium | | |

To minimize the impacts caused by the project's implementation, some measures will be taken such as:


To address pressure from inward migration:

- Hiring of local labor will be prioritized and the diffusion of lectures, events, campaigns and training will be focused on this theme. Actions and content related to the Social Communication Program, the Human Resource Management Program (the training programs of which will include an Environmental Education Program) should include the issue of coexistence between people "from different cultures", as well as respect for local customs and habits.
- In addition, ensuring a healthy work environment, which highlights the benefits of teamwork to achieve goals, often generates a sense of "belonging" that indirectly influences individual behavior.

Regarding noise from operations:

- Assess and identify sources of noise, requiring mitigating measures to contain and minimize these impacts. Use of screens/earth bunds with height determined according to the height of the equipment (noise sources). The noisiest activities will be scheduled during the day, leaving for nights those activities with less noise and vibrations. Inform the local residents in advance when the most disturbing activities might occur.

These measures will be part of the Social Communication Program.

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To reduce the levels of noise, vibration and dust emitted by the traffic of heavy and light vehicles there will be:

- Proper maintenance and conservation of roads
- Establishment of ideal speed for vehicles, that is, that minimise the levels of noise and dust while still ensuring practical operations
- Sprinkling water on the unpaved roads to be used near established dwellings, in order to reduce the suspension of particulate matter
- Traffic planning for heavy vehicles, avoiding the night shift

The actions related to vehicle traffic will be included in the Traffic Management Program.

Table 8-21 Community Discomfort Impact Degree of Relevance

| Degree of Resolution and Relevance | |
|------------------------------------|--------|
| Degree of Resolution of Measures | Medium |
| Relevance Degree of the Impact | Medium |

8.11 JOBS, INCOME AND ECONOMIC ACTIVITY


Increase in jobs, income, and economic activity to the local population and municipalities is an overall positive impact and will occur during construction and operation stages from the following PNP1000 activities:

- Acquisition of goods, supplies and services
- Construction of the project and its structures
- Operation of the project and its structures

These activities will result in the following:

- Demand for goods and services from the Project
- Job creation in construction and operations
- Consumption of inputs and natural resources
- Generation of taxes (taxes, fees, contributions, royalties)
- Changing local or regional economic dynamics

PNP1000 is committed to giving priority to the recruitment and hiring of local labor, which means during construction peak some 90 workers are expected to be hired locally (60% of the total) and for operations 100 of the total workers shall be residents of local municipalities (83% of the total workforce demand). According to the PNP full-scale ESIA, investments in civil construction and mining activities generate, respectively 0.6 and 1.05 indirect jobs for each direct job created. Therefore, some additional 90 indirect jobs are expected to be created during construction period, and some 120 during operation, not all necessarily from the local municipalities.

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Although PNP1000 is of small scale, the jobs generated in these phases will have an important positive impact on the local economy, since, according to the data assessed in the PNP full-scale ESIA, about 90% of formal employment in these small local municipalities came from the public administration, which indicates the low dynamism of their economies.

The PNP1000 workers will spend part of their wages on the purchase of local goods and services, and PNP1000 itself should demand different types of inputs and services necessary to maintain its operation, as far as possible, these should be purchased from the ADI suppliers. Therefore, both actions will cause a further increase in jobs and income for the local and regional economy.

This impact was assessed as follows:

Table 8-22 Jobs, Income and Economic Activity Impact Magnitude Assessment

| Attributes | | | |
|--------------------------------|-----------|-----------------------------|-------------|
| Nature | Positive | Order | Direct |
| Occurance - Probability | Certain | Reversibility | Reversible |
| Occurance - Term | Medium | Form of interference | Intensified |
| Occurance - Spatiality | Dispersed | Duration | Temporary |
| Magnitude | | | |
| Qualitative | Medium | | |

The measures that can enhance the positive effects of this impact are:

- Adoption of measures that encourage the hiring of suppliers of local and regional goods and services
- Hire as many local workers as possible (including the service providers), focussing on the municipalities of the ADI
- Training of hired workers, aiming at their future employability, as well as expanding the future matrix of local specialized labour and enabling reintegration into the labour market during the closure phase of the project
- Establishment of frequent communication channels that provide official information on the demand and qualification required for hiring labour
- Dissemination of information to the population explaining how the recruitment and selection of labour will take place in due time



These actions are detailed in the Human Resource Management Program, Contractor Management Program, and the Social Communication and Stakeholder Management Program.

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Table 8-23 Jobs, Income, and Economic Activity Impact Degree of Relevance

| Degree of Empowerment and Relevance | |
|-------------------------------------|--------|
| Degree of Potentiation of Measures | Medium |
| Relevance Degree of the Impact | Medium |

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9 SOCIO-ENVIRONMENTAL PROGRAMS

The socio-environmental programs detail the actions and measures proposed in the Environmental and Social Impact Assessment which aim to enhance the positive effects and minimize the negative effects of the implementation of the PNP1000. These follow the same objectives and principles as the ones envisaged for the PNP full scale, in compliance with all related regulations and informed by the applicable IFC Performance Standards, but will be fit for purpose for the smaller PNP1000 project. Regular management reports presenting performance indicators and evidences of actions taken and results will be produced and disclosed to authorities and project stakeholders as needed. The PNP1000 programs are presented below:

Below are the programs proposed in this study (and their main objectives):

- Sulfuric Acid Transport Management Plan (*ensure safety*)
- Solid Waste Management Program (*ensure correct disposal of waste*)
- Effluent Monitoring Program (*ensure good quality*)
- Traffic Management Program (*ensure optimized vehicles movement*)
- Prevention and Control of Erosion Processes (*prevent, monitor, and correct erosions*)
- Air Quality Monitoring Program (*ensure good quality*)
- Surface Run-off Control Program (*control of water emissions*)
- Groundwater Monitoring Program (*ensure good quality*)
- Bio-diversity Management Plan, including:
 - Flora Removal Control Program (*ensure correct vegetation clearing*)
 - Fauna Chase Away and Management Program (*minimize damage and being run over*)
 - Degraded Areas Recovery Program (*recovery areas*)
- Social Communication and Stakeholder Management Program (*ensure continuous, transparent and two-way communication about project development, Grievance Mechanism*)
- Human Resource Management Program (*train and value the workforce*)
- Contractor Management Program (*establish good performance requirements*)
- Local Communities Self-Sustainable Development Program (*sponsor and provide support to community projects*)
- Risk Management Program and Emergency Response Plans
- Security Management
- Cultural Heritage and Chance Finds Procedure (*managing any archaeological finds*)
- Greenhouse Gas Emission Reduction

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9.1 ORGANIZATIONAL CAPABILITY

At PNM, the Environmental and Social organizational responsibilities include but are not limited to the following:


- Perform, manage, and control all action plans including those that resulted from the licensing process to secure the continuity of the project implementation activities and future operation
- Complete and maintain up to date a detailed list of local, regional, and national stakeholders that might have a direct or indirect impact on the project activities or that will be positively or negatively impacted by the project activities
- Assess each key stakeholder to identify those that require specific actions plans to manage the relationship targeting win-win scenarios
- Complete and maintain up to date a detailed list of all the legal requirements, international standards, and best practices; then define and manage action plans to guarantee full compliance of all project activities
- Establish working relationships with local and regional authorities to identify, propose, and manage social programs that contribute to the improvement of the quality of life index in the project area

9.2 SULFURIC ACID TRANSPORT MANAGEMENT PLAN

The transportation of sulfuric acid will be contracted following a formal bidding process that calls for the following requirements:

- Evidence of all legal permits authorizing the transportation company to handle, and transport concentrated sulfuric acid
- Emergency response plan for events during:
 - Loading of the truck at the supplier
 - Transit in public roads
 - Offloading of the truck at the project facilities
- Details of training program for drivers and for the emergency response team
- Driving protocols:
 - Proposed routes
 - Hours (the expectation is that the driving will only occur during daylight hours allowing time for the driver to properly rest)
 - Live monitoring system
- Insurance policies (proposed to be negotiated or included)
- Track records with similar clients

The future operation of the PNP1000 plant will require 118 t of acid per day. This is equivalent to 4 trucks per day. The proposed storage capacity is equivalent to 13 days of operations.

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The procurement team have already identified several transportation companies that are suitable to participate in this bidding process with the fleet capacity required to meet the PNP1000 sulfuric acid transportation needs without affecting the market (i.e. we do not need to compete for trucks with other customers).

9.3 SOLID WASTE MANAGEMENT PROGRAM



This program covers two principal activities; management of solid wastes generated directly by the mining and processing operations (waste mine rock, IFC/BFC, and spent ore) and 'domestic' type waste generated by the operational areas and camp.

Mine rock will be stored in an area adjacent to the PNP1000 pit. A run-off water collection box will be installed to avoid silty water generated by rainfall entering local water courses. This material has no propensity to generate acid rock drainage.

The process plant solid residue storage (for spent ore and IFC/BFC) will be an area properly prepared (vegetation removal, ground leveling and compaction) and protected with the following components:

- Sub drainage system to conduct groundwater and rain runoff outside of the project area without getting in contact with the residues
- Protection berms and structural berms to allow the stacking of residue to a maximum height of 10 m per bench and engineered slope angles
- Underlining system with a low-density polyethylene geomembrane, 2.0 mm (80 mil) thickness to eliminate the infiltration of process water to the ground
- Water collection system to gather any released by the compaction of the stacked residues plus any rainfall over the area. The channels and drainage networks will conduct that water to a pond located at the lowest point of the residue storage facility from where it will be pumped and added to the process water system (reducing the fresh water intake during the rainy season)

Regarding 'domestic' waste, the Solid Waste Management Program aims to ensure adequate collection, segregation, temporary storage, transportation, treatment and final disposal of the remaining solid waste generated by the project, thus minimizing and avoiding the risk of contamination of soil and water resources. Actions will be implemented to establish procedures and standards, to train project personnel, to establish inventories and to control, monitor, and report on these efforts with a view to reduce, reuse, compost or recycle waste where practicable

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9.4 EFFLUENT MONITORING PROGRAM

Planned mitigation measures will entail refurbishment of the septic tank systems at the plant and camp. The latter to manage increased loads due to the camp expansion. The water and oil separator system at the plant site will also be refurbished. There will also be implementation of inspection boxes and an emergency pond in the area of the leach solution ponds to control and monitor any acidic solution leakage.

The Effluent Monitoring Program will then check the efficiency of the treatment systems and ensure compliance with legislation and regulations relating to environmental quality, through routine inspections of the control structures and through laboratory analysis of effluent samples, aiming to avoid soil and water contamination and that effluent composition are in compliance with Brazilian standards before any discharge to the environment (which is not currently envisaged).

9.5 TRAFFIC MANAGEMENT PROGRAM

One of the main socio-environmental risks identified before the operation of the Demonstration Plant began was the potential for traffic accidents involving own and or third-party vehicles.

The Traffic Management Program will ensure optimized vehicle movement (including third parties and service providers) aiming to reduce noise, vibration, dust and risks of accidents for the project and surrounding communities, besides reducing pressure on the roads' structural conditions. The following further actions will also be included in the program

- Drivers and staff (including third parties) will be trained for safe driving, to strictly follow procedures and restrictions (speed, communication, driving hours etc.), and also to register near misses and accidents
- Vehicle tracking and speed monitoring system will be operational to assist traffic control and to support prevention and investigation of incidents
- The program will also act to communicate with the effected communities in a timely manner to disclose the internal traffic procedures and project's development, and to motivate them to use the companies' grievance mechanism to report nonconformities and also to suggest actions to continuously improve safety and reduce associated discomfort.
- Continuous partnering with the municipality to promote maintenance and signaling of used roads to assure good and safe conditions to users



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Figure 9-1 PNM's voluntary lecture on Road Safety in Gonçalo Dias School for elementary students in the municipality of Campo Alegre do Fidalgo (August, 2017)



9.6 PREVENTION AND CONTROL OF EROSION PROCESSES

The Prevention and Control of Erosion Processes Program aims to avoid, monitor, and correct erosion processes during project construction and operation, through installation of control structures, routine inspections and monitoring actions, and recovery of degraded areas as soon as possible and feasible. This program presents complementary actions with the ones envisaged by the Surface Run-off Control Program and Degraded Areas Recovery Program. The actions and guidelines predicted are:

- Identification of areas susceptible to erosive processes
- Systematic visual monitoring of the target areas. In the rainy season and after significant rainfall events, the inspection should be intensified due to the increase in the potential for carrying solids
- Issuing reports with the status and characterization of each target area, prompting those responsible for preventive actions, maintenance / cleaning and correction of non-conformities
- Application of sediment containment methods in areas with exposed soil (storage, excavation, borrowed material area, etc.), as well as implementation of a definitive and temporary drainage system equipped with sediment containment systems and other relevant devices.
- Protection and maintenance of slopes and cuts in an appropriate condition;
- Careful execution of earthmoving services, according to meteorological forecasts, so as not to expose areas more sensitive to erosion to rains, and adopting construction practices to prevent soil erosion, including measures to temporarily protect the slopes, for example, using covers
- Consolidation of the earthworks, and starting the recovery of the areas / plant protection, in sections as they reach their definitive geometry
- Every area subject to soil interventions must be provided with a water drainage system for temporary rainwater control, with the necessary cleaning, unblocking and maintenance of the respective system

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9.7 AIR QUALITY MONITORING PROGRAM

The Air Quality Monitoring Program will act to reduce, control and monitor generation/resuspension of dust and particulate matter and exhaust fumes from vehicles and equipment, to minimize impacts and discomfort to employees and surrounding communities.

Water sprinkling of the access roads is envisaged in both the construction and operation phases during the dry season to reduce the impact of dust generation by vehicles (especially trucks). The plan is to limit this to the areas near to the community houses which is estimated to be less than 3 kilometers in total (out of the 20 km of the unpaved road). A detailed survey of the road to define the specific points that will require dust control will be conducted and in parallel cost-efficient alternatives to apply some sort of sealant to replace the use of water will be explored.

Drivers and staff (including third parties) will be trained for safe driving and to strictly follow procedures and restrictions in order to minimize any discomfort to effected populations.

PNM will document (and retain copies of) all own and contractors' vehicle and equipment inspection reports which include measurement of emissions and operating hours.

9.8 SURFACE RUN-OFF CONTROL PROGRAM

The water management plan includes in the design an emergency pond sized to hold water from a 200 mm of rainfall in any 24-hour period over all plant catchment areas (leach pad, process ponds and residue disposal areas). The dynamic water balance model shows less than 2% probability of the emergency pond overflowing to the environment during this type of event. Despite this low probability, the planned operating protocols include the treatment of water with hydrated lime to adjust pH and element contents follow by a filtration system to guarantee the maximum total suspended solid allowed by the discharge standards established by the Brazilian Environmental authorities. The planned capacity of the water treatment plant to be installed as part of the PNP1000 processing facilities is 7 m³/h which will always be used proactively to maintain the emergency pond level close to zero.



The treated water will be first used to replace freshwater intake with release to the environment as the last resort.

The release (if necessary) will be done into the Várzea stream and the release system will include monitoring and sampling points to document any event and demonstrate compliance with the environmental standards.

The maximum recorded 24-hour rainfall event is 100 mm (based on seven years of historical databases in the project area).

9.9 GROUNDWATER MONITORING PROGRAM



Similarly to the Effluent Monitoring Program, the Groundwater Monitoring Program will evaluate the efficiency of the proposed control systems and ensure compliance with legislation and regulations relating to environmental quality. Among the actions are routine inspections and maintenance of control structures (inspection boxes, residue storage, fuel stations, equipment and vehicles shop, oil and water separators), and continuance of sampling and laboratory analysis of ground water from the existing boreholes at the Demo

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Plant (done quarterly), and from additional boreholes to be drilled when future pads and ponds detailed engineering layouts are ready, to confirm that the project is not causing any groundwater contamination.

A geophysics study will be developed to define the exact and best location for the future project raw water borehole (some 3km away from the Demo Plant to reach the Serra Grande Aquifer). The study will be followed by drilling a pilot borehole (with technical specs defined and expected to be of some 100m deep), and also carrying out pumping tests on the existing boreholes within the target area (such as the ones in the Várzea's and Veredas' settlements) to confirm the aquifer capacity in the area. Once sustainable water availability is confirmed, documentation will be prepared and submitted to SEMAR to apply for the water use permit award.

The program will also sample and monitor for any adverse effects to existing water borehole users in the closest surrounding communities (abovementioned), which is not currently expected, both in quantity and in quality.

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9.10 BIO-DIVERSITY MANAGEMENT PLAN

For establishment of this plan it was necessary to determine if the proposed land to be cleared should be considered modified or natural habitat, according to IFC Performance Standard – PS 06.

Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area’s primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.

Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area’s primary ecological functions and species composition



PNM has undertaken detailed mapping of the habitats across the Project footprint and surrounding areas. The Caatinga vegetation which will be removed by the Project is, whilst in large part degraded by human actions, classified as natural habitat as per IFC PS6. The Project alternatives assessment has identified that there are no viable alternatives to the location of the PNP1000 plant or the proposed mining area, with the use and expansion of the existing Demonstration Plant area considered to result in the lowest impact on the Caatinga habitat.

In addition to applying the mitigation hierarchy, minimizing habitat fragmentation, and post mining restoration planting, as part of the design of the Project, PNM will assess off-setting opportunities. The Caatinga habitat is currently subject to clearance for agriculture and has no protection status. As part of PNM’s Biodiversity Management Plan, PNM will work with the local stakeholders and Affected Communities to develop off-setting strategies which are sustainable and supported by the local stakeholders. These are likely to include initiatives to restrict foraging by goats and the subsequent degradation of the Caatinga, and discussions with the local municipalities on the protection of areas with existing Caatinga and preservation of the habitat and its biodiversity value.

9.10.1 FLORA REMOVAL CONTROL PROGRAM

Part of the overall Bio-diversity Management Plan, the Flora Removal Control Program aims to ensure correct and minimum Caatinga vegetation clearing to allow construction of the project elements and compliance with deforestation permits, standards and best practices, including wooden material management and its final destination and potential use. Some of the actions predicted are:

- Checking of compliance requirements before activity start: deforestation permit in place, execution team is experienced, trained and fully permitted, all machinery and equipment legally registered
- Deforestation Planning: kickoff meeting, deforestation areas defined over engineering layouts, field delimitation of areas to be cleared, installation of control and drainage systems to avoid impacts to surrounding environment, schedule of activities, activity risk assessment, and team HSEC training.
- Promote, whenever possible, the collection of plant material of species for use in rehabilitation of areas (specially from the “ipê-cascudo” - *Handroanthus spongiosus* tree species, which is the only plant species considered “In Danger” according to the official Brazilian list of threatened species).
- Fauna chase away, following the procedures predicted in the specific program

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- Vegetation clearing: accesses opening, maneuvering yards and planned stock, and subsequent thinning, separation and stacking of wood material by diameter class and potential use (firewood, fence posts, sawmills) for later transport to storage and cubing yard.
- Area cleaning: root detachment, wood chipping, raking, removal and use of vegetation remains
- Inspections, and activity monitoring and control, producing evidence and reports of procedural fulfilment.

9.10.2 FAUNA CHASE AWAY AND MANAGEMENT PROGRAM


Fauna Chase Away and Management Program aims to minimize impacts on fauna during vegetation clearing and to monitor any fauna run over by vehicles in order to act to reduce such accidents. Predicted actions are:

- Chase away (sirens and whistles) and translocation (nests and low escape capacity specimens) of fauna specimens, done by trained personnel with PPE prior and concomitant with the operation of the machines and equipment used during the cutting and removal of vegetation, in order to avoid death by being run over.
- Actions to control the speed of vehicles and equipment through signaling on site and local roads, and the discouragement of driving at night
- Guidance for drivers and pedestrians regarding the necessary precautions for safe traffic
- Periodic maintenance of equipment and vehicles
- Train workers on the prohibition on hunting wild animals, emphasizing their importance in the maintenance and sustainability of natural environments, and
- Demystify issues related to snakes and other wild animals, guiding workers on ways to avoid encountering potentially dangerous species and enabling them to take the right actions in the event of chance encounters
- Death of wild animals must be avoided as a priority, and recorded if it happens by all personnel (inside and outside site), for later compilation of data and indicators to be organized and reported by the Environment team in performance reports

9.10.3 DEGRADED AREAS RECOVERY PROGRAM

The Degraded Areas Recovery Program aims to reestablish ground physical stability, as well as the readjustment and / or improvement of landscape and environmental conditions, restoring, when necessary and feasible, the ecological or economic use of the affected area. The following activities are part of this program:

- Schedule project activities to be both compatible with later recovery actions and to minimize the time that soil and slopes are exposed to erosive agents
- Where possible, schedule construction earthmoving to be carried out outside the rainy season
- Shaping of slopes in effected areas to reduce erosion potential
- Promote systematic preventive and corrective actions to reduce as much as possible environmental degradation from erosion processes

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- Adoption of constructive soil protection techniques (containment, drainage, and other systems)
- Maintenance of drainage systems and access structures
- Management and storage of surplus material, including topsoil
- Use of topsoil from other land clearing areas to cover degraded areas, when timely available and feasible
- Partnership with research institutions and local communities to define possible and feasible future use of degraded areas, and monitor performance of recovery strategies deployed

9.11 SOCIAL COMMUNICATION AND STAKEHOLDER MANAGEMENT PROGRAM



BRN's PNP1000 Stakeholder Management Plan will build on the existing stakeholder engagement activities that have already been undertaken at a community and municipality level. This will set out BRN's approach to the on-going disclosure and dissemination of information, working towards achieving the IFC PS1 requirement of Informed Consultation and Participation (ICP). The Stakeholder Engagement Management Plan shall include an improved description and profile of stakeholders taking into consideration the socio-economic areas of influence. Stakeholders include regional municipal representatives, as well as the five communities surrounding the Project which are essentially made up of small groups of rural agricultural producers. Specifically, the Veredas community will be engaged with in relation to potential community health and safety impacts arising from the Project's use of the municipal road.

Community-level engagement will focus on potential employment and training opportunities, community development initiatives, potential adverse impacts arising from the Project, as well as unplanned and emergency events. The engagement shall seek to obtain the views and opinions of men, women, agricultural livelihood groups, and focus on the way in which Project impacts could disproportionately affect vulnerable and disadvantage groups.

A transparent, culturally appropriate and effective grievance mechanism will be established to enable grievances to be recorded and investigated in a timely manner. The mechanism will enable grievances to be submitted anonymously.

The Stakeholder Management Program will be scaled to the project risks and impacts of the PNP1000 project, and sit within BRN's broader Stakeholder Engagement Framework which will set out BRN's general principles and strategy to identify the Affected Communities and other relevant stakeholders for engagement once BRN commences the BFS for the full scale project. This will also set out BRN's strategy and commitments to ongoing reporting to the Project-Affected Communities and other stakeholders, and the manner of consultation to ensure that this is a two-way process, and commences early in process of identifying potential risks and adverse impacts which may be of concern to the Affected Communities.

PNM also seeks to maintain constant and transparent communication with public and private representatives at the regional and state levels, aiming to establish partnerships and potential synergies for the sustainable development of the region. To this end, a "Protocol of Intent" between PNM and the Piauí State Government was signed in May 2017 to formalize the partnership between the parties thereby strengthening local sustainable development through the generation of local jobs and use of local services by PNM. More recently, PNM agreed with the State and Municipal governments to donate some medical and sanitation supplies and PPE (Personal Protective Equipment) to aid the fight against the COVID-19 pandemic.

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PNM executed a successful plan to enable the local community to participate at the Piauí Nickel Project Full Scale Public Hearing, held by SEMAR (the state environmental authority) on June 18th, 2019 as part of the project's *Licença Prévia* (LP, preliminary environmental license) permitting process. Timely publicity of the event through different channels (flyers, banners, websites, sound cars, radio stations and personal invitations) was conducted. In addition, pre-meetings were held with the project's key stakeholders, leaders, and communities (including participation of the consulting company responsible for the project's Environmental and Social Impact Assessment) to engage and prepare for the event. PNM also provided transportation for rural communities and hired an adequate and comfortable hall for the event (along with good quality audio-video transmission and recording facilities). All this proved to be an effective strategy, with around 300 people participating in the 3-hour event, including the State Environmental Secretary and mayors and counsellors from the four local municipalities surrounding the project. The meeting was successful, with no interruptions, and all questions (both written and oral) were pertinent and legitimate, were properly and effectively answered and there were no complaints against the project's concept or development. SEMAR issued the project's LPs in October 2019 and January 2020 without any unexpected conditions for the next permitting phases.

The main issue raised regarding the PNP1000 implementation is the high expectation of the local stakeholders for new job openings locally and that the project kicks off as soon as possible, this coming especially from the public representatives of Capitão Gervásio Oliveira.

Further details of past and current social communication and stakeholder management are provided in a separate PNM report on "Social Actions & Stakeholders Management" to April 2020.

9.12 HUMAN RESOURCE MANAGEMENT PROGRAM

The Human Resource Management Program aims to make maximum use of the local supply of workers (recruitment and selection process), to seek to increase the professional qualification of contracted workers and carry out actions aimed at professional training.



Thus, the PNM Human Resources Management System aims to:

- Ensure employee relations issues are managed justly and in a coordinated and consistent manner
- Achieve compliance with relevant industrial relations legislation
- Minimize lost time due to industrial action by delivering a stable employee relations environment

The main components of the human resources management system are:

Labor Sourcing. People from the local community will be the first to be assessed to determine if they can fulfil a job opening. The next level of search will be to the State level, then within the north-east region of Brazil and lastly in Brazil as a whole. The main purpose of this is to minimize the influx of people from other areas while there are not job opportunities for local people.

To this end, PNM has already established and standardized the procedures and criteria for the personnel recruitment and selection process. The procedure also designed to ensure that PNM is in full compliance with its commitments to the Piauí State (PI State Protocol, as published in the Official Gazette May 26th 2017) to assess worker availability with sufficient skills in the municipalities of the project's Areas of Direct Influence, the surrounding communities and Statewide.

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In preparation for, and during, the Demonstration Plant operations in 2016/2017, which was comparable to the PNP1000 in terms of the attributes and skills required, all temporary workers were recruited from the neighboring municipalities within the project's ADI. PNM's Community Relations Coordinator led this process, initially by inviting local residents to apply for temporary positions during site cleanup activities, prior to operations of Demonstration Plant, in December 2015. By inducting temporary employees into the Group's standards of practice and conduct, and offering basic relevant training to them throughout the cleaning up process, many of the recruited local residents became appropriate candidates for full-time employment in 2016. Those hired were appropriately trained to maintain and operate the Demonstration Plant throughout the refurbishment and operational stages.

Remuneration scheme. Designed to attract and retain skilled and competent employees using competitive market labor rates and benefits according to the area where the project is located and to similar industries.

Compliance with Labor Laws. Implement all legal requirements to guarantee full compliance.

Relationships with Unions. Effectively manage communications, employee relations and the working environment to maintain a positive relationship with all employees and their unions associations.

Fair Treatment Protocol. Established to timely and effectively correct any unacceptable performance or behavior while guaranteeing fairness, consistency, and equitable treatment to all employees.

Training Programs. Designed to improve people's skills and competencies.



9.13 CONTRACTOR MANAGEMENT PROGRAM

The project management plan gives specific guidelines to pre-select, select and work with specialized contractors and general service providers. Some highlights from those guidelines are:

- The pre-selection process will be based on legal compliance of a potential contractor. Verification of all applicable legal permits to fulfil the specific scope to be contracted, applicable tax regime to estimate total cost and the evaluation of the financial state of the company will be part of this process
- The bidding process to be circulated for the final selection process will include our expectations regarding sourcing of the work force:
 - Local personnel are highly preferred. If skills are not available in the towns close to the project area (Capitão Gervásio Oliveira, Campo Alegre do Fidalgo and São João do Piauí) then Piauí state should be the next area to search with the aim of maximizing the regional source of people
 - Workforce diversity is encouraged

These are recommendations and PNM understand the decision to employ is solely at the Contractor's discretion and responsibility.

- Equal opportunities for employment, compensation, instruction, and advancement will be enforced. Any sort of differentiation, harassment and discrimination on any ground including but not limited to race, caste, nationality, religion, disability, gender, sexual orientation, union

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membership, political affiliation or age is firmly prohibited

- For specialized contractors, specific training records and certificates must be provided as evidence of people’s qualifications to perform the activities before the startup of field works
- Contractors performing works on site must provide adequate levels of technical and health & safety supervision (depending the complexity of the scope of work and regardless the number of people in the crew). The number of supervisors will be defined based on the scope of work
- All general and specific health, safety and environmental policies, standards, guidelines, and procedures defined by PNM are to be applied in the exact same way to both the employees and the contractors. This means that all people working at the project site, regardless of the contracting entity, will have the same quality of working conditions
- The contractor is required to present evidence of the on-time payment of all labor legal obligations to all people working at the project site. Specific controls will be detailed in the terms and conditions of the contract
- Child labor is strictly prohibited
- PNM will clearly inform the selected contractor with detailed standards and procedures regarding change orders to minimize conflicts at the end of the services and to ensure the adequate control of the time and money allocated to each contract
- No job will be performed without a formalized contract

9.14 LOCAL COMMUNITIES SELF-SUSTAINABLE DEVELOPMENT PROGRAM

Local Communities Self-Sustainable Development Program aims to foster the skills and capacities of the local communities, promoting the development of other activities in parallel to the project and independent of it, and expanding the local productive dynamics and capacity, aiming to leave a positive legacy of the project in the region (especially near to project closure and workforce demobilization). Actions of this program are:

- Creation of a working group, composed of representatives of organized civil society, local government, and impacted communities, focusing on proposing and monitoring local development activities
- Setting up of a diagnostic study of the economic potential of the municipalities of the ADI, which must be done in rural and urban areas
- Establishment of partnerships with institutions, public and / or private, for the development of the program's actions
- Proposals from the project’s working group, based on the diagnosis made, which should be for both rural and urban areas;
- Monitoring of the developed projects, through indicators, targets, and action plans;
- Offering courses and training related to the development of activities relating to pilot projects, giving successful activities sufficient scale to develop the local community;
- Supporting the implementation of infrastructure that can serve as drivers of productive activities, such as irrigation projects.

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It is important to emphasize that the activities proposed for the development of local communities will start in the middle of the project's operation phase, and must not maintain an economic relationship with the project activities, so that they can be self-sustainable even after the project is deactivated.

9.15 RISK MANAGEMENT PROGRAM AND EMERGENCY RESPONSE PLANS

Risk Management Program and Emergency Plan aim to increase safety and promote a faster and efficient response to emergencies, through well established procedures and periodical risk assessments within the team and with key stakeholders.



The risk management system also analyzed, in a separate exercise, site and travel security.

9.15.1 SECURITY MANAGEMENT

Results of the security risk analysis are presented below:

Table 9-1 Security Risk Analysis Results

| Hazard / Risk Scenario | Risk Rating | | | Risk Category |
|--|--|--|--|---------------------|
| | Severity | Exposure | Probability | |
| Crime = Robbery, break-in, assaults, carjacking and/or armed hold-ups in both company property and public roads. | Moderate (An event going wrong could lead to a Single Fatality) | Occasional (Travel guidelines and restrictions to daytime only, continuous security updates from Police Department) | Improbable (Area with low crime rates in comparison with large urban areas and adequate police presence) | Category 3 – Medium |
| Social Stability – Lack of government presence to attend basic public needs, high poverty rate, inadequate community engagement plans by PNM, poor management of community expectations regarding jobs and project benefits. | Medium (Continuous social and local community issues impacting normal project activities) | Frequent (Link to continuous project activities) | Possible (Good community acceptance to date with high expectation of project benefits, management plans still need to be implemented) | Category 3 – Medium |
| Terrorism – Deliberate attack to a targeted project facility with the aim of producing significant harm. | Very High (Multiple fatalities, significant damage to property and permanent damage to the environment) | Remote (Once or more times in the project life) | Exceptional (No known terrorist groups in Brazil, no evidence of organized crime or gangs presence in the project area) | Category 4 – Low |

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Following on from the above, PNM has the following security management plans which include the following current and planned actions:

- Partnership with the Public Security Secretariat of the Piauí State and the local civil police and military police representatives to have access to detailed security assessment and recommendations from the authorities
- Travel guidelines for employees, contractors, and visitors
 - Travel at night is not allowed
 - Vehicles with continuous monitoring via GPS. This includes vehicle transporting reagents (i.e. sulfuric acid) and valuable cargo
- Local stakeholder's management plan to promote local development and thereby enhanced local security situation
 - Direct and indirect promotion of job creation:
 - Recruitment of community members
 - Contracting local and regional service providers
 - Search local and regional markets first for procurement of goods
 - Promote sustainable projects unrelated to the project activities (i.e. that can continue after project closure)
 - Collaboration with the municipal authorities to improve the quality of life index for the region developing projects that positively impact, security, health-care services, education, and basic infrastructure for public services such as water supply and treatment, sewage treatment, waste management among others.

9.16 CULTURAL HERITAGE AND CHANCE FINDS PROCEDURE

Mineral workings have the potential to impact archaeological resources directly through land clearance and the disturbance of above or below-ground sites and indirectly, through ground vibration, the deposition of airborne dust, traffic movements and waste disposal. The Sustainability Management System contains a procedure which provides guidance to BRN employees and contractors on how to deal with chance finds arising through construction and operational activities.

The procedure requires that all personnel involved in land clearance and excavation should take responsibility for managing archaeological protection and are to be trained in these aspects. BRN employees should respect the cultural and social significance of any such finds during the life of mine and are strictly prohibited from interfering with or disturbing any such deposits. Should any archaeological artefacts (relics, stone tools, bricks, bones, ceramics, graves etc.) be encountered, activities will halt immediately, the site will be isolated and clearly marked and the HSE Manager immediately informed. The HSE Manager will then liaise with the relevant ministry to determine the need for further investigation/appropriate action and any subsequent investigation or excavation works will be conducted by a suitably qualified archaeologist according to the legal requirements and BRN's procedure.

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9.17 GREENHOUSE GAS EMISSION REDUCTION

The nickel and cobalt products from the PNP1000 will most likely be sold as feed for the electric vehicle battery market. The direct (scope 1) CO₂ emissions for BRN's heap leach process are already lower than most peers in the nickel mining industry however there are opportunities to reduce the emissions further. Therefore BRN is looking at innovative ways to reduce the project carbon footprint as much as possible, with the ultimate vision of being carbon neutral.

As part of the PNP1000 project, BRN will investigate capturing the CO₂ emissions from the use of limestone in downstream precipitation plant which is one of the main sources of the gas.

The pregnant leach solution (PLS) from the heaps is fed to the downstream plant where limestone is used to raise the pH to enable impurity removal before the purer solutions can be further treated to produce the nickel and cobalt products.

In the case of PNP1000 this use of limestone emits 4,815 tonnes of CO₂ per year or 3.35 t CO₂ /t Ni, this is more than 70% of the scope 1 CO₂ emissions. In the final stage of the process the "barren" solution contains significant amounts of magnesium sulfate (MgSO₄) theoretically this can be used to react with the CO₂ to capture it as stable magnesium carbonate (MgCO₃) which can then be safely stored or sold for use in the varied industrial end uses.

The process needs a catalyst and various options are available which will be tested by BRN with the expectation of future commercialization within its projects, and in particular the full-scale project at the PNP.

Furthermore, investigations will be undertaken to review whether all electric vehicle fleets could be used in the future of the Piauí Nickel Project for both personnel transportation and mining. This could further reduce the company's GHG Scope 1 and 3 emissions.

Finally, as part of further studies for the full scale PNP, investigations will also be made into whether any reductions in atmospheric carbon dioxide levels would be possible by capturing, removing and/or storing carbon in biological or non-biological sinks (e.g. forestry, land use management, underground reservoirs) within the project area.