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ENVIRONMENTAL IMPACT REPORT – EIR FOR THE THERMOELECTRIC COMPLEX

BARRA DOS COQUEIROS/SE

December/2015
Revision 00
Vol.01

SUMMARY

PRESENTATION

This Environmental Impact Report (EIR) is based on the Environmental Impact Assessment (EIA) produced for the planned Thermoelectric Complex in the city of Barra dos Coqueiros, Sergipe.

In accordance with Brazilian legislation and in order to initiate the preliminary environmental licensing process for the project referred to as the Barra dos Coqueiros Thermoelectric Complex, Genival Nunes project and environmental consultants work contracted to carry out preliminary studies, which will be used as the technical basis for the process involving the State Department for the Environment (Administração Estadual do Meio Ambiente - ADEMA).

The development referred to as Barra dos Coqueiros Thermoelectric Complex is part of a group of three thermal power stations referred to in this document as Porto de Sergipe I, Laranjeiras I and Marcelo Deda. The EIA contains a detailed description of the technology used to teach Plant.

Supporting the environmental feasibility phase, this RIMA provides a summary of the analysis and conclusions from the EIA, addressing various issues in the region surrounding the development.

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PRELIMINARY LICENSING PROCESS

Number: **2015-002193/ADM/ADM-0495**

Project: **Barra dos coqueiros Thermoeletric Complex.**

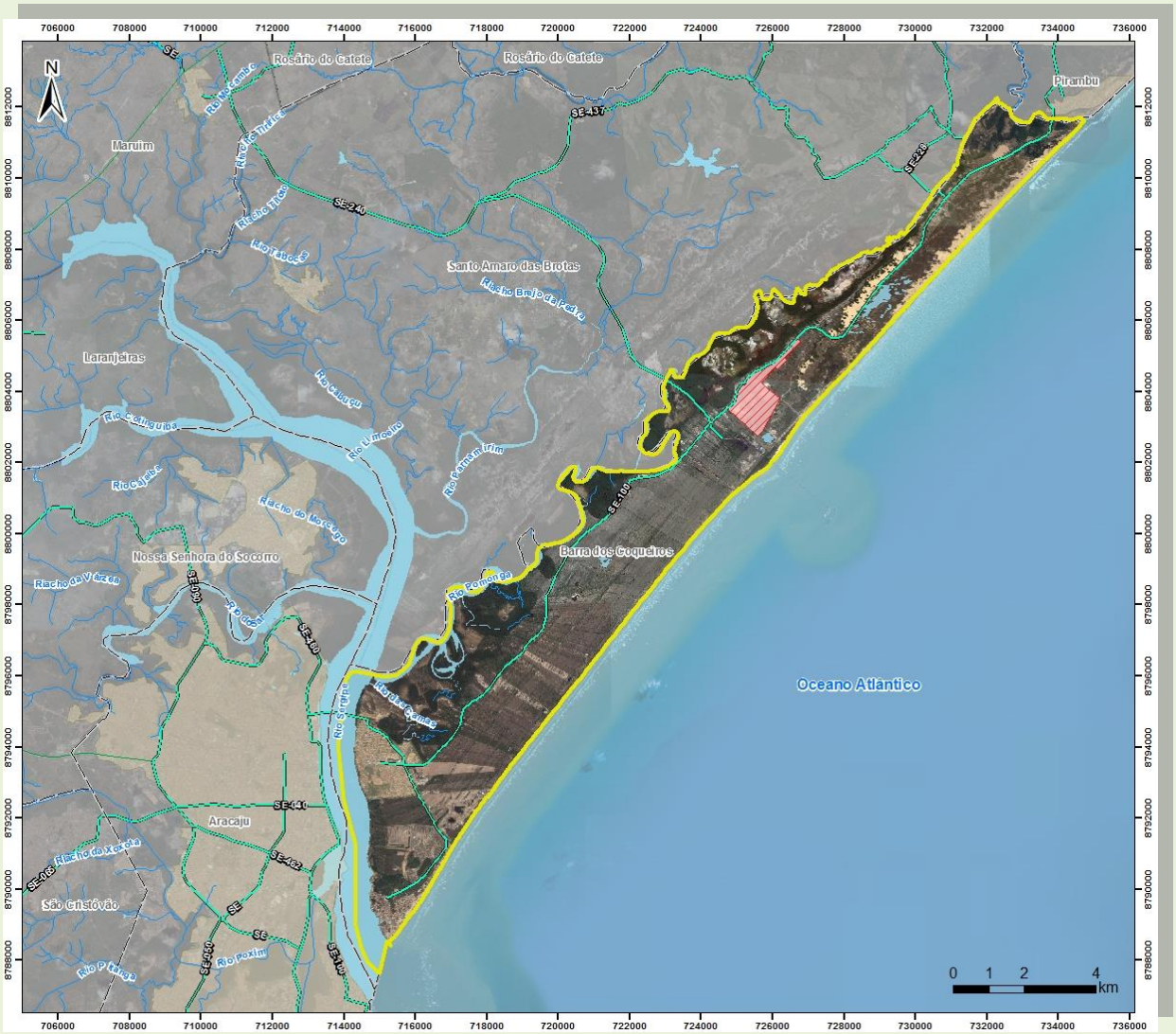

Figura 1. Project Site (polygon marked in red).

THE PROJECT

The Thermoelectric Complex is an industrial project located in the city of Barra dos Coqueiros - SE and covering a total area of 1,646,886.31 m2.

The site designated for the project is adequate for installation of the plant equipment, units and buildings. Certain alterations will be made in light of dynamic and static load distribution and characteristics. The land is level and free of any significant vegetation.

ALTERNATIVE LOCATIONS

Initially, three possible sites were analyzed for the thermoelectric complex:

- An area in the city of Laranjeiras;
- An area in the city of Santo Amaro das Brotas;
- An area in the city of Barra dos Coqueiros.

The reasons for selecting the area in Barra dos Coqueiros are listed below.

- Fuel supply logistics;
  - Liquefied gas will be transported by ship and, using a regasification process, it will be transported to the TPP (Thermoelectric Power Plant) via pipeline;
  - Proximity to the Inácio Barbosa Sea Terminal (IBST).
- Gas pressure over the section between the IBST - TPP;
- Physical site characteristics;
  - Level of anthropisation;
  - Proximity to Conservation Units and Preservation Areas;
  - Local industrial development;
- Water supply logistics.

In the past, the area has been readied for construction of a chlorine and chemical plant and certain basic structures have already been built at the project site (access roads, earthmoving, etc.)

According to the Master Plan for Sustainable and Collaborative Development in the city of Barra dos Coqueiros, the project is located in a Rural Zone (RZ).

The project includes construction of three thermoelectric power plants, referred to as Porto de Sergipe I, Laranjeiras I and Marcelo Deda.

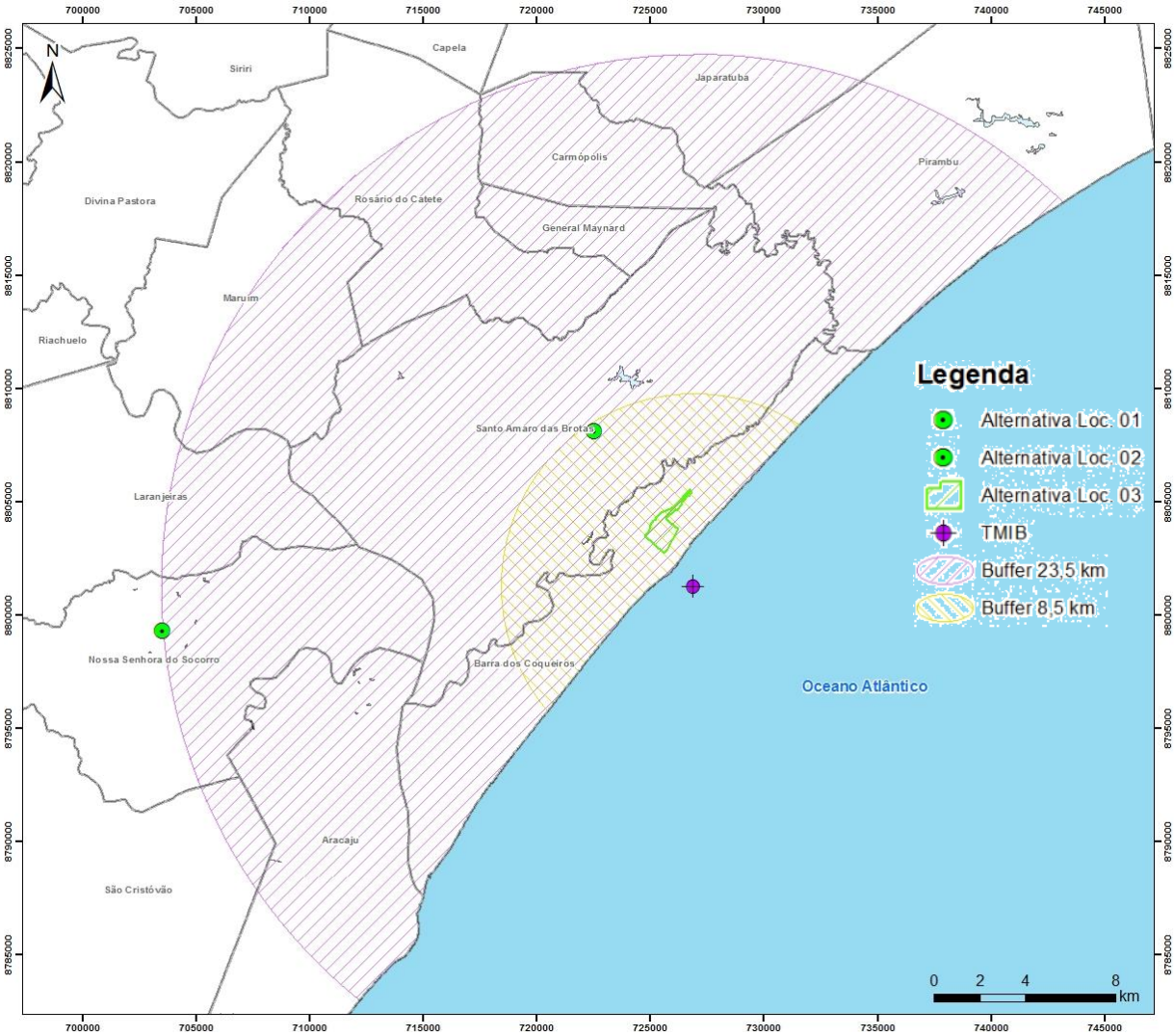

Figure 2. Map showing the location of the alternate areas considered for the project.

AREAS OF INFLUENCE

According to CONAMA Resolution 01, dated January 23, 1986, the areas of influence were divided into three spatial units: the Directly Affected Area (DAA), Area of Direct Influence (ADI) and Area of Indirect Influence (AII).

Directly Affected Area

This is the area that will be effectively occupied by the project, i.e. the intervention area.

Area of Direct Influence (ADI)

This is the geographical area that will be directly impacted by the project, i.e. aspects of this area will be changed by direct action from the project during the construction and

operation phases, which includes both the site and surrounding areas. This area is calculated using the environmental and behavioral characteristics assessed (physical, biotic and socioeconomic factors) and the specific characteristics presented by the project.

The ADI for the physical and biotic areas was established 2 km away from the ADA threshold, bounded to the west by the Pomogona River. The socioeconomic boundary represents a section of land around the project that includes the Porto das Cabras and Praia de Jatobá Settlements.

Area of Indirect Influence (AII)

This is a geographic area that may or will be either positively or negatively impacted by the project during the construction and operation phases and will also have an impact on physical, biotic and socioeconomic factors.

In this study, the city of Barra dos Coqueiros is the socioeconomic AII. A section of the Pomonga River hydrographic basin represents the AII for the physical and biotic environments.

Figure 3. Directly Affected Area.

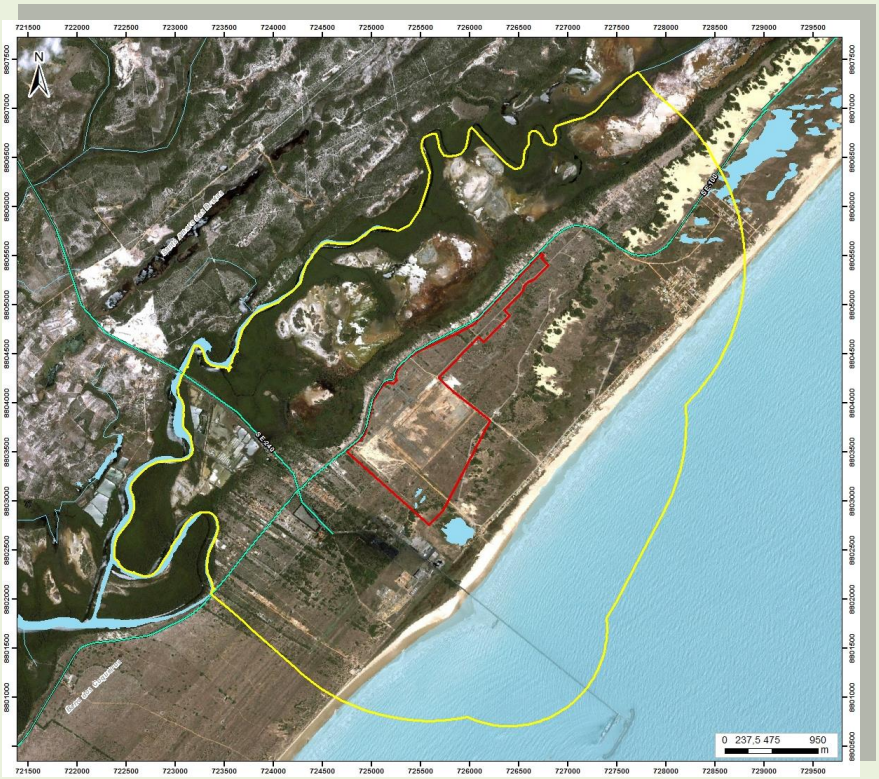

Figure 4. Area of Direct Influence for the physical and biotic environment.

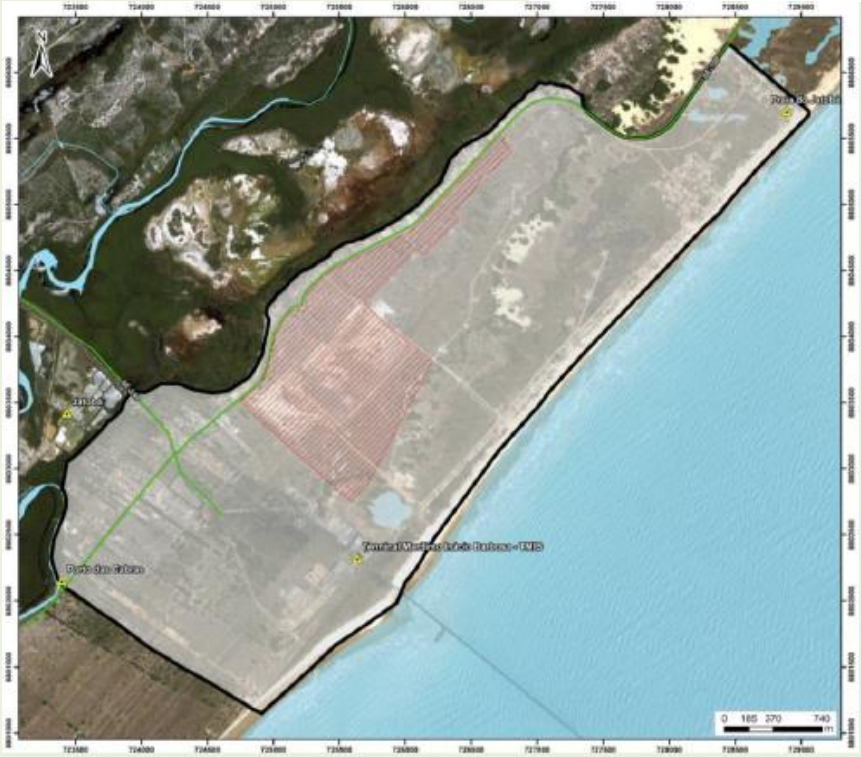

Figure 5. Area of Direct Influence for the socioeconomic environment.

Figure 6. Area of Indirect Influence for the physical and biotic environment.

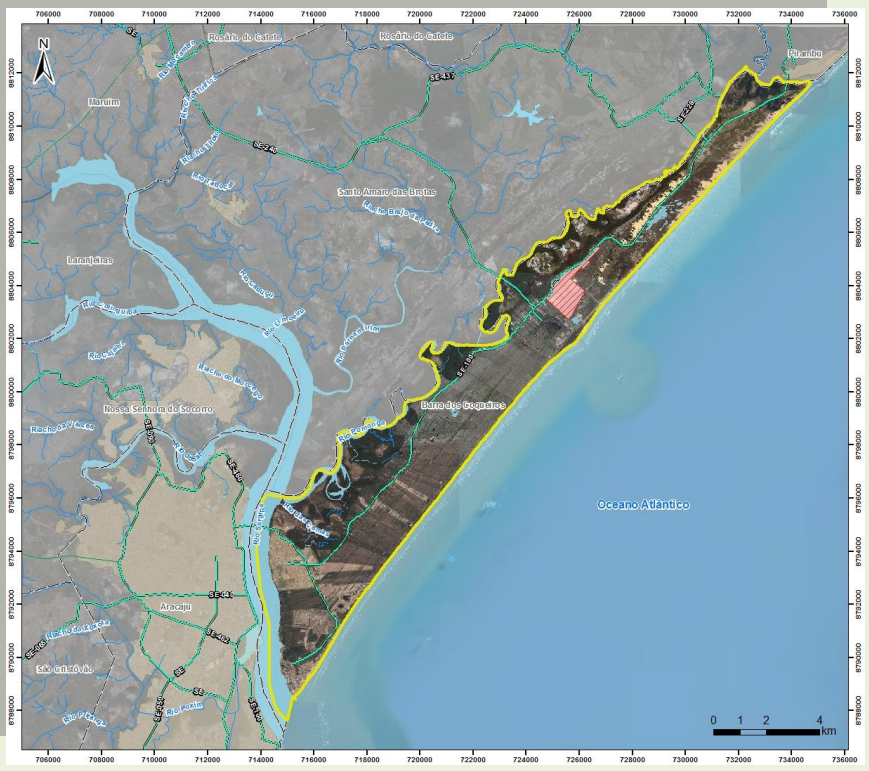

Figure 7. Area of Indirect Influence for the socioeconomic environment.

ENVIRONMENTAL DIAGNOSIS

The Environmental Diagnosis of the site selected for project construction and its areas of influence involves surveying the environmental factors associated with the physical, biotic and socioeconomic environments.

Physical Environment

In the city of Barra dos Coqueiros, the predominant Climate is Subhumid Megathermal and classified as the rainiest in the state of Sergipe. Alongside the level of rainfall in this region, we find that rainfall occurs predominantly between the months of April and July.

Geographically, the region surrounding the project is generally influenced by quartenary, such as the swamp and mangrove deposits, and coastal (wind deposits and marine terrace) sediment deposits.

In terms of geomorphology, the region is on the Coastal Plain relief unit, which can be divided into Marine Terraces, River–Marine Terraces and the River Marine Plain. Overall, in the past, the land has undergone a process of substrate leveling, rainfall drainage channel creation and vegetation suppression.

The soil (pedology) in the project area of influence is sedimentary material basically comprised of sand and clay, which, based on stratification and the main subsoil components, can be classified as: Spodosols, Quartzenic Neolos and Indiscriminate Swamp Soils.

Figure 8. Typical marine terrace sedimentation, forming spodosols, located in the region surrounding the area of direct influence.

Figure 9. Area of indirect influence, indicating a mangrove swamp ecosystem in the area surrounding the Pomonga River.

Figure 10. Coastal Plain in the directly affected area.

In terms of water resources, the project is located in the Sergipe River hydrographic basin. The project is located near the meanders of the Pomonga River to the east of the AII (Area of Indirect Influence), which is the closest perennial water source.

Based on on-site surveys, digital mapping and consultation of the regional database, we are able to observe some intermittent lagoons in the project ADI. Although most of these bodies present surface exposure of less than 1 ha, to the east of the DAA we are able to observe a body of water exceeding this area. According to law 12,651, this body of water must remain at least 50 m distant from the PPA, as this area is located in the city's Rural Zone.

In general terms, the region's water table is not very deep and there is significant local rainfall, which supports formation of these lagoons.

Figure 21. DAA and ADI water resources for the development.

Figure 32. Example of an area within the ADI susceptible to flooding.

Underground water resources in the area directly affected by the development and its areas of influence includes the aquifer, which is made up of a granular system and water capture is associated with drainage of this resource via the sediment interstices that can be found there. Regionally, this hydrogeological domain is known as Cenozoic Surface Formations and is locally called the Tacaratu unit.

In Barra dos Coqueiros, we were able to calculate the renewable and permanente aquifer reserves, based on lithological classification of its strata.

Renewable reserves:

• Coastal Deposits: 42.24 x 106 m3/ano;

• Swamps and Mangroves: 12.93 x 106 m3/ano.

Permanent reserves:

• Coastal Deposits: 396.0 x 106 m3.

Biotic Environment

Flora

The area selected for construction of the thermal plants and their areas of influence are associated with a Sergipe coastal region, where it was originally possible to find species of restinga vegetation. Today, after a period of intense anthropic activity in the region, as part of efforts to build previous industrial sites, it is possible to find rare species of flora in the area directly affected by the development. Native vegetation has changed significantly from its original condition. Native vegetation is highly prevalent along the boundaries of the area of indirect influence (ADI) on the borders of the Pmonga River and in isolated regions along the Barra dos Coqueiros coastline.

In this region, given their water retention capacity during periods of higher rainfall, it is possible to find a variety of species on the post-beach plains. This variety of flora is generically made up of herbaceous species.

Figure 43. Photographs of species identified in the beach and post-beach belts. a) *Cyperus maritimus;* b) *Paspalum maritimum;* c) *Blutaparon portulacoides* seedlings; d) *Ipomoea pes-caprae.*

Figure 54. *Conocarpus erectus* photographed on the post-beach plains.

Figure 15. Environments sampled during the study: *A - open area with the presence of dunes and Restinga bushes; B - fragment of Restinga with open and closed areas and shrubs – tree formations; C - damp area of Atlantic Forest transitioning to mangrove swamp; D - beach zone(Jatobá). * Photo D taken from http://f5sergipe.com.br*

Figure 16. Photographs of the dominant herbaceous species identified in the post-beach plains region. *a)* Richardia grandiflora; *b)* Piriqueta duarteana; *c)* Chamaecrista flexuosa; *d)* Cereus fernambucensis; *e)* Alternanthera littoralis; *f)* Hyptis pectinata; *g)* Centrosema *sp.; h)* Polygala cyparissias.

Figure 67. Species of tree identified in the project ADI dune area. a) *Mouriri guianensis;* b) *Syagrus schizophylla;* c) *Ficus gomelleira;* d) *Inga ciliata,* e) *Cynophalla flexuosa,* f) *Tocoyena sellowiana;* g) *Byrsonima vacciniifolia,* h) *Ziziphus undulata.*

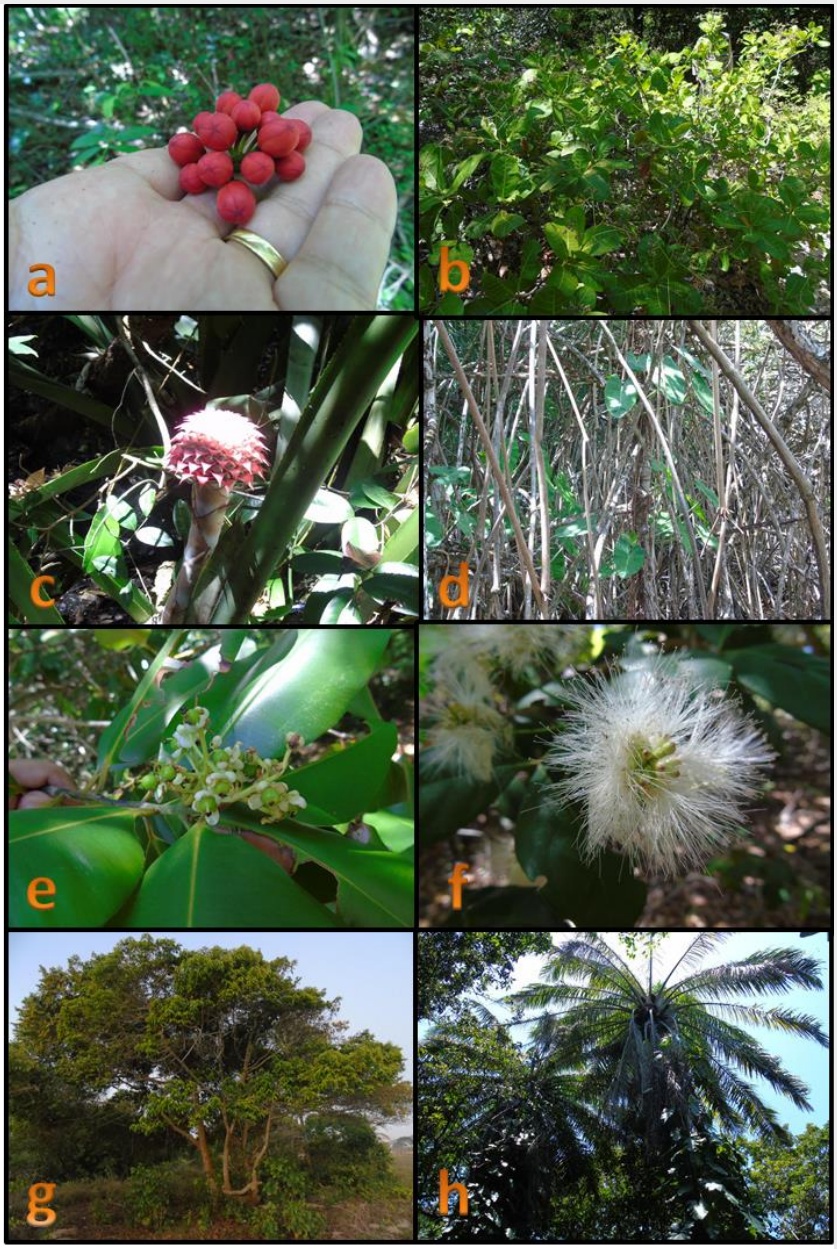

Figure 78. Examples of species identified in the project ADI restinga forests. a) Symphonia globulifera; b) Anacardium occidentale; c) Aechmea multiflora; d) Philodendron acutatum in Rhizophora mangle sub-canopy; and) Matayba discolor; f) inga capitata; g) Andira anthelmia; h) Elaeis guineensis.

Figure 89. Examples of vegetation species identified in the project AII restinga shrub areas. a) *Chamaecrista cytisoides;* b) *Allagoptera brevicalyx;* c) unidentified; d) *Mabea* sp.; e) *Comolia ovalifolia;* f) *Humiria balsamifera;* g) *Attalea funifera;* h) *Syngonanthus gracilis;* i) *Miconia* sp.; j) *Ocotea notata;* l) *Melocactus violaceus;* m) *Waltheria cinerescens.*

Fauna

The region covered by the project's direct and indirect areas of influence presents a variety of ecosystems that belong to the Atlantic Forest Biome: mangrove, restinga, beach and floodable bodies of water. Both environments present diversified fauna and flora; most have undergone a variety of morphological and physiological adaptations allowing them to live in these environments (permanently or not).

These ecosystems include many species of fauna, such as the Eurialinas species, that migrate to reproduce and forage, thereby completing their life cycles.

Below are some of the species found mainly within the project area of indirect influence (AII).

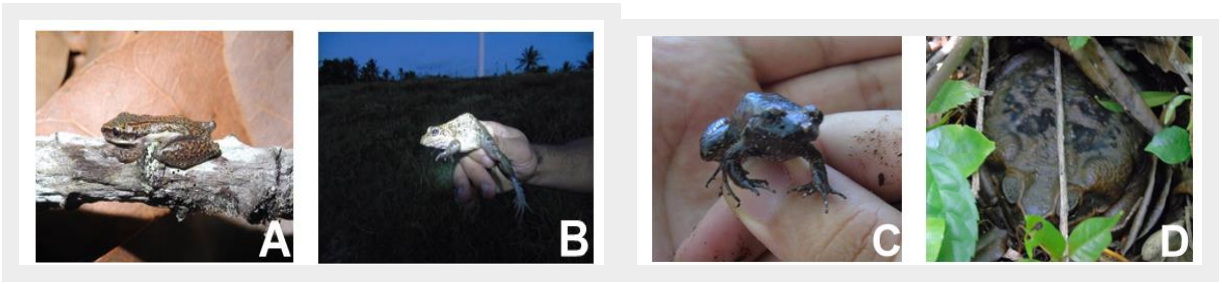

Figure 20. Certain anurans encountered during the study: A - Scinax melanodactylus; B - Leptodactylus latrans; C - Leptodactylus natalensis; D - Rhinella jimi.

Figure 21. Certain reptiles encountered during the study: A - Gymnodactylus geckoides; B - Ameivula ocellifera; c - Tropidurus hygomi; D - Lepidochelys olivacea found dead on the Jatobá beach. *The Lepidochelys olivacea photograph was obtained from Portal A8 Sergipe.

Figure 22. Sanderling *(Calidris alba),* Semipalmated plover *(Charadrius semipalmatus),* respectively.

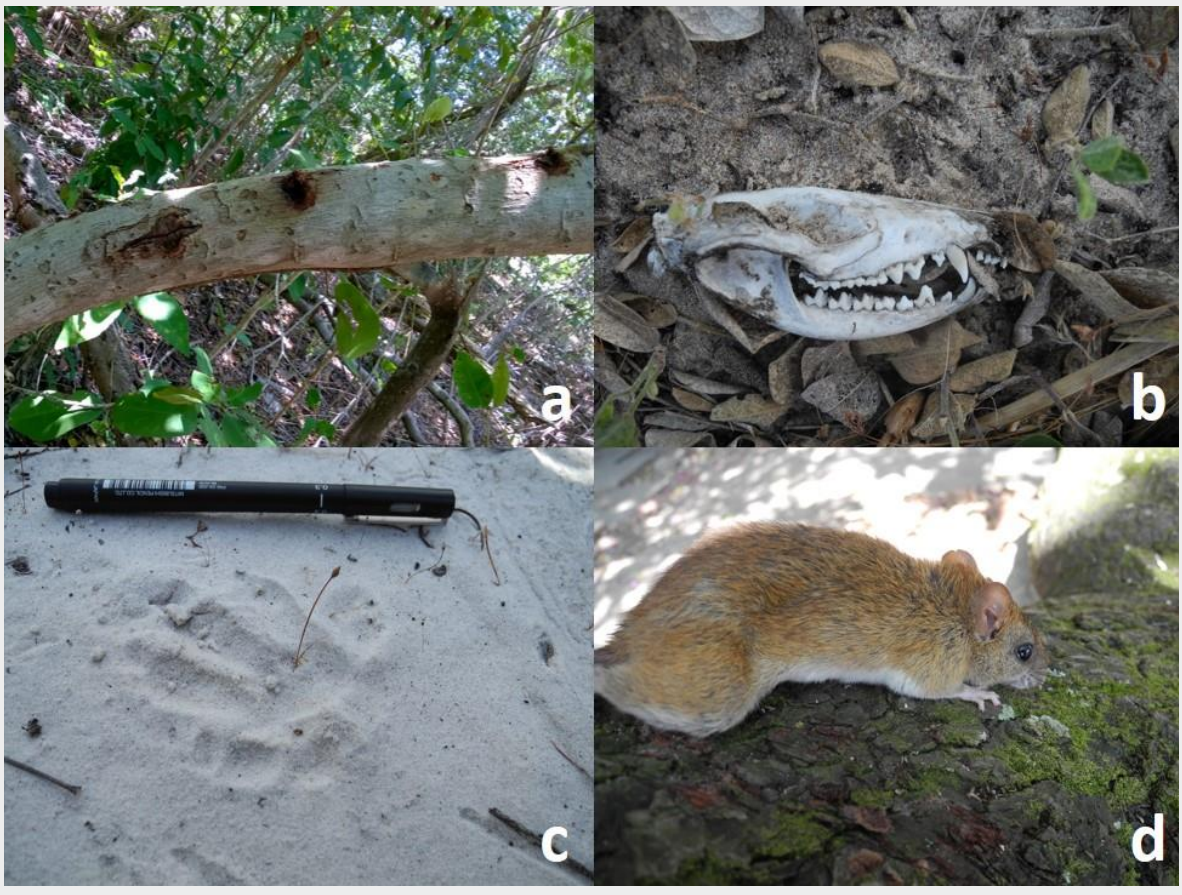

Figure 93. Illustration of species directly and indirectly sampled throughout the area. In (a) we can observe scarifications from a marmoset *(Callithrix jacchus)* **on a cashew tree and (b) we can observe the skull of a white-eared possum (***Didelphis albiventris),* in (c) there is the footprint of a crab-earing racoon (*Procyon cancrivorus)* and in (d), we can observe the only example of a rodent captured live during the study, a jungle rat (*Oecomys catherinae).*

Figure 104. Examples of species fished in the Jatobá Beach region. a) *Gymnura micrura;* b) *Narcine brasiliensis;* c) *Trichiurus lepturus;* d) *Cathorops spixii;* e) *Bagre bagre;* f) *Sciades herzbergii.*

SocioeconomicEnvironment

Population

The municipal region of Barra dos Coqueiros is similar to most municipal regions in Sergipe: the female population is predominant and mostly located in the urban zone, representing 51.11%, whereas the male population (50.88%) is predominant in the rural zone.

Table 1. Barra dos Coqueiros population by gender, Source: IBGE Demographic census, 2010.

Population	Total	Male	%	Female	%
Total	24.976	12.212	48,89	12.774	51,11
Urban	20.886	10.131	48,50	10.755	51,50
Rural	4.090	2.081	50,88	2.009	49,12

By age, in 2010 we observed that the region is following the same aging trend occurring throughout Brazil, i.e. adults are predominant (55.61%) while youth represents 37.10% of the poulation and the elderly account for 7.29%.

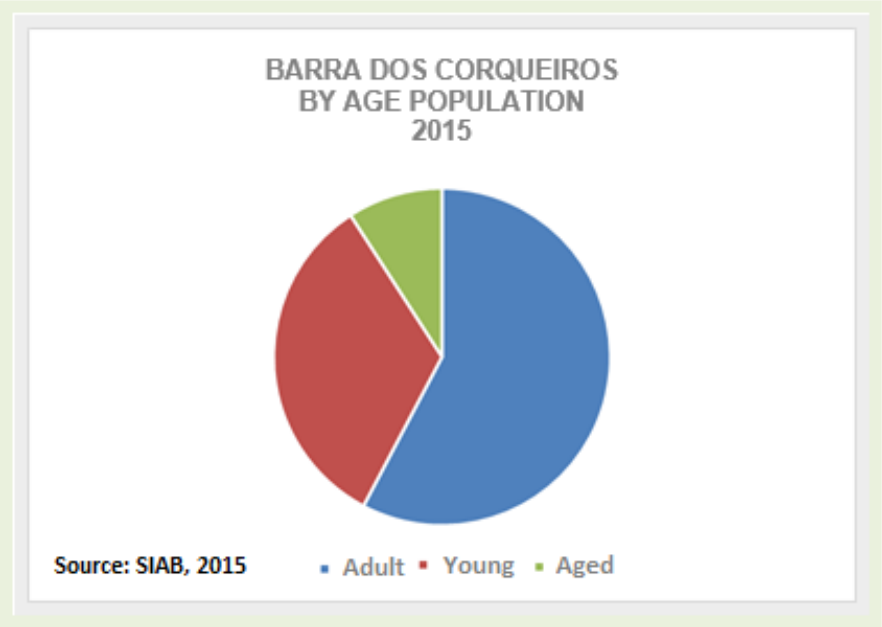

Figure 115. Barra dos Coqueiros population, 2015.

Directly affected community

According to the Macro Zoning arrangement in the Sustainable Urban Development Master Plan, the project is located in the rural zone and in close proximity to the Jatobá settlement, an area with low population density providing agricultural, industrial and service.

The community residing in the Jatobá Settlement is the only one that will be directly affected by the thermoelectric plant. The settlement is located on the junction between the SE-100 North and the SE-240 highways, connecting the BR-101 and the Sea Port Terminal. Occupation of the area intensified during construction of the Sea Port Terminal and the SE-240 highway in the 1980s. Because of the business generated by the Terminal, the area remains occupied with businesses serving truck drivers, such as small restaurants, bodegas, minimarts, tire repair shops and others. Along the margins of the SE-100 highway, a plot of land owned by the State Government and which fronts onto the proposed Plant site is occupied. People began occupying the land in 2011, building

huts, however in recent years these huts have been replaced with brick buildings.

Along the Atlantic Ocean coastline, there are a number of beach homes, most of which belong to people residing in Aracaju and which are only used at weekends or as summer residences. Some of these houses occupy permanent preservation areas and the local population is also facing problems with the Public Prosecutor because access to the beach has been closed off.

Figure 126. Jatobá dos Coqueiros beach.

ENVIRONMENT IMPACTS

The process of identifying and assessing environmental impacts addresses the various activities involved in planning, building and running the project, how it interacts with the physical, biotic and socioeconomic environments and the resulting impact.

The methodology we adopted was based on CONAMA Resolution 001/86 and on the technical guidelines in the Leopold Matrix (PARANÁ, 1992). The following table presents the impacts that have been identified and whether they are expected to occur during the planning, construction or operational phases of the Thermoelectric Complex.

Table 2. **Impacts that have been identified and whether they are expected to occur during the planning, construction or operational phases of the Thermoelectric Complex.**

IMPACTS		PROJECT PHASE					
		PLAN		CONS		OPE	
		+	-	+	-	+	-
1	Changes to noise levels				X		X
2	Changes in air quality				X		
3	Changes to the hydrogeological regime				X		
4	Erosion and silting processes				X		
5	Changes to surface water quality				X		X
6	Reduced vegetation coverage				X		
7	Reduction in habitat and food supply for local fauna				X		
8	Disturbance to local fauna				X		
9	Loss of local fauna specimens				X		
10	Interference with species under threat of extinction				X		
11	Interference with the Conservation Unit				X		
12	Expectations generated in relation to the project	X	X				
13	Change of land usage and occupation					X	X
14	Rise in job openings			X		X	
15	Increase in the number of work accidents				X		X
16	Interference with sites of archaeological and/or cultural value			X	X		
17	Increase in vehicle traffic				X		
18	Increase in tax revenues			X		X	
19	Increased waste and effluent generated				X		X

PLAN - Planning / CONS - Construction / OPE – Operation.

ENVIRONMENTAL PROGRAMS

The assessment of possible environmental impacts resulting from the Thermoelectric Complex planning, construction and operation phases indicates that certain environmental programs must be implemented.

The process of identifying and analyzing environmental impacts was carried out on an objective basis in order to recommend which preventive, mitigating and compensate three measures will be needed to support thermoelectric complex deployment, construction and operation, in light of the relevant environmental and legal requirements and community anxieties.

As a result, the proposed plans, programs and measures address the environmental impacts identified during the study and are intended to effectively reduce, avoid and/or mitigate the project's effects on the physical, biotic and socioeconomic environments.

We have identified a number of programs that should be implemented and are listed in the following table.

Table 3. Environmental programs proposed for the project.

Environmental Programs
Surface Water Quality Monitoring Program
Biota Monitoring Program
Program to Create Protected Areas to Offset Carbon and the Impact on Regional Fauna and Flora
Solid Waste Management Program
Monitoring and Rescue Program for Threatened Fauna and Flora
Environmental Monitoring Program
Workforce Environmental Education Project
Social Responsibility and Communication Program
Archaeological Heritage Monitoring and Rescue Program
Air Quality Monitoring Program

PLAN - Planning / CONS - Construction / OPE - Operation

ENVIRONMENTAL PROGNOSIS

Environmental prognosis following project construction

Given the need to increase energy supplies in the state of Sergipe to accompany the rising population alongside industrial and residential development, it is fair to say that a thermoelectric project such as the planned Complex in Barra dos Coqueiros would be an appropriate solution to meet this demand. In terms of electrical power generation, this project is a significant opportunity to achieve energy self-sufficiency in the state of Sergipe, which would increase the complex's attractiveness for new businesses and raise confidence in Brazilian power transmission and generation. The project's development would therefore support these positive growth scenarios.

In the future, construction of the Thermoelectric Units would therefore: increase state and municipal tax revenue; boost regional demand for infrastructure; increase power distribution and generation and, as a result, create direct and indirect jobs.

Environmental prognosis without project development

In the past, the site proposed for construction of the thermoelectric plant has been considered an ideal location for a chlorine chemical plant and has, in fact, been the recipient of infrastructure works, earthmoving, asphalt road paving and rainwater drainage. Many in the state wanted to see this proposal succeed but, for a number of reasons, it has never come to fruition, however the area has always been subject to speculation.

This has encouraged illegal occupation of areas bordering the highway and the project area, however this unorganized growth poses a threat to the port region, as does further construction of large residential condominiums north of Barra dos Coqueiros which could also transform the port region, one of the main drivers for state development, into a strictly residential area. As Sergipe is unlikely to build a commercial port, this would signal the end of any type of port activity in the state.

Therefore, this region's benefits must be evenly shared between speculative and real estate development and efforts to drive industrial and commercial growth that would generate income, jobs and taxes and increase opportunities for growth.

Our scenario, based on an assessment of the local region and includes physical, environmental and socioeconomic issues, reveals that if the project does not go ahead,

this “naked” area will likely be targeted for real estate development, which is not in the best interests of the general public.

As a result, a decision not to go ahead with this project would give up any additional tax revenues that the development would produce and the possibility of energy self-sufficiency in the State, negatively affecting economic development in the state of Sergipe and the municipal region of Barra dos Coqueiros.