



APPENDIX E

Flora and Fauna Study

November 2010

Environmental Impact Statement – Preliminary

Renewable Power Generation and Resources
Recovery Plant

BARRIO CAMBALACHE OF ARECIBO

EnergyAnswers
Arecibo

Flora and Fauna Study

Preliminary Environmental Impact Statement Renewable Power Generation and Resources Recovery Plant

BARRIO CAMBALACHE IN ARECIBO



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1.0 EXECUTIVE SUMMARY

Energy Answers International has retained the services of CSA Group, Inc. / CSA Architects & Engineers (CSA) to conduct a Terrestrial Flora and Fauna study for the development of a renewable energy generation facility that will be fueled by municipal solid waste on a property with an area of approximately 81.3 *cuerdas* (78.96 acres) at Cambalache Ward in the Municipality of Arecibo (the Project). This study includes observations of the flora and fauna at a neighboring parcel, referred to as Central Cambalache Sugar Mill, which will harbor the interconnection to transmit the produced electrical energy. This interconnection will cross through land property of the Land Authority until it reaches the existing Cambalache power substation. In addition, the study will describe the biodiversity in the water pipeline route along Road PR-2 at kilometer 73 toward El Vigía pump station at Islote Ward.

This technical document presents the Terrestrial Flora and Fauna Study in the Project area in Arecibo, Puerto Rico which provides a description of the existing biological communities as well as details on the climate and life zones. The purpose of this study is to evaluate and describe the flora and fauna in general and the different existing ecological associations present in the project site and neighboring areas, determine the presence of critical, threatened or endangered species, and recommend measures that will reduce or avoid impacting these resources.

The site proposed for this development shows typical vegetation found on abandoned industrial areas in which herbaceous species, mostly grasses such as Guinea grass (*Megathyrsus maxima*), vines and the invasive shrub black mimosa (*Mimosa pigra*). Woody species are found forming isolated patches throughout the site especially along its South and West borders and along the banks of the *Río Grande de Arecibo* and the abandoned stormwater canals. A total of 159 species of flora were identified in the project site and the Central Cambalache Sugar Mill, all common and of ample distribution in lands near large rivers in the Island. None of the

species of flora in the study areas are considered as critical elements, threatened or endangered by state or federal laws and regulations.

In respect to the fauna in the Project area, a total of 57 species of vertebrates were observed, most of which are birds of which 45 species were identified. The most common bird species in the site are Bananaquit (*Coereba flaveola*), Greater Antillean Grackle (*Quiscalus niger*), Rock Pigeon (*Columba livia*), Common Ground-Dove (*Columbina passerina*), Northern Mockingbird (*Mimus polyglottos*), Gray Kingbird (*Tyrannus dominicensis*), Smooth-billed Ani (*Crotophaga ani*), Black-faced Grassquit (*Tiaris bicolor*) and Orange-cheeked Waxbill (*Estrilda melpoda*). Other vertebrate groups include two (2) mammals and ten (10) species of amphibians and reptiles. Among these are worth mentioning the Small Indian Mongoose (*Herpestes auropunctatus*), y and several species of coquí frogs (*Eleutherodactylus* spp.) and anoles (*Anolis* spp.). None of the species of fauna in the study areas are considered as critical elements, threatened or endangered by state or federal laws and regulations.

The construction of the Project will have short and long term impacts to the terrestrial flora and fauna during its different phases including activities such as earth movement, pruning and clearing of trees. These impacts should be avoided or minimized by implementing the suggested conservation measures and engineering best practices, in some instances these actions may promote the reestablishment and recovery of the species in the Project site.

2.0 INTRODUCTION

Energy Answers International has retained the services of CSA Group, Inc. / CSA Architects & Engineers (CSA) to conduct a Terrestrial Flora and Fauna study for the development of a renewable energy generation facility that will be fueled by municipal solid waste on a property with an area of approximately 81.3 *cuerdas* (78.96 acres) at Cambalache Ward in the Municipality of Arecibo (the Project). This study includes observations of the flora and fauna at a neighboring parcel, referred to as Central Cambalache Sugar Mill, which will harbor the interconnection to transmit the produced electrical energy. This interconnection will cross through land property of the Land Authority until it reaches the existing Cambalache power substation. In addition, the study will describe the biodiversity in the water pipeline route along Road PR-2 at kilometer 73 toward El Vigía pump station at Islote Ward.

The purpose of this study is to evaluate and describe the flora and fauna in general the different existing ecological associations, determine the presence of critical, threatened or endangered species within the proposed site set for development as well as the external right of ways for the power lines and water pipeline. This study also presents recommendations for measures to reduce or avoid potential impacts of the Project to these resources. The following sections are included in this study:

- Description of the Study Area;
- Methodology;
- Results;
- Discussion;
- Impacts and Mitigation Measures;
- Conclusion and Recommendations; and
- Appendices to uphold the Study.

The study and report were conducted and prepared by CSA biologist José A. Salguero-Farías between January and September 2010. Additional site visits to area of Central Cambalache Sugar Mill were made during August 2010 by CSA biologist María Luisa Rivera.

3.0 GENERAL AREA DESCRIPTION

The Project is located in the Northern Coast of Puerto Rico in Cambalache Ward of the Municipality of Arecibo and is accessed through highway PR-2. The site has an approximate area of 81.3 *cuerdas* (78.96 acres) which is partially developed for industrial purposes and is currently abandoned. The site borders highway PR-2 to the East, Puerto Rico Land Authority land to the North and South and the *Río Grande de Arecibo* to the West. (See [Appendices 1 and 2: Location Map and Aerial Photograph](#)).

At the present, the acquired parcel is covered by grasses and sedges, forested patches and abandoned structures where vines, lianas and woody species of rapid growth have become established. During the industrial operation of the site there were five (5) artificial ponds used in the process; one located on the southeast part of the site whose bottom has a liner and thus collects rain water and four others on the western portion of the site.

Outside the Project site, but adjacent to the southern limits, lies the former Central Cambalache Sugar Mill. The Project proposes to install the interconnection line to transport the energy produced by the plant. (See [Appendix 2: Aerial Photograph](#)). This land rather flat and harbors the servicing Cambalache power substation plus abandoned structures, debris and thrash. The vegetation is composed by common species of grasses and other herbs with scattered tree stands and scrubland. Most of the open grassy areas in the Central Cambalache Sugar Mill site lie to the North coinciding with the South border of the Project site. Trees and shrubs are associated to the abandoned buildings, dirt roads and internal site fencing, and the bank of the *Río Grande de Arecibo*. Species composition is typical of riparian areas and impacted industrial terrain and consists mostly by invasive, fast growing plants.

The proposed raw water pipeline is proposed to run along roads PR-2, PR-6681 and PR-681. This line will be installed on the right of way of these roads until connecting the proposed facility with the El Vigía pump station at Islote Ward, where the raw water intake will be

installed. This route presents open pastures with scattered common trees subject to maintenance by government authorities along most of the proposed line, including roads PR-6681 and PR-681. Along Road PR-681 it is possible to see the discharge canal that is parallel to the road which is covered by a forested stand formed by mangrove trees and other associated species.

3.1. CLIMATE

The National Oceanic and Atmospheric Administration (NOAA) has divided the Island in climatic provinces depending on their climatological characteristics. The Municipality of Arecibo is located in the northern climatic province according to NOAA.

Temperature for this region of Puerto Rico varies little. Average temperature for the northern region of Puerto Rico is 78.0 degrees Fahrenheit. The average temperature fluctuates between 72.8 degrees Fahrenheit in February to approximately 93 degrees Fahrenheit during the months of June and September (NOAA, 2000).

Average rainfall in the Municipality of Arecibo is 51.02 inches. October has the highest rainfall average of 6.12 inches and March the lowest rainfall average with 2.66 inches.

Meteorological substation *Arecibo 3 ESE* (station 660410 at 10 feet above sea level) was used for reference of normal rainfall and temperature due to its proximity to the Project site in Arecibo. Normal values are average values for climatological elements, such as rainfall and temperature, collected for a period of time, in this case between 1971 and 2000.

The winds in the region, including the Project area, respond to prevailing patterns of the Island. Wind circulation in the Caribbean Sea and Puerto Rico is dominated for most of the year by the Trade Winds which blow from East to West. These winds originate from high pressure systems near the Azores Islands off the Western Coast of Africa. Coastal sectors of Puerto Rico receive constant flow of these winds, which are affected by tides, and existing terrain conditions that can affect their speed, and channelize or change its local flow direction. Generally, prevailing winds in Puerto Rico come from the East, while local systems produce daily changes in wind

direction; toward the mountains during the daytime while reversing during colder periods at night.

3.2. HYDROLOGY AND WETLANDS

The proposed site for the Project lies within the alluvial plain of the *Río Grande de Arecibo* (RGA), which flows along the western border of the site. Within the site there is a system of canals that served the former cardboard manufacturing plant and the storm water system and which drain into the RGA. An additional canal is located on the Northern border of the site flowing from East to West before draining into the RGA. These canals are shown in [Appendix 3: Hydrology and Wetlands Map](#).

The National Wetland Inventory (NWI) of the U.S Fish and Wildlife Service (USFWS) identifies a series of wetland systems within the site ([Appendix 3: Hydrology and Wetlands Map](#)). These include areas identified as forested patches, evergreen shrubland and part of the RGA. Presence of these wetland areas was not confirmed during site inspections during the months of March and August 2010 as part of the Jurisdictional Wetland Determination study. According to the USFWS, the wetlands in the Project area are:

- *PSS3C* – Palustrine broad-leaved evergreen scrub/shrub, seasonally flooded. The NWI identifies this wetland type fringing the Eastern border of the *Río Grande de Arecibo* and the western portion of the site.
- *PEM1A* – Palustrine, emergent, persistent, temporarily flooded. According to the NWI, it is distributed through a large portion of the site.
- *PFO3A*- Palustrine, forested, broad-leaved evergreen, temporarily flooded. The NWI identifies this wetland in the center of the site.
- *PSS3A* – Palustrine, scrub/shrub broad-leaved evergreen, temporarily flooded. Associated with *PEM1A* identified in the NWI throughout the site.
- *PFO3C* – Palustrine, forested, broad-leaved evergreen, seasonally flooded. Identified for the Southeast corner of the site.
- *E1UBL* – Estuarine, subtidal, unconsolidated bottom. This classification makes reference to the *Río Grande de Arecibo* that flows through a portion of the site.

3.3. GEOLOGY, TOPOGRAPHY AND SOILS

The information regarding the geology at the proposed site was obtained from the Arecibo Quadrangle (Briggs, 1968). Most of the geological formation of the area was formed by sediments including alluvial deposits (Qa), composed by sand, gravel, silt and clay gradually stratified with a depth that may surpass 230 feet (70 meters). It also includes swamp deposits (Qs) which are formed by clay, sandy clay, and silty clay. These are rich in organic content and can have a depth ranging from 0 to 10 feet (0 a 3 meters).

The topography of the site is composed of a flat area associated to the alluvial plain of the *Río Grande de Arecibo*. This terrain lies at an average elevation of 10 feet above mean sea level.

According to the Soil Survey for Arecibo: Northern Area for Puerto Rico prepared by the Natural Resource Conservation Service (NRCS), the United States Department of Agriculture and the list of hydric soils of the United States Geological Service (USGS), the soils present at the Project site are:

- To – Toa silty clay loam. Found practically in the western half of sites A and C along the banks of the *Río Grande de Arecibo*. It is a typically leveled, deep soil with good drainage and is considered as a hydric soil.
- Cn – Coloso silty clay. It is found within the eastern half of the site. This is a leveled, deep, soil with poor drainage and is considered as a hydric soil.

3.4. ECOLOGICAL LIFE ZONES

The ecological life zone present in the site for the proposed Project is known as Subtropical Moist Forest (Ewel and Whitmore, 1973). Approximately 58% Puerto Rico's total area lies under this classification. Subtropical moist forests are characterized by an average rainfall of 39.37 to 86.61 inches. This life zone is the most exploited in terms of land use for agricultural purposes as it provides ideal conditions for a varied number of crops. As a consequence, most of the area has been deforested at some point in time. Pastures in natural areas dominate the landscape in the subtropical moist forest life zone.

Among the most common species in this life zone are: royal palm, (*Roystonea borinquena*), white cedar (*Tabebuia heterophylla*), mountain immortelle (*Erythrina poeppigiana*), guaba (*Inga vera*), guamá (*Inga laurina*), royal poinciana (*Delonix regia*) and trumpet tree (*Cecropia schreberiana*), among others. Common crops in this life zone include pineapple (*Ananas comosus*), sugarcane (*Saccharum officinarum*), coffee (*Coffea arabica*) and tobacco (*Nicotiana tabacum*) (Ewel and Whitmore, 1973).

3.5. PROTECTED AREAS IN THE REGION

The closest natural reserve is the Caño Tiburones Natural Reserve which lies at approximately 1.5 kilometers from the Eastern limit of the Project area and its land is property of the Puerto Rico Land Authority though is managed by the Department of Natural and Environmental Resources (DNER). This reserve is the most extensive wetland in Puerto Rico covering an area of 5,665 *cuerdas* between the *Río Grande de Manatí* on the East and the *Rio Grande de Arecibo* to the West. [Appendix 4: Priority Conservation Areas near the Project Site](#) presents a figure showing the spatial relation between the reserve and the proposed site for the Project.

4.0 METHODOLOGY

This section describes the procedures used throughout this flora and fauna study and the criteria for the selection of the study areas. The studies were conducted following the procedures accepted by the DNER and the USFWS using field evaluations throughout the whole site for the proposed Project.

4.1. CONSULTATION OF AVAILABLE LITERATURE AND SPECIES MAPS WITH THE NATURAL HERITAGE OFFICE OF THE DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES

A revision of available scientific literature was conducted previous to initiating the flora and fauna study, including a preliminary version of an environmental impact report for a previous proposal of the Project (Renova, 1999). In addition, the Critical Species List of the DNER's Natural Heritage Division was reviewed. This list includes all species protected by state and

federal laws as well as other species whose populations are small or that are indicative of the presence of specific habitats within the Commonwealth of Puerto Rico. The information was validated in the field by visiting the Project area by the scientific team.

4.2. FIELD WORK

The site was visited during a preliminary inspection to become familiarized with the different areas within the site as well as finding the parcel limits. This visit also served to validate the available information from reports and maps (topographic, aerial photograph, soils, land use, wetlands, survey plans and design, among others). The information was analyzed jointly to present a better comprehensive understanding of the site's present conditions.

Field work in the Project area was conducted primarily during January 2010. Additional visits took place during the month of August 2010. The area was surveyed in its entirety without the need for establishment of quadrants or transects. Observations were conducted on different localities within the site to identify with detail the different vegetation associations. The list of flora and fauna present in the site came from these visits. Also, the flora and fauna was described along the pipeline route from the El Vigía pump station to the Project site, as well as the terrain for the proposed electrical interconnection in the Central Cambalache Sugar Mill.

Bird diversity was noted throughout the whole site and all species identified by calls or seen were annotated. In addition, bird counts were conducted during fixed time periods on the different ecosystems during the morning and afternoon following methods described in Wunderle (1994) with the purpose of determining the bird diversity in each.

For amphibians and reptiles, the team searched in appropriate habitats for these species under fallen tree trunks and branches, rock crevices, in the soil and on damp areas. Vegetation was also surveyed including trees and pastures, which are known to harbor many species of fauna. Searches were conducted during the daytime following the methods described by Rivero (1998). A nocturnal survey was conducted to determine the presence of Puerto Rican boa and other nocturnal species in the Project site.

Species considered as critical elements by the DNER and the USFWS were included in the survey. The main purpose was to determine the presence of any of these species in the site and identify the location of any individual.

The existing habitats and flora and fauna species were documented photographically. [\(Appendix 7: Photographic Documentation\)](#).

Other sources of information that were consulted include the Critical Wildlife Areas study (CWA) (DRNA 2005), data from the Puerto Rico Breeding Bird Atlas (SOPI, unpublished) and the PR-GAP project (2007), among others.

4.3. DATA ANALYSIS

The identification of species found at the proposed Project site was done primarily in the field. Species not identified in the field were brought to the lab or their pictures taken to be identified. For plant and animal identification the team used the following publications for reference: Woodbury and Wadsworth (1974), Liogier (1985; 1988; 1991; 1995; 1997), Acevedo-Rodríguez and Woodbury (1985), Proctor (1989), Más and García-Molinari (2006), Raffaele et al.(1998), Rivero (1998), Little and Wadsworth (1999), Acevedo-Rodríguez (2003), Acevedo-Rodríguez and Strong (2005), and Acevedo-Rodríguez (1996).

5.0 RESULTS

FLORA

The site proposed for this development shows typical vegetation found on abandoned industrial areas in which herbaceous species, mostly grasses such as Guinea grass (*Megathyrsus maxima*), vines and the invasive shrub black mimosa (*Mimosa pigra*). Woody species are found forming isolated patches throughout the site especially along its South and West borders and along the banks of the *Río Grande de Arecibo* and the abandoned stormwater canals. A total of 159 species of flora were identified in the project site and the Central Cambalache Sugar Mill, all common and of ample distribution in lands near large rivers in the Island.

Pastures extend through most of the proposed Project site and show the highest species diversity. These areas are dominated by grasses (Poaceae family) such as Guinea grass (*Megathyrsus maxima*), African Bermuda grass (*Cynodon nlemfuensis*), Bermuda grass (*Cynodon dactylon*), railroad track grass (*Dichanthium annulatum*), and to a lesser degree species such as bur grass (*Cenchrus echinatus*), goose grass (*Eleusine indica*), and several species of *Paspalum*. In isolated areas where the ground remains relatively humid or with superficial water para grass (*Urochloa mutica*) forms almost monotypic patches. Among the grasses and other herbs the shrub black mimosa forms dense thickets especially within the five abandoned ponds in the Project site. Along the bank of the *Río Grande de Arecibo* and borders of the ponds the exotic wildcane (*Gynerium sagittatum*) has become established. Also, vines abound forming dense and extensive aggregations dominated by moon vine (*Ipomoea alba*).

Tree cover is relatively scarce and dominated by African tulip tree, tall albizia and Panama berry (*Muntingia calabura*). The entrance to the site via road PR-2 has several trees planted for landscaping purposes that include Indian almond (*Terminalia catappa*), fish tail palm (*Caryota urens*) and Benjamin ficus (*Ficus benjamina*).

The terrain at the Central Cambalache Sugar Mill, owned by the Puerto Rico Land Authority, presents a similar flora to that described for the Project site. Areas near the substation show a mixture of shrubs and herbaceous species with common and invasive trees characteristic of impacted landscapes. Between the substation and the abandoned structures there are some dispersed individual trees of African tulip tree (*Spathodea campanulata*), clammy cherry (*Cordia obliqua*), royal poinciana (*Delonix regia*), yellow poinciana (*Peltophorum pterocarpum*), and tall albizia (*Albizia procera*). Established between these trees are shrubs of black mimosa, sensitive plant (*Mimosa pudica*), castor bean (*Ricinus communis*) and candle bush (*Senna alata*).

Some areas in the Central Cambalache Sugar Mill presents bare grounds (areas with debris, roads and the floors of abandoned structures) but some herbs and spreading vines have taken hold of the edges and cracks. Among the dominant herbaceous species are water neptunia (*Neptunia plena*), shyleaf (*Aeschynomene americana*), amaranth (*Amaranthus dubuis*), el bittervine (*Mikania micrantha*), hog weed (*Boerhavia diffusa*), pyramid flower (*Melochia pyramidata*), sandmats (*Chamaesyce* spp.), and a variety of grasses.

In the junction between the Central Cambalache Sugar Mill and Road PR-2, where the proposed power line interconnection will be installed, Guinea grass and talquezal grass (*Paspalum virgatum*) dominate the landscape. Other shorter grasses such as Mexican crown grass (*Paspalum fasciculatum*) and hilo grass (*Paspalum conjugatum*) abound in the area. This area also includes facultative wetland species like nut grass (*Cyperus rotundus*), moning glory (*Ipomoea tiliacea*), water neptunia, papagayo (*Sesbania sericea*), primrose willow (*Ludwigia octovalvis*) which is considered as a obligate wetland species. Even with the presence of these wetland species, the jurisdictional wetland determination study concluded that there are no wetlands in this portion of the Central Cambalache Sugar Mill.

With respect to the flora along the proposed water pipeline, the water intake area, along roads PR-2, PR-6681 and PR-681, it is composed of common species found along the edges of roads and impacted areas. Along the section of Road PR-2, the vegetation consists primarily of grasses with Guinea grass dominating along Southern crab grass (*Digitaria ciliaris*) and hilo

grass. Some large tall albizia trees, royal poinciana, monkey pod (*Pithecellobium dulce*), golden apple (*Spondias cytherea*), and coconut palm (*Cocos nucifera*) along the green fringes. At the junction with Road PR-6681, common species associated to humid areas, such as umbrella flatsedge (*Cyperus involucratus*) and jungle rice (*Echinochloa colona*), mix with other herbs that prefer open areas like wild balsam apple (*Momordica charantia*), blue day flower (*Commelina erecta*), shepherd's needle (*Bidens alba*), and ocean blue morning glory (*Ipomoea indica*).

Along Road PR-681 dominance of herbaceous and vine species continues by forming hedges along the green fringes of the road. Behind the hedge, there is a canal parallel to Road PR-681 which is lined with trees of white mangrove (*Laguncularia racemosa*), red mangrove (*Rhizophora mangle*) and a few black mangroves (*Avicennia germinans*). Besides the mangrove trees, the banks of the canal also show scattered inland leathern fern (*Acrostichum danaeifolium*). Other species found between the mangroves and the road include coconut palms, Spanish cork (*Thespesia populnea*), Indian almond, royal poinciana, mahogany (*Swietenia mahagoni*), and coin vine (*Dalbergia ecastaphyllum*). At the end of the route in the proposed water extraction site at El Vigía pump station white mangrove, cattail (*Typha domingensis*) and water lilies (*Nymphaea ampla*), indicative of wet areas, abound.

Appendix 5 includes a list of the species of flora identified in the Project area. None of the species of flora in the study areas are considered as critical elements, threatened or endangered by state or federal laws and regulations.

FAUNA

In respect to the fauna in the Project area, a total of 57 species of vertebrates were observed, most of which are birds of which 45 species were identified. The most common bird species in the site are Bananaquit (*Coereba flaveola*), Greater Antillean Grackle (*Quiscalus niger*), Rock Pigeon (*Columba livia*), Common Ground-Dove (*Columbina passerina*), Northern Mockingbird (*Mimus polyglottos*), Gray Kingbird (*Tyrannus dominicensis*), Smooth-billed Ani (*Crotophaga ani*), Black-faced Grassquit (*Tiaris bicolor*) and Orange-cheeked Waxbill (*Estrilda melpoda*). Other vertebrate groups include two (2) mammals and ten (10) species of amphibians and

reptiles. Among these are worth mentioning the Small Indian Mongoose (*Herpestes auropunctatus*), and several species of coquí frogs (*Eleutherodactylus* spp.) and anoles (*Anolis* spp.).

Appendix 6 includes a list of the species of fauna identified in the Project area. None of the species of fauna in the study areas are considered as critical elements, threatened or endangered by state or federal laws and regulations.

The fauna in the Central Cambalache Sugar Mill and along the proposed raw water pipeline is very much similar to what was described for the Project site. Other species, such as migratory birds, may be reported in the future increasing the known diversity of the fauna in the area.

6.0 DISCUSSION

As mentioned above, the vegetation throughout most of the study area is very homogeneous, predominating herbaceous species associated to impacted terrain used for agricultural and industrial purposes on flood plains on the North Coast. Woody species are found forming small dispersed patches through the site, along canals and the bank of the *Río Grande de Arecibo*.

The development of the Project will have short and long term impacts over the terrestrial flora and fauna due to the location of the proposed structures where pastures and forested patches now reside. The main impact over the vegetation will be as a result of excavated material and removal of the earth crust for the installation of the structures proposed Project. All activities conducted in the site may cause that some of the fauna using the existing habitats may be displaced during the construction phase. It is possible that some of these species become established in nearby habitats and return after the Project's construction phase has been completed. Notwithstanding, it is expected that this impacts are temporary and that these will be mitigated by activities such as reforestation, restoration, creation and conservation of habitats, all of which should be contemplated as part of the proposed Project.

Any removal of trees must be in compliance with Planning Regulation #25 (Regulation for Planting, Cutting and Forestation for Puerto Rico, of November 24 1998, as amended). It is recommended that for those forested areas impacted by the Project footprint, that nearby areas be reforested to create an attractive area for the reestablishment of species once the construction activities have ended. The Project will mitigate with the percentage of native trees and palms as stipulated in Regulation #25.

Also, it is recommended that the United States Corps of Engineers be consulted in relation to their jurisdiction over the existing canals and its relation to waters of the U.S.

Even if the site does not harbor species considered as priority for conservation, that the area was previously impacted by agricultural and industrial purposes during the operation of the

cardboard manufacturing plant, that no ecologically sensitive areas are present in the study area and that the area is considered as Natural Habitat with Low Potential of Becoming an Essential, High Value or of Ecological Value (Category 6) according to the New Wildlife Law, as amended (Law No. 241 of August 15 of 1999), it is expected that careful planning will assure that important habitats for wildlife, such as the RGD, are not altered and any potential impacts be minimized or remediated. For these reasons it is recommended that the Project complies with the New Wildlife Law and the Environmental Public Policy Law, as amended (Law No. 416 of September 22 of 2004), in relation to protecting the environment and the species of flora and fauna that inhabit the area.

The pipeline for the raw brackish water for the Project will be located along roads PR-2, PR-6681 and PR-681, immediate to the edge of the asphalt, therefore no impacts to wetlands are expected nor to trees through the route that ends at the El Vigía pump station.

7.0 CONCLUSIONS AND RECOMENDATIONS

The proposed site for the development of the resource recovery facility was impacted previously for agricultural and industrial purposes associated to the operation of a cardboard manufacturing plant. No ecologically sensitive areas were found within the study areas although *Río Grande de Arecibo* adjoins the site. This terrain is currently covered by herbaceous species along with dispersed trees and shrubs. It is recommended that the Project design minimizes the impacts to natural areas in the vicinity of the river.

During this flora and fauna study, no species considered as critical, threatened or endangered by state or federal laws were detected within the Project area.

The flora and fauna in the Project area may be affected on a short-term basis. Notwithstanding, the compliance with Environmental protection regulations and laws, and implementation of the suggested measures may avoid or minimize the identified impacts and promote the recovery of the species in the Project site.

The list below presents some general recommendations for the Project:

- It is recommended that the Project design must consider minimizing the impacts to the flora and fauna of the area.
- It is recommended that the Project design must consider respecting the required distances as solicited by pertinent agencies in the areas near the riparian zones that lie within the site. This effort must be conducted in close coordination with the pertinent agencies, such as the DNER and the USACE.
- Protection barriers should be constructed between the Project area and the zones set for protection, such as forested areas that will remain. This practice will protect the flora and fauna that remains within the site. All construction activities must be maintained within the set limits. This measure will reduce any impact to areas outside during construction.

- It is suggested that zones adjoining the project areas where trees will be impacted be reforested to create an attractive habitat for the reestablishment of the flora and fauna after construction activities have been completed.
- It is recommended that the Project complies with Planning Regulation #25, which was developed in conjunction by the DNER and the Puerto Rico Planning Board. A tree inventory of the trees found within the Project area must be performed in compliance of Regulation #25 to identify and protect the woody vegetation present in the site. The information gathered will be presented to the DNER as part of the permitting process with the different agencies. This inventory must be conducted by authorized personnel and certified arborists, as established by the DNER. Mitigation procedures will be required according to Regulation #25 if a project will remove existing trees, as is the case with this particular project because of the extent of terrain required. A conceptual plan must be finished to clearly indicate the location and extent of the proposed structures and determine the areas where vegetation will be removed and displacement of faunal species. A reforestation plan must be prepared taking into consideration the amount of trees that will be affected by the Project (Regulation No. 25).
- Implement maintenance measures for the adjacent ecosystems such as the bank of the *Río Grande de Arecibo*, as a control method during the construction period. One way to prevent adversely impacting the ecosystems is to implement buffer zones (protection of natural areas) surrounding the sensitive areas.
- Implement best management practices during the construction and operation phases of the Project to minimize the impacts to nearby bodies of water. The Erosion and Sediment Control Plan (ESC) and the Earth Movement permit must be presented to the Environmental Quality Board and the DNER, respectively, for their evaluation and approval before any earth movement takes place. The sediment barriers that will be used should be regularly inspected to avoid discharging sediments into the nearby bodies of water and therefore stop or minimize the prolonged exposure of bare soils resulting from human activities.

- Before earth movement activities start, the contractor in charge must select areas that will be used as staging areas and access roads and provide a protection plan for those near areas deemed as ecologically sensitive.
- The DNER and the USCOE must be consulted to evaluate any impacts to bodies of water/potential wetlands in compliance with Law No. 136 of June 3, 1976, 12 LPRA § et seq.; also in compliance with Section 404 of the Clean Water Act (33USC §1344) and USACE regulation 33 C.F.R. parts 320-330.

8.0 REFERENCES

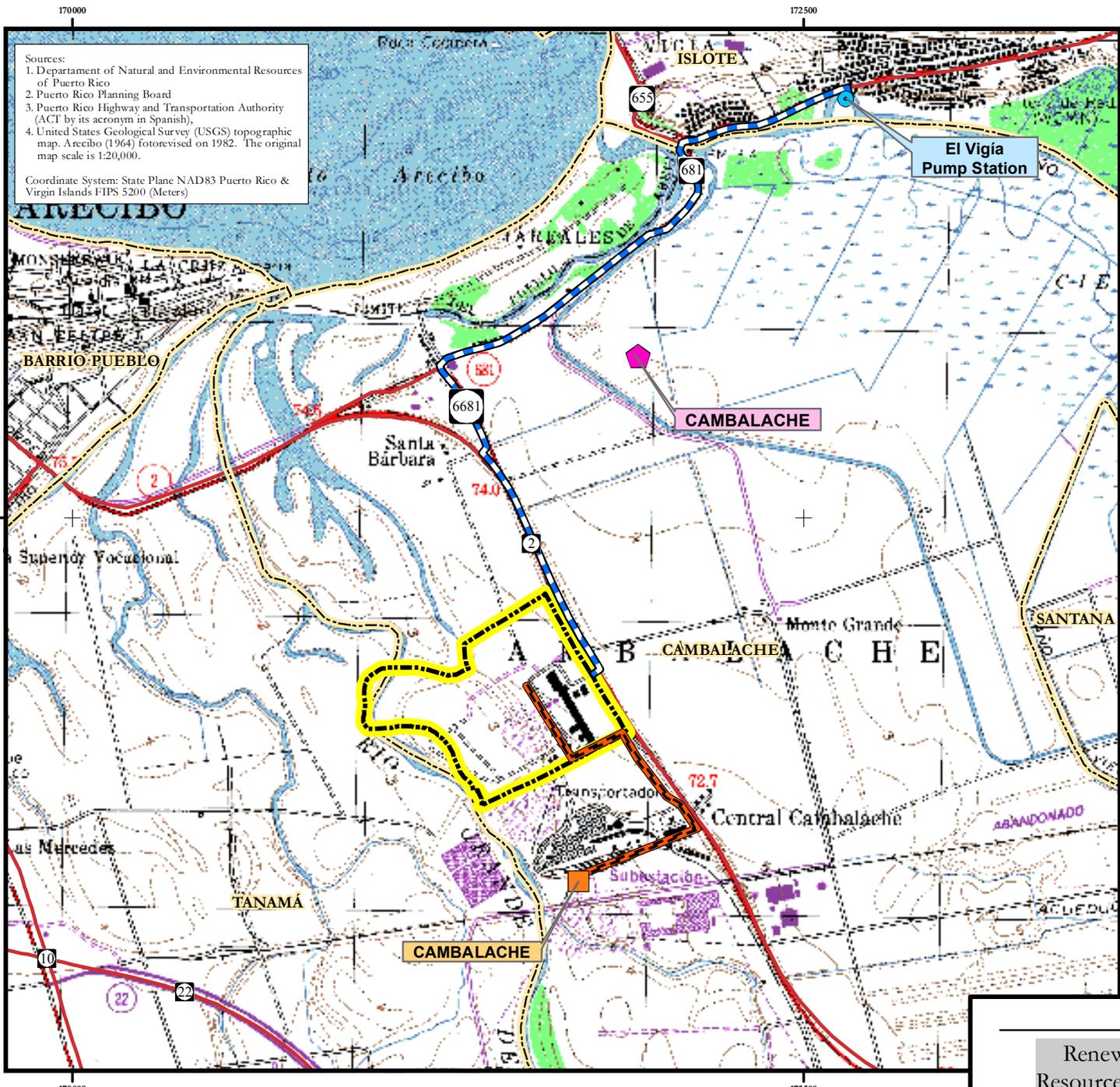
- Acevedo-Rodríguez, P., and R. O. Woodbury. 1985. Los Bejucos de Puerto Rico. Volumen 1. General Technical Report SO-58. United States Department of Agriculture, New Orleans, LA. 331 pp.
- Acevedo-Rodríguez, P. 1996. Flora of St. John: U.S. Virgin Islands, Memoirs of the New York Botanical Garden Vol. 78., New York Botanical Garden Press, Bronx, NY. 581 pp.
- Acevedo-Rodríguez, P. 2003. Bejucos y Plantas Trepadoras de Puerto Rico e Islas Vírgenes. Sheridan Press, Hanover, PA. 491 pp.
- Acevedo-Rodríguez, P and M.T. Strong. 2005. Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. National Museum of Natural History, Smithsonian Institution, Washington, DC. 415 pp.
- Briggs, R.P. 1968. Geologic map of the Arecibo quadrangle, Puerto Rico: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-551, scale 1:20,000.
- Department of Natural and Environmental Resources. 2005. Puerto Rico Critical Wildlife Areas. Commonwealth of Puerto Rico. Bureau of Fish and Wildlife, Terrestrial Resources Division, San Juan, PR 385 pp.
- Ewel, J. J. and J. L. Whitmore. 1973. The Ecological Life Zones of Puerto Rico and the United States Virgin Islands. Research Paper ITF-18. United States Department of Agriculture, Forest Service, Institute of Tropical Forestry, Río Piedras, PR.
- Liogier, H. A and L. F. Martorell. 1999. Flora of Puerto Rico and Adjacent Islands: a Systematic Synopsis. 2nd Ed. Editorial Universidad de Puerto Rico, Río Piedras, PR. 382 pp.
- Liogier, H. A. 1985. Descriptive Flora of Puerto Rico and Adjacent Islands. Vol. I. Editorial Universidad de Puerto Rico, Río Piedras, PR. 357 pp.
- Liogier, H. A. 1988. Descriptive Flora of Puerto Rico and Adjacent Islands. Vol. II. Editorial Universidad de Puerto Rico, Río Piedras, PR. 481 pp.
- Liogier, H. A. 1991. Descriptive Flora of Puerto Rico and Adjacent Islands. Vol. III. Editorial Universidad de Puerto Rico, Río Piedras, PR. 461 pp.
- Liogier, H. A. 1995. Descriptive Flora of Puerto Rico and Adjacent Islands. Vol. IV. Editorial Universidad de Puerto Rico, Río Piedras, PR. 617 pp.

- Liogier, H. A. 1997. Descriptive Flora of Puerto Rico and Adjacent Islands. Vol. V. Editorial Universidad de Puerto Rico, Río Piedras, PR. 436 pp.
- Little, E. L., and F. H. Wadsworth. 1999. Common Trees of Puerto Rico and the Virgin Islands. A private reprinting by the authors from Forest Service U.S. Department of Agriculture Handbook No. 249. Río Piedras, PR. 556 pp.
- Little, E. L., R. O. Woodbury and F. H. Wadsworth. 1974. Trees of Puerto Rico and the Virgin Islands. Second Volume. United States Department of Agriculture Handbook No. 449-S. Washington, DC. 1024 pp.
- Más, E., and O. García-Molinari. 2006. Guía Ilustrada de Yervas Comunes de Puerto Rico. 2^{da} Edición Ampliada y Revisada. Servicio de Extensión Agrícola de la UPR. USDA Servicio de Conservación de Recursos Naturales, Área del Caribe, NY. 303 pp.
- Oficina de Patrimonio Natural de Puerto Rico. 2008. Lista de Elementos Críticos de la División de Patrimonio Natural. Departamento de Recursos Naturales y Ambientales, San Juan, PR.
- Proctor, G. R. 1989. Ferns of Puerto Rico and the Virgin Islands. Memoirs of the New York Botanical Garden Vol. 53. Bronx, NY. 387 pp.
- Raffaele, H. A., J. Wiley, O. Garrido, A. Keith and J. Raffaele. 1998. A guide to the birds of the West Indies. Princeton University Press, Princeton, New Jersey. 411 pp.
- Renova. 1999. Reporte de Impacto Ambiental. Volumen 2: Consulta de Ubicación para Renova Facilidad de Recuperación de Recursos y Parque de Recuperación de Recursos.
- Rivero, J. 1998. Los Anfibios y Reptiles de Puerto Rico. Revised Second Edition. Editorial de la Universidad de Puerto Rico, Río Piedras, PR. 510 pp.
- Sociedad Ornitológica Puertorriqueña, Inc. (Unpublished). Puerto Rican Breeding Bird Atlas.
- United States Geological Survey. 2007. PR-GAP: Puerto Rico Gap Analysis Project, Assessing Biodiversity and Conservation in Puerto Rico. Final Report and Data. U. S. Department of Interior. Digital Version.
- Wunderle, J. M. 1994. Census Methods for Caribbean Land Birds. General Technical Report SO-100. U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, New Orleans, LA.

9.0 APPENDICES

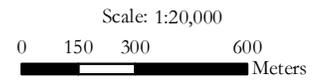
Appendix 1: Location Map

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Sources:
 1. Department of Natural and Environmental Resources of Puerto Rico
 2. Puerto Rico Planning Board
 3. Puerto Rico Highway and Transportation Authority (ACT by its acronym in Spanish),
 4. United States Geological Survey (USGS) topographic map, Arcibo (1964) fotorevised on 1982. The original map scale is 1:20,000.

 Coordinate System: State Plane NAD83 Puerto Rico & Virgin Islands FIPS 5200 (Meters)



- Legend:**
- El Vigía Pump Station¹
 - Substation²
 - Cambalache Power Plant²
 - Alineación línea eléctrica
 - Brackish Water Pipeline Route
 - Roads³
 - Property Boundary
 - Ward Limit²

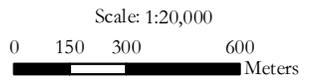
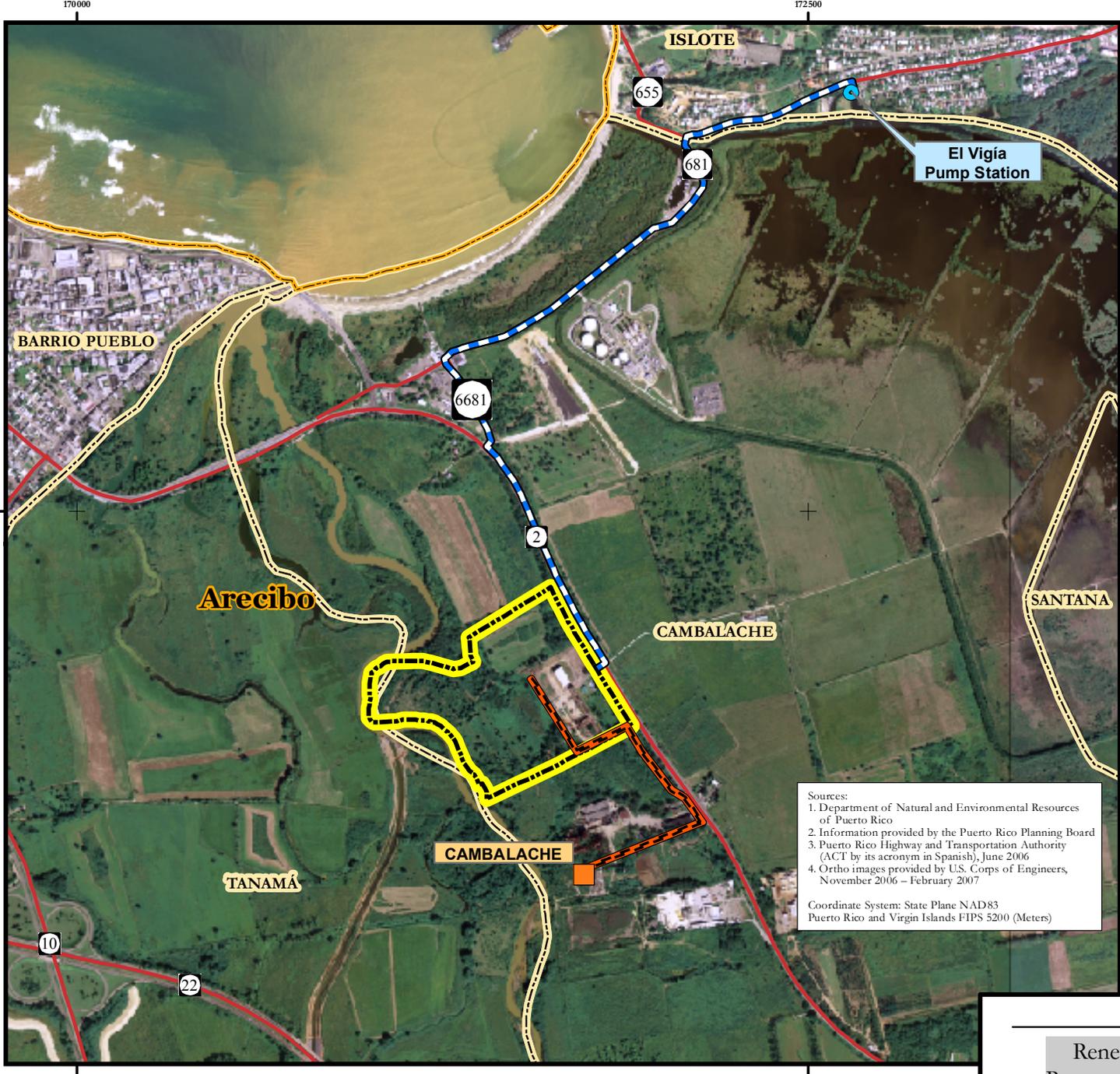


Location Map
 Renewable Power Generation and Resource Recovery Plant / Arcibo, PR

Appendix 2: Aerial Photograph

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Legend:

- El Vigia Pump Station¹
- Substation²
- Power Interconnection Alignment
- Brackish Water Pipeline Route
- Roads³
- Property Boundary
- Municipal Limit²
- Ward Limit²



Sources:
 1. Department of Natural and Environmental Resources of Puerto Rico
 2. Information provided by the Puerto Rico Planning Board
 3. Puerto Rico Highway and Transportation Authority (ACT by its acronym in Spanish), June 2006
 4. Ortho images provided by U.S. Corps of Engineers, November 2006 – February 2007

Coordinate System: State Plane NAD83
 Puerto Rico and Virgin Islands FIPS 5200 (Meters)

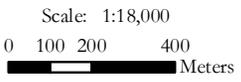
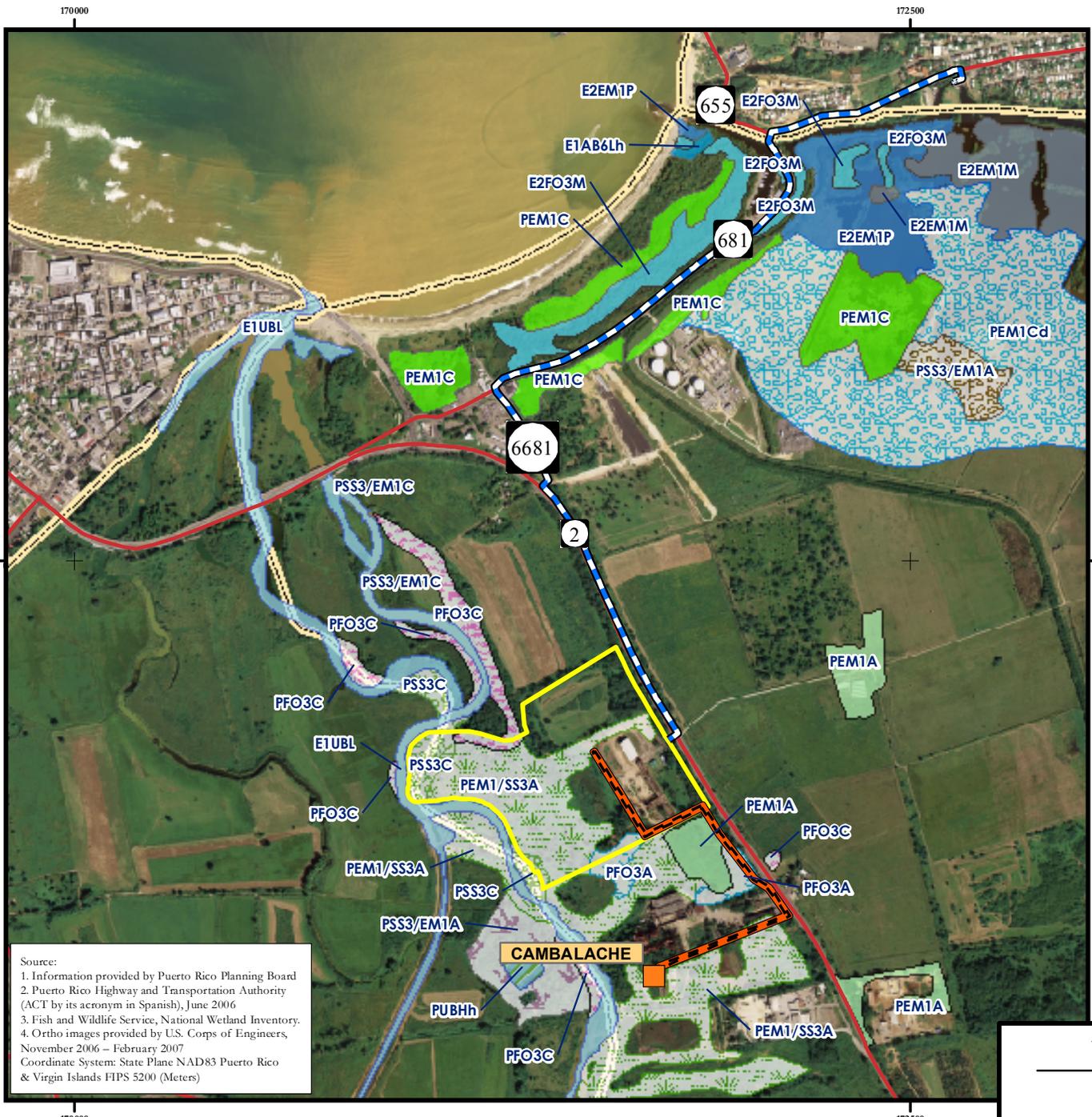


Aerial Photograph
 Renewable Power Generation and Resource Recovery Plant / Arecibo, PR

Appendix 3: Hydrology and Wetlands Map

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Legend:

- Substation¹
- Power Interconnection Alignment
- Raw Water Force Line Alignment
- Roads²
- Project Limit
- Wetlands²
- E1UBL - Estuarine, subtidal, unconsolidated bottom, subtidal
- PEM1/SS3A - Palustrine, emergent, persistent / Scrub-shrub, broad leaved evergreen, temporarily flooded
- PEM1A - Palustrine, emergent, persistent, temporarily flooded
- PFO3A - Palustrine, forested, broad-leaved evergreen, temporarily flooded
- PFO3C - Palustrine, forested, broad-leaved evergreen, seasonally flooded
- PSS3/EM1A - Palustrine, scrub-shrub, broad-leaved evergreen / Emergent, persistent, temporarily flooded
- PSS3C - Palustrine, scrub-shrub, broad-leaved evergreen, seasonally flooded
- PUBHh - Palustrine, unconsolidated bottom, permanently flooded, diked/impounded
- PSS3/EM1A - Palustrine, scrub-shrub, broad-leaved evergreen / Emergent, persistent, temporarily flooded
- Substation¹
- Power Interconnection Alignment
- Raw Water Force Line Alignment
- Roads²
- Project Limit
- Wetlands²
- E1AB6Lh - Estuarine, subtidal, aquatic bed, unknown surface, subtidal, diked/impounded
- E2EM1M - Estuarine, intertidal, emergent, persistent, irregularly exposed
- E2EM1P - Estuarine, intertidal, emergent, persistent, irregularly flooded
- E2FO3M - Estuarine, intertidal, forested, broad leaved evergreen, irregularly exposed
- PEM1C - Palustrine, emergent, persistent, seasonally flooded
- PEM1Cd - Palustrine, emergent, persistent, seasonally flooded, partially drained/ditched
- PSS3/EM1A - Palustrine, scrub-shrub, broad-leaved evergreen / Emergent, persistent, temporarily flooded



Source:
 1. Information provided by Puerto Rico Planning Board
 2. Puerto Rico Highway and Transportation Authority (ACT by its acronym in Spanish), June 2006
 3. Fish and Wildlife Service, National Wetland Inventory, November 2006 – February 2007
 4. Ortho images provided by U.S. Corps of Engineers, November 2006 – February 2007
 Coordinate System: State Plane NAD83 Puerto Rico & Virgin Islands FIPS 5200 (Meters)

National Wetland Inventory

Renewable Power Generation and Resource Recovery Plant / Arcibo, PR

Appendix 4: Priority Conservation Areas near the Project Site

Appendix 5: Inventory of the Flora

Table 1: Inventory of the Flora at the Renewable Energy Generation and Resource Recovery Project Site.

Scientific Name	Nombre Común	Common Name
<u>Polypodiaceae</u>		
<i>Acrostichum danaeifolium</i> Langsd & Fischer	Helecho de pantano	Inland leatherfern
<i>Nephrolepis multiflora</i> (Roxb.) Jarret	Helecho común	Common fern
<i>Thelypteris dentata</i> (Forsk.) E. St. John	-	-
<u>Urticaceae</u>		
<i>Pilea microphylla</i> (L.) Liebm.	Madreperla	Artillery plant
<u>Moraceae</u>		
<i>Ficus benjamina</i> L.	Laurel Benjamín	Benjamin fig
<u>Polygonaceae</u>		
<i>Antigonon leptopus</i> Hook. & Arn.	Coral	Love-chain
<u>Amaranthaceae</u>		
<i>Achyranthes aspera</i> L. var. <i>aspera</i>	Rabo de gato	Man-better-man
<i>Amaranthus dubius</i> Mart.	Bledo	Amaranth
<i>Amaranthus spinosus</i> L.	Blero espinoso	Spiny amaranth
<u>Nyctaginaceae</u>		
<i>Boerhavia diffusa</i> Mill.	Yerba de puerco	Hog-weed
<u>Phytolaccaceae</u>		
<i>Trichostigma octandrum</i> (L.) H. Walt.	Bejuco de palma	Basket wiss
<u>Portulacaceae</u>		
<i>Portulaca oleracea</i> L.	Verdolaga	Purslane
<u>Nymphaeaceae</u>		
<i>Nymphaea ampla</i> (Salisb.) DC.	Lirio de agua	Dotleaf waterlily
<u>Capparaceae</u>		
<i>Cleome speciosa</i> HBK.	Volantines preciosos	-
<u>Fabaceae</u>		
<i>Aeschynomene americana</i> L.	Yerba rosario	Shyleaf
<i>Albizia procera</i> (Roxb.) Benth.	Albicia	Tall albizia
<i>Alysicarpus vaginalis</i> (L.) DC.	Yerba de contrabando	False moneywort
<i>Chamaecrista nictitans</i> (Vogel) Irwin & Barneby	Morivivi bobo	Partridge pea
<i>Dalbergia ecastaphyllum</i> (L.) Taub.	Maraimaray	Coin vine
<i>Delonix regia</i> (Boger ex Hook) Raf.	Flamboyán	Royal poinciana
<i>Desmodium glabrum</i> (Mill.) DC.	Zarabacoa dulce	-

Scientific Name	Nombre Común	Common Name
<i>Indigofera suffruticosa</i> Miller	Añil	Indigo
<i>Leucaena leucocephala</i> (Lam.) DeWit	Tamarindillo	Wild tamarind
<i>Macroptilidium lathyroides</i> (L.) Urb.	Habichuela parada	Wild bush bean
<i>Mimosa pellita</i> HBK.	Moriviví gigante	Black mimosa
<i>Mimosa pudica</i> L.	Moriviví	Sensitive plant
<i>Neptunia plena</i> (L.) Benth.	Desmanto amarillo	Water neptunia
<i>Peltophorum pterocarpum</i> (DC.) Back. & Heyne	Flamboyán amarillo	Yellow poinciana
<i>Pithecellobium dulce</i> (Roxb.) Benth.	Guamá americano	Manila tamarind
<i>Senna alata</i> (L.) Roxb.	Talantala	Candle bush
<i>Senna bicapsularis</i> (L.) Roxb.	-	-
<i>Senna occidentalis</i> (L.) Link	Hedionda	Stinking weed
<i>Sesbania sericea</i> (Willd.) Link	Papagayo	-
<i>Stylosanthes hamata</i> (L.) Taud	Zarabacoa enana	Pencil flower
<i>Vigna adenantha</i> (G. F. W. Meyer) Maréchal & al.	Habichuela cimarrona	Wild bean
<i>Vigna luteola</i> (Jacq.) Benth.	Frijol silvestre	Deer pea
<i>Vigna vexillata</i> (L.) A. Rich.	-	-
<u>Oxalidaceae</u>		
<i>Oxalis barrelieri</i> L.	-	Barrelier's woodsorrel
<u>Zygophyllaceae</u>		
<i>Kallstroemia maxima</i> (L.) Hook & Arn.	Verdolaga de abrojo	Big caltrop
<u>Meliaceae</u>		
<i>Swietenia mahagoni</i> (L.) Jacq.	Caoba dominicana	Mahogany
<u>Euphorbiaceae</u>		
<i>Chamaesyce hirta</i> (L.) Millspaugh	Lehecillo	-
<i>Chamaesyce hyssopifolia</i> (L.) Small	Lechera	-
<i>Chamaesyce prostrata</i> (Ait.) Small	Lehecillo	Postrate sandmat
<i>Chamaesyce serpens</i> (HBK.) Small	Sanguinaria	-
<i>Euphorbia heterophylla</i> L.	Lehecilla	-
<i>Jatropha gossypifolia</i> L.	-	-
<i>Ricinus communis</i> L.	Higuereta	Castor bean
<u>Phyllanthaceae</u>		
<i>Phyllanthus niruri</i> L.	Quinino del pobre	Gale of the wind
<u>Anacardiaceae</u>		
<i>Spondias cytherea</i> Sonn.	Jobo de la India	Golden apple
<u>Sapindaceae</u>		
<i>Melicoccus bijugatus</i> Jacquin	Quenepa	Spanish lime

Scientific Name	Nombre Común	Common Name
<u>Vitaceae</u>		
<i>Cissus verticillata</i> (L.) Nicholson & Jarvis	Bejuco de caro	Pudding vine
<u>Elaeocarpaceae</u>		
<i>Muntingia calabura</i> L.	Capulín	Panama berry
<u>Tiliaceae</u>		
<i>Corchorus hirsutus</i> L.	Malvavisco	Jack-switch
<i>Corchorus siliquosus</i> L.	Escoba blanca	Broom weed
<i>Triumfetta semitriloba</i> Jacquin	Cadillo de perro	Sacramento burrbark
<u>Malvaceae</u>		
<i>Sida acuta</i> Burm f.	Escoba blanca	Wire weed
<i>Sida cordifolia</i> L.	Escoba acorazonada	-
<i>Sida rhombifolia</i> L.	Escoba colorada	-
<i>Thespesia populnea</i> (L.) Solander ex Correa	Emajagüilla	Spanish cork
<i>Urena lobata</i> L.	Cadillo	Bur
<u>Sterculiaceae</u>		
<i>Melochia nodiflora</i> Swartz	Bretónica prieta	-
<i>Melochia pyramidata</i> L.	Bretónica piramidal	Pyramid flower
<i>Waltheria indica</i> L.	Malvabisco	-
<u>Guttiferae</u>		
<i>Clusia rosea</i> Jacquin	Cupey	Balsam fig
<u>Flacourtiaceae</u>		
<i>Casearia guianensis</i> (Aublet) Urban	Cafeillo	Wild coffee
<u>Lythraceae</u>		
<i>Cuphea hyssopifolia</i> HBK,	-	False heather
<i>Cuphea strigulosa</i> HBK.	-	-
<u>Rhizophoraceae</u>		
<i>Rhizophora mangle</i> L.	Mangle rojo	Red mangrove
<u>Combretaceae</u>		
<i>Laguncularia racemosa</i> (L.) Gaertn.	Mangle blanco	White mangrove
<i>Terminalia catappa</i> L.	Almendro	Indian almond
<u>Onagranaceae</u>		
<i>Ludwigia octovalvis</i> (Jacq.) Raven	Yerba de clavo	Primerose willow
<u>Loganiaceae</u>		
<i>Spigelia anthelmia</i> L.	Lombricera	Worm grass
<u>Convolvulaceae</u>		
<i>Ipomoea alba</i> L.	Claro de luna	Moon vine

Scientific Name	Nombre Común	Common Name
<i>Ipomoea indica</i> (Burm. f.) Merr. var. <i>acuminata</i>	Bejuco de gloria	Ocean blue morning glory
<i>Ipomoea setifera</i> Poir.	Bejuco de puerco	Wild morning glory
<i>Ipomoea tiliacea</i> (Willd.) Choisy	Bejuco de puerco	-
<i>Merremia aegyptia</i> (L.) Urb.	-	-
<i>Merremia quinquefolia</i> (L.) Hallier	Batatilla blanca	-
<i>Merremia umbellata</i> (L.) Hall f.	Aguinaldo amarillo	Yellow morning glory
<u>Boraginaceae</u>		
<i>Heliotropium indicum</i> L.	Cotorrera	Indian heliotrope
<u>Verbenaceae</u>		
<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Bretónica	-
<u>Avicenniaceae</u>		
<i>Avicennia germinans</i> (L.) L.	Mangle negro	Black mangrove
<u>Labiatae</u>		
<i>Mentha x piperita</i> L.	Agua florida, menta	Peppermint
<u>Lamiaceae</u>		
<i>Leonotis nepetifolia</i> (L.) R. Br.	Botón de cadete	Lion's ear
<u>Solanaceae</u>		
<i>Cestrum diurnum</i> L.	Galán de día	Day cestrum
<i>Physalis angulata</i> L.	Sacabuche	Ground cherry
<i>Solanum torvum</i> Sw.	Berenjena cimarrona	Turkey berry
<u>Scrophulariaceae</u>		
<i>Capraria biflora</i> L.	Té del país	Goat-weed
<u>Bignoniaceae</u>		
<i>Spathodea campanulata</i> Beav.	Tulipán africano	African tulip
<u>Acanthaceae</u>		
<i>Asystasia gangetica</i> (L.) Anders.	Coromandel	-
<i>Ruellia brittoniana</i> Leon.	A-las-doce-me-voy	-
<i>Ruellia tuberosa</i> L.	-	Many-roots
<i>Thumbergia alata</i> Bojer	Flor de poeta	Black-eye Susan
<i>Thumbergia fragrans</i> Roxb.	Susana blanca	-
<u>Rubiaceae</u>		
<i>Spermacoce confusa</i> Rendle & Gillis	Hierva de hierro	Iron grass
<i>Spermacoce eryngioides</i> (Cham. & Schl.) O. Ktze	-	-
<u>Cucurbitaceae</u>		
<i>Cayaponia americana</i> (Lam.) Cogn.	Bejuco de torero	-
<i>Cucumis anguria</i> L.	Cohombro	West Indian cucumber

Scientific Name	Nombre Común	Common Name
<i>Melothria pendula</i> L.	Pepinito	-
<i>Momordica charantia</i> L.	Cundeamor	Wild balsam apple
<u>Asteraceae</u>		
<i>Bidens alba</i> (L.) DC. var. <i>radiata</i>	Margarita silvestre	Shepherd's needle
<i>Eclipta prostrata</i> (L.) L.	Eclipta blanca	-
<i>Emilia fosbergii</i> Nicolson	Clavelito colorado	-
<i>Melanthera aspera</i> (Jacq.) Small var. <i>aspera</i>	Salaílo	-
<i>Parthenium hysterophorus</i> L.	Yerba amarga	Feverfew
<i>Mikania micrantha</i> HBK	Guaco falso	Bittervine
<i>Pluchea odorata</i> (L.) Cass.	Salvia	-
<i>Pseudoelephantopus spicatus</i> (Juss.) C. F. Baker	Lengua de vaca	-
<i>Synedrella nodiflora</i> (L.) Gaertn.	Serbatana	Nodeweed
<i>Tridax procumbens</i> L.	Pancha	-
<i>Vernonia cinerea</i> (L.) Lessing	Yerba socialista	-
<i>Youngia japonica</i> (L.) DC.	-	-
<u>Typhaceae</u>		
<i>Typha domingensis</i> Pers.	Yerba de eneas	Cat-tail
<u>Poaceae</u>		
<i>Bambusa vulgaris</i> Schrad. ex J.C. Wendl.	Bambú	Bamboo
<i>Urochloa mutica</i> (Forsk.) T.Q. Nguyen	Malojillo	Para grass
<i>Cenchrus echinatus</i> L.	Abrojo	Bur grass
<i>Chloris inflata</i> Link	Paragüita	Mexican blue grass
<i>Cynodon dactylon</i> (L.) Pers.	Bermuda común	Bermuda grass
<i>Cynodon nlemfuensis</i> Vanderyst	Estrella morada	African Bermuda grass
<i>Dactyloctenium aegyptium</i> (L.) Willd.	Yerba egipcia	Egyptian grass
<i>Dichantherium acuminatum</i> (Sw.) Gould & C.A. Clark	Yerba de ramillete	Hotsprings panicum
<i>Dichanthium annulatum</i> (Forsk.) Stapf.	Yerba de las traviesas	Railroad-track grass
<i>Digitaria ciliaris</i> (Retz.) Koel.	Pata de gallina fina	Southern crab grass
<i>Digitaria sanguinalis</i> (L.) Scop.	Pendejuelo	Hairy crab grass
<i>Echinochloa colona</i> (L.) Link	Arrocillo	Jungle rice
<i>Eleusine indica</i> (L.) Gaertn.	Pata de gallina	Goose grass
<i>Eragrostis ciliaris</i> (L.) R. Br.	Yerba de amor	Gophertail lovegrass
<i>Gynerium sagittatum</i> (Aubl.) Beauv.	Caña brava	Wildcane
<i>Megathyrsus maximus</i> (Jacq.) B.K. Simon & S.W.L.	Yerba de guinea	Guinea grass
<i>Melinis repens</i> (Willd.) Zizka	Yerba rosada	Natal grass
<i>Paspalum ghiesbreghtii</i> Fourn.	-	-

Scientific Name	Nombre Común	Common Name
<i>Paspalum conjugatum</i> Berg.	Horquetilla	-
<i>Paspalum fasciculatum</i> Willd.	Yerba venezolana	Mexican crown grass
<i>Paspalum fimbriatum</i> HBK.	Pata de conejo	-
<i>Paspalum millegrana</i> Schrad.	Yerba brava	-
<i>Paspalum paniculatum</i> L.	Yerba peluda	Hairy grass
<i>Paspalum virgatum</i> L.	Matojo blanco	-
<i>Pennisetum purpureum</i> Schum.	Yerba de elefante	-
<i>Setaria geniculata</i> (Lam.) Beauv.	Arrocillo	Yellow foxtail
<i>Sorghum halapense</i> (L.) Pers.	Yerba Johnson	Johnson grass
<i>Sporobolus jacquemontii</i> Kunth	Cerrillo	-
<i>Sporobolus tenuissimus</i> (Schränk) Kuntze	-	-
<i>Steinchisma laxa</i> (Sw.) Zuloaga	Malojillo del monte	Gaping grass
<u>Cyperaceae</u>		
<i>Cyperus involucratus</i> Rottb.	Paragüita	Umbrella flatsedge
<i>Cyperus iria</i> L.	-	-
<i>Cyperus ligularis</i> L.	-	-
<i>Cyperus odoratus</i> L.	-	-
<i>Cyperus rotundus</i> L.	Coqui	Nut grass
<i>Cyperus surinamensis</i> Rothb.	-	-
<i>Fimbristylis dichotoma</i> (L.) Vahl.	Junquito	-
<u>Arecaceae</u>		
<i>Caryota urens</i> L.	Palma cola de pez	Fishtail palm
<i>Cocos nucifera</i> L.	Palma de Coco	Coconut Palm
<i>Roystonea borinquena</i> O. F. Cook	Palma real	Royal palm
<u>Araceae</u>		
<i>Alocasia macrorrhiza</i> (L.) Schott	Alocasia gigante	Giant alocasia
<i>Syngonium podophyllum</i> Schott	Malanga trepadora	Arrow-head vine
<i>Xanthosoma sagittifolium</i> (L.) Schott	Yautía blanca	Tanier
<u>Commelinaceae</u>		
<i>Commelina diffusa</i> Burm. f.	Cojitre	French weed
<i>Commelina erecta</i> L.	Cohitre azul	Blue day-flower
<u>Musaceae</u>		
<i>Musa paradisiaca</i> L.	Guineo	Banana

Appendix 6: Inventory of the Fauna

Table 2: Inventory of the Fauna at the Renewable Energy Generation and Resource Recovery Project Site.

Scientific Name	Nombre Común	Common Name
AVES		
<u>Podicipedidae</u>		
<i>Podilymbus podiceps</i>	Zaramago	Pied-billed Grebe
<u>Fregatidae</u>		
<i>Fregata magnificens</i>	Fragata Magnífica	Magnificent Frigatebird
<u>Ardeidae</u>		
<i>Ardea herodias</i>	Garzón Cenizo	Great Blue Heron
<i>Ardea alba</i>	Garza Real	Great Egret
<i>Egretta thula</i>	Garza Blanca	Snowy Egret
<i>Egretta caerulea</i>	Garza Azul	Little Blue Heron
<i>Egretta tricolor</i>	Garza Pechiblanca	Tricolored Heron
<i>Bubulcus ibis</i>	Garza Ganadera	Cattle Egret
<i>Butorides virescens</i>	Martinet Verde	Green Heron
<u>Accipitridae</u>		
<i>Buteo jamaicensis</i>	Guaraguao Colirrojo	Red-tailed Hawk
<u>Falconidae</u>		
<i>Falco sparverius</i>	Falcón Común	American Kestrel
<u>Rallidae</u>		
<i>Gallinula chloropus</i>	Gallareta Común	Common Moorhen
<u>Charadriidae</u>		
<i>Charadrius vociferus</i>	Chorlo Sabanero	Killdeer
<u>Scolopacidae</u>		
<i>Actitis macularius</i>	Playero Coleador	Spotted Sandpiper
<u>Columbidae</u>		
<i>Columba livia</i>	Paloma Doméstica	Rock Pigeon
<i>Zenaida asiatica</i>	Tórtola Aliblanca	White-winged Dove
<i>Zenaida aurita</i>	Tórtola Cardosantera	Zenaida Dove
<i>Columbina passerina</i>	Rolita	Common Ground-Dove
<u>Psittacidae</u>		
<i>Myiopsitta monachus</i>	Perico monje	Monk parakeet
<u>Cuculidae</u>		
<i>Coccyzus minor</i>	Pájaro Bobo Menor	Mangrove Cuckoo
<i>Crotophaga ani</i>	Garrapatero	Smooth-billed Ani
<u>Trochilidae</u>		
<i>Anthracothorax dominicus</i>	Zumbador Dorado	Antillean Mango

Scientific Name	Nombre Común	Common Name
<u>Alcedinidae</u>		
<i>Megaceryle alcyon</i>	Martín Pescador Norteño	Belted Kingfisher
<u>Picidae</u>		
<i>Melanerpes portoricensis</i>	Carpintero de Puerto Rico	Puerto Rican Woodpecker
<u>Tyrannidae</u>		
<i>Tyrannus dominicensis</i>	Pitirre Gris	Gray Kingbird
<u>Hirundinidae</u>		
<i>Progne dominicensis</i>	Golondrina de Iglesias	Caribbean Martin
<i>Petrochelidon fulva</i>	Golondrina de Cuevas	Cave Swallow
<u>Mimidae</u>		
<i>Mimus polyglottos</i>	Ruiseñor	Northern Mockingbird
<i>Margarops fuscatus</i>	Zorzal Pardo	Pearly-eyed Thrasher
<u>Parulidae</u>		
<i>Parula americana</i>	Reinita Pechidorada	Northern Parula
<i>Dendroica discolor</i>	Reinita Galana	Prairie Warbler
<i>Seiurus noveboracensis</i>	Pizpita de Mangle	Northern Waterthrush
<u>Coerebidae</u>		
<i>Coereba flaveola</i>	Reinita Común	Bananaquit
<u>Thraupidae</u>		
<i>Spindalis portoricensis</i>	Reina Mora de Puerto Rico	Puerto Rican Spindalis
<u>Emberizidae</u>		
<i>Tiaris bicolor</i>	Gorrión Negro	Black-faced Grassquit
<i>Tiaris olivacea</i>	Gorrión Barba Amarilla	Yellow-faced Grassquit
<i>Annodromus savanarum</i>	Gorrión Chicharra	Grasshopper Sparrow
<u>Icteridae</u>		
<i>Quiscalus niger</i>	Mozambique	Greater Antillean Grackle
<i>Molothrus bonariensis</i>	Tordo Lustroso	Shiny Cowbird
<u>Passeridae</u>		
<i>Passer domesticus</i>	Gorrión Doméstico	House Sparrow
<u>Ploceidae</u>		
<i>Euplectes franciscanus</i>	Obispo Colorado	Orange Bishop
<i>Vidua macroura</i>	Viuda Colicinta	Pin-tailed Whydah
<u>Estrildidae</u>		
<i>Estrilda melpoda</i>	Veterano	Orange-cheeked Waxbill
<i>Lonchura cucullata</i>	Diablito	Bronze Mannikin
<i>Lonchura punctulata</i>	Gorrión Canela	Nutmeg Mannikin
AMPHIBIA		
<u>Bufo</u>		
<i>Bufo marinus</i>	Sapo Común	Cane Toad

Scientific Name	Nombre Común	Common Name
<u>Leptodactylidae</u>		
<i>Eleutherodactylus antillensis</i>	Coquí Churí	-
<i>Eleutherodactylus coqui</i>	Coquí Común	-
<i>Leptodactylus albilabris</i>	Ranita de Labio Blanco	White-lipped Frog
<u>Rannidae</u>		
<i>Rana catesbeana</i>	Rana Toro	Bullfrog
REPTILIA		
<u>Emydidae</u>		
<i>Trachemys stejnegeri</i>	Jicotea de Puerto Rico	Puerto Rican Slider
<u>Iguanidae</u>		
<i>Iguana iguana</i>	Iguana Verde	Green Iguana
<u>Polychrotidae</u>		
<i>Anolis cristatellus</i>	Lagartijo Común	Common Anole
<i>Anolis pulchellus</i>	Lagartijo de Jardín	Grass Anole
<u>Teiidae</u>		
<i>Ameiva exsul</i>	Siguana Común	Puerto Rican Common Ameiva
MAMMALIA		
<u>Phyllostomidae</u>		
<i>Artibeus jamaicensis</i>	Murciélago Frutero Común	Jamiacan Fruit Bat
<u>Mustelidae</u>		
<i>Herpestes auropunctatus</i>	Mangosta	Indian Mongoose

Appendix 7: Photographic Documentation



Photo 1

View of the Parcel toward the north.



Photo 2

View of the *Rio Grande de Arecibo*.



Photo 3

View of the northwest corner of the parcel showing the dense cover of vines such as moon vine, *Ipomoea alba*.



Photo 4

Pastures dominated by African Bermuda grass (*Cynodon nlemfuensis*) along the northern part of the Parcel.



Foto 5

Wildcane (*Gynerium sagittatum*) forming dense rows along the canals, roadsides and ponds.



Photo 6

Example of the interior of the abandoned ponds.



Photo 7

Wet terrain filled by storm water along Road PR-2 outside the Project parcel. The accumulation of water is the result of poor drainage in a canal that serves the said road.



Photo 8

View of the vegetation cover in the area formerly used to store prime material for the manufacture of cardboard.



Photo 9

View of the Central Cambalache Sugar Mill parcel where the proposed power line transmit the produced power to the interconnection point.



Photo 10

View of part of the raw water pipeline route along roads PR-2 and PR-681, respectively.