Arecibo Waste-to-Energy and Resource Recovery Project Draft Environmental Impact Statement

Prepared for:

U.S. Department of Agriculture, Rural Utilities Service

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ACRONYMS

AADT	annual average daily traffic
APE	area of potential effect
Arecibo WTE Project	Waste-to-Energy and Resource Recovery Project at the site of the former Global Fibers Paper Mill in Arecibo, Puerto Rico
BACT	Best Available Control Technology
BMP	best management practice
BTU	British thermal unit
°C	degrees Celsius
cfs	cubic feet per second
CAA	Clean Air Act
cal. BP	calibrated years before present
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
COPC	constituents of potential concern
COPEC	contaminants of potential ecological concern
dB	decibel
dBA	A-weighted decibel
DE/EC	duplicate effective/existing condition model
Dynamic Itinerary	Dynamic Itinerary for Infrastructure Projects
EBSL	ecologically-based screening level
EIA	Energy Information Administration
EIS	environmental impact statement
Energy Answers	Energy Answers Arecibo, LLC
EPA	U.S. Environmental Protection Agency
EQB	Puerto Rico Environmental Quality Board
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FE/PC	floodway encroachment/proposed condition model
FR	Federal Register
gpd	gallons per day
kV	kilovolt
L_{eq}	equivalent continuous noise level
LOS	level of service
$\mu g/m^3$	micrograms per cubic meter

MACT	Maximum Achievable Control Technology
mgd	million gallons per day
msl	mean sea level
MSW	municipal solid waste
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OGPe	Oficina de Gerencia de Permisos
$PM_{2.5}$	particulate matter smaller than or equal to 2.5 microns
PM_{10}	particulate matter smaller than or equal to 10 microns
PR-2	State Road Puerto Rico-2
PRASA	Puerto Rico Aqueduct and Sewer Authority
PRDNER	Puerto Rico Department of Natural and Environmental Resources
PREPA	Puerto Rico Electric Power Authority
PRIDCO	Puerto Rico Industrial Development Company
PSD	Prevention of Significant Deterioration
Regional Infrastructure Plan	Regional Infrastructure Plan for Recycling and Solid Waste Disposal
ROI	region of influence
RSCR	regenerative selective catalytic reduction
RUS	Rural Utilities Service
SLERA	Screening Level Ecological Risk Assessment
SWMA	Puerto Rico Solid Waste Management Authority
TCDD	tetrachlorodibenzo-p-dioxin
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Vazquez WTP	Dr. Santiago Vazquez Water Treatment Plant
WTE	Waste-to-Energy

1.0 INTRODUCTION

Energy Answers Arecibo, LLC (Energy Answers), is a private developer and operator of waste-to-energy (WTE) and resource recovery projects. Energy Answers International, the parent company of Energy Answers, develops integrated solid waste management and resource recovery facilities that utilize municipal solid waste (MSW) to generate energy. Energy Answers proposes to construct and operate a new 67-megawatt (MW) WTE and resource recovery project at the site of the former Global Fibers Paper Mill in Arecibo, in the Commonwealth of Puerto Rico (Puerto Rico) (hereinafter referred to as the Arecibo WTE Project or Project).

Energy Answers has approached the U.S Department of Agriculture (USDA), Rural Utilities Service (RUS) and indicated its intent to obtain a loan or a loan guarantee. RUS has determined that the issuance of a loan or loan guarantee would constitute a major federal action and that an environmental impact statement (EIS) is the appropriate level of environmental review for this proposed action under the National Environmental Policy Act of 1969 (NEPA) (42 United States Code [USC] 4321 *et seq.*).

RUS has prepared this EIS in compliance with the requirements of NEPA, the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] §1500–1508), RUS Environmental Policies and Procedures (7 CFR §1794), the RUS Scoping Guide for RUS Funded Projects requiring Environmental Impact Statements (RUS Bulletin 1794A-603), and other applicable regulations.

This EIS was prepared to meet the following key objectives:

- Identify baseline conditions in the Arecibo WTE Project area
- Identify and assess potential impacts on the natural and human environment that might result from implementation of the proposed Project if RUS decides to provide funding
- Describe and evaluate the no-action alternative
- Identify specific mitigation measures, as appropriate, to minimize environmental impacts
- Facilitate decision making by RUS and other applicable federal regulatory agencies responsible for the issuance of associated permits and approvals

This chapter presents an overview of the proposed Project and describes the Arecibo WTE Project and connected actions (Sections 1.1 and 1.2), the purpose and need for the Project (Section 1.33), and the regulatory framework and authorizing actions that are pertinent to the Project (Section 1.44).

1.1 PROJECT OVERVIEW AND DESCRIPTION

Energy Answers proposes to construct a WTE generation and resource recovery project in the Cambalache Ward of Arecibo, Puerto Rico. The Project would process approximately 2,300 tons of municipal solid waste per day and generate a net output of approximately 67 MW, which the Puerto Rico Electric Power Authority (PREPA) would purchase. The preferred location for the plant is the site of the former Global Fibers Paper Mill; the plant would encompass approximately 79.6 acres (32 hectares) of the 90-acre parcel. The proposed Project would include the following components: MSW receiving and processing building; a processed refuse fuel storage building; a boiler and steam turbine; an emission control system; an ash processing and storage building; and other associated infrastructure and buildings. The proposed Project also would require the installation of an approximately 2-mile (3.2 kilometers) raw water line for cooling and process water, and construction of a 115 kilovolt (kV) transmission line approximately 0.8 mile (1.2 kilometers) long to transmit the energy to PREPA's electrical grid.

1.2 PROJECT BACKGROUND

Puerto Rico faces challenges in meeting its solid waste management requirements through the existing network of aging landfills. The island is also challenged by its dependency on fuel imports for energy sources. The following sections discuss the recent past and present situation related to solid waste management and energy in Puerto Rico as it relates to Energy Answers' identification of an opportunity to construct and operate a WTE Project.

1.2.1 Solid Waste Management

Puerto Rico's public policy regarding solid waste management is established, among others, by the Solid Waste Authority Organic Act (Act No. 70 of June 13, 1978, as amended), the Solid Wastes Reduction and Recycling Act of Puerto Rico (Act No. 70 of September 18, 1992, Recycling Act, as amended), and by the regulations promulgated by the Puerto Rico Solid Waste Management Authority (SWMA). These acts and regulations are designed to minimize the solid waste volume generated on the island. As ordered by the Recycling Act, the hierarchy for solid waste disposal options was established as follows:

- Source reduction
- Reuse
- Recycling/composting
- WTE plants
- Landfill

The U.S. Environmental Protection Agency (EPA), Region 2, made the following observations about solid waste management in Puerto Rico (EPA 2015a):

- The management and disposal of solid waste in Puerto Rico has long been a challenge.
- The problem is intensified by the limited disposal space available on an island community and Puerto Rico's delicately balanced ecosystem.
- Puerto Rico's residents generate more waste than people living on the mainland, and recycling rates on the island are lower.
- Most of Puerto Rico's solid waste ends up in one of the island's landfills, most of which do not comply with Puerto Rico's and federal landfill requirements.
- The solution is a comprehensive and integrated solid waste management plan that calls for a reduction in the amount of solid waste generated, an increase in the recycling rate, the use of waste to produce energy, and the proper and efficient management of all landfills.

SWMA and the Puerto Rico Environmental Quality Board (EQB) have local responsibility for managing solid waste on the island. The solid waste management system in Puerto Rico serves 78 municipalities that generate about 4 million tons per year of residential, commercial, and industrial waste. This infrastructure includes programs that promote source reduction/reuse and recycling of these wastes; 9 material recovery facilities, 4 composting plants, 17 transfer stations, and 27[1] sanitary landfill systems.

SWMA has the task of establishing and executing public policy with respect to the technical, administrative, and operational aspects of the solid waste management system. Under this authority, SWMA creates mandatory disposal regions and identifies priority infrastructure projects. SWMA also established the solid waste framework for Puerto Rico that includes: (1) transfer stations, (2) recyclable materials recover plants, (3) compost plants, and (4) energy recovery plants.

Subsequently, in 2003, SWMA prepared a *Solid Waste Management Strategic Plan* (PRIDCO 2010). The strategic plan included areas that had not been addressed in previous plans, such as market development and public participation. In addition to these efforts, SWMA completed two large studies around the same time. One of them, the *Solid Waste Characterization Study* (SWAMA 2003), consisted of an analysis of the quantities and characteristics of the solid waste stream. The second study, *Assessment, Diagnosis and Recommendations for Landfill Systems*, 2004, also known as the Landfill Useful Life Study, provided a detailed analysis of the remaining capacity of all disposal facilities or landfills. These efforts identified a solid waste management system with numerous challenges, including landfills that did not comply with EPA and Resource Conservation and Recovery Act regulations.

[1] The number of active landfills varies depending on the date of the source document because numerous landfills received closure orders from the EPA and EQB; some of which have extended their closure dates.

Executive Order 2007-48, issued by the Governor of Puerto Rico and approved on November 2, 2007, ordered a reduction on the use of landfills as a principal method of disposition and management of solid waste in Puerto Rico. In response to this executive order, the findings of the above-mentioned studies, and a need to address solid waste management into the future, SWMA developed its *Dynamic Itinerary for Infrastructure Projects* (Dynamic Itinerary) (SWMA 2008) to implement strategies that responsibly address the development of the appropriate infrastructure needed to manage the solid waste until 2030.

In 2011, EQB adopted Resolution No. R-11-16-5, as amended by Resolution No. R-12-8 of May 4, 2012, which mandated, among other things, compliance by all landfills in Puerto Rico, within 36 months, with the requirements of Regulation No. 5717 adopted by EQB on November 14, 1997, as amended, and Subtitle D of the Federal Resource Conservation and Recovery Act and applicable local laws and regulations, for the closure of non-compliant landfills. In September 2014, EQB issued a series of letters to municipalities with non-compliant landfills reiterating the need for the closure of these facilities.

Federal and state regulations are important factors in Puerto Rico's solid waste management system and ultimately are used by agencies to determine facilities that will continue to operate and those that will close. The most critical regulations that affect current landfill facilities are the EPA's Subtitle D[2] (40 CFR §258) regulations of the Resource Conservation and Recovery Act that enforce how the construction, operation, and closure of landfills should be undertaken.

The Dynamic Itinerary included the development of a disposal capacity model that projected the expected lifespans of existing landfills under different solid waste management scenarios. The Dynamic Itinerary proposed strategies to reach at least a 35 percent diversion rate on or before 2016. The scenarios in the capacity model include:

- **Do Nothing Scenario**—The projections of the disposal capacity model for the Do Nothing scenario, where no additional disposal or processing capacity is added and no growth in the diversion rate is achieved, show that Puerto Rico would run out of disposal capacity by 2018, demonstrating the need for urgent action in terms of planning and execution of waste management strategies, including diverting recyclable materials from landfills and simultaneously provide adequate disposal capacity for solid waste.
- **Base Case Scenario**—Under this scenario, SWMA-planned diversion strategies reach the diversion goals, which would result in seven operating landfills with 17.8 years of

[2] Resource Conservation and Recovery Act Subtitle D focuses on state and local governments as the primary planning, regulating, and implementing entities for the management of non-hazardous solid waste. EPA developed federal criteria for the proper design and operation of municipal solid waste landfills and other solid waste disposal facilities, and Puerto Rico has adopted these criteria into its solid waste programs.

useful life left at the end of the planning period (2030). The Base Case scenario establishes the steps necessary to reduce the use of sanitary landfill systems as a primary alternative to manage MSW. It also defines the initial goals to increase the diversion rate and incorporates two WTE facilities (a 1,560 ton per day facility in the northeast region in service by 2013 and a 1,350 tons per day facility in the northwest region in service in 2012).

- **Back-up Case Scenario**—This scenario estimates that the diversion rate goal of 35 percent would be met in 2030 instead of 2016, assumes that WTE plants would not be developed, and estimates that in 2030 there would be only eight landfills in operation with 7.5 years of useful life left.

1.2.2 Solid Waste Generation in Puerto Rico

The projected solid waste generation in the Dynamic Itinerary was calculated based on 2006 population projections published by the Puerto Rico Planning Board and assumed that the estimated daily generation rate would remain constant in the future. The Dynamic Itinerary used a daily generation rate of 5.6 pounds (2.5 kilograms) per person, based on historical solid waste generation data and above the U.S. average of 4.4 pounds (22 kilograms) per person per day (EPA 2015b). SWMA has been tracking and updated this information and estimated a 2014 daily generation rate of 5.0 pounds per person in 2014 based on total solid waste generation and population data.

1.2.3 Recycling Rates for Puerto Rico

SWMA reported the recycling rates achieved in Puerto Rico for 2004 through 2014. According to SWMA, the rates were based on the document *Measuring Recycling: A Guide for State and Local Government* published by EPA in 1997. SWMA reported that recycling rates have steadily increased from 6.8 percent in 2004 to 14 percent in 2014. It is important to note that the September 18, 1992, Law No. 70 for the Reduction and Recycling of Solid Waste in Puerto Rico established a recycling target of at least 35 percent. Therefore, Puerto Rico continues to not meet this target.

1.2.4 Solid Waste Management Capability in Puerto Rico

As part of the Dynamic Itinerary, SWMA evaluated the 32 operating sanitary landfill systems in Puerto Rico at the time of publication to identify their individual expansion capacities. The evaluation used the criteria outlined in 40 CFR §258, Subpart B that specifies the construction, operation, and closure criteria for sanitary landfill systems. Using this evaluation and based on public policy that established the reduction in the use of sanitary landfill systems as the main method for solid waste handling and disposal in Puerto Rico, SWMA determined the potential expansion capabilities of these systems.

1.2.5 Existing Operating Landfills Overview

According to SWMA, between 2010 and 2011, Puerto Rico had 24 operating landfills managed by private and public entities (excluding landfills under compliance and/or closure orders by EQB and EPA). There are closure orders issued by EPA and locally by EQB, closure agreements, and closure plans in place for 21 non-compliant landfills, but the landfills have continued operation because, among other things, there are no viable alternatives for the management of the displaced waste that would facilitate the implementation of these closures.

The Dynamic Itinerary projected the closure of additional landfills over a 25-year timeframe, based on a disposal capacity model that considered the remaining useful life of the landfills documented in the *Useful Life Study*. The capacity model also assumed disposal rates for each landfill and a potential feasible waste flow transfer scenario from closed landfills to other remaining landfills. According to the Dynamic Itinerary, the remaining landfills were divided in two categories: (1) non-compliant landfills that would not be expanded for various reasons; and (2) landfills that potentially comply with Resource Conservation and Recovery Act Subtitle D requirements but would not be expanded. In the Dynamic Itinerary, SWMA expected most of the remaining landfill facilities to close by 2018, including all the facilities in the Northern Region, except for Isabela, which would experience limited expansion.

The 21 municipal landfills designated for closure by EQB include the following:

Añasco	Arroyo
Arecibo	Barranquitas
Cayey	Culebra
Florida	Guayama
Isabela	Jayuya
Juana Díaz	Juncos
Lajas	Moca
Santa Isabel *(Closed)*	Toa Alta
Toa Baja (old cells)	Vega Baja (old cells)
Vieques	Mayaguez
Yauco	Hormigueros

The compliant landfills, as certified by EQB, include:

Cabo Rojo*	Carolina*
Fajardo*	Peñuelas (new landfill)
Humacao	Toa Baja (new cell)
Ponce	Salinas
Vega Baja (new cell)	

Note: * – landfills whose compliance with EPA Sub-Title D regulations has not been confirmed

1.2.6 Energy Supply

According to PREPA, in 2013, 55.3 percent of Puerto Rico's electricity came from petroleum, 27.6 percent from natural gas, 16 percent from coal, and 1.1 percent from renewable energy (PREPA 2015). The electric power and transportation sectors are the largest petroleum consumers. About two-thirds of petroleum-based electricity generating capacity consumes No. 6[3] residual fuel oil and one-third consumes No. 2 diesel fuel. Despite the island's overall low energy consumption, Puerto Rico's per capita petroleum consumption is about four-fifths of the U.S. average, primarily because of its dependence on residual fuel oil and diesel fuel for two-thirds of the island's electricity. The island neither produces nor refines petroleum, so all petroleum products are imported. Prior to the oil price crash of 2014–2015, high world petroleum prices drove typical Puerto Rico power prices to two to three times the U.S. average. In response to these high oil prices and low natural gas prices, PREPA developed plans to add natural gas capability at its five largest petroleum-burning plants. The first natural gas conversion, at the Costa Sur (South Coast) station in Guayanilla, is operating, but other conversions depend on construction of liquefied natural gas import terminals and gas distribution infrastructure.

Puerto Rico has enacted a Renewable Energy Portfolio Standard requiring PREPA to obtain 12 percent of its electricity from renewable sources starting in 2015, scaling up to 15 percent by 2020, and 20 percent by 2035. Technologies meeting the standard include hydroelectric, solar photovoltaic, wind, geothermal, biomass (including MSW), and ocean and tidal energy generation (EIA 2015a).

To meet the renewable electricity standard, PREPA is focusing on wind, solar, and WTE projects. The utility has signed long-term power purchase agreements with renewable energy developers for about 1,000 MW of renewable capacity, which could supply enough renewably sourced electricity to meet the 2015 portfolio standard if all the projects are built. The first of

[3] ASTM specifies the various fuel grades. No. 6 fuel oil is commonly called industrial or heavy industrial fuel oil when used by utilities for electricity and steam generation. No. 2 diesel fuel is also typically marketed as No. 2 heating oil.

those utility-scale renewable energy projects started operations in 2012. A 24-MW solar photovoltaic plant at Guayama, managed by the same company that owns Puerto Rico's coal plant, and a 26-MW solar photovoltaic plant at Loiza also initiated operations. A 95-MW wind farm at Santa Isabel became Puerto Rico's first operating wind generator and the largest wind facility in the Caribbean. A 23-MW wind project at Punta de Lima, Naguabo, also started up in 2012.

Overall, Puerto Rico had 5,616 MW of installed electrical capacity as of 2012 (EIA 2015b). Given that close to 70 percent of Puerto Rico's energy is supplied from oil-derived fuels, it is extremely vulnerable to the fluctuations in the cost of oil. During 2012, there were 20.026 billion kilowatt-hours of generation of which 0.148 billion was renewable generation, including hydro, geothermal, wind, solar, tidal, wave, biomass, and waste.

1.3 PURPOSE AND NEED FOR THE ACTION

The following section describes the purpose and need for the Project. The purpose and need is described with reference to the factors influencing the need for the Project and the agency actions involved in developing the Project. RUS, as the lead agency, will use this analysis as a factor in making decisions related to providing financial assistance (e.g., engineering design, consistency with RUS programs, and providing financial assistance) for the proposed Project.

1.3.1 Energy Answers' Purpose and Need

Energy Answers' proposal would address a combination of environmental and energy issues in Puerto Rico. It would provide an alternative to landfilling solid waste using proven combustion technologies that produce heat and steam for energy production and diversify the island's energy sources. Energy Answers is a developer and operator of WTE and resource recovery facilities and has proposed the Project after evaluating it as an opportunity to provide a service to Puerto Rico that is consistent with its business model.

1.3.2 Municipal Solid Waste Purpose and Need

The proposed Project addresses the dwindling number of certified landfills for municipal and industrial solid waste by providing an alternative end use for the waste and recovering recyclable materials. In doing so, the Project would help address the solid waste management limitations related to long-term landfill constraints and extend the life span of the landfills certified to remain open. The reduction in the contribution of solid waste to landfills also would have a measureable reduction in the amount of greenhouse gas emissions from landfill methane production.

1.3.3 Energy Need in Puerto Rico

Administrative Bulletin No. OE-2010-034 (Executive Order), issued on July 19, 2010, by Governor Luis G. Fortuño, declared an emergency regarding the power generation infrastructure in Puerto Rico. The executive order triggered an expedited process of Law No. 76 for the development of projects that promote new power generation infrastructure that use alternative sources to petroleum fuels, sustainable renewable energy sources, and alternative renewable energy. The executive order had a limited life and could not be extended beyond Governor Fortuño's term of office, which expired at the end of 2012; however, it set in motion actions that address the need to diversify the island's energy supply.

Puerto Rico still depends on oil-derived fuels for the majority of its energy supply. On May 27, 2014, Governor Alejandro Garcia-Padilla signed into law Act 57, known as the "Act for the Transformation and Energy Relief of Puerto Rico," which implements reforms that repeal and replace a number of existing sections of Puerto Rico law related to energy resources. Act 57 recognizes that Puerto Rico needs to evolve from its dependence on fossil fuels and use to the maximum extent possible the island's energy resources, such as sun and wind, conservation efforts, and efficiency improvements.

High dependence on oil also contributes to greater environmental pollution, which in turn, affects the health and safety of Puerto Ricans. The federal government established measures to mitigate some of these health hazards, through standards known as the Mercury and Toxic Air Standards, which compel Puerto Rico to transform the electric power generation system to comply with these standards by 2015 (Act 57). Development of the proposed Project responds to the need to develop an alternative generation source to oil-derived fuels and reduces the fossil fuel emissions associated with petroleum fuel sources and methane emissions from diverting the waste from landfills.

1.3.4 Rural Utilities Service

RUS is authorized to make loans and loan guarantees to finance the construction of electric distribution, transmission, and generation facilities, including system improvements and replacements required to furnish and improve electric service in rural areas, as well as demand side management, energy conservation programs, and on-grid and off-grid renewable energy systems. Energy Answers is requesting financing assistance from RUS for the proposed 67 MW WTE and resource recovery project. RUS's proposed federal action is to decide whether to provide financing assistance for the Project. Completing the NEPA process is one requirement, along with other technical and financial considerations, in processing Energy Answers' application.

The Rural Electrification Act of 1936, as amended (7 USC §901 et seq.), generally authorizes the Secretary of Agriculture to make rural electrification and telecommunication loans, including specifying eligible borrowers, references, purposes, terms and conditions, and security requirements. RUS's agency actions include the following:

- Provide engineering reviews of the purpose and need, engineering feasibility, and cost of the Project
- Ensure that the Project meets the borrower's requirements and prudent utility practices
- Evaluate the financial ability of the borrower to repay its potential financial obligations to RUS
- Review and study the alternatives to mitigate and improve solid waste and electrical generation issue.
- Ensure adequate fuel supply and waste streams are available to meet the Project needs
- Ensure NEPA and other environmental requirements and RUS environmental policies and procedures are satisfied prior to taking a federal action

1.4 AUTHORIZING ACTIONS

Table 1-1 summarizes the federal, state, and local laws, regulations, associated permits, approvals, coordination and other required actions that would be necessary for the Project.

Table 1-1. Permits, Regulations, or Consultations Needed for Listed Agencies and Required Actions Necessary for the Project

Agency	Law or Regulation	Agency Action
RUS	NEPA	- Review and approve NEPA documentation - Ensure that all actions associated with the Project are in compliance with all applicable federal, state, and local regulations - Decide whether to approve financing assistance for the Project - Sign Record of Decision
	RUS Environmental Policies and Procedures	- Consult with appropriate agencies to provide decision makers with information to ensure that decisions and actions are based on an understanding of environmental consequences
	Executive Order 11988, *Floodplain Management* (issued by the President of the United States)	- Avoid, to the extent possible, the long- and short-term, adverse impacts associated with the occupancy and modification of floodplains

Agency	Law or Regulation	Agency Action
	Executive Order 11990, *Protection of Wetlands* (issued by the President of the United States)	- Ensure that short- and long-term impacts on wetlands are avoided where practical alternatives exist
	Executive Order 13112, *Invasive Species* (issued by the President of the United States)	- Do not authorize, fund, or carry out actions that are likely to cause or promote the introduction or spread of invasive species in the United States - Implement all feasible and prudent measures to minimize risk of harm from introduction or spread of invasive species
USACE	Clean Water Act, Section 404	- Regulate and provide permits for the discharge of dredged or fill material in jurisdictional wetlands of waters of the United States
	Rivers and Harbors Act Section 10	- Regulate and provide permits for structures or work in, over, or otherwise affecting navigable waters of the United States
USFWS/National Marine Fisheries Service	Endangered Species Act Section 7	- Avoid/minimize impacts to threatened and endangered species and critical habitat - Participate in Section 7 consultation - Review the biological assessment and provide a biological opinion, if necessary
	Migratory Bird Treaty Act	- Avoid/minimize impacts on migratory birds and habitat
	Bald and Golden Eagle Protection Act	- In accordance with the permitting program established by the Division of Migratory Bird Management, if activities require the removal or relocation of an eagle nest, a permit is required from the Regional Bird Permitting Office
	Fish and Wildlife Conservation Act	- Ensure that mitigation measures conserve wildlife and wildlife habitat.
	Fish and Wildlife Coordination Act	- In coordination with PRDNER, provide consultation if it is determined that the proposed Project would affect water resources.
	Clean Water Act, Section 404	- Work with USACE and EPA to ensure regulation of discharge of dredged or fill material in jurisdictional wetlands of water of the United States

Agency	Law or Regulation	Agency Action
	National Invasive Species Act	- Prevent the introduction and spread of nonnative invasive species as a result of Project activities
	Magnuson-Stevens Fishery Conservation and Management Act	- Provide consultation if the Project may adversely affect Essential Fish Habitat
USDA-NRCS	Farmland Protection Policy Act	- Identify and quantify adverse impacts that the Project may have on farmlands - Minimize contribution to the unnecessary and irreversible conversion of agricultural land to non-agricultural uses
U.S. Department of Labor	Occupational Safety and Health Act	- Ensure that Occupational Health and Safety Administration standards are met during the construction, maintenance, and operation of the proposed Project
Federal Aviation Administration	Determination of No Hazard to Air Navigation	- Issue a determination stating whether the Project would be a hazard to air navigation
EPA	CAA Section 309	- Review and comment on EISs for major federal actions and provide rating
	CAA PSD Permit	- Under 40 CFR §52, ensure that the Project is designed, constructed, and operated to comply with national ambient air quality standards
	Resource Conservation and Recovery Act	- Ensure that the treatment, storage, and disposal of hazardous wastes associated with the Project would be handled in accordance with Resource Conservation and Recovery Act regulations
	Noise Control Act	- Ensure that the Project is designed in a manner that furthers the national policy of promoting an environment free from noise that may jeopardize health and welfare
	Clean Water Act, Sections 318, 402, 405	- Obtain a National Pollutant Discharge Elimination System General Stormwater Permit for construction activity
	Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*	- Identify and address disproportionately high and adverse human health or environmental effects on minority populations and low income populations

Agency	Law or Regulation	Agency Action
Puerto Rico Planning Board	Coastal Zone Management Act Consistency Determination	
EQB, PRDNER, PREPA, PRASA, Institute of Puerto Rican Culture, and Highway Authority		- Endorse the Project
PR Energy Affairs Administration		- Endorse the Project
EQB	Clean Water Act, Section 401	- Obtain Water Quality Certificate
		- Obtain permit for the construction of a wastewater treatment system without discharges to a body of water
		- Obtain permit to operate an air emissions source
		- Obtain permit for the operation of a non-hazardous solid waste facility
		- Obtain permit for the operation of a wastewater treatment system without discharges to a body of water
PRASA		- Endorse construction of water and sewer facilities
		- Obtain pretreatment permit
		- Endorse the use of water and sewer facilities
		- Obtain use permit (occupancy permit)
PRDNER		- Obtain permit for the construction of a water intake, if required
		- Obtain permit for the operation of a water extraction franchise (intake)
	Authorization for the Use of Maritime Terrestrial Zone	- Survey Maritime Terrestrial Zone
		- Obtain incidental permit for the extraction of materials for the earth crust components
OGPe		- Obtain general consolidated permit
		- Obtain rough grading permit (clearing and grubbing)
Highway Authority/OGPe		- Obtain access approval and highway improvements construction permit

Agency	Law or Regulation	Agency Action
OGPe		- Obtain construction permit for facility structures
		- Obtain construction permit for site fill/site improvements/site infrastructure
		- Obtain permits for transmission structures
		- Obtain permits for hydrostatic tanks test
PREPA		- Endorse substation construction
		- Endorse transmission structures construction
		- Obtain power connection approval
Fire Department		- Obtain permit to store flammable liquids
		- Endorse OGPe use permit
		- Obtain Fire Prevention Inspection Certificate
Department of Health		- Endorse OGPe use permit
		- Obtain sanitary license

Notes: CAA – Clean Air Act, EIS – environmental impact statement, EPA – U.S. Environmental Protection Agency, EQB – Puerto Rico Environmental Quality Board, NEPA – National Environmental Policy Act, NRCS – Natural Resources Conservation Service, OGPe – Oficina de Gerencia de Permisos, PRASA – Puerto Rico Aqueduct and Sewer Authority, PRDNER – Puerto Rico Department of Natural and Environmental Resources, PREPA – Puerto Rico Electric Power Authority, PSD – Prevention of Significant Deterioration, RUS – Rural Utilities Service, USACE – U.S. Army Corps of Engineers, USDA – U.S. Department of Agriculture, USFWS – U.S. Fish and Wildlife Service

1.5 PUBLIC PARTICIPATION

NEPA requires that agencies responsible for preparing environmental review documents involve the public in environmental review of projects. Prior to development of an EIS, the responsible agencies determine what information is to be evaluated in the EIS. A "scope" is a determination of what issues need to be assessed in the environmental review to fully inform decision makers and the public about the possible impacts of a project or potential alternatives. In part, these issues are identified during the scoping process for a project. Through the scoping process, RUS invited federal, state, and local units of government; organizations; and individuals interested in the Project to comment on the Project and to identify issues and concerns to be addressed in the EIS. This section summarizes the scoping process and issues raised that will be addressed in the EIS.

1.5.1 Scoping Process

On April 12, 2013, RUS published in the *Federal Register* [FR] a Notice of Intent to Prepare a Supplemental Final EIS in connection with potential impacts related to the proposal by Energy Answers (78 FR 21908). In accordance with 7 CFR §1794.74 and 40 CFR §1502.21, RUS intended to incorporate by reference the 2010 environmental impact analyses and documentation prepared by the Puerto Rico Industrial Development Company (PRIDCO). PRIDCO served as a lead agency in preparation of an EIS prepared under the Puerto Rico Environmental Public Policy Act, Article 4(B)(3), (Law No. 416, September 22, 2004). The EIS is referred to as the PRIDCO EIS in this EIS.

According to the April 12, 2013, Notice of Intent, the supplemental final EIS was scheduled for publication in March 2013, and the public was invited to submit comments on the proposal to prepare a supplemental final EIS to inform RUS's decision making in its environmental review process.

On November 28, 2014, RUS published a *Notice of Cancellation of the Supplemental Final EIS and Notice of Public Scoping and Intent to Prepare an Environmental Impact Statement* (79 FR 70846). Through this notice, RUS announced that it was cancelling its Notice of Intent for the supplemental final EIS and announced its intent to conduct public scoping and prepare an EIS. The public was invited to submit comments concerning the public scoping, the Notice of Intent, or to participate as a "consulting party" under Section 106 of the National Historic Preservation Act. These comments were to be submitted to RUS on or before December 29, 2014.

On January 14, 2015, following the closing of the comment period, RUS published a *Notice of Extension of Public Comment Period, Notice of Public Scoping Meeting and Intent to Prepare an Environmental Impact Statement* (80 FR 1892). Through this notice, RUS extended the comment period by an additional 30 days from the date of the notice to February 13, 2015. The notice also announced that a public scoping meeting would be held on January 28, 2015, from 3:00 p.m.–7:00 p.m. at the *Colegio de Ingenieros y Agrimensores de Puerto Rico, Capıtulo de Arecibo,* Ave. Manuel T. Guillan 1, Arecibo. Project-related information was available at RUS's website[4] and at the *Tribunal General de Justicia, Centro Judicial*, and the *Casa Alcaldıa del Municipio de Arecibo.* In addition, individuals who contacted RUS were provided with information on the date and format of the proposed public scoping meeting.

The public scoping meeting was conducted in an open house format with a court reporter available for transcription of verbal comments. The meeting provided the public with the opportunity to learn more about the Project and to provide comments on potential environmental

[4] Available at: http://www.rd.usda.gov/publications/environmental-studies/impact-statements/arecibo-waste-energy-generation-and-resource.

issues associated with the Project. Overall, 134 attendees registered on the sign-in sheets. Additionally, 38 members of the public signed up to provide verbal statements, and 34 people gave verbal comments at the meeting; their comments were transcribed by a court stenographer. Forty-six written comments were submitted at the meeting using the comments sheets provided, and an additional four prepared comments were submitted at the meeting, including comments from the Puerto Rico Mayors' Association. In addition to the comments received during the scoping meeting, RUS received scoping comments in the form of written letters or emails from private citizens, government agencies, and nongovernmental organizations during the 2014 and 2015 public scoping comment periods.

1.5.2 Public Review and Comment Analysis

The scoping report is attached to this document as Appendix A; however, the concerns expressed during the public scoping meeting are summarized below.

- The meeting attendees were upset with the government of Puerto Rico's review and approval process of the 2010 PRIDCO EIS and expressed concern that the Project was rushed through without adequate oversight.
- The attendees stated that the air emissions permit issued by EPA did not adequately protect the health of the community. Particular concerns were expressed with emissions of lead and a high incidence of childhood lead poisoning in the area. Concerns were also expressed that the air dispersion modeling was inadequate and did not use proper data and assumptions.
- Commenters expressed concern that Energy Answers' health and safety risk assessment was inadequate, and that sufficient documentation or explanation was not provided to allow for the community to evaluate the results of the analysis.
- Commenters suggested that the Project would prevent or discourage the recycling of MSW.
- The public expressed concerns that the format of the scoping meeting was not conducive to people providing comments because they were used to the format of public hearings.
- The public expressed concerns about the public notifications for the RUS scoping meeting and the lack of explanation of its purpose.

1.5.3 Issues Considered But Dismissed

Issues and potential concerns covering a wide range of natural and human resources for the Project were identified and discussed, as summarized in the Scoping Report (RUS 2015). Upon review and consideration of the comments received and resources identified, all issues were deemed appropriate for consideration and evaluation as part of the EIS process. Therefore, none of the issues and concerns raised during the scoping process was dismissed from further evaluation. This EIS contains a comprehensive review of the issues raised during scoping, as well as others that were not raised but are typical for a project of this nature. However, given the proposed Project would occupy a former industrial use site with private agricultural or vacant lands surrounding the property and no recreation resources in the vicinity that could potentially be affected, the EIS does not evaluate potential effects to recreation resources.

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2.0 PROPOSED ACTION AND ALTERNATIVES

Under NEPA regulations established by CEQ, RUS is required to identify and evaluate reasonable alternatives to the Project, as well as the no-action alternative. Reasonable alternatives are those that are "practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant" (CEQ 1981). In determining reasonable alternatives, RUS is required to consider a number of factors that may include, but are not limited to "the proposed action's size and scope, state of the technology, economic considerations, legal considerations, socioeconomic concerns, availability of resources, and the timeframe in which the identified need must be fulfilled" (40 CFR §1500–1508).

2.1 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER CONSIDERATION

Several factors influencing the development of this type of project were considered early in the process to meet the purpose and need. Those factors evaluated included location, WTE technologies, and sources of water for steam and cooling purposes throughout the operations phases of the Project. This section discusses the alternatives that have been considered throughout the planning process but were eliminated for various reasons from further consideration. These alternatives, as well as other alternatives considered as a result of the purpose and need for the Project, are summarized below.

2.1.1 Project Site Selection

As part of its planning phase, Energy Answers conducted a site selection study to identify a potential site for the proposed Project's location (CSA Group 2010a). One of the stated objectives in guiding location and site preferences for the study was to look for Brownfield and inactive industrial or physical disturbed sites that would be suitable for recovery and the proposed use, avoiding undisturbed properties. Energy Answers evaluated 33 potential site locations as part of its evaluation. Because of the island's geography, a substantial portion of the potentially suitable sites was situated at the confluences of coastal plains and river valleys and frequently subject to flooding. The potentially suitable sites also were relatively far from developed areas.

Energy Answers implemented a tiered four-phase analysis, which included the following:

- Exclusion Analysis—excluded those sites with location characteristics that are protected by precautionary policies and regulations from land use and environmental perspective
- Inclusion Analysis—included sites with specific, desirable, project-driven characteristics that are necessary for the viability and proper execution of the WTE and resources recovery facility

- Suitability Analysis using GIS-based suitability model—classified and described the level of suitability of the sites identified in the previous phase
- Comparative Assessment—compared and ranked the most suitable sites

Through this tiered approach, Energy Answers reduced the number of potential sites to six sites that met the majority of the inclusion criteria after the Inclusion Analysis. Those sites, according to the Suitability Analysis, were all classified as *high and medium suitable*. The Comparative Assessment evaluated project-specific parameters, such as philosophical objectives, community and regional considerations, and schedule and feasibility. The following sites ranked in the top three of the Comparative Analysis and represented the most suitable sites for the proposed Project:

- Central Cambalache Sugar Mill and Global Fibers Paper Mill complex in Arecibo
- Phillips Petroleum Plant Area in Guayama
- Old Paper Mill/Bottling Factory in Guaynabo

The Phillips Petroleum Plant Area is located on the south side of the island, which is outside the SWMA's Dynamic Itinerary northwest region (target service area) and already has the majority of electrical generation capacity on the island. The Old Paper Mill/Bottling Factory in Guaynabo is also located outside the SWMA's Dynamic Itinerary northwest region outside the target service area. Use of either of these sites would require transporting wastes for long distances from the source area within the northwest region, resulting in higher transportation costs and associated emissions and cause increased road congestion along north-south road networks. Therefore, Energy Answers identified the Central Cambalache Sugar/Global Fibers Paper Mill complex site as the preferred site for the proposed Project and narrowed this selection to the Global Fibers Paper Mill property as the preferred property.

2.1.2 Waste-to-Energy Technologies

Several WTE technologies produce energy from MSW, and alternative thermal conversion technologies for MSW are discussed below. Thermal energy is referred to as the energy that uses heat to generate power either as electricity or steam.

2.1.2.1 Gasification

Gasification is a method for extracting energy from organic materials, such as wood and biomass. In addition, fossil fuels and petroleum-derived materials like plastics can be gasified to generate electricity by converting carbon materials, such as organic fuel, petroleum, coal, or biomass, into carbon monoxide (CO) and hydrogen by reacting the raw material at high temperatures with a controlled amount of oxygen and/or steam. The resulting gas mixture is called synthesis gas or syngas. Syngas may be used directly in internal combustion engines, used to produce methanol and hydrogen, or converted into synthetic fuel.

In the process, a limited amount of oxygen or air is introduced into a reactor to oxidize some of the organic material to produce CO and energy, which drives a second reaction that converts further organic material into hydrogen and carbon dioxide (CO_2). A third reaction occurs from the previous one when residual water from the organic material mixes with the CO to produce methane and excess CO_2.

Gasification can be considered a hybrid between pyrolysis and combustion because it involves the oxidation of a substance, meaning that the oxygen that is added is not sufficient for the fuel to be completely oxidized and for full combustion to occur. The temperatures employed are typically above 1,200 degrees Fahrenheit (°F) (650 degrees Celsius [°C]). One of the main products produced by gasification is an ash with low carbon content. The calorific value of syngas from gasification and pyrolysis is far lower than natural gas. During gasification, part of the fuel (organic material) is burned to provide the temperature necessary to heat the remaining organic material.

2.1.2.2 Pyrolysis

Pyrolysis is the thermal degradation of a substance in the absence of oxygen. This process requires an external heat source to maintain the required temperature. Typically, temperatures between 570 to 1,500°F (300°C to 850°C) are used during pyrolysis of materials, such as MSW. The product produced from pyrolysis is a solid residue known as char, which is formed by carbon and non-combustible materials and synthetic gas (syngas). The syngas is a mixture of flammable constituents such as CO, hydrogen, methane, and volatile organic compounds (VOCs). A portion of these can be condensed to produce oils, waxes, and other substances. It has a calorific value that is lower than the value of natural gas. Pyrolysis differs from combustion in that it does not involve reactions with oxygen, water, or any other reagents. The difference from hydrous pyrolysis is that hydrous pyrolysis consists of placing decomposed organic material in the presence of superheated water or steam. Pyrolysis, on the other hand, consists of indirect heating of the organic material in an oxygen-free environment to produce hot gases that are used to produce electricity and heat.

2.1.2.3 Plasma Arc Gasification

Plasma arc gasification is a waste treatment technology that uses electrical energy and high temperatures created by an electrical arc gasifier. The arc in a device called a plasma converter breaks down waste primarily into elemental gas and solid waste. The process has been intended to be a net generator of electricity, depending upon the composition of input wastes, and to reduce the volumes of waste being sent to landfill sites.

This technology consists of a relatively high voltage electric current that is passed between two electrodes, spaced apart, that create an electrical arc. Inert gas under pressure is passed through the arc into a sealed container of waste material, reaching temperatures as high as 25,000°F (13,900°C) in the arc column. The temperature a few feet from the torch can be as high as 5,000 to 8,000°F (2,760 to 4,427°C). At these temperatures, most types of waste are broken into a gaseous form, and complex molecules are separated into individual atoms.

A reactor operates at a relatively negative pressure, meaning that the feed system is supported by a gaseous removal system, and then by a solids removal system. Depending on the input waste (plastics tend to be high in oxygen and carbon), gas from the plasma can be removed as synthetic gas, which may be converted into alternate fuels at later stages.

2.1.2.4 Mass Burn

The mass burn technology burns municipal wastes without separating recyclables from non-recyclables and without prior waste processing. In this type of combustion, municipal wastes are fed directly into a furnace, and generally large items and potential hazardous materials are removed prior to combustion. Mass burning plants process from 200 to 3,000 tons of municipal solid wastes per day.

In typical large-scale mass burn operations, refuse trucks transport waste to a pit inside a building where traveling cranes move the waste to a boiler. In some facilities, tires from vehicles, appliances, and larger wastes are separated, removed, and are sent to a landfill. Front loaders are used to crush furniture and boxes.

After large items have been sorted and crushed, the remaining materials are transported through a feed hopper to the boiler. The boilers, which are diverse in design and usually constructed in situ, convey waste on grates through the boiler to burn. The grate moves below the materials continuously as it feeds the waste into the boiler. The system blows air through the boiler to promote the burning process.

In some facilities, large materials get stuck in the feeding hopper and in the ash exhaust where available space is reduced, resulting in a decrease in the efficiency of burning waste and recoverable energy. On the other hand, the energy, which is released on or near the grate, results in a sufficiently high temperature to melt glass and metal, making its subsequent recovery difficult and expensive. In addition, the high temperature of the ash and burned residual materials requires the ash to be quenched in water, further complicating the process to recover valuable materials.

2.1.2.5 Processed Refuse Fuel

Processed refuse fuel technology is a variation of the mass burn system. It was introduced in the United States in the 1970s and was referred to as refuse derived fuel. The idea behind the refuse derived fuel technology was to process MSW before it is introduced to incinerator boilers. The MSW often would be shredded for size reduction and run under magnets for ferrous metal removal. Some refuse derived fuel technologies included eddy current separators for aluminum removal, while other refuse derived fuel facilities first would have the MSW placed on large conveyor belts where employees would hand pick items such as corrugated cardboard, propane tanks, ropes, hoses or other items that would be problematic in the shredding process. By producing a more uniform fuel, the intent is that the boilers would not be exposed to significant variations in heating content and would not require as robust a design. Compared to mass burn facilities, the processed refuse fuel process produces a more homogeneous fuel and results in less bottom ash. However, a processed refuse fuel facility requires:

- Increased labor costs to operate the shredders
- Increased energy requirements for the shredders
- Increased down time required for repairs and maintenance of the shredders
- Increased capital costs to install the shredders
- Recognition that not all of the solid waste arriving on site is suitable for fuel and non-recoverable portions must be landfilled along with the bottom ash

2.1.2.6 Preferred Waste-to-Energy Technology

Both mass burn and processed refuse fuel facilities have been operating throughout the United States for more than 20 years, and both types of facilities have been demonstrated to be feasible and reasonable technologies for generating electricity through the combustion of MSW. However, after evaluating alternative technologies and based on its experience operating a processed refuse fuel facility in Massachusetts,[5] Energy Answers selected the processed refuse fuel technology for use in the Arecibo Project. Energy Answers' proposal builds on its experience developing and operating the SEMASS facility and improves on the processed refuse fuel technologies and operations of that facility. The preferred processing includes ferrous metal removal from the waste stream before entering the boiler and additional ferrous and non-ferrous metal removal from the ash streams, further increasing the amount of material recovered and recycled and diverted from landfill. In addition to separating out the ferrous- and non-ferrous metals from the bottom ash, Energy Answers' proprietary process also separates the granular material known as Boiler Aggregate™, which Energy Answers would market as a construction material if a market for the material exists, and only after such time as testing of the actual ash produced demonstrates it complies with applicable environmental and commercial requirements and its reuse receives regulatory approval.

[5] Energy Answers International, owned and operated the plant until it was sold in 1995, developed the SEMASS WTE facility in southeastern Massachusetts. The proposed Arecibo facility would be a newer version of the technologies used at the SEMASS plant.

2.1.3 Water Sources

The proposed Project would need about 2.1 million gallons per day (mgd) of water for all of its processes. This demand includes about 100,000 gpd of potable water for domestic and boiler makeup water and about 2.0 mgd of non-potable water for cooling and process needs. Energy Answers provided a feasibility analysis of potentially available water sources necessary for the Project's cooling process. Considering the Project location and the cooling process water quality requirements, the following water sources were identified and analyzed:

- Puerto Rico Aqueduct and Sewer Authority (PRASA) water main
- Groundwater
- Surface water
- Brackish water from Caño Tiburones discharged through the Puerto Rico Department of Natural and Environmental Resources (PRDNER) El Vigía Pumping Station into the Atlantic Ocean
- Reclaimed water from Arecibo Waste Water Treatment Plant

2.1.3.1 Puerto Rico Aqueduct and Sewer Authority's Water Main

The Project site is located within PRASA's Miraflores and Superaqueduct Service Area, which is supplied by Dr. Santiago Vazquez Water Treatment Plant (Vazquez WTP) and three wells. Arecibo treated water storage tanks distribute the water from the plant to the service area. Water could be supplied from PRASA's distribution system by connecting a new pipeline from the Project site to the existing 36-inch pipeline at the intersection of Avenue Domingo Ruiz with Highway PR-22.

PRDNER's *Plan de Aguas de Puerto Rico* estimates that PRASA currently serves an average daily demand of 5.76 mgd of water within the Miraflores and Superaqueduct Service Area. The Vazquez WTP performance targets are expected to increase Arecibo treated water storage tank production to produce a surplus of about 0.40 mgd of water after 2010, which could supply the potable water requirement for the Project. However, this increase will not be enough to satisfy an additional 2.0 mgd of cooling and process water demand. For these reasons, PRASA's water main was not evaluated further.

2.1.3.2 Groundwater

Energy Answers consultants prepared a pump test report for a 240-foot well drilled at the site. Groundwater quality was also monitored in the study (PRIDCO 2010). The report concluded that based on the initial tests, the well can produce a yield of at least 1.0 mgd of water without significant drawdown in the underlying aquifer. The initial tests did not rule out higher withdrawal rates as being equally feasible. Quality analysis showed total dissolved solids values greater than 15,000 milligrams per liter, indicating the presence of brackish water in the aquifer.

Based on the pumping test results, it is uncertain whether this source would produce the required 2.0 mgd of water needed for cooling and process water. For this reason, groundwater was not evaluated further for use as the Project's primary cooling and process water source. Further study would be required to confirm the availability of the required 2.0 mgd of water, prior to the use of groundwater as a backup or alternate source of cooling water.

2.1.3.3 Surface Water

Energy Answers evaluated the feasibility of extracting surface water from Río Grande de Arecibo, which is located west of the site. The Global Fibers Paper Mill, a former paper mill at the site, used surface water from the river for its process water needs. The paper mill ceased operations in 1996; its PRDNER water permit expired and the river intake structure was subsequently abandoned. Surface water from the Río Grande de Arecibo is currently diverted upstream of this location for treatment and delivery for municipal uses. Energy Answers reported that of the 102 mgd of water potentially available in the river system, 100 mgd were dedicated to delivery to the Vazquez WTP. Consequently, the ability to permit the withdrawal of water for Project purposes would be difficult given the ecological needs in the river system. For this reason, surface water was not evaluated further.

2.1.3.4 Brackish Water from Cano Tiburones

This alternative involved obtaining water from the Caño Tiburones estuary. Caño Tiburones extends eastward from the Río Grande de Arecibo to the Río Grande de Manatí as a western boundary and covers approximately 7,000 acres (2,832 hectares). In 1998, the government of Puerto Rico designated 3,428 acres (1,387 hectares) of the Caño Tiburones as a natural reserve to protect the island's largest wetland and its animal and flora species.

El Vigía Pumping Station was constructed in 1949 to provide drainage and control water levels at the Caño Tiburones. PRDNER operates a brackish water pumping system that contributes to the maintenance of Caño Tiburones by managing saline intrusion in the wetland. As part of this pumping system, PRDNER currently discharges approximately 100 mgd of excedant brackish water into the Atlantic Ocean through El Vigía Pumping Station. The pumping system includes the pumping station located at El Vigía sector and the discharge channel that ends in an area adjacent to the Arecibo Yacht Club (*Club Náutico*). Currently there are two, 1,500 horsepower pumps operating in the station, each with capacity to pump 80,000 gallons per minute. These pumps are operated with two electric power generators. In addition, the El Vigía Pumping Station discharges brackish water twice daily through gravity flow during ocean low tides.

Under this alternative, approximately 2.1 mgd (i.e., 1,460 gallons per minute) of brackish water would be pumped through a 14-inch diameter and 2-mile (3,200-meter) long force line to the plant (see **Figure 2-1**). This volume represents approximately 2 percent of PRDNER's daily discharge of brackish water into the ocean. The pumping proposed by Energy Answers would only apply to the excedant brackish water that PRDNER discharges daily into the outflow channel. This alternative would use brackish excedant water, thereby minimizing the use of potable water for facility operations.

2.1.3.5 Reclaimed Water from Arecibo Waste Water Treatment Plant

This alternative consisted of reusing water from the Arecibo's Waste Water Treatment Plant discharge. The Project's cooling and process water needs would require about 2.0 mgd of water with a water quality equal to or better than a typical effluent of a secondary waste water treatment plant. Therefore, discharge data for Arecibo Waste Water Treatment Plant was reviewed and analyzed to verify that this facility consistently discharges the amount of water required by the cooling and process needs. To meet the water quality standards required for the Project, additional treatment would be necessary to remove nutrients (such as phosphorous) to avoid problems such as biological growth and corrosion in the cooling towers. Development of this alternative would require a secondary treatment technology, a new pump station at the waste water treatment plant, and a 3.35-mile-long (5.4-kilometer-long) pipeline. Although this alternative would reduce the amount of effluent discharged to the Atlantic Ocean, the construction costs associated with the secondary treatment plant and pipeline resulted in higher costs than the proposed alternative. For this reason, reclaimed waste water was not evaluated further.

2.2 SELECTION OF PROPOSED ALTERNATIVE

NEPA requires that an EIS consider a full range of alternatives to the proposed action and fully evaluate all reasonable alternatives. In addition, the EIS must also consider the no-action alternative. Two alternatives are analyzed in detail in this EIS—Energy Answers' proposal to construct the Arecibo WTE and Resource Recovery Project and the no-action alternative.

2.2.1 No-action Alternative

Under the no-action alternative, RUS would not provide financial assistance to Energy Answers to construct the Project. For the purposes of this analysis under NEPA, RUS assumes that under the no-action alternative, the Project would not be constructed. The existing environment within the Project area would remain the same, and no land would be used for a WTE facility, ancillary facilities, transmission line, or a water pipeline. The residents of Puerto Rico would continue to have solid waste management disposal issues. In addition, electricity sources will continue to rely on imported oil and coal resources. The no-action alternative does not meet the identified purpose and need for the Project.

2.2.2 Arecibo Waste-to-Energy and Resource Recovery Project

This section describes the Arecibo WTE and Resource Recovery Project, including the proposed location, areas to be served, main components, preliminary construction schedule, security controls for the plant, flood design, contingency plans for emergency events, and off-site works necessary to: (1) supply brackish water for the cooling tower and steam production in the boilers, and (2) connection of the electricity produced at the plant to PREPA's electric distribution network.

The plant would be located in a site of approximately 78.9 acres (82 *cuerdas*[6]) of area, which formerly housed the Global Fibers Paper Mill. The site is located at Km 73.1 of State Road PR-2 (PR-2) of the Cambalache Ward in Arecibo. **Figure 2-1** shows the site and adjacent land on an aerial photograph. The industrial activity in the site began in the late 1950s and ceased in the mid-1990s.

The site is bordered on the north by 68.9 acres (71 *cuerdas*) of land belonging to Finca Santa Bárbara, owned by the Puerto Rico Land Authority and partly used for growing hay; on the south by 14.6 acres (15 *cuerdas*) of vacant land owned by the Puerto Rico Land Authority and the site of the former Central Cambalache Sugar Mill; on the west by the Río Grande de Arecibo; and on the east by PR-2.

The existing structures in the eastern side of the proposed Project site are steel frame structures, several of which have been abandoned. The existing topography is essentially flat and varies in elevation from 3.3 to 24.6 feet (1.0 to 7.5 meters) above mean sea level (msl). Five percolation ponds, which were part of the infrastructure previously used at the site to store stormwater and process water from the operation of the paper mill, are located in the west-northwest and southeast portions of the site. Artificial channels that run through the property were also created as part of the stormwater and process water drainage system. These artificial channels connect to another channel that runs along the northern boundary of the site and discharge into the Río Grande de Arecibo. Currently, the channels and ponds are not in use.

The Cambalache Ward—the site location—is located within the alluvial valley of the Río Grande de Arecibo where agricultural uses, industrial activities, and small isolated communities coexist. In the past, the former Central Cambalache Sugar Mill dominated land use in the area. In the early 1980s, 55 percent of the land was used for growing sugarcane, approximately 30 percent for rice cultivation, and 15 percent for cattle grazing. The main use of the land has remained agricultural (primarily to produce hay), although the former Central Cambalache Sugar Mill ceased operations in the early 1980s.

[6] In Puerto Rico, a cuerda is a traditional unit of land area equivalent to nearly 3,930 square meters or 0.97 acre.

Figure 2-1. Location of Proposed Plant, Water Pipeline, and Transmission Line

The Project would use solid waste as the raw material for the production of energy. Because of its location, the plant would receive MSW from the municipalities along the north-central and north-eastern side of the island, as well as the mountain region (see **Figure 2-2**).

Figure 2-2. Planned Area of Raw Material Collection for the Production of Processed Refuse Fuel

Table 2-1 summarizes the estimated waste generation for the geographical area described above. It should be noted that even if the region reaches its 35 percent recycling target, a large amount of waste would remain that must be managed in an environmentally responsible and safe way. These projections do not take into account the quantities of waste that could be available as a result of future landfill closures, commitments with municipalities outside the indicated geographical area, or contracts with private carriers that could potentially use the Project to dispose of their waste. Energy Answers has entered into an agreement with the Puerto Rico Solid Waste Management Authority (SWMA or locally known as La Autoridad de Desperdicios Sólidos or ADS) for the delivery of municipal waste from the above described region to ensure the waste volume needed to produce 2,100 tons per day of processed refuse fuel, which is needed for the proposed Project to operate at its generation capacity.

Table 2-1. Projected Sources of Raw Materials for the Project

Year	Population Projections[a]	Solid Waste Generation Projection (tons/year)[b]	Solid Waste Generation Projection (tons/day)	% Recycling	Amount of Waste after Recycling (tons/day)[c]
2012	1,579,234	1,602,449	3,480[c]	14.7[c]	2,985
2020	1,604,217	1,627,799	4,460[b]	35[b]	2,899
2025	1,620,905	1,644,732	4,506[b]	35[b]	2,929

[a] Puerto Rico Planning Board's population projections as of August 22, 2006
[b] SWMA (2008)
[c] SWMA (2015)

Figure 2-3 shows the schematic layout of the plant and other buildings on the property. The Project would have the following main components:

- MSW receiving and storage
- Processed refuse fuel processing and storage
- Processed refuse fuel combustion in spreader-stoker boilers
- EPA-permitted emission control system, monitoring system, and filing of periodical reports
- Management and recovery of combustion residues
- Production of alternative renewable energy (steam and electricity)
- Water use for operation (cooling, process, and boilers)
- Capability to manage alternative fuels
- Rehabilitation of an industrial site and building construction
- Process automatic control systems

Once produced, the processed refuse fuel would be fed to one of two identical process lines, each with capacity of 1,050 tons per day. The process would use the following sequence of units or equipment: (1) processed refuse fuel feed line; (2) spreader-stoker boiler with a design heat input rate of 500 million British thermal units (BTU) per hour; (3) activated carbon injection system to remove heavy metals and dioxins/furans; (4) Turbosorp® dry scrubber that removes acids by injecting lime in a fluidized bed; (5) fabric filters (baghouse) to control particulate emissions, including metals; (6) ammonium hydroxide injection system followed by regenerative selective catalytic reduction unit to reduce emissions of nitrogen oxides; (7) induced draft fan, and (8) stack.

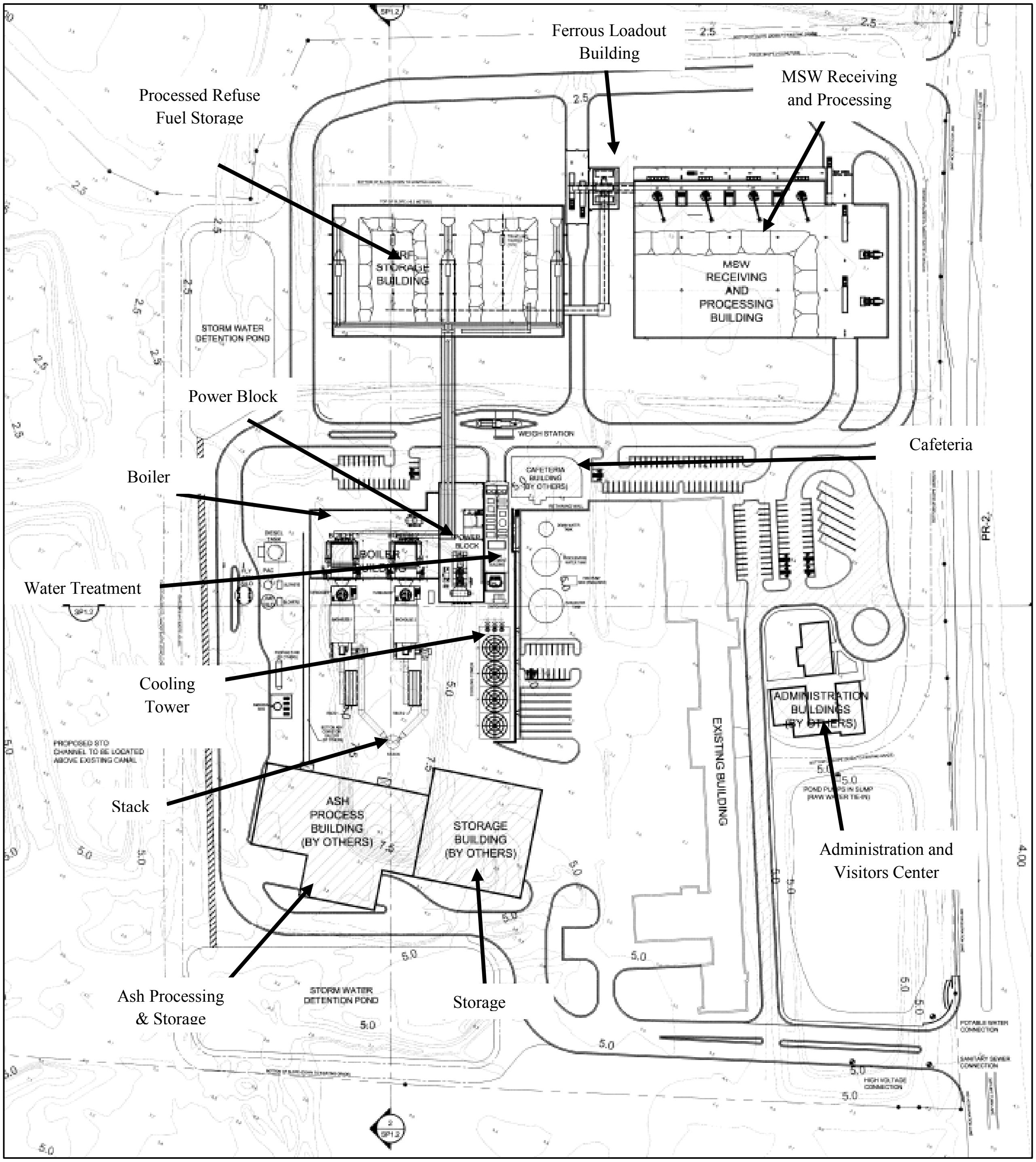


Figure 2-3. Site Plan and Building Layout

Steam from the boilers would be used to generate electricity using a turbine generator. As a result, enough electricity would be produced for in-plant usage and for sale to PREPA. Each boiler would have three auxiliary burners that use fuel no. 2 (ultra-low sulfur distillate) for startup and shutdown and, when and if necessary, to maintain temperature in case of short term interruptions of processed refuse fuel feed.

In addition to processed refuse fuel, the Project could handle any of the following alternative fuels: automotive shredder residue, tires or tire derived fuel, and processed urban wood waste. Only one alternative fuel could be combusted at any time, and only when well blended with processed refuse fuel. The amount of these wastes that could be used would be confirmed through performance tests and would be included in the federal and local plant emission control permits, as applicable.

2.2.2.1 Receiving and Handling of Processed Refuse Fuel Raw Material

The MSW material would arrive daily at the plant by trucks, which vary in type and size, and would be weighed on scales located at a weigh station. From the weigh station, incoming trucks would be directed to the enclosed, ventilated MSW tipping and storage area for inspection.

The storage area would be designed to store approximately 6,000 tons of MSW. In this area, readily recyclable waste along with waste that cannot be processed or accepted for processing would be separated from acceptable waste. Waste that is deemed acceptable and can be processed would be shredded to produce the processed refuse fuel. Waste that cannot be accepted or processed would be rejected and re-directed to the weighing station before leaving the plant and being transported to a licensed facility for disposal or to recycling markets. According to data from the SEMASS Plant, about 1 percent (by weight) of the initial waste received at that facility was non-processable or unacceptable material (which was removed prior to processing).

Readily recyclable waste (that is present in large quantities and is easily discernible and separable), such as bulk old corrugated cardboard or white goods, would be removed in the designated sorting stations and stored for recycling and sale locally or internationally. As part of the plant operation, a quality control program would be implemented to prevent the delivery of unacceptable waste to the Project. Unacceptable materials would be rejected at the time of inspection. The non-processable material would be separated and transported to consumer markets or a licensed facility for disposal. Acceptable and unacceptable materials are described below:

- **Acceptable materials** would be processed into processed refuse fuel and include materials that have the typical characteristics of household waste collected as part of MSW collection programs, commercial/retail waste, and non-hazardous solid waste from industrial facilities.

- **Unacceptable materials** would not be processed into processed refuse fuel and consist of, but are not limited to, radioactive materials, explosives, hazardous waste, biomedical waste, liquids, motor vehicles except automotive shredder residue[7], trailers, boats, biological waste, pathological waste, infectious and chemotherapy waste, agricultural machinery, vehicle batteries, cathode ray tubes, fluorescent lamps, thermostats or any other material that can be hazardous or pose a substantial threat to health and safety, or has a reasonable possibility of adversely affecting the plant in any way.
- **Non-processable materials** cannot be processed at the plant because of their size or type.

2.2.2.2 Production and Storage of Processed Refuse Fuel

The MSW would be converted into processed refuse fuel using two process lines consisting of slow speed shear shredders followed by ferrous metal separators. This system would operate for a period of 24 hours per day, 7 days a week. While two shredders are required for operation, three will be provided, so that one unit will always be undergoing maintenance or be in a standby mode to back up the two operating shredders. The operation would begin when the loader collects the MSW and places it in the vicinity of stationary grapple cranes that feed the shredders. After shredding, the material would be discharged onto conveyor belts, where a magnetic separator would remove a large portion of the ferrous material. Conveyors would carry the processed refuse fuel to the processed refuse fuel storage building. The processed refuse fuel would be stored adjacent to the MSW receiving building, in a building that would contain a structure at least 25 feet (7.6 meters) high to store up to 6,000 tons of processed refuse fuel, equivalent to approximately 3 days of operation. The plant would be designed to combust processed refuse fuel with an average heat content of 5,700 BTU/pound, within a range of 4,600 to 7,600 BTU per pound; an average moisture content of about 25 percent and approximately 20 percent of inert material.

2.2.2.3 Processed Refuse Fuel Combustion

Using loaders, the processed refuse fuel would be transferred from the storage area to a reclaim conveyor system for transport to the storage bins that feed the boilers. Each boiler would receive processed refuse fuel at a nominal rate of approximately 44 tons per hour. The conveyor belts in the processed refuse fuel storage area would be variable speed to allow the proper delivery rate of processed refuse fuel to each of the processed refuse fuel feed systems.

Once in the boiler feed chutes, the processed refuse fuel would fall by gravity to a point about 6 feet (1.8 meters) above the boiler grate where it would be blown into the boiler by a stream of distribution air. Lighter materials would burn in suspension, while heavier portions of the

[7] Automotive shredder residue is currently included as a supplementary fuel in the EPA PSD permit; however, Energy Answers must first conduct a demonstration consistent with the PSD permit to incorporate automotive shredder residue into the processed refuse fuel stream.

processed refuse fuel, including the non-combustibles, would drop to the rear of the grate where burnable, heavier material would be burned. The grate would move from the back to the front of the boiler at a speed adjusted to allow time for complete processed refuse fuel burnout. After final burnout, the ash would drop into the bottom ash hoppers (devices for the management of granular or pulverized material) where the dry ash would be continuously removed via a bottom ash removal system located below the boiler ash hoppers. **Figure 2-4** provides an illustration of the process of combustion of processed refuse fuel in the boiler.

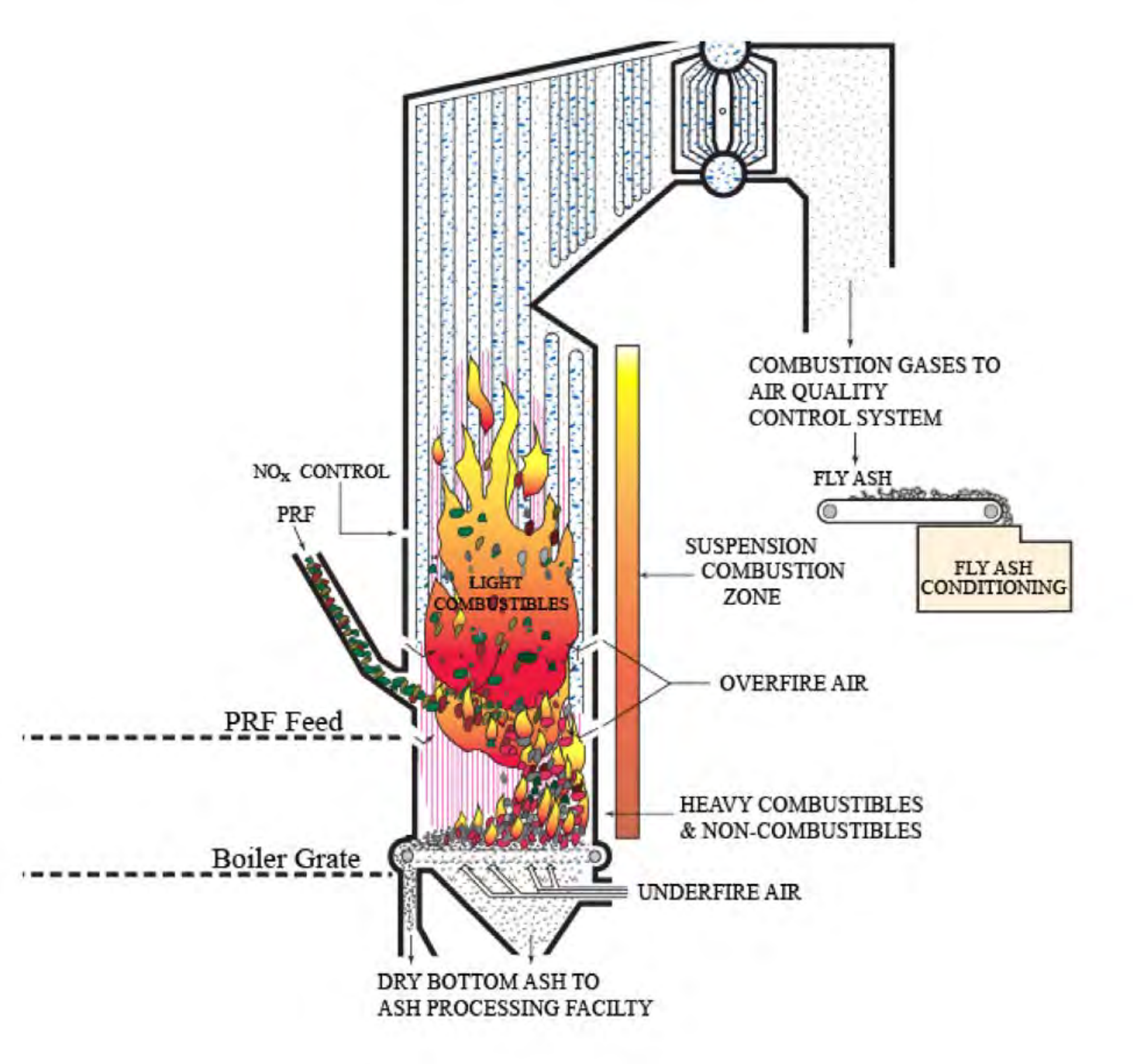


Figure 2-4. Processed Refuse Fuel Combustion in Spreader-Stoker Boiler

Steam would be produced in each steam generator (boilers) from the heat generated by the combustion of processed refuse fuel. Each steam generator would consist of a waterwall boiler, superheater, steam and mud drums, economizer, and air heater. The superheater assembly would consist of a primary superheater, followed by a desuperheater complete with spray internals and then a final superheater. The main steam system would transport high-pressure, superheated steam from the superheater outlets to the turbine inlet for the generation of electricity. The boilers would be designed to use No. 2 fuel (ultra-low sulfur distillate) that would be used during startup and shutdown and to maintain system temperature at 1,500°F (800°C) during short-term plant upsets. Fuel would not be used for power generation. Under normal operation, combustion air for the boilers would be drawn from the MSW and processed refuse fuel receiving and storage areas by a forced draft fan supplying air to the windbox under the grate to the plenum chambers. This design would serve to minimize the emissions of fugitive dust and odor from the plant.

2.2.2.4 Design Parameters

The plant would be designed to process approximately 2,100 tons per day of processed refuse fuel with a heat content of 5,700 BTU per pound and would have the capacity to manage alternative fuels and to generate steam and electric power. Each boiler would have a design heat input rate of 500 million BTU per hour, which translates to an approximate processed refuse fuel feed rate of 44 tons per hour per boiler. The maximum short-term operating level of each boiler would be equivalent to 110 percent of the design capacity, and the minimum would be 60 percent.

2.2.2.5 Emission Control System

The design and operation of the emission control systems would meet EPA-applicable standards, such as the Standards of Performance for New Stationary Sources and the Best Available Control Technology (BACT) requirements as described in the EPA Prevention of Significant Deterioration (PSD) permit. In addition, Maximum Achievable Control Technology (MACT) emission limits apply for the substances included in the PSD permit and the local permit known as the Puerto Rico EQB Rule 405.

Four independent emission control systems are proposed for each boiler and would consist of the following:

- An activated carbon injection system to remove heavy metals and dioxins/furans
- A Turbosorp® dry circulating fluid bed scrubber system to remove acid gases from the boiler flue gas with lime injection
- A fabric filter (baghouse) to control particulate emissions (including metals)

- A regenerative selective catalytic reduction (RSCR) system (including an oxidation catalyst and selective catalytic reduction modules) to reduce emissions of nitrogen oxides (NO_x)
- A drift eliminator to control the particulate emissions from the cooling tower

These technologies qualify as MACT and BACT. The Turbosorp® system would remove acid gases, primarily hydrogen chloride and sulfuric acid, from the boiler flue gas. The principle of the Turbosorp® dry scrubbing technology is to bring together high levels of solid circulation, finely atomized water, hydrated lime, and flue gas within a circulating bed reactor. Lime and finely atomized water are injected independently into the turboreactor to lower flue gas temperatures and enhance absorption capacity. The fluid bed material is composed of solids, including calcium hydroxide, recirculated fly ash from the combustion process, and solid reaction products from the fabric filter. Upon leaving the turboreactor, the solid particles are separated from the flue gas in a baghouse and recycled back to the reactor. Following the fabric filter, the flue gas is injected with an aqueous ammonia solution and enters the RSCR and then an induced draft fan, which would be connected to the stack.

Each air quality control system would include a complete system for the storage of the Turbosorp® and the RSCR reagents, hydrated lime and aqueous ammonia, respectively. Aqueous ammonia solution would be stored in a 12,000-gallon storage tank. Lime would be stored in a silo with a bin vent filter to control particulate emissions. The proposed air quality control system would be equipped with devices that would continuously monitor the following parameters: NO_x, CO, sulfur dioxide (SO_2), and CO_2. Numerous other pollutants would be monitored monthly or annually, with special initial monitoring required during the first year of operation (refer to EQB Construction Permit for a detailed list of the monitoring requirements).

The continuous emission monitoring systems equipment would be designed and operated in conformance with the performance specifications of 40 CFR §60, Appendix B, as referenced from 40 CFR §60, Subpart Eb. The plant would have a dedicated computer system to accumulate and process monitoring data from the stack gas monitors and boiler operating data. It would be instrumental for preparing reports of stack gas emissions as required by EPA and EQB. The data also would be shared by the digital control system of the plant for performance monitoring. The plant stack would have a maximum height of 351 feet (107 meters) from ground level in accordance with Good Engineering Practices. Federal Aviation Administration requirements for stack lightning would be incorporated into its design, which also would include platforms and access paths for emission monitoring.

2.2.2.6 Management and Recovery of Combustion Residues

Processed refuse fuel combustion would result in the generation of the following two types of ash:

- Bottom ash, which is the heavier, coarse fraction of the ash that remains on the boiler grate and is collected at the bottom of the boiler
- Fly ash, which is the lighter, finer fraction of the ash that is carried by combustion gases to the air pollution control equipment where it is removed

These two ash streams represent a total of approximately 20 percent (by weight) of the processed refuse fuel that would be processed at the plant. Because the two ash streams have different characteristics, they would be collected and managed separately, as noted below:

- Fly ash handling system—Fly ash would be collected from the air heater hoppers, Turbosorp® hoppers, and fabric filter hoppers using drag flight conveyors and then transported into a storage silo.
- Bottom ash handling system—Each boiler would be equipped with four bottom ash hoppers and four siftings hoppers, which would discharge into a bottom ash discharge conveyor located at each hopper outlet.

The bottom ash hopper would discharge onto two collection conveyors passing under each boiler. Each of the common redundant collection conveyors would have a design conveying capacity of 125 percent to 150 percent, based on the maximum hourly design and production rate of both boilers discharging to the same conveyor.

Fly ash would be conditioned with the addition of a conditioning agent (if required) and water. The process is expected to result in a material that is considered nonhazardous based on Toxicity Characteristic Leaching Procedure testing.

Energy Answers proposes to dispose of the fly ash waste in an authorized landfill in compliance with the applicable legal requirements. The bottom ash would be conveyed from the boilers to the ash processing building where it would be processed by separating it into three components: ferrous metal, non-ferrous metals (e.g., aluminum, brass, and copper), and a granular material known as Boiler Aggregate™. Energy Answers states Boiler Aggregate™ has been demonstrated to have useful applications as a substitute for conventional aggregate in asphaltic underlayment and other construction-related products (PRIDCO 2010); however, as of this writing, Energy Answers plans to send the material to an authorized landfill, until such time as testing of the actual ash produced demonstrates it complies with applicable environmental and commercial requirements and its reuse receives regulatory approval.

2.2.2.7 Electric Power Production

The steam turbine would be a single-casing, single-flow extraction machine with three uncontrolled and one controlled extraction and a downward or axial exhaust. The turbine would be directly coupled to an electrical generator that operates at 3,600 revolutions per minute and would be sized at 110 percent of the rated flow of both boilers. Turbine throttle conditions would be 850 pounds per square inch and 830°F (440°C). The generator would be specified to produce approximately 80 MW. Electric power exported from the proposed Project would be transmitted through a switchyard to PREPA transmission system. The main and auxiliary transformers would be located at the Project's electrical switchyard, located south of the power central structure or powerhouse, and would be equipped with containment dikes to retain oil in the event of leakage. The electrical switchyard also would contain a circuit breaker, a disconnect switch, provisions for electric power metering and other interconnection criteria. A takeoff tower would provide the interface with the transmission line. The necessary power for the proposed Project would be provided by an auxiliary transformer, which would receive power from the switchyard. The auxiliary transformer would be sized so that it would be capable of providing auxiliary power during normal, startup, and shutdown operations. The auxiliary transformer would supply the 4.16-kV switchgear, which would be the distribution source for all large motors, the 480 kV load centers and motor control centers, and all other plant loads.

2.2.2.8 Water Supply for Plant Operation

Brackish water would be obtained from the PRDNER El Vigía Pumping Station discharge into the Atlantic Ocean, through a force line to the plant for process and cooling water. The brackish water would be stored on site in a brackish water storage pond with a capacity of approximately 5 million gallons, which will feed into a cooling and process water storage tank with a capacity of 700,000 gallons. The plant cooling water system also would require chemical controls to prevent the formation of solid deposits and control corrosion, oxygen content, and pH of the water and steam. These chemicals are typically provided by the chemical supplier in portable totes or drums, and added at low level concentrations (parts per million) to the cooling water cycle. Potable water would be supplied to the demineralizer system to provide high-purity demineralized boiler makeup water as required to maintain boiler system performance. The demineralized water supply for the system would offset the boiler blow down (typically 1 percent of the steam production rate) necessary to maintain required steam quality and cycle performance. Deionized water also would be produced, which could be used for cleaning the equipment inside the steam cycle and for cleaning and maintenance of the demineralization system.

The demineralization system would be a three-stage process, based on reverse osmosis membrane technology: (1) pretreatment particulate filtration and dechlorination with either granular activated carbon adsorption and chemical dechlorination; (2) reverse-osmosis demineralization; and, (3) final demineralization "polishing." Plant ancillary systems would include backwash and cleaning systems, chemical injection systems and possibly an ion exchange regeneration system using sulfuric acid and sodium hydroxide solutions. The exact system configuration and optimization are highly sensitive to service water quality. Further characterization would be conducted during the Project design phase to refine the indicated treatment scheme to minimize water use, chemical use, and wastewater generation. A steam cycle and water analysis system would be provided, consisting of a sampling panel with coolers, valves, pressure and temperature gauges, continuous sample analyzers and local grab sample connections. Sample points include boiler drum saturated steam, boiler drum water, feed water to the economizer inlet, and condensate to the deaerator.

2.2.2.9 Supplementary Fuels

As per the approved PSD Permit, the plant may also use supplementary fuels, including automotive-shredder residue, tire-derived fuel, and processed urban wood waste if it is blended with the processed refuse fuel. Prior to using any supplementary fuel, Energy Answers must conduct a combustion demonstration program to verify the efficiency of the municipal waste combustor units' air pollution control equipment in reducing the air pollutants resulting from the combustion of the supplementary fuels and must submit to EPA a report that documents the results of the trial program. Once the combustion demonstration program has been successfully completed, the use of the supplemental fuels will be governed by the conditions established in the PSD permit which limit their use to only one supplemental fuel at a time.

2.2.2.10 Main Plant Buildings

The plant would consist of the following main buildings, which follows the same sequence as the schematic site plan (**Figure 2-3**):

- MSW receiving and processing building for MSW receiving and processing areas, where trucks would deposit waste; readily recyclable, unacceptable, and non-processable materials would be removed; and acceptable materials would be shred to produce processed refuse fuel.
- Processed refuse fuel storage building
- Adjacent buildings that would house the two spreader-stoker boilers, steam turbine, and employee facilities (e.g., cafeteria, dining room, training area, and dressing room)
- Ash processing building where fly ash would be conditioned and processed prior to disposal; bottom ash would be collected and processed to separate and recover ferrous metals from nonferrous metals and to produce Boiler Aggregate™
- Warehouse
- Existing former paper mill building
- Administrative building

2.2.2.11 Safety Controls

The plant would have control systems whose main goal is to promote plant and staff safety during operations, both on the site and in the surrounding areas. Security controls to be implemented are described below:

Fire Protection System

The main objective of the fire protection system is to provide the plant with an adequate detection and alarm system and a means for controlling and extinguishing fires. The fire protection system would be developed according to the requirements of the Puerto Rico Fire Department and the Puerto Rico Human Safety and Fire Protection Code and would follow the guidelines of the National Fire Protection Association. In addition, local fire protection codes would be incorporated into the design of the plant.

The fire protection system would be a loop-type distribution system designed to service the main buildings of the project. It would consist of a water fire main around the plant servicing a yard hydrant system and sprinkler, deluge and standpipe systems within the various buildings. A jockey pump and redundant fire pumps would be installed to boost the pressure and flow as necessary.

Isolated structures, such as the administration building, may be served directly from the municipal water supply. Fire hydrants would be located at approximately 250-foot (76-meter) intervals. Hose cabinets would be located adjacent to yard fire hydrants. Post-indicating valves and/or underground valves with roadway boxes would be furnished to isolate sections of the yard main and individual building supplies. The source of water for the fire systems would be the raw water storage tank. The water system would be supplemented by portable extinguishers throughout the plant, in accordance with the current applicable regulations.

A detection and alarm system would be designed as part of the fire protection system and would meet the requirements of the National Fire Protection Association. The fire alarm system would actuate the audible alarms required for building evacuation signals. Three hundred thousand gallons of water would be stored at all times and reserved for the fire protection system.

Control Systems

MSW processing operations and boiler and the power block operations would be monitored and controlled from a central control room in the power block building. Ash processing would be controlled from the ash processing building. Pan/tilt/zoom cameras would be provided at the MSW and processed refuse fuel storage areas that also can monitor the storage transfer belt conveyor discharge. The fuel feed system to the boilers would be provided with one camera at each boiler feed conveyor.

A distributed control system would provide overall plant control and monitoring functions. The distributed control system would include microprocessor-based process control units and redundant data. The distributed control system microprocessor control units would be redundant, with diagnostics to alert the control room operator of a malfunction. Separate programmable controllers would be provided for packaged equipment such as the water treatment system, lime slurry preparation and fire protection.

A burner management system would be provided to supervise the operation of the boiler auxiliary natural gas burners. The burner management system would include boiler purge, burner light-off, burner shutdown, burner safety, and overall management of these features. The burner management system would conform to National Fire Protection Administration standards.

The turbine would be controlled by an electro-hydraulic governor system with operator interface from the main control room. Generator controls for synchronization, voltage regulation, and generator breaker operation would be hardwired for control from the main control room. Unit protective functions would be directly wired to turbine trip, boiler trip, electrical lockout relays, etc., with a minimum of interposing relays or solid-state devices in the circuit. Other self-controlling loops, such as feed water heater drain control, would be local to equipment.

Equipment requiring periodic actuation while the plant is in normal operation, such as conveyors, burners, and other load-dependent equipment, would be controlled from the main control room while the plant is operating. Two operator stations would be provided as part of the main control room console. Boiler and turbine panel inserts would be supplied and integrated into the main control room auxiliary panel. Printers and engineers' work stations would be provided for performing program modifications. The operator would be alerted to abnormal conditions by LCD station displays and by alarm printer(s). The LCD stations would have access to all the information transmitted on the data network. The distributed control system also would provide specific shift and daily logs to augment the operator's log. These would be automatically printed or printed upon demand. The operator also would be able to create additional logs. These logs would summarize fuel consumption, lime reagent, power, and water usage.

Ventilation and Air Conditioning Systems

Designated zones of the plant would be equipped with a ventilating and air conditioning system where necessary to provide an environment suitable for personnel and/or equipment operations, with consideration to maintaining acceptable conditions of temperature, humidity, filtration, fresh air supply, pressurization, air movement and exhaust removal of vitiated or contaminated air. Outside ambient conditions of temperature and relative humidity would be used for design of the system. MSW, processed refuse fuel, and ash processing, storage and equipment areas would not be air conditioned but would have ventilation systems designed for dust and odor control.

2.2.2.12 Education Program

Energy Answers would conduct an education program to prevent delivery of unacceptable and non-processable wastes to the plant. A brochure would be prepared for distribution to schools and residential areas to alert and educate the public of the proper way to handle and dispose of household hazardous waste. A separate brochure would be prepared for commercial, industrial, and institutional customers identifying the unacceptable wastes that should not be delivered to the plant and alternative means of disposal of such wastes. Depending on availability, Energy Answers proposes to provide presentations to students in science and environmental courses and training schools, regarding recycling and proper disposal of solid waste. All waste haulers would be advised about unacceptable wastes and would be required to sign statements that they are not collecting and delivering such wastes to the site. Warning signs and listings of unacceptable waste materials would be located near the main gate and ahead of the incoming truck scales. During the first few months of operation and periodically thereafter, the scalehouse operator would query drivers to determine if their waste loads contain unacceptable waste. All known loads consisting of unacceptable waste would be rejected.

2.2.2.13 Municipal Solid Waste Inspection Program

Several measures would be taken at the site to inspect the incoming waste stream for the presence of unacceptable and non-processable waste. The scalehouse would be equipped with radiation detectors just ahead of the incoming scales to screen all truck deliveries for radioactive waste. If the alarm sounds, further inspection of the load would be conducted. Upon confirmation of the presence of radioactive waste, the load would be rejected and the appropriate authorities notified.

Waste delivery trucks which have been properly identified, screened and weighed-in would proceed to the MSW tipping area to be unloaded. Loads would be visually inspected during unloading onto the tipping floor. Random inspections of vehicles also would be conducted to detect unacceptable and non-processable items. Waste loads deemed unacceptable by the operations personnel would be rejected, and the driver would be issued a written rejection slip. A record would be maintained of unacceptable waste deliveries, by delivery vehicle, and repeated deliveries by a particular vehicle or by a particular waste hauler would result in a prohibition of future deliveries to the plant. Special handling procedures would be implemented in the event of returned waste, and vehicles carrying rejected waste would be weighed out before leaving the site.

Specific procedures for the management of hazardous waste that inadvertently arrives at the plant would be developed in accordance to a Plant Operation, Management and Safety Manual. An extensive training program would be provided for the waste receiving area attendants and frontend loader operators so they can inspect for and remove unacceptable and non-processable waste materials from the waste stream that has been unloaded and accepted. The operators of the grapple cranes that feed the shredders would provide additional inspection of the acceptable waste stream. Unacceptable materials discovered in the acceptable waste stream would be removed and stored in a designated area of the MSW tipping area, to be loaded into a container or transfer trailer for shipment to licensed disposal facilities. Non-processable items discovered in the acceptable waste stream would be removed or recovered, if possible, or disposed of in accordance with applicable regulations.

2.2.2.14 Household Hazardous Waste Collection

Energy Answers would encourage and work with municipalities that the plant serves to conduct "hazardous waste days," for the special collection of household hazardous wastes, through contract agreements with the concerned municipalities. Energy Answers would work with communities and licensed hazardous waste disposal contractors to establish such collection programs and/or drop-off programs at the plant. As soon as the program is implemented, it would be published in the residential and commercial brochures.

2.2.3 Flooding

The Río Grande de Arecibo is located west of the site that has been proposed for the development of the plant. Based on the Flood Insurance Rate Map (FIRM), Panel 230J of November 18, 2009, the site is located in a Zone AE within the floodway of the Río Grande de Arecibo, with a base flood (100-year) elevation of 17.06 feet (5.2 meters) above msl.

Energy Answers conducted a Hydrological-Hydraulic Study to determine Río Grande de Arecibo flood levels for the 10-, 50-, 100-, and 500-year events and to revise the limits of the floodway within the site, taking into account the existing topography and model estimates. The study provides the hydraulic modeling and required documentation to request from the Federal Emergency Management Agency (FEMA) and the Puerto Rico Planning Board an amendment to the floodway limits. The model was prepared to determine the new floodway limits for a 100-year event, where regulatory limits and the new floodway limit were analyzed. The new floodway limits were determined along Río Grande de Arecibo based on the highest allowable increase of 0.3 meters in flood level.

2.2.4 Stormwater Management

In addition to the flooding analysis, a preliminary assessment of the stormwater retention capability of the site was conducted for compliance with Section 14.0, Stormwater Management, Planning Regulation No. 3, *Planning Board Subdivision and Urbanization Regulation*. The peak stormwater discharge produced by the site in its existing and proposed states was preliminarily determined. Stormwater discharge generated by the proposed development shall not exceed the existing discharge. The assessment consisted of a hydraulic modeling of the site to determine the dimensions of the ponds that would limit the proposed peak discharge, so that it does not exceed the existing peak discharge for storms with different recurrences.

Two retention ponds, each approximately 6.6 feet (2 meters) deep, are proposed to be located in the northwest and southwest corners of the Project site. However, the final dimensions of the ponds would be defined during the design of the Project. Preliminarily, the Project has been divided into three drainage areas. The stormwater discharge would be directed to the two ponds, using the Project's final slopes to direct runoff as surface flow into the ponds. The stormwater discharge would keep the existing drainage pattern and would reduce the Project peak discharge, in compliance with Puerto Rico Planning Board Regulation No. 3, *Subdivision and Urbanization*.

2.3 OFF-SITE WORKS

The Project would require the completion of off-site work to bring brackish water to the plant and to connect the electric power produced by the plant to the PREPA network. In addition, the plant would be connected to PRASA's water line and sanitary trunk located on PR-2 adjacent to the Project site. Following are the details of the proposed off-site work.

2.3.1 Brackish Water Pumping and Transfer Pipeline

PRDNER operates a brackish water pumping system that contributes to the maintenance of Caño Tiburones by helping to manage saline intrusion into the wetland and by protecting regional farms, roadways, and residences from flooding. As part of this pumping system, PRDNER historically pumps between 30 and 100 mgd of brackish water into the Atlantic Ocean through El Vigía Pumping Station and has the capacity to pump up to 150 mgd, if required. In addition to this pumping capacity, the El Vigía Pumping Station discharges brackish water twice daily during low tides through gravity flow. The pumping system is composed of the pumping station located at El Vigía and the discharge channel that ends in an area adjacent to the Arecibo Yacht Club. Currently, two 1,500-horsepower pumps operate in the station, each with capacity to pump 80,000 gallons per minute. These pumps are operated with two diesel powered electric generators. The pumping station has two aboveground storage tanks with capacities of 5,000 and 280 gallons (i.e., daily tank) to store the diesel fuel used by the generators.

Approximately 2.0 mgd (i.e., 1,390 gallons per minute) of brackish water would be pumped through a 14-inch-diameter (35.56-centimeter-diameter) and 1.98-mile-long (3,200-meter-long) force line to the plant (see **Figure 2-1**). This volume represents a small percentage of PRDNER's average daily pumped discharge of brackish water into the ocean (not including the daily discharge to the ocean associated with gravity flow). The withdrawal proposed by Energy Answers would be from the brackish water that PRDNER discharges daily into the dedicated channel, and not in addition to that water. PRDNER and Energy Answers have signed an agreement confirming the validity of the proposal to use the brackish water from its daily discharge. In addition to making the necessary modifications required for pumping water for Project purposes, the agreement requires Energy Answers to make additional improvements to the El Vigía Pumping Station (e.g., deferred maintenance like new paint, dredge sediment from pump pits, install trash racks and flow meters, etc.) and become responsible for routine maintenance of all pumping and support systems located in the station.

The brackish water line to the plant would be located in the pump station downstream of the sluice gates that constitute the PRDNER extraction point. Two pumps with pumping capacity of 1,460 gallons per minute each would be installed to transfer brackish water to the plant. These pumps would work alternately and would be backed up by an emergency generator of up to 100 horsepower capacity that would maintain operation in the event of interruptions in PREPA's electrical service. The emergency generator would use diesel fuel that would be stored in an aboveground storage tank with a secondary containment system, as required by the current regulations.

The force line would be installed along the right of way of State Roads PR-681, PR-6681, and PR-2 to the plant. The line would be installed in a trench at a depth of 4.1 feet (1.25 meters) beneath the existing street level. Approximately 5,886 cubic yards (4,500 cubic meters) of material would be excavated for the proposed trench, and approximately 65 percent of this amount would be reused to refill the trench. In addition, selected fill material would be used for the installation of the pipeline.

The existing infrastructure in these state roads was identified, and no impediment is expected for the installation of the proposed pipeline. The proposed route would cross the existing bridge at PR-681 (near the Arecibo Yacht Club), with the pipeline running attached to its right side in the direction of PR-2. Currently, no pipes are installed on that side of the bridge, so support structures for the installation of the brackish water line would be needed. As part of the installation of the pipeline, a Maintenance of Traffic Plan would be prepared and submitted to the Highway and Transportation Authority, outlining the security and operational measures that would be established and implemented during this process so that temporary impacts to traffic would be minimal.

2.3.2 Power Transmission Line and Improvements to Existing Substation

The proposed Project would produce 80 MW of electric power. Approximately 70 MW would be sold to PREPA through a purchase agreement and delivered at the Project interconnection point.

To determine the best route for the transmission line to the existing substation, parameters such as the distance from the Project interconnection point, parcel owners of adjacent properties, adjacent land use, existing utility easements, flooding areas, wetlands, and the costs associated with the construction of the electrical system were considered. PREPA evaluated several interconnection alternatives for the proposed Project and determined that the preferred electrical interconnection point would be the Cambalache Transmission Center, located approximately 0.5 mile (804 meter) south of the plant site. The power would be transmitted from the proposed

Project at 115kV and would connect to the high voltage side of PREPA's 115 kV to 38 kV transformer located at the Cambalache Transmission Center.

Of the evaluated alternatives, the best route was determined to be a feeder or dual conductor simple circuit line. The aerial feeder line leaves the plant heading south and would run parallel (with an easement of approximately 25 feet [7.62 meter] wide) to the west side of the PR-2, up to the southern boundary of the former Central Cambalache Sugar Mill where it would continue west until reaching the Cambalache Transmission Center. The aerial power line would run on steel poles that would be approximately 70 feet (21.5 meter) above ground level and spaced 150 feet (45.7 meters) apart.

2.4 SUMMARY OF POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED ENERGY ANSWERS' PROJECT

A summary of potential impacts from the construction, operation, maintenance, and emergency repairs associated with the proposed Energy Answers' and the No Action Alternative are presented in the following resource area discussions and summarized in **Table 2-2**. The full impact analysis, along with Applicant-proposed measures and best management practices (BMPs) to avoid or minimize potential impacts, is presented in Chapter 3, *Present Environment and Effects of Alternatives*, and Chapter 4*, Other Required Considerations*, of this EIS.

Table 2-2. Summary of Potential Impacts Associated with the Proposed Arecibo Waste-to-Energy Project

Comparison Factor/ Resource Area	Impacts on Resource Areas from Construction and Operations	
	Proposed Energy Answers' Project	**No Action Alternative**
Soils and Geology	Construction: Disturbance to geology or soils from construction would be detectable but localized. Cut-and-fill techniques would be implemented, modifying the landscape at the site. The proposed construction activities of the Project would result in permanent changes in local topography to accommodate flood flows. An estimated 80 acres (32.4 hectares) would be disturbed; however, the disturbance would be confined to the Project site and would not extend beyond the immediate vicinity. Operations: Minor impacts to geology and topography would occur. No landscape changes would occur as the result of plant operations.	None expected. No new impacts to soils and geology would occur.
Water Resources and Quality	Construction (surface water): The effect on surface waters would be measurable or perceptible, but these impacts would be small and localized. Any construction-related effects would not alter the physical or chemical characteristics of the surface water or aquatic influence zone resource. Project construction would not greatly affect the flow regime of the Rio Grande de Arecibo. Any downstream sediment issues would be short in duration and impact. With the use of BMPs, water quality impacts would be within regulatory standards. Construction (groundwater): Impacts on local groundwater resources during Project construction would be minimal. Construction activities would result in limited soil compaction and a minimal reduction in soil permeability. Groundwater quality impacts would be within regulatory standards. Construction (water infrastructure): Project construction would require an estimated 6,500 gpd of potable water. Water would be supplied through the existing 12-inch service line along PR-2. No adverse impacts on existing drinking water infrastructure are expected. Operations (surface water): Project operations have the potential to result in short-term, moderate intensity impacts to surface water features and quality. The Project would not generate direct discharges of pollutants but would utilize brackish water (2.1 mgd) discharged from the Cano Tiburones wetland for cooling purposes. Long-term impacts to the Project	None expected. No new impacts to water resources and quality would occur.

Comparison Factor/ Resource Area	Impacts on Resource Areas from Construction and Operations	
	Proposed Energy Answers' Project	No Action Alternative
	site would include filling 2.42 acres (0.9 hectare) of wetlands to flood-proof the Project site to a height of 21 feet (6.3 meters). Operations (groundwater): Operations of the Project could result in minor impacts on local groundwater resources. Groundwater usage would not be affected during the operational period of the Project, but adverse effects on groundwater quality due to spills or accidental releases are possible. Operations (water infrastructure): Project operations would require an estimated 100,000 gpd of potable water. No adverse effects on existing infrastructure are expected. Project discharges are not expected to adversely affect existing wastewater infrastructure.	
Flooding	Construction (floodplain): Project construction would require long-term modifications to the existing floodplain adjacent to the Project. Excavations would be required to provide additional hydraulic conveyance capacity during floods. Construction (existing structures): Project construction would result in an increase in base flood elevations along predominately undeveloped properties located to the east and west, as well as immediately upstream, of the Project. Operations (floodplain): The Project facilities would be raised above the 100- and 500-year floodway limits. Significant storm events (i.e., hurricanes) could moderately affect Project operations. Operations (existing structures): Structures would be moved or flood-proofed in accordance with appropriate regulations.	None expected. No changes to existing flood patterns would occur.
Air Quality	Construction: Construction activities would result in temporary emissions through vehicle exhaust and fugitive dust. Emissions would be greatest during the early phases of construction. Primary pollutants of concern are particulate matter and NO_x. Ambient air quality at the Project site would decrease as a result of construction activity. Operations: The PSD permit required for normal Project operations has been issued. Emissions (tons per year) for the criteria pollutants are estimated as: (1) CO – 357; (2) NOx – 352; (3) SO_2 – 260; (4) PM_{10}, –	None expected. No new air quality impacts would occur.

Comparison Factor/ Resource Area	Impacts on Resource Areas from Construction and Operations	
	Proposed Energy Answers' Project	No Action Alternative
	104 and $PM_{2.5}$ – 90; (5) VOCs (as ozone precursor) – 52.4; and (6) lead – 0.31. Facility emissions would be in compliance with the NAAQS.	
Greenhouse Gas Emissions	Construction: Construction would result in minimal greenhouse gas emissions from vehicle traffic. Operations: The Project would directly emit 924,750 tons per year CO_2e. The Project could result in a net reduction of greenhouse gas emissions of 1,107,818 tons per year to 93,721 tons per year when considering the amount of landfill greenhouse gases avoided.	None expected. No new greenhouse gas impacts would occur.
Vegetation	Construction: Construction-related activities would result in both short- and long-term impacts on vegetation. Construction would alter 80 acres of abandoned pasture with some patches of forest habitat. Vegetation that would be removed includes many invasive species and is not high quality habitat. BMPs implemented during Project construction are expected to ensure that no vegetation beyond the approved limits of disturbance would be affected. Operations: Project operations are not expected to have a direct effect on nearby vegetation. The implementation of a 27.7-acre (11.2 hectares) upland natural preserve area would mitigate for the disturbed vegetation. Trees would be replanted on site and the Project would not have a long-term impact on area forest habitat. A conservation deed restriction would maintain the 9.3 acres (37,676.2 square meters) of compensatory wetlands and 27.7 acres (11.2 hectares) of upland habitat in their natural state in perpetuity.	None expected. No new impacts to vegetation would occur.
Wetlands	Construction: Project construction would require the filling of 2.4 acres (9,793.4 square meters) of on-site wetlands. Affected wetlands provide low wetland ecological function and value because the vegetative cover of the affected wetlands has such low floristic diversity and the wetlands rarely retain water. The loss of the on-site wetlands would reduce the Project's site capacity for sediment deposition, filtration, and recharge. The Project is not expected to affect any wetlands along the proposed transmission line interconnection or brackish water pipeline ROWs. BMPs in Energy Answers' erosion and sediment control plan are expected to limit the effects on the Rio Grande de Arecibo during any	None expected. No new impacts to wetlands would occur.

Comparison Factor/ Resource Area	Impacts on Resource Areas from Construction and Operations	
	Proposed Energy Answers' Project	**No Action Alternative**
	construction activities. Wetland mitigation is expected to include the addition of 9.3 acres (37,676.2 square meters) of emergent wetland on the Project site. Operations: Project operations are not expected to directly affect other nearby wetlands. At the Project site, the wetland benefits lost due to construction would be re-established through the use of the Project's unlined stormwater retention system and the proposed 9.3-acre (37,676.2-square meter) wetland mitigation site.	
Wildlife	Construction: Construction would have both short- and long-term effects on wildlife resources. The construction of the proposed brackish water pipeline is not expected to affect wildlife habitat because of its placement in existing ROWs. Some wildlife is expected to be displaced during construction in the immediate vicinity of the Project. This disturbance would likely be due the aforementioned habitat loss and the increased noise and activity associated with the Project. Habitat in adjacent areas would be undisturbed and available for short-term migration. Operations: Impacts to wildlife during normal Project operations are not expected because species would be expected to return to the site following completion of construction. Approximately 37 acres of wetland and upland habitat would be preserved through a deed restriction.	None expected. No new impacts to wildlife would occur.
Special-Status Species	Construction: Construction-related activities are not expected to have an effect on federally listed species. USFWS indicated in pre-construction meeting that suitable habitat for federally list species is not present at the Project site. Operations: No effect.	None expected. No new impacts to special-status species would occur.

Comparison Factor/ Resource Area	Impacts on Resource Areas from Construction and Operations	
	Proposed Energy Answers' Project	No Action Alternative
Water Pipeline	Construction: Construction of the proposed brackish water pipeline would require construction work with road ROW. Impacts would be short-term with original ROW status returning following construction-related activities. Operations: Normal Project operations are not expected to have any effect on existing ROWs.	None expected. The pipeline would not be constructed without the Project.
Brownfield Site	Construction: Project construction would require the immediate remediation of the existing brownfield located at the Project site. The construction of the plant and ancillary structures would permanently alter the existing brownfield and remediate the entire area. Operations: Project operations would restore industrial use activities associated with energy production at the site, which was previously used in the manufacture of paper products. Operations would change the existing brownfield sites to an active property consistent with neighboring industrial uses such as the Cambalache Power Plant, electrical switchyard, and other businesses.	None expected. No site construction activities would occur.
Visual Resources	Construction: Project construction is not expected to include the addition of any new roads to the Project site, but new entrances and exits would be required. Transmission line construction would occur within a 25-foot (7.6-meter) ROW, resulting in effects on 1.5 acres (5,989.4 square meters). A portion of the construction activities would be visible from parts of Domingo Ruiz and Arecibo. To most viewers, construction within the existing footprint of the former paper mill would bring activity to the vacant parcel similar to past operations. Construction activities would likely last up to 3 years, the majority of which would be located in existing ROWs and visible to passing drivers. Local air visibility would be slightly reduced during construction practices due to fugitive dust emissions and exhaust from construction vehicles. Operations: During normal Project operations, proposed buildings would be visible from areas within the Rio Grande de Arecibo Valley. The features would typically be in the viewer's middle ground and obstructed	None expected. Now new visual impacts would occur.

Comparison Factor/ Resource Area	Impacts on Resource Areas from Construction and Operations	
	Proposed Energy Answers' Project	No Action Alternative
	by vegetation in the foreground. Views of the new facilities, most notably the 351-foot-tall (107-meter) plant stack could be visible from parts surrounding the Rio Grande de Arecibo floodplain but would be muted in the greater landscape. The facility elements would be consistent with the historical use of the site and existing structures. Project operations are not expected to affect visibility at the local level. The opacity of combustion exhausts from the plant combustion units would be below 10 percent, typically at or approaching zero. Visible emissions from the ash handling systems would be less than 5 percent of the observation period.	
Acoustic Resources	Construction: Project construction has the potential to cause an increase in sound that is well above ambient noise levels. Construction activities include equipment that is typically found at large-scale construction sites. Construction activities with higher noise levels would primarily be limited to occur only during daytime hours. Noise associated with construction activity at the nearest existing residences would be minor, given ambient noise sources in the area. Noise associated with the loudest construction activity would increase sound level at the closest residence, Receptor 4, by less than 1 dBA. All construction activities would adhere to EQB noise regulations. Operations: Normal Project operations are expected to result in a minor increase in the noise levels at the receptors surrounding the property due to noise from facility operations and increased truck traffic accessing the site. Project operations would increase the level of vehicular traffic on PR-2 in the Project vicinity. A total of 227 vehicle trips would be generated per day, which is less than 2 percent of the existing traffic volume on PR-2. Noise levels along PR-2 are expected to increase by less than 3 dBA.	None expected. No new noise impacts would occur.
Roads and Traffic	Construction: Project construction would result in the increased traffic flow of large trucks and other construction vehicles. An estimated 480 daily trips would be taken on the roads surrounding the Project area during the aggregate hauling phase of construction. Traffic impacts during this phase of Project construction would be short term (about 8	None expected. No new transportation impacts would occur.

Comparison Factor/ Resource Area	Impacts on Resource Areas from Construction and Operations	
	Proposed Energy Answers' Project	No Action Alternative
	months) and modest because the road network in the area was designed to accommodate heavy traffic. Travel time for construction activities would be set from 6:00 a.m. to 10:00 p.m. Operations: The volume of traffic entering and exiting the site would increase by 227 additional vehicles (454 trips) per day, of which 70 percent would be trucks. These additional vehicles represent less than 2 percent of the existing number of vehicles on PR-2. Project operations would require a 351-foot aboveground stack that is not expected to interfere with the current airspace and air travel at nearby airports.	
Public Health and Safety	Construction: During Project construction, the general contractor would adhere to construction standards and implement occupational safety programs applicable to construction activities and restrict access to construction site. Water would be used to control fugitive dust emissions. Operations: Project operations would fall under the EPA PSD permit and the EQB permit to construct issued to Energy Answers. The permits include requirements that BACTs be used to reduce emissions and that all the emissions do not cause or contribute to a violation of any applicable PSD increment or NAAQS. The analysis completed in the Human Health Risk Assessment showed that potential risks associated with the emissions from the Project would be below the EPA cancer risk range and benchmark levels for the protection of human health; therefore, the Project is not expected to adversely affect human health. The assessment also showed that direct and indirect impacts to nearby industrial growth, soil, or vegetation are not expected. The plant would maintain a safety program aimed at preventing occupational injuries in all its processes and an EPA- and EQB-approved emissions and air quality monitoring program would be put in place prior to any facility operations.	None expected. No new public health and safety impacts would occur.
Ash Management	Construction: Project construction would not result in any ash production. Operations: Ash generated through combustion of MSW at the plant would be stored onsite in fully enclosed structures for the short term until	None expected. Ash byproduct would not be generated without Project operations.

Comparison Factor/ Resource Area	Impacts on Resource Areas from Construction and Operations	
	Proposed Energy Answers' Project	No Action Alternative
	its final disposition in an approved landfill.	
Socioeconomics	Construction: The impact during Project construction would be an increase in construction employment. It is anticipated that most of the construction workforce would commute to the Project site from San Juan and Ponce, as well as from the nearby municipalities and Arecibo. Up to 4,285 full-time jobs would be created during the 3-year construction period. Operations: Project operations would have a minor, positive impact on socioeconomics from the employment of approximately 150 full-time operating personnel for 30 operating years.	None expected. No impacts to socioeconomics would occur.
Environmental Justice	Construction: Project construction is not expected to cause any significant environmental or human health impacts that may directly or indirectly affect people or their activities. Operations: The Project is not expected to have any significant socioeconomic impacts or any disproportionate impacts on minorities or impoverished populations. The Project also would not adversely or disproportionately affect the health of children in the area of influence.	None expected. No environmental justice concerns would occur.
Cultural Resources	Construction/Operations: The Project is not expected to affect historic properties or archaeologic resources.	None expected. No impacts to cultural resources would occur.

Notes: BACT – Best Available Control Technology, BMP – best management practice, CO – carbon monoxide, CO_2 – carbon dioxide, CO_2e – CO_2-equivalent, dBA – A-weighted decibel, EPA – U.S. Environmental Protection Agency, EQB – Puerto Rico Environmental Quality Board, gpd — gallons per day, mgd – million gallons per day, MSW – municipal solid waste, NAAQS – National Ambient Air Quality Standards, NO_x – nitrogen oxides, $PM_{2.5}$ – particulate matter smaller than or equal to 2.5 microns, PM_{10} – particulate matter smaller than or equal to 10 microns, PSD – Prevention of Significant Deterioration, PR-2 – State Road PR-2, SO_2 – sulfur dioxide, ROW – right-of-way, USFWS – U.S. Fish and Wildlife Service, VOC – volatile organic compound

3.0 PRESENT ENVIRONMENT AND EFFECTS OF ALTERNATIVES[8]

In this section, we address each affected environmental resource. For each resource, we first describe the affected environment—the existing condition and baseline against which to measure the effects of the proposed Project and then the environmental effects of the proposed Project, including proposed mitigation measures. The following resources are analyzed in this section: Soils and Geology, Water Resources, Air Quality, Biological Resources, Land Resources, Visual Resources, Acoustic Environment, Transportation, Cultural Resources, Public Health and Safety, and Socioeconomics. The following resources were eliminated from consideration: Recreation Resources.

3.1 SOILS AND GEOLOGY

3.1.1 Affected Environment

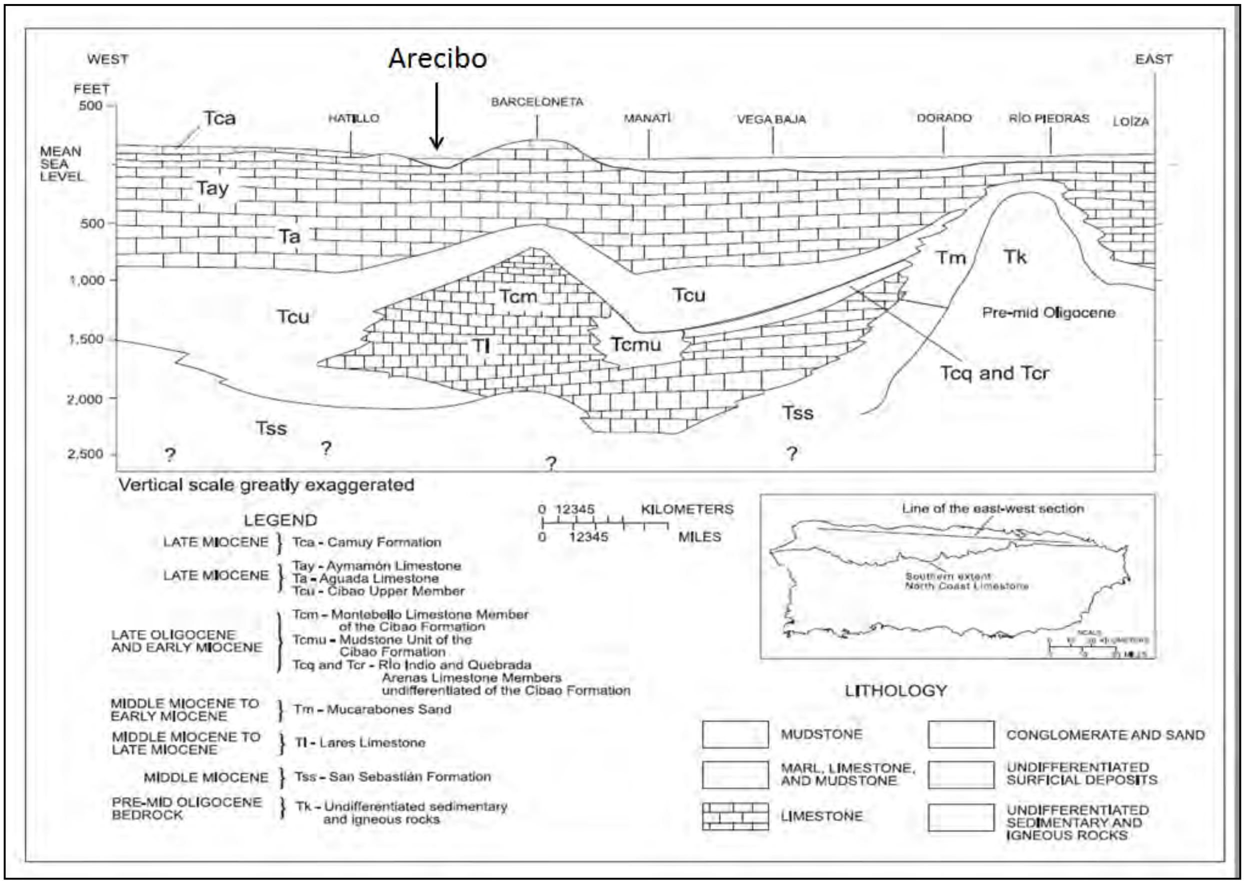
3.1.1.1 Geology and Topography

Regional Geologic and Topographic Setting

Limestone constitutes the underlying geology of approximately 28 percent of the island of Puerto Rico. The island's north coast is underlain by a formation known as the north coast limestone region, or Karst Belt (USDA 2001), with limestone formations in the region reaching top elevations of 1,739 feet (530 meters) above msl. This region extends for approximately 87 miles (140 kilometers) in an east-west direction along the north coast with a maximum width of about 14 miles (22 kilometers) near Arecibo (Monroe 1976). The underlying limestone stratigraphy of the Arecibo region, as compared to the greater North Coast, is presented in **Figure 3-1**.

The sequence of limestone formation from the late to mid Tertiary period was the result of wind dynamics and intermittent oceanic regressions and transgressions that occurred between the Oligocene and Miocene epochs. It was during this time that the oldest tertiary strata emerged and the North Coast of Puerto Rico sank as a result of ongoing orogenic processes in the Caribbean region. These processes culminated with deposits of consolidated sand dunes that date from the Pliocene and Holocene epochs and have since been overlain by more recent sedimentary deposits.

[8] Unless otherwise indicated in this section, information is based on the Revised Preliminary Environmental Impact Statement – Renewable Power Generation and Resource Recovery Plant (PRIDCO 2010).



Source: USDA (2001)

Figure 3-1. Regional Geologic Section of the Northern Karst Belt

The specific geology of the Arecibo region is illustrated in **Figure 3-2** and includes the following formations (Briggs 1968):

- Aymamón Limestone (Tay)—consists chiefly of fine to medium grained limestone, white to light gray with mixed moderate tones of orange, and contains a high degree of purity. In some places it can be mottled with light brown streaks, light gray and light reddish brown. Commonly chalky, locally coarsely fragmented. It can reach 709 feet (216 meters) in thickness. Karstic mogote physiography was developed along the base and middle parts of the formation.
- Camuy Limestone (Tca)—fine to medium grained, with different tones of orange, yellow, and light brown. Ranges in composition from a pure limestone to a somewhat clayey limestone interbedded with light gray chalk, clayey chalk, and marl. Approximately 561 feet (171 meters) in thickness.
- Floodplain alluvium (Qa)—moderately well-sorted, gradational stratified sand, gravel, silt, and clay. Largely composed of quartz, feldspar, and plutonic rock fragment sand

grains, but silicified plutonic-rock and volcanic-rock pebbles and cobbles are common. The thickness of these deposits varies from 0–230 feet (0–70 meters).

- Swamp deposits (Qs)—adjacent to meanders of Río Grande de Arecibo on its floodplain, tributaries, and Caño Tiburones east/northeast of the Project site. Sediments consist of mixed clay, sandy clay, and silty clay that is black, gray, and blue-gray. Water saturated, it contains a high degree of organic material. Thickness varies from 0–10 feet (0–3 meters).
- Beach Deposits (Qbq)—chiefly quartz sand, coarse to medium grained, well-sorted with minor concentrations of feldspar, plutonic rock fragments, and calcium carbonate.
- Sand dunes (Qd)—medium grained sand that is 0–32 feet (0–10 meters) thick.
- Transitional Deposits (Qdt)—wind-blown sand from dunes and beaches mixed by natural government agencies or by cultivation with blanket deposits, lagoonal, or swamp deposits.
- Cemented dunes (Qcd)—friable to well-indurated calcite-cemented, thin-bedded, commonly cross-bedded, locally fossiliferous, sandstone with interbedded conglomerates.
- Blanket Deposits (QTs)—quartz sand, medium to fine grained, white to light gray, contains less than 2 percent impurities.
- Fill Deposits or (Qf) Artificial Fill (Af)—consists of a mixture of poorly sorted sediments of calcite, sand, and clay fragments that reach an average depth of 13 feet (0–4 meters) from surface grade.

Several prominent geologic formations are evident in the Arecibo region. Caño Tiburones, which occupies an extensive swampy area extending from the valley of the Río Grande de Arecibo until it reaches the municipality of Barceloneta, is one of the most prominent geologic features in the region. It contains swamp and peaty marsh deposits at msl or near msl. Floodplain alluvial deposits from the Río Grande de Arecibo adjoin Caño Tiburones to the east.

The Arecibo region possesses a topography that varies greatly in elevation, with typical karst features such as karst hills or karst haystack hills (mogotes) as well as sinkholes, buried karst, and low rolling hills. Typical karstic hills reach 164 feet (50 meters) in elevation above valley plains and inter karstic hill valley elevations. The foot of the mogotes spans 328 to 492 feet (100 to 150 meters) in diameter (Briggs 1968). Steeper relief can be observed towards the southern sector of the quadrangle where short chains of mogotes reach maximum altitudes of 820 feet (250 meters) msl. The lower Río Grande de Arecibo Valley is located approximately 45 miles (72 kilometers) west of San Juan and occupies an area of 31.5 square miles (81.6 square kilometers) (Quiñones-Aponte 1986). Karstic depressions and steep hills border the western and southern limits of the valley. Irregular plains with minor karst features, river valleys, floodplains, and coastal rolling lowlands also characterize the area.

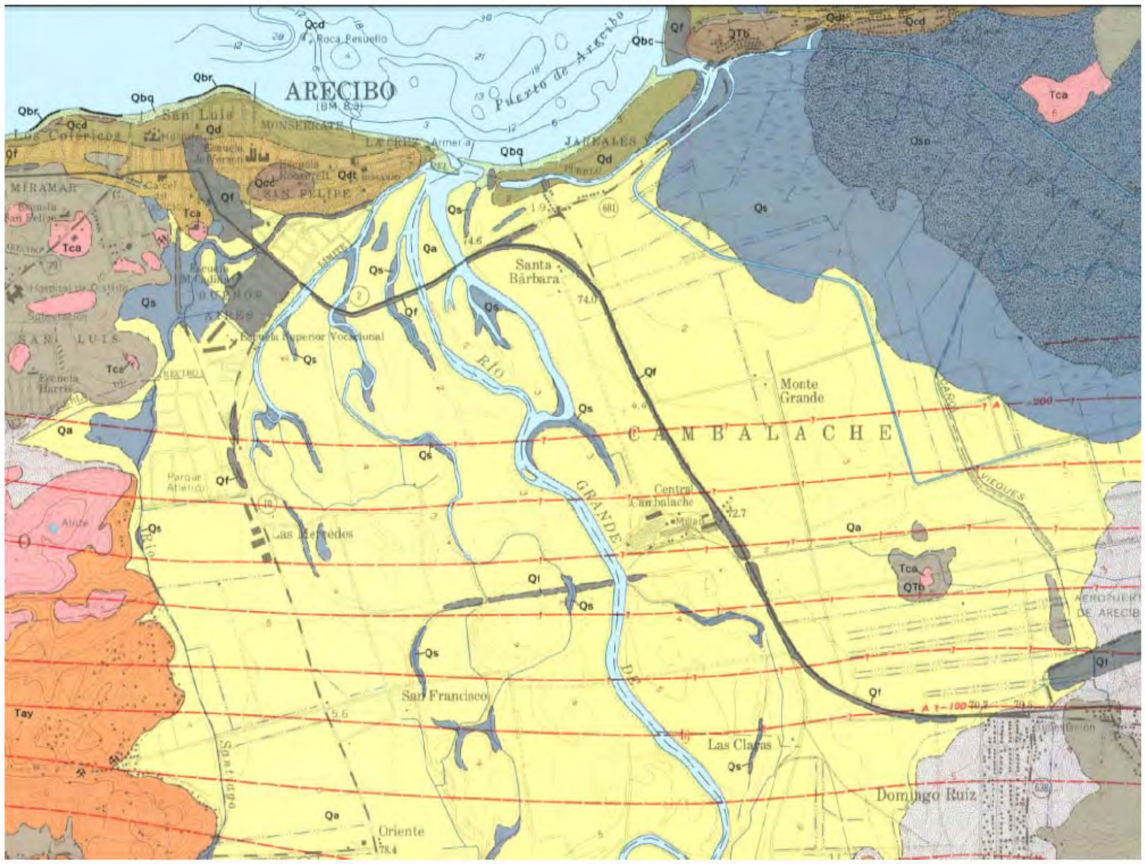


Figure 3-2. Regional Geologic Map

The lower valley of the Río Grande de Arecibo is one of the most prominent features on the Arecibo quadrangle. Elevation gradients in this alluvial valley range from almost vertical cliff walls at elevations of 590 feet (180 meters) above the level of the river floodplain, up to 820 feet (250 meters) above msl toward the southern sector of the quadrangle where abrupt topography dominates. Riverbanks contain irregular, moderately developed karstic features, which are found on both sides of the alluvial valley and represent the transition zone with adjacent terrain. Both riverbanks exhibit a gradational decrease in elevation towards the north, where the river mouth is found, and to the northeast until reaching Caño Tiburones.

Local Geology and Topography

The Project site is located on the western segment of the coastal plain on a coastal flat land portion of the Río Grande de Arecibo's alluvial floodplain in the Cambalache Ward of the municipality of Arecibo. The area immediately surrounding the Project site is dominated by alluvium deposits amid older, Tertiary-era limestone outcrops such as the Camuy Formation. Natural weathering processes have resulted in a landscape where sporadic karstic hills protrude amid the flat coastal corridor that is part of the Río Grande de Arecibo floodplain. The alluvial valley formation began with the erosion and dissolution of limestone bedrock around the Middle Miocene Epoch due to abrasion and acid rain (Monroe 1976). This process gave way to the development of a canyon with steep slopes that narrow further inland and to the south.

The geologic composition of the Project site itself consists mainly of organic material deposits mixed with sandy, silty, and clayey fine sediments from alluvial and swamp deposits generally found near meanders of the Río Grande de Arecibo. Geologic deposits that underlie the Project site consist of 230-foot (70-meter)-thick Río Grande de Arecibo floodplain alluvium (Qa) and 10-foot (3-mete)-thick swamp deposits (Qs). Geologic formations consist chiefly of moderately well-sorted gradationally bedded sand, silt, and clay. These sediments are composed of unconsolidated material that was deposited during the Río Grande de Arecibo's periods of flood and discharge. Swamp deposits were deposited in areas adjacent to the Río Grande de Arecibo and are composed of clay. These sediments are water saturated and have a high organic content (Briggs 1968). Aligned and discontinuous low-lying outcrops of limestone belonging to the Camuy Formation are present to the east and west of the Project site. To the southeast and southwest of the Project site, short ranges of karstic hills and mogotes from the Aymamón Limestone Formation are evident, showing typical karst topographic features.

Local topography at the property proposed for the Project buildings (plant site) has been previously impacted by the industrial activities of a paper mill that ceased operations in 1996. **Figure 3-3** shows the existing topography of the site. The prevailing topographic characteristic of the Project site is flat land, with the site and surrounding areas dominated by the Río Grande de Arecibo floodplain and therefore level with elevations that vary from 3.2 feet up to 24.6 feet (1 meter up to 7.5 meters) msl (USGS 1982). The topography is typical of floodplains that are associated with waterways. Approximately 3,907 feet (1,191 meters) of artificial channels flow throughout the property, which also contains five artificial ponds.

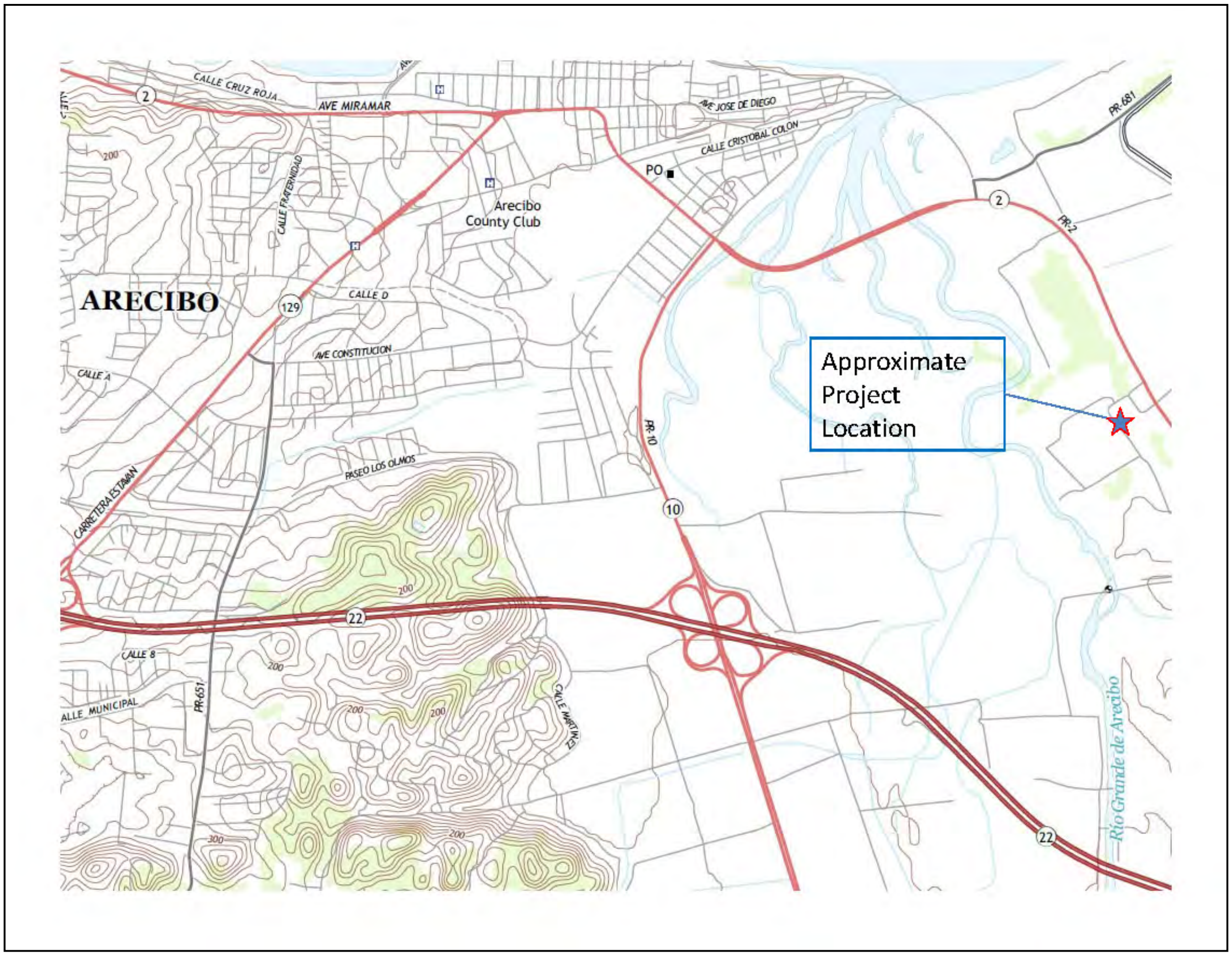


Figure 3-3. Topographic Site Map

3.1.1.2 Soils

Soils at the Project Site

Within the study area, the dominant soil order (the highest level of soil taxonomy) is Mollisols. Mollisols are developed under grassland vegetation and tend to be classified as prime farmland. The soils in the area have a soil temperature regime reflecting their northern location, a soil moisture regime reflecting a moist climate, and mixed mineralogy (NRCS 2006). Soil orders are composed of numerous soil series (the lowest level of soil taxonomy). Series found at the Project site are described in greater detail in **Table 3-1**. According to the Natural Resource Conservation Service (NRCS) Soil Survey for the Arecibo area, soils found at the Project site are those of the Toa-Coloso-Bajura Association and consist of Toa silty clay loam (To) and Coloso silty clay (Cn). These soils are directly associated to the Río Grande de Arecibo alluvial valley and have a good farming potential. Soils of this association are relatively deep and occur on almost flat terrain. The soils are well to poorly drained, with clayey and loamy characteristics. Historically, these soils have been used to grow sugar and food crops, as well as used for cattle grazing.

Table 3-1. Description of Soils at the Project Site

Soil	Description	Area of Occurrence
Toa silty clay loam (To)	The Toa series consists of very deep, well drained, moderately permeable soils on river floodplains. These soils formed in stratified alluvial sediments of mixed origin. The mean annual temperature is about 78°F, and the mean annual precipitation is about 70 inches (1.8 meters). Slopes range from 0 to 2%. Permeability is moderate. Most areas of Toa soils are used for the production of sugarcane. Some areas include tame grasses used for pasture. Vegetation consists of native and introduced species.	Western portion of the Project site
Coloso silty clay (Cn)	The Coloso series consists of very deep, somewhat poorly drained, slowly permeable soils on floodplains and low terraces. These soils are formed in stratified loamy and clayey alluvial sediments. The mean annual precipitation is about 80 inches (2 meters) and the mean annual air temperature is about 78°F. Slopes range from 0 to 8%. Drainage is somewhat poor, with slow permeability. Most areas of Coloso soils are used for sugarcane production. Some areas are used for pasture, and a few areas are in woodland that consists of native and introduced species.	Eastern portion of the Project site

Figure 3-4 shows the distribution of these soils at the plant site.

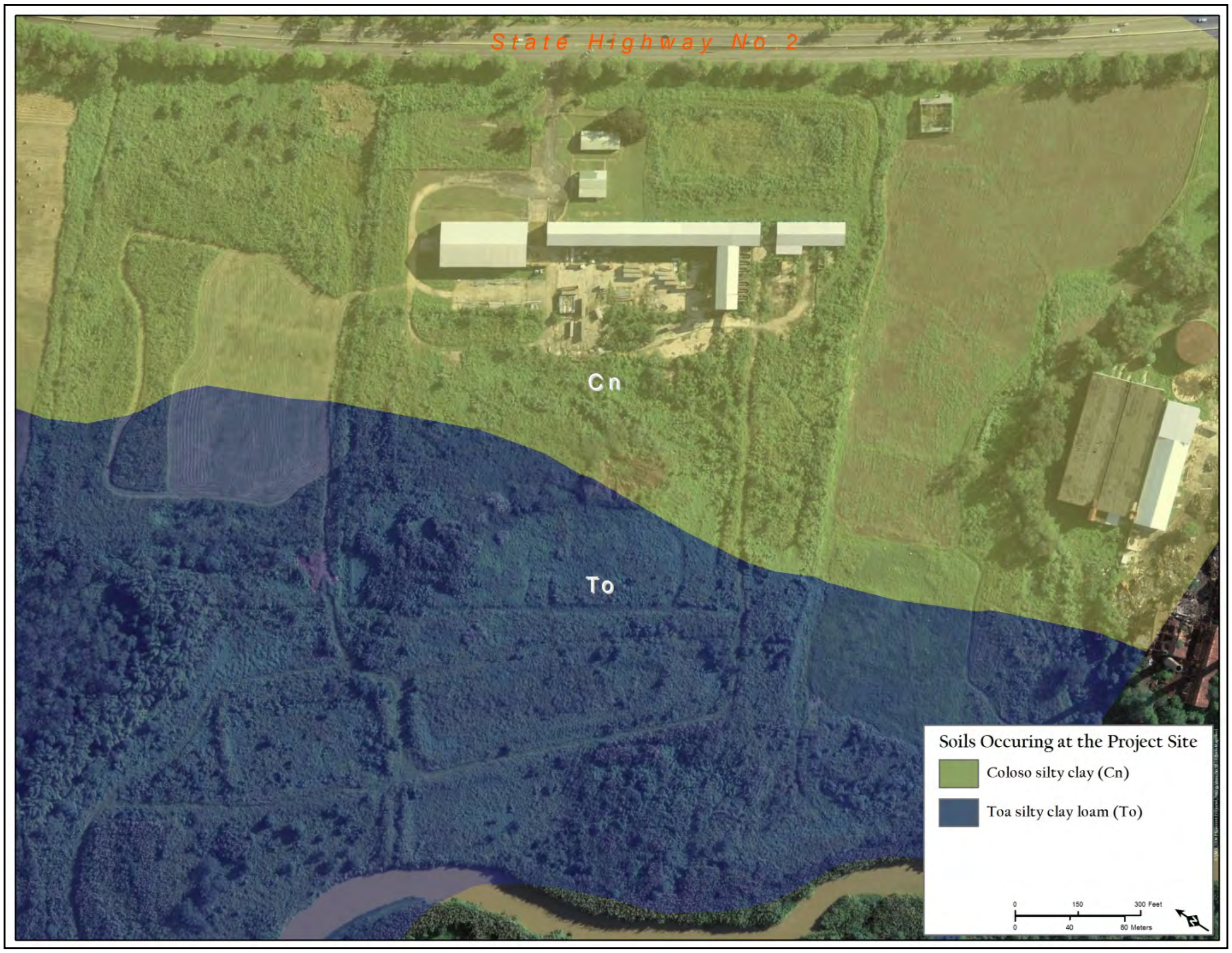


Figure 3-4. Project Site Soil Map

Prime and Unique Farmland Soils

Prime farmland soils, as defined by USDA, are soils that have been determined to have the best combination of physical and chemical properties for agricultural production (NRCS 2015). In addition, land may be classified as prime farmland if it is drained, irrigated, or of statewide importance, as determined by the state. Both types of soils that occur at the Project site have been classified as prime farmland. Toa silty clay loam is classified as prime farmland, and Coloso silty clay is also classified as prime farmland if drained.

3.1.2 Effects Analysis

Impacts on soils and geology include how the proposed Project could potentially impact these resources from the construction and operation of the plant, water pipeline, and transmission line. Most of the impacts would occur during construction and likely would be temporary. This section discusses the potential effects of the proposed Project on the various soil and geologic resources throughout the Project area. To determine whether the proposed Project would have the potential to result in significant impacts on soil and geologic resources, it is necessary to consider both the duration and the intensity of the impacts. Definitions for duration and intensity of soils and geology impacts established for this Project are described in **Table 3-2**.

Table 3-2. Soils and Geology Impacts Context and Intensity Definitions

Geology and Soils			
Context (Duration)	**Low Intensity**	**Moderate Intensity**	**High Intensity**
Short term: During construction period Long term: Life of the Project (50 years)	Disturbance to geology or soils from construction and operation would be detectable but localized and discountable. Erosion and/or compaction would occur from construction and operation in localized areas.	Disturbance would occur over a relatively wide area from construction and operation of the Project. Impacts to geology or soils would be readily apparent and result in short-term changes to the soil character or local geologic characteristics. Erosion and compaction impacts would occur over a wide area.	Disturbance would occur over a large area from construction and operation of the Project. Impacts to geology or soils would be readily apparent and would result in short-term and long-term changes to the character of the geology or soils over a large area both in and out of the Project boundaries. Erosion and compaction would occur over a large area.

3.1.2.1 Construction

Geology and Topography

The Project site would be flood-proofed as part of the initial Project construction. The design high water elevation for stormwater detention storage is approximately 19.6 feet (6 meters) above msl. The nominal finished floor elevation of the plant buildings is approximately 20.7 feet (6.3 meters) above msl. As a result, plant construction would involve the modification of the existing drainage canals to open more floodway and raising the footprint elevation of the site so that it is above the 100-year floodplain. These activities would involve movement of earth to construct the Project.

Adverse impacts on geology and topography resulting from the construction of the Project would be long-term and moderate as a result of the removal of existing material within the floodway and recontouring of the landscape. Cut and fill techniques would be implemented, which would modify the landscape at the site, and new material would be brought in to raise the elevation of the site. Impacts on geology and topography would be confined to the Project site itself and would not extend beyond the site footprint and immediate vicinity.

Soils

Impacts on soils at the Project site would be minor. Although an estimated 80 acres (32.4 hectares) of soils would be taken out of potentially productive agricultural uses at the site of the Project, the majority of the site was formerly used for industrial purposes and land at the plant site is currently overgrown and vacant. Only the properties north of the plant site are currently in active agricultural use. Thus, the Farmland Protection Policy Act is not applicable for this Project. Of the 80 acres (32.4 hectares) on site, 42.3 acres (17.1 hectares) is Coloso silky clay (Cn) and 41.5 acres (16.8 hectares) are Toa silky clay loams (To). The resulting loss in soils would be confined to the Project site itself and would not extend beyond the immediate vicinity.

3.1.2.2 Operation

Geology and Topography

During the operational lifetime of the Project, there would be no impacts on geology or topography. Geologic features and landforms would not be disturbed during plant operation. Because no landscape changes would occur as the result of plant operation, surface geology would be unaffected. The underlying bedrock geology would similarly remain undisturbed given that no ground-penetrating activities would occur during plant operation. Overall, there would be no long-term impacts on geology and topography.

Soils

No impacts would occur on soils during the operational lifetime of the Project. Soils outside of the plant footprint would remain undisturbed because plant operations would not result in measurable changes to soils. Soil structure and underlying substrate would remain intact, and the suitability of prime farmland soils outside of the plant footprint for agricultural uses would be unaffected.

3.2 WATER RESOURCES

3.2.1 Affected Environment

3.2.1.1 Surface Water

Surface Water Features

Located in the central area of Arecibo near Cambalache, the Project is within the Río Grande de Arecibo floodplain. With its headwaters located in the Cordillera Central mountain range, the Río Grande de Arecibo flows north to the Atlantic Ocean draining an area of 209 square miles (541 square kilometers) (EPA 2010). The Río Grande de Arecibo is one of the largest drainage basins in Puerto Rico with eight major tributaries and two main-stem reservoirs. The Río Grande de Arecibo has the highest mean-annual discharge of all Puerto Rican river systems, averaging about 504 cubic feet per second (cfs) (14.2 cubic meters per second [cms]) (Quinones-Aponte 1986). The only major tributary near the Project, the Río Tanama, enters the Río Grande de

Arecibo an estimated 3 miles (4.8 kilometers) upstream from the Project, near Tanama Ward. The Río Tanama has a mean-annual discharge of about 107 cfs (3 cms) and a drainage area of 58 square miles (150 square kilometers) (Quinones-Aponte 1986). Although, not designed for flood control purposes, the two major reservoirs within the watershed, Lago Dos Bocas and Lago Caonillas, offer peak flow attenuation during large storm events.

The Río Grande de Arecibo Watershed is split into two distinct geomorphic regions (Quinones-Aponte 1986). The upper watershed consists mainly of undeveloped forested areas with steep canyon-like terrain. The lower watershed consists of a coastal floodplain that is relatively flat with significant areas of ponding water in some overbank areas. River banks in this area contain irregular, moderately developed karstic features and dip in elevation towards the north, toward the river mouth (Quinones-Aponte 1986). The Río Grande de Arecibo enters a wide alluvial floodplain downstream of the Highway PR-22 bridge before meandering past the west side of the plant. The floodplain is 2.5 miles (4 kilometers) wide, and extends from the river mouth at the Atlantic Ocean about 7 miles (11.2 kilometers) upstream. Topography in this area is relatively flat, as described in Section 3.1, *Soils and Geology*. The Project site is located along the eastern portion of the Río Grande de Arecibo floodplain west of the Río Grande de Arecibo main channel. The Caño Tiburones wetland is located to the east, and Arecibo Bay and the Atlantic Ocean are located to the north. **Table 3-3** shows the distance and direction from the existing structures at the plant to the major surface water features found in the lower Río Grande de Arecibo Valley.

Table 3-3. Major Surface Water Features in the Lower Río Grande de Arecibo Valley

Feature	Distance from Project Boundary (feet [meters])	Direction from Project
Río Grande de Arecibo	0.00–1,056 [322]	West
Río Tanama	11,086 [3,380]	Southwest
Caño Tiburones	5,278 [1,609]	East
Arecibo Bay/Atlantic Ocean	5,278 [1,609]	North

Five artificial ponds, constructed when the site was used as a paper mill, remain on the site. Located on the southeastern side of the Project area, one pond was used for retention of water from the former paper mill. The four remaining ponds on the western side of the Project area acted as infiltration ponds to store stormwater and discharged stored waters by percolation to the Río Grande de Arecibo. These ponds are currently not in use and do not store water. Near the plant area, 3,907 feet (1,191 meters) of artificial channels were created as part of the stormwater and process water drainage system. These channels connect to a larger channel along the northern boundary of the Project site that discharges to the Río Grande de Arecibo. No rivers or creeks cross directly through the immediate Project site.

U.S. Geological Survey Gages

Table 3-4 provides information on the three U.S. Geological Survey (USGS) gages directly upstream from the Project. The closest streamflow recording gage, USGS gage no. 50029000, *Río Grande de Arecibo at Central Cambalache*, is located an estimated 0.75 mile (1.2 kilometers) upstream from the plant. USGS gage no. 50028400, *Río Tanama at Charco Hondo*, is located an estimated 3 miles (4.8 kilometers) upstream from the plant, near the confluence of the Río Tanama and Río Grande de Arecibo. USGS gage no. 50027750, *Río Grande de Arecibo Abv Arecibo*, is located just above the confluence of the Río Tanama and Río Grande de Arecibo, an estimated 4 miles (6.4 kilometers) upstream from the Project site (USGS 2015a).

As shown in **Table 3-4**, the Central Cambalache and the Charco Hondo gages have the longest periods of record (46 years) and are both located just upstream from the Project site. As a result, information from these gages has been used to represent long-term inflows to the Project site. **Table 3-5** shows monthly flow statistics based on daily average flows for the Río Grande de Arecibo at Central Cambalache. Flows from the period October 15, 1983, to September 30, 1996, were prorated to account for the difference in drainage area at the Central Cambalache gage (200 square miles or 518 square kilometers) and at the Arecibo gage (175 square miles or 453 square kilometers), assuming the drainage basins have similar hydraulic and meteorological characteristics. Flow data from the Charco Hondo gage was added to the Arecibo gage prior to prorating the flow values to the downstream Central Cambalache gage.

Monthly flows are generally highest in September, October, and November and lowest in January, February, and March. Flows range from a low of 18 cfs (0.5 cms) to a high of 16,914 cfs (479 cms).

Table 3-4. Río Grande de Arecibo U.S. Geological Survey Gage Information

Time Period		Gage Name	Gage Number	Drainage Area mi^2
From	To			
04/29/1982	09/30/2002	Río Grande de Arecibo ABV Arecibo	50027750	175
04/09/1969	Present	Río Tanama at Charco Hondo	50028400	58
05/19/1969	Present	Río Grande de Arecibo at Central Cambalache	50029000	200

Source: USGS (2015b, 2015c, 2015d)

Table 3-5. Monthly Flow Data for Río Grande de Arecibo at Central Cambalache, Puerto Rico

Month	Mean Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)	10%	50%	90%
				Exceedance Flow (cfs)		
October	741	14,726	35	1,518	565	212
November	706	8,400	35	106	494	141
December	459	9,994	32	847	318	106
January	318	4,131	32	600	247	71
February	247	1,377	28	530	212	71
March	247	6,321	18	530	176	71
April	388	6,992	18	812	282	71
May	600	16,916	35	1,271	424	106
June	424	4,555	32	847	318	106
July	318	3,108	35	671	247	71
August	388	15,891	25	742	282	71
September	671	14,055	21	1,271	494	141

Source: USGS (2015b, 2015c, 2015d)

[a] Data from USGS Gage No. 50027750, Río Grande de Arecibo ABV Arecibo, PR, were prorated by 200/175 to account for the difference in drainage area between the gage and the downstream USGS gage no. 50029000 for the period October 15, 1983, to September 30, 1996.

Water Withdrawals

The Puerto Rico Aqueduct and Sewer Authority provides drinking water to Arecibo. Public water supply data for 2005 is provided in **Table 3-6**.

Table 3-6. Total Surface Water Withdrawal for Arecibo in 2005

Area	PRASA Surface Water Withdrawals (mgd)
Arecibo	91.90

Source: USGS (2012)

Note: USGS maintains cooperative agreements with the Puerto Rico Aqueduct and Sewer Authority (PRASA) to compile water-use data and maintain an adequate database for major water use categories.

Local Precipitation

Mean-annual rainfall in the general area varies between 60 to 100 inches (152 to 254 centimeters) per year. Seasons in Puerto Rico are defined as follows: a relatively dry period from December to March, a spring-rainy period in April and May, a relatively short dry period in June and July, and a wet season from August to November. Data from the National Oceanic and Atmospheric Administration presented in **Table 3-7** shows total monthly rainfall from 1990 to 2014 for Arecibo. Total annual rainfall values and monthly mean, maximum, and minimum values are also provided.

Surface Water Quality

EQB promulgated the Water Quality Standards Regulation to comply with Section 305(b) of the Clean Water Act. USGS manages the network of surface water monitoring stations throughout the Río Grande de Arecibo Basin through a cooperative agreement with the government of Puerto Rico. The designated uses for waterbodies under the Water Quality Standards Regulation include: drinking water supply, preservation and propagation of desirable aquatic species, primary contact recreation, and secondary contact recreation.

EPA’s 2010 Total Maximum Daily Loads report identified the impaired waters in the Río Grande de Arecibo Basin, which are subject to assessment methodologies and the beneficial uses discussed above. **Table 3-8** identifies the 12 assessment units in the Río Grande de Arecibo Basin (EPA 2010).

Of the 12 assessment units identified in **Table 3-8**, 5 are not listed. Two of the seven impaired assessment units fully support the designated uses of aquatic life or drinking water. Six of the seven impaired assessment units support the designated use of secondary contact recreation; none support the designated use of primary contact recreation. Water quality impairment sources include agricultural crop production, individual home sewage systems, managed pasture grazing, site clearance from development, and rural residential areas. There are 13 total permitted point source facilities in the Río Grande de Arecibo Basin. Nonpoint sources in the area include nearby agricultural practices and rural sewage systems (EPA, 2010).

Table 3-7. Monthly Total Precipitation (inches) for Arecibo Observation, Puerto Rico (1990–2014)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1990	2.19	3.90	7.41	4.02	3.32	6.34	19.2	4.56	9.12	18.3	5.11	4.00	87.44
1991	1.31	6.77	4.07	7.27	9.41	9.41	4.87	11.8	6.49	5.39	4.23	3.94	74.94
1992	2.71	0.70	6.71	3.75	11.8	4.16	5.28	7.78	M	M	6.25	9.77	M
1993	M	2.06	2.43	10.61	M	M	M	5.48	11.9	9.98	7.81	1.07	M
1994	1.63	1.34	3.22	2.97	6.25	5.22	4.42	4.94	3.77	10.6	4.11	8.12	57.24
1995	4.11	M	3.28	2.80	25.7	M	8.02	12.7	16.04	7.68	4.77	3.28	M
1996	4.37	4.88	3.87	M	8.14	4.99	5.70	13.3	14.8	6.85	6.74	4.28	M
1997	14.4	2.37	2.66	1.85	6.74	2.63	9.01	8.51	2.94	6.28	2.96	2.94	63.27
1998	3.18	2.84	4.95	7.02	11.0	7.72	11.1	12.9	19.0	12.2	5.60	6.63	104.1
1999	2.71	5.38	4.94	5.33	6.02	13.0	6.15	8.10	10.8	14.0	12.2	10.5	99.24
2000	5.53	2.40	1.74	3.45	7.81	0.96	4.96	6.97	8.67	12.2	M	1.71	M
2001	4.22	3.03	3.86	5.26	12.5	7.40	6.19	6.96	4.12	8.53	10.7	10.1	82.96
2002	3.39	2.07	3.34	16.1	7.43	2.61	6.18	11.9	6.48	9.42	6.91	1.31	77.11
2003	4.43	2.40	2.11	13.3	7.33	7.27	3.13	9.59	9.43	13.1	10.4	6.05	88.48
2004	1.28	1.66	5.91	6.26	12.8	5.54	4.14	8.82	12.3	4.36	14.6	3.89	81.50
2005	M	2.35	0.44	19.6	15.1	7.42	6.52	12.5	6.26	7.73	6.80	0.77	M
2006	7.03	0.40	9.64	5.46	8.81	11.2	3.43	8.90	6.55	6.73	7.96	1.93	77.99
2007	2.59	6.92	8.53	7.87	10.9	5.20	2.84	10.2	6.52	5.13	6.23	10.2	83.11
2008	2.54	0.91	2.39	7.91	9.21	6.73	12.9	3.45	17.6	6.00	9.65	M	M
2009	3.03	7.99	6.71	2.23	7.65	9.97	5.41	8.97	11.07	4.32	7.37	1.77	76.49
2010	10.4	2.54	3.53	10.9	17.6	8.42	8.53	10.5	7.60	9.64	6.14	9.92	105.73
2011	1.57	2.22	7.24	4.50	9.59	11.1	11.7	7.03	11.2	10.2	14.6	5.71	96.74
2012	5.16	5.64	16.4	11.8	8.61	1.98	7.71	9.04	6.33	12.0	10.7	3.74	99.12

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2013	2.80	2.06	8.30	5.16	17.6	6.36	M	10.4	9.47	4.56	6.16	4.45	M
2014	0.84	1.41	0.45	4.93	8.07	5.33	6.83	16.9	7.80	10.3	6.93	4.45	74.24
Mean	3.92	2.93	5.37	8.32	10.7	6.49	6.47	9.47	8.76	8.28	8.94	4.77	86.92
Max	10.40 2010	7.99 2009	16.4 2012	19.6 2005	17.6 2010	11.2 2006	12.9 2008	16.9 2014	17.6 2008	13.1 2003	14.6 2011	10.2 2007	105.73 2010
Min	0.84 2014	0.40 2006	0.44 2005	2.23 2009	7.33 2003	0.96 2000	2.84 2007	3.45 2008	4.12 2001	4.32 2009	6.14 2010	0.77 2005	76.49 2009

Source: National Oceanic and Atmospheric Administration (2014)

Notes: M – absent data for specific time period

Table 3-8. Assessment Units in the Río Grande de Arecibo Watershed

Basin	2006 Assessment Unit	State Impairment	Associated USGS Station	Priority Ranking
Río Grande de Arecibo	Río Grande De Arecibo (PRNR7A1)	Fecal coliform	50029000, 50027250, A1-B	High
	Río Grande De Arecibo (PRNR7A2)	Fecal coliform	50020500, A3-B, A3-A	High
	Túnel (PRNR7A3)	Fecal coliform	50020500, A3-A	High
	Río Tanama (PRNR7B1)	Unlisted	–	–
	Río Tanama (PRNR7B2)	Fecal coliform	50228000, A3-5	High
	Río Caonillas (PRNR7C1)	Fecal coliform	50026050, A4-A, A4-B	High
	Río Limon (PRNR7C2)	Fecal coliform	A1-B, A2-B, A1-A	High
	Río Yunes (PRNR7C3)	Fecal coliform	A2-A, A2-B	High
	Lago Dos Bocas	Unlisted	–	–
	Lago Caonillas	Unlisted	–	–
	Lago Garzas	Unlisted	–	–
	Terminal Basin	Unlisted	–	–

Source: EPA (2010)

3.2.1.2 Groundwater

Aquifers

Found within alluvial and shallow limestone aquifers, groundwater resources are abundant in the lower Río Grande de Arecibo Valley. An unconfined aquifer within the alluvial valley is hydraulically continuous with bordering limestone formations (Quinones-Aponte 1986). The entire aquifer system is divided into two separate hydraulic systems, the upper and lower aquifers. Groundwater from the alluvial upper aquifer has not been widely developed (Quinones-Aponte 1986). High capacity wells tend to draw from the lower aquifer that occurs below the dividing clay layer within the alluvium and underlying limestone. The upper aquifer is mainly non-confined within limestone formations and the coastal alluvial deposits found in the Arecibo area. The aquifer extends between the municipalities of Río Grande and Aguada, covering an area of 600 square miles (1,554 square kilometers) (Quinones-Aponte 1986).

The lower aquifer is located near the coast and has a confining unit composed of calcareous clayey rock and other limestone materials. The lower aquifer's extension into the Project site is not well known.

Transmissivity ranges from 3,000 square feet (279 square meters) per day in the upper alluvial area to 42,000 square feet (3,902 square meters) per day in the lower adjacent limestone areas (Quinones-Aponte 1986). Estimated values of hydraulic conductivity range from 25 to 40 feet (7.62 to 12.20 meters) per day for the alluvial aquifer (Quinones-Aponte 1986). Total groundwater flow through the aquifers within the Project area is estimated at 20.6 mgd. Groundwater flow within the Project area is from southwest to northeast with almost half of the flow going to the eastern area of Caño Tiburones where it discharges as springs and seeps (Quinones-Aponte 1986). The other half flows directly to the Atlantic Ocean.

The water table in the lower Río Grande de Arecibo Valley ranges in depth from 15 feet (4.6 meters) below the ground surface in alluvial areas up to 300 feet (91.4 meters) below the ground surface in the limestone upland areas (Quinones-Aponte 1986). Within the Project site, the water table occurs 20 to 40 feet (6 to 12 meters) above the clay confining layer. The water table varies in elevation from 2 to 5 feet (0.6 to 1.5 meters) between wet and dry months (Quinones-Aponte 1986). This relatively small variation in water level suggests constant recharge from surface waters to the alluvial upper aquifer.

Surface/Groundwater Interactions

Both the Río Tanama and Río Grande de Arecibo lose part of their annual flow to underground seeps near the Project area. Water infiltration from the Río Grande de Arecibo near the former Central Cambalache Sugar Mill accounts for about 11.6 mgd of the total flow of the groundwater system. A portion of the Río Tanama reemerges as the San Pedro Spring near Charco Hondo with an average discharge rate of 13 cfs (0.4 cms) and helps maintain minimum flows through the Project site (Quinones-Aponte 1986). According to USGS estimates, 36 inches (91.4 centimeters) of net precipitation also percolates to underground systems through sinkholes and other karst features found in the lower Río Grande de Arecibo Valley.

Groundwater Extractions—Twenty extraction wells are located in the vicinity of the Project area. These wells were identified in the Puerto Rico Water Resources Comprehensive Plan and represent a combination of wells for public, agricultural, and industrial practices. The nine wells listed below are located within a 1,500-foot (457-meter) radius of the plant location.

- Cambalache 1
- Arecibo 03 McGuiness
- Arecibo 05 Cambalache
- Arecibo 06 Cambalache

- Central Cambalache
- Grace Paper 1
- Grace Paper 2
- Grace Paper 3
- Grace Paper 4

Table 3-9 shows groundwater withdrawal amounts based on data supplied from PRASA for 2005. These values are for public water supply and industrial practices.

Table 3-9. Groundwater Withdrawals for Arecibo by Public Sector

Area	Type of Withdrawal	PRASA Groundwater Withdrawals (mgd)
Arecibo	Public water supply	11.47
	Industry	0.41

Source: USGS (2012)

Groundwater Quality

The groundwater systems in the karst region of northern Puerto Rico are highly productive and offer important freshwater resources for human consumption, ecological integrity, and industrial and urban development. Spatial and historical distributions of contaminants in the northern karst aquifer show that transport processes in these aquifers are extremely complex and may be highly influenced by hydrologic conditions (Padilla 2011).

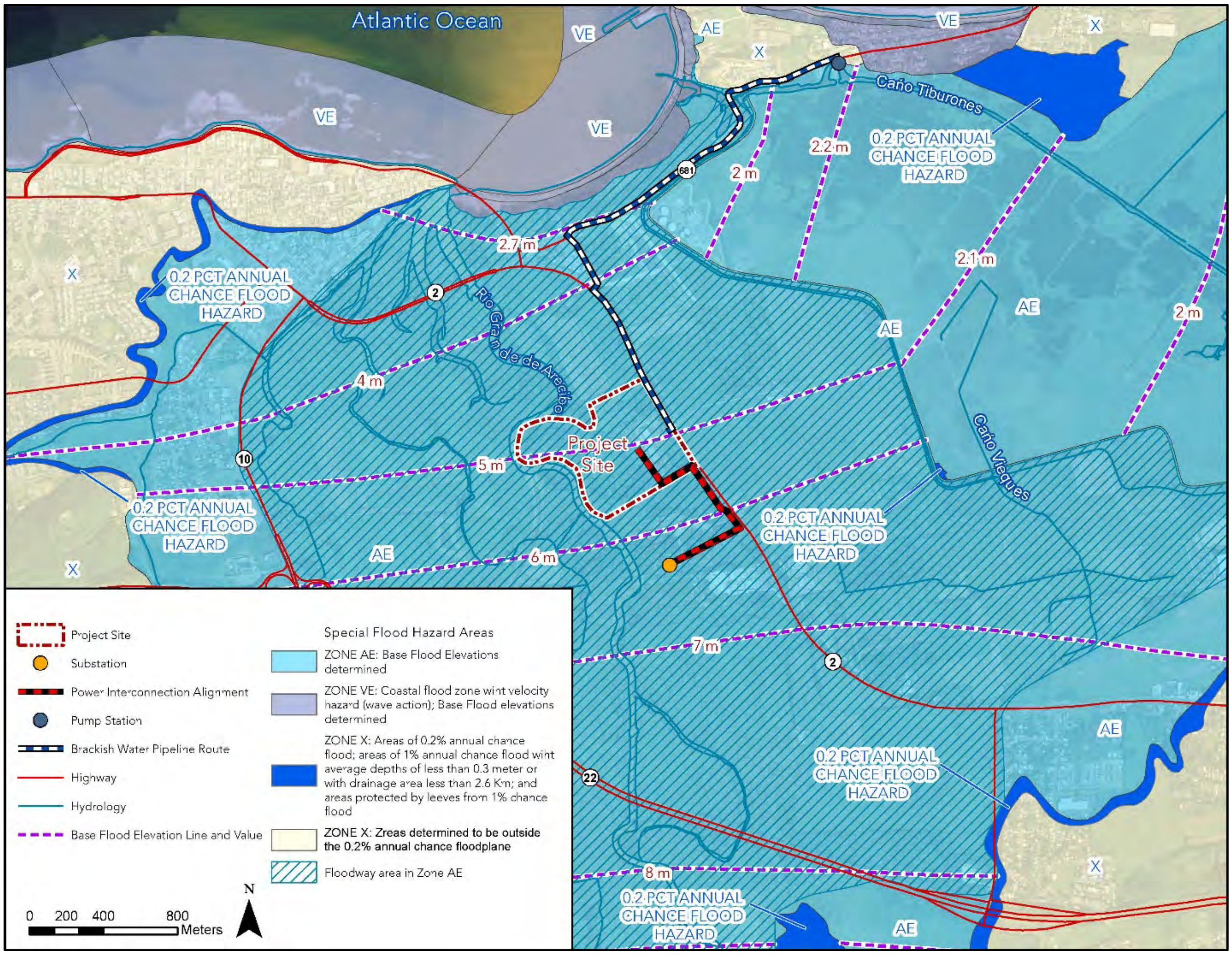
In 2000, two pump tests were performed to characterize water quality and productivity at the Project site. A groundwater test well was drilled to a maximum depth of 260 feet (79.2 meters) within the Project site, penetrating the upper aquifer system. The groundwater evaluation measured temperature, pH, total dissolved solids, and specific conductance. Field samples yielded variations in water temperature from 25.2°C to 24.9°C, a pH of 7.1, and high levels of conductivity and total dissolved solids. Conductivity measurements were between 25.0 and 28.7 micro siemens per centimeter. Total dissolved solid concentration was measured at 15,000 parts per million and the ionic concentration of the well water was approximately 50 percent that of seawater.

3.2.1.3 Flooding

As described in Section 3.2.1.1, *Water Resources*, the plant would be located in the lower Río Grande de Arecibo Basin. Published by FEMA in 1980, a Flood Insurance Study for the lower Río Grande de Arecibo Basin determined peak discharge, base flood elevations, and floodway limits for the reach of the Río Grande de Arecibo extending 10.5 miles (17 kilometers) upstream from the river mouth (GLM 2010). The plant would be located an estimated 1.2 miles

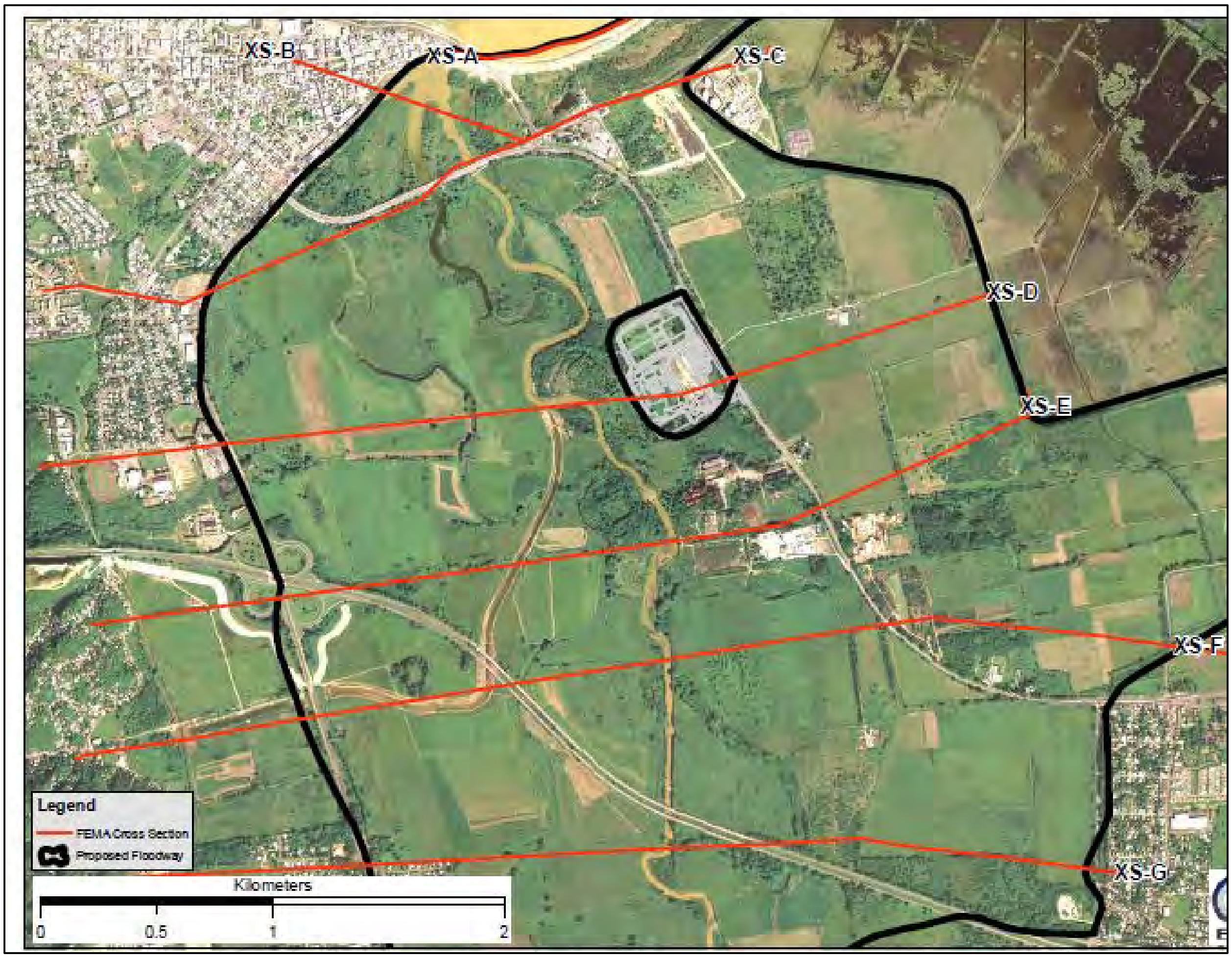
(2 kilometers) upstream from the river mouth. FEMA determined the study limit along the eastern portion of the Río Grande de Arecibo floodplain to be the dike that runs southward from the Caño Tiburones mouth, and parallels PR-2 for approximately 7 miles (11.2 kilometers) (GLM 2010). According to the flood insurance rate map, the Project site has a base flood (100-year) elevation of 17.1 feet (5.2 meters) above msl (GLM 2010). **Figure 3-5** shows the FEMA flood insurance rate map, Panel 230J.

Energy Answers proposes to revise the floodway limits to follow the perimeter of the proposed development, and to reclassify the land as Zone AE outside the floodway, in accordance with updated regulations from the Puerto Rico Planning Board, effective January 7, 2010. The proposed amendment would require a change to the topography of the floodplain area between the Project and the Río Grande de Arecibo River channel to provide greater flow area along the river bank. The generated fill would be used to raise the Project area outside the floodway limit. The application for amending the Map for Flood Prone Area was filed with the Puerto Rico Planning Board on October 8, 2010. **Figure 3-6** shows the proposed 100-year floodway limit around the Project and FEMA-delineated cross sections. The Project is located at FEMA cross section “D.” **Figure 3-7** shows the area of the proposed bank modification, where field elevations would be lowered to 8.2 feet (2.5 meters).



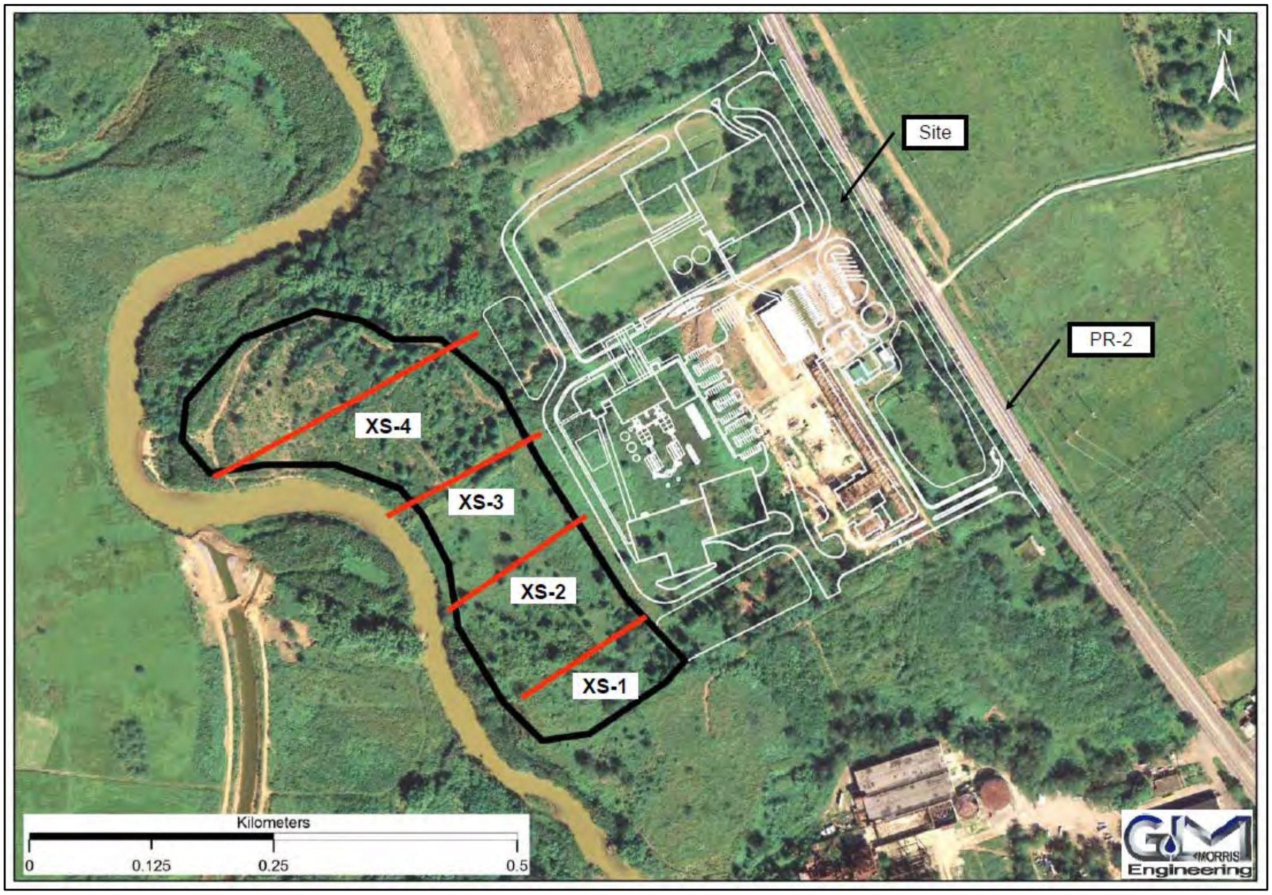
Source: FEMA (2015), NRCS (2014), digitized by Louis Berger

Figure 3-5. FEMA Flood Insurance Rate Map, Panel 230J



Source: GLM (2010)

Figure 3-6. Proposed 100-year Floodway Limit and Cross Sections



Source: GLM (2010)

Figure 3-7. Proposed Bank Modification Site

U.S. Geological Survey Study

USGS assessed peak discharges and flood levels for the Project in a study using a flood event that occurred in the lower Río Grande de Arecibo Basin as a result of the passing of Hurricane Georges in September 1998. USGS computed peak discharge over the spillways at the Caonillas and Dos Bocas Dams using recorded flood stage data and the theoretical spillway discharge rate curve for each reservoir (GLM 2010). **Table 3-10** shows the peak discharge calculated by USGS for the September 1998 event.

Table 3-10. Peak Discharge Calculated by USGS for Hurricane Georges (September 1998)

Location	Drainage Area mi² (km²)	Peak Discharge cfs (cms)
Río Grande de Arecibo at the Dos Bocas Dam	440 (170)	115,126 (3,260)
50027750 Río Grande de Arecibo above Arecibo[a]	450 (175)	117,598 (3,330)
50028400 Río Tanama at Charco Hondo	150 (58)	27,475 (78)

Source: GLM (2010)

[a] Does not include discharge from Río Tanama

U.S. Army Corps of Engineers Study

USACE prepared a hydrologic-hydraulic study of the lower Río Grande de Arecibo Basin in July 1993. The study analyzed the proposed flood control project for the Río Grande de Arecibo and two of its tributaries (GLM 2010). The control project consists of approximately 2.8 miles (4.5 kilometers) of levee and floodwalls around the eastern and southern boundaries of the town of Arecibo, 1.8 miles (2.9 kilometers) of a trapezoidal earthen channel to divert flow from the upper Río Santiago Basin into the Río Grande de Arecibo floodplain, downstream of Highway PR-22, and 0.7 mile (1.1 kilometers) of levee north of Río Tanama, immediately upstream of PR-10 (GLM 2010). The USACE study determined peak discharge along Río Grande de Arecibo based on Log-Pearson III and HEC-1 flood frequency analyses performed with data from the USGS gage 50029000, *Río Grande de Arecibo at Central Cambalache*, combined with peak data from gage 50027750, *Río Grande de Arecibo Abv Arecibo*. **Table 3-11** presents the discharges calculated by USACE.

Table 3-11. USACE Peak Discharge at Río Grande de Arecibo and Río Tanama

Location	Area mi² (km)²	100-year Peak Discharge (cfs [cms])	
		Log-Pearson III	HEC-1
50028400 Río Tanama at Charco Hondo	58 (150)	N/A	23,308 (660)
50027750 Río Grande de Arecibo above Arecibo[a]	175 (450)	N/A	156,338 (4,427)
50029000 Río Grande de Arecibo at Central Cambalache[b]	200 (518)	141,259 (4,000)	171,982 (4,870)

Source: GLM (2010)

[a] Does not include discharge from Río Tanama.

[b] Gage closest to project site.

For the FEMA Flood Insurance Study, the highest, most conservative, peak discharge was used. **Table 3-12** presents the peak discharge used to determine the base flood elevation at the Project.

Table 3-12. FEMA Flood Insurance Study 100-Year Peak Discharge at Río Grande de Arecibo

Location	Drainage Area mi^2 (km^2)	Peak Discharge (cfs)
Confluence with Río Tanama	188 ()	200,587 ()

Source: GLM (2010)

Historical Floods

A 1986 USGS report on the water resources of the lower Río Grande de Arecibo alluvial valley determined that major historical flooding events inundated the lower alluvial valley to an average flood level of 4 feet (1.2 meters) msl (Quinones-Aponte 1986). The report indicates that overbank flows occurred whenever the instantaneous discharge of the Río Grande de Arecibo exceeded 17,000 cfs (481 cms) at USGS gage 50029000, *Río Grande de Arecibo at Central Cambalache* (Quinones-Aponte 1986). **Table 3-13** shows the peak streamflow at USGS gage 50029000 for the period of 1997–2014. The 17,000 cfs (481 cms) events for water years 1998 and 1999 were a result of Hurricane Georges. **Figure 3-8**, a USGS historical flood atlas, shows the flooding caused by Hurricane Georges. Flood water levels in the plant site ranged from 17 to 24 feet (5.2 to 7.3 meters) above msl.

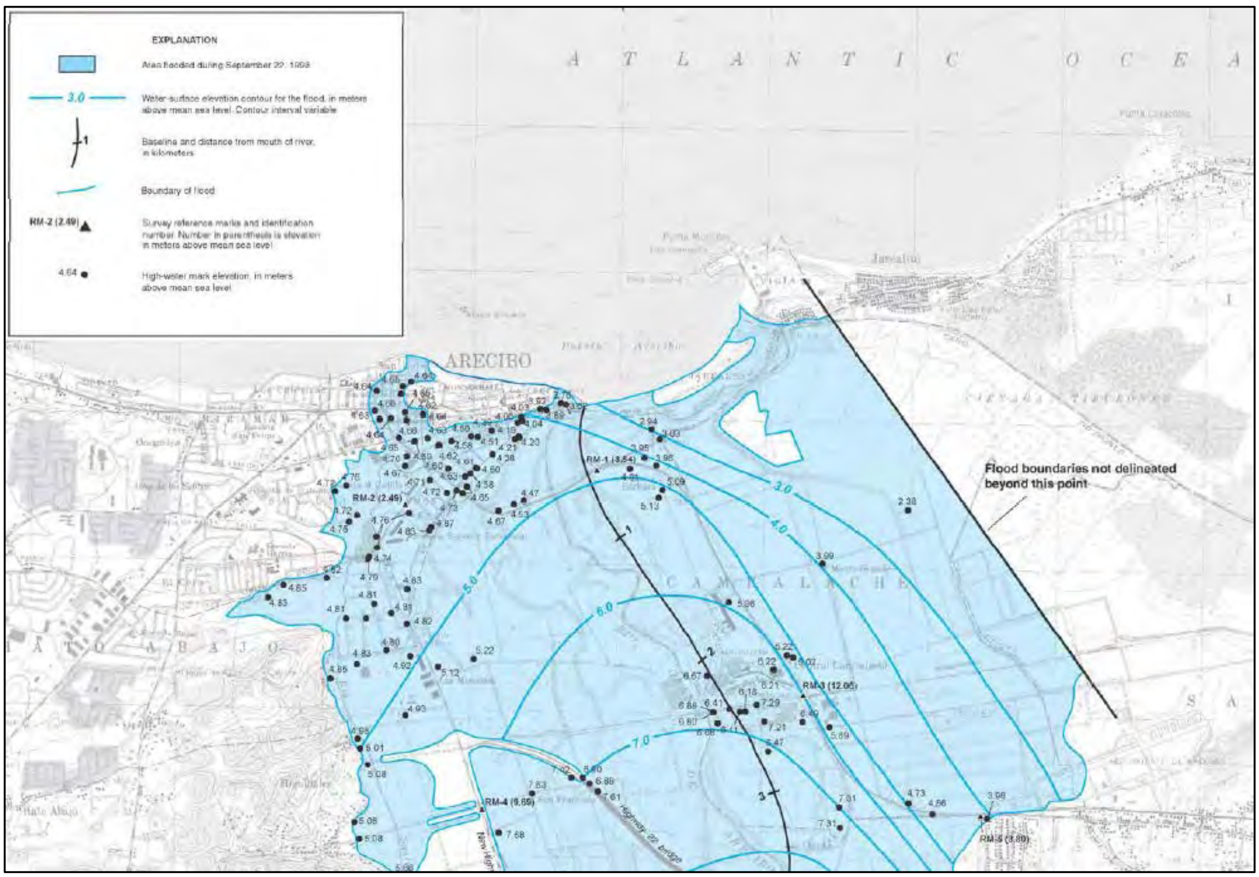
Table 3-13. Peak Streamflow (Instantaneous) for USGS gage 50029000, Río Grande de Arecibo at Central Cambalache (1997–2014)

Water Year	Date	Streamflow (cfs)	Streamflow (cms)
1997	January 22, 1997	5,750	163
1998	September 22,1998	17,000[a]	481[a]
1999	October 28, 1998	17,000[a]	481[a]
2000	October 31,1999	7,870	223
2001	May 7, 2001	5,000	141
2002	November 8, 2001	10,300	292
2003	May 21, 2003	1,860	53
2004	November 14, 2003	12,800	362
2005	November 14, 2004	11,700	331
2006	October 11, 2005	17,000	481
2007	November 28, 2006	2,770	64
2008	December 11, 2007	17,000	481
2009	September 18, 2009	2,110	60

Water Year	Date	Streamflow (cfs)	Streamflow (cms)
2010	August 31, 2010	6,160	174
2011	August 23, 2011	17,000	481
2012	March 29, 2012	15,600	441
2013	October 26, 2012	6,430	182
2014	August 24, 2014	11,500	326

Source: USGS (2015e)

[a] Discharge actually greater than indicated value.



Source: GLM (2010)

Figure 3-8. Area Inundated as a Result of Hurricane Georges

Energy Answers-Prepared Studies

Based on the FEMA Flood Insurance Study, and the USGS and USACE studies, Energy Answers prepared a duplicate effective/existing condition model (DE/EC) to simulate the FEMA 100-year flow presented in **Table 3-12**, and match the FEMA effective flood profile. The model was run for the 10-, 50-, 100-, and 500-year events (GLM 2010). The model included the Río Santiago diversion channel that was dug for the USACE flood control project.

In addition to the DE/EC model, Energy Answers prepared a floodway encroachment/proposed condition model (FE/PC) for the 100-year event to simulate regulatory limits, plus new floodway limits surrounding the Project site, based on the DE/EC model. This model included the proposed river bank modification between the Project's developed areas and the Río Grande de Arecibo channel, which would provide additional hydraulic conveyance capacity and compensate for the proposed encroachment around the plant (GLM 2010).

Both models were calibrated to match the FEMA effective 100-year water levels based on the calculated peak discharge. The DE/EC model was used to determine base flood elevations for the Project for the 10-, 50-, 100-, and 500-year flood levels (GLM 2010). **Table 3-14** provides the 100-year flood levels above msl calculated by FEMA, the DE/EC model, and the FE/PC model, which included the proposed river bank modification.

Table 3-14. 100-Year Flood Levels for the Project Site

FEMA Cross Section	Distance Upstream from River Mouth miles (kilometers)	FEMA	DE Model	EC Model	Prop Model	Floodway Model
D (site)	1.3 (2.1)	17.06 (5.2)	17.09 (5.21)	17.13 (5.22)	17.29 (5.27)	17.26 (5.26)

Source: GLM (2010)
Note: 100-year flood levels are presented as meters about msl.

3.2.2 Effects Analysis

To determine whether the Project would have the potential to result in significant impacts to water resources, it is necessary to consider both the duration and the intensity of the impacts. Impacts on surface waters would occur during both construction and operation of the project and would likely be temporary. Impacts on groundwater during the operational phase of the Project as a result of spills and other potential pollutant releases from liquid storage tanks (e.g., diesel, ammonia) could occur. The potential impact of any spill and infiltration to groundwater would likely be short in duration, but moderate in intensity.

This section discusses the potential effects of the Project on the various water resources throughout the Project. Definitions for duration and intensity of water resources impacts established for this Project are described in **Table 3-15**.

Table 3-15. Water Resources Impacts Context and Intensity Definitions

Water Resources			
Context (Duration)	**Low Intensity**	**Moderate Intensity**	**High Intensity**
Short term: During construction period Long term: Life of the Project (50 years or more)	The effect on surface and ground waters would be measurable or perceptible but small and localized. The effect would not alter the physical or chemical characteristics of the surface water or aquatic influence zone resource.	The effect on surface and ground waters would be measurable or perceptible and could alter the physical or chemical characteristics of the surface and ground water resources to an extent requiring mitigation but not to large areas. The functions typically provided by the water or aquatic influence zone would not be substantially altered.	The impact would cause a measurable effect on surface and ground waters and would modify physical or chemical characteristics of the surface and ground water. The impact would be substantial and highly noticeable. The character of the water or aquatic influence zone would be changed so that the functions typically provided by the water or aquatic influence zone would be substantially altered.
Flooding			
Short term: During construction period Long term: Life of the Project (50 years or more)	Impacts would result in a detectable change to natural and beneficial floodplain values, but the change would be expected to be small, of little consequence, and localized. No appreciable increased risk of flood loss would occur, including impacts on human safety, health, and welfare.	Impacts would result in a change to natural and beneficial floodplain values that would be readily detectable and relatively localized. Location of operations in floodplains could increase risk of flood loss, including impacts on human safety, health, and welfare.	Impacts would result in a change to natural and beneficial floodplain values that would have substantial consequences on a regional scale. Location of operations would increase risk of flood loss including impacts on human safety, health, and welfare.

Floodplain conversion alternatives analysis as required by Executive Order 11988, was conducted prior to the final Project site selection. Executive Order 11988 requires federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of floodplains, and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Amended by Executive Order 13690 on January 30, 2015, Executive Order 11988 defines floodplains in three different ways: using the best available climate model information, adding 2 feet to the mapped 100-year flood elevations, or using the floodplain area subject to flooding by the 0.2 percent annual chance flood. This final condition applies to the proposed plant area because it would be in an area that would be subject to the 0.2 percent annual flood; however, following construction the site would be raised to a level that is outside of the 0.2 percent annual flood area.

As discussed in Section 2.1.1 of this document, Energy Answers conducted a comprehensive site selection process that considered and evaluated 33 potential site locations. Due to the Commonwealth's topography, a substantial portion of these sites were located at the confluences of the coastal plains and river valleys that are frequently subject to flooding and may contain wetlands. Therefore, Energy Answers' exclusion analysis did not include flood zones as exclusion criteria because development in these zones would be feasible when regulatory rules are incorporated into project design. During the comparative assessment, alternative sites located in a flood-prone area were considered less desirable and accordingly given a negative score for that particular criterion. Even though the proposed site (Central Cambalache Sugar Mill, including the Global Fibers Paper Mill site in Arecibo), received a negative score for being located in a flood-prone area, it received a higher overall score due to other factors such as proximity to similar land uses, current site conditions (i.e., previously developed industrial site), and lack of nearby residences. It was the only site of the final six carried forward in the comparative assessment that received a high suitability value.

Project designers initially proposed to avoid and/or minimize the conversion of floodplains and wetlands on the plant site by building a perimeter earthen dike system. However, Energy Answers decided to shift away from a dike system and to elevate the proposed site because of the need to conform to Section 65.10 of the National Flood Insurance Plan. This plan requires that all freeboard requirements be met and that a levee must tie into natural high ground at a minimum of 3 feet (0.9 meter) above the base flood elevation. Given that the entire proposed plant site is below the base flood elevation, FEMA recommended that the entire area be protected from flooding by elevating it to a level above the base flood elevation. To achieve this requirement, additional fill material must be brought on the plant site to raise the ground elevation to a height of 21 feet (6.3 meters) above msl.

Based on these factors and RUS's review of the proposed Project need, RUS determined that there is a demonstrated need for the Project and that there are no practicable alternatives to avoiding the conversion of floodplains. Energy Answers would be required to implement mitigation for the conversion of these resources. Such mitigation would be performed in accordance with the requirements of the Section 404 permit and a Conditional Letter of Map Revision for this Project.

3.2.2.1 Construction

Surface Water

The Project would be constructed in the existing floodplain of the Río Grande de Arecibo. Plant construction would include excavating a portion of the Río Grande de Arecibo floodplain located west of the Project site to increase floodway capacity. Excavation and land-clearing activities associated with construction of the Project have the potential to contribute to sedimentation and the release of pollutants into nearby surface waters. Energy Answers proposes to incorporate preventive measures outlined in the Project's Soil Erosion Control Plan to prevent impacts on the Río Grande de Arecibo and surface water quality.

Adverse impacts on the Río Grande de Arecibo resulting from the construction of the Project would be short-term and moderate as a result of the removal of existing soil material within the floodway of the Río Grande de Arecibo. Construction of the Project would not result in a significant impact on the flow regime pattern of the Río Grande de Arecibo, because the proposed excavation would not alter the hydraulic section of the Río Grande de Arecibo channel. During construction, best management practices, including silt fences, sediment traps, and other procedures would be used to prevent erosion and the introduction of sediment into the river system.

Water quality impacts related to increased stormwater runoff would be mitigated through the construction of two retention ponds located in the northwest and southwest corners of the Project site. Hydraulic modeling of the site would determine the dimensions of the ponds needed to limit the proposed post-construction peak discharge at the plant site.

Long-term impacts on the Project site would include filling 2.42 acres (0.9 hectare) of wetlands to flood-proof the Project site to a height of 21 feet (6.3 meters) msl. The affected wetlands consist of 1.48 acres (0.6 hectare) of man-made stormwater collection canals and a 0.94 acre (0.3 hectare) overflow area associated with the northernmost canal. Wetland mitigation efforts proposed for an area contiguous to the plant site are discussed in Section 3.4.2.1, *Biological Resources*.

Groundwater

There would be little to no impact on local groundwater resources during construction of the Project. Groundwater would not be used as a source of water for construction-related practices. Construction activities would result in soil compaction and a related decrease in soil permeability and the reduction in infiltration area around the plant. However, the anticipated soil compaction would have a small effect on the underlying large aquifer (600 square miles [1,554 square kilometers]). Impacts related to soil impermeability and a reduction in infiltration area would be confined to the plant site itself and would not extend beyond the plant footprint and its immediate vicinity.

Impacts on groundwater quality would be mitigated by measures presented in the Project's Spill Prevention Plan. Fuel and oil that would be used during construction would be placed in areas designed for storage and would be protected by secondary containment systems. Impacts related to potential chemical spills could adversely affect groundwater resources at the plant site and groundwater resources extending beyond the Project footprint.

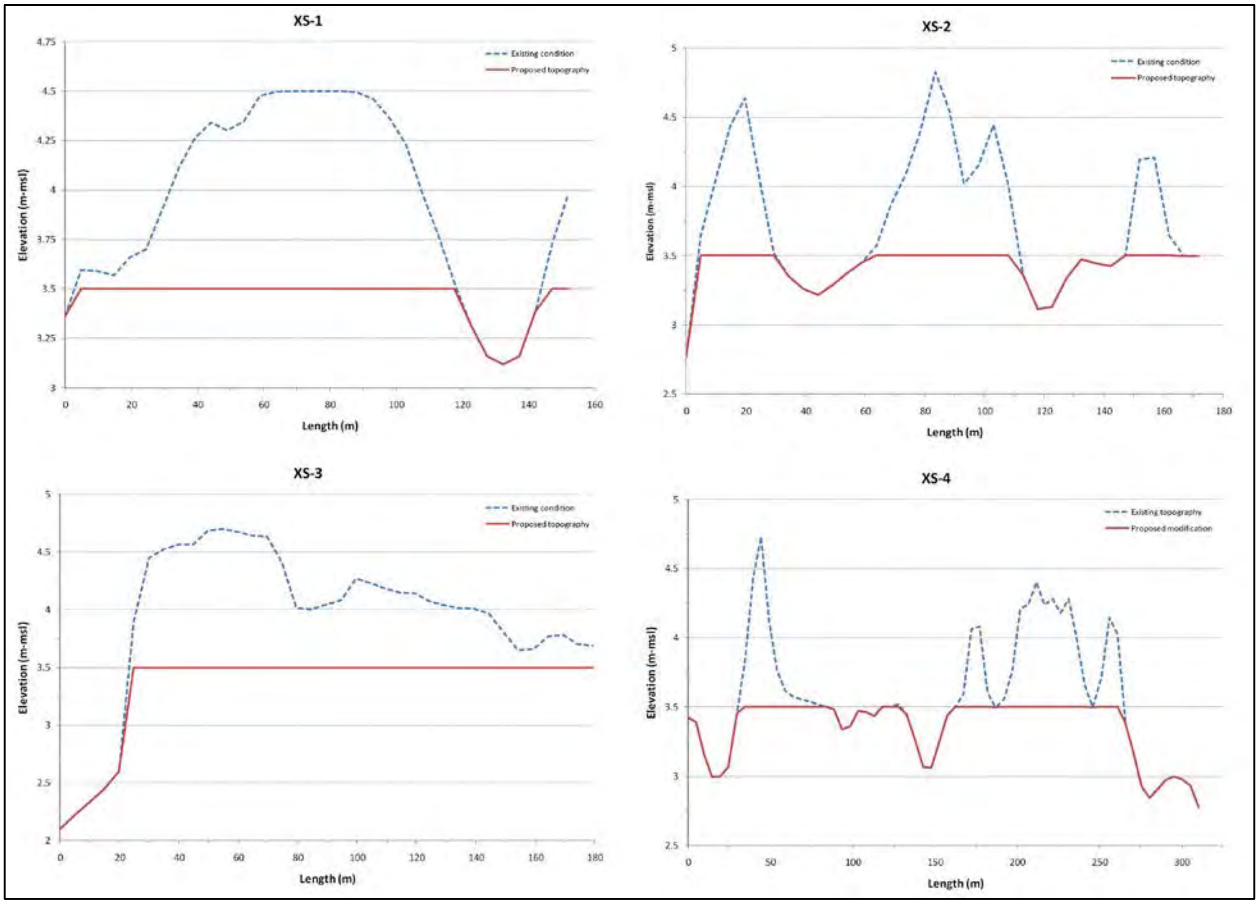
Water Infrastructure

Construction of the Project would require an estimated 6,500 gallons per day (gpd) of potable water. Energy Answers proposes to receive potable water via the Vazquez WTP located approximately 4.8 miles (7.7 kilometers) southeast of the Project site. Water would be supplied to the Project through the existing 12-inch service line along PR-2 east of the Project. The Vazquez WTP has a water supply capacity of 100 mgd; therefore, no adverse impacts on existing drinking water infrastructure are expected.

Flooding

Effects on the Floodplain—To protect the facility from flooding and to minimize any changes to the floodway, Energy Answers proposes to excavate higher ground on the floodplain between the plant and the river channel to provide additional hydraulic conveyance capacity during floods. As a result, plant construction would involve modifying the existing drainage canals and basins to open more floodway, and raising the footprint elevation of the plant so that it is above the 100-year floodplain. The plant would be flood-proofed as part of the initial construction of the Project. The nominal finished floor elevation of the plant buildings would be approximately 21 feet (6.3 meters) above msl. Elevations within the floodplain area proposed to be modified would be lowered to a maximum 11.5 feet (3.5 meters) msl, while areas that are already lower than 11.5 feet (3.5 meters) would not be altered. **Figure 3-9** shows the proposed geometry of bank modification for the effected floodplain area. Although Project construction would not alter the current floodway limits beyond acceptable FEMA regulation standards, the Project would still be located in an area susceptible to large flooding events. Given the expected operational lifetime of the Project (30 or more years), there is a chance the facility would experience a significant flood inducing event (e.g., a hurricane). However, the design elevation places the facility above both the 100-year and 500-year flood elevations, minimizing the risk of a major flooding event affecting the Project

Effects on Existing Structure—In a letter dated September 19, 2011, FEMA stated that base flood elevations would increase as a result of the Project. Section 65.12 of the National Flood Insurance Program requires that individual legal notices be sent to all property owners affected by the proposed increases in base flood elevations and that no structures are located in areas impacted by the increased base flood elevations. Landowner notifications were sent on December 5, 2011.



Source: GLM (2010)

Figure 3-9. Proposed Geometry of Bank Modification Area

Project construction would result in an increase in base flood elevations along predominately undeveloped properties located east and west, as well as immediately upstream, of the Project site. As seen in **Figure 3-6**, the existing structures located along FEMA cross section "E" would not be subject to base flood elevation increases. Several structures located within the immediate plant area and a nearby off-site area would fall within the area of base flood elevation increase. **Figure 3-10** shows the structures that would be impacted by the increase in base flood elevation.

Structures

To satisfy Puerto Rico Planning Board (Regulation #13 – Regulations for Special Flood Areas Section 7.01(d)(4)) and Environmental Quality Board (Rule 531[P]) regulations, the plant must be designed so that the elevation of the lowest floor is up to or above the base flood elevation and that non-hazardous solid waste cannot be stored in the floodplain. In addition, the proposed Project must be consistent with FEMA flood insurance rate maps, which would need to be revised to account for the proposed elevation changes. The map revision process requires Energy Answers to model the potential changes in flood elevations within the floodway caused by elevating the plant site and altering the floodway. Removal of structures that potentially could be affected by the changes in flood elevations, and certification that the structures were removed by a professional engineer are required before the Puerto Rico Planning Board and FEMA, respectively, would approve the proposed Project and make the required map revisions. To ensure the properties affected by the increase in the base flood elevation meet the Puerto Rico Planning Board regulations and as a requirement by FEMA to approve the Conditional Letter of Map Revision, Energy Answers has agreed to demolish or move the affected structures. The structures identified east of the Project site were primarily used for agricultural purposes, including ancillary support structures for a commercial hydroponic farm.

A topographic survey performed for the off-site location determined the elevation at the property to be 9.8 feet (3 meters) msl. Energy Answers hydraulic modeling indicates the maximum base flood elevation increase at the structures due to modifications at the plant site is 0.22 feet (0.07 meter). **Table 3-16** lists the structures that were found at the off-site location and the current status of each. In a letter dated November 1, 2012, Interlink Construction (Ponte 2012) provided the scope of work and status of each facility. Structures #1, #3, #5, and #6 were approved for demolition; structure #2 would be relocated elsewhere within the off-site area, and structure #4 would be removed from the site.

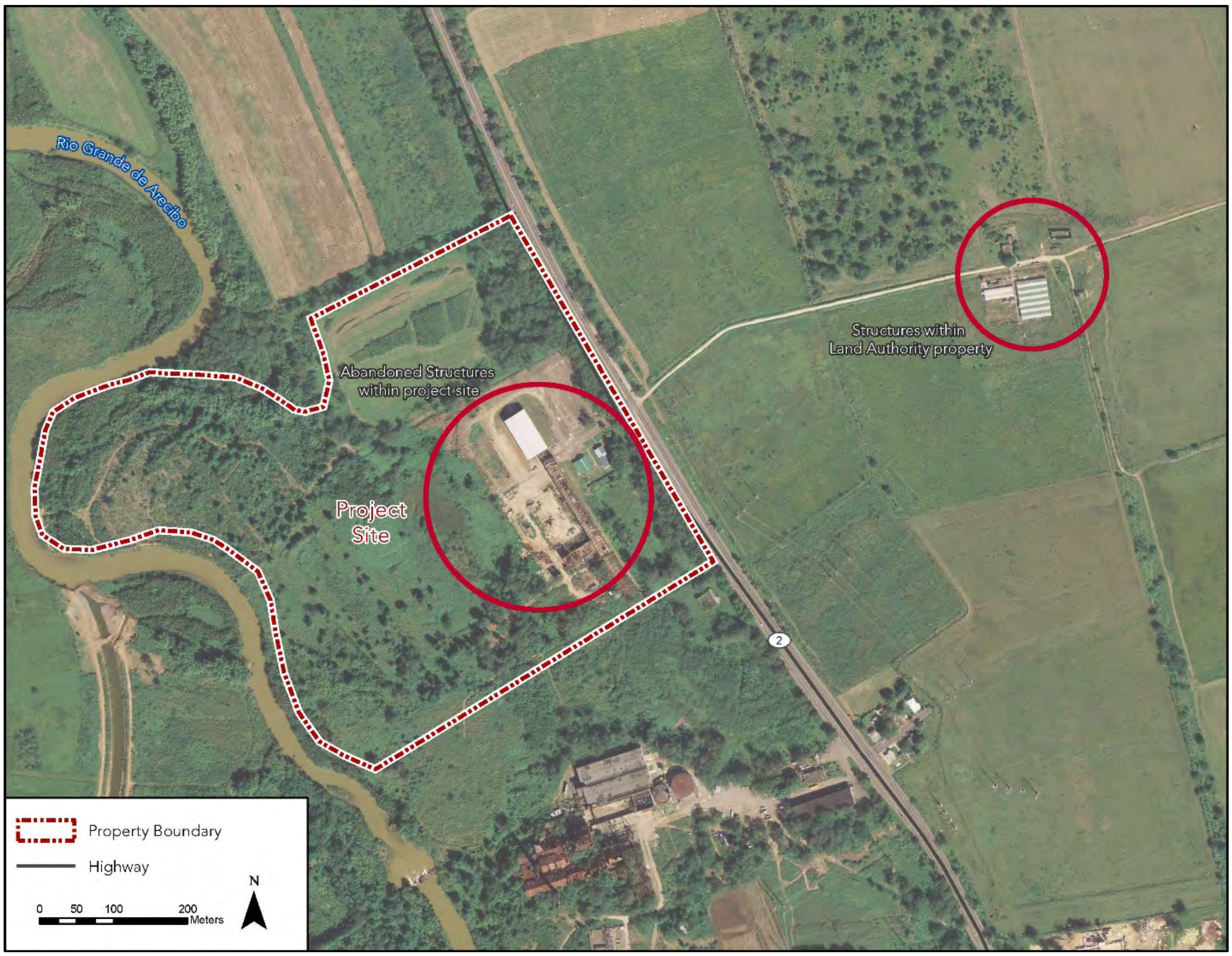
Table 3-16. Off-site Structures Identified for Demolition or Relocation

Building Number	Building Name	Demolished	Relocated	Presence of Lead	Presence of Asbestos
1	Packing and storage building (hydroponic garden	Yes		No	No
2	Storage trailer		Yes		
3	Office and bathroom building	Yes		No	No
4	Water tanks (2)		Yes		
5	Abandoned Farm structure	Yes		No	No
6	Residential structure	Yes		Yes	No

Source: Ponte (2012)

At the Project site, existing structures include former Global Fibers Paper Mill buildings. According to the topographic survey, the ground elevation around the buildings is 14.7 feet (4.5 meters) msl. The maximum base flood elevation increase at these structures is 0.98 feet (0.30 meters). **Figure 3-10** shows the location of the existing buildings, including three main concrete and structural steel industrial structures and two concrete and structural steel office/storage structures. A meeting minutes document dated February 28, 2012, from the Risk

Assessment, Mapping, and Planning Partners includes a description of an action plan to demolish, raise, or flood-proof the structures impacted by the increases in base flood elevations due to the Project (Hannan 2012). For the on-site structures, one of the main industrial structures and both of the office/storage structures would be demolished prior to Project construction. The two remaining buildings would be flood-proofed in accordance with the regulations (44 CFR 60.3). Once the action plan is in place and implemented, a professional engineer would be able to certify that no structures are located in areas impacted by the increase in base flood elevations in accordance with Section 65.12 of the National Flood Insurance Program regulations.



Source: NRCS (2014)

Figure 3-10. Existing Structures Located within Area of Base Flood Elevation Increase

3.2.2.2 Operation

Surface Water

During the operational lifetime of the Project, there would be short-term, moderate impacts on surface water quantity and quality. Best management practices would be implemented to minimize impacts of stormwater discharge into the Río Grande de Arecibo. The installation of grease traps, rip-rap, and settlement ponds in the stormwater system, would mitigate the majority of adverse effects. With proper maintenance of these stormwater best management practices and the development of an inspection plan schedule prior to and after precipitation events, the Project would have little to no impact to surface waters throughout its operational lifetime. The Project would not generate direct discharges of pollutants to the Río Grande de Arecibo or other surface waters. The sanitary and sewage systems for the plant would be connected to the existing sanitary line located along PR-2.

The plant would require about 2.1 mgd of water for all of its processing needs. This demand includes about 2.0 mgd of non-potable water for process and cooling water. As discussed previously, the 2.0 mgd for Project operational processes would be obtained from the existing Caño Tiburones Natural Reserve discharge via the existing El Vigía Pumping Station. To manage water levels in the Caño Tiburones wetland and to protect regional farms and roadways from flooding, brackish water is being pumped from Caño Tiburones to the Atlantic Ocean via the El Vigía Pumping Station. In addition to this pumping operation, brackish water exits the Caño Tiburones Natural Reserve via gravity flow twice daily at low tides through the El Vigía Pumping Station. The pump station is operated by PRDNER and has a daily brackish water pumping rate that varies from year to year, but that historically has pumped approximately between 30 to 100 mgd. The proposed use would involve diverting about 2.0 mgd of the existing 30 to 100 mgd discharge (approximately 2 to 7 percent) and diverting it from the estuary that empties into Arecibo Harbor approximately 3,500 feet (1,000 meters) downstream of the El Vigía Pumping Station. The resulting minor reduction in flow would pose little to no impact on the existing condition of the estuary downstream of the El Vigía Pumping Station.

Initial estimates placed the potable water demand for the operation of the Project at 10,000 gpd. In a November 29, 2012, letter and by acceptance from PRASA, the demand for potable water for Project operations was increased to 100,000 gpd. This increase in demand is anticipated to have little to no impact on surface water.

Groundwater

During the operational lifetime of the Project, there could be minor impacts on local groundwater resources. During normal operations, there would be no effect on groundwater because groundwater extraction would not be used to supply the normal water needs of the Project for any of its operational procedures. If groundwater were to be used for backup or emergency purposes, the impacts to the groundwater would be long term in duration and moderate in intensity. There is the potential to pollute groundwater resources in the Project area via chemical spills; however, if this were to occur, adverse effects on groundwater would be prevented or limited by the implementation of measures presented in Energy Answers' Spill Prevention Plan and proposed stormwater best management practices.

Water Infrastructure

Operation of the Project would require an estimated 100,000 gpd of potable water for boiler makeup and sanitary use. No adverse impacts on the existing drinking water infrastructure are expected.

Non-potable water supplies would be supplied from the brackish water that is discharged into the Atlantic Ocean from the El Vigía Pumping Station at Caño Tiburones. The Project is not anticipated to have an impact on the existing non-potable water infrastructure.

Energy Answer's proposal to discharge 800,000 gpd of wastewater during the operation of the Project would have little impact on local wastewater infrastructure. The Arecibo Regional Wastewater Treatment Plant is located 2 miles (3.2 kilometers) northeast of Project, and has a 10 mgd capacity and an average flow of 4.3 mgd. The effluent from the wastewater treatment plant is discharged into the Atlantic Ocean. PRASA indicated, by letter dated November 29, 2012, that there would be enough capacity in the 48-inch trunk sewer line and at the wastewater treatment plant to serve the Project. PRASA's approval for the Project is conditional on Energy Answers preparing a plan for treating the discharge in accordance with the wastewater treatment plant's industrial pretreatment program requirements.

Flooding

The flood levels caused by Hurricane Georges represent an outlier in terms of typical streamflow expected at the Project. Although there were other storm events in 2005, 2007, and 2011 that led to instantaneous flows in excess of 17,000 cfs (481 cms), the monthly average of flows near the plant site for all years fall below the 17,000 cfs (481 cms) mark. Energy Answers should establish flood management measures in the event of other extreme events similar to the flooding the plant site experienced as a result of Hurricane Georges. Energy Answers' proposal to excavate higher ground as shown in **Figure 3-7** and to construct the facility at a base elevation of 121 feet (6.3 meters) msl would provide the necessary hydraulic conveyance capacity and flood protection for the 100 year flood level the Project site may experience.

3.3 AIR QUALITY

3.3.1 Affected Environment

3.3.1.1 Regulatory Framework

The Clean Air Act (CAA) and its amendments led to the creation of National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants: CO, SO_2, ozone, particulate matter (PM), nitrogen dioxide (NO_2), and lead. There are two types of NAAQS—primary standards and secondary standards. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly, with an adequate margin of safety. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings (EPA 2014a).

Table 3-17 summarizes the primary and secondary NAAQS for the criteria pollutants. The six criteria pollutants are briefly described below.

- **Carbon monoxide**—CO is a colorless, odorless gas emitted from combustion processes, including engine exhaust. Elevated CO concentrations can cause adverse health impacts by reducing oxygen delivery to vital organs. Very high concentrations can cause death (EPA 2014b). CO is most commonly a consideration in the evaluation of congested signalized intersections with high traffic volumes.
- **Lead**—Lead is a toxic heavy metal that can have numerous adverse health impacts, including neurological damage to children and cardiovascular effects in adults (EPA 2014c). Lead emissions can contribute to exposure through the air directly or indirectly by causing soil/water contamination. Prior to the phase out of leaded gasoline, automobiles were a source of lead emissions. According to EPA, the major sources of lead emissions in the air today are ore and metals processing and piston-engine aircraft operating on leaded aviation gasoline (EPA 2014c).
- **Nitrogen dioxide**—NO_2 is one of a group of reactive gases called nitrogen oxides or NO_x. NO_2 forms small particles that penetrate deep in the lungs and can cause or worsen existing respiratory system problems such as asthma, emphysema, or bronchitis. NO_2 emission sources include automobiles and trucks, construction equipment, and industrial sources, among others. NO_x are also a precursor to the formation of ozone (EPA 2014g).
- **Ozone**—Ground-level ozone is an important component of smog and is formed through reactions of NO_x and VOCs in the presence of sunlight. Sources of NO_x and volatile organic compound emissions include both mobile and stationary sources. Health effects of ozone exposure include respiratory irritation, reduced lung function, and worsening of diseases such as asthma. People with lung disease, children, older adults, and people who are active outdoors may be particularly sensitive to ozone. Elevated ozone can also impact sensitive vegetation (EPA 2014h). Ozone formation is a regional air quality concern; therefore, the potential impacts in terms of ozone formation are addressed by quantifying the contribution of the Project to precursor emissions rather than predicting project-specific ozone concentrations.
- **Particulate matter**—PM is a broad class of air pollutants that exist as liquid droplets or solids, with a wide range of size and chemical composition. Smaller particulates that are smaller than or equal to 10 and 2.5 microns in size (PM_{10} and $PM_{2.5}$) are of particular health concern because they can get deep into the lungs and affect respiratory and heart function. Particulates can also impact visibility; damage soil, plants, and water quality; and stain stone materials (EPA 2014i). PM emission sources include heavy-duty trucks

and other equipment with diesel engines, industrial sources, and fugitive dust from unpaved roads and construction sites.

- **Sulfur dioxide**—SO_2 is part of a group of reactive gases called oxides of sulfur. Health effects of SO_2 exposure include adverse respiratory effects, such as increased asthma symptoms (EPA 2015e). The largest sources of SO_2 emissions are from fossil fuel combustion at power plants/industrial facilities, electrical utilities, and residential/commercial boilers. Mobile sources are not a significant source of SO_2 emissions (EPA 2008).

Table 3-17. National Ambient Air Quality Standards

Pollutant	Primary / Secondary		Averaging Time	Level	Form
CO	primary		8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead	primary and secondary		Rolling 3-month average	0.15 μg/m^3	Not to be exceeded
NO_2	primary		1-hour	100 ppb	98th percentile, averaged over 3 years
	primary and secondary		Annual	53 ppb	Annual mean
Ozone	primary and secondary		8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
PM	$PM_{2.5}$	primary	Annual	12 μg/m^3	Annual mean, averaged over 3 years
		secondary	Annual	15 μg/m^3	Annual mean, averaged over 3 years
		primary and secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2	primary		1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

Pollutant	Primary / Secondary	Averaging Time	Level	Form
	secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: NAAQS (2014)

Notes: CO – carbon monoxide, NO_2 – nitrogen dioxide, PM – particulate matter, ppb – parts per billion, ppm – parts per million, SO_2 – sulfur dioxide, µg/m^3 – microns per cubic meter

3.3.1.2 Attainment Status

Areas that do not meet NAAQS are classified as nonattainment areas for that pollutant. Areas that have never been designated nonattainment for a pollutant and NAAQS are considered attainment areas. State implementation plans are designed to bring nonattainment areas into compliance with the NAAQS, including the establishment of emissions "budgets" or the maximum emissions allowed for different source categories to ensure the air quality standards would be met. Former nonattainment areas currently meeting the NAAQS are designated maintenance areas and must have maintenance plans for 20 years.

The Project is located in an attainment are for all criteria pollutants except for lead. A portion of Arecibo, the area within a 2.5-mile (4-kilometer) radius of the Battery Recycling Company facility, is designated a nonattainment area for lead (EPA 2015f). The Battery Recycling Company, which is located 0.75 mile (1.2 kilometers) from the Project site, was found to be in violation of federal hazardous materials management requirements and entered into an agreement to take corrective measures in 2012 (EPA 2012a). The corrective measures include completely enclosing the lead recycling processing areas, installing new dust collection systems, and washing trucks and pavement to reduce the spread of lead dust into the environment. Air quality monitoring data for 2013 and 2014 appear to show these control measures have substantially reduced ambient lead concentrations compared to 2012 levels (see **Table 3-18**), and the area may potentially be redesignated to "maintenance" in the future if the current trend continues.

3.3.1.3 General Conformity

Section 176(c) of the CAA (42 USC §7506[c]) requires federal agencies that license, permit, or approve any activity to demonstrate that the action conforms to the applicable state implementation plan before the action is approved. In this context, "conformity" requires that federal actions be consistent with the objective of state implementation plans to eliminate or reduce the severity and number of violations of NAAQS, and achieve expeditious attainment of those standards. EPA's general conformity regulations at 40 CFR, §93, Subpart B apply to federal activities except those covered under transportation conformity (40 CFR §93, Subpart A). General conformity regulations apply to a federal action in a nonattainment or maintenance area if the total of direct and indirect emissions of the relevant criteria pollutants and precursor pollutants caused by the federal action equal or exceed certain *de minimis* rates. If the action will cause emissions above the *de minimis* rates and the action is not otherwise exempt, "presumed to conform," or included in the existing emissions budget of the state implementation plan, the agency must conduct a conformity determination before it takes the action.

For this project, general conformity does not apply because major sources requiring a PSD permit are exempted (40 CFR §93.153[d][1]). Despite the non-applicability of general conformity, it should be noted that lead is the only pollutant for which the Project area is designated as nonattainment or maintenance, and the Project's proposed emissions of lead (0.31 ton per year) are well below the *de minimis* threshold for lead (25 tons per year).

3.3.1.4 Permitting Requirements

The New Source Review program, enacted by the U.S. Congress in 1977 as part of the CAA amendments, aims to preserve air quality in NAAQS attainment areas and achieve progress toward clean air in nonattainment areas. In attainment areas (including Arecibo at the time the permitting process began), the New Source Review program is implemented under the federal program known as PSD. Under the PSD program, major sources are required to install BACT to reduce emissions; perform an air quality analysis to demonstrate the source will not cause an exceedance of the NAAQS; conduct an analysis of impacts on soils, vegetation, and visibility; and provide an opportunity for public input during the permit review process (EPA 2014d).

In addition, the Project would be subject to the Standards of Performance for New Stationary Sources codified under Title 40 CFR §60, which specify the minimum performance requirements for certain new sources or modifications of existing sources. The plant also would be subject to National Emissions Standards for Hazardous Air Pollutants and therefore would be considered a major source under Section 112 of the CAA. Section 112 establishes standards to reduce hazardous air pollutant emissions based on control technology. The emission control system of the plant would meet the control level considered MACT (Energy Answers 2011a).

EQB Regulations for the Control of Atmospheric Pollution, Rules 201, 202, and 203 establish the local requirements for approval and construction permits for major stationary sources. Rule 201 describes the rules for granting location approval for a new major stationary source. Among the rules is a requirement to demonstrate that emissions from the new major stationary source will not cause any NAAQS to be exceeded. In addition, a public hearing is required for the location approval. The EQB permit application describes the operation of the new source, the emission control system, and the air quality impact analysis that demonstrates that the increase in allowable emissions from the proposed new major stationary source would not significantly cause or contribute to air pollution in violation of any NAAQS.

EQB Rules 401 to 417 set emission rules applicable to authorized stationary sources. To this end, Rule 403 states specific limitations for the emission of air pollutants with opacity greater than 20 percent in an average of 6 minutes. Rule 406 sets a limit to the emission of particulate matter in excess of 0.3 pound per million BTU. Rule 407 specifies an allowable emission rate of particulate matter from non-fuel burning equipment (e.g., silos, and conveyors) based on the total weight of the material to be processed. In general, it is anticipated that the emission limits established in the PSD are equal or more stringent than those permitted by Rules 403, 406, and 407. Thus, by complying with the PSD requirements, the Project also would be in compliance with EQB air quality standards.

3.3.1.5 Permitting History

The PSD application for the Project was submitted to EPA Region 2 in February 2011 (Energy Answers 2011a). In response to EPA comments, the PSD air quality modeling analysis was revised and refined several times and was finalized in October 2011. On May 9, 2012, EPA issued a preliminary determination to approve the PSD permit. A public review period of 105 days was provided and six public hearings were held between June 25, 2012, and August 27, 2012. EPA reviewed all the comments, prepared responses to those comments, and made changes to the draft permit, as appropriate. EPA issued the final PSD permit on June 11, 2013 (EPA 2013a). The permit decision was appealed administratively through EPA's Environmental Appeals Board. Except for a limited revision with respect to biogenic CO_2 emissions, the PSD permit decision was upheld by the Environmental Appeals Board. The final PSD permit became effective on April 10, 2014 (EPA 2014e). A Permit to Construct Application was submitted to EQB under Rule 201 and Rule 203 in August 2011 and the final EQB permit was issued in December 2014.

3.3.1.6 Local Meteorology

The annual average temperature in the zone of the Project site is 77.9ºF (25.5ºC) and normally only varies a few degrees from winter to summer (in part due to the temperature moderating influence of the ocean). The maximum and minimum average temperature in Arecibo fluctuates between 87.7ºF (30.9ºC) and 68.0ºF (20.0ºC). Arecibo received 53.01 inches (134.6 centimeters) of precipitation per year on average for the 30-year period from 1971 to 2000.

The winds in the Project area blow from the east in almost all months of the year with an average speed that varies from 6 to 9 miles per hour (9.7 to 14.5 kilometers per hour). An important characteristic of the coastal areas is the temporary adjustment of the eastern trade winds caused by the daily breeze from the land and the sea, which regularly form in the coastal perimeter of the island. The typical pattern is that during daytime hours the wind blows almost constantly from the ocean to the land and after sunset, the wind direction changes off the land—from the mountains to the sea.

3.3.1.7 Ambient Air Quality Monitoring Data (2012–2014)

Existing ambient air quality monitoring data (for 2012–2014, after Energy Answers applied for the PSD permit) for the criteria pollutants was obtained from EPA's AirData portal, which incorporates the monitoring data reported by EQB (EPA 2014f). Two lead monitoring stations are located near the battery recycling plant. For pollutants other than lead, no active ambient air quality monitors are located near the Project site or Arecibo. Therefore, **Table 3-18** includes the closest available regional monitors for the remaining criteria pollutants, the majority of which are located in and around the San Juan area. The available monitoring data provide a general context for understanding existing air quality conditions; however, they are not an official determination by EPA regarding whether or not the NAAQS were met at a specific monitor or whether or not the data were sufficient for EPA to make such a determination. It should be noted there are several limitations to the 2012–2014 data in terms of the number of measurements that affect the determination of completeness. For example, although the data showed improved lead concentrations in 2013 and 2014, the small number of measurements taken makes it impossible to attribute this improvement with certainty to changes in ambient concentrations or measurement bias, although the implementation of EPA corrective measures and reduced activity by the Battery Recycling Facility would seem to support this conclusion.

The available CO, NO_2, ozone, $PM_{2.5}$, and PM_{10} data show concentrations below the NAAQS. The lead NAAQS was exceeded once (three-month rolling average) in 2012, and the annual average in 2012 was nearly at the level of the three-month average NAAQS (0.15 micrograms per cubic meter [$\mu g/m^3$]). High SO_2 levels occurred in San Juan in 2013; however, this level may have been an anomaly due to substantially lower concentrations at the same monitor in 2012 and 2014.

Table 3-18. Existing Air Quality Monitoring Data, 2012–2014

Pollutant	Average Time	National Ambient Air Quality Standards	2012	2013	2014	Monitor Location
CO	8 hour	9 ppm	3.2 ppm	2.8 ppm	2.7 ppm	San Juan 72-127-0003
	1 hour	35 ppm	14.9 ppm	10.7 ppm	11.5ppm	
Lead*	Rolling 3-month average	0.15 µg/m3	1 exceedance 0.14 annual average	0 Exceedances 0.08 annual average	0 Exceedances 0.05 annual average	Project Area 72-013-0001
NO_2	1 hour	100 ppb	24 ppb (2007)	35.8 ppb (2012)	ND	San Juan 72-033-0008
	Annual	53 ppb	8.13 ppb (2007)	19.8 ppb (2012)	ND	
Ozone	8 hour	0.075 ppm	0.045 ppm (4th highest)	0.034 ppm (4th highest)	0.038 ppm (4th highest)	Juncos 72-077-0001
$PM_{2.5}$	Annual	12 µg/m^3	7.5 µg/m^3	6.6 µg/m^3	5.9 µg/m^3	San Juan 72-061-0005
	24 hour	35 µg/m^3	18.2 µg/m^3 (98th Percentile)	11.8 µg/m^3 (98th Percentile)	13.9 µg/m^3 (98th Percentile)	
PM_{10}	24 hour	150 µg/m^3	98 µg/m^3	74 µg/m^3	96 µg/m^3	San Juan 72-033-0004
SO_2	1 hour	75 ppb	35 ppb (99th Percentile)	89 ppb (99th Percentile)	26 ppb (99th Percentile)	San Juan 72-033-0004
	3 hour	500 ppb	35 ppb	107 ppb	16.6 ppb	

Source: EPA (2014f)

Note: *Lead monitoring data for 2013 and 2014 is based on a low number of valid measurements, below EPA criterion of 75 percent completeness. CO – carbon monoxide, NO_2 – nitrogen dioxide, PM – particulate matter, ppb – parts per billion, ppm – parts per million, SO_2 – sulfur dioxide, µg/m^3 – microns per cubic meter

3.3.1.8 Global Climate Change

Emissions of greenhouse gases such as CO_2, methane, nitrous oxide, and fluorinated gases contribute to global climate change (EPA 2015c). Earth's average temperature has risen by 1.4°F over the past century (EPA 2015c). Average global temperatures are expected to increase by 2°F to 11.5°F by 2100, depending on the level of future greenhouse gas emissions (National Research Council 2010). The global warming of the past 50 years is primarily due to human activities such as the burning of fossil fuels and deforestation (U.S. Global Change Research Program 2014). Islands such as Puerto Rico have particular vulnerability to climate change related impacts, including higher sea levels, more powerful tropical storms and hurricanes, and warmer, more acidic coastal waters (EPA 2015c).

In 2014, CEQ issued *Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts* (CEQ 2014). The draft guidance recommends NEPA documents consider both the impact of the changing climate on the project (such as changes in environmental resource conditions, increased flooding risk, more extreme temperatures, to the extent such information is available for the project area), and the impact of the project on greenhouse gas emissions. The draft guidance suggests 25,000 metric tons of CO_2-equivalent (CO_2e) per year as the level above which quantification of greenhouse gas emissions may be warranted. The draft guidance recommends considering mitigation measures to lower greenhouse gas emissions.

3.3.2 Effects Analysis

This section discusses potential impacts, their duration, and intensity on air quality and greenhouse gas emissions resulting from the construction and operation of the proposed Project, including the no-action alternative. Definitions for context and intensity are described in **Table 3-19**.

Table 3-19. Air Quality Impacts Contexts and Intensity Definitions

Air Quality			
Context (Duration)	**Low Intensity**	**Moderate Intensity**	**High Intensity**
Short term: During construction period Long term: Life of the Project (50 years)	The impact on air quality associated with emissions from the operation, maintenance and construction is measureable, but localized and small such that emissions do not exceed EPA's *de minimis* criteria for a general conformity analysis, or the EPA mandatory reporting	The impact on air quality would be measurable and primarily localized, but have the potential to result in regional impacts. Emissions of criteria pollutants associated with operation, maintenance and construction would be at the EPA's *de minimis* criteria levels for general conformity analysis and the EPA	The impact on air quality would be measurable on a local and regional scale. Emissions from operation, maintenance and construction are high, such that they would exceed EPA's *de minimis* criteria levels for a general conformity analysis and the EPA mandatory reporting threshold for greenhouse gas emissions.

Air Quality			
Context (Duration)	**Low Intensity**	**Moderate Intensity**	**High Intensity**
	threshold for greenhouse gas emissions.	mandatory reporting threshold for greenhouse gas emissions.	

3.3.2.1 Construction

Construction activities would result in temporary emissions of criteria pollutants through vehicle exhaust and fugitive dust. These emissions would be greatest during the early phases of construction when ground clearing and excavation activities are ongoing. For diesel construction trucks and equipment, the primary pollutants of concern are PM and NO_x. PM emissions (primarily PM_{10}) also would be generated from fugitive dust from exposed soil, unpaved roads, and increased traffic/soil loading on paved roads. The Project site would require 382,000 cubic meters of fill material, generating construction trips along PR-2, PR-10, Highway PR-22, PR-8861, and PR-861. The 2010 traffic study assumed this activity would generate 480 daily trips for an estimated time of 228 days. Construction activities would generally occur between 6:00 a.m. to 10:00 p.m. The trips that would be generated during the construction of the Project represent an increase of 1.59 to 2.73 percent in traffic volume on PR-2.

Ambient air quality near the construction site would decrease as a result of construction activity; however, concentrations of criteria pollutants exceeding the NAAQS are not anticipated at sensitive receptors because the nearest occupied area with receptors is 598 yards (547 meters) to the southeast (noise receptor R-4), and air quality construction mitigation measures would be employed as discussed below.

The following air quality mitigation measures would be implemented during construction.

- **Utilization of newer equipment**—Heavy duty diesel construction equipment greater than 50 horsepower would meet EPA Tier 2 or better emission standards. Older equipment greater than 100 horsepower would incorporate diesel particulate filters or other EPA-approved retrofit technology to reduce PM emissions (EPA 2015d).
- **Dust control**—Fugitive dust control plans would be required as part of contract specifications. For example, stabilized truck exit areas would be established for washing off the wheels of all trucks that exit the construction site. Tracking pads would be established at construction exits to prevent dirt from being tracked onto roadways. Any truck routes within the site would be either watered as needed or, in cases where such routes would remain in the same place for an extended duration, the routes would be stabilized, covered with gravel, or temporarily paved to avoid the re-suspension of dust. During dry weather, exposed soil areas (unpaved access roads, soil piles, staging areas)

would be watered once per day to control fugitive dust. All trucks hauling loose material would have their loads securely covered prior to leaving the construction sites. To minimize fugitive dust emissions, vehicles on site would be limited to a speed of 15 miles per hour.

- **Idling limits**—Idling times would be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes. Clear signage indicating idling limits would be provided for construction workers at all access points.

3.3.2.2 Operation

Overview of Emissions Sources and Control Measures

The main potential sources of emissions from the plant would consist of two combustion units (i.e., spreader-stoker boilers), ash management systems, an activated carbon storage silo, a lime storage silo, an emergency generator, a firefighting pump, a four-chamber cooling tower, and an ammonia storage tank.

The municipal combustion units would use processed refuse fuel as their primary fuel and would be capable of using supplemental fuel, when available, consisting of automotive shredder residue, tire-derived fuel, and processed urban wood waste. These supplemental fuels would replace a portion of the processed refuse fuel; however, they would be subject to the same emissions standards as set for processed refuse fuel combustion.

MSW would be received at the tipping floor of the storage area and separated into acceptable, unacceptable, non-processable, and readily recyclable materials. Acceptable materials would be shredded and then processed to magnetically remove approximately 70 percent of the ferrous metal, which would be recycled. The remaining processed material, which is known as processed refuse fuel, would be stored or loaded on conveyors to stoke the boilers. Supplemental fuels would be distributed separately from the MSW, and unloaded and stored in a designated space in the enclosed MSW storage area. Tire-derived fuel and processed urban wood waste would be received already shredded or would be shredded at the facility. Automotive shredder residue would be delivered only in shredded form. Supplemental fuels could be mixed with MSW before being shredded or could be mixed directly in the processed refuse fuel stream before burning. Supplemental fuels would only be mixed and burned with processed refuse fuel, and there would only be one supplemental fuel present in the processed refuse fuel mixture at any given time. Mixing supplemental fuel with processed refuse fuel is subject to completion of a combustion demonstration program and EPA approval, as discussed in Section 2.2.2.9.

Each municipal waste combustion unit would have a nominal production capacity of 359,779 pounds of steam per hour. The steam originating from municipal waste would operate a steam turbine, which would have the capacity to produce about 79 MW of electricity, for a net Project output of about 67 MW after in-plant needs are considered. Ultra-low sulfur diesel would be used with a maximum sulfur concentration of 0.0015 percent (15 parts per million by weight) for: the auxiliary municipal waste combustion unit burners during warm-up and shut-down, and for maintaining the temperature of the combustion chamber during short-term interruptions in the supply of waste; the emergency generator; the firefighting pump; and the RSCR system burners to provide the necessary temperature range for nitrogen control.

Each municipal waste combustion unit would use the following air pollution control equipment: a Turbosorp dry circulating gas scrubber, an activated carbon injection system, fabric filters, and a RSCR system with a catalytic oxidizer module and a selective catalytic reduction module. The fabric filters would control the particulate emissions resulting from the emission units of the ash management systems and the silos. Additionally, the cooling tower would be equipped with drift eliminators for controlling particulate emissions.

Emissions Inventory

Table 3-20 provides an overview of the annual emissions of criteria and non-criteria pollutants associated with the operation of the Project. **Table 3-20** also indicates the thresholds for PSD applicability and whether or not PSD review applies to the Project for each pollutant.

Table 3-20. Potential to Emit Criteria and Hazardous Air Pollutants

Pollutant	PSD Significant Emission Rate (tons/year)	Proposed Emission Rate (tons/year)	PSD Review Required
Carbon monoxide	100	357	Yes
Nitrogen oxides (as NO_2)	40	352	Yes
Sulfur dioxide	40	260	Yes
Particulate matter (PM) – filterable	25	51.7	Yes
Particulate matter < 10 microns (PM_{10}) – filterable and condensable	15	104	Yes
Particulate matter < 2.5 microns ($PM_{2.5}$) – filterable and condensable	10	90	Yes
Volatile organic (as ozone precursor)	40	52.4	Yes
Lead	0.6	0.31	No
Beryllium	0.0004	0.0032	Yes
Nickel	NA	0.024	NA
Cadmium	NA	0.041	NA
Chromium	NA	0.016	NA
Zinc	NA	0.93	NA

Pollutant	PSD Significant Emission Rate (tons/year)	Proposed Emission Rate (tons/year)	PSD Review Required
Ammonia	NA	28.8	NA
Fluorides (as HF)	3	10.8	Yes
Mercury	0.1	0.0692	No
Sulfuric acid	7	16.6	Yes
Hydrogen Chloride	NA	124	NA
Municipal waste combustor organics- measured as 2,3,7,8-Tetrachlorodibenzodioxin (TCDD-2378)	3.5E-6	4.07E-05	Yes
Municipal waste combustor metals (measured as particulate matter)	15	42.8	Yes
Municipal waste combustor acid gases (measured as sulfur dioxide and hydrogen chloride)	40	415	Yes
Arsenic	Any Emission Rate	0.0020	Yes

Source: Energy Answers (2011b)

Note: NA – Not Applicable, no PSD significant emission rate established

Air Quality Modeling

A detailed air quality modeling analysis was completed in support of the PSD permit application (February 2011, revised July 2011 and October 2011). The latest available version of the AERMOD (11103) dispersion model was used at the time of the final modeling analysis was performed.[9]

The air quality modeling examined the impacts of normal operations under a variety of boiler load scenarios, as well as the impact from boiler startup and shutdown emissions. A screening analysis was completed that first compared the maximum potential impact to the "Significant Impact Level" under PSD regulations. If an individual facility projects an increase in air quality impacts less than the corresponding Significant Impact Level, its impact is said to be *de minimis,*

[9] AERMOD is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and simple and complex terrain. Key inputs to AERMOD include the emission rate for the various sources associated with the Project, the physical Project configuration (including details of the exhaust stack height and diameter), meteorology data that is used to simulate how project emissions would affect ambient concentrations at specific receptors, and terrain data defining the ground level for receptors and emission sources. Refer to the October 2011 PSD Air Quality Modeling Analysis (Revised) for detailed information on each of the modeling assumptions.

and the permit applicant is not required to perform a more comprehensive, cumulative modeling analysis. A cumulative analysis involves measuring the impact of the new facility in addition to impacts from other existing sources in the area (including background concentrations).

Table 3-21 summarizes the results of the screening analysis, showing that the Significant Impact Level would be exceeded for the 1-hour NO_2, 1-hour SO_2, and the 24-hour $PM_{2.5}$ NAAQS. The modeled concentrations were below the Significant Impact Level for 24-hour PM_{10}, 1-hour and 8-hour CO, annual NO_2 and the 3-hour, 24-hour, and annual SO_2. Therefore, a cumulative analysis was not necessary for these NAAQS below the Significant Impact Level.

Table 3-21. Maximum Project Increment—Significant Impact Level Screening Analysis

Pollutant	Averaging Time	Maximum Project Increment (µg/m3)	Significant Impact Level (µg/m3)	Significant Impact Level Exceeded?
CO	1-hr	118.5 (startup of 1 boiler while second boiler is active)	2000	No
	8-hr	33.7 (normal operations, 80% load)	500	No
PM_{10}	24-hr	2.65 (normal operations, 80-110% load)	5	No
$PM_{2.5}$	**24-hr**	**1.95 (normal operations, 100% load)**	**1.2**	**Yes**
	Annual Average	0.18 **(normal operations, 100% load)**	0.3	No
SO_2	**1-hr**	**40.7 (normal operations, 100% load)**	7.8	**Yes**
	3-hr	22.03 (normal operations, 100% load)	25	No
NO_2	**1-hr**	**55.84 (normal operations 110% load)**	**7.5**	**Yes**
	Annual Average	0.80 (normal operations, 100% load)	1.0	No

Notes: $\mu g/m^3$– micrograms per cubic meter. Bold text denotes pollutants/standards that would exceed Significant Impact Level and require further analysis.

A cumulative air modeling analysis was completed in accordance with EPA's *Guidelines on Air Quality Models* (40 CFR §51, Appendix W) to evaluate compliance with the 1-hour NAAQS for NO_2 and SO_2 as well as for the 24-hr $PM_{2.5}$ averaging period.

Table 3-22 summarizes the results, demonstrating that the NAAQS would not be exceeded. The "total concentration" shown in the table includes the background concentrations obtained from ambient air quality monitoring data and representing the existing or baseline air quality in the Project area. The total concentration also includes the incremental impact of Project-related emissions and the impact of other major air pollutant sources in the region. It is this combination of existing air quality, Project impacts, and impacts of other sources that constitutes a "cumulative analysis" for PSD purposes. The cumulative analysis is also consistent with the NEPA definition of cumulative impacts at 40 CFR §1508.7.

The process of identifying "other sources" to include in the cumulative analysis began with identifying the relevant study area for each pollutant (significant impact area) based on dispersion modeling. The study areas for SO_2, NO_2, and $PM_{2.5}$ were 2.2 miles, 2.8 miles, and 0.9 mile (3.6 kilometers, 4.5 kilometers, and 1.5 kilometers) around the Project site, respectively. Major and minor sources within these study areas were inventoried; additional major sources within 31 miles (50 kilometers) of the study area were also added. Emissions information for other sources was obtained from EQB Air Quality Division and EPA Region 2, and included reviewing permit files and EPA's Air Facility System and National Emissions Inventory databases. A detailed list of other sources and the emission rates assumed for each are provided in the October 2011 Revised PSD Modeling report (Energy Answers 2011b). Other sources on the south side of the island (which are separated from the Project area by a mountain range), were excluded following a screening analysis showing these sources would not appreciably affect the receptors in the Project area. The modeling parameters were reviewed and approved by EPA.

Table 3-22. Cumulative Air Quality Analysis Results for Criteria Pollutants

NAAQS	Maximum Increment—Project Plus Other Sources	Background Concentration	Total Concentration	NAAQS	NAAQS Exceeded?
1-hour NO_2	85.5	65.2	150.7	188	No
1-hour SO_2	94.23	66.44	160.67	196	No
24-hour $PM_{2.5}$	9.25	16	25.3	35	No
Annual $PM_{2.5}$	2.03	5.05	7.5	12	No

Notes: Background concentration for NO_2 based on 2005–2007 data from the monitor in Catano (Monitor ID 72-033-0008) according to the Tier 2 approach.

Background concentration for SO_2 based on 2003–2005 data from the monitor in Barceloneta (Monitor ID 72-017-0003 following a Tier 3 approach.

Background concentrations for $PM_{2.5}$ based on 2007–2009 data from the monitor in Barceloneta (Monitor ID 72-017-0003).

A PSD analysis of lead emissions was not required for permitting purposes because the maximum annual emissions of 0.31 ton per year is below the significant emission rate of 0.6 ton/year. Nevertheless, Energy Answers completed a lead dispersion modeling analysis voluntarily during the permitting of the Project. Results of this analysis indicated that the maximum predicted concentration of lead is 0.00056 $\mu g/m^3$, which is well below the 0.15 $\mu g/m^3$ NAAQS (3-month average).

As noted previously in the regulatory framework section, the primary NAAQS are established by EPA to protect public health with an adequate margin of safety, while the secondary NAAQS provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Compliance with the NAAQS means that Project-related emissions of the criteria pollutants NO_2, SO_2, $PM_{2.5}$, and lead would not adversely impact sensitive populations (e.g., asthmatics, children, and the elderly), agriculture (e.g., soils and livestock), and vegetation/wildlife.

With respect to impacts from non-criteria and hazardous air pollutants, Section 3.11, *Public Health and Safety*, summarizes the Human Health Risk Assessment (HHRA) completed for this project.

Greenhouse Gas Emissions

With respect to greenhouse gas emissions, this Project would use waste that would otherwise be landfilled to produce electricity. Landfilled waste results in the emissions of methane, a very potent CO_2 equivalent (CO_2e) source.[10] In addition, the electricity produced by the Project is expected to displace electricity generated by fossil-fuel based sources. Therefore, an analysis of the net effect of the Project on greenhouse gas emissions considers the direct emissions from the combustion of MSW, as well as the avoided emissions from landfills and fossil fuel power generation if the Project is not built. This section explains the key terminology with respect to biogenic and non-biogenic greenhouse gas emissions, the methodologies used to quantify emissions, and the results.[11]

Key Terminology—Biogenic CO_2 emissions are defined as "CO_2 emissions related to the natural carbon cycle, as well as those resulting from the production, harvest, combustion, digestion,

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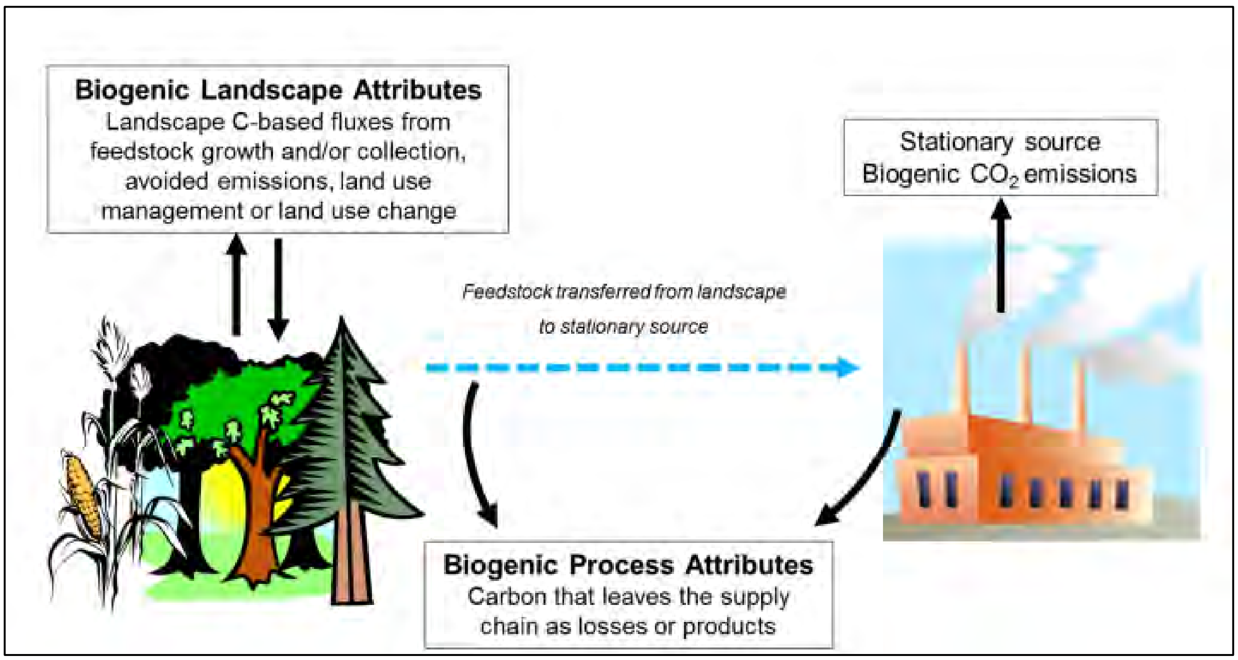
[10] CO_2e is a metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential. For example, methane has a global warming potential of 21, which means that methane will cause 21 times as much warming as an equivalent mass of carbon dioxide over a 100-year time period. Expressing greenhouse gas emissions on a CO_2e basis provides a common unit for comparing the total emissions of various greenhouse gases (EPA 2013b, 2015c).

[11] Unless otherwise noted, all information in this section is from a combination of the following sources: Energy Answers 2011a, 2011c (September), and Scott 2011 (November). The September 2011 report and November 2011 email supersede portions of the February 2011 initial application; however, much of the basic methodologies detailed in the initial application remain the same.

fermentation, decomposition, and processing of biologically based materials" (EPA 2014j). Biogenic CO_2 emissions have a smaller net atmospheric contribution of CO_2 than non-biogenic emissions (e.g., from the combustion of fossil fuels) because fossil fuels such as coal or oil are effectively isolated from the carbon cycle underground and emissions from these fuels would not occur but for human activities. In contrast, the emissions released when burning a biological material such as a tree need to be considered in the context that the eventual natural decomposition of the tree also would have released greenhouse gas emissions if it was not burned. The evaluation of biogenic emissions involves complex considerations of the timing of emissions over time. **Figure 3-11** conceptually illustrates the fluxes of carbon addressed in EPA's guidance on assessing biogenic CO_2 emissions from stationary sources, including the transfer of biogenic materials to the stationary source (blue line) and flows of carbon (black arrows).



Source: EPA (2014j)

Figure 3-11. Conceptual Illustration of Carbon Fluxes between Landscape/Natural Systems and Stationary Sources

The Project would emit both biogenic and non-biogenic emissions based on the varied composition of MSW. For example, paper/cardboard materials combusted are considered biogenic emissions, while emissions from combusting plastics are considered non-biogenic. It should be noted that the effect of greenhouse emissions on the atmosphere and climate change is the same regardless of whether the source is biogenic or non-biogenic. Therefore, the evaluation of greenhouse gas emissions for this Project discloses total emissions in addition to the breakdown by biogenic and non-biogenic.

Methodology—Energy Answers prepared a BACT analysis for greenhouse gas emissions. EPA determined that off-setting emissions from avoided landfill and oil-fired power plant emissions could not be specifically credited as part of the PSD permitting process. However, these offsetting emissions are relevant for the broader consideration of environmental impacts under NEPA.

The maximum emissions for the potential fuel mixes to be used by the plant (processed refuse fuel, tire-derived fuel, automotive shredded residue, and processed urban wood waste) were calculated based on 40 CFR 98 Subpart C Table C-1 for CO_2, and Table C-2 for CH_4 and N_2O. The calculation assumed an annual steam generation of 6,264 million pounds per year.

The calculation of oil-fired power plant displaced emissions assumed two 500 million BTU/hour units consuming a total of 62,571,429 gallons/year.

EPA's LandGEM Landfill Gas Emissions Model version 3.02 was used to quantify displaced landfill emissions. The model provides a relatively simple approach to quantifying landfill emissions based on empirical data from U.S. landfills. The landfill analysis assumed a landfill with a capacity of 38,325,000 short tons, an opening year of 2013, and a closure year of 2062. The average emissions over the life of the landfill (including the post-closure period) were used.

Results—**Table 3-23** summarizes the greenhouse gas emissions analysis results. The Project would directly emit 924,750 tons/year CO_2e. However, these emissions would be offset by displaced landfill and oil-fired power plant emissions avoided by the Project. Therefore, the net effect of the Project on greenhouse gas emissions would be a reduction of -1,107,818 tons/year CO_2e, assuming no landfill methane flaring. If the landfill is assumed to flare 100 percent of methane emissions, the Project would still result in a net greenhouse gas emissions reduction; however, the size of the greenhouse gas emissions reduction would be reduced to -93,721 tons/year CO_2e. These numbers represent the upper and lower bounds of Project effects on greenhouse gas emissions. Detailed information on the extent to which landfill methane flaring or landfill gas collection occurs at Puerto Rico's landfills is not available, but it would be reasonable to assume the percent of methane combusted is substantially less than 100 percent, given the observation of a lack of gas control at most of the landfills.

Table 3-23. Greenhouse Gas Emissions Results

Emissions Source	Non-Biogenic CO_2e (Max tons/year)	Biogenic CO_2e (Max tons/year)	Total Greenhouse Gas Emissions as CO_2e (tons/year)
Energy Answers facility stack emissions[a]	466,619	763,509	924,750
Transportation to Energy Answers facility	1,187	0	1,187
Displaced landfill emissions (no methane flaring)	0	1,319,354	1,319,354
Displaced landfill emissions (100% methane flaring)		305,257	305,257
Displaced oil-fired power plant emissions	712,679	0	712,679
Transportation emissions to landfill	1,722	0	1,722
Net change – no landfill flaring	**-246,595**	**-555,845**	**-1,107,818**
Net change – with 100% landfill flaring of methane	**-246,595**	**458,252**	**-93,721**

[a] Non-biogenic and biogenic emissions for the facility do not sum to the total because the numbers reflect the maximum possible emissions under different fuel use scenarios.

Visibility Impacts

According to the revised air quality modeling report, visibility impairment at the local level is not expected as a result of the types and quantities of emissions from the plant sources. The opacity of combustion exhausts from the plant would be low, typically at or approaching zero. Emissions of primary particulates and sulfur oxides due to combustion also would be low due to the installation of advanced controls. The contribution of emissions of volatile organic compounds to the potential for haze formation in the area would be minimal given the low volatile organic compound emission rate from the plant. Emissions of NO_x would be controlled using state-of-the-art technology such that any potential for visibility impairment associated with NO_x would be minimized.

A visibility analysis of the potential plume from the boiler stacks was conducted using VISCREEN.[12] The analysis was conducted to evaluate whether the plume would be visible especially from nearby protected areas, including the Cambalache Forest and Río Abajo Forest. The findings of the VISCREEN analysis incorporating the revised particulate matter emissions

[12] VISCREEN is an EPA-approved atmospheric plume visibility model that calculates the potential impact of a plume of specified emissions for specific transport and dispersion conditions. VISCREEN is a conservative tool for estimating visual impacts in accordance with the Workbook for Plume Visual Impact Screening and Analysis (Revised) (EPA 1992). Details for the VISCREEN analysis are provided in the February 2011 PSD application.

indicated that the plume from the Project stack would be below the visibility screening criteria for these areas.

Screening Level Ecological Risk Assessment

Energy Answers prepared a Screening Level Ecological Risk Assessment (SLERA) to evaluate potential ecological risks associated with emissions from the proposed Project and a Human Health Risk Assessment, which is discussed in Section, 3.11, *Public Health and Safety* (Arcadis 2010a,b). The SLERA focused on evaluating potential adverse effects on ecological receptors (wildlife) within a 6.2-mile (10-kilometer) radius of the proposed Project from predicted constituent concentrations in environmental matrices (i.e., soil, surface water, and sediment) as a result of the Project's air emissions.

Constituents of potential concern (COPCs) were initially identified based recommendations provided in EPA guidance (EPA 2005, 2003, 1998, 1997), and on stack test data generated from a Resource Recovery Facility with a similar design to the proposed facility (SEMASS Unit 3) located in Massachusetts. Emission rates estimates were also based on SEMASS Unit 3 data and limits established in the PSD permit prepared for that facility, which are in some cases greater than those of the Project.

Air dispersion and deposition modeling combined source emission rates and facility information (i.e., source parameters and building profile) with physical data from the area surrounding the proposed Project (i.e., meteorology, terrain, and land use information) to estimate unitized ambient air concentrations and deposition fluxes. Potential emissions were modeled for risk assessment purposes using AERMOD. Since COPCs emitted from the combustion unit flues are dispersed and deposited as either vapors or particulates (i.e., particles or particle bound), AERMOD was run to generate estimates of air concentrations and deposition fluxes for vapor phase, particle phase, and particle bound COPCs. Fate and transport models recommended by EPA (EPA 2005) were used to estimate COPC concentrations in environmental media (e.g., soil, surface water) and other components of the environment that may contribute to exposure.

Potential impacts on land and surface water within a 6.2-mile (10-kilometer) radius of the Project were evaluated. The SLERA integrated the four components of an ecological risk assessment (EPA 1998, 1997) as described below:

1. **Problem Formulation** is the first step in the SLERA process during which the site setting, the conceptual site model, and assessment and measurement endpoints are described (EPA 1998).
2. **Exposure Assessment** involves the process of estimating the magnitude of chemical exposure, identifying potentially exposed ecological receptors, and evaluating potentially complete exposure pathways. The process considers various site-related conditions, such as air dispersion and deposition modeling results, proximity to environmentally sensitive

areas, and receptor-specific activity patterns. For this SLERA, exposure-point concentrations were calculated based on the results of air dispersion and deposition modeling.

3. **Effects Assessment** involves comparing the calculated exposure-point concentrations of contaminants of potential ecological concern (COPEC) in various media (i.e., soil, surface water, and sediment) at receptor locations to ecologically-based screening levels (EBSLs) for different classes of receptor organisms. The purpose of this comparison is to identify the potential for adverse effects on receptor populations.
4. **Risk Characterization** estimates the level of potential risk for ecological receptors with potentially complete exposure pathways identified in the Problem Formulation and Exposure Assessment steps of the SLERA. Risks are estimated by comparing maximum detected concentrations in each modeled medium to the EBSLs identified in the Effects Assessment.

Based on the information above, the SLERA examined the potential coincidence of environmentally sensitive areas, COPEC, and complete exposure pathways at ecological habitat areas or environmentally sensitive areas within 6.2 miles (10 kilometers) of the plant. The risk characterization step of the SLERA integrated and evaluated the results of the data screening and nature of ecological exposures to provide a characterization of potential ecological risk based on site-specific conditions.

The following conclusions were reached regarding potential ecological risk associated with the plant:

- Exposure pathways for wildlife to site-related COPEC are present within the 6.2-mile (10-kilometer) radius, but are expected to be limited to habitat areas such as the state forests to the southwest and southeast and the conservation areas to the northeast because of their distance from the emissions source and/or being positioned away from the area of greatest dispersion and deposition.
- Comparison of the worst-case maximum COPEC results for soil to EBSLs showed concentrations of COPEC to be at least several orders-of-magnitude less than the soil EBSLs. As a result, the potential for risk to ecological receptors exposed to soil is anticipated to be negligible.
- Comparison of the worst-case maximum COPEC results for surface water (Caño Tiburones area) to EBSLs showed concentrations of COPEC to be at least one order-of-magnitude less than the surface water EBSLs and three orders-of-magnitude less than the sediment EBSLs. As a result, the potential for risk to ecological receptors exposed to surface water and sediment is anticipated to be negligible.

- Comparison of the worst-case maximum COPEC results for sediment (Caño Tiburones area) to EBSLs showed concentrations of COPEC to be at least three orders-of-magnitude less than the sediment EBSLs. As a result, the potential for risk to ecological receptors exposed to sediment is anticipated to be negligible.

Due to COPEC concentrations in soil, and surface water and sediment that are orders-of-magnitude less than the conservative ecological screening levels, a low potential for ecological risk is expected for habitat areas within 6.2 miles (10 kilometers) of the plant.

Ultrafine Particulates/Nanoparticles

Particulate matter contains a range of particle sizes, including $PM_{2.5}$ and PM_{10} for which NAAQS have been established under the CAA. Ultrafine particles are defined as particles that are 100 nanometers or less in diameter, and no NAAQS have been established to date for these extremely small particles. Both animal and human studies provide evidence for respiratory and cardiovascular effects associated with exposure to ultrafine particles; however, a comprehensive literature review completed by the Health Effects Institute in 2013 concluded there were limitations and contradictions in the available studies that prevent drawing definitive conclusions on ultrafine particle-specific health effects (as opposed to health effects caused by other size particles) (Health Effects Institute 2013).

In the absence of a specific standard, $PM_{2.5}$ emissions are an indicator for ultrafine particles (EPA 2012b). As discussed previously, a cumulative impact analysis was prepared for $PM_{2.5}$ and showed health-based NAAQS would not be exceeded at the receptors affected by the Project. The fabric filters that would be used by the proposed Project would be effective in removing ultrafine particles, as they are in removing $PM_{2.5}$ (EPA 2013c). Studies have shown the fabric filters are effective across the range of particle sizes (Buonanno et al. 2011). Therefore, ultrafine particle-specific health effects beyond those already addressed through $PM_{2.5}$ analysis are not reasonably foreseeable.

Hauling of Solid Waste and Ash

The 2010 traffic study determined the Project would generate a total of 453 trips per day, 70 percent of which would consist of heavy trucks. These trips would be spread throughout the day, with 64 or fewer occurring in any one of the peak hours. The traffic study also concluded that the Project would not cause adverse impacts on congestion or the performance of the transportation system. Specific operational improvements were recommended to improve traffic flow, such as adjustments to signal timing and acceleration/deceleration lanes. Based on the traffic study results and lack of severe congestion on the roadways that would be used to access the Project site (e.g., level of service [LOS] E and LOS F), an intersection hot-spot analysis for CO, $PM_{2.5}$ or PM10 is not warranted based on consideration on the EPA criteria used for transportation conformity.

Transportation conformity does not apply to the Project, but the criteria provide a useful basis for evaluating the potential significance of mobile-source related emissions. For example, among the criteria triggering a CO hot-spot analysis is a project in CO nonattainment or maintenance area and "affecting intersections that are at level of service D, E, or F, or those that will change to level of service D, E, or F because of increased traffic volumes related to the project." For PM hot-spots, the criteria include "highway projects that have a significant number of diesel vehicles, and expanded highway projects that have a significant increase in the number of diesel vehicles" (40 CFR §93.123[b][1][i]). A significant number of diesel vehicles is subsequently explained using an example of "facilities with greater than 125,000 annual average daily traffic (AADT) and 8 percent or more of such AADT is diesel truck traffic" or 10,000 AADT. The heavy duty truck traffic generated by the project and the total truck volumes on PR-2 are far below this level, demonstrating the project is not a "project of local air quality concern" warranting a PM hot-spot analysis due to truck traffic. Trucks hauling solid waste and ash would be required to be covered to avoid airborne distribution of dust and hauled materials.

3.4 BIOLOGICAL RESOURCES

3.4.1 Affected Environment

The Project site is bordered to the west by the Río Grande de Arecibo, which has one of the largest watersheds on the island. The Caño Tiburones swamp is located approximately 1 mile (1.6 kilometers) to the east of the site. This is the most extensive wetland in Puerto Rico covering an area of 5,500 acres (22.3 square kilometers) between the Río Grande de Manatí to the east and the Río Grande de Arecibo to the west. The Caño Tiburones Natural Reserve, which encompasses some of this wetland system is located approximately 0.9 mile (1.5 kilometers) from the eastern limit of the Project site.

3.4.1.1 Vegetation, Invasive Species, and Noxious Weeds

The Project site presents typical vegetation of abandoned industrial areas and is dominated by herbaceous species, mostly grasses and vines, and the invasive shrub black mimosa (*Mimosa pigra*). Woody species are found on small patches throughout the property, especially along the southern and western borders of site and along the Río Grande de Arecibo and the existing (abandoned) stormwater canals. The CSA Group (CSA Group 2010b) conducted a flora and fauna study for the Project site and for (1) the former Central Cambalache Sugar Mill, whose land adjoins the southern border of the Project and would contain the Project's transmission line interconnection to the Central Cambalache substation; and (2) the rights-of-way of PR-2, PR-6681, and PR-681, where a raw water line would be installed to obtain water from the pump station in Islote Ward and sent to the plant. A total of 159 species of plants were identified in the Project site and the former Central Cambalache Sugar Mill, all of which are considered common species in the region.

Pastures extend through most of the 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 surface 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*).

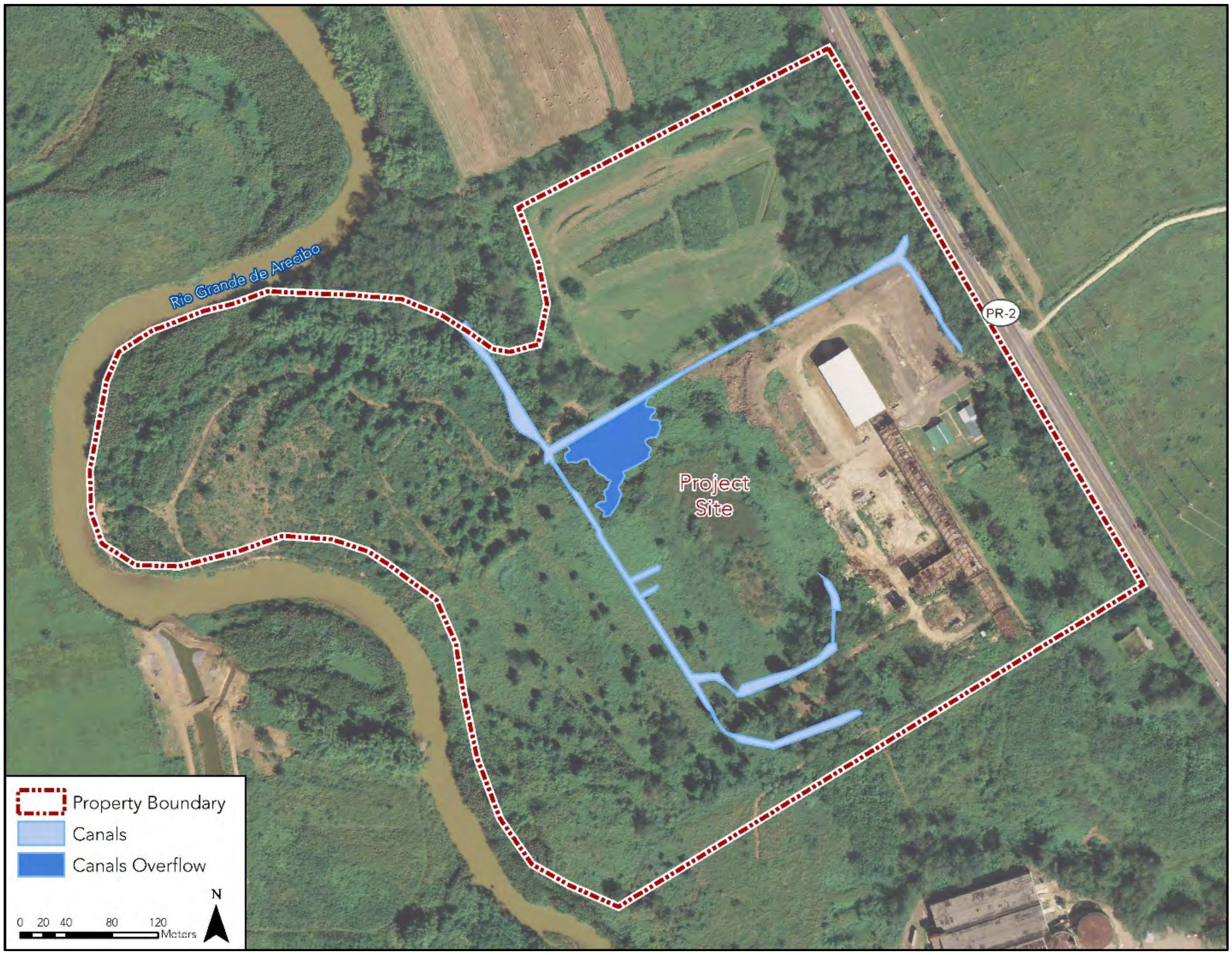
Tree cover is relatively scarce and dominated by African tulip tree, tall albizia, and Panama berry (*Muntingia calabura*). The entrance to the Project site via PR-2 has several trees planted for landscaping purposes that include Indian almond (*Terminalia catappa*), fish tail palm (*Caryota urens*), and Benjamin ficus (*Ficus benjamina*). The terrain at the former Central Cambalache Sugar Mill, owned by the Puerto Rico Land Authority, presents a flora similar 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. In the junction between the former Central Cambalache Sugar Mill and PR-2, where Energy Answers would install the proposed transmission line interconnection, 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.

The vegetation where Energy Answers would install the proposed brackish water pipeline along PR-2, PR- 6681, and PR-681 is composed of common species found along the edges of roads and impacted areas. Along this section of 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*) are found along the green fringes. At the junction with PR-6681, common species associated with humid areas, such as umbrella flatsedge (*Cyperus involucratus*) and jungle rice (*Echinocloa 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 PR-681, the 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 PR-681 that 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 leather 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 Pumping Station, white mangrove, cattail (*Typha domingensis*), and water lilies (*Nymphaea ampla*), indicative of wet areas, abound.

3.4.1.2 Wetlands and Riparian Areas

Energy Answers conducted a wetland study at the Project site and associated transmission line and brackish water pipeline areas to determine the location of wetlands and streams that comply with the requirements for federal jurisdiction under Section 404 of the Clean Water Act (CSA Group 2010c). The CSA Group delineated wetlands according to the 1987 USACE Wetlands Delineation Manual, looking for the three necessary components of a wetland (hydrophytic vegetation, hydrology, and hydric soils). The study showed that a total of approximately 2.4 acres (9,793.4 square meters) of inland jurisdictional wetlands occur within the Project site. This acreage consists of a series of palustrine unconsolidated bottom man-made abandoned canals totaling 1.5 acres (5,989.4 square meters) or 1,191.1 feet (363.1 meters) that are found in the property and 0.954 acre (3,804.1 square meters) of a small wetland in an overflow area where the canals interconnect. These canals drain through a short canal on the north central border of property to the Río Grande de Arecibo, which occurs just outside the study area. These channels were part of the water management system associated with the paper manufacturing processes and stormwater management. These channels are abandoned and covered by exotic vegetation such as, Guinea grass (*Megathyrsus (Panicum) maximun*), malojillo (*Brachiaria purpurascens*) and cane grass (*Gynerium sagittarum*), the latter along the upper borders of the ditches. The CSA Group did not identify any jurisdictional wetlands at either the Old Central Cambalache parcel where the proposed transmission line interconnection would occur or along the area crossed by the proposed water pipeline. **Figure 3-12** shows the location of jurisdictional wetlands within the Project site.



Source: CSA Group (2010c), NRCS (2014), digitized by Louis Berger

Figure 3-12. Jurisdictional Wetland Locations within Plant Site

3.4.1.3 Wildlife and Fish Resources

As part of the flora and fauna study, the CSA Group observed a total of 56 species of vertebrates, with most species being birds of which 44 were identified (CSA 2010b). The most common bird species at the Project site were 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 observed vertebrate groups included two mammals and ten species of amphibians and reptiles, including the small Indian mongoose (*Herpestes auropunctatus*), several species of coquí frogs (E*leutherodactylus spp*.), and anoles (*Anolis spp*.).

The wildlife in the former Central Cambalache Sugar Mill and along the proposed raw water pipeline was very similar to what was described for the Project site.

Because there are no streams or rivers located within the immediate Project site or the transmission line or water pipeline rights-of-way, there are no fish species in the immediate Project footprint. However, the Río Grande de Arecibo is located immediately to the east of the Project facility, and has a plentiful fish population.

3.4.1.4 Special Status Species

Federally Listed Species

According to the U.S. Fish and Wildlife Service's (USFWS) Information, Planning, and Conservation System, several federally listed species could occur in the Project area (**Table 3-24**). The USFWS report identifies species found in the general area and is not indicative of those species that are likely to occur on the specific site. The CSA Group's Flora and Fauna study (2010b) did not observe any federally listed species in the Project area. In the 2011 letter, USFWS indicated that suitable habitat for federally listed species is not present within the Project site (Muniz 2011).

Table 3-24. Federally Listed Species in the Project Area

Species Name	Status
Amphibians	
Puerto Rican crested toad (*Peltophryne lemur*)	Threatened
Birds	
Puerto Rican broad-winged hawk (*Buteo platypterus brunnescens*)	Endangered
Puerto Rican sharp-shinned hawk (*Accipiter striatus venator*)	Endangered
Puerto Rican parrot (*Amazona vittata*)	Endangered
Roseate tern (*Sterna dougallii dougallii*)	Threatened
Ferns and Allies	
(*Tectaria estremerana*)	Endangered
Flowering Plants	
Beautiful goetzea (*Goetzea elegans*)	Endangered
Chupacallos (*Pleodendron macranthum*)	Endangered
Erubia (*Solanum drymophilum*)	Endangered
Palma de manaca (*Calyptronoma rivalis*)	Threatened
Palo de nigua (*Cornutia obovata*)	Endangered
Palo de rosa (*Ottoschulzia rhodoxylon*)	Endangered
(*Auerodendron pauciflorum*)	Endangered
(*Schoepfia arenaria*)	Threatened
(*Cordia bellonis*)	Endangered
(*Myrcia paganii*)	Endangered
Mammals	
West Indian manatee (*Trichechus manatus*)	Endangered

Species Name	Status
Reptiles	
Green sea turtle (*Chelonia mydas*)	Threatened
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered
Puerto Rican boa (*Epicrates inornatus*)	Endangered

Source: USFWS (2015)

In its October 1, 2014, email (Vargas 2014), USFWS indicated that its comments regarding the lack of suitable habitat for federally listed species on the Project site contained in its May 4, 2011, letter are still valid.

Commonwealth-Listed Species

As part of the Flora and Fauna Study, the CSA Group (2010b) reviewed the PRDNER Natural Heritage Division's Critical Species List. This list includes all Commonwealth or federally listed threatened or endangered species, as well as other species whose populations are small or that are indicative of the presence of specific habitats within Puerto Rico. The PRDNER data base did not show any reports of special-status species at the Project site. During the field study, no special-status species were observed.

3.4.2 Environmental Effects

This section discusses potential effects on vegetation, wildlife, and special status species resulting from construction and operation of the proposed Project, including the no-action alternative. Definitions for duration and intensity developed for this Project are described in **Table 3-25**.

Table 3-25. Biological Resources Impacts Contexts and Intensity Definitions

Biological Resources			
Context (Duration)	**Low Intensity**	**Moderate Intensity**	**High Intensity**
Vegetation			
Short term: During construction period Long term: Life of the Project (50 years or more)	Impacts to native vegetation would be detectable but discountable and would not alter natural conditions measurably. Infrequent disturbance to individual plants could be expected but without affecting local or range-wide population stability.	Impacts to native vegetation would be detectable and/or measurable. Occasional disturbance to individual plants could be expected. These disturbances could affect local populations negatively but would not be expected to affect regional population stability. Some	Impacts to native vegetation would be measurable and extensive. Frequent disturbances of individual plants would be expected with negative impacts to both local and regional population levels. These disturbances could negatively affect local

Biological Resources			
Context (Duration)	**Low Intensity**	**Moderate Intensity**	**High Intensity**
	Infrequent or insignificant one-time disturbance to local populations could occur, but sufficient habitat would remain functional at both the local and regional scales to maintain the viability of the species. Opportunity for increased spread of noxious weeds would be detectable but discountable. There would be some minor potential for increased spread of noxious weeds.	impacts might occur in key habitats, but sufficient local habitat would remain functional to maintain the viability of the species both locally and throughout its range. Opportunity for increased spread of noxious weeds would be detectable and/or measurable. There would be some moderate potential for increased spread of noxious weeds.	populations and could affect range-wide population stability. Some impacts might occur in key habitats, and habitat impacts could negatively affect the viability of the species both locally and throughout its range. Opportunity for increased spread of noxious weeds would be measurable and extensive. There would be major potential for increased spread of noxious weeds.
Wetlands			
Short term: During construction period Long term: Life of the Project (50 years or more)	The effect on wetlands would be measurable or perceptible but small in terms of area and the nature of the impact. A small effect on size, integrity, or connectivity would occur; however, wetland function would not be affected and natural restoration would occur if left alone.	The impact would cause a measurable effect on one of the three wetlands indicators (size, integrity, connectivity) or would result in a permanent loss of wetland acreage over small areas. However, wetland functions would not be adversely affected.	The impact would cause a measurable effect on two or more wetlands indicators (size, integrity, connectivity) or a permanent loss of large wetland areas. The impact would be substantial and highly noticeable. The character of the wetland would be changed so that the functions typically provided by the wetland would be substantially altered.
Wildlife			
Short term: During construction period Long term: Life of the Project (50 years or more)	Impacts to native species, their habitats, or the natural processes sustaining them would be detectable, but discountable, and would not measurably alter natural conditions. Infrequent responses to disturbance by some individuals could be expected but without interference to feeding,	Impacts to native species, their habitats, or the natural processes sustaining them would be detectable and/or measurable. Occasional responses to disturbance by some individuals could be expected with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local population levels. Some	Impacts to native species, their habitats, or the natural processes sustaining them would be detectable, and would be extensive. Frequent responses to disturbance by some individuals would be expected with negative impacts to feeding, reproduction, or other factors resulting in a decrease in both local

Biological Resources			
Context (Duration)	**Low Intensity**	**Moderate Intensity**	**High Intensity**
	reproduction, resting, or other factors affecting population levels. Small changes to local population numbers, population structure, and other demographic factors could occur. Sufficient habitat would remain functional at both the local and range-wide scales to maintain the viability of the species.	impacts might occur in key habitats. However, sufficient population numbers or habitat would retain function to maintain the viability of the species both locally and throughout its range.	and range-wide population levels and habitat type. Impacts would occur during critical periods of reproduction or in key habitats and would result in direct mortality or loss of habitat that might affect the viability of a species. Local population numbers, population structure, and other demographic factors might experience large changes or declines.
Special-status Species			
Short term: During construction period Long term: Life of the Project (50 years or more)	Impacts to sensitive species, their habitats, or the natural processes sustaining them would be detectable, but discountable, and would not measurably alter natural conditions. Infrequent responses to disturbance by some individuals could be expected but without interference to feeding, reproduction, resting, or other factors affecting population levels. Small changes to local population numbers, population structure, and other demographic factors might occur. However, some impacts might occur during critical reproduction periods or migration for a species but would not result in injury or mortality. Sufficient habitat would remain functional at both the local and range-wide scales to maintain the viability of the species.	Impacts to sensitive species, their habitats, or the natural processes sustaining them would be detectable and/or measurable. Some alteration in the numbers of sensitive or candidate species, or occasional responses to disturbance by some individuals could be expected with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local population levels. Some impacts might occur in key habitats. However, sufficient population numbers or habitat would remain functional to maintain the viability of the species both locally and throughout its range. No mortality or injury of federally listed species is expected; however, some disturbance to individuals or impacts to potential or designated critical habitat could occur. Impacts would likely result in a may affect,	Impacts to sensitive species, their habitats, or the natural processes sustaining them would be detectable and would be permanent. Substantial impacts to the population numbers of sensitive or candidate species, an impact to the population numbers of any federally listed species, or interference with their survival, growth, or reproduction would be expected. There would be direct or indirect impacts on candidate or sensitive species populations or habitat, resulting in substantial reduction to species numbers, take of federally listed species numbers, or the destruction or adverse modification of designated critical habitat. Impacts would like result in an adverse effect determination.

Biological Resources			
Context (Duration)	Low Intensity	Moderate Intensity	High Intensity
	No take of federally listed species or impacts to designated critical habitat is expected to occur. Impacts would likely result in a may affect, unlikely to adversely affect determination.	unlikely to adversely affect determination.	

3.4.2.1 Construction

Vegetation and Wildlife

Project construction would result in both short- and long-term impacts on vegetation and wildlife habitat. Project construction would result in the permanent loss of approximately 80 acres (0.32 square kilometer) of abandoned pasture with some patches of forest habitat. Because this is a previously disturbed site, the vegetation lost includes many invasive species and is not high quality habitat. Construction of the proposed brackish water pipeline is not expected to impact wildlife habitat, because Energy Answers would construct it within road rights-of-ways immediately adjacent to the edge of asphalt. Most vegetation lost as a result of this construction would be invasive species. In addition, Energy Answers would adhere to the conditions of both its Section 404 Clean Water Act Permit and its Soil Erosion Control Plan for the site. As such, Energy Answers would follow best management practices to ensure that no vegetation beyond the approved limits of disturbance would be impacted. Therefore, the Project would not impact the nearby Caño Tiburones Nature Reserve, which is located 0.9 mile (1.5 kilometers) from the boundary of the Project site. Overall, Project construction would have a short-term, low impact on regional vegetation diversity and habitat quality because the habitat lost would be low quality and is plentiful in the region around the Project site.

Although, as mentioned, the majority of the Project site is abandoned pasture, Energy Answers would need to cut some trees at the site, which would result in the permanent loss of this forested habitat. To mitigate the impacts of the loss of trees, Energy Answers conducted a tree inventory in compliance of Regulation #25 (Regulation for Planting, Cutting and Forestation for Puerto Rico, of November 24 1998, as amended) in those areas within the Project's footprint where trees would be impacted. In addition, Energy Answers prepared a tree planting plan as part of its September 24, 2012, DS-2 Permit Application Submission that identifies where trees would be replanted on site. Because trees would be replanted on site, overall, the Project would not have a long-term impact on forest habitat.

Project construction also would result in short-term, low intensity impacts on wildlife in the vicinity of construction areas. Some wildlife would be temporarily displaced during construction due to the loss of habitat and construction noise and activity. It is possible that some smaller slower-moving wildlife species such as small rodents, may be lost if they do not leave the Project site prior to the start of construction; however, because the site does not contain any unique wildlife habitat or species, plentiful habitat is available in adjacent areas and wildlife population would not be impacted long term.

Wetlands

Energy Answers would need to fill all 2.4 acres (9,793.4 square meters) of on-site wetlands for Project construction. According to the CSA Group's response to USACE with additional information regarding the Section 404 of the Clean Water Act application (CSA Group 2012), the impacted wetlands provide low wetland ecological function and value because the vegetative cover of the impacted wetlands has such low floristic diversity and rarely retains water by their own design. The functions and values that would be lost when Project construction fills in these wetlands include: sediment deposition or filtration from runoff and stormwater and groundwater recharge. The Project would not affect any wetlands or waters of the U.S. along the proposed transmission line interconnection or the brackish water pipeline.

In addition to the on-site wetlands to be impacted, the Río Grande de Arecibo is adjacent to the Project site. To protect the Río Grande de Arecibo from direct impacts during Project construction, Energy Answers would implement its erosion and sediment control plan, which contains best management practices that would prevent contaminants from entering the stormwater that drains into the river and would contain and minimize erosion and sedimentation. Implementing the erosion and sedimentation control plan would minimize impacts to the Río Grande de Arecibo during Project construction.

The compensatory wetland mitigation package includes: (1) the creation of 9.3 acres (37,676.2 square meters) of persistent emergent palustrine wetlands on site within the Río Grande de Arecibo floodway; (2) the preservation through a Conservation Trust of 37 acres (0.2 square kilometer) of the remnant site parcel, including the creation of 9.3 acres (37,676.2 square meters) of wetlands; and, (3) the long-term protection of the mitigation sites through required monitoring and the Conservation Easement. The newly created wetland would be planted with native herbaceous and shrub species including but not limited to members of the following genera: *Pterocarpus officinalis*, *Anonna globra*, *Amphitecna latifolia*, *Eleocharis*, *Calophyllum antillarum*, *Andira inermis*, *Roystonea borinquen*, *Cyperus* and *Fimbristylis* sedges, *Acrostichum* ferns, *Ludwigia*, *Sagittaria*, and *Polygonum*, all of which are found locally in the nearby wetlands, including the Caño Tiburones Nature Reserve (CSA Group 2012). In addition, Energy Answers would plant woody species such as *Pterocarpus officinalis*, *Anonna glabra*, *Amphitecna latifolia*, *Andira inermis*, *Calophyllum calaba*, and *Roystonea borinquena* along the edge of the new wetland.

On April 17, 2014, USACE issued Energy Answers a Section 404 Permit for the Project, which included conditions that Energy Answers' proposed mitigation plan be implemented within 6 months from the date of initiating the authorized work or 12 months from the effective date of the permit, whichever first occurs (USACE 2014). On June 10, 2015, Energy Answers submitted a letter to the USACE requesting an extension of this timeframe as a result of delays in obtaining all the required government approvals for the Project for reasons beyond the control of Energy Answers. In addition to the mitigation plan identified above, USACE also required Energy Answers to implement a monitoring plan to ensure that the permit-specified performance standards are met. The performance standards for the mitigation site include such things as: 80 percent cover by appropriate wetland species, less than 5 percent invasive exotic plant cover, and less than 20 percent mortality of planted wetland species.

Although filling 2.4 acres (9,793.4 square meters) of wetlands at the Project site would result in the loss of certain functions and values, as discussed above, the proposed compensatory mitigation plan would adequately replace these losses at an almost 4:1 ratio. The plant species proposed to be planted are native wetland species that are attractive to wildlife. In addition to wildlife habitat, these plant species and wetland soils would provide improved sediment deposition or filtration from runoff and stormwater, water storage, and groundwater recharge. Creating the 9.3 (37,676.2 square meters) acre wetland and preserving the entire 37 acres (0.2 square kilometer) remnant portion of the Project site parcel under a conservation easement would result in the Project having no net impact on wetlands.

Executive Order 11990, *Protection of Wetlands*, requires federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. USDA Departmental Regulation 9500-3, *Land Use Policy*, states that when land use regulations or decisions are inconsistent with USDA policies and procedures for the protection of wetlands and floodplains, USDA agencies shall not assist in actions that would convert wetlands and floodplains to other uses or encroach upon them, unless (1) there is a demonstrated, significant need for the project, program, or facility, and (2) there are no practicable alternative actions or sites that would avoid the conversion of these lands or, if conversion is unavoidable, reduce the number of acres to be converted or encroached upon directly and indirectly.

As discussed in Section 2.1.1, *Project Site Selection*, Energy Answers conducted a comprehensive site selection process that considered and evaluated 33 potential site locations. Due to the Commonwealth's topography, a substantial portion of these sites were located at the confluences of the coastal plains and river valleys that are frequently subject to flooding and may contain wetlands. Project designers initially proposed to avoid and/or minimize the conversion of floodplains and wetlands on the plant site by building a perimeter earthen dike system. However, as discussed in Section 3.2.2, Energy Answers decided to shift away from a dike system and to elevate the proposed site because of the need to conform to Section 65.10 of the National Flood

Insurance Plan. This would require importing offsite fill material to bring the site grade above the 100-year floodway elevation and would prevent the site from avoiding impacts to on-site wetlands.

Based on these factors and RUS's review of the proposed Project need (see Section 1.3), RUS has determined that there is demonstrated need for the Project and that there are no practicable alternatives to avoiding the conversion of wetlands. Energy Answers will be required to implement mitigation for the wetland conversion, as contained in the Section 404 permit and specified above.

Special-status Species

Because USFWS indicated that suitable habitat for federally listed species is not present within the Project site, Project construction and operation would have no effect on federally listed species. Likewise, the CSA Group (2010b) reviewed the PRDNER Natural Heritage Division's Critical Species List and conducted surveys at the Project site and transmission line and pipeline rights-of-way and did not identify any Commonwealth listed or special-status species in the Project area. Therefore, the Project would have no effect on Commonwealth-listed species.

3.4.2.2 Operation

Project operation would not have a direct impact on biological resources. Energy Answers would construct a permanent stormwater retention system at the plant that would include unlined stormwater retention ponds to provide filtration and temporary retention of waters exiting the site, helping to control nutrient and contaminant runoff, and sediment filtration into the Río Grande de Arecibo. The implementation of a 27.7-acre (11.2-hectare) upland natural preserve area would mitigate for the disturbed vegetation. Trees would be replanted on site and the Project would not have a long-term impact on area forest habitat. A conservation deed restriction would maintain the 9.3 acres (37,676.2 square meters) of compensatory wetlands and 27.7 acres (11.2 hectares) of upland habitat in their natural state in perpetuity. In addition, because the wetland mitigation site would be located between the Project facility and the Río Grande de Arecibo, it would, in conjunction with the proposed site stormwater facilities, protect the river from any run off or sedimentation from the Project during operations.

As discussed in Section 3.3.2.2, *Air Quality*, Energy Answers' consultant Arcadis prepared a SLERA to evaluate potential ecological risks associated with emissions from the Project (Arcadis 2010a). The SLERA results indicate that COPEC concentrations in soil, surface water, and sediment would be orders-of magnitude less than the conservative ecological screening levels. This would result in a low potential for ecological risk for habitat areas within 6.2 miles (10 kilometers) of the Project site. Therefore, Project operation would present a low potential of ecological risk to wildlife or vegetation in the Project vicinity.

3.5 LAND RESOURCES

3.5.1 Affected Environment

3.5.1.1 Land Use and Zoning

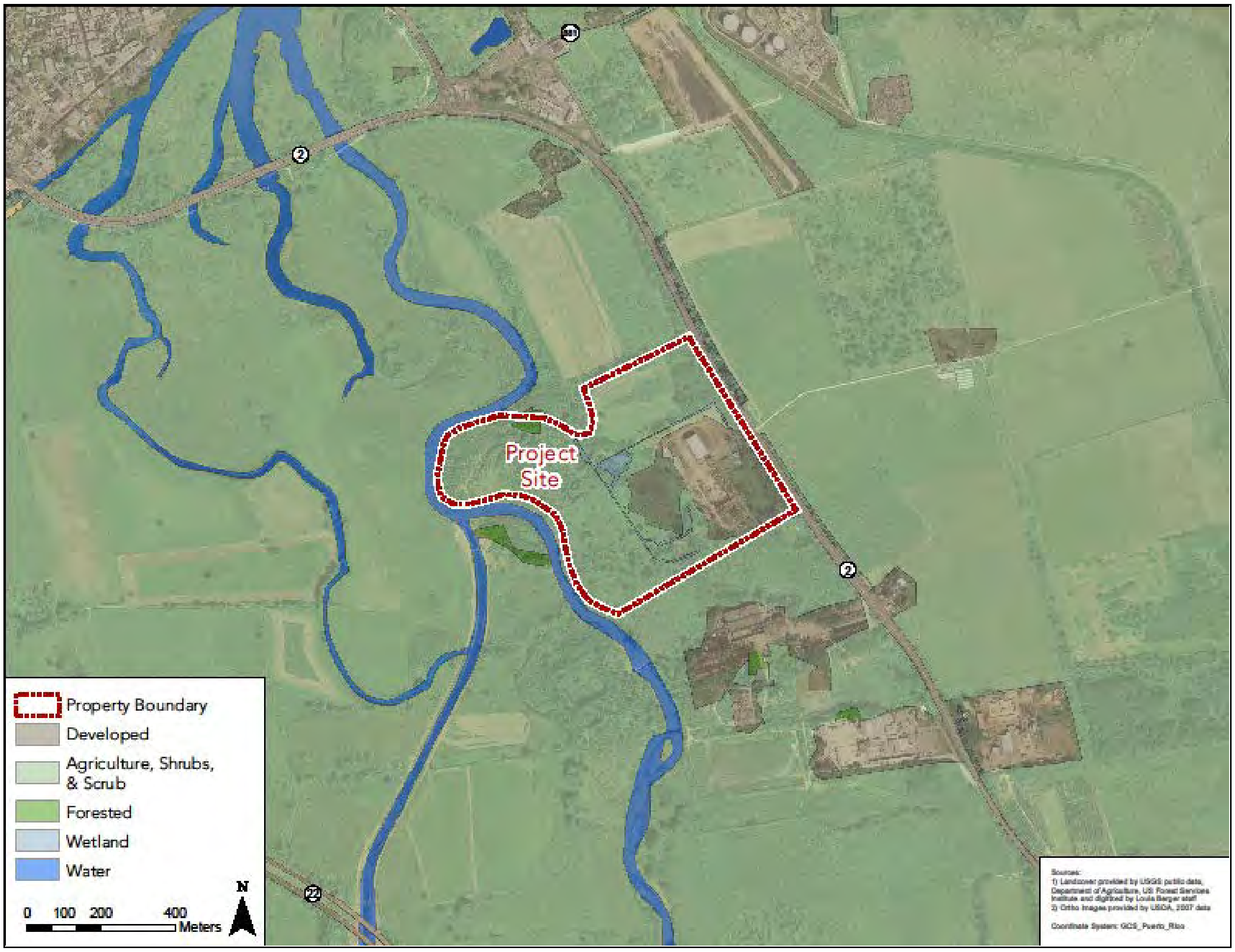
The Project is located in the municipality of Arecibo in the area of Cambalache Ward along the north coast of Puerto Rico. Land use in this region is characterized by expansive areas of agricultural fields and marshlands. Some small residences and a few industrial developments are located near the Project site, but the largest residential and commercial area is the city of Arecibo, located approximately 1.3 miles (2 kilometers) to the northwest. Demographics of the area are discussed in Section 3.12, *Socioeconomic Resources*.

Cambalache Ward is located in the Río Grande de Arecibo floodplain. Most of the coastal valley is used for agricultural purposes while the urban center of Arecibo is closer to the coast and scattered along PR-2. Land use in Cambalache has been mostly agricultural for the past few decades, primarily due to the presence of the Central Cambalache Sugar Mill. Between 1982 and 1983, sugarcane cultivation occupied approximately 55 percent of the valley, rice plantations about 30 percent, and livestock pastures approximately 15 percent. Forest land constitutes another predominant use covering approximately 41 percent of the total Río Grande de Arecibo Basin land area, while urban development and rural settlements comprise around 13 percent. Since the closing of the Central Cambalache Sugar Mill in the 1980s, there have been very few changes in the land use of the region. **Figure 3-13** shows generic land cover classes in the Project area, which can be used as a surrogate for land uses. Aerial photography of the same area shows evidence of the agricultural lands throughout the Río Grande de Arecibo Valley.

Commercial and industrial uses within 2 miles (3.2 kilometers) of the plant are shown on **Figure 3-14**. The closest agricultural land use is immediately east of PR-2 and across from the plant. The closest house is located southeast of the plant site, adjacent to PR-2. This house is located 569 meters (1,867 feet) from the center of the plant site. Five other homes are located in this housing cluster while four residences are located in Santa Barbara neighborhood, approximately 0.34 mile (550 meters) north of the plant, west of PR-2.

Most of the Project site has been altered by the previous activities of the Global Fibers Paper Mill. The natural topography was modified to reach the existing ground level for the construction of the paper mill structures, ponds, channels, and other elements. The structures on the west side of the Project site are made of steel frame construction and are in deteriorated conditions.

The closest school is located at approximately 1,480 meters (0.9 mile) northwest of the plant site, and the closest hospital is located at approximately 2,035 meters (1.3 miles) northwest of the plant site.



Source: USGS (2014), NRCS (2014), digitized by Louis Berger

Figure 3-13. Land Cover Surrounding the Project Area

Figure 3-14. Land Uses and Industries near the Project

Adjacent owners and primary land uses include: Finca Santa Barbara owned by the Land Authority of Puerto Rico to the north; Land Authority of Puerto Rico property to the south and east; PR-2 leading to the city of Arecibo to the east; and the Río Grande de Arecibo to the west. The old Global Fibers Paper Mill buildings and structures still remain on the property.

The majority of the property where the plant would be built was previously used for producing medium and heavy weight recycled paper from waste paper and sugarcane fiber between 1959 and 1995. Energy Answers' investigative studies indicated some areas of contamination on the property, most notably, asbestos contained in existing buildings and areas of "spot" contamination (i.e., stained soils near fuel and hydraulic oil aboveground storage tanks and fueling areas).

The proposed non-potable water pipeline right-of-way would parallel PR-2, PR-6681, and PR-681. These state roads are used for transportation, infrastructure (aboveground electricity, buried water and wastewater lines), and communications. The proposed transmission line would cross the currently abandoned sugar mill property due south of the plant.

Law for the Protection and Conservation of Karstic Physiography of Puerto Rico

Law No. 292 of August 21, 1999, as amended, known as the Law for the Protection and Conservation of Karstic Physiography of Puerto Rico, (Law 292) provides for the protection, conservation, and the prohibition of the destruction of the karstic physiography, its formations and natural materials, such as flora, fauna, soil, rocks, and minerals; and the avoidance of transportation and sale of natural materials without permission. This law instructs the Secretary of PRDNER to prepare a study to define the areas that deserve protection and cannot be used for the extraction of materials from the earth's crust with commercial purposes or for commercial exploitation. This law also mandates that the recommendations of this study be incorporated in the Regulation for the Extraction, Removal and Dredging of Earth Crust Materials and in the regulations of PRDNER, so that areas of karst region can be zoned for preservation.

On June 6, 2008, PRDNER finished the Karst Study, based on the parameters of function and value established by Law 292. The Karst Study establishes and defines a conservation priority area of the karstic region of Puerto Rico. However, PRDNER has not finished the amendment to the earth crust regulation to include the priority conservation area, nor has it completed the zoning designation.

Zoning

The proposed plant property is zoned IL-2 (heavy industrial) for the footprint of the buildings and UR (developable land) for the remainder of the property. IL-2 zoning comes with limitations that require special siting considerations regarding the type of industries permitted to operate in this zone. Puerto Rico Planning Board Regulation No. 4, Section 30.03, Additional Uses, defines the IL-2 zoning uses to include warehouse storage for petroleum and its products, electrical stations, and combustible conversion facilities. Structure heights are established according to Section 30.04, (Heights in IL-2) with consideration to the nature of the specific industry. Adjacent properties to the south (the former Central Cambalache Sugar Mill and existing hardware store shown in **Figure 3-14**) are also zoned IL-2. A small portion of the parcels that would be crossed by the electric transmission line are not zoned. Lands to the west, north, and east of the Project site are zoned UR, developable land.

Energy Answers consulted the Puerto Rico Planning Board to verify the Project would be consistent with the most current plan. At that time, the Municipality of Arecibo was working on the fourth and final phase of the zoning plan and had recently finalized draft zoning maps in digital format; however, the Puerto Rico Planning Board had not officially approved the Arecibo Municipal Land Use Plan. Nevertheless, the entire Project site, according to sheets 058, 044, 034, 027, 057, 043, 033, and 026 of the Arecibo Municipal Land Use Plan, would be zoned as I-P (heavy industrial) in the subsequent plan. This new zoning classification is established to classify heavy industrial areas that are developed or would be developed for specific projects which, because of their nature and identify, require a special location.

3.5.1.2 Formally Classified Lands

Formally Classified Lands are properties administered either by federal, state, or local agencies or have been given special protection through formal legislative designation. There are no formally classified lands adjacent to the proposed plant site or transmission line. Caño Tiburones Natural Reserve was designated on October 16, 1998, and includes 3,805 acres (1,540 hectares). The water pipeline would pump water from the El Vigía Pumping Station at the head of Caño Tiburones and transfer water that would otherwise be pumped into the Atlantic Ocean. There are no other formally classified lands adjacent to the Project in the area.

3.5.2 Effects Analysis

Impacts on land use resources include how the Project could potentially affect elements of the human and land use environments, and include the types of allowable uses. The effects from the Project on many of these factors are mostly limited to the construction and operation of the former Global Fibers Paper Mill site (brownfield), construction of the water pipeline in the road right-of-way, and clearing of the transmission right-of-way, construction of the structures, stringing the lines, and the maintenance of the cleared right-of-way for the life of the Project.

This section discusses the potential effects of the Project on the various land uses throughout the Río de Arecibo Grande Valley. The intensity of the impacts on land use can be described through the thresholds shown in **Table 3-26**.

3.5.2.1 Construction

Changes in topography would be required to accommodate flood flows in Río Grande de Arecibo and the construction of the plant and ancillary structures. Development of the Project on a former industrial use site (brownfield) would be consistent with the historical use of the site. Construction of the water pipeline would require work performed within road rights-of-way; however, once complete, the rights-of-way would return to their designed uses. As such, effects from construction of the Project would be short term and of low intensity. Overall the change from abandoned use to a power plant that uses MSW as fuel would be consistent with the historical industrial use of the property, local zoning, and surrounding land uses.

Table 3-26. Land Use Impacts Context of Intensity of Effects

Land Use			
Context—Duration	**Low intensity**	**Moderate Intensity**	**High Intensity**
Short term: During construction period Long term: Life of the Project (50 years)	Other than at the footprint of Project features (e.g., plant buildings, water pipeline, and transmission line) surrounding land uses would continue without interruption. Existing neighboring land uses such as transportation, industrial, agricultural, and residential uses may experience temporary construction-related disturbances and intermittent, infrequent interruptions due to operation and maintenance. There would be no conflicts with local zoning.	Previous land uses (e.g., industrial, agricultural, and residential) surrounding the plant would be diminished or required to change to be compatible with the Project. Only a few parcels within the Project area would require zoning changes to be consistent with local plans. Some parcels within the Project area (water pipeline right-of-way, transmission right-of-way) may require a change in land ownership.	More than 25 percent of the land surrounding the Project features (plant, water pipeline right-of-way, transmission right-of-way.) would require a change in land ownership. All land use (e.g., industrial, agricultural, and residential) on these parcels would be discontinued. Most parcels of land within the Project area would require zoning changes to be consistent with local plans.

3.5.2.2 Operation

Operation of the Project would restore industrial use activities associated with energy production to the site previously used in the manufacture of paper products. The existing brownfield site would be converted to an active property consistent with neighboring industrial uses such as battery recycling, historic sugarcane mill, hardware store, and transmission substation. Residences in the area are few and separated by open agricultural spaces; however, they could be affected by this revitalization of the property and the potential changes this would bring to the area. Potential changes on traffic patterns are discussed in Section 3.8, *Transportation*, and changes in noise levels are discussed in Section 3.7, *Acoustic Environment*. The proposed use of the plant site is consistent with the proposed Arecibo Municipal Land Use Plan and the applicable zoning. Similarly, the water pipeline would remain buried in the road right-of-way resulting in no change to the adjacent land uses. Water withdrawals would occur from water destined for the Atlantic Ocean from the El Vigía Pumping Station, which is pumped to maintain water quality for Caño Tiburones. Diverting this water to the plant would have no effect on the classification of the Caño Tiburones as a formal nature reserve. Potential effects on the water and biological resources are discussed in Section 3.2.2, *Water Resources*, and Section 3.4.2, *Biological Resources*, respectively. The transmission line would require maintenance of the right-of-way and exclude inconsistent uses within this corridor for the life of the Project.

The Project would fully comply with the public policy established by Law 292 for the Protection and Conservation of Karstic Physiography of Puerto Rico and the current rule of law, because although the Project is within the Karstic Region of the Puerto Rico North Coast, it is located on the alluvial deposits of the Río Grande de Arecibo Valley and not on typical features of karst physiography such as haystacks (mogotes) or sinks (sumideros). Moreover, the plant would be located about 1.3 miles (2 kilometers) northeast and approximately 3 miles (5 kilometers) northwest from the boundary of the priority conservation area established under Law 292.

Processing the MSW would produce fly and bottom ash. The dry weight of this byproduct is projected to be about 20 percent of the weight of the processed refuse fuel or about 420 tons per day. Energy Answers proposes to mix the fly ash with a conditioning agent and water and ship it to an EPA subtitle-D compliant landfill. The bottom ash, which represents about 75 percent of the total ash, also has the potential to be conditioned and used as construction materials (e.g., road base, foundation material, aggregate); however, Energy Answers proposes to dispose of this material at a landfill until a market for its use develops, and until such reuse is approved.

Conditioned fly ash can be used as a lining within landfills, while the coarser bottom ash can be used as road base material within a fully lined landfill that is equipped with leachate control equipment designed to collect leachate and runoff, as opposed to being considered an additional waste component. Combined ash (both fly and bottom ash) is typically used as an alternative daily cover instead of soil. As such, the Plant would provide a destination for MSW, alleviating landfill space constraints at existing landfills and creating a byproduct that would be returned to landfills, thereby reducing the total weight destined for landfills by between 80 to 90 percent and thereby slowing the rate at which landfills reach capacity.

As described in Section 1.3, *Purpose and Need*, landfill space and capacity have become limited. Diverting 2,300 tons per day of MSW to the plant for processing would result in the production of ash that requires landfilling. Assuming the plant converts 20 percent of the processed refuse fuel to ash (dry basis), this would result in about 420 tons per day or about 140,000 tons per year, considering the annual Project availability. Over a 30 year period, the plant would generate about 4.2 million tons of ash. Assuming all of this ash was sent to a landfill and used as an alternative daily cover, landfill space would not be compromised. Using a standard conversion for sand and gravel, 315 tons equals about 225 cubic yards of ash disposal per day. Federal regulations require landfill operators to use a minimum of 6 inches (15.2 centimeters) of earthen materials as daily cover; however, regulations also allow for the use of alternative covers such as ash, which would eliminate the need for excavation and transport of soil at the landfill site. Use of the mixed ash as a landfill cover would further extend the capacity of the landfills by not using capacity for the burial of the entire ash waste load.

Overall, operation of the Project would revitalize a brownfield site. Changes in land use surrounding the plant are unlikely to occur given the potential for flooding and existing industrial uses in close proximity to the Project. Landfill life expectancies would be extended via the transformation of the MSW to ash slowing the rate at which landfill capacities would be reached. As a result, land uses are likely to remain unchanged for the long term. Overall, the Project would result in low intensity level changes to land use surrounding the Project site.

3.6 VISUAL RESOURCES

3.6.1 Affected Environment

The proposed Project is located about 1.25 miles (2 kilometers) from the city of Arecibo within the Río Grande de Arecibo floodplain. The overall area is characterized by tropical and subtropical moist broadleaf forest, mountains, floodplains, and coastal shorelines. Local elevations range from just above sea level to about 1,700 feet (530 meters) msl.

The components of the proposed Project would be located in an area that is visually characterized by broad, flat floodplains/agricultural lands bordered by highly vegetated mountains to the south and the Atlantic Ocean to the north. This tropical environment is conducive to rapid colonization of new vegetation to disturbed lands and dense vegetation obstructing views across the flat floodplain areas. Longer views are possible from elevated locations outside the floodplain. The proposed Project would occupy the former Global Fiber Paper Mill property within the floodplain with the water pipeline and transmission line running across the Río Grande de Arecibo floodplain. The floodplain is mostly flat and is bordered by mountains to the south that gradually wrap around the river, sloping to the ocean just west of the city of Arecibo. The communities of Arecibo, Cambalache, Domingo Ruiz, Tanama, and Bajadero are located around the floodplain within 2–3 miles (3.3–4.8 kilometers) from the paper mill site. There are no visual resource inventories, management classes, frameworks, or systems in place for lands in and around the proposed Project.

3.6.1.1 Existing Site-specific Aesthetics

Plant Site

Most of the proposed plant site has been previously altered by activities associated with the former Global Fibers Paper Mill. Natural topography was modified to accommodate the construction of the paper mill structures, ponds, channels, and other elements throughout the site. The remaining steel skeletal structures on the west side of the property have been stripped of their outer walls, exhibiting deteriorated conditions. The remaining structural elements contrast with the surrounding vegetation; however, this site is an abandoned industrial site along PR-2, neighboring an abandoned sugar mill, and close to the battery recycling plant. Alfalfa farming or fallow plots is the dominate land use throughout the floodplain. Unmaintained vegetative growth on the property obstructs most views and limits sight distances from 10 to a few hundred feet at most on the property. In addition to the abandoned sugar mill and battery recycling plant, other neighboring properties are predominantly rural, with some clustered residential and industrial properties along PR-2 south of the proposed plant site. Farther southeast of the proposed plant site, the topography rises out of the valley and residential housing increases. North and west, the topography is flat and dominated by the presence of the Río Grande de Arecibo. Sight lines throughout the area towards the plant site are obstructed by herbaceous and shrub vegetation along farm property lines, surrounding the river and the overgrowth at the property from lack of maintenance since the mill closed. A small cluster of residential structures are nearby.

Although the landscape is relatively flat at the proposed plant site, views are obstructed by roadside vegetation before the landscape opens up across the agricultural lands. Fields are separated by tree lines further diminishing the views across open agricultural areas while some fields are fallow and full of quickly colonizing stands of shrubs and other tall vegetation. Human-made disturbances that visibly stand out from the landscape include roads, transmission line, the two brick stacks from the abandoned sugar mill, and the working stacks from the Cambalache power plant on PR-681 north of the plant site.

Transmission Line and Pipeline

The proposed water pipeline would be co-located in the road right-of-way along PR-681, PR-6681, and PR-2. The proposed pipeline corridor would consist mainly of relatively flat to gently sloping topography providing good sightlines to motorists using the corridor. Similar to other areas in region, the area is dominated by the colors and textures of the physical landscape, including asphalt, vehicles, guardrails, road markings, signage, and shoulder vegetation. The proposed transmission line would exit the plant and cross the neighboring abandoned sugar mill property to the south connecting with the existing substation about 0.75 mile (1.2 kilometers) away.

Almost all of the visible features throughout the Río Grande de Arecibo Valley are the result of modifications to the landscape from human settlement in and around the area. These include farming; residential and commercial developments; flood control measures; transportation infrastructure like roads, bridges, airports, communication towers, and power plants; and transmission and distribution lines. The expansive scale of the floodplain and flat topography of the valley are muted and minimized by the presence of these visual obstructions and the fast growing vegetation. The overall character is typical for the regional landscape setting in Puerto Rico.

3.6.1.2 Key Viewpoints Associated with the Project

Many of the features associated with constructing the proposed Project would be visible from public roads or lands that adjoin the proposed Project site. Changes to the landscape would be most visible to people who use PR-2 and less noticeable from PR-681, Highway PR-22, and the area near the residences along Avenue Domingo Ruiz south of the proposed Project and along PR-10 on the southeast side of Arecibo. **Figure 3-15** shows the locations of the key observation points; representative photos from each location are included in Appendix B.

Figure 3-15. Locations of Representative Viewpoints near the Proposed Project

Avenue Domingo Ruiz

The community of Domingo Ruiz is located about 1.3 miles (2 kilometers) from the proposed Project. Avenue Domingo Ruiz runs north-south along the western edge of this community and intersects with PR-2 at the north end of the road. Views from Avenue Domingo Ruiz towards the former paper mill site capture a typical setting within the area, with foreground views of overgrown agricultural fields and tree lines around the property obstructing longer views across the flat valley. A pair of brick stacks at the old sugar mill are visible in the distance.

PR-2

PR-2 is the main travel route connecting Arecibo to the north with Domingo Ruiz and communities south. Between these two areas, the flat floodplain is marked with sparse residential structures; extensive agricultural fields; and some commercial, industrial, and abandoned buildings, including the former paper and sugar mills. The road runs primarily through the middle of the valley and views along the road provide direct access to the proposed property. Trees and other tall vegetation left to grow along property lines paralleling PR-2 provide intermittent views beyond the road corridor to motorists using this route.

Yacht Club Parking Lot

The Yacht Club parking lot is located 1 mile (1.6 kilometers) north of the proposed Project site, along PR-681. When the marina is open, it is very busy and almost completely full with boats parked in each of its approximately 100 slips. The view out to the ocean is this location's key viewpoint. PR-681 is the main travel route for this location. Besides the Ocean view, the areas surrounding the marina are mostly forested, so there are no direct views to the proposed Project from this location, although some of the Cambalache Power Plant's taller stacks are visible in the direction of the Project site.

Intersection of PR-2 and PR-6681

The intersection of PR-2 and PR-6681 is about 0.5 mile (0.8 kilometer) north of the proposed Project along PR-2. This area has some fields to the south, with wooded areas to the north and east. To the west are some smaller buildings surrounded by woody landscapes. Also to the south, across the flat field, are the remaining buildings on the Project site peeking over the tree tops.

Intersection PR-10 and PR-2 near Arecibo

Motorists traveling east on PR-2 leaving Arecibo, have a view into the distance over the existing tree line as the road transitions out of the city and across the floodplain. Driving farther east, drivers cross over the multiple channels of the Río Grande de Arecibo. These crossings have mostly forested areas on each of their banks. None of the remaining former paper mill structures are visible looking southeast toward the proposed Project site because of the tree cover around the site.

PR-2 near Residences

Views from PR-2 near the small community of residences just south of the proposed plant site are dominated by the divided highway. Mature trees line both sides of the highway precluding continuous direct views into the adjacent lands, most of which are farmed or were farmed in the past and are now overgrown. This is also the case with views into the former paper mill property. Motorists using PR-2 through this stretch of road are exposed to typical highway visual resources such as signs, pavement, intersections, and the adjacent property features. PREPA transmission lines parallel the east side of the highway connecting the Cambalache Power Plant north of this site and the existing substation where the proposed Project would connect. The lines cross the highway south of these residences and the former paper mill property.

PR-10 near the Baseball Stadium

Views from near PR-10 on the southeast side of Arecibo near the baseball stadium toward the proposed Project site include low lying agricultural lands in the foreground and the former sugar mill stacks in the middle ground distance. Views looking east capture the flat terrain of the floodplain with no tall features in the skyline visible beyond the brick stacks of the former sugar mill.

PR-22 West of PR-10

PR-22 is a four-lane divided highway along the north shore of the island. West of the Río Grande de Arecibo, the highway crosses the foothills and descends in elevation towards the floodplain, offering sweeping, albeit short-lived views to motorists traveling through this area, across the floodplain. The elevated position of this viewpoint provides unobstructed views of the existing structures of both the former paper and sugar mill sites. The roof of the former paper mill site is clearly visible due to its white color and rectangular shape, which contrast with the mostly natural vegetation and flat topography in the near ground. These structures are the central feature in the middle ground viewing area as motorists travel east on PR-22 down the modest grade.

3.6.2 Effects Analysis

Construction and operation of the proposed Project would use the existing Global Fibers Paper Mill property and redevelop the industrial site into a new WTE project, introducing visual elements similar to those that existed on the site in the past. These elements would include buildings, modifications to the road network, stacks, water pipelines and transmission line, landscaped grounds, fences, and water detention ponds.

This section discusses the potential effects of the proposed Project on the visual resources throughout the Río de Arecibo Grande Valley. The intensity of the impacts visual resources can be described through the thresholds shown in **Table 3-27**.

Table 3-27. Visual Resources Impacts Context of Intensity of Effects

Visual Resources			
Context (Duration)	Low Intensity	Moderate Intensity	High Intensity
Short term: During construction period Long term: Life of the project (30 years)	Proposed changes could attract attention but would not dominate the view or detract from current user activities.	Proposed changes would attract attention and contribute to the landscape but would not dominate. User activities would remain unaffected.	Changes to the characteristic landscape would be considered significant when those changes dominate the landscape and detract from current user activities.

No new roads would be developed to access the Project site, because access to the site already exists; however, new entrances and exit driveways would be built. Construction in the road right-of-way would be required to place the water pipeline. This pipeline would be buried and out of view once the Project is operational. The area above the pipeline would be resurfaced with the native material and maintained to protect the pipeline (e.g., mowing).

Construction of the transmission line would occur within a 25-foot (7.6-meter) right-of-way, resulting in effects on a total of 1.5 acres (0.6 hectare) that would be required for the lines. The transmission line would connect to an existing substation on land neighboring the former Central Cambalache Sugar Mill property, a distance of about 0.5 mile (0.8 kilometer).

Energy Answers proposes a landscaping plan that would help minimize the visual contrast with the construction and operations of a new facility at the currently unmaintained property.

The most common views of the construction activity and the resulting changes in landscape would be from public roads. To most viewers, construction within the existing footprint of the former paper mill would bring activity to the vacant parcel similar to past operations. Construction activity would include active heavy machinery and earth-moving equipment associated with developing the new structures at the site.

Because of its location in the floodplain along PR-2 and its relatively obstructed setting, a portion of construction activities at the plant site would be visible from parts of Domingo Ruiz and Arecibo. Activities would be most visible to people traveling along the local roads in the vicinity of the plant site; however, the overall ability to see specific activities on the site would be difficult because vegetation along the road would disrupt the view, and the speed of the vehicles passing the site would create relatively short viewing times. Motorists travelling on PR-2 in the vicinity of the plant site represent the largest number of viewers potentially affected by construction, while the residents in the small community along PR-2 would have the greatest viewing times as a result of their proximity. The view of construction activities would become more prominent after the elevation of the site is increased above the base flood elevations. The clearing of vegetation along PR-2 would provide clear sight lines into the property allowing longer viewing times; however, the speed passing vehicles would remain unchanged resulting in short viewing windows.

Construction of the water pipeline would be in the road right-of-way adjacent to PR-681, PR-6681, and PR-2 and would be clearly visible to passing motorists. Activities would focus around the exposed trench as workers install the proper substrate, pipe, and backfill material. Construction would introduce a visible scar along the road right-of-way; however, the tropical environment should aid in a fast vegetative recovery over the pipeline. Transmission line construction activities would introduce heavy machinery into the plant area and along the property line closest to PR-2 across the Central Cambalache Sugar Mill property to connect with the existing substation. Construction would require clearing of existing material and the setting of steel poles every 150 feet (45.7 meters).

Construction activities of the plant, water line, and transmission line would likely last up to 3 years. Although construction equipment and activities could be visible from numerous viewpoints throughout the area, the majority of people viewing the construction would be motorists passing the active construction areas. As a result, the impact of these changes on the landscape character during construction would be moderate.

Effects of Operations on Viewsheds

Under Energy Answers' proposal, the buildings and transmission line would introduce new and different uses to the former Global Fibers Paper Mill site. Proposed buildings would be visible from areas within the Río Grande de Arecibo Valley; however, the details would be difficult to ascertain depending on the viewpoint because the features would typically be in the viewer's middle ground and obstructed by vegetation in the foreground. These new structures would supplement and restore industrial uses to the currently vacant and neglected property. The presence of the proposed stack would introduce a new tall visual feature currently absent from the plant site; however, the adjacent abandoned sugar mill has two such stacks, albeit slightly lower, on its property. Photosimulations from key observation points around the Río Grande de Arecibo Valley depict the potential new visual elements that the proposed Project would introduce to the area (Appendix B).

Because the elevation of the Project would be raised to site the plant above the base flood elevation, the buildings would be most visible to viewers in the foreground and middle ground distance, with diminished visibility proportional to the observer's distance. Views of the new facilities, most notably the 351-foot (107-meter) tall plant stack could be visible from parts surrounding the Río Grande de Arecibo floodplain; however, the narrow lines would be muted in the greater landscape. In the foreground and middle ground view distances, the new buildings, truck traffic, and landscaped grounds would restore a former industrial site currently in dilapidated conditions from years of abandonment and neglect.

The transmission line would be most visible to motorists on PR-2 passing in front of the plant and substation properties because the line would run along the road just outside the road right-of-way in a new right-of-way. Because there are existing steel pole transmission lines running along the east side of PR-2 that connect to the existing substation, the operation of the new line would create a modest increase to the industrial development along this stretch of road. Structures built with a dull finish would be consistent with construction trends designed to minimize visual contrast from new transmission line. Operation of the water pipeline would not be noticeable because the pipeline would be buried.

Overall, operation of the proposed Project would result in new visual resources in the existing landscape. The new buildings and landscaped exterior of the plant site would replace the abandoned mill and introduce new structures to the former industrial site. Raising the plant footprint above the base flood elevation would increase its visibility from middle ground distances. These changes would result in moderate intensity level changes to the visual resources surrounding the Project site.

3.7 ACOUSTIC ENVIRONMENT

3.7.1 Affected Environment

3.7.1.1 Background

Noise is defined as unwanted sound. The degree to which unwanted sounds can impact the human environment ranges from levels that interfere with speech and sleep to levels that can cause adverse health effects, such as hearing loss and psychological effects. Human response to noise is subjective and can vary greatly between different people. Factors that influence an individual's response to unwanted sound include the frequency, intensity, pattern, time of day, amount of background noise, and the nature of the work or human activity that is exposed to the noise source.

Transient noise sources, such as passing aircraft or motor vehicles, produce noise usually of short duration. Stationary sources such as urban freeways, commercial and industrial facilities, and transmission lines, substations, and transformers can emit noise over a longer period. Ambient noise at any one location is all noise generated by typical sources such as traffic, neighboring businesses or industries, and weather (wind or rain). The ambient noise level is typically a mix of noise from natural and man-made sources that may be near or distant.

Sound is made up of tiny fluctuations in air pressure. Sound, within the range of human hearing, can vary in intensity by more than one million units. Therefore, a logarithmic scale, known as the decibel (dB) scale, is used to quantify sound intensity and to compress the scale to a more manageable range.

Sound is characterized by both its amplitude (how loud it is) and frequency (or pitch). The human ear does not hear all frequencies equally. In fact, the human hearing organs of the inner ear deemphasize very low and very high frequencies. The A-weighted decibel (dBA) is used to reflect this selective sensitivity of human hearing. This scale puts more weight on the range of frequencies where the average human ear is most sensitive and less weight on those frequencies that humans do not hear as well. The human range of hearing extends from approximately 3 dBA to around 140 dBA. **Table 3-28** shows a range of typical noise levels from common noise sources.

Table 3-28. Common Noise Sources and Noise Levels

Sound Pressure Level (dBA)	Typical Sources
160	Jet aircraft takeoff
140	75-piece orchestra
110	Blaring radio
100	Auto on highway
90	Voice – shouting
70	Voice – conversational level
30	Voice – very soft whisper

Source: EPA (1973)

Environmental noise is often expressed as a sound level occurring over a stated period of time, typically 1 hour. When the acoustic energy is averaged over a stated period of time, the resulting equivalent sound level represents the energy-based average sound level for that period. This is called the equivalent continuous noise level (L_{eq}), and it represents an energy-based average (or mean) noise level occurring over a stated time period. The L_{eq} represents a constant sound that, over the specified period, has the same acoustic energy as the time-varying sound. This metric is used as a baseline by which to compare project-related noise levels (i.e., noise modeling results, which are also expressed as an hourly L_{eq}) and to assess the potential project-related noise increase over existing (or ambient) conditions.

3.7.1.2 Federal Guidelines

Federal codes, primarily the Occupational Safety and Health Act of 1970, exist that address worker exposure noise levels. These regulations would be applicable during construction and operation of the Project. These codes limit worker exposure to noise levels of 85 dB or lower over an 8-hour period. EPA (1974) has established general guidelines for noise levels in sensitive areas. These general guidelines have been established to give state and/or local governments' guidance in establishing local laws, ordinances, rules, or standards. EPA guidelines suggest that the average residential outdoor noise level should be 55 dB and the indoor level should be 45 dB. The indoor level also applies to hospitals, schools, and libraries.

3.7.1.3 Puerto Rico Noise Pollution Control Regulations

Noise Pollution Control Regulations have been adopted by EQB (*Puerto Rico Noise Pollution Control Regulation, Amended Version*, 1987) and establish different sound level criteria for daytime and nighttime hours. As defined by EQB, the daytime period begins at 7:01 a.m. and ends at 10:00 p.m., with the nighttime period beginning at 10:01 p.m. and ending at 7:00 a.m.

Maximum noise levels have been established for four categories of land use—residential, commercial, industrial, and quiet zones (Zones I, II, III and IV). **Table 3-29** identifies the noise levels prescribed by EQB for the four zones.

Table 3-29. Noise Level Limits

Emitting Source	Receiving Zones Noise Levels dBA							
	Zone 1 (Residential)		Zone 2 (Commercial)		Zone 3 (Industry)		Zone 4 (Quiet)	
	Day	Night	Day	Night	Day	Night	Day	Night
Zone I	60	50	65	55	70	60	50	45
Zone II	65	50	70	60	75	65	50	45
Zone III	65	50	70	65	75	75	50	45

Source: EQB (1987)
Note: Units = noise level exceeded 10% of the measurement period (L_{10})

EQB uses a dBA that is exceeded 10 percent of the time for the period under consideration as its unit of measurement. This is the noise level exceeded for 10 percent of the time of the measurement period. For example, a noise limit of L_{10} 75 dBA means that over a period of one hour, the noise from regulated activities can only exceed 75 dBA for a total of 6 minutes or, 1 minute over a period of 10 minutes.

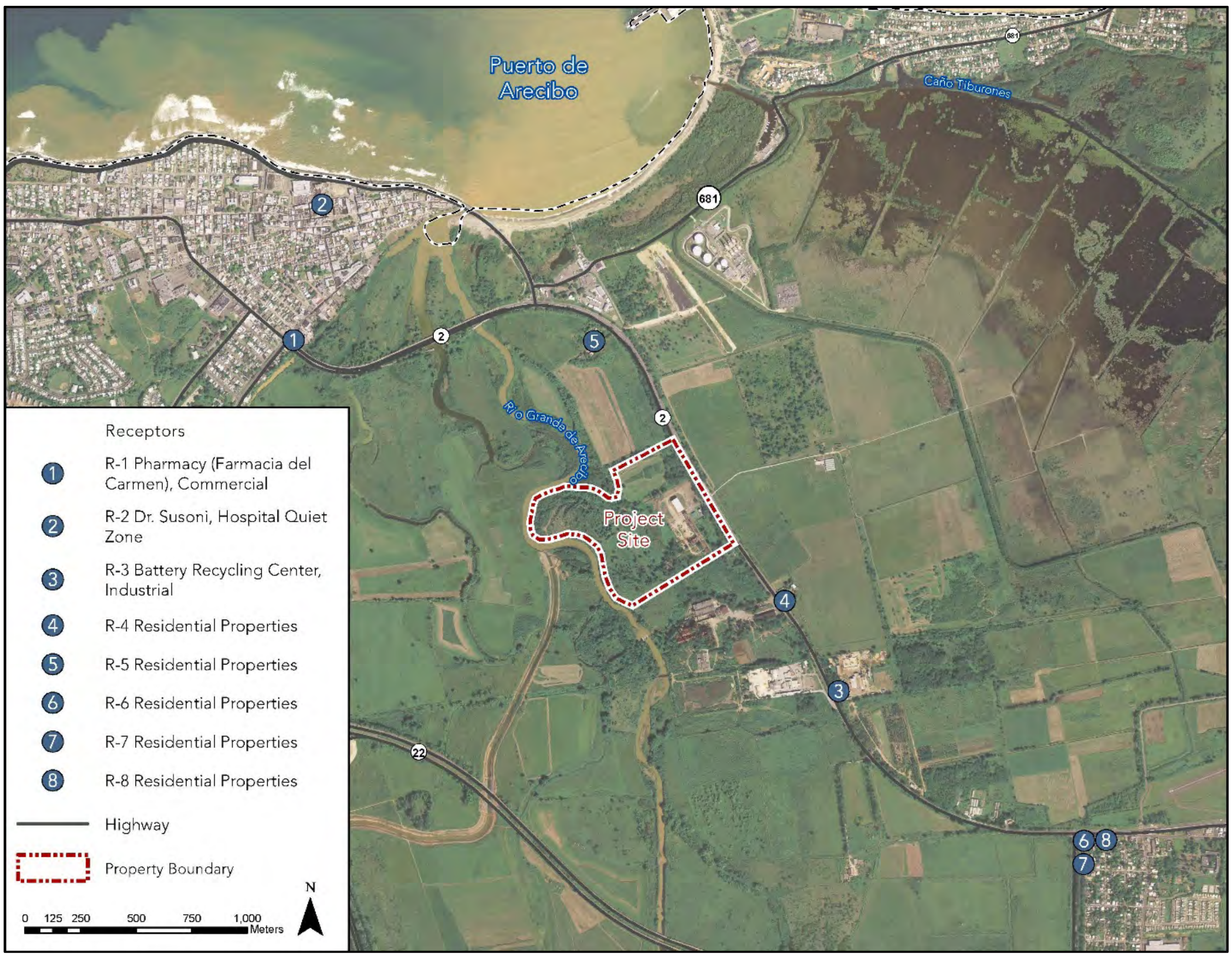
In accordance with the Regulation for the Control of Noise Pollution provisions, the noise level limits in **Table 3-28** are adjusted depending on the level of ambient noise at a sensitive receptor. For example:

- If existing noise levels are less than the level specified in **Table 3-29** by more than 5 dBA, the limits specified in **Table 3-29** are applied
- If existing noise levels are less than the level specified in **Table 3-29** by less than 5 dBA, 3 dBA are added to the limits

- If existing sound levels are greater than the level specified in **Table 3-29**, 5 dBA are added to the limits specified
- For any stationary noise source that emits noises in cycles, or in repetitions of impulsive noises, the limits specified are reduced by 5 dBA

3.7.1.4 Baseline Noise Levels

To establish baseline sound levels, Energy Answers measured sound levels at sensitive receptors during the daytime and nighttime hours. These receptors are described in **Figure 3-16** and on **Table 3-30**. The selected receptors (R1 through R5) correspond to the closest locations that represent each of the four zones (Zones I, II, III, and IV) in which the greatest noise impact from a Project is expected to occur. In addition, three receptors (R6, R7, and R8) were selected along PR-2 to characterize existing daytime traffic-related noise levels in nearby residential areas.



Source: CSA (2010d), NRCS (2014), digitized by Louis Berger

Figure 3-16. Noise Sensitive Receptor Locations

Table 3-30. Noise Sensitive Receptors

Receptor	Zone Classification	Description
1	Zone II – Commercial	Farmacia Del Carmen
2	Zone IV – Quiet	Hospital Dr. Susoni
3	Zone III – Industrial	Battery Recycling, Inc.
4	Zone I – Residential	Residential Properties
5	Zone I – Residential	Residential Properties Santa Barbara Parcel
6	Zone I – Residential	Domingo Ruiz Ward (Residential)
7	Zone I – Residential	Domingo Ruiz (Residential)
8	Zone I – Residential	Domingo Ruiz (Residential)

Source: CSA Group (2010d)

Sound level measurements were taken at these receptors on January 21 and 22, 2010, and again on February 16, 2010, and March 27, 2010, during daytime and nighttime periods. Note that nighttime noise measurements were not made for Receptors 6-8. The results of these measurements are provided in **Table 3-31**.

Table 3-31. Baseline Sound Levels

Receptor	Measurement Period	Monitored Level	
		L_{eq} dB(A)	L_{10} dB(A)
1	Day	66.2	68.1
	Night	63.1	66.0
2	Day	66.8	68.8
	Night	66.7	68.8
3	Day	74.1	78.3
	Night	68.9	73.9
4	Day	71.1	74.9
	Night	66.8	70.3
5	Day	61.1	64.0
	Night	60.1	63.5
6	Day	61.0	66.9
	Night	N/A	N/A
7	Day	56.6	62.1
	Night	N/A	N/A
8	Day	70.7	72.0
	Night	N/A	N/A

Source: CSA Group (2010d)

3.7.2 Effects Analysis

Impacts on the acoustic environment include those from construction and operation of the Project. Construction equipment and vehicles would use highways and local roadways to access the Project site. Large equipment, including, drill rigs, cranes, low boys, large trucks, bucket trucks, graders, excavators, and dump trucks would be required to construct the plant, excavate and install the waterline line, and pull the transmission line. Operation of the plant would include truck traffic to haul MSW on site and recoverables, recyclables, and wastes off site in addition to the constant combustion of the processed shredded fuel and and generation of electricity. Potential noise impacts are commonly divided into two groups: temporary and long term. Temporary impacts are associated with noise generated by construction activities. Long-term impacts are associated with impacts on surrounding land uses generated by operation of the Project and those impacts that occur at or in close proximity to the Project site. The intensity of the impacts on land use are in **Table 3-32**.

Table 3-32. Acoustic Environment Impacts Context and Intensity Definitions

Acoustic Environment			
Context (Duration)	**Low Intensity**	**Moderate Intensity**	**High Intensity**
Short term: During the construction period Long term: Life of the Project (50 years)	Noise impacts could attract attention, but would not dominate the soundscape or detract from current user activities.	Noise impacts would attract attention, and contribute to the soundscape, but would not dominate. User activites would remain unaffected.	Impacts on the characteristic soundscape would be considered significant when those impacts dominate the soundscape and detract from current user activities.

The assessment of potential noise impacts considers the introduction of anticipated noise levels generated during Project construction and operation to ambient noise levels in areas where sensitive receptors exist. The Project would have a significant effect on the environment if noise generated during construction or operation would:

- Result in a significant increase in noise levels to sensitive receptors in the area
- Conflict with applicable noise restrictions or standards imposed by regulatory agencies

3.7.2.1 Construction

Construction activities could cause an increase in sound that is well above ambient noise levels. Noise sources from Project construction activities would include equipment that is typically found at large-scale construction sites. A variety of sounds are emitted from graders, loaders, trucks, pavers, and other work activities and processes. Construction equipment usually exceeds the ambient sound levels by 20 to 25 dBA in an urban environment and up to 30 to 35 dBA in a quiet suburban area (EPA 1971). **Table 3-33** presents a list of construction equipment that might be used for the Project and associated noise levels that would result from their use.

Table 3-33. Noise Level Ranges of Typical Construction Equipment

Construction Equipment	Noise Levels in dBA at 50 feet (15 meters)*
Trucks	82–95
Cranes (moveable)	75–88
Cranes (derrick)	86–89
Vibrator	68–82
Saws	72–82
Pneumatic Impact Equipment	83–88
Jackhammer	81–98
Pumps	68–72
Generators	71–83
Compressors	75–87
Concrete Mixers	75–88
Concrete Pumps	81–85
Front Loader	73–86
Back Hoe	73–95
Pile Driving (peaks)	95–107
Tractor	77–98
Scraper/Grader	80–93
Paver	85–88

Source: EPA (1971)

Note: *Construction equipment equipped with noise control devices would be expected to generate lower noise levels than shown in this table.

Construction activities with higher noise levels, such pile driving, would primarily be limited to occur only during daytime hours. Noise levels at 15 meters (50 feet) from earth-moving equipment typically range from 73 to 96 dBA. Construction equipment noise typically has a drop-off rate of 6 dBA per doubling of distance (EPA 1971). Based on this standard, noise levels associated with the earth-moving equipment would be approximately 67 to 90 dBA at 30 meters (100 feet) from the source.

Noise associated with construction activity at the nearest existing residences (approximately 1,700 to 1,900 feet [520 to 580 meters]) from the nearest proposed construction area) would not be perceptible, especially given the ambient noise sources in the area. Noise associated with the loudest construction activity, pile driving or the installation of sheet pile, would increase the sound level at the closest residence, Receptor 4, by less than 1 dBA, a level that is imperceptible. Therefore, the anticipated off-site noise levels during the construction phase would not be expected to noticeably increase the existing ambient noise environment within the Project area.

The active construction phase of the Project is projected to last approximately 3 years, with the balance of the approximately 42 month construction schedule dedicated to commissioning and startup. Pile driving, expected to occur over a 13 month period, is the construction activity expected to produce the most noise. However, based on the noise impact results during the construction phase of the project, no significant increases in noise levels are expected during the pile driving activities at any receptors, because the closest receptor (Receptor 4) to the Project is approximately 1,800 feet (550 meters) away. Additionally, pile driving activities would be conducted during the day. Because construction noise levels associated with the proposed Project would be temporary, and Energy Answers would adhere to EQB noise regulations, the construction noise from the Project would be short term and of moderate intensity.

3.7.2.2 Operation

The Project’s operation is expected to increase the noise levels at the receptors surrounding the property due to noise from facility operations and increased truck traffic accessing the site. **Table 3-34** describes the primary equipment that would be used within the Project that could generate noise impacts on the surrounding areas to the site.

Table 3-34. Operating Equipment Noise Levels

Potential Noise Sources	Noise Levels in dBA
Truck maneuver area	75
Tipping floor activity	85
Shakers	55
Boilers	78
Cooling tower	85
Blowers	95
ID fans (casings)	43
Building vent fans	63
Dust collector systems	70

Potential Noise Sources	Noise Levels in dBA
Condensers	92
Transformers	60
Steam generators	75
Deareators	100
Precipitators	96
Stack	93

Source: CSA Group (2010d)

Note: Sound levels are for all three system modules combined without sound attenuation by silencers, buildings, and shielding.

Most of the equipment described in **Table 3-34** would be located within the plant buildings. Therefore, it is estimated that the noise generated from this equipment would be reduced from 10 to 15 dBA.

Table 3-35 and **Table 3-36** describe the noise levels that would be generated by the equipment operation on the receptors located closer to the plant for daytime and nighttime, respectively. The location of the equipment was estimated using the Project's site plan. Calculations were performed using the noise levels generated by the deareators operation (100 dBA), because it would be the noisiest equipment in the plant. A deaerator is a device that is widely used for the removal of air and other dissolved gases from the feedwater to steam-generating boilers. Deareators would be located inside a building. The interior of the building may provide some noise attenuation to the emission source and the receptors under evaluation; therefore, a reduction of 20 dBA was estimated.

Table 3-35. Estimated Daytime Noise Impact

Receptor	Distance to Receptor (Feet)	Daytime Noise Levels dBA				
		Background L_{10}	Maximum Expected Level	L_{10} Due to Operation	Total Combined L_{10}	Daytime Regulation for Operation
1	5,380	68.1	38.8	41.8	68.1	70
2	6,214	68.8	37.6	40.6	68.8	55
3	3,363	78.3	42.8	45.8	78.3	80
4	1,795	74.9	47.0	50.0	74.9	70
5	1,916	64.0	45.1	48.1	64.2	68

Source: CSA Group (2010d)

Table 3-36. Estimated Nighttime Noise Impact

Receptor	Distance to Receptor (Feet)	Nighttime Noise Levels dBA				
		Background L_{10}	Maximum Expected Level	L_{10} Due to Operation	Total Combined L_{10}	Nighttime Regulation for Operation
1	5380	66.0	38.8	41.8	66.0	70
2	6214	68.8	37.6	40.6	68.8	50
3	3363	73.9	42.8	45.8	73.9	78
4	1795	70.3	47.0	50.0	70.4	55
5	1916	63.5	45.1	48.1	63.7	55

Source: CSA Group (2010d)

The noise impact assessment showed that there would essentially be no change in the noise level due to the operation of the plant during daytime hours because of the distance between the plant and the receptors and the existing high ambient noise levels. The total combined levels at Receptors 2 and 4 exceeded EQB thresholds limits for a quiet suburban or a residential zone; however, background noise levels from these receptors already exceeded EQB threshold limits for these zones.

Calculations of operation noise levels for the nighttime period showed a *de minimis* increase at Receptor 5 of 0.2 dBA. An increase of 0.2 dBA is not perceptible to the human ear. The total combined noise levels at Receptors 2, 4, and 5 were above EQB threshold limits for the nighttime period; however, background noise levels for these receptors already exceeded EQB noise limits for the nighttime period.

Operation of the Project would result in an increased level in vehicular traffic on PR-2 in the Project vicinity, specifically solid waste trucks that would unload waste at the plant. (Traffic is discussed in detail in Section 3.8.) A total of 227 vehicle trips would be generated per day, of which 70 percent or 159 would be heavy trucks. This is less than 2 percent of the existing traffic volume on PR-2. Even taking into account the higher noise levels generated by trucks compared to autos, noise levels along PR-2 are expected to increase by less than 3 dBA, a change that is considered barely perceptible.

All receptors are currently affected by the noise generated by the traffic of cars and trucks on PR-2 because the area is in commercial and industrial use. Ambient noise levels at Receptors 6 and 7 (66.9 and 62.1 dBA, respectively) did not exceed the Federal Highway Administration's guidelines of 70 dBA for noise abatement on Type II Highway Projects (2011); however, the ambient level at Receptor 8 did. It is important to note that Receptors 6 and 8 are located less than 25 feet (8 meters) from PR-2, which in this area is a four-lane divided highway, and Receptor 8 is less than 1,100 feet (345 meters) from Antonio Nery Juarbe Airport.

Operation of the Project is not expected to increase the noise levels already experienced in the area or surrounding areas during the daytime or nighttime periods. The noise from plant operation would therefore be long term and of low intensity.

Energy Answers proposes the following construction noise mitigation measures:

- Restrict construction activities to daytime hours (7:00 a.m. to 7:00 p.m.)
- Ensure that all construction equipment has noise mufflers and is in good working order
- Incorporate the use of silencers into the equipment to be used during the operation of the Project
- Position the noisiest equipment as far away as possible from the most sensitive areas

Construction noise would also be mitigated by some of the air quality construction impact mitigation measures, such as limitations on idling and vehicle speeds.

3.8 TRANSPORTATION

3.8.1 Affected Environment

3.8.1.1 Roads and Traffic

The northwest area is served by an excellent road network that consists mainly of primary and secondary roads. This network has been improved as follows.

The construction of primary and secondary roads allow easy access from north to south, east to west, or around the island, considerably shortening travel time and connecting to the tertiary roads system. This network of primary and secondary roads is used by freight trucks to transport food and general merchandise to commercial and industrial sectors at different areas of the island and also is used by private vehicles. The roads are defined below according to the Federal Highway Administration Manual of Uniform Devices for Traffic Control (Federal Highway Administration 2009) of Department of Transportation and Public Works, as amended.

- Highway is an arterial roadway system divided by a central median, with or without frontage road, with full access control and overpass intersections with all other public roads.
- Main road is a road that typically has the highest traffic volume in its access to an intersection.

- Secondary road is a road that typically has lower traffic volume in its access or accesses to an intersection.

The main connecting roads between the Arecibo region and the municipalities of the Northern Island Area include:

- PR-2 is the longest road in Puerto Rico's network system. It begins in its intersection with Ponce de León Avenue in Santurce, San Juan Municipality, and extends from east to west connecting all the municipalities of the North Coast up to the Aguadilla Municipality. From there, it extends north to south through the western part of the island, up to the Ponce Municipality. East of the Project site, PR-2 consists of four lanes, two in each direction divided by a concrete median barrier, where there are also left turning lanes at the center of the road, protected by median barriers.
- Highway PR-22 is a four-lane toll road that begins in San Juan Municipality and extends from east to west connecting the municipalities of the north side of the island ending in the Hatillo Municipality. In the vicinity of the Project site it consists of four lanes separated by a grassy median. Along the entire route, there are six alternating one-way toll plazas.
- PR-10 begins in the Ponce Municipality and extends from south to north, ending in the Arecibo Municipality. The intersection that is close to the Project site consists of four lanes with no median barrier.

From these roads, PR-2 provides excellent direct access to the Project site on its eastern side. PR-2 can be accessed from the east by Highway PR-22 or by the west from PR-10 in Arecibo (**Figure 3-17**). **Table 3-37** shows traffic volumes on PR-2 through Arecibo.

To maintain traffic efficiency on site, the Project would have separate entrances for trucks and automobiles. Each access would have two lanes—an entrance and an exit lane. Deceleration and acceleration lanes are proposed for both accesses to provide safety for those entering and exiting the project, and to reduce conflicts with oncoming traffic on PR-2. Access #1, the north entrance, would be used for heavy vehicles only. Energy Answers estimates that 75 percent of the heavy vehicles would travel from the eastern part of the island, and 25 percent would travel from the west. Access #2, the south entrance, would mainly be used as the employee/visitor entrance. Energy Answers estimates that 50 percent of the cars would travel from the eastern part of the island, and 50 percent would travel from the west.

Source: NRCS (2014), digitized by Louis Berger

Figure 3-17. Transportation Network

Table 3-37. Traffic Volumes on PR-2 through Arecibo

Route Number	Km Marker	Classification	Municipality	Location	Year	AADT
2	75.45	Primary Urban	Arecibo	Between PR-10 and Ave. Constitución	2005	21492
2	75.7	Primary Urban	Arecibo	Between Ave. Constitución and Ave. Rotario	2005	21801
2	77	Primary Urban	Arecibo	Between Calle Ángel M. Marín and Calle Unión	2005	21215
2	77.7	Primary Urban	Arecibo	Between Calle Unión and Calle de La Cruz	2005	N/A
2	72.3	Secondary	Arecibo	Between Access Highway PR-22 and PR-638	2006	29703
2	74.15	Secondary	Arecibo	West of PR-6681	2006	17425
2	76.4	Primary Urban	Arecibo	Between Calle Susoni and PR-129	2006	14794
2	76.75	Primary Urban	Arecibo	Between PR-129 and Ángel M. Marín	2006	15308
2	77.65	Primary Urban	Arecibo	Between Calle Unión and Calle de La Cruz	2006	22155
2	70.35	Primary	Arecibo	Between PR-638 and Highway PR-22 Access	2007	30364
2	70.4	Secondary	Arecibo	Between PR-638 and Highway PR-22 Access	2008	30589
2	79.26	Primary Urban	Arecibo	Between Calle De La Cruz and Ave. san Daniel	2009	19966
2	76.7	Primary	Arecibo	Between PR-129 and Calle Celis Aguilera	2010	15131
2	77.65	Primary	Arecibo	Between Calle de la Cruz and Calle Unión	2010	28102
2	70.4	Secondary	Florida	Between PR-638 and Highway PR-22	2012	23383
2	74.9		Arecibo	Arecibo Urban Limit and PR-10	2012	19632
2	76.4	Primary Urban	Arecibo	Between Calle Sulsoni and PR-129	2012	12084
2	77	Primary Urban	Arecibo	Between Calle Marín and Calle Unión	2012	11224

Source: data.Pr.gov (2012)

Note: AADT – annual average daily traffic

Energy Answers conducted a traffic study in March 2010 to assess the capacity and operation of the current traffic conditions, determine the future potential impact on major intersections around the Project site, and establish mitigation measures as a result of the operation of the Project. To this end, several field inspections were conducted at the following intersections to observe the traffic pattern in the area:

- Intersection 1: PR-2 with PR-10 and Juan Rosado Avenue
- Intersection 2: PR-2 with Victor Rojas Avenue
- Project's north entrance: located on road PR-2, Km. 73.1
- Project's south entrance: located on road PR-2, Km. 73.6

Levels of service (LOS) were used as the main criteria to describe the traffic conditions of the road network. Evaluation criteria included different types of roads and their associated components, including ramps and intersections. Category designations varied according to the conditions of the roads, the type of roads, and associated components. All references related to LOS are from the Highway Capacity Manual and the Puerto Rico Guidelines for the Preparation of Traffic Access of the Department of Transportation and Public Works.

LOS A represents excellent, ideal traffic conditions, while the LOS F represents the worst conditions and heavy vehicular congestion. LOS is based on average delays experienced by vehicles crossing intersections, both signalized and unsignalized.

The categories for each LOS are described below:

- LOS A—An excellent road condition with low traffic and high speeds
- LOS B—Very good condition with certain traffic restrictions
- LOS C—Good condition with controlled speed due to high traffic volumes
- LOS D—Acceptable condition with unstable flow and tolerable operation speeds
- LOS E—Traffic flow becomes unstable and frequent stops occur, with considerable delays and increases in vehicular congestion
- LOS F—Vehicular congestion with frequent lockstep

As part of the traffic study, Energy Answers projected that approximately 453 trips (227 vehicles) would be generated by the Project in a 24-hour period. The summary of incoming and outgoing vehicles from the Project is presented in **Table 3-38**. Approximately 30 percent of the Project's incoming and outgoing vehicles would be cars and 70 percent would be trucks (**Table 3-39**).

Table 3-38. Estimated Incoming and Outgoing Vehicles from the Project

Vehicles in 24 Hours	Enter Peak Hour Volume (a.m.)	Exit Peak Hour Volume (a.m.)	Enter Peak Hour Volume (p.m.)	Exit Peak Hour Volume (p.m.)
453	56	11	14	50

Table 3-39. Vehicle Type Distribution

Vehicle Type	Enter Peak Hour Volume (a.m.)	Exit Peak Hour Volume (a.m.)	Enter Peak Hour Volume (p.m.)	Exit Peak Hour Volume (p.m.)
Cars	17	3	4	15
Heavy Vehicles	39	8	10	35
Total	56	11	14	50

Based on the findings of the traffic study, Energy Answers proposed a number of road improvements to maintain traffic levels in the area. These improvements include:

- Intersection 1: PR-2, PR-10, and Juan Rosado Avenue—At present, drivers are using the PR-10 shoulder as an exclusive right-turning lane. Energy Answers recommends that the shoulder pavement marking be erased and a right-only lane with a storage length of 60 feet (18.3 meters) be marked. Traffic signs indicating this is a right-only lane also would be installed, and the traffic signals would be changed according to the recommendations from the appendix of the traffic study.
- Intersection 2: PR-2 and Victor Rojas Avenue—At present, drivers are using the westbound shoulder as an exclusive right-turning lane. Energy Answers recommends that the shoulder pavement marking be erased and replaced by a right-only lane with a storage length of 400 feet (122 meters). Traffic signs indicating the new right-only lane also would be installed to guide the traffic, and the traffic light time would be adapted according to the recommendations from the Energy Answers' traffic study.
- Intersection 3: PR-2 and the North entrance (Access #1) to the Project—Project design includes a 400-foot (122-meter) deceleration lane and a 350-foot (107-meter) acceleration lane to enter and exit the Project for southbound traffic. A 350-foot (107-meter) left-turning lane is proposed for northbound traffic, as well as devices to alert drivers that a truck crossing is ahead. The traffic devices would be installed according to the Manual of Uniform Devices for Traffic Control on Public Roads, DTPW 2009 Edition (*Manual de Dispositivos Uniformes para el Control del Tránsito en las Vías Públicas*). Finally, a traffic light would be installed based on the times defined in the Energy Answers' traffic study.

- Intersection 4: PR-2 and the South entrance (Access #2)—Energy Answers proposes a 400-foot (122-meter) deceleration lane and a 350-foot (107-meter) acceleration lane to enter and exit the Project site for southbound traffic. Additionally, Energy Answers proposes a 350-foot (107-meter) left-turning lane for northbound traffic, as well as the necessary devices to alert that a truck crossing is ahead. The traffic devices would be installed according to the Manual of Uniform Devices for Traffic Control on Public Roads, DTPW 2009 Edition.

During Project construction, a Maintenance of Traffic plan would be prepared and implemented in compliance with the Department of Traffic and Public Works guidelines. Once the Project is completed, pavement markings and traffic signing would be placed according to the aforementioned Manual of Uniform Devices.

3.8.1.2 Airports

Regional aviation infrastructure of the north coast of Puerto Rico includes four public-use airports, which are part of the local and national airport network. These are Fernando Luis Ribas Dominicci Airport in Isla Grande, Luis Munoz Marín International Airport in Carolina, Antonio Nery Juarbe Airport in Arecibo, and Rafael Hernández International Airport in Aguadilla. Luis Muñoz Marín and Rafael Hernández Airports are both international airports.

Antonio Nery Juarbe Airport in Arecibo is approximately 1.26 miles (2 kilometers) southeast of the Project, in the Barrio Santana, (PR-2, Km 69.5) on a 159-acre (164-*cuerdas*) site. It is 5 miles (8 kilometers) southeast from the city of Arecibo and 50 miles (80.4 kilometers) west of San Juan. The airport has passenger terminal facilities, ground transportation, and runways and taxiways with capacity for commercial flights. Originally it was used for military purposes, although it is currently used for general aviation, with an average of eight departures and arrivals daily. On March 31, 1947, the airport was transferred by the U.S. Navy to the Puerto Rico Ports Authority, along with the Mercedita Airport and the old Santa Isabel Airport.

3.8.2 Effects Analysis

3.8.2.1 Construction

It is anticipated that during the construction phase of the Project trucks hauling aggregates to modify the topography of the site would increase traffic flow. Aggregate hauling trucks and heavy equipment would have access to the Project site via PR-2, PR-10, Highway PR-22, PR-8861, and PR-861. Using an estimated 10 mile-trip (16 kilometers) (round trip) by 20 hauling trucks with capacities of 20 metric tons and 3 hours per trip for hauling aggregates (material) would generate 480 daily trips for an estimated time of 228 days. The travel time would be set from 6:00 a.m. to 10:00 p.m. This estimate is a daily average and may vary as a result of weather conditions and other factors. According to data provided to Energy Answers from the Puerto Rico Highway Department, the average daily traffic in for PR-2 in the Project area (near the intersection with PR-10) was between 19,632 (2012 count) and 21,492 (2005 count) vehicles per day. Thus, the estimated number of trips that would be generated during construction of the Project represent an increase of 2.4 to 2.2 percent in traffic volume.

However, the traffic impacts during construction of the Project would be short term (about 8 months) and modest because the road network in the area was designed to accommodate the estimated increase. Similarly, construction of the proposed Project would likely require the use of cranes for the buildings and stack. The use of cranes in large scale construction is common practice and would not have any effect on air travel at nearby airports.

3.8.2.2 Operation

Once the plant is operational, the volume of traffic entering and exiting the plant would increase by 227 additional vehicles per day. This includes the staff and administration operating the plant as well as the truck traffic arriving with MSW and departing with waste, recyclables, recoverable metals, and ash destined for landfill. These additional vehicles represent less than 2 percent of the existing number of vehicles on PR-2. Because traffic levels have not substantially changed since the Energy Answers traffic study was conducted, these conclusions are still valid.

The construction and operation of the Project would require a 313-foot, aboveground stack, which could interfere with airspace and air travel at nearby airports. On November 26, 2014, the Federal Aviation Administration issued a letter to Energy Answers indicating that the Project would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace or by the operation of air navigation facilities (Federal Aviation Administration 2014). As such, airplanes and helicopters using the nearby airport would not be compromised due to the presence of the proposed stack once the Project is operational.

3.9 CULTURAL RESOURCES/HISTORIC PROPERTIES

3.9.1 Definition of Cultural Resources and Historic Properties

This section of the EIS identifies known cultural resources in the Project area that may be potentially affected by the Project. Cultural resources would continue to be identified as consultation under Section 106 of National Historic Preservation Act proceeds.

There is no legal or generally accepted definition of “cultural resources” within the federal government; however, the term is used to refer to historic, aesthetic, and cultural aspects of the human environment. Under NEPA, the human environment includes the natural and physical (e.g., buildings) environment, and the relationships of people to that environment. Accordingly, a thorough NEPA analysis should address the human (social and cultural) and natural aspects of the environment, and the relationships between them. In meeting its requirements as the lead agency for NEPA, RUS must consider the impact of its actions on all aspects of the human environment, including “cultural resources.”

Cultural resources include archaeological sites, defined as locations "that contain the physical evidence of past human behavior that allows for its interpretation;" buildings; structures; and traditional resources and use areas (NPS 1997). Those cultural resources that qualify for listing in the National Register of Historic Places (NRHP) must meet one or more of the following criteria for evaluation.

- The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association, and:
- Criterion A—that are associated with events that have made a significant contribution to the broad patterns of our history; or
- Criterion B—that are associated with the lives of persons significant in our past; or
- Criterion C—that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- Criterion D—that yielded, or may be likely to yield, information important in prehistory or history.

In general, these resources must also be greater than 50 years in age. Properties less than 50 years of age must be exceptionally important to be considered eligible for listing, as outlined in NRHP Bulletin Number 22 (Sherfy and Luce 1998).

The NRHP is a commemorative listing of those resources significant to the American past. Those cultural resources listed on or eligible for listing on the NRHP are designated "historic properties." Under the National Historic Preservation Act, as amended 2006, "historic property" means "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register of Historic Places," including artifacts, records, and material remains related to such a property or resource (16 USC 470w). In accordance with Section 106 of the National Historic Preservation Act, 16 USC §470f, RUS is required to consider the effects of its undertakings on historic properties. The regulation, "Protection of Historic Properties" (36 CFR §800), implementing Section 106 establishes the process through which RUS and other federal agencies consider effects on historic properties in their decision making.

3.9.2 Area of Potential Effects

Pursuant to Section 106, RUS must consider whether any historic property within the Project's area of potential effect (APE) could be affected by the Project. The APE is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. In this case, the APE can be divided into two areas: the proposed renewable power generation and resource recovery plant, and the connection routes of a brackish water line and electric transmission line.

The proposed renewable power generation and resource recovery plant APE is on a property measuring 78.9 acres (82 *cuerdas*) bounded to the east by PR-2, to the north and south by vacant lots, and to the west by the Río Grande de Arecibo River.

The new brackish water line would follow about 1.9 miles (3,100 meters) in the rights-of-way of PR-2, PR-681, and PR-6681. A new electric transmission line would be extended from the existing substation, 2,789 feet (850 meters) north to the proposed plant APE across undeveloped property (Eduardo Questell y Asociados 2010a).

3.9.3 Culture History Overview

3.9.3.1 Prehistoric Context

The prehistoric cultural sequence of Puerto Rico, based on the general cultural chronology for the Caribbean, is generally divided into two periods: the Mesoindian or Archaic Period from ca 6000 calibrated years before present (cal. BP) to ca. 1900 cal. BP, and the Neoindian or Ceramic Period, from ca. 2400 cal. BP to European settlement around 1500 AD (SEAC 2009).

Mesoindian (7000 BP–2400 BP)

Ortioroid (7000 BP to 2400 BP)—The first settlers of Puerto Rico arrived on the island between 7000 cal. BP and 6000 cal. BP, after crossing the Caribbean Sea in canoes or rafts, probably from the region south of the Yucatan Peninsula (present-day Belize) (Encyclopedia of Puerto Rico [EPR] 2004). To date, the oldest known settlement on the island is at Angostura, with a calibrated date of 6900 cal. BP (Rodriguez Ramos 2007, Ayes Suarez 1988). Other early occupation sites include Hato Viejo (5190 cal. BP), Paso del Indio, Vega Baja (4860 cal. BP), Maruca, Ponce (4850 cal. BP) and Puerto Ferro, Vieques (4140 cal. BP) (Rodriguez Ramos 2007, Ayes Suárez and Dávila Dávila 1993, EPR 2004). Rodriguez presents a sequence of calibrated radiocarbon dates obtained from Pre-Arawak settlements in Puerto Rico that demonstrates a continuous occupation from first settlement to 1810 cal. BP (Rodriguez Ramos 2007). These established early sites contradict the settlement model for Puerto Rico developed by Irving Rouse in the 1950s. In this model, Puerto Rico was uninhabited until approximately 3000 cal. BP, when a preceramic population (labeled as Corosan Ortioroid) migrated to the island from Trinidad. This small, widely dispersed population, according to Rouse's model, was easily displaced by the next wave of immigrants, who began arriving in 2400 cal. BP (Rouse 1992). Rouse postulated a general settlement pattern for the Lesser Antilles that moved south to north, based on his analysis of radiocarbon dates. Rodriguez, however, argues that the presence of radiocarbon dates in Puerto Rico that predate any samples obtained from the rest of the Lesser

Antilles by more than 1000 years calls into question both Rouse's origination and directional settlement models for Puerto Rico (Rodriguez Ramos 2007).

The first inhabitants of Puerto Rico were primarily semi-nomadic or nomadic, with subsistence patterns that focused on gathering, fishing (coastal/ freshwater fish and shellfish), and small-game hunting rather than agriculture. Settling first along the coast and in mangrove swamps, they migrated as needed to follow the available food supplies and procure natural resources from the mountainous interior (EPR 2004, Vega 1992). This transitory settlement pattern is questioned by Rodriguez Ramos, who points out that recent paleo-environmental studies (Burney et al. 1994, Siegel et al. 2005, Sara et al. 2003) have indicated that pre-Arawak societies, beginning ca. 5300 cal. BP, altered the landscape, shaping the environment to suit their needs. He notes that "the early evidence for anthropogenic alterations of the environment of Puerto Rico is not only indicative of cultivation practices but might also be related to the construction of what Rhindos (1984) has labeled agrolocalities. These are built landscapes that served both to humanize the distribution of important resources and to enact a sense of territoriality in such groups" (Rodriguez Ramos 2007). Other possible markers for a higher degree of sedentism and/or territorialism in pre-Arawak societies than previously suspected include sites with multiple burials in a formal space (Ortiz [Kosti-Karell 2003] and Maruca [Crespo Torres 2004, Rodríguez López 2004]), the presence of multiple middens with configurations similar to those at long-term habitation sites during other periods (Angostura [Rodríguez López 1997, Siegel 1992]), and the presence of complete lithic tool assemblages at some sites, rather than just tools for a specific activity (Maruca, Angostura) (Rodriguez Ramos 2007).

Rouse has proposed two subseries for the Ortioroid cultures: Coroso and Krum Bay. In Puerto Rico, the Krum Bay subseries is primarily restricted to the north coast and the island of Vieques. Subsistence strategies emphasized shellfish, birds, turtles, and fish as the primary food sources. Habitation sites tended to be open air and located near the coast, and the artifact assemblage included stone, bone, and shell pendants and beads, shell picks, fairly fine-grained basalt flake tools, hammerstones, and partially ground stone celts (SEAC 2009).

Sites of the Coroso subseries occur across Puerto Rico, including all the coasts, and into the interior of the island. Both open air sites near shell middens and cave sites have been identified for this subseries. According to the faunal assemblage for Coroso sites, Early Coroso populations maintained a generalized diet of crabs, turtles, fish, and shellfish, while later Coroso groups tended to focus on shellfish as a primary source of food. Flaked tools, pebble grinders, hammerstones, pebble choppers, shell plates, and shell scrapers characterize the artifact assemblage (SEAC 2009).

Recent starch grain analysis studies conducted on Pre-Arawak stone tools from the Maruca and Puerto Ferro sites have also called into question the date for the introduction of agriculture. The analysis showed the presence in Puerto Rican Pre-Arawak contexts of such domesticated plants as maize, beans, tannia, and sweet potatoes, as well as the use of wild resources such as yam and zamia (Pagan Jimenz et al. 2005). Other studies have produced similar results for both non-native grains (maize) and local cultivated plants (zamia) (Fortuna 1980, 1981, Newsom and Pearsall 2003, Siegel et al. 2005, Veloz Maggiolo 1980). In Rodriguez Ramos view, "this evidence conclusively indicates that the origins of agriculture in the Antilles predate the entrance of both L[a] H[uerta] and Cedrosan Saladoid societies to the islands" (Rodriguez Ramos 2007).

The common assertion is that the pre-Arawak people typically took shelter in caves or rockshelters, occasionally building temporary expedient structures, since the transitory nature of culture did not warrant the construction of long-term structures (Rouse 1992). Terrestrial shell midden sites are thought to be evidence of temporary subsistence activity areas (e.g., Dávila Dávila 2003, Espenshade et al. 1986, Figueroa 1991, Tronolone et al. 1984, Veloz et al. 1975). Rodriguez Ramos, however, argues that the currently established residential patterns stem from an absence of complete archaeological analysis, as past excavations of open air pre-Arawak sites have focused on large shell middens while disregarding the surrounding space where evidence of residential features might exist. He contends that more archaeological studies focusing on the void space around these middens should be conducted in an effort to determine the presence or absence of residential features, particularly in light of the discovery of postmolds at the Maruca site in southern Puerto Rico (Rodriguez Lopez 2004, Rodriguez Ramos 2007).

The artifact assemblage of Pre-Arawak societies is dominated by lithic technologies, with an absence of ceramics. However, pottery has been recovered from Pre-Arawak contexts in north central Puerto Rico, most notably at the Cueva La Tembladera site (Martinez 1994). At other sites, the presence of pottery within Pre-Arawak contexts has been documented but has been deemed to be intrusive (i.e., Cueva Gamelos [Dávila Dávila 1981:177]), while pot shards that have returned early radiocarbon dates are seen as anomalous (e.g. Palmar de Animas [Siegel and Joseph 1993:45]). Rodriguez Ramos contends that the dismissal of such finds as "intrusive" and "anomalous" explains the low recordation of ceramics from Pre-Arawak contexts (Rodríguez Ramos 2005; Rodriguez Ramos et al. 2008). In regard to the non-ceramic technologies, several formal preceramic typologies have been produced, including Kozlowski (1974), Pina et al. (1976), Rouse (1951), and Rouse and Allaire (1978). Though the typologies may diverge in the details, the general established typology divides Pre-Arawak artifacts into three primary groups: Pattern 1, Pattern 2, and Pattern 3. Pattern 1 includes the ground stone artifacts, such as mortars, grinders, and stone balls. Pattern 2 consists of the flaked stone artifacts, such as lanceolate points, knives, choppers, and scrapers, with the occasional presence of ground stone tools. A shell tool assemblage containing tools such as gouges, utilized conch vessels, and picks, characterizes Pattern 3 (Vega 1992). Rodriguez Ramos (2007) provides an extensive analysis of the ground and flake stone tool technologies of Pre-Arawak societies in Puerto Rico.

Major sites of the Ortoiroid period in Puerto Rico include the Corosan sites of Cueva de María la Cruz (Loíza Cave), Cayo Cofresí, Coroso site, and Playa Blanca, and the Krum Bay site of Cana Hondo on the island of Vieques (SEAC 2009).

Neoindian [2400 cal. BP to 500 BP]

Saladoid/Huecoid (2400 BP to 1400 BP) — According to the traditional view of Puerto Rican prehistoric settlement, the pre-Arawak societies of Puerto Rico were displaced by the arrival of the people from the Arawak linguistic group, who began migrating to the island from the middle and lower Orinoco Basin (present-day Venezuela) around 2400 cal. BP (Rouse 1992, EPR 2004). This new influx of people brought with them a major shift in subsistence practices, settlement patterns, societal organization, and technologies. Among the major changes visible in the archaeological record are: the shift from hunter-gatherer subsistence strategies to horticulture; the widespread introduction of ceramics; and the settlement of permanent villages (Vega 1992). Rouse's settlement model emphasizes the conquest and subsequent displacement of the first inhabitants of Puerto Rico by the Arawak groups. Rouse and Alegría's (1990:80) statement that "[s]ince the Corosans [Pre-Arawak] were a relatively small population, they may have been absorbed by the Hacienda Grande who replaced them in Puerto Rico. Alternately, they may have been pushed into Hispaniola and assimilated into its El Caimito population. In either event, they would have contributed little to the subsequent peoples and cultures of the Greater Antilles," succinctly summarizes the traditional view.

However, alternative models have been proposed recently that emphasize transculturation and coexistence over conflict, with the two groups managing to cohabitate the island. Rodriguez Ramos, a proponent of the coexistence model, argues that the existence in the archaeological record of Pre-Arawak sites dating to 1910 cal. BP (Paseo del Indio; Clark et al. 2003, Walker 2005) and 1800 cal. BP (Yanuel 9 site, Tronolone et al. 1984) shows that the Pre-Arawak population was still inhabiting the island at least 600 years after the arrival of the Arawaks. In the case of Paseo del Indio, the habitation was located in relatively close proximity to an Arawak settlement (Maisabel) Further, the archaeological evidence suggests that simple trade networks may have been in place between the two groups, based on the presence of a radiolarian limestone celt at the Paseo del Indio site, a raw material only available from St. Martin, while the archaeological assemblage at Maisabel included calcite, a raw material obtained from the karst hills surrounding Paseo del Indio (Rodriguez Ramos 2007, Siegel 1992).

This group of Arawak people is typically divided into two subgroups within Puerto Rico: the Saladoid and Huecoid, based on distinctive cultural manifestations in pottery and other artifacts. The Saladoid group, which inhabited western Puerto Rico, settled first on the coastal plains and along estuaries. Around 1600 cal. BP, the Saladoids started to shift their settlements to the interior valleys, before finally occupying the piedmont of the Cordillera Central. Archaeological deposits found at the caves in Trujillo Alto as well as communal cave dwellings excavated in 1995 at the Paseo del Indio site in Vega Baja suggest that the Saladoid people may have switched from open-air settlements to cave dwellings during this phase (EPR 2004). The Huecoid group occupied eastern Puerto Rico and the island of Vieques, with major settlements at La Hueca, on Vieques, and Punta Candelaro near the modern city of Humadao (Chanlatte and Narganes 1980, EPR 2004).

Community organization during this period is centered around a central plaza, with the inhabitants occupying oblong communal structures called *malocas*. The central plaza typically faced a semi-circular cluster of shell middens. Excavated burials at sites from this time period, typically located underneath the central plaza or the shell middens, show an equitable distribution of grave goods, indicating a fairly egalitarian social structure (EPR 2004, SEAC 2009).

Subsistence strategies shifted during this period. The Saladoid and Huecoid groups practiced horticulture, and their primary food source was the cultivated cassava (manioc) plant, supplemented by maize, cocoyam, pineapple, and other fruits and vegetables. Hunting and gathering subsistence practices, though secondary to farming, were also employed, providing needed protein in the form of small game, fish, and shellfish. Based on the increased quantities of claws in the faunal remains recovered from excavated sites, the land crab was a particularly important element of the diet (EPR 2004).

The Saladoid artifact assemblage is typically defined by the presence of its distinctive pottery wares, which include white-on-red, black paint, orange slip, and negative-painted designs. Ceramic vessel forms include zoomorphic effigy vessels, trays, and platters (some depicting animals native only to South America), jars and bowls with D-shaped strap handles, censers, and bell-shaped vessels (SEAC 2009). The motifs are often connected to terrestrial food sources such as crabs and in some cases were incised or modeled onto the vessels (Vega 1992). Other diagnostic artifacts include jewelry made from mother-of-pearl, tiny beads, and semiprecious stones, as well as cohoba pipes, *zemis*, and lithic pendants carved or worked from exotic materials (e.g., jasper-chalcedony, amethyst, crystal quartz, fossilized wood, greenstones, carnelian, lapis lazuli, turquoise, garnet, epidote, and obsidian). These pendants are shaped to resemble South American raptors, and their widespread distribution across the Caribbean suggests the existence of a significant trade network for both raw materials and luxury items (Vega 1992, SEAC 2009). In contrast, the Huecoid artifact assemblage primarily consists of unadorned ceramic vessels, though the bird-shaped pendants described above are also present (EPR 2004).

The earliest known Arawak settlement is the site of Hacienda Grande, Loíza, located in northeastern Puerto Rico. In the south central region surrounding Ponce, sites dating to the Saladoid time period or with Saladoid components include Tibes, La Vega, Las Flores, Buenos Aires, Tecla, Canas, Carmen, and Hernandez Colon (Vega 1992). Huecoid sites are typically found in eastern Puerto Rico.

Ostionoid or Pre-Taíno (1400 BP to 800 BP) — Around 1400 cal. BP, a marked shift appears in the pottery making styles throughout the Antilles, including Puerto Rico, suggesting the rise of a new cultural group within the Caribbean. The traditional explanation for this new culture was the migration of a new group of peoples from the northern South American coast that spread throughout the Antilles, similar to the previous wave of Saladoid people (Haag 1963, SEAC 2009). Current theories, however, suggest internal rather than external forces at work, and favor the natural evolution of the Saladoid culture into the Ostionoid (SEAC 2009). As the National Park Service website notes, "there seems to be a breakdown in cultural continuity between the Caribbean Islands and mainland South America due to the lack of trade goods, such as the Saladoid exotic stone pendants, and the concomitant rise of regional ceramic styles in both Puerto Rico and the Virgin Islands" (SEAC 2009). While the reasons for the apparent disintegration of the trade network remain unknown, a lack of contact with outside cultural groups would explain the development of regional pottery styles, and the focus on internal development.

Like the Saladoid groups before them, the Ostionoid cultures continued to practice agriculture, produce pottery, and reside in sedentary villages. While settlement patterns did not shift dramatically, new site types emerge, the size and general complexity of established village settlements increased, ball courts and ceremonial stone-lined plazas began appearing in the archaeological record, and the frequency of the religious icons known as *zemis* increased within the artifact assemblage (SEAC 2009, EPR 2004). The new site types include dispersed and lineal settlements. In dispersed settlements, individual dwellings, possibly farmsteads, were spaced out over the landscape rather than organized around a central plaza. In the lineal arrangement, the plaza as the main focal point was replaced by a river bank or coastline. The spatial configuration of established villages also changed during the Ostionoid period. Around 1100 cal. BP, the communal dwellings began to be replaced by smaller oblong structures situated around a stone or earthen mound-lined central plaza usually decorated with stone figures or petroglyphs, and public and ritual spaces became formally divided (Vega 1992:). Overall the trend toward greater complexity, coupled with the expenditure of manpower and resources for ceremonial spaces and activities, suggests that the societal structure during the Ostionoid period was shifting from an egalitarian tribal system to a ranked hierarchy of chiefdoms, with each chieftain presiding over a specific region.

Subsistence strategies continued to focus on agricultural food sources like cassava, maize, cocoyam, and other fruits and vegetables, supplemented by shellfish, fish, and small game. However, archaeological evidence suggests that protein sources favored during this period shifted from land crabs to shelled animals, based on the relative proportions of faunal remains for each animal (SEAC 2009).

The Ostionoid culture, like the previous Saladoid culture, is divided into two subseries based on varying artifact assemblages, the Ostionan and the Elenan Ostionoid. The Ostionan subgroup populated the western half of Puerto Rico, while the Elenan Ostionoid peoples inhabited the eastern side of the island. Both groups followed similar settlement patterns, and developed ball courts, lined plazas, and ceremonial centers (SEAC 2009).

The Ostionan artifact assemblage includes ceramics, stone, clay and shell *zemis*, and stone celts. The ceramics were typically decorated with zoomorphic modeled and appliqué designs, and were often polished, with red paint (or a red slip) covering the entire vessel surface. Later decorative motifs expanded to include horizontal bands of geometric line-and-dot incising. The introduction of petroglyphs is also associated with this subgroup (SEAC 2009, Vega 1992). The early Elenan Ostionoid ceramic assemblage is typically decorated with red- or black-painted geometric designs and strap handles. In later assemblages, ceramics typically lack strap handles, bowls are the dominate vessel forms, and painted and polished decorative methods are largely abandoned, replaced by modeling and incising (SEAC 2009).

Major Ostionan sites in western Puerto Rico include Boquerón, Calvache, Las Cucharas, Las Mesas, Llanos Tuna, Abra, Buenos Aires, Cañas, Carmen, Diego Hernandez, and Pitahaya. In eastern Puerto Rico, Tibes, El Bronce, Santa Elena, Monserrate, Vacia Talega, and Collores provide examples of major Elanan Ostionoid sites. In the south central region near Ponce, the major Ostionoid sites include Tibes, El Bronce, El Bronce II, El Bronce III, Tiburones, Tizol, Maraguez, Holiday Inn, Canas, and Los Caobos (SEAC 2009, Vega 1992). Tibes and El Bronce are discussed in more detail below.

Chicoid/Chican-Ostionoid or Taíno (800 cal. BP to 500 BP) — According to Rouse's model, the Ostionoid culture evolved into the Chicoid or Taíno Culture around 800 cal. BP, possibly as the result of cultural influence from inhabitants of the Dominican Republic that may have established a colony on the south coast of Puerto Rico during this time. This group practiced a new ceramic tradition known as the Boca Chica style, and evidence of its influence starts to appear in native Puerto Rican ceramic styles at the beginning of the Chicoid period (Rouse 1992, EPR 2004, SEAC 2009).

During the 300 years before Spanish colonization, the Taíno people experienced rapid population growth, with both the number of sites and size of settlements increasing. Settlement patterns became concentrated, with large settlements clustered around a central ceremonial center. Current theories on Taíno societal and political structure suggest confederations of large territorial units, each ruled by a powerful chieftain. This chiefdom society might have continued to increase in complexity to the formation of a state, had its development not been interrupted by the arrival of the Spanish (EPR 2004, SEAC 2009).

Community organization during the Chicoid period was developed around multiple public plazas lined with monolithic stones, including a central plaza and several outlying plazas. The *cacique* or chieftain for each village lived in a large rectangular house at the head of the main plaza, while the other inhabitants lived in round dwellings 6 to 8 meters (19.7 to 26.2 feet) in diameter that were arranged around the main plaza according to social hierarchy, clan, or lineage. In addition to the ball courts and plazas, communal structures such as temples would have been constructed in the village (EPR 2004).

Agricultural activities continued to provide the primary source of subsistence for the Taíno people. In addition to garden and orchards placed around each dwelling, the Taíno produced cassava, corn, and other plants from farm fields that surrounded the village. These fields were typically irrigated by a complex system of mounds and furrows (EPR 2004).

The Taíno artifact assemblage includes ceramics, polished ground stone tools such as choppers and axes, mortars, pestles, and unique objects such as carved stone idols and large polished ground stone collars or rings. As noted above, the native Capá (western) and Esperanza (eastern) ceramic styles were heavily influenced by the Boca Chica ceramic tradition. The major characteristics of this style include surface polishing, complicated vessel forms, a lack of paint or slips, and elaborate incised, modeled, and punctated designs. The native Taíno could have learned the Boca Chica style from trade ware, examples of which have been recovered from both Capá and Espenranza sites, and then incorporated the new designs and techniques into their own vessels (SEAC 2009).

Examples of major ceremonial centers dating to the Chicoid period include Caguana in western Puerto Rico, and Cuevas-2 in eastern Puerto Rico (SEAC 2009). In the Ponce Region, Chicoid sites include Punto Oro, Caracoles, El Bronce, and Tibes II (Vega 1992:28). Lundberg speculates that the decreased number of Chicoid sites in the south central region compared to Ostionoid sites may be the result of population consolidation into larger settlements (Sickler et al 1983).

3.9.3.2 Historic Context

European explorers first encountered the island of Puerto Rico in 1493, during Christopher Columbus's second voyage to the Americas, but the island was not explored until 1504 when Vicente Yanes Pinzon led a survey. His exploration of the island resulted in both the introduction of large domesticated livestock (horses, goats, and pigs), and a royal grant to Pinzon with the title of "Capitan General y Gobernador." Rather than settling in Puerto Rico, Pinzon chose to focus on establishing settlements in Brazil (Vega 1992).

Accounts of the indigenous population during the contact period were written by Fernández Oviedo (1526, 1535) and Fray Bartolomé de las Casas (1542, 1561, 1566), and provide a glimpse into the culture and society of the Taíno people. These accounts describe a stratified society divided into the upper class (*nitaino*), the priesthood (*bohique*), and the common workers (*nabora*), all ruled by the *cacique*, or chieftain. Indigenous settlements might have held as many as 2,000 dwellings, with plazas where religious and political ceremonies and feasts were held, and ball courts where the ceremonial ball game of *batey* was played. Oviendo provides a detailed account of the *areytos*, or feasts of the Taíno people, which included ritual singing and dancing (Oviendo 1526). In addition, the plazas also served as the focal point of communal activities such as gambling and as centers for markets where goods could be traded at the regional level. Taíno social structure was both hereditary and matrilineal (EPR 2004).

The first European settlement in Puerto Rico, a minor outpost, was briefly established at Caparra in 1508 by Juan Ponce de Leon, before being relocated to the natural harbor at Rich Port (now San Juan) the following year. De Leon had entered into a formal agreement (capitulación) with the Spanish crown to settle Puerto Rico and would be appointed as governor in 1509 (Vega 1992, Schimmer 2010). As Spanish colonists began to settle the island in force, the indigenous population began to suffer the effects. The Taíno population was shifted to econmienda settlements and subjected to forced labor in return for the promise of military protection (Rouse 1992). An attempted revolt by the Taíno, led by Agueybana II, was quickly suppressed by the Spanish at the Battle of Yaguecas in 1511 (NPS n.d. [a]). Following the revolt, a second settlement, San Germain, was founded in the southwest region of the island (Schimmer 2010). Despite an attempt to reform the forced labor system in 1512, and the emancipation of the native population by royal decree in 1520, the Taíno death rate continued to rise. Within a few decades, the indigenous population of Puerto Rico had been largely eradicated on the island by disease, violence, and suicide (Rouse 1992). A 1530 government census documents only 1,148 Taíno living on the island (Schimmer 2010). The Spanish chronicler de Las Casas described the impact of Spanish colonization on the Antilles:

> The island of Cuba is nearly as long as the distance between Valladolid and Rome; it is now almost completely depopulated. San Juan [Puerto Rico] and Jamaica are two of the largest, most productive and attractive islands; both are now deserted and devastated. On the northern side of Cuba and Hispaniola the neighboring Lucayos comprising more than sixty islands including those called Gigantes, beside numerous other islands, some small some large. The least felicitous of them were more fertile and beautiful than the gardens of the King of Seville. They have the healthiest lands in the world, where lived more than five hundred thousand souls; they are now deserted, inhabited by not a single living creature. All the people were slain or died after being taken into captivity and brought to the Island of Hispaniola to be sold as slaves…More than thirty other islands in the vicinity of San Juan are for the most part and for the same reason depopulated, and the land laid waste. On these islands I estimate there are 2,100 leagues of land that have been ruined and depopulated, empty of people [de Las Casas 1542].

The general route from Europe to the Americas during the sixteenth through eighteenth centuries, dictated by ocean currents and trade winds, guided ships directly past Puerto Rico. Because the island was the first large land mass that could provide shelter, fresh water, and other supplies, it was logical for Spain to establish a military presence there as an attempt to control the route and protect its South and North American possessions. The construction of fortifications began in 1533 at San Juan. In 1539, construction started on Castillo San Felipe del Morro, a process that was not completed until 1790. Construction on the San Juan city walls and a second large fort, the Castillo San Cristobal, was started in 1634 and completed in 1783. San Juan and its fortifications were the target of several English (1595, 1598) and Dutch (1625) attacks during the sixteenth and seventeenth centuries, but Spain retained control over the island (NPS n.d. [b]). The southern side of the island was far less heavily fortified, though Spanish ships on route to Mexico and Santo Domingo did follow the southern coast and resupply at Añasco Bay (Vega 1992).

Because Puerto Rico was a Spanish possession, the Catholic Church dominated the religious development of the island during the sixteenth century. Pope Julius II established one of the three dioceses for the Americas in Puerto Rico in 1511, and Alsonso Manso, the island's first appointed bishop, arrived in 1513 (Jones 1911). The Catholic Church, while advocating the reformation of the encomienda system, also pressed the native populations to convert to Catholicism.

Named for Arasibo, the cacique of a nearby Taíno village, the city of Arecibo is one of the oldest in Puerto Rico, appearing first in a census made in 1530. It was noted that sugarcane, coffee, tobacco, and corn were grown there. In 1616, a group of around 80 families living at the mouth of the Río Grande de Arecibo were officially recognized as a town with a parish under the governorship of Captain Felipe de Beaumont y Navarra (Eduardo Questell y Asociados 2010b, EPR 2015).

Arecibo was subjected to various minor military incursions during the eighteenth century, including a failed English invasion in 1702. The two attacking English vessels were repulsed through the actions of the Spanish colonel Antonio de los Reyes Correa. Following the engagement, the colonel was awarded the Royal Effigy medal by the Spanish crown and was promoted to captain. Arecibo is still known as the "Village of Captain Correa," in honor of this engagement (EPR 2015).

During the nineteenth century, Arecibo became one of the principal centers of economic progress in the region. Agricultural activities continued to dominate the economy of the region. However, the subsistence farming of earlier centuries gave way to a plantation system where non-native, often French, landowners exploited slaves, typically imported from Africa, to produce export crops such as sugarcane, coffee, and sugar (EPR 2010). Though Puerto Rico's slave population in the nineteenth century accounted for only 10 percent of the total population, the relative proportion of slaves was much higher, with more brutal working conditions, in agricultural sectors such as Arecibo. In 1873, the Spanish government emancipated all slaves on the island. (Kinsbruner 2004).

In a secondary economic development, Madrid opened the ports of several Puerto Rico cities to foreign trade in 1805. The Spanish government hoped that doing so would both increase trade with other Spanish-American ports and reduce smuggling activities and illicit trading with foreign nationals (Vega 1992). In addition to the principal crops of sugar and coffee, other products exported from Puerto Rico included tobacco, cotton, animal hides, and meat (Kinsbruner 2004).

The major military engagement of the nineteenth century from the perspective of the inhabitants of Puerto Rico was the Spanish-American war of 1898. American forces landed at Guanica, and marched to the town of Ponce, occupying Yauco en route. After only minor skirmishes, the U.S. troops, supported by the arrival of three U.S. naval ships in Ponce Bay, captured Ponce, and the Spanish military retreated into the mountains (Library of Congress 2011, Rivero 1973). No serious fighting occurred on the island, and the war ended after only a few weeks. In the 1898 Treaty of Paris that ended hostilities, Spain ceded Puerto Rico to the United States, and a military government was established for the island (Kinsbruner 2004).

Agriculture remained a dominant force in the economy in the first half of the twentieth century, and sugar became the dominant export after 1900. With the transition to American rule, however, Puerto Rico found itself cut off from its traditional trading partners of Spain and other European countries. Into this void stepped U.S. investors, who, lured by the tax-free status of the island's sugar, imported it to the United States, where it was refined and sold. The typical Puerto Rican farmer saw very little benefit from this arrangement, as most of the profit went to American sugar refining companies. Moreover, agricultural practices shifted from small family farms to large-scale business-owned operations. By 1930, large corporations, many of them based in the United States, controlled 45 percent of Puerto Rican sugarcane production (Kinsbruner 2004).

Economic stagnation gripped the island during the late 1920s and 1930s. Hurricanes in 1928 and 1932 caused widespread destruction to houses and businesses on the island, while at the same time Puerto Rico was plunged into the same depression occurring in the United States and much of the rest of the world. The depression caused severe deprivation to much of the island's population, only minimally mitigated by relief programs introduced as part of Franklin D. Roosevelt's New Deal (Kinsbruner 2004). The Nationalist movement, fueled by local discontent with the economy and Puerto Rico's status as a territory, began during this period, led by Pedro Albizo Campos. While the movement began as a political party, some of its adherents eventually turned to violence. The most violent episode occurred in Ponce in 1937, when police and Nationalist party members clashed during a parade, resulting in 20 deaths and 100 wounded (Kinsbruner 2004).

While Puerto Rico was not significantly impacted by the outbreak of World War II, the post-war economic revival that occurred in the United States also stimulated the economy of the island. In Arecibo, agricultural production of sugar and coffee remained important, but efforts were made to expand into other economic spheres such as commerce and distilling (Kinsbruner 2004). Today, with a population of around 100,000 people, Arecibo has industries related to textiles, chemical production, and electronics equipment. The service industry, business, agriculture, and fishing are also important to the local economy (EPR 2015).

3.9.4 Archeological Resources

In an effort to identify historic properties and other cultural resources that may be affected by the Project, Eduardo Questell y Asociados (2010a, 2010b) conducted archival research, surface, and subsurface investigations. The archival research included information from the following sources:

- Council for the Protection of the Terrestrial Archaeological Heritage of Puerto Rico
- Puerto Rico State Historic Preservation Office
- *Archaeological Sites in Puerto Rico*, by S.K. Lothrop (manuscript in possession of Questell y Asociados)
- Field notes of the archaeological sites of Puerto Rico made by Dr. Irving B. Rouse (on file at the Puerto Rico State Historic Preservation Office)
- Inventory of Historic Engineering and Industry of Puerto Rico (on file at the Puerto Rico State Historic Preservation Office)
- Historic American Engineering Record Inventory (on file at the Puerto Rico State Historic Preservation Office)
- SHPO archaeological, geographical, geological, etc. literature
- Local informants
- Other Puerto Rican archaeologists

Archival research revealed that there are three previously known historic properties in the vicinity of the Project APE. Again, the APE is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. In this case, the APE can be divided into two areas: the proposed renewable power generation and resource recovery plant, and the connection routes of a brackish water line and electric power line.

The proposed renewable power generation and resource recovery plant APE is on a property measuring 78.9 acres (82 *cuerdas*) bounded to the east by PR-2, to the north and south by vacant lots, and to the west by the Río Grande de Arecibo River.

The new brackish water line would follow about 1.9 miles (3,100 meters) in the rights-of-way of PR-2, PR-681, and PR-6681. Also a new electric transmission line would be extended 0.53 mile (850 meters) north from an existing substation to the proposed plant APE across undeveloped property (Eduardo Questell y Asociados 2010a).

The first previously known historic property is AR005 ("*El Caney*"), a prehistoric site located 4,921 feet (1,500 meters) north-northeast of the proposed resource recovery plant and 492 feet (150 meters) west of the proposed brackish water line route. The second is AR004 ("*Pozo del Obispo*"), another prehistoric site located 7,874 feet (2,400 meters) north-northeast of the resource recovery plant and 1,640 feet (500 meters) north of the brackish water line route. The third property consists of the ruins of the historic *Hacienda Santa Bárbara*, located 2,297 feet (700 meters) north-northeast of the resource recovery plant.

No previously unknown archaeological sites or isolated finds were discovered during the surface and subsurface investigations conducted within the Project APE by Eduardo Questell y Asociados (2010a, 2010b).

3.9.5 Historic Structures

An abandoned paper mill now stands on the location of the proposed recovery plant. The mill and associated structures were constructed between 1957 and 1959 and had been closed prior to 1998. Eduardo Questell y Asociados noted (2010b) that the structures were rapidly deteriorating and that there was an abundance of modern trash that had been dumped on the property. Because of its lack of integrity, the remains of the mill have been recommended as not eligible for listing on the NRHP.

3.9.6 Effects Analysis

Because there are no known historic properties identified within the current APE, no historic properties would be affected by the Project.

If human remains are encountered, work would halt in the vicinity of the find and the coroner and the Puerto Rico State Historic Preservation Office would be notified immediately, pursuant to 36 CFR §800.13 of the National Historic Preservation Act, *Post-Review Discoveries*.

3.10 PUBLIC HEALTH AND SAFETY

3.10.1 Affected Environment

As discussed in Section 1.3, the purpose and need for the Project is to address solid waste management on the north side of the island and generate renewable energy in the process. There are potential human health and safety impacts related to the construction and operation of the Project. Construction impacts are confined to the Project property; operation impacts are confined to the general vicinity surrounding the Project in the Río Grande de Arecibo Valley.

As described in Section 1.2.5, *Existing Operating Landfills Overview*, Puerto Rico should have had 24 landfills in operation by the end of 2010. Seven of these landfills are compliant with EPA Subtitle D requirements. The Puerto Rico Solid Waste Authority is responsible for the management of solid and hazardous waste on the island. The proposed combustion of MSW has the potential to expose the public to emissions from the combustion units or from the disposal of the residual ash. Human health risks arise from both direct and indirect exposure pathways. EPA and the EQB regulate the amount of allowable emissions. Energy Answers has applied for and obtained a PSD permit that is required prior to construction of the Project. The Project is subject to both federal and Puerto Rico air quality control regulations and emission limits.

3.10.2 Effects Analysis

3.10.2.1 Construction

During the construction phase, the general contractor would adhere to construction standards and implement occupational safety programs, as required in 29 CFR Part 1926, including scaffolding safety; fall prevention; personal protective equipment; excavation safety; ladder safety; electrical safety; hand tools safety; crane safety; critical lifts; material handling, order, and cleanliness; vehicles safety; and contractor safety. Water would be used to control fugitive dust generation caused by earth disturbance activities and materials used during construction works, as well as the transit of heavy equipment. Confirmation of these measures at the end of each work day (for dust control) and the end of each work week (for safety protocols) would ensure workers are provided a safe working environment while constructing the Project.

3.10.2.2 Operations

EPA administers the PSD program in Puerto Rico and therefore is responsible for issuing PSD permits for major new stationary sources or major modifications to existing major stationary sources. Whenever a new major stationary source or a major modification is constructed, the source must apply for and obtain a PSD permit that meets regulatory requirements including:

- BACT, which is an emissions limitation based on the maximum degree of reduction achievable for each pollutant based on specific factors
- An ambient air quality analysis that demonstrates all the emission increases do not cause or contribute to a violation of any applicable PSD increment or NAAQS
- An additional impact analysis to determine direct and indirect effects of the proposed source on industrial growth in the area, soil, vegetation, and visibility
- Consideration of public comments, including an opportunity for citizens to request a public hearing

EPA issued a PSD permit to Energy Answers for the Project on June 11, 2013. A discussion of the PSD and estimated air emissions is provided in Section 3.3, *Air Quality*.

Human Health Risk Assessment for Non-Criteria/Hazardous Air Pollutants

Non-criteria pollutants for which NAAQS have not been established also were evaluated during the permitting of the Project through the completion of an HHRA (originally completed in 2010, and revised in October 2011, and discussed further in Energy Answers' 2011 Environmental Justice Evaluation [Arcadis 2011, 2010b]). The HHRA was consistent with EPA's guidance on Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 2005). Emissions were evaluated based on the following general approach.

Project emissions (e.g., chemicals or chemical classes), including polycyclic aromatic hydrocarbons, dioxins, furans, and metals (antimony, arsenic, beryllium, cadmium, chromium VI, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, tin, vanadium, and zinc), polychlorinated biphenyls, hydrochloric acid, and hydrofluoric acid gases, were evaluated in the HHRA. In the context of an HHRA, these chemicals are called COPCs.

The HHRA analysis included a calculation of COPC concentrations in air, COPC deposition rates onto the earth's surface, and COPC concentrations in a variety of environmental media (e.g., soil, surface water, sediment) and food items (e.g., milk, beef, pork, poultry, home-grown produce, eggs, fish) through which humans may be indirectly (i.e., ingestion) exposed.

The HHRA analysis also included calculations regarding the potential exposures to COPCs for several different types of individuals or "receptors" living within 6.2-mile (10-kilometer) radius from the Project that could be exposed to COPC from the Project. The receptors used in the HHRA included: suburban resident (adult and child), urban resident (adult and child), farmer (adult and child), fisher (adult and child), and nursing infants. Each adult and child receptor was assumed to be simultaneously exposed to COPCs through one of more of the following exposure pathways—via inhalation (COPCs in air), soil ingestion, drinking water from surface water sources, and food ingestion (locally grown produce (e.g., lettuce, other leafy produce, corn, peas, fruits), milk from local dairies, beef, poultry from locally raised animals, fish from local surface waterbodies, and eggs. Each adult receptor was assumed to be the mother of a breast-fed infant, and therefore the nursing infant was assumed to be exposed to dioxins/furans via breast milk.

Specifically, exposure to COPCs was calculated using a "reasonable maximum exposure" scenario, to overestimate the potential for exposure and associated health hazards to provide a conservative (health protective) evaluation.

The exposure duration parameter used in the HHRA is 70 years for evaluating cancer risks. For evaluating non-cancer health effects, the exposure durations are 40 years for farmer receptor, 30 years for other adult receptors, and 6 years for child receptors.

For assessing the human exposure through food ingestion, it was assumed that 100 percent of a particular type of food consumed was grown or raised within the 6.2-mile (10-kilometer) radius of the proposed Project.

The HHRA also included other examples of a reasonable maximum exposure by assuming that a farmer drinks 6 cups (1.4 liters) of untreated drinking water from a local surface water source (North Coast Aqueduct System known as Superacueducto or reservoir), eats locally raised beef, poultry, produce, eggs, pork, and milk, and that 100 percent of the food is affected by COPCs from the proposed Project, for 350 days per year, and for 40 years out of a lifetime.

The drinking water ingestion pathway considered exposure to COPCs potentially associated with combustion emissions from the proposed Project that are deposited onto a surface waterbody used as a drinking water source (e.g., a reservoir). The main water system in the region, the Superacueducto, was modeled as a waterbody receptor, and it was conservatively assumed that the potable water from it was untreated.

Exposure to milk from dairy cows was evaluated by estimating COPC concentrations in the cow's diet and through incidental ingestion of soil. It was assumed that the cow's diet consisted of forage (pasture grass and hay), grain, and silage (grain that has been stored and fermented). It was conservatively assumed that 100 percent of the animal's diet is grown locally on soil that receives COPC deposition and COPC in soil are 100 percent bioavailable, and metabolism does not decrease the COPC concentration in fat and muscle tissue. The milk ingestion pathway was modeled at the farmer receptor location, and the pathway cancer risks and non-cancer hazards were added to each receptor evaluated.

The fish ingestion pathway considered exposure to COPCs that are deposited onto fishable waterbodies. Three fishable waterbodies were selected for the fish ingestion pathway: the estuary where the Río Grande de Arecibo meets Puerto Arecibo, Cienega Tiburones, and Puerto Arecibo.

The HHRA included a calculation of the chronic (long-term) cancer risks and non-cancer hazards for each receptor by combining all the exposure estimates for all COPCs and all exposure pathways (including untreated drinking water, milk, beef, and other locally raised animal products).

For example, to calculate the cancer risks and non-cancer hazard index values for the farmer receptor, all the following farmer's exposure pathways were totaled, including air inhalation, soil ingestion, ingestion of locally grown produce, ingestion of drinking water from surface source (reservoir), ingestion of beef, milk from dairy cows, poultry, eggs, and pork.

The HHRA also included a calculation of the acute (short-term) non-cancer risks caused by exposure to COPCs through inhalation. Additionally, the potential for non-cancer health effects from oral (ingestion) exposure to dioxin/furan expressed as toxic equivalent 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (TCDD) for nursing infants and adults was calculated.

Based on the HHRA, the calculated Excess Lifetime Cancer Risks, and Non-cancer Hazard Indices for all COPCs combined and across all exposure pathways, fall within, or are less than the acceptable EPA range and benchmark. EPA generally finds excess lifetime cancer risks between one-in-ten thousand (1E-04) and one-in-a million (1E-06) (or less) and non-cancer hazard indices of less than 1 to be considered an acceptable level of risk. Furthermore, the HHRA indicated that the potential for acute (i.e., short -term) exposure is less than the EPA benchmark, and the estimated dioxin/furans, expressed as toxic equivalent 2, 3, 7, 8-TCDD, intakes from ingestion are less than the national average background exposure level for nursing infants and adults.

In conclusion, the analysis completed in the HHRA showed that potential risks associated with the combined emissions estimated to result from the two proposed combustors were below the EPA cancer risk range and benchmark levels for human health. Consequently, the Project is not expected to have an adverse impact on human health.

Ash Management

Ash generated through the combustion of MSW at the plant would be stored on site for a short term until its final destination in a landfill. A conditioning agent and water would be mixed with the fly ash component essentially locking in heavy metals and other harmful elements into a mortar-like compound so it could be transported to a landfill where it can be used as a cap. Energy Answers would condition the bottom ash, and the Boiler Aggregate™ product could be marketed as a construction material (e.g., road base). Although neither federal nor most state regulations categorically restrict the use of MSW combustor ash (as long as the ash is determined to be nonhazardous in accordance with regulatory testing criteria), the presence of trace metals, such as lead and cadmium, in MSW combustor ash, and concern over leaching of these metals, as well as the presence of dioxins and furans in selected ash fractions (fly ash), has led many regulatory agencies to take a cautious approach in approving the use of MSW combustor ash as a substitute aggregate material (Federal Highway Administration 2012).

The use of the boiler ash components would be considered secondary raw material and could displace primary materials like sand and gravel. In Europe, bottom ash is used in road construction, as a foundation material; in noise barriers, as a capping layer on landfill sites; and in some countries as an aggregate in asphalt and concrete (Confederation of European WTE Plants n.d.). The use of ash in granular base and fill applications in the United States has been limited primarily to demonstrations (Federal Highway Administration 2012). Until the Boiler Aggregate™ produced at the Project has been tested to demonstrate its conformance with environmental and commercial standards, until it has received regulatory approval for reuse, and until a market is realized, the byproduct of plant operations would be transported to an EPA Subtitle D-compliant landfill.

Safety Controls

The plant would maintain a safety program aimed at preventing occupational injuries in all its processes. The program would include occupational safety training; accident research and prevention; first aid care; fire prevention and protection; and training in the areas of emergency response, natural disasters, hazards communication, personal protective equipment, permit-required confined space, hazardous energy control, human resources, cutting and welding, laboratory safety, material handling, electrical safety, emergency response groups, respiratory and hearing protection, and industrial hygiene.

As described in Section 2.2, *Selection of Proposed Alternative*, the Project would incorporate fire protection devices such as dedicated water mains for fire hydrants and alarm systems. The fire protection system would be developed according to the requirements of the Puerto Rico Fire Department and the Puerto Rico Human Safety and Fire Protection Code. The system would follow the guidelines of the National Fire Protection Association, which develops, publishes, and disseminates more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks (National Fire Protection Association 2014). The 300,000 gallons of water stored at the Project site all times and reserved for the fire protection system exceeds National Fire Protection Association standards.

Integrated video surveillance systems would assist in monitoring equipment operations and worker safety. Audible warning systems would notify workers and nearby citizens of an emergency at the plant. The nearest fire station is 1.4 miles (2,290 meters) northwest of the plant site. MSW, processed refuse fuel, and ash processing, storage, and equipment areas would have ventilation systems designed for dust and odor control.

3.11 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

3.11.1 Affected Environment

3.11.1.1 Region of Influence

The region of influence (ROI) for socioeconomics is defined as the geographical area within which the principal direct and secondary socioeconomic effects of actions associated with the Project would likely occur, and where most consequences for local jurisdictions would be expected. The proposed Project would be sited within the Cambalache Ward, located in the municipality of Arecibo, Puerto Rico. Located on the north shore of the main island of Puerto Rico, the Arecibo municipality occupies 126 square miles, making it one of the larger municipalities on the island (Government of Puerto Rico 2015a). The region of influence is defined as Arecibo, as well as the contiguous municipalities, Hatillo, Utuado, Ciales, Florida, and Barceloneta. In addition, the metropolitan areas of San Juan and Ponce are included in the ROI, because these cities are in close enough to Arecibo that construction workers and personnel would most likely commute from these cities.

It is anticipated that these municipalities and metropolitan areas would house a majority of the population that would serve as the construction and operational workforces for the Project. All dollar values in this section are presented in 2013 dollar values unless stated otherwise.

3.11.1.2 Population and Demographics

Of the six municipalities that make up the ROI, Arecibo (the location of the Project) is the largest in terms of population while the metropolitan area of San Juan has the largest population overall. Like Puerto Rico as a whole, population declined in Arecibo for the period 2000 through 2013. The population of Puerto Rico is projected to continue to decline through 2030. All six municipalities presented in **Table 3-40** saw population increases from 1990 to 2000, although San Juan and Ponce experienced declines in population for the same time period (U.S. Department of Commerce 1990, 2013a, Pew Research Center 2015).

Table 3-40. Municipality Population Estimates and Puerto Rico Population Projections

Geography	1990	2000	2009-2013	2020	2030
Puerto Rico	3,522,037	3,808,610	3,682,966	3,500,000	3,400,000
Arecibo	93,985	100,131	95,185		
Hatillo	32,703	38,925	41,932		
Utuado	34,980	35,336	32,593		
Ciales	18,084	19,811	18,509		
Florida	8,689	12,367	12,645		
Barceloneta	20,947	22,322	24,884		
San Juan	437,745	421,958	374,129		
Ponce	187,749	155,038	132,106		

Source: U.S. Department of Commerce (2013a), Pew Research Center (2015)
Note: Projection data not available at the municipality level.

3.11.1.3 Income

Median household incomes for the six municipalities that make up the ROI are examined in **Table 3-41**. All six had median incomes lower than Puerto Rico as a whole for the period 2009 to 2013. Of the six, Hatillo enjoyed the highest median household income at $19,199, while Ciales had the lowest at $13,802, or 70 percent of Puerto Rico's median household income. Overall, the San Juan urban zone exhibited the highest median household income at $22,687 (U.S. Department of Commerce 2013b).

Table 3-41. Median Household Income Estimates, 2009–2013

Geography	Median Household Income	Percent of Puerto Rico Median Household Income
Puerto Rico	$19,624	100%
Arecibo	$16,977	87%
Hatillo	$19,199	98%
Utuado	$14,852	76%
Ciales	$13,802	70%
Florida	$16,750	85%
Barceloneta	$14,848	76%
San Juan	$22,687	116%
Ponce	$17,545	89%

Source: U.S. Department of Commerce (2013b)

3.11.1.4 Labor Force and Unemployment

Of the six municipalities in the ROI, Arecibo, Hatillo, and Utuado saw declines in unemployment from 2011 to 2013. Arecibo had the largest increase in labor force participation for the same time period. Puerto Rico experienced a decline in unemployment from 2011 to 2013, although labor force participation increased (U.S. Department of Labor 2013). Both San Juan and Ponce saw declines in both unemployment and labor force participation for the time period shown. Trends in labor force and unemployment are presented in **Table 3-42**.

Table 3-42. Trends in Labor Force & Unemployment, 2011–2013

Geography	2011		2013		Percent Change Labor Force 2011–2013
	Labor Force	Unemployment	Labor Force	Unemployment	
Puerto Rico	1,222,543	16.0%	1,170,784	14.3%	-4.4%
Arecibo	26,226	16.3%	28,177	14.6%	6.9%
Hatillo	12,168	18.3%	11,822	16.3%	-2.9%
Utuado	8,059	20.0%	7,768	18.6%	-3.7%
Ciales	4,556	22.7%	4,619	25.2%	1.4%
Florida	3,335	20.6%	3,352	21.4%	0.5%
Barceloneta	7,386	18.2%	7,454	19.0%	0.9%
San Juan	782,812	15.0%	752,335	12.8%	-4.1%
Ponce	117,786	16.8%	113,778	15.5%	-3.5%

Source: U.S. Department of Labor (2013)

3.11.1.5 Employment by Industry

Table 3-43 presents average employment by industry from 2009 to 2013 for Puerto Rico and the six municipalities within the ROI, as well as San Juan and Ponce. Within Arecibo, the largest industry sector in terms of employment is educational services, healthcare, and social assistance, with 26 percent of total employment, followed by manufacturing with 13.9 percent. The employment distribution among the presented industry sectors within the ROI is similar to that of greater Puerto Rico, with educational services, healthcare and social assistance; retail trade; manufacturing; and public administration representing the largest sectors.

Within Puerto Rico, construction commands 6 percent of total employment, or 65,828 persons employed. Within the ROI, Ciales and Florida have the highest employment percentages in construction, at 7.8 percent for both municipalities (U.S. Department of Commerce 2013c). Employment projections are not available at the municipality level; however, the government of Puerto Rico projects island-wide employment in the construction sector will decline between 2012 and 2022 overall, by approximately 9.8 percent (Government of Puerto Rico, Department of Labor and Human Resources 2015).

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Table 3-43. Average Employment by Industry, 2009–2013

Employment Type	Puerto Rico		Arecibo		Hatillo		Utuado		Ciales		Florida	Barceloneta		San Juan	Ponce			
	Industry Total	Percent of Total	Industry Total	Percent of Total	Industry Total	Percent of Total	Industry Total	Percent of Total	Industry Total	Percent of Total	Industry Total	Percent of Total	Industry Total	Percent of Total	Industry Total	Percent of Total	Industry Total	Percent of Total
Total Employment	1,099,138	100%	24,526	100%	12,412	100%	6,604	100%	3,659	100%	3,286	100%	5,474	100%	136,017	100%	37,211	100%
Agriculture, forestry, fishing and hunting, and mining	14,535	1.3%	359	1.5%	313	2.5%	346	5.2%	74	2.0%	61	1.9%	37	0.7%	286	0.2%	281	0.8%
Construction	65,828	6.0%	1,085	4.4%	804	6.5%	428	6.5%	286	7.8%	256	7.8%	237	4.3%	7,945	5.8%	1,774	4.8%
Manufacturing	102,420	9.3%	3,401	13.9%	1,259	10.1%	280	4.2%	583	15.9%	403	12.3%	817	14.9%	5,416	4.0%	3,853	10.4%
Wholesale trade	32,146	2.9%	439	1.8%	222	1.8%	65	1.0%	38	1.0%	12	0.4%	261	4.8%	4,687	3.4%	759	2.0%
Retail trade	146,147	13.3%	3,289	13.4%	1,753	14.1%	858	13.0%	507	13.9%	281	8.6%	920	16.8%	14,593	10.7%	5,675	15.3%
Transportation and warehousing, and utilities	40,822	3.7%	755	3.1%	320	2.6%	403	6.1%	73	2.0%	115	3.5%	81	1.5%	4,867	3.6%	1,183	3.2%
Information	19,222	1.7%	466	1.9%	151	1.2%	16	0.2%	15	0.4%	71	2.2%	109	2.0%	3,617	2.7%	562	1.5%
Finance and insurance, real estate rental and leasing	58,834	5.4%	787	3.2%	440	3.5%	189	2.9%	72	2.0%	54	1.6%	202	3.7%	10,591	7.8%	1,377	3.7%
Professional, scientific, management, administrative, waste management services	102,274	9.3%	1,798	7.3%	923	7.4%	460	7.0%	198	5.4%	234	7.1%	539	9.8%	18,648	13.7%	3,055	8.2%
Educational services, and health care and social assistance	256,271	23.3%	6,387	26.0%	3,431	27.6%	1,919	29.1%	1,058	28.9%	946	28.8%	1,258	23.0%	30,196	22.2%	9,823	26.4%
Arts, entertainment, recreation, accommodation and food services	94,481	8.6%	1,469	6.0%	966	7.8%	516	7.8%	220	6.0%	229	7.0%	324	5.9%	14,217	10.5%	3,864	10.4%
Other services, except public administration	60,421	5.5%	1,235	5.0%	817	6.6%	264	4.0%	82	2.2%	167	5.1%	171	3.1%	9,910	7.3%	1,913	5.1%
Public administration	105,737	9.6%	3,056	12.5%	1,013	8.2%	860	13.0%	453	12.4%	3,286	100%	518	9.5%	11,044	8.1%	3,092	8.3%

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3.11.1.6 Housing

Table 3-44 provides insight into housing characteristics for Puerto Rico and the six municipalities within the ROI. Of the municipalities within the ROI, Utuado had the lowest rental vacancy rate for the time period (3 percent). San Juan had the highest rate at 9.5 percent. Median home values were lower in all six municipalities compared to Puerto Rico, except for Hatillo, which had a median home value of $134,500. Of the geographies presented, housing values were highest in San Juan ($166,400) and lowest in Utuado ($99,900). Owner occupancy exceeded 70 percent in all the ROI municipalities except for Utuado, while San Juan and Ponce exhibited owner occupancy percentages of 54.1 and 65.1 percent, respectively (U.S. Department of Commerce 2013d).

Table 3-44. Evaluation of Area Household and Housing Characteristics, 2009–2013

Geography	Total Housing Units	Percent Occupied	Percent Vacant	Total Occupied	Percent Owner Occupied	Percent Renter Occupied	Rental Vacancy Rate	Median Housing Values
Puerto Rico	1,524,877	80.7%	19.3%	1,230,868	70.1%	29.9%	7.6%	$121,200
Arecibo	40,692	80.1%	19.9%	32,590	72.4%	27.6%	7.1%	$101,700
Hatillo	16,156	84.8%	15.2%	13,708	71.5%	28.5%	3.2%	$134,500
Utuado	12,977	79.0%	21.0%	10,247	65.5%	34.5%	3.0%	$99,900
Ciales	7,143	78.7%	21.3%	5,624	70.6%	29.4%	3.2%	$104,300
Florida	4,810	85.2%	14.8%	4,099	74.6%	25.4%	3.8%	$108,700
Barceloneta	9,588	85.4%	14.6%	8,184	78.6%	21.4%	4.6%	$104,500
San Juan	182,203	79.2%	20.8%	144,380	54.1%	45.9%	9.5%	$166,400
Ponce	55,549	83.9%	16.1%	46,626	65.1%	34.9%	7.0%	$108,000

Source: U.S. Department of Commerce (2013d)

3.11.1.7 Government and Emergency Services

Civilian law enforcement in Puerto Rico is provided by the Puerto Rico Police Department, an island-wide government agency. The island is divided into 14 police regions; each is operated by a “comandancia,” and is further divided into districts. The Project is located in the Arecibo police region (Government of Puerto Rico 2015b). Fire protection is provided by the Puerto Rico Fire Department, an island-wide government operated agency. The agency operates six districts across the island, the Project is located in the Arecibo district; the district’s main station is located in Arecibo (Government of Puerto Rico 2015c).

Metro Pavia Health System operates the two hospitals in Arecibo, Hospital Metropolitano Dr. Susoni Arecibo and Hospital Metropolitano Cayetano Colly Toste Arecibo. Hospital Metropolitano Dr. Susoni Arecibo has 134 beds and includes an emergency room, pediatric services, a vascular laboratory, and MRI (Metro Pavia Health System, 2015). Hospital

Metropolitano Cayetano Colly Toste Arecibo has 198 beds. In addition, both San Juan and Ponce have multiple hospitals and medical centers (American Hospital Directory 2015).

3.11.1.8 Utilities

Electrical power in Puerto Rico is generated and operated by PREPA, which operates five main power plants. According to PREPA, 55 percent of power is generated using fuel-oil, 27.6 percent using natural gas, 16 percent using coal, and 1.1 percent is hydroelectric (PREPA 2015). Puerto Rico electric system generating capacity is 6,023 MW with a peak demand reached in September 2005 of 3,685 MW.

PRASA provides water and sewer service to the island. The agency is divided into five operational regions. The Project would occur within the North region, which includes Arecibo (Authority of Aqueducts and Sewers 2015).

3.11.1.9 Environmental Justice and Protection of Children

On February 11, 1994, President Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. Executive Order 12898 directs agencies to address environmental and human health conditions in minority and low-income communities so as to avoid the disproportionate placement of any adverse effects from federal policies and actions on these populations. The general purposes of this executive order are as follows:

- Focus the attention of federal agencies on human health and environmental conditions in minority communities and low-income communities with the goal of achieving environmental justice.
- Foster nondiscrimination in federal programs that substantially affect human health or the environment.
- Improve data collection efforts on the impacts of decisions that affect minority communities and low-income communities and encourage more public participation in federal decision making by ensuring documents are easily accessible (e.g., in multiple languages and readily available).

As defined by the Environmental Justice Guidance Under NEPA (CEQ 1997), "minority populations" include persons who identify themselves as Asian or Pacific Islander, Native American or Alaskan Native, Black (not of Hispanic origin), or Hispanic. Race refers to census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and central or South American.

A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations are identified using the U.S. Census Bureau's statistical poverty threshold, which is based on income and family size. The U.S. Census Bureau defines a "poverty area" as a census tract with 20 percent or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level. A census tract is a small geographic subdivision of a county and typically contains between 2,500 and 8,000 persons (U.S. Department of Commerce, 2013e).

As illustrated in **Table 3-45**, the majority of the population of Puerto Rico, the ROI, and the selected census tracts are minorities. Within each of these geographies, 98 percent or more of the population identified themselves as Hispanic or Latino (U.S. Department of Commerce 2013f). As defined by the U.S. Department of Commerce, the entire island of Puerto Rico is considered an "extreme poverty area," as is the ROI and the selected census tracts.

Table 3-45. Minority Status, Income, and Poverty Data for Select Areas, 2009–2013

Geography	Total Population	Percent Minority	Percent of Population Below Poverty Level
Puerto Rico	3,682,966	99.2%	45.1%
Arecibo	95,185	99.5%	47.4%
Hatillo	41,932	99.5%	46.1%
Utuado	32,593	99.6%	55.8%
Ciales	18,509	99.8%	60.6%
Florida	12,645	99.8%	54.8%
Barceloneta	24,884	99.6%	54.2%
San Juan	374,129	99.5%	40.4%
Ponce	132,106	98.7%	50.2%
Census Tract 3003.01	3,259	100%	47.8%
Census Tract 3003.02[a]	5,720	100%	31.8%
Census Tract 3016	4,112	98.4%	43.4%

Source: U.S. Department of Commerce (2013f)
[a] Includes the proposed Project

3.11.2 Effects Analysis

3.11.2.1 Construction

The Project includes construction and operation of a WTE plant in Arecibo, and the associated water, power, and sewer lines to service the plant. Socioeconomic impacts on the ROI would include an increase in construction employment during the construction of the plant. Due to the close proximity of San Juan and Ponce (49 miles [79 kilometers] and 44.7 miles [72 kilometers], respectively) and adequate existing infrastructure, it is anticipated the construction workforces could commute from these cities as well as from the nearby municipalities and Arecibo. Some of the construction workforce could also be temporarily housed on site.

It is anticipated that most of this employment demand would be met with workers already living in Puerto Rico because the island already has adequate existing construction workforce (averaging approximately 66,000 total employed between 2009 and 2013) living near the Project.

It also is anticipated that some construction workers, particularly those with specific skills, would come from outside Puerto Rico. The additional employment from construction would have an impact on the local economy, in terms of sales volume and taxation, and on emergency services within the ROI.

Two prime construction contractors would be engaged to complete the construction phase of the Project, with an anticipated construction period of 3 years. It is further anticipated that the Project would create 4,286 full-time equivalent construction jobs based upon $32,680 per construction job pursuant to an analysis by Estudios Técnicos, Inc.

While some construction personnel may come from outside Puerto Rico, a significant impact on housing or government services is not anticipated. Because some construction workers associated with the Project may commute from throughout the ROI (such as from Ponce and San Juan) and from other areas in Puerto Rico, impacts on the economy and emergency services would be distributed beyond the immediate Project area.

3.11.2.2 Operation

Employment

Socioeconomic impacts on the ROI would include an increase in employment in terms of plant operations. Similar to construction employment, the close proximity of the Project to the metropolitan areas of San Juan and Ponce and the smaller urban center of Arecibo could supply the workforce required for operations. The additional employment from operations would have an impact on the local economy, in terms of sales volume and taxation, and on emergency services within the ROI. The Project will employ approximately 150 full-time operating personnel for 30 operating years. The total annual payroll in 2015 dollars is projected to be about $8.5 million. While any impacts on sales volume or taxation likely would be positive, these socioeconomic impacts associated with long-term operations are not anticipated to be significant. While some operating personnel may come from outside Puerto Rico, a significant impact on housing or government services is not anticipated.

Ash Production

A byproduct associated with WTE plants is the production of waste ash that is typically distributed to landfills. The dry weight of this byproduct is projected to be about 20 percent of the weight of the processed refuse fuel or about 420 tons per day. Energy Answers proposes to mix the fly ash produced by the plant with a conditioning agent and water and ship it to an EPA subtitle-D compliant landfill. Energy Answers proposes to dispose of the bottom ash at a landfill until a market for its use as a construction material (e.g., road base) develops. Conditioned fly ash can be used as a lining within landfills, while the coarser bottom ash can be used as road base material within a fully lined landfill that is equipped with leachate control equipment designed to collect leachate and runoff, as opposed to being considered an additional waste component. As such, it is not anticipated that any additional personnel would be required at the landfill, and no significant socioeconomic impacts are expected.

Environmental Justice and Protection of Children

The analysis has not identified any significant environmental or human health impacts that may directly or indirectly affect people or their activities as a result of the Project. Under the criteria defined by the U.S. Census Bureau, the ROI and the census tracts that would contain and surround the Project all contain impoverished populations and proportionally high minority populations. Indeed, Puerto Rico as a nation is demographically 99.2 percent minority under these criteria for the time period analyzed. As such, the identified non-significant impacts described previously would not have any *disproportionate* impacts on minorities or impoverished populations. This assessment is reinforced by the EPA's Region 2 Interim Environmental Justice Policy that states, "In certain circumstances, a Community of Concern may be virtually indistinguishable from any of its neighbors for a given Environmental Justice demographic factor. The examples in Region 2 are in Puerto Rico and the U.S. Virgin Islands, where every community is classified as Hispanic, in the case of Puerto Rico, and as communities of color in the case of the U.S. Virgin Islands, even though additional racial differences may exist. When the population in the larger area incorporating the COC is relatively homogeneous for a given Environmental Justice demographic factor, it is usually not useful to compute a difference in that factor between the Community of Concern and the reference area" (EPA 2000).

The Project is not anticipated to disproportionately affect the health of children in the ROI as a result of the construction and operation of the WTE plant. There may be some children living near the plant; however, no significant environmental or human health impacts have been identified as a result of the Project. There are not expected to be any adverse impacts on children living in the vicinity of the Project or within the ROI.

Additionally, the Project is not anticipated to disproportionately affect the health of children in the ROI as a result of the distribution of ash to any identified landfills. No significant environmental or human health impacts have been identified with the distribution of ash to Puerto Rican landfills. As a result, no adverse impacts on children living in the vicinity of any landfills is anticipated.

4.0 OTHER REQUIRED CONSIDERATIONS

4.1 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are the effects on natural and human resources that would remain after mitigation measures have been applied. As discussed below, unmitigated adverse impacts would remain in the areas of air quality, visual resources and transportation.

4.1.1 Air Quality

As described in Section 3.3.2, *Air Quality*, the PSD permit (and use of BACT) show that the Project is designed to the maximum extent practicable to minimize emissions from the plant; however, estimated emissions would exceed the 100 tons/year intensity threshold described at the beginning of Section 3.3.2 and would therefore be considered a high impact. Specifically, emissions of CAA criteria pollutants CO, NO_x, SO_2, and PM_{10} would exceed 100 tons/year (see **Table 3-20**). The Project also would emit a number of non-criteria hazardous air pollutants. As a result, regional air quality would be incrementally impacted during the operation of the Project. However, based on the air quality modeling supporting the EPA-approved PSD permit that considered the design of the Project, meteorological conditions, background concentrations, and other emission sources in the region, emissions at this level would not exceed the NAAQS or health risk thresholds.

4.1.2 Land Resources

The revitalization of the currently abandoned Global Fibers Paper Mill to an operating WTE plant and resource recovery facility would convert the vacant property to a working industrial site. Because the property was previously used in a similar capacity, the change in use is modest considering active uses; however, because the property is currently abandoned, the change in use is more substantive. The property is currently zoned for industrial type uses, which dictate the types of allowable uses on the property.

4.1.3 Visual Resources

As described in Section 3.6.3, *Visual Resources*, the proposed Project would result in new visual impacts as a result of its construction and operation. Construction activities would be short term; however, once the Project is operating, the finished buildings and facilities and traffic would be visible from select locations throughout the Río Grande de Arecibo Valley. Construction and operation of the Project at the former Global Fibers Paper Mill would revitalize a currently abandoned property and restore industrial type activities on the premises consistent with historical uses.

4.1.4 Transportation

The proposed Project's potential impact on traffic conditions were examined at four intersections for 2010 and 2013 conditions (when the Project was modeled to be operating at full capacity), and future conditions in 2018. After implementation of the proposed physical and traffic operational improvements, unmitigated impacts in the form of additional wait times at traffic lights would remain at three intersections. Although these increased wait times are unavoidable, the overall wait times at intersections along PR-2 near the Project would be increased by a maximum of 45 seconds as a result of the installation of a new traffic signal at the north entrance (Access #1). New Project-generated trips would be similar to those that existed during operations of the Global Fibers Paper Mill and the Central Cambalache Sugar Mill; however, traffic should flow more smoothly with the proposed roadway improvements, and because only one of these two vacant properties would be reinstated as a functioning industrial use.

4.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible commitment of resources refers to the loss of future options for resource development or management, especially of nonrenewable resources such as cultural resources. Construction and operation of the proposed Project would require the permanent conversion of approximately 78.9 acres (82 cuerdas) of area for the plant. However, the area is private land that formerly housed the Global Fibers Paper Mill (brownfield) and was used for industrial purposes. Construction of the water pipeline would occur in the road right-of-way and the Department of Transportation would maintain the cleared right-of-way for the life of the Project. Construction of the transmission line would require a new right-of-way across the vacant Cambalache Sugar Mill property; Project personnel would maintain (clearing and mowing) the right-of-way for the life of the Project, or this maintenance could be contracted to PREPA. The introduction of plant would result in a long-term change to the visual landscape; however, the area proposed for the plant currently has several structures from the Global Fibers Paper Mill, and the change would constitute a different set of structures in the same area. The proposed Project would be constructed in the existing floodplain of the Río Grande de Arecibo and would include excavation to increase floodway capacity. However, construction of the Project would not result in a significant impact on the flow regime pattern of the Río Grande de Arecibo because the proposed excavation would not alter the hydraulic section of the Río Grande de Arecibo channel. The Project also would include filling 2.42 acres (0.9 hectare) of wetlands, and wetland mitigation efforts would focus on an area contiguous to the plant site. The construction of the Project would require the irretrievable commitment of non-recyclable building materials and fuel consumed by construction equipment.

4.3 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Regulations for the preparation of an EIS require that the relationship between short-term use of the environment and the maintenance and enhancement of long-term productivity be addressed.

Long-term benefits of the proposed Project would occur at the expense of short-term impacts in the vicinity of the Project site. These short-term impacts would occur during the construction period, which is estimated to last 3 years. Construction activities would include demolition, a combination of clearing and grubbing, excavating, surfacing, paving, erecting structures, and landscaping. Short-term impacts on local noise, air quality, water quality, and natural resources, as well as traffic, could occur at and in the area surrounding the Project site. During construction, short-term gains to the local economy would occur from employment of providers of services and supplies. It is projected that the Project will create over 4,000 construction jobs.

The proposed Project would require the permanent conversion of approximately 78.9 acres (82 cuerdas) of area for the plant. Impacts on geology and topography of the construction of the Project would be long term, resulting from the excavation within the floodway and recontouring of the landscape. The proposed Project requires filling of 2.42 acres (9,793.39 square meters) of on-site wetlands; however, the proposed compensatory mitigation plan would adequately replace these losses at an almost 4:1 ratio.

Landfill life expectancies would be extended via the transformation of the MSW to ash, which would slow the rate at which landfill capacities would be reached. The Project will employ about 150 full-time operating personnel once completed. The net effect of the Project on greenhouse gas emissions reduction would be in the range of 1,107,818 tons/year CO_2e to 93,721 tons/year CO_2e. The Project would also allow for the proper closure of non-compliant landfills and aid PREPA in diversifying its fuel mix to meet the renewable energy goals of Puerto Rico.

4.4 CUMULATIVE EFFECTS ANALYSIS

The following section provides an overview of past, present, and reasonably foreseeable future actions that have affected, are affecting, or have the potential to affect, the resources analyzed in the cumulative effects analysis.

The cumulative effects analysis includes projects that have been filed with Puerto Rico Planning Board from 2005 to 2015 (March) that are located in the Río Grande de Arecibo Watershed, or other appropriate geographic scope. Energy Answers originally conducted a cumulative effects analysis as part of the 2010 preliminary draft EIS (PRIDCO 2010). Since that time, only four siting consultation projects have been filed with the Puerto Rico Planning Board, including two solar generation projects, construction of a new sanitary lift pump in downtown Arecibo, and one commercial development. Since the 2010 preliminary draft DEIS was published, the Via Verde Project was withdrawn indefinitely so it is no longer considered as part of this cumulative effects analysis. The USACE Flood Control project on the Río Grande de Arecibo Watershed is still active and is included in the analysis.

The cumulative effects analysis excludes from consideration those resources where significant cumulative effects are not expected. The following resources were eliminated from consideration: soils and geology, biological resources, land resources, public health and safety, and cultural resources/historic properties. This EIS considers the following resources under cumulative effects: water resources, air quality, visual resources, acoustic environment, transportation, and socioeconomics and environmental justice.

The geographic scope for the analysis of cumulative effects associated with the proposed projects in a foreseeable time horizon, including the Project, was defined based on the scope or boundary of the resource. For those resources, such as air quality, visual resources, and acoustic environment, that have specific studies that are, by definition, cumulative analyses, the geographic scope is that which is contained in the study.

The geographic spatial scope considered in the cumulative effects analysis for the various resources is:

- **Water Resources—**The scope for this resource is the Río Grande de Arecibo Watershed.
- **Air Quality—**The scope for this resource was defined according to the guidelines for Air Quality Models EPA (40 CFR § 51) and the selected model AERMOD.
- **Visual Resources—**The scope for this resource is the area within visual proximity to the Project.
- **Acoustic Environment—**The scope for this resource is the area around the Project to the nearest receptors, as defined in Section 3.7, *Acoustic Environment*.
- **Transportation—**The capacity and current traffic operation was evaluated and the potential impact on future major intersections around the Project site was determined. At the same time, the potential impacts of other proposed projects in the area were also considered.
- **Socioeconomics and Environmental Justice—**The scope for this resource includes the economy, population, and public services with a spatial scope that includes the whole ROI, defined as Arecibo, the contiguous municipalities of Hatillo, Utuado, Ciales, Florida, and Barceloneta, and the metropolitan areas of San Juan and Ponce.

4.4.1 Water Resources

The spatial extent of the analysis for water resources, both surface water and groundwater, is the Río Grande de Arecibo Watershed.

As discussed in Section 3.2, *Water Resources*, the construction and operation of the Project would have little to no impact on groundwater. The Project would not extract groundwater to supply its water needs (other than for emergency or backup supply, which would be the subject of further study), nor is water extraction proposed from rivers and streams that also function as aquifer recharge areas. The Project also would not have a cumulative effect on the potential degradation of groundwater and the public water supply because any potential Project effects on groundwater quality would be mitigated by measures presented in the Project's Spill Prevention Plan. The Project would not have a cumulative impact on groundwater recharge because of the limited footprint of the Project and the presence of large permeable surfaces in the Río Grande de Arecibo Watershed. In addition, the application of best management practices in the Spill Prevention Plan would prevent contaminant spills from gaining access to the subsurface during the Project's construction and operation activities.

The Project would, however, increase the amount of impermeable surface in the watershed, which could result in increased runoff downstream. When combined with other proposed projects in the watershed, runoff downstream could be increased substantially. To avoid negative cumulative impacts downstream, Energy Answers would implement their proposed stormwater best management practices. The proposed impervious portion of the plant's footprint would have a small effect on the underlying large aquifer (600 square miles [1,554 square kilometers]). Other projects recently built or proposed in the watershed include residential, commercial, and industrial developments. It is likely that developers of these projects would implement stormwater measures such as partially permeable pavements, underground chambers to retain stormwater runoff to discharge into existing systems, or others. Impacts related to soil impermeability and a reduction in infiltration area for the Arecibo WTE Project would be confined to the plant site itself and would not extend beyond the plant footprint and immediate vicinity. Therefore, the cumulative effect of the Project on both surface water and the underlying aquifer would be minimal.

The Project and other projects in the watershed could cumulatively affect surface water through an increased risk of contamination of streams due to loss of riparian vegetation. The removal of natural vegetation in river valleys could reduce the strip of riparian vegetation to the minimum of 16.4 feet (5 meters) allowed by law. The ability of vegetation to absorb nutrients and pollutants would be reduced to what the vegetation could absorb. If these projects do not implement pollution control programs for dispersed sources of contamination and solid waste collection, the amount of pollutants that reach streams and rivers could increase, eventually representing potential cumulative impacts in their respective estuaries. The Project, however, is not expected to generate additional significant cumulative impacts caused by nonpoint source pollution in the Río Grande de Arecibo Basin because it would not remove riparian vegetation or cause any point source pollution. In addition, Energy Answers' implementation of the Project's Spill Prevention Plan and stormwater best management practices would further minimize the potential for the Project to contribute to surface water contamination in the Río Grande de Arecibo Basin.

The Project would not result in a significant impact on the flow regime pattern of the Río Grande de Arecibo, which is located on the western boundary of the site, because the proposed excavation would not alter the hydraulic section of the Río Grande de Arecibo channel. Project construction, however, would result in a small increase in base flood elevations along predominately undeveloped properties located east and west, as well as immediately upstream, of the Project site. To achieve the desired floodway limits around the Project, Energy Answers proposes to excavate higher ground on the floodplain between the plant and the river channel for additional hydraulic conveyance capacity. As a result, plant construction would involve modifying the existing drainage canals to open more floodway, and raising the footprint elevation of the plant so that it is above the 100-year floodplain. Cumulatively, along with other projects located within the Río Grande de Arecibo Watershed, the projected impact for the development of these projects would not be adverse because of the minimal extent of the increased base flood areas.

As mentioned in Section 3.2.2, *Water Resources*, the Project's effects on surface water resources would be limited to an increase in the generation of stormwater runoff and local precipitation runoff. However, Energy Answers would take the necessary mitigation measures during Project construction, and therefore, it is not expected that the Project would cause an adverse cumulative impact on surface water resources, particularly the Río Grande de Arecibo. Additionally, it is not expected that the temporary impacts associated to the removal of soil during Project construction would degrade the quality of surface water because Energy Answers would implement the best management practices contained in the Soil Erosion Control Plan. As such, the Project would not contribute to cumulatively impacting surface water quality.

4.4.2 Air Quality

A detailed air quality modeling analysis was completed in support of the PSD permit application (February 2011, revised July 2011 and October 2011), using the latest available version of the AERMOD dispersion model. The modeled concentrations were below the Significant Impact Level for 24-hour PM_{10}, 1-hour and 8-hour CO, annual NO_2, and the 3-hour, 24-hour, and annual SO_2. Therefore, a cumulative analysis was not necessary for these NAAQS below the Significant Impact Level.

A cumulative air modeling analysis was completed in accordance with EPA's *Guidelines on Air Quality Models* (40 CFR §51, Appendix W) to evaluate compliance with the 1-hour NAAQS for

NO_2 and SO_2 as well as for the 24-hr $PM_{2.5}$ averaging period. As shown in Section 3.2.2, *Air Resources*, and **Table 3-22**, the NAAQS would not be exceeded. The "total concentration" shown in the table includes the background concentrations obtained from ambient air quality monitoring data and represents the existing or baseline air quality in the Project area. The total concentration also includes the incremental impact of Project-related emissions and the impact of other major air pollutant sources in the region. It is this combination of existing air quality, Project impacts, and impacts of other sources that constitutes a "cumulative analysis" for PSD purposes. The cumulative analysis is also consistent with the NEPA definition of cumulative impacts at 40 CFR §1508.7.

The process of identifying "other sources" to include in the cumulative analysis began with identifying the relevant study area for each pollutant (significant impact area) based on dispersion modeling. The study areas for SO_2, NO_2, and $PM_{2.5}$ were 2.2 miles, 2.8 miles, and 0.93 mile (3.6 kilometers, 4.5 kilometers, and 1.5 kilometers) around the Project site, respectively. Major and minor sources within these study areas were inventoried; additional major sources within 31 miles (50 kilometers) of the study area were also added. Emissions information for other sources was obtained from EQB Air Quality Division and EPA Region 2 and included reviewing permit files and EPA's Air Facility System and National Emissions Inventory databases. A detailed list of other sources and the emission rates assumed for each are provided in the October 2011 Revised PSD Modeling report. Other sources on the south side of the island (which are separated from the Project area by a mountain range), were excluded following a screening analysis showing these sources would not appreciably affect the receptors in the Project area. The modeling parameters were reviewed and approved by EPA.

A PSD analysis of lead emissions was not required for permitting purposes because the maximum annual emissions of 0.31 tons per year are below the significant emission rate of 0.6 tons per year. Nevertheless, Energy Answers completed a lead dispersion modeling analysis voluntarily during the permitting of the Project. Results of this analysis indicated that the maximum predicted concentration of lead is 0.00056 $\mu g/m^3$, which is well below the 0.15 $\mu g/m^3$ NAAQS (3-month average).

Compliance with the NAAQS means that Project-related emissions of the criteria pollutants NO_2, SO_2, $PM_{2.5}$, and lead would not have a cumulative adverse impact on sensitive populations (e.g., asthmatics, children, and the elderly), agriculture (e.g., soils and livestock), and vegetation/wildlife.

4.4.3 Visual Resources

The proposed plant site was used for decades as a paper mill and is currently abandoned and unmaintained. The historical industrial use provided the original context for the visual setting surrounding the property. Given the current state of disrepair, construction activities would be marginally less attractive as the vacant site is developed into a modern industrial facility with landscaped grounds. Once construction is complete, the visual attractiveness of the property would be improved. Over the short term, the visual resources would be changed from a passive, degraded former industrial site to an active construction site with workers, heavy machinery, scaffolding, dust, and truck traffic bringing materials to the site. These conditions would last for the duration of the construction period, estimated to be 3 years. Once construction is complete, operation of the plant would provide a new industrial building complex along PR-2 with modern architecture, industrial shapes and textures, formal landscaping, and a steady flow of truck traffic entering and leaving the site. There are no other projects in the vicinity that would be visible from the plant site that would contribute to cumulative effects on the visual resources in the area. Therefore there would be no cumulative impacts on visual resources associated with the proposed Project.

4.4.4 Acoustic Environment

Agriculture and community development activities have occurred and continue to occur in the Project area, creating a localized level of noise that depends on the activity and is not significant in scale. Project construction activities could cause an increase in sound that is well above ambient noise levels in the area immediately surrounding the plant. However, construction noise at the nearest residential receptor would not be perceptible, especially given the ambient noise sources in the area. Noise associated with the loudest construction activity, pile driving or the installation of sheet pile, would increase the sound level at the closest residence, Receptor 4, by less than 1 dBA, a level that is imperceptible. Therefore, the anticipated off-site noise levels during the construction phase would not be expected to noticeably increase the existing ambient noise environment in the Project area.

The Project's operation is expected to increase the noise levels at the receptors surrounding the property due to noise from facility operations and increased truck traffic accessing the site. However, the noise impact assessment showed that there would essentially be no change in the noise level due to the operation of the plant during daytime hours because of the distance between the plant and the receptors and the existing high ambient noise levels. Operation of the Project would result in an increased level in vehicular traffic on PR-2 in the Project vicinity, specifically solid waste trucks that would unload waste into the plant and haul recyclables and waste off site. Since all receptors are currently affected by the noise generated by the traffic of cars and trucks on PR-2, because the area is in commercial and industrial use, and since the increase in traffic caused by the Project will be less than 2 percent of existing levels, there will be no perceptible increase in noise as a result of Project traffic. When taken cumulatively with existing noise sources and proposed new development, the Project would not have a long-term effect.

4.4.5 Transportation

Energy Answers conducted a traffic study that projected traffic volume for 2013 and 2018 using anticipated annual growth for four intersections (Intersection #1: PR-2, PR-10 and Juan Rosado Avenue, Intersection #2: PR-2 and Victor Rojas Avenue, and the intersections of PR-2 with the two entrances to the site). After implementation of the proposed physical and traffic operational improvements, additional wait times at traffic lights would remain at three intersections. Although these increased wait times are unavoidable, the overall wait times at intersections along PR-2 near the Project would increase by a maximum of 45 seconds as a result of the installation of a new traffic signal at the north entrance (Access #1). Because these increases are minimal, the Project would not have any adverse cumulative impacts on traffic.

4.4.6 Socioeconomic Resources and Environmental Justice

The cumulative effects analysis spatial scope includes the whole ROI, which is defined as Arecibo and the contiguous municipalities of Hatillo, Utuado, Ciales, Florida, and Barceloneta. In addition, the metropolitan areas of San Juan and Ponce are included in the ROI because these cities are close enough to Arecibo that construction workers and personnel would most likely commute from these cities.

Project construction is projected to create over 4,000 construction jobs over three years. While some construction personnel may come from outside Puerto Rico, a significant impact on housing or government services is not anticipated. Because some construction workers associated with the Project may commute from throughout the ROI (e.g., from Ponce and San Juan) and from other areas in Puerto Rico, impacts on the economy and emergency services would be distributed beyond the immediate Project area. Labor mobility could have effects on the provision of public services in the area, namely fire stations, police stations, hospitals, and schools. However, it is difficult to determine if additional facilities would be needed. For example, the Police Department considers the territorial area of the municipalities, the crime rate, the floating population, among other criteria for determining the facilities that are needed. Likewise, the Department of Education, and the Department of Recreation and Sports, among other agencies have specific criteria for determining the need for additional facilities.

Project operations also would result in additional employment. This additional employment would have an impact on the local economy in terms of sales volume and taxation and on emergency services within the ROI. The Project will employ approximately 150 full-time operating personnel once completed. While any impacts on sales volume or taxation would likely be positive, these socioeconomic impacts associated with long-term operations are not anticipated to be significant. While some operating personnel may come from outside Puerto Rico, a significant impact on housing or government services is not anticipated.

In terms of cumulative effects, the Project, together with the potential proposed projects in the area would generate a low-intensity positive economic impact due to the socioeconomic activity in the area. These effects would be reflected in the area of new direct, indirect, and induced jobs as new business and commercial activity occur.

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APPENDIX A:

SCOPING REPORT

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Arecibo Waste-to-Energy and Resource Recovery Project

Environmental Impact Statement

Scoping Summary Report

Prepared by:

Louis Berger

Prepared for:

USDA Rural Development
United States Department of Agriculture

April 2015

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1.0 INTRODUCTION

1.1 Overview

Energy Answers Arecibo, LLC (Energy Answers or the applicant) proposes to a construct a waste-to-energy (WTE) generation and resource recovery facility in the Cambalache Ward of Arecibo, Puerto Rico, and may request financial assistance from the United States Department of Agriculture (USDA) Rural Utilities Service (RUS) for the project. Energy Answers has stated that it may request a loan from RUS.

RUS has determined that the agency's decision to finance the proposed project would constitute a major federal action that may have a significant impact upon the environment within the context of the National Environmental Policy Act of 1969 (NEPA) and has also determined that an Environmental Impact Statement (EIS) is the appropriate level of environmental review. Prior to making a decision on Energy Answers' request, RUS must consider possible environmental impacts of the proposed project. RUS will use the NEPA planning process to encourage agency and public involvement in the review of the proposed project and to identify the range of reasonable alternatives.

The EIS will be prepared in accordance with the Council on Environmental Quality's regulations for implementing NEPA (40 CFR Parts 1500–1508), and RUS' Environmental and Policies and Procedures (7 CFR Part 1794). RUS is the lead federal agency, as defined at 40 CFR 1501.5, for preparation of the EIS.

In addition, as part of its broad environmental review process, RUS must take into account the effect of the proposal on historic properties in accordance with Section 106 of the National Historic Preservation Act (Section 106) and its implementing regulation, ''Protection of Historic Properties'' (36 CFR part 800). Pursuant to 36 CFR 800.2(d)(3), RUS is using its procedures for public involvement under NEPA to meet its responsibilities to solicit and consider the views of the public during the Section 106 review.

Among the alternatives that RUS will address in the EIS is the No Action alternative, under which the proposal would not be undertaken. In the EIS, the effects of the proposal will be compared to the existing conditions in the proposal area. Public health and safety, environmental impacts, and engineering aspects of the proposal will be considered in the EIS.

Any final action by RUS related to the proposal will be subject to, and contingent upon, compliance with all relevant executive orders and federal, state, and local environmental laws and regulations in addition to the completion of the environmental review requirements as prescribed in RUS' Environmental Policies and Procedures, 7 CFR Part 1794, as amended.

1.2 Public Outreach

On April 12, 2013, RUS published in the *Federal Register* a Notice of Intent (NOI) to Prepare a Supplemental Final EIS (SFEIS) in connection with potential impacts related to the proposal by Energy Answers (78 FR 21908). In accordance with 7 CFR 1794.74 and 40 CFR 1502.21, RUS intended to incorporate by reference the 2010 environmental impact analyses and documentation prepared by the Puerto Rico Industrial Development Company (PRIDCO). PRIDCO served as a lead agency in preparation of an EIS prepared under the Puerto Rico Environmental Public Policy Act, Article 4(B)(3), (Law No. 416, September 22, 2004). The EIS is referred to as the PRIDCO EIS in this scoping report.

According to the April 12, 2013, NOI, the SFEIS was scheduled for publication in March 2013 and the public was invited to submit comments on the proposal to prepare an SFEIS, to inform RUS decision-making in its environmental review process.

On November 28, 2014, RUS published in the *Federal Register* a Notice of Cancellation of the SFEIS and Notice of Public Scoping and Intent to Prepare an Environmental Impact Statement (79 FR 70846). Through this notice, RUS announced that it was cancelling its NOI for the SFEIS and announced its intent to conduct public scoping and prepare an EIS. The public was invited to submit comments concerning the public scoping, the NOI, or to participate as a ''consulting party'' under Section 106. These comments were to be submitted to RUS on or before December 29, 2014.

On January 14, 2015, following the closing of the comment period, RUS published in the *Federal Register* a Notice of Extension of Public Comment Period, Notice of Public Scoping Meeting and Intent to Prepare an Environmental Impact Statement (80 FR 1892). Through this notice, RUS extended the comment period by an additional 30 days from the date of the notice to February 13, 2015. The notice also announced that a public scoping meeting would be held on January 28, 2015, from 3:00– 7:00 p.m. at the *Colegio de Ingenieros y Agrimensores de Puerto Rico, Capıtulo de Arecibo,* Ave. Manuel T. Guillan 1, Arecibo. Project-related information was available at RUS' web site (*http://www.rurdev.usda.gov/ UWP-AreciboPuertoRico.html*) and at the *Tribunal General de Justicia, Centro Judicial*, and the *Casa Alcaldıa del Municipio de Arecibo.*

In addition, individuals who contacted RUS were provided with information on the date and format of the proposed public scoping meeting. Copies of the *Federal Register* notices are provided in **Appendix A**. **Appendix B** contains copies of the newspaper notices and affidavits.

The public scoping meeting was conducted in an open house format with a court reporter available for transcription of verbal comments. The meeting provided the public with the opportunity to learn more about the proposed project and to provide comments on potential environmental issues associated with the project. Overall, 134 attendees registered on the sign in sheets (see **Appendix C)**. Additionally, 38 members of the public signed up to provide verbal statements, and 34 people gave verbal comments at the meeting; their comments were transcribed by court stenographer. The transcript is provided in **Appendix D**. There were 46 written comments submitted at the meeting using the comments sheets provided, and an additional 4 prepared comments were submitted at the meeting, including comments from the Puerto Rico Mayor's Association. Those, along with the comments received via other avenues during the 2014 and 2015 scoping periods are provided in **Appendix E**.

In general, the following concerns were expressed during the public scoping meeting:

- The meeting attendees were upset with the government of Puerto Rico review and approval process of the 2010 PRIDCO EIS and expressed that the proposed project was rushed through without adequate oversight.
- The attendees stated that the air emissions permit issued by the United States Environmental Protection Agency (USEPA) did not adequately protect the health of the community. Particular concerns were expressed with emissions of lead and a high incidence of childhood lead poisoning in the area. Concerns were also expressed that the air dispersion modeling was inadequate and did not use proper data and assumptions.

- Commenters expressed concern that the applicant's health and safety risk assessment was inadequate and sufficient documentation or explanation was not provided to allow for the community to evaluate the results of the analysis.
- Comments were expressed that the project will prevent or discourage the recycling of municipal solid waste.
- The public expressed concerns that the format of the scoping meeting was not conducive to people providing comments because they were used to the format of public hearings.
- The public expressed concerns about the public notifications for the RUS scoping meeting and the lack of explanation of its purpose.

In addition to the comments received during the scoping meeting, RUS received scoping comments in the form of written letters or emails from private citizens, government agencies, and nongovernmental organizations during the 2014 and 2015 public scoping comment periods. Copies of comment letters and written materials submitted for the record during the two scoping periods are included in **Appendix E** to this report and are also available at: http://www.rd.usda.gov/publications/environmental-studies/impact-statements/arecibo-waste-energy-generation-and-resource. Overall, 160 individuals provided comments related to the proposed project during the scoping period with 21 individuals contributing via multiple pathways (e.g., a verbal comment and written comment).

RUS' Draft EIS (DEIS) will also contain a subsection that summarizes the comments received during the scoping period.

1.3 Public Scoping Timeline

The following timeline summarizes the scoping period events:

April 12, 2013	RUS issued a Federal Register NOI to prepare an SFEIS (78 FR 21908).
November 28, 2014	RUS published in the *Federal Register,* a Notice of Cancellation of the SFEIS and Notice of Public Scoping and Intent to Prepare an EIS (79 FR 70846).
January 14, 2015	RUS published, in the *Federal Register,* a Notice of Extension of Public Comment Period, Notice of Public Scoping Meeting and Intent to Prepare an EIS (80 FR 1892).
January 28, 2015	RUS held a public scoping meeting at the *Colegio de Ingenieros y Agrimensores de Puerto Rico* in Arecibo.
February 13, 2015	Public scoping period ended.

1.4 Project Overview

The proposed facility would process approximately 2,100 tons of municipal waste per day and generate a net capacity of 67 megawatts (MW). The Puerto Rico Electric Power Authority (PREPA) would purchase power generated from the facility. In addition to municipal solid waste, the proposed facility would be designed to combust up to 286 tons per day of auto-shredded residue (ASR), 330 tons per day of tire-derived fuel (TDF), or 898 tons per day of processed urban wood waste (PUWW) as supplementary fuel. The proposed facility would also recover and recycle 240 tons per day of ferrous metals (such as iron and steel, among others) and nonferrous metals (aluminum, copper, and tin, among others).

The proposed project would also include a system for processing bottom ash. This system is designed to recover ferrous and non-ferrous metals and would produce a granular material known as Boiler Aggregate™. Boiler Aggregate can be used as filler for roadway asphalt and in the manufacturing of concrete blocks, among other applications. Energy Answers also proposes to process the fly ash using a separate and independent system to condition it for disposal in a landfill or reuse as a marketable material.

The facility would be located at the former site of the Global Fibers Paper Mill, and it would cover approximately 79.6 acres of the 90-acre parcel. The proposal would include the following facility components: a municipal solid waste receiving and processing building; processed refuse fuel storage building; boiler and steam turbine; emission control system; ash processing and storage building; and other associated infrastructure and buildings. Two other connected actions, which would be constructed by Energy Answers, include an approximately 2.0-mile underground raw water line and a 38-kilovolt (kV) transmission line approximately 0.8 mile in length.

The proposed project would consist of two spreader-stoker boilers, each with a design heat input rate of 500 MMBtu/hr, which translates to an approximate waste feed rate of 1,053 tons per day per boiler. Each boiler would have three auxiliary oil burners to be used to control system temperatures during startup, shutdown, and upset conditions. The boilers would produce steam that would be used to generate electricity using a turbine generator. The proposed project would be capable of extracting some steam for sale at up to 600 pounds per square inch gauge, or condensing all of the steam for reuse using a four cell cooling tower. Electricity would be produced for in-facility usage and for sale to PREPA. An overhead electric transmission line would connect to the preferred electrical interconnection point at the Cambalache Transmission Center (CTC), located at approximately 0.5 mile south of the site. The transmission line and the interconnection point in the CTC would have a voltage of 38 kV. The aerial power line would run on steel poles 70 feet high and spaced approximately 150 feet apart.

Combustion gases from each boiler would be treated to meet emission regulations using an air quality control system (AQCS) consisting of an activated carbon injection system, a dry lime injection system, a circulating dry fluid bed scrubber, a fabric filter baghouse, and a regenerative selective catalytic reduction (RSCR) system for nitrogen oxides (NOx) control. Potable water would be supplied for personnel use and consumption. Cooling tower and boiler makeup water would be obtained from the existing Department of Natural and Environmental Resources (DNER) discharge from Caño Tiburones to the Atlantic Ocean, through an underground force main from the Vigía Pumping Station to the proposed facility.

Table 1 lists the permits that would be required for the proposed project.

Table 1 Permits Required for Proposed Energy Answers Arecibo Facility

Agency	Permit
PR Environmental Quality Board (EQB)	Location Approval of an Air Emissions Source (Rule 201)
US Environmental Protection Agency (USEPA)	Prevention of Significant Deterioration (PSD) Permit (Clean Air Act, Section 40 CFR § 52.21)
PR EQB	Permit to Construct an Air Emissions Source (Rule 203)
PR EQB	Permit for Construction of Non-hazardous Solid Waste Facility
Federal Aviation Administration (FAA)	Determination of No Hazard to Air Navigation (49 U.S.C. §44718)
PR Planning Board	Siting Consultation, Site Development and Preliminary Design Approval
PR State Historic Preservation Office (SHPO)	Consultation under the National Historic Preservation Act (NHPA)
US Advisory Council on Historic Preservation (ACHP)	Section 106 of NHPA
US National Marine Fisheries Service	Section 7 of Endangered Species Act
US Fish and Wildlife Service	Section 7 of Endangered Species Act
PR DNER	Authorization for the Use of Maritime Terrestrial Zone
PR Planning Board	Coastal Zone Management Act Consistency Determination
PR EQB, DNER, PREPA, PRASA, Institute of Puerto Rican Culture, Highway Authority, etc.	Endorsement of the project
PR Energy Affairs Administration	Endorsement of the project
PR Electric Power Authority (PREPA)	Power Connection Approval
PR EQB	Water Quality Certificate
PR Aqueduct and Sewer Authority (PRASA)	Endorsement for construction of water and sewer facilities
PR DNER	Permit for the Construction of a Water Intake
PR DNER	Permit for the Operation of a Water Extraction Franchise (intake)
PR DNER	Survey of Maritime Terrestrial Zone
PR EQB	Wetlands jurisdictional determination and Individual Permit or a Nationwide Permit (Section 404 of CWA)
USEPA	General Consolidated Permit
PR Permits Management Office (OGPe)	General Consolidated Permit
PR Permits Management Office (OGPe)	Rough Grading Permit (Clearing and Grubbing)
PR DNER	Incidental Permit for the Extraction of Materials for the Earth Crust Components
USEPA	NPDES General Stormwater Permit for Construction Activity
Highway Authority/OGPe	Access Approval & Highway Improvements Construction Permit

Agency	Permit
PR OGPe	Construction Permit for Facility Structures
PR OGPe	Construction Permit for Site Fill / Site Improvements / Site Infrastructure
PR OGPe	Permits for Transmission Structures
PREPA	Endorsement of Substation Construction
PREPA	Permits for Transmission Structures
PRASA	Endorsement for the use of water and sewer facilities
PR EQB	Permit for the construction of a wastewater treatment system without discharges to a body of water
PR EQB	Permit to Operate an Air Emissions Source
PR EQB	Permit for the Operation of a Non-Hazardous Solid Waste Facility
Fire Department	Permit to Store Flammable Liquids
PRASA	Use Permit (Occupancy Permit)
Fire Department	Endorsement for OGPe Use Permit
Fire Department	Fire Prevention Inspection Certificate
Department of Health	Endorsement for OGPe Use Permit
PR OGPe	Permits for Hydrostatic Tanks Test
PRASA	Pretreatment Permit
PR EQB	Permit for the Operation of a wastewater treatment system without discharges to a body of water
Department of Health	Sanitary License
USEPA	Spill Prevention, Containment and Cleanup Plan (CWA, 33 U.S.C. §1321 (j)(a)

2.0 SCOPING COMMENTS

An overview of the public concerns expressed during the public scoping meeting is presented in Section 1.2, *Public Outreach*, and a summary of comments received during the 2014 and 2015 public scoping periods, catalogued by general topic, is provided in **Table 2**. Issues potentially relevant to the scope of the RUS EIS will be considered by RUS during development of the DEIS.

As noted in Section 1.2 and Table 2, many commenters expressed that the public was unaccustomed to the format of the scoping meeting and requested additional public scoping meetings and extension of the scoping period. After reviewing and considering the comments received during the entire scoping process, RUS determined that the public has been afforded several avenues to provide comments and input into the scoping process and that RUS has received substantive comments that will inform the DEIS preparation. RUS will provide the public timely updates on the process and ensure that there is adequate time for the DEIS review. RUS will also hold public hearings in Puerto Rico for the DEIS. Therefore, RUS does not intend to extend the scoping period and hold additional scoping meetings.

Table 2 Summary of Scoping Comments Received by RUS

Subject Area	Comment Summary
NEPA Process (EIS scope, public information process, need for project)	*Purpose and Need* • Commenters objected to the classification of the project as a renewable energy activity because they stated that it should be clearly defined as a municipal waste incinerator or with the more refined term of a WTE system. • Commenters questioned the purpose of and need for the project, noting that the RUS EIS must establish the evidence that the demand for solid waste disposal exists (or would exist) for the proposed project. • Commenters questioned the need for the project, stating that there is an excess of installed energy capacity in Puerto Rico and, with declining population, less may be required in the future. Commenters also stated that the project would produce energy that is less than 1% of the energy produced on the island. • Commenters questioned the viability and need for the incineration facility and stated that the PRIDCO EIS used outdated population estimates from 2006, that there are one million fewer people than the projection included in the document, and that the reduced population translates to one million tons less of waste. • Commenters stated the need for new comments from local and federal agencies regarding project need and impact as a major solid waste management project and a minor energy generation project. • Commenters stated that the need identified in the previous EIS as it relates to the 2010 Executive Order declaring an energy emergency no longer exists, nor is an energy emergency identified in Executive Order 2013-038. *Public Involvement* • Prior to the extension of the scoping period and the public meeting, commenters requested public meeting(s) in Puerto Rico; that the scoping meeting notice and the EIS must be in Spanish to allow for a more transparent permitting and review process; and that public outreach and participation must be expanded. • Commenters noted that the format of the scoping meeting was confusing and not conducive to people providing comments because they were used to the format of public hearings. Commenters also stated that a description of the proposed project was not available at the scoping meeting. • Commenters requested additional public scoping meetings and

Subject Area	Comment Summary
	extension of the scoping period. • Commenters requested additional public scoping meeting(s) during off-working hours to facilitate public participation. • Commenters asked that RUS provide proof of the public announcements in local media. • A commenter stated that RUS should solicit expertise from other agencies. • Commenters requested an additional scoping meeting without the applicant being present. • Commenters stated that the RUS point of contact had not been functioning because the public had not received responses to their emails or voicemails and because the RUS website changed and did not function for a few days. *Process* • Commenters expressed objection to RUS' plan to incorporate by reference the PRIDCO EIS. • Commenters questioned why RUS is the lead federal agency for the EIS and why USEPA, USACE, or FEMA did not also require an EIS. *Permits* • Commenters expressed that the Prevention of Significant Deterioration (PSD) permit issued by the USEPA was not protective of the health of the community and would not provide emissions sufficient controls.
Proposed Project and Alternatives	*Alternative to Waste-to-Energy* • Commenters stated that other alternatives with less environmental and health impacts such as waste management alternatives (reducing, reusing, and recycling) and energy generation alternatives (such as solar and wind) must be analyzed. • Commenters stated that it was important for the EIS to analyze the recent demonstration of the viability of profitable recycling alternatives for the island's solid waste problem. Municipalities such as Carolina and Guaynabo export recycled materials from solid waste, make a profit, and provide jobs to people. • Commenters stated the need to evaluate the project in the context of current local policy regarding waste management and the hierarchy established in Article 3 of Law No. 70 of September 18, 1992, as well as subsequent policy statements from the Puerto Rican executive and legislative branches. • Commenters stated the need to reassess the impact on municipalities that would not be able to implement effective reduction and recycling programs because of possible fines and penalties to be imposed through the Solid Waste Authority, as

Subject Area	Comment Summary
	specified in the Waste Delivery and Support Agreement. *Alternate Waste Processing Technologies* • Commenters stated that, although the proposed project is primarily a solid waste management strategy, the PRIDCO EIS does not evaluate well-known and available alternatives, such as solid waste reduction, reuse, and recycling. • Commenters stated that the alternatives analysis in the EIS should examine how the infrastructure choice to handle solid wastes would compare to other infrastructure alternatives that would favor lower carbon impacts and those alternatives should include recycling. • Commenters discussed that, if the proposed project commits Puerto Rico to a particular solution for its solid waste disposal and closes out many local recycling, reuse, and reduction of waste initiatives, the EIS should present a more comprehensive analysis of alternatives. *Alternatives to Water Supply* • Commenters noted that no alternative to water supply was evaluated as part of the PRIDCO EIS, and the document needs to be revised and updated to include the analysis. *Disposal of Ash* • Commenters requested including the existing ash disposal requirements in Arecibo in impact assessment, including ash disposals from Safetech Corporation Carolina and the Battery Recycling Company Inc. • Commenters stated that there is a need to conduct an ash characterization, disposal, and fate and transport study to define health and environmental risks and to define and make public an ash management and disposal strategy. • Commenters recommended conducting a chemical analysis of the ashes under an accredited laboratory to ensure the reliability of the results and their impacts on public health.
Solid Waste	• Commenters stated that the implementation of the proposed project, when acceptable recycling rates have not yet been attained and no reduction, reuse, or recycling plans are in place, would jeopardize the effective implementation of reducing, reusing, and recycling efforts. • The commenters stated that the impact assessment in the previous EIS regarding the effect on reduced contamination on landfills is highly overstated and lacks precision and quantifiable data and that the ash disposal on landfills would have a higher concentration of contaminants than regular municipal waste stream on a per volume basis. The commenters also noted that, because the information regarding the handling of this residual ash was not discussed as part of the PRIDCO EIS, the conclusion in

Subject Area	Comment Summary
	the PRIDCO EIS regarding decreased impact on landfills is false and misleading. • Commenters asked whether solid waste would be imported from off of the island because the 2,100 tons required by the proposed project would not be generated on the island.
Soils and Geology	*Contamination* • Commenters noted that using ash deposit as fill would contaminate the soils. • Commenters noted that the proposed project would contaminate the agricultural area surrounding the proposed facility with dioxins and heavy metals.
Water Resources	*Impacts to Floodplains* • Commenters expressed concern over the potential flooding impacts from constructing the plant in the floodplain of the Rio Grande de Arecibo River and potential for contamination. • Commenters stated that locating an incineration facility within the floodzone of one of Puerto Rico's main rivers should be questioned particularly when the PR DNER has identified the area as the ecologically rich last miles of the Arecibo River. • Commenters stated that the location of the proposed ash landfill should be made known to the residents and whether or not the site has ever been affected by flooding. • Commenters stated the need to assess the impacts of channeling of the Rio Grande de Arecibo by the U.S. Army Corp of Engineers, specifically impacts on the river's water levels, speed, and concentration at any given moment, but particularly on major events such as hurricanes because it is within FEMA's flood zone. • Commenters noted that, according to FEMA, the location of the proposed project is under a "no-use" area because of floods. • Commenters noted that the selection of the recycling of sanitary waters was done without an analysis of the ecological effects of reducing freshwater input into coastal wetlands and coastal waters while increasing marine influence on the coastal zone. Commenters also stated that assurances are needed to the effect that the water withdrawal can be sustained without irreversible change in salinity or functioning of coastal wetlands. *Impacts to Ecosystems and Potable Water* • Commenters noted that no hydrology and hydraulics (H/H) study was presented in the PRIDCO EIS to evaluate the impact of water extraction from the Caño Tiburones Reserve. Commenters noted that any proposed additional extraction from the Caño Tiburones requires a new H/H water study to evaluate the accumulated impact of the Dos Bocas extraction during the past decade, as well as the impact of future extractions that may be required

Subject Area	Comment Summary
	from the Superaqueduct system. • Commenters also noted that, in February 2014, the PR DNER denied the applicant's request to extract water from Caño Tiburones because of the environmental impacts such an extraction would impose on the natural ecosystem. The commenters asked, if the alternative source to Caño Tiburones would be under the Autoridad de Acueductos y Alcantarillados (Water and Sewer Authority), how would the water shortage to 5,250 families be mitigated. • Commenters asked how the changes to the water temperature would be avoided with the outflow of the water that cools the plant. • Commenters stated the need to assess the impact on the existing water project ordered by USEPA through a settlement in Court with the Municipality of Arecibo to mitigate and control water discharges and flood control on the Rio Grande de Arecibo in La Puntilla Sector located 3 to 5 miles downstream from the proposed project.
Air Quality	*Impacts on Human Health* • Commenters stated that the USEPA PSD permit is inadequate and that it allows burning of toxic wastes. They stated that EPA did not adequately address the emissions of lead from the facility and pointed to a high incidence of childhood lead poisoning in the surrounding community. • Commenters also noted that, since 2011, USEPA declared an area of 4 kilometers around the lead smelter facility a nonattainment area for lead. • Commenters noted that the air emissions from garbage trucks transporting waste from one corner of the island to get to the Arecibo site were not accounted for in the PRIDCO EIS. • Commenters noted that there were inadequate emission controls on the stacks. • Commenters questioned the indirect impact of use of limestone (impacts from quarrying) on air quality. • Commenters cited problems from incinerators in other countries and used Syracuse, New York, ash dispersion problem as an example. *Impact Assessment Methodology* • Commenters stated that the explanation of emissions during periods of shutdown and startup is extremely limited in the PRIDCO EIS and needs to be studied and explained in detail. • Commenters noted that the EIS should include a health risk assessment including impact of nanoparticles.

Subject Area	Comment Summary
	• Also see comments under *Public Health and Safety*.
Acoustic Environment	*Facility and Traffic Noise* • Commenters stated that the previous EIS disregards the noise impact that would be caused by the operation of the facility, particularly the dramatic increase in garbage trucks in the area that will transit through PR-2. • Commenters stated the need to conduct a new noise level study that accounts for predictable noise polluting activities that would be expected and the impact on quiet zones and residential areas.
Biological Resources	*Protected/Special Species* • Commenters stated that the EIS must analyze the impacts from the ashes and other chemicals on the Puerto Rican parrot, an endangered species. *Protected Lands/Reserves* • Commenters stated that the EIS must analyze the impact of the quality of water discharge on the river and its ecosystems, especially on the Ceti in Arecibo's Rio Abajo Natural Reserve forest.
Land Resources	• Commenters noted that the project is within 1 mile of an airport. • Commenters noted that the project location is not in a rural area, but a residential area with educational institutions that may be affected by the project. • Commenters noted that, in the area of the proposed project, there is productive land used for agriculture.
Visual Resources	• Commenters noted that there are no renditions of the visual impact of the project on the region and particularly from reference points outside property boundaries. • Commenters stated that there would be visual impacts from the waste collection centers and that the project would bring more waste to the surrounding areas.
Transportation	• Commenters stated that the transport of the ash represents an additional impact. • Also see comments under *Noise and Air Quality*.
Cultural Resources/Historic Properties	• Commenters noted that the areas of potential effects of the project extend beyond the archaeological surveyed areas included in the PRIDCO EIS and that the documentation is insufficient to evaluate the potential effects on historic properties. A commenter also noted that no studies have been conducted in the areas where the pipelines that are to bring water to the plant from Caño Tiburones would be installed and that the segment along PR 681 crosses areas that are archaeologically sensitive.

Subject Area	**Comment Summary**
	• Commenters requested to become consulting parties to the Section 106 process.
Public Health and Safety	• Commenters noted that Arecibo and Hatillo, adjacent cities have among the highest prevalence of asthma (~16%) and very high mortality, both well above the national averages. • Commenters noted that the fact that Arecibo is a non-attainment area should also constitute an important element of the environmental justice evaluation in the EIS. • Commenters expressed concerns that the project would increase air pollution in a community that has already suffered for more than 10 years from the impact of contaminating industries and stated the need for a cumulative analysis of the contamination. • Commenters noted that Human Health Risk Assessment (HHRA) referenced in the PRIDCO EIS document must be revised because it is based on incomplete information. The commenter expanded that the need for a revised HHRA is because it must be based on an updated waste characterization study for Puerto Rico and not the SEMASS facility in Massachusetts, include a cumulative impact analysis, and incorporate local studies made by Colegio de Médicos de Puerto Rico and the Centers for Disease Control. • Commenters stated that the EIS should include a health risk assessment including heavy metals such as mercury. • Commenters stated that risk assessment procedures established by the World Health Organization should be used. • Commenters stated that the project represents a threat not only to human health but also to agriculture because the smoke stack of an incinerator disperses pollutants such as dioxin, which affects agriculture and cattle and concentrates in animal fat. Commenters noted that more than 25,000 people depend on the areas of Arecibo, Hatillo, and Camuy, which is Puerto Rico's "Dairy Belt," for their living. • Commenters noted that the entire food chain would be contaminated. • Commenters stated that the EIS must specify the health risks to the workers at the WTE plant. • A commenter asked how the applicant would manage a fire. Another commenter noted the need for contingency plan in case of a fire because SEMASS had a fire that lasted for 3 days that required several fire departments and the neighbors were confined to their houses for days because of the toxic emissions.
Socioeconomics and Environmental Justice	• Commenters questioned the projection of jobs in the PRIDCO EIS and stated that, compared to similar facilities in the United States, the number seemed to be overstated. Commenters stated that a more in-depth analysis of job creation from the project is

Subject Area	Comment Summary
	needed. • Commenters stated that the PRIDCO EIS used outdated population estimates from 2006. They stated that there are one million fewer people than the projection included in the document and that the reduced population translates to one million tons less of waste. • Commenters stated that a large proportion of the money invested would not benefit the economy of Puerto Rico because it would go to the purchase of technology off-island. • Commenters stated the need to conduct an in depth and thorough environmental justice study as required by NEPA and Council on Environmental Quality regulations, specifically taking into account the persistent siting of contaminating and polluting industries and activities in the Arecibo Region within economically depressed communities. • Commenters stated that the proposed project violates the principles of environmental justice because incinerators are disproportionately sited in poor or rural communities and areas of least political power. • Commenters noted that the proposed project would impact eco-tourism in places such as the Cuenca de Caño Tiburones, Bosque Cambalache, and Playa Posa as well as universities, schools, and day care facilities. • Commenters noted that the proposed project would not benefit the economy in the area.
Climate Change	• Commenters stated that the proposed project's contribution to global climate change must be evaluated because incinerators emit significant quantities of direct greenhouse gases (GHGs), including carbon dioxide and nitrous oxide, that contribute to global climate change and because their greatest contribution to climate change is through undermining waste prevention and recycling programs, and encouraging increased resource extraction. • Commenters stated the need to assess the emissions of GHGs that would be associated with the proposed project during its lifetime. This includes both direct and indirect emissions attributable to the construction and operation of the incinerator (including the transportation of solid wastes and ash wastes to and from to the facility) • A commenter noted that the RUS EIS must discuss the impacts of the proposed project on broader foreign policy objectives, including a comprehensive strategy to address climate change. • Commenters stated the need to assess the emissions of GHGs and their interrelationship with dust from the Sahara Desert, which has been flown in by air currents over the entire island of Puerto

Subject Area	Comment Summary
	Rico on an increasing regular basis.
Energy Use and Sustainability	• Commenters stated that WTE wastes energy, recovering energy by burning costs more energy, and the use of raw material (if available) to replace burnt products would require even more energy.
Cumulative Impacts	• Commenters expressed concerns that the project would increase air pollution in a community with existing polluters, including a lead smelter facility that is located approximately 2,000 feet from the project location. Commenters stated the need for a cumulative analysis of the contamination. • Commenters stated that a comprehensive cumulative impact analysis that considers impacts on ecologically sensitive and environmentally rich areas of the Arecibo Region is needed.
Project Finances and Use of Public Funds	• Commenters questioned the use of the public funds for the project because there is an excess of installed energy capacity in Puerto Rico and with declining population may require less in the future. Commenters also stated that the project would produce energy that is less than 1% of the energy production on the island. • Commenters questioned whether the location of the project, Arecibo, meets the criteria of rural as defined under 7 USC 1926 (D) (13). • Commenters stated that Title 7 U.S.C. 1926 funds would not be available when the proposed project violates compliance with the Safe Drinking Water Act. • A commenter noted that 7 CFR, Subtitle B, Chapter XVII, Subpart D, Section 1700, establishes that, if funds are already invested producing energy, RUS is required to determine whether a debt exists for such technology. From there, RUS is required to evaluate whether the applicant has a private interest that endangers public use. • Commenters requested that RUS make public the entire information regarding the financial aid solicited by the applicant. • A commenter noted that, if RUS is interested in subsidizing a project that truly supports agriculture, it should withhold loans from the applicant and provide assistance for clean water in Arecibo. • Commenters stated that overall costs of the project must be reassessed in the light of lower oil prices and the benefits of a municipal waste incineration facility in lieu of other alternatives with less environmental and health impacts such as waste management alternatives (reducing, reusing, and recycling) and energy generation alternatives such as solar and wind. • Commenters asked who would have the financial liabilities if the project goes bankrupt.

Subject Area	Comment Summary
PRIDCO EIS	• Commenters stated that the public review period for the PRIDCO EIS was inadequate. • Commenters stated that the PRIDCO EIS document must be revised because it is based on incomplete and outdated information.
Additional Studies	• Commenters stated that, because the applicant proposes to change the topography of the area and would impact public wetlands for private economic benefit, the public deserves a cost/benefit analysis for such a tradeoff. • Commenters noted that, at a minimum, a new waste characterization study should be completed to better assess the type of pollutants and amounts that can be expected to be released, thus allowing for a better assessment of the environmental and health impacts. Commenters also noted that the study would provide the specific volumes of recyclables and toxic materials that would enter the incineration waste stream and also determine the project's viability. • Commenters also noted that no studies have been conducted in the areas where the pipelines that are to bring water to the plant from Caño Tiburones are to be installed and that the segment along PR 681 would cross areas that are archaeologically sensitive. • Commenters suggested that RUS require the applicant to use the most advanced scientific model, known as the leaching environmental assessment framework, to consider the impacts of the ash disposal. • Commenters requested a new noise level study that accounts for noise polluting activities that could be expected and the impact on quiet zones and residential areas. • Commenters noted that no H/H study was presented in the previous EIS document to evaluate the impact of water extraction from the Caño Tiburones Reserve.

APPENDIX A Federal Register Notice(s)

APPENDIX B Newspaper Notices and Affidavits

APPENDIX C Scoping Meeting Sign-in Sheets

APPENDIX D Scoping Meeting Transcript

APPENDIX E Scoping Comment Forms, Letters, and Emails

This appendices are not included with this document but may be found at:
http://www.rd.usda.gov/publications/environmental-studies/impact-statements/arecibo-waste-energy-generation-and-resource

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APPENDIX B:

REPRESENTATIVE CONDITIONS AND PHOTO-SIMULATIONS

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Figures B-1 to B-10 show the existing visual resources from the key observation points discussed in Section 3.6.1.2 *Key Viewpoints Associated with the Project,* and provide a simulation of what the completed proposed plant would look like within its current surroundings.

Figure B-1a. Key Observation Point 1 – Looking Northwest from Avenue Domingo Ruiz, South of PR-2

Figure B-1b. Key Observation Point 1 – Photosimulation of Project from Avenue Domingo Ruiz

Figure B-2a. Key Observation Point 1 Alternate – View from Avenue Domingo Ruiz towards the Project Site

Figure B-2b. Key Observation Point 1 Alternate – Photosimulation from Avenue Domingo Ruiz towards the Project Site

Figure B-3a. Key Observation Point 2 – Looking Southwest from the Yacht Club Parking Lot

Figure B-3b. Key Observation Point 2 – Photosimulation of Project from the Yacht Club Parking Lot

Figure B-4a. Key Observation Point 2 (Alternative) – Looking Southwest from Neighborhood just North of the Yacht Club

Figure B-4b. Key Observation Point 2 (Alternative 2) – Looking Southwest from Neighborhood just North of the Yacht Club

Figure B-5a. Key Observation Point 3 – Looking South off of PR-2 near Intersection with PR-6681

Figure B-5b. Key Observation Point 3 – Photosimulation of View towards Plant from PR-2 near Intersection with PR-6681

Figure B-6a. Key Observation Point 3 (Alternative) – Looking South off of PR-2 near Intersection with PR-681

Figure B-6b. Key Observation Point 3 (Alternative) – Photosimulation of Project from PR-2 near Intersection with PR-681

Figure B-7a. Key Observation Point 4 – View of Project looking Southeast off PR-2, before Crossing the Río Grande de Arecibo

Figure B-7b. Key Observation Point 4 – Photosimulation of Project Looking Southeast off PR-2, before Crossing the Río Grande de Arecibo

Figure B-8a. **Key Observation Point 5 – Looking Northwest off of PR-2 near Residences**

Figure B-8b. **Key Observation Point 5 – Photosimulation Looking towards Project Site from PR-2 near Residences**

Figure B-9a. Key Observation Point 6 – Looking East towards Project Site from PR-10 near the Baseball Stadium

Figure B-9b. Key Observation Point 6 – Photosimulation Looking towards Project Site from PR-10 near the Baseball Stadium

Figure B-10a. Key Observation Point 7 – Looking East from Highway PR-22

Figure B-10b. Key Observation Point 7 – Photosimulation of Project Site from Highway PR-22