APENDICE L

Estudio de Riesgo Ecológico

Noviembre 2010

Declaración de Impacto Ambiental – Preliminar

Planta de Generación de Energía Renovable y Recuperación de Recursos

BARRIO CAMBALACHE DE ARECIBO

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Arecibo, Puerto Rico Renewable Energy Project

Screening Level Ecological Risk Assessment for the Renewable Energy Power Plant to be located in Arecibo

October 2010

ARCADIS

Screening Level Ecological Risk Assessment

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Executive Summary

A Screening Level Ecological Risk Assessment (SLERA) was performed to assimilate facility emissions data and ecological information and provide a screening of potential risks to ecological receptors within a 10-kilometer (km) radius of Energy Answers' (EA) proposed Resource Recovery Facility (Facility) site (the "Site") in Arecibo, Puerto Rico. Within this radius, the most significant atmospheric deposition of such emissions generally occurs. The SLERA integrated the four components of an ecological risk assessment (United States Environmental Protection Agency 1997, 1998) as described below:

I. Problem Formulation: This first step in the SLERA process describes the Site setting, the conceptual site model (CSM), and assessment and measurement endpoints (USEPA, 1998).

II. Exposure Assessment: Involves the process of estimating the magnitude of chemical exposure, and includes the identification of potentially exposed ecological receptors and the evaluation of potentially complete exposure pathways. The process considers various site-related conditions, such as air dispersion and deposition modeling results, proximity to environmentally-sensitive areas (ESAs), and receptor-specific activity patterns. For this SLERA, exposure-point concentrations are calculated based on the results of air dispersion and deposition modeling.

III. Effects Assessment: Involves comparison of the calculated exposure-point concentrations of chemicals 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 to receptor populations.

IV. Risk Characterization: The level of potential risk is estimated for ecological receptors with potentially complete exposure pathways identified in the Problem Formulation and Ecological 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 Evaluation.

Based on the information above, the SLERA examined the potential coincidence of ESAs, COPEC, and complete exposure pathways at ecological habitat areas or ESAs within 10 km of the Site. 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 Site:

- Exposure pathways for wildlife to Site-related COPEC are present within the 10 km 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 due to 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 (SLERA 3 area) 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 (Cienaga Tiburones area) to EBSLs showed concentrations of COPEC to typically be at least one order-of-magnitude less than the surface water EBSLs and 3 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 COPC results for sediment (Cienaga Tiburones area) to EBSLs showed concentrations of COPEC to be at least 3 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.

The evaluation presented in this report is considered to be conservative and the potential risks to ecological receptors are likely lower than those discussed above based on the uncertainties discussed in Section 5.2.

Due to COPC concentrations in soil, 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 10 km of the Site. As a result, additional evaluation of potential ecological exposures at the Site is unwarranted.

1. INTRODUCTION

On behalf of Energy Answers International (EA), ARCADIS U.S. Inc. (ARCADIS) has prepared this Screening Level Ecological Risk Assessment (SLERA) to evaluate potential ecological risks associated with the proposed Resource Recovery Facility (Facility) site (the “Site”) in Arecibo, Puerto Rico (Figures 1 and 2). The proposed Facility is designed to process approximately 2,100 tons of municipal solid waste (MSW) per day; shred MSW into process refuse fuel; and generate approximately 80 mega-watts (MW) of electricity. As part of the Facility permitting process, the SLERA focuses on evaluating potential adverse effects to ecological receptors (wildlife) from predicted constituent concentrations in environmental matrices (i.e., soil, surface water and sediment) as a result of Facility air emissions.

1.1 Background

Puerto Rico is an island located between the Caribbean Sea and North Atlantic Ocean. It has a land mass of approximately 8,870 square miles and is divided into 78 municipalities [Central Intelligence Agency (CIA), 2010]. Historically, municipal wastes have been disposed of in landfills in Puerto Rico. Currently, there are approximately 32 active landfills in Puerto Rico. However, space for landfills is limited and the cost to comply with landfill regulations continues to increase because of on-going maintenance and repair of existing facilities and updates needed to comply with new requirements. Resource Recovery facilities provide a good alternative to land-filling wastes. Resource Recovery facilities produce energy from waste and recover valuable recyclable materials to benefit the local community while significantly reducing the volume of solid waste (approximately 90% reduction) that ultimately needs to be disposed of.

The proposed Facility will be located in Barrio Cambalache in the Municipality of Arecibo, which is west of the capital, San Juan, and within the coastal plains in the northern part of the commonwealth. Figure 1 indicates the project location and a topographic map that shows the Site location is provided as Figure 2. A map showing land use in the area surrounding the Site is provided as Figure 3 and an aerial photograph of the area surrounding the proposed Facility is included as Figure 4 (10 kilometer [km] radius). Municipalities near Arecibo and the surrounding area evaluated in this risk assessment include Hatillo, Barceloneta and Floridia.

The Facility will be constructed on approximately 42 acres of the 81-acre property. A former paper mill occupies an additional 13 acres of the property. The proposed Facility is designed to operate continuously for 30 years and to process approximately 2,100 tons of municipal solid waste per day. It will produce approximately 80 megawatts of electricity per day. Waste derived fuel will constitute 100% of operating fuel. In addition, the fuel preparation system is designed to recover 23.8% by weight for the municipal solid waste in the form of recyclable materials. Air pollution control systems for the types of combustors that will be used in this Facility have been characterized by USEPA and several state air permitting agencies as best achievable control technology (BACT) based on demonstrated actual performance levels at similar facilities.

1.2 SLERA Approach

The purpose of the SLERA is to assimilate air emissions fate and transport modeling results and ecological information for the Site and surrounding area to provide a screening of potential risks to ecological receptors proximal to the Site. The SLERA has been conducted in accordance with the United States Environmental Protection Agency's (USEPA's) Guidelines for Ecological Risk Assessment (USEPA, 1998) and Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (ERAGS) (USEPA, 1997). As a result, the SLERA consists of a problem formulation step where potential exposure pathways are identified, a screening-level exposure assessment, an effects assessment, and ecological risk characterization. These steps are summarized as follows:

<u>Problem Formulation</u> - includes a conceptual site model (CSM) that describes the environmental setting, constituent fate and transport associated with the Site, potential ecotoxicity of site-related constituents of potential ecological concern (COPEC), the ecological receptors that may potentially be affected by exposure, potentially complete exposure pathways, and the selection of screening ecological risk endpoints.

<u>Exposure Assessment</u> - involves review of available information regarding the natural features associated with the Site and surrounding area, and identification of environmentally-sensitive areas (ESAs) in the vicinity of the Site. The primary objective of the exposure assessment is to identify site-specific ESAs and potential ecological receptors. Potential exposure pathways related to predicted concentrations of COPEC in environmental matrices in the vicinity of the Site are also evaluated and refined during this step.

Effects Assessment – involves screening the predicted matrix concentrations using ecologically-based screening levels (EBSLs) to identify COPEC associated with environmental matrices of interest. The predicted matrix concentrations include those modeled for the proposed permit emissions case as well as the expected actual emissions case.

Risk Characterization – involves integration and evaluation of the results of the previous steps to provide a characterization of potential ecological risk based on site-specific conditions. Potential risks are evaluated for complete exposure pathways by comparing the proposed permit emissions case as well as the expected actual emissions case concentrations in each medium to the EBSLs identified in the previous step.

Details regarding the results of implementation of these steps are presented in Sections 1 through 4, respectively, and additional information supporting the SLERA is provided as appendices.

2. PROBLEM FORMULATION

The first step in ecological risk assessment is problem formulation, which describes the Site setting, the conceptual site model (CSM), and assessment and measurement endpoints (USEPA, 1998). These components of the problem formulation are discussed below.

2.1 Site Setting

The proposed Resource Recovery Facility (the “Site”) is located on the northwest coast of Puerto Rico in the Coastal Lowlands Province, which includes the Rio Grande de Arecibo River valley and floodplain. The general location of the Site and the physiographic features of the surrounding area are shown on Figure 2, developed from the United States Geological Survey (USGS) 7.5-minute quadrangles for Arecibo, Puerto Rico (1982).

The following section provides a brief description of conditions in the area of interest surrounding the proposed Facility.

2.1.1 Physical Conditions

Terrain

Puerto Rico is mostly mountainous with a coastal plain belt in the north; mountains precipitous to the sea on the west coast; and sandy beaches along most coastal areas. Elevations range from sea level at the Caribbean Sea to a high of 1,339 m at Cerro de Punta.

The entire Cambalache region is shown on the 1999 Federal Emergency Management Agency (FEMA) Flood Zone Map as being within a special flood hazard area of Zone AE (FEMA, 1999). Zone AE is within the floodway area of a 100-year coastal flood. The base flood elevation for the 100-year storm event in the area near the proposed Facility is between 4 and 5 meters above mean sea level.

Surface Water

Puerto Rico's high central mountains and many small rivers provide fresh water to much of the island. The northern portion of the island is a fertile coastal plain belt. Wetlands range from the interior montane wetlands of the rain forest to intertidal mangrove swamps along the coast (USGS, 1997a).

The Rio Grande de Arecibo flows north along the western boundary of the proposed Facility site. Its headwaters are in the mountainous terrain of volcanic origin to the south. It drains more than 200 square miles as it flows through the north coast limestone and empties into the Atlantic Ocean at Port Arecibo, approximately 2 km downstream of the proposed Facility site. The average width of the Rio Grande de Arecibo near the site is 80 feet, and the current velocity is 0.57 m/s (USGS stream gage at Central Cambalache, data from 1996-2010). Upstream of the site, the Rio Grande de Arecibo flows through Dos Bocas Reservoir, a source of hydroelectric power, and the Superacueducto, a source of local drinking water.

Cienaga Tiburones is Puerto Rico's largest wetland and is located northeast of the proposed Facility site. It encompasses approximately 6,000 acres along the Atlantic Coast, between Rio Grande de Arecibo and Rio Grande de Manati to the east. The wetland was historically a shallow coastal lagoon that drained freshwater from the surrounding river valleys to the ocean through subterranean conduits (Zack and Class-Cacho, 1984). In the mid-nineteenth century, the Puerto Rico Department of Agriculture installed a series of ditches and canals (e.g., Caño Tiburones, Caño Norte) to drain the swamp for rice production. De-watering resulted in subsidence and reversed the hydraulic gradient. By 1980, the previously freshwater wetland was inundated with saltwater, making the area unsuitable for agriculture and freshwater wetland flora and fauna. The USGS and Puerto Rico Department of Agriculture instituted a number of measures in the mid-1980s, including building earthen dams and plugging the subterranean conduits, to restore the wetland to its freshwater status. These measures were largely successful and today, Cienaga Tiburones is a protected wildlife conservation area.

Climate

Puerto Rico has a mild tropical marine climate with little seasonal temperature variation (CIA, 2010). The average annual precipitation in Puerto Rico is 60 to 80 inches per year (USGS, 1997b). Natural climactic hazards include periodic droughts and hurricanes.

Geology and Hydrogeology

The area of interest is of a flat relief with elevations commonly between 2 to 6 meters. Rio Grande de Arecibo and its tributaries abut to the west and Cano Tiburones is approximately 1 km to the NNE. The Atlantic Ocean is approximately 1 km to the NNW. It should be noted that the area of interest is prone to flooding especially during the hurricane season. The amount of water flowing in the river is controlled by a hydroelectric power reservoir farther south from the site.

The geology of the area can be described as floodplain alluvium deposits (QA, Geological Map of the Arecibo Quadrangle, Puerto Rico, Briggs, R.P., 1968) consisting mainly of sands, gravels, silts, and clays. These soils are underlain by karstic Aymamon limestone (Miocene). The soils commonly contain limestone fragments.

The water level is usually found 6 to 10 feet below ground surface (bgs). The groundwater levels vary according to seasons (dry versus wet), tides, and rates of pumping (Cano Tiburones is often pumped which might reverse the hydraulic gradient) among others. The groundwater flow is generally towards the Atlantic Ocean. There are two more aquifers i.e., intermediate (cca 150-200 feet bgs) and deep (cca 800-2,000 ft bgs) beneath the area.

2.1.2 Land – Condition and Use

Land in Puerto Rico is composed of 3.69% arable land, 5.59% permanent crops and 90.72% other (CIA, 2010). Land near the proposed Facility includes the city of Arecibo (approximately two [2] kilometers [1.3 miles]) to the northwest, surrounding suburban residential development, and rural areas that include large areas of crop lands and dairy and cattle farms (Figures 3 and 4). Rural areas also include small residential areas and some industrial facilities.

Land use within ten (10) km of the proposed Facility is depicted on Figure 3. Approximately 20 percent of the area within three (3) kilometers is urban while rural land use constitutes approximately 80 percent.

The area of Barrio Cambalache is located in the Rio Grande de Arecibo flood plain. Land use in Barrio Cambalache has been mostly agricultural for the past few decades. Between 1982 and 1983, sugar cane cultivation occupied approximately 55 percent of the valley, rice plantations about 30 percent and livestock pastures approximately 15 percent. Forest land occupies approximately 41 percent (34,500 acres) of the total Rio Grande de Arecibo basin land area, while urban development and rural settlements comprise around 13 percent (10,700 acres).

The area surrounding the Site is primarily farmland and pastureland and the region is characterized by expansive areas of agricultural fields. Terrain within approximately 3 kilometers (km) of the proposed Facility is flat to gently rolling and hilly terrain is found at distances greater than 3 km from the Site. The largest nearby residential and commercial area is the city of Arecibo, which is located approximately 2 km to the northwest. The area to the west of the Site for approximately 1.6 km is open farmland used for crops, grassland, and pastures according to the Puerto Rico Planning Board and the Department of Natural and Environmental Resources (Figures 3 and 4). The area to the southwest and south has similar usage for a distance of approximately 3.0 to 5.0 km, respectively. Patches of wet meadow and forested wetlands are found within portions of this larger agricultural area on the east and west sides of the Rio Grande de Arecibo River (Figures 3 and 4). Beyond the farmland to the northwest is an urban/suburban area (the city of Arecibo), and some forest/woodland areas are found at higher elevations beyond the farmland to the south and southwest.

The area to the north of the Site for a distance of approximately 0.7 km is used for agricultural purposes. To the north of the agricultural fields is a narrow strip of land along the coastline near the mouth of the Rio Grande de Arecibo River that is designated as Priority Conservation Area (Area con Prioridad de Conservacion Cano Tiburones). The larger portion of this Priority Conservation Area is found approximately 1.0 km or more to the northeast of the Site. Approximately 1.4 km to the east of the Site is a nature preserve known as Reserva Natural Cano Tiburones. The area to the southeast is urban/suburban and is developed primarily for residential/commercial use (Figure 3).

2.2 Conceptual Site Model

The CSM identifies potentially complete exposure pathways at the Site. For an exposure pathway to be complete, it must contain a source, a transport mechanism, an exposure point, and a receptor present at the exposure point. If any of these components is not present, the exposure pathway is considered incomplete.

Potential ecological receptors at the Site were identified and potentially complete exposure pathways for site-related constituents were evaluated based on the following approach:

- identify potential ecological receptors and ecologically-sensitive areas (ESAs) through records review and database searches and discussions with local natural resource officials

- review air modeling results to identify the direction of air emissions plume movement and areas where deposition of stack-related constituents contained within the plume is likely to occur

- identify constituents of potential ecological concern (COPEC) based on a comparison of constituent concentrations detected in environmental media following constituent deposition to available ecologically-based screening levels (EBSLs)

- evaluate the potential for ecological effects from COPEC based on the presence of critical habitats and a complete exposure pathway

The following sections summarize the results of the ecological database search, the ecological setting at the Site and areas within a 10-kilometer (km) radius of the Site, and the potential ecological receptors within the area of interest. ESA and receptor identification are based on a review of database search results and a review of readily available information.

2.2.1 Ecological Records Review

This section summarizes the results of the natural resources data review for the Site and surrounding area. Records available through the Puerto Rico Department of Natural and Environmental Resources (DNER) Natural Heritage Program, the National Oceanic and Atmospheric Administration (NOAA), and the United States Fish and Wildlife Service (USFWS) were reviewed to identify the potential presence of critical habitats and threatened/endangered species on or within 10 km of the Site. Other studies conducted at the Site and in the surrounding area were also used as sources of information regarding natural resources.

The Puerto Rico DNER provided information regarding habitat types and ESA within the area of interest associated with the Site. Figure 4 presents relevant environmental indicators, cover types, and sensitive areas, including wetlands, within a 10 km radius of the Site. As indicated, with the exception of the adjacent Rio Grande de Arecibo River and associated wetlands, the majority of the area proximal to the Site is used for agriculture (crops, grassland, and pasture). Additional patches of wet meadow and forested wetlands are found within portions of the larger agricultural area primarily to the south and southwest of the Site as indicated in Figure 4. These wetlands are consistent with those mapped by the USFWS as part of their National Wetlands Inventory (NWI), which characterizes these wetlands as freshwater palustrine emergent (PEM), scrub-shrub (PSS), or forested (PFO) (Appendix A). Estuarine wetlands (E2EM and E2FO) are mapped in areas closer to the coastal zone to the north and northeast of the Site.

The DNER also provided information on threatened and endangered species within a 10 km radius of the Site as summarized in Appendix B. The USFWS Caribbean Endangered Species Map for Puerto Rico (Appendix C) was also reviewed for the Arecibo area. This mapping system identified only the coastal zone as critical habitat and indicated the presence of threatened or endangered species primarily in State Forests, including the Rio Abajo State Forest and the Cambalache State Forest. The Puerto Rican Boa (Epicrates inornatus) was indicated as being found in forested volcanic and limestone (karst) hills, and the Puerto Rican Crested Toad (Peltophryne lemur) is found in northern karst regions. Based on information obtained from the DNER and USFWS, potential ecological receptors are expected to be restricted to relatively small areas of potential habitat found to the west and southwest of the Site. Natural areas to the northeast and east of the Site are in an upwind direction and should not receive significant deposition from the stack emissions.

2.2.2 Potential Ecological Exposure Pathways

Based on the ecological receptors and ESA identified at the Site and surrounding area, the primary exposure pathway involves transport of COPEC from the Site via stack emissions and subsequent deposition to the ecological habitat areas. The habitat areas include open water near the Site, wetlands to the west and southwest of the Site, and upland forested habitat beyond the agricultural areas and patches of wetlands to the southwest. Wildlife foraging in these areas could come into contact with site-related COPEC, but it is anticipated that only individuals of a given species may use these areas and, if used, the areas would represent a small portion of the organism's home range or foraging area. Based on the wildlife observed at the Site and the information regarding threatened and endangered species in the region, it appears that the majority of wildlife species potentially using the area of interest will be birds and mammals.

It is worth noting that the areas identified as containing threatened and/or endangered species are located to the southwest and southeast of the Facility at a distance of 6 km or more. In addition, the areas east and northeast of the Site that are designated as conservation areas or natural areas are upwind of the primary flow direction of the Site emissions plume to the southwest. As a result, these areas are expected to receive limited deposition of Site-related constituents.

2.2.3 Assessment and Measurement Endpoints

Based on the ecological resources and potentially complete exposure pathways assumed to be present in the area surrounding the Site and identified above in the CSM, preliminary assessment endpoints (AEs) were developed to identify the ecological attributes in the area of interest that should be protected. It should be noted that onsite areas are not considered for ecological exposure because the Site will be a developed, operational Facility in the future, and will not represent ecologically significant habitat.

In general, AE selection considers the ecosystem, communities, and species relevant to a specific site. AEs are defined based on technical considerations, including the following:

- chemicals present and their concentration

- ecologically relevant receptor groups that are potentially sensitive or highly exposed to the chemicals

- potentially complete exposure pathways

Based on this CSM, the potential habitat areas subject to deposition of Site-related COPEC are found west and southwest of the Site and consist of open (surface) water, areas supporting wet meadow or forested wetlands, and woodlands.

Based on the CSM established for these areas, preliminary AEs identified for the Site are as follows: the survival, growth and/or reproduction of plants, birds, and mammals potentially present in the area of interest surrounding the Site. Measurement endpoints for each of these AEs include comparisons of surface water, soil and/or sediment concentrations of COPEC to benchmarks protective of these potential effects in these receptors.

3. EXPOSURE ASSESSMENT

The exposure assessment for the Site involves a refinement of the location of potential ecological receptors within a 10-kilometers mile radius, including different habitat types and environmentally sensitive areas (ESAs). In addition, the nature and extent of constituents of potential ecological concern (COPEC) as they relate to these ESAs are identified based on air dispersion and deposition modeling. The COPEC and the pathways by which ecological exposure can occur are also discussed.

3.1 Identification of Environmentally Sensitive Areas

ARCADIS personnel familiar with USEPA's ecological risk assessment process reviewed available information regarding the natural features associated with the site and surrounding area, and discussed the site and surrounding area with CSA personnel to identify ESAs in the vicinity of the site. Sources of information included a Natural Heritage Database search, the Arecibo Topographic Quadrangle, and the National Wetlands Inventory (NWI) Map, regulatory records, and review of available maps and figures related to environmental indicator areas. This section presents the results of the information review related to identification of ESA and potential ecological receptors.

As discussed in Section 2, habitat areas and species of interest within a 10 km radius of the Site were identified as potential ecological receptors. Predicted concentrations of

Site-related COPEC were then calculated for selected habitat areas based on air dispersion and deposition modeling results.

3.1.1 Environmental Indicator Areas

Figure 4 indicates relevant environmental indicators within a 10 km radius of the Facility based on information provided by the Department of Natural and Environmental Resources of Puerto Rico and Appendix D provides an Environmental Sensitivity Index for the area surrounding the Site. The following relevant indicators were identified for evaluation:

- Broad Winged Hawk Habitat located approximately 5 km southwest of the proposed Facility (including Rio Abajo State Forest, a protected natural area)

- Critical Wildlife Areas located approximately 1 km northeast of the Site (Area con Prioridad de Conservacion Cano Tiburones) and approximately 1.4 km to the east (Reserva Natural Cano Tiburones)

- Karst Region Priority Conservation Area located approximately 3 km to the southwest (including the Rio Abajo State Forest) and approximately 3.5 km to the southeast of the Site (including the Cambalache State Forest)

- Waterfowl Focus Area within the Critical Wildlife Areas to the northeast and east of the Site as described above.

- Priority Conservation Areas within the Critical Wildlife Areas to the northeast and east of the Site as described above.

- Protected Natural Areas include the Rio Abajo State Forest and the Cambalache State Forest located within the karst regions to the southwest and southeast of the Site

3.1.2 Wetlands

Additional habitat areas identified on Figure 3 and Appendix A include wetlands as follows:

- Open water and Herbaceous marsh associated with the Rio Grande de Arecibo adjacent to, and south of, the Site

- Open Water Estuary to the northwest of the Site within the priority conservation area
- Brackish and Saltwater Marsh (and to a lesser extent herbaceous marsh) to the northeast and east of the Site within the priority conservation area
- Herbaceous Marsh and Forested Swamp in discontinuous areas to the west, southwest, and south of the Site, mostly associated with the floodplain of the Rio Grande de Arecibo

Results of a review of the National Wetland Inventory Map for the project (Appendix A) area were consistent with the Environmental Sensitivity Index Map (Appendix D) and indicated freshwater emergent and some freshwater forested wetlands occurring sporadically in the area to the west, southwest, and south of the Site. In addition, estuarine and marine wetlands were identified to the north and northeast of the Site.

3.1.3 Habitat for Rare Plant and Animal Species

Appendix B identifies various plant and animal species that may occur within a 10 km radius of the Site, including threatened or endangered species. In addition, Appendix C identifies threatened and endangered species in the Arecibo area based on mapping conducted by the United States Fish and Wildlife Service (USFWS 2007). According to USFWS, the majority of threatened or endangered species in the Arecibo region are found in the Rio Abajo or Cambalache State Forests, the karst regions, or the coastal zone. Several bird and plant species are associated with the Rio Abajo or Cambalache State Forests, the Puerto Rican Boa (Boa puertorriquena) and Puerto Rican Crested Toad (Peltophryne lemur) are associated with the karst regions, and several species of sea turtles as well as the Roseate Tern (Sterna dougallii), Brown Pelican (Pelecanus occidentalis) and Antillean Manatee (Trihechus manatus manatus) are associated with coastal zones.

3.2 Ecological Receptor Analysis

Based on the information provided above, the following representative ESA locations were selected for evaluation of exposure to potential ecological receptors:

Rio Grande de Arecibo adjacent to Site (SLERA 1): Surface water and sediment concentrations were calculated for this location immediately west of the Site based on air dispersion and deposition modeling to identify potential exposure to Site-related COPEC.

Rio Grande de Arecibo Estuary/Priority Conservation Area (SLERA 2): Surface water and sediment COPEC concentrations were calculated for this location within the Priority Conservation Area located approximately 1.5 km north of the Site.

Forested Wetlands (SLERA 3): COPEC concentrations in soil were calculated for this location approximately 3 km west of the Site and just south of the populated area of the town of Arecibo.

Woodlands (SLERA 4): COPEC concentrations in soil were calculated for this large area of woodlands within a karst region approximately 5 km southwest of the Site and south of the populated area of the town of Arecibo.

Woodlands at Rio Abajo State Forest (SLERA 5): COPEC concentrations in soil were calculated for this area of woodlands encompassed by the Rio Abajo State Forest, a conserved area approximately 6 km southwest of the Site.

Forested and Emergent Wetlands (SLERA 6): COPEC concentrations in soil were calculated for this floodplain location approximately 5 km south of the Site.

Woodlands at Cambalache State Forest (SLERA 7): COPEC concentrations in soil were calculated for this area of woodlands encompassed by the Cambalache State Forest, a conserved area approximately 7 km southeast of the Site.

Reserva Natural Cano Tiburones (SLERA 8): Soil, surface water, and sediment COPEC concentrations were calculated for this Priority Conservation Area located approximately 2 km northeast and east of the Site.

The above habitat areas of interest include open water near the Site, an estuarine area to the north and tidal wetlands to the northeast, freshwater wetlands to the west and southwest of the Site, and upland forested habitat in the karst region beyond the agricultural areas and patches of wetlands to the southwest. In addition, two conservation areas, the Rio Abajo State Forest and the Cambalache State Forest, are found within the karst region to the southwest and southeast of the Site, respectively. The conservation areas to the north and northeast of the Site also contain wetland habitat areas of interest, but these areas are upwind of the Facility and are likely to receive lower levels of atmospheric deposition from operation of the Facility as discussed below. Wildlife foraging in these areas could come into contact with site-related COPEC, but it is anticipated that only individuals of a given species may use these areas and, if used, the areas would represent a small portion of the organism's home range or foraging area. Based on the wildlife observed at the Site and the information regarding threatened and endangered species in the region, it appears that the majority of wildlife species potentially using the area of interest will be birds and mammals.

Based on the receptor analysis, the potential habitat areas subject to deposition of Site-related COPEC are found west and southwest of the Site and consist of open (surface) water, areas supporting wet meadow or forested wetlands, and woodlands.

3.3 Air Modeling Methods

As indicated in the human-health risk assessment (HHRA) report for the Site (ARCADIS 2010), the most significant atmospheric deposition of emissions from waste combustion units occurs within 10 km of the source (USEPA, 2005). The air modeling conducted for this screening ecological risk assessment confirms that the highest air concentrations and greatest deposition impacts occur closest to the source. Therefore, the potential for exposure and associated ecological effects were evaluated for exposure scenarios and receptor locations identified within a 10-km radius of the proposed Facility.

Proposed Facility Emissions

This SLERA evaluates the combined emissions from the two proposed combustion units. Emissions from ancillary equipment (i.e., emergency generator engines, silos, cooling towers, etc.) and fugitive truck traffic emissions at the proposed Facility were not included due to the negligible emissions of COPEC from those sources. Those additional emissions sources are addressed through the air quality plan approval permitting process.

Table 1 indicates the COPEC associated with the Site and the modeling results for the COPEC are provided in Appendix E. A detailed description of the air modeling effort and characterization of Facility emissions is provided in the HHRA Report (ARCADIS 2010). The COPEC were specified by USEPA and are the chemicals potentially associated with Facility emissions that have the potential to cause adverse ecological effects via indirect (e.g., through soil, water, or food sources) exposure pathways. With the exception of lead, the risk assessment does not address emissions of the criteria pollutants [i.e., sulfur dioxide, PM less than 10 microns in size, nitrogen dioxide, ozone, lead, and carbon monoxide].

Emission rates for each COPEC were derived using stack test data, where available, from the SEMASS Resource Recovery Facility (SEMASS) in West Wareham, Massachusetts, which is a RRF with a similar design to the proposed Facility. Specifically, emissions estimates were based on stack test data collected from the "SEMASS Unit 3". Average emission rates representative of typical conditions were used to assess risks from chronic exposure. Because the SEMASS Unit 3 data were collected over years of operations, it not only represents an actual baseline for emissions but should capture variations in emissions, including times when controls and combustion conditions are not optimal. For COPECs for which SEMASS stack test data were not available (i.e., hydrogen fluoride), emission rates were based on manufacturing specifications.

3.3.1 Fate and Transport Modeling

Source information was combined with physical data (e.g., meteorological, building profile, and land use information) from the area surrounding the proposed Facility to estimate unitized[1] air concentrations and deposition fluxes using the American Meteorological Society – Environmental Protection Agency Regulatory Model (AERMOD, version 6.7.1). The unitized ambient air concentrations and deposition fluxes were multiplied by the COPC-specific emission rates to yield COPEC-specific ambient air concentrations and deposition fluxes.

The COPEC-specific ambient air concentrations, deposition fluxes, and chemical-specific physicochemical data were used to estimate COPEC concentrations in various exposure media (e.g., soil, surface water, and sediment). These medium-specific COPEC concentrations were then used to evaluate the potential for ecological risk. The exposure media calculations were facilitated with the use of commercially available software, Industrial Risk Assessment Program-Health (IRAP-h View, or IRAP, version 4.0) developed by Lakes Environmental.

3.4 Nature and Extent of COPEC

3.4.1 Soil

A screening of modeled COPEC concentrations in soil was conducted to evaluate potential ecological risk at representative terrestrial habitats and wetland habitats (hydric soil) within a 10-km radius of the Facility. The air dispersion model was used to identify the areas within the 10-km radius with the highest soil concentrations and these areas were evaluated for the presence of critical habitat and/or sensitive terrestrial wildlife species. Terrestrial areas with the combination of highest COPEC concentrations and ecological receptors of concern were screened for potential impacts using soil EBSLs. In addition, certain sensitive habitat areas such as nature reserves within the 10-km radius were evaluated even if COPEC concentrations in these areas were not the maximum concentrations identified by the modeling effort.

Concentrations of COPEC within the habitat or nature reserve areas were calculated at five nodes (point locations) within a polygon encompassing the entire habitat or reserve area. The maximum COPEC concentration from the five node locations was selected as a conservative value for the data screening process presented in Section 4. These maximum soil concentrations are presented in Table 1 and the modeling results are provided in Appendix 5. The terrestrial areas and /or hydric-soil wetland areas evaluated for COPEC in soil are shown on Figure 3 and include SLERA-3 through SLERA-8 as discussed below.

3.4.1.1 Rio Grande de Arecibo Estuary/Priority Conservation Area (SLERA 2):

COPEC concentrations in soil were calculated for this location within the Priority Conservation Area located approximately 1.5 km north of the Site. (Figure 5).

Table 1 presents the COPEC concentrations for this habitat area. The maximum modeled COPEC concentrations for soil in this habitat area include: 3.61E-08 mg/kg for Aroclor-1254 (PCB); 9.73E-09 mg/kg benzo(a)pyrene; 2.04E-11 mg/kg naphthalene; 3.51E-10 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 3.58E-06 (selenium) to 1.61E-02 mg/kg (zinc).

3.4.1.2 Forested Wetlands (SLERA 3):

COPEC concentrations in soil were calculated for this location to the west of the Site and just south of the populated area of the town of Arecibo (Figure 5).

Table 1 presents the COPEC concentrations for this habitat area. The maximum modeled COPEC concentrations for soil in this habitat area include: 1.56E-07 mg/kg for Aroclor-1254 (PCB); 4.19E-08 mg/kg benzo(a)pyrene; 1.02E-10 mg/kg naphthalene; 1.53E-09 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 3.43E-05 (methyl mercury) to 6.99E-02 mg/kg (zinc).

3.4.1.3 Woodlands (SLERA 4):

COPEC concentrations in soil were calculated for this large area of woodlands within a karst region to the southwest of the Site and south of the populated area of the town of Arecibo (Figure 5).

Table 1 presents the COPEC concentrations for this habitat area. The maximum modeled COPEC concentrations for soil in this habitat area include: 6.63E-08 mg/kg for Aroclor-1254 (PCB); 1.82E-08 mg/kg benzo(a)pyrene; 4.08E-11 mg/kg naphthalene; 6.64E-10 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 1.51E-05 (methyl mercury) to 3.04E-02 mg/kg (zinc).

3.4.1.4 Woodlands at Rio Abajo State Forest (SLERA 5):

COPEC concentrations in soil were calculated for this area of woodlands encompassed by the Rio Abajo State Forest, a conserved area approximately 5 miles southwest of the Site (Figure 5).

Table 1 presents the COPEC concentrations for this habitat area. The maximum modeled COPEC concentrations for soil in this habitat area include: 1.04E-08 mg/kg for Aroclor-1254 (PCB); 1.72E-09 mg/kg benzo(a)pyrene; 1.02E-11 mg/kg naphthalene; 6.78E-11 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 5.74E-07 (selenium) to 2.58E-03 mg/kg (zinc).

3.4.1.5 Forested and Emergent Wetlands (SLERA 6):

COPEC concentrations in soil were calculated for this floodplain location approximately 5 km south of the Site (Figure 5).

Table 1 presents the COPEC concentrations for this habitat area. The maximum modeled COPEC concentrations for soil in this habitat area include: 5.77E-09 mg/kg for Aroclor-1254 (PCB); 1.08E-09 mg/kg benzo(a)pyrene; 4.09E-11 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 3.76E-07 (selenium) to 1.68E-03 mg/kg (zinc).

3.4.1.6 Woodlands at Cambalache State Forest (SLERA 7):

COPEC concentrations in soil were calculated for this area of woodlands encompassed by the Cambalache State Forest, a conserved area approximately 7 km southeast of the Site (Figure 5).

Table 1 presents the COPEC concentrations for this habitat area. The maximum modeled COPEC concentrations for soil in this habitat area include: 2.51E-10 mg/kg for Aroclor-1254 (PCB); 1.04E-10 mg/kg benzo(a)pyrene; 4.19E-12 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 3.10E-08 (selenium) to 1.39E-04 mg/kg (zinc).

3.4.1.7 Reserva Natural Cano Tiburones (SLERA 8):

COPEC soil concentrations were calculated for this Priority Conservation Area located approximately 2 km northeast of the Site (Figure 5) .

Table 1 presents the COPEC concentrations for this habitat area. The maximum modeled COPEC concentrations for soil in this habitat area include: 6.31E-09 mg/kg for Aroclor-1254 (PCB); 1.29E-09 mg/kg benzo(a)pyrene; 4.72E-11 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 1.03E-06 (methyl mercury) to 2.10E-03 mg/kg (zinc).

Based on these results, the SLERA 7 area showed the lowest concentrations of COPEC in soil and the SLERA 3 area showed the highest concentrations. As indicated above, the SLERA 7 area (Woodlands at Cambalache State Forest) showed trace COPEC concentrations ranging from 4.06E-12 mg/kg for benzo(b)fluoranthene to 1.39E-04 mg/kg for zinc. The SLERA 3 area (Forested Wetlands west of Facility) showed trace COPEC concentrations ranging from 6.48E-11 mg/kg for Acenaphthene to 6.99E-02 mg/kg for zinc. The remaining areas had similar low-level concentrations of COPEC ranging between the concentrations observed in these two areas. It should be noted that many of the Facility-related metals concentrations modeled for soil in the SLERA areas are substantially less than background concentrations of these metals in soil based on information provided by USEPA in their Eco-SSL documents (USEPA 2005 a-e).

3.4.2 Surface Water/Sediment

A screening of modeled COPEC concentrations in surface water and sediment was conducted to evaluate potential ecological risk to organisms at representative aquatic habitats within a 10-km radius of the Facility. Aquatic habitat areas with the combination of potential COPEC concentrations and ecological receptors of concern were screened for potential impacts using EBSLs. In addition, certain sensitive habitat areas such as nature reserves within the 10-km radius were evaluated even if COPEC concentrations in these areas were not the maximum concentrations identified by the modeling effort, but aquatic habitat and/or sensitive aquatic wildlife species were present.

Similar to the approach used for soil, concentrations of COPEC within the aquatic habitat were calculated at five nodes (point locations) within a polygon encompassing the entire habitat area. However, the average COPEC concentration from the five node locations was used for the data screening process discussed in Section 4. The average surface water and sediment concentrations that integrate exposure across the aquatic habitat areas are presented in Tables 2 and 3, respectively, and the modeling results are provided in Appendix E. The surface water COPEC concentrations presented in Appendix E have units of milligrams per liter (mg/l). These units have been converted to micrograms per liter (ug/l) in Table 2 to match the units associated with the screening levels. As a result, surface water COPEC concentrations are presented in ug/l units. The aquatic areas evaluated for COPEC in surface water and sediment correspond to SLERA-1, SLERA-2 and SLERA-8 as discussed below. An additional area, Puerto Arecibo, was also evaluated.

3.4.2.1 Rio Grande de Arecibo adjacent to Site (SLERA 1):

Surface water and sediment concentrations were calculated for this location adjacent to the Facility (Figure 5) based on air dispersion and deposition modeling to identify potential exposure to Site-related COPEC.

Table 2 presents the surface water and Table 3 presents the sediment COPEC concentrations for this habitat area. The average modeled COPEC concentrations in surface water for this habitat area include: 7.16E-11 ug/l for Aroclor-1254 (PCB); 8.18E-11 ug/l benzo(a)pyrene; 9.02E-12 mg/kg naphthalene; 4.68E-13 ug/l 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 9.01E-08 (beryllium) to 7.16E-04 ug/l (zinc).

The modeled COPEC concentrations in sediment for this habitat area include: 1.05E-09 mg/kg for Aroclor-1254 (PCB); 1.05E-09 mg/kg benzo(a)pyrene; 4.28E-13 mg/kg naphthalene; 7.25E-12 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 1.03E-08 (selenium) to 4.43E-05 mg/kg (zinc).

3.4.2.2 Rio Grande de Arecibo Estuary/Priority Conservation Area (SLERA 2):

Surface water and sediment COPEC concentrations were calculated for this location within the Priority Conservation Area north of the Site (Figure 5).

Table 2 presents the surface water and Table 3 presents the sediment COPEC concentrations for this habitat area. The maximum modeled COPEC concentrations in surface water for this habitat area include: 1.04E-10 ug/l for Aroclor-1254 (PCB); 7.91E-11 ug/l benzo(a)pyrene; 1.73E-11 ug/l naphthalene; 4.05E-13 ug/l 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 3.23E-08 (beryliium) to 1.98E-04 ug/l (zinc).

The modeled COPEC concentrations in sediment for this habitat area include: 1.34E-09 mg/kg for Aroclor-1254 (PCB); 8.48E-10 mg/kg benzo(a)pyrene; 8.23E-13 mg/kg naphthalene; 5.48E-12 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 2.81E-09 (selenium) to 1.22E-05 mg/kg (zinc).

3.4.2.3 Reserva Natural Cano Tiburones (SLERA 8):

Surface water, and sediment COPEC concentrations were calculated for this Priority Conservation Area located approximately 2 km northeast of the Site (Figure 5).

Table 2 presents the surface water and Table 3 presents the sediment COPEC concentrations for this habitat area. The average modeled COPEC concentrations in surface water for this habitat area include: 1.92E-10 ug/l for Aroclor-1254 (PCB); 8.41E-10 ug/l benzo(a)pyrene; 1.99E-11 ug/l naphthalene; 1.08E-12 ug/l 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 6.12E-04 (beryllium) to 3.93E+01 ug/l (zinc).

The modeled COPEC concentrations in sediment for this habitat area include: 6.64E-09 mg/kg for Aroclor-1254 (PCB); 1.89E-08 mg/kg benzo(a)pyrene; 9.45E-13 mg/kg naphthalene; 4.30E-11 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 4.06E-04 (methyl mercury) to 2.44E+00 mg/kg (zinc).

3.4.2.4 Puerto Arecibo:

Surface water, and sediment COPEC concentrations were calculated for this estuarine area to the north of the Site (Figure 5).

Table 2 presents the surface water and Table 3 presents the sediment COPEC concentrations for this habitat area. The average modeled COPEC concentrations in surface water for this habitat area include: 3.64E-10 ug/l for Aroclor-1254 (PCB); 2.92E-10 ug/l benzo(a)pyrene; 5.12E-11 ug/l naphthalene; 1.44E-12 ug/l 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 4.62E-08 (beryllium) to 1.68E-04 ug/l (zinc).

The average modeled COPEC concentrations in sediment for this habitat area include: 4.69E-09 mg/kg for Aroclor-1254 (PCB); 3.13E-09 mg/kg benzo(a)pyrene; 2.43E-12 mg/kg naphthalene; 1.95E-11 mg/kg 2,3,7,8-Tetrachlorodibenzodioxin (TCDD); and metals concentrations ranging from 2.26E-09 (selenium) to 1.04E-05 mg/kg (zinc).

Based on these results, the Puerto Arecibo area showed the lowest concentrations of COPEC in surface water and sediments and the SLERA 8 area showed the highest concentrations. As indicated above and in Tables 2 and 3, the Puerto Arecibo area showed trace COPEC concentrations in surface water ranging from 1.44E-12 ug/l for 2,3,7,8-TCDD to 1.68E-04 ug/l for zinc. Sediment concentrations at this area ranged from 2.43E-12 mg/kg for naphthalene to 1.32E-05 mg/kg for lead. The SLERA 8 area (Reserva Natural Cano Tiburones) showed trace COPEC concentrations in surface water ranging from 1.08E-12 ug/l for 2,3,7,8-TCDD to 3.93E+001ug/l for zinc. Sediment concentrations at this area ranged from 9.45E-13 mg/kg for naphthalene to 2.44E+00 mg/kg for zinc. The remaining areas had similar low-level surface-water and sediment concentrations of COPEC ranging between the concentrations observed in these two areas. Although not confirmed in the field, it is likely that many of the Facility-related metals concentrations modeled for surface water and sediment in the SLERA areas are less than existing background concentrations of these metals in surface water and sediment within the 10 km. radius of the Site.

The potential for ecological risk was evaluated by comparing these estimated COPEC concentrations in each potential exposure medium (i.e., soil, surface water, and sediment to medium- and chemical-specific ecotoxicity screening values (ESV) or EBSLs. The EBSLs were obtained from readily available sources, such as the USEPA and the Oak Ridge National Laboratory (ORNL). The potential for ecological risk from inhalation exposure was not evaluated, due to the lack of readily available EBSLs for COPC concentrations in air and because inhalation is considered a relatively insignificant exposure pathway for wildlife receptors (USEPA, 2003).

Results of the data screening for each habitat area or ESA and potential effects to ecological receptors are discussed in the next section.

4. EFFECTS ASSESSMENT

The effects assessment compares the modeled exposure-point concentrations of COPEC in various media (i.e., soil, surface water, and sediment) to EBSLs for different classes of receptor organisms. These comparisons provide information on potential impacts to ecological receptors and form the basis for assessment of ecological risk.

4.1 Identification of EBSLS

Results of the data screening using EBSLs are summarized below for each SLERA area discussed in Section 3. It should be noted that multiple EBSLs were used for comparison purposes to help put the results into context and to identify potential adverse environmental effects, such as effects on plant and animal populations and communities. The EBSLs used in this evaluation were obtained from on-line sources, including the USEPA Region 3 (http://www.epa.gov/ reg3hwmd/ risk/eco/index.htm), the Oak Ridge National Laboratory (ORNL) (http://www.esd.ornl.gov/ programs/ecorisk/ecorisk.html), and the National Oceanic and Atmospheric Administration (NOAA) (http://response.restoration.noaa.gov/topic_ subtopic_ entry.php). These EBSLs included the following:

- USEPA Ecological Soil Screening Levels (Eco-SSLs): concentrations of COPEC in soil protective of ecological receptors that come into contact with soil or ingest biota that live in or on the soil.

- ORNL screening values and wildlife PRGs for soil and acute/chronic values for freshwater.

- Ambient Water Quality Criteria (AWQC) established by EPA for ecological effects.

- USEPA Biological Technical Assistance Group (BTAG) Sediment Benchmarks: primarily based on chronic effects to aquatic organisms.

- Marine sediment effects range low (ERL) and effects range medium (ERM) values (Long et al. 1993): the ERL concentration represents adverse impacts to benthic organisms in 10 percent of studies, and the ERM represents adverse impacts to benthic organisms in 50 percent of studies.

- Freshwater sediment lowest effects levels (LELs) and severe effects levels (SELs): the LEL represents the concentration at which adverse effects may begin to be seen in benthic organisms based on research conducted by Persaud et al. (1993). The SEL represents severe benthic impacts in most cases.

- NOAA Screening Quick Reference Tables (SQUIRTs) for COPEC EBSLs unavailable from other sources for all matrices, including Lowest Observable Adverse Effects Levels (LOAELs) for surface water.

- Preliminary Remediation Goals (PRGs): based on potential effects to flora and fauna.

Modeled results for soil, surface water and sediment at ESAs are provided in Tables 1, 2 and 3, respectively. These tables also include the EBSLs and data screening results for these matrices and a summary of EBSLs is provided in Table 4. The raw data from the modeling effort are also provided in Appendix 5. The results of data screening using the EBSLs are discussed below.

The potential for ecological risk was evaluated by comparing these modeled COPEC concentrations in each potential exposure medium (i.e., soil, surface water, and sediment) to medium- and chemical-specific ecotoxicity screening values (ESV) or EBSLs. The EBSLs were obtained from readily available sources, such as the USEPA and ORNL as indicated above. The potential for ecological risk from inhalation exposure was not evaluated, due to the lack of readily available EBSLs for COPEC concentrations in air and because inhalation is considered a relatively insignificant exposure pathway for wildlife receptors (USEPA, 2003).

Based on the information presented in Section 3, eight representative ESA locations (SLERA 1 through SLERA 8) and the Puerto Arecibo area were selected for evaluation of exposure to COPECs and potential effects to ecological receptors. These habitat areas of interest include open water near the Site, an estuarine area to the north and tidal wetlands to the northeast, freshwater wetlands to the west and southwest of the Site, and upland forested habitat in the karst region beyond the agricultural areas and patches of wetlands to the southwest. In addition, two conservation areas, the Rio Abajo State Forest and the Cambalache State Forest, are found within the karst region to the southwest and southeast of the Site, respectively. The conservation areas to the north and northeast of the Site also contain wetland habitat areas of interest, but these areas are upwind of the Facility and are likely to receive lower levels of atmospheric deposition from operation of the Facility as discussed below. Wildlife foraging in these areas could come into contact with site-related COPEC, but it is anticipated that only individuals of a given species may use these areas and, if used, the areas would represent a small portion of the organism’s home range or foraging area. Based on the wildlife observed at the Site and the information regarding threatened and endangered species in the region, it appears that the majority of wildlife species potentially using the area of interest will be birds and mammals.

4.2 Screening of COPEC

4.2.1 SOIL

A screening of modeled COPEC concentrations in soil was conducted to evaluate potential ecological risk at representative terrestrial habitats and wetland habitats (hydric soil) within a 10-km radius of the Facility. The air dispersion model was used to identify the areas within the 10-km radius with the highest soil concentrations and these areas were evaluated for the presence of critical habitat and/or sensitive terrestrial wildlife species. Terrestrial areas with the combination of highest COPEC concentrations and ecological receptors of concern were screened for potential impacts using soil EBSLs. In addition, certain sensitive habitat areas such as nature reserves within the 10-km radius were evaluated even if COPEC concentrations in these areas were not the maximum concentrations identified by the modeling effort.

Concentrations of COPEC within the habitat or nature reserve areas were calculated at five nodes (point locations) within a polygon encompassing the entire habitat or reserve area. The maximum COPEC concentration from the five node locations was selected as a conservative value for the soil data screening process. The terrestrial areas and /or hydric-soil wetland areas evaluated for COPEC in soil include SLERA-2 through SLERA 8 as discussed below. Due to the very low or trace concentrations of COPEC estimated at the receptor areas, the differences between modeled media concentrations and screening levels are indicated in “orders of magnitude” (with one order of magnitude representing 10 times, 2 orders of magnitude 100 times, and 3 orders of magnitude 1,000 times).

4.2.1.1 Rio Grande de Arecibo Estuary/Priority Conservation Area (SLERA 2):

COPEC concentrations in soil were calculated for this location within the Priority Conservation Area north of the Site. Table 1presents the COPEC concentrations for this habitat area. The modeled COPEC concentrations for this habitat area are typically more than 3 orders of magnitude (i.e., 1,000 times) less than the screening levels. As a result, the modeled soil concentrations are substantially less than the ecological screening levels and potential ecological effects are unlikely.

4.2.1.2 Forested Wetlands (SLERA 3):

COPEC concentrations in soil were calculated for this location to the west of the Site and just south of the populated area of the town of Arecibo. As indicated in Section 3, of all the SLERA areas evaluated, this area showed the highest concentrations of COPEC in soil.

Table 1presents the COPEC concentrations for this habitat area. The modeled COPEC concentrations for this habitat area are typically more than 3 orders of magnitude (i.e., 1,000 times) less than the screening levels. The only exceptions were the toxicity equivalent concentration for dioxins/furans (mammalian), methyl mercury and zinc, which were approximately 2 orders of magnitude (or 100 times) less than the most-conservative screening levels for these constituents. As a result, the modeled soil concentrations in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

4.2.1.3 Woodlands (SLERA 4):

COPEC concentrations in soil were calculated for this large area of woodlands within a karst region to the southwest of the Site and south of the populated area of the town of Arecibo.

Table 1 presents the COPEC concentrations for this habitat area. The modeled COPEC concentrations for this habitat area are typically more than 3 orders of magnitude (i.e., 1,000 times) less than the screening levels. The concentration of methyl mercury modeled for this location was 2 orders of magnitude less than the screening level. As a result, the modeled soil concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

4.2.1.4 Woodlands at Rio Abajo State Forest (SLERA 5):

COPEC concentrations in soil were calculated for this area of woodlands encompassed by the Rio Abajo State Forest, a conserved area approximately 5 miles southwest of the Site.

Table 1 presents the COPEC concentrations for this habitat area. The modeled COPEC concentrations for this habitat area are typically more than 3 orders of magnitude (i.e., 1,000 times) less than the screening levels. As a result, the modeled soil concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

4.2.1.5 Forested and Emergent Wetlands (SLERA 6):

COPEC concentrations in soil were calculated for this floodplain location approximately 5 km south of the Site.

Table 1 presents the COPEC concentrations for this habitat area. The modeled COPEC concentrations for this habitat area are typically more than 4 orders of magnitude (i.e., 10,000 times) less than the screening levels. As a result, the modeled soil concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

4.2.1.6 Woodlands at Cambalache State Forest (SLERA 7):

COPEC concentrations in soil were calculated for this area of woodlands encompassed by the Cambalache State Forest, a conserved area approximately 7 km southeast of the Site. As indicated in Section 3, of all the SLERA areas evaluated, this area showed the lowest concentrations of COPEC in soil.

Table 1 presents the COPEC concentrations for this habitat area. The modeled COPEC concentrations for this habitat area are typically more than 4 orders of magnitude (i.e., 10,000 times) less than the screening levels. As a result, the modeled soil concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

4.2.1.7 Reserva Natural Cano Tiburones (SLERA 8):

COPEC soil concentrations were calculated for this Priority Conservation Area located approximately 2 km northeast of the Site.

Table 1 presents the COPEC concentrations for this habitat area. The modeled COPEC concentrations for this habitat area are typically more than 4 orders of magnitude (i.e., 10,000 times) less than the screening levels. The concentration of methyl mercury modeled for this location was approximately 3 orders of magnitude, or 1,000 times, less than its soil screening level. As a result, the modeled soil concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

Based on these data screening results, site-related concentrations of COPEC in soil are expected to be very low and typically more than 3 orders of magnitude less than the EBSLs for a range of potential ecological receptors, including plants, invertebrates, birds, and mammals (Table 1). As a result, potential adverse effects to ecological receptors from COPEC concentrations in soil are unlikely.

4.2.2 Surface Water/Sediment

A screening of modeled COPC concentrations in surface water and sediment was conducted to evaluate potential ecological risk to organisms at representative aquatic habitats within a 10-km radius of the Facility. Similar to the approach used for soil and terrestrial receptors, aquatic habitat areas potentially influenced by site-related COPEC concentrations were screened for potential impacts using EBSLs. In addition, certain sensitive habitat areas such as nature reserves within the 10-km radius were evaluated even if COPC concentrations in these areas were not the maximum concentrations identified by the modeling effort, but aquatic habitat and/or sensitive aquatic wildlife species were present.

Similar to the approach used for soil, concentrations of COPEC within the aquatic habitat were calculated at five nodes (point locations) within a polygon encompassing the entire habitat area. However, the average COPEC concentration from the five node locations was calculated for use in the data screening process to integrate exposure within the aquatic habitat. The aquatic areas evaluated for COPC in surface water and sediment include SLERA-1, SLERA-2, SLERA-8 and the Puerto Arecibo area as discussed below.

4.2.2.1 Rio Grande de Arecibo adjacent to Site (SLERA 1):

Surface water and sediment concentrations were calculated for this location based on air dispersion and deposition modeling to identify potential exposure to Site-related COPEC. Table 2 presents the surface water and Table 3 presents the sediment COPEC concentrations for this habitat area.

The modeled surface water COPEC concentrations for this habitat area are typically orders of magnitude less than the screening levels. For example, the modeled concentration of 2,3,7,8-TCDD is more than five orders of magnitude (or 100,000 times) less than the chronic screening level. As a result, the modeled surface water concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

The modeled sediment COPEC concentrations for this habitat area are more than 3 orders of magnitude less than the screening levels. The modeled concentration of 2,3,7,8-TCDD at this location is approximately 5 orders of magnitude (or 100,000 times) less than the chronic screening level for sediment. As a result, the modeled sediment concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

4.2.2.2 Rio Grande de Arecibo Estuary/Priority Conservation Area (SLERA 2):

Surface water and sediment COPEC concentrations were calculated for this location within the Priority Conservation Area north of the Site. Table 2 presents the surface water and Table 3 presents the sediment COPEC concentrations for this habitat area.

The modeled surface water COPEC concentrations for this estuarine habitat area are more than 3 orders of magnitude less than the screening levels. As a result, the modeled surface water concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

The modeled sediment COPEC concentrations for this habitat area are also more than 3 orders of magnitude less than the screening levels. The modeled concentration of 2,3,7,8-TCDD at this location is approximately 5 orders of magnitude (or 100,000 times) less than the chronic screening level for sediment. As a result, the modeled sediment concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

4.2.2.3 Reserva Natural Cano Tiburones (SLERA 8):

Surface water, and sediment COPEC concentrations were calculated for this Priority Conservation Area located approximately 2 km northeast of the Site. Table 2 presents the surface water and Table 3 presents the sediment COPEC concentrations for this habitat area.

The modeled surface water concentrations for COPEC associated with this estuarine habitat area are typically at least one order of magnitude less than the screening levels. The zinc concentration is 2 to 3 factors less than the most-conservative EBSL. As a result, the modeled surface water concentrations for COPEC in this area are less than the ecological screening levels and potential ecological effects are unlikely.

The modeled sediment COPEC concentrations for this habitat area are more than 3 orders of magnitude less than the screening levels. The modeled concentration of

2,3,7,8-TCDD at this location is approximately 5 orders of magnitude less than the chronic screening level for sediment. As a result, the modeled sediment concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

3.4.2.4 Puerto Arecibo:

Surface water, and sediment COPEC concentrations were calculated for this estuarine area to the north of the Site. Table 2 presents the surface water and Table 3 presents the sediment COPEC concentrations for this habitat area.

The modeled surface water COPEC concentrations for this estuarine habitat area are more than 3 orders of magnitude less than the screening levels, For example, the concentration of 2,3,7,8-TCDD in surface water is 5 orders of magnitude less than the chronic screening level. As a result, the modeled surface water concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

The modeled sediment COPEC concentrations for this habitat area are more than 3 orders of magnitude less than the screening levels. The modeled concentration of 2,3,7,8-TCDD at this location is approximately 5 orders of magnitude less than the most-conservative chronic screening level for sediment. As a result, the modeled sediment concentrations for COPEC in this area are substantially less than the ecological screening levels and potential ecological effects are unlikely.

Results of the data screening for each habitat area or ESA and potential effects to ecological receptors are discussed in the next section.

5. RISK CHARACTERIZATION

Based on the information above, the SLERA examines the potential coincidence of ESAs, COPEC, and complete exposure pathways at ecological habitat areas or ESAs within 10 km of the Site. The risk characterization step integrates and evaluates the results of the data screening and nature of ecological exposures to provide a characterization of potential ecological risk based on site-specific conditions.

Specifically, information obtained during the exposure and effects assessment is combined to evaluate the relationship between environmental concentrations of chemical stressors and any observed or predicted adverse biological effects. The metric used in this assessment to evaluate potential risk through direct exposure and food-chain exposure is a comparison of site soil, surface water, and sediment concentrations to screening-level toxicity benchmarks or EBSLs. Risks are estimated by comparing maximum modeled concentrations in each medium to the EBSLs identified in the effects assessment. The purpose of this comparison is to identify the potential for adverse effects to receptor populations.

It should be noted that exceedence of the screening-levels does not necessarily indicate risk. Proper interpretation of these comparisons is critical to the risk assessment process and to risk management decision making. Consistent with a screening level assessment, the comparisons are interpreted as follows:

- When the concentrations of COPEC in the area of interest are below the lowest applicable benchmark, there is high confidence in a finding of de minimis risk.

- When the concentrations of COPEC in the area of interest are greater than the lowest applicable benchmark but less than the highest applicable benchmark, the potential for risk is categorized as low. Within this category the exact threshold of risk is unknown, and to ensure conservatism, risk is considered possible.

- When the concentrations of COPEC in the area of interest are greater than the highest applicable benchmark, risk is considered moderate. Within this category, risks may be possible and/or further evaluation may be required.

In a screening-level assessment, the interpretation of results in the context of uncertainties and conservatism of the analysis (i.e., the exposure and effects assessment) is the final step. In this assessment, when the available exposure and effects information was uncertain, conservative assumptions were made to reduce the likelihood that risks were not underestimated. These factors should be considered, along with the magnitude of any benchmark exceedances, the spatial distribution of exceedances, and the regional background levels of COPEC, if available, to provide context to any risk findings.

5.1 Area-Specific Risk Characterization

The findings of the SLERA at the Site can be characterized as follows:

- A review of published information and conversations with local natural resource officials were conducted to identify ESAs and potential ecological receptors within approximately 10 km of the Site. The following representative ESA locations, identified on Figure 3, were selected for evaluation of exposure to potential ecological receptors: the Rio Grande de Arecibo adjacent to Site (SLERA 1); Rio Grande de Arecibo Estuary/Priority Conservation Area (SLERA 2); Forested Wetlands (SLERA 3 - approximately 3 km west of the Site); Woodlands (SLERA 4 - within a karst region approximately 5 km southwest of the Site); Woodlands at Rio Abajo State Forest (SLERA 5 - at the Rio Abajo State Forest, a conserved area approximately 6 km southwest of the Site); Forested and Emergent Wetlands (SLERA 6 - approximately 5 km south of the Site); Woodlands at Cambalache State Forest (SLERA 7 - at the Cambalache State Forest, a conserved area approximately 7 km southeast of the Site); the Rio Grande de Arecibo Estuary/Priority Conservation Area (SLERA 8 - the Priority Conservation Area located approximately 2 km northeast of the Site), and the Puerto Arecibo area.

- Screening of soil, surface water, and sediment data indicated concentrations of COPEC that are typically orders-of-magnitude less than screening levels. As discussed in the following sections for each area of interest, these findings provide a high-end estimate of potential risk due to the use of maximum modeled COPEC concentrations and/or conservative screening values, and are indicative of de minimus risk to ecological receptors.

Based on this information, the characterization of risk for the areas of ecological interest is provided below.

5.1.1 Rio Grande de Arecibo adjacent to Site (SLERA 1)

Surface water and sediment concentrations were calculated for this location immediately west of the Site. A comparison of surface water and sediment COPEC concentrations to EBSLs indicated that COPEC concentrations are several orders-of-magnitude less than the surface water. COPEC concentrations for sediment at this location were shown to be more than 3 orders of magnitude less than the sediment EBSLs. As a result, the potential for risks to aquatic receptors at this location is negligible.

5.1.2 Rio Grande de Arecibo Estuary/Priority Conservation Area (SLERA 2)

Soil, surface water and sediment COPEC concentrations were calculated for this location within the Priority Conservation Area located approximately 1.5 km north of the Site. A comparison of soil, surface water, and sediment COPEC concentrations to EBSLs indicated that COPEC concentrations are 3 orders-of magnitude less than the soil EBSLs, more than 3 orders-of magnitude less than the surface water EBSLs, and more than 3 orders-of magnitude less than the sediment EBSLs. As a result, the potential for risks to terrestrial and aquatic receptors at this location is negligible.

5.1.3 Forested Wetlands (SLERA 3)

COPEC concentrations in soil were calculated for this location approximately 3 km west of the Site and just south of the populated area of the town of Arecibo. A comparison of soil COPEC concentrations to EBSLs indicated that COPEC concentrations are at least 2 orders-of magnitude less than the soil EBSLs. As a result, the potential for risks to terrestrial receptors at this location is negligible.

5.1.4 Woodlands (SLERA 4)

COPEC concentrations in soil were calculated for this large area of woodlands within a karst region approximately 5 km southwest of the Site and south of the populated area of the town of Arecibo. A comparison of soil COPEC concentrations to EBSLs indicated that COPEC concentrations are at least 2 orders-of magnitude less than the soil EBSLs. As a result, the potential for risk to terrestrial receptors at this location is negligible.

5.1.5 Woodlands at Rio Abajo State Forest (SLERA 5)

COPEC concentrations in soil were calculated for this area of woodlands encompassed by the Rio Abajo State Forest, a conserved area approximately 6 km southwest of the Site. A comparison of soil COPEC concentrations to EBSLs indicated that COPEC concentrations are at least 3 orders-of magnitude less than the soil EBSLs. As a result, the potential for risk to terrestrial receptors at this location is negligible.

5.1.6 Forested and Emergent Wetlands (SLERA 6)

COPEC concentrations in soil were calculated for this floodplain location approximately 5 km south of the Site. A comparison of soil COPEC concentrations to EBSLs indicated that COPEC concentrations are typically more than 4 orders-of magnitude less than the soil EBSLs. As a result, the potential for risk to terrestrial receptors at this location is negligible.

5.1.7 Woodlands at Cambalache State Forest (SLERA 7)

COPEC concentrations in soil were calculated for this area of woodlands encompassed by the Cambalache State Forest, a conserved area approximately 7 km southeast of the Site. A comparison of soil COPEC concentrations to EBSLs indicated that COPEC concentrations are typically more than 4 orders-of magnitude less than the soil EBSLs. As a result, the potential for risk to terrestrial receptors at this location is negligible.

5.1.8 Reserva Natural Cano Tiburones (SLERA 8):

Soil, surface water, and sediment COPEC concentrations were calculated for this Priority Conservation Area located approximately 2 km northeast of the Site. A comparison of soil, surface water, and sediment COPEC concentrations to EBSLs indicated that COPEC concentrations are at least 3 orders-of magnitude less than the soil EBSLs, at least one or more orders of magnitude less than the surface water EBSLs, with the exception of zinc, which was 2 to 3 factors less than the most-conservative EBSL. Sediment COPEC concentrations were at least 3 orders of magnitude less than the sediment EBSLs. As a result, the potential for risk to terrestrial and aquatic receptors at this location is negligible.

5.1.9 Puerto Arecibo

Surface water and sediment concentrations were calculated for this location north of the Site. A comparison of surface water COPEC concentrations to EBSLs indicated that COPEC concentrations are several orders-of-magnitude less than the EBSLs. COPEC concentrations for sediment at this location were shown to be more than 3 orders of magnitude less than the sediment EBSLs. As a result, the potential for risk to aquatic receptors at this location is negligible.

5.2 Uncertainties

The understanding of the underlying uncertainties inherent in the data and the risk assessment approach is crucial to the appropriate interpretation of risk assessment results. The nature of a screening-level assessment mandates that the uncertainties are largely mitigated by making conservative assumptions to reduce the likelihood of overlooking or underestimating risks. Thus, a significant portion of the uncertainty discussed in this section relates to conservative assumptions. These conservative assumptions, when taken together, result in predicted risk levels that are likely higher than those actually present at the Site. Factors that may have resulted in underestimation of risk are also identified and discussed below.

Several major sources of uncertainty were identified and include the following:

- Modeling of COPEC concentrations
- Habitat quality and receptor selection
- Toxicity benchmarks
- Bioavailability of COPEC.

The following sections describe potential uncertainties in more detail.

The air dispersion and deposition modeling methodologies and results are summarized in Section 3.3 and Appendix E, and are described in detail in the HHRA Report (ARCADIS 2010). The assumptions associated with the air modeling and calculation of COPEC concentrations in various media are conservative based on the discussion presented in Section 3 of the HHRA Report. As a result, predicted concentrations of COPEC are likely overestimated, which, in turn, results in the likely overestimation of potential exposure and risks when compared to screening levels. Additionally, some of the most stringent Eco-SSLs for metals, including arsenic and lead, are actually less than naturally occurring (regional background) concentrations of these metals in soil (USEPA, 2005a-d). As a result, there is a degree of uncertainty associated with the soil screening process for ecological receptors.

The assumption that terrestrial and aquatic habitat is of sufficient quality and that receptor species would be present and chronically exposed to COPEC may be conservative because potential physical disturbances to the habitat and potential contributions of COPEC from other sources (e.g., urban or agricultural runoff) are not considered in this evaluation. In addition, wildlife foraging in the selected habitat areas could come into contact with Site-related COPEC, but it is anticipated that only individuals of many species may use these areas and, if used, the areas would represent a small portion of the organism's home range or foraging area.

The toxicity studies used to develop metal benchmarks for plants and wildlife are generally conducted with soluble metal salts, which are likely to be more bioavailable than mixtures of forms found in the field. Thus, these benchmarks would likely over- rather than underestimate potential toxicity. In the SLERA, it is assumed that the modeled concentrations of COPEC, including metals and organic compounds, are completely bioavailable. However, it is unlikely that this is the case. Therefore, actual exposure to COPEC is likely to be overestimated.

5.3 Summary and Conclusions

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

- Exposure pathways for wildlife to Site-related COPEC are present within the 10 km radius, but are expected to be limited to habitat areas such as the State Parks to the southwest and southeast and the conservation areas to the northeast . Exposure at these habitat locations is expected to be limited due to 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 (SLERA 3 area) 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 and sediment (Cienga Tiburones area) to EBSLs showed concentrations of COPEC to be at least one order-of-magnitude less than the surface water EBSLs, with the exception of zinc which was 2 to 3 factors less, and 3 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.

The evaluation presented in this report is considered to be conservative and the potential risks to ecological receptors are likely lower than those discussed above based on the uncertainties discussed in Section 5.2.

A low potential for ecological risk is expected for habitat areas within 10 km of the Site because COPEC concentrations in soil, surface water and sediment are typically orders-of-magnitude less than the conservative ecological screening levels. As a result, additional evaluation of potential ecological exposures related to operation of the Site is unwarranted.

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Table 1. Comparison of Soil COPEC Concentrations to EBSLs
EA International - Renewable Energy Project
Arecibo, Puerto Rico

Area		Soil EBSLs				SLERA #2	SLERA #3	SLERA #4	SLERA #5	SLERA #6	SLERA #7	SLERA #8
Location		Invert	Plant	Avian	Mammal	2 - 1	3 - 2	4 - 2	5 - 1	6 - 1	7 - 1	8 - 3
X/Y Coordinates	Units					742002.13 / 2043651	740702.13 / 2042051	739802.13 / 2040851	738602.13 / 2037051	741602.13 / 2038551	749102.13 / 2040051	743902.13 / 2043251
Polychlorinated Biphenyls (PCBs)												
Aroclor 1254	mg/kg	--	40	--	0.371	3.61E-08	1.56E-07	6.63E-08	1.04E-08	5.77E-09	2.15E-10	6.31E-09
Polycyclic Aromatic Hydrocarbons (PAHs)												
Acenaphthene	mg/kg	29	20	--	682	1.30E-11	6.48E-11	2.59E-11	6.48E-12	0.00E+00	0.00E+00	0.00E+00
Acenaphthylene	mg/kg	29	--	--	682	1.04E-10	5.19E-10	2.08E-10	5.19E-11	0.00E+00	0.00E+00	0.00E+00
Anthracene	mg/kg	29	--	--	1480	3.82E-09	1.49E-08	6.57E-09	1.11E-09	6.28E-10	8.04E-11	5.56E-10
Benzo(a)anthracene	mg/kg	18	--	--	5.21	1.16E-08	4.95E-08	2.16E-08	2.20E-09	1.37E-09	1.38E-10	1.56E-09
Benzo(a)pyrene	mg/kg	18	--	--	1.52	9.73E-09	4.19E-08	1.82E-08	1.72E-09	1.08E-09	1.04E-10	1.29E-09
Benzo(b)fluoranthene	mg/kg	18	--	--	59.8	4.59E-10	2.02E-09	8.71E-10	8.45E-11	4.52E-11	4.06E-12	5.64E-11
Benzo(k)fluoranthene	mg/kg	18	--	--	148	3.46E-08	1.51E-07	6.59E-08	5.81E-09	3.72E-09	3.32E-10	4.53E-09
Chrysene	mg/kg	18	--	--	4.73	1.32E-08	5.46E-08	2.39E-08	2.90E-09	1.74E-09	1.93E-10	1.81E-09
Dibenz(a,h)anthracene	mg/kg	18	--	--	18.4	2.88E-08	1.25E-07	5.45E-08	4.71E-09	3.04E-09	2.73E-10	3.77E-09
Fluoranthene	mg/kg	18	--	--	122	2.75E-09	1.07E-08	4.72E-09	7.90E-10	4.47E-10	5.71E-11	3.99E-10
Indeno(1,2,3-cd) pyrene	mg/kg	18	--	--	109	1.58E-08	6.87E-08	2.99E-08	2.53E-09	1.66E-09	1.37E-10	2.07E-09
Methylnaphthalene, 2-	mg/kg	29	--	--	3.24	2.21E-11	1.10E-10	4.42E-11	1.10E-11	0.00E+00	0.00E+00	0.00E+00
Naphthalene	mg/kg	29	--	--	0.0994	2.04E-11	1.02E-10	4.08E-11	1.02E-11	0.00E+00	0.00E+00	0.00E+00
Pyrene	mg/kg	18	--	--	78.5	9.55E-09	3.72E-08	1.64E-08	2.75E-09	1.56E-09	1.99E-10	1.39E-09
Total HMW PAHs	mg/kg	- -	1.1 / 39 / 110	- -	18	1.26E-07	5.41E-07	2.36E-07	2.35E-08	1.47E-08	1.44E-09	1.69E-08
Total LMW PAHs	mg/kg	- -	100	- -	29	3.98E-09	1.57E-08	6.88E-09	1.19E-09	6.28E-10	8.04E-11	5.56E-10
Dioxins/Furans												
HeptaCDD, 1,2,3,4,6,7,8-	mg/kg	--	--	--	--	7.09E-09	3.09E-08	1.34E-08	1.16E-09	7.46E-10	6.70E-11	9.30E-10
HeptaCDF, 1,2,3,4,6,7,8-	mg/kg	--	--	--	--	5.15E-09	2.24E-08	9.74E-09	8.40E-10	5.42E-10	4.87E-11	6.75E-10
HeptaCDF, 1,2,3,4,7,8,9-	mg/kg	--	--	--	--	1.34E-09	5.83E-09	2.53E-09	2.20E-10	1.41E-10	1.28E-11	1.76E-10
HexaCDD, 1,2,3,4,7,8-	mg/kg	--	--	--	--	4.97E-10	2.16E-09	9.39E-10	8.12E-11	5.23E-11	4.71E-12	6.52E-11
HexaCDD, 1,2,3,6,7,8-	mg/kg	--	--	--	--	1.22E-09	5.30E-09	2.30E-09	1.99E-10	1.28E-10	1.16E-11	1.60E-10
HexaCDD, 1,2,3,7,8,9-	mg/kg	--	--	--	--	1.24E-09	5.42E-09	2.35E-09	2.03E-10	1.31E-10	1.18E-11	1.63E-10
HexaCDF, 1,2,3,4,7,8-	mg/kg	--	--	--	--	2.83E-09	1.23E-08	5.36E-09	4.65E-10	2.99E-10	2.70E-11	3.72E-10
HexaCDF, 1,2,3,6,7,8-	mg/kg	--	--	--	--	4.83E-09	2.10E-08	9.13E-09	7.92E-10	5.09E-10	4.60E-11	6.34E-10
HexaCDF, 1,2,3,7,8,9-	mg/kg	--	--	--	--	9.77E-10	4.25E-09	1.85E-09	1.61E-10	1.03E-10	9.37E-12	1.28E-10
HexaCDF, 2,3,4,6,7,8-	mg/kg	--	--	--	--	4.50E-09	1.96E-08	8.52E-09	7.39E-10	4.75E-10	4.30E-11	5.91E-10
OctaCDD, 1,2,3,4,6,7,8,9-	mg/kg	--	--	--	--	1.65E-08	7.17E-08	3.12E-08	2.69E-09	1.73E-09	1.56E-10	2.16E-09
OctaCDF, 1,2,3,4,6,7,8,9-	mg/kg	--	--	--	--	3.95E-09	1.72E-08	7.48E-09	6.45E-10	4.16E-10	3.74E-11	5.18E-10
PentaCDD, 1,2,3,7,8-	mg/kg	--	--	--	--	1.84E-09	8.02E-09	3.48E-09	3.05E-10	1.95E-10	1.78E-11	2.42E-10
PentaCDF, 1,2,3,7,8-	mg/kg	--	--	--	--	3.12E-09	1.36E-08	5.90E-09	5.28E-10	3.35E-10	3.11E-11	4.11E-10
PentaCDF, 2,3,4,7,8-	mg/kg	--	--	--	--	4.50E-09	1.96E-08	8.52E-09	7.57E-10	4.82E-10	4.44E-11	5.93E-10
TetraCDD, 2,3,7,8-	mg/kg	--	--	1.58E-05	3.15E-06	3.51E-10	1.53E-09	6.64E-10	6.78E-11	4.09E-11	4.19E-12	4.72E-11
TetraCDF, 2,3,7,8-	mg/kg	--	--	--	--	4.90E-09	2.13E-08	9.27E-09	1.02E-09	6.00E-10	6.49E-11	6.67E-10

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X/Y Coordinates	Units					742002.13 / 2043651	740702.13 / 2042051	739802.13 / 2040851	738602.13 / 2037051	741602.13 / 2038551	749102.13 / 2040051	743902.13 / 2043251
Dioxins/Furans												
TetraCDD Avian TEQ	mg/kg	--	--	1.58E-05	3.15E-06	1.35E-08	5.85E-08	2.55E-08	2.46E-09	1.51E-09	1.49E-10	1.79E-09
TetraCDD Mammalian TEQ	mg/kg	--	--	1.58E-05	3.15E-06	5.88E-09	2.56E-08	1.11E-08	1.00E-09	6.36E-10	5.94E-11	7.76E-10
Metals												
Antimony	mg/kg	78	5	0	0.27	2.45E-04	1.07E-03	4.63E-04	3.93E-05	2.57E-05	2.12E-06	3.21E-05
Arsenic	mg/kg	60	18	43	46	1.97E-05	8.59E-05	3.73E-05	3.16E-06	2.07E-06	1.71E-07	2.58E-06
Beryllium	mg/kg	40	10	0	21	3.38E-05	1.47E-04	6.40E-05	5.42E-06	3.55E-06	2.93E-07	4.42E-06
Cadmium	mg/kg	140	32	0.77	0.36	5.87E-05	2.55E-04	1.11E-04	9.40E-06	6.15E-06	5.08E-07	7.67E-06
Chromium, hexavalent	mg/kg	--	--	0	130	3.84E-05	1.67E-04	7.26E-05	6.15E-06	4.02E-06	3.32E-07	5.02E-06
Cobalt	mg/kg	--	13	120	230	7.84E-06	3.41E-05	1.48E-05	1.26E-06	8.22E-07	6.78E-08	1.03E-06
Copper	mg/kg	80	70	28	49	9.12E-05	3.97E-04	1.72E-04	1.46E-05	9.56E-06	7.89E-07	1.19E-05
Lead	mg/kg	1700	120	11	56	1.17E-02	5.07E-02	2.20E-02	1.87E-03	1.22E-03	1.01E-04	1.52E-03
Manganese	mg/kg	450	220	4300	4000	2.91E-04	1.26E-03	5.50E-04	4.66E-05	3.05E-05	2.51E-06	3.80E-05
Mercury (mercuric chloride)	mg/kg	0.1	0.3	--	--	4.02E-04	1.76E-03	7.75E-04	9.70E-05	5.80E-05	5.39E-06	5.31E-05
Methyl mercury	mg/kg	--	--	--	0.00158	7.83E-06	3.43E-05	1.51E-05	1.89E-06	1.13E-06	1.05E-07	1.03E-06
Molybdenum	mg/kg	--	2	44	4.75	5.80E-05	2.52E-04	1.10E-04	9.30E-06	6.08E-06	5.02E-07	7.58E-06
Nickel	mg/kg	280	38	210	130	1.00E-04	4.37E-04	1.90E-04	1.61E-05	1.05E-05	8.68E-07	1.31E-05
Selenium	mg/kg	4.1	0.52	1.2	0.63	3.58E-06	1.56E-05	6.78E-06	5.74E-07	3.76E-07	3.10E-08	4.69E-07
Tin	mg/kg	--	50	0	7.62	2.36E-03	1.03E-02	4.47E-03	3.79E-04	2.48E-04	2.05E-05	3.09E-04
Vanadium	mg/kg	--	2	7.8	280	2.75E-04	1.20E-03	5.20E-04	4.41E-05	2.89E-05	2.38E-06	3.60E-05
Zinc	mg/kg	120	160	46	79	1.61E-02	6.99E-02	3.04E-02	2.58E-03	1.68E-03	1.39E-04	2.10E-03
Miscellaneous												
Hydrogen chloride	mg/kg	--	--	--	--	5.86E-06	2.93E-05	1.17E-05	2.93E-06	0.00E+00	0.00E+00	0.00E+00
Hydrogen fluoride	mg/kg	--	--	--	--	1.68E-01	6.54E-01	2.89E-01	4.90E-02	2.77E-02	3.55E-03	2.45E-02

Notes:

COPEC = Constituent of Potential Ecological Concern

EBSL = Ecologically-based screening level

Total LMW (Low-molecular weight) PAHs = sum of naphthalene, 2-methylnaphthalene, acenaphthylene, acenaphthene, and anthracene

Total HMW High-molecular weight) PAHs = sum of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and dibenzo(a,h)anthracene

Value of 0.00E+00 indicates negligible deposition for constituent at the given location and no observable concentration as a result.

Table 2. Comparison of Surface Water COPEC Concentrations to EBSLs
EA International - Renewable Energy Project
Arecibo, Puerto Rico

Waterbody ID		Freshwater EBSLs		SLERA 1	Saltwater EBSLs		Puerto Arecibo	RGA Estuary	Cienaga Tiburones
Receptor ID				SLERA 2-1			3 - 2	4 - 2	5 - 1
X/Y Coordinates	Units	Acute	Chronic	742002.13 / 2043651	Acute	Chronic	740702.13 / 2042051	739802.13 / 2040851	738602.13 / 2037051
Polychlorinated Biphenyls (PCBs)									
Aroclor 1254	ug/L	0.6	0.033	7.17E-11	0.6	0.033	3.65E-10	1.04E-10	1.92E-10
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	ug/L	--	38	2.23E-12	970	40	1.66E-11	4.41E-12	9.28E-12
Acenaphthylene	ug/L	--	4840	1.44E-12	300	4840	1.83E-11	2.79E-12	7.94E-12
Anthracene	ug/L	13	0.73	1.99E-11	300	0.73	6.64E-11	2.49E-11	6.30E-11
Benzo(a)anthracene	ug/L	0.49	0.027	6.57E-11	0.49	0.027	2.65E-10	6.12E-11	2.62E-10
Benzo(a)pyrene	ug/L	0.24	0.014	8.81E-11	300	0.014	2.92E-10	7.91E-11	8.41E-10
Benzo(b)fluoranthene	ug/L	--	9.07	5.08E-12	300	9.07	2.09E-11	5.98E-12	1.27E-11
Benzo(k)fluoranthene	ug/L	--	--	8.50E-11	300	--	1.88E-10	7.26E-11	6.61E-09
Chrysene	ug/L	--	--	4.75E-11	300	--	1.16E-10	4.81E-11	7.53E-11
Dibenz(a,h)anthracene	ug/L	--	--	1.69E-10	300	--	3.62E-10	1.43E-10	4.45E-08
Fluoranthene	ug/L	--	1.9	1.49E-11	40	11	6.10E-11	1.93E-11	1.58E-10
Indeno(1,2,3-cd) pyrene	ug/L	--	4.31	1.29E-10	300	4.31	2.72E-10	1.09E-10	7.16E-09
Methylnaphthalene, 2-	ug/L	37	2.1	1.34E-12	300	2.1	7.32E-12	2.56E-12	2.72E-12
Naphthalene	ug/L	190	12	9.02E-12	2350	1.4	5.12E-11	1.73E-11	1.99E-11
Pyrene	ug/L	--	0.3	1.37E-11	300	0.3	5.28E-11	1.66E-11	1.90E-10
Dioxins/Furans									
HeptaCDD, 1,2,3,4,6,7,8-	ug/L	--	--	1.00E-11	--	--	1.97E-11	7.93E-12	1.43E-10
HeptaCDF, 1,2,3,4,6,7,8-	ug/L	--	--	7.21E-12	--	--	1.40E-11	5.66E-12	4.45E-11
HeptaCDF, 1,2,3,4,7,8,9-	ug/L	--	--	1.87E-12	--	--	3.74E-12	1.48E-12	1.20E-11
HexaCDD, 1,2,3,4,7,8-	ug/L	--	--	7.02E-13	--	--	1.40E-12	5.54E-13	7.03E-12
HexaCDD, 1,2,3,6,7,8-	ug/L	--	--	1.71E-12	--	--	3.34E-12	1.34E-12	6.18E-12
HexaCDD, 1,2,3,7,8,9-	ug/L	--	--	1.74E-12	--	--	3.37E-12	1.37E-12	6.22E-12
HexaCDF, 1,2,3,4,7,8-	ug/L	--	--	3.90E-12	--	--	7.47E-12	3.04E-12	1.13E-11
HexaCDF, 1,2,3,6,7,8-	ug/L	--	--	6.63E-12	--	--	1.30E-11	5.17E-12	2.97E-11
HexaCDF, 1,2,3,7,8,9-	ug/L	--	--	1.34E-12	--	--	2.66E-12	1.05E-12	4.69E-12
HexaCDF, 2,3,4,6,7,8-	ug/L	--	--	6.19E-12	--	--	1.20E-11	4.83E-12	2.11E-11
OctaCDD, 1,2,3,4,6,7,8,9-	ug/L	--	--	2.34E-11	--	--	4.61E-11	1.84E-11	6.06E-10
OctaCDF, 1,2,3,4,6,7,8,9-	ug/L	--	--	5.59E-12	--	--	1.10E-11	4.41E-12	3.37E-10
PentaCDD, 1,2,3,7,8-	ug/L	--	--	2.47E-12	--	--	5.51E-12	1.89E-12	7.62E-12
PentaCDF, 1,2,3,7,8-	ug/L	--	--	4.18E-12	--	--	9.95E-12	3.29E-12	2.13E-11
PentaCDF, 2,3,4,7,8-	ug/L	--	--	5.93E-12	--	--	1.26E-11	4.50E-12	1.94E-11
TetraCDD, 2,3,7,8-	ug/L	1.00E-02	1.00E-05	4.68E-13	1.00E-02	1.00E-05	1.44E-12	4.05E-13	1.08E-12
TetraCDF, 2,3,7,8-	ug/L	--	--	5.97E-12	--	--	2.16E-11	4.90E-12	1.48E-11
Dioxins/Furans - Total TEQ									
TetraCDD (dioxin TEQ)	ug/L	1.00E-02	1.00E-05	8.93E-11	1.00E-02	1.00E-05	1.89E-10	7.02E-11	1.29E-09

Table 2. Comparison of Surface Water COPEC Concentrations to EBSLs
EA International - Renewable Energy Project
Arecibo, Puerto Rico

Waterbody ID		Freshwater EBSLs		SLERA 1	Saltwater EBSLs		Puerto Arecibo	RGA Estuary	Cienaga Tiburones
Receptor ID				SLERA 2-1			3 - 2	4 - 2	5 - 1
X/Y Coordinates	Units	Acute	Chronic	742002.13 / 2043651	Acute	Chronic	740702.13 / 2042051	739802.13 / 2040851	738602.13 / 2037051
Metals									
Antimony	ug/L	180	30	1.54E-05	1500	500	3.52E-06	4.22E-06	1.10E+00
Arsenic	ug/L	340	150	1.95E-06	69	36	4.39E-07	5.34E-07	1.98E-01
Beryllium	ug/L	35	0.66	9.01E-08	1500	100	4.62E-08	3.23E-08	6.12E-04
Cadmium	ug/L	2	0.25	2.13E-06	40	8.8	5.07E-07	5.91E-07	9.93E-02
Chromium, hexavalent	ug/L	16	11	5.85E-06	1100	50	1.30E-06	1.60E-06	8.01E-01
Cobalt	ug/L	1500	23	4.91E-07	1500	1	1.13E-07	1.35E-07	3.52E-02
Copper	ug/L	13	9	7.43E-06	4.8	3.1	1.68E-06	2.04E-06	6.51E-01
Lead	ug/L	65	2.5	2.76E-05	210	8.1	1.52E-05	1.02E-05	1.71E-01
Manganese	ug/L	2300	120	1.23E-05	2300	100	2.90E-06	3.41E-06	6.50E-01
Mercury (Mercuric chloride) *	ug/L	1.4	0.77	1.98E-07	1.8	0.94	5.24E-07	2.18E-07	9.29E-05
Molybdenum	ug/L	16000	370	8.39E-06	16000	23	1.87E-06	2.29E-06	1.11E+00
Nickel	ug/L	470	52	4.25E-06	74	8.2	1.00E-06	1.18E-06	2.24E-01
Selenium	ug/L	--	5	2.07E-06	290	71	4.52E-07	5.62E-07	5.64E-01
Tin	ug/L	2700	73	2.13E-05	2700	73	6.43E-06	6.31E-06	1.02E+01
Vanadium	ug/L	280	20	5.94E-07	280	50	3.47E-07	2.26E-07	3.42E-03
Zinc	ug/L	120	120	7.16E-04	90	81	1.68E-04	1.98E-04	3.93E+01
Miscellaneous									
Hydrogen chloride	ug/L	860000	230000	1.13E-04	--	--	3.88E-05	1.20E-04	1.03E+01
Hydrogen fluoride	ug/L	200	--	1.72E-03	1500	--	8.37E-04	8.33E-04	8.93E+01

* Mercury results are also less than ecologically-based screening levels for methyl mercury of 0.099 ug/l (Acute) and 0.0028 ug/l (Chronic).

<u>Notes:</u>
COPEC = Constituent of Potential Ecological Concern
EBSL = Ecologically-based screening level

Table 3. Comparison of Sediment COPEC Concentrations to EBSLs
EA International - Renewable Energy Project
Arecibo, Puerto Rico

Watebody ID		Freshwater EBSLs		SLERA 1	Saltwater EBSLs		Puerto Arecibo	RGA Estuary	Cienaga Tiburones
Receptor ID				SLERA 2-1			3 - 2	4 - 2	5 - 1
X/Y Coordinates	Units	Acute	Chronic	742002.13 / 2043651	Acute	Chronic	740702.13 / 2042051	739802.13 / 2040851	738602.13 / 2037051
Polychlorinated Biphenyls (PCBs)									
Aroclor 1254	mg/kg	34	0.06	1.05E-09	0.709	0.0633	4.69E-09	1.34E-09	6.64E-09
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	mg/kg	0.0889	0.62	4.32E-13	0.5	0.016	3.21E-12	8.53E-13	1.81E-12
Acenaphthylene	mg/kg	0.128	0.00587	0	0.64	0.044	0	0	0
Anthracene	mg/kg	370	0.22	1.7758E-11	1.1	0.0853	5.871E-11	2.2012E-11	5.8167E-11
Benzo(a)anthracene	mg/kg	1480	0.32	5.14E-10	1.6	0.261	1.93E-09	4.46E-10	2.95E-09
Benzo(a)pyrene	mg/kg	1440	0.37	1.05E-09	1.6	0.43	3.13E-09	8.48E-10	1.89E-08
Benzo(b)fluoranthene	mg/kg	--	--	6.19E-11	0	1.8	2.29E-10	6.55E-11	2.99E-10
Benzo(k)fluoranthene	mg/kg	1340	0.24	1.02E-09	1340	1.8	2.03E-09	7.83E-10	1.50E-07
Chrysene	mg/kg	460	0.34	3.94E-10	2.8	0.384	8.93E-10	3.71E-10	9.29E-10
Dibenz(a,h)anthracene	mg/kg	130	0.06	2.34E-09	0.26	0.0634	4.44E-09	1.76E-09	1.36E-06
Fluoranthene	mg/kg	1020	0.75	2.62E-11	5.1	0.6	1.06E-10	3.35E-11	2.99E-10
Indeno(1,2,3-cd) pyrene	mg/kg	320	0.2	1.95E-09	320	0.6	3.59E-09	1.44E-09	2.66E-07
Methylnaphthalene, 2-	mg/kg	0.201	0.0202	1.24E-12	0.67	0.07	6.73E-12	2.35E-12	2.56E-12
Naphthalene	mg/kg	0.561	0.176	4.28E-13	2.1	0.16	2.43E-12	8.23E-13	9.45E-13
Pyrene	mg/kg	850	0.49	3.22E-11	2.6	0.665	1.21E-10	3.82E-11	4.93E-10
Dioxins/Furans									
HeptaCDD, 1,2,3,4,6,7,8-	mg/kg	--	--	1.72E-10	--	--	2.91E-10	1.17E-10	7.44E-09
HeptaCDF, 1,2,3,4,6,7,8-	mg/kg	--	--	1.21E-10	--	--	2.02E-10	8.20E-11	2.19E-09
HeptaCDF, 1,2,3,4,7,8,9-	mg/kg	--	--	3.14E-11	--	--	5.41E-11	2.14E-11	5.87E-10
HexaCDD, 1,2,3,4,7,8-	mg/kg	--	--	1.19E-11	--	--	2.06E-11	8.13E-12	3.62E-10
HexaCDD, 1,2,3,6,7,8-	mg/kg	--	--	2.84E-11	--	--	4.81E-11	1.93E-11	2.97E-10
HexaCDD, 1,2,3,7,8,9-	mg/kg	--	--	2.90E-11	--	--	4.84E-11	1.97E-11	2.99E-10
HexaCDF, 1,2,3,4,7,8-	mg/kg	--	--	6.27E-11	--	--	1.04E-10	4.25E-11	4.96E-10
HexaCDF, 1,2,3,6,7,8-	mg/kg	--	--	1.07E-10	--	--	1.81E-10	7.22E-11	1.30E-09
HexaCDF, 1,2,3,7,8,9-	mg/kg	--	--	2.16E-11	--	--	3.72E-11	1.46E-11	2.06E-10
HexaCDF, 2,3,4,6,7,8-	mg/kg	--	--	9.96E-11	--	--	1.68E-10	6.74E-11	9.26E-10
OctaCDD, 1,2,3,4,6,7,8,9-	mg/kg	--	--	4.00E-10	--	--	6.80E-10	2.72E-10	3.19E-08
OctaCDF, 1,2,3,4,6,7,8,9-	mg/kg	--	--	9.56E-11	--	--	1.62E-10	6.50E-11	1.76E-08
PentaCDD, 1,2,3,7,8-	mg/kg	--	--	3.66E-11	--	--	7.18E-11	2.46E-11	2.72E-10
PentaCDF, 1,2,3,7,8-	mg/kg	--	--	6.45E-11	--	--	1.34E-10	4.44E-11	8.43E-10
PentaCDF, 2,3,4,7,8-	mg/kg	--	--	8.36E-11	--	--	1.57E-10	5.61E-11	6.13E-10
TetraCDD, 2,3,7,8-	mg/kg	2.15E-05	8.5E-07	7.25E-12	2.15E-05	8.5E-07	1.95E-11	5.48E-12	4.30E-11
TetraCDF, 2,3,7,8-	mg/kg	--	--	6.61E-11	--	--	2.17E-10	4.92E-11	2.90E-10

Table 3. Comparison of Sediment COPEC Concentrations to EBSLs
EA International - Renewable Energy Project
Arecibo, Puerto Rico

Watebody ID		Freshwater EBSLs		SLERA 1	Saltwater EBSLs		Puerto Arecibo	RGA Estuary	Cienaga Tiburones
Receptor ID				SLERA 2-1			3 - 2	4 - 2	5 - 1
X/Y Coordinates	Units	Acute	Chronic	742002.13 / 2043651	Acute	Chronic	740702.13 / 2042051	739802.13 / 2040851	738602.13 / 2037051
Dioxins/Furans - Total TEQ									
TetraCDD Avian TEQ	mg/kg	2.15E-05	8.5E-07	2.35E-10	2.15E-05	8.5E-07	5.37E-10	1.63E-10	1.69E-09
TetraCDD Mammalian TEQ	mg/kg	2.15E-05	8.5E-07	1.17E-10	2.15E-05	8.5E-07	2.31E-10	7.98E-11	1.06E-09
Metals									
Antimony	mg/kg	--	--	6.90E-07	--	--	1.58E-07	1.90E-07	4.95E-02
Arsenic	mg/kg	33	6	5.66E-08	70	8.2	1.27E-08	1.55E-08	5.73E-03
Beryllium	mg/kg	--	--	6.95E-08	--	--	3.55E-08	2.48E-08	4.80E-04
Cadmium	mg/kg	10	0.6	1.59E-07	9.6	1.2	3.79E-08	4.42E-08	7.44E-03
Chromium, hexavalent	mg/kg	--	--	1.11E-07	--	--	2.47E-08	3.03E-08	1.52E-02
Cobalt	mg/kg	--	--	2.21E-08	--	--	5.06E-09	6.07E-09	1.58E-03
Copper	mg/kg	110	16	2.60E-07	270	34	5.88E-08	7.12E-08	2.28E-02
Lead	mg/kg	250	31	2.41E-05	218	46.7	1.32E-05	8.90E-06	1.52E-01
Manganese	mg/kg	1100	460	7.99E-07	1100	460	1.88E-07	2.21E-07	4.22E-02
Mercury (mercuric chloride)	mg/kg	2000	200	2.41E-06	710	150	5.70E-06	2.37E-06	2.32E-03
Methyl mercury	mg/kg	--	--	1.57E-08	--	--	3.74E-08	1.54E-08	4.06E-04
Molybdenum	mg/kg	--	--	1.68E-07	--	--	3.73E-08	4.58E-08	2.22E-02
Nickel	mg/kg	75	16	2.76E-07	51.6	20.9	6.49E-08	7.63E-08	1.46E-02
Selenium	mg/kg	--	--	1.03E-08	--	--	2.26E-09	2.81E-09	2.82E-03
Tin	mg/kg	--	--	0.00E+00	--	--	0.00E+00	0.00E+00	0.00E+00
Vanadium	mg/kg	--	--	5.76E-07	--	--	3.35E-07	2.18E-07	3.39E-03
Zinc	mg/kg	820	120	4.43E-05	410	150	1.04E-05	1.22E-05	2.44E+00
Miscellaneous									
Hydrogen chloride	mg/kg	--	--	0	--	--	0	0	0
Hydrogen fluoride	mg/kg	--	--	2.56E-04	--	--	1.25E-04	1.24E-04	1.34E+01

Notes:
COPEC = Constituent of Potential Ecological Concern
EBSL = Ecologically-based screening level

Table 4. Ecologically-Based Screening Levels
EA International - Renewable Energy Project
Arecibo, Puerto Rico

Analyte	Soil									FW Surface water					FW Sediment					SW Surface water					SW Sediment				
	units	Invert	#	Plant	#	Avian	#	Mammal	#	units	Acute	#	Chronic	#	units	Acute	#	Chronic	#	units	Acute	#	Chronic	#	units	Acute	#	Chronic	#
Polychlorinated Biphenyls (PCBs)																													
Aroclor 1254	mg/kg	--		40	2	--		0.371	4	ug/L	0.6	7	0.033	7	mg/kg	34	8	0.06	8	ug/L	0.6	7†	0.033	7†	mg/kg	0.709	11	0.0633	11
Polycyclic Aromatic Hydrocarbons (PAHs)																													
Acenaphthene	mg/kg	29	1	20	2	--		682	5	ug/L	--		38	5	mg/kg	0.0889	11	0.62	9	ug/L	970	12	40	12	mg/kg	0.5	13	0.016	13
Acenaphthylene	mg/kg	29	1	--		--		682	5	ug/L	--		4.84E+03	5	mg/kg	0.128	11	0.00587	11	ug/L	300	12	4.84E+03	5†	mg/kg	0.64	13	0.044	13
Anthracene	mg/kg	29	1	--		--		1480	5	ug/L	13	7	0.73	7	mg/kg	370	8	0.22	8	ug/L	300	12	0.73	7†	mg/kg	1.1	13	0.0853	13
Benzo(a)anthracene	mg/kg	18	1	--		--		5.21	5	ug/L	0.49	7	0.027	7	mg/kg	1480	8	0.32	8	ug/L	0.49	7†	0.027	7†	mg/kg	1.6	13	0.261	13
Benzo(a)pyrene	mg/kg	18	1	--		--		1.52	5	ug/L	0.24	7	0.014	7	mg/kg	1440	8	0.37	8	ug/L	300	12	0.014	7†	mg/kg	1.6	13	0.43	13
Benzo(b)fluoranthene	mg/kg	18		--		--		59.8	5	ug/L	--		9.07	5	mg/kg	--		--		ug/L	300	12	9.07	5†	mg/kg			1.8	12
Benzo(k)fluoranthene	mg/kg	18		--		--		148	5	ug/L	--		--		mg/kg	1340	8	0.24	8	ug/L	300	12	--		mg/kg	1340	8†	1.8	12
Chrysene	mg/kg	18	1	--		--		4.73	5	ug/L	--		--		mg/kg	460	8	0.34	8	ug/L	300	12	--		mg/kg	2.8	13	0.384	13
Dibenz(a,h)anthracene	mg/kg	18	1	--		--		18.4	5	ug/L	--		--		mg/kg	130	8	0.06	8	ug/L	300	12	--		mg/kg	0.26	13	0.0634	13
Fluoranthene	mg/kg	18	1	--		--		122	5	ug/L	--		1.9	5	mg/kg	1020	8	0.75	8	ug/L	40	12	11	12	mg/kg	5.1	13	0.6	13
Indeno(1,2,3-cd) pyrene	mg/kg	18		--		--		109	5	ug/L	--		4.31	5	mg/kg	320	8	0.2	8	ug/L	300	12	4.31	5†	mg/kg	320	8†	0.6	12
Methylnaphthalene, 2-	mg/kg	29	1	--		--		3.24	5	ug/L	37	7	2.1	7	mg/kg	0.201	11	0.0202	11	ug/L	300	12	2.1	7†	mg/kg	0.67	13	0.07	13
Naphthalene	mg/kg	29	1	--		--		0.0994	5	ug/L	190	7	12	7	mg/kg	0.561	10	0.176	10	ug/L	2350	12	1.4	12	mg/kg	2.1	13	0.16	13
Pyrene	mg/kg	18	1	--		--		78.5	5	ug/L	--		0.3	5	mg/kg	850	8	0.49	8	ug/L	300	12	0.3	5†	mg/kg	2.6	13	0.665	13
Dioxins/Furans *																													
HeptaCDD, 1,2,3,4,6,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HeptaCDF, 1,2,3,4,6,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HeptaCDF, 1,2,3,4,7,8,9-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HexaCDD, 1,2,3,4,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HexaCDD, 1,2,3,6,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HexaCDD, 1,2,3,7,8,9-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HexaCDF, 1,2,3,4,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HexaCDF, 1,2,3,6,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HexaCDF, 1,2,3,7,8,9-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
HexaCDF, 2,3,4,6,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
OctaCDD, 1,2,3,4,6,7,8,9-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
OctaCDF, 1,2,3,4,6,7,8,9-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
PentaCDD, 1,2,3,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
PentaCDF, 1,2,3,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
PentaCDF, 2,3,4,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
TetraCDD, 2,3,7,8-	mg/kg	--		--		1.58E-05	4	3.2E-06	4	ug/L	1.00E-02	12	1.00E-05	12	mg/kg	2.15E-05	11	8.5E-07	11	ug/L	1.00E-02	12†	1.00E-05	12†	mg/kg	2.2E-05	11	8.5E-07	11
TetraCDF, 2,3,7,8-	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
Metals																													
Antimony	mg/kg	78	1	5	2			0.27	1	ug/L	180	7	30	7	mg/kg	--		--		ug/L	1500	12	500	12	mg/kg	--		--	
Arsenic	mg/kg	60	3	18	1	43	1	46	1	ug/L	340	6	150	6	mg/kg	33	8	6	8	ug/L	69	6	36	6	mg/kg	70	13	8.2	13
Beryllium	mg/kg	40	1	10	2			21	1	ug/L	35	7	0.66	7	mg/kg	--		--		ug/L	1500	12	100	12	mg/kg	--		--	
Cadmium	mg/kg	140	1	32	1	0.77	1	0.36	1	ug/L	2	6	0.25	6	mg/kg	10	8	0.6	8	ug/L	40	6	8.8	6	mg/kg	9.6	13	1.2	13
Chromium	mg/kg	0.4	3	1	2	26	1	34	1	ug/L	570	6	74	6	mg/kg	110	8	26	8	ug/L	10300	12	27.4	12	mg/kg	370	13	81	13
Chromium, hexavalent	mg/kg	--		--				130	1	ug/L	16	6	11	6	mg/kg	--		--		ug/L	1100	12	50	12	mg/kg	--		--	
Cobalt	mg/kg	--		13	1	120	1	230	1	ug/L	1500	7	23	7	mg/kg	--		--		ug/L	1500	7†	1	12	mg/kg	--		--	
Copper	mg/kg	80	1	70	1	28	1	49	1	ug/L	13	6	9	6	mg/kg	110	8	16	8	ug/L	4.8	6	3.1	6	mg/kg	270	13	34	13
Lead	mg/kg	1,700	1	120	1	11	1	56	1	ug/L	65	6	2.5	6	mg/kg	250	8	31	8	ug/L	210	6	8.1	6	mg/kg	218	13	46.7	13
Manganese	mg/kg	450	1	220	1	4300	1	4000	1	ug/L	2300		120		mg/kg	1100	8	460	8	ug/L	2300	7†	100	12	mg/kg	1100	8†	460	8†
Mercury (mecuric chloride)	mg/kg	0.1	1	0.3	1	--		--		ug/L	1.4	12	0.77	12	mg/kg	2000	8	200	8	ug/L	1.8	12	0.94	12	mg/kg	710	9	150	9
Methyl mercury	mg/kg	--		--		--		0.00158	5	ug/L	0.099	7	0.0028	7	mg/kg	--		--		ug/L	0.099	7†	0.0028	7†	mg/kg	--		--	
Molybdenum	mg/kg	--		2	2	44	4	4.75	4	ug/L	16000	7	370	7	mg/kg	--		--		ug/L	16000	7†	23	12	mg/kg	--		--	
Nickel	mg/kg	280	1	38	1	210	1	130	1	ug/L	470	6	52	6	mg/kg	75	8	16	8	ug/L	74	6	8.2	6	mg/kg	51.6	13	20.9	13
Selenium	mg/kg	4.1	1	0.52	1	1.2	1	0.63	1	ug/L	--		5	6	mg/kg	--		--		ug/L	290	6	71	6	mg/kg	--		--	
Tin	mg/kg	--		50	2			7.62	5	ug/L	2700	7	73	7	mg/kg	--		--		ug/L	2700	7†	73	7†	mg/kg	--		--	

Table 4. Ecologically-Based Screening Levels
EA International - Renewable Energy Project
Arecibo, Puerto Rico

Analyte	Soil									FW Surface water					FW Sediment					SW Surface water					SW Sediment				
	units	Invert	#	Plant	#	Avian	#	Mammal	#	units	Acute	#	Chronic	#	units	Acute	#	Chronic	#	units	Acute	#	Chronic	#	units	Acute	#	Chronic	#
Vanadium	mg/kg	--		2	2	7.8	1	280	1	ug/L	280	7	20	7	mg/kg	--		--		ug/L	280	7†	50	12	mg/kg	--		--	
Zinc	mg/kg	120	1	160	1	46	1	79	1	ug/L	120	6	120	6	mg/kg	820	8	120	8	ug/L	90	6	81	6	mg/kg	410	13	150	13
Miscellaneous																													
Hydrogen chloride	mg/kg	--		--		--		--		ug/L	860000	6	230000	6	mg/kg	--		--		ug/L	--		--		mg/kg	--		--	
Hydrogen fluoride	mg/kg	--		--		--		--		ug/L	200	12	--		mg/kg	--		--		ug/L	1500	12	--		mg/kg	--		--	
Mercuric chloride	mg/kg	--		--		--		--		ug/L	--		--		mg/kg	--		--		ug/L	--		--		mg/kg	--		--	

* Dioxin/Furans were evaluated using a Toxicity Equivalency (TEQ) approach and concentrations were normalized to 2,3,7,8- TCDD prior to screening.

Notes:
† Freshwater value used for Saltwater

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ENERGY ANSWERS
ARECIBO, PUERTO RICO

PROJECT LOCATION MAP

ARCADIS

FIGURE
1

CITY:NOVI DIV/GROUP:ENV DB: PIC: PM: TM: TR: PROJECT NUMBER:
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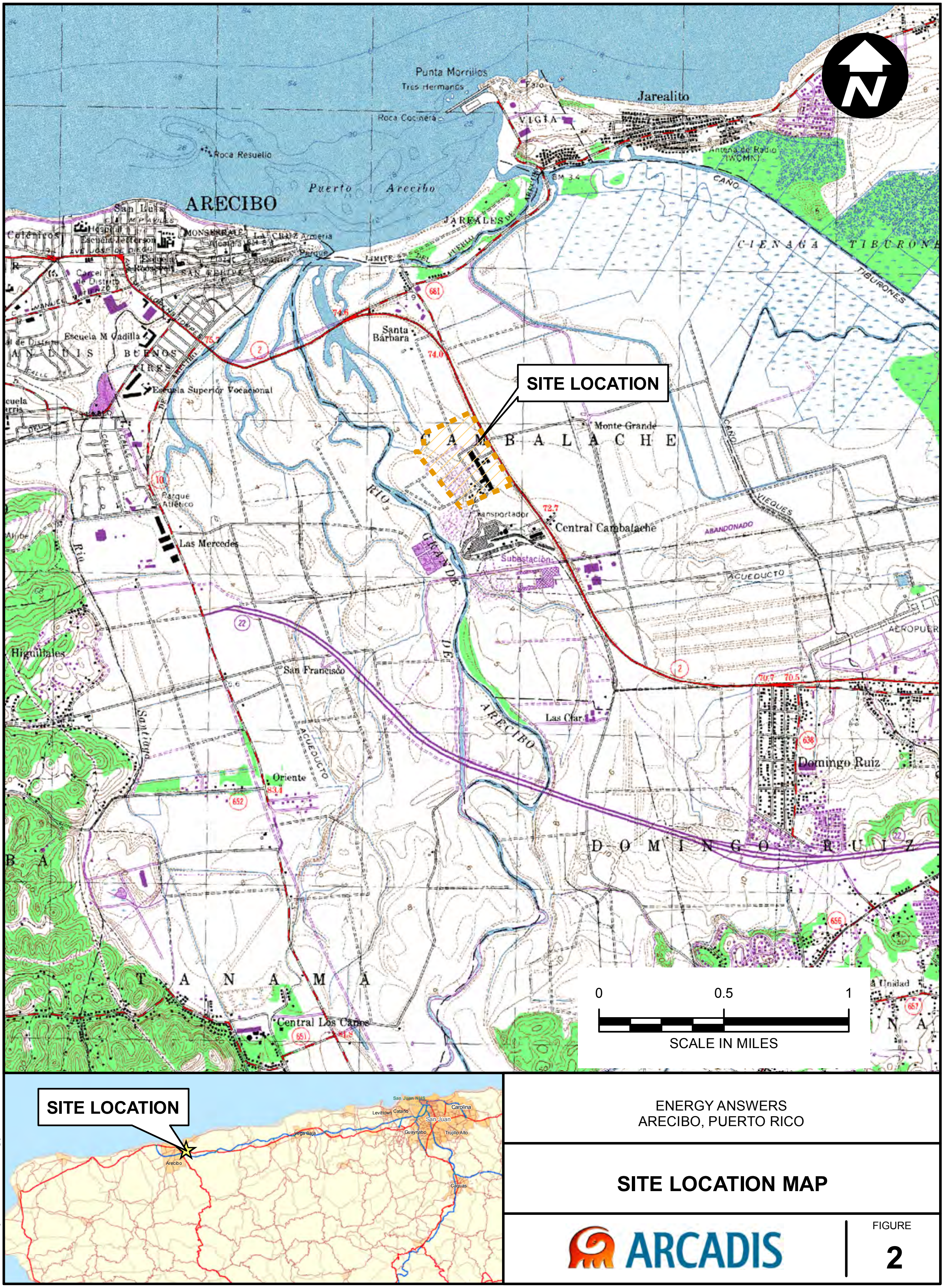

ENERGY ANSWERS
ARECIBO, PUERTO RICO

SITE LOCATION MAP

ARCADIS

FIGURE
2

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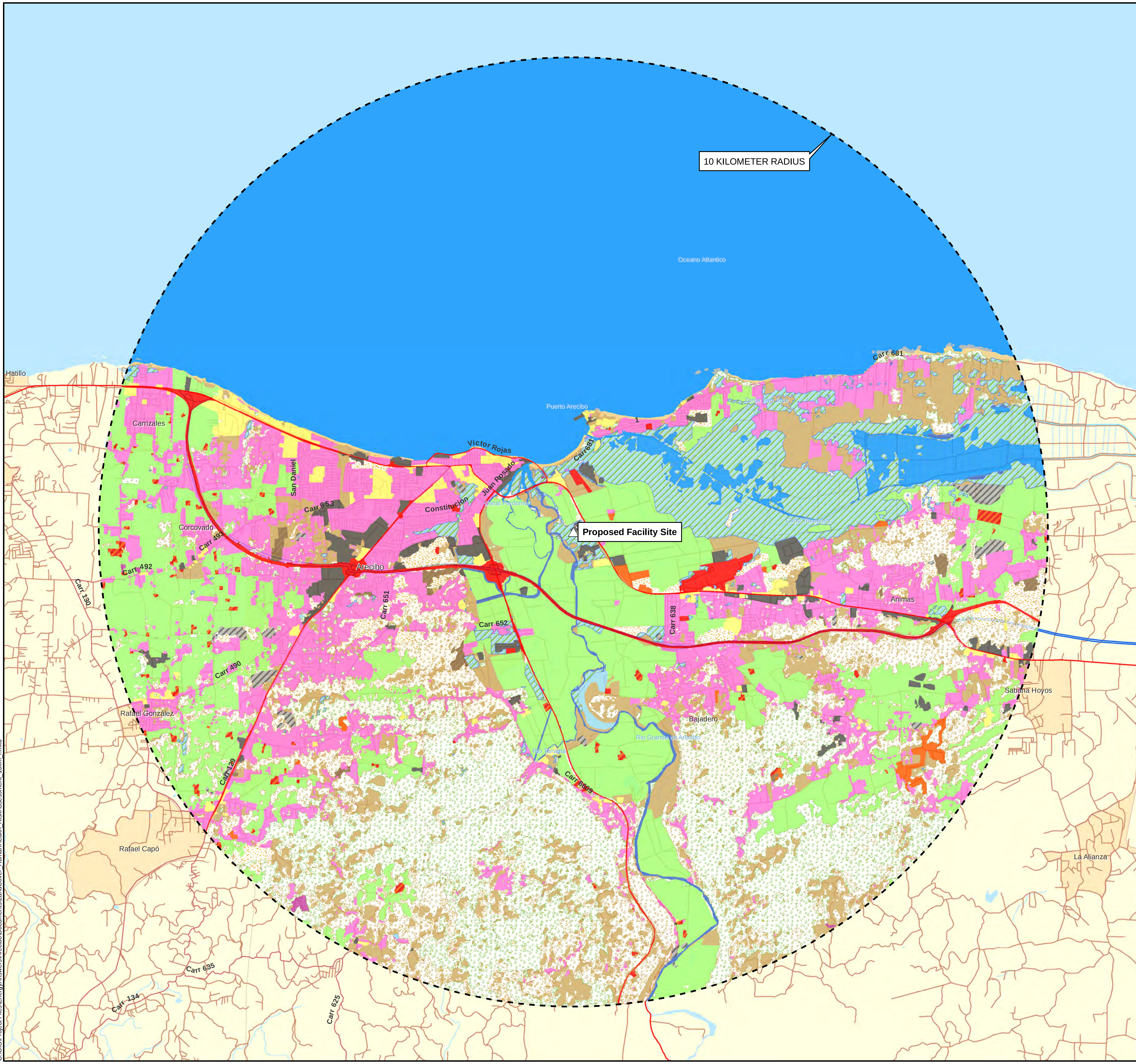

LEGEND

- Proposed Facility Site
- Bare Exposed Rock
- Bays and Estuaries
- Beaches
- Commercial and Services
- Confined Feeding Operations
- Cropland and Pasture
- Deciduous Forest Land
- Evergreen Forest Land
- Herbaceous Rangeland
- Industrial/Urban
- Orchads,Groves, Vineyards, Nurseries, and Hornamental Horticultural Areas
- Other Agricultural Land
- Reservoirs/Lakes
- Residential
- Shrub and Brush Rangeland
- Streams and Canals
- Strip Mines Quarries, and Gravel Pits
- Transitional Areas
- Transportation, Communications, and Utilities
- Wetland

0 1,400 2,800

Scale in Meters

ENERGY ANSWERS
ARECIBO, PUERTO RICO

LAND USE (10 KILOMETER RADIUS)

ARCADIS

FIGURE
3

PROJECT NUMBER: NCENRGY1.0003.0007
CITY:NOVI DIV/GROUP:ENV DB: PIC: PM: TM: TR:
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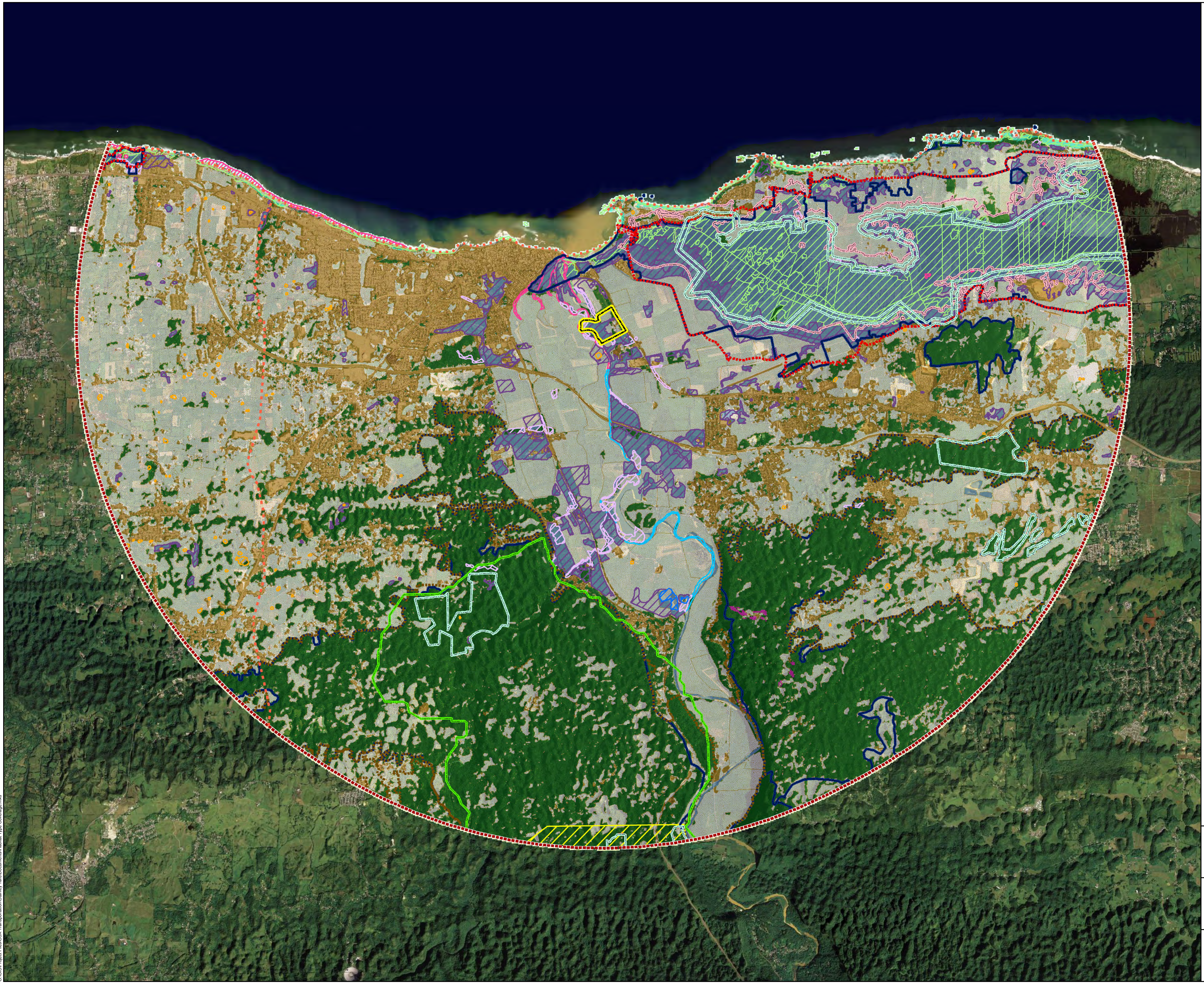


Legend:

- 10 Km Buffer Zone
- Municipal Limit[1]
- Property Limit

Relevant Indicators[2]

- Broad Winged Hawk Habitat Range
- Broad Winged Hawk Home Range
- Critical Wildlife Areas
- Karst Region Priority Conservation Area
- Waterfowl Focus Area
- Priority Conservation Areas
- Protected Natural Areas

Land Cover[2]

- Beaches
- Coffee
- Crops, Grassland and Pastures
- Developed and Barren Land
- Forests and Shrubland and Woodland
- Wetlands

Wetlands[2]

- Forested swamp or wetland shrub bog or wetland
- Herbaceous marsh, fen, swale and wet meadow
- Lake or reservoir basin
- Open water estuary, bay, sound, open ocean
- Pond
- River or stream channel
- Vegetated and non-vegetated brackish and saltwater marsh, shrubs, beach, bar, shoal or flat

Relevant Environmental Indicators Map Source: Information provided by the Puerto Rico Planning Board and Department of Natural and Environmental Resources of Puerto Rico.
Ortho images provided by U.S. Corps of Engineers, Novemebr 2006 – February 2007

0 2 4

Scale In Kilometers

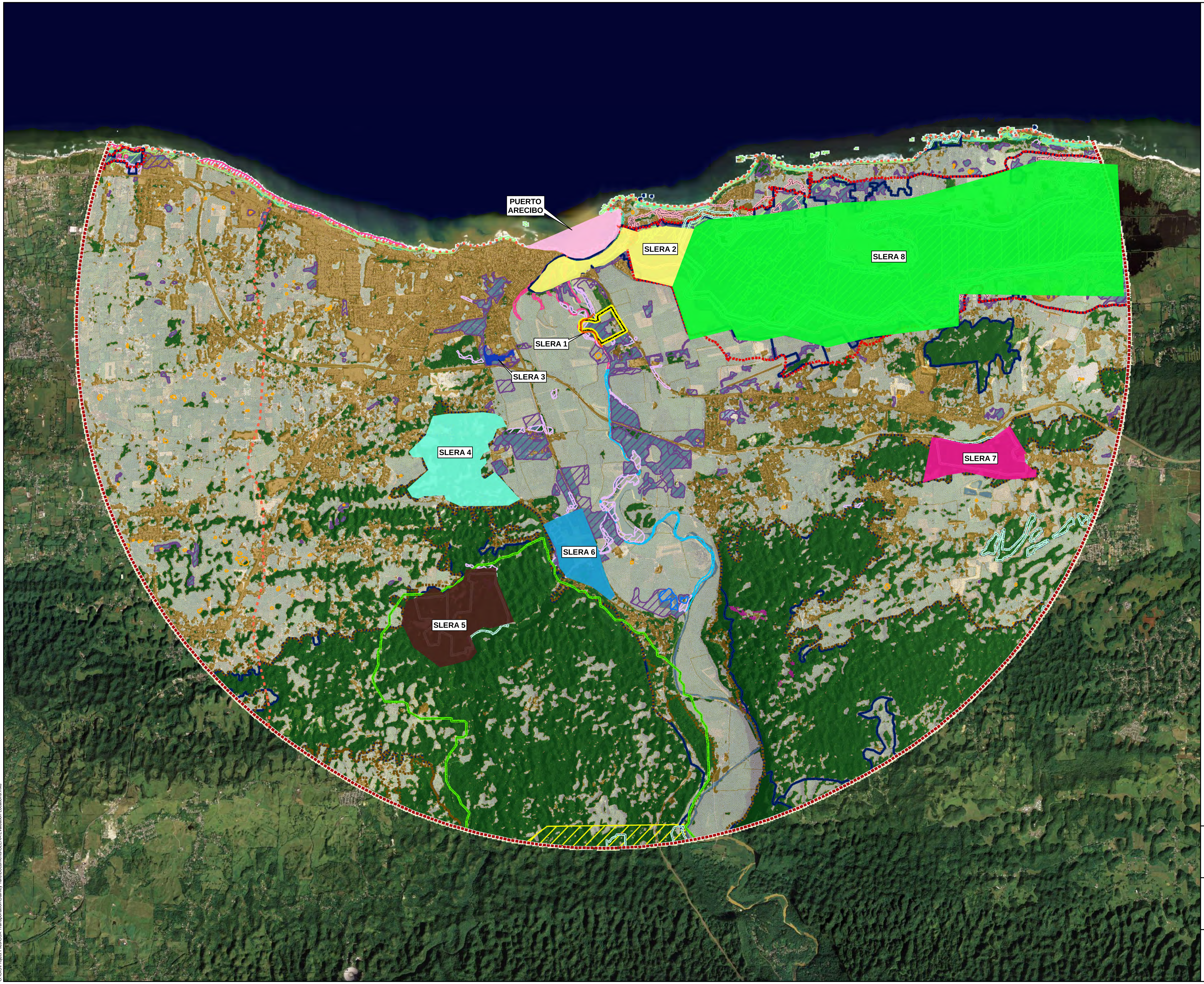
ENERGY ANSWERS
ARECIBO, PUERTO RICO

HABITAT TYPE/COVERAGE MAP

ARCADIS

FIGURE

4



Legend:

- 10 Km Buffer Zone
- Municipal Limit[1]
- Property Limit

Relevant Indicators[2]

- Broad Winged Hawk Habitat Range
- Broad Winged Hawk Home Range
- Critical Wildlife Areas
- Karst Region Priority Conservation Area
- Waterfowl Focus Area
- Priority Conservation Areas
- Protected Natural Areas

Land Cover[2]

- Beaches
- Coffee
- Crops, Grassland and Pastures
- Developed and Barren Land
- Forests and Shrubland and Woodland
- Wetlands

Wetlands[2]

- Forested swamp or wetland shrub bog or wetland
- Herbaceous marsh, fen, swale and wet meadow
- Lake or reservoir basin
- Open water estuary, bay, sound, open ocean
- Pond
- River or stream channel
- Vegetated and non-vegetated brackish and saltwater marsh, shrubs, beach, bar, shoal or flat

SLERA LEGEND

Puerto Arecibo	SLERA 3	SLERA 6
SLERA 1	SLERA 4	SLERA 7
SLERA 2	SLERA 5	SLERA 8

Relevant Environmental Indicators Map Source: Information provided by the Puerto Rico Planning Board and Department of Natural and Environmental Resources of Puerto Rico. Ortho images provided by U.S. Corps of Engineers, Novemebr 2006 – February 2007

0 2 4
Scale In Kilometers

ENERGY ANSWERS
ARECIBO, PUERTO RICO

SLERA EVALUATION LOCATIONS

ARCADIS

FIGURE
5

PROJECT NUMBER:
CITY:NOVI DIV/GROUP:ENV DB: PIC: PM: TM: TR:
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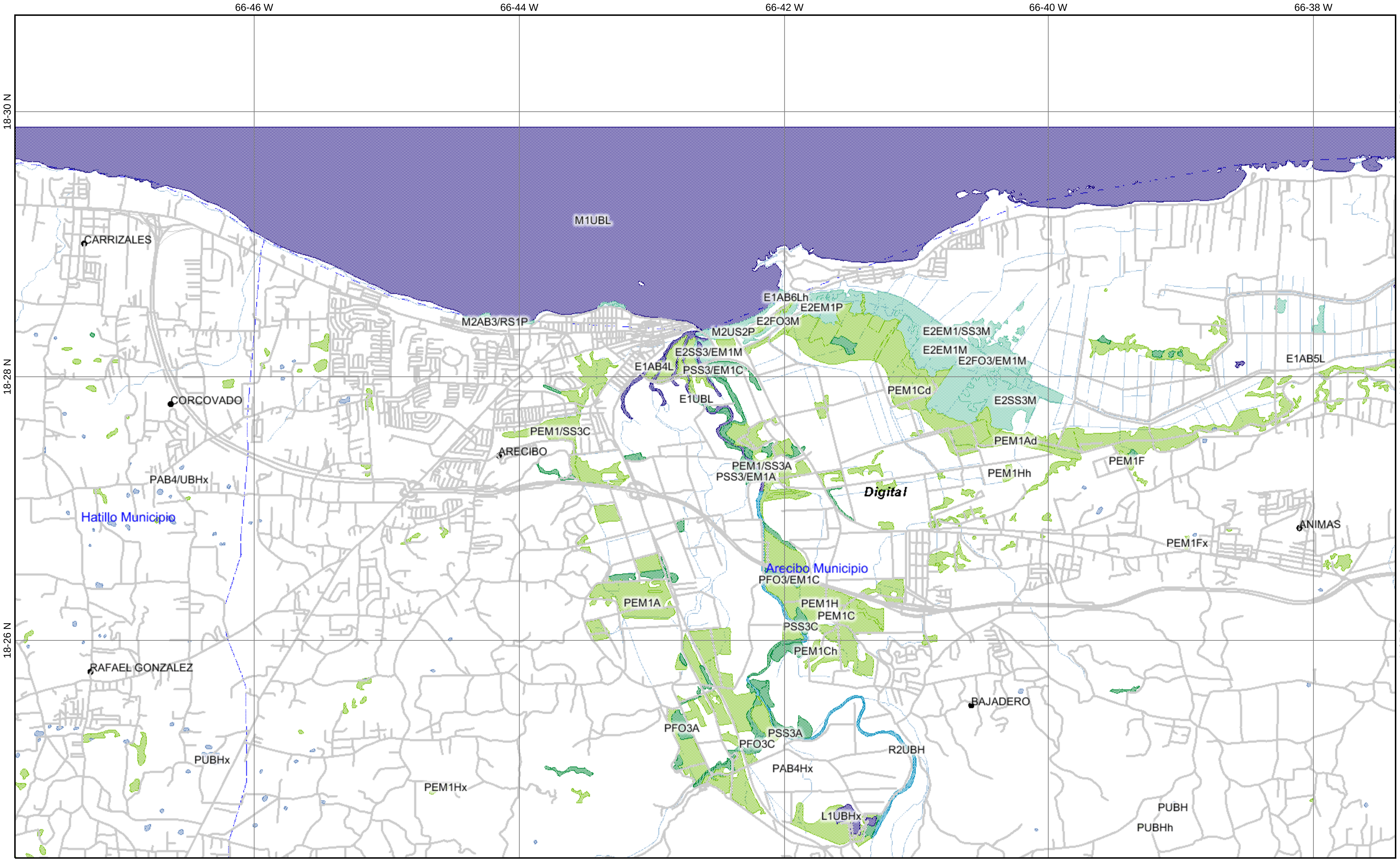
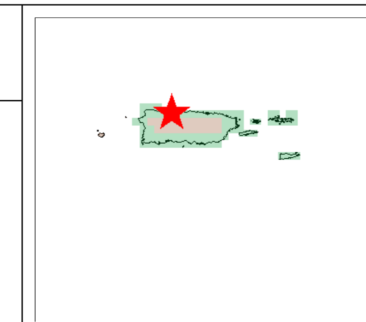
ARCADIS

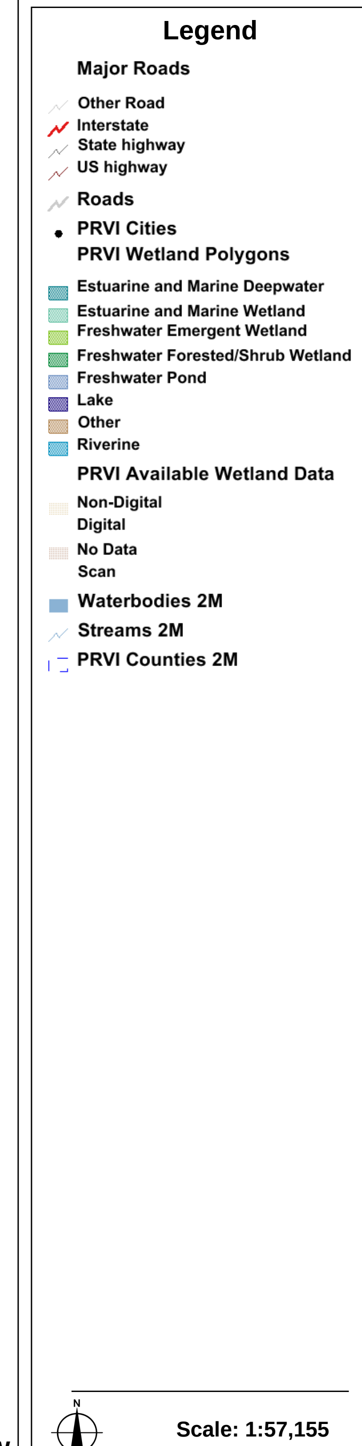
Appendix A

National Wetlands Inventory Map

NWI Wetlands







Map center: 18° 27' 33" N, 66° 42' 36" W

Scale: 1:57,155

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

System: M - Marine

Subsystem: 1 - Subtidal

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	RF – Reef
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud	1 Algal 3 Rooted Vascular	1 Coral 3 Worm

Subsystem: 2 - Intertidal

Class	AB – Aquatic Bed	RF – Reef	RS – Rocky Shore	US – Unconsolidated Shore
Subclass	1 Algal 3 Rooted Vascular	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

System: E - Estuarine

Subsystem: 1 - Subtidal

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	RF – Reef
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 4 Floating Vascular	2 Mollusk 3 Worm

Subsystem: 2 - Intertidal

Class	AB – Aquatic Bed	RF – Reef	SB – Streambed	RS – Rocky Shore	US – Unconsolidated Shore	EM – Emergent	SS – Scrub-Shrub	FO – Forested
Subclass	1 Algal 3 Rooted Vascular 4 Floating Vascular	2 Mollusk 3 Worm	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Non-persistent 5 *Phragmites australis*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen

System: R - Riverine

Subsystem: 1 - Tidal; 2 – Lower Perennial; 3 – Upper Perennial; 4* - Intermittent; 5** – Unknown Perennial

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	SB*** – Streambed	AB – Aquatic Bed	RS – Rocky Shore	US – Unconsolidated Shore	EM – Emergent
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent

* **Intermittent** is limited to the **Streambed** Class
** **Unknown Perennial** is limited to **Unconsolidated Bottom**
*** **Streambed** is limited to **Tidal** and **Intermittent** Subsystems

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

System: L - Lacustrine

Subsystem: 1 - Limnetic

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular

Subsystem: 2 - Littoral

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	RS – Rocky Shore	US – Unconsolidated Shore	EM – Emergent
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent

System: P - Palustrine

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	US – Unconsolidated Shore	ML – Moss-Lichen	EM – Emergent	SS – Scrub-Shrub	FO – Forested
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent 5 *Phragmites australis*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen

MODIFIERS

In order to more adequately describe the wetland and deepwater habitats, one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

Water Regime			Special Modifiers	Water Chemistry			Soil
Nontidal	**Saltwater Tidal**	**Freshwater Tidal**		**Coastal Halinity**	**Inland Salinity**	**pH Modifiers for all Fresh Water**	
A Temporarily Flooded	L Subtidal	S Temporarily Flooded-Tidal	b Beaver	1 Hyperhaline	7 Hypersaline	a Acid	g Organic
B Saturated	M Irregularly Exposed	R Seasonally Flooded-Tidal	d Partly Drained/Ditched	2 Euhaline	8 Eusaline	t Circumneutral	n Mineral
C Seasonally Flooded	N Regularly Flooded	T Semipermanently Flooded-Tidal	f Farmed	3 Mixohaline (Brackish)	9 Mixosaline	I Alkaline	
E Seasonally Flooded/ Saturated	P Irregularly Flooded	V Permanently Flooded-Tidal	h Diked/Impounded	4 Polyhaline	0 Fresh		
F Semipermanently Flooded			r Artificial	5 Mesohaline			
G Intermittently Exposed			s Spoil	6 Oligohaline			
H Permanently Flooded			x Excavated	0 Fresh			
J Intermittently Flooded							
K Artificially Flooded							

Appendix B

DNER Threatened and Endangered Species

Table B-1
Threatened or Endangered Species within a 10-Kilometer Radius of
Energy Answers' Proposed Resource Recovery Facility
Arecibo, Puerto Rico

Elementos Críticos a un radio de 10 km del predio [Critical elements within a 10 km radius]				
Nombre Científico	**Nombre Común**	**Nombre Científico**	**Nombre Común (Inglés)**	**Nombre-Categoría**
Pisonia aculeata (helleri)	Escambron	*Pisonia aculeata (helleri)*	Prickly Manpoo	Vascular Plant
Enallagma (*Amphitecna*) *latifolia*	Higüerillo	Enallagma (*Amphitecna*) *latifolia*	Black-calabash	Vascular Plant
Maytenus ponceana	Cuero de Sapo	*Maytenus ponceana*	Cuero de Sapo	Vascular Plant
Bletia patula var. *alba*	Bletia Blanca	*Bletia patula var. alba*	White Bletia	Vascular Plant
Falco peregrinus	Falcon Peregrino	*Falco peregrinus*	Peregrine Falcon	Vertebrate Animal
Hyperbaena domingensis	Un Bejuco Lenoso o Arbol Peque	*Hyperbaena domingensis*	Forest snakevine	Vascular Plant
Trichechus manatus manatus	Manati	*Trichechus manatus*	West Indian Manatee	Vertebrate Animal
Dermochelys coriacea	Tinglar	*Dermochelys coriacea*	Leatherback Sea Turtle	Vertebrate Animal
Anolis occultus	Lagartijo Enano	*Anolis occultus*	Puerto Rican Pygmy Anole	Vertebrate Animal
Tadarida brasiliensis antillarum	Murcielago de Cola Libre	*Tadarida brasiliensis*	Brazilian Free-tailed Bat	Vertebrate Animal
Enallagma (*Amphitecna*) *latifolia*	Higüerillo	Enallagma (*Amphitecna*) *latifolia*	Black-calabash	Vascular Plant
Polygala cowellii	Arbol de Violeta	*Polygala cowellii*	Violet Tree	Vascular Plant
Mappia racemosa	Palo de Cana	*Mappia racemosa*	Palo de Cana	Vascular Plant
Oxyura jamaicensis	Pato Chorizo	*Oxyura jamaicensis*	Ruddy Duck	Vertebrate Animal
Diploglossus pleei	Culebra de Cuatro Patas	*Diploglossus pleei*	Puerto Rican Galliwasp	Vertebrate Animal
Nymphaea ampla	Calderon	*Nymphaea ampla*	Water Lilly	Vascular Plant
Drypetes lateriflora	Cueriduro	*Drypetes lateriflora*	Guinea-plum	Vascular Plant
Eugenia stewardsonii	Hoja Menuda	*Eugenia stewardsonii*	Stewardson's Eugenia	Vascular Plant
Epicrates inornatus	Boa de Puerto Rico	*Epicrates inornatus*	Puerto Rico Boa	Vertebrate Animal
Tadarida brasiliensis antillarum	Murcielago Viejo	*Tadarida brasiliensis*	Brazilian Free-tailed Bat	Vertebrate Animal
Oxyura dominica	Pato Dominico	*Oxyura dominica*	Masked Duck	Vertebrate Animal
Govenia utriculata	Una OrquideaTerrestre	*Govenia utriculata*	Tropical Govenia	Vascular Plant
Fulica caribaea	Gallinazo Caribeño	*Fulica caribaea*	Caribbean Coot	Vertebrate Animal
Dendrocygna arborea	Chiriria Caribeña	*Dendrocygna arborea*	West Indian Whistling-duck	Vertebrate Animal
Manilkara pleeana	Ausuba	*Manilkara pleeana*	Zapote de Costa	Vascular Plant
Epidendrum oncidioides	Orquídea	*Epidendrum oncidioides*	an Orchid	Vascular Plant
Drypetes ilicifolia	Encinillo	*Drypetes ilicifolia*	Encinillo	Vascular Plant
Fulica caribaea	Gallinazo Nativo	*Fulica caribaea*	Caribbean Coot	Vertebrate Animal
Passiflora murucuja	Parchita	*Passiflora murucuja*	Virgin Island's Passion-flower	Vascular Plant
Maytenus ponceana	Cuero de Sapo	*Maytenus ponceana*	Cuero de Sapo	Vascular Plant
Myrcia paganii	Ausu	*Myrcia paganii*	Ausu	Vascular Plant
Cynometra portoricensis	Oreganillo	*Cynometra portoricensis*	Oreganillo	Vascular Plant
Marsilea polycarpa	Un Helecho Acuatico	*Marsilea polycarpa*	Guayanan Waterclover	Vascular Plant
Nymphaea ampla	Calderon	*Nymphaea ampla*	Water Lilly	Vascular Plant
Diospyros sintenisii	Guayabota	*Diospyros sintenisii*	Guayabota	Vascular Plant
Epicrates inornatus	Boa de Puerto Rico	*Epicrates inornatus*	Puerto Rican Boa	Vertebrate Animal
Stenoderma rufum darioi	Murcielago Rojo Frutero	*Stenoderma rufum*	Desmarest's Fig-eating Bat	Vertebrate Animal
Guatteria caribaea	Haya Blanca	*Guatteria caribaea*	Haya Blanca	Vascular Plant
Sabal causiarum	Palma de Sombrero	*Sabal causiarum*	Puerto Rican Hat-palm	Vascular Plant
Nymphaea amazonum	Yerba de Hicotea	*Nymphaea amazonum*	Amazon Water-lily	Vascular Plant
Tachybaptus dominicus	Tigua	*Tachybaptus dominicus*	Least Grebe	Vertebrate Animal

Threatened or Endangered

ARCADIS

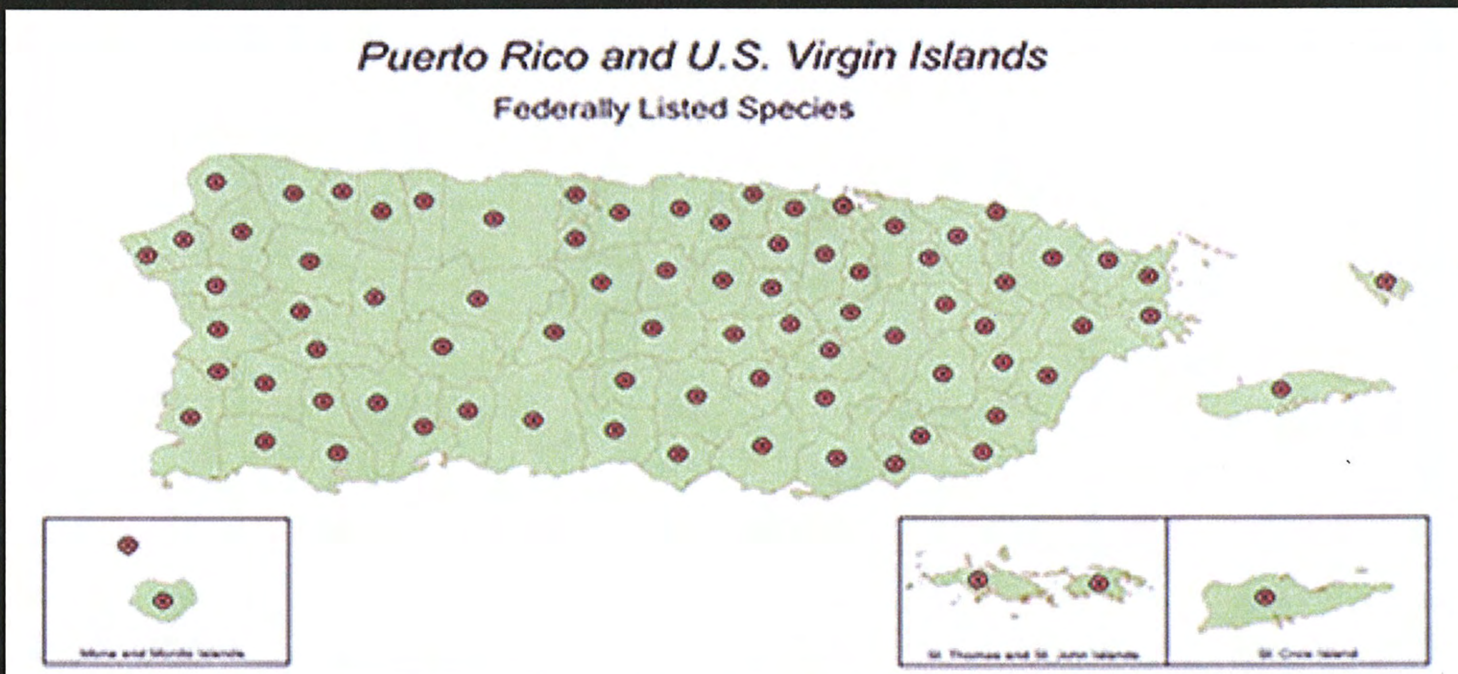
Appendix C

USFWS Caribbean Endangered Species Map for Puerto Rico

U.S. Fish & Wildlife Service

Caribbean Endangered Species Map

Mapa de Especies Caribeñas en Peligro de Extinción



Carey

Coquí guajón

Higuero de Sierra

Palometas

U.S.Fish & Wildlife Service

Ecological Services in the Caribbean

DISCLAMER: The Endangered Species Map is provided as a tool for developers, consultants, land management agencies, resource agency staff and the general public as a quick reference for the evaluation of possible effects that may result from development projects. The information provided in this map identifies general areas where the species may be located. The information does not represent the absolute distribution of a particular species. The map and table were developed with the best information available to the Service, but additional sightings of the species may occur. If the project is located within the currently known distribution of a species, additional information may be required to determine the presence of suitable habitat within the project area, and in some cases, specialized surveys may be required to determine presence/absence of the species.

Continue to Map

Last Revised: 2007

ARECIBO (1-2)

SCIENTIFIC NAME	COMMON NAME	COMMON NAME SPANISH	GROUP	STATUS	DISTRIBUTION
Accipiter striatus venator	Puerto Rican Sharp-Shinned Hawk	Falcon de Sierra	Bird	E	Rio Abajo State Forest
Amazona vittata vittata	Puerto Rican Parrot	Cotorra Puertorriqueña	Bird	E	Rio Abajo State Forest
Auerodendron pauciflorum	No Common Name	No Tiene Nombre Comun	Plant	E	Rio Abajo State Forest
Buteo platypterus brunnescens	Puerto Rican Broad-winged Hawk	Guaraguao de Bosque	Bird	E	Rio Abajo State Forest
Calyptronoma rivalis	No Common Name	Palma de Manaca	Plant	T	Rio Abajo State Forest
Chelonia mydas	Green Sea Turtle	Peje Blanco	Reptile	T, CH	Coastal Zones
Cordia bellonis	No Common Name	No Tiene Nombre Comun	Plant	E	Rio Abajo State Forest
Cornutia obovata	No Common Name	Palo de Nigua	Plant	E	Rio Abajo State Forest, Near Arecibo Observatory
Dermochelys coriacea	Leatherback Sea Turtle	Tinglar	Reptile	E, CH	Coastal Zones
Epicrates inornatus	Puerto Rican Boa	Boa Puertorriqueña	Reptile	E	Forested Volcanic and Limestone (Karst) Hills
Eretmochelys imbricata	Hawksbill Sea Turtle	Carey	Reptile	E, CH	Coastal Zones
Goetzea elegans	Beautiful Goetzea	Matabuey	Plant	E	Cambalache State Forest
Continues on Next Page					

Status
E=Endangered
T=Threatened
CH=Critical Habitat

BACK CONTINUE

ARECIBO (2-2)

SCIENTIFIC NAME	COMMON NAME	COMMON NAME SPANISH	GROUP	STATUS	DISTRIBUTION
Myrcia paganii	No Common Name	No Tiene Nombre Comun	Plant	E	Biafara Arrozal
Ottoschulzia rhodoxylon	No Common Name	Palo de Rosa	Plant	T	Cambalache State Forest, Sabana Hoyos
Pelecanus occidentalis	Brown Pelican	Pelicano Pardo	Bird	E	Coastal Zones, Inland Waterbodies, No Nesting
Peltophryne lemur	Puerto Rican Crested Toad	Sapo Concho	Amphibian	T	Northern Karst Regions
Pleodendron macranthum	No Common Name	Chupacallos	Plant	E	Rio Abajo State Forest
Schoepfia arenaria	No Common Name	No Tiene Nombre Comun	Plant	T	Rio Abajo State Forest
Solanum drymophilum	No Common Name	Erubia	Plant	E	Rio Abajo State Forest
Sterna dougallii	Roseate Tern	Palometa	Bird	T	Coastal Areas and Offshore Cays, Nesting
Tectaria estremerana	No Common Name	No Tiene Nombre Comun	Plant	E	Rio Abajo State Forest, Near Arecibo Observatory
Trichechus manatus manatus	Antillean Manatee	Manati Antillano	Mammal	E	Coastal Zones

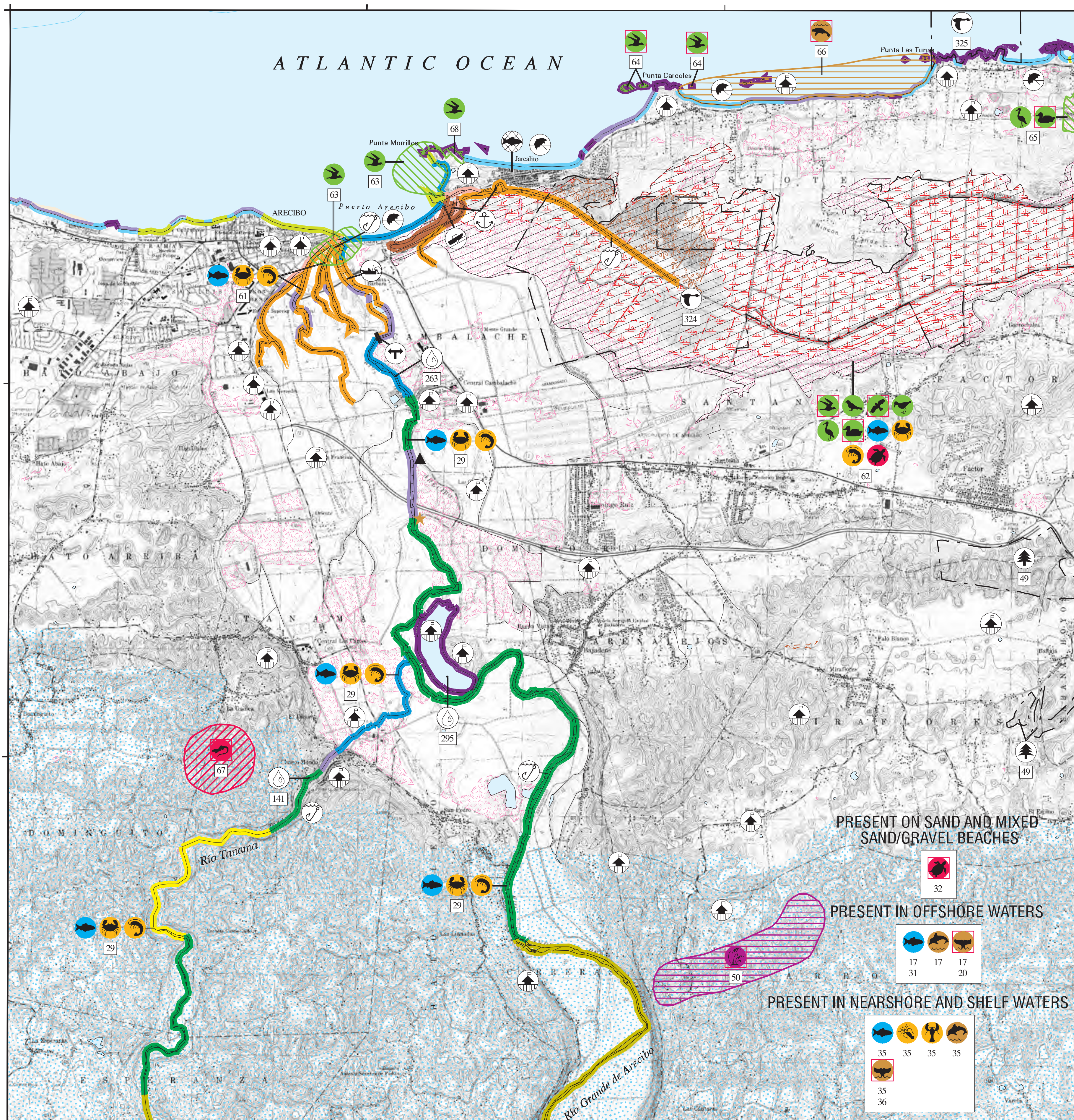
Status
E=Endangered
T=Threatened
CH=Critical Habitat

BACK PREVIOUS

Appendix D

Environmental Sensitivity Index Map

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

- 1A EXPOSED ROCKY CLIFFS
- 1B EXPOSED, SOLID MAN–MADE STRUCTURES
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- 2B SCARPS AND STEEP SLOPES IN MUDDY SEDIMENTS
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- 5 MIXED SAND AND GRAVEL BEACHES
- 6A GRAVEL BEACHES
- 6B RIPRAP
- 7 EXPOSED TIDAL FLATS
- 8A SHELTERED ROCKY SHORES
- 8B SHELTERED, SOLID MAN–MADE STRUCTURES
- 9A SHELTERED TIDAL FLATS
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- 10D MANGROVES
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- FRESHWATER MARSHES
- FRESHWATER SWAMPS
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- 1 QUIET POOL; LOW–SENSITIVE BANKS
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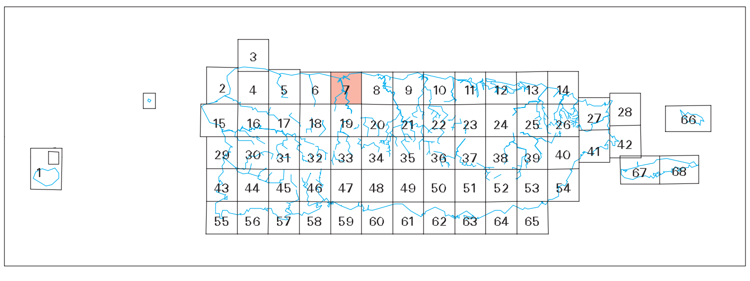
- 9 LARGE FALLS; BOULDERS IN CHANNEL
- 10 CHANNELS WITH ASSOCIATED VULNERABLE WETLANDS
- KARST



N W E S

SCALE 1:55000

1 .5 0 1 KILOMETER

1 .5 0 1 MILE

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National Ocean Service
Office of Response and Restoration
Hazardous Materials Response Division

ARECIBO, P.R. (1982) PR-7

PUERTO RICO - ESIMAP 7

BIOLOGICAL RESOURCES:

BIRD:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting
62	American coot			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	American kestrel			HIGH	X	X	X	X						X	X	X	-
	American wigeon				X	X	X	X						X	X	X	-
	Black skimmer				X	X	X	X							X	X	-
	Blue-winged teal			HIGH	X	X	X	X						X	X	X	-
	Brown pelican	S/F	E/E	HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Caribbean coot	S	T	LOW	X	X	X	X	X	X	X	X	X	X	X	X	-
	Common moorhen			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Common snipe			HIGH	X	X	X	X						X	X	X	-
	Green-winged teal			LOW	X	X	X							X	X	X	-
	Lesser scaup			LOW	X	X	X								X	X	-
	Masked duck	S	T	LOW	X	X	X	X	X	X	X	X	X	X	X	X	-
	Merlin			LOW	X	X	X							X	X	X	-
	Northern pintail			LOW	X	X	X	X					X	X	X	X	-
	Osprey			HIGH	X	X	X	X					X	X	X	X	-
	Peregrine falcon	S	E	LOW	X	X	X	X						X	X	X	-
	Purple gallinule			LOW	X	X	X	X	X	X	X	X	X	X	X	X	-
	Red-tailed hawk			MEDIUM	X	X	X	X	X	X	X	X	X	X	X	X	-
	Ring-necked duck			LOW	X	X	X							X	X	X	-
	Ruddy duck	S	T	HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Shorebirds			HIGH	X	X	X	X	X			X	X	X	X	X	-
	Wading birds			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	West Indian whistling-duck	S	T	HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	White-cheeked pintail			MEDIUM	X	X	X	X	X	X	X	X	X	X	X	X	-
	White-crowned pigeon				X	X	X	X	X	X	X	X	X	X	X	X	-
63	Seabirds				X	X	X	X	X	X	X	X	X	X	X	X	-
64	Roseate tern	S/F	E/T					X	X	X	X	X	X				MAY-JUL
65	Caribbean coot	S	T		X	X	X	X	X	X	X	X	X	X	X	X	-
	Common moorhen				X	X	X	X	X	X	X	X	X	X	X	X	-
	Masked duck	S	T		X	X	X	X	X	X	X	X	X	X	X	X	-
	Pied-billed grebe				X	X	X	X	X	X	X	X	X	X	X	X	-
	Purple gallinule				X	X	X	X	X	X	X	X	X	X	X	X	-
	Ruddy duck	S	T		X	X	X	X	X	X	X	X	X	X	X	X	-
	Wading birds				X	X	X	X	X	X	X	X	X	X	X	X	-
68	Bridled tern							X	X	X	X	X					APR-JUL
	Brown noddy				X	X	X	X	X	X	X	X	X	X	X	X	APR-AUG
	White-tailed tropicbird						X	X	X	X	X						MAR-JUL

FISH:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Spawning	Eggs	Larvae	Juveniles	Adults
17	Pelagic fish				X	X	X	X	X	X	X	X	X	X	X	X	JAN-DEC	JAN-DEC	JAN-DEC	JAN-DEC	JAN-DEC
29	Native stream fish				X	X	X	X	X	X	X	X	X	X	X	X	APR-MAY AUG-NOV	APR-MAY AUG-NOV	APR-MAY AUG-NOV	JAN-DEC	JAN-DEC
31	Blue marlin			HIGH					X	X	X	X	X	X	X		MAY-NOV	MAY-NOV	MAY-NOV	-	MAY-NOV
35	Pelagic fish				X	X	X	X	X	X	X	X	X	X	X	X	JAN-DEC	JAN-DEC	JAN-DEC	JAN-DEC	JAN-DEC
	Reef fish				X	X	X	X	X	X	X	X	X	X	X	X	JAN-DEC	JAN-DEC	JAN-DEC	JAN-DEC	JAN-DEC
61	Native stream fish							X	X			X	X	X	X		-	-	APR-MAY AUG-NOV	-	-
	Nursery fish				X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	-
	Sirajo goby (seti)			HIGH										X			-	-	OCT-OCT	-	-
	Snook				X	X	X	X	X	X	X	X	X	X	X	X	APR-FEB	APR-FEB	JAN-DEC	JAN-DEC	JAN-DEC
	Tarpon				X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-DEC	JAN-DEC	JAN-DEC
62	Native stream fish							X	X			X	X	X	X		-	-	APR-MAY AUG-NOV	-	-
	Nursery fish				X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	-
	Snook				X	X	X	X	X	X	X	X	X	X	X	X	APR-FEB	APR-FEB	JAN-DEC	JAN-DEC	JAN-DEC
	Tarpon				X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-DEC	JAN-DEC	JAN-DEC
	Tilapia				X	X	X	X	X	X	X	X	X	X	X	X	DEC-JUL	DEC-JUL	DEC-JUL	JAN-DEC	JAN-DEC

PLANT:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D
50	Myrcia paganii	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X

INVERTEBRATE:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Spawning	Eggs	Larvae	Juveniles	Adults
29	Freshwater crab				X	X	X	X	X	X	X	X	X	X	X	X	APR-MAY AUG-NOV	APR-MAY AUG-NOV	-	JAN-DEC	JAN-DEC
	Native stream shrimp				X	X	X	X	X	X	X	X	X	X	X	X	APR-MAY AUG-NOV	APR-MAY AUG-NOV	APR-MAY AUG-NOV	JAN-DEC	JAN-DEC
35	Caribbean spiny lobster				X	X	X	X	X	X	X	X	X	X	X	X	JAN-DEC	JAN-DEC	JAN-DEC	JAN-DEC	JAN-DEC
	Octopus				X	X	X	X	X	X	X	X	X	X	X	X	DEC-MAR	DEC-APR	-	JAN-DEC	JAN-DEC
61	Blue land crab				X	X	X	X	X	X	X	X	X	X	X	X	JUL-AUG	JUL-AUG	JUL-SEP	JAN-DEC	JAN-DEC
	Native stream shrimp							X	X			X	X	X	X		-	-	APR-MAY AUG-NOV	-	-
62	Blue crabs				X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	JAN-DEC
	Blue land crab				X	X	X	X	X	X	X	X	X	X	X	X	JUL-AUG	JUL-AUG	JUL-SEP	JAN-DEC	JAN-DEC
	Native stream shrimp							X	X			X	X	X	X		-	-	APR-MAY AUG-NOV	-	-

MARINE MAMMAL:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Mating	Calving
17	Dolphins				X	X	X	X	X	X	X	X	X	X	X	X	-	-
	Whales				X	X	X	X	X	X	X	X	X	X	X	X	-	-
20	Sperm whale	S/F	E/E	HIGH	X	X	X	X	X	X	X		X	X	X	X	-	-
35	Dolphins				X	X	X	X	X	X	X	X	X	X	X	X	-	-
	Whales				X	X	X	X	X	X	X	X	X	X	X	X	-	-
36	Humpback whale	S/F	E/E	VERY HIGH	X	X	X	X	X						X	X	-	-
66	West Indian manatee	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X	JAN-DEC	JAN-DEC

REPTILE:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting	Hatching	Internesting	Juveniles	Adults
32	Green sea turtle	S/F	E/T		X	X	X	X	X	X	X	X	X	X	X	X	JAN-DEC	JAN-DEC	-	JAN-DEC	JAN-DEC
	Hawksbill sea turtle	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X	JAN-DEC	JAN-DEC	-	JAN-DEC	JAN-DEC
	Leatherback sea turtle	S/F	E/E			X	X	X	X	X	X	X	X				FEB-JUN	APR-SEP	-	APR-SEP	FEB-JUN
62	Jicotea				X	X	X	X	X	X	X	X	X	X	X	X	APR-JUL	JUN-OCT	-	JAN-DEC	JAN-DEC
67	Puerto Rican boa	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	JAN-DEC

HUMAN USE RESOURCES:

HUN#	Name	Owner/Manager	Contact	Phone
	FOREST:			
49	BOSQUE CAMBALACHE	DRNA	DIVISION DE MANEJO BOSQUES ESTATALES	787/721-5495
	WILDLIFE REFUGE:			
324	RESERVA NATURAL CANO TIBURONES	DRNA	DIVISION DE RESERVAS NATURALES Y REFUGIOS DE VIDA SILVESTRE	787/724-2816
325	RESERVA NATURAL CUEVA DEL INDIO	DRNA	DIVISION DE RESERVAS NATURALES Y REFUGIOS DE VIDA SILVESTRE	787/724-2816

WATER INTAKE:

HUN#	Name	Owner/Manager	Location	Phone
141	ARECIBO FILTER PLANT	PRASA	PR 636, KM 1.6	787/878-3195
263	POWER PLANT			
295	SUPER AQUEDUCT INTAKE			

Biological information shown on the maps represents known concentration areas or occurrences, but does not necessarily represent the full distribution or range of each species. This is particularly important to recognize when considering potential impacts to protected species.

PUERTO RICO

SHORELINE HABITATS (ESI)

- 1A EXPOSED ROCKY CLIFFS
- 1B EXPOSED, SOLID MAN-MADE STRUCTURES
- 2A EXPOSED WAVE-CUT PLATFORMS IN BEDROCK
- 2B SCARPS AND STEEP SLOPES IN MUDDY SEDIMENTS
- 3A FINE- TO MEDIUM-GRAINED SAND BEACHES
- 4 COARSE-GRAINED SAND BEACHES
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- FRESHWATER MARSHES
- FRESHWATER SWAMPS
- FRESHWATER SCRUB/SHRUB

STREAM REACHES (RSI)

- 1 QUIET POOL; LOW-SENSITIVE BANKS
- 2 STRAIGHT CHANNEL WITH CURRENTS; LOW-SENSITIVE BANKS (MUD DOMINANT)
- 3 MEANDERING CHANNEL; SAND POINT BARS
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- 5 RAPIDS OVER BEDROCK
- 6 MEANDERING CHANNEL; SAND AND GRAVEL POINT BARS
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- 8 SMALL FALLS; BOULDERS IN CHANNEL
- 9 LARGE FALLS; BOULDERS IN CHANNEL
- 10 CHANNELS WITH ASSOCIATED VULNERABLE WETLANDS
- KARST

BENTHIC MARINE HABITATS

- CORAL REEF
- HARDBOTTOM
- SEAGRASS

HUMAN-USE FEATURES

- AIRPORT
- AQUACULTURE
- ARCHAEOLOGICAL/HISTORICAL SITE
- ARTISANAL/COMMERCIAL FISHING
- BOAT RAMP
- COAST GUARD
- DAM
- DESIGNATED CRITICAL HABITAT
- DIVE SITE
- MARINA
- NATIONAL ESTUARINE RESEARCH RESERVE
- FISHING ASSOCIATION
- FOREST
- RECREATIONAL BEACH
- RECREATIONAL FISHING
- NATIONAL PARK
- WATER INTAKE
- WILDLIFE REFUGE/ NATURAL RESERVE
- BRIDGE
- MANAGEMENT AREA
- ESI/RSI BREAK
- SHELF BOUNDARY
- RSI COLLECTION POINT
- RSI FIELD STATION
- RSI HIGH-WATER LEAKAGE POINT
- 123 HUMAN-USE NUMBER

SENSITIVE BIOLOGICAL RESOURCES

BIRD

- PASSERINE-LIKE BIRD
- RAPTOR
- SEABIRD
- SHOREBIRD
- WADING BIRD
- WATERFOWL

MARINE MAMMAL

- DOLPHIN
- MANATEE
- WHALE

TERRESTRIAL MAMMAL

- BAT

FISH

- FISH

INVERTEBRATE

- BIVALVE
- CRAB
- GASTROPOD
- LOBSTER
- OCTOPUS
- SHRIMP

REPTILE/AMPHIBIAN

- AMPHIBIAN/OTHER REPTILE
- TURTLE

PLANT

- RARE PLANT/HABITAT
- FLOATING AQUATIC VEGETATION
- SUBMERGED AQUATIC VEGETATION

MULTI-GROUP

- THREATENED/ENDANGERED
- 123 RAR NUMBER

Guidelines for Interpreting ESI Maps

To help users interpret the ESI maps and tabular data, we offer the following guidelines for use in addition to the map legend:

• Shoreline Habitats. The “shoreline,” representing the boundary between land and water, is color-coded with the ESI classification. Most shoreline habitats are shown as a line, with no areal dimension. Where there is more than one shoreline type (e.g., a beach in front of a seawall), the colors for each habitat are shown, with the color for the landward habitat on the land side of the shoreline and the color for the seaward habitat on the water side. In areas where the intertidal zone is wide (e.g., wide tidal flats, wave-cut rocky platforms), the habitat from high to low water is filled with the ESI classification color. When data are available, the entire extent of wetlands are filled with colored patterns. The seaward edge of the wetland is color-coded with the ESI classification; the landward extent of the wetland is indicated by a dashed, colored line.

• Biological Resources. The distribution of biological resources is shown using many different conventions. The major convention is an icon associated with a point, line, or polygon that shows the species’ areal distribution. The icon’s reference number corresponds to a data table with details on species and life history. Biological resource data are organized into six major groups, each with a reference color: birds (green), mammals (brown), fish (blue), shellfish (orange), reptiles (red), and rare / endangered plants and special habitats (purple). These colors are used to fill hatched polygons and the icons. Each major group has subgroups with unique icons to visually indicate the type of organism or feature present. The icon or group of icons is usually located inside the polygon it represents; however, sometimes a line is connected between the icon and the polygon or point to make it easier to relate the two. Note that icons are used to indicate the types of resources present, but the actual data are the points and polygons. A red box around an icon indicates the presence of a species on the state or Federal list of threatened or endangered species.

The number listed below each icon refers to the first column of a data table for each map. The data tables, organized by group (birds, fish, etc.), include the following information: species name, status as threatened or endangered on state and Federal lists, concentration (specifically for each point or polygon), presence by month, and special life-history time periods. When a polygon contains multiple groups, the one number under the group of icons is listed under each group heading in the data tables. Where possible, the same number is used on multiple maps. For example, all bald eagle nests with the same seasonality could have the same number throughout the atlas, or the same assemblage of fish would have the same number wherever it occurred.

A data table has a separate listing for every unique combination of species, concentration, seasonality, life-history stage, and source. By looking at the monthly seasonality data in the table for each map, the species present at the time of concern can be easily identified. An ‘X’ or number is placed under each month in which any life stage of the species is present in the area represented by the point or polygon. Numbers are used typically for fish and shellfish where data on relative abundance are available. The final columns in the data tables include the months when reproductive activities occur or early life stages are present. Users should pay close attention to the data tables because they contain much of the information needed to identify the most sensitive resources at different times of the year.

Points, lines, and polygons on a map represent the distribution of the resources. Green points show bird nesting sites, including bald eagle nests and dense colonial nesters (e.g., heron rookeries and seabird nesting colonies). Animals and habitats are also represented as: 1) hatched polygons in the color for the animal group (e.g., green for birds); 2) black hatched polygons which contain multiple groups of resources (birds and fish in the same tidal channels); 3) solid lines (usually used for fish in small streams); or 4) in “common in ...” boxes. When showing the biological resource polygons would make the maps too difficult to read (usually when multiple polygons cover a large area), the polygons are not plotted and the presence of the resource is indicated by placing the icon in a box labeled “common in ...” The box contains an appropriate geographic reference. Different boxes can be used on the same map when, for example: “common in Winyah Bay” or “common in tidal creeks.” The data for these resources are still fully present in the database but are not shown to make the maps more readable.

- Human-use Resources. Most of the human-use resources are point features indicated by a black-and-white icon. Managed lands, such as refuges and sanctuaries, have their boundaries shown as a dot-dash line with an icon and name placed inside. Where the feature is a known point location (e.g., a drinking water intake, boat ramp, marina), the exact location is shown as a small black dot and a line is drawn from it to the icon. Activities such as commercial and recreational fishing and areas such as recreational beaches are also indicated by an icon placed in the general area without any lines to points or polygons since the boundaries are not readily defined.

Some features, like historic and archaeological sites, are location-sensitive: the agency managing the resource believes the exact location should not be shown in order to protect the site. In these cases, the icon is placed in the general area of the resource, but the exact location is not shown.

ARCADIS

Appendix E

Modeled COPEC Concentrations in Environmental Media

	SLERA 2-1
X/Y	742002.13 / 2043651
COPCs	Max Soil Concentration mg/kg
Acenaphthene	1.30E-11
Acenaphthylene	1.04E-10
Anthracene	3.82E-09
Antimony	2.45E-04
Aroclor 1254	3.61E-08
Arsenic	1.97E-05
Benzo(a)anthracene	1.16E-08
Benzo(a)pyrene	9.73E-09
Benzo(b)fluoranthene	4.59E-10
Benzo(k)fluoranthene	3.46E-08
Beryllium	3.38E-05
Cadmium	5.87E-05
Chromium, hexavalent	3.84E-05
Chrysene	1.32E-08
Cobalt	7.84E-06
Copper	9.12E-05
Dibenz(a,h)anthracene	2.88E-08
Fluoranthene	2.75E-09
HeptaCDD, 1,2,3,4,6,7,8-	7.09E-09
HeptaCDF, 1,2,3,4,6,7,8-	5.15E-09
HeptaCDF, 1,2,3,4,7,8,9-	1.34E-09
HexaCDD, 1,2,3,4,7,8-	4.97E-10
HexaCDD, 1,2,3,6,7,8-	1.22E-09
HexaCDD, 1,2,3,7,8,9-	1.24E-09
HexaCDF, 1,2,3,4,7,8-	2.83E-09
HexaCDF, 1,2,3,6,7,8-	4.83E-09
HexaCDF, 1,2,3,7,8,9-	9.77E-10
HexaCDF, 2,3,4,6,7,8-	4.50E-09
Hydrogen chloride	5.86E-06
Hydrogen fluoride	1.68E-01
Indeno(1,2,3-cd) pyrene	1.58E-08
Lead	1.17E-02
Manganese	2.91E-04
Mercuric chloride	4.02E-04
Methyl mercury	7.83E-06
Methylnaphthalene, 2-	2.21E-11
Molybdenum	5.80E-05
Naphthalene	2.04E-11
Nickel	1.00E-04
OctaCDD, 1,2,3,4,6,7,8,9-	1.65E-08
OctaCDF, 1,2,3,4,6,7,8,9-	3.95E-09
PentaCDD, 1,2,3,7,8-	1.84E-09
PentaCDF, 1,2,3,7,8-	3.12E-09
PentaCDF, 2,3,4,7,8-	4.50E-09
Pyrene	9.55E-09
Selenium	3.58E-06
TetraCDD, 2,3,7,8-	3.51E-10
TetraCDF, 2,3,7,8-	4.90E-09
Tin	2.36E-03
Vanadium	2.75E-04
Zinc	1.61E-02

	SLERA 3-2
X/Y	740702.13 / 2042051
COPCs	Max Soil Concentration mg/kg
Acenaphthene	6.48E-11
Acenaphthylene	5.19E-10
Anthracene	1.49E-08
Antimony	1.07E-03
Aroclor 1254	1.56E-07
Arsenic	8.59E-05
Benzo(a)anthracene	4.95E-08
Benzo(a)pyrene	4.19E-08
Benzo(b)fluoranthene	2.02E-09
Benzo(k)fluoranthene	1.51E-07
Beryllium	1.47E-04
Cadmium	2.55E-04
Chromium, hexavalent	1.67E-04
Chrysene	5.46E-08
Cobalt	3.41E-05
Copper	3.97E-04
Dibenz(a,h)anthracene	1.25E-07
Fluoranthene	1.07E-08
HeptaCDD, 1,2,3,4,6,7,8-	3.09E-08
HeptaCDF, 1,2,3,4,6,7,8-	2.24E-08
HeptaCDF, 1,2,3,4,7,8,9-	5.83E-09
HexaCDD, 1,2,3,4,7,8-	2.16E-09
HexaCDD, 1,2,3,6,7,8-	5.30E-09
HexaCDD, 1,2,3,7,8,9-	5.42E-09
HexaCDF, 1,2,3,4,7,8-	1.23E-08
HexaCDF, 1,2,3,6,7,8-	2.10E-08
HexaCDF, 1,2,3,7,8,9-	4.25E-09
HexaCDF, 2,3,4,6,7,8-	1.96E-08
Hydrogen chloride	2.93E-05
Hydrogen fluoride	6.54E-01
Indeno(1,2,3-cd) pyrene	6.87E-08
Lead	5.07E-02
Manganese	1.26E-03
Mercuric chloride	1.76E-03
Methyl mercury	3.43E-05
Methylnaphthalene, 2-	1.10E-10
Molybdenum	2.52E-04
Naphthalene	1.02E-10
Nickel	4.37E-04
OctaCDD, 1,2,3,4,6,7,8,9-	7.17E-08
OctaCDF, 1,2,3,4,6,7,8,9-	1.72E-08
PentaCDD, 1,2,3,7,8-	8.02E-09
PentaCDF, 1,2,3,7,8-	1.36E-08
PentaCDF, 2,3,4,7,8-	1.96E-08
Pyrene	3.72E-08
Selenium	1.56E-05
TetraCDD, 2,3,7,8-	1.53E-09
TetraCDF, 2,3,7,8-	2.13E-08
Tin	1.03E-02
Vanadium	1.20E-03
Zinc	6.99E-02

	SLERA 4-2
X/Y	739802.13 / 2040851
COPCs	Max Soil Concentration mg/kg
Acenaphthene	2.59E-11
Acenaphthylene	2.08E-10
Anthracene	6.57E-09
Antimony	4.63E-04
Aroclor 1254	6.63E-08
Arsenic	3.73E-05
Benzo(a)anthracene	2.16E-08
Benzo(a)pyrene	1.82E-08
Benzo(b)fluoranthene	8.71E-10
Benzo(k)fluoranthene	6.59E-08
Beryllium	6.40E-05
Cadmium	1.11E-04
Chromium, hexavalent	7.26E-05
Chrysene	2.39E-08
Cobalt	1.48E-05
Copper	1.72E-04
Dibenz(a,h)anthracene	5.45E-08
Fluoranthene	4.72E-09
HeptaCDD, 1,2,3,4,6,7,8-	1.34E-08
HeptaCDF, 1,2,3,4,6,7,8-	9.74E-09
HeptaCDF, 1,2,3,4,7,8,9-	2.53E-09
HexaCDD, 1,2,3,4,7,8-	9.39E-10
HexaCDD, 1,2,3,6,7,8-	2.30E-09
HexaCDD, 1,2,3,7,8,9-	2.35E-09
HexaCDF, 1,2,3,4,7,8-	5.36E-09
HexaCDF, 1,2,3,6,7,8-	9.13E-09
HexaCDF, 1,2,3,7,8,9-	1.85E-09
HexaCDF, 2,3,4,6,7,8-	8.52E-09
Hydrogen chloride	1.17E-05
Hydrogen fluoride	2.89E-01
Indeno(1,2,3-cd) pyrene	2.99E-08
Lead	2.20E-02
Manganese	5.50E-04
Mercuric chloride	7.75E-04
Methyl mercury	1.51E-05
Methylnaphthalene, 2-	4.42E-11
Molybdenum	1.10E-04
Naphthalene	4.08E-11
Nickel	1.90E-04
OctaCDD, 1,2,3,4,6,7,8,9-	3.12E-08
OctaCDF, 1,2,3,4,6,7,8,9-	7.48E-09
PentaCDD, 1,2,3,7,8-	3.48E-09
PentaCDF, 1,2,3,7,8-	5.90E-09
PentaCDF, 2,3,4,7,8-	8.52E-09
Pyrene	1.64E-08
Selenium	6.78E-06
TetraCDD, 2,3,7,8-	6.64E-10
TetraCDF, 2,3,7,8-	9.27E-09
Tin	4.47E-03
Vanadium	5.20E-04
Zinc	3.04E-02

	SLERA 5-1
X/Y	738602.13 / 2037051
COPCs	Max Soil Concentration mg/kg
Acenaphthene	6.48E-12
Acenaphthylene	5.19E-11
Anthracene	1.11E-09
Antimony	3.93E-05
Aroclor 1254	1.04E-08
Arsenic	3.16E-06
Benzo(a)anthracene	2.20E-09
Benzo(a)pyrene	1.72E-09
Benzo(b)fluoranthene	8.45E-11
Benzo(k)fluoranthene	5.81E-09
Beryllium	5.42E-06
Cadmium	9.40E-06
Chromium, hexavalent	6.15E-06
Chrysene	2.90E-09
Cobalt	1.26E-06
Copper	1.46E-05
Dibenz(a,h)anthracene	4.71E-09
Fluoranthene	7.90E-10
HeptaCDD, 1,2,3,4,6,7,8-	1.16E-09
HeptaCDF, 1,2,3,4,6,7,8-	8.40E-10
HeptaCDF, 1,2,3,4,7,8,9-	2.20E-10
HexaCDD, 1,2,3,4,7,8-	8.12E-11
HexaCDD, 1,2,3,6,7,8-	1.99E-10
HexaCDD, 1,2,3,7,8,9-	2.03E-10
HexaCDF, 1,2,3,4,7,8-	4.65E-10
HexaCDF, 1,2,3,6,7,8-	7.92E-10
HexaCDF, 1,2,3,7,8,9-	1.61E-10
HexaCDF, 2,3,4,6,7,8-	7.39E-10
Hydrogen chloride	2.93E-06
Hydrogen fluoride	4.90E-02
Indeno(1,2,3-cd) pyrene	2.53E-09
Lead	1.87E-03
Manganese	4.66E-05
Mercuric chloride	9.70E-05
Methyl mercury	1.89E-06
Methylnaphthalene, 2-	1.10E-11
Molybdenum	9.30E-06
Naphthalene	1.02E-11
Nickel	1.61E-05
OctaCDD, 1,2,3,4,6,7,8,9-	2.69E-09
OctaCDF, 1,2,3,4,6,7,8,9-	6.45E-10
PentaCDD, 1,2,3,7,8-	3.05E-10
PentaCDF, 1,2,3,7,8-	5.28E-10
PentaCDF, 2,3,4,7,8-	7.57E-10
Pyrene	2.75E-09
Selenium	5.74E-07
TetraCDD, 2,3,7,8-	6.78E-11
TetraCDF, 2,3,7,8-	1.02E-09
Tin	3.79E-04
Vanadium	4.41E-05
Zinc	2.58E-03

	SLERA 6-1
X/Y	741602.13 / 2038551
COPCs	Max Soil Concentration mg/kg
Acenaphthene	0.00E+00
Acenaphthylene	0.00E+00
Anthracene	6.28E-10
Antimony	2.57E-05
Aroclor 1254	5.77E-09
Arsenic	2.07E-06
Benzo(a)anthracene	1.37E-09
Benzo(a)pyrene	1.08E-09
Benzo(b)fluoranthene	4.52E-11
Benzo(k)fluoranthene	3.72E-09
Beryllium	3.55E-06
Cadmium	6.15E-06
Chromium, hexavalent	4.02E-06
Chrysene	1.74E-09
Cobalt	8.22E-07
Copper	9.56E-06
Dibenz(a,h)anthracene	3.04E-09
Fluoranthene	4.47E-10
HeptaCDD, 1,2,3,4,6,7,8-	7.46E-10
HeptaCDF, 1,2,3,4,6,7,8-	5.42E-10
HeptaCDF, 1,2,3,4,7,8,9-	1.41E-10
HexaCDD, 1,2,3,4,7,8-	5.23E-11
HexaCDD, 1,2,3,6,7,8-	1.28E-10
HexaCDD, 1,2,3,7,8,9-	1.31E-10
HexaCDF, 1,2,3,4,7,8-	2.99E-10
HexaCDF, 1,2,3,6,7,8-	5.09E-10
HexaCDF, 1,2,3,7,8,9-	1.03E-10
HexaCDF, 2,3,4,6,7,8-	4.75E-10
Hydrogen chloride	0.00E+00
Hydrogen fluoride	2.77E-02
Indeno(1,2,3-cd) pyrene	1.66E-09
Lead	1.22E-03
Manganese	3.05E-05
Mercuric chloride	5.80E-05
Methyl mercury	1.13E-06
Methylnaphthalene, 2-	0.00E+00
Molybdenum	6.08E-06
Naphthalene	0.00E+00
Nickel	1.05E-05
OctaCDD, 1,2,3,4,6,7,8,9-	1.73E-09
OctaCDF, 1,2,3,4,6,7,8,9-	4.16E-10
PentaCDD, 1,2,3,7,8-	1.95E-10
PentaCDF, 1,2,3,7,8-	3.35E-10
PentaCDF, 2,3,4,7,8-	4.82E-10
Pyrene	1.56E-09
Selenium	3.76E-07
TetraCDD, 2,3,7,8-	4.09E-11
TetraCDF, 2,3,7,8-	6.00E-10
Tin	2.48E-04
Vanadium	2.89E-05
Zinc	1.68E-03

	SLERA 7-1
X/Y	749102.13 / 2040051
COPCs	Max Soil Concentration mg/kg
Acenaphthene	0.00E+00
Acenaphthylene	0.00E+00
Anthracene	8.04E-11
Antimony	2.12E-06
Aroclor 1254	2.15E-10
Arsenic	1.71E-07
Benzo(a)anthracene	1.38E-10
Benzo(a)pyrene	1.04E-10
Benzo(b)fluoranthene	4.06E-12
Benzo(k)fluoranthene	3.32E-10
Beryllium	2.93E-07
Cadmium	5.08E-07
Chromium, hexavalent	3.32E-07
Chrysene	1.93E-10
Cobalt	6.78E-08
Copper	7.89E-07
Dibenz(a,h)anthracene	2.73E-10
Fluoranthene	5.71E-11
HeptaCDD, 1,2,3,4,6,7,8-	6.70E-11
HeptaCDF, 1,2,3,4,6,7,8-	4.87E-11
HeptaCDF, 1,2,3,4,7,8,9-	1.28E-11
HexaCDD, 1,2,3,4,7,8-	4.71E-12
HexaCDD, 1,2,3,6,7,8-	1.16E-11
HexaCDD, 1,2,3,7,8,9-	1.18E-11
HexaCDF, 1,2,3,4,7,8-	2.70E-11
HexaCDF, 1,2,3,6,7,8-	4.60E-11
HexaCDF, 1,2,3,7,8,9-	9.37E-12
HexaCDF, 2,3,4,6,7,8-	4.30E-11
Hydrogen chloride	0.00E+00
Hydrogen fluoride	3.55E-03
Indeno(1,2,3-cd) pyrene	1.37E-10
Lead	1.01E-04
Manganese	2.51E-06
Mercuric chloride	5.39E-06
Methyl mercury	1.05E-07
Methylnaphthalene, 2-	0.00E+00
Molybdenum	5.02E-07
Naphthalene	0.00E+00
Nickel	8.68E-07
OctaCDD, 1,2,3,4,6,7,8,9-	1.56E-10
OctaCDF, 1,2,3,4,6,7,8,9-	3.74E-11
PentaCDD, 1,2,3,7,8-	1.78E-11
PentaCDF, 1,2,3,7,8-	3.11E-11
PentaCDF, 2,3,4,7,8-	4.44E-11
Pyrene	1.99E-10
Selenium	3.10E-08
TetraCDD, 2,3,7,8-	4.19E-12
TetraCDF, 2,3,7,8-	6.49E-11
Tin	2.05E-05
Vanadium	2.38E-06
Zinc	1.39E-04

	SLERA 8-3
X/Y	743902.13 / 2043251
COPCs	Max Soil Concentration mg/kg
Acenaphthene	0.00E+00
Acenaphthylene	0.00E+00
Anthracene	5.56E-10
Antimony	3.21E-05
Aroclor 1254	6.31E-09
Arsenic	2.58E-06
Benzo(a)anthracene	1.56E-09
Benzo(a)pyrene	1.29E-09
Benzo(b)fluoranthene	5.64E-11
Benzo(k)fluoranthene	4.53E-09
Beryllium	4.42E-06
Cadmium	7.67E-06
Chromium, hexavalent	5.02E-06
Chrysene	1.81E-09
Cobalt	1.03E-06
Copper	1.19E-05
Dibenz(a,h)anthracene	3.77E-09
Fluoranthene	3.99E-10
HeptaCDD, 1,2,3,4,6,7,8-	9.30E-10
HeptaCDF, 1,2,3,4,6,7,8-	6.75E-10
HeptaCDF, 1,2,3,4,7,8,9-	1.76E-10
HexaCDD, 1,2,3,4,7,8-	6.52E-11
HexaCDD, 1,2,3,6,7,8-	1.60E-10
HexaCDD, 1,2,3,7,8,9-	1.63E-10
HexaCDF, 1,2,3,4,7,8-	3.72E-10
HexaCDF, 1,2,3,6,7,8-	6.34E-10
HexaCDF, 1,2,3,7,8,9-	1.28E-10
HexaCDF, 2,3,4,6,7,8-	5.91E-10
Hydrogen chloride	0.00E+00
Hydrogen fluoride	2.45E-02
Indeno(1,2,3-cd) pyrene	2.07E-09
Lead	1.52E-03
Manganese	3.80E-05
Mercuric chloride	5.31E-05
Methyl mercury	1.03E-06
Methylnaphthalene, 2-	0.00E+00
Molybdenum	7.58E-06
Naphthalene	0.00E+00
Nickel	1.31E-05
OctaCDD, 1,2,3,4,6,7,8,9-	2.16E-09
OctaCDF, 1,2,3,4,6,7,8,9-	5.18E-10
PentaCDD, 1,2,3,7,8-	2.42E-10
PentaCDF, 1,2,3,7,8-	4.11E-10
PentaCDF, 2,3,4,7,8-	5.93E-10
Pyrene	1.39E-09
Selenium	4.69E-07
TetraCDD, 2,3,7,8-	4.72E-11
TetraCDF, 2,3,7,8-	6.67E-10
Tin	3.09E-04
Vanadium	3.60E-05
Zinc	2.10E-03

Receptor Name	COPC Name	CAS Number	Average Water Column Concentration [mg COPC/L water]	Average Concentration [mg COPC/kg sed]
SLERA 1	Antimony	7440-36-0	1.54E-08	6.90E-07
SLERA 1	Arsenic	7440-38-2	1.95E-09	5.66E-08
SLERA 1	Beryllium	7440-41-7	9.01E-11	6.95E-08
SLERA 1	Cadmium	7440-43-9	2.13E-09	1.59E-07
SLERA 1	Chromium, hexavalent	18540-29-9	5.85E-09	1.11E-07
SLERA 1	Cobalt	007440-48-4	4.91E-10	2.21E-08
SLERA 1	Copper	7440-50-8	7.43E-09	2.60E-07
SLERA 1	HeptaCDD, 1,2,3,4,6,7,8-	35822-46-9	1.00E-14	1.72E-10
SLERA 1	HeptaCDF, 1,2,3,4,6,7,8-	67562-39-4	7.21E-15	1.21E-10
SLERA 1	HeptaCDF, 1,2,3,4,7,8,9-	55673-89-7	1.87E-15	3.14E-11
SLERA 1	HexaCDD, 1,2,3,4,7,8-	39227-28-6	7.02E-16	1.19E-11
SLERA 1	HexaCDD, 1,2,3,6,7,8-	57653-85-7	1.71E-15	2.84E-11
SLERA 1	HexaCDD, 1,2,3,7,8,9-	19408-74-3	1.74E-15	2.90E-11
SLERA 1	HexaCDF, 1,2,3,4,7,8-	70648-26-9	3.90E-15	6.27E-11
SLERA 1	HexaCDF, 1,2,3,6,7,8-	57117-44-9	6.63E-15	1.07E-10
SLERA 1	HexaCDF, 1,2,3,7,8,9-	72918-21-9	1.34E-15	2.16E-11
SLERA 1	HexaCDF, 2,3,4,6,7,8-	60851-34-5	6.19E-15	9.96E-11
SLERA 1	Indeno(1,2,3-cd) pyrene	193-39-5	1.29E-13	1.95E-09
SLERA 1	Lead	7439-92-1	2.76E-08	2.41E-05
SLERA 1	Manganese	7439-96-5	1.23E-08	7.99E-07
SLERA 1	Molybdenum	0074939-98-7	8.39E-09	1.68E-07
SLERA 1	Nickel	7440-02-0	4.25E-09	2.76E-07
SLERA 1	OctaCDD, 1,2,3,4,6,7,8,9-	3268-87-9	2.34E-14	4.00E-10
SLERA 1	OctaCDF, 1,2,3,4,6,7,8,9-	39001-02-0	5.59E-15	9.56E-11
SLERA 1	PentaCDD, 1,2,3,7,8-	40321-76-4	2.47E-15	3.66E-11
SLERA 1	PentaCDF, 1,2,3,7,8-	57117-41-6	4.18E-15	6.45E-11
SLERA 1	PentaCDF, 2,3,4,7,8-	57117-31-4	5.93E-15	8.36E-11
SLERA 1	Selenium	7782-49-2	2.07E-09	1.03E-08
SLERA 1	TetraCDD, 2,3,7,8-	1746-01-6	4.68E-16	7.25E-12
SLERA 1	TetraCDF, 2,3,7,8-	51207-31-9	5.97E-15	6.61E-11
SLERA 1	Tin	007440-31-5	2.13E-08	0.00E+00
SLERA 1	Vanadium	7440-62-2	5.94E-10	5.76E-07
SLERA 1	Zinc	7440-66-6	7.16E-07	4.43E-05
Port Arecibo	Antimony	7440-36-0	3.52E-09	1.58E-07
Port Arecibo	Arsenic	7440-38-2	4.39E-10	1.27E-08
Port Arecibo	Beryllium	7440-41-7	4.62E-11	3.55E-08
Port Arecibo	Cadmium	7440-43-9	5.07E-10	3.79E-08
Port Arecibo	Chromium, hexavalent	18540-29-9	1.30E-09	2.47E-08
Port Arecibo	Cobalt	007440-48-4	1.13E-10	5.06E-09
Port Arecibo	Copper	7440-50-8	1.68E-09	5.88E-08
Port Arecibo	HeptaCDD, 1,2,3,4,6,7,8-	35822-46-9	1.97E-14	2.91E-10
Port Arecibo	HeptaCDF, 1,2,3,4,6,7,8-	67562-39-4	1.40E-14	2.02E-10
Port Arecibo	HeptaCDF, 1,2,3,4,7,8,9-	55673-89-7	3.74E-15	5.41E-11
Port Arecibo	HexaCDD, 1,2,3,4,7,8-	39227-28-6	1.40E-15	2.06E-11
Port Arecibo	HexaCDD, 1,2,3,6,7,8-	57653-85-7	3.34E-15	4.81E-11
Port Arecibo	HexaCDD, 1,2,3,7,8,9-	19408-74-3	3.37E-15	4.84E-11
Port Arecibo	HexaCDF, 1,2,3,4,7,8-	70648-26-9	7.47E-15	1.04E-10
Port Arecibo	HexaCDF, 1,2,3,6,7,8-	57117-44-9	1.30E-14	1.81E-10
Port Arecibo	HexaCDF, 1,2,3,7,8,9-	72918-21-9	2.66E-15	3.72E-11
Port Arecibo	HexaCDF, 2,3,4,6,7,8-	60851-34-5	1.20E-14	1.68E-10
Port Arecibo	Indeno(1,2,3-cd) pyrene	193-39-5	2.72E-13	3.59E-09

Port Arecibo	Lead	7439-92-1	1.52E-08	1.32E-05
Port Arecibo	Manganese	7439-96-5	2.90E-09	1.88E-07
Port Arecibo	Molybdenum	0074939-98-7	1.87E-09	3.73E-08
Port Arecibo	Nickel	7440-02-0	1.00E-09	6.49E-08
Port Arecibo	OctaCDD, 1,2,3,4,6,7,8,9-	3268-87-9	4.61E-14	6.80E-10
Port Arecibo	OctaCDF, 1,2,3,4,6,7,8,9-	39001-02-0	1.10E-14	1.62E-10
Port Arecibo	PentaCDD, 1,2,3,7,8-	40321-76-4	5.51E-15	7.18E-11
Port Arecibo	PentaCDF, 1,2,3,7,8-	57117-41-6	9.95E-15	1.34E-10
Port Arecibo	PentaCDF, 2,3,4,7,8-	57117-31-4	1.26E-14	1.57E-10
Port Arecibo	Selenium	7782-49-2	4.52E-10	2.26E-09
Port Arecibo	TetraCDD, 2,3,7,8-	1746-01-6	1.44E-15	1.95E-11
Port Arecibo	TetraCDF, 2,3,7,8-	51207-31-9	2.16E-14	2.17E-10
Port Arecibo	Tin	007440-31-5	6.43E-09	0.00E+00
Port Arecibo	Vanadium	7440-62-2	3.47E-10	3.35E-07
Port Arecibo	Zinc	7440-66-6	1.68E-07	1.04E-05
RGA Estuary	Antimony	7440-36-0	4.22E-09	1.90E-07
RGA Estuary	Arsenic	7440-38-2	5.34E-10	1.55E-08
RGA Estuary	Beryllium	7440-41-7	3.23E-11	2.48E-08
RGA Estuary	Cadmium	7440-43-9	5.91E-10	4.42E-08
RGA Estuary	Chromium, hexavalent	18540-29-9	1.60E-09	3.03E-08
RGA Estuary	Cobalt	007440-48-4	1.35E-10	6.07E-09
RGA Estuary	Copper	7440-50-8	2.04E-09	7.12E-08
RGA Estuary	HeptaCDD, 1,2,3,4,6,7,8-	35822-46-9	7.93E-15	1.17E-10
RGA Estuary	HeptaCDF, 1,2,3,4,6,7,8-	67562-39-4	5.66E-15	8.20E-11
RGA Estuary	HeptaCDF, 1,2,3,4,7,8,9-	55673-89-7	1.48E-15	2.14E-11
RGA Estuary	HexaCDD, 1,2,3,4,7,8-	39227-28-6	5.54E-16	8.13E-12
RGA Estuary	HexaCDD, 1,2,3,6,7,8-	57653-85-7	1.34E-15	1.93E-11
RGA Estuary	HexaCDD, 1,2,3,7,8,9-	19408-74-3	1.37E-15	1.97E-11
RGA Estuary	HexaCDF, 1,2,3,4,7,8-	70648-26-9	3.04E-15	4.25E-11
RGA Estuary	HexaCDF, 1,2,3,6,7,8-	57117-44-9	5.17E-15	7.22E-11
RGA Estuary	HexaCDF, 1,2,3,7,8,9-	72918-21-9	1.05E-15	1.46E-11
RGA Estuary	HexaCDF, 2,3,4,6,7,8-	60851-34-5	4.83E-15	6.74E-11
RGA Estuary	Indeno(1,2,3-cd) pyrene	193-39-5	1.09E-13	1.44E-09
RGA Estuary	Lead	7439-92-1	1.02E-08	8.90E-06
RGA Estuary	Manganese	7439-96-5	3.41E-09	2.21E-07
RGA Estuary	Molybdenum	0074939-98-7	2.29E-09	4.58E-08
RGA Estuary	Nickel	7440-02-0	1.18E-09	7.63E-08
RGA Estuary	OctaCDD, 1,2,3,4,6,7,8,9-	3268-87-9	1.84E-14	2.72E-10
RGA Estuary	OctaCDF, 1,2,3,4,6,7,8,9-	39001-02-0	4.41E-15	6.50E-11
RGA Estuary	PentaCDD, 1,2,3,7,8-	40321-76-4	1.89E-15	2.46E-11
RGA Estuary	PentaCDF, 1,2,3,7,8-	57117-41-6	3.29E-15	4.44E-11
RGA Estuary	PentaCDF, 2,3,4,7,8-	57117-31-4	4.50E-15	5.61E-11
RGA Estuary	Selenium	7782-49-2	5.62E-10	2.81E-09
RGA Estuary	TetraCDD, 2,3,7,8-	1746-01-6	4.05E-16	5.48E-12
RGA Estuary	TetraCDF, 2,3,7,8-	51207-31-9	4.90E-15	4.92E-11
RGA Estuary	Tin	007440-31-5	6.31E-09	0.00E+00
RGA Estuary	Vanadium	7440-62-2	2.26E-10	2.18E-07
RGA Estuary	Zinc	7440-66-6	1.98E-07	1.22E-05
Cienaga Tiburones	Antimony	7440-36-0	1.10E-03	4.95E-02
Cienaga Tiburones	Arsenic	7440-38-2	1.98E-04	5.73E-03
Cienaga Tiburones	Beryllium	7440-41-7	6.12E-07	4.80E-04
Cienaga Tiburones	Cadmium	7440-43-9	9.93E-05	7.44E-03
Cienaga Tiburones	Chromium, hexavalent	18540-29-9	8.01E-04	1.52E-02
Cienaga Tiburones	Cobalt	007440-48-4	3.52E-05	1.58E-03

Cienaga Tiburones	Copper	7440-50-8	6.51E-04	2.28E-02
Cienaga Tiburones	HeptaCDD, 1,2,3,4,6,7,8-	35822-46-9	1.43E-13	7.44E-09
Cienaga Tiburones	HeptaCDF, 1,2,3,4,6,7,8-	67562-39-4	4.45E-14	2.19E-09
Cienaga Tiburones	HeptaCDF, 1,2,3,4,7,8,9-	55673-89-7	1.20E-14	5.87E-10
Cienaga Tiburones	HexaCDD, 1,2,3,4,7,8-	39227-28-6	7.03E-15	3.62E-10
Cienaga Tiburones	HexaCDD, 1,2,3,6,7,8-	57653-85-7	6.18E-15	2.97E-10
Cienaga Tiburones	HexaCDD, 1,2,3,7,8,9-	19408-74-3	6.22E-15	2.99E-10
Cienaga Tiburones	HexaCDF, 1,2,3,4,7,8-	70648-26-9	1.13E-14	4.96E-10
Cienaga Tiburones	HexaCDF, 1,2,3,6,7,8-	57117-44-9	2.97E-14	1.30E-09
Cienaga Tiburones	HexaCDF, 1,2,3,7,8,9-	72918-21-9	4.69E-15	2.06E-10
Cienaga Tiburones	HexaCDF, 2,3,4,6,7,8-	60851-34-5	2.11E-14	9.26E-10
Cienaga Tiburones	Indeno(1,2,3-cd) pyrene	193-39-5	7.16E-12	2.66E-07
Cienaga Tiburones	Lead	7439-92-1	1.71E-04	1.52E-01
Cienaga Tiburones	Manganese	7439-96-5	6.50E-04	4.22E-02
Cienaga Tiburones	Molybdenum	0074939-98-7	1.11E-03	2.22E-02
Cienaga Tiburones	Nickel	7440-02-0	2.24E-04	1.46E-02
Cienaga Tiburones	OctaCDD, 1,2,3,4,6,7,8,9-	3268-87-9	6.06E-13	3.19E-08
Cienaga Tiburones	OctaCDF, 1,2,3,4,6,7,8,9-	39001-02-0	3.37E-13	1.76E-08
Cienaga Tiburones	PentaCDD, 1,2,3,7,8-	40321-76-4	7.62E-15	2.72E-10
Cienaga Tiburones	PentaCDF, 1,2,3,7,8-	57117-41-6	2.13E-14	8.43E-10
Cienaga Tiburones	PentaCDF, 2,3,4,7,8-	57117-31-4	1.94E-14	6.13E-10
Cienaga Tiburones	Selenium	7782-49-2	5.64E-04	2.82E-03
Cienaga Tiburones	TetraCDD, 2,3,7,8-	1746-01-6	1.08E-15	4.30E-11
Cienaga Tiburones	TetraCDF, 2,3,7,8-	51207-31-9	1.48E-14	2.90E-10
Cienaga Tiburones	Tin	007440-31-5	1.02E-02	0.00E+00
Cienaga Tiburones	Vanadium	7440-62-2	3.42E-06	3.39E-03
Cienaga Tiburones	Zinc	7440-66-6	3.93E-02	2.44E+00

Receptor Name	COPC Name	CAS Number	Average Water Column Concentration [mg COPC/L water]	Average SED Concentration [mg COPC/kg sed]
SLERA 1	Anthracene	120-12-7	1.99E-14	1.78E-11
SLERA 1	Benzo(a)anthracene	56-55-3	6.57E-14	5.14E-10
SLERA 1	Benzo(a)pyrene	50-32-8	8.81E-14	1.05E-09
SLERA 1	Chrysene	218-01-9	4.75E-14	3.94E-10
SLERA 1	Fluoranthene	206-44-0	1.49E-14	2.62E-11
SLERA 1	Hydrogen fluoride	7664-39-3	1.72E-06	2.56E-04
SLERA 1	Pyrene	129-00-0	1.37E-14	3.22E-11
Port Arecibo	Anthracene	120-12-7	6.64E-14	5.87E-11
Port Arecibo	Benzo(a)anthracene	56-55-3	2.65E-13	1.93E-09
Port Arecibo	Benzo(a)pyrene	50-32-8	2.92E-13	3.13E-09
Port Arecibo	Chrysene	218-01-9	1.16E-13	8.93E-10
Port Arecibo	Fluoranthene	206-44-0	6.10E-14	1.06E-10
Port Arecibo	Hydrogen fluoride	7664-39-3	8.37E-07	1.25E-04
Port Arecibo	Pyrene	129-00-0	5.28E-14	1.21E-10
RGA Estuary	Anthracene	120-12-7	2.49E-14	2.20E-11
RGA Estuary	Benzo(a)anthracene	56-55-3	6.12E-14	4.46E-10
RGA Estuary	Benzo(a)pyrene	50-32-8	7.91E-14	8.48E-10
RGA Estuary	Chrysene	218-01-9	4.81E-14	3.71E-10
RGA Estuary	Fluoranthene	206-44-0	1.93E-14	3.35E-11
RGA Estuary	Hydrogen fluoride	7664-39-3	8.33E-07	1.24E-04
RGA Estuary	Pyrene	129-00-0	1.66E-14	3.82E-11
Cienaga Tiburones	Anthracene	120-12-7	6.30E-14	5.82E-11
Cienaga Tiburones	Benzo(a)anthracene	56-55-3	2.62E-13	2.95E-09
Cienaga Tiburones	Benzo(a)pyrene	50-32-8	8.41E-13	1.89E-08
Cienaga Tiburones	Chrysene	218-01-9	7.53E-14	9.29E-10
Cienaga Tiburones	Fluoranthene	206-44-0	1.58E-13	2.99E-10
Cienaga Tiburones	Hydrogen fluoride	7664-39-3	8.93E-02	1.34E+01
Cienaga Tiburones	Pyrene	129-00-0	1.90E-13	4.93E-10

Receptor Name	COPC Name	CAS Number	Average Water Column Concentration [mg COPC/L water]	Average Concentration [mg COPC/kg sed]
SLERA 2-1	Benzo(k)fluoranthene	207-08-9	8.50E-14	1.02E-09
SLERA 2-1	Dibenz(a,h)anthracene	53-70-3	1.69E-13	2.34E-09
SLERA 2-1	Mercuric chloride	7487-94-7	1.98E-10	2.41E-06
SLERA 3-2	Benzo(k)fluoranthene	207-08-9	1.88E-13	2.03E-09
SLERA 3-2	Dibenz(a,h)anthracene	53-70-3	3.62E-13	4.44E-09
SLERA 3-2	Mercuric chloride	7487-94-7	5.24E-10	5.70E-06
SLERA 4-2	Benzo(k)fluoranthene	207-08-9	7.26E-14	7.83E-10
SLERA 4-2	Dibenz(a,h)anthracene	53-70-3	1.43E-13	1.76E-09
SLERA 4-2	Mercuric chloride	7487-94-7	2.18E-10	2.37E-06
SLERA 5-1	Benzo(k)fluoranthene	207-08-9	6.61E-12	1.50E-07
SLERA 5-1	Dibenz(a,h)anthracene	53-70-3	4.45E-11	1.36E-06
SLERA 5-1	Mercuric chloride	7487-94-7	9.29E-08	2.32E-03