APPENDIX J FLORA AND FAUNA STUDY AND USFWS CONCURRENCE LETTER

Descriptive Study of Flora and Fauna




CARRAÍZO RESERVOIR DREDGING PROJECT
MUNICIPALITIES OF CAGUAS AND GURABO, PUERTO RICO

Prepared for:

PUERTO RICO AQUEDUCT AND SEWER AUTHORITY

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Table of Contents

Executive Summary

The Carraízo Reservoir is a major component of PRASA's municipal water treatment, transmission, and distribution system and meets the definition of a critical service. The purpose of the Proposed Action is to restore the water storage capacity of the Carraízo Reservoir which is the only water source provides water to PRASA's Sergio Cuevas Water Treatment Plant. The excess sediment deposited during Hurricane María significantly reduced the reservoir's storage capacity, further impacting the availability and delivery of potable water during periods of drought.

The Proposed Action would dredge and transfer the accumulated sediments to three sites, which have been designated as disposal dikes A, B and C. Also, an area adjacent to the Carraízo Reservoir will be prepared as a staging area. Locations of the four sites are as follows (see **Appendix A, Figures 1** and **2**):

- ❖ Disposal dike A: north of State Road PR-9189, west of Paseo de Santa Bárbara Residential Development, Rincón Ward in the Municipality of Gurabo.
- ❖ Disposal dike B: north of State Road PR-941, Celada Ward in the Municipality of Gurabo.
- ❖ Disposal dike C: south of State Road PR-944, Hato Nuevo Ward in the Municipality of Gurabo.
- ❖ Staging Area: north of State Road PR-796, northeast of La Serranía Residential Development, Río Cañas Ward in the Municipality of Caguas.

This document constitutes the Descriptive Study of Flora and Fauna (the study) for the proposed Project. The purpose of this study is to:

- Evaluate and describe the general flora and fauna within the proposed Project sites,
- Describe the existing ecological associations, and
- Determine the presence of threatened or endangered species and associated critical habitats.

The three disposal dikes are man-made features that were in function between 1994 and 1998 - last time the Carraízo Reservoir was dredged. The Staging Area was also in use during those years. Once dredging activities ended, vegetation established in all four areas and animal diversity increased. At present, the four sites are under low intensity cattle ranching.

In general, a total of 140 plant species within 44 families were observed within studied areas. The disposal dike C and the staging area were the most diverse. The most common tree species were: the albicia (*Albizia procera*), péndula (*Citharexylum spinosum*), cenizo (*Zanthoxylum martinicense*), sena de Siam (*Senna siamea*), almendro (*Terminalia cattapa*) and the tulipán Africano (*Spathodea campanulata*). The most common shrub/herbaceous species were: *Mimosa pellita* (no common name), the hierba venezolana (*Paspalum fasciculatum*), hierba de elefante (*Cenchrus purpureus*), moriviví (*Mimosa pudica*), zarza (*Mimosa casta*), cascabelillo (*Crotalaria retusa*), talantalán (*Senna alata*) and the dormidera (*Senna obtusifolia*). No flora species designated as threatened or endangered were found.

Dominant vertebrate species (in terms of frequency of observations) are the guaraguao (*Buteo jamaicensis*), garza ganadera (*Bubulcus ibis*), reinita común (*Coereba flaveola*), rolita (*Columbina paserina*), paloma turca (*Patagioenas squamosa*), tórtola aliblanca (*Zenaida asiática*), chango (*Quicalus niger*), chamoro negro (*Tiaris bicolor*), iguana (*Iguana iguana*), lagartijo común (*Ctenonotus cristatellus*), coquí común (*Eleutherodactylus coqui*), and the coquí churí (*Eleutherodactylus antillensis*). Invertebrate dominant species were the abeja (*Apis mellifera*), cigarrón (*Xylocopa mordax*), comején (*Nasutitermes costalis*) and the libélula (*Erythrodiplax umbrata*). Total animal species were 78, divided in 42 families. Among these, there are eight endemic, four migratory, one critical element and one endangered species. The critical element was the jicotea (*Trachemys stejnegeri*). The endangered species observed was the Puerto Rican Plain Pigeon (*Columba inornata wetmorei*), which is also one of the endemic species.

According to the Environmental Sensitivity Index (ESI) maps of the National Oceanic and Atmospheric Administration (NOAA), disposal dikes A and C are located within areas where the Puerto Rican Plain Pigeon (*Columba inornata wetmorei*) has been recorded. This species is listed as an endangered species (State and Federal).

The Information for Planning and Consultation (IPaC), of the United States Fish and Wildlife Service (USFWS), includes the Puerto Rican Boa (*Chilabothrus inornatus*) as a reptile specie with the potential to occur within the study area. The Puerto Rican Boa is also listed as an endangered species (State and Federal). The endangered listed bird species include the Broad-winged hawk (*Buteo platypterus brunnescens*), the Puerto Rican Parrot (*Amazona vittata*) the Puerto Rican Plain Pigeon (*Columba inornate wetmorei*). According to IPaC, no critical habitats have been designated by the USFWS within the study area

Introduction

The Puerto Rico Aqueduct and Sewer Authority (PRASA) proposes the dredging of the Carraízo Reservoir (the Project) to remove the sediments accumulated as a consequence of extreme rains during Hurricane María in September 2017. Dredged material will be pumped to three disposal dikes, which have been designated as A, B and C. Also, an area adjacent to the Carraízo Reservoir will be prepared as a staging area. These four sites were constructed and used when the Carraízo Reservoir was dredged in 1998. Locations of the four sites are as follows (see **Appendix A, Figures 1** and **2**):

- Disposal dike A: north of State Road PR-9189, west of Paseo de Santa Bárbara Residential Development, Rincón Ward in the Municipality of Gurabo.
- Disposal dike B: north of State Road PR-941, Celada Ward in the Municipality of Gurabo.
- Disposal dike C: south of State Road PR-944, Hato Nuevo Ward in the Municipality of Gurabo.
- Staging Area: north of State Road PR-796, northeast of La Serranía Residential Development, Río Cañas Ward in the Municipality of Caguas.

This study was carried out, using sampling methods that conformed to the characteristics and conditions of the study areas. Steps taken before the fieldwork included a consultation to the Inventory of Critical Species of the Office of Natural Heritage of the DNER, the Environmental Sensitivity Index (ESI) of the National Oceanic and Atmospheric Administration (NOAA), and the Information for Planning and Consultation (IPaC) of the U.S, Fish and Wildlife Service (USFWS).

This document presents the analysis of the data collected during field work and the associated findings. Also included are consultations with the previously mentioned local and federal agencies. Field work for this Descriptive Study of Flora and Fauna was performed from November 24, 2021 to December 4, 2021.

Study Sites Description

Disposal dike A

Dike A is located north of the end of State Road PR-9189, west of Paseo de Santa Bárbara Residential Development, Rincón Ward in the Municipality of Gurabo, Puerto Rico (see **Appendix A, Figures 1**, **2** and **3**). Geographic coordinates of the center of Dike A are 18.259051° N, -66.008372° W.

Rainfall

According to the National Climatic Data Center (NCDC), average rainfall for the region is 65.06 inches (1,652.5 mm). The wettest months of the year are from July to November. This data is collected in the Gurabo Substation.

Topography

According to the Topographic Quadrangle of Aguas Buenas (USGS), Dike A is located between 45.0 and 50.0 meters above mean sea level (amsl). **Figure 1** (**Appendix A**) shows the study site over the topographic quadrangles of Aguas Buenas, Caguas, Gurabo and Juncos.

Hydrology

The hydrographic map (**Figure 4**, **Appendix A**) shows a creek along the eastern side of the study site. This watercourse does not currently have permanent or seasonal base flow. It is possible that this creek was impacted by the quarry activities that took place within the disposal dike A. In the conceptual design of dike A that is described in the Final Environmental Impact Statement prepared on December 15, 1995, the headwaters of this creek are shown approximately at 300 meters from the northeastern corner of the study site. The Río Grande de Loíza is found at approximately 145 meters to the southwest corner of dike A. The Río Grande de Loíza discharges into the Atlantic Ocean.

Soils

According to the U.S. Department of Agriculture's Soil Conservation Service, soils within Dike A are classified as Juncos clay, 12 to 20% slopes (JuD), Mabi clay, 0 to 2% slopes (MaA), Toa silty clay loam, 0 to 2% slopes (To) and Reilly sandy loam (Re). **Figure 5** (**Appendix A**) shows the soil map for the study area. **Table 1** includes the description of these soils.

Table 1. Description of soils within Dike A*

Area	Soil Survey Area	Soil	Landform	Slope	Drainage Class	Permeability	Frequency of Flooding	Frequency of Ponding	Depth to Water Table
Dike A	San Juan Area	Juncos clay, 12 to 20% slopes (JuD)	Hillslopes	12 to 20%	Moderately well drained	Moderately low to moderately high	None	None	More than 80 inches
		Mabi clay, 0 to 2% slopes (MaA)	Alluvial fans, terraces	0 to 2%	Somewhat poorly drained	Moderately low to moderately high	None	None	About 18 to 36 inches
		Toa silty clay loam, 0 to 2% slopes (To)	Flood plains	0 to 2%	Well drained	Moderately low to moderately high	Occasional	None	About 39 to 80 inches
		Reilly sandy loam (Re)	Flood plains	0 to 2%	Excessively drained	Moderately high to very high	Frequent	None	About 30 to 60 inches

*United States Department of Agriculture, Soil Conservation Service.

Disposal dike B

The dike B is located north of State Road PR-941, Celada Ward in the Municipality of Gurabo, Puerto Rico (see **Appendix A, Figures 1**, **2** and **6**). Geographic coordinates of the center of Dike A are 18.270354° N, -65.989855° W.

Rainfall

According to the National Climatic Data Center (NCDC), average rainfall for the region is 65.06 inches (1,652.5 mm). The wettest months of the year are from July to November. This data is collected in the Gurabo Substation.

Topography

According to the Topographic Quadrangle of Gurabo (USGS), the dike B is located between 50.0 and 60.0 meters above mean sea level (amsl). **Figure 1** (**Appendix A**) shows the study site over the topographic quadrangles of Aguas Buenas, Caguas, Gurabo and Juncos.

Hydrology

There are no hydrographic features within dike B (**Figure 7**, **Appendix A**). The closest hydrographic feature is an unnamed creek located approximately 60 meters to the east side of dike B. This creek discharges into the Río Gurabo, which discharges into the Río Grande de Loíza. The Río Grande de Loíza discharges into the Atlantic Ocean.

Soils

According to the U.S. Department of Agriculture's Soil Conservation Service, soils within the dike B are classified as Mucara clay, 20 to 40% slopes (MxE), Naranjito silty clay loam, 12 to 20% slopes (NaD2), Rio Arriba clay, 5 to 12% slopes (RoC2), Toa silty clay loam, 0 to 2% slopes (To), Naranjito silty clay loam, 20 to 40 % slopes (NaE) and Coloso silty clay loam, 0 to 2% slopes (Cs). **Figure 8** (**Appendix A**) shows the soil map for the study area. **Table 2** includes the description of these soils.

Table 2. Description of soils within Dike B*

Area	Soil Survey Area	Soil	Landform	Slope	Drainage Class	Permeability	Frequency of Flooding	Frequency of Ponding	Depth to Water Table
Dike B	San Juan Area	Mucara clay, 20 to 40% slopes (MtcE)	Hillslopes, mountain slopes	12 to 20%	Well drained	Moderately low	None	None	More than 80 inches
		Naranjito silty clay loam, 12 to 20% slopes (NaD2)	Mountain slopes, ridges	12 to 20%	Well drained	Moderately low	None	None	More than 80 inches
		Rio Arriba clay, 5 to 12% slopes (RoC2)	Alluvial fans, terraces	5 to 12%	Moderately well drained	Moderately low to moderately high	None	None	More than 80 inches
		Toa silty clay loam, 0 to 2% slopes (To)	Flood plains	0 to 2%	Well drained	Moderately low to moderately high	Occasional	None	About 39 to 80 inches
		Naranjito silty clay loam, 20 to 40% slopes (NaE)	Mountain slopes, ridges	20 to 40%	Well drained	Moderately low to moderately high	None	None	More than 80 inches
		Coloso silty clay cloam, 0 to 2% slopes (Cs)	Flood plains on river valleys	0 to 2%	Somewhat poorly drained	Moderately low	Occasional	None	About 0 to 11 inches

*United States Department of Agriculture, Soil Conservation Service.

Disposal dike C

The dike C is located south of State Road PR-944, Hato Nuevo Ward in the Municipality of Gurabo, Puerto Rico (see **Appendix A, Figures 1**, **2** and **9**). Geographic coordinates of the center of dike C are 18.264122° N, -65.954329° W.

Rainfall

According to the National Climatic Data Center (NCDC), average rainfall for the region is 65.06 inches (1,652.5 mm). The wettest months of the year are from July to November. This data is collected in the Gurabo Substation.

Topography

According to the Topographic Quadrangle of Gurabo (USGS), dike C is located between 55.0 and 70.0 meters above mean sea level (amsl). **Figure 1** (**Appendix A**) shows the study site over the topographic quadrangles of Aguas Buenas, Caguas, Gurabo and Juncos.

Hydrology

The hydrographic map (**Figure 10**, **Appendix A**) shows two creeks that cross dike C from north to south. However, according to the conceptual design of dike C that is described in the Final Environmental Impact Statement prepared on December 15, 1995, these two creeks were deviated to the sides of the study site. The closest existing hydrographic feature is the Río Gurabo, which is located approximately 175 meters to the south side of dike C, which discharges into the Río Grande de Loíza. The Río Grande de Loíza discharges into the Atlantic Ocean.

Soils

According to the U.S. Department of Agriculture's Soil Conservation Service, soils within Dike C are classified as Mabi clay, 2 to 5% slopes (MaB), Mabi clay, 5 to 12% slopes (MaC), Naranjito silty clay loam, 12 to 20% slopes (NaD2), Rio Arriba clay, 2 to 5% slopes (RoB), Rio Arriba clay, 5 to 12% slopes (RoC2), Via clay loam, 5 to 12% slopes, eroded (VkC2), Toa silty clay loam, 0 to 2% slopes (To), Estacion clay loam (Es)

and Dique loam (Dm). **Figure 11** (**Appendix A**) shows the soil map for the study area. **Table 3** includes the description of these soils.

Table 3. Description of soils within Dike C*

Area	Soil Survey Area	Soil	Landform	Slope	Drainage Class	Permeability	Frequency of Flooding	Frequency of Ponding	Depth to Water Table
Dike C	San Juan Area	Mabi clay, 2 to 5% slopes (MaB)	Alluvial fans, terraces	2 to 5%	Somewhat poorly drained	Moderately low to moderately high	None	None	About 18 to 36 inches
		Mabi clay, 5 to 12% slopes (MaC)	Alluvial fans, terraces	5 to 12%	Somewhat poorly drained	Moderately low to moderately high	None	None	About 18 to 36 inches
		Naranjito silty clay loam, 12 to 20% slopes (NaD2)	Mountain slopes, ridges	12 to 20%	Well drained	Moderately low	None	None	More than 80 inches
		Rio Arriba clay, 2 to 5% slopes (RoB)	Alluvial fans, terraces	2 to 5%	Moderately well drained	Moderately low to moderately high	None	None	More than 80 inches
		Rio Arriba clay, 5 to 12% slopes (RoC2)	Alluvial fans, terraces	5 to 12%	Moderately well drained	Moderately low to moderately high	None	None	More than 80 inches
		Via clay loam, 5 to 12% slopes, eroded (VkC2)	Alluvial fans	5 to 12%	Well drained	Moderately low to high	None	None	More than 80 inches
		Toa silty clay loam, 0 to 2% slopes (To)	Flood plains	0 to 2%	Well drained	Moderately low to moderately high	Occasional	None	About 39 to 80 inches
		Estacion silty clay	Flood plains, terraces	0 to 2%	Well drained	Moderately low to high	Occasional	None	More than 80 inches

Area	Soil Survey Area	Soil	Landform	Slope	Drainage Class	Permeability	Frequency of Flooding	Frequency of Ponding	Depth to Water Table
		loam (Es)							
		Dique loam (Dm)	Flood plains	0 to 2%	Well drained	Moderately high to high	Occasional	None	More than 80 inches

*United States Department of Agriculture, Soil Conservation Service.

Staging Area

The Staging Area is located north of State Road PR-796, northeast of La Serranía Residential Development, Río Cañas Ward in the Municipality of Caguas, Puerto Rico (see **Appendix A, Figures 1**, **2** and **12**). Geographic coordinates of the center of staging area are 18.277718° N, -66.010743° W.

Rainfall

According to the National Climatic Data Center (NCDC), average rainfall for the region is 65.06 inches (1,652.5 mm). The wettest months of the year are from July to November. This data is collected in the Gurabo Substation.

Topography

According to the Topographic Quadrangle of Gurabo (USGS), the Staging Area is located around 50.0 meters above mean sea level (amsl). **Figure 1** (**Appendix A**) shows the study site over the topographic quadrangles of Aguas Buenas, Caguas, Gurabo and Juncos.

Hydrology

There are no hydrographic features within the Staging Area (**Figure 13**, **Appendix A**). However, the Carraízo Reservoir (Río Grande de Loíza) is adjacent to the north, northeast, east and southeast sides of the study site. The Río Grande de Loíza discharges into the Atlantic Ocean.

Soils

According to the U.S. Department of Agriculture's Soil Conservation Service, soils within the Staging Area are classified as Canteras and Graveros (GPQ) and Rio Arriba clay, 5 to 12% slopes (RoC2). **Figure 14** (**Appendix A**) shows the soil map for the study area. **Table 4** includes the description of these soils.

Table 4. Description of soils within the Staging Area*

Area	Soil Survey Area	Soil	Landform	Slope	Drainage Class	Permeability	Frequency of Flooding	Frequency of Ponding	Depth to Water Table
Staging Area	San Juan Area	Canteras and Graveros (GP●)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Rio Arriba clay, 5 to 12% slopes (RoC2)	Alluvial fans, terraces	5 to 12%	Moderately well drained	Moderately low to moderately high	None	None	More than 80 inches

*United States Department of Agriculture, Soil Conservation Service.

Methodology

Reconnaissance Visit

To design the fieldwork plan and allocate efforts, a reconnaissance field visit was performed at each of the study sites. A general survey was conducted to collect information about the area, study limitations, characteristics, and other natural features.

Consultation of Maps from the Office of the Program of Natural Heritage of the Department of Natural and Environmental Resources

After the reconnaissance field visits to the four sites, a visit to the Office of the Program of National Heritage of the DNER was performed in order to consult the maps which hold the records of critical, threatened or endangered species (shown over the topographic quadrangles of Puerto Rico) within the study sites. Consultation with DNER and other scientists is necessary to acquire additional information and records for each species as well as to provide suggestions of additional efforts that have been performed.

Consultation of the Environmental Sensitivity Index (ESI) Maps of the National Oceanic and Atmospheric Administration (NOAA, 2000)

The ESI is a study by the NOAA together with other organizations and agencies, among which are the USFWS and the DNER. This study shows the records of observations of the threatened or endangered species and critical habitat around the whole coast, river basins, and major streams in Puerto Rico.

Consultation Information for Planning and Consultation (IPaC) of the United States Fish & Wildlife Service (USF&WS, 2021)

This source of information includes at a federal level, the species that are threatened or endangered, and the designated critical habitats for these species.

Field Work

The fieldwork for this study was performed from November 24, 2021 to December 4, 2021.

Surveys for the identification of flora and fauna species were carried out by:

- Walking along the outer perimeter of each site and where the slurry pipe is proposed to be located.
- Walking along the top of the dikes.
- Walking within the center area of each site, with the exception of Dike B, which was flooded during field work. In this case, binoculars and spotting scopes were used to identify the species.

Flora species were identified in the field. If it was not possible to identify a species, a specimen was collected to be identified in the laboratory, or by consultation with a botanist.

For birds identification, a morning and an evening census were carried out using the point count method around and within each study site (as described above). The observed and heard bird species were recorded according to Wunderle's suggestion (1994).

The method described by Rivero (1998) was used for amphibians and reptiles identification. The method consist in searching in humid areas, trees, under tree trunks and fallen branches, rocks, tree bifurcations, dead vegetation, garbage, scrap metal, etc. In order to support the identification of amphibious species, a digital sound recorder was used. The sounds recorded were transferred to a computer, where they were compared with the sounds recorded in the Compact Disk included in the reference book Amphibians and Reptiles of Puerto Rico (Rivero, 1998).

Results and Discussion

The disposal dikes A, B and C were built to dispose of sediments generated during dredging activities that occurred within the Carraízo Reservoir from 1994 to 1998. Therefore, the natural conditions that existed on those sites prior to their construction were altered. The same occurred at the staging area. After site visits and reconnaissance activities, all studied sites show low intensity cattle ranching activities.

The **Appendix B** includes the flora and fauna species list observed for all studied sites.

Disposal dike A

The most common tree species within dike A were the cenizo (*Zanthoxylum martinicense*) and the tulipán Africano (*Spathodea campanulata*). Most common shrub/herbaceous species were *Mimosa pellita* (no common name), the hierba venezolana (*Paspalum fasciculatum*), moriviví (*Mimosa pudica*), zarza (*Mimosa casta*), cascabelillo (*Crotalaria retusa*), *Ipomoea indica* (no common name) and the dormidera (*Senna obtusifolia*). A total of 75 plant species within 24 families were observed.

Most represented families were Poaceae (20 species), then Cyperaceae, Fabaceae-Faboideae and Fabaceae-Mimosidae with 7 species each. Native species represent 60% of the observed flora. 53% of the species observed are herbaceous, 20% trees, 18% vines and shrubs 9%. No flora species designated as threatened or endangered were observed.

Dominant fauna species (in terms of frequency of observations) were reinita común (*Coereba flaveola*), paloma turca (*Patagioenas squamosa*), tórtola aliblanca (*Zenaida asiática*), chango (*Quicalus niger*) and lagartijo común (*Ctenonotus cristatellus*).

Five endemic fauna species were observed. These are the juí de Puerto Rico (*Myarchus antillarum*), coquí churí (*Eleutherodactylus antillensis*), coquí común (*Eleutherodactylus coqui*), and the butterflies *Chorantus vitellius* and *Phyrisitia portoricensis*. In addition, three migratory species were observed. These are the Martín pescador (*Megaceryle*

alcyon), águila pescadora (*Pandion haliaetus*) and the reinita galana (*Setophaga discolor*). Total animal species were 41, divided in 24 families. No fauna species designated as threatened or endangered were observed.

Environmental Sensitivity Index (ESI) Map

According to the Environmental Sensitivity Index (ESI) maps of the National Oceanic and Atmospheric Administration (NOAA), dike A is located within an area where the paloma sabanera de Puerto Rico (*Patagioenas inornata*) has been recorded (see **Figures 15** and **16**, **Appendix A**). This species is listed as an endangered species (State and Federal). However, it was not observed during field work.

Information for Planning and Consultation (IPaC)

The Information for Planning and Consultation (IPaC), of the United States Fish and Wildlife Service (USFWS), includes the boa de Puerto Rico (*Chilabothrus inornatus*) as a species with the potential to occur within dike A. The boa de Puerto Rico is also listed as an endangered species (State and Federal). This species was not observed during field work (see **Appendix C**).

Ecological Associations within Dike A

Dike A is mostly covered by an association of shrub (dominated by *Mimosa pellita*) and herbaceous vegetation (mostly dominated by *Paspalum fasciculatum*), especially in the lower areas of the dike. However, trees have grown within the northeast corner, where sediments from the former dredging activities were deposited, and also along the outer perimeter of the dike. Slurry pipe segment is mostly dominated by *Paspalum fasciculatum*. According to Helmer et al. (2002), the dike A is mostly covered by pastures and agriculture/hay (see **Figure 17**, **Appendix A**).

Disposal dike B

The most common tree species within dike B were the cenizo (*Zanthoxylum martinicense*), albicia (*Albizia procera*), péndula (*Citharexylum spinosum*), guayaba (*Psidium guajava*) and the tulipán Africano (*Spathodea campanulata*). Most common

shrub/herbaceous species were *Mimosa pellita* (no common name), the hierba venezolana (*Paspalum fasciculatum*), moriviví (*Mimosa pudica*), zarza (*Mimosa casta*), cascabelillo (*Crotalaria retusa*), *Ipomoea indica* (no common name) and the dormidera (*Senna obtusifolia*). Within the flooded area of dike B, dominant species are hierba de enéas (*Typha domingensis*), *Rhynchospora holoschoenoides* (no common name) and other species from the family Cyperaceae. A total of 63 plant species within 28 families were observed.

Most represented families were Poaceae (10 species), Cyperaceae (7 species), then Boraginaceae, Fabaceae-Caesalpinioidae, Fabaceae-Faboideae and Fabaceae-Mimosidae with 4 species each. Native species represent 65% of the observed flora. A 55% of the species observed are herbaceous, 24% trees, 11% vines and shrubs 10%. No flora species designated as threatened or endangered were observed.

Dominant fauna species were reinita común (*Coereba flaveola*), paloma turca (*Patagioenas squamosa*), tórtola aliblanca (*Zenaida asiática*), Chamorro negro (*Tiaris bicolor*), lagartijo común (*Ctenonotus cristatellus*) and the butterfly *Aphrissa statira cubana*.

Six endemic fauna species were observed. These are the reina mora (*Spindalis portoricensis*), pájaro carpintero de Puerto Rico (*Melanerpes portoricensis*), juí de Puerto Rico (*Myarchus antillarum*), coquí churí (*Eleutherodactylus antillensis*), coquí común (*Eleutherodactylus coqui*), and the butterfly *Phyrisitia portoricensis*. Total animal species were 39, divided in 23 families. No fauna species designated as threatened or endangered were observed.

Environmental Sensitivity index Map

According to the Environmental Sensitivity Index (ESI) maps of the National Oceanic and Atmospheric Administration (NOAA), there are no critical elements, threatened or endangered species within dike B (see **Figures 18** and **19**, **Appendix A**).

Information for Planning and Consultation (IPaC)

The Information for Planning and Consultation (IPaC), of the United States Fish and Wildlife Service (USFWS), includes the boa de Puerto Rico (*Chilabothrus inornatus*) as a species with the potential to occur within dike B (see **Appendix C**). The boa de Puerto Rico is listed as an endangered species (State and Federal). This species was not observed during field work.

Ecological Associations within dike B

The dike B is mostly covered by an association of shrub (dominated by *Mimosa pellita*) and herbaceous vegetation (mostly dominated by *Paspalum fasciculatum*), especially in the inner slopes of the dike. There is a pond in the center of dike B, which shallow areas are dominated by hierba de enéas (*Typha domingensis*) and species from the Cyperaceae family. The pond is mostly open water, but seasonally it is covered by herbaceous species, also from the Cyperaceae family (mostly *Rhynchospora holoschoenoides*). Scattered trees are mostly found in higher ground areas to its north, or in the outer slopes. Slurry pipe segment is mostly dominated by *Paspalum fasciculatum*. According to Helmer et al. (2002), the dike B is mostly covered by lowland moist seasonal evergreen forest/shrub (see **Figure 20**, **Appendix A**).

Disposal dike C

The most common tree species within dike C were the cenizo (*Zanthoxylum martinicense*), albicia (*Albizia procera*), péndula (*Citharexylum spinosum*), guayaba (*Psidium guajava*), sena de Siam (*Senna siamea*) and the tulipán Africano (*Spathodea campanulata*). Most common shrub/herbaceous species were *Mimosa pellita* (no common name), the hierba venezolana (*Paspalum fasciculatum*), moriviví (*Mimosa pudica*), zarza (*Mimosa casta*), cascabelillo (*Crotalaria retusa*), *Ipomoea indica* (no common name) and the dormidera (*Senna obtusifolia*). A total of 83 plant species within 32 families were observed.

Most represented families were Poaceae (10 species), Fabaceae-Caesalpinioidae (7) and then Fabaceae-Faboideae and Fabaceae-Mimosidae with 6 species each. Native species

represent 70% of the observed flora. 40% of the species observed are herbaceous, 29% trees, 22% vines and shrubs 9%. No flora species designated as threatened or endangered were observed.

Dominant fauna species were reinita común (*Coereba flaveola*), paloma turca (*Patagioenas squamosa*), tórtola aliblanca (*Zenaida asiática*), chango (*Quicalus niger*), lagartijo común (*Ctenonotus cristatellus*) and the butterfly *Aphrissa statira cubana*.

Seven endemic fauna species were observed. These are the paloma sabanera de Puerto Rico (*Patagioenas inornata*, a State/Federal endangered species), pájaro carpintero de Puerto Rico (*Melanerpes portoricensis*), juí de Puerto Rico (*Myarchus antillarum*), coquí churí (*Eleutherodactylus antillensis*), coquí común (*Eleutherodactylus coqui*), and the butterflies *Chorantus vitellius* and *Phyrisitia portoricensis*. In addition, one migratory species was observed. This is the reinita pechidorada (*Setophaga americana*). The jicotea (*Trachemys stejnegeri*), species designated as critical element by the Department of Natural Environmental Resources (DNER) was also observed. Total animal species were 44, divided in 28 families. The paloma sabanera de Puerto Rico was observed flying over the dike C (see **Critical Elements, Threatened and Endangered Species** section below).

Environmental Sensitivity index Map

According to the Environmental Sensitivity Index (ESI) maps of the National Oceanic and Atmospheric Administration (NOAA), Dike C is located within an area where the paloma sabanera de Puerto Rico (*Patagioenas inornata*) has been recorded (see **Figures 21** and **22**, **Appendix A**). This species is listed as an endangered species (State and Federal).

Information for Planning and Consultation (IPaC)

The Information for Planning and Consultation (IPaC), of the United States Fish and Wildlife Service (USFWS), includes the boa de Puerto Rico (*Chilabothrus inornatus*) as a species with the potential to occur within dike C (see **Appendix C**). The boa de Puerto

Rico is also listed as an endangered species (State and Federal). This species was not observed during field work.

Ecological Associations within Disposal dike C

The dike C is mostly covered by an association of shrub (dominated by *Mimosa pellita*) and herbaceous vegetation (mostly dominated by *Paspalum fasciculatum*), especially in the inner slopes and the center of the dike. However, trees have grown within the southwest corner, where sediments from the former dredging activities were deposited. Slurry pipe segment is mostly dominated by *Paspalum fasciculatum* and *Bambusa vulgaris*. According to Helmer et al. (2002), the dike C is mostly covered by pastures and agriculture/hay (see **Figure 23**, **Appendix A**).

Staging Area

The most common tree species within the staging area were: the albicia (*Albizia procera*), péndula (*Citharexylum spinosum*), almendro (*Terminalia cattapa*) and the tulipán Africano (*Spathodea campanulata*). Most common shrub/herbaceous species were *Mimosa pellita* (no common name), the hierba venezolana (*Paspalum fasciculatum*), moriviví (*Mimosa pudica*), zarza (*Mimosa casta*), hierba de elefante (*Cenchrus purpureus*), cascabelillo (*Crotalaria retusa*), higuereta (*Ricinus communis*), cohítre azul (*Commelina erecta*) and the dormidera (*Senna obtusifolia*). A total of 85 plant species within 29 families were observed.

Most represented families were Poaceae (19 species), Fabaceae-Faboideae (8 species), then Fabaceae-Mimosidae and Malvaceae with 6 species each. Native species represent 57% of the observed flora. 56% of the species observed are herbaceous, 19% vines, 17% trees, and shrubs 8%. No flora species designated as threatened or endangered were observed.

Dominant fauna species were reinita común (*Coereba flaveola*), paloma turca (*Patagioenas squamosa*), tórtola aliblanca (*Zenaida asiática*), pitirre (*Tyrannus dominicensis*) and the lagartijo común (*Ctenonotus cristatellus*).

Six endemic fauna species were observed. These are the pájaro carpintero de Puerto Rico (*Melanerpes portoricensis*), juí de Puerto Rico (*Myarchus antillarum*), coquí churí (*Eleutherodactylus antillensis*), coquí de las hierbas (*Eleutherodactylus brittoni*), coquí común (*Eleutherodactylus coqui*), and the butterfly *Chorantus vitellius*. I n addition, two migratory species were observed. These are the Martín pescador (*Megaceryle alcyon*) and the águila pescadora (*Pandion haliaetus*). The jicotea (*Trachemys stejnegeri*), species designated as critical element by the DNER was also observed. Total animal species were 49, divided in 31 families.

Environmental Sensitivity index Map

According to the Environmental Sensitivity Index (ESI) maps of the National Oceanic and Atmospheric Administration (NOAA), there are no critical elements, threatened or endangered species within the Staging Area (see **Figures 24** and **25**, **Appendix A**).

Information for Planning and Consultation (IPaC)

The Information for Planning and Consultation (IPaC), of the United States Fish and Wildlife Service (USFWS), includes the boa de Puerto Rico (*Chilabothrus inornatus*) as a species with the potential to occur within the Staging Area (see **Appendix C**). The boa de Puerto Rico is listed as an endangered species (State and Federal). This species was not observed during field work.

Ecological Associations within the Staging Area

Soil within the Staging Area is mostly composed of fill material; however, vegetation has grown within it. Some of the materials from previous construction or dredging activities were observed along the area. Also, lots of refuse are found scattered within the site. The Staging Area is mostly covered by an association of herbaceous vegetation (mostly dominated by *Paspalum fasciculatum* and *Cenchrus purpureus*), and some scattered trees. According to Helmer et al. (2002), the Staging Area is mostly covered by pasture (see **Figure 26**, **Appendix A**).

Critical Elements, Threatened and Endangered Species

One critical element (as designated by the DNER) and one endangered species (State/Federal) were observed during field work. These are the jicotea (*Trachemys stejnegeri*, critical element) and the Puerto Rican Plain Pigeon (*Patagioenas inornata*, endangered species).

Jicotea (*Trachemys stejnegeri*)

The jicotea was observed in dike C and in the staging area. It was designated as a critical element by the DNER, based in the hybridization potential that this species has with the introduced species *Chrysemys scripta elegans*. Its category as a critical element is of Data Deficiency (DD). The DD category is assigned to a species when available information is inadequate to make a direct or indirect evaluation about the risk of extinction on the base of its distribution and/or population condition. The jicotea is commonly found in ponds, rivers, lakes, and freshwater channels.

Paloma Sabanera de Puerto Rico (*Patagioenas inornata*)

Two individuals of the paloma sabanera de Puerto Rico were observed flying from south to north near the eastern side of dike C. This is a State and Federal species designated as endangered.

The paloma sabanera de Puerto Rico belongs to the Columbidae family. It can measure up to 16 inches long. It is distinguished from other large species (like the paloma turca, *Patagioenas squamosa*) and the paloma casera, *Columba livia*) by the purplish color on its wings and belly, and by a white band on the front side of wings. Generally, its plumage has a more defined brown tonality (Raffaele, 1998).

The paloma sabanera de Puerto Rico habitat includes primary and secondary succession groves in lowlands, scrub/shrub areas, mountainous rain forest with broad-leaved evergreen trees, coastal mangroves, open land and agricultural lands (Birdlife International, 2000).

Initially, this species was observed in the municipalities of Cidra, Cayey, Caguas, Comerío, Aguas Buenas and Aibonito. However, it has been recorded lately in the municipalities of Ciales, Corozal, Guayama, Guaynabo, Gurabo, Jayuya, Juncos, Las Piedras, Luquillo, Mayaguez, Orocovis, Ponce, Río Grande, Salinas, San Lorenzo, San Sebastián, Utuado, Vega Alta and Vieques.

The paloma sabanera de Puerto Rico feeds on fruits from the palma real (*Roystonea borinquena*), tulipán africano (*Spathodea campanulata*), laurel geo (*Ocotea leucoxylon*), camasey de paloma (*Miconia laevigata*), guaraguao (*Guarea guidonia*) and other species. It nests on bambú (*Bambusa vulgaris*), mangó (*Mangifera indica*), almendro (*Terminalia catappa*), palma de coco (*Cocos nucifera*) and other trees (DRNA, 2000).

The paloma sabanera de Puerto Rico was listed as an endangered species on October 13, 1970.

Conclusions and Recommendations

In conclusion, a total of 140 plant species within 44 families were observed within all studied areas. The dike C and the staging area were the most diverse. The most common tree species were the albicia (*Albizia procera*), péndula (*Citharexylum spinosum*), cenizo (*Zanthoxylum martinicense*), sena de Siam (*Senna siamea*), almendro (*Terminalia cattapa*) and the tulipán Africano (*Spathodea campanulata*). Most common herbaceous species were *Mimosa pellita* (no common name), the hierba venezolana (*Paspalum fasciculatum*), hierba de elefante (*Cenchrus purpureus*), moriviví (*Mimosa pudica*), zarza (*Mimosa casta*), cascabelillo (*Crotalaria retusa*), talantalán (*Senna alata*) and the dormidera (*Senna obtusifolia*). No flora species designated as threatened or endangered were found.

Dominant vertebrate species are the guaraguao (*Buteo jamaicensis*), garza ganadera (*Bubulcus ibis*), reinita común (*Coereba flaveola*), rolita (*Columbina passerina*), paloma turca (*Patagioenas squamosa*), tórtola aliblanca (*Zenaida asiática*), chango (*Quiscalus niger*), chamoro negro (*Tiaris bicolor*), iguana (Iguana iguana), lagartijo común (*Ctenonotus cristatellus*), coquí común (*Eleutherodactylus coqui*), and the coquí churí (*Eleutherodactylus antillensis*). Invertebrate dominant species were the abeja (*Apis mellifera*), cigarrón (*Xylocopa mordax*), comején (*Nasutitermes costalis*) and the libélula (*Erythrodiplax umbrata*). Total animal species were 78, divided in 42 families.

Among these species, there are eight endemic, four migratory, one critical element and one endangered species, as follows:

- Reina mora (*Spindalis portoricensis*), endemic.
- Paloma sabanera de Puerto Rico (*Patagioenas inornata*), endemic/endangered.
- Pájaro carpintero de Puerto Rico (*Melanerpes portoricensis*), endemic.
- Juí de Puerto Rico (*Myarchus antillarum*), endemic.
- Coquí común (*Eleutherodactylus coqui*), endemic.
- Coquí churí (*Eleutherodactylus antillensis*), endemic.

- ❖ Coquí de las hierbas (*Eleutherodactylus antillanum*), endemic.
- ❖ Chorantus vitellius, endemic
- ❖ Phyrisitia portoricensis, endemic.
- ❖ Martín pescador (Megaceryle alcyon), migratory.
- ❖ Aguila pescadora (Pandion haliaetus), migratory.
- ❖ Reinita pechidorada (Setophaga americana), migratory.
- ❖ Reinita galana (Setophaga discolor), migratory.
- ❖ Jicotea (Trachemys stejnegeri), critical element.

The three dikes are man-made features that were in function between 1994 and 1998 - last time the Carraízo Reservoir was dredged. The proposed staging area was also in use during those years. Observed plants and animals are considered as common species within the region where the Project is proposed. Therefore, no significant impacts are expected, given that the Project is proposed within the same foot print where the former dredging activities occurred.

However, in terms of protected species, even though the boa de Puerto Rico (*Chilabothrus inornatus*) was not observed during field work its presence cannot be discarded. The paloma sabanera de Puerto Rico was found within project area.

Therefore, to protect the boa de Puerto Rico, the paloma sabanera and other natural areas nearby the following measures are recommended:

1. Implement a protocol to protect the boa de Puerto Rico during construction activities.
2. Implement a protocol to protect the paloma sabanera de Puerto Rico and its habitat during construction activities.
3. Establishing protection measures so that rivers and other streams and their associated habitats (including wetlands) are not affected. Some of these measures may include:
    a. Noise barriers
    b. Fugitive dust containment fences

c. Silt fences

d. Erosion/sedimentation control measures

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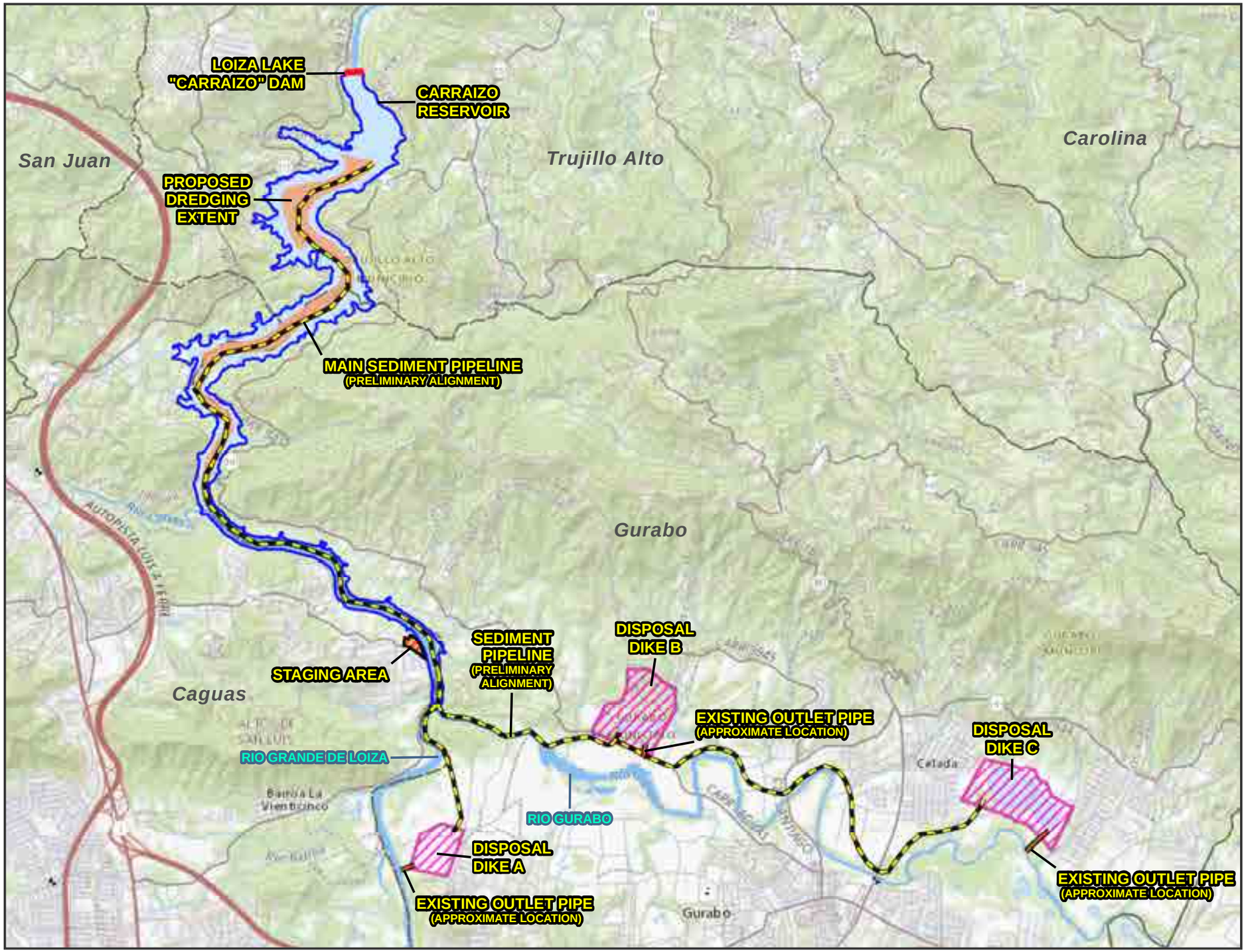
Appendix A: Figures

Figure 1: Study Sites Location Map (1:45,000)



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 1: Study Sites Location Map

N
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Legend

- Carraízo Dam
- Carraízo Reservoir
- Sediment Pipeline
- Oulet Pipe
- Disposal Dikes
- Dredging Extent
- Staging Area
- Municipal Limit[1]

Sources:
1. Puerto Rico Planning Board, 2015.
2. United States Geological Survey (USGS)Topographic Map, Aguas Buenas and Juncos Quadrangles, 2018. Contour interval is 20 feet.
3. Service Layer Credits: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed August, 2021.

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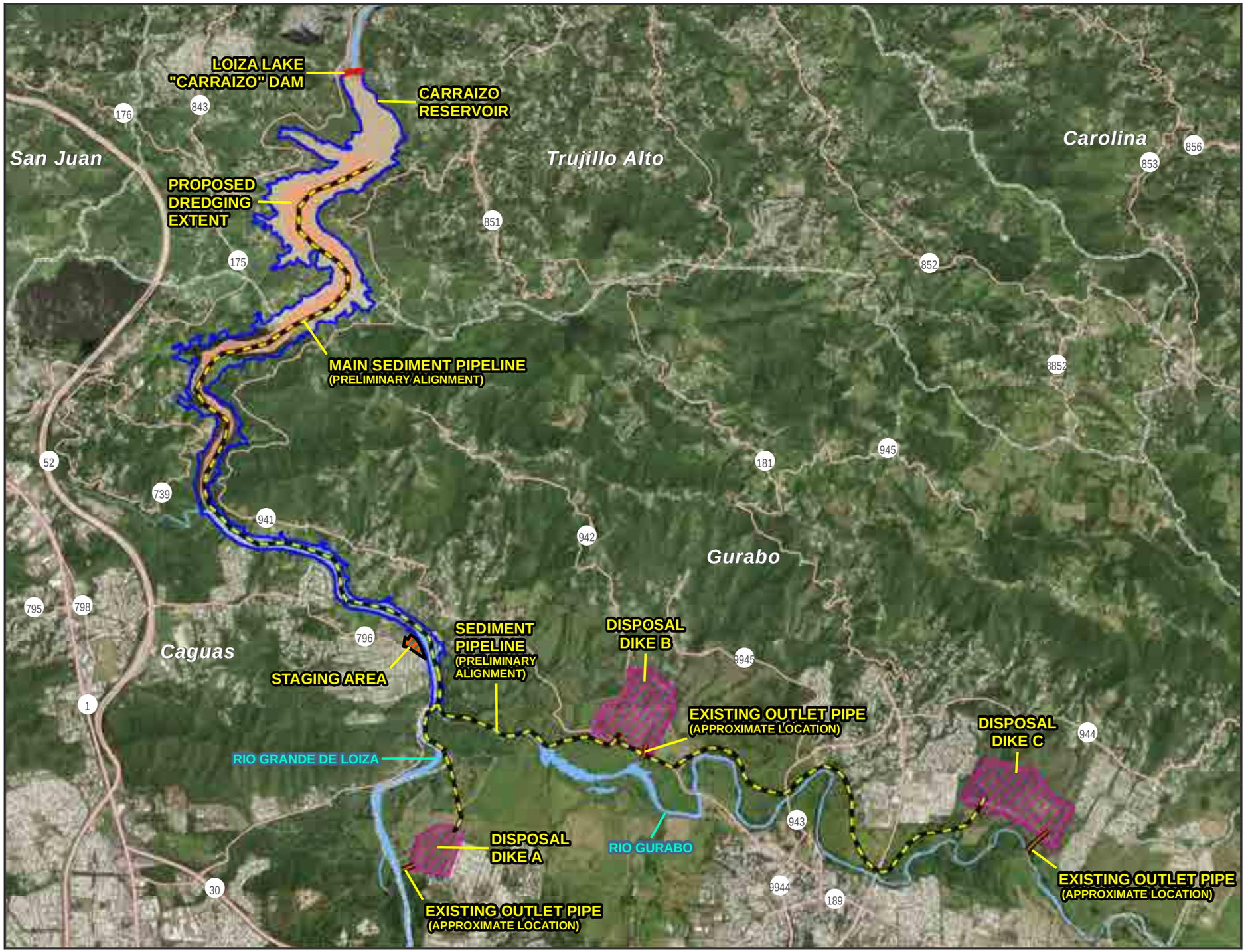
Figure 2: Study Sites over Aerial Photograph (1:45,000)



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Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 2: Study Sites over Aerial Photo

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0 0.5 1 mi

Legend

- Carraízo Dam
- Carraízo Reservoir
- Sediment Pipeline
- Oulet Pipe
- Disposal Dikes
- Dredging Extent
- Staging Area
- State Road[1]
- Municipal Limit[2]

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. PR Planning Board, 2015.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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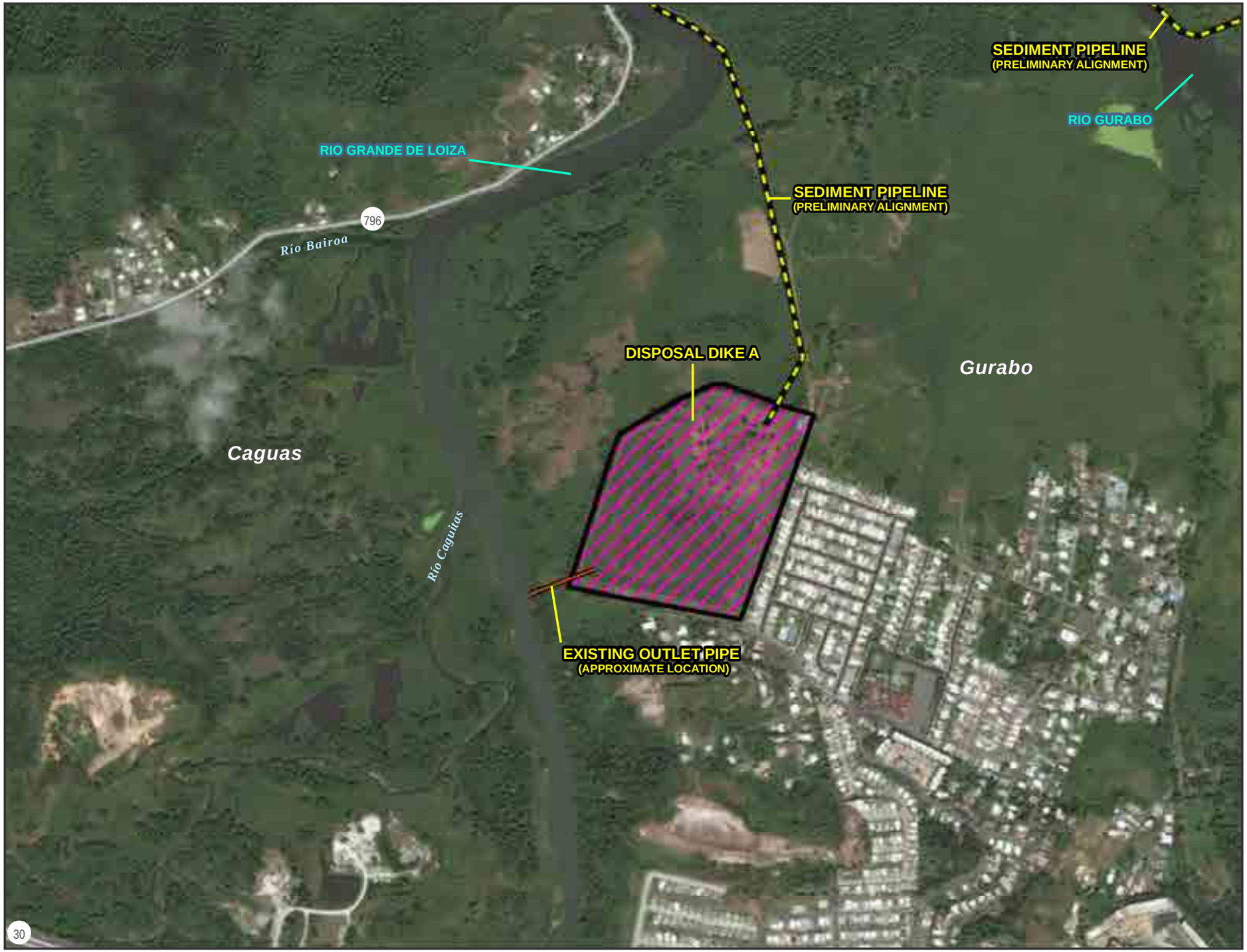
Figure 3: Location of Dike A over Aerial Photo



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 3: Location of Dike A over Aerial Photo

N
W E
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0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- State Road[1]

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 4: Hydrography within the Vicinity of Dike A

Descriptive Study of Flora and Fauna Carraízo Reservoir Dredging Project Figure 4: Hydrography within the Vecinity of Dike A

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0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- Hydrography[1]
- State Road[2]

Sources:
1. USGS National Hydrography Dataset, 2020.
2. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
3. PR Planning Board, 2015.
4. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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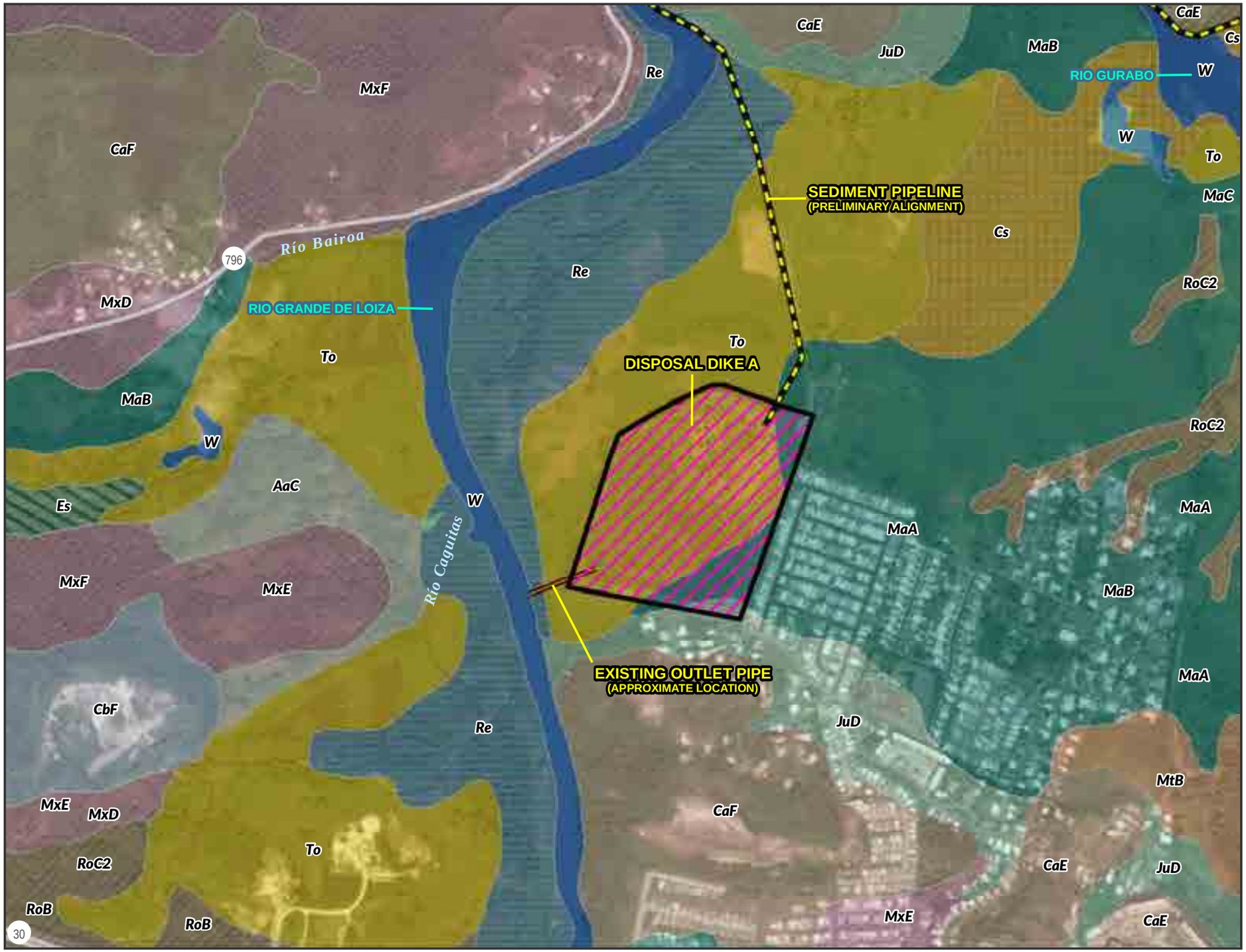
Figure 5: Soils within the Vicinity of Dike A



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 5: Soils within the Vecinity of Dike A

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Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- State Road[1]

Soil Association[3]

- Aceitunas (AaC)
- Caguabo (CaE, CaF)
- Caguabo-Rock Complex (CbF)
- Coloso (Cs)
- Estación (Es)
- Juncos (JuD)
- Mabí (MaA, MaB, MaC)
- Montegrande (MtB)
- Múcara (MxD, MxE, MxF)
- Reilly (Re)
- Río Arriba (RoB, RoC2)
- Toa (To)
- Water (W)

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. USDA-Natural Resources Conservation, Soil survey mapping units, Puerto Rico, SSURGO database, 2015.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 6: Location of Dike B over Aerial Photo

Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 6: Location of Dike B over Aerial Photo

N
W E
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1:10,000

0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- State Road[1]

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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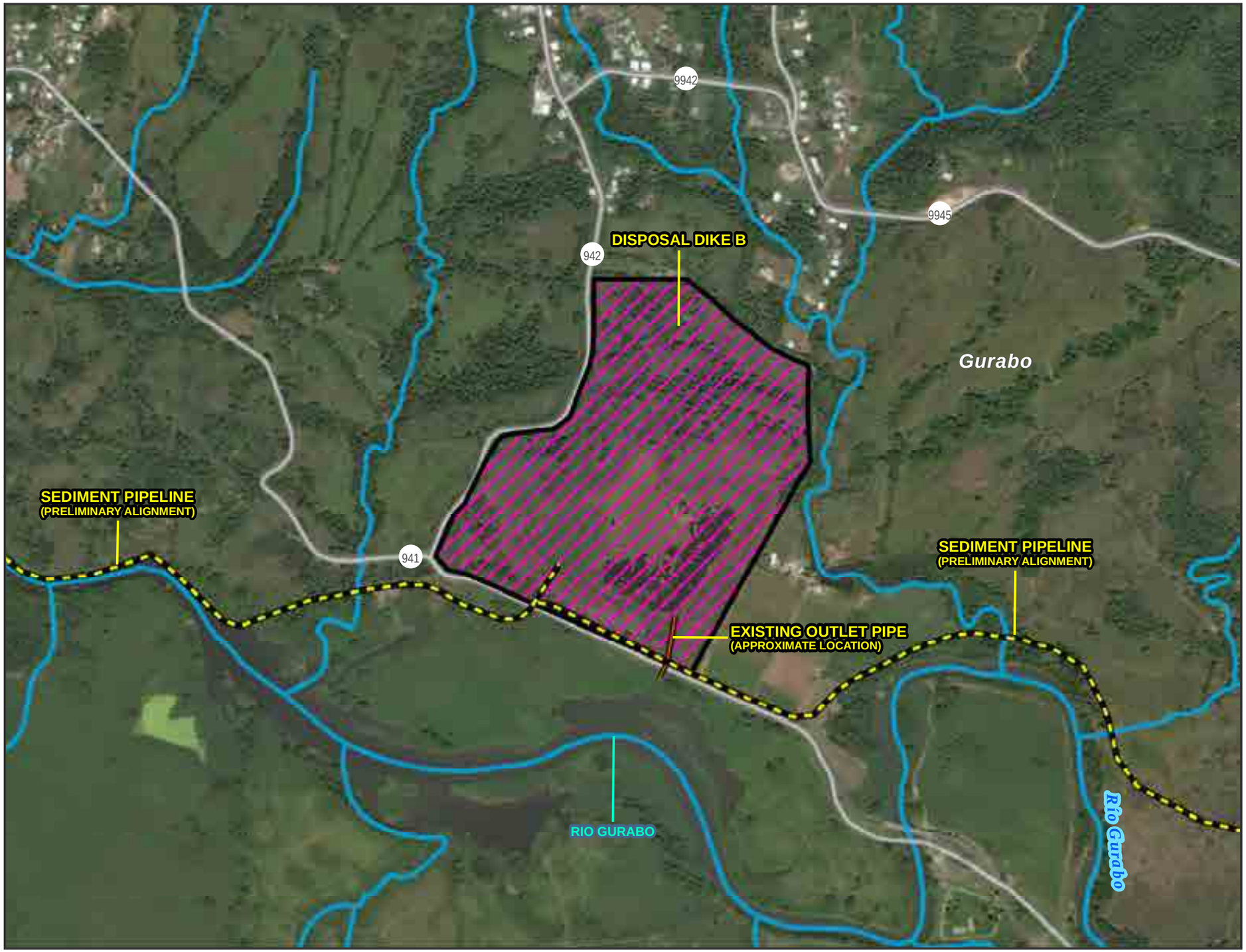
Figure 7: Hydrography within the Vicinity of Dike B



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 7: Hydrography within the Vecinity of Dike B

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0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- Hydrography[1]
- State Road[2]

Sources:
1. USGS National Hydrography Dataset, 2020.
2. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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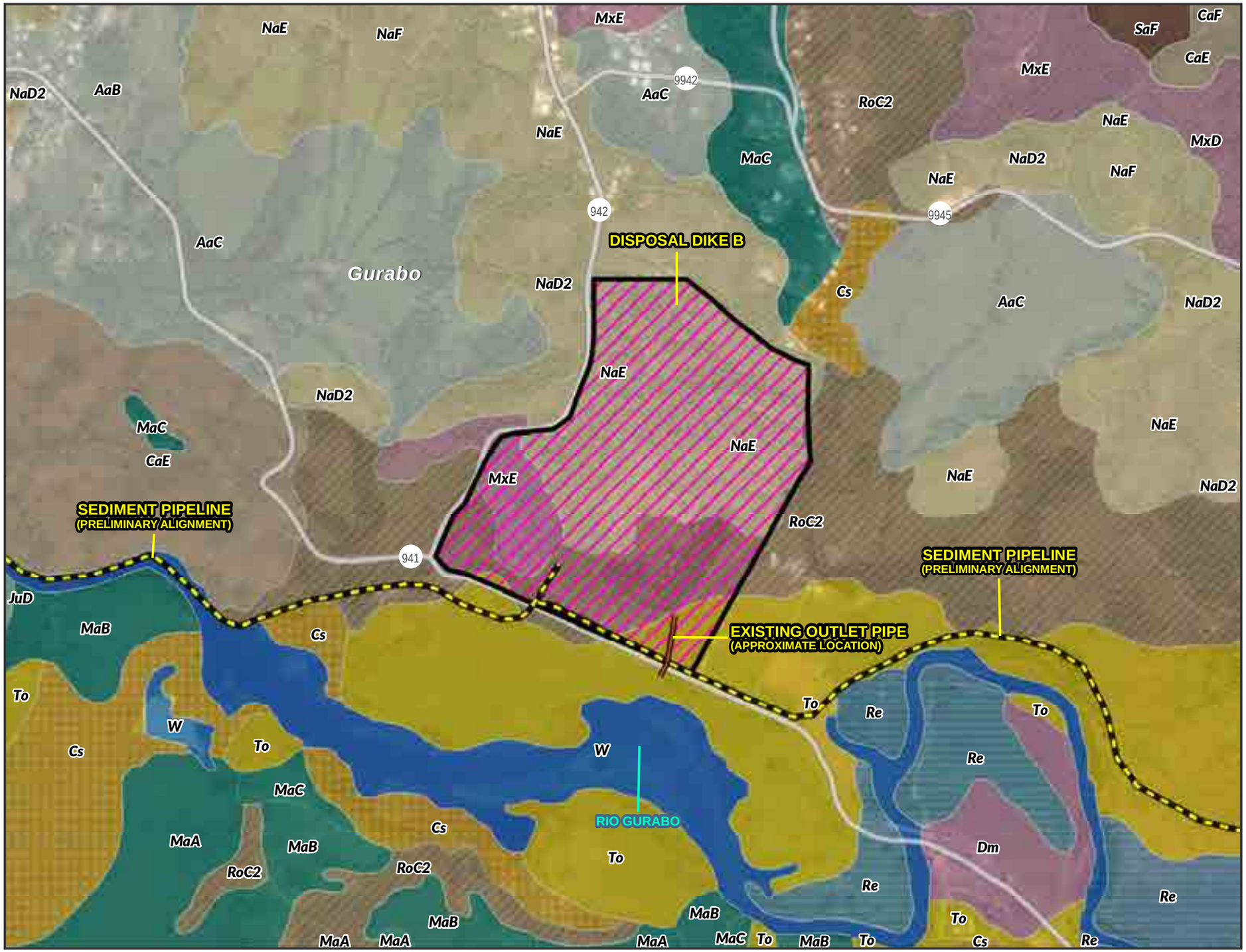
Figure 8: Soils within the Vicinity of Dike B



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Descriptive Study of Flora and Fauna Carraízo Reservoir Dredging Project

Figure 8: Soils within the Vecinity of Dike B

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0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- State Road[1]

Soil Association[2]

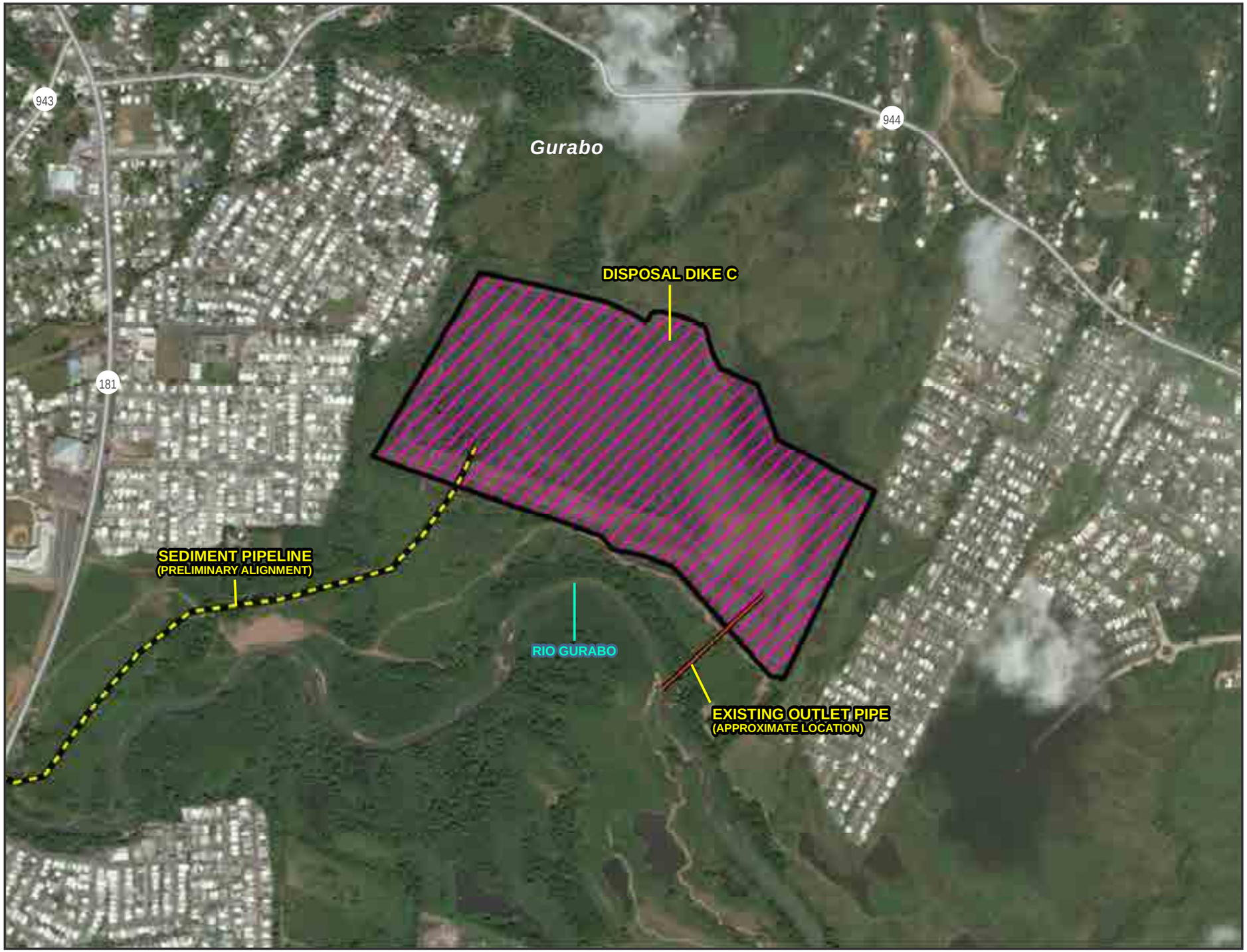
- Aceitunas (AaC)
- Caguabo (CaE, CaF)
- Coloso (Cs)
- Dique (Dm)
- Juncos (JuD)
- Mabí (MaA, MaB, MaC)
- Múcara (MxD, MxE, MxF)
- Naranjito (NaD2, NaE, NaF)
- Reilly (Re)
- Río Arriba (RoB, RoC2)
- Sabana (SaF)
- Toa (To)
- Water (W)

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. USDA-Natural Resources Conservation, Soil survey mapping units, Puerto Rico, SSURGO database, 2015.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FEMA Region 2

COR3

Figure 9: Location of Dike C over Aerial Photo



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 9: Location of Dike C over Aerial Photo

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Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- State Road[1]

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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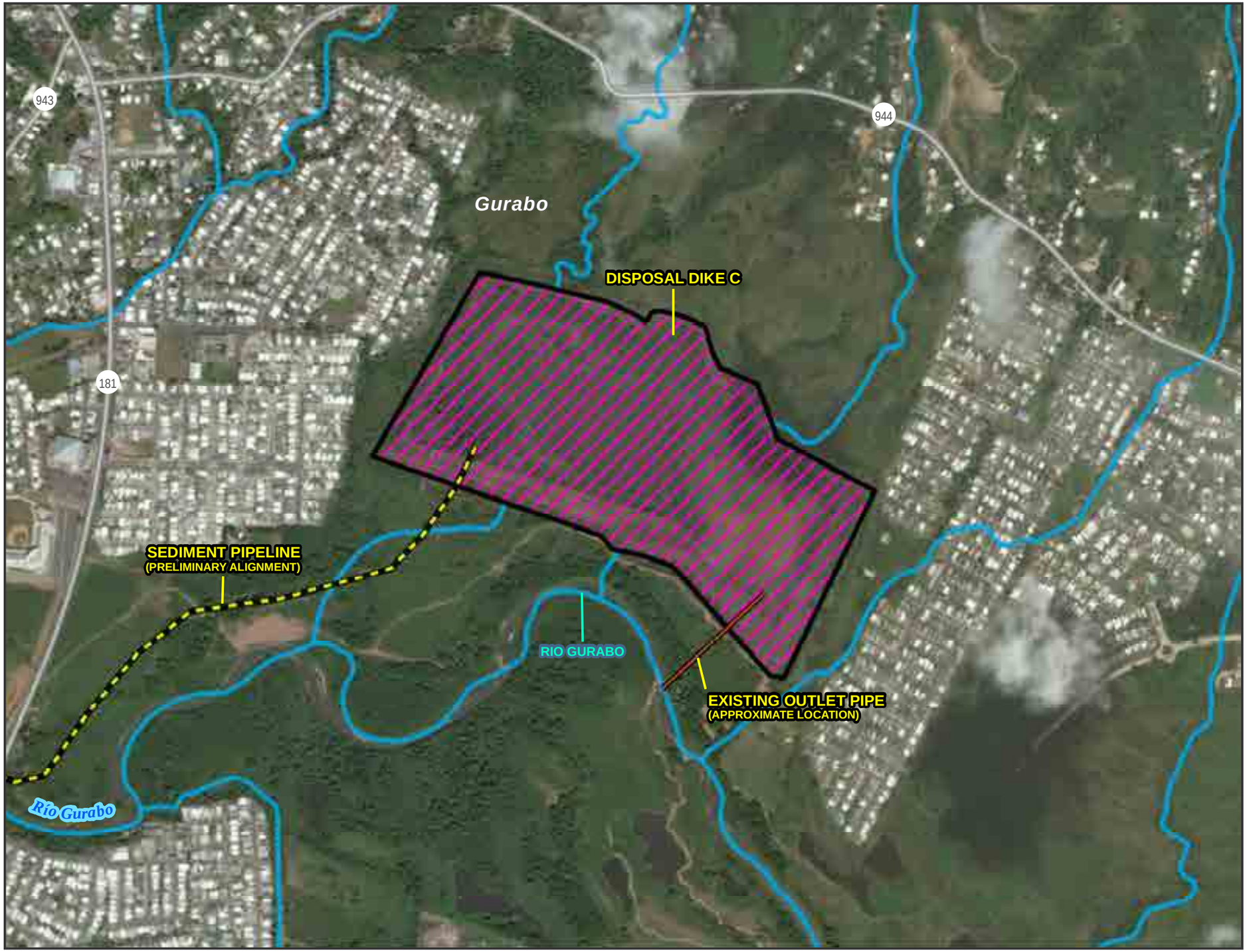
Figure 10: Hydrography within the Vicinity of Dike C



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 10: Hydrography within the Vecinity of Dike C

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0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Area (Dike)
- Hydrography[1]
- State Road[2]

Sources:
1. USGS National Hydrography Dataset, 2020.
2. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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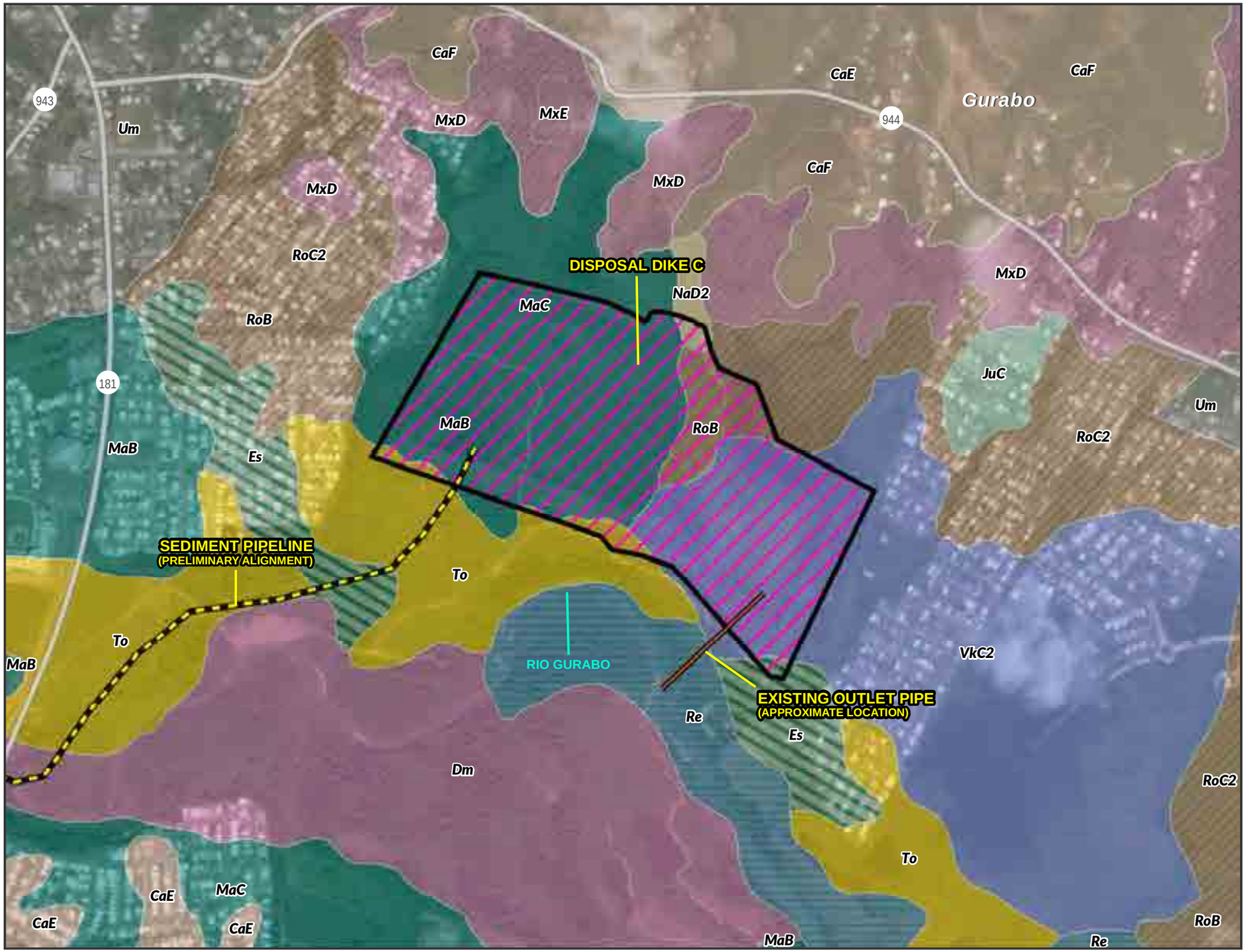
Figure 11: Soils within the Vicinity of Dike C



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 11: Soils within the Vecinity of Dike C

N
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1:10,000

0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- State Road[1]

Soil Association[2]

- Caguabo (CaE, CaF)
- Dique (Dm)
- Estación (Es)
- Juncos (JuD)
- Mabí (MaA, MaB, MaC)
- Múcara (MxD, MxE, MxF)
- Naranjito (NaD2, NaE, NaF)
- Reilly (Re)
- Río Arriba (RoB, RoC2)
- Toa (To)
- Urban land-Múcara complex (Um)
- Vía (VkC2)

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. USDA-Natural Resources Conservation, Soil survey mapping units, Puerto Rico, SSURGO database, 2015.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FEMA Region 2

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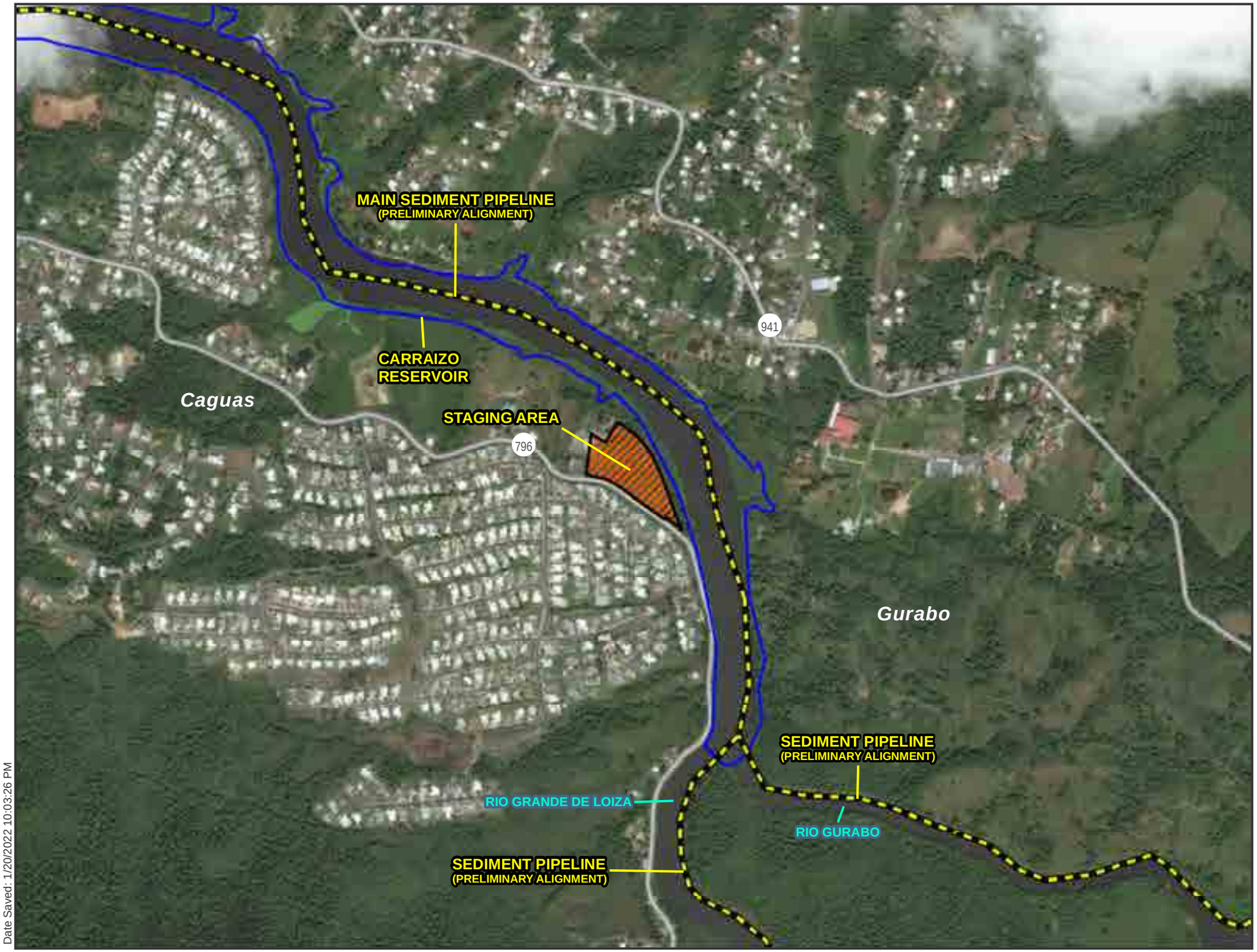
Figure 12: Location of the Staging Area over Aerial Photo



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 12: Location of Staging Area over Aerial Photo

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1:10,000

0 0.125 0.25 mi

Legend

- Carraízo Reservoir
- Sediment Pipeline
- Staging Area
- State Road[1]

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FEMA Region 2

COR3

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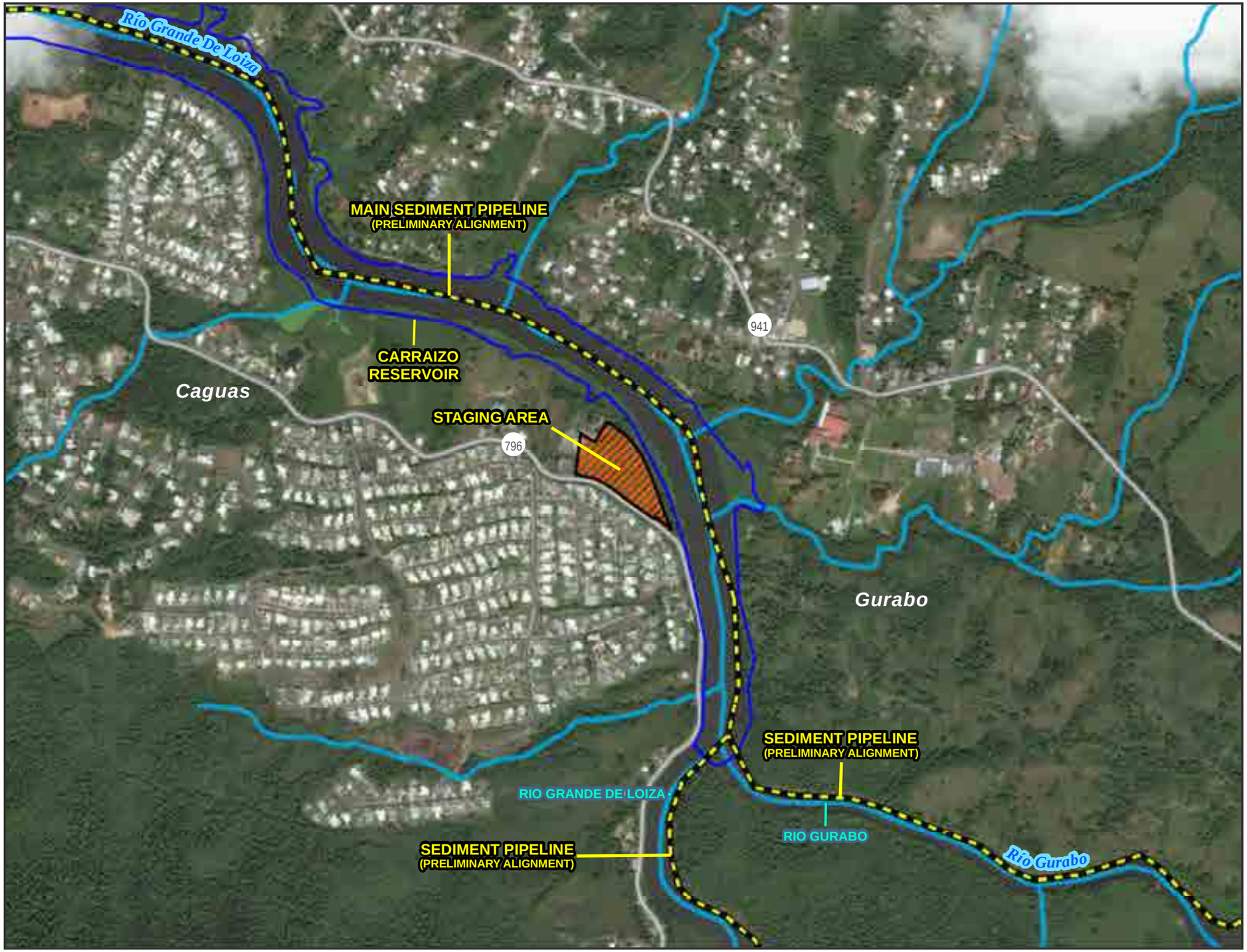
Figure 13: Hydrography within the Vicinity of the Staging Area



Descriptive Study of Flora and Fauna
Carraízo Reservoir
Dredging Project
Figure 13: Hydrography within the Vecinity of the Staging Area

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1:10,000

0 0.125 0.25 mi

Legend

- Carraízo Reservoir
- Sediment Pipeline
- Staging Area
- Hydrography[1]
- State Road[2]

Sources:
1. USGS National Hydrography Dataset, 2020.
2. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FEMA Region 2

COR3

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Figure 14: Soils within the Vicinity of the Staging Area

Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 14: Soils within the vecinity of the Staging Area

N
W E
S

1:10,000

0 0.125 0.25 mi

Legend

- Carraízo Reservoir
- Sediment Pipeline
- Staging Area
- State Road[1]

Soil Association[2]

- Aceitunas (AaC)
- Caguabo (CaE, CaF)
- Quarry and gravel pit (GPQ)
- Coloso (Cs)
- Humatas (HtE)
- Juncos (JuD)
- Mabí (MaA, MaB, MaC)
- Múcara (MxD, MxE, MxF)
- Naranjito (NaD2, NaE, NaF)
- Reilly (Re)
- Río Arriba (RoB, RoC2)
- Sabana (SaF)
- Water (W)

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. USDA-Natural Resources Conservation, Soil survey mapping units, Puerto Rico, SSURGO database, 2015.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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COR3

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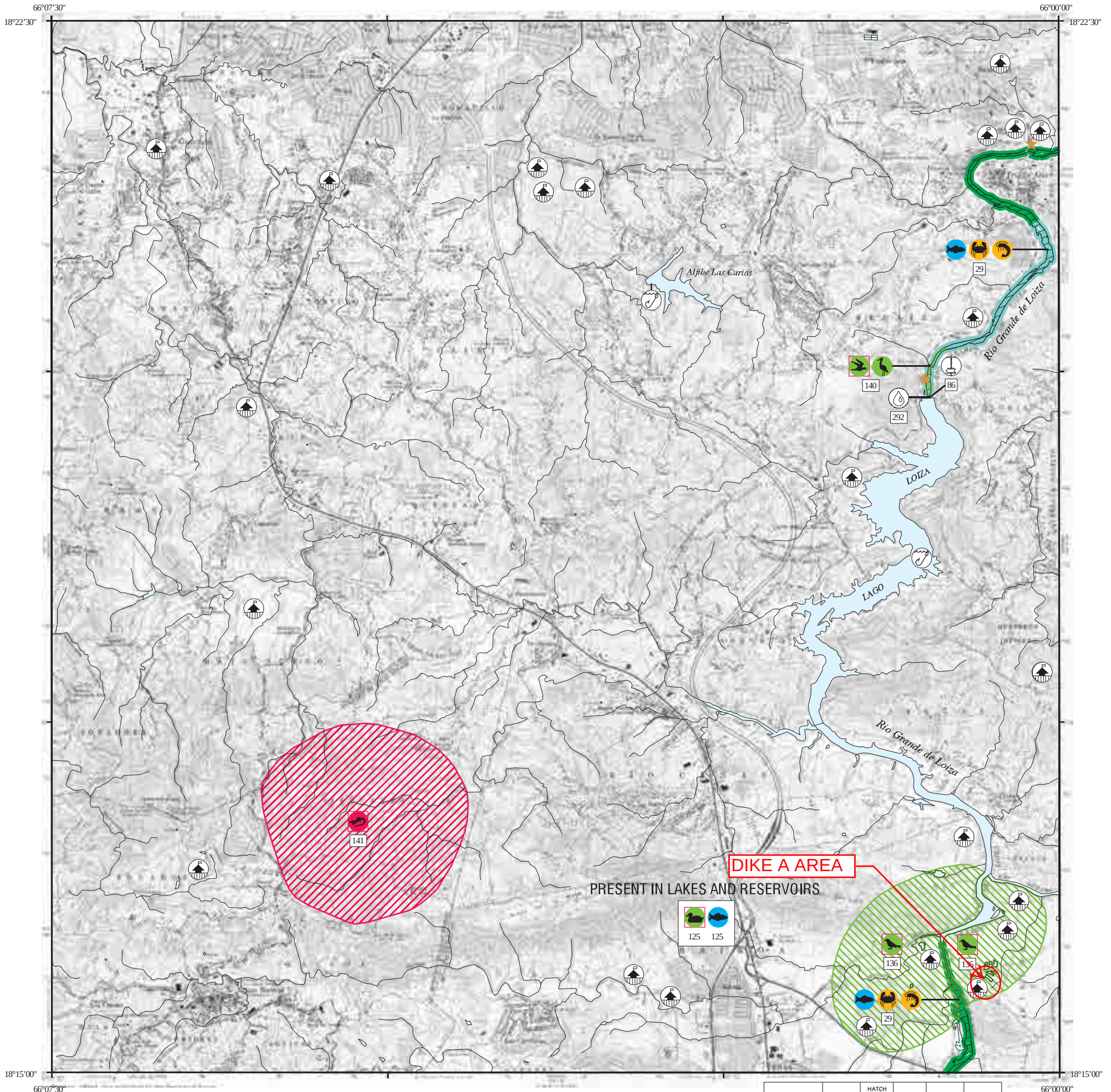
Figure 15: Environmental Sensitivity Index Map of Dike A

ENVIRONMENTAL SENSITIVITY INDEX MAP



ELEMENT	COLOR	HATCH PATTERN ANGLE	SYMBOL	CMYK	RGB
Birds	Green	45		56/0/100/0	136/185/0
Habitats	Violet	90		31/100/0/0	168/0/102
Fish	Cyan	135		100/0/0/0	0/159/230
Invertebrates	Light Orange	45		0/31/100/0	255/184/0
Marine Mammals	Light Brown	0		19/44/88/0	215/153/52
Reptiles and Amphibians	Red	135		0/100/56/0	216/0/67
Terrestrial Mammals	Light Brown	90		19/44/88/0	215/153/52

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
- 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
- 9B SHELTERED VEGETATED LOW BANKS
- 10D MANGROVES
- SALT- AND BRACKISH-WATER MARSHES
- FRESHWATER MARSHES
- FRESHWATER SWAMPS
- FRESHWATER SCRUB/SHRUB

STREAM REACHES (RSI)

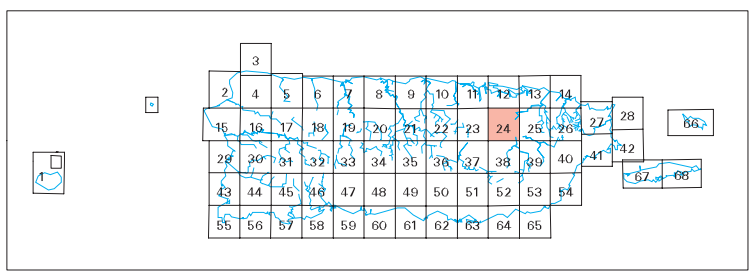
- 1 QUIET POOL; LOW-SENSITIVE BANKS
- 2 STRAIGHT CHANNEL WITH CURRENTS; LOW-SENSITIVE BANKS (MUD DOMINANT)
- 3 MEANDERING CHANNEL; SAND POINT BARS
- 4 MEANDERING CHANNEL; VEGETATED POINT BARS
- 5 RAPIDS OVER BEDROCK
- 6 MEANDERING CHANNEL; SAND AND GRAVEL POINT BARS
- 7 SPLIT CHANNEL WITH COARSE GRAVEL; SOME RAPIDS
- 8 SMALL FALLS; BOULDERS IN CHANNEL
- 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 Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
Hazardous Materials Response Division

AGUAS BUENAS, P.R. (1982) PR-24

PUERTO RICO - ESIMAP 24

BIOLOGICAL RESOURCES:

BIRD:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting

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

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

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

HUMAN USE RESOURCES:

LOCK AND DAM:

HUHR	Name	Owner/Manager	Contact	Phone

WATER INTAKE:

HUHR	Name	Owner/Manager	Location	Phone

Figure 16: Environmental Sensitivity Map Zoom In - Dike A

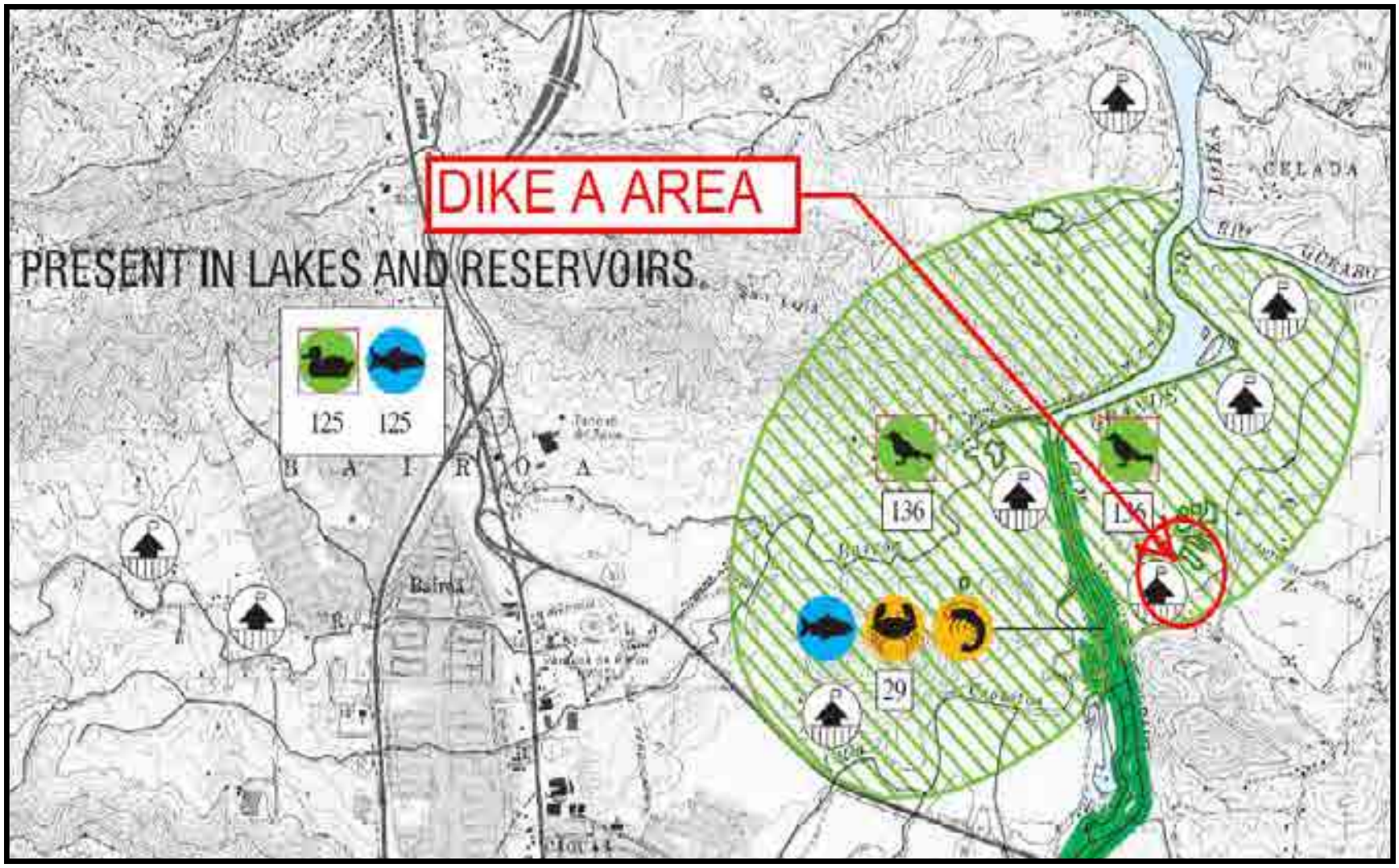

FIGURE 16
ENVIRONMENTAL SENSITIVITY INDEX MAP
ZOOM IN - DIKE A

CARRAÍZO RESERVOIR DREDGING PROJECT
RINCÓN WARD, GURABO

N
W E
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Figure 17: Land Cover within the Vicinity of Dike A

Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 17: Land Cover within the Vicinity of Dike A

N
W E
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1:10,000

0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Area (Dike)
- State Road[1]

Land Cover[2]

- Forest
- Developed Land
- Wetland
- Pasture and Shrub

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. University of Puerto Rico and Puerto Rico Planning Board, 2006.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,

FEMA Region 2

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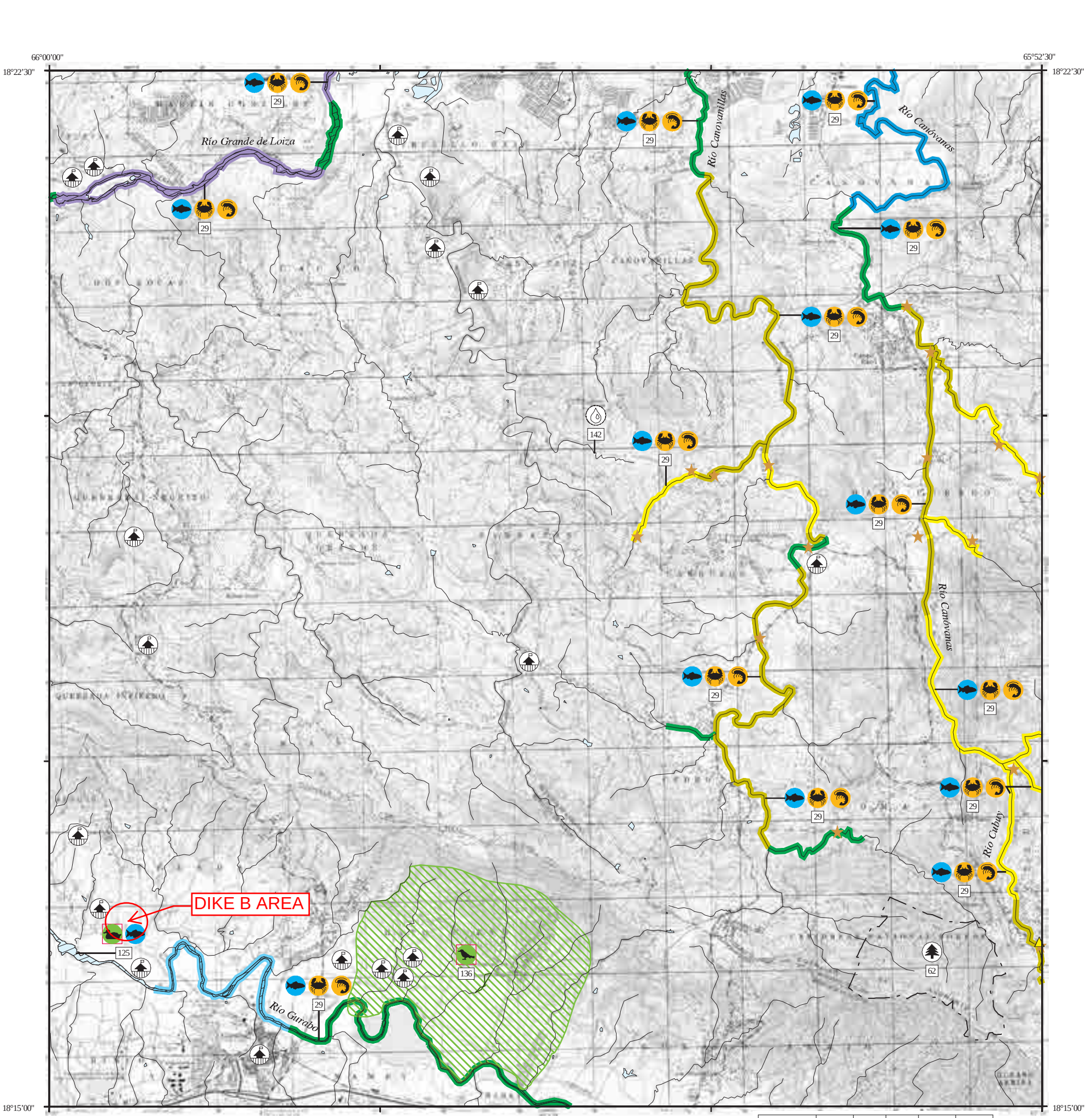
Figure 18: Environmental Sensitivity Map of Dike B

ENVIRONMENTAL SENSITIVITY INDEX MAP



ELEMENT	COLOR	HATCH PATTERN ANGLE	SYMBOL	CMYK	RGB
Birds	Green	45		56/0/100/0	136/185/0
Habitats	Violet	90		31/100/0/0	168/0/102
Fish	Cyan	135		100/0/0/0	0/159/230
Invertebrates	Light Orange	45		0/31/100/0	255/184/0
Marine Mammals	Light Brown	0		19/44/88/0	215/153/52
Reptiles and Amphibians	Red	135		0/100/56/0	216/0/67
Terrestrial Mammals	Light Brown	90		19/44/88/0	215/153/52

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
- 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
- 9B SHELTERED VEGETATED LOW BANKS
- 10D MANGROVES
- SALT- AND BRACKISH-WATER MARSHES
- FRESHWATER MARSHES
- FRESHWATER SWAMPS
- FRESHWATER SCRUB/SHRUB

STREAM REACHES (RSI)

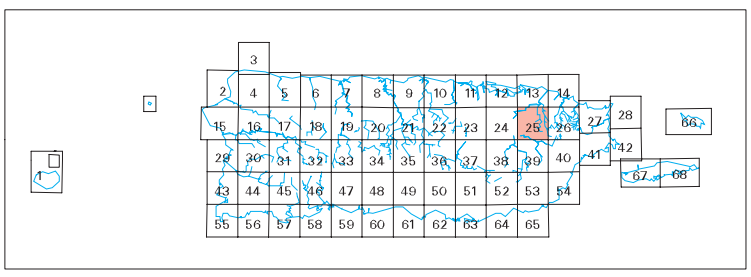
- 1 QUIET POOL; LOW-SENSITIVE BANKS
- 2 STRAIGHT CHANNEL WITH CURRENTS; LOW-SENSITIVE BANKS (MUD DOMINANT)
- 3 MEANDERING CHANNEL; SAND POINT BARS
- 4 MEANDERING CHANNEL; VEGETATED POINT BARS
- 5 RAPIDS OVER BEDROCK
- 6 MEANDERING CHANNEL; SAND AND GRAVEL POINT BARS
- 7 SPLIT CHANNEL WITH COARSE GRAVEL; SOME RAPIDS
- 8 SMALL FALLS; BOULDERS IN CHANNEL
- 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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Published: May 2000

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National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
Hazardous Materials Response Division

GURABO, P.R. (1982) **PR-25**

PUERTO RICO - ESIMAP 25

BIOLOGICAL RESOURCES:

BIRD:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting
125	Common moorhen			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Pied-billed grebe			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Ruddy duck	S	T	LOW	X	X	X	X	X	X	X	X	X	X	X	X	-
136	Puerto Rican plain pigeon	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X	FEB-JUN

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
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
125	Channel catfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC
	Largemouth bass				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC
	Peacock bass				X	X	X	X	X	X	X	X	X	X	X	X	APR-NOV	APR-NOV	APR-NOV	JAN-DEC	JAN-DEC
	Redear sunfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	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
	White catfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC

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

HUMAN USE RESOURCES:

FOREST:

HUH#	Name	Owner/Manager	Contact	Phone
62	CARIBBEAN NATIONAL FOREST	USFS	FOREST BIOLOGIST	787/888-5659

WATER INTAKE:

HUH#	Name	Owner/Manager	Location	Phone
142	BARAZAS PARTIAL PLANT	PRASA		

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.

SENSITIVE BIOLOGICAL RESOURCES

BIRD
- Alcid / Pelagic Bird
- Diving Bird
- Gull / Tern
- Passerine Bird
- Raptor
- Shorebird
- Wading Bird
- Waterfowl

TERRESTRIAL MAMMAL
- Bear
- Deer
- Small Mammal

MARINE MAMMAL
- Dolphin
- Manatee
- Polar Bear
- Sea Otter
- Seal / Sea Lion
- Whale

REPTILE / AMPHIBIAN
- Alligator / Crocodile
- Turtle
- Other Reptiles / Amphibians

FISH
- Fish
- Nursery Area

SHELLFISH AND INSECT
- Bivalve
- Crab
- Echinoderm
- Gastropod
- Lobster/ Crayfish
- Shrimp
- Squid/ Octopus
- Insect

HABITAT
- Coral/ Hardbottom Reef
- Floating Aquatic Vegetation
- Rare Plant
- Submerged Aquatic Vegetation

HUMAN-USE FEATURES

- Access
- Airport
- Aquaculture
- Archaeological Site
- Beach
- Boat Ramp
- Camping
- Coast Guard
- Commercial Fishing
- Diving
- Factory
- Ferry
- Historical Site
- Hoist
- Indian Reservation / Tribal Land
- Logging
- Marina
- Marine Sanctuary
- Mining
- National Park
- Park
- Recreational Fishing
- Special Management Area
- Subsistance Fishing
- Water Intake
- Wildlife Refuge, Reserve, Preserve
- National or State Boundary
- Park or Refuge Boundary

Figure 11 ESI symbols for representing the biological and human-use resources.

Figure 19: Environmental Sensitivity Map Zoom In - Dike B

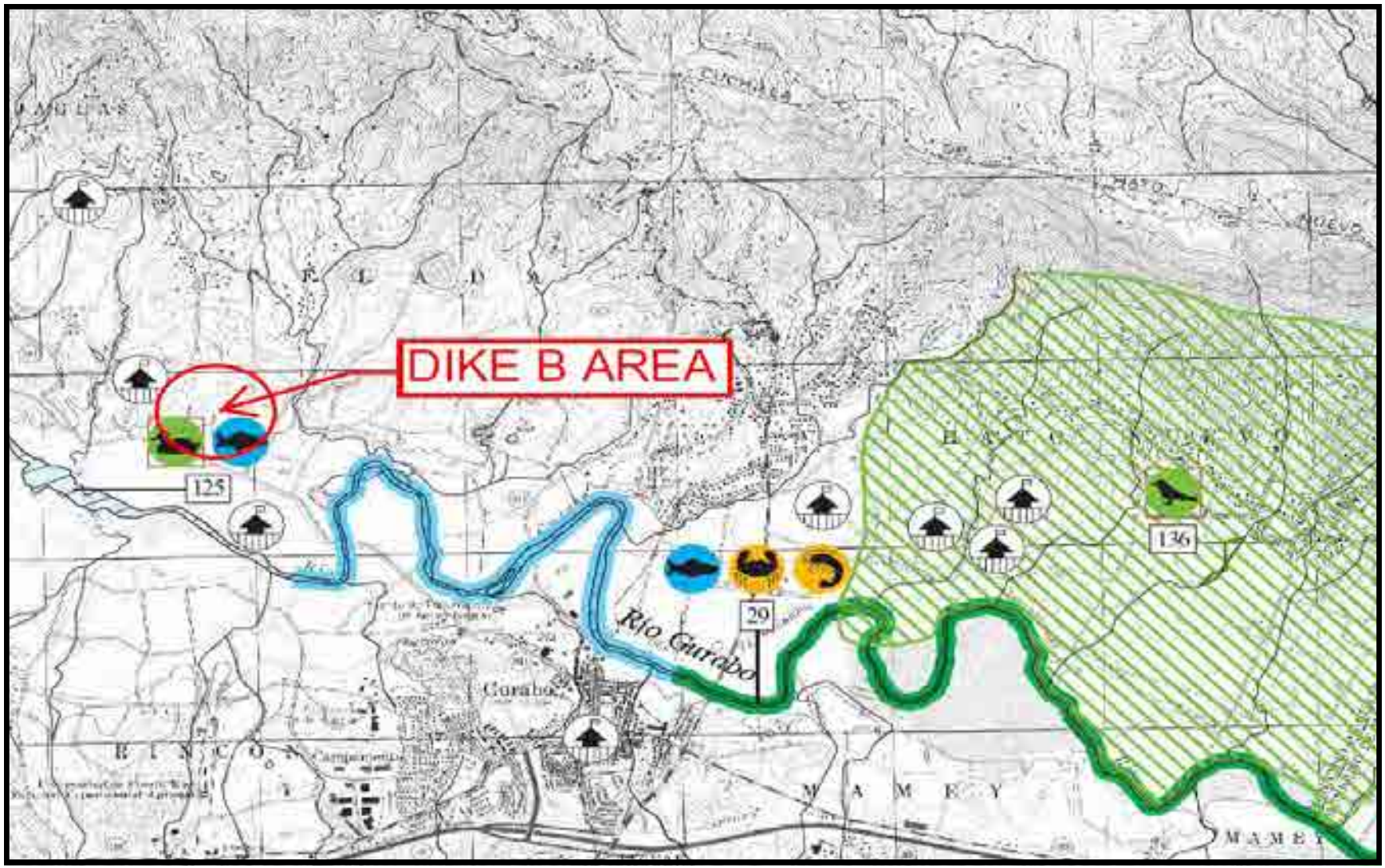

FIGURE 19
ENVIRONMENTAL SENSITIVITY INDEX MAP
ZOOM IN - DIKE B

CARRAÍZO RESERVOIR DREDGING PROJECT
CELADA WARD, GURABO

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Figure 20: Land Cover within the Vicinity of Dike B

Descriptive Study of Flora and Fauna Carraízo Reservoir Dredging Project

Figure 20: Land Cover within the Vicinity of Dike B

N
W E
S

1:10,000

0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- State Road[1]

Land Cover[2]

- Forest
- Developed Land
- Wetland
- Pasture and Shrub

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. University of Puerto Rico and Puerto Rico Planning Board, 2006.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,

FEMA Region 2

COR3

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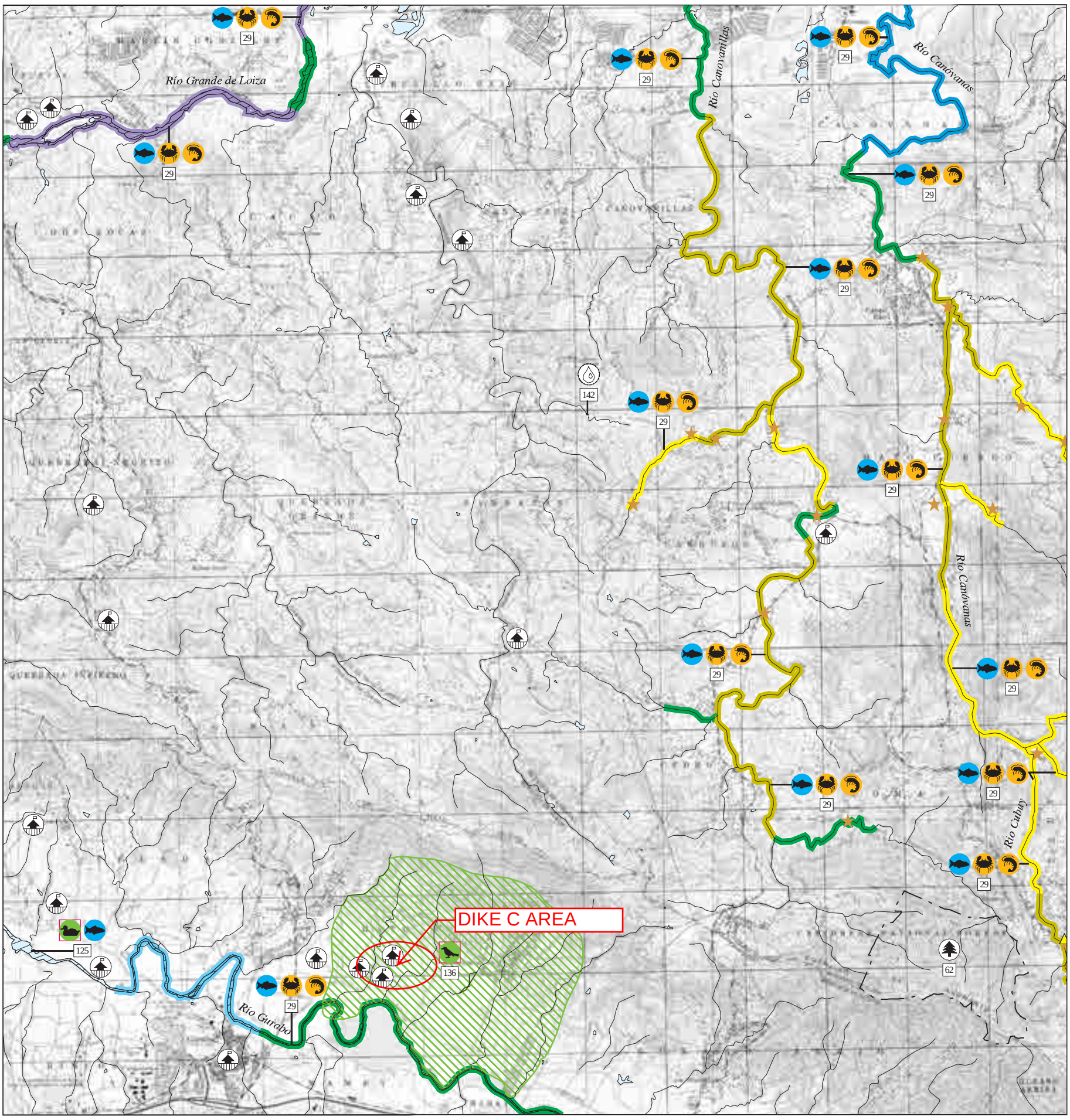
Figure 21: Environmental Sensitivity Map of Dike C

ENVIRONMENTAL SENSITIVITY INDEX MAP



ELEMENT	COLOR	HATCH PATTERN ANGLE	SYMBOL	CMYK	RGB
Birds	Green	45		56/0/100/0	136/185/0
Habitats	Violet	90		31/100/0/0	168/0/102
Fish	Cyan	135		100/0/0/0	0/159/230
Invertebrates	Light Orange	45		0/31/100/0	255/184/0
Marine Mammals	Light Brown	0		19/44/88/0	215/153/52
Reptiles and Amphibians	Red	135		0/100/56/0	216/0/67
Terrestrial Mammals	Light Brown	90		19/44/88/0	215/153/52

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
- 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
- 9B SHELTERED VEGETATED LOW BANKS
- 10D MANGROVES
- SALT- AND BRACKISH-WATER MARSHES
- FRESHWATER MARSHES
- FRESHWATER SWAMPS
- FRESHWATER SCRUB/SHRUB

STREAM REACHES (RSI)

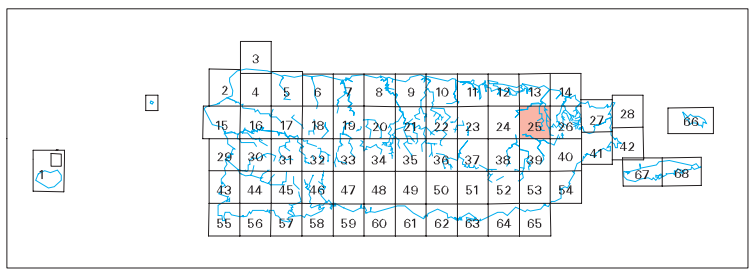
- 1 QUIET POOL; LOW-SENSITIVE BANKS
- 2 STRAIGHT CHANNEL WITH CURRENTS; LOW-SENSITIVE BANKS (MUD DOMINANT)
- 3 MEANDERING CHANNEL; SAND POINT BARS
- 4 MEANDERING CHANNEL; VEGETATED POINT BARS
- 5 RAPIDS OVER BEDROCK
- 6 MEANDERING CHANNEL; SAND AND GRAVEL POINT BARS
- 7 SPLIT CHANNEL WITH COARSE GRAVEL; SOME RAPIDS
- 8 SMALL FALLS; BOULDERS IN CHANNEL
- 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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Office of Response and Restoration
Hazardous Materials Response Division

GURABO, P.R. (1982) PR-25

PUERTO RICO - ESIMAP 25

BIOLOGICAL RESOURCES:

BIRD:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting
125	Common moorhen			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Pied-billed grebe			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Ruddy duck	S	T	LOW	X	X	X	X	X	X	X	X	X	X	X	X	-
136	Puerto Rican plain pigeon	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X	FEB-JUN

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
29	Native stream fish				X	X	X	X	X	X	X	X	X	X	X	X	APR-MAY	APR-MAY	APR-MAY	JAN-DEC	JAN-DEC
																	AUG-NOV	AUG-NOV	AUG-NOV		
125	Channel catfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC
	Largemouth bass				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC
	Peacock bass				X	X	X	X	X	X	X	X	X	X	X	X	APR-NOV	APR-NOV	APR-NOV	JAN-DEC	JAN-DEC
	Redear sunfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	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
	White catfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC

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	APR-MAY	-	JAN-DEC	JAN-DEC
																	AUG-NOV	AUG-NOV			
	Native stream shrimp				X	X	X	X	X	X	X	X	X	X	X	X	APR-MAY	APR-MAY	APR-MAY	JAN-DEC	JAN-DEC
																	AUG-NOV	AUG-NOV	AUG-NOV		

HUMAN USE RESOURCES:

FOREST:

HUN#	Name	Owner/Manager	Contact	Phone
62	CARIBBEAN NATIONAL FOREST	USFS	FOREST BIOLOGIST	787/888-5659

WATER INTAKE:

HUN#	Name	Owner/Manager	Location	Phone
142	BARAZAS PARTIAL PLANT	PRASA		

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.

SENSITIVE BIOLOGICAL RESOURCES

BIRD
- Alcid / Pelagic Bird
- Diving Bird
- Gull / Tern
- Passerine Bird
- Raptor
- Shorebird
- Wading Bird
- Waterfowl

TERRESTRIAL MAMMAL
- Bear
- Deer
- Small Mammal

MARINE MAMMAL
- Dolphin
- Manatee
- Polar Bear
- Sea Otter
- Seal / Sea Lion
- Whale

REPTILE / AMPHIBIAN
- Alligator / Crocodile
- Turtle
- Other Reptiles / Amphibians

FISH
- Fish
- Nursery Area

SHELLFISH AND INSECT
- Bivalve
- Crab
- Echinoderm
- Gastropod
- Lobster/ Crayfish
- Shrimp
- Squid/ Octopus
- Insect

HABITAT
- Coral/ Hardbottom Reef
- Floating Aquatic Vegetation
- Rare Plant
- Submerged Aquatic Vegetation

HUMAN-USE FEATURES

- Access
- Airport
- Aquaculture
- Archaeological Site
- Beach
- Boat Ramp
- Camping
- Coast Guard
- Commercial Fishing
- Diving
- Factory
- Ferry
- Historical Site
- Hoist
- Indian Reservation / Tribal Land
- Logging
- Marina
- Marine Sanctuary
- Mining
- National Park
- Park
- Recreational Fishing
- Special Management Area
- Subsistance Fishing
- Water Intake
- Wildlife Refuge, Reserve, Preserve
- National or State Boundary
- Park or Refuge Boundary

Figure 11. ESI symbols for representing the biological and human-use resources.

Figure 22: Environmental Sensitivity Map Zoom In - Dike C

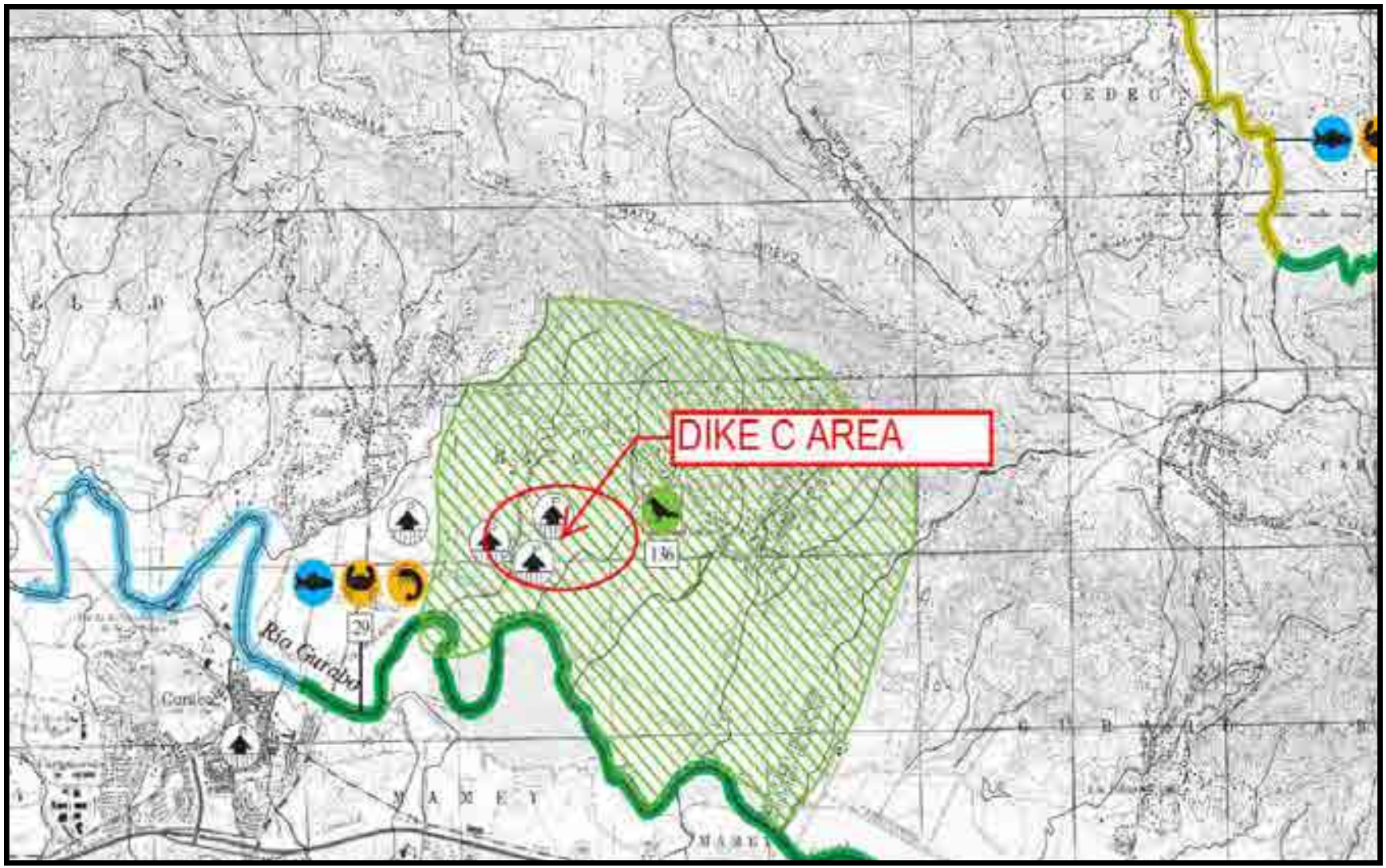

FIGURE 22
ENVIRONMENTAL SENSITIVITY INDEX MAP
ZOOM IN - DIKE C

CARRAÍZO RESERVOIR DREDGING PROJECT
HATO NUEVO WARD, GURABO

N
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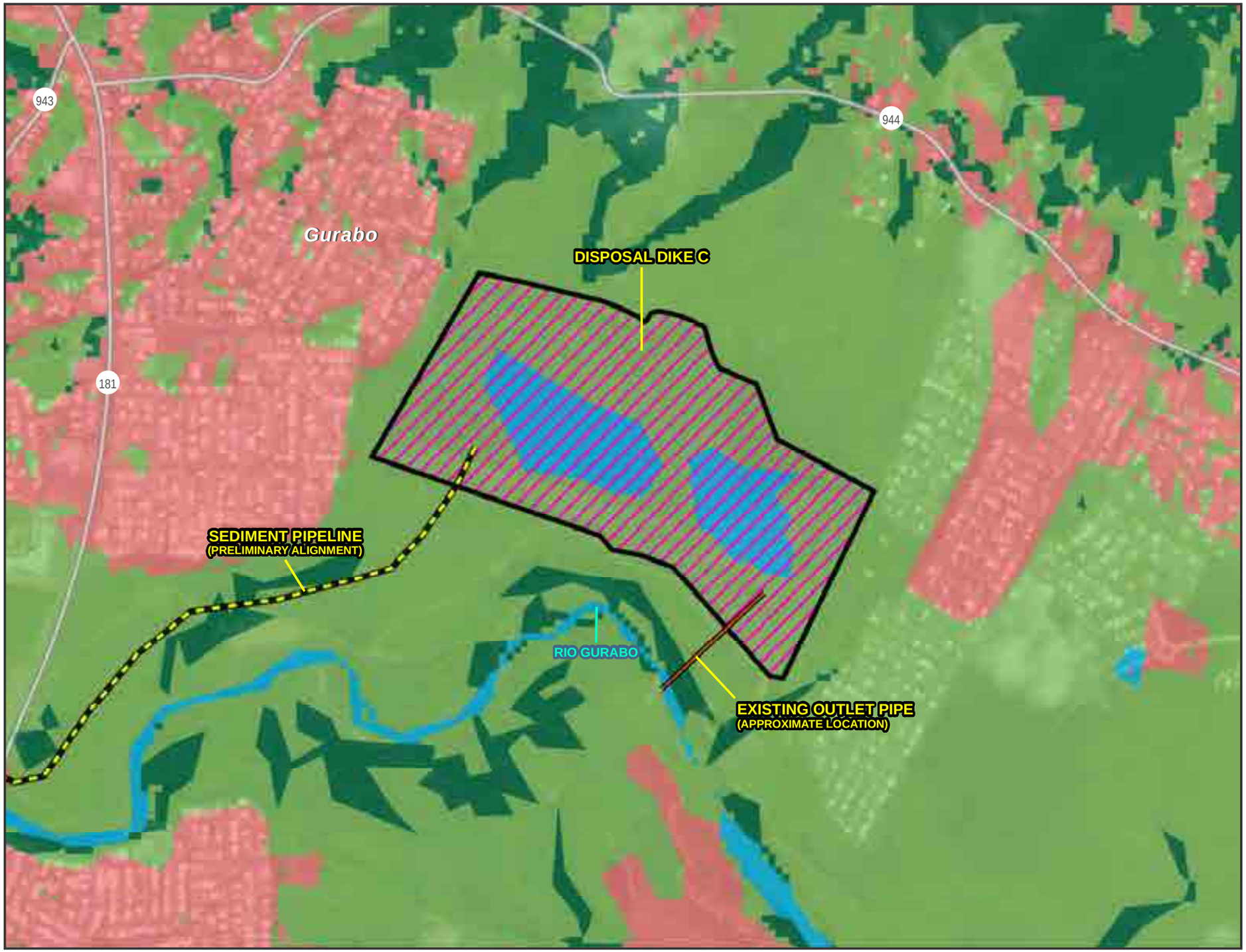
S

Figure 23: Land Cover within the Vicinity of Dike C



Descriptive Study of Flora and Fauna
Carraízo Reservoir Dredging Project
Figure 23: Land Cover within the Vicinity of Dike C

N
W E
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1:10,000

0 0.125 0.25 mi

Legend

- Sediment Pipeline
- Oulet Pipe
- Disposal Dike
- State Road[1]

Land Cover[2]

- Forest
- Developed Land
- Wetland
- Pasture and Shrub

Sources:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. University of Puerto Rico and Puerto Rico Planning Board, 2006.
3. Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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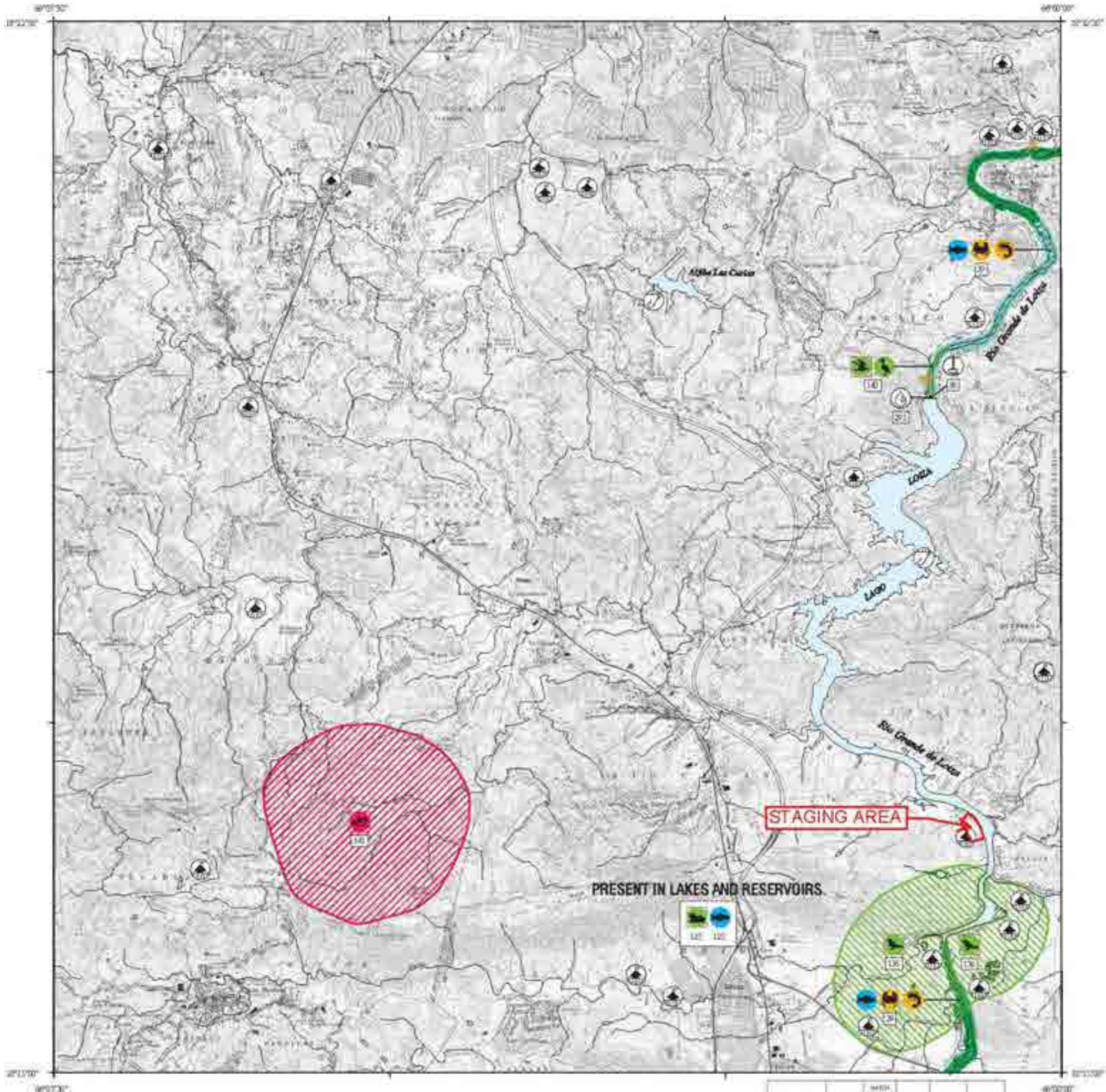
Figure 24: Environmental Sensitivity Map of the Staging Area

ENVIRONMENTAL SENSITIVITY INDEX MAP



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
- 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
- 9B: SHELTERED VEGETATED LOW BANKS
- 10: MANGROVES
- SALT- AND BRACKISH-WATER MARSHES
- FRESHWATER MARSHES
- FRESHWATER SWAMPS
- FRESHWATER VEGETATION

STREAM REACHES (RSI)

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

SCALE 1:55000

1 0 1 KILOMETER

1 0 1 MILE

Not For Navigation

Published: May 2000

Published at Seattle, Washington
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
Hazardous Materials Response Division

AGUAS BUENAS, P.R. (1982) PR-24

PUERTO RICO - ESIMAP 24

BIOLOGICAL RESOURCES:

BIRD:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting
125	Common moorhen			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Pied-billed grebe			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Ruddy duck	S	T	LOW	X	X	X	X	X	X	X	X	X	X	X	X	-
136	Puerto Rican plain pigeon	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X	FEB-JUN
140	Brown pelican	S/F	E/E		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	-

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
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
125	Channel catfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC
	Largemouth bass				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC
	Peacock bass				X	X	X	X	X	X	X	X	X	X	X	X	APR-NOV	APR-NOV	APR-NOV	JAN-DEC	JAN-DEC
	Redear sunfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	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
	White catfish				X	X	X	X	X	X	X	X	X	X	X	X	FEB-AUG	FEB-AUG	FEB-AUG	JAN-DEC	JAN-DEC

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

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
141	Mottled coqui	S	T		X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	JAN-DEC

HUMAN USE RESOURCES:

LOCK AND DAM:

HDR#	Name	Owner/Manager	Contact	Phone
86	LOIZA DAM	PRASA	ING.JAVIER GARCIA	787/761-8710

WATER INTAKE:

HDR#	Name	Owner/Manager	Location	Phone
292	SERGIO CUEVAS PLANT, CARRAIZO INTAKE	PRASA	PR 175, KM 3.0	787/761-8710

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.

SENSITIVE BIOLOGICAL RESOURCES

BIRD
- Alcid / Pelagic Bird
- Diving Bird
- Gull / Tern
- Passerine Bird
- Raptor
- Shorebird
- Wading Bird
- Waterfowl

TERRESTRIAL MAMMAL
- Bear
- Deer
- Small Mammal

MARINE MAMMAL
- Dolphin
- Manatee
- Polar Bear
- Sea Otter
- Seal / Sea Lion
- Whale

REPTILE / AMPHIBIAN
- Alligator / Crocodile
- Turtle
- Other Reptiles / Amphibians

FISH
- Fish
- Nursery Area

SHELLFISH AND INSECT
- Bivalve
- Crab
- Echinoderm
- Gastropod
- Lobster/ Crayfish
- Shrimp
- Squid/ Octopus
- Insect

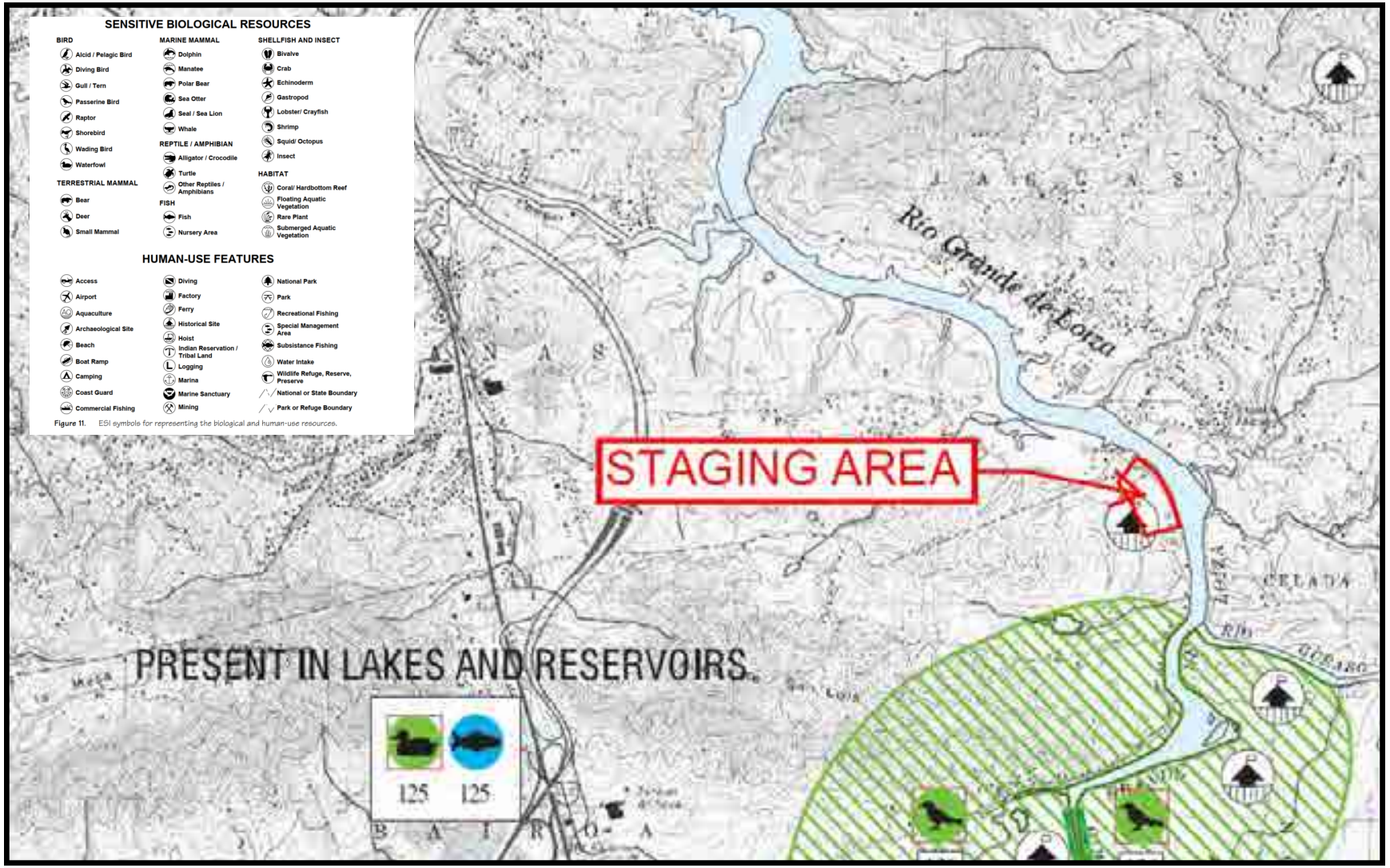
HABITAT
- Coral/ Hardbottom Reef
- Floating Aquatic Vegetation
- Rare Plant
- Submerged Aquatic Vegetation

HUMAN-USE FEATURES

- Access
- Airport
- Aquaculture
- Archaeological Site
- Beach
- Boat Ramp
- Camping
- Coast Guard
- Commercial Fishing
- Diving
- Factory
- Ferry
- Historical Site
- Hoist
- Indian Reservation / Tribal Land
- Logging
- Marina
- Marine Sanctuary
- Mining
- National Park
- Park
- Recreational Fishing
- Special Management Area
- Subsistance Fishing
- Water Intake
- Wildlife Refuge, Reserve, Preserve
- National or State Boundary
- Park or Refuge Boundary

Figure 11. ESI symbols for representing the biological and human-use resources.

Figure 25: Environmental Sensitivity Map Zoom In - Staging Area



ENVIRONMENTAL SENSITIVITY INDEX MAP
ZOOM IN - STAGING AREA

CARRAÍZO RESERVOIR DREDGING PROJECT
RÍO CAÑAS WARD, CAGUAS

N
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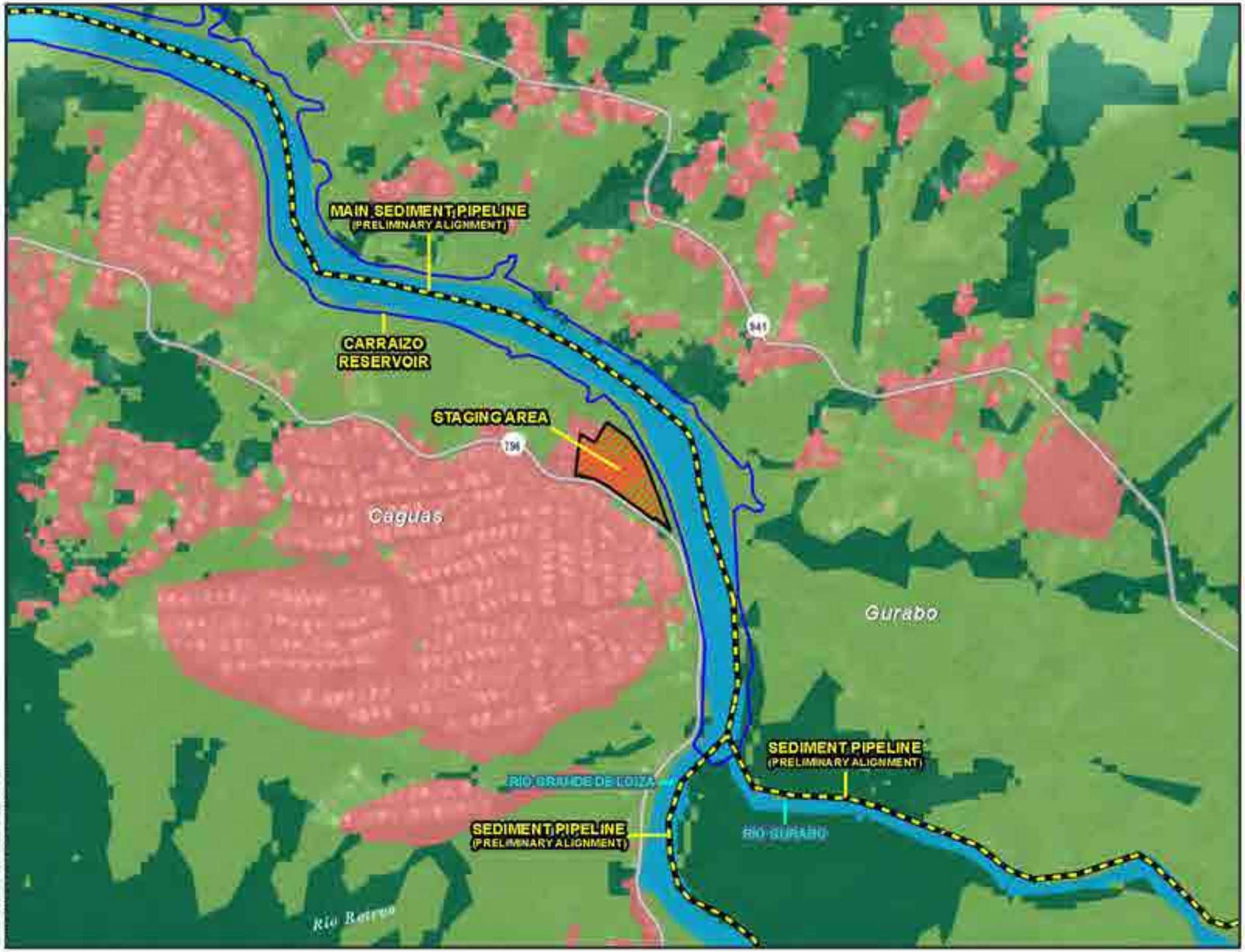
Figure 26: Land Cover within the Vicinity of the Staging Area



Descriptive Study of Flora and Fauna Carraizo Reservoir Dredging Project

Figure 26: Land Cover within the Vicinity of the Staging Area

N
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1:10,000

0 0.125 0.25 mi

Legend

- Carraizo Reservoir
- Sediment Pipeline
- Staging Area
- State Road[1]

Land Cover[2]

- Forest
- Developed Land
- Wetland
- Pasture and Shrub

Source:
1. Puerto Rico Highways and Transportation Authority (PRHTA), 2020.
2. University of Puerto Rico and Puerto Rico Planning Board, 2005.
3. Service Layer Credit: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Appendix B: Flora and Fauna Inventory

Flora Carraízo Reservoir Dredging Project							
Family	**Scientific Name**	**Common Name**	**Status**	**Dike A**	**Dike B**	**Dike C**	**Staging Area**
Amaranthaceae	*Achyranthes aspera* L.var. pubescens (Moq.) C.C. Towns	D	I	X	X	X	
Pteridaceae	*Acrostichum aureum* L.	Palmita de río	N		X		
Fabaceae-Mimosidae	*Albizia procera* (Roxb.) Benth.	Albicia	I	X	X	X	X
Amaranthaceae	*Amaranthus dubius* Mart. Ex Thel.	Blero blanco	I	X	X	X	
Fabaceae-Faboideae	*Andira inermis* (W. Wright) Kunth ex DC.	Moca	N	X			
Polygonaceae	*Antigonon leptopus* Hook. & Arn.	Coral	I	X			
Moraceae	*Artocarpus altilis* (Parkinson) Fosberg	Pana	I				X
Poaceae	*Arundo donax* L.	Guajana	I			X	X
Apocynaceae	*Asclepias curassavica* L.	Algodoncillo	I			X	
Poaceae	*Bambusa vulgaris* Schrad. Ex J.C. Wendl.	Bambú	I		X	X	X
Asteraceae	*Bidens pilosa* L.	Margarita	I	X		X	X
Blechnaceae	*Blechnum polypodioides* Raddi	D	N		X		
Poaceae	*Bothriochloa pertusa* (L.) Camus	Yerba huracán	I	X		X	X
Boraginaceae	*Bourreria succulenta* Jacq.	Palo de vaca	N		X		
Fabaceae-Faboidae	*Calopogonium caeruleum (* Benth.) C. Wright in Sauvalle	D	N			X	
Sapindaceae	*Cardiospermum halicababum* L. var. *microcarpum* (Kunth) Blume	Farolito	N	X			
Salicaceae	*Casearia decandra* Jacq.	Caracolillo	N			X	
Salicaceae	*Casearia guianensis* (Aublet) Urban	Cafeíllo	N	X	X	X	X
Salicaceae	*Casearia sylvestris* Sw.	Cafeíllo cimarrón	N	X	X	X	X
Poaceae	*Cenchrus purpureus* (Schumach.) Morrone	Yerba elefante	I	X	X		X
Fabaceae-Faboidae	*Centrosema plumieri* (Turpin ex. Pers.) Benth.	Flor de conchitas	N	X	X	X	X
Fabaceae-Faboidae	*Centrosema pubescens* Benth.	Flor de conchitas	N	X			
Fabaceae-Faboidae	*Centrosema virginianum* (L.) Benth.	Conchita de Virginia	I	X	X	X	X
Solanaceae	*Cestrum diurnum* L.	Galán de día	N	X	X		
Poaceae	*Chloris barbata* Sw.	Horquetilla morada	N			X	X
Poaceae	*Chloris radiata* (L.) Sw.	Grama de costa	N	X			X
Asteraceae	*Chromolaena odorata* (L.) R.M. King & H. Rob.	Cariaquillo Santa María	N			X	
Vitaceae	*Cissus verticillata (L.)* Nicolson & Jarvis	Bejuco de caro	N	X	X	X	X
Verbenaceae	*Citharexylum spinosum* L.	Péndula	N	X		X	X
Rutaceae	*Citrus x aurantifolius* (Christm.) Swingle (pro sp.)	Limón	I	X			
Araceae	*Colocasia esculenta* (L.) Schott in Schott & Endlicher	Malanga	I	X			X
Commelinaceae	*Commelina diffusa* Burm. F.	Cohítre	N			X	X
Commelinaceae	*Commelina erecta* L.	Cohitre azul	N	X		X	
Boraginaceae	*Cordia dentata* Poir.	Capá blanco	N	X	X	X	

Family	Scientific Name	Common Name	Status	Dike A	Dike B	Dike C	Staging Area
Boraginaceae	*Cordia sulcata* DC.	Moral	N		X	X	
Asteraceae	*Cosmos sulphureus* Cav.	Cosmos	I				X
Fabaceae-Faboidae	*Crotalaria retusa* L.	Cascabelillo	I	X	X	X	X
Sapindaceae	*Cupania americana* L.	Guara	N		X	X	X
Asteraceae	*Cyanthillium cinereum* (L.) H. Rob.	Rabo de buey	I	X			X
Poaceae	*Cynodon dactylon* (L.) Pers.	Yerba de Bermuda	I	X	X	X	X
Cyperaceae	*Cyperus esculentus* L.	Chufas	N			X	
Cyperaceae	*Cyperus imbricatus* Retz.	D	N	X	X		X
Cyperaceae	*Cyperus iria* L.	D	I	X			X
Cyperaceae	*Cyperus ochraceus* Vahl	D	N	X			X
Cyperaceae	*Cyperus odoratus* L.	D	N	X	X	X	X
Poaceae	*Dactyloctenium aegyptium* (L.) Willd.	Yerba egipcia	I				X
Fabaceae-Faboidae	*Desmodium axillare* (Sw.) DC. var. *axillare*	Zarzabacoa del monte	N			X	X
Poaceae	*Dichanthium annulatum* (Forssk.) Stapf in Prain	Pajón	I			X	
Poaceae	*Digitaria ciliaris* (Retz.) Koeler	Pendejuelo	N				
Poaceae	*Echinochloa colona* (L.) Link	Arrocillo	N	X			X
Pontederiaceae	*Eichhornia crassipes* (Mart.) Solms in A. & C. de Candolle	Jacinto de agua	I			X	
Cyperaceae	*Eleocharis mutata* (L.) Roem. & Schult.	D	N		X	X	
Poaceae	*Eleusine Indica* (L.) Gaernt.	Pata de gallina	I	X	X		X
Asteraceae	*Emilia sonchifolia* (L.) DC. in Wight	Yerba socialista	I				X
Poaceae	*Eragrostis tenella* (L.) P. Beauv. ex Roem. & Schult.	Yerba de amor	I				X
Myrtaceae	*Eugenia biflora* (L.) DC.	Hoja menuda	N			X	
Euphorbiaceae	*Euphorbia hyssopifolia* L.	Lechera	N	X			X
Rubiaceae	*Genipa americana* L.	Jagua	N			X	
Fabaceae-Faboidae	*Gliricidia sepium* (Jacq.) Kunth in Walpers	Mata ratón	I				X
Poaceae	*Gynerium sagittatum*	Caña brava	N	X			
Nyctaginaceae	*Guapira fragrans* (Dum. Cours.) Little	Corcho	N			X	X
Meliaceae	*Guarea guidonia* (L.) Sleumer	Guaraguao	N		X	X	
Poaceae	*Hymenachne amplexicaulis* (Rudge) Nees	Trompetilla	N	X		X	X
Convolvulaceae	*Ipomoea indica* (Burm.) Merr. var. *acuminata* (Vahl)	Bejuco de gloria	N	X		X	X
Convolvulaceae	*Ipomoea purpurea* (L.) Roth	D	N	X		X	
Convolvulaceae	*Ipomoea setifera* Poir.	Bejuco de puerco	N		X	X	X
Convolvulaceae	*Ipomoea triloba* L.	Bejuquillo de puerco	N			X	X
Euphorbiaceae	*Jatropha gossypiifolia* L.	Higuereta cimarrona	N	X	X	X	
Cyperaceae	*Kyllinga brevifolia* Rottb.	D	N		X	X	

Family	Scientific Name	Common Name	Status	Dike A	Dike B	Dike C	Staging Area
Cyperaceae	*Kyllinga pumila* Michx.	D	N	X		X	X
Cyperaceae	*Kyllinga nemoralis* (J.R. Forst. & G. Forst) Dandy ex Hutch. & Dalziel	D	N	X	X	X	X
Verbenaceae	*Lantana camara* L.	Cariaquillo	N	X		X	
Fabaceae-Mimosidae	*Leucaena leucocephala* (Lam.) DeWitt	Tamarindillo	I	X		X	X
Onagraceae	*Ludwigia octovalvis* (Jacq.) P.H. Raven	Cangá	N		X		X
Fabaceae-Faboidae	*Macroptilium lathyroides* (L.) Urb.	Habichuela parada	I	X	X		
Malvaceae	*Malachra alceifolia* Jacq.	Malva de caballo	N				X
Malvaceae	*Malvastrum americanum* (L.) Torr. In Emory	Malva silvestre	I				X
Poaceae	*Megathyrsus maximus* (Jacq.) R. D. Webster	Yerba de Guinea	I	X	X	X	
Convolvulaceae	*Merremia quinquefolia* (L.) Hallier f.	Batatilla blanca	I	X	X	X	X
Asteraceae	*Mikania congesta* DC.	Guaco Falso	N	X	X	X	X
Asteraceae	*Mikania micrantha* Kunth in Humboldt	Guaco falso	N			X	
Fabaceae-Mimosidae	*Mimosa casta* L.	Zarza	N	X	X	X	X
Fabaceae-Mimosidae	*Mimosa ceratonia* L.	Zarza	N			X	
Fabaceae-Mimosidae	*Mimosa pellita* HBK	D	N	X	X	X	X
Fabaceae-Mimosidae	*Mimosa pudica* L.	Moriviví	N	X	X	X	X
Cucurbitaceae	*Momordica charantia* L.	Cundeamor	I	X	X	X	X
Lomariopsidaceae	*Nephrolepis brownii* (Sw.) Schott	D	I		X		
Poaceae	*Paspalum conjugatum* P.J. Bergius	Horquetilla	N	X	X	X	X
Poaceae	*Paspalum dilatatum* Poir	Yerba dalis	I	X		X	X
Poaceae	*Paspalum fasciculatum* Willd. Ex Fluggé	Yerba venezolana	N	X	X		
Poaceae	*Paspalum laxum* Lam.	Matojo de arena	N		X		
Poaceae	*Paspalum paniculatum* L.	Arrocillo	N	X			
Passifloraceae	*Passiflora suberosa* L.	Parcha yedra	N			X	
Fabaceae-Caesalpinioideae	*Peltophorum pterocarpum* (DC.) Backer ex K. Heyne	Flamboyán amarillo	I			X	
Verbenaceae	*Phyla nodiflora* (L.) Greene	Yerba de sapo	N		X		
Euphorbiaceae	*Phyllanthus niruri* L.	Quinino del pobre	N	X			X
Piperaceae	*Piper aduncum* L.	Higuillo	N			X	X
Piperaceae	*Piper amalago* L.	Higuillo de limón	N			X	
Araceae	*Pistia stratiotes* L.	Lechuga de río	N				X
Polygonaceae	*Polygonum glabrum* Wild.	Yerba de jicotea	N				X
Polygonaceae	*Polygonum punctatum Elliott*	Yerba de jicotea	N	X			X
Portulacaceae	*Portulaca oleracea* L.	Verdolaga	I	X			
Myrtaceae	*Psidium guajava* L.	Guayaba	I	X	X	X	X
Rubiaceae	*Randia aculeata* L.	Tintillo	N			X	

Family	Scientific Name	Common Name	Status	Dike A	Dike B	Dike C	Staging Area
Cyperaceae	*Rhynchospora holoschoenoides* (Rich.) Herter	D	N		X		
Euphorbiaceae	*Ricinus communis* L.	Higuereta	I	X			X
Palmae	*Roystonea borinquena* O.F. Cook	Palma real	N		X	X	X
Fabaceae-Mimosidae	*Samanea saman* (Jacq.) Merr.	Samán	I	X			X
Araliaceae	*Schefflera morototoni* (Aubl.) Maguire	Yagrumo macho	N	X			
Cyperaceae	*Scleria microcarpa* Nees ex Kunth	D	N	X			
Fabaceae-Caesalpinioideae	*Senna alata* (L.) Roxb.	Talantalan	I	X	X	X	
Fabaceae-Caesalpinioideae	*Senna bicapsularis* (L.) Roxb. Var. *bicapsularis*	Sen del país	N			X	
Fabaceae-Caesalpinioideae	*Senna hirsuta* (L.) H.S. Irwin & Barneby var. *hirsuta*	Hedionda cimarrona	N	X		X	
Fabaceae-Caesalpinioideae	*Senna obtusifolia* (L.) H.S. Irwin & Barneby	Dormidera	N	X	X	X	X
Fabaceae-Caesalpinioideae	*Senna occidentalis (L.) Link*	Hedionda	N	X	X	X	X
Fabaceae-Caesalpinioideae	*Senna siamea* (Lam.) H.S. Irwin & Barneby	Casia de Siam	I	X	X	X	
Poaceae	*Setaria parviflora* (Poir.) Kerguélen	Deshollinador	N				X
Malvaceae	*Sida abutifolia* Mill.	D	N		X		
Malvaceae	*Sida acuta* Burm. f.	Escoba blanca	N			X	X
Malvaceae	*Sida rhombifolia* L.	Escoba colorada	N		X	X	X
Malvaceae	*Sida urens* L.	D	N			X	X
Solanaceae	*Solanum mammosum* L.	Berenjena de cucarachas	N	X	X	X	X
Solanaceae	*Solanum torvum* Sw.	Berenjena cimarrona	I	X	X	X	X
Bignoniaceae	*Spathodea campanulata* Beauv.	Tulipán africano	I	X	X	X	X
Anacardiaceae	*Spondias mombin* L.	Jobillo	I			X	X
Poaceae	*Sporobolus indicus* (L.) R. Br.	Cerrillo	N		X		X
Araceae	*Syngonium podophyllum* Schott.	Malanga trepadora	I	X			X
Combretaceae	*Terminalia catappa* L.	Almendro	I			X	X
Acanthaceae	*Thunbergia alata* Boger ex Sims	Ojo de poeta	I				X
Boraginaceae	*Tournefortia hirsutissima* L.	Nigua	N	X	X	X	X
Meliaceae	*Trichilia hirta* L.	Cabo de hacha	N			X	
Phytolaccaceae	*Trichostigma octandrum* (L.) H. Walt.	Bejuco de nasa	N			X	
Typhaceae	*Typha domingensis* Pers.	Hierba de enéas	I		X		
Malvaceae	*Urena lobata* L.	Cadillo	N	X	X	X	X
Poaceae	*Urochloa mutica* (Forssk.) T.Q. Nguyen	Malojillo	I		X		X
Fabaceae-Mimosidae	*Vachellia farnesiana* (L.) Wight & Arn.	Aroma	N	X			
Fabaceae	*Vigna hosei* (Craib) Backer & Heyne	D	I				X
Fabaceae-Faboidae	*Vigna vexillata* (L.) Rich. in Sagra	Frijol cimarrón	N	X		X	X
Araceae	*Xanthosoma undipes* (K.Koch & C.D. Bouché)	Yautía rascana	N		X		

Family	Scientific Name	Common Name	Status	Dike A	Dike B	Dike C	Staging Area
Rutaceae	*Zanthoxylum martinicense* (Lam.) DC.	Cenizo	N	X	X	X	
Leyenda:							
I: Introducido							
N: Nativo							

Fauna Carraízo Reservoir Dredging Project						
Scientific Name	**Common Name**	**Status**	**Dike A**	**Dike B**	**Dike C**	**Staging Area**
VERTEBRATES						
Birds						
Accipitridae						
Buteo jamaicensis	Guaraguao colirrojo	R	X	X	X	X
Alcedinidae						
Megaceryle alcyon	Martín pescador	M	X			X
Ardeidae						
Ardea alba	Garza real	R		X	X	X
Ardea herodias	Garzón cenizo	R		X		
Bubulcus ibis	Garza ganadera	R	X	X	X	X
Butorides virescens	Martinete	R	X	X	X	X
Egretta thula	Garza blanca	R		X	X	X
Nyctanassa violacea	Yaboa común	R				X
Charadriidae						
Charadrius vociferus	Playero sabanero	R	X			
Coerebidae						
Coereba flaveola	Reinita común	R	X	X	X	X
Spindalis portoricensis	Reina mora	E		X		
Columbidae						
Columbina passerina	Rolita	R	X	X	X	X
Patagioenas inornata	Paloma sabanera de Puerto Rico	E, EE, EF			X	
Patagioenas squamosa	Paloma turca	R	X	X	X	X
Zenaida asiatica	Tórtola aliblanca	R	X	X	X	X
Zenaida aurita	Tórtola cardosantera	R	X		X	X
Cuculidae						
Crotophaga ani	Judío	R		X	X	X
Estrildidae						
Estrilda melpoda	Veterano	IE	X			X
Spermestes cucullata	Diablito	IE			X	
Falconidae						
Falco sparverius	Falcón común	R				X
Hirundinidae						
Petrochelidon fulva	Golondrina de cuevas	R			X	
Icteridae						

Scientific Name	Common Name	Status	Dike A	Dike B	Dike C	Staging Area
Molothrus bonariensis	Tordo lustroso	IE				X
Quiscalus niger	Chango	R	X	X	X	X
Laridae						
Sterna hirundo	Gaviota común	R				X
Mimidae						
Margarops fuscatus	Zorzal pardo		X		X	
Mimus polyglottos	Ruisenor	R	X		X	X
Pandionidae						
Pandion haliaetus	Aguila pescadora	M	X			X
Parullidae						
Setophaga americana	Reinita pechidorada	M			X	
Setophaga discolor	Reinita galana	M	X			
Pelecanidae						
Pelecanus occidentalis	Pelícano pardo	R				X
Picidae						
Melanerpes portoricensis	Pájaro carpintero de P.R.	E		X	X	X
Podicipedidae						
Podilymbus podiceps	Zaramago	R				X
Psittacidae						
Brotogeris versicolurus	Perico aliamarillo	IE	X	X		
Myiopsitta monachus	Perico monje	IE		X	X	
Rallidae						
Gallinula chloropus	Gallareta común	R		X	X	X
Thraupidae						
Sicalis flaveola	Gorrión azafrán	I	X			
Tiaris bicolor	Chamorro negro	R	X	X	X	X
Throchilidae						
Anthracothorax dominicus	Zumbador dorado	R	X			
Turdidae						
Turdus plumbeus	Zoral de patas coloradas	R				X
Tyrannidae						
Elaenia martinica	Juí blanco	R				X
Contopus latirostris	Bobito antillano menor	R				X
Myarchus antillarum	Juí de P.R.	E		X	X	X
Tyrannus caudifasciatus	Clérigo	R				X

Scientific Name	Common Name	Status	Dike A	Dike B	Dike C	Staging Area
Tyrannus dominicensis	Pitirre	R	X		X	X
Viduidae						
Vidua macroura	Viuda colicinta	IE	X	X		
Vireonidae						
Vireo altiloquus	Julián chiví	R			X	
Reptiles						
Emydidae						
Trachemys stejnegeri	Jicotea	N, EC				X
Iguanidae						
Iguana iguana	Iguana	I	X	X	X	X
Dactyloidae						
Anolis cristatellus	Lagartijo común	R	X	X	X	X
Anolis pulchellus	Lagartijo de hierbas	R	X	X		X
Anolis stratulus	Lagartijo manchado	R			X	
Amphibians						
Bufonidae						
Rhinella marina	Sapo común	I				X
Eleuntherodactylidae						
Eleutherodactylus antillensis	Coquí churí	E	X	X	X	X
Eleutherodactylus brittoni	Coqui de las yerbas	E		X		X
Eleutherodactylus coqui	Coquí común	E	X	X	X	X
Leptodactylus albilabris	Ranita de labio blanco	R	X	X		X
INVERTEBRATES						
Insects						
Apoidea						
Apidae						
Apis mellifera	Abeja	R	X	X	X	X
Xylocopa mordax	Cigarrón	R	X	X	X	X
Blattoidea						
Termitidae						
Nasutitermes costalis	Comején	R	X	X	X	X

Scientific Name	Common Name	Status	Dike A	Dike B	Dike C	Staging Area
Gryllidae						
Gryllus assimilis	Grillo	R		X	X	X
Colinidae						
Kricogonia lyside	Mariposa	R		X		
Erebidae						
Utetheisa ornatrix	Mariposa	R			X	
Hesperiidae						
Chorantus vitellius	Mariposa	E	X		X	X
Pyrgus oileus	Mariposa	R			X	
Nymphalidae						
Agraulis vanillae insularis	Mariposa del Golfo de México	N	X	X	X	
Danaus plexippus portoricensis	Mariposa monarca de P.R.	N	X	X	X	
Heliconius charitonia charitonia	Mariposa zebra	N		X	X	X
Hemiargus hanno watsoni	Mariposa	N	X			X
Siproeta stelenes	Malaquita	R			X	
Pieridae						
Aphrissa statira cubana	Mariposa migratoria	N	X	X	X	
Ascia monuste eubotea	Mariposa	N				
Phyrisitia portoricensis	Mariposa	E	X	X	X	
Odonata						
Anisoptera						
Libellulidae						
Brachymesia furcata	Libélula de cola roja	R	X			
Erythemis vesiculosa	Libélula	R			X	
Erythrodiplax umbrata	Libélula	R	X	X	X	X
Orthemis sp.	Libélula	R	X			
Coenagrionidae						
Ischnura ramburii	Damisela de Rambur	R		X		
Orthoptera						
Acrididae						
Schitocerca sp.	Saltamonte	R				X

Leyenda:						
E: Endémica para Puerto Rico						
I: Introducida						
IE: Introducida establecida						
N: Nativa						
R: Residente						

Appendix C: Information for Planning and Consultation (IPaC)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Caribbean Ecological Services Field Office
Post Office Box 491
Boqueron, PR 00622-0491
Phone: (787) 851-7297 Fax: (787) 851-7440
http://www.fws.gov/caribbean/es

In Reply Refer To: January 17, 2022
Consultation Code: 04EC1000-2022SLI0262
Event Code: 04EC10002022-E-00349
Project Name: Carraizo Reservoir Dredging Project

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

THE FOLLOWING SPECIES LIST IS NOT A SECTION 7 CONSULTATION. PLEASE CONTACT OUR OFFICE TO COMPLETE THE CONSULTATION PROCESS

The purpose of the Endangered Species Act (Act) is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect those species and/or their designated critical habitat.

Federal agencies are required to "request of the Secretary of Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action". The enclosed species list provides information to assist with the consultation process with the U.S. Fish and Wildlife Service (Service) under section 7 of the Act. However, the enclosed species list **does not complete the required consultation process**. The species list identifies threatened, endangered, proposed and candidate species, as well as proposed and designated critical habitats, that may occur within the boundary of your proposed project and/or may be affected by your proposed project.

A discussion between the Federal agency and the Service should include what types of listed species may occur in the proposed action area, and what effect the proposed action may have on those species. This process initiates informal consultation.

When a Federal agency, after discussions with the Service, determines that the proposed action is not likely to adversely affect any listed species, or adversely modify any designated critical habitat, and the Service concurs, the informal consultation is complete and the proposed project

moves ahead. If the proposed action is suspected to affect a listed species or modify designated critical habitat, the Federal agency may then prepare a Biological Assessment (BA) to assist in its determination of the project's effects on species and their habitat.

However, a BA is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a BA where the agency provides the Service with an evaluation on the likely effects of the action to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a BA are described at 50 CFR 402.12.

If a Federal agency determines, based on its BA or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to further consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species, and proposed critical habitat be addressed within the consultation process.

More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at:

http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in

the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

For more information:

U.S. Fish and Wildlife Service

Caribbean Ecological Services Field Office

Road 301, Km. 5.1 / Bo. Corozo

Boquerón, PR 00622

Telephone: (787) 851-7297

Fax: (787) 851-7440

Email: caribbean_es@fws.gov

http://www.fws.gov/caribbean/es

Send all documents to:

U.S. Fish and Wildlife Service

P.O. Box 491

Boquerón, Puerto Rico 00622

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Caribbean Ecological Services Field Office
Post Office Box 491
Boqueron, PR 00622-0491
(787) 851-7297

Project Summary

Consultation Code: 04EC1000-2022-SLI-0262
Event Code: Some(04EC1000-2022-E-00349)
Project Name: Carraizo Reservoir Dredging Project
Project Type: WATER SUPPLY / DELIVERY
Project Description: Caguas, Gurabo and Trujillo Alto
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@18.29210895,-66.01801142979915,14z

Counties: Caguas, Gurabo, and Trujillo Alto counties, Puerto Rico

Endangered Species Act Species

There is a total of 4 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Birds

NAME	STATUS
Puerto Rican Broad-winged Hawk *Buteo platypterus brunnescens* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5512	Endangered
Puerto Rican Parrot *Amazona vittata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3067	Endangered
Puerto Rican Plain Pigeon *Columba inornata wetmorei* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7955	Endangered

Reptiles

NAME	STATUS
Puerto Rican Boa *Epicrates inornatus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6628 General project design guidelines: https://ecos.fws.gov/ipac/project/DMWAKB5RU5GDBMBNR63QS7HQPU/documents/generated/6757.pdf	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

THERE ARE NO FWS MIGRATORY BIRDS OF CONCERN WITHIN THE VICINITY OF YOUR PROJECT AREA.

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?
The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects
For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical

Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?
If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report
The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Wetlands

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

WETLAND INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE VISIT HTTPS://WWW.FWS.GOV/WETLANDS/DATA/MAPPER.HTML OR CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

Appendix D: General Photographic Documentation of Dike A


Unnamed Road
Rincón
Gurabo


Caguas
Rincón
Gurabo

Appendix E: General Photographic Documentation of Dike B


Acceso al Estación Experimental
Rincón
Sorabo

Appendix F: General Photographic Documentation of Dike C


Jun 17, 2021 12:00:02 PM
Hato Nuevo
Gurabo


Hato Nuevo
Gurabo

Appendix G: General Photographic Documentation of the Staging Area


Barrio
Caguas

U.S. Department of Homeland Security
Federal Emergency Management Agency
FEMA Region II - JRO
FEMA-4336/4339/4473-DR-PR
#501 65, Suite 3
Parque Industrial Buchanan
Guaynabo, PR 00968

December 15, 2021

Marelisa Rivera, Deputy Field Supervisor
US Fish and Wildlife Service
Caribbean Ecological Services Field Office
P.O. Box 491 Boquerón, Puerto Rico 00622

Re: ESA Section 7 Informal Consultation
FEMA Project: PA-02-PR-4339-PW-08535 GM-169882
Applicant: Puerto Rico Aqueduct and Sewer Authority (PRASA)
Title: Carraízo Reservoir Dredging

Dear Ms. Rivera:

The Endangered Species Act of 1973 requires federal agencies to determine the effects of their actions on federally threatened and endangered species or their designated critical habitats, and to take steps to conserve and protect these species. The Federal Emergency Management Agency (FEMA) is notifying your office of the **proposed** work to be completed for the **Carraizo Reservoir Dredging Project** (Project Number 169882) using Public Assistance (PA) funds. FEMA requests a consultation with your office regarding the proposed scope of work and concurrence of **may affect, but not likely to adversely affect** for endangered and threatened species. To aid in your review, FEMA has included project location maps, photographs, and the USFWS IPaC Report for the project area.

Project Information
Due to damages incurred during Hurricane María on September 20th, 2017, the Puerto Rico Aqueduct and Sewer Authority (PRASA), proposes to use contract services to restore the Carraizo Reservoir to pre-disaster function and to approved codes and standards. Proposed restoration includes the removal of sediment accumulated in the reservoir. Removal of sediment is crucial to maintain the Carraizo Reservoir water levels to safe conditions, and to guarantee adequate water supply to Sergio Cuevas Filtration Plant, the second-largest filtration plant in Puerto Rico, serving nearly half the population.

Proposed Workplan for Carraizo Reservoir Dredging Project
The proposed scope of work for this project includes the dredging of sediment from the Lago Loíza Reservoir (commonly known as "Carraizo Reservoir"). The sediment will be

staging areas. Sediment control measures will be installed in the staging, dredging, and disposal areas.

- **Dredging**: The Applicant will dredge a channel at the bottom of the lake to remove approximately 2.0 Mm^3 of sediment along the reservoir using hydraulic dredges with a centrifugal pump.
- **Transportation & Disposal:** Sediment will be transported in a liquid slurry form via pipeline to its final disposal location at three pre-existing dikes that were used in the previous dredging project from 1997 to 1999. The pre-existing dikes are located at [18.25959, -66.008197] [18.270174, -65.98996] and [18.263986, -65.953448]. The pipeline sections will be installed on floating platforms and/or in the easement along the river. Intermediate booster pump stations will be placed along the pipeline on floating platforms and/or in the easement along the river. Proposed activities include the demolition and reconstruction of weir outlet structures at the existing dikes to manage decanted water from the dredged sediment, returning it to the reservoir. Selective vegetation removal and perimeter grading will be performed for disposal dike rehabilitation, and to create slopes toward the outlet structures for drainage. Water decanting management equipment ("geotubes") will be installed.
- **Staging Area:** A proposed staging area ("contractor's operations base"), located at [18.277555, -66.0108] to include clearing and grubbing for the placement of temporary facilities such as office trailers, storage areas, and an access road. It is located at State Road PR-798 in Caguas, Puerto Rico.
- **Temporary Dock:** Ground disturbance of 420 m^2 (26.26m L x 15.97m W x 0.20m D) is proposed for the construction of a temporary dock at the staging area. The temporary dock will be used for barges, equipment staging, fueling, and operations and is located at [18.277636, -66.0099].
- **Support Vessel:** A support vessel will be used to transport personnel, equipment, and to fuel. This vessel will travel from temporary dock to the dredge several times per day. The vessel will also assist in dredging maneuvers within the reservoir.

Threatened and Endangered Species & Critical Habitat Review

Per the Flora and Fauna Inventory, performed during diurnal and nocturnal site visits from November 24th through December 4th, 2021, and review of the U.S. Fish and Wildlife Service's Information, Planning, and Consultation System (IPaC), dated 10/19/2021, FEMA has determined that threatened/endangered species and/or critical habitats are present near Carraizo Reservoir Dredging project area. Based on the project location and scope of work, FEMA has made the following determinations, providing that USFWS conservation measures (attached) are implemented:

- Puerto Rican Broad-winged hawk (*Buteo platypterus)* Threatened/Endangered – May affect, not likely to adversely affect
- Puerto Rican Parrot (*Amazona vittata*) Threatened/Endangered – May affect, not likely to adversely affect

- Puerto Rican Plain Pigeon (*Patagioenas inornata wetmorei)* - Threatened/Endangered – May affect, not likely to adversely affect
- Puerto Rican Boa (*Epicrates inoratus*) Threatened/Endangered – May affect, not likely to adversely affect

We need your concurrence with our determination that the proposed action **may affect, but not likely to adversely affect** the previously mentioned species with the application of the BMP's specified in the above document. Should you have any questions please contact Louise Krenciglova at louise.krenciglova@fema.dhs.gov or (202) 538-2235.

Sincerely,

Sindulfo Castillo
Director, Environmental & Historic Preservation Division
DR-4336 & 4339-PR (Hurricanes Irma/María)
DR-4473-PR (Earthquakes)

DR-4473 PR (Earthquakes) Enclosures

- Project location maps
- USFWS Conservation Measures
- USFWS IPaC Reports
- Flora and Fauna Inventory

References

- USFWS IPaC Information for Planning and Consultation https://ecos.fws.gov/ipac/
- USFWS Required Conservation Measures (FEMA Project Conditions)
- USFWS Recovery plan for *Buteo platypterus* (Puerto Rican Broad-winged Hawk), 9/8/1997
- UFFWS Recovery plan for *Patagioenas inornata wetmorei* (Puerto Rican Plain Pigeon), 1982
- UFFWS Recovery plan for *Amazona vittata* (Puerto Rican Parrot), 5/9/2009
- USFWS Recovery plan for *Epicrates inoratus* (Puerto Rican Boa), 3/27/1986

Location Maps, Site Pictures, Supporting Information

Figure 1. Conceptual design of proposed work area, courtesy of Puerto Rico Aqueduct and Sewer Authority

Figure 2. Conceptual design of dredging channel, courtesy of Puerto Rico Aqueduct and Sewer Authority

USFWS Conservation Measures

Puerto Rican Broad-winged hawk (*Buteo platypterus)*, Puerto Rican Parrot (*Amazona vittata*), and Puerto Rican Plain Pigeon (*Patagioenas inornata wetmorei)*
During breeding seasons (see below), nest surveys shall be conducted if a project occurs in a species' range. Nest searches must be conducted by qualified personnel with the appropriate DNER permits prior to start of work. If nesting activity is detected, all construction activities or human disturbance must be avoided within a 200-meter buffer to the closest nest. This avoidance strategy must be kept until fledglings successfully leave the nest permanently.
Outside the nesting season, if a nest is encountered, work shall not interfere with the species until they have left the site. If nesting activity is detected, all construction activities or human disturbance must be avoided within a 200-meter buffer to the closest nest. This avoidance strategy must be kept until juvenile birds fledge the nest and are permanently gone.

Nesting season: Puerto Rican parrot (Amazona vittata): February to June; Puerto Rican plain pigeon (Patagioenas inornata wetmorei [Columba inornata]): April-September; Puerto Rican broad-winged hawk (Buteo platypterus): December-June.

For all nest sightings, the Applicant must record the time and date of the sighting and the specific location where it was found. Data should also include a photo of the nest and eggs, relocation site GPS coordinates, and the time and date of the relocation. All sightings and incidental lethal take reports should be sent to the USFWS Caribbean Ecological Services Field Office, Marelisa Rivera - Deputy Field Supervisor, 787-851-7297 extension 206, 787-510-5207, marelisa_rivera@fws.gov.

Puerto Rican Boa (*Epicrates inoratus)*
Inform all personnel about the potential presence of the PR boa and the VI boa in areas where the proposed work will be conducted. Photographs of the PR and VI Boa are to be prominently displayed at the site. The recipient must ensure that project personnel is able to correctly identify a PR or VI boa. For information on PR boa, please visit: https://ecos.fws.gov/ecp/species/6628. Prior to any construction activity, including removal of vegetation and earth movement, the boundaries of the project area must be delineated, buffer zones, and areas to be excluded and protected, should be clearly marked in the project plan and in the field to avoid further habitat degradation into forested areas. Once areas are clearly marked, and prior to any construction activity, including site preparation, project personnel able to correctly identify a PR or VI boa must survey the areas to be cleared to ensure

that no boas are present within the work area. Vehicle and equipment operation must remain on designated access roads/paths and within rights-of way.

If a PR boa is found within any of the working or construction areas, activities should stop in the area where the boa was found. Do not capture the boa. If boas need to be moved out of harm's way, project personnel designated by the recipient shall immediately contact the Puerto Rico Department of Natural and Environmental Resources (PRDNER) Rangers for safe capture and

relocation of the animal (PRDNER phone #s: 787-724-5700, 787-230-5550, 787-771-1124). If immediate relocation is not an option, project-related activities at this area must stop until the boa moves out of harm's way on its own. Activities at other work sites, where no boas have been found after surveying the area, may continue.

Measures should be taken to avoid and minimize PR boa casualties by heavy machinery or motor vehicles being used on site. Any heavy machinery left on site (staging) or near potential PR boa habitat (within 50 meters of potential boa habitat), needs to be thoroughly inspected each morning before work starts to ensure that no boas have sheltered within engine compartments or other areas of the equipment. If PR boas are found within vehicles or equipment, do not capture the animal and let it move on its own or call PRDNER Rangers for safe capture and relocation of the boa (PRDNER phone #s: 787-724-5700, 787-230-5550, 787-771-1124). If not possible, the animal should be left alone until it leaves the vehicle on its own.

PR boas may seek shelter in debris piles. Measures should be taken to avoid and minimize boa casualties associated with sheltering in debris piles as a result of project activities. Debris piles should be placed far away from forested areas. Prior to moving, disposing or shredding, debris piles should be carefully inspected for the presence of boas. If PR boas are, found within debris piles, do not capture the animal and let it move on its own or call PRDNER Rangers for safe capture and relocation of the animal. If debris piles will be left on site, we recommend they be placed in areas that will not be disturbed in the future.

For all boa sightings (dead or alive), personnel designated by the recipient must record the time and date of the sighting and the specific location where the boa was found. Data should also include a photo of the animal dead or alive, and site GPS coordinates, and comments on how the animal was detected and its behavior. If the PR boa was accidentally killed as part of the project actions, please include information on what conservation measures had been implemented and what actions will be taken to avoid further killings. All boa-sighting reports should be sent to the USFWS Caribbean Ecological Services Field Office, Marelisa Rivera - Deputy Field Supervisor, 787-851-7297 extension 206, 787-510-5207, marelisa_rivera@fws.gov.

EHP - USFWS ESA App for Environmental Consideration

Oct 1 2021 10:45:57 Bolivia Time

Summary

Name	Count	Area(m²)	Length(m)
Critical_Habitat_AGAVE EGGERSIANA	0	0	N/A
Critical_Habitat_GONOCALYX CONCOLOR	0	0	N/A
Critical_Habitat_CATESBAEA MELANOCARPA	0	0	N/A
Critical_Habitat_ANOLIS ROOSEVELTI	0	0	N/A
Critical_Habitat_ELEUTHERODACTYLUS JAPERI	0	0	N/A
Critical_Habitat_ELEUTHERODACTYLUS COOKI	0	0	N/A
Critical_Habitat_ELEUTERODACTYLUS JUANARIVEROI	0	0	N/A
Critical_Habitat_EPICRATES MONENSIS SSP MONENSIS	0	0	N/A
Critical_Habitat_CYCLURA CORNUTA SPP STEJNEGERI	0	0	N/A
Critical_Habitat_SPHAERODACTYLUS MICROPITHECUS	0	0	N/A
Critical_Habitat_VARRONIA RUPICOLA	0	0	N/A
Critical_Habitat_AGELAIUS ZANTHOMUS	0	0	N/A
AGAVE_EGGERSIANA	0	0	N/A
Crescentia_portoricensis	0	0	N/A
Cyathea_dryopteroides	0	0	N/A
Vernonia_proctorii	0	0	N/A
Banara_vanderbiltii	0	0	N/A
Peperomia_wheeleri	0	0	N/A
Harrisia_portoricensis	0	0	N/A
Ilex_sintenisii	0	0	N/A
Ternstroemia_luquillensis	0	0	N/A
Ternstroemia_subsessilis	0	0	N/A
Leptocereus_grantianus	0	0	N/A
Lyonia_truncata_var_proctorii	0	0	N/A
Aristida_chaseae	0	0	N/A
Aristida_portoricensis	0	0	N/A
Mitracarpus_maxwelliae	0	0	N/A
Mitracarpus_polycladus	0	0	N/A
Styrax_portoricensis	0	0	N/A
Cranichis_ricarti	0	0	N/A
Gesneria_pauciflora	0	0	N/A
Calyptronoma_rivalis	0	0	N/A
Eugenia_haematocarpa	0	0	N/A
Eugenia_woodburyana	0	0	N/A
Daphnopsis_hellerana	0	0	N/A

Auerodendron_pauciflorum	0	0	N/A
Myrcia_paganii	0	0	N/A
Lepanthes_eltoroensis	0	0	N/A
Chamaecrista_glandulosa_mirabilis	0	0	N/A
Stahlia_monosperma	0	0	N/A
Adiantum_vivesii	0	0	N/A
Thelypteris_inabonensis	0	0	N/A
Thelypteris_verecunda	0	0	N/A
Thelypteris_yaucoensis	0	0	N/A
Solanum_drymophilum	0	0	N/A
Catesbaea_melanocarpa	0	0	N/A
Goetzea_elegans	0	0	N/A
Callicarpa_ampla	0	0	N/A
Buxus_vahlii	0	0	N/A
Elaphoglossum_serpens	0	0	N/A
Ilex_cookii	0	0	N/A
Cornutia_obovata	0	0	N/A
Ottoschulzia_rhodoxylon	0	0	N/A
Schoepfia_arenaria	0	0	N/A
Varronia_rupicola	0	0	N/A
Cordia_bellonis	0	0	N/A
Juglans_jamaicensis	0	0	N/A
Polystichum_calderonense	0	0	N/A
Tectaria_estremerana	0	0	N/A
Pleodendron_macranthum	0	0	N/A
Trichilia_triacantha	0	0	N/A
Solanum_conocarpum	0	0	N/A
Calyptranthes_thomasiana	0	0	N/A
GONOCALYX_CONCOLOR	0	0	N/A
Zanthoxylum_thomasianum	0	0	N/A
ANOLIS_ROOSEVELTI	0	0	N/A
ELEUTHERODACTYLUS_JAPERI	0	0	N/A
CYCLURA_CORNUTA_SPP_STEJNEGERI	0	0	N/A
EPICRATES_MONENSIS_SSP_MONENSIS	0	0	N/A
SPHAERODACTYLUS_MICROPITHECUS	0	0	N/A
Epicrates_monensis_granti	0	0	N/A
Eleutherodactylus_juanariveroi	0	0	N/A
Atlantea_tulita	0	0	N/A
Selected_Beaches_Turtles_PR	0	0	N/A

Selected_Beaches_Turtles_USVI	0	0	N/A
Trichechus_manatus_VI	0	0	N/A
Agelaius_xanthomus	0	0	N/A
Setophaga_angelae	0	0	N/A
Trichechus_manatus_PR	0	0	N/A
Accipiter_striatus_venator	0	0	N/A
Buteo_platypterus_brunnescens	1	1,662.52	N/A
Amazona_vittata	1	1,662.52	N/A
Epicrates_inornatus	1	8,416,823.10	N/A
Eleutherodactylus_cooki	0	0	N/A
Patagioenas_inornata_wetmorei	0	0	N/A
Peltophryne_lemur	0	0	N/A
Sterna_dougallii_dougallii	0	0	N/A
Caprimulgus_noctitherus	0	0	N/A

Buteo_platypterus_brunnescens

#	Scientific_Name	Common_Spanish_Name	Common_English_Name	HTML_ECO	Area(m²)
1	Buteo platypterus brunnescens	guaragüao de bosque	Puerto Rican broad-winged hawk	https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B06Y	1,662.52

Amazona_vittata

#	Scientific_Name	Common_Name_Spanish	Common_Name_English	HTML_ECO	Area(m²)
1	Amazona vittata	Cotorra Puertorriquena	Puerto Rican parrot	https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B00L	1,662.52

Epicrates_inornatus

#	Scientific_Name	Common_Spanish_Name	Common_English	HTML_ECO	Area(m²)
1	Epicrates inornatus	Boa de Puerto Rico	Puerto Rican boa	https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=C00P	8,416,823.10

Species under Fish & Wildlife Service (USFWS) jurisdiction are indeed polygons that represent the suitable habitat for the species This means the areas where we expect the species to be present or found. These suitable areas will include areas of critical habitat for the species that have critical habitat designated.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Caribbean Ecological Services Field Office
PO Box 491
Boquerón, PR 00622

In Reply Refer To:
FWS/R4/CESFO/72025-050

Mr. Jorge Rodríguez López
Acting Director, Environmental and Historic Preservation Branch
FEMA Region II – JRO
#50 165, Suite 3
Parque Industrial Buchanan
Guaynabo, PR 00968

Re: FEMA-PR-4339-PW-08535 GM-169882
Carraízo Reservoir Dredging

Dear Mr. Rodríguez:

This is in reply to your December 15, 2021, request for consultation regarding the proposed dredging of the Carraizo Reservoir to restore pre storm capacity. At that time, we requested additional information, which was provided on January 25, 2022, in the form of a Flora and Fauna Study dated December 2021. Our comments are issued as technical assistance in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and the Endangered Species Act (16 U.S.C. 1531 et seq. as amended).

The Puerto Rico Aqueduct and Sewer Authority (PRASA), is proposing the dredging of sediment from the Lago Loíza Reservoir (commonly known as "Carraizo Reservoir"). The sediment will be transported to three (3) existing disposal areas via pipeline placed on floating platforms and/or placed in the easement along the river. A previously used and impacted staging area will also be rehabilitated and used for this action. Decanting management equipment will be installed to decant and fill the sediment into the disposal dikes. The existing weir outlet structures will be demolished and reconstructed to drain the decanted water. Selective vegetation removal and perimeter grading will be performed for disposal area dike rehabilitation. These disposal areas and staging area were used for past dredging of the reservoir from 1994-1998. Funding will be provided by FEMA. The fieldwork for the Flora/Fauna study was performed from November 24, 2021, to December 4, 2021.

The three disposal areas are designated A, B and C, and have been under low intensity cattle pasture along with the staging area since their last use.

Disposal area A is located north of the end of State Road PR-9189, west of Paseo de Santa

Bárbara Residential Development, Rincón Ward in the Municipality of Gurabo. The geographic coordinates of the center of disposal area are 18.259051° N, -66.008372° W. A total of 75 plant species within 24 families of vegetation were recorded. The vegetation in this area is mostly scrub/shrub according to the Flora/Fauna study. No federally listed or sensitive plant species were observed. The area is mostly in hay production. Total animal species were 41, divided in 24 families, including osprey (*Pandion haliaetus*), scaly naped pigeons (*Patagioenas squamosal*), and several species of coqui (*Eleutherodactylus* spp). Although not recorded during the Flora and Fauna study, the study indicates that the site is located within an area where the endangered Puerto Rico plain pigeon (*Patagioenas inornata*) has been recorded in the past.

Disposal area B is located north of State Road PR-941, Celada Ward in the Municipality of Gurabo. Geographic coordinates of the center of Dike B are 18.270354° N, -65.989855° W. This area has a freshwater marsh within the diked area and a pond is located in the center of the disposal area with the margins dominated by cattails (*Typha domingensis*) and species from the *Cyperaceae* family. The pond is mostly open water, but seasonally it is covered by herbaceous species, mostly (*Rhynchospora holoschoenoide*). A total of 63 plant species within 28 families were observed. No federally listed flora species were observed. The total animal species were 39, divided in 23 families. No species designated as threatened or endangered were observed. According to the Flora and Fauna study, this disposal site also is located within an area where the Puerto Rico plain pigeon (*Patagioenas inornata*) has been recorded in the past. However, it was not observed during the flora and fauna study.

Disposal area C is located south of State Road PR-944, Hato Nuevo Ward in the Municipality of Gurabo. Geographic coordinates of the center of dike C are 18.264122° N, -65.954329° W. Trees have grown within the southwest corner, where sediments from the former dredging activities were deposited. The slurry pipe segment is mostly dominated by (*Paspalum fasciculatum*) and bamboo (*Bambusa vulgaris*). A total of 83 plant species within 32 families were observed. No threatened or endangered flora was observed. However, this site was the most wooded. Seven endemic fauna species were observed, including the Puerto Rican plain pigeon (*Patagioenas inornata)*. Two individuals of the plain pigeon were observed flying from south to north near the eastern side of the disposal area. In addition to the plain pigeon, the endemic Puerto Rico freshwater turtle known as the jicotea (*Trachemys stejnegeri*) was observed in the wetland areas.

The Staging Area is located north of State Road PR-796, northeast of La Serranía Residential Development, Río Cañas Ward in the Municipality of Caguas. The geographic coordinates of the center of staging area are 18.277718° N, -66.010743° W. The site borders the Río Grande de Loíza and it is mostly composed of fill material where vegetation has grown over time. As per the Flora/Fauna study, some of the materials from previous construction or dredging activities were observed at this site as well as clandestine dumping. A total of 85 plant species within 29 families were observed at the Staging Area. No species federally listed species were observed. Six endemic animal species were observed although none is federally listed.

All of the above-referenced areas are man-made features that were constructed for disposal of dredged material during the Carraízo Reservoir dredging in 1994 and 1998. The years of

abandonment has resulted in wetlands, pasture and woody vegetation becoming established and providing wildlife habitat.

Based on the Flora and Fauna Study and the Fish and Wildlife Service's online Information for Planning and Consultation website, FEMA has identified the following listed species as potentially being present within the action area:

Puerto Rican Broad-winged hawk	(*Buteo platypterus)*
Puerto Rican Parrot	(Amazona vittata)
Puerto Rican Plain Pigeon	(*Patagioenas inornata wetmorei*)
Puerto Rican Boa	(*Epicrates inornatus* now known as *Chilabothrus inornatus*)

However, based on the species biology and habitat needs, we recommend that FEMA not consider the PR parrot or broad-winged hawk further, since there is no suitable habitat for these species within the action area. FEMA should concentrate conservation, avoidance and minimization on the PR boa and PR plain pigeon.

FEMA is proposing to implement Puerto Rican boa conservation measures during vegetation clearing, disposal of dredge material, and dike maintenance. In addition, for the plain pigeon, parrot and broad-winged hawk, nest survey would be required during the breeding season to ensure that any trees or other large vegetation being cut do not contain nests. Nest surveys be conducted by qualified individuals independent of the contractor and only a few days prior to any vegetation clearing. If listed species nests are found, a 200-meter buffer zone will be established around the nest and no work will be allowed in the area until the chicks are fledged.

Based on these conservation measures, FEMA has determined that the proposed action may affect but is not likely to adversely affect the above listed species.

We have reviewed the information provided in your letter and our files and concur with your determination that the proposed action may affect, but is not likely to adversely affect, the above referenced species. No adverse impacts to designated critical habitat are anticipated as there is none within the proposed project area.

In view of this, we believe that requirements of section 7 of the Endangered Species Act (Act) have been satisfied. However, obligations under section 7 of the Act must be reconsidered if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner that was not previously considered; (2) this action is subsequently modified in a manner not previously considered in this assessment; or, (3) a new species is listed or critical habitat determined that may be affected by the identified action.

With regards to the Fish and Wildlife Coordination Act, the jicotea or freshwater turtle is an endemic species found only to Puerto Rico. Several of the disposal areas have ponds or ponded water and wetlands which are reported in the Fauna and Flora study to have the jicotea. Since these wetland areas will be eliminated as part of the disposal area rehabilitation, we recommend that prior to any earth movement or filling of these areas, efforts should be made to capture and relocate as many of these turtles as possible. This will help in preserving this species.

Thank you for the opportunity to comment on his action, if you have any questions please contact Félix López of my staff at felix_lopez@fws.gov.

Sincerely yours,

Edwin E. Muñiz
Field Supervisor

fhl
cc:
DNER, San Juan
COE, San Juan
EPA, San Juan
PRPB, San

APPENDIX K CULTURAL RESOURCES AND SHPO CONCURRENCE

U.S. Department of Homeland Security
Federal Emergency Management Agency
FEMA Region II - JRO
FEMA-4336/4339/4473-DR-PR
#50 165, Suite 3
Parque Industrial Buchanan
Guaynabo, PR 00968

December 21, 2021

Carlos Rubio Cancela
State Historic Preservation Officer
Puerto Rico State Historic Preservation Office
P. O. Box 9023935
San Juan, Puerto Rico 00902-3935

Section 106 Consultation: FEMA-4339-DR-PR
Project Number: PA-02-PR-4339-PW-08535 (GM-169882)
Sub-Recipient: Puerto Rico Aqueduct and Sewer Authority (PRASA)
Undertaking: FAASt Carraizo Reservoir Dredging - Reservoir sediment dredging and sediment disposal
Addresses/Coordinates:

1. Staging Area or "Area F": PR-798, Bo. Bairoa, Caguas (18.277555, -66.010800)
2. Dike A or "Area A": PR-9189, Bo. Rincon, Gurabo, (18.259218, -66.008300)
3. Dike B or "Area B1": PR-941, Bo. Celada, Gurabo (18.270155, -65.989676)
4. Dike C or "Area V": PR-944, Bo. Hato Nuevo, Gurabo (18.263897, -65.954098)

Determination: No Adverse Effect to Historic Properties with Conditions

Dear Mr. Rubio-Cancela:

The Federal Emergency Management Agency (FEMA) will be providing funds authorized under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288, as amended, in response to the major Disaster Declaration for FEMA-4339-DR-PR, dated September 20, 2017, as amended. FEMA, through its Public Assistance Program, proposes to fund the FAASt Carraizo Reservoir Dredging project, as requested by Puerto Rico Aqueduct and Sewer Authority (PRASA). FEMA is initiating Section 106 review for the above referenced Undertaking in accordance with the "Programmatic Agreement Among the Federal Emergency Management Agency, the Puerto Rico State Historic Preservation Officer, and the Puerto Rico Central Office of Recovery, Reconstruction and Resiliency", as amended on November 13, 2019 and providing your office with the opportunity to comment on the proposed Undertaking. Documentation in this letter is consistent with the requirements in 36 CFR §800.11(e).

Undertaking

The Carraizo Reservoir or Lago Loíza Reservoir is one of the largest reservoirs in Puerto Rico and its considered one of the most critical reservoirs in terms of its importance as a water source for potable use. The Carraizo Reservoir serves the Sergio Cuevas Water Treatment Plant (SCWTP), located at the Municipality of Trujillo Alto, which serves a population of approximately 491,663 persons within the municipalities of Caguas, San Lorenzo, Las Piedras, Juncos, Gurabo, parts of Trujillo Alto and San Juan supplying approximately 90 million gallons per day (MGD). The reservoir storage capacity has been impacted by an increasing level of sedimentation that has decreased its useful life significantly in the last

years, particularly after Hurricanes Irma and Maria. The sedimentation, due to surface water runoff, landslides and large inflows of rivers and streams, caused by the heavy rains associated with Hurricane Maria produced a significant decrease in the storage capacity of the Carraizo Lake Reservoir.

The Carraizo Reservoir was built in 1953 and the Lago Loíza Dam structure is located at the Municipality of Trujillo Alto (18.329906, -66.016669), approximately 13.5 miles (21.7 Km) upstream from where Río Grande de Loíza flows into the Atlantic Ocean, and its basis occupy and area of approximately 207.7-square miles within the municipalities of Caguas, Gurabo and Trujillo Alto. The original reservoir capacity when built was 26.8 Mm3 and in 1997 it reported a decrease in its capacity to 13.26 Mm3, which led to a dredging project between 1997 and 1999 to restore its capacity to 20.6 Mm3. Currently, the reservoir is reaching approximate pre-dredge conditions, namely 15.06 Mm3 according to the 2019 bathymetry.

The proposed scope of work (SOW) for the Carraizo Reservoir involves the dredging of approximately 2,615,901 cubic yards (2.0 Mm3) of sediments from the Lago Loíza Reservoir and dispose the sediments in the existing dikes built during the 1997-1999 dredging project in the Municipality of Gurabo.

The Scope of Work (SOW) for this project includes actions in several discontinuous geographical areas and the conceptual design considers the establishing a staging area, the installation of system of pump stations and dredged sediment transportation pipes, and disposal of the dredged sediment at the three above mentioned disposal dikes (Figure 1 and 2). These activities will be described correspondently, for further detail about the undertaking's plans please see Appendix A.

1. Staging Area

The staging area is the contractor's operations base. The staging area will be used to store equipment and materials, as well as office trailers. It is located at State Road PR-798, coordinates 18.277555/-66.0108, and is the same staging area used in the previous 1997-1999 dredging. The proposed SOW includes ground surface grading and the installation of office trailers (19m L x 24m W), storage areas (36m L x 33m W), stabilize access roads (405m L x 8m W x 0.20m D), and the construction of a temporary dock (26.26m L x 15.97m W).

2. Sediment Disposal at Dikes A, B And C

As mentioned before, the dredged sediment will be deposited in three sediment disposal dikes constructed in the municipality of Gurabo for the 1997-1999 dredging project: Dike A, at 18.259590/-66.008197; Dike B, at 18.270174/-65.989960; and Dike C, at 18.263986/-65.953448.
The process of decanting the dredged material will be through a geo-tube system. The installation of a geo-tube system is recommended to reduce the decanting time and to reduce the risk of solids being resuspended. This system will optimize the capacity of the dikes increasing the efficiency of the dewatering process and reducing the need to raise the dike walls. Also, the use of geo-tube system reduces the material handling at the disposal areas and the dredging time.

Demolition and reconstruction of the weir outlet structures of the exiting dikes will be considered to manage the decanted water from the dredged material and return it to the reservoir and/or river.

The dike areas will be cleared and grubbed creating positive slopes toward the outlet structures and ditches for drainage purposes. The proposed actions at the sediment disposal dikes are the same for all three:

- Rehabilitation of existing weir outlet discharge at disposal areas.
- Clearing and grubbing, grading and drainage blanket at disposal areas.
- Installation of above ground surface decanting management equipment (geo-tube).
- Sediment control measures implementation at disposal areas: Combination Barrier (silt fence and strawbales) 3,000 LM.

As recommended by the PRASA representative during the November 4, 2021 site visit, there are other actions (not in the SOW) that may be needed to perform after the dredging is started:

- Raising the dikes wall to increase capacity
- Creating a dike wall reinforcement by building an outer wall around the actual wall perimeter

These last two actions will require a soil burrow and the reinforcement of the dike's wall will enlarge the actual footprint. PRASA representative stated that these are only contemplated if the need arises, and that the soil burrow for both will be the previous sediment already available inside the actual dikes from the previous dredging.

3. Dredged material transportation and disposal at the three disposal dikes

Dredging of the sediments will be performed using hydraulic dredges with a centrifugal pump. The dredged sediments will be pumped from the reservoir and transported in a liquid slurry form to the disposal areas, namely the three existing dikes. The pipes will be placed in the easement of the reservoir or river shore and the pipeline sections will be installed on reservoir floating platforms or rafts or along the river. None of those actions involve ground disturbing activities since both the pipe and the pump system setting will be completely above ground or water surface. In addition, intermediate booster pump stations will be placed along the pipe route and will also be installed either on floating platforms or on the ground. The final location for the booster pumps may vary, but preliminarily, the intended locations are: **(1)** 18.307692, -66.018139; **(2)** 18.288164, -66.028042; **(3)** 18.271497, -66.008397; **(4)** 18.264411, -65.984350; and **(5)** 18.258478, -65.971814.

Area of Potential Effects (APE)

Pursuant to 36 CFR 800.4(a)(1), the Area of Potential Effects (APE) is defined as the geographic area(s) within which the undertaking may directly or indirectly affect historic resources. Based on the proposed scope of work, FEMA has determined that the APE for this undertaking is delimited by the footprints and rights-of-way of the Staging Area, Dike "A", Dike "B", and Dike "C" (Figures 3 to 6):

- **Staging Area**: Area determined by PRASA to be used for contractor office trailers, equipment staging, access entrances and dock location, which encompasses an area of 14,389.87sqm
- **Dike A**: Area within and including the boundaries of the dike embankment as established in the 97-99 dredging project, which covers an area of approximately 168,959.33 sqm

- **Dike B**: Area within and including the boundaries of the dike embankment as stablished in the 97-99 dredging project, which covers an area of approximately 140,328.45 sqm
- **Dike C**: Area within and including the boundaries of the dike embankment as stablished in the 97-99 dredging project, which covers an area of approximately 381,698.20 sqm

Identification and Evaluation

Research conducted by FEMA's SOI-Qualified Archaeologist, Juan Rivera Groennou, and Historic Preservation Specialist, Hernan Bustelo, regarding the identification and evaluation of historic properties, was carried out independently for each APE using the SHPO and ICP/CAT GIS databases and archaeological concerning the archaeological evaluations and surveys conducted as part of the 1997-99 Carraizo Dam dredging project. After further research, FEMA has determined that the Carraizo Dam structure is eligible for the National Register, however, and because the SOW does not include actions directly on this structure, the identification and evaluation of historic properties will be done specifically for those APEs where the proposed actions are to be taken and that were defined above.

1. ***Staging Area or "Area F" (18.277555, -66.010800)***

The archaeological evaluation conducted by Ortiz Aguilú (1996[1]) in "Area F", revealed the presence of the remnants of a Pre-Columbian deposit near the northern edge of the APE, where lithic tools, charcoal and few potsherds associated to late Pre-Taino and Taino ceramic styles, such as *Santa Elena* and possibly *Capá* (800-1500 AD), were found (Figure 3). This deposit, identified as "F-1", was found 30cm below the surface floor and covers an area of about 25 x 25m near the river's edge. Although Ortiz Aguilú acknowledge the possible impacts to this site because of the gravel and sand mining in the previous decades, and the relocation of the State Road PR-796, he concludes that this deposit retained integrity, that the materials contained therein are in-situ, and that it and can be part of a larger site.

As a result of the 1996 archeological evaluation and considering the temporary use of the site by PRASA as a staging area for the dredging project at that time, Ortiz-Aguilú proposed to protect the archaeological resource with a thick layer of "clean sand" over an area that exceeds the established limits of the resource by about 10 meters in the surrounding area and, on top of this, place steel plates that can withstand the traffic of heavy machinery. These avoidance measures were memorialized in the *Programmatic Agreement among the United State Army of Engineers, The Advisory Council on Historic Preservation and The Puerto Rico State Historic Preservation Officer Regarding the Implementation of the Carraizo Reservoir Dredging Proyecto*, signed by all parties, including PRASA, in August 1996.

However, according to the documentation consulted in the SHPO files, on February 12, 1997, PRASA notified SHPO that the contractor selected to perform the dredging activities was capable to perform the activities excluding the archaeological site named as "F1", for which an amendment was requested to replace the control measures (layer of sand topped with steel planks) by installing a fence around the

[1] Ortiz Aguilú, J. y Marisol Garayalde (1996): *Evaluación Arqueológica del Área F del Proyecto para el dragado del Lago Carraizo.* Subdirectorado de Planificación Estratégica e Ingeniería Autoridad de Acueductos y Alcantarillados, San Juan, Puerto Rico. ICP/CAT-GR-96-04-06.

archaeological site perimeter, including a buffer zone of 10 meters. On March 31,1997, SHPO accepted the proposed change to the mitigation requirements, and subsequently, on May 20th, 1997, a chain link fence was installed. The communication also explained that a site visit was performed by Archaeologist José Ortiz Aguilú on April 15, 1997, to evaluate impacts to the archaeological deposits. The archaeologist reported no damage to cultural resources identified on site. An aerial images review using the Google Earth Pro Historic Imaging tool shows that Site F1 has remained undisturbed since that time to the present, even during times, like 2015, were extensive vegetation removal and surface disturbance activity is clearly visible in the rest of the proposed staging area.

Taking into consideration the information obtained through the archaeological surveys of 1996, an assessment was performed by PRASA consultant (CSA) to georeferenced the archaeological site location over PRASA's proposed staging area and propose the implementation of protection measures to avoid any potential impacts to the resource during the current project's implementation phase. These protection measures would be based on the fencing and signage of the area where the archaeological site is located, including a buffer zone of 10 meters, by providing the contractors with all the necessary information regarding the location of the archaeological site and the required protection measures that must be implemented prior to initiating works within the staging area. For further details please see Appendix B.

2. Dike A or "Area A" (18.259218, -66.008300)

As the result of the archaeological evaluation conducted in 1996 in "Area A", archaeologist Ortiz Aguilú[2] identified two areas of archaeological deposits located north of Dike A's APE: Area "A-1", located 330 meters north of the APE, is described as a Pre-Columbian deposit with lithic tools and potsherd associated with the *Santa Elena* ceramic style (900-1300 AD); Area "A-2", located 650 meters north-northeast of the APE, and described as a deposit containing historic construction materials debris, such as bricks, mortar fragments, and cobblestones, between 54-71cm below surface (Figure 4).

In addition, about 150 meters south of the southwest corner of Dike B's APE, are the remnants of the late 19th century Hacienda Santa Bárbara with its two adjoining chimneys (GR-7/GR0200002; Figure 4). Between 1996 and 2001, archaeologist A. Maurás conducted three phases of archaeological evaluations and surveys in an area between the Hacienda Santa Bárbara chimneys and the southwest corner of Dike B's APE[3]. As result, Maurás was able to document deposits with accumulations of historic debris related with the hacienda's structures and other Pre-Columbian deposits that, according with the repot, reached a depth of 80cm below surface and its archaeological materials can date back between 400-1500 A.D. The northernmost excavated units with positive results for Pre-Columbian materials were dug merely 25.5 m south of the SW corner of Dike A. Maurás concluded that the Hacienda's high degree of contextual and depositional integrity makes the site eligible for inclusion to the National Register of Historic Places.

[2] Ortiz Aguilú, J. (1996): *Evaluación Arqueológica para el Dragado del Lago Carraízo, Áreas A, B1 y V.* Fases IA-IB. ICP/CAT-GR-96-05-04.
[3] Maurás Casillas, A. (1996): *Alcantarillado Sanitario y Troncal Sanitaria Para la Comunidad Navarro*. Fase IA-IB. ICP/CAT-GR-96-05-01; Maurás (1997): *Nueva Alineación de la Troncal Sanitaria en el Área de las Ruinas de la Hacienda de Santa Bárbara Alcantarillado Sanitario y Troncal Sanitaria para la Comunidad Navarro.* Fase IB. ICP/CAT-GR-97-06-02; Maurás (2001): *Hacienda Santa Bárbara.* Fase II. ICP/CAT-GR-01-14-01.

3. Dike B or "Area B1" (18.270155, -65.989676)

As the result of the archaeological evaluations and surveys conducted in 1996 and 1997 in the 3. Dike B or "Area B1", by archaeologist Ortiz Aguilú[4] and later in 1999, by archaeologist Marisol Meléndez[5], revealed the existence of the remnants of two brick structures and an associated refuse deposit with mid-19th century archaeological materials (ICP/CTA GR-8; Figure 5). The archaeologist Melendez suggests that these archaeological remnants correspond to a rustic farm from the first half of the 19th century, with a varied use, probably concerning the subsistence of the family and the production on a smaller scale of different crops such as sugar cane, corn and small fruits.

4. Dike C or "Area V" (18.263897, -65.954098)

As the result of the archaeological evaluations and surveys conducted in 1996 in the Dike C or "Area V", by archaeologist Ortiz Aguilú[6], and later in 1999, by archaeologist Marisol Meléndez, evidenced three areas of late 18th-late 19th century archaeological deposits within its APE (Figure 6): Area "V-1" described as a historic deposits associated with an area of domestic structure, evidenced by the finding of post holes and roof tiles, and in which pearlware and whiteware ceramics predominate; in Area "V-2" the remnants of another wooden structure, roofed with tiles was documented, associated with a dense deposit of domestic refuse in which a large quantity of creamware and pearlware ceramics were recovered; and the Area "V-3" was characterized by a low artifactual density refuse deposit in which many lead-glazed ceramics and other types of utilitarian ceramics were found. Archaeologist Melendez determined that the three sites described for Area V were part of the grounds of *Hacienda Buena Vista*, a sugar cane *hacienda* that became one of the most important in the Gurabo River valley by the end of the 19th century.

Determination of Effect

Based on the identification and evaluation, FEMA finds that there are historic properties, as defined in 36 CFR 800.16(l) within and adjacent to the project's APEs:

- The archaeological site within the Staging Area's APE, identified as "F1", it is potentially eligible under Criteria D, as its research has yielded and may yield important information about the way of life of Pre-Columbian societies during the 9th to 16th centuries in the Rio Grande de Loiza basin. Considering that this site was fenced during the 97-99 dredging project, including a 10-meter buffer around it, it can be expected to retain some level of integrity.
- The archaeological resources associated with the Hacienda Santa Barbara and its structural remnants, located off the southwest corner of the Dike A's APE, and the resources found within the Dike B's and Dike C's APEs are potentially eligible under Criteria D, since its research has yielded and may yield important information on social dynamics within a sugar plantation during the mid-18th- and late 19th century. Considering that the sediments deposited within Dike B and Dike C during the 97-99 dredging project, we can expect that the archaeological resources found within them may retain some level of integrity.

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[4] Ortiz Aguilú, J. (1996): *Evaluación Arqueológica para el Dragado del Lago Carraízo, Áreas A, B1 y V.* Fases IA-IB. ICP/CAT-GR-96-05-04.

[5] Meléndez Maiz, M., et al. 1999. *Mitigación Arqueológica del Proyecto del Dragado Carraizo Área de disposición en los barrios Celada y Hato Nuevo, Gurabo*. SHPO# 07-28-94-01.

[6] Ortiz Aguilú, J. (1996): *Evaluación Arqueológica para el Dragado del Lago Carraízo, Áreas A, B1 y V.* Fases IA-IB. ICP/CAT-GR-96-05-04.

FEMA requests SHPO concurrence with this determination.

From the discussion during the field visit and later with Miguel Bonini on the last visit to SHPO, it was determined that for the dikes: PRASA: vegetation scrubbing would be within the area of the dikes and on the sediment top layer deposited in the previous dredging. The removed vegetation would be deposited or stored within the same dike. If it were necessary to raise the height of the retaining wall of the dikes, it would be made with material (the burrow) from within the same dike, and of the type deposited in the previous dredging, also, in the event that it was necessary to reinforce the retaining wall of the dikes, it would be done by creating a reinforcement as a second wall, outside the current one. SHPO: This last action of raising the retaining wall or creating a reinforcement, would increase the current footprint of the dike. Miguel Bonini specified that if this action is limited to depositing dredged or burrow material on the current surface outside the wall, and as long as it did not create a ground disturbance, it would not affect the archaeological resources (the site) described by Maurás south of Dike A and associated with the Hacienda Santa Barbara complex. (Maurás excavated its test wells further north just 25 meters from the SW corner of dam A)

Therefore, and recognizing the possibility that the archaeological site retains some integrity, FEMA has determined that the Undertaking will result in **No Adverse Effect to Historic Properties with Conditions**. FEMA will include the following conditions in the approved Project Worksheet for the Undertaking:

1. In the Staging Area's APE or "Area A", PRASA will follow the protection measures based on the fencing and signage of the area where the archaeological site is located, including a buffer zone of 10 meters, and will provide the contractors with all the necessary information regarding the location of the archaeological site and the required protection measures that must be implemented prior to initiating works within the staging area. For further details about the proposed protection measures, please see Appendix B.
2. In the Staging Area's APE or "Area A", FEMA will require that an archaeologist meeting the Secretary of Interior (SOI) Qualification Standards (36 CFR Part 61) be present to monitor all ground-disturbance activities related with, but not limited to, ground surface grading, installation of underground utility lines, and the construction of the temporary dock.
3. In the Dike A's, Dike B's and Dike C's APEs, FEMA will require that an archaeologist meeting the Secretary of Interior (SOI) Qualification Standards (36 CFR Part 61) be present to monitor all ground-disturbance activities outside its boundaries and any ground disturbance activity that may impact the soils below the sediments layer deposited during the 97-99 dredging project, such as, but not limited to, the elevation or reinforcement of the dike's perimeter walls, ground surface grading, installation of the geotube systems, or construction of access roads for the installation of the pipes and pump systems.
4. In the event that historically or archaeologically significant materials (or evidence thereof) are discovered during the implementation of this project, the Sub-Recipient and the Recipient shall proceed as indicated in Stipulation III.B. of the Programmatic Agreement, and the project shall be halted until such time as FEMA, in consultation with the PRSHPO, determines that appropriate measures have been taken to ensure that the project is in compliance with the NHPA.

5. Archaeological monitoring of the activities will be documented by the SOI-qualified archaeologist in a report that will be submitted to FEMA for review after the demolition work has concluded and prior to the start of new construction. The level of description and documentation in the report shall be consistent with the Secretary of the Interior's Standards and Guidelines for Archaeological Documentation (http://www.nps.gov/history/local-law/arch_stnds_7.htm) and will include recommendations on further actions (if any) that may be required to gain sufficient information to identify and evaluate integrity of and impacts on historic properties.
6. The artifacts recovered from the archaeological monitoring, if any, as well as field and laboratory records sufficient to document the collection, shall be curated at a facility that meets the standards of, and in accordance with, the provisions of 36 CFR Part 79. The location of artifacts and a description of the facility shall be included in the monitoring report.
7. The artifacts recovered from the archaeological monitoring, if any, as well as field and laboratory records sufficient to document the collection, shall be curated at a facility that meets the standards of, and in accordance with the provisions of 36 CFR Part 79.
8. If there are any further changes to the SOW, including any increase in the extent of ground disturbance during the construction that entails ground disturbing activities beyond the existing footprint, the applicant must notify FEMA beforehand, prior to engaging in further construction.

We request concurrence with this determination of effect within fifteen (15) calendar days. Should you need additional information please contact FEMA Historic Preservation Should you need additional information please contact Archaeologist Juan M. Rivera Groennou by phone at 202-341-5352, or by email at juan.riveragroennou@fema.dhs,gov, and email FEMA EHP at fema-ehp-dr4339@fema.dhs.gov.

Sincerely,

Sindulfo Castillo
Director, Environmental & Historic Preservation Division
DR-4336 & 4339-PR (Hurricanes Irma/María)
DR-4473-PR (Earthquakes)

SC / jrg / hb
Enclosures:
Figures
Appendix A: Carraizo Reservoir Dredging Conceptual Drawings
Appendix B: PRASA's Protection Measures Proposal

FIGURES

Figure 1. Location map.

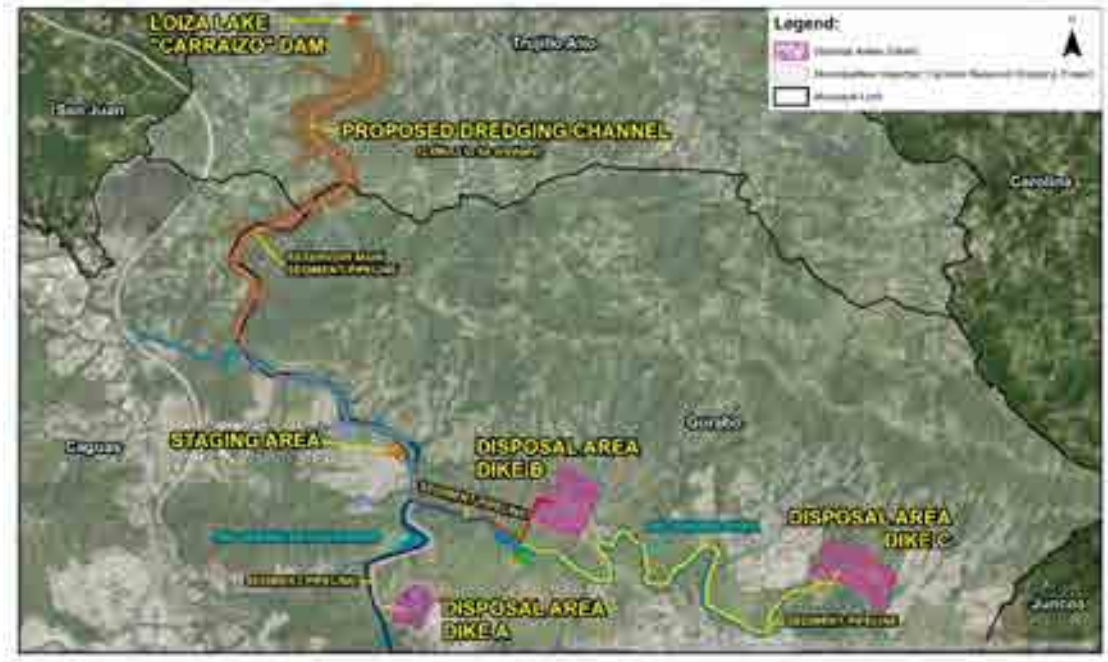

Figure 2. Location map of all APEs and associated work.

Figure 3. Staging Area or "Area F" area of potential effect (APE) showing the areas of archaeological deposits documented by Ortiz Aguilú in 1996.

Figure 4. Dike A or "Area A" area of potential effect (APE) showing the areas of archaeological deposits documented by Ortiz Aguilú in 1996 and the location of Hacienda Santa Bárbara.

Figure 5. Dike B or "Area B1" area of potential effect (APE) showing the areas of archaeological deposits documented by Ortiz Aguilú in 1996.

Figure 6. Dike C or "Area V" area of potential effect (APE) showing the areas of archaeological deposits documented by Ortiz Aguilú in 1996.

GOVERNMENT OF PUERTO RICO
STATE HISTORIC PRESERVATION OFFICE
Executive Director I Carlos A. Rubio-Cancela I carubio@prshpo.pr.gov

December 30, 2021

Sindulfo Castillo Maldonado
Director, Environmental & Historic Preservation Division
Federal Emergency Management Agency
FEMA Region II – JRO
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SHPO 12-21-21-01 FAASt CARRAIZO RESERVOIR DREDGING – RESERVOIR SEDIMENT DREDGING AND SEDIMENT DISPOSAL, ISLANDWIDE, PUERTO RICO / PA-02-PR-4339-PW-08535 (GM-169882)

Dear Mr. Castillo,

Our Office has received and reviewed the above referenced project in accordance with 54 U.S.C. 306108 (commonly known as Section 106 of the *National Historic Preservation Act*) and 36 CFR Part 800*: Protection of Historic Properties*.

We agree with your finding of **no adverse effect with conditions**, as they are listed in your letter of December 21, 2021. Please note, any changes to the scope of work of this undertaking will require reopening of the Section 106 consultation and a reassessment of project effects on historic properties.

If you have any questions regarding our comments, please do not hesitate to contact our Office.

Sincerely,

Carlos A. Rubio-Cancela
State Historic Preservation Officer

CARC/GMO/MB

Recomendaciones

Carraízo Reservoir Dredging CIP 1-01-9000

Datos de Localización

De acuerdo a la información suministrada se propone una actividad: Público en:

Dirección Física

STATE ROAD PR-175 KM 7.5
Trujillo Alto Puerto Rico, 00976

Número(s) de Catastro

144-038-270-01

Dueño

Autoridad de Acueductos y Alcantarillados de P.R.

Calificación

Distrito(s) de Calificación: CR-C (83%), AGUA (14%),

Distrito en el Mapa de Inundabilidad: X (87.6%), 0.2 PCT (5.4%), A (5.0%), AE (2.0%)
Tipo de Suelo: MxF (67.1%), CaF (27.8%), W (2.7%),

Cabida

Cabida según escritura: 49133.64 metros cuadrados

Arqueología y Conservación Histórica

COMENTARIO DACH-ICP A CASO NUM: 2021-416078-SRA-051408-- Proyecto: Carraízo Reservoir Dredging CIP 1-01-9000-- I. El Programa de Arqueología y Etnohistoria del Instituto de Cultura Puertorriqueña (PAE) Base Legal: La Ley 161-2009, según enmendada, Artículo 19.6, enmienda las Secciones 2 y 3 de la Ley Núm. 112 de 20 de julio de 1988, según enmendada, conocida como “Ley de Protección del Patrimonio Arqueológico Terrestre de Puerto Rico”, a los fines de transferir al Instituto de Cultura Puertorriqueña toda facultad, deber u obligación referente a la evaluación para la otorgación o denegación de determinaciones finales o permisos, esto en coordinación con la Oficina de Gerencia de Permisos. El Reglamento Conjunto para la Evaluación y Expedición de Permisos Relacionados al Desarrollo, Uso de Terrenos y Operaciones de Negocios (RC-2020); registrado en el Departamento de Estado de Puerto Rico bajo el Número 9233 con vigencia de 2 de enero de 2021, establece, entre otros, lo siguiente: a. Regla 2.1.8, Sección 2.1.8.7, Inciso “b”: Todo proyecto público o privado que conlleve movimiento de terreno, excavación, extracción de corteza terrestre o construcción, reconstrucciones o canalizaciones deberá solicitar a la División o Unidad de Evaluación Ambiental (DECA) la recomendación del ICP sobre Arqueología y Conservación Histórica, ya sea a través de la OGPe, los Municipios Autónomos con Jerarquía 1 a la III o el Profesional Autorizado. b. CAPÍTULO 10.2, Sección 10.2.1.2 se requerirá la recomendación del ICP en todos los Permisos relacionados con construcción, reconstrucción, trabajos de excavación, extracción o movimiento de tierras en lugar alguno del que haya documentación previa o indicios fidedignos de presencia de material arqueológico. Incluye los centros fundacionales de los municipios, entiéndase, plaza de recreo y bloques circundantes, conforme a la Ley 89-1955, supra, Sección 4. —Propósitos, Funciones y Poderes del Instituto. (18 L.P.R.A. sec. 1198) y la Ley Número 112 del 20 de julio de 1988, conocida como la “Ley de Protección del Patrimonio Arqueológico Terrestre”, según enmendada. II. EVALUACION ICP-PAE: SOLICITUD PLAN DE TRABAJO PARA MONITORIA ARQUEOLOGICA: El Programa de Arqueología y Etnohistoria del Instituto de Cultura Puertorriqueña ha evaluado los documentos relacionados al proyecto de referencia recibidos a través de la Oficina de Gerencia de Permisos. Como resultado de esta evaluación, hemos llegado a la conclusión de que las actividades de desarrollo que contempla este proyecto pueden afectar recursos de naturaleza arqueológica conocidos y por descubrirse. La evaluación fue realizada conforme a las disposiciones de la Sección 10 de la Ley 112 del 20

Recomendaciones

Carraízo Reservoir Dredging CIP 1-01-9000

de julio de 1988, conocida como la Ley de Arqueología Terrestre de Puerto Rico. • Estructura histórica en lago Carraizo: Se deberá evitar el dragado 10 metros alrededor de la estructura sumergida previamente identificada, según se ha hecho en dragados anteriores para evitar cualquier impacto a la misma. • Dique A: Protección de los sitios previamente identificados (A-1, A-2, A-3 y A-4) en el límite norte del dique manteniendo una zona de amortiguamiento (buffer zone) de 10 metros entre los límites de los sitios arqueológicos y cualquier actividad relacionada al proyecto, incluyendo, pero no limitándose a, excavaciones, limpieza de terreno, paso de vehículos, etc., según se ha hecho en obras de dragado anteriores. Deberán tomarse las medidas necesarias para evitar cualquier impacto a estos sitios por la instalación de las tuberías de transporte de sedimentos y tránsito de vehículos y/o maquinaria pesada. • Diques B y C: Los sitios identificados en estas áreas fueron mitigados y destruidos con la construcción de los diques. La existencia de recursos culturales conocidos en estas áreas que puedan ser impactados es mínima. Se deberá tener en cuenta que a la hora de instalar las tuberías de transporte de sedimentos hacia estos diques se pudieran impactar sitios sobre y/o debajo de la superficie que no sean conocidos. • Staging Area (Area F): Protección del sitio identificado como CS-49 por medio de la colocación de una verja de alambre de ciclón (cyclone fence) temporero y una zona de amortiguamiento (buffer zone) de 10 metros, según fue realizado en trabajos previos de dragado. No se deberán realizar trabajos de limpieza, desyerbo, etc. dentro del área protegida. Al finalizar los trabajos del proyecto, la verja debe ser removida. • Tuberías de transporte de sedimentos: Se explica en el memorial que la colocación de la tubería sobre el terreno no debería tener impactos en sitios arqueológicos bajo superficie. Sin embargo, que las labores de limpieza y remoción de vegetación pudieran tener impacto en sitios arqueológicos no conocidos y que estén sobre y/o debajo de la superficie. Por lo tanto, no tendríamos objeción a las obras a realizarse en el lago, Dique A, B, C y Staging Area (Área F), siempre y cuando se lleven a cabo las medidas de protección según presentadas por la Arqla. Raquel Camacho. Sin embargo, para la instalación de tubería de transporte de sedimentos se deberá presentar para nuestra evaluación y determinación, un PLAN PARA MONITORIA ARQUEOLOGICA. Este deberá ser preparado por un arqueólogo cualificado para dicho nivel de investigación por el Consejo para la Protección del Patrimonio Arqueológico Terrestre de Puerto Rico. Deberá ser radicado en el Programa de Arqueología y Etnohistoria del Instituto de Cultura Puertorriqueña, localizado en el Viejo San Juan y cumplir con el Reglamento para la Radicación y Evaluación Arqueológica de Proyectos de Construcción y Desarrollo de 2016, Núm. 8932, aprobado en 2017, https://vlex.com.pr/source/reglamentos-departamento-estado-14072/chapter/instituto-de-cultura-puertorriquena-1665710. De acuerdo con lo establecido en el Plan de Control Exposición al COVID-19 del I.C.P, deberá comunicarse con la Sra. Marly Ferrer, Directora de la Oficina de Administración de Documentos del I.C.P. a través del correo electrónico mferrer@icp.pr.gov o llamando al 787-724-0700 ext. 1180 o 1184, para coordinar la entrega de los documentos. No deberá realizarse ningún movimiento de terreno, limpieza, desyerbo o construcción hasta contar con la aprobación final de esta oficina. Se le apercibe que el incumplimiento de cualquiera de los requerimientos establecidos en la presente carta, podrá ser objeto de sanciones administrativas según lo establecido en las citadas leyes. III. RECOMENDACIÓN: La División de Arqueología y Conservación Histórica de la OGPe ha evaluado el caso y SOLICITA UN PLAN D TRAAJO PARA UNA MONITORIA ARQUEOLOGICA para el proyecto propuesto, bajo las condiciones emitidas por El Programa de Arqueología y Etnohistoria del Instituto de Cultura Puertorriqueña. Se le apercibe que el incumplimiento de estos requerimientos será objeto de sanciones administrativas,

Recomendaciones

Carraízo Reservoir Dredging CIP 1-01-9000

según lo establecido en las citadas leyes.

Condiciones Especiales

NINGUNA

Condiciones Generales

Esta recomendación es solamente aplicable a la situación de hechos y los datos según presentados y evaluados en el caso. La OGPe se reserva el derecho de reevaluar, variar o modificar el mismo en cualquier momento anterior a la emisión del permiso o la acción administrativa correspondiente por parte de la agencia solicitante o proponente cuando surja nueva información oficial específica estableciendo que el derecho aplicable o las condiciones ambientales en el predio han cambiado sustancialmente, o cuando la recomendación original se emitió bajo premisas falsas o fraudulentas.

Las vigencias de las diferentes agencias del proceso de recomendación serán las establecidas en los comunicados que estas emiten conforme a sus reglamentos.

Firma / Sellos

Fecha de Expedición:

24/MAR/2022

OFICINA DE GERENCIA DE PERMISOS
Ing. Gabriel Hernández
Secretario Auxiliar
Departamento de Desarrollo Económico y Comercio de Puerto Rico
Oficina de Gerencia de Permisos

Ing. Gabriel Hernández Rodríguez

Secretario Auxiliar

APPENDIX L BENTHIC STUDY

Benthic Study

JANUARY 2022

CARRAÍZO RESERVOIR DREDGING PROJECT

MUNICIPALITIES OF CAGUAS AND GURABO, PUERTO RICO

Prepared For:

PUERTO RICO AQUEDUCT AND SEWER AUTHORITY

SAN JUAN, PR

Contents

Table of Tables

Table of Figures

1 PROJECT OVERVIEW

Reservoirs represent a water resource of vital importance for the provision of water in Puerto Rico. However, supply levels could be threatened due to sediment accumulation process (Ortíz-Zayas, Quiñones, Palacios, Vélez, & Mas, 2004).

This reservoir's source of surface water is the Rio Grande de Loíza and is the source of the Sergio Cuevas Water Filtration Plant, which serves a population of approximately 491,663 within the municipalities of San Juan, Carolina, Canóvanas, Trujillo Alto, Gurabo, Loiza, and Juncos. However, sediment accumulation is reducing reservoir volume. A dredging project is being evaluated as a measure to reduce sedimentation (Project). The biological evaluation of the aquatic ecosystem represented by the dam contributes to the concrete identification of environmental problems associated with the accumulation of sediments.

A sediment sampling protocol has been undertaken to characterize the flora and fauna communities that are present in the reservoir bottom. These communities found on the bottom sediments are known as benthos. Typically include crustacean, worms, insects larvae and mollusks like mussels and clams.

Previous studies have indicated that a limited benthic population exists in Carraízo due to the high Biological Oxygen Demand (BOD) which causes extremely low dissolved oxygen concentrations in the reservoir bottom (Autoridad de Acueductos y Alcantarillados, 1995).

2 ECOLOGICAL SEDIMENT CHARACTERIZATION

2.1 Carraízo Reservoir Ecological Sediment Sampling

The ten (10) sampling points chosen were the same established in the sediment sampling study conducted for the Project. A Global Position System (GPS) was used to identify such sampling points location on December 9, 2021 (**Table 1**).

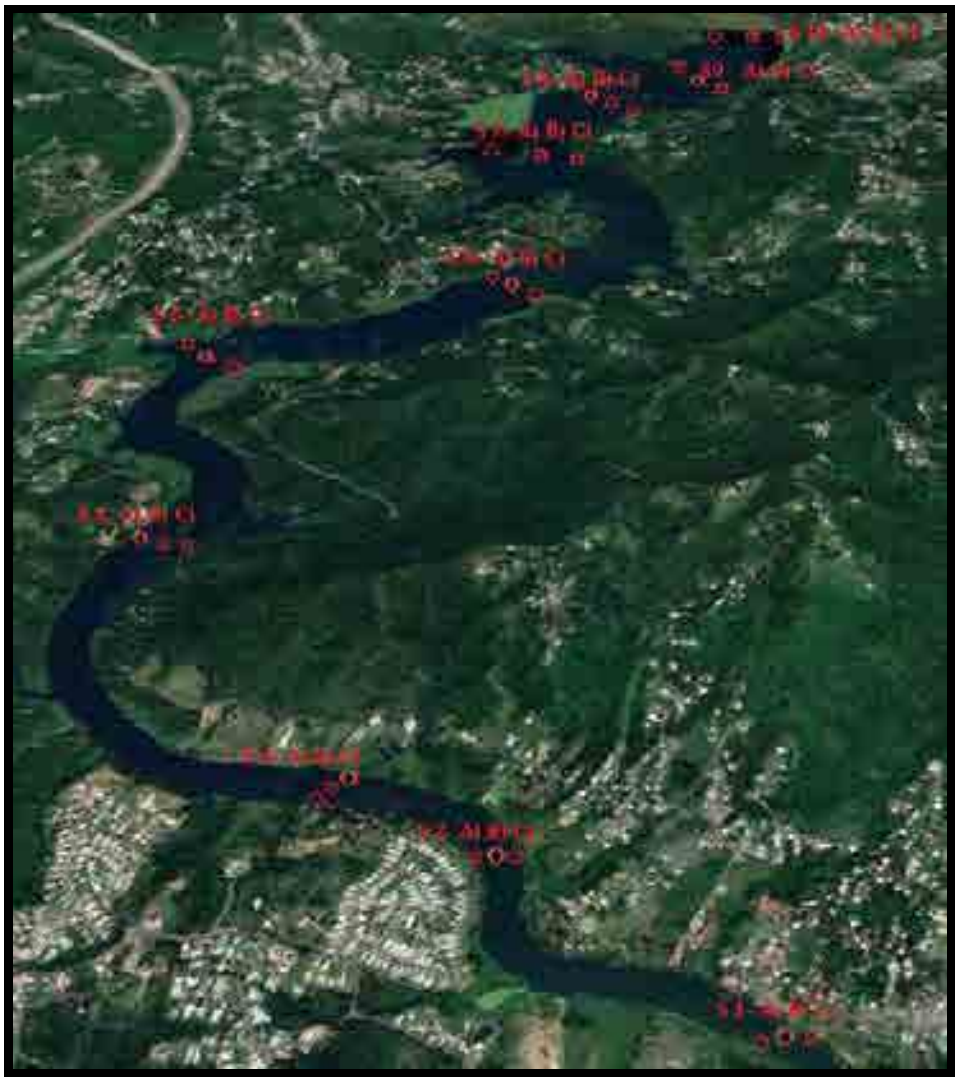
Table 1. Sampling Locations Coordinates

Site Number	Sample ID- A	Sample ID- B	Sample ID- C
1) Latitude	18°16'44.22" N	18°16'45.08" N	18°16'45.75" N
Longitude	66°00'38.95" W	66°00'32.12" W	66°00'37.04" W
2) Latitude	18°17'02.04" N	18°17'02.09" N	18°17'01.46" N
Longitude	66°01'04.25" W	66°01'03.25" W	66°01'01.13" W
3) Latitude	18°17'11.30" N	18°17'10.39" N	18°17'08.79" N
Longitude	66°01'17.00" W	66°01'17.57" W	66°01'18.73" W
4) Latitude	18°17'40.78" N	18°17'40.70" N	18°17'39.07" N
Longitude	66°01'46.52" W	66°01'44.93" W	66°01'41.22" W
5) Latitude	18°18'12.63" N	18°18'09.86" N	18°18'07.49" N
Longitude	66°01'49.90" W	66°01'46.24" W	66°01'44.56" W
6) Latitude	18°18'25.35" N	18°18'23.65" N	18°18'21.05" N
Longitude	66°01'16.60" W	66°01'13.50" W	66°01'11.10" W
7) Latitude	18°18'52.30" N	18°18'51.57" N	18°18'50.81" N
Longitude	66°01'24.26" W	66°01'13.51" W	66°01'09.49" W
8) Latitude	18°19'06.24" N	18°19'06.17" N	18°18'03.99" N

Longitude	66°01′16.32″ W	66°01′08.63″ W	66°00′58.16″ W
9) Latitude	18°19′11.42″ N	18°19′10.22″ N	18°19′09.25″ N
Longitude	66°01′01.42″ W	66°00′54.28″ W	66°00′48.22″ W
10) Latitude	18°19′22.94″ N	18°19′22.45″ N	18°19′21.94″ N
Longitude	66°00′53.81″ W	66°00′47.28″ W	66°00′43.01″ W

At each sampling point, a transect crossing reservoir's width (east to west) was carried out, where three (3) collection points were marked. Therefore one (1) point near the right bank, another near the left bank and one (1) in the middle of the transect. Having three (3) localities across the reservoir allowed to see variants by depth, between shallower and deeper areas (**Figure 1**).

Figure 1. Location of sediment samples collected in Carraízo during the month December 2021.



The sediment was collected with a bottom dredge (**Figure 2**), specifically a stainless steel Petit Ponar dredge with a weight and volume of 6.8 kg (24 lb), 2.4 Liter volume and a sample area of 152 x 152 mm (6 x 6”). The dredge is suitable for bottoms with muddy or fine sediments, in deep areas (Ramírez, 2010).

The separation of the samples consisted of two phases: the initial washing and the bug picking for taxonomic identification, using the materials and recommended procedures for ecological studies with macroinvertebrates (Ramírez, 2010).

The initial washing was performed using a 250 µm sieve and running water. The material separated with the sieve was preserved in 70% ethyl alcohol in glass containers sealed and labeled according to the number and replica of the sample. Each sample was observed under a microscope in detail using Petri dishes, tweezers and droppers, which allowed the separation of insects from the material for taxonomic identification and counting.

Figure 2. Petite Ponar Dredge sediment sampling equipment used in Carraizo Peservoir

The sediment was deposited or in plastic bags (**Figure 3**), fixed with 4% formaldehyde and kept in beach coolers with ice to prevent altering or decomposing the organisms, these samples are examined in the laboratory using a microscope.

Figure 3. Sediment Collection.

Once removed the organisms from the sediment were preserved in 70% ethyl alcohol. The identification of taxa, except Nematodes, Oligochaeta and Acari was carried out at the family level, using identification keys and guides.

The relative abundance of each group of organisms or taxon and the Shannon Diversity Index (Gotelli & Ellison, 2004) were calculated to make comparisons and statistical analyses. In addition, Shannon's Diversity and Evenness Indices were calculated in order to make comparisons and statistical analyses. The BMW-PR and IBF-PR Indices for water quality were also calculated (Gutierrez-Fonseca & Ramírez, 2016).

3 RESULTS

The final results will reflect a change in the abundance of individuals per sampling point.

Table 2. Sample Points: Relative Abundance.

Sampling Points	ABD
1	43
2	74
3	41
4	31
5	47
6	31
7	82
8	96
9	31
10	106
Relative Abundance	**582**

The relative abundance (evenness of distribution of individuals among species in a community) is 582 individuals. The relative abundance was obtained by dividing the abundance of each family by the total number of individuals in the complete sample. This

proportion was multiplied by one hundred percent to obtain the percentage represented by each family in the sample.

A total of 12 families have been identified. This amount represents a low richness, considering that in Puerto Rico up to 61 families of aquatic macroinvertebrates have been identified (Gutiérrez-Fonseca, Rosas, & Ramírez, 2013). The most abundant families preliminarily were: Chaoboridae with 170 individuals (29% of the samples), Oligochaetae with 132 individuals (235 of the samples), Hidrachnidia with 106 individuals (18% of the samples) and Physidae with 58 individuals (8% of the samples) respectively (**Table 3**).

Table 3. Families of aquatic invertebrates identified in sample points.

Families	**ABD**
Chaoboridae	170
Oligochaetae	132
Acari	106
Physidade	47
Chironomidae	28
Ostracoda	26
Ancylidae	22
Psycodidade	21
Planaria	17
Hydraenidae	8

Hirudinea	4
Syrphidae	1

All these families are characterized by tolerance to impacted aquatic environments, except for the Hydraenidae family, which is characterized by being more sensitive to organic pollution.

According to the *Biological monitoring working party* (BMWP-PR) (Gutierrez-Fonseca & Ramírez, 2016) the families represented in the samples evaluated reflect poor quality and very impared water (score of 18-36 in orange) which represents 40% of the sampled points. Scores in red color represent very poor quality and extremely impiared waters (score equal to or less than 17) which are 60% of the sampled points. This index considers the presence of families of aquatic insects, which are associated with a number of tolerances to different levels of contamination. Basically the tolerance values of the families represented are added, BMWP = $\sum t_i$, where ti are the tolerance values for each family (Gutierrez-Fonseca & Ramírez, 2016).

(**Table 4**).

Table 4. Biological Monitoring Working Party.

Sampling Points	**BMWP**
1	21
2	27
3	11
4	6

5	11
6	9
7	10
8	27
9	10
10	20

Below is **Table 5**, which contains the interpretation of the index according to the scoring ranges (Gutierrez-Fonseca & Ramírez, 2016).

Table 5. Water Classification according to water quality total points for the BMWP-PR

Water Quality	Score	Representative Color
Excellent Quality Waters	≥97	Blue
Good Quality Waters, non-contaminated or not sensibly altered	77-96	Celestial Blue
Mild Quality Waters, Eutrophic, Moderate Polluted	57-16	Green
Bad Quality Waters, Polluted	37-56	Yellow
Bad Quality Waters, Very Polluted	18-36	Orange
Very Bad Quality Waters, Extremely Polluted	≤17	Red

Table 6. Water Classification according to water quality total points for the BMWP-PR in Carraízo.

Sampling Points	FBI-PR
1	4.19
2	3.96
3	3.71
4	5.45
5	3.70
6	5.94
7	7.93
8	4.78
9	5.32
10	9.07

According to the *Family Biotic Index* (FBI-PR) (Gutierrez-Fonseca & Ramírez, 2016) the families represented in the samples evaluated showed excellent to good quality water with little chance of organic contamination (ranges between 0.0 - 5.98), which accounted for 80% of the sampling points. However, it also showed water of very poor quality, that is, with severe organic pollution (7.73-10.00), which represented 20% of the sampling points. Unlike the previous index, this one considers the number of individuals per family in the calculation for the final score. The following formula is used: $IBF= \sum (n_i *t_i)/N$, where n_i is the number of individuals per family, t_i the assigned tolerance number and N the total number of individuals.

Unlike the previous index, this one considers the number of individuals per family in the calculation for the final score. Below is **Table 7** to facilitate the interpretation of the scores (Gutierrez-Fonseca & Ramírez, 2016).

Table 7. Water Classification according to total score for the IBF-PR.

Water Quality	Pollution Level Interpretation	Category	IBF-PR Value	Representative Color
Excellent	Low Possibility Organic Pollution	1	0.0- 4.24	Blue
Very Good	Mild Organic Pollution	2	4.25- 5.11	Celestial Blue
Good	Some Organic Pollution	3	5.12- 5.98	Light Blue
Moderate	Substantial Organic Pollution	4	5.99- 6.85	Green
Moderate- Poor	Very Substantial Organic Pollution	5	6.86- 7.72	Yellow
Poor	Severe Organic Pollution	6	7.73- 8.59	Orange
Very Poor	Very Severe Organic Pollution	7	8.60- 10.00	Red

3.1 Diversity and Evenness Indices

3.1.1 Shannon Diversity (H)

None of the Shannon diversity values that were obtained were found within the range of values expected from an ecological point of view (1.5-3.5). The Shannon Diversity Index calculation indicates low diversity as all values were below 1.5. This means that the

number of individuals per family reflects similar abundances. In the context of a tropical aquatic ecosystem, low diversity indicates poor habitat quality or that the ecosystem is being impacted.

3.1.2 Shannon Evenness (E)

This index evaluates the evenness in the abundances of the sampled individuals. The ranges of this index are zero to one. Zero means no uniformity and 1 means complete uniformity. In the case of the samples analyzed, 90% of the values were equal to or greater than 0.75, indicating high uniformity (that is, the species occur in equal abundance).

Because the Shannon index values were low, it can be interpreted that the state of the habitat favors that certain families to be the dominant ones or are the only ones that can be present.

In general, low diversity (H) per site and simultaneously high uniformity (E) were found. In addition to this, the ecological richness was low, and the organisms collected were of very small size. The results reflect that the condition of the habitat is not optimal, or that it is degraded.

Table 8. Diversity and Evenness Results.

Sample Points	Shannon Diversity (H)	Shannon Evenness (E)
1	0.9933	0.821
2	0.6575	0.7897
3	1.0371	0.8638
4	0.4454	0.6767
5	1.1181	0.9722

6	0.8062	0.9698
7	0.7839	0.7778
8	1.1237	0.7798
9	0.8185	0.8749
10	0.8038	0.7317

4 CONCLUSION

The samples reflect deteriorating conditions associated with organic contamination. This can be related to sediment overload in the dam, which means more nutrients and algae overgrowth. The richness of aquatic macroinvertebrate families is low and is composed mostly of families tolerant of organic pollution. Biodiversity and evenness indices showed that the macroinvertebrate families present are dominated by a small group of taxa of similar abundances.

Results show the relevance of the integration of biomonitoring assessments as routine protocols to evaluate the reservoir aquatic ecosystems. It is important to highligt that biomonitoring assessments have been used successfully to evaluate aquatic ecosystems response to disturbances (Sauer, 2004); (Bae, Kil, & Bae, 2005).

The development of reservoirs and its further sedimentation process is a common management issue associated with river ecosystems that needs to be evaluated on a long -term basis (SoonAh, Jongsun, & chulwon, 2011). Different studies had suggested the use of macroinvertebrates as adequate indicators for the assessment of changes on the aquatic ecosystem over the time associated with sediment management actions like reservoir flushing (Brignoli, 2017), sediment removal and placement (Stevenson & Koel, 1999), and chemical contamination of the benthos (Fanny , et al., 2013).

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APPENDIX M 8-STEP FLOODPLAIN MANAGEMENT

Appendix M

EO11988/EO11990 Eight-Step Decision Making Process

Puerto Rico Aqueduct and Sewer Authority (PRASA): FAASt Carraizo Reservoir Dredging, Guaynabo, Puerto Rico
Executive Order 11988 – Floodplain Management
Executive Order 11990 – Protection of Wetlands
Eight-Step Decision Making Process

Date: 02/04/2022

Step 1 **Determine if the proposed action is located in the base floodplain or wetlands.**

The proposed action is not a critical action and was therefore reviewed against the *100-Year Floodplain*. The proposed action is to dredge and remove sediment from the Carraizo Reservoir. The proposed action includes six project components: staging area, temporary dock three existing disposal dikes, and a sediment pipeline (four sections). The six proposed project sites are located within the *100-Year Floodplain* in Zones A and AE according to the *Advisory Base Flood Elevations* (ABFE) map, and five are located in Wetlands (Table 1). The proposed action will not potentially adversely affect the floodplain or support floodplain development, but the proposed action will potentially be adversely affected by the floodplain. According to the *Carraizo Reservoir Dredging Project Environmental Assessment Study of Flora and Fauna*, the proposed action is subject to flooding, and FEMA assumes the proposed action is subject to flooding based on previous flooding of the area. The project is not located in a coastal high hazard area, but the sediment pipeline is located in the Floodway.

Table 1. Proposed work locations and their designations in the floodplain and on wetlands.

Location	Coordinates	ABFE Designation	Wetlands Designation*
Disposal Dike A	18.259051, -66.008372	ABFE Zone A	Palustrine
Disposal Dike B	18.270354, -65.989855	ABFE Zone AE	None present
Disposal Dike C	18.263986, -65.953448	-	Palustrine
Staging Area	18.277718, -66.010743	ABFE Zone A	None present
Temporary Dock	18.27768, -66.009900	ABFE Zone A	Riverine
Sediment Pipeline *Section 1*	Start: 18.320072 -66.014141 End: 18.272129 -66.008188	ABFE Zone A Floodway	Lake/Riverine
Section 2	Start: 18.272129, -66.008188 End: 18.26079, -66.00658	ABFE Zone A Floodway	Riverine/Freshwater
Section 3	Start: 18.272129, -66.008188 End: 18.269214 -65.99148	ABFE Zone A Floodway	Riverine/Freshwater Emergent
Section 4	Start: 18.268727, -65.991701 End: 18.263428, -65.958203	ABFE Zone A Floodway	Riverine/Freshwater Emergent

* Wetland designations are based on select field surveys or on USFWS National Wetland Inventory Maps where surveys have not yet been conducted. The entire project area has not been delineated and a U.S. Army Corps of Engineers jurisdictional determination is not yet available.

Step 2 Early public notice (Preliminary Notice).

A disaster wide cumulative public notice was published in El Vocero newspaper on December 18, 2017.

Step 3 Identify and evaluate alternatives to locating in the base floodplain and wetlands.

The scope of work in the proposed action includes the following: clearing and grubbing the internal areas of the disposal dikes A, B, and C (129,575-, 130,000- and 315,000-square meters, respectively), by removing large vegetation that could impact the integrity of the disposal dikes; re-grading the perimeter road of the disposal dikes (using previously deposited sediment); disposing any generated solids waste as a result of the clearing and grubbing to certified landfills; pumping dredged materials through a pipeline from the reservoir to the disposal dikes; decanting water through geotubes; and installing erosion control measures with a combination of barriers (straw bales and silt fence) and rip rap at the end of the decanted water outfall.

For the temporary staging area, the applicant will perform clearing and grubbing work, will dispose of any generated solids waste to certified landfills, will store equipment and materials, will install trailer offices, and will install an erosion control silt fence and a temporary perimeter fence.

For the dock site, the applicant will install a temporary dock within the staging area for barges which will be used to transport equipment and fuel needed for the dredging operations. The dimensions of ground disturbance associated with the dock construction are: 420 square meters (L = 26.26 m W = 15.97 m, D = 0.20 m). The dock will be built in the same location as the dock used during the 1997 dredging event. The dock will be removed after this dredging event.

Installation of the temporary (two-years) sediment pipeline and associated equipment will include: a pipeline up to 24-inches in diameter and up to 17 km (10.9 miles [mi]) long, with approximately 10 km (6.2 mi) of pipeline sections in the open water of the reservoir and approximately 7 km (4.3 mi) of pipeline sections on land. Booster pumps will be located along the pipeline alignment, as required. The applicant will perform incidental vegetation clearing and grubbing and will dispose of any generated solids waste to certified landfills. To limit ground disturbance, PRASA will employ non-invasive temporary anchorage (pipeline fasteners using weighted brackets) for the sediment pipeline and road crossings will employ above-ground crossing devices.

The proposed action is not an alteration of a structure or facility listed on the National Register of Historic Places or a State Inventory of Historic Places.

The proposed action includes the temporary construction of a sediment pipeline in the floodway. There are no practicable alternatives to locating the proposed project sites outside the ABFE Zones and/or wetlands to address floodplain management and wetlands protection (Executive Order [EO] 11988 and EO 11990 compliance). The Carraizo Reservoir is functionally dependent on the floodplain; therefore, dredging and associated activities must be located along the riverway to fulfill the project's purpose and function of restoring its design capacity.

The project purpose and need will not be met with the No Action Alternative. No Action Alternative will not mitigate the impacts to Carraízo Reservoir's water storage capacity after Hurricane María. There will be a continuing deposit of sediments that will eventually prevent the operation of the Sergio Cuevas Water Filtration Plant (SCWTP) raw water intake. During droughts, sediment barriers will form, reducing the necessary constant water flow to the water intake. This will result in negative effects to PRASA's ability to provide a reliable source of potable water due to the permanent reservoir capacity loss.

Other alternatives considered and dismissed include raising the height of the dam structure to increase water storage capacity or constructing a new desalination plant to provide a new source of water. Raising the height of the dam was dismissed because a higher elevation in the reservoir will raise the elevations of the flood zone for the surrounding area and will cause a greater risk of flooding for the adjacent communities of Caguas and Gurabo. These areas and other developed locations have already suffered from flooding problems. Flood control levees have been built in these areas to reduce flooding impacts. Due to the potential increased risk of flooding to the adjacent communities, it was determined this alternative was not feasible.

A new desalination plant will require construction of a new seawater pipeline inlet and a brine discharge outfall which will require a considerable extension of new pipelines towards the Atlantic Ocean. The desalination plant could be located within an urbanized area near the Atlantic Ocean or within the port of San Juan. It is estimated it will take approximately three years for planning, permitting, design, and construction of a new desalination plant before starting operations to deliver drinking water. The Carraizo Reservoir will still be needed to store water and will have to be dredged every two years to maintain storage capacity and a safe yield of water. Due to projected high construction costs and the elevated energy costs associated with the desalination plant operation, including the potential environmental impacts linked to the development of this alternative, it was determined this alternative was not feasible.

Step 4 **Identify impacts of proposed action associated with occupancy or modification of the floodplain or wetlands.**

The proposed action conducted at the six sites will not adversely impact the floodplain in comparison to its pre-disaster state. Therefore, it will not increase the risk of flood loss. Moreover, the proposed action at project sites will not result in an increase base discharge or increase the flood hazard potential to other properties and structures. The action does not minimize the impact of flood loss on human health, safety, or welfare, and will not induce future growth and development, which will potentially adversely affect the floodplain. The action does involve dredging, but it will not result in the discharge of pollutants into the floodplain. The proposed action does not restore and/or preserve the natural and beneficial values served by floodplains. The proposed action, however, will result in an increase to the useful life of the Carraizo Reservoir.

Portions of the proposed project area are within the floodplain. According to FEMA Map Sheets 72000C0735J, 72000C0745J and 72000C0645J dated November 18, 2009, portions of the proposed project area are within Zones A, AE and X. Two of the disposal dikes are located within the floodplain, however, due to their design with tall, 40ft+ dike walls, the risk of flood damage is minimal.

Zone A

Project components within Zone A (moderate flood hazard) include the proposed floating sediment pipeline and booster pumps, staging area, temporary dock, disposal dike A, the inshore aboveground sediment pipeline, and a small area of disposal dike B. Floating sediment pipelines in Zone A will be built to be flexible enough to endure the movement of the water within the reservoir and the currents that may be associated with flood events. Disposal dike A is man-made site with 40ft+ tall dike walls therefore the risk to flood damage is minimal for the disposal dike itself. Since it is an existing structure in the floodplain, it has the capacity to displace water during a flood event. The staging area and temporary dock are within Zone A.

The inshore aboveground sediment pipeline and booster pumps will also be within Zone A. The inshore aboveground pipeline could cause localized interruptions to local drainage patterns, such as ponding in the areas adjacent to the pipeline. To mitigate potential flood damage to the pipeline, the aboveground pipeline will be installed using non-invasive temporary weighted anchors, while

booster pumps. Booster pumps will be mounted on skids, sitting at grade. A temporary demobilization plan will be implemented if a major atmospheric event is forecasted.

Zone X

Most of disposal dike B and all of disposal dike C are entirely in Zone X (minimal flood hazard). Disposal dikes B and C have little risk of flood damage.

The proposed project will not permanently impact wetlands. Wetland areas within disposal dikes A and C are likely not federally jurisdictional because the dikes are constructed features that were built in uplands and do not constitute impoundments of traditional navigable waters or tributaries to traditional navigable waters. There are no wetlands within the staging area. Wetlands along the pipeline route will be temporarily impacted by placement of the temporary anchorage platforms. After the platforms are removed, a native wetland seed mix will be laid down in disturbed wetland areas to promote the return of wetland vegetation. The temporary dock will temporarily disturb wetlands on the edge of the reservoir. After dredging is complete, the dock will be removed, and a native wetland seed mix will be laid down in disturbed wetland areas to promote the return of wetland vegetation.

The Carraízo Reservoir is a major component of PRASA's municipal water treatment, transmission, and distribution system and meets the definition of a critical service. The proposed action will support the long-term ability of PRASA to provide a steady, reliable source of potable water for the SCWTP. The proposed action will restore the water storage capacity of the Carraízo Reservoir which is the only water source to PRASA's SCWTP. The proposed action will result in an increase to the useful life of the Carraizo Reservoir.

Step 5 **Design or modify the proposed action to minimize threats to life and property and preserve its natural and beneficial floodplain or wetland or wetland values.**

No flood hazard reduction techniques were applied to the proposed action to minimize flood impacts. In addition, no avoidance and minimization measures were applied to the proposed action to minimize the short- and long-term impacts on the floodplain. Moreover, no measures were implemented to restore and preserve the natural and beneficial values of the floodplain.

Impacts to wetlands were deigned to be temporary in nature. The in-water portion of the pipeline will float and will be removed after dredging is complete. The on-land portion of the pipeline will not require ground disturbance other than the placement of platforms on which the pipeline will sit. The dock is water dependent and cannot avoid impacting wetlands but will be removed after dredging is complete. Disturbed wetland areas will be covered with a native wetland seed mix to promote the return of wetland vegetation after the dredging is complete.

No floodplain or wetland benefits will be provided with the proposed action. The Carraizo Reservoir was constructed to store water for consumption. It does not store or help control flood waters therefore the proposed action will not minimize the risk of future floodplain damage.

Step 6 **Re-evaluate the proposed action.**

There are no practicable alternatives identified for the proposed project. The proposed action is functionally dependent on the floodplain and must be located within the Rio Grande de Loíza watershed to serve its purpose of providing water for the SCWTP service area. The proposed project will not disrupt floodplain values because it will not change water levels or permanently reduce habitat in the floodplain. The proposed project will not aggravate the current flood hazard because the staging area, dock and sediment pipeline are temporary facilities which will not impede or redirect flood flows. There is no potential for limiting the action to increase the practicability of previously rejected non-floodplain sites and alternative actions. Moreover, minimization of harm to or within the floodplain can be achieved using all practicable means. FEMA and the applicant determined that the proposed project is the most feasible alternative. There is no practicable alternative to locating the proposed project outside the 100-Year Floodplain.

There is no practicable alternative to placement of the temporary dock along the shore of the reservoir because the dock is water dependent. The proposed dock is temporary, and wetlands will be restored after the dock is removed. Placement of the temporary pipeline platforms on land will be decided after the wetland delineation has been completed and the final design is prepared. Platforms will be placed in uplands to the extent practicable to minimize temporary impacts to the wetlands.

Step 7 **Findings and public explanation (Final Notification).**

A disaster wide cumulative public notice was published in El Vocero newspaper on December 18, 2017. An additional project specific public notice will be provided in the public comment period for the Environmental Assessment for this project.

Step 8 **Implement the action.**

Approval is conditioned on review of implementation and post-implementation phases to ensure compliance with the requirement(s) stated in 44 CFR 9.11. The proposed project will be constructed in accordance with floodplain development requirements and other applicable laws, regulations, and executive orders.

For disposal dikes A and B, staging area, temporary dock, and sediment pipeline, the applicant must obtain any required permits from the Puerto Rico Planning Board prior to initiating work and comply with any conditions of the permit, as well as the National Flood Insurance Program (NFIP) requirements to ensure harm to and from the floodplain is minimized. All coordination (emails, letters, documented phone calls) pertaining to these activities and compliance must be provided and maintained in the applicant's permanent files.

Moreover, the applicant is responsible for proper identification of wetlands. For disposal dikes A, C, the temporary dock, and inshore sediment pipeline, to ensure that wetlands are not adversely impacted, per the Clean Water Act and EO 11990, equipment storage and staging of construction materials and machinery must be in a location that will prevent erosion and sedimentation. In addition, under EO 11990, the applicant is responsible for coordinating with and obtaining required Section 404 Permit(s) from the United States Army Corps of Engineers (USACE) prior to initiating work. The applicant shall comply with all conditions of the required permit(s). All coordination (emails, letters, documented phone calls) pertaining to these activities and compliance must be provided and maintained in the applicant's permanent files.