3.0 AFFECTED ENVIRONMENT

This chapter describes the actual physical and socioeconomic environment of the Project area.

3.1 Introduction

This section describes the existing environmental resources of the areas that would be affected if any of the alternatives for the development of the PTA were implemented, but limited to those environmental resources that are relevant to the proposed action. The descriptions include a general overview of the environment of the region, and details of those environmental resources that would be affected by any of the alternatives if they were implemented. In conjunction with the description of the No-Action alternative, this section provides base line conditions for determining the environmental impacts of the proposed action and the alternatives considered by the Applicant for its implementation.

3.2 General Environmental Setting

3.2.1 Climate

The climate of the region where the PTA is proposed in typical of the subtropical-dry climatic zone of the south coast of Puerto Rico, as defined by National Oceanic and Atmospheric Administration (NOAA). Average temperatures in the region generally exceed 85 degrees Fahrenheit, while average rainfall is only 31-40 inches per year, as compared to the island average of 76 inches.

3.2.1.1 Temperature and Precipitation

The temperatures of the South Coast Region vary throughout the year in a manner similar to the other coastal regions of the Island. The Project area is located in the South Coast Climate Province (National Oceanic and Atmospheric Administration, NOAA). NOAA divided the Island in climate provinces according to their climatologic characteristics. For each of these provinces, the averages of these climatologic characteristics are calculated using data from stations that register temperature on a daily or continuous basis. NOAA operates 3 climate stations in the Project area as illustrated in Figure 3-1.

In Puerto Rico, precipitation varies by season and area. The area variations are due to combinations of topographical traits and prevailing easterly winds. The annual precipitation average varies from less than 40 inches in the southwestern coast to more than 200 inches in the mountainous region of El Yunque, on the eastern coast near Fajardo. The dry season begins in December and ends in March or April, and is followed by a rainy season that extends from April to May. During June until mid-August there is a reduction in precipitation, immediately followed by a rainy season until November, during which 50 percent of the annual precipitation occurs (USGS, Hydrologic Investigations Atlas 730, 1997).

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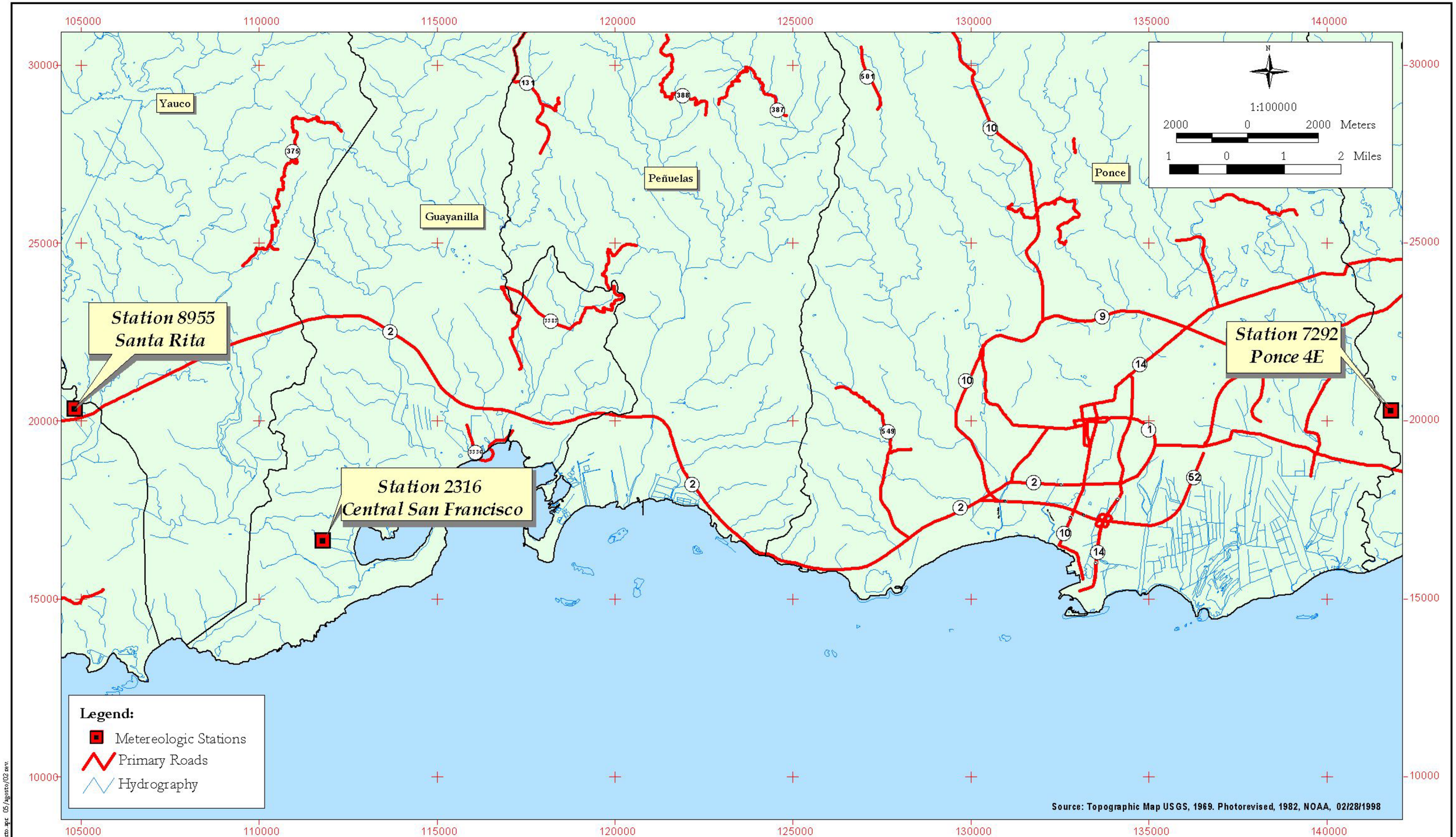

Coordinates in State Plane NAD 27

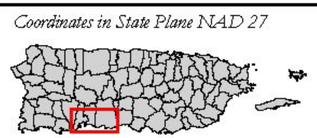

Figure 3-1 Location of the Selected Meteorologic Stations in the Study Area

Port of the Americas

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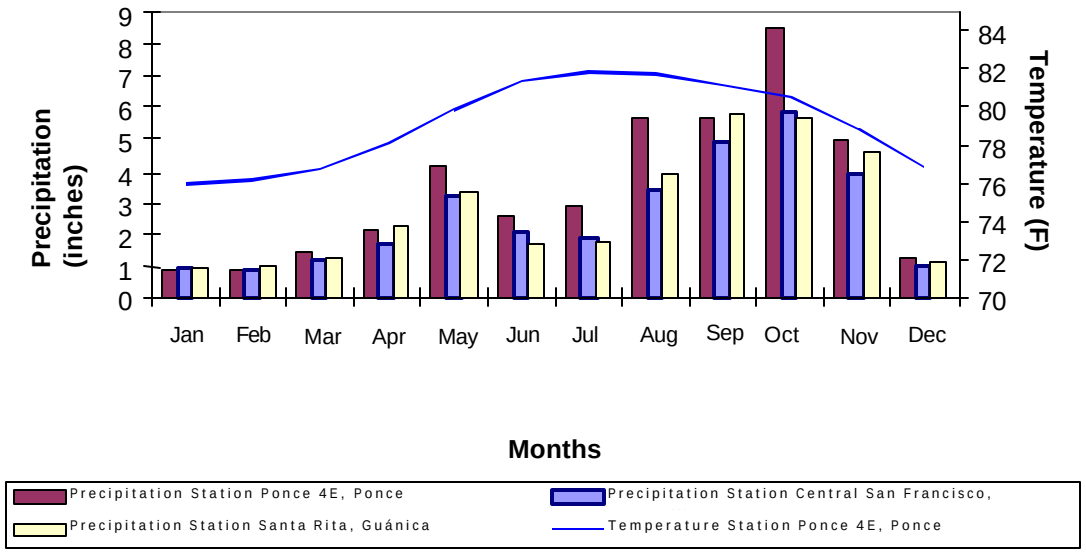
The climate at the Project area is warm and semi-dry, with average annual precipitation totals ranging from 31 to 40 inches. The average temperature at Ponce, where the closest meteorological station is located, is 79 degrees Fahrenheit. Values of the normal, monthly and annual precipitation and temperature at the meteorological stations in the Project area are summarized in Table 3-1 and Figure 3-2. These stations include the Central San Francisco station at Guayanilla, Ponce 4E station at Ponce and Santa Rita station at Guánica. The normal values represent average statistics for climatic data such as precipitation and temperature, for a specific period of time. NOAA utilizes a 30-year period to calculate normal precipitation and temperature values. The period changes at the end of each decade to reflect the most recent 30-year period. The current normal values represent the time period from 1961 to 1990.



Source: NOAA, 1992

Figure 3-2: Normal Precipitation and Temperature at Stations near the Project area, for 1961-1990

Table 3-1: Normal Precipitation and Temperature (1961-1990) at Climatic Stations near the Project Area (South Coast Climate Province)

	Station Central San Francisco Guayanilla (NOAA # 2316)		Station Ponce 4E Ponce (NOAA # 7292)		Station Santa Rita, Guánica (NOAA # 8955)	
Month	**Precipitation (inches)**	**Tempe-rature (F)**	**Precipitation (inches)**	**Tempe-rature (F)**	**Precipitation (inches)**	**Tempe-rature (F)**
January	0.93	NA	0.85	76.0	0.94	NA
February	0.85	NA	0.84	76.2	1.05	NA
March	1.18	NA	1.44	76.7	1.27	NA
April	1.70	NA	2.12	78.1	2.25	NA
May	3.20	NA	4.15	79.9	3.30	NA
June	2.02	NA	2.55	81.4	1.70	NA
July	1.90	NA	2.93	81.9	1.74	NA
August	3.39	NA	5.68	81.8	3.87	NA
September	4.87	NA	5.69	81.2	5.80	NA
October	5.88	NA	8.51	80.5	5.67	NA
November	3.97	NA	4.97	78.9	4.63	NA
December	1.09	NA	1.25	76.8	1.15	NA
Annual	**30.98**	**----**	**40.98**	**79.1**	**33.37**	**----**
NA – Not available						

Source: NOAA. (1992). Station Monthly Normal Temperature, Precipitation and Heating and Cooling Degrees Days 1961 – 1990.

3.2.1.2 Winds

During most of the year, wind circulation in the Caribbean Sea and Puerto Rico is dominated by the trade winds that blow from east to west. These winds originate in high-pressure systems in the vicinity of the Azores Islands, west of the African continent. In the mountainous sectors of Puerto Rico, orogenic effects, such as hills, cliffs and elevated terrain, where the winds are accelerated, channeled or deviated from their course, affect the movement of the trade winds. However, along the coast line the orographic influence exerted on the trade winds is mild. In general, the prevailing winds in Puerto Rico, including the South Coast Region, are predominately easterly.

An important trait of coastal areas is the temperature adjustment due to the trade winds, caused by the daily ocean and land breezes that form at the coast. Ocean breezes form when the air over the coastal plain is warmer than the air over the ocean. This phenomenon occurs from early morning to late afternoon on days when the land surface is sufficiently warm. During daytime, this warmth expands the air and lowers pressures above land to a lesser degree than the ocean. Since air above land flows from higher pressures to lower pressures, an ocean breeze is formed. At the higher levels in the atmosphere, the flow inverts, from land to the sea, maintaining the ocean breeze circulation. In the South Coast Region, the ocean breeze flows northerly most of the time.

The ocean breeze continues to circulate inwardly until the land friction or the prevailing wind flow compensates for the inflowing breeze. The ocean breeze will only weaken or cease to flow when the solar radiation is diminished at sunset or when clouds, stimulated by the ocean breezes, act as shields against the sunrays. The land breeze develops during the night when the difference in the land air temperature and the ocean is inverted. Therefore, the typical pattern during daytime hours is a constant wind flowing from the ocean inland, and at sunset the wind will change direction and flow from land out to sea.

The wind characteristics in the Project area can be estimated from the data obtained at the Tallaboa Meteorological Station operated by the Puerto Rico Electric Power Authority (PREPA). Investigations on the long-term wind direction/velocity are available for the Tallaboa Meteorological Station and the Magueyes station near Mayagüez. The Tallaboa Meteorological Station, located at approximately 0.93 miles (1.5 km) from the Guayanilla-Peñuelas study area and 7.39 miles (11.9 km) from the Port of Ponce, is more representative of the Project area than the Magueyes site. The meteorological station measures the wind at elevations of 33 and 250 feet above the land surface. The data registered at this station during the period of January to December 1997 are presented in Tables 3-2 and 3-3. The windrose data presented for this station (Figures 3-3, 3-4 and 3-5) shows that the prevailing winds are from the northeast and east-northeast at the indicated elevations of 33 and 250 feet above land, respectively. The average wind velocity is 6.1 and 11.2 miles per hour (MPH) (5.30 and 9.73 knots, respectively) at the indicated elevations.

Stability is one of the determinants of atmospheric disturbances and is divided into three categories: stable, neutral and unstable. A plume of a contaminant will have a greater dispersion under unstable conditions, while under stable conditions it will have a smaller dispersion. Data are available on the stability of the wind at the PREPA meteorological station at Tallaboa (Peñuelas), for the period between 1989 and 1993 (Federal Energy Regulatory Commission, 1996). A frequency analysis of the data on the different stability degrees for this period at the station shows that the wind is generally stable or neutral with very few hours of unstable or extremely unstable conditions.

Table 3-2: Wind Velocity, Direction and Occurrence Data for the Tallaboa Meteorological Station (Elevation 250 Feet above Land)

Direction	Velocity (mph)						Observation Totals by Wind Direction	Average Velocity by Wind Direction	Percentage of Occurrence by Wind Direction
	0.75-3	3-7	7-12	12-18	18-24	> 24			
N	9	33	4	0	0	0	46	4.3	0.525
NNE	10	145	92	19	2	0	268	7.1	3.060
NE	18	495	202	27	2	0	744	6.5	8.495
ENE	12	951	1,425	51	1	0	2,440	7.6	27.860
E	10	231	942	465	35	1	1,684	10.4	19.228
ESE	3	55	315	528	329	53	1,283	15.1	14.649
SE	8	21	115	405	611	131	1,291	18.2	14.741
SSE	2	20	152	404	109	2	689	14.3	7.867
S	3	26	56	7	0	0	92	8.3	1.050
SSW	5	20	14	1	0	0	40	6.2	0.457
SW	3	8	15	6	0	0	32	8.7	0.365
WSW	3	5	4	5	7	7	31	15.0	0.354
W	8	13	8	5	4	0	38	8.2	0.434
WNW	4	11	7	5	0	0	27	7.8	0.308
NW	4	10	5	7	0	0	26	7.5	0.297
NNW	6	10	3	1	0	0	20	5.0	0.228
Observation Totals by Observation Range	108	2,054	3,359	1,936	1,100	194			
Average Velocity by Velocity Range	2.3	5.7	9.1	14.7	20.5	25.5		11.2	
Calm									**0.080**
Percentage Total									**100.000**

Source: Puerto Rico Electric Power Authority, 1997
Notes: Total Number of Occurrences: 8,758
Number of Hours that data was lost: 2

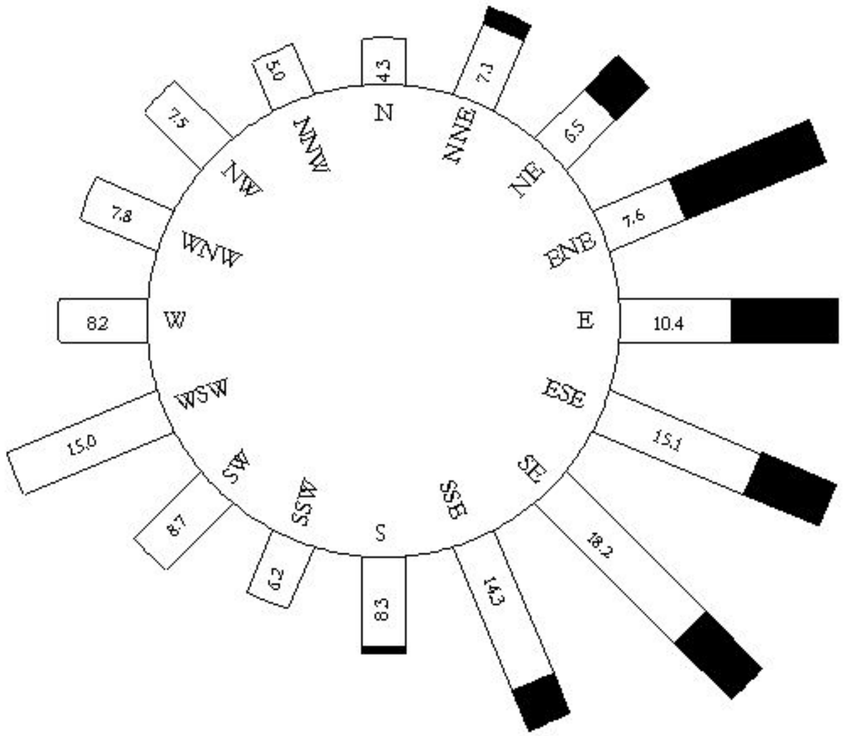
Table 3-3: Wind Velocity, Direction and Occurrence Data for the Tallaboa Meteorological Station (Elevation 33 Feet above Land)

Direction	Velocity (mph)						Total Observances by Wind Direction	Average Velocity by Wind Direction	Occurrence Percentage by Wind Direction
	0.75-3	3-7	7-12	12-18	18-24	>24			
N	25	7	2	0	0	0	34	2.7	0.388
NNE	207	273	7	0	0	0	487	3.4	5.563
NE	359	2,307	15	0	0	0	2,681	4.0	30.623
ENE	146	851	23	0	0	0	1,020	4.1	11.650
E	66	871	373	6	0	0	1,316	5.9	15.031
ESE	16	288	770	125	0	0	1,199	8.7	13.695
SE	9	99	570	245	0	0	923	10.2	10.543
SSE	7	121	635	71	0	0	834	9.2	9.526
S	11	79	9	0	0	0	99	5.1	1.131
SSW	8	27	6	0	0	0	41	4.6	0.468
SW	7	16	4	2	0	0	29	5.3	0.331
WSW	5	9	9	0	0	0	23	6.1	0.263
W	6	9	7	0	0	0	22	5.1	0.251
WNW	9	6	0	0	0	0	15	3.2	0.171
NW	3	9	0	0	0	0	12	4.4	0.137
NNW	6	8	0	0	0	0	14	3.4	0.160
Observation Totals by Velocity Range	890	4,980	2,430	449	0	0			
Average Velocity by Velocity Range	2.4	4.6	9.3	13.1	0	0		6.1	
Calm									**0.069**
Percentage Total									**100.000**

Source: Puerto Rico Electric Power Authority, 1997
Notes: Total Number of Occurrences: 8,755
Number of Hours that data was lost: 5

VELOCITIES	
RANGES	AVERAGE VELOCITY (M.P.H)
0.75-3	2.3
3-7	5.7
7-12	9.1
12-18	14.7
18-24	20.5
> 24	25.5

OCCURRANCE PERCENTAGE	
DIRECTION	PERCENTAGE
N	0.525
NNE	3.060
NE	8.495
ENE	27.860
E	19.228
ESE	14.649
SE	14.740
SSE	7.867
S	1.050
SSW	0.456
SW	0.365
WSW	0.353
W	0.433
WNW	0.308
NW	0.296
NNW	0.228
CALM	0.080



LEGEND:

AVERAGE VELOCITY

OCCURRENCE PERCENTAGE

OBSERVATION PERIOD

FROM JANUARY 1, 1997 TO DECEMBER 31, 1997

SOURCE:

PUERTO RICO ELECTRIC POWER AUTHORITY

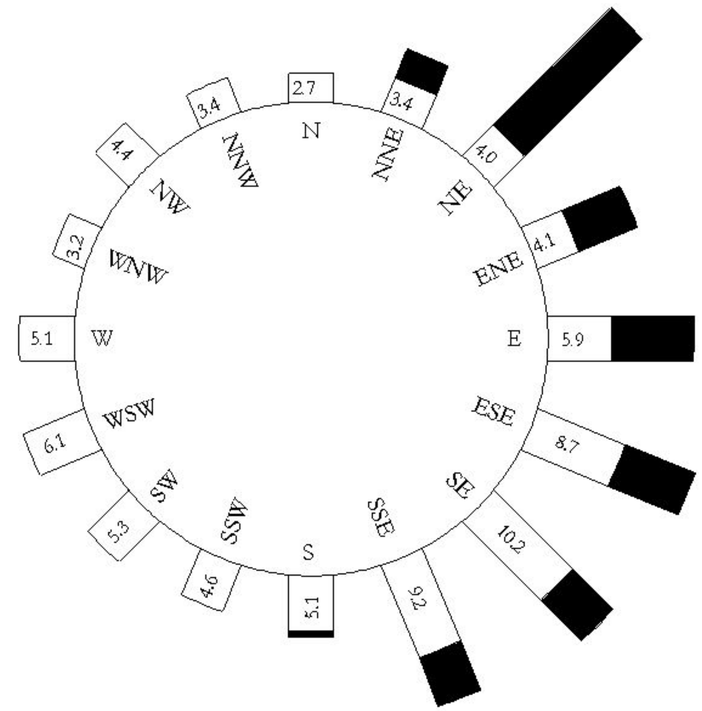
TALLABOA METEOROLOGICAL STATION

FIGURE 3-3 WIND ROSE
TALLABOA METEOROLOGICAL STATION
(TOWER ELEVATION 250 FEET)

Port of the Americas

VELOCITIES	
RANGES	AVERAGE VELOCITY (M.P.H)
0.75-3	2.4
3-7	4.6
7-12	9.3
12-18	13.1
18-24	0
> 24	0

OCCURRANCE PERCENTAGE	
DIRECTION	PERCENTAGE
N	0.388
NNE	5.562
NE	30.622
ENE	11.650
E	15.031
ESE	13.695
SE	10.542
SSE	9.525
S	1.130
SSW	0.468
SW	0.331
WSW	0.262
W	0.251
WNW	0.171
NW	0.137
NNW	0.160
CALM	0.068



LEGEND:

AVERAGE VELOCITY

OCCURRENCE PERCENTAGE

OBSERVATION PERIOD

FROM JANUARY 1, 1997 TO DECEMBER 31, 1997

SOURCE:

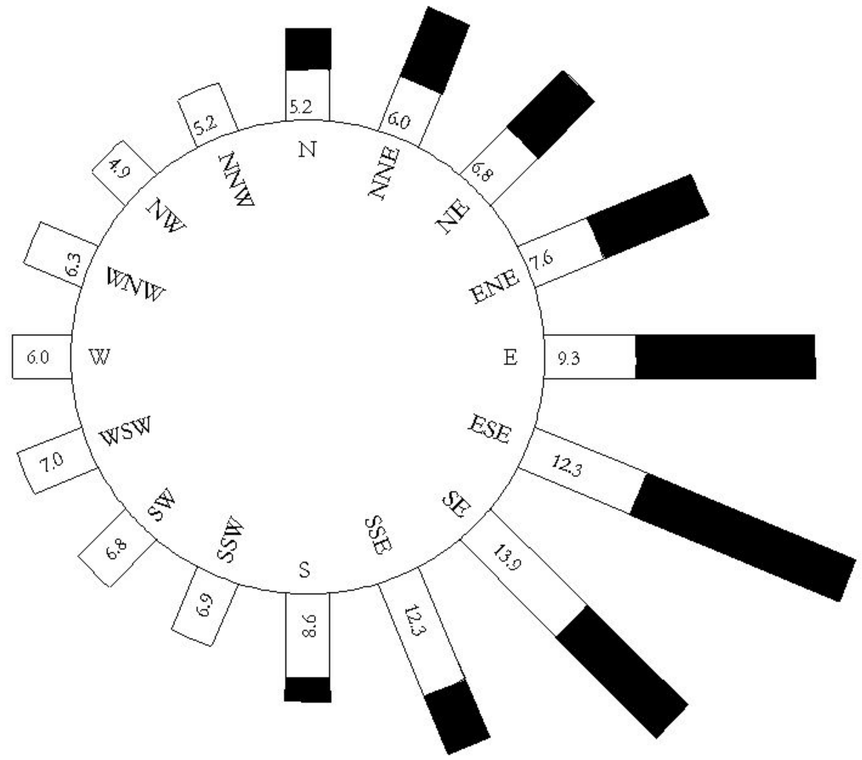
PUERTO RICO ELECTRIC POWER AUTHORITY
TALLABOA METEOROLOGICAL STATION

FIGURE 3-4 WIND ROSE
TALLABOA METEOROLOGICAL STATION
(TOWER ELEVATION 33 FEET)

Port of the Americas

VELOCITIES	
RANGES	AVERAGE VELOCITY (KNOTS)
1-3	0.3
4-6	1.5
7-10	2.1
11-16	2.7
17-21	1.5
> 22	0.3

OCCURRANCE PERCENTAGE	
DIRECTION	PERCENTAGE
N	4.0
NNE	7.4
NE	8.1
ENE	11.4
E	18.1
ESE	22.8
SE	14.3
SSE	6.3
S	2.3
SSW	0.7
SW	0.4
WSW	0.4
W	0.4
WNW	0.4
NW	0.5
NNW	0.9
CALM	1.6



LEGEND:

AVERAGE VELOCITY

OCCURRENCE PERCENTAGE

OBSERVATION PERIOD

FROM 1902 TO 1992

SOURCE:

PUERTO RICO AND U.S. VIRGIN ISLANDS
CLIMATOLOGY CENTER

FIGURE 3-5 WIND ROSE
PONCE 785203 STATION
(TOWER ELEVATION 30 FEET)

Port of the Americas

3.2.2 Land Uses and Zoning

The following sections describe the land uses and zoning for the Project area. The most recent land use map for Puerto Rico was published in 1977. This information was complemented with recent aerial photographs to document the present use of the land in the proposed sites and its surrounding area. The zoning description is based on the zoning documents approved for the area where the PTA proposed facilities would be located, including: Zoning Maps of the Puerto Rico Planning Board (PB) for the Guayanilla and Peñuelas municipalities and the Autonomous Municipal Land Use Plan for the Municipality of Ponce.

The Land Use Plans for Ponce were developed to protect the land and promote balanced, beneficial, and efficient land uses, and to encourage the full development of each municipality. A Land Use Plan must be developed, approved and reviewed by the municipalities, in close coordination with the Puerto Rico Planning Board and other pertinent public agencies, to ensure compatibility with the plans from government, state, and regional entities, as well as from other municipalities.

3.2.2.1 Guayanilla-Peñuelas Area

One of the main components of the PTA would be located in the Guayanilla Bay, between the municipalities of Guayanilla and Peñuelas. The unused UCC parcel, preliminarily designated for development of value-added activities, is located in land within the Municipality of Peñuelas.

Land Uses: In the vicinity of the Guayanilla Peninsula and Bay, land uses are predominately industrial (Figure 3-6). The land within the parcel occupied by the inactive CORCO refinery is located to the north of the site. At present, the operations of the oil refinery are limited to the storage of petroleum derivatives. Also, located to the north are the South Pearl Chemicals, and the Gulf Chemical Corporation. South of the site operates the EcoEléctrica, a private co-generation power plant, which operates a terminal and a dock at the Guayanilla Bay for receiving liquid natural gas (LNG) as fuel for generating electric power. To the southwest of the site there is an industrial area property of Peerless Oil & Chemicals, and to the west industrial lots property of CORCO and the Costa Sur Power Plant, operated by the Puerto Rico Electric Power Authority (PREPA).

Zoning: According to the PB zoning maps for the Municipality of Peñuelas (Sheets No. 13, 14, 16, 17, 19, 20, 23 (February 13, 1972); 15 (March 25, 1978); 18 (December 22, 1979); and 21 (October 9, 1976), the areas proposed for development as part of the PTA, and the adjacent areas, are zoned for industrial use (IL-2, Limited Heavy Industry) (Figure 3-7). As specified in Section 30.00 of the Puerto Rico Zoning Regulations (*Reglamento de Planificación Número 4*, as amended), District IL-2 was established to classify heavy industrial areas previously developed or to be developed for projects, which, due to their nature and intensity, require a particular location.

At present, the municipalities of Guayanilla and Peñuelas have not completed an “Autonomous Municipality Land Use Plan” for approval by the PB and the Governor of Puerto Rico. The development of an Autonomous Municipality Land Use Plan involves preparing four (4) documents: Statement of Objectives and Work Plan; General Brief; Draft Autonomous Municipality Land Use Plan; and Autonomous Municipality Land Use Plan. The Municipality of Guayanilla began to develop its Plan, filing in 1998 the General Brief with the PB. As part of the coordination and development effort for the PTA, the Applicant coordinated with the Municipality of Guayanilla the inclusion of the Project in the Guayanilla Autonomous Municipality Land Use Plan. The Municipality of Peñuelas has not filed any documents pertinent to the development of such plan with the PB.

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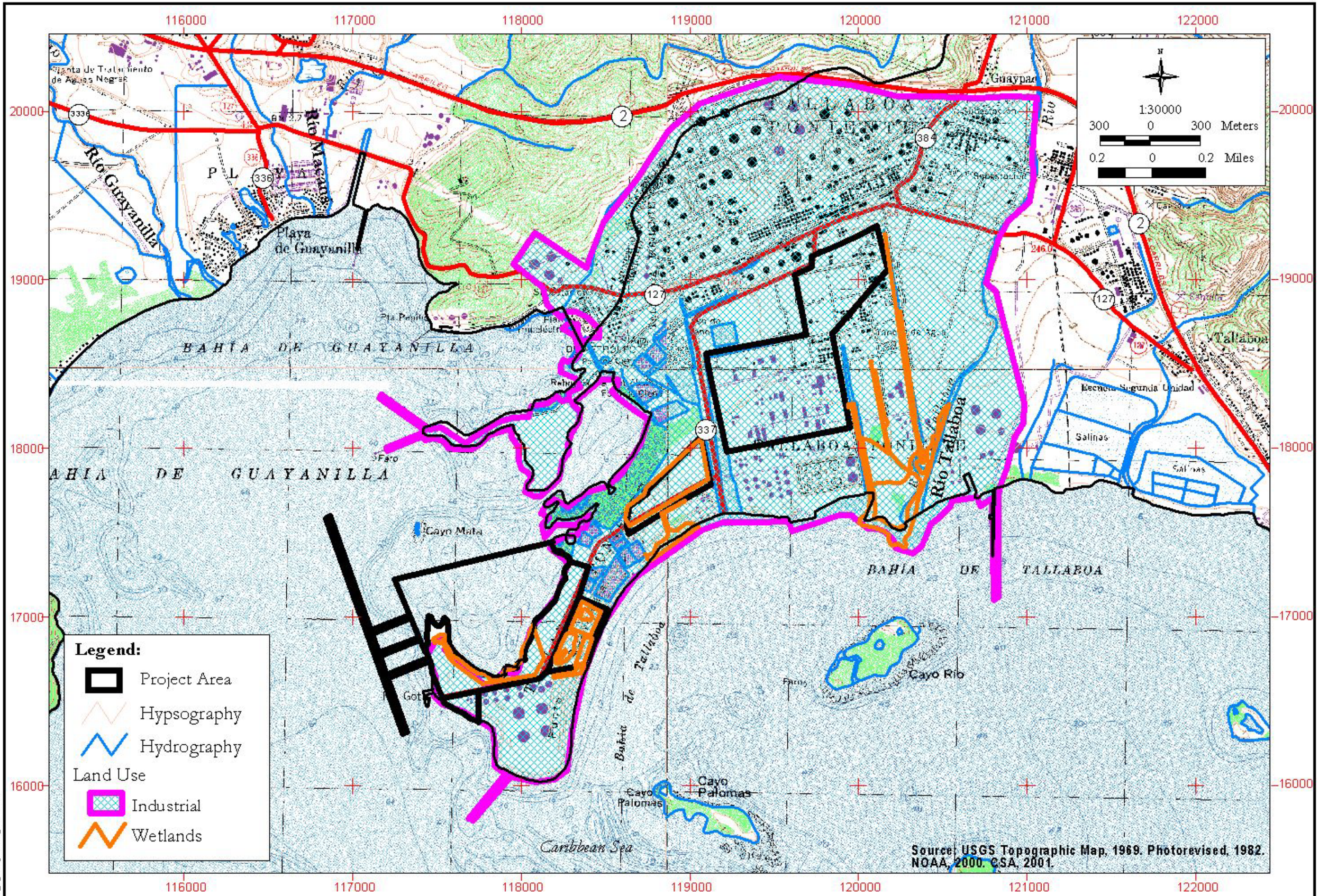
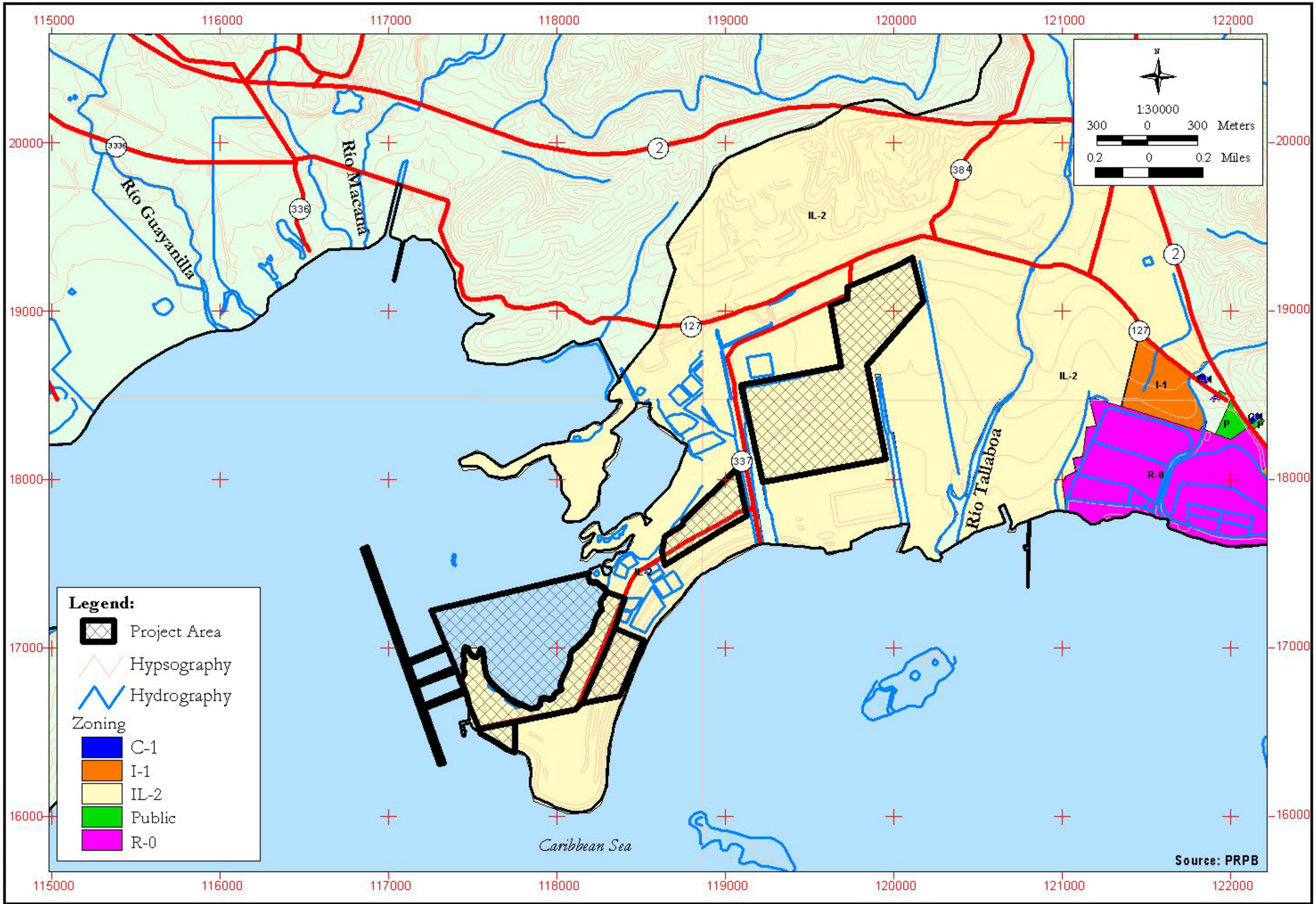


Coordinates in State Plane NAD 27

Figure 3-6 Land Use Map: Guayanilla-Peñuelas Area

Port of the Americas



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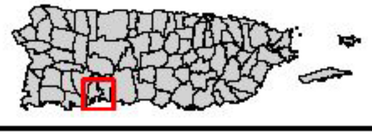


Figure 3-7 Territorial Zoning Map: Guayanilla-Peñuelas Area

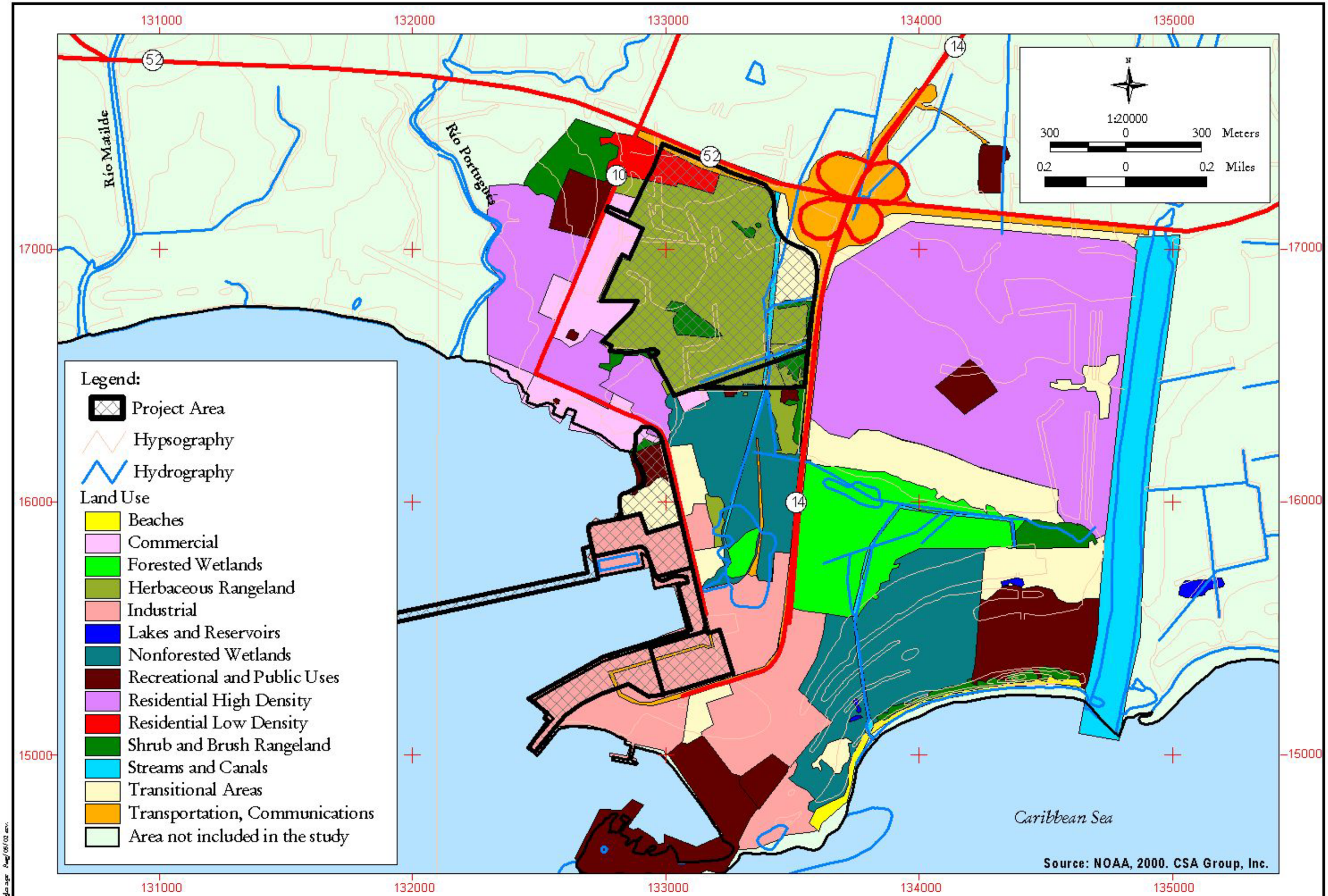
Port of the Americas

3.2.2.2 Ponce Area

Land Uses: The second major component of the Project would be located within the jurisdiction of the Municipality of Ponce. The land uses for the selected site in the La Playa de Ponce Sector are primarily industrial. The site is associated with the operations of the Port of Ponce, the second largest dry cargo commercial port in Puerto Rico and includes various storage areas, structures that house different companies that use the port facilities, and a scrap iron collection/pick up area. North of the site are two open areas, one is a grassland area and another in which wetlands were identified (Section 3.8).

The land located in the vicinity of the Port of Ponce has diverse uses, and includes recreational, hotel and residential parcels (Figure 3-8). The Ponce Hilton Hotel and Villa del Carmen, a large residential development, are located north of the site. The Caribbean Sea and a residential area of the Playa de Ponce Sector are located to the west of the site. South of the grasslands within the proposed site are several warehouses rehabilitated for other uses, including car and equipment repair shops and a cardboard recycling facility. Some of these buildings are abandoned.

Zoning: The PB approved and adopted the Autonomous Municipality Land Use Plan for the Municipality of Ponce in October 28, 1992. The Municipality of Ponce, by means of its Master Plan, established the mechanism by which appropriate uses are determined for all municipal land and its adjacent islands. An integral master plan for the totality of municipal land was defined with the fundamental elements for the plan, a work plan, and divided the totality of the land in three basic categories: urban land, development land and rustic land.



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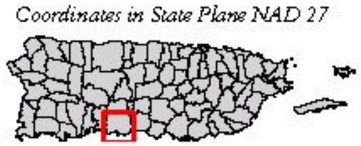


Figure 3-8 Land Use Map: Ponce Area

Port of the Americas

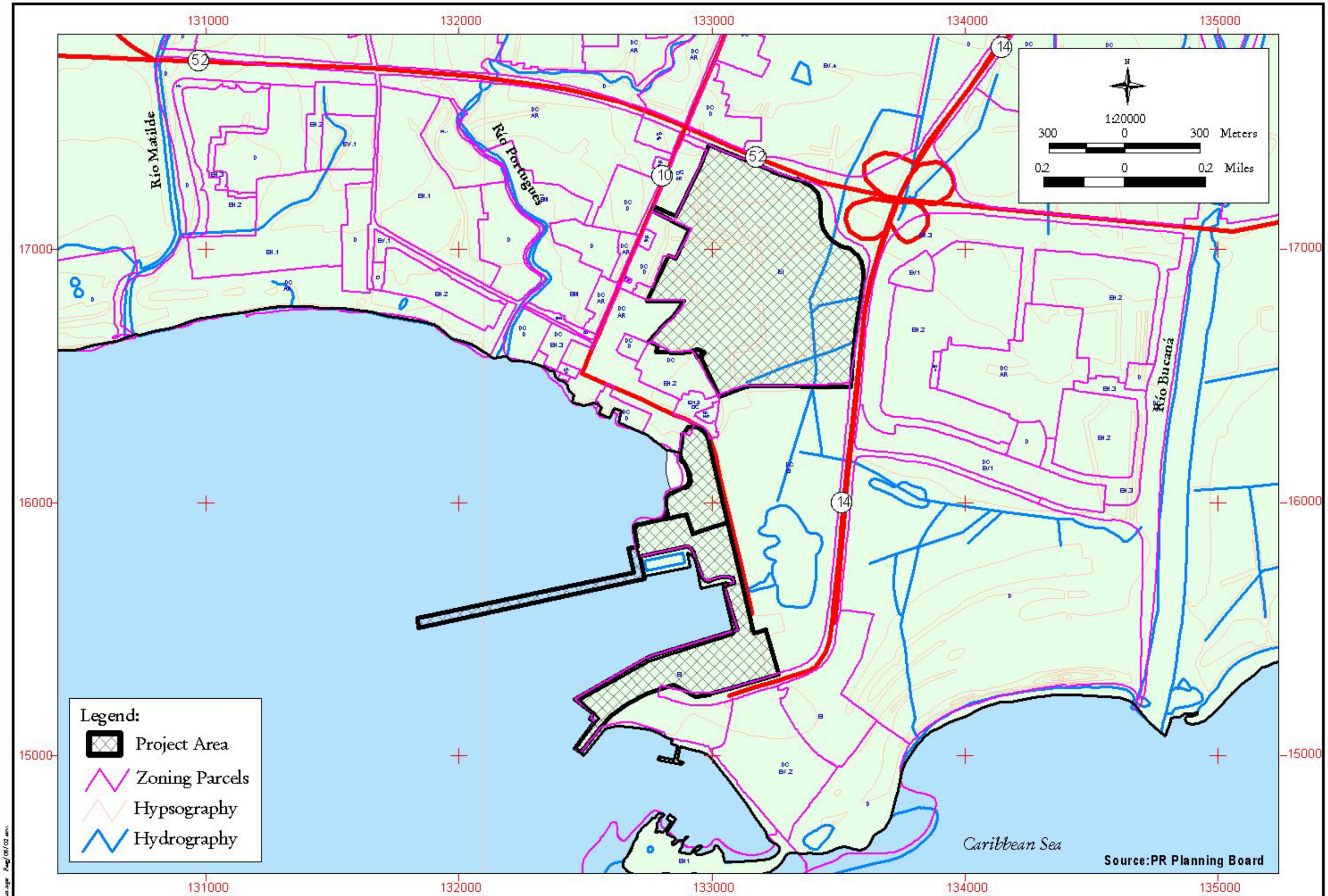
The Municipality of Ponce Action Program, approved in 1992, identifies the Port of Ponce as one of the areas to be developed with the goal of maximizing its available space, as well as increasing its loading and unloading capacity. The program proposes to reconstruct the existing piers, install a new loading crane and construct a 2,200 feet long tourist pier, regulate the loading and unloading areas, and the expansion of the port area. For this purpose, the port area was classified as urban land, and expects to define those areas within the municipality capable of accommodating the development or redevelopment of urban uses due to existing infrastructure or the ease with which it can be provided.

The urban land classification divides the municipality into fourteen (14) land use districts and three (3) superimposed districts. The Port of Ponce area is classified as land use district *EI*, corresponding to Industrial Construction (*Edificación Industrial*) (Figure 3-9). This district was established to provide the parameters needed to plan the vast construction of offices, warehouses or manufacturing facilities as separate buildings or as part of an industrial park. The port areas to be developed are classified as a superimposed conceptual development land use districts (*Desarrollo Conceptual*). The purpose of this superimposed district is to facilitate the implementation of conceptual developments in specific areas, one of which is the port.

The Autonomous Municipality Act establishes that all Municipality Land Use Plans will be reviewed at least every eight (8) years. In addition to complying with this legal requirement, the Municipality of Ponce identified various sections of the Municipality Land Use Plan, dated 1992, which needed to be reviewed. One of these sections was precisely the development of a transshipment port in the southern area, which obliged the Municipality to redefine the previously defined infrastructure pattern and land availability.

In 1999, the Municipality of Ponce began reviewing the Municipal Land Use Plan, and proposed to make feasible the development of a transshipment port in the southern region absorbing the impact on its land, and developing the Port of Ponce facilities as a world-class maritime center. This effort is in harmony with the Project as proposed in this document.

On June 29, 2000, the Municipality of Ponce held public hearings regarding the Statement of Objectives and Work Plan. Presently, the municipality is developing the General Brief and Draft Municipality Land Use Plan.



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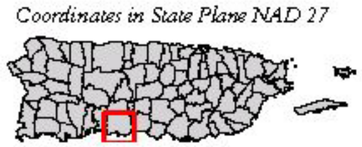

Figure 3-9 Territorial Zoning Map: Ponce Area

Port of the Americas

3.2.3 Topography

The general area for the proposed Project consists of the coastal region at the municipalities of Guayanilla, Peñuelas and Ponce. The limits of each municipality are illustrated in Figure 3-10 and Figure 3-11. The Project is located in the Peñuelas-Guánica and Juana Díaz-Ponce Regions, as defined by the USGS (Atlas of Ground Water Resources in Puerto Rico and the US Virgin Islands, USGS, 1996). The physiographic and topographic characteristics for each region are discussed in the following sections.

3.2.3.1 Peñuelas-Guánica Region

The Peñuelas-Guánica Region includes the municipalities of Peñuelas, Guayanilla, Yauco and part of Guánica. This region includes the drainage basins of Río Tallaboa, Río Macaná, Río Guayanilla, Río Yauco, and Río Loco. Among the typical physiographic characteristics of this region are limestone hills, which can reach elevations as high as 1,100 feet above mean sea level (AMSL), and border the alluvial valleys to the north, east and west of the Region. The elevation of the alluvial valleys can reach 150 feet AMSL, and are slightly sloped towards the coast at elevations only slightly above sea level.

3.2.3.2 Juana-Díaz-Ponce Region

The Juana Díaz-Ponce Region includes the municipalities of Ponce, Juana Díaz and Villalba. The major surface bodies of water in this region are the Río Cañas, Río Portugués, Río Bucaná, Río Inabón and Río Jacaguas, as well as the Toa Vaca Reservoir. Among the predominant physiographic characteristics in the region are the steep volcanic mountains with elevations as high as to 4,500 feet AMSLl, eroded limestone hills and coastal alluvial valleys.

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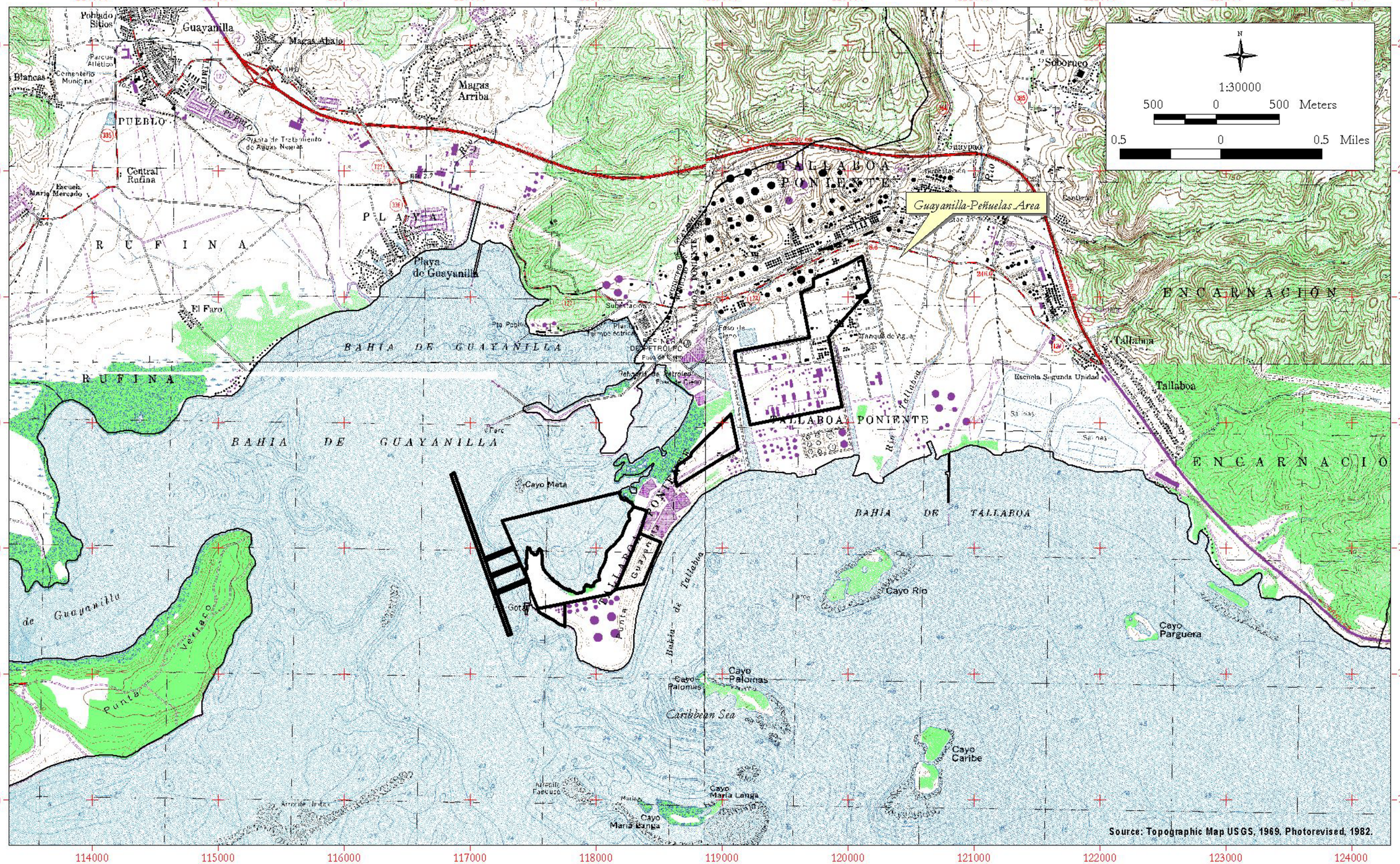

Coordinates in State Plane NAD 27

Figure 3-10 Topographic Map: Guayanilla - Peñuelas Area

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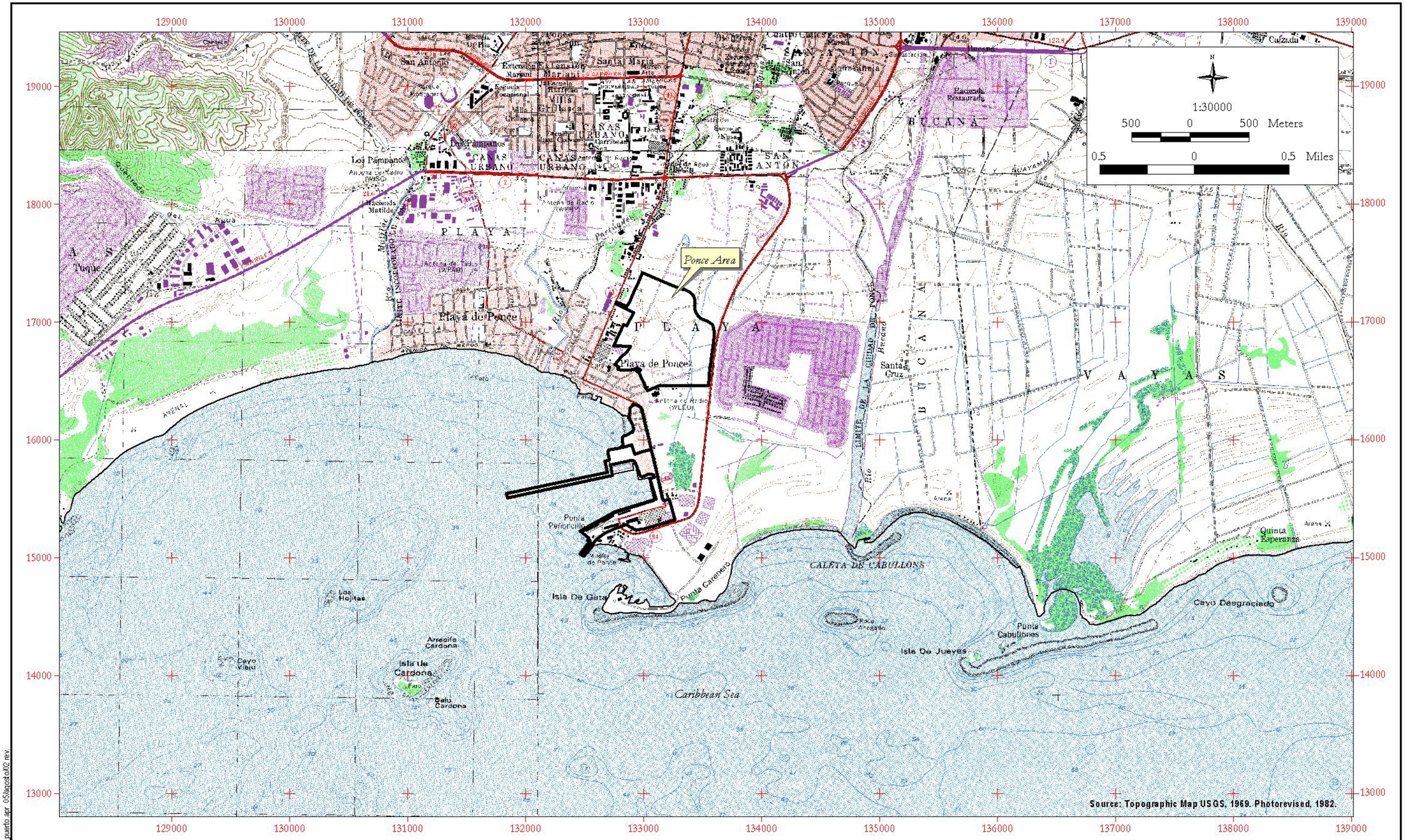

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Figure 3-11 Topographic Map: Ponce Area

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3.2.4 Soils

This section describes the soil associations in the area proposed for the development of the PTA in the municipalities of Guayanilla, Peñuelas and Ponce. The descriptions are based on the Soil Survey of the Ponce Area of the US Natural Resources Conservation Service (previously the Soil Conservation Survey (SCS), 1979).

3.2.4.1 Guayanilla-Peñuelas Area

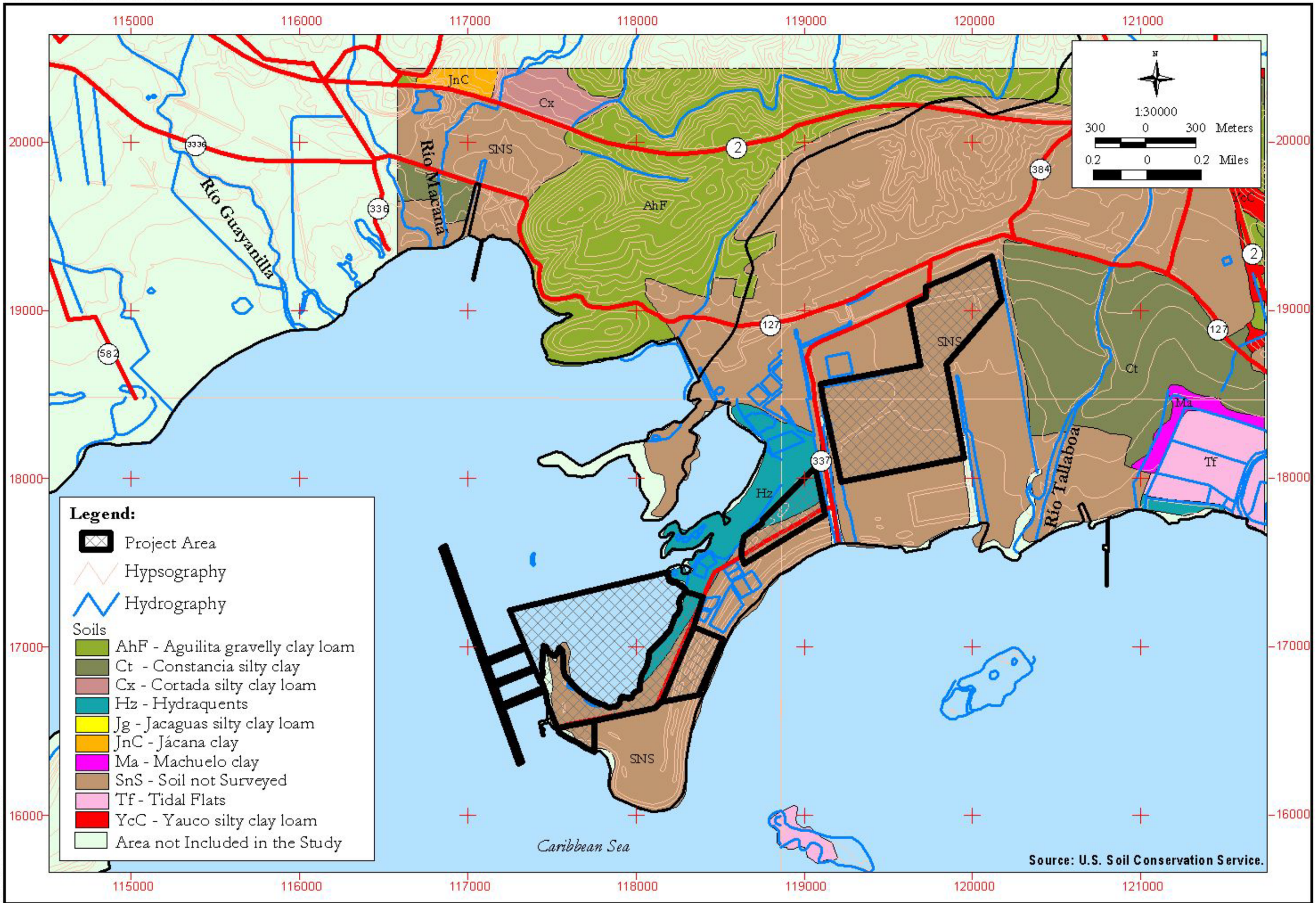
The local soils in this area consist of sediment-covered valleys in which the deposits extend out as a separate peninsula that separates the Guayanilla and Tallaboa bays. The soils are composed of two associations and large tracts of land where the soils are not defined (Figure 3-12). The soil associations identified in the Project area include:

- Hydraquents Saline Soils (Hz)
- Constancia Silty Clay (Ct)

In addition, part of the facilities for the PTA would be constructed in proposed reclaimed areas with underlying marine sediments.

3.2.4.1.1 Hydraquent Saline Soils (Hz)

The saline soils of the Hydraquent association are located in the west area of the peninsula and cover a small area of the land. According to the Soil Survey (SCS, 1979), these soils consist of lagoon zones or depressions in the floodplains of semiarid areas rivers. These areas are between 50 to 100 acres and consist of saline soils. The water table level is close to the surface for most of the year. The soil varies in color and texture throughout the profile. In addition, organic material from decayed mangrove trees as well as shells, corals and marl are found scattered throughout the profile.



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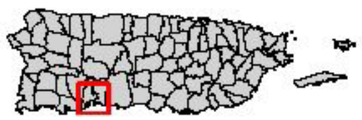


Figure 3-12 Soils Map: Guayanilla-Peñuelas Area

Port of the Americas

The agricultural productivity of these soils is severely limited, due to its high content of salt and the proximity of the water table to the surface. The rehabilitation of these soils for agricultural use would be extremely costly. Most of what grow in these soils is wetland trees that are used as wildlife habitats for birds, oysters and crabs. The soil has severe limitations for non-agricultural uses and is defined as Capacity Unit VIIIs-1 (SCS, 1979).

3.2.4.1.2 Constancia Silty Clay (Ct)

The Constancia Silty Clay soils are located in the northeast area of the Guayanilla Peninsula and cover a small portion of the land. The Constancia Silty Clay is part of the Constancia series. The soils in this group are leveled at the alluvial fans next to the rivers and springs of the semiarid areas. Generally, they occur in areas of 50 to 200 acres with 0 to 2 percent slopes. These soils can be used for intense farming if adequately drained and irrigated. The soils in this series are subject to floods during certain years and could be saturated after intense rainfall due to its low permeability. Improving these soils is laborious, and leveling of the land would be costly and difficult due to the plasticity and stickiness of the soil. These soils are classified as Capacity Unit IIw-1 with irrigationand III-c without irrigation (SCS, 1979).

3.2.4.1.3 Marine Sediments

Elements of the PTA at Guayanilla would be constructed on proposed reclamation areas with underlying marine sediments. These areas are located to the southwest of the Guayanilla Bay peninsula, adjoining Punta Gotay. The Marine Geologic Map of the Puerto Rico Insular Shelf-Guánica to Ponce Area (Trías, 1991) describes the sediments of the Guayanilla Bay area as Unit 2 (silt and fine sand). The indicated map describes Unit 2 as located close to the shore and in closed areas. The principal components of Unit 2 are terrigenous sediments such as quartz, feldspar and fragments of mafic rock. Terrigenous particles are mixed with carbonate constituents such as mollusks fragments.

Areas of active reef deposits (Unit 6) shown on the same geological map are not included in the proposed design of the PTA. The indicated map describes in depth Unit 6 as coral reefs areas. Carbonate reef banks such as Cayo Ratones and Cayo Caña Gorda, are composed of reef detritus consisting of calcareous silt, sand, gravel and calcareous algae (Trías, 1991). Cayo Mata, also a carbonate reef bank, is located adjacent to the area near Punta Gotay where reclamation of the marine land by fill is proposed.

A preliminary subsurface study of the soils was performed in the proposed wharf area, container storage area (fill area), and in the western segment of the Union Carbide parcel, where value-added activities would be located. The purpose of the study was to define the main characteristics of the subsurface soils in these areas (ERTEC, 2001). Six soil borings were drilled in the Guayanilla-Peñuelas area where elements of the PTA are proposed. The soil profile obtained from the subsurface exploration was consistent with the information from the published maps of the soils and geology of the area.

- In the marine area where the wharf is proposed, 40 to 48 feet of water were followed by 2-5 feet of mud. Below the mud, a layer of very soft slightly organic silty clay with traces of sand occurs to a depth of 90 feet. Chemical analysis of the subsurface samples from the wharf area indicated that the soil is not contaminated or hazardous (ERTEC, 2001).

- In the coastal area adjacent to Punta Gotay, proposed for reclamation through fill, 5 to 8 feet of water were followed by a layer of mud 8 to 10 feet thick. Underlying the mud layer, a few feet of very soft slightly organic material occurs.

Below this layer, fine to medium sand in a medium to dense condition was sampled to a depth of 20 feet. Contaminants were not detected in samples from these borings.

- In the land area, subsoil profiles consisted of an uppermost fill layer approximately 10 feet thick composed of silty clay and limestone fragments in a medium to stiff consistency. Below this layer to a depth of 25 to 45 feet, soft to very soft, slightly organic dark gray clayey silt was identified. Underlying this layer (up to 70 feet), silty clay or sandy silt in a very stiff consistency was sampled. Groundwater in the land soil borings was found at a depth of 4 feet from existing grade.

This subsurface study concluded that the presence of very soft materials constitutes the main consideration in the selection of appropriate foundations, and that the proposed wharf should be placed over a pile foundation (ERTEC, 2001). Also, the area to be reclaimed near Punta Gotay for container staging purposes would be dredged to remove the shallow mud and then backfilled with a free draining material until final grade is attained. Structures planned for the land portion of the Project may require pile foundations, but further studies would be needed to confirm this (ERTEC, 2001).

3.2.4.1.4 Areas Not Studied

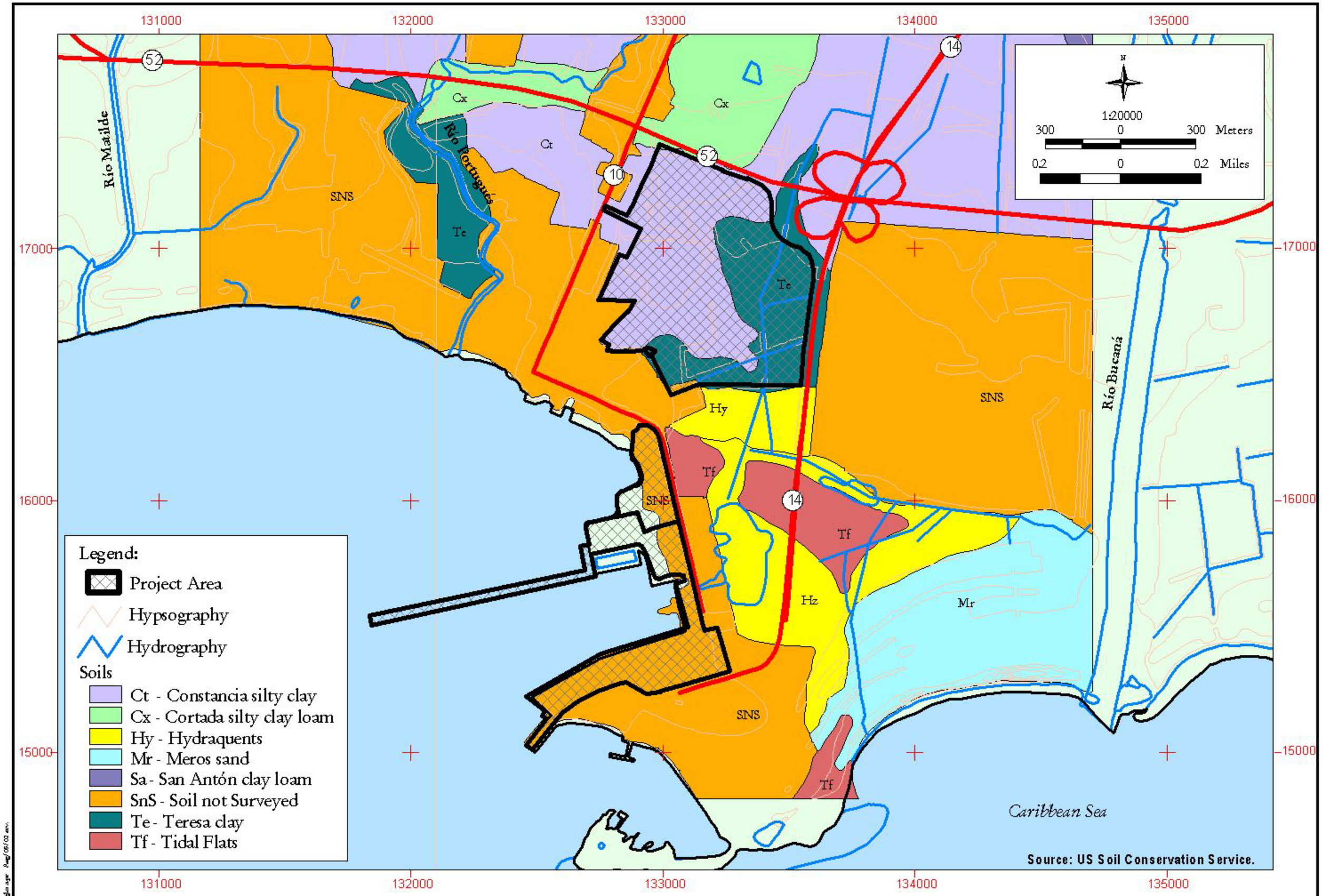
The greater part of the land to be developed is located in non-surveyed areas. In the past, these areas have been occupied by petrochemical industries. It can be assumed that these locations, presently occupied with man-made facilities, were artificially filled. The depth of this fill is unknown.

3.2.4.2 Ponce Area

The proposed land in Ponce for the PTA development is located on a peninsula of the coastal plain known as Punta Peñoncillo. This peninsula and adjacent areas are composed of four types of soils (Figure 3-13):

- Hydraquent Saline Soils (Hy)
- Constancia Silty Clay (Ct)
- Tidal Flats (Tf)
- Teresa Clay (Te)

Hydraquent Saline Soils and Constancia Silty Clay were discussed in Sections 3.2.4.1.1 and 3.2.4.1.2. The Tidal Flats and Teresa Clay soils are described in the following paragraphs.



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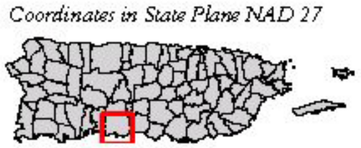

Figure 3-13 Soils Map: Ponce Area

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3.2.4.2.1 Tidal Flats

The Tidal Flats occupies two areas of the proposed site in the vicinity of Ponce, towards the eastern and west-central part of the land. These soils are located in the coastal plains of semiarid areas, sandy and sterile, that are periodically flooded by the tide. Some of the areas are permanently covered by salt water, and other areas are only covered by salt water during the high tide. When these areas are dry, there are places covered by a few inches of mud as well as thin layers of a fine texture soil material deposited by rivers close by. In a similar manner, salt accumulations are common on the dry soil. These soils do not have any agricultural value due to their high content of salt in areas with a high water table. This type of soil has severe limitations for agricultural uses that are difficult to overcome. The upgrading of these soils for agricultural production is not practical. These soils are classified as Capacity Unit VIIIs-1 (SCS, 1979).

3.2.4.2.2 Teresa Clay (Te)

The Teresa Clay (Te) (Teresa soil series) occupies part of the northern area of the parcels proposed for the development of the value-added activities close to the Port of Ponce. These soils are located in semiarid areas of coastal plains. The soils are adjacent to the beach in areas of approximately 100 to 200 acres of saline deposits with slopes of 0 to 2 percent. Some areas may contain Serrano sands and tidal flats, and in a few areas non-saline Meros sands. The runoff is slow and the erosion potential low. Due to its high content of salt, these soils are not appropriate for cultivating or sowing of pasture. A costly effort would be required to condition these soils for agricultural uses, due to their poor drainage. These soils are devoid of vegetation and previous attempts to grow sugar cane in them have failed. These soils have little agricultural value and are classified as Capacity Unit VIs-2 (SCS, 1979).

3.2.4.2.3 Marine Sediments

As previously indicated, part of the PTA facilities would be constructed on water overlying marine sediments. These areas are located south of the Punta Gotay in the Guayanilla Bay. This area is not included in the "Marine Geologic Map of the Puerto Rico Insular Shelf- Guánica to Ponce Area" (Trías, 1991). Nevertheless, the sediments are estimated to be consistent with Unit 2 (silt and fine sand) as described for the Guayanilla Bay.

3.2.4.2.4 Areas Not Surveyed

The soils in most of the areas adjoining the docks at the Port of Ponce, including the parcels proposed for value-added activities, have not been surveyed, as illustrated in the "Soils Survey of Ponce, Sheet No. 38" (SCS, 1979). It is reasonable to assume that most of the areas presently occupied by man-made facilities were artificially filled. If the same pattern of other coastal deposits occurs in the area, the fill probably overlies marine sediments composed of sand and limestone. The depth of the fill is unknown.

3.2.5 Geology

The regional and local geological context of the project area in Guayanilla-Peñuelas and Ponce are discussed in the following sections. The information provided in these sections was obtained from USGS publications and maps. Additional information was obtained from environmental and geological studies conducted by private entities in adjacent land to the proposed sites.

3.2.5.1 Guánica-Juana Díaz Regional Geology

The geology of the regions from Guánica to Peñuelas and Ponce to Juana Diaz, where the PTA is proposed, is described in the USGS study entitled "Water Resource Investigations Report 94-4198" (USGS, 1996). The USGS subdivided the geology of these areas in four basic lithologic types. These are, in ascending order, the following:

- Rocks that include volcaniclastic rocks severely impacted; volcanic; plutonic and limestone rocks from the Superior Cretaceous Period and the Eocene Period. This unit represents 60% of the region.
- The Juana Díaz formation (limestone and basaltic conglomerates) from the Oligocene to Miocene Periods.
- The Ponce Formation (limestone, chalk and marl) from the Miocene Period; and
- Alluvial deposits (consolidated and non-consolidated clay, silt, sand and gravel) from the Quaternary Period.

The regional geology of the study area is described in Figure 3-14.

3.2.5.2 Regional Marine Geology

The marine geology of the greater part of the study area is described in the "Marine Geologic Map of the Puerto Rico Insular Shelf- Guánica to Ponce Area" (Trías, 1991). The proposed areas for the development of the PTA in Ponce are not included in the marine geology maps of the aforementioned study.

The sediments in the study area, from Guánica to Ponce including the Guayanilla Bay and the Port of Ponce area, can be divided into five basic units composed of two major sediment types. A brief description of the sediment units (Units 1 to 5) follows.

- Unit 1: Silt and clay;
- Unit 2: Silt and sand;
- Unit 3: *Halimeda* Sediments, close to the shore;
- Unit 4: Exterior Continental Platform Sand; and
- Unit 5: Hemipelagic Sediments

The major sediment types are:

- Terrigenous sandy mud (Unit 1 and 2) from the bay areas and relatively tranquil areas of the continental insular interior platform areas; and
- Carbonate sands (Units 3, 4 and 5) of the continental insular exterior platform and major carbonate sources.

The location of various units relative to the proposed site for the development of the PTA in Guayanilla-Peñuelas is shown in Figure 3-15.

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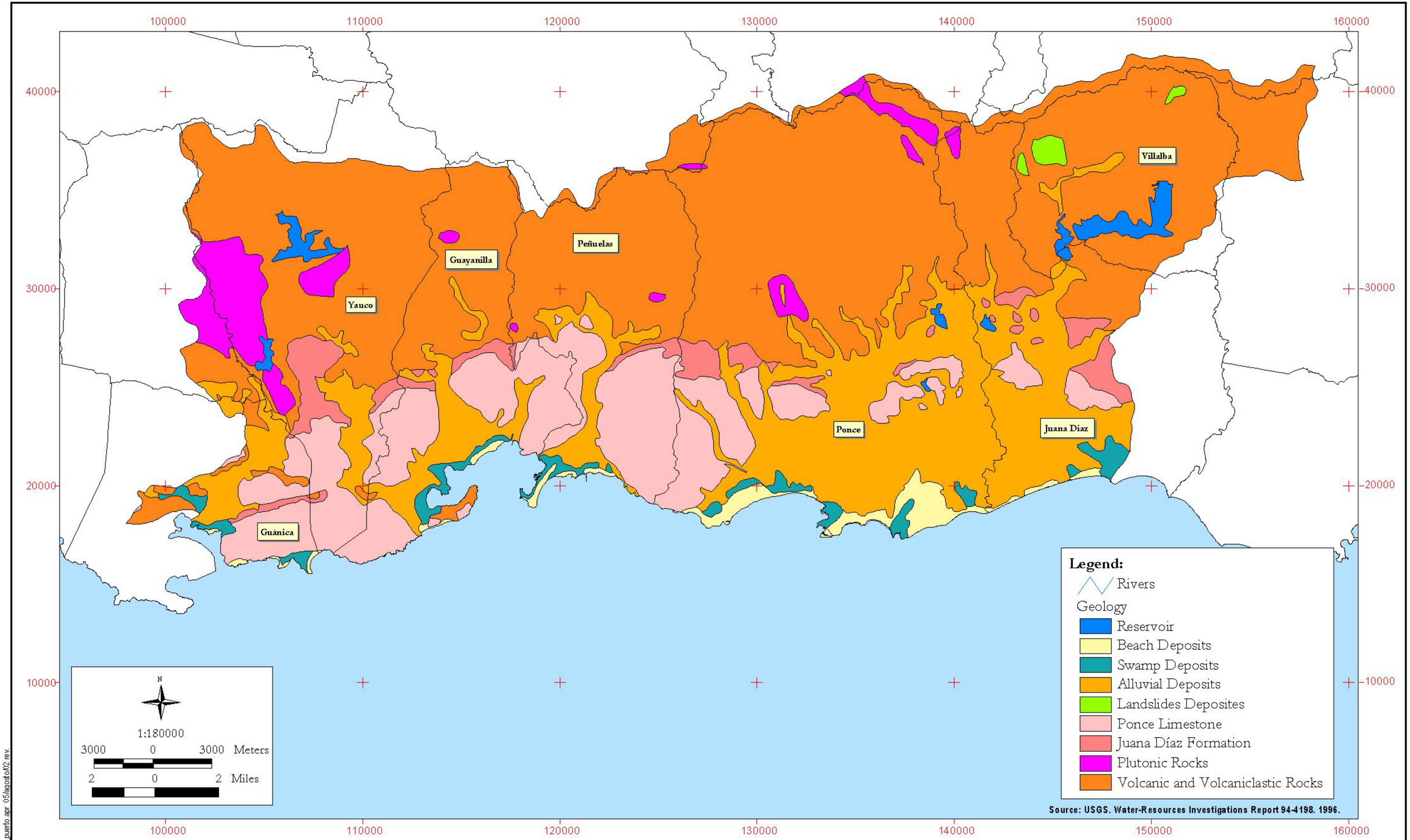

Coordinates in State Plane NAD 27

Figure 3-14 Generalized Regional Surface Geology: Guánica-Juana Díaz Region

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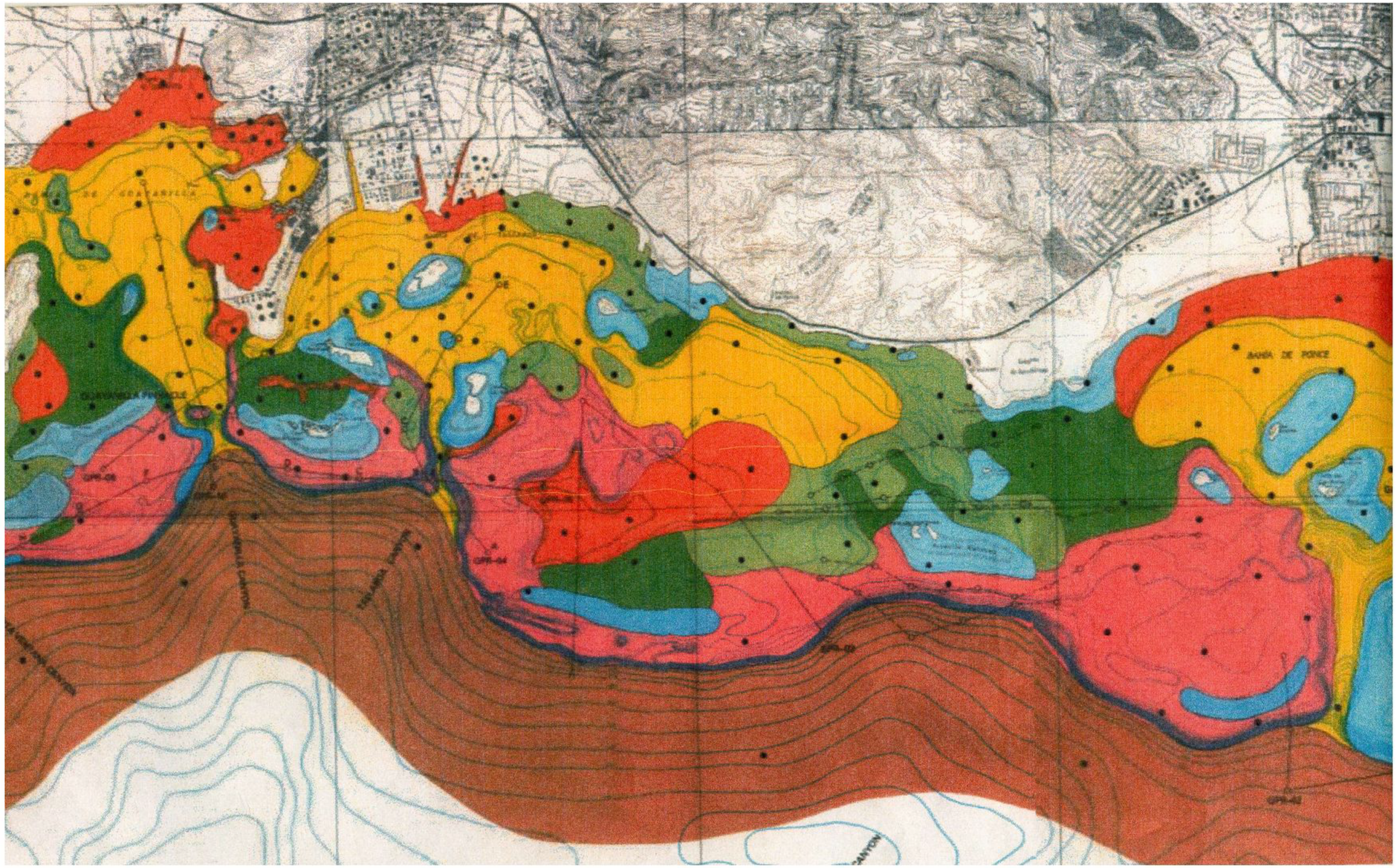

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Description of Map Units

- Unit 1 (Silt and Clay)
- Unit 2 (Silt and Fine Sand)
- Unit 3 (Nearshore *Halimeda* Sediment)
- Unit 4 (Outer Shelf Sand)
- Unit 5 (Hemipelagic Sediment)
- Unit 6 (Active Reefs)
- Unit 7 (Submerged Shelf Edge Reefs)
- Unit 8 (Hard Ground)

Source: USGS. Miscellaneous Investigations Series, MAP I- 2263. 1991.

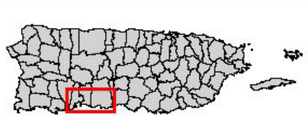

Figure 3-15 Generalized Regional Marine Geologic Map: Guánica-Juana Díaz Region

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3.2.5.3 Guayanilla-Peñuelas Area

The proposed site for the PTA at the Guayanilla Bay is located in a small coastal valley covered with fine sediments with non-consolidated deposits. The valley extends into a peninsula that separates the Guayanilla and Tallaboa bays (Figure 3-16). The valley is surrounded on its west-northwest and east-northeast sides by small hills, rounded by erosion up to the Ponce Limestone Formation of the Miocene Period. The Juana Díaz Formation borders the northern part of the valley. The Ponce Limestone Formation within the valley is covered by a wedge of non-consolidated alluvial material and by marine lagoonal sediments from shallow waters of the Quaternary Period, which increase in thickness as they approach the coast. The Quaternary Period alluvium in rivers and valleys is superimposed discordantly to the Juana Díaz and Ponce Limestone Formations. The Quaternary Period alluvium is composed of layers or lenses of non-consolidated clay, sand, gravels and round and angular boles mostly derived from volcanic rocks. Nevertheless, the alluvium can contain limestone fragments, which suggest that these materials are in part of colluvial origin.

In general, the size of the particles decreases as the coast is approached. The thickness of the alluvial deposits varies from 0 feet at the contact point with the mother rock, up to approximately 200 feet at the coast. At the beginning of the Quaternary Period, the alluvium was deposited by rivers when the sea level was lower than the present day level. Later during the Quaternary Period, the sea level began to rise and the old valleys, including some of the floodplain, became submerged. This favored the accumulation of a series of marine sediments of shallow water (Holocene Beaches) and lagoonal sediments (Holocene Swamps) of great thickness.

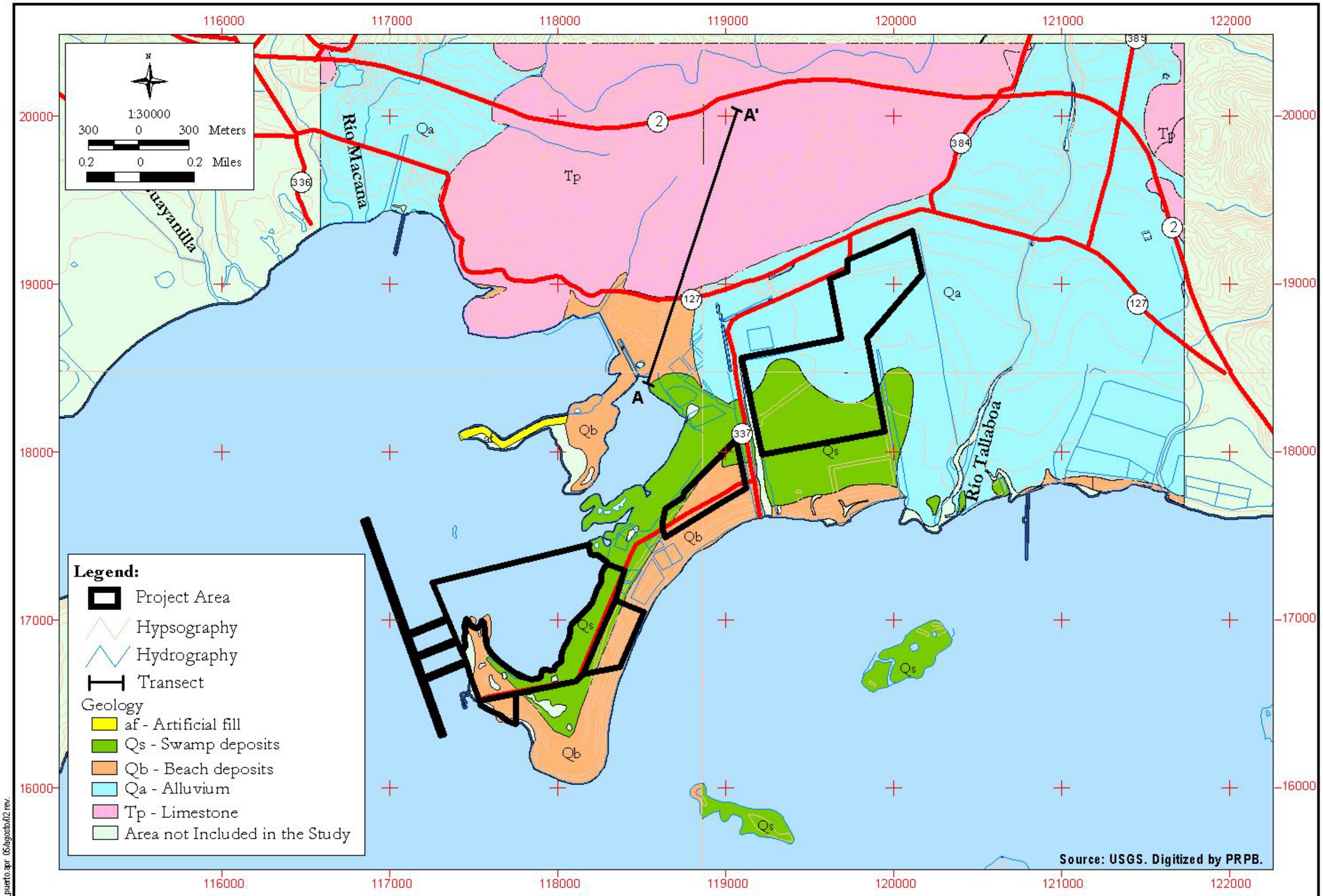
The marine-lagoonal deposits are composed of lenticular bodies and masses interweaved with sand, silt and clay that vary in color from gray to black. The swamp conditions that existed during this period favored the formation of organic clay and peat. In addition, local reef patches were developed that provide protection to the bay. Eventually, the sea level fell and the marine-lagoonal sediments remained exposed. In turn, the rivers extended their channels to the new coast and began depositing clay, silt and sand on the flood plain and at present could be covering the marine-lagoonal deposits (Geraghty & Miller, 1995).

According to the geologic maps of the Yauco and Punta Verraco Quadrants (USGS, 1979), and the Peñuelas and Punta Cuchara Quadrants (USGS, 1978), the peninsula is composed of beach (marine) and swamp (lagoonal) deposits of the Quaternary Period. It is probable that the areas with man-made facilities were artificially filled and their thickness is unknown.

Part of the facilities of the PTA would be built over water now underlain by marine sediments (Figure 3-16). These areas are located to the southeast of the peninsula in the bay. As described in the “Marine Geologic Map of the Puerto Rico Insular Shelf- Guánica to Ponce Area” (Trías, 1991), the sediments in the Guayanilla Bay area belong to Unit 2 (silt and fine sand). The map describes Unit 2 as predominantly in nearshore and enclosed areas. The principal components of Unit 2 are terrigenic sediments such as quartz, feldspar, and mafic rock fragments. The terrigenious particles are interweaved with calcareous constituents such as molluscan fragments. The Project design would not impact the active reef deposits classified as Unit 6.

The geologic maps (USGS, 1978 and 1979) illustrate small faults at the Ponce Limestone, northwest of the Project area. The extension and location of the faults are somewhat speculative, reflected by the broken line that represents the fault (the common practice in geology is to illustrate the uncertainty of a structural trait's location or existence by the use of diverse types of broken lines). Nonetheless, these faults give the indication of a normal or

reverse movement process. In addition, according to the geologic map, the faults do not extend to the alluvial deposits in the coastal plain, which implies that the faults are ancient and have not experienced movement since the alluvium was deposited. The tendency and direction of the stratum slope is approximately 7 degrees south.



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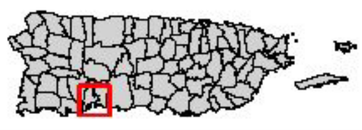

Figure 3-16 Generalized Local Surface Geology: Guayanilla-Peñuelas Area

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A marine geophysical investigation offshore at Guayanilla Bay was performed as part of this DEIS. For the shallow-water area, selected points along each survey line were chosen to provide information on the depth to the seafloor, sediment thickness, and depth to the underlying alluvium or rock. A preliminary line drawing was made from the data contained on each of the six survey lines (Appendix R). These depth and thickness point data were combined with a cursory review of the geologic units to develop a map of sediment thickness and depth to alluvium or rock. The depth to the underlying alluvium or rock was mapped using 28 data points located along the selected sub-bottom survey lines. Using a sediment velocity of 2,000 m/sec, the depth to a major acoustic interface seen in the sub-bottom profiles, here assumed to be alluvium or rock, varies across the survey area from about 6 to 15 meters (m) below mean sea level. The central and eastern parts of the site have depth values between 6 and 8 m. The western part of the site has a north-south trending trough where basement depth reaches as great as 15 m. The extreme western side of the site, although at the edge of the survey area, seems to shallow and may represent a "high" in the underlying alluvium. The small cays south of Cayo Mata likely represent this basement high, the area located between the shallow and deep survey areas.

The sediment thickness was determined by using the water depth and the depth to the top of the alluvium or rock. The contour map of unconsolidated sediment thickness shows a range from about 4 m up to 10 m. The sediment thickness generally mimics the depth to rock contours. Sediment is thinnest in the central and eastern parts of the survey area and increase in thickness along the western margin of the survey area where the underlying bedrock shows the trough-like configuration. The western trough has sediment thickness of between 8 and 10 m. Similarly, slightly thicker sediment accumulation occurs along the eastern margin of the survey area in the vicinity of the possible fault structure (see discussion below).

The underlying alluvium/rock in the western side of the survey site has topographic irregularities that may represent buried coral reefs. These reefs may have occupied the site before being buried by the beach and/or swamp sediments. A second feature, which has been tentatively identified as a possible fault, runs along the extreme eastern margin of the survey areas adjacent to the land (Punta Guayanilla). An initial analysis shows the fault plane to be dipping toward the northwest at about 30° (down from horizontal).

For the deep-water area, ten survey lines were selected for a preliminary analysis and geologic interpretation. The depth to the top of alluvium/rock (major acoustic interface) was mapped in the deep survey area with of use of 58 individual data points taken from the ten reconnaissance survey lines. The depth data indicate significant changes across the survey areas: a relatively shallow basement (<20 m) on the east-central and southeast part of the survey site, with progressive deepening (>30 m) along the northern and southwestern part of the survey grid. The depth ranges from <5 meters along the landward part of the survey, running from Punta Gotay up to the area immediately west of Cayo Mata. The shallow basement protrudes out (westward) in the vicinity of survey lines 20 to 32 forming a shallow promontory. The extension in this area reaches westward nearly to the location of the north-south oriented Line 50, whereas basement depth along Line 50 reach nearly 40 m in the north and exceed 45 m in the south.

The unconsolidated sediment in the survey area also shows considerable thickness variations related to the irregular topography of the underlying alluvial/rock unit. A map constructed from the same 58 data points that were used in the depth map, shows sediment thickness ranging from less than 5 m in the east-central and southeast parts of the survey area to near 25 and 30 meters in the northern and southwestern parts, respectively. As expected, the bedrock promontory between Lines 20 and 32 shows the least amount of sediment accumulation,

usually less than 2 meters. The bedrock promontory appears to have relatively steep sides, as sediment thickness changes abruptly to between 10 and 20 meters westward from the 5-m contour line (see acoustic profile and line drawing for Line 53, Appendix R).

3.2.5.4 Ponce Area

According to the USGS (1996), the geology of the proposed site for the PTA in Ponce is similar to that of the Guayanilla area (Figure 3-16). The site to be developed is located in a small coastal valley composed of fine sediments, deposited in a similar manner to a peninsula known as Punta Peñoncillo. The valley is bordered by small and rounded hills to the west-northwest and the east-northeast, eroded to the same Ponce Limestone Formation of the Miocene Period. The Juana Díaz Formation borders the northern part of the valley. The Ponce Limestone within the valley are covered by a wedge of non-consolidated piedmontite alluvium, piedmontite alluvium with salt accumulation and marine-lagoonal sediments of shallow water (swamp deposits) of the Quaternary Period, which increase in thickness as it approaches the coast. The piedmontite alluvium is composed of sand, clay and non-consolidated silt of an unknown thickness (USGS, 1971).

According to the geological quadrant of the Playa de Ponce (USGS, 1971), Punta Peñoncillo is composed of piedmontite alluvium of the Quaternary Period, salt accumulations and swamp deposits (lagoonal), with minimal quantities of beach deposits (marine). It is probable that the areas with existing man-made facilities were artificially filled and their thickness is unknown. The proposed Ponce sites are not included in the marine geologic map (Trías, 1991), therefore, a Geophysical Investigation Offshore was performed in order to provide a preliminary, general estimate of the sediment thickness and the depth to key target horizons (Appendix S). Target horizons are those that may represent indurated rock and therefore potentially impact dredging operations. The general geologic sequence within the Ponce survey area consists of three main units: a basal rock or reef unit; a basal shoal and flank unit; and an overlying sediment unit. The two basal units can occur separately or merge in the vicinity of either large shoals or isolated shoals.

- The basal rock or reef unit occurs throughout most of the survey area and is the main horizon of concern (target) regarding potential dredging operations. This unit follows the general bathymetric depth contour and thus deepens progressively in a seaward direction. With no core borings available for ground-truth, it is not certain at this time whether this is a reefal unit or an eroded bedrock unit, or perhaps some combination of the two.

- The basal shoal and flank unit occurs where a shoal is exposed at the seafloor, completely buried, or partially buried along its flanks by onlapping sediment. This geologic unit almost certainly represents cemented rock, likely of reefal origin. The shoal flanks usually dip away from the shoal and are covered by sediment in a very short distance from the shoal edge.

- The uppermost geologic unit is the blanket of sediment that covers the survey area. The sediment thickness generally increases from about 10 m in the northern part of the survey area to nearly 20 m in southern part of the survey areas (outside of the above mentioned shoals). Dredging activities of the existing channel to a depth of approximately 12 m has partially removed the upper part of this sediment unit.

The preliminary geologic assessment concludes that the depth to the main target horizon deepens from north to south from about 15 m to >40 m. Similarly, the sediment thickness also

increases from north to south, from about 10 m in the very northern part of the survey area to about 20 m in the south. Isolated shoals occur throughout the survey area, these shoals rise above the surrounding target depth and can form areas of concern.

3.2.6 Hydrology

The surface water resources at the project region consist of rivers, creeks and artificial canals. At the Guayanilla-Peñuelas project area, the main surface water resources are Río Macaná, Río Guayanilla, Río Tallaboa, two (2) artificial canals and one drainage canal.

- The streams closest to the Project include Río Tallaboa, which borders the designated area for the value-added activities (UCC site), the two (2) artificial canals, and the drainage canal. These canals were used to transport the effluent generated from the cooling processes at the UCC, when this facility was in operation.
- Located to the west of the Ponce study area are Río Matilde and Río Portugués, and to the east Río Bucaná.

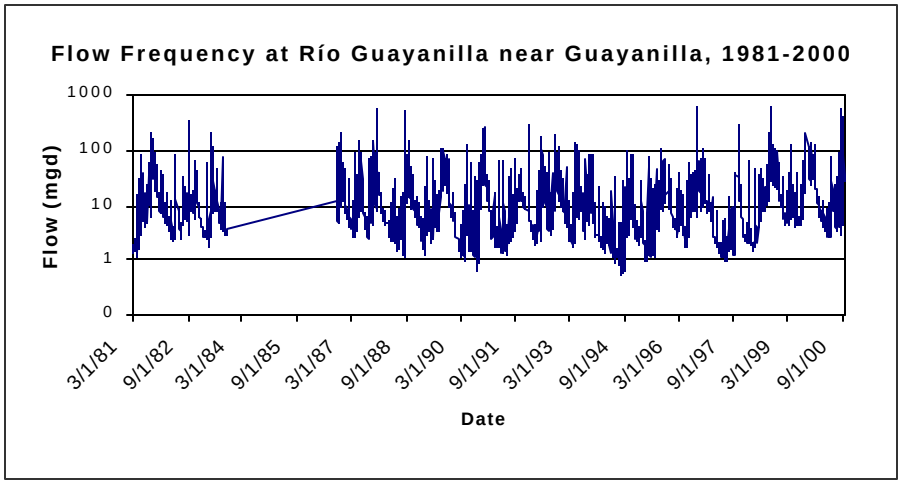
The surface water resources of the area are described as follows:

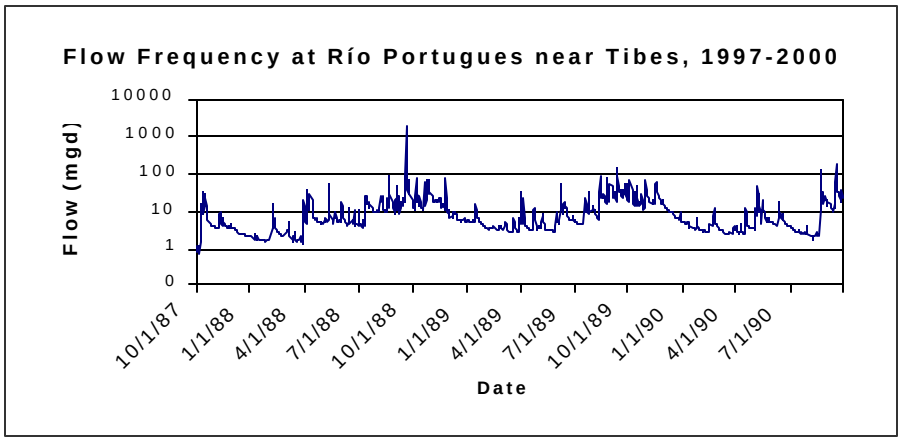
- Guayanilla-Peñuelas:
  - Río Macaná flows from the central part of the Municipality of Guayanilla to the east until reaching the Guayanilla Bay. This river drains the hydrographic basin of Quebrada de los Cedros. The river mouth into the Caribbean Sea is located approximately 1.2 miles east from the Guayanilla Project site.
  - Río Guayanilla flows from the northern part of the Municipality of Guayanilla, crosses along the municipality until reaching the Guayanilla Bay. This river has a drainage area of approximately 49.0 square kilometers (18.9 square miles), including the basins of the Quebrada Guamá, Limón, Motete and Consuelo. The mouth of the river is located at Guayanilla Bay approximately 2.5 kilometers west of the Guayanilla Project site. According to a USGS report study (USGS, 1999) the average annual discharge for Río Guayanilla is approximately 15 million gallons per day (MGD).
  - Río Tallaboa flows into the northern part of the Tallaboa Bay, bordering the eastern part of the Guayanilla-Peñuelas Project site. According to USGS reports, Río Tallaboa has a drainage area of 81.6 square kilometers (31.5 square miles) and an average daily discharge of 31 MGD. Flows in Río Tallaboa are generally due limited to low precipitation and watershed water extractions for irrigation purposes.
- Ponce:
  - Río Matilde flows into the Ponce Bay approximately 2.0 kilometers west of the Port of Ponce. The river is formed by the confluence of Río Pastillo, Río Cañas and Quebrada del Agua.
  - Río Chiquito and Quebrada Sin Nombre feed into Río Portugués, which flows into the Ponce Bay approximately 1.0 kilometer east of the Port of

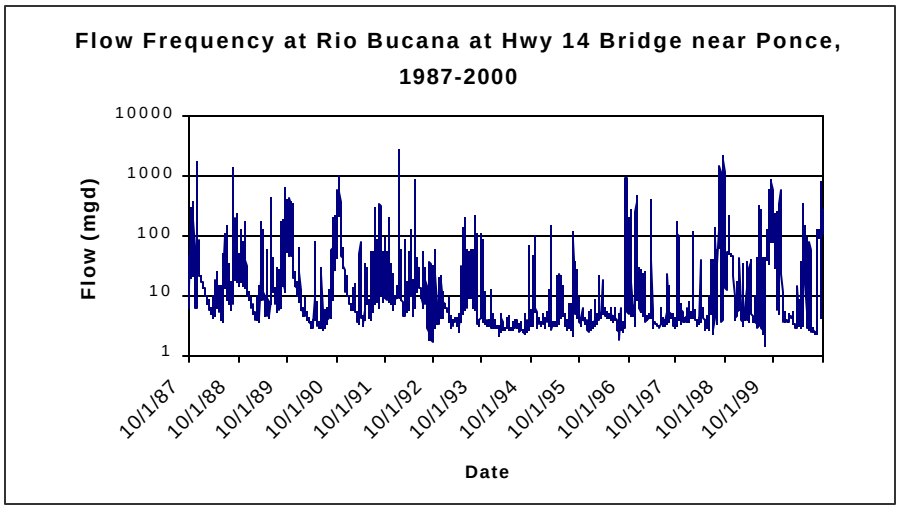
Ponce. According to a USGS report (USGS, 1999), the drainage area of Río Portugués is approximately 20 square miles (51.8 square kilometers) and the average daily discharge is 34 MGD. A dam is planned for construction upstream from the urban area of Ponce, mostly for flood control and recreation.

- Río Bucaná flows into the Ponce Bay approximately 1.2 kilometers east of the Port of Ponce. This river has a drainage area of 24.9 square miles (64.5 square kilometers), and is mostly channeled for flood control near the Port of Ponce.

The average discharge at selected rivers in the South Central Region of Puerto Rico is summarized in Table 3-4. These data was obtained from the network of gaging stations operated by the USGS in Puerto Rico. The average daily discharge data for the rivers with gages in the Project vicinity are plotted in Figure 3-17.







Source: United States Geological Survey. (1999) Water Resources Data Puerto Rico and the U.S. Virgin Islands Water Year 1999.

Figure 3-17: Flow Frequency Diagram for the Rivers at the Vicinity of the Project

Table 3-4: Average Discharge (Cubic feet per second) at Selected Rivers in the South Central Region of Puerto Rico for the Water Year 1998-99

Stations	Months											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Río Guayanilla, near Guayanilla	72.4	55.5	28.9	17.3	9.41	13.2	31.2	10.5	16.2	9.30	35.0	118
Río Portugués at Tibes	41.6	32.9	11.4	9.51	5.66	5.64	11.1	5.96	17.6	14.0	34.5	61.1
Río Bucaná at Highway 14 Bridge near Ponce	129.0	84.5	23.9	14.9	11.3	18.0	30.8	13.8	194.0	21.1	140.0	411.0

Source: United States Geological Survey. (1999) Water Resources Data Puerto Rico and the U.S. Virgin Islands Water Year 1999.

3.2.7 Hydrogeology and Groundwater Resources

The following sections describe the hydrogeology of the Guánica to Juana Díaz Region, as defined by the USGS, including the groundwater movement and levels in the region. In addition, it describes the local and regional hydrogeology for the proposed sites to be developed as part of the PTA. Figure 3-18 presents a general map of the local surface geological conditions in the Ponce area.

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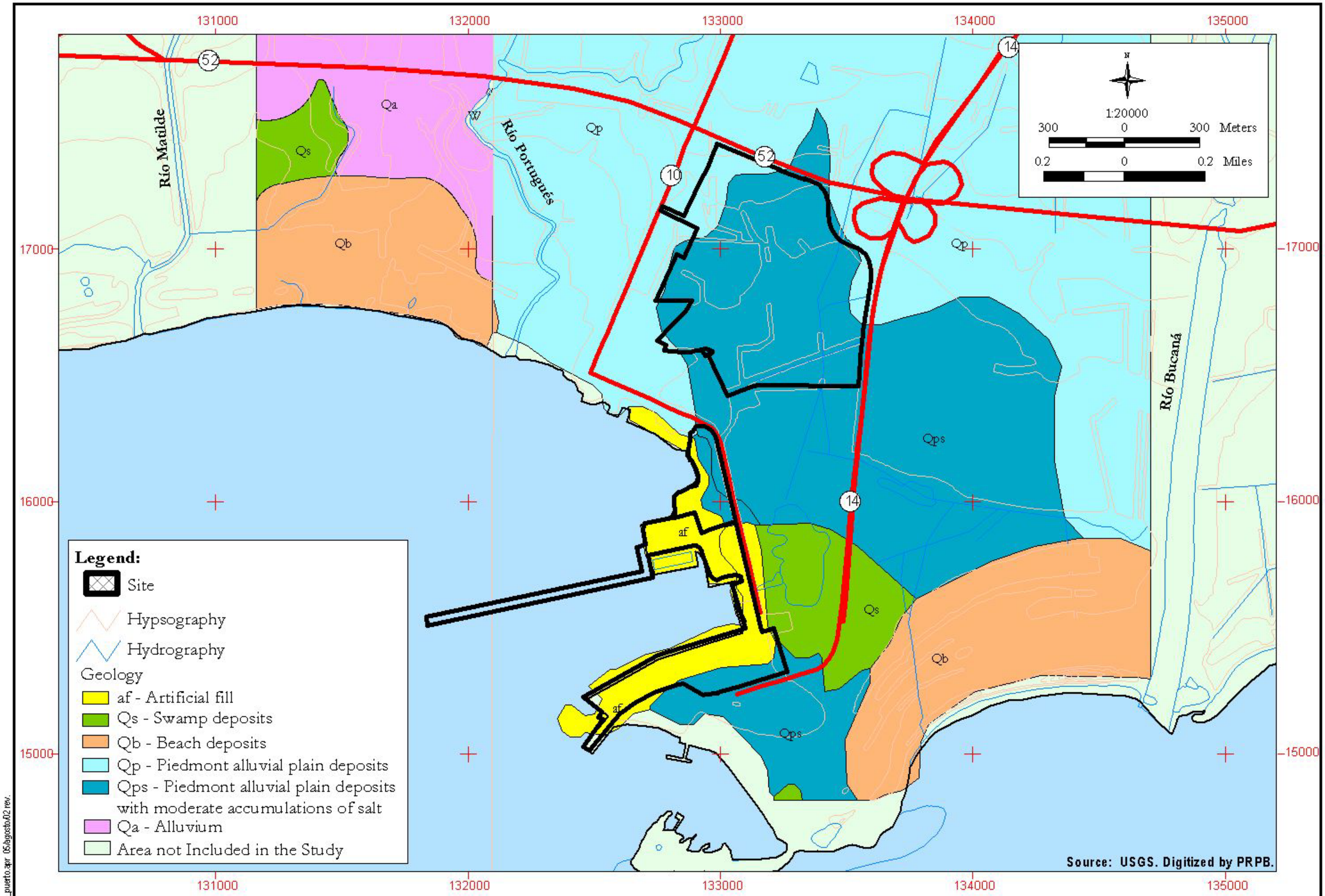

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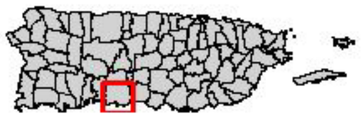

Figure 3-18 Generalized Local Surface Geology: Ponce Area

Port of the Americas

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3.2.7.1 Guánica-Juana Díaz Region Hydrogeology

According to the *Water-Resources Investigation Report* (USGS 1996), the principal aquifers of the Peñuelas-Juana Díaz Region occur in non-confined conditions in alluvial deposits of the Quaternary Period. The thickness of the alluvial deposits vary from less than one (1) foot along the point of contact with the mother rock, to approximately 300 feet closer to the coast, although it can reach 2,000 feet in depth in areas of existing faults (Gómez-Gómez, Heisel, 1980).

The hydraulic conductivity of the zone was estimated with specific capacity test of wells in the Río Loco and Río Yauco valleys. For these valleys, the hydraulic conductivity can be as high as 300 feet per day, decreasing in proportion to an increase in the content of silt and clay. In a similar manner, the hydraulic conductivity decreases towards the east. The transmissivity of the alluvial aquifer in the Guánica-Juana Díaz Region can be as high as 10,000 square feet per day and generally, increasing inland and upstream, in proportion to increases in the hydraulic conductivity.

The aquifers in the Ponce Limestone Formation and the Juana Díaz Formation can produce more water in the higher than in the lower areas of the valley. The hydraulic conductivity estimates for the wells located in the Ponce Limestone and Juana Díaz Formations vary from 2.7 feet per day to 270 feet per day (USGS, 1996).

3.2.7.2 Regional Groundwater Movement and Levels

The groundwater levels in the alluvial deposits in the Guánica-Juana Díaz Region vary from 100 feet below mean sea level in elevated areas in the valley, to almost zero feet below mean sea level along the coastline. Groundwater levels in the Region fluctuate seasonally in proportion to the extraction of water for agricultural uses and human consumption.

The recharge and discharge of groundwater in the Guánica-Juana Díaz Region can vary throughout the year as a result of precipitation, pumping and river deviations. Greater stream seepage into the aquifer was observed in upper valley areas during low streamflow conditions although streams are generally gaining, rather than losing water in the lower reaches. The aquifer recharge from stream seepage is affected by the regulation of streamflow at the headwaters and by diversions to irrigation channels in the Río Tallaboa, Río Yauco and the Río Loco. The aquifer recharge due to precipitation is minimal because of the high rate of evapotranspiration and the low frequency, intensity and duration of rain events. Generally, groundwater flows towards the ocean, from the recharge areas to the discharge areas, following the topography and normal drainage patterns of the alluvial valley.

3.2.7.3 Local Hydrogeology

This section describes the local hydrogeology in the proposed sites to be developed as part of the PTA and adjacent areas. The discussion is subdivided in two subsections: the first describes the local groundwater, and the second subsection lists the inventory of wells in the study areas.

In addition to the Caribbean Sea, including the Ponce, Tallaboa and Guayanilla bays, the principal water bodies in the Region include Río Bucaná and Río Portugués and Río Matilde at Ponce, Río Tallaboa at Peñuelas and Río Guayanilla at Guayanilla. Río Tallaboa is the principal river in the Guayanilla area flowing from the hills north of Peñuelas towards the abandoned CORCO and Union Carbide petrochemical complex, discharging to the Tallaboa Bay. In the Guayanilla area several swamp deposits underlie wetlands in parts of the proposed sites for development, as well as small lakes in the western and southern part of the peninsula.

Among the man-made superficial bodies of water are several lagoons and drainage channels located within the industrial sites (CSA Group, 2000). Other drainage structures to discharge water during storm events include ditches, trenches and superficial channels.

Río Portugués discharges to the Ponce Bay west of the Peñoncillo Peninsula, while Río Bucaná flows into the bay east of the Port of Ponce. There are various swamp deposits south of the Peñoncillo Peninsula. No man-made lagoons occur in the Ponce site. However, there are various drainage structures to discharge runoff during storm events.

3.2.7.3.1 Groundwater

Groundwater is abundant in the alluvial valleys of Río Bucaná and Río Portugués north of the Port of Ponce and the area proposed for development. In the port area itself, ground water is affected by saline intrusion, and is not significant as a water supply. The subsurface Quaternary Alluviumand the Ponce Limestone reportedly act as unconfined water bearing units capable of yielding significant amounts of water (Grossman et al., 1972), although artesian conditions have been observed in the Ponce area (McClymonds, 1972). The Ponce Limestone, which presumably underlies the Quaternary Period alluvium in both areas, exhibits variable porosity and permeability.

In the Guayanilla-Peñuelas area, groundwater conditions are similar to the Ponce area, with alluvial and limestone deposits north of the bays that yield significant amounts of water, while to the coast, saline intrusion impacts most of the zone. In the area of the abandoned petrochemical complex adjacent to the Guayanilla-Peñuelas area, the hydraulic gradient of the water table is approximately 0.001 (5 feet /5,000 feet). Since the hydraulic gradient is low, the groundwater contained in relatively permeable soils will migrate at a low rate in this area (Figure 3-19). The hydraulic gradient for the Ponce area is unknown, but most likely is comparable with the estimates for Guayanilla-Peñuelas.

The materials underlying the proposed sites in Guayanilla and Ponce can be grouped in three general hydrogeology units: (1) loose and soft marine-lagoonal sands and clays; (2) alluvial piedmont sand, gravel, silt and clay; and (3) thin to medium-bedded, south-dipping limestone strata.

In the Ponce area, a significant portion of the recharge to the saturated limestone occurs to the north of the Ponce Bay in the limestone mountains that border the basins of the Río Portugués, Río Bucaná and Río Inabón, at a distance of approximately 3 to 5 miles north of the Project area. The limestone contains layers of different permeability and therefore, groundwater may flow preferentially down the dip of the strata.

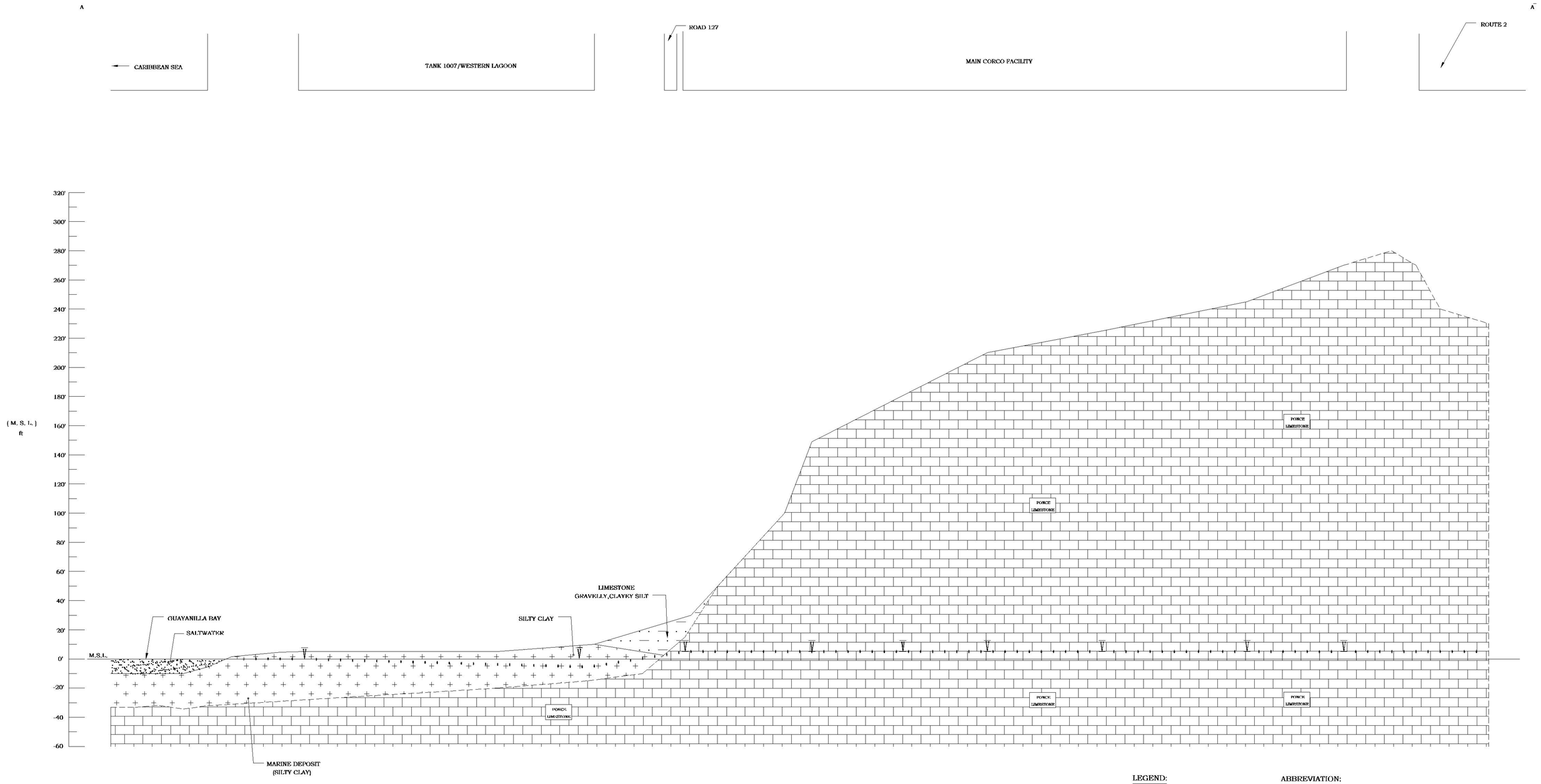


Figure 3-19: GENERALIZED HYDROGEOLOGIC CROSS SECTION

SCALE= HORZ.= 1"= 320' VERT.= 1/32"=1'-0"

LEGEND:

- = WATER TABLE
- = INFERRED
- = SILTY CLAY
- = SALTWATER
- = LIMESTONE
- = LIMESTONE,GRAVELLY, CLAYEY SILT

ABBREVIATION:

(ft)	= FEET
M.S.L.	= MEAN SEA LEVEL

AUTORIDAD PARA EL FINANCIAMIENTO DE LA INFRAESTRUCTURA DEL TERRITORIO

Source : CSA Group,2000
08/20/2002 Rev

In Guayanilla, a significant portion of the recharge to the saturated limestone occurs to the north of the bay, in the limestone hills that enclose the Tallaboa Basin, at a distance of 2 to 5 miles north of the project area. The limestone contains layers of varied permeability and therefore, groundwater may flow preferentially down the dip of the strata.

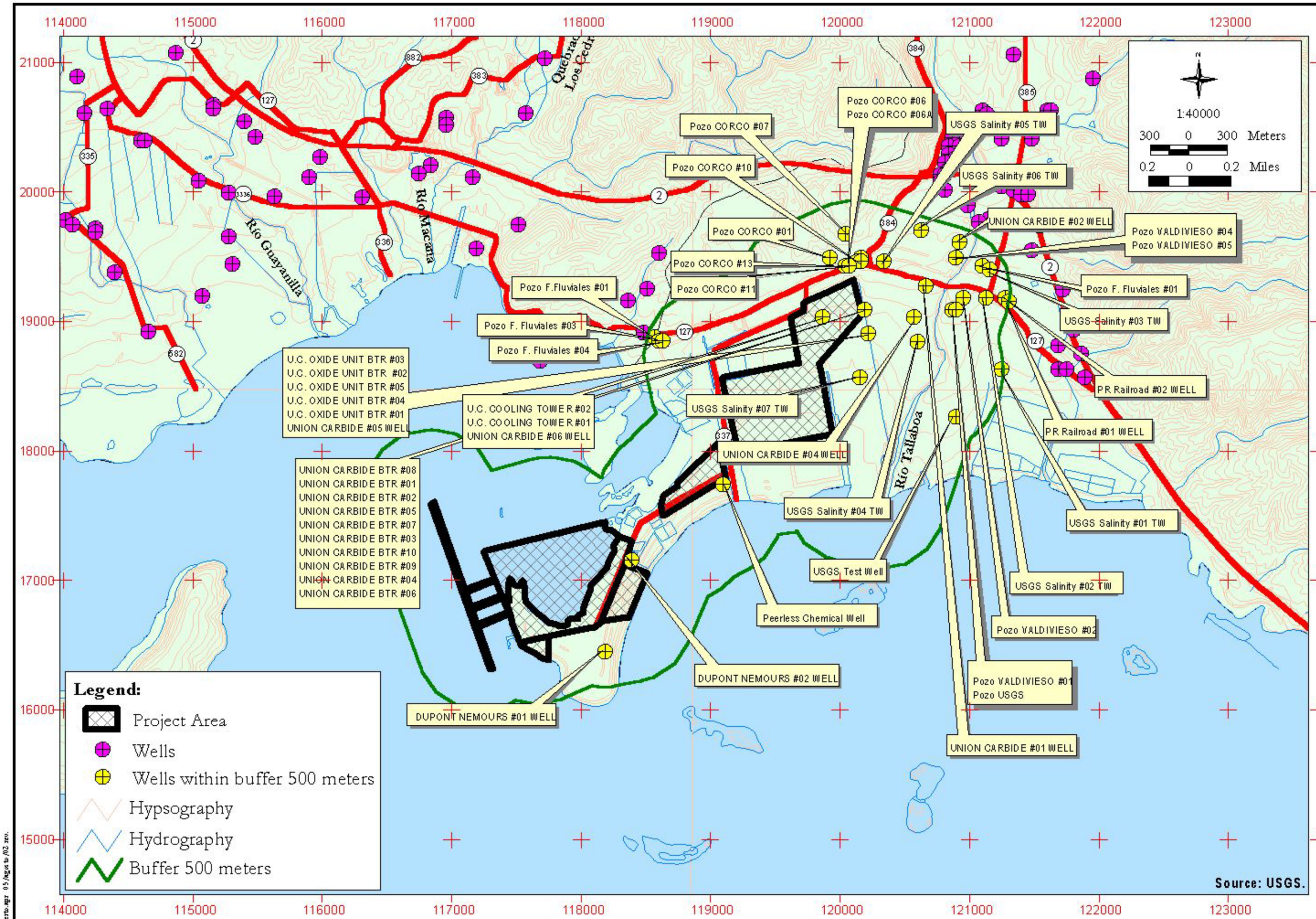
Local intermittent rivers, when flowing, will also contribute recharge to the saturated alluvial sediments in the Guayanilla and Ponce sites.

3.2.7.3.2 Well Inventory

An inventory of the wells in the Guayanilla-Peñuelas area revealed approximately 52 production, water supply and irrigation wells within a 0.3 miles (482 meters) radius from the area proposed for the development of the PTA. A similar inventory near the Port of Ponce revealed approximately 22 wells within a similar radius. The wells were identified using USGS and DNER data and are shown in Figures 3-20 and 3-21.

The wells in the Guayanilla area closer to the bay can reach depths of 187 feet below ground level and have a maximum yield of 30 gallons per minute. Wells in the Peñuelas area drilled into the limestone rocks can yield as much as 800 gallons per minute. CORCO and Union Carbide supplied their plants mostly from deep wells in Tallaboa and the Barinas Valley in Yauco and Guayanilla. Many of these wells are still viable, although not in use after the closure of the petrochemical complex. CORCO and Union Carbide still maintain the franchises with legal rights to extract water from these wells. The wells in the vicinity of Punta Peñoncillo in Ponce can reach depths of up to 215 feet below ground level and have a maximum yield of 2,000 gallons per minute.

Wells located between 0.50 and 0.75 mile from the coast, in Ponce and Guayanilla, respectively, are not used as a source of potable water. Many of these wells are used for production or process supply in industrial facilities or for irrigation. Some of these wells are classified by the USGS as domestic, but probably are used for residential lawn irrigation, wastewater systems and other domestic tasks, and not for human consumption.



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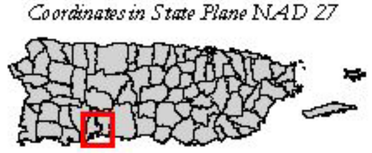

Figure 3-20 Well Inventory: Guayanilla-Peñuelas Area

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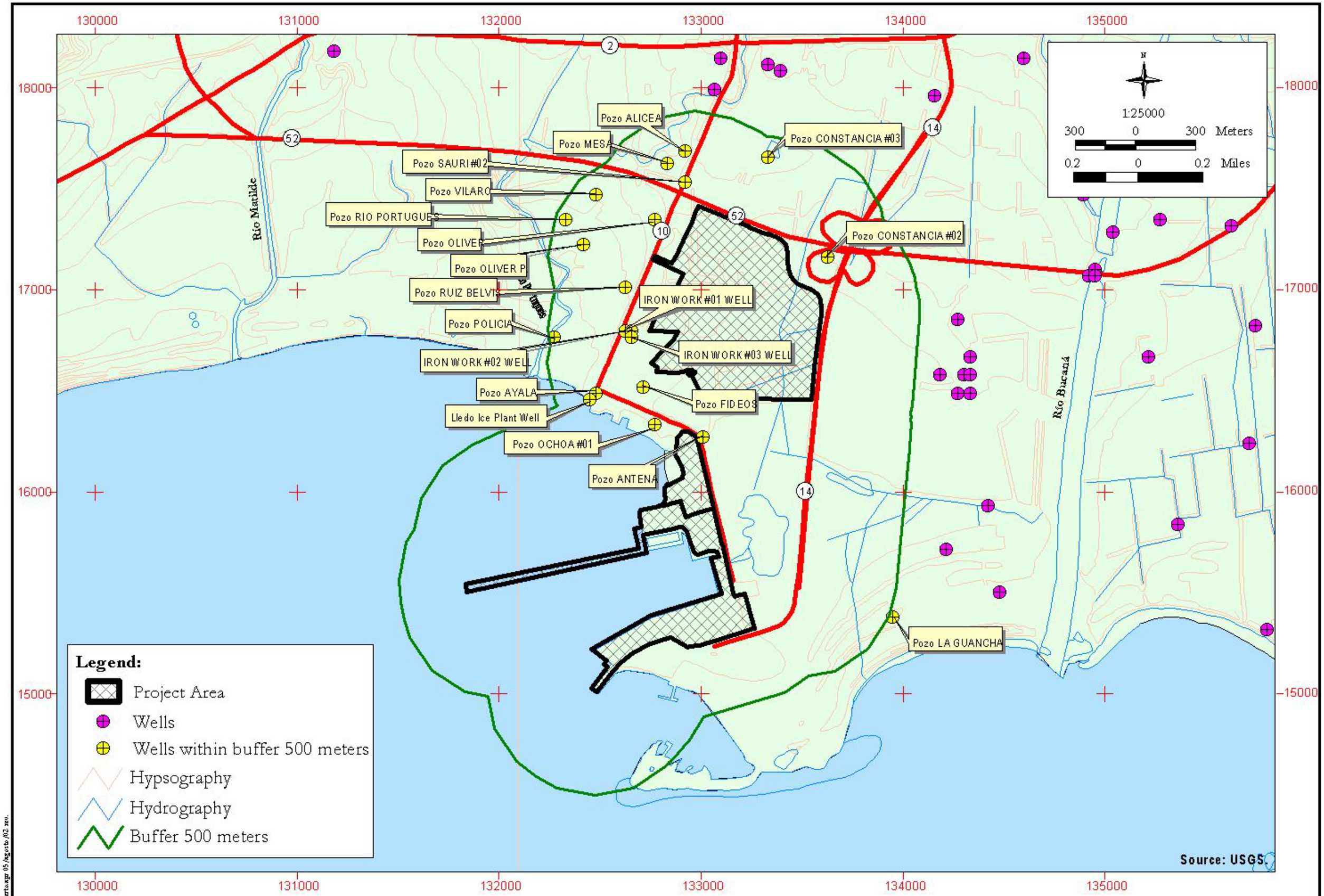

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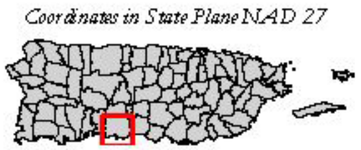

Figure 3-21 Well Inventory: Ponce Area

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3.3 Fish and Wildlife Resources

This section describes the aquatic and terrestrial flora and fauna resources according to studies conducted in the proposed sites. Wetlands are discussed in a separate section.

3.3.1 Terrestrial Flora

The vegetation in the proposed Project areas is typical of areas highly disturbed by human activity. Much of this land is or has been occupied by industrial-type activities, which remain active in some sites but have been abandoned in others. Most of the land was filled during the construction of existing wharves and facilities. However, due to the extent of floodplains and wetlands in the Project's coastal areas, a great diversity of plants and animals associated with these ecosystems were observed. Also observed were a diverse number of plants associated with disturbed areas (Appendix J).

Guayanilla-Peñuelas Area: Two hundred and thirty-one (231) plant species were identified in the Guayanilla-Peñuelas project area. This area was segregated in two sectors for which the flora composition differ significantly: Tallaboa and Punta Guayanilla.

- The Tallaboa sector is bounded on the west by the Río Tallaboa and extends along the former Union Carbide Caribe lot. Inside this sector, two vegetative associations occur: coastal and thorny shrub vegetation.

- Coastal vegetation is found at the Río Tallaboa's mouth as well as the Punta Guayanilla area. The vast majority of the 119 species identified of this type are characteristic of impacted coastal areas, wetlands, or secondary coastal forests. Among the dominant species prevail the grasses (*Poaceae*), sedges (*Cyperaceae*), Saltwort (*Batis maritima*), and small trees such as Wild tamarind (*Leucaena leucocephala*), "Lechecillo" (*Croton discolor*), "Malvavisco" (*Corchorus hirsutus*), Wild cotton (*Gossypium hirsutum*), and Giant milkweed (*Calotropis procera*). Around the coast prevail the Black mangrove (*Avicennia germinans*), Red mangrove (*Rhizophora mangle*), White mangrove (*Laguncularia racemosa*), Button mangrove (*Conocarpus erectus*), and Cork tree (*Thespesia populnea*).

- The remaining parcels in the Guayanilla-Peñuelas area show vegetation covered by pastureland and thorny bushes that consists of 223 species. Here prevail the Guinea grass (*Urochloa maxima*), vines (*Vigna luteola and V. vexillata*), and trees such as the Twisted acacia (*Acacia tortuosa*), Sweet acacia (*A. farnesiana*), West-Indian elm (*Guazuma ulmifolia*), and Mesquite (*Prosopis juliflora*).

- Within the proposed area for the Project in Guayanilla-Peñuelas, three species of plants considered as critical elements by DNER were identified. These are the Holywood lignum vitae (*Guaiacum sanctun*), "Escoba babosa" (*Bastardia bivalvis*), and Gray nicker (*Caesalpinia bonduc*). The Holywood lignum vitae was identified in the premises located to the west of the Río Tallaboa very near the bridge of Road PR-127 crossing said river (**Figure 3-22**). *Bastardia bivalvis* was found in a dirt road that runs parallel to the gas pipeline near the Río Tallaboa. The Gray nickers individuals were localized along the parcels to the east of Punta Guayanilla. No threatened or endangered species were found in the premises of Guayanilla-Peñuelas. Table 1 of **Appendix J** shows a complete list of flora species found in the study area.

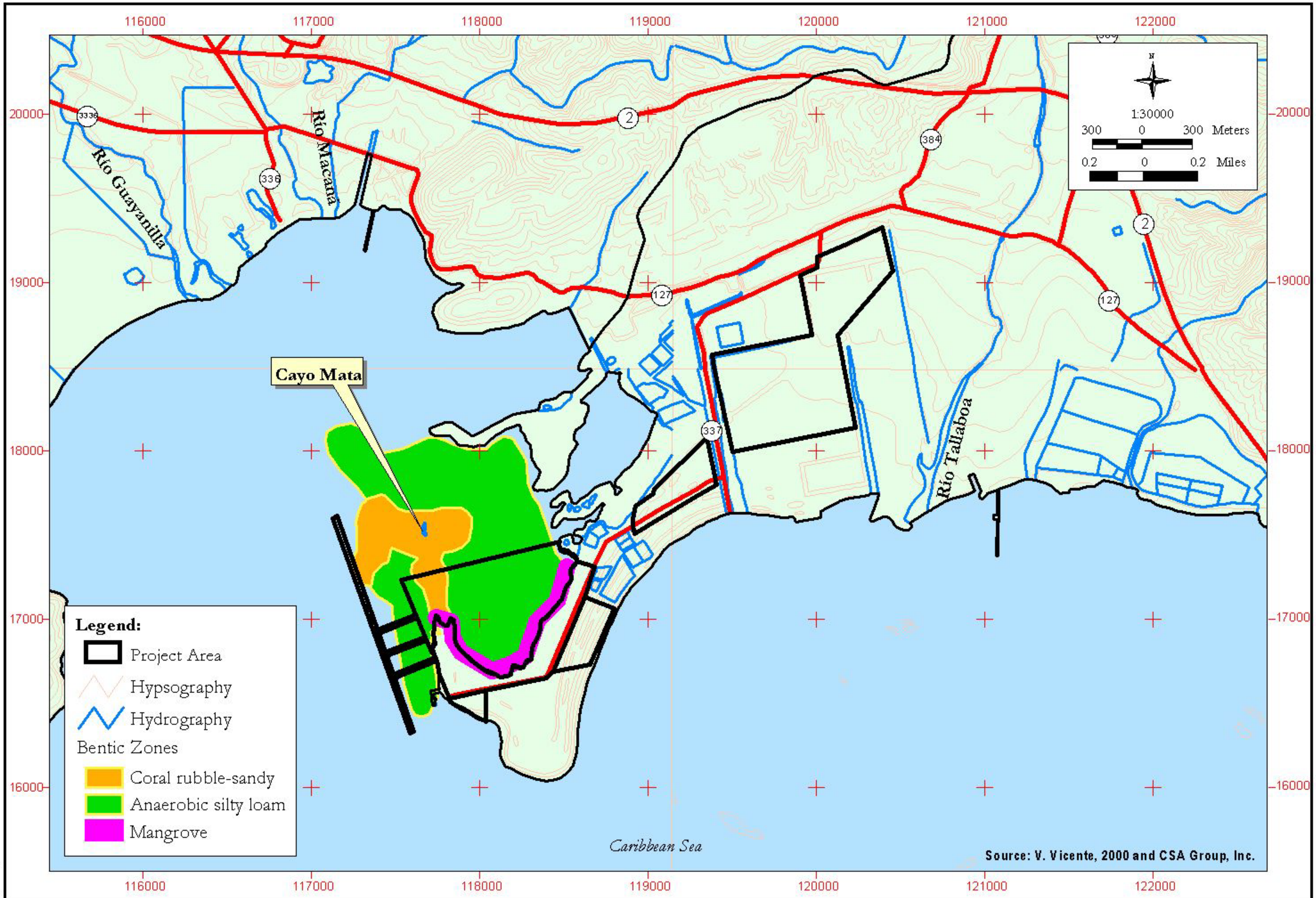
Ponce Area: The proposed area for the Project in Ponce is a commercial port zone of intense activity. However, some areas may be ecologically sensitive, such as the salt flat to the west of PR-14, and the mangroves along the coasts and channels. These would not be impacted by the Project.

- In the proposed area in Ponce, 123 plant species were identified; most of them are species of impacted areas, wetlands, or secondary coastal forests. Among the dominant species, are the grasses (*Poaceae*), sedges (*Cyperaceae*), Saltwort, and small trees such as Wild tamarind (*Leucaena leucocephala*), Wild cotton (*Gossypium hirsutum*), and Giant milkweed (*Calotropis procera*). In the Ponce coast, and in the salt flats area, to the west of Road PR-14, prevail the Black mangrove, Red mangrove, White mangrove, Cork tree, and Wild cotton, as well as wetland species such as Saltwort, Shoreline seapurslane (*Sesuvium portulacastrum*), and Southern cattail (*Typha domingensis*). Table 1 of Appendix J presents a complete list of the flora species found in the study area.

3.3.2 Aquatic Flora

Guayanilla-Peñuelas Area: The Marine Flora study in the Project areas was completed according to the procedures approved by the Puerto Rico Department of Natural and Environmental Resources (DNER), and the United States Fish and Wildlife Service (USFWS) (Appendix G). Most of the information used to prepare the report of this study originates from a review of the available scientific data about studies performed in the Project's area and from field observations. Also, a consultation was made to the Critical Species Inventory Office of the DNER's Natural Heritage Program.

- The marine flora includes 24 algae species, four aquatic angiospermae species like the Turtle-grass (*Thalassia testudinum*), the Manatee-grass (*Syringodium filiforme*), the Sea vine (*Halophila decipiens),* and the Green seagrass (*Halodule wrightii*), several common herbaceous plants from the coasts, and three semiaquatic species that consist of mangroves: Red mangrove (*Rhizophora mangle)*, Black mangrove (*Avicennia germinans*), and White mangrove (*Laguncularia racemosa*). Most of the aquatic species are associated with coraline and sandy bottoms. The mangrove is found along the Bay's shore.



Coordinates in State Plane NAD 27

Figure 3-22 Bentic Zones: Guayanilla-Peñuelas Area

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Ponce Area: A study of the marine communities in the Ponce study area was performed with the main objective of providing a taxonomic characterization and an ecological analysis of the marine communities present in the navigation channel and interior areas of the Ponce Bay.

- The interior region of the Bay represents an estuarine system that extends seaward, influencing the marine communities of the external regions depending on the magnitude of Río Matilde and Río Portugués discharges and the dilution effect provided by the direction and velocity of the ocean currents. Besides the estuarine influence associated to the rivers, the marine communities of the interior of the Ponce Bay are influenced by the ocean outfall of the Regional Wastewater Treatment Plant (RWWTP-PRASA) and of the salmon industries established along the Bay decades ago.

- The marine communities in the navigation channel and interior zones of the Ponce Bay were studied between August 3 and August 5 of 2001. A total of 20 sampling stations were established. The characterization of benthic communities was complemented by samplings with fish traps and fresh squid as bait in 20 stations and fish samplings with line and hook in 10 stations. The characterization of pelagic communities was complemented by micronecton collections using a net of 0.5 millimeters in a surface horizontal towing covering the 20 sampling stations of the navigation channel and turning basin areas.

- The communities of seagrasses in the Ponce Bay were studied by García et al. (1985 a, b) in the zones behind the coral reefs of Cayo Arenas and Cayo Viejo. In Cayo Arenas, areas of Turtle grass (*Thalassia testudinum)* were growing along side green algae such as *Ulva lactuca*, *Cladorphora* sp. and *Enteromorpha* sp., which are indicators of high dissolved nutrient availability (García et al., 1985 a). The study by García et al. (1985 a) highlights the incidence of mobile macroinvertebrates and fish associated to seagrass beds in Cayo Arenas. From the reports of García et al. (1985 a, b), it can be concluded that the development of seagrasses in Cayo Viejo was associated to the presence of *Halophila decipiens* growing along side a group of macroalgae at depths between 5 and 8 meters in the zones behind the reefs (north). Among the algae associated with the seagrass bed, the following were reported *Caulerpa* spp., *Udotea flabellum*, *Cladophora* sp., *Gracilaria* sp. and *Dictyopteris* sp. (García et al.,1985 a, b).

- Muddy sea bottoms that are sticky and level, completely deprived of vegetation and/or coral reef structures, characterize the study area that includes the navigation channel in the Ponce Bay. Benthic populations typical of bland sea bottoms and pelagic estuarine populations that are characterized by the poor diversity of species and low structural complexity prevail. The benthic-sessile biological component is mostly represented by the Sea Feather, *Stylatula* sp., the gorgonians, *Leptogorgia* sp. and the polychaete worm *Arenicola cristata* (Southern Lugworm). Some debris entrained in the muddy sea bottom demonstrated growth of the hydrozoan *Thyroscyphus ramosus* (Algae Hydroid). Adjacent to this debris, the Yellowline Arrow crab, *Stenorhincus seticornis*, was observed as well as the shrimp, *Stenopus hispidus* (Banded Coral Shrimp). The fishnets also captured Decorator Crabs, *Stenocionops furcatus*. The red algae, *Gracilaria* sp. was observed over the sea bottom. This algae was not adhered to a solid substrate, but was free flowing. The Branching Fire Coral, *Millepora alcicornis*, was observed encrusted in a navigational buoy.

- Areas near the navigation channel have a predominately bland (muddy), sticky and mostly deprived of a vegetative sea bottom, except for small areas of seagrass, Halophila decipiens. The grass grows in scattered rows that do not form a seagrass bed. On the sea bottom, a great amount of holes and hills possibly produced by the polychaete worm, *Arenicola cristata* (Southern Lugworm), were observed. The Sea Feather, *Stylatula* sp., was widely observed growing in the sea bottom. At depths between 6 and 7 meters, the gastropod *Strombus pugilis* (West Indian Fighting Conch) was observed. This herbivore mollusk is possibly associated to the seagrass Halophila decipiens, since the greater densities of both coincided in the same areas. Besides these benthic communities that dominated numerically, the sea bottom of the study area near the navigation channel represent a habitat with low diversity of species since it is deprived of reefs or other structures that could house complex marine communities.

- The muddy sea bottoms are used as feeding areas by various species of fish, such as Trunk Fish (*Lactophris* spp., *Acanthostracion* spp.), Grey Triggerfish (*Balistes capriscus*), Snapper (*Lutjanus synagris*) and others (CSA/CH2MHill, 2001). Also, the fishing with line and hook caught a Bonefish, *Albula vulpes* and a Tarpon (*Megalops atlantica*) was observed.

- The section with the richest diversity of benthic species near the navigation channel was observed near the shoreline. Between depths of 1 to 2 meters, a prairie mixed with seagrasses grows, *Halophila decipiens*, and Manatee grass, *Syringodium filiforme*, along with calcareous macroalgae (*Halimeda discoidea*, *Penicillum* sp., *Udotea* sp. and brown macroalgae (*Dyctiota* spp.). Both seagrasses were observed completely covered with fine sediments.

- Appendix I presents a complete listing of all the species identified in the study area of Ponce.

3.3.3 Terrestrial Fauna

Guayanilla-Peñuelas Area: The fauna of the Project's area in Guayanilla-Peñuelas consists of a total of 95 vertebrate species, where birds dominate. A total of 75 bird species were identified. These species were classified as endemic, resident, migratory or introduced (Table 2 of Appendix J).

- Among these birds three species considered as critical, threatened, or endangered were identified. The Brown Pelican (*Pelecanus occidentalis*) is considered an endangered species by the USFWS, and the DNER while the Least Tern (*Sterna antillarum*), and the White-cheeked Pintail (*Anas bahamensis*) are considered by the DNER as threatened species.

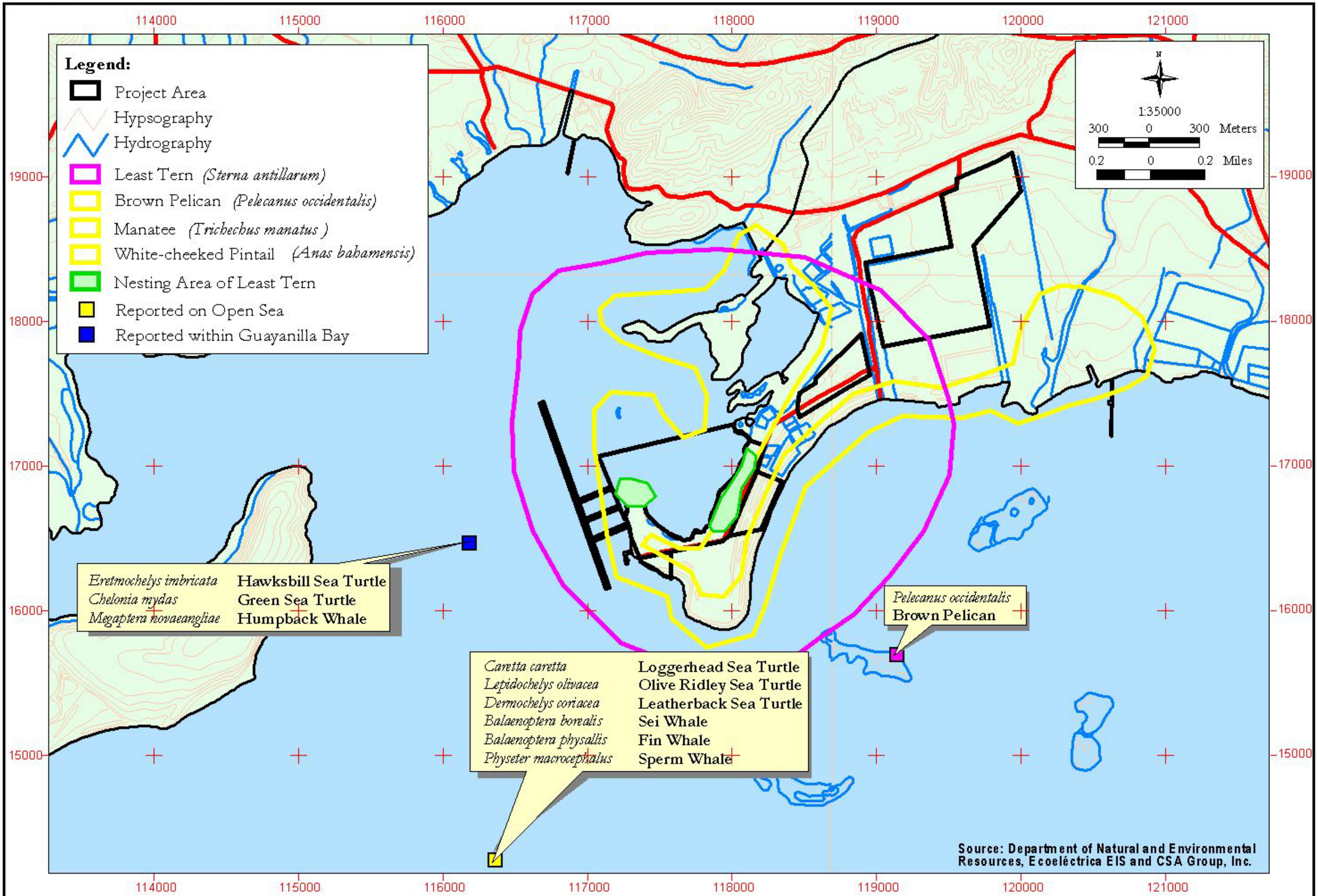
- As to the herpetofauna, a total of 11 species of amphibians and reptiles, such as the Common Coquí (*Eleutherodactylus coqui*), White-lipped Frog (*Leptodactylus albilabris*), several lizard species (*Anolis* spp.), and the Puerto Rican Common Siguana (*Ameiva exsul*) were identified. As to the mammals, two bat species belonging to the genus *Molossus* and *Artibeus*, and introduced species such as Indian Mongoose (*Herpestes auropunctatus*), Brown Rats and House Mice (*Ratus norvegicus* and *Mus musculus*), and feral cats (*Felis domesticus*) were found. The detailed results are shown in Table 2 of Appendix J.

- According to the DNER's Heritage Program Critical Species Inventory, at the Project area in Guayanilla-Peñuelas there are no critical elements, threatened or endangered within a radius of 400 meters from the proposed Project. However, two species of lizards, the Dry Forest Anole (*Anolis cooki*) and Ponce's Garden Lizard (*Anolis poncensis*), are both considered as critical elements by the DNER. These were identified in the Punta Guayanilla area. In the areas close to the Project in Guayanilla, the DNER has reported the presence of the Puerto Rican Nightjar (*Caprimulgus noctitherus*) and the Yellow-shouldered Blackbird (*Agelaius xanthomus*). The United States Fish and Wildlife Service (USFWS) consider the Puerto Rican Nightjar and the Yellow-shouldered Blackbird as endangered species. None of these species were observed when the study was being performed in the Project areas or their vicinity. Critical, threatened and endangered species elements within the Guayanilla-Peñuelas area are shown in **Figure 3-23**.

Ponce Area: The fauna of the Project's area in the Port of Ponce shows a certain diversity of vertebrates, where birds dominate.

- A total of 45 bird species were observed. These species were classified as endemic, resident, migratory or introduced in Table 2 (**Appendix J**). Among the most common birds are the Antillean Nighthawk (*Chordeiles gundlachii*), the Black-necked Stilt (*Himantopus mexicanus*), several species of egrets (*Ardeidae*), sandpipers (*Scolopacidae and Charadriidae*), columbids and passerids. The herpetofauna consists of seven species of amphibians and reptiles, among them the Common Coquí, (*Eleutherodactylus coqui*), the White-lipped Frog (*Leptodactylus albilabris*), several species of lizards (*Anolis* spp.), and the Puerto Rican Common Siguana (*Ameiva exsul*). Four species of mammalians were observed, a bat (*Molossus* sp.), Brown rats, House Mice and Indian Mongooses. The detailed results are shown in Table 2 of **Appendix J**.

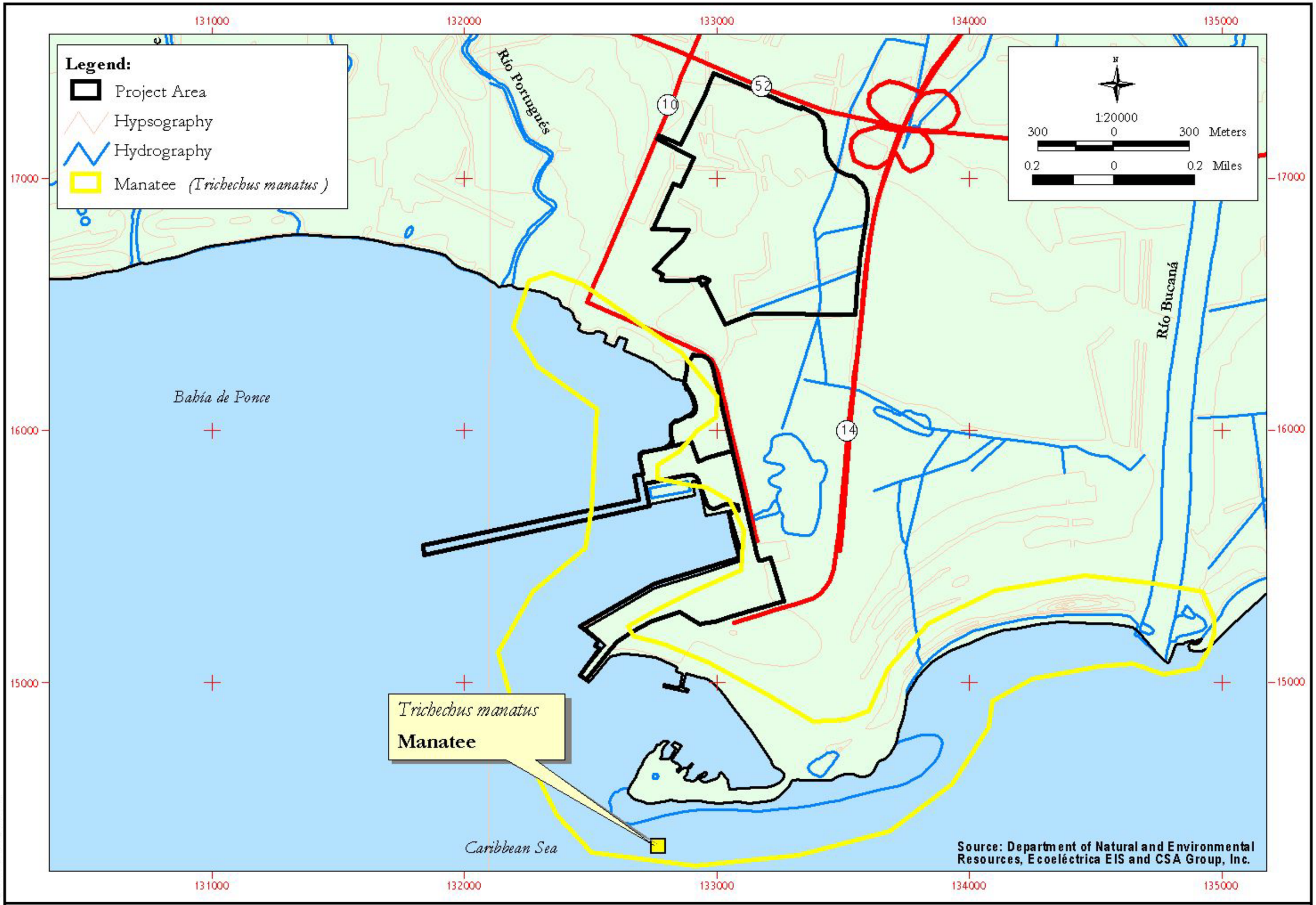
- Critical, threatened and endangered species elements within the Ponce area are shown in **Figure 3-24**. In this area, only the Brown Pelican (*Pelecanus occidentalis*) was observed. flying over the area of the wharves.



Coordinates in State Plane NAD 27

Figure 3-23 Critical, Threatened and Endangered Elements: Guayanilla-Peñuelas Area

Port of the Americas



Coordinates in State Plane NAD 27

Figure 3-24 Critical, Threatened and Endangered Elements: Ponce Area

Port of the Americas

3.3.4 Aquatic Fauna

Guayanilla-Peñuelas Area: The Marine Fauna investigations in the Project areas were completed according to the procedures established by the Puerto Rico Department of Natural and Environmental Resources (DNER), and the United States Fish and Wildlife Service (USFWS) (Appendix G). Most of the information used to prepare the report of this study originates from a review of the available scientific data about studies performed in the Project's area and from field observations. Also, a consultation was made to the Critical Species Inventory Office of the DNER's Natural Heritage Program.

- In the Project's area, 254 animal species have been reported. From these, 116 species are fish, 112 invertebrates, 9 marine mammalians, 12 birds associated with coastal environments, and 5 marine reptiles. Just as the flora, most of them are concentrated in the marine bottom, especially in coraline and sandy bottoms. Several species are considered as commercially valuable species, but these are not common, and youthful individuals represent most of them. Dominant fish species are from the Haemulidae Family.

- Mammalians and birds may be observed in the water's surface, in the open sea, and associated with the mangroves. Among these species, CSA staff observed the Brown Pelican, Least Tern, White-cheeked Pintail, and Manatee. This one was observed several times in the channels within the Union Carbide premises.

Ponce Area: A study of the marine communities in the Ponce study area was performed with the main objective of providing a taxonomic characterization and an ecological analysis of the marine communities present in the navigation channel and interior areas of the Ponce Bay.

- There are five abundant coral reefs in the Ponce Bay. These are: Cayo Arena and Cayo Ratones located to the south of Punta Cucharas; Cayo Viejo, Las Hojitas e Isla Cardona in the center and exterior of the bay. The maximum development of coral (18% average linear coverage) in the coral reefs of the Ponce Bay were reported by García et al. (1985b) for the area of Cayo Ratones at depths of 17 to 19 meters. The reefs of Cayo Hojitas and Cayo Viejo demonstrated a very limited development of scleractinian coral (less than 5% of linear coverage), with hard substrates mostly covered with layers of algae, sponges and encrusting zoanthides.

- Associated with navigational buoys, juvenile fish from the coral reefs, such as the Surgeon Fish (*Acanthurus chirurgus*), Butterfly fish (*Chaetodon capistratus*), Sergeant Major (*Abudefduf sexatilis*) as well as small schools of Jacks, Atlantic Bumberfish (*Chloroscombrus chrysurus*) and Leatherjackets, *Oligoplites saurus*, both of which were in juvenile stages. Other biological components associated with the seabed of the navigation channel include fish that feed mostly from the sea bottom, such as Lane Snapper, *Lutjanus synagris*, Rhomboidal Mojarra, *Diapterus rhombeus*, and Spadefish, *Chaetodipterus faber*, which were captured by fishnets. These fish have feeding habits that include diets based on benthic invertebrates (Randall, 1967).

- The pelagic fauna samples with micronecton superficial tows in the transverse direction of the navigation channel reflect estuarine and shoreline coral reef characteristics. All stations demonstrated an abundant component of planktonic copepods (calanoids and cyclopods) and sergestids shrimp, along with an

abundant group in the larval stage of invertebrates and estuarine and coral reef fish. The anchovy family (Engraulidae) was represented by eggs and larvae in various stages of development. These fish sustain their complete life cycle in a coastal and estuarine system, contrary to many other species of coral reef fishes, which have a larval pelagic development away from the coast (García et al. 1995; García et al., 1996). Other common species typical of estuarine communities collected in the micronecton were White Mullets (Family Mugilidae), larvae of Silversides, Family Atherinidae and the Ballyhoo (Family Hemiramphidae). Other principal species collected in the micronecton of the navigation channel include post-larval stages of fish from coastal coral reefs, such as the representatives of the Damselfish (Family Pomacentridae) and White Grunt (Family Haemulidae).

- Larval stages of caridean shrimp (Section Caridea) and portunid crabs (Section Brachyura) were found in all stations on the navigation channel. An important component of the larvae of caridean shrimp are composed of members from the families Atyidae and Palaemonidae. These are fresh water shrimps that go through larval stages in estuarine or marine zones. The adults remain in the rivers while the larvae are transported downstream (anphydromous). The presence of these larval shrimps in estuaries of Puerto Rico has been reported by various investigators (Ching-Morales, 1982; Montero-Oliver, 1987; March et al., 1998; Holmquist et al., 1998; García, 1998). Larvae of hermitage crab (Section Anomura) were limited to the most seaward stations of the channel. The ctenophor, *Mnemiopsis* sp. (Sea Walnut), a known predator of zooplankton was collected on the navigation channel, so it can be concluded that they represent an important component of the pelagic fauna in this region of the Ponce Bay.

- The pelagic fauna of the area near the navigation channel is highly influenced by high densities of zooplankton, which is characteristic of estuarine zones (García 1990, 1993, 1995; García y Castro, 1995; García et al., 1996). Samples obtained from the micronecton net demonstrate a high incidence of calanoids and cyclopods, segestid shrimp and larval stages of caridean shrimp (Section Caridea, including Family Atyidae and Palaemonidae), Hermit Porcelain Crabs (Section Anomura), portunid crabs (Section Brachyura), as well as eggs and fish larvae (Family Engraulidae, Atherinidae, Hemiramphidae and Pomacentridae). Associated to the plankton food chain were the jellyfish (Class Scyphozoa), among which the cube jellyfish *Carybdea alata* (Sea Wasp) was identified as well as the ctenophor *Mnemiopsis* sp. (Sea Walnut).

- Zooplanktivore species of fish were observed in schools throughout all the study area. These pelagic fish schools have great mobility and are being constantly followed by predators of bigger size, which forces them to cover all the study area. The zooplanktivore fish observed include the Dwarf Herring, *Jenkinsia lamprotaenia* and anchovies (Family Engraulidae). Probably the group of zooplanktivore fish includes sardines (e.g. Harengula spp.) and scads (Decapterus spp.), which have been reported previously for similar estuarine systems in Puerto Rico (CSA/CH2MHill, 2001). Psicivore predators are at the top of the food chain, among them including the Tarpon (*M. atlantica*), Mackerel (*Scomberomorus* spp.) and Blue Runner (*Carangoides crysos*).

Appendix I presents a complete listing of all the species identified in the study area of Ponce.

3.4 Marine Resources and Special Aquatic Sites

In Puerto Rico, benthic marine habitats can be classified in four general categories: 1) hardbottoms; 2) coral reefs; 3) seagrass beds; and 4) muddy bottoms.

Hardbottoms generally consist of two categories, namely Hardgrounds and Rock Reef. The term "hardground" is applied to areas of relatively low relief; such as hard carbonate banks or eolianite terraces dominated by encrusting species such as sponges, turf algae and gorgonians. "Rock Reefs" include nearshore and emergent reefs found along the northern and northwestern coast of the Island, typically consisting of submerged bedrock features of moderate to high relief colonized by encrusting biota, including isolated coral colonies.

Vicente (1999) and García (2000, 2001) conducted marine flora and fauna investigations in the Guayanilla and Ponce project areas, following scientific procedures accepted by the Puerto Rico Department of Natural and Environmental Resources (DNER), and the United States Fish and Wildlife Service (USFWS). The purpose of these investigations was to characterize benthic and pelagic marine communities associated with the location of the proposed action, as well as to survey said sites for significant marine resources. Please refer to Appendices H and L for details on these efforts.

Also, some of the information used to characterize the proposed sites originates from a review of the available scientific data about studies performed in the Project's area and from field observations. Additionally, a consultation was made to the Critical Species Inventory Office of the DNER's Natural Heritage Program.

3.4.1 Hardbottoms

3.4.1.1 Guayanilla-Peñuelas Site

No hard bottoms are found at the Guayanilla-Peñuelas project site. The proposed fill area in Guayanilla-Peñuelas consists of unconsolidated sediments, mainly mud, sand and rubble or a combination of the above (Vicente, 2000).

3.4.1.2 Ponce Site

No hardbottoms are found at the Ponce project site. In Ponce, the bottom of the harbor and navigation channel consists of soft sticky mud devoid of vegetation (García, 2001).

3.4.2 Coral Reefs

3.4.2.1 Guayanilla-Peñuelas Site

The Guayanilla-Peñuelas site consists of unconsolidated sediments consisting of mainly of mud, sand and coral rubble. The closest coral reefs to the project site in Guayanilla include Unitas and Guayanilla reefs to the southwest and Cayos Palomas and Maria Langa reef complex to the southeast. These are located about 1.5 miles from the project site.

3.4.2.2 Ponce Site

There are no coral reefs associated with the Ponce site. There are five emergent reefs in the general Ponce Harbor area, namely Cayo Arenas and Cayo Ratones south of Punta Cucharas, and Cayo Viejo, Las Hojitas and Cayo Cardona to the southwest. Maximum coral development (18.0% average lineal coverage) for this area was reported at Cayo Ratones (Garcia, 1985), located over three miles from the Project site.

Hojitas and Viejo reefs, located close to the project site, showed a very limited sclereantinian coral development. These reef systems would not be directly or indirectly affected by project development.

3.4.3 Seagrass Beds

3.4.3.1 Guayanilla-Peñuelas Site

According to Vicente (2000), the distribution of seagrasses within the proposed fill area is patchy. This habitat is characterized by the presence of patches of different sizes dominated by four marine plant species: Turtle grass (*Thalassia testudinum*), Manatee grass (*Syringodium filiforme*), Sea vine (*Halophila decipiens*) and Green seagrass (*Halodule wrightii*) (Vicente, 1979). These seagrass patches are found at depths of less than four meters. Other important species associated to the seagrass patches are red (Rhodophyta), brown (Phaeophyta) and green algae (Chlorophyta).

A wide-area survey of the proposed project vicinity was performed (Garcia, 2002) and the presence of the following benthic communities has been reported: Approximately 25.2 acres of seagrasses (19.7 acres of *Thalassia testudinum;* 3.9 acres of *Halodule wrightii;* and 1.6 acres of *Halophila decipiens*); 144.4 acres of shallow mud (lacking vegetation cover); 40.0 acres of mixed algae and mud; 321.4 acres of deep mud; 23.0 acres of sandy bottoms; 3.7 acres of coral rubble; and 13.9 acres of coral reefs. The total area surveyed was 575 acres. (Appendix BB).

3.4.3.2 Ponce Site

At the Ponce site, the sea bottom consists of fine sticky mud completely devoid of vegetation or reef structures, including sea grasses (García, 2001).

3.4.4 Muddy Bottoms

3.4.4.1 Guayanilla-Peñuelas Site

Vicente (1979; 2000) and García (2002) describe this habitat as a relatively smooth bottom, usually lacking vegetation cover. It is the most common bottom substrate of the Guayanilla Bay, especially on the deeper portions, including the navigation channel. These muddy “soft bottoms” have a lower diversity of marine species than seagrasses, hard bottoms, coral reefs or mangroves.

3.4.4.2 Ponce Site

In Ponce, the bottom of the harbor and navigation channel consists predominately of soft sticky mud devoid of vegetation (García, 2001).

3.5 Essential Fish Habitat

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act mandates that the NMFS, Regional Fisheries Management Councils (FMC), and other Federal agencies, identify and protect important marine fish habitat. The Caribbean FMC, with assistance from the NMFS, has delineated “Essential Fish Habitat” (EFH) for federally managed species within the Caribbean waters under the jurisdiction of the U.S. Federal agencies which fund, permit or carry out activities that may adversely affect EFH, are required to consult with NMFS regarding the potential impacts of their actions on EFH, and respond in writing to NMFS or FMC recommendations.

EFH, as defined in the Magnuson-Stevens Fishery Conservation and Management Act of 1976, includes those waters and substrate necessary to the fish for spawning, breeding, feeding, or growth to maturity. In the Caribbean waters under the jurisdiction of the U.S., EFHs are identified and described based on areas where the life phases of 17 selected species of fish and coral reefs occur. The 17 selected species are: 1) *Epinephelus fulvus* (Coney); 2) *Epinephelus guttatus* (Red Hind); 3) *Epinephelus striatus* (Nassau Grouper); 4) *Lutjanus analis* (Mutton Snapper); 5) *Lutjanus apodus* (Schoolmaster); 6) *Lutjanus griseus* (Gray Snapper); 7) *Lutjanus vivanus* (Silk Snapper); 8) *Ocyurus chrysurus* (Yellowtail Snapper); 9) *Haemulon plumieri* (White Grunt); 10) *Chaetodon striatus* (Banded Butterfly fish); 11) *Balistes vetula* (Queen Triggerfish); 12) *Holocentrus ascensionis* (Squirrelfish); 13) *Malacanthus plumieri* (Sand Tile Fish); 14) *Sparisoma chrysopterum* (Redtail Parrotfish); 15) *Lactophrys qudricornis* (Trunkfish); 16) *Panulirus argus* (Spiny Lobster); and 17) *Strombus gigas* (Queen Conch).

Since all of these species occur in all habitats within the Caribbean waters under U.S. jurisdiction, the EFH includes all waters and substrates, including coral habitats, submerged vegetation, and adjacent intertidal vegetation, including wetlands and mangroves. Therefore, EFH includes virtually all marine waters and substrates from the shoreline to the seaward limits of the EEZ. For Puerto Rico and the U.S. Virgin Islands, this represents an area of approximately 76,252 square miles (48.8 million acres).

3.5.1 Guayanilla-Peñuelas Site

Approximately 70 to 80 percent of the bottom area of the Guayanilla Bay consists of unconsolidated, silt-clay sediments (Yoshioka, 1979). These “soft bottoms” are typically less diverse in species composition than seagrass, hard bottoms or coral reef formations. Polichaetes, crustaceans and mollusks dominate the soft bottom benthic community within the Bay (Yoshioka, 1979). Amphipods, copepods and echinoderms are also typical. According to Vicente (2000) and Garcia (2002) (Appendix H and CC), the area proposed to be filled as part of the PLA (between Punta Guayanilla and Punta Gotay south of Cayo Mata) consists of unconsolidated sediments composed of mud, sand rubble or a combination of these. According to both surveys, the distribution of seagrasses within the proposed fill area is very sparse, and the density of the associated fauna in the zone is very low.

According to the Caribbean Fish Management Council, non-vegetated bottoms consisting of sand and mud, or those with low percent cover, are typical of habitats where none of the selected species inhabit. The area for the proposed fill in Guayanilla is typical of these environments. Habitats typical of sandy and muddy bottoms are wide-ranging, and include inshore sandy areas separating living reefs from Turtle grass, and shorelines and mud substrates along mangrove fringed shorelines.

Data from the Caribbean Fishery Management Council (CFMC, 1988) indicate that mud bottom habitats do not support a great diversity of the selected species used to describe EFH. According to these data, in mud habitats only adult individuals of *Lutjanus vivanus* (Silk Snapper) and *Haeumulon plumieri* (White Grunt) are present. For these two species and the remaining selected species of finfish, there are no records of the presence of eggs, larvae, juveniles or spawners in mud bottoms. Similarly, the Spiny Lobster and Queen Conch, and each of their life stages, are absent in muddy bottoms. Based on this information, the bottom areas proposed for fill in Guayanilla can be identified as EFH for adult White Grunts and the Silk Snappers.

The proposed fill area in the Guayanilla Bay would directly affect about 12 acres of mangrove wetlands and associated saltflats. Mangroves have been identified as EFH for several of the

17 managed species including the following: *Epinephelus striatus* (Nassau Grouper), *Lutjanus analis* (Mutton Snapper), *Lutjanus griseus* (Gray Snapper), *Ocyurus chrysurus* (Yellowtail Snapper), *Haemulon plumieri* (White Grunt), *Chaetodon striatus* (Banded Butterfly fish), and *Panulirus argus* (Spiny lobster).

According to the Caribbean Fishery Management Council (CFMC, 1988), these species only occur in mangrove areas as adults or juveniles as follows: Nassau Grouper (Juveniles); Mutton Snapper (Juveniles and adults); Schoolmaster (Juveniles and adults); Gray Snapper (Juveniles and adults); Yellowtail Snapper (Juveniles); White Grunt (Juveniles); Banded Butterfly fish (Adults); and Spiny Lobster (Juveniles). No other life stages of these species are known to be present in mangrove areas.

The proposed fill in the Guayanilla Bay would eliminate the water column in the area selected, since the fill would raise land above sea level to provide areas for parking and staging of containers. The water column has been identified as EFH for the planktonic life stages of all of the 15 managed finfish species identified by the CFMC. Planktonic life stages refer to the eggs and larvae of the referenced species. All of the selected species have planktonic eggs and larvae, but their distribution is unknown. Except for general descriptions, there is little information on the distribution of eggs and the development of larvae, or information on the settling of fish larvae and subsequent development (CFMC, 1988). Most of the information available for these stages is only known at the Family level.

The proposed fill and pier construction would directly affect approximately 12 acres of seagrasses in Guayanilla Bay, primarily consisting of isolated patches of *Thalassia,* and *Syringodium.* Seagrasses are considered EFH for adults and juveniles of the following managed species: Nassau Grouper (juveniles); Mutton Snapper (adults and juveniles); Schoolmaster (juveniles); Gray Snapper (adults and juveniles); Yellowtail Snapper (adults and juveniles); White Grunt (adults and juveniles); Banded Butterfly fish (adults); and Spiny Lobster (adults and juveniles). Seagrasses do not support eggs, larvae or spawners of any of the 15 managed finfish species. However, seagrasses provide EFH to the Queen Conch in several of its life stages including eggs, adults, juveniles and spawners.

3.5.2 Ponce Site

Similar to the Guayanilla-Peñuelas site, muddy bottoms characterize the areas in the Bay of Ponce where the PTA activities are proposed. These areas include the navigation channel, where dredging is proposed, and the zone adjacent to Pier #8, where extension of the pier is planned. Dredging (1986-87) previously impacted these areas. Only adult individuals of *Lutjanus vivanus* (Silk Snapper) and *Haeumulon plumieri* (White Grunt) are present in this type of habitat. For these two species and the remaining selected species of finfish, there are no records of the presence of eggs, larvae, juveniles or spawners in mud bottoms. Similarly, the Spiny Lobster and Queen Conch, and each of their life stages, are absent in muddy bottoms. Based on this information, the areas proposed for dredging or construction in the Bay of Ponce can be identified as EFH for adult White Grunts and the Silk Snappers.

The proposed dredging of the Ponce Harbor would have temporary effects in the water column, primarily increases in turbidity due to suspension of bottom sediments. The water column has been identified as EFH for the planktonic life stages of all of the 15 managed finfish species identified by the CFMC. Planktonic life stages refer to the eggs and larvae of the referenced species. All of the selected species have planktonic eggs and larvae, but their distribution is unknown. Except for general descriptions, there is little information on the distribution of eggs and the development of larvae, let alone information on the settling of fish larvae and

subsequent development (CFMC, 1988). Most of the information available for these stages is only known at the Family level.

3.6 Threatened and Endangered Species

Following is a description of threatened (vulnerable) or endangered species reported in the vicinity of the Project areas, as well as species that are frequent visitors or may occur in the vicinity of the Project sites at Guayanilla-Peñuelas and Ponce. A summary of this baseline information is presented at the end of this section in Table 3-5.

3.6.1 Loggerhead Sea Turtle

The Loggerhead Sea Turtle (*Caretta caretta)* is a species of marine turtle designated as threatened by the USFWS. It is found throughout tropical and temperate seas. This species have not been reported for the Project area. It feeds on fish and invertebrates, including coral polyps, sea anemones, and sponges. It is occasionally found in the waters of Cuba, Puerto Rico, and the Eastern Caribbean Sea. In Puerto Rico, it is not as common as the Hawksbill Turtle and the Green Sea Turtle, and there is no beach known to be used as a nesting site. The main causes for its population decrease are: the destruction of nesting areas, shrimp fishing by trolling, and contamination. Locally, this species is not listed by the DNER. The occurrence of this species in the project area is probable.

3.6.2 Green Sea Turtle

The Green Sea Turtle (*Chelonia mydas)* is a mostly herbivorous turtle considered as an endangered species by the DNER. In the federal jurisdiction the Green Sea Turtle is considered as a threatened species. It may be found throughout the Pacific and Atlantic Oceans. In the Atlantic, there are nesting beaches in Surinam, Costa Rica, Florida, the Virgin Islands, and Puerto Rico. The island of Culebra and adjacent keys have been designated as a critical habitat for the Green Sea Turtle. This species has been reported for Guayanilla and Tallaboa Bays. The occurrence of this species in the project area is likely. The main causes for this species' population decrease have been the loss of a habitat for nesting, the theft of eggs, hunting, disturbances in nesting beaches, dredging, floating debris, and destruction of feeding areas. It is estimated that there are between 200 and 1,100 female turtles nesting in the coasts of the United States.

3.6.3 Hawksbill Sea Turtle

The Hawksbill Sea Turtle (*Eretmochelys imbricata*) is a marine turtle designated as an endangered species by the USFWS and the DNER. It nests in undisturbed coasts between the months of May to November. The Hawksbill Sea Turtle visits the coral reefs and feeds mostly on marine sponges, although it also feeds on fruits, leaves, and Red mangrove (*Rhizophora mangle*) bark as well as from other marine invertebrates. This species is considered as one of the most endangered species in the world. The critical habitat of this species covers the islands of Mona, Culebra, Puerto Rico, and adjacent keys. This species has been observed in the Guayanilla and Tallaboa bays. The occurrence of this species in the project area is probable. Nest looting, and development in the beaches where this turtle nests constitute the main cause for the decrease of this species.

3.6.4 Leatherback Sea Turtle

The Leatherback Sea Turtle (*Dermochelys coriacea*) is a marine turtle designated as an endangered species by the USFWS and the DNER. It nests between the months of February and August in the beaches of the north, east and west of Puerto Rico. It has also been documented as nesting in the coasts of Mona, Culebra and Vieques. This species has not been reported for the Project area, however its occurrence is probable. The species shows a preference for high-energy beaches. Vandalism, egg looting, destruction of adequate breeding areas and coastal development are the main causes for the decrease of this species. The Leatherback Sea Turtle feeds on invertebrates, particularly pelagic jellyfish. At present, there are no nesting areas of the Leatherback Sea Turtle in the vicinity of the Project areas.

3.6.5 Brown Pelican

The Brown Pelican (*Pelecanus occidentalis*) is a common resident of Puerto Rico. This bird is designated as an endangered species by the USFWS and the DNER. It is found in the coast, bays and lagoons, but may be seen also in the Island's interior, in fresh-water dams located in the mountains. Its main nesting area is Cayo Conejo in Vieques. It may be observed in mangrove forests along the coast of the Project, both in Guayanilla-Peñuelas and Ponce. Individuals of this species were seen in both sites in the field studies conducted for this PEIS. The occurrence of this species in the project area is likely. It feeds mainly on fish from the sea.

3.6.6 Least Tern

The Least Tern (*Sterna antillarum*) is designated as threatened under Commonwealth jurisdiction. The USFWS designates it as an endangered species in the United States, but not in Puerto Rico. This bird is an uncommon and local resident during the breeding season. It is found throughout coastal zones, bays, and lagoons. It nests between April and July in various substrata, such as sand, mud, and "carricoche" (coral fragments). It has been reported nesting particularly in the southwest and northwest, where it returns to the same place every year. It lies from 2 to 4 eggs that are incubated by both parents. The main problem affecting this species is the destruction and loss of its habitat. It feeds mainly on fish. It may be found along the entire coast of the Project areas. This species nest in the Guayanilla-Peñuelas site and its occurrence in the project area is likely.

3.6.7 White-cheeked Pintail

The White-cheeked Pintail (*Anas bahamensis*) is an uncommon species whose populations have substantially diminished in Puerto Rico and the Virgin Islands. The DNER considers it a critical species. The USFWS had not listed this species. It is a frequent visitor at fresh and brackish water bodies, and was seen in the Guayanilla-Peñuelas site during the field studies conducted for this PEIS. The occurrence of this species in the project area is likely. It nests between June and August, although may do so throughout the year, since males in nuptial plumage have been seen courting during the first months of the year. It constructs its floating nest amidst the emergent vegetation in the banks of the lagoons where it lives, and lays between 4 and 12 eggs. It feeds on plants and invertebrates.

3.6.8 Puerto Rican Crested Toad

The Puerto Rican Crested Toad (*Peltophryne lemur*) is an amphibian classified as threatened by the USFWS and the DNER. It occurs frequently west of the Guayanilla Project area, in the coastal zone of the Guánica State Forest. The Puerto Rican Crested Toad is middle sized, and it lives in arid and semiarid sectors of low lands and in rocky lands of low elevation. It is

frequently observed near seasonal evergreen vegetation, under limestone boulders in humid ravines and under the bark of dead mangrove (Schwartz and Henderson, 1991). This species has been reported at the Barinas Valley, west of the Project site. The occurrence of this species in the project area is unlikely.

3.6.9 Roseate Tern

The Roseate Tern (*Sterna dougallii*) is classified as an endangered species by the DNER and the USFWS. It is a migratory species that visits the Caribbean during its breeding season. It is found in coastal areas throughout the Caribbean, but the larger populations occur in the Lesser Antilles. It nests normally over scattered vegetation in the islets and small keys close to the coast. In Puerto Rico they nest mostly in the south coast, particularly in the region of La Parguera, Guánica and Guayanilla, from May until September. The occurrence of this species in the project area is probable, within known range.

3.6.10 Puerto Rican Nightjar

Both the USFWS and the DNER classify the Puerto Rican Nightjar (*Caprimulgus noctitherus*) as an endangered species. It is commonly found in the thick forests of Puerto Rico's southwest coast, particularly in the Guánica State Forest, and areas surrounding Guayanilla Bay, including Punta Verraco and the woody forests to the north of highway PR-2. The occurrence of this species in the project area is unlikely but likely near potential fill material sources (quarries). Puerto Rican Nightjars are nocturnal birds, which feed on insects. They nest and lay eggs directly on the ground.

3.6.11 Yellow-shouldered Blackbird

The Yellow-shouldered Blackbird (*Agelaius xanthomus*) is classified as an endangered species both by the USFWS and the DNER. Yellow-shouldered Blackbirds nest in low lands in Puerto Rico and the limestone plateau of Isla de Mona. This species can occur in hills north of Guayanilla. They are commonly found near lagoons and coastal swamps, although they also occur in open areas. They are rarely observed in high or mountainous regions. Yellow-shouldered Blackbirds nest frequently in colonies and construct their cup-shaped nests in trees, palms and cactus plants. The occurrence of this species in the project area is probable, but unlikely.

3.6.12 Manatee

The Manatee is an endangered species, both by the USFWS and the DNER, of which two subspecies are known, the Florida Manatee (*Trichechus manatus latirostris*) and the Antillian Manatee (*T. manatus manatus*). The Antillian subspecies is found throughout the coastal zones of the Mar Caribe, the Golf of Mexico, and the Atlantic coast of Brazil. They prefer bays, estuaries, and coastal lagoons. They are also frequent visitors at hot water discharges near industrial areas. They feed on algae and aquatic plants such as Turtle grass (*Thalassia testudinum*), Manatee grass (*Syringodium filiforme*), Red mangrove (*Rhizophora mangle*) and Water hyacinths (*Eichornia* sp.). It is estimated that between 2,000 and 3,000 individuals of this species are now in existence, 100 of which are found in the coasts of Puerto Rico. It is frequently observed in the Guayanilla and Tallaboa bays. This species has been reported for the Ponce Bay and its occurrence in the Project area is likely.

3.6.13 Vahl's boxwood

Vahl's boxwood (*Buxus vahlii*) is a short, endemic Puerto Rican tree (3) classified as an endangered species by the USFWS and the DNER. Mostly found in the karst zone of the

central-mountainous, northwest and south central regions, in the areas of Guayanilla and Peñuelas. Although its presence in the Project area has not been reported, it may occur in the hills to the north of Highway PR-2, and it may be impacted by ground cover material removal activities. Known in only three localities in Puerto Rico, Punta Higüero in Rincón, Hato Tejas, in Bayamón, and the hills north of Highway PR-2 in Guayanilla. The occurrence of this species in the Project area is unlikely except near the quarries that may be used as sources of fill material.

3.6.14 Palo de rosa

Palo de rosa (*Ottoschulzia rhodoxylon*) is a small tree (3) found only in the western part of Puerto Rico and in the Dominican Republic. It is classified as an endangered species by the USFWS and the DNER. Its presence has been reported in the northern limestone (mogotes) area, and in the State Forests of Guánica, Maricao and Río Abajo. Its occurrence in the limestone hills to the north of the proposed Guayanilla-Peñuelas component is probable. The occurrence of this species in the Project area is unlikely except near the quarries that may be used as sources of fill material.

3.6.15 Bariaco

Bariaco (*Trichilia triacantha*) is a small shrub or tree endemic to the arid zones of southwest Puerto Rico. It is classified as an endangered species by the USFWS and the DNER. As a shrub it may grow up to 5 feet, and as a tree it can reach a height between 15 and 30 feet. Its presence has been reported in the Guánica State Forest and the Peñuelas area, and it is also probable in the limestone hills to the north of the proposed Project, in the Guayanilla Peñuelas site. The occurrence of this species in the Project area is unlikely except near the quarries that may be used as sources of fill material.

3.6.16 *Mitracarpus polycladus*

Mitracarpus polycladus is an endemic shrub listed as endangered by the USFWS and the DNER. Its distribution is limited to the coastal areas of the Guánica State Forest, where it occurs in association with isolated clayey deposits in the rocky limestone of the Forest (DNER, Vicente Quevedo, personal communication). It is also probable in the limestone hills to the north of the proposed Project, in the Guayanilla Peñuelas site. The occurrence of this species in the Project area is unlikely except near the quarries that may be used as sources of fill material.

3.6.17 Humpback Whale

The USFWS considers *Megaptera novaeangliae* an endangered species, while the DNER had not listed it. During the spring, summer and fall, North Atlantic Humpback Whales feed over a vast area of ocean encompassing the west coast of the U.S. (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and the west coast of Greenland. Other foraging areas in the North Atlantic include the waters off Iceland, north Norway and the islands of Bear and Jan Mayen (Christensen et al., 1992). During the summer, Humpback Whales from all six foraging areas migrate primarily to the Caribbean to breed and take care of their young. In the Caribbean, most of these whales are found in waters off the Dominican Republic, particularly in the Navidad and Silver banks, and in Samaná Bay. They also are present, but to a lesser degree, along the entire Antillean Arc, from Puerto Rico to Venezuela.

Most of the sightings of Humpback Whales in Puerto Rico have been along the north coast, notably the area around Rincón and the Mona Passage. Sightings are less frequent along the south coast, where the proposed Project would be located. According to Mignucci (1989),

Humpback Whales can be found occasionally in the Guayanilla-Peñuelas area. The occurrence of this species in the project area is probable.

3.6.18 Blue Whale

Neither the USFWS nor the DNER have listed the Blue Whale. The Blue Whale is distributed worldwide and occurs primarily in cold open waters. They mate and calve in tropical-to-temperate waters during winter months and feed in polar waters during summer months. Its distribution in the Western Atlantic generally extends from the Arctic to mid latitudes. They can be found near the coast, usually along the edges of the continental shelf. The Blue Whale is best considered as an occasional visitor in the US Atlantic EEZ waters, which probably represents the current southern limit of its feeding range. Little is known about the population size of Blue Whales. Pre-whaling numbers have been estimated at 200,000, and though exact figures are not known, an estimated 5,000 survive today in three populations: North Atlantic, North Pacific, and the Southern Hemisphere. Its presence in the Project area is probable, but unlikely, within its known range.

3.6.19 Finback Whale

Both the USFWS and the DNER classify *Balaenoptera physalus* as an endangered species. Finback whales are distributed worldwide, mostly in temperate waters in the Southern Hemisphere. It is a deepwater species commonly observed within the EEZ north of Cape Hatteras. They are found mostly offshore and tend to be very nomadic. The waters off New England represent an important forage area for this species. In Puerto Rico, Finback Whales have only been observed in deep waters. The occurrence of this species in the project area is probable, but unlikely within its known range. Between 1984 and 1988 the NMFS reported only three deaths of finbacks attributed to collisions with ships. As with other species of whales, Finback Whales populations have suffered from many years of hunting. The pre-hunting population has been estimated at about 30-50,000 in the North Atlantic Ocean. In 1977, the International Whaling Commission estimated only about 7,200 Finback Whales in Newfoundland and Nova Scotia.

3.6.20 Sei Whale

The USFWS considers this whale an endangered species, while the DNER had not listed it. Sei Whales are distributed worldwide in deep waters. They are found in the North Atlantic from Iceland south to the northeastern Venezuelan coast, and northwest to the Gulf of Mexico. There are also records from Cuba and the Virgin Islands. This species thrives around islands but rarely close to shore. Its worldwide distribution is estimated at 54,000 individuals. Although its population size within the North Atlantic EEZ is not known, it is believed that it may reach 3,000 in the Western North Atlantic (NMFS, 1998). No deaths or severe lesions to this species due to human actions, including collisions with ships, were reported between 1991 and 1997. The New England Aquarium documented a Sei Whale carcass hung on the bow of a container ship as it docked in Boston on November 17, 1994. The crew estimated that the whale hung from the bow for approximately four days prior to the ship's arrival into port. This species has not been reported for the study area. The occurrence of this species in the project area is probable, but unlikely within its known range.

3.6.21 Sperm Whale

Both the USFWS and the DNER classify this whale as an endangered species. This species has not been reported for the study area. Sperm Whales are found in all oceans of the world. The males, alone or in groups, are found in higher latitudes during the summer. In winter they

migrate toward lower latitudes, and only the physically mature appear to enter the breeding grounds close to the equator. Females, calves and juveniles remain in the warmer tropical waters of the Pacific, Atlantic and Indian Oceans. In the Caribbean, large and small adults, and calves and juveniles of different sizes have been reported (Watkins et al., 1985). The occurrence of this species in the project area is probable, but unlikely within its known range.

It is estimated that at one time there were two million Sperm Whales worldwide. Present population estimates are the subject of controversy, but most experts agree that there may be a minimum of 500,000.

3.6.22 Caribbean Monk Seal

Both the USFWS and the DNER classify the *Monachus tropicalis* as an endangered species. The Caribbean, or West Indian Monk Seal inhabited the Caribbean Sea, northwest to the Gulf of Mexico, as well as from the Bahamas to the Yucatán Peninsula, south along the coast of Central America and east to the northern Antilles. There have been no confirmed sightings since 1952. Since 1964 there have been several sightings by fishermen of a seal-like animal in Puerto Rican waters, along the north coast of Haiti and the Dominican Republic, and in the eastern Bahamas. The most recent of these sightings was in 1984. This has led some to believe that remnants of the original population still exist, although most scientists believe this is not the case. A 6,377 km aerial survey of the former range of this species in 1973 yielded no evidence of the presence of Caribbean Monk Seals, and similar searches, such as one conducted in the Gulf of Mexico and the Mexican Caribbean in 1984, have also proved unsuccessful. The occurrence of this species in the project area is unlikely.

Table 3-5: Threatened and Endangered Species Evaluated in the DEIS

Item	Species	Distribution	Probability of Occurrence in the Area	Status		Reported		Comments
				Federal	Locally	Guayanilla-Peñuelas	Ponce	
1	Loggerhead Sea Turtle (*Caretta caretta*)	Worldwide in tropical and temperate seas and oceans. Nests in Culebra.	Probable	Threatened	Threatened	No	No	
2	Green Sea Turtle (*Chelonia mydas*)	Worldwide in tropical and temperate sea and oceans. Generally found on shallow water. Nests in Puerto Rico and Culebra.	Likely	Threatened	Endangered	Yes. Have been reported for Guayanilla and Tallaboa Bays.	No	Nests in Mona and Caja de Muertos. Have been reported for Guayanilla and Tallaboa bays.
3	Hawksbill Sea Turtle (*Eretmochelys imbricata*)	Tropical seas. Nests on Mona.	Probable	Endangered	Endangered	Yes. Have been observed in Guayanilla and Tallaboa bays.	No	Nests in Mona and Caja de Muertos and Tamarindo beach. Have been observed in Guayanilla and Tallaboa bays.
4	Leatherback Sea Turtle (*Dermochelys coriacea*)	Tropical, temperate and sub polar. Nests in Culebra.	Probable	Endangered	Endangered	No	No	Nests in Culebra, Mona, Guánica, el Tuque and Ballena Bay.
5	Sei Whale (*Balaenoptera borealis*)	Worldwide in deep waters. Occurs around islands but in open waters.	Probable, but unlikely.	Endangered	Not Listed	No	No	Observed in Puerto Rico in deep waters.
6	Finback Whale (*Balaenoptera physalus*)	Worldwide in temperate waters and in southern hemisphere. Least common in the tropics.	Probable, but unlikely.	Endangered	Endangered	No	No	Observed in deep waters around Puerto Rico.

Item	Species	Distribution	Probability of Occurrence in the Area	Status		Reported		Comments
				Federal	Locally	Guayanilla-Peñuelas	Ponce	
7	Humpback Whale (*Megaptera novaeangliae*)	Widely distributed in all oceans. Inquisitive and shows little fear of boats. Mates and breeds in the Caribbean.	Probable	Endangered	Not Listed	Yes. Seen near Guayanilla and Tallaboa Bays.	No	Seen near Guayanilla and Tallaboa bays.
8	Sperm Whale (*Physeter macrocephlus*)	Wide oceanic distribution in offshore waters. May occur near continental shelves.	Probable, but unlikely.	Endangered	Endangered	No	No	Reported in the southeastern Caribbean.
9	Blue Whale (*Balaenoptera musculus*)	Worldwide distribution, primarily in cold waters and open seas. Found at edge of continental shelf and near polar ice caps.	Probable, but unlikely.	Endangered	Not Listed	No	No	Rare in Caribbean waters.
10	Brown Pelican (*Pelecanus occidentalis occidentalis*)	Bahamas, Greater and Lesser Antilles down to Monserrat. South coast of N. America, Central America and north part of S. America.*	Likely	Endangered	Endangered	Yes. Feeds in Guayanilla. Roost on Cayos María Langa and Palomas near the Project.	Yes. Was seen flying over the wharves area.	Feeds in Guayanilla. Roosts on Cayos María Langa y Palomas near the Project. Primary nesting area in Cayo Conejo, Vieques.
11	Least Tern (*Sterna antillarum*)	Local breeding resident in the Bahamas and Greater Antilles, Cayman Islands, St Martin, Antigua and Barbuda.*	Likely	Not listed	Threatened	Yes. Nests in the Project area.	No	Nests in the project area.

Item	Species	Distribution	Probability of Occurrence in the Area	Status		Reported		Comments
				Federal	Locally	Guayanilla-Peñuelas	Ponce	
12	White-cheeked Pinktail (*Anas bahamensis*)	Bahamas, Greater Antilles, Virgin Islands and northern Lesser Antilles from Anguilla to Antigua.*	Likely	Not listed	Critical Specie	Yes. Seen in the Project area.	No	Seen in the project area.
13	Roseate Tern (*Sterna dougallii*)	Tropical and temperate coasts of the Atlantic and East Africa.	Probable	Threatened	Threatened	Yes. Nests in the coastal cays near Guayanilla and Guánica.	No	Observed near project area.
14	Puerto Rican Nightjar (*Caprimulgus noctitherus*)	Endemic to Puerto Rico. Locally common only around Guánica Forest.	Unlikely, except near some quarries.	Endangered	Endangered	No. May be found in hills north of Guayanilla	No	Found around Guánica and Susúa forests. May be found in hills north of Guayanilla.
15	Yellow-shouldered Blackbird (*Agelaius xanthomus*)	Lower regions of Puerto Rico and Mona Island.	Possible within known range.	Endangered	Endangered	No. Uncommon in the project area but can occur in hills north of Guayanilla	No	Uncommon in the project area, but can occur in hills north of Guayanilla.
16	Manatee (*Trichechus manatus*)	Southeast coast of U.S., Caribbean Sea and south America.	Likely	Endangered	Endangered	Yes. Regularly observed in the Guayanilla and Tallaboa bays.	Yes	Frequent visitor to Guayanilla and Ponce bays.
17	Puerto Rican Crested Toad (*Peltophryne lemur*)	Arid or semi-arid rocky low lands of Puerto Rico. A stable population is found in the Guánica State Forest. A small population reported in Quebradillas	Unlikely	Threatened	Threatened	No	No	No reports of this species in the project area.
18	Vahl's boxwood (*Buxus vahlii*)	Central karst zones of Puerto Rico, northwest and south central mountains in Guayanilla y Peñuelas.	Unlikely, except near some quarries.	Endangered	Endangered	No. May occur in the hills north of Guayanilla	No	May occur in the hills north of Guayanilla.

Item	Species	Distribution	Probability of Occurrence in the Area	Status		Reported		Comments
				Federal	Locally	Guayanilla-Peñuelas	Ponce	
19	Palo de Rosa (*Ottoschulzia rhodoxylon*)	Puerto Rico and Dominican Republic.	Unlikely, except near some quarries.	Endangered	Endangered	No. May occur in the hills north of Guayanilla	No	Reported for Susúa, Maricao, and Río Abajo Forests. May occur in the hills north of Guayanilla.
20	Bariaco (*Trichilia triacantha*)	Southwest Puerto Rico.	Unlikely, except near some quarries.	Endangered	Endangered	No. May occur in the hills north of Guayanilla	No	May occur in the hills north of Guayanilla.
21	*Mitracarpus poycladus*	Sierra Bermeja in Cabo Rojo and Lajas. Guánica Forest.	Unlikely, except near some quarries.	Endangered	Endangered	No. May occur in the hills north of Guayanilla	No	May occur in the hills north of Guayanilla.
22	Caribbean Monk Seal (*Monachus tropicalis*)	Caribbean Sea, northwest to the Gulf of Mexico, as well as from the Bahamas to the Yucatán Peninsula, south along the coast of Central America and east to the northern Antilles.	Unlikely	Endangered (Extinct)	Endangered (Extinct)	No	No	There have been no confirmed sightings since 1952.

Source: CSA Group
Note: * Observed during field surveys (**Appendices H, I and J**).

3.6.23 Ecologically Sensitive Areas

The south coast of Puerto Rico, where the proposed PTA would be developed, contains numerous ecologically sensitive areas. These sensitive areas include coastal uplands, marshes and cays between Punta Verraco and Ponce Harbor, which would be subject to indirect and/or cumulative impacts resulting from additional port-promoted developments. High on this list of sensitive areas are Punta Verraco, and the hills north of state road PR-2 near Peñuelas, which are discussed first in the following paragraphs.

Federal and local conservation experts have recognized Punta Verraco as an area of high ecological value. Punta Verraco is a high headland with well-developed dry forest underlain by highly erodible soils. According to the USFWS, the point is fringed with red mangroves and has a basin mangrove forest in its western end. The density of seagrasses in Guayanilla Bay is higher and healthier around Punta Verraco (Plate Number 58 of the Environmental Sensitivity Atlas, NOAA, 2000). The area was slated for port development some time ago, but to date remains reasonably intact. An access road leading to the Point has partially cut off hydrology to the basing mangrove forest and has resulted in a mangrove die off. This site offers an excellent opportunity for mangrove restoration. Also, the federally listed Puerto Rican Nightjar, a ground nesting bird restricted to southwestern Puerto Rico, is known to occur in the Punta Verraco area.

Caves and sinkhole structures characterize the limestone hills north of Highway PR-2 near Peñuelas, also a known habitat of the Puerto Rican Nightjar. Since any fill for the Project would be obtained from operating quarries, there would not be any impact to this species.

According to the Environmental Sensitivity Index (Plate Number 58, 59 and 60) (NOAA, 2000) several sensitive coastal resources occur between Punta Verraco and Ponce Harbor, including sea grass beds, coral reefs, mangrove fringes, and marshes. As indicated before, Punta Verraco has been recognized as an area of high ecological value. Sea grass beds occur mainly adjacent to Punta Verraco and to several cays along the segment between Punta Verraco and Ponce Harbor, including:

- Cays located south of Tallaboa Bay, which include Cayo Paloma, Cayo María Langa and Cayo Caribe.
- Cays in the area of Punta Cucharas, which includes Cayo Arenas and Isla Ratones.

Several marshes occur along the aforementioned coastal segment. One of the most relevant one is a salt brackish water marsh in La Esperanza north of Punta Cabullones in Ponce. This wetland has an approximate area of 500 acres. Another important wetland area is located at an old shrimp farm east of Tallaboa Bay and Laguna Las Salinas just to the east of Punta Cuchara. The lagoon functions as a nursery area and its associated wetlands provide habitat for a variety of wading birds, shorebirds and other coastal avifauna. These wetland areas represent excellent opportunities for a wetland conservation easement.

The following cays occur in the coastal segment between Punta Gotay in the Guayanilla Bay and Punta Carenero in Ponce: Cayo Mata, in the Guayanilla Bay; Cayo Palomas, Cayo María Langa, Cayo Río, Cayo Caribe and Cayo Parguera in the Tallaboa Bay and Cayo Arenas, Isla de Ratones and Isla de Cardona to the South-Southeast of Punta Cucharas.

Mangrove fringes and coral reefs occur along the coast of the majority of the aforementioned cays (Plates Number 58, 59 and 60 of the Environmental Sensitivity Atlas, NOAA, 2000). Other

relevant coral reefs are: Unitas, Guayanilla and Fanduco, southeast of Punta Verraco and Las Hojitas in the Ponce Bay area.

3.7 Wetlands

Wetlands are defined as those areas that are flooded or saturated with surface or underground water at a frequency and duration enough to sustain, and in normal circumstances, maintain a prevailing typical vegetation adapted to living in saturated soil conditions (USACE, 1987b). In general, an area must meet three criteria to be regulated under Section 404 of the Clean Water Act of 1977: hydrophitic vegetation, hydric soils, and wetland hydrology (Clean Water Act, 1969).

From April 16 to April 27, 2001, an investigation was completed to identify the wetland limits in the proposed premises (Appendices P and Q). Preliminary wetland delineation was approved by the USACE on December 18, 2001.

3.7.1 Guayanilla-Peñuelas Area

The Guayanilla-Peñuelas study area consists of approximately 764 acres. The limits of this area are: Road PR-127 to the north, Río Tallaboa to the east, Tallaboa Bay to the south, and Guayanilla Bay to the west. This area is characterized by the presence of an industrial type infrastructure, according to Section 3.2.2, Land Uses.

The area with more vegetation within the Project is located to the west of the Río Tallaboa. The most important hydrographic characteristics within the study area are the Caribbean Sea, and the Río Tallaboa. In addition, there are some channels that flow from north to south in the Project area adjacent to the Río Tallaboa. Some of these channels have small bridges, pipelines, and other structures crossing the channels from east to west.

The NWI (Figure 3-25) identifies nine different types of wetlands. Table 3-6 includes these classifications. Based on the wetlands jurisdictional studies, approximately 93 acres of jurisdictional wetlands were preliminarily identified within the Guayanilla-Peñuelas study area. However, some of this acreage could be later classified by the USACE as non-jurisdictional wetlands, due to their prior use as basins to contain dredged material.

Table 3-6: Wetlands Classifications in the Study Area in Guayanilla-Peñuelas

Wetlands Classification	Description
E1AB3/UBL	Estuarine, sub tidal, aquatic bed, rooted vascular /unconsolidated bottom, sub tidal
E1RF1/AB3L	Estuarine, sub tidal, reef, coral/aquatic bottom, rooted vascular, sub tidal
E1UBL	Estuarine, sub tidal, unconsolidated bottom, sub tidal
E2EM1P	Estuarine, intertidal, emergent, persistent, irregularly flooded
E2FO3N	Estuarine, intertidal, forested, broad-leave evergreen, regularly flooded
E2FO3P	Estuarine, intertidal, forested, broad-leaved evergreen, regularly flooded
E2SS3/UBL	Estuarine, intertidal, low-height bushes, broad-leaved evergreen/ unconsolidated shore, sub tidal
E2US2/3P	Estuarine, intertidal, unconsolidated shore, sand/mud, irregularly flooded, spoiled
PUBHx	Palustrine, unconsolidated bottom, flooded, permanently excavated

Source: National Wetland Inventory, US Fish and Wildlife Service.

With regards to the NWI Assessment, the preliminary JD performed in the Guayanilla-Peñuelas project area identified the following existing conditions:

- E1AB3/UBL – This type of wetland was found outside the study area. It generally corresponds to permanent submerged wetlands outside the coastal area and within the sea.
- E1RF1/AB3L – This type of wetland was found outside the study area. It generally corresponds to permanent submerged wetlands outside the coastal area and within the sea.
- E1UBL - This type of wetland was found outside the study area. It generally corresponds to permanent submerged wetlands outside the coastal area and within the sea.

- E2EM1P – The area occupied by this type of wetland within the JD is smaller than in the NWI.
- E2FO3N – The area occupied by this type of wetland within the JD is the same as in the NWI.
- E2FO3P – The area occupied by this type of wetland within the JD is larger than in the NWI.
- E2SS3/UBL – The area occupied by this type of wetland within the JD is smaller than in the NWI.
- E2US2/3P - The area occupied by this type of wetland within the JD is larger than in the NWI.
- PUBHx – This type of wetland should be classified in the NWI as PUBWx. The area it occupies within the JD is the same as in the NWI.

Different types of wetlands were identified within the Guayanilla-Peñuelas study area (Figure 3-26). However, most of them may be classified as estuarine due to the brackish characteristics of the system. The most common wetland systems are the mangroves and the related salt flats. The fringe mangroves are well established throughout the coast of the study area. This system is also present in the Río Tallaboa's mouth.

In a forest to the west of the Río Tallaboa, an intermittent brook and a channel system were noted. The brook is channeled to the north of Road PR-127, crossing the study area where it changes to a dirt channel that flows towards the south until it encounters the Río Tallaboa. Palustrine wetlands have developed in these channels because they are not in use. The channels are interconnected and flow towards the south until they connect with the Río Tallaboa.

The prevailing vegetation in the wetlands identified within the study area is presented in Table 3-7. These species are commonly found in estuarine wetlands subject to the tides.

Table 3-7: Prevailing Vegetation in the Wetlands

Scientific Name	Common Name
Leucaena leucocephala	Wild tamarind
Chloris inflata	Swollen fingergrass
Andira inermis	Angeline tree
Cyperus odoratus	----------
Sporobolus virginicus	Seashore rushgrass
Sesuvium portulacastrum	Sea Purslane
Batis marítima	Saltwort
Avicennia germinans	Black mangrove
Rhizophora mangle	Red mangrove
Lancularia racemosa	White mangrove

Source: Wetland Jurisdictional Determination, **Appendix P.**

3.7.2 Ponce Area

The study area in the Municipality of Ponce includes approximately 321 acres. The limits of this study area are as follows: PR-52 to the north, PR-14 to the east, Punta Peñoncillo and the Ponce Bay to the south, and the Port of Ponce and PR-10 to the west. Río Bucaná and Río Portugués are at distances of approximately 1.0 and 0.4 kilometers from the study area by its east and west limits, respectively. The existing infrastructure of the Port of Ponce occupies a significant portion of the south end of the Project's area proposed in Ponce. At this point, it is not expected that the development of this port would require partial or complete filling of some of the wetlands located within the Project's area.

Based on the studies, there are approximately 60 acres of jurisdictional wetlands within the study area in Ponce. The NWI (Figure 3-27), identifies five different wetland types. Table 3-8 includes these classifications.

Table 3-8: Wetlands Classifications within the Study Area in Ponce

Wetlands Classifications	Description
E2EM1P	Estuarine, intertidal, emergent, persistent, irregularly flooded
E2FO3M	Estuarine, intertidal, forested, broad-leaved evergreen, irregularly exposed
E2FO3P	Estuarine, intertidal, forested, broad-leaved evergreen, irregularly flooded
E2US2/3P	Estuarine, intertidal, unconsolidated shore, sand/mud irregularly flooded
E2US3M	Estuarine, intertidal, unconsolidated shore, mud, irregularly exposed

Source: National Wetland Inventory, US Fish and Wildlife Service

With regards to the NWI Assessment, the preliminary JD performed in the Ponce project area identified the following existing conditions:

- E2EM1P - The area occupied by this type of wetland within the JD is larger than in the NWI.
- E2FO3M – The location of this type of wetland within the JD is different than in the NWI. In the NWI they are identified as E2FO3P and occupy a smaller area than in the JD.
- E2FO3P – The area occupied by this type of wetland within the JD is smaller than in the NWI.
- E2US2/3P – This type of wetland was not found within the JD.
- E2US3M - This type of wetland was not found within the JD.

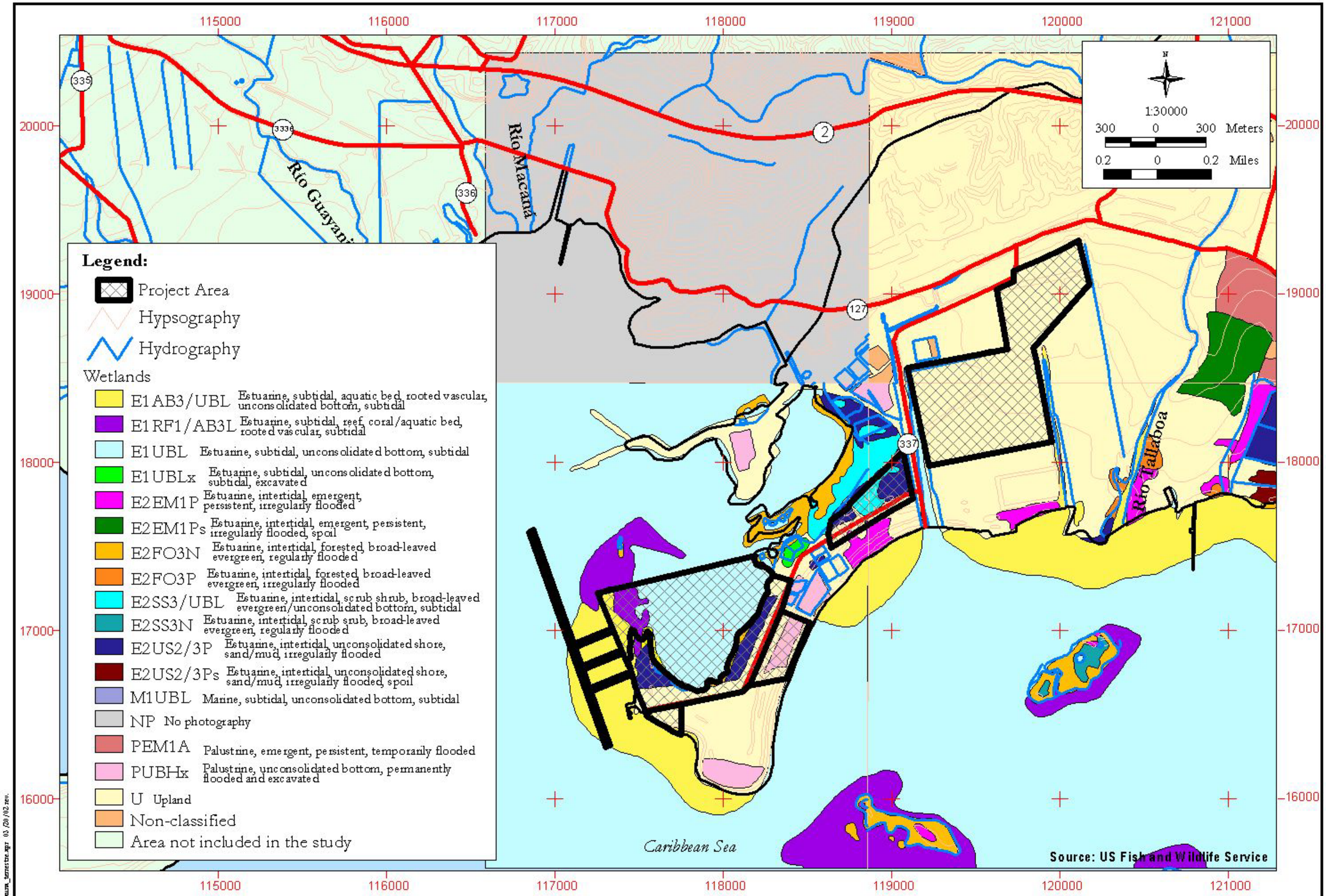
The findings of this preliminary JD are summarized in Figure 3-28.

The prevailing vegetation in the wetlands identified within the study area is shown in Table 3-9. These species were in almost all of the delineated wetlands within the study area.

Table 3-9: Predominant Vegetation in Wetlands

Scientific Name	Common Name
Batis maritima	Saltwort
Sesuvium portulacastrum	Sea Purslane
Sporobolus virginicus	Sea-shore rush grass
Avicennia germinans	Black mangrove

Source: Wetland Jurisdictional Determination, Appendix Q



Coordinates in State Plane NAD 27

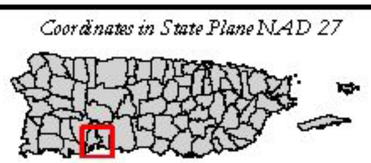


Figure 3-25 National Wetland Inventory Map: Guayanilla-Peñuelas Area

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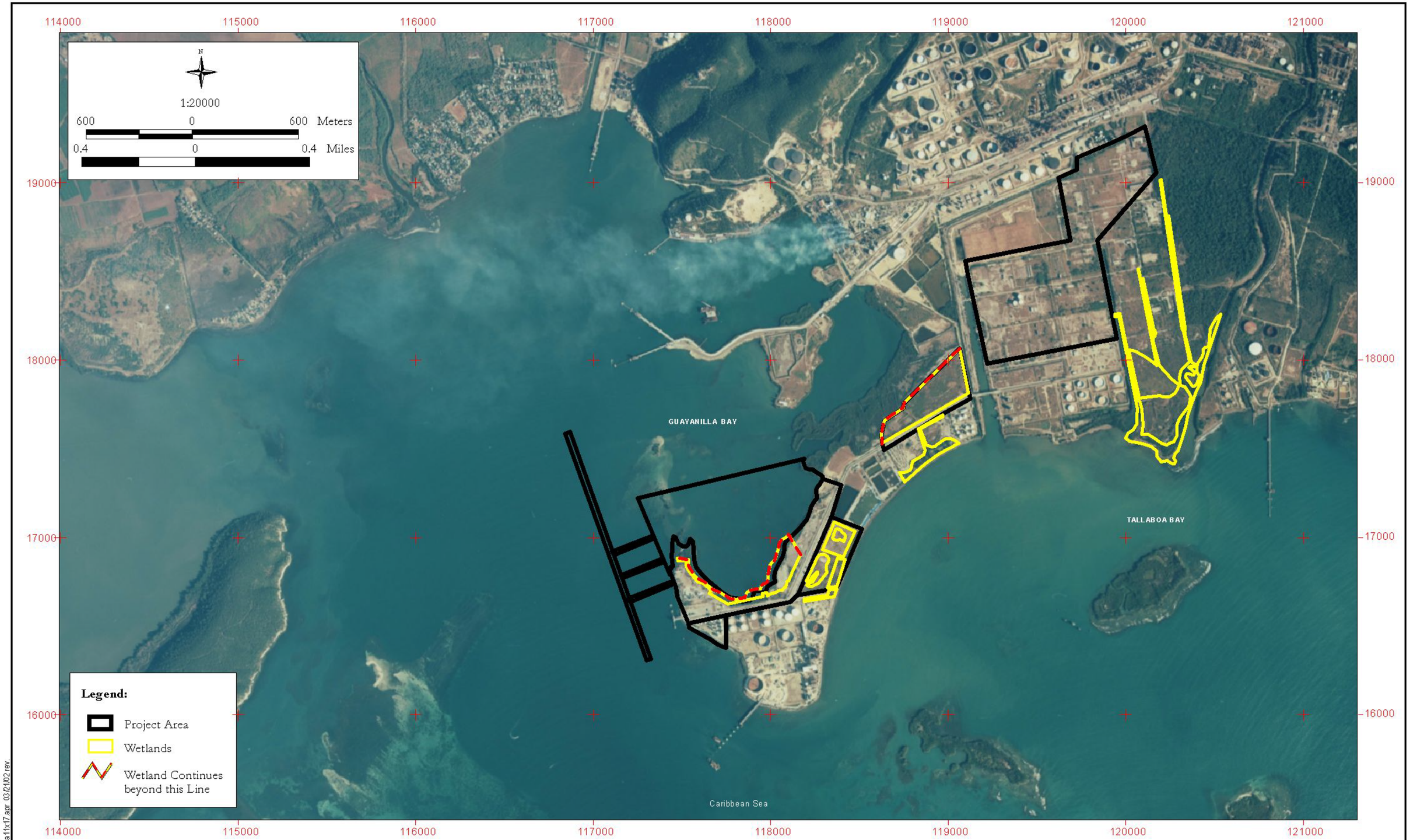

Coordinates in State Plane NAD 27

Figure 3-26 Jurisdictional Wetland Delineation Map: Guayanilla-Peñuelas Area

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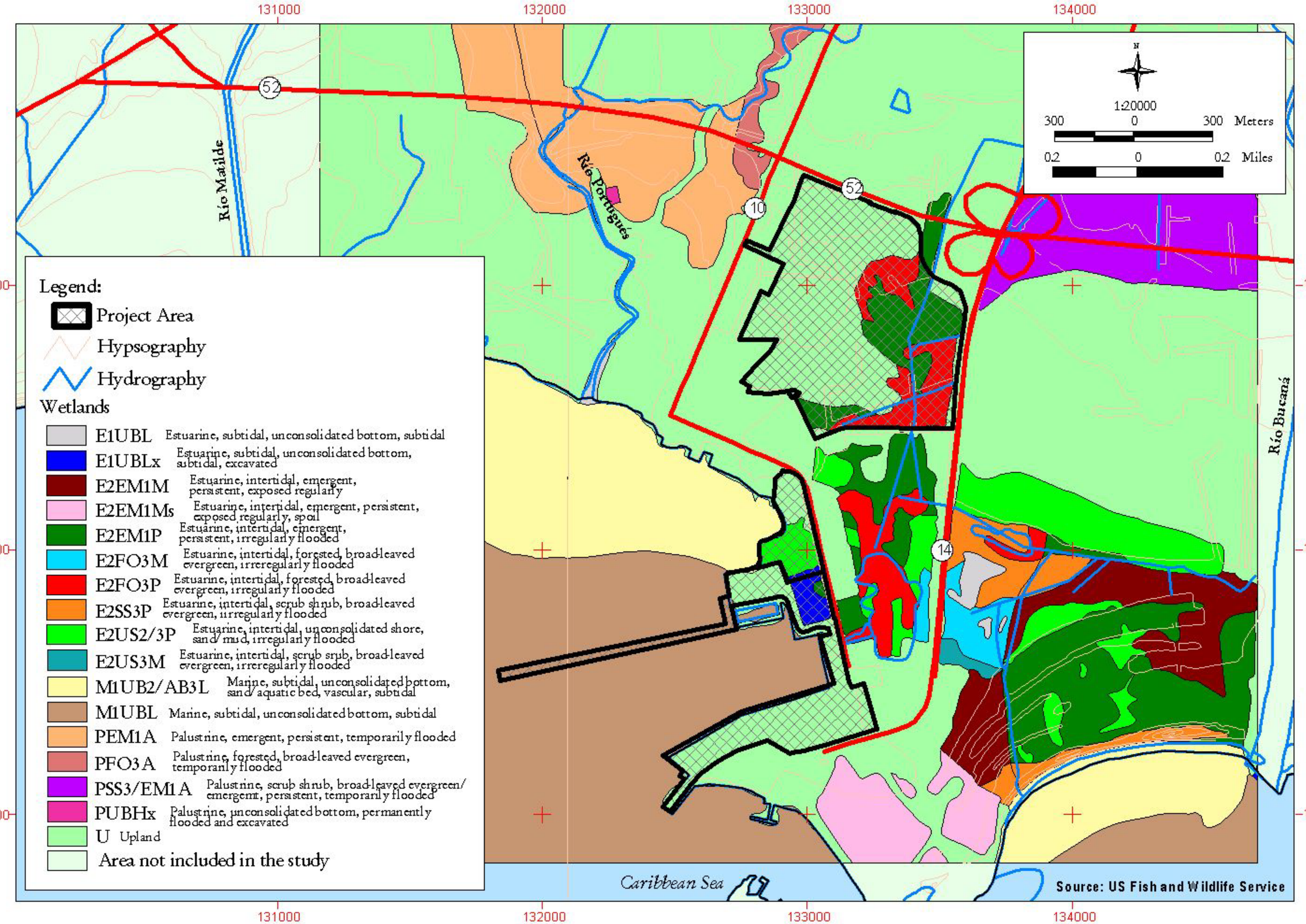

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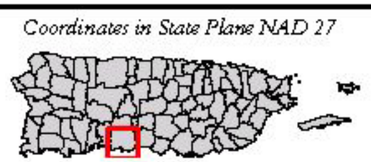

Figure 3-27 National Wetland Inventory Map: Ponce Area

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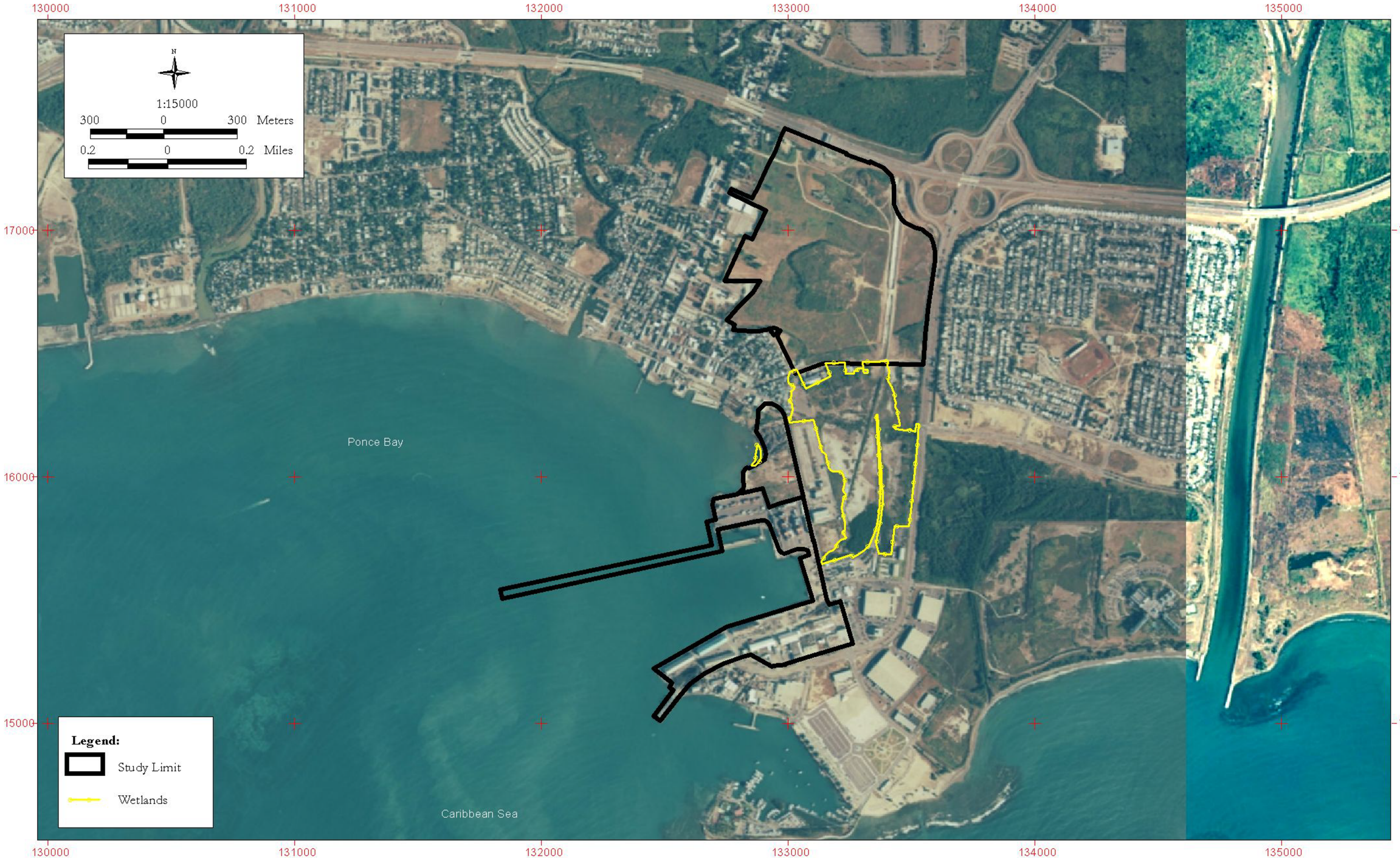

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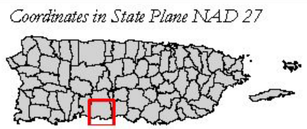

Figure 3-28 Jurisdictional Wetland Delineation Map: Ponce Area

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3.8 Coastal Zone

In response to the intense pressures for development in the coastal zone, and its importance of the welfare of the United States, Congress passed in 1972 the Coastal Zone Management Act (CZMA). The Act affirms a national interest in the effective protection and development of the coastal zone by providing assistance and encouragement to coastal states and territories to develop and implement regional programs for managing their coastal zones. The purpose of the CZMA was to establish a national policy and develop a national program for the management, beneficial use, protection and development of the land and water resources of the Nation's coastal zone. The Puerto Rico Coastal Zone Management Program (PRCZMP) was approved in September 1978.

The term "federal consistency" refers to the requirement in Section 307(c) of the CMZA that identifies several types of federal actions that must be consistent with the approved Coastal Zone Management Program. In Puerto Rico, the Planning Board is the agency designated to administer federal consistency procedures.

All federal projects to be carried out in the coastal zone are subject to consistency review. The Act also requires that any non-federal applicant for a federal license or permit to furnish a consistency certification that the proposed activity would comply with the local coastal zone management program. Generally, no permit will be issued until the Planning board has concurred with the non-federal applicant's certification.

In 1981, the U.S. Flood Insurance Act of 1968 (Public Law 90-448) was amended by the U. S. Congress to forbid issuing new federal flood insurance in favor of new construction or substantial improvements to structures located in areas designated as "undeveloped coastal barriers". The purpose of this Law was the elimination of federal incentives for developments in these coastal areas, with the purpose of avoiding the loss of life and property, minimizing federal expenses, and protecting fish and wildlife habitats.

In addition to the limitation of flood insurance, the Act also prohibited federal disbursements and economic aid for activities or projects that promote their development. The legislation ordered the Secretary of the Interior to designate coastal barriers as per their definition in the Act and to submit recommendations to add other areas. Coastal barriers are coastal landscape formations, which protect the coast against the wind, waves and tides. Following the Secretary's recommendations, in the fall of 1982 Congress approved the Coastal Barriers Resources Act (CBRA Public Law 97-384).

The act established a Coastal Barriers Resources System, which originally included 186 units, representing 666 miles of coastline and 452,834 acres of unprotected and undeveloped land in the Atlantic Coasts and the Gulf of Mexico. Later, the System was expanded and new sites have been added to it. At present, the system has 585 units in 1,200 coastline miles with an extension of approximately 1.3 million acres of unprotected and undeveloped land.

The Coastal Barriers Resources System includes 41 units in Puerto Rico. The local units are somewhat different from the sandy coastal barriers that are usually found in the east coast and in the Continental United States part of the Gulf of Mexico. Along the Island's north coast, a line of cemented sand dunes that runs parallel to the coast mainly defines coastal barriers. In other areas, cemented sand deposits present in layers along the beaches define barriers. Fringe mangroves represent another type of coastal barrier. In tropical and semitropical regions, fringe mangroves and their associated coral reefs are considered coastal barriers because the

protection they offer to inland aquatic systems is similar to the protection offered by coastal sand barriers in the continent.

There are no Coastal Barriers Resources System units in the project area. The units nearest to the Project are Punta Cabullones (PR-56), Punta Cucharas (PR-57) and Punta Ballena (PR-59). None of these units would be affected by the proposed Project.

3.9 Flood Areas

3.9.1 Guayanilla-Peñuelas Area

The site proposed for the development of the Guayanilla-Peñuelas Project element is located to the Southeast of the mouth of Río Guayanilla, Río Macaná (in the Municipality of Guayanilla) and Río Tallaboa (in the Municipality of Peñuelas). The Río Guayanilla Basin is located to the north of the Guayanilla-Peñuelas Project site. The total drainage area for this basin is approximately 80.6 square kilometers (31 square miles). Most of the town of Guayanilla is located in the Río Guayanilla flood plain.

- The oldest flood events in the Guayanilla Basin for which records area available occurred on 1876 and 1886. One of the most severe flood events on record occurred on August 8, 1899 with elevations of 22 feet above sea level and a recurrence interval of approximately 70 years. Large-scale flood events were registered during 1926, 1928 (recurrence interval of approximately 22 years), 1932 (recurrence interval of approximately 32 years) and 1954 (recurrence interval of approximately 16 years), among others. It is important to notice that the rapid urbanization of the areas surrounding the river could be responsible for some of the changes in the base of the floods and the river's drainage patterns (USGS, 1971).

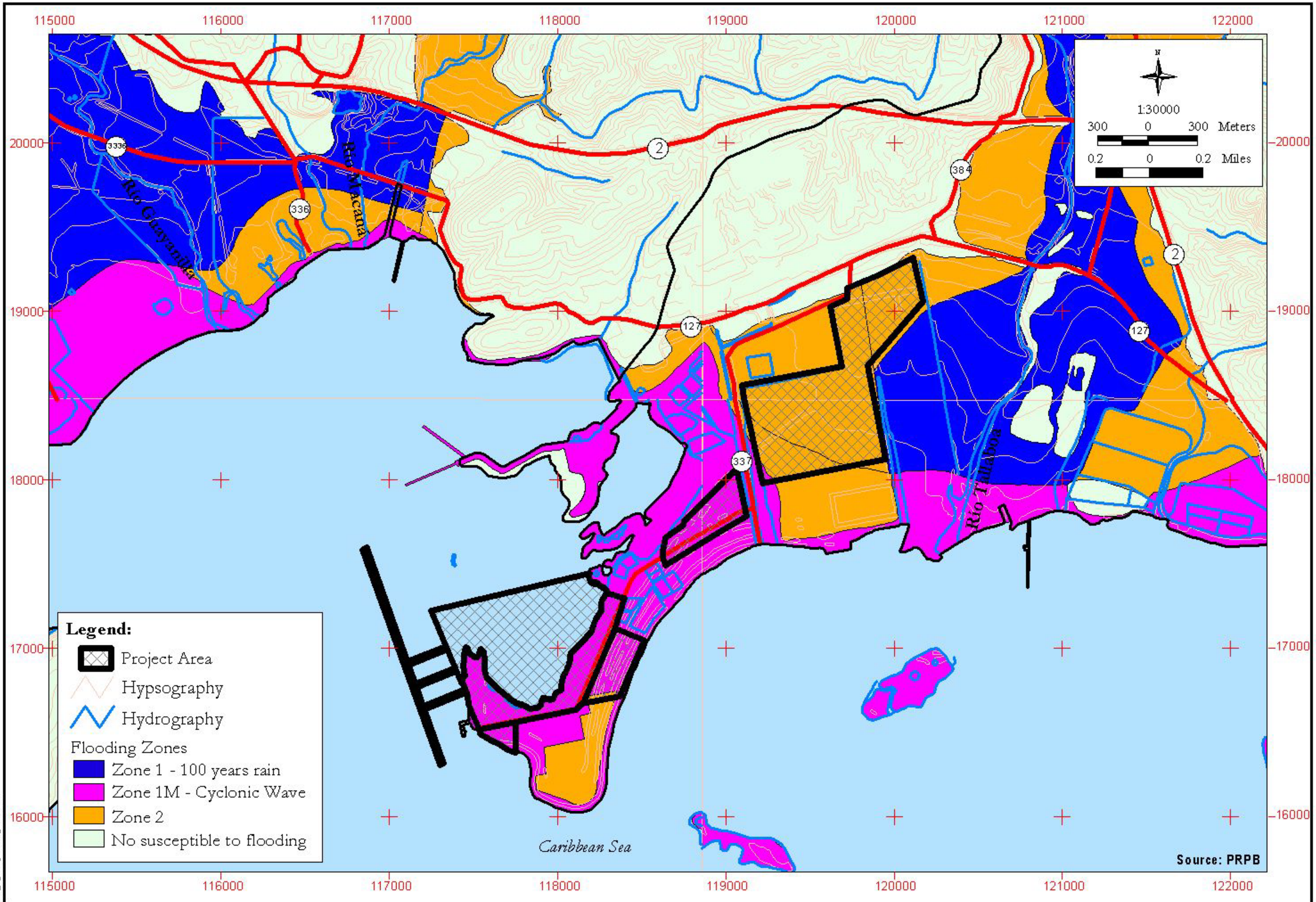
- Río Tallaboa is located to the northeast of the Guayanilla-Peñuelas site. The drainage area at the mouth of the river is 80.6 square kilometers (31 square miles), relatively small compared to other rivers in Puerto Rico. Sugarcane production was the main crop in the Río Tallaboa Valley up to the 1950's. The upper portion of the valley is still dedicated to agriculture, mainly for raising cattle. The lower portion of the valley, from the bridge at PR-2 up to the mouth of the river is occupied by heavy industries. The constant industrial growth has driven the urban growth to the flood plain (USGS, 1981).

Proposed Guayanilla-Peñuelas Site: According to the flood maps from the Puerto Rico Planning Board (Figure 3-29), the site proposed for the new dock in the Guayanilla Bay is located within an area classified as Zone 1M. The sites proposed for the value-added industries are classified as Zone 2, Zone 1M and Zone 1 (the limit of the area to be acquired). This classification includes the Río Tallaboa floodway area, adjacent to the proposed Project limit. The PB defined Zone 1 with the purpose of avoiding the establishment of new barriers once the limits are established. It is important to note that the portion of the site located within Zone 1 is mostly a wetland area. The Project would not impact this wetland area.

- According to the Flood Insurance Rate Maps (720000 0215 D, 720000 0275 F, 720000 0218 C, y 720000 0276 D), the Project site located at Punta Gotay (site where submarine land would be reclaimed by fill) is classified as VE. The site located at Punta Guayanilla is mostly located in areas classified as VE, except a small portion that is classified as AE (**Figure 3-30**). The sites where the value-

added areas would be located are classified as AE, except a small portion to the West of Río Tallaboa, which is classified as VE. Zone AE represents flood areas with a recurrence period of 100 years, determined by specific methods. Zone AE is equivalent to the Zone 2 classification established by the PB. The Zone VE is equivalent to coast flood susceptible areas with recurrence period of 100 years, and subject to the action of the ocean swell.

Figure 3-31 shows the worst-case scenario of hurricane storm tide floods at Ponce (USACE, FEMA, 1992). The information therein contained should be used in connection with risks for emergency management and evacuation purposes only, and not as a basis for permitting. The FEMA FIRM and Planning Board floods maps must be used for the latter purpose.



Coordinates in State Plane NAD 27

Figure 3-29 Hydrography and Zones Susceptible To Flooding (PB): Guayanilla-Peñuelas Area

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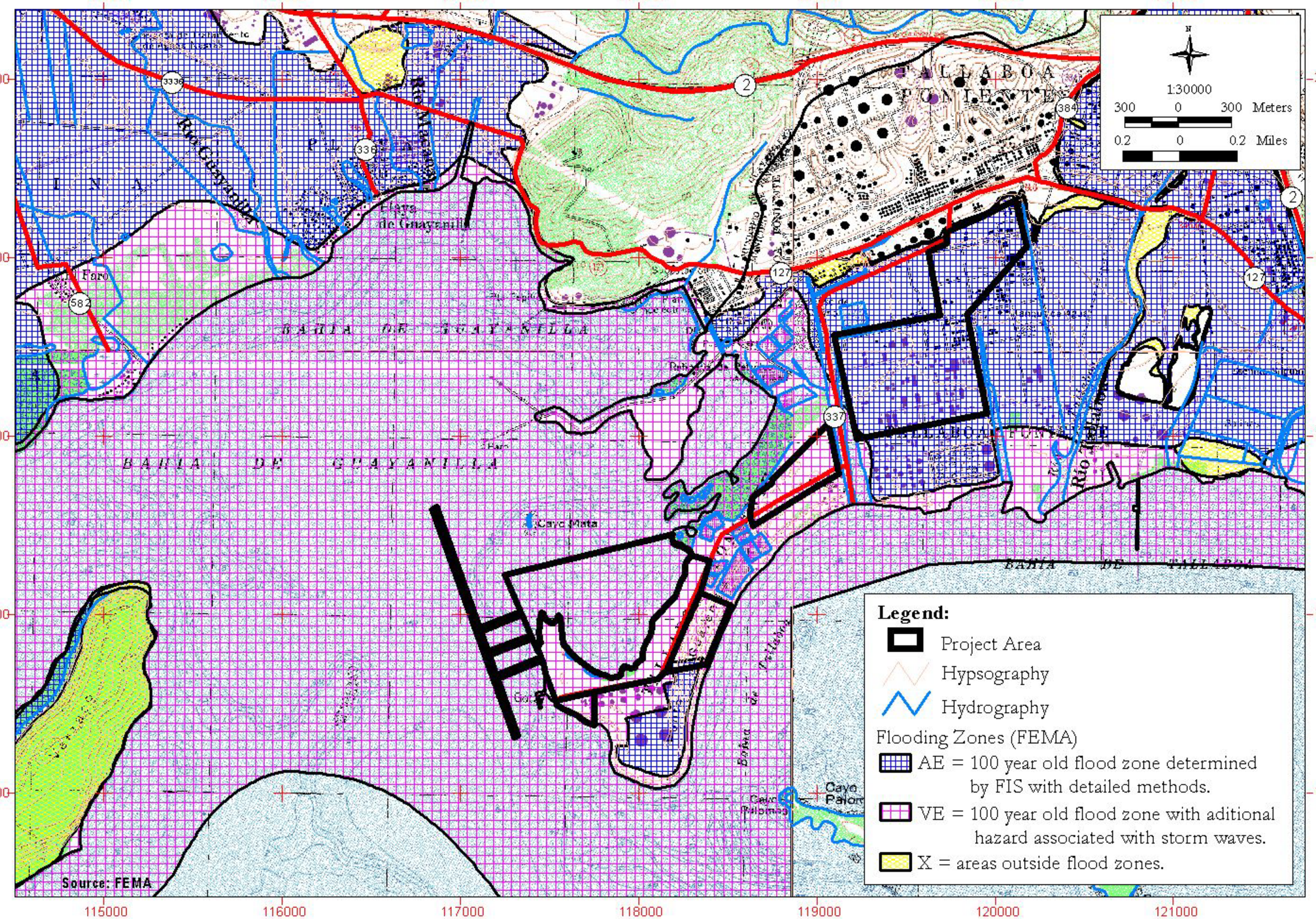

Coordinates in State Plane NAD 27

Figure 3-30 Hydrography and Zones Susceptible To Flooding (FEMA): Guayanilla-Peñuelas Area

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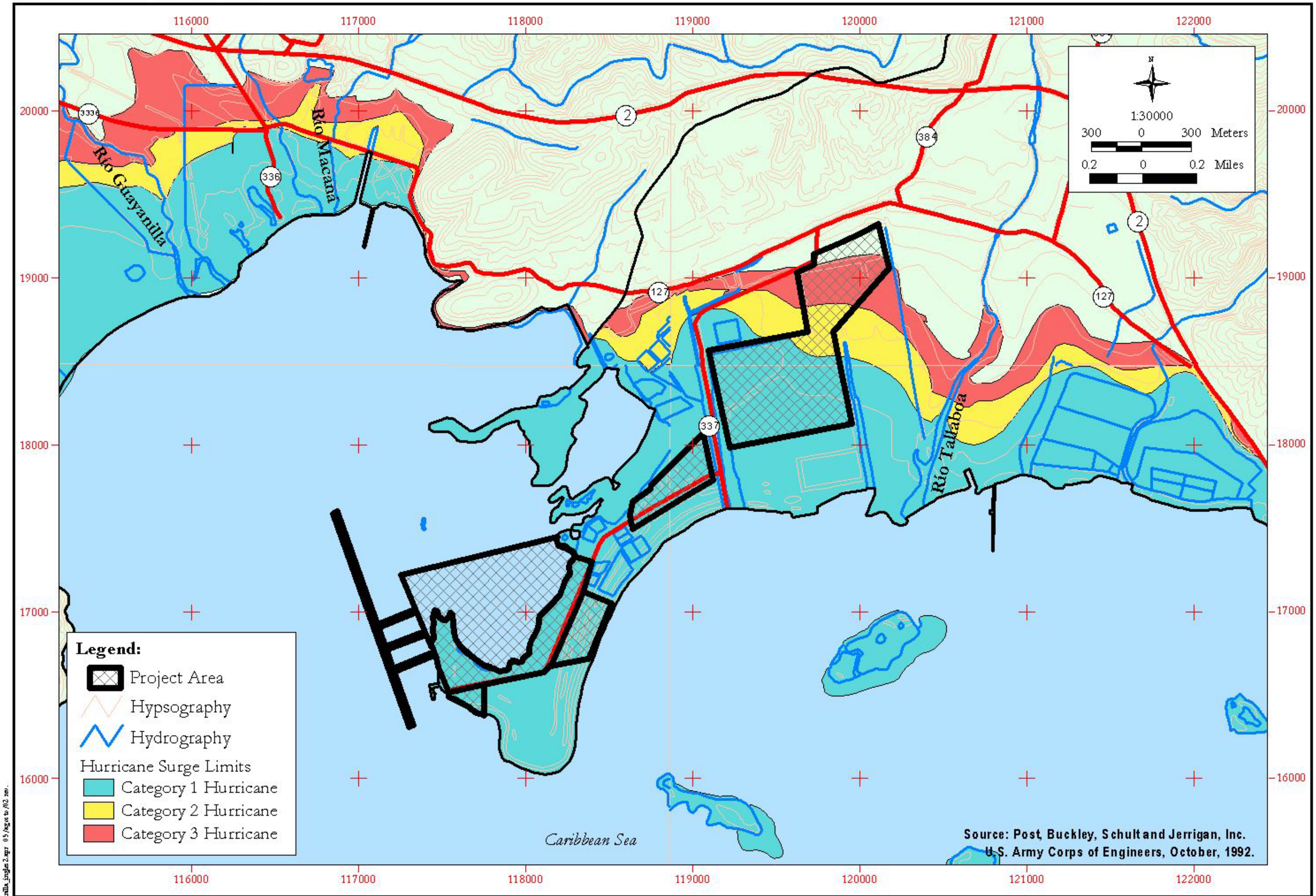

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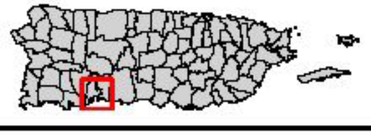

Figure 3-31 Category 1, 3, 5 Hurricane Surge Limits: Guayanilla-Peñuelas Area

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3.9.2 Ponce Area

Historical floods in Ponce have occurred due the overflow of the three (3) main rivers in the area: Río Bucaná, Río Portugués and Río Matilde (USGS, 1967). Río Bucaná and Río Portugués are the rivers closest to the project site. The rivers and currents that cause floods at the Ponce area originate at the southern slopes of the Cordillera Central.

Río Bucaná is located at the east of the project area and has a drainage area of 27.3 square miles at the PR-1 intersection. Río Portugués, at the west of Río Bucaná, has a drainage area of 18.6 square miles at the PR-14 intersection. Río Cañas has a drainage area of 8.6 square miles as the intersection with Río Pastillo, which has a drainage area of 10.7 square miles, and feeds into Río Matilde. Before 1964, the roads at the area were located near the flooding level of Río Cañas, Río Pastillo and Río Matilde valleys, which served as obstacles to floods. In 1964 construction for PR-2 disturbed the Río Matilde Valley, which is higher than the valley elevation. This caused changes to the magnitude of the flood events in the valley.

Although flood records are compiled since 1852, the flood that occurred on August 8, 1899 was the first one for which water levels was recorded. During this flood, the water level at the streets near the Plaza Degetau, the economic center of Ponce Town, reached heights of 1 to 2 meters. Other important floods in the area were the floods of 1954 during which the water levels overflowed the banks of Río Bucaná to the northeast of Ponce. The water flowed toward the southeast and entered Río Portugués upstream of PR-183. The 1958 event flooded approximately 10 square miles of residential, industrial, commercial and agricultural areas to the west of town. Since the basins of these rivers are close to each other, is highly probable that a flood event on all the rivers can occur at the same time, although the relative magnitude of the flood at each river could be different.

Proposed Site at Ponce: According to the PB Flood Map for the Bucaná River (Figure 3-32), a small portion of the parcel selected for the PTA in Ponce and that corresponds to the pier area, is classified as Zone 1M, or storm surge zone (Puerto Rico Planning Board and FEMA, 1999). The portion of the parcel where value-added activities would be located has been classified as Zone 2. This type of classification includes the land prone to base flooding located between the limits of Zone 1 and the external limits of the floodplain, in this case between the Río Bucaná and Río Portugués. Zone 2 is established based on detailed studies of the area and allows the construction of new developments with the requirement that these new projects have to implement protective measures against floods.

On the other hand, according to the *Flood Insurance Rate Map* (FIRM) published by FEMA, the area where the existing pier is located, and where the proposed improvements are scheduled, is mostly classified as Zone A, with a small portion classified as Zone VE and Zone C (Figure 3-33, FIRM, panel 7200000281B, July 19, 1982). Zone A includes areas prone to floods with a 100-year recurrence, and is determined by approximation. Zone C includes those areas with minimal flooding located outside the flood limits with a recurrence period of 500 years. The parcels where it has been proposed to develop the value-added operations are located in an area classified as Zone A.

Figure 3-34 shows the worst-case scenario of hurricane storm tide floods at Ponce (USACE, FEMA, 1992). It should be noted that the information therein contained should be used in connection with risks for emergency management and evacuation purposes only, and not as a basis for permitting. The FEMA FIRM and Planning Board floods maps must be used for the latter purpose.

It is important to point out that the Río Bucaná and Río Portugués flood-control projects have changed substantially the flood patterns at the proposed site. For example, during Hurricane Georges on September 21, 1998, the Río Bucaná and Río Portugués basins received a combined 27 inches of precipitation. Preliminary estimates made by FEMA (FEMA Information on Federally Declared Disasters, updated March 4, 1999) indicate that potential damages totaling an estimated $100 million were avoided thanks to these flood control projects. The majority of the losses caused by Hurricane Georges were prevented by the successful operation of the Cerrillo's Dam and the Bucaná and Portugués channels. Levels at the Cerrillo's Reservoir increased 30 feet in 15 hours. It is estimated that, without the Cerrillo's Dam and the flood-control channels at the Río Bucaná and Río Portugués, flood levels would have reached 4.5 feet in downtown Ponce.

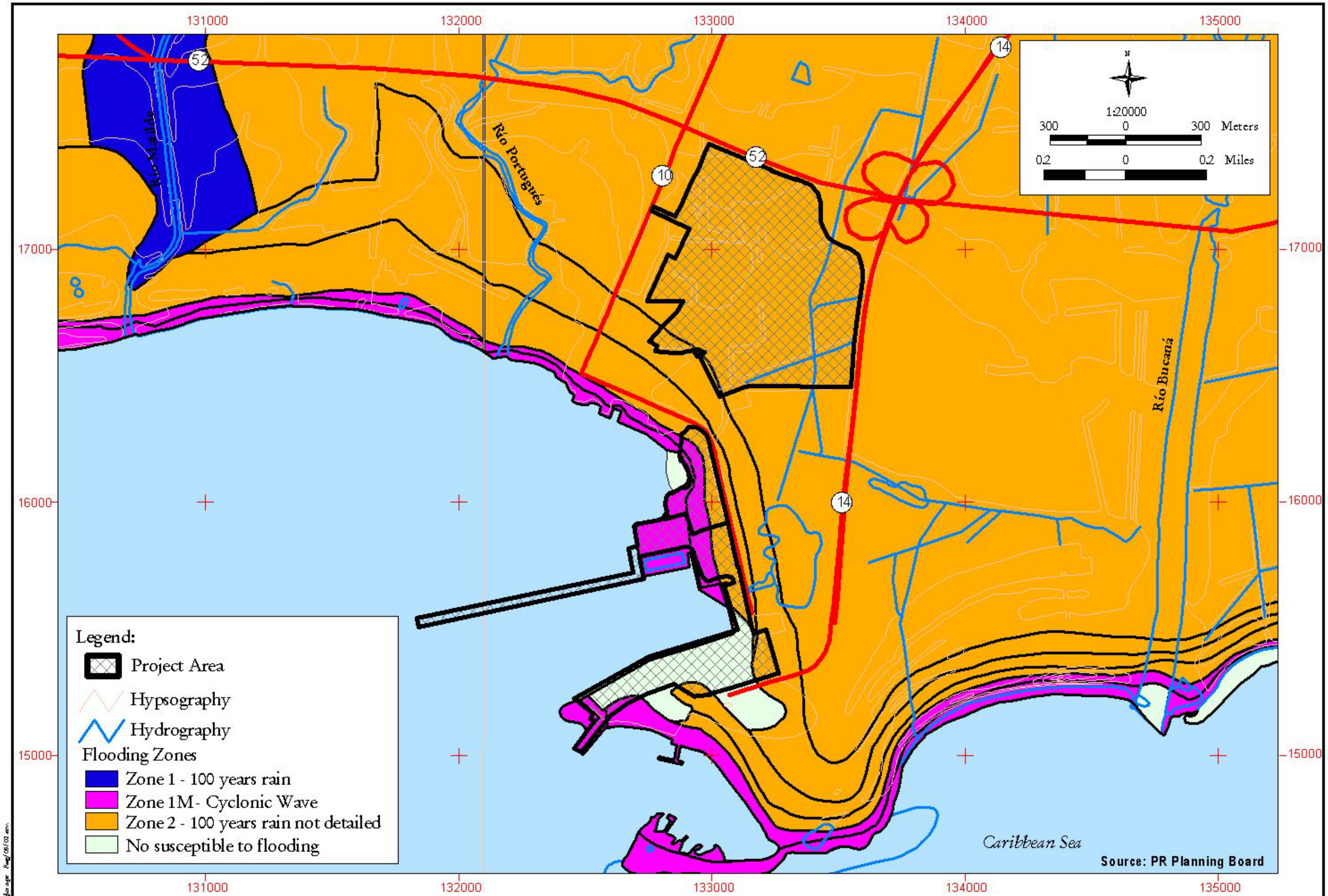

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Figure 3-32 Hydrography and Zones Susceptible to Flooding (PB): Ponce Area

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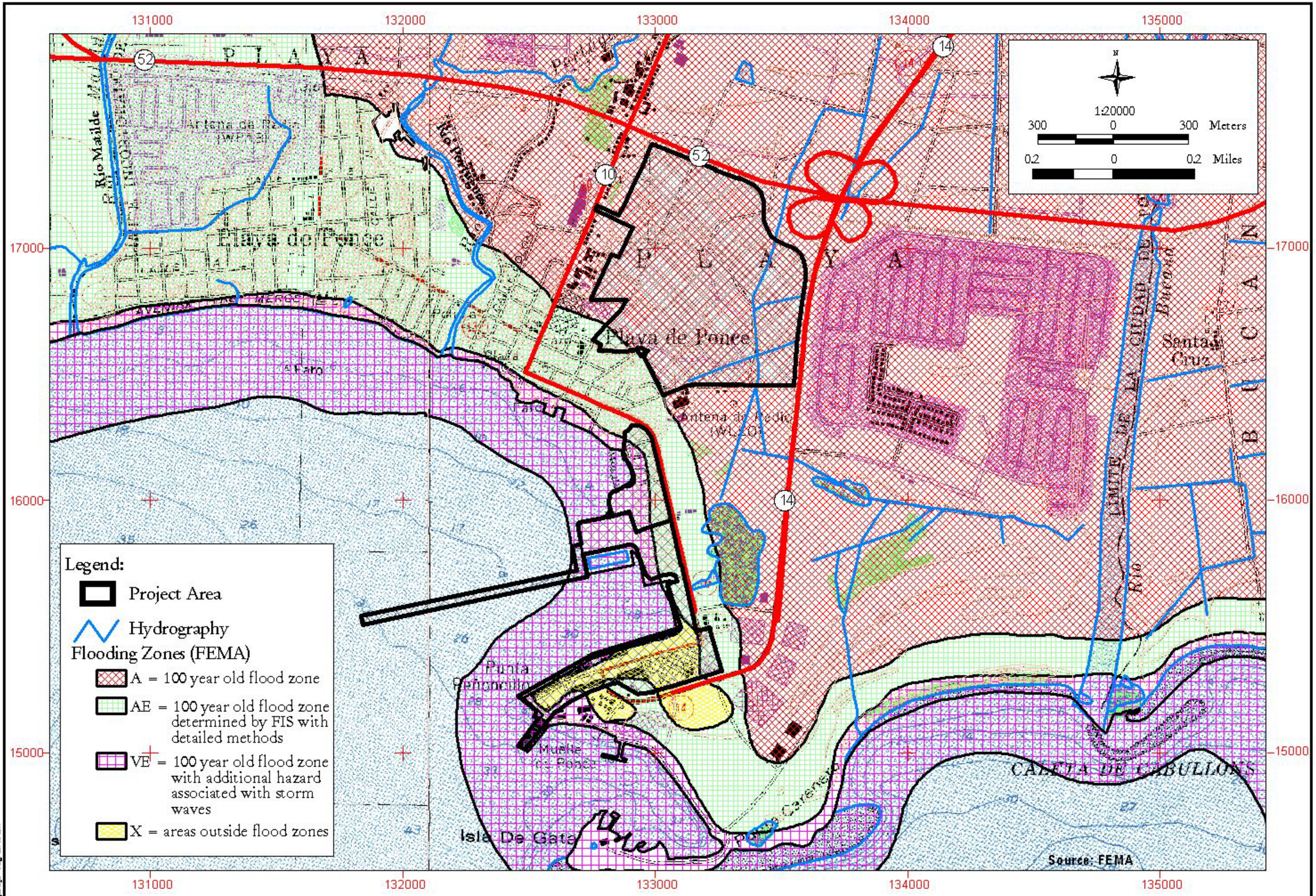

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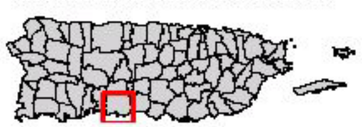

Figure 3-33 Hydrography and Zones Susceptible to Flooding (FEMA): Ponce Area

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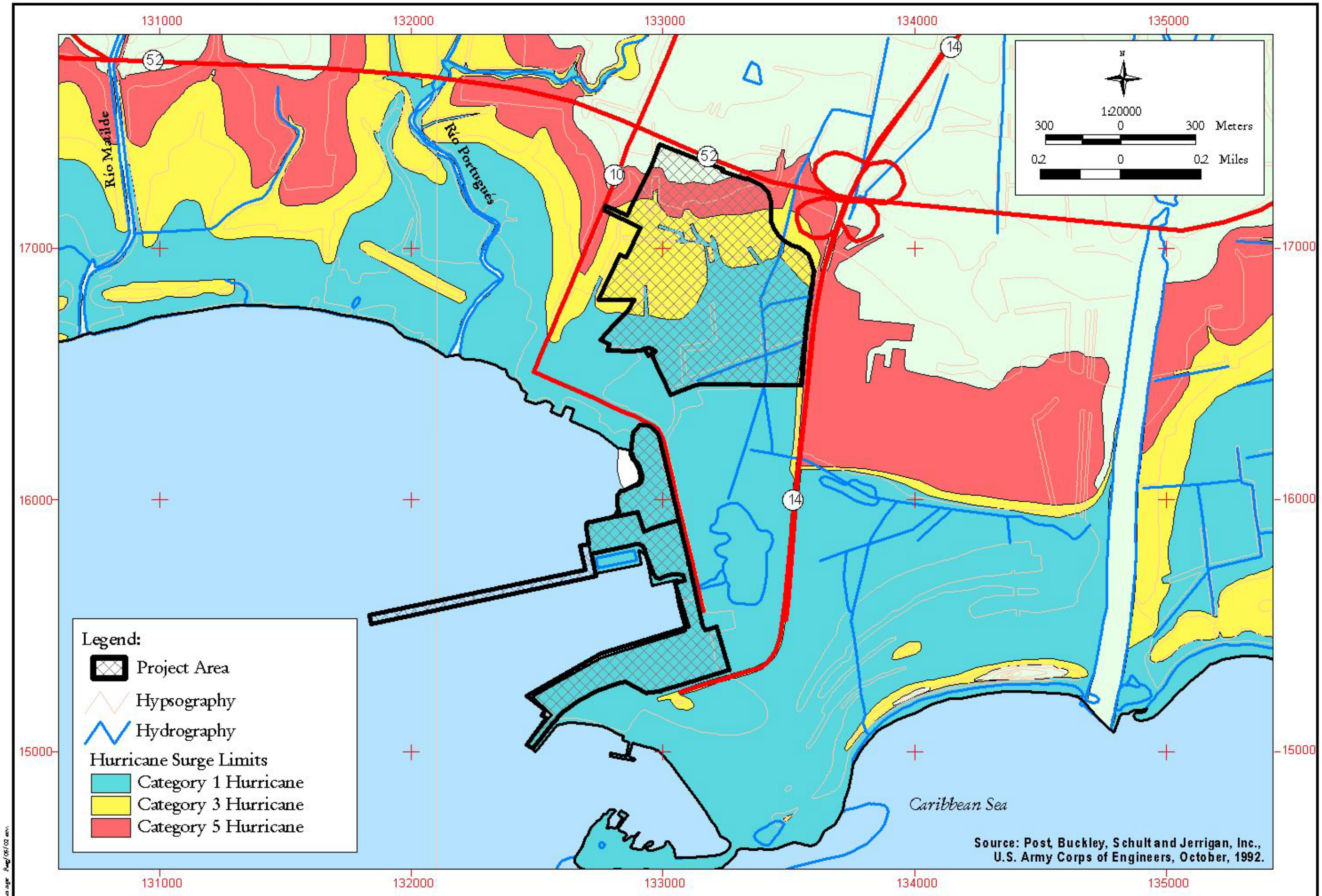

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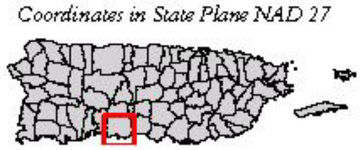

Figure 3-34 Category 1, 3 and 5 Hurricane Surge Limits: Ponce Area

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3.10 Water and Sediment Quality

3.10.1 Marine Waters

A water quality investigation in the Guayanilla Bay and Ponce Bay was performed as part of the environmental studies for this DEIS (Appendix E). This study was made to evaluate both the bays' current water conditions and their compliance with the water quality standards set forth by the EQB. To that end, a sampling event was carried out in a total of 10 sampling stations in the Guayanilla and Ponce bays. The water samples collected in both bays were analyzed for a total of 168 water quality parameters, including conventional parameters, nutrients, metals, pesticides, polychlorinated biphenyl compounds (PCBs), and volatile and semi-volatile organic compounds (VOC/SVOC).

The main findings of the study are summarized below:

- Dissolved oxygen concentrations in both bays (5.0 - 5.9 mg/L) comply with the minimum standard of 4.0 mg/L for coastal waters.
- At the Guayanilla Bay, of the 168 analyzed parameters, only 29 were detected in concentrations over their respective detection limits. These were:
  - Ammonia
  - Chlorophyll-a
  - Total coliforms
  - Fecal coliforms
  - Enterococci
  - Color
  - Fluoride
  - Nitrate + Nitrite
  - Suspended solids
  - Sulfates
  - Total nitrogen
  - Total phosphorus
  - Turbidity
  - Arsenic (total/dissolved)
  - Barium
  - Boron
  - Total cadmium
  - Copper (total/ dissolved)
  - Manganese
  - Mercury
  - Nickel (total/ dissolved)
  - Selenium
  - Zinc (total/ dissolved)
  - Asbestos
  - Di (2-ethylhexyl) phthalate
- Waters from Guayanilla Bay comply with the standards set forth by the EQB for class SC coastal waters except for five (5) of the studied parameters: Turbidity, total coliforms, boron, sulfate, and asbestos.
  - Water turbidity and high-density of bacteria detected in the Guayanilla Bay may be related to stormwater runoffs that occurred before taking the water samples. The sampling event was conducted on May 5, 2001 through May 7, 2001. However, during the days before and the period May 6-7 2001, Puerto Rico received torrential rainfall of significant magnitude. According to the National Weather Service (NWS), an estimated 7 to over 12 inches of rain fell in a 24-hour period over sections

of the South, West, and Western Interior of the island. Elsewhere rainfall varied from 1 to near 7 inches (NWS, 2001).

- Asbestos concentrations exceeding the PREQB standard of 7 million fibers per liter (MFL) were detected in two of the sampling stations located in the Guayanilla Bay, ranging from 12-20 MFL. However, the origin of this material can be traced to the geological formation that exists underneath the Río Yauco Basin. The Río Yauco Basin is characterized by significant deposits of serpentinite, a type of rock were asbestos materials occur naturally. Such rock formations are exposed throughout the river's reach, particularly in an area some 4 kilometers north of the river's mouth. This area is located along the floodway and could have contributed significant levels of this type of deposit to the volume of water discharged to the Guayanilla Bay during the rain event described previously.

- At the Ponce Bay, of 168 parameters analyzed, only 26 were detected in concentrations exceeding their respective detection limits. These were:

  - Chlorophyll-a
  - Fecal coliforms
  - Total coliforms
  - Enterococci
  - Color
  - Fluoride
  - Nitrate + Nitrite
  - Suspended solids
  - Sulfates
  - Total nitrogen (TKN)
  - Total phosphorous
  - Turbidity
  - Total arsenic
  - Total barium
  - Total boron
  - Total cadmium
  - Copper (total/dissolved)
  - Total manganese
  - Nickel (total/dissolved)
  - Selenium
  - Zinc (total/dissolved)
  - Asbestos
  - Bromoform

- At the Ponce site, the water quality standards established for coastal waters were exceeded for two (2) of these parameters. The parameters exceeding their respective water quality standards were sulfates and boron.

- Neither pesticides nor polychlorinated biphenyl compounds (PCBs) were found in the bays of Guayanilla and Ponce.

- Volatile and semivolatile organic compounds (VOC/SVOC) analyses in both bays resulted either below the detection limits or were not detected except for bromoform, and Di (2-ethylhexyl) phthalate.

  - Bromoform was detected in two stations in the Ponce Bay. Its concentrations were below the standard (4.3 µg/L) recommended by EPA.

  - Di (2-ethylhexyl) phthalate was found in two samples collected in the Guayanilla Bay. However, this is a lab contaminant and could have been

introduced into the samples by the use of gloves during its collection and handling.

3.10.2 Ground Water

According to the USGS (1972), the area of Guayanilla-Peñuelas has been affected by an increase in the intrusion of saline water from the sea. This phenomenon has adversely affected the fresh water supply of deep wells located to the south of State Road PR-127 and to the east and west of the Río Tallaboa. Moreover, the shallow underground water in Guayanilla has been impacted in many places by the migration of petrochemical compounds coming from industrial facilities that have been operating in the region since the mid 1950's.

- The local population surrounding the project area in Guayanilla-Peñuelas does not depend on ground water as the principal potable water supply. The chloride concentration in the shallow underground water in the aquifers located at 0.75 miles from the sea is usually higher than the level regulated by the Safe Drinking Water Act. For human consumption, the chloride level is 250 milligrams per liter (mg/L). In many areas of the aquifer, the chloride concentration is more than 1,000 mg/L, making underground water inappropriate for irrigation or for livestock consumption (Grossman et al., 1972).

- According to the USGS (Grossman et al., 1972), the coastal area of Ponce is also affected by an increase in the intrusion of saline water from the sea. This phenomenon has adversely affected the fresh water well supplies. In Ponce, the interface between fresh and saline water is generally located 0.50 miles away from the coast. Moreover, the shallow underground water is being replaced by deeper underground water with a higher concentration of dissolved solids and chloride (Gómez-Gómez, 1991). Along the coastal area of Ponce, the saline water intrusion is present in the west end of the alluvial plain (near the Río Jacaguas mouth) and in the southeast part of the Salinas alluvial fan.

- As in Guayanilla-Peñuelas, and due to the proximity of the coast, the local population in the areas surroundings the premises to be developed in Ponce does not depend on underground water as its main potable water supply. In many areas the chloride concentration is higher than 1,000 mg/L; therefore, the underground water is inappropriate for irrigation use or livestock consumption (Grossman et al., 1972).

3.10.3 Sediment Quality

As part of one of the elements of the Project, the reclamation by filling of an area of about 110 acres at the Guayanilla Bay is proposed. A sediment quality investigation was performed focused on the characterization of bottom sediments in the area where the laying of fill is proposed for the construction of the wharf (Appendix F). The study's objectives were:

- Determine the presence of detectable concentrations of main contaminants and pesticides in the surface sediment layer in the area proposed for the construction of the wharf;

- Evaluate the levels of contamination based on a comparison with the sediments evaluation criteria recommended by the EPA; and

- Review historical data about sediment quality in the Guayanilla Bay to assess trends in sediment quality through time.

The sampling was completed on May 28, 2001 following the protocols approved by the EQB and the EPA for marine sediment sampling in Puerto Rico. Sediment samples from the bottom were collected from 16 stations. A certified laboratory analyzed the sediment samples for 148 volatile and semi-volatile organic compounds, cyanide, and metals. In nine of the sixteen stations, besides the chemical analysis, a sediment granulometric analysis was performed to define the percent of gravel, sand, silt, and clay.

- The granulometry of the area's sediments is characterized by the abundance of thin elements (silt and clay), particularly in the deeper portions; in the more shallow areas the presence of thick elements (sand and gravel) is greater.

- At present, there are no compulsory compliance quality standards for sediments. However, the EPA published several criteria to evaluate the concentration of certain substances in sediments. These criteria include maximum recommended values but they do not represent compliance standards. Two of these criteria were used to compare the concentrations of the compounds reported by the laboratory: TEL (*Threshold Effects Level*) and ER-L (*Effects Range Low*). **Table 3-10** presents the contaminants that exceeded the TEL and ER-L.

- The TEL represents the higher concentration levels of the contaminant where the cases not having noticeable toxicological effects (e.*g*. the minimum effects range) prevail. Within this range, the contaminant concentrations in the sediment are not considered a significant risk for aquatic organisms. The TEL is the most conservative of the two types of criteria used in this analysis. The ER-L represents the contaminant level for which 90% of the samples show no significant effects in bioassay testing. This is based in the same database as the TEL and is slightly less restrictive.

- For each sample, the levels of each substance analyzed were compared with the stated criteria. Only four compounds exceeded one of the recommended levels in one or several of the sampling stations: nickel, copper, chromium, and aroclor 1254. A comparison between concentrations detected in Guayanilla and those recorded in ambient stations in Puerto Rico (Aguadilla, Arecibo, Carolina, Ponce, Puerto Nuevo/Bayamón) reflected that detected chromium concentrations in Guayanilla are within the ambient range found in other stations in Puerto Rico. Nickel, copper, and aroclor 1254 concentrations recorded in Guayanilla seem to be above the range found in these other ambient stations, which could suggest a local contamination effect. Nickel was found above EPA's most restrictive criterion (15.9 ppm) in 13 of 16 stations, thus it seems to be in most of the study area. According to the EPA's Toxic Release Inventory (TRI), during 1999 the Costa Sur Thermoelectric Plant, which discharges into the Guayanilla Bay near the sampled areas, discharged a total of 170,521 pounds of nickel compounds to the environment (37,387 into the air, 1,290 into the sea and 131,844 into the land). Therefore, it is believed that the Costa Sur Thermoelectric Plant may have contributed to nickel contamination in the area.

- Although no PCB discharges were reported in the TRI, there is a probability that industrial activities in the area are the cause of the high concentrations of copper

and aroclor 1254. It should be noted that aroclor 1254 was found above EPA's criteria in only one station (G11).

- Other substances included by EPA in the CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) list of priority hazardous substances were detected, although below the maximum concentrations recommended by EPA. Some of them are: arsenic, lead, cyanide and thallium. Moreover, some of these substances show a tendency to bioaccumulate, both in fish and in benthic invertebrates, particularly aroclor 1254, nickel, lead and thallium.

- Historical literature was reviewed to assess trends in sediment quality throughout time. This review reflected that the chemical characteristics of sediments in the Guayanilla Bay have been altered over the last 40 years. This is mainly due to activities related to the operation of the petrochemical industry located on or near Punta Guayanilla, and also by the local transport of petroleum products. A sampling made in 1961 (González, 1961) indicates that sediments in the southeast coast of Guayanilla consist of an oily mud layer approximately six inches thick. A later study (López, 1979) mentions traces of common contaminants in Guayanilla's waters and sediments. These contaminants consist of petroleum hydrocarbons and metallic elements: copper, cadmium, chromium, lead, nickel, mercury, and zinc. All of these elements, except cadmium and mercury, have also been detected in the sampling reported here. This suggests that, although contamination appears to have diminished with the passing of time, some effects of industrial activities in the area can still be perceived.

Preliminary analyses of the bottom sediments within Ponce's inner harbor and navigation channel were conducted on April 2001 (ERTEC, 2001). Results show that the sediment layer between 40 to 60 feet below the surface of the inner harbor consists of soft, dark gray, silty clays of organic origin. In the navigation channel, the sediments are composed of fine sand and organic silty clays. Analytical results of the sediment samples from these two locations indicate that the subsurface soils are non-hazardous (Appendix U).

Table 3-10: Concentration of contaminants that exceeded EPA's TEL and ER-L criteria (ppm) in the Guayanilla Bay

Criterion	Station ID															
Element, TEL	**G1**	**G10**	**G11**	**G12**	**G14**	**G15**	**G16**	**G16 D**	**G2**	**G3**	**G3 D**	**G4**	**G5**	**G7**	**G8**	**G9**
Nickel, 15.9	36.7	26.8	18.9	18.9	22.9	26.1	27.2	26.2	31.6	26.4	27.1	18.9		20.5	39.5	34.7
Copper, 18.7	36.7	45.6	29.3	31.8	26.1	39.0			29.5	27.9	28.4		40.4	26.6	26.0	33.2
Chromium, 52.3		58.5	61.0	53.5	55.0								54.5			53.5
Aroclor 1254, 0.02			0.07													
Element, ER-L	**G1**	**G10**	**G11**	**G12**	**G14**	**G15**	**G16**	**G16 D**	**G2**	**G3**	**G3 D**	**G4**	**G5**	**G7**	**G8**	**G9**
Nickel, 20.9	36.7	26.8			22.9	26.1	27.2	26.2	31.6	26.4	27.1				39.5	34.7
Copper, 34.0	36.7	45.6				39.0							40.4			
Chromium, 81.0																
Aroclor 1254, 0.02			0.07													

Source: Environmental Protection Agency
TEL = Threshold Effects Level
ER-L = Effects Range Low
Blank cells represent sampling stations for which TEL and ER-L levels were not exceeded.
The "D" suffix in the Station ID field stands for duplicate samples.

3.11 Air Quality

The Clean Air Act regulates ambient air quality and the EPA, under this statute, establishes National Ambient Air Quality Standards (NAAQS) as baseline amounts to determine the quality of air. As part of these NAAQS, a set of primary standards have been developed to preserve the public health, including the well being of sensitive individuals such as asthma patients, infants and the elderly.

Secondary air standards were developed as well to protect and preserve the health from known and anticipated adverse effects. Primary standards include contaminants like sulfur dioxide (SO_2), particulate matter with a size of 10 microns or less (PM_{10}), nitrogen oxides (NO_X), carbon monoxide (CO), ozone (O_3), and lead (Pb). These standards are detailed in Table 3-11.

Table 3-11: National Ambient Air Quality Standards

Contaminant	Standard Type	Period	Limit[1]	
			(µg/m^3)	(ppm)
SO_2	Primary	Arithmetic yearly average	80	0.030
	Primary	24-hour average	365	0.140
	Secondary	3-hour average	1,300	0.5
NO_2	Primary & Secondary	Yearly average	100	0.053
CO	Primary	8-hour average	10 mg/m^3	9
	Primary	1-hour average	40 mg/m^3	35
Ozone (O_3)	Primary & Secondary	1-hour average	235	0.12
Particulate Matter (PM_{10})	Primary & Secondary	Arithmetic yearly average	50	
Particulate Matter (PM_{10})	Primary & Secondary	24-hour average	150	
Lead	Primary & Secondary	Quarterly average	1.5	

Source: http://www.epa.fov/airs/criteria.html

[1] To protect public health.

In general terms, air quality in Puerto Rico remains relatively clean. Currently, the Island is classified as a regulatory attainment zone for all air pollutants, with the exception of the Municipality of Guaynabo, which does not comply with the PM_{10} criteria.

The EQB operates various ambient air-sampling stations throughout the Island. Monitoring stations are located in the municipalities of Barceloneta, Carolina, Cataño, Fajardo, Guayama, Manatí, Ponce, Río Grande, San Juan and Yabucoa. These stations screen the following parameters: PM_{10}, CO, NO_2, SO_2 and O_3.

The closest sampling station to the proposed PTA is located at the Civil Defense building in the San Antonio neighborhood, Municipality of Ponce. This station has been in operation since December 1998 (personal communication, PREQB) and was originally located at the Fireman Station on Christina street. PREQB gathers samples at this station to determine the concentration of particulate matter with a diameter of 10 micrometers or less (PM_{10}). The station is located approximately 16 kilometers southwest of the Guayanilla-Peñuelas component of the Project and 13.7 kilometers north of the Ponce component. In the year 2000, this station reflected a PM_{10} annual arithmetic mean of 40 µg/m^3. The highest 24-hour average for that same year was 94 µg/m^3. Both of these values are at levels that comply with the PM_{10} NAAQS standard of 50 µg/m^3 and 150 µg/m^3, respectively. Table 3-12 presents the air quality data for EQB Station No. 4 with respects to PM10 in a tabular format while Figure 3-35 presents it graphically.

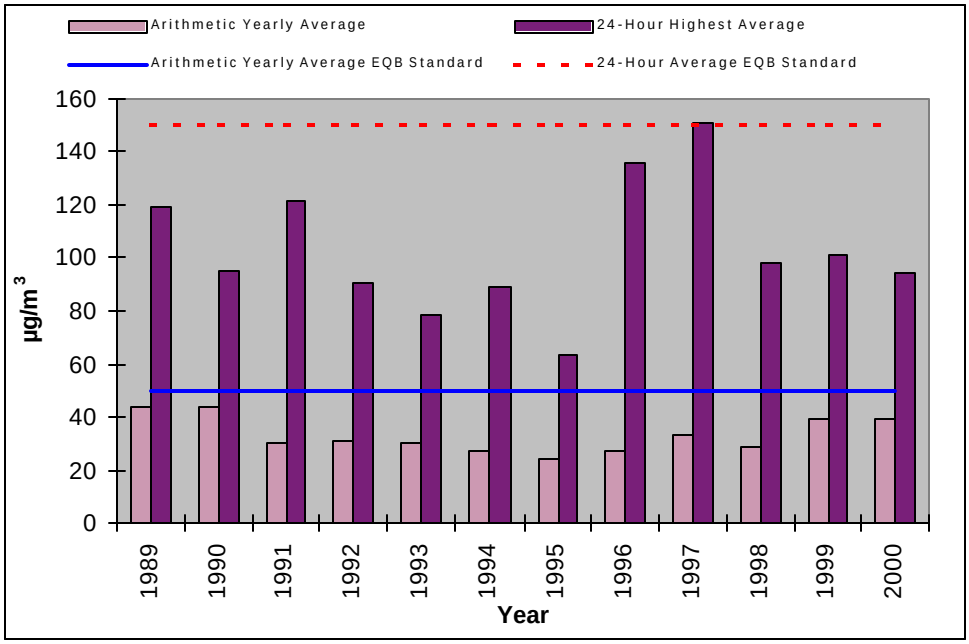
Table 3-12: Air Quality Data: EQB Station No. 4 - PM_{10}

Year	Arithmetic Yearly Average (mg/m^3)	24-hour Highest Average
1989	44	119
1990	44	95
1991	30	121
1992	31	90
1993	30	78
1994	27	89
1995	24	64
1996	27	136
1997	33	151[2]
1998[1]	29	98
1999[1]	39.4	101
2000[1]	39.7	94

Source: Environmental Quality Board- 1997 Air Quality Data Summary

[1] Environmental Quality Board, personal communication

[2] Sample exceeded the primary and secondary standard of 150 ì g/m^3 in a 24-hour period.



Source: Environmental Quality Board

Figure 3-35: Air Quality Data: EQB Station No. 4 -PM_{10}

In the past, PREPA operated an air sampling station in the Municipality of Guayanilla that monitored levels of SO_2, and was located in the Municipal Government Building. Table 3-13 shows SO_2 data for the years 1993 through 1997 while Figure 3-36 presents the same data graphically.

Table 3-13: Air Quality Data: PREPA Station Guayanilla Gov. Center - SO_2

Year	Highest value for the 3-Hour Maximum Monthly Mean (ppm)	Highest value for the 24-Hour Maximum Monthly Mean (ppm)	Yearly Arithmetic Mean (ppm)
1993	0.048	0.020	0.002
1994	0.080	0.012	0.002
1995	0.035	0.008	0.001
1996	0.056	0.016	0.003
1997	0.051	0.019	0.003

Source: PREPA.

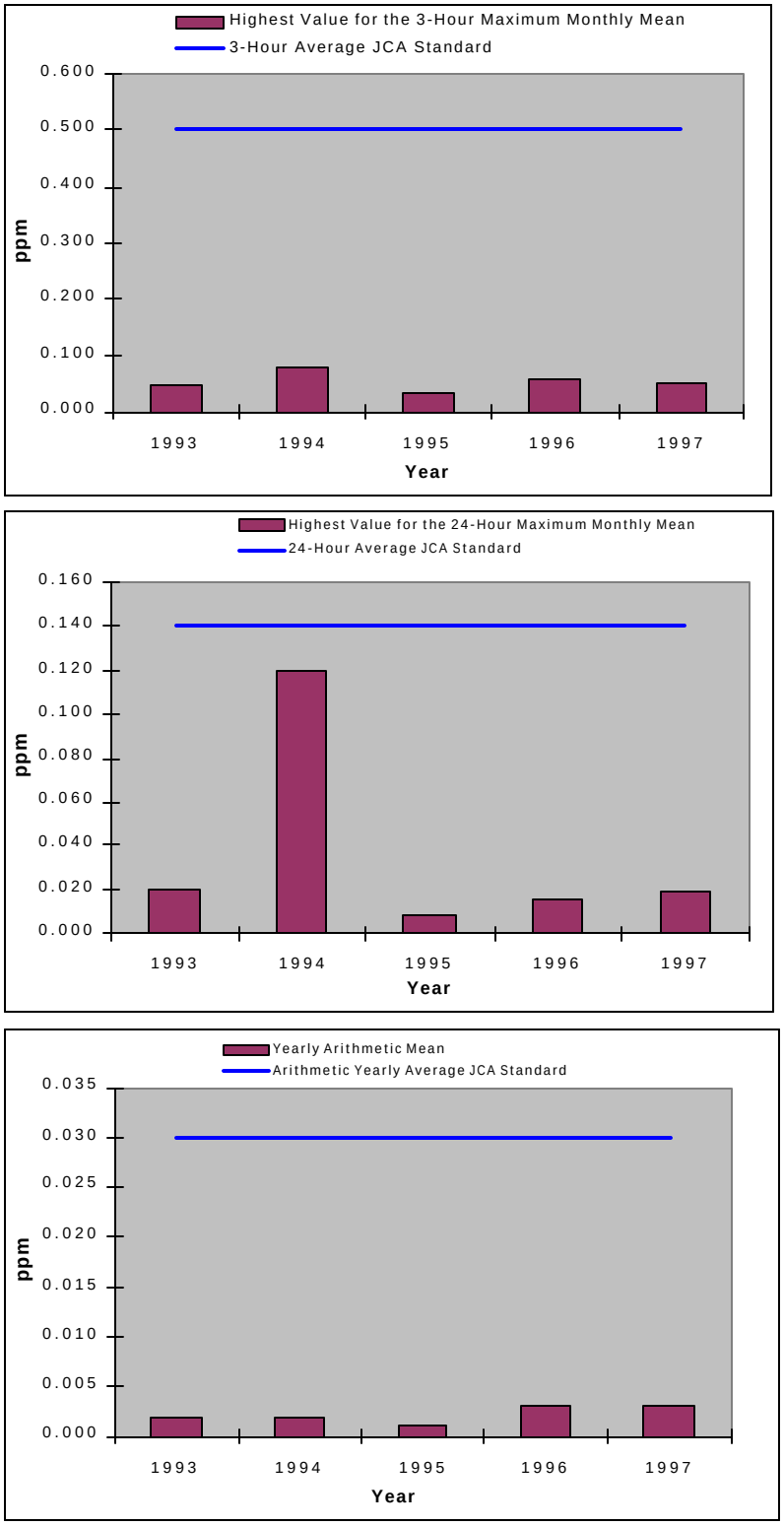


Figure 3-36: Air Quality Data: PREPA Station Guayanilla Gov. Center - SO_2

3.12 Cultural Resources

3.12.1 Archeology

3.12.1.1 Terrestrial Archeology

A Phase IA Terrestrial Archeological Investigation was conducted in the proposed project area to characterize the cultural or historical resources (Appendix K). The results of the investigation served as the basis to determine the level of archeological sensitivity of the area encompassing the Guayanilla Bay, the coastal zone between the Río Tallaboa and Río Yauco, and the area of the Port of Ponce. Upon completion of the fieldwork, the data were analyzed and conclusions were made about the potential impact on any archeological resources that would occur from the development of the PTA.

An archeological deposit representative of the ceramic period of our pre-history was identified during the fieldwork conducted in the Guayanilla-Peñuelas component of the Project, on the banks of Río Tallaboa and outside the Project's eastern boundary. This finding is currently at great risk from the effects of floods, because of its location on the exposed west bank of Río Tallaboa. The stratigraphy of the profile of the west bank of the river reflects that the cultural residues of this find are about one meter deep. It is considered that the field methodology for further studies of this find must be adjusted to reach about two meters in depth below the land surface.

The installations of EcoEléctrica and Union Carbide occupy land adjoining the proposed site for the development of the Project in the Guayanilla-Peñuelas area. Within these parcels there are some areas where the impacts of construction are minimal, and where additional archeological soundings would be completed if needed.

From the compilation of the archives data and the field investigations in the area near Punta Guayanilla, it may be concluded that there is a high probability that native Taíno groups visited this coastal zone in the past, during its hunting and fishing trips. This peninsula off the coast from Guayanilla-Peñuelas is a natural mangrove zone. Currently, some of the land is dry due to historical filling that has occurred in the area approximately 40 to 50 years ago. The filling in this zone makes it possible to visit the area on foot or in vehicles that can penetrate in the sector.

In the evaluation of the cultural resources that are located in the Ponce area where the Project is planned, consideration was given to the geographical, topographical and ecological characteristics of the zone, as well as data on known archeological findings in the area. This is a region where alluvial valleys, rivers, wetlands and the coastal zone converge. These geographical and ecological characteristics define the region of the Ponce coast and of the valleys between the hydrographic basins of the Río Portugués and Río Bucaná, as ideal areas for the support of communities during the pre-history of the zone. Equally, these conditions promoted the siting of colonial Spanish settlements during the first centuries of the Island's history.

The archeological sensitivity of the Port of Ponce region was evaluated on the basis of the archeological finds near the area. Currently, there is evidence of some 11 pre-columbine archeological finds within a radius of five kilometers from the area where the Port of Ponce is located, including the finds Po-10, Po-8 and Po-6, which contain evidence of pre-columbine settlements dating from the "salaloid" period to the "chicoide" period of our pre-history (400-1,500 d.C.) (Figures 3-37 and 3-38). The archeological evidence in the archives shows that this area can be considered highly sensitive in terms of archeology.

3.12.1.2 Sub-Aquatic Archeology

A Phase IA Subaquatic Archeological Investigation was conducted to address the elements of the Project (Appendices L and M). This was necessary due to the proposed reclamation by fill of approximately 110 acres from the ocean to build the loading and unloading facilities for the piers at the Guayanilla-Peñuelas site. Also, dredging activities for the navigation channel are proposed at the Ponce Bay. With these objectives in mind, an investigation related to the Phase 1A Terrestrial Archeological Investigation was completed.

The investigation included a compilation of the published literature related to submerged archeological deposits within the study area, historical and pre-historical, including inspection from the shore and dives in the area.

The Submerged Cultural Resources Survey, Stage IA documents extensive coastal and maritime human activity at Guayanilla and Ponce Bay, south coast of Puerto Rico, potentially extending 5,000 years into the past. The south coast in general is highly sensitive to both preceramic and ceramic prehistoric sites.

In terms of actual sites within the Project Area, the conclusions of the study show that no subaquatic archeological resources were identified at the areas to be used for the Project elements within the Guayanilla or Ponce ports. The study also suggests that in both bays there is a high probability of the occurrence of archeological resources, potentially eligible to the National Register of Historic Places, including the following:

- Submerged prehistoric sites due to eustatic changes in sea level
- Aboriginal canoes, including prehistoric and historic eras
- Historic shipwrecks
- Historic port discards, 16th to early 20th centuries

However, in the Guayanilla Bay, other than the area to be filled, the remaining submarine bottom would not be disturbed, since dredging is not required. Post-Panamax vessel traffic would not cause any more turbulence and sediment uplifting than what it is now caused by the LNG ships arriving for EcoEléctrica. Similarly, in the Port of Ponce, some of the areas proposed for dredging were previously dredged in 1987-88, and any artifacts in the navigation channell or turning basin were already disturbed. Similarly, no archeological resources were identified in the vicinity of the navigation channel and turning basin expansion area.

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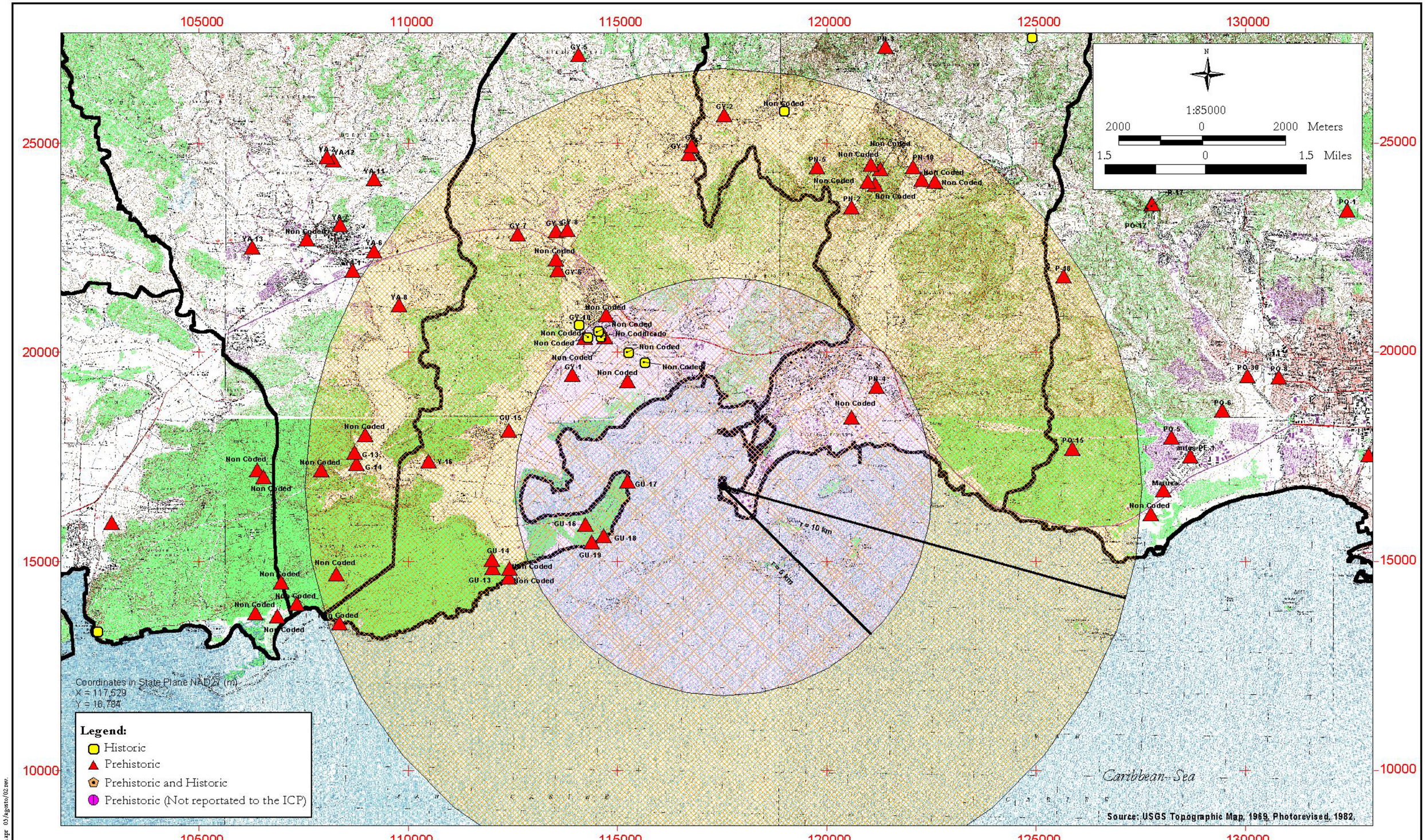

Figure 3-37 Archeological Resources: Guayanilla-Peñuelas Area

Port of the Americas

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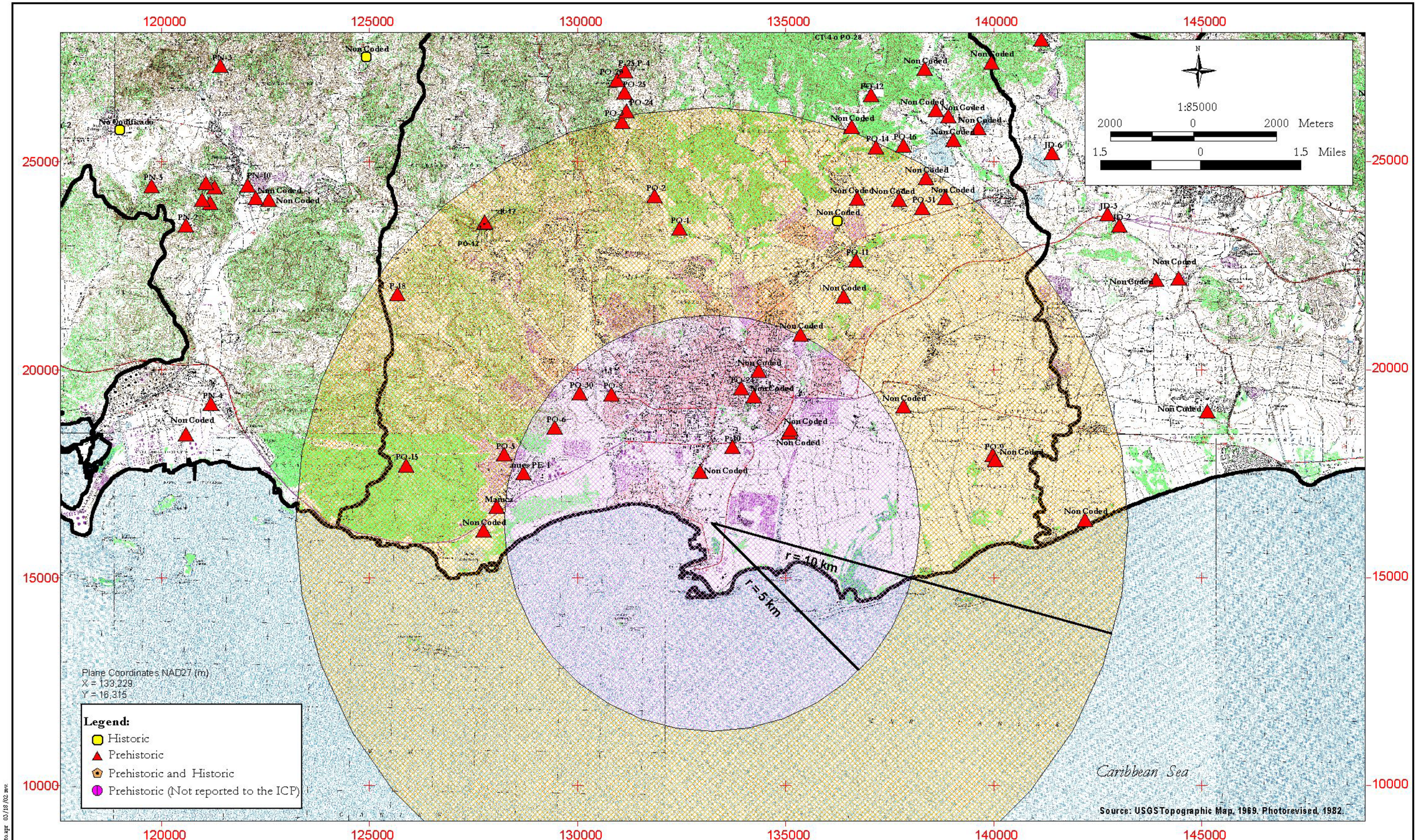


Figure 3-38 Archeological Resources: Ponce Area

Port of the Americas

3.13 Socioeconomic Conditions

A socioeconomic study was conducted as part of this DEIS to support the environmental justice analysis and establish the context of the socioeconomic analysis of the municipalities of Ponce, Guayanilla and Peñuelas, and their wards, where the proposed facilities would be located (Appendix O and FF). This assessment evaluated the social and economic variables of the seven municipalities that compose this region: Ponce, Yauco, Juana Díaz, Guayanilla, Peñuelas, Santa Isabel and Guánica and is based from data from the 1990 and 2000 Census effort.

The wards at the coast of the municipalities of Guayanilla, Peñuelas and Ponce constitute the immediate context of the proposed facilities for which there are available data. The target of this socioeconomic study was to present a clear frame of the socioeconomic situation of these areas and to determine if in the selection of the site proposed for the construction of the facilities there was discrimination because of social or economic reasons. The wards included in the analysis were: Boca, Indios, Playa and Rufina in Guayanilla; Encarnación and Tallaboa Poniente in Peñuelas; and Bucaná, Cañas, Capitanejo, Playa and Vayas in Ponce. The proposed project sites are located in the Playa ward of Ponce, the Playa ward of Guayanilla and the Tallaboa Poniente ward of Peñuelas.

Also, the development of the Ponce or Guayanilla-Peñuelas alternatives separately implies a reduction with respect to the employments and incomes estimated for the Applicant's Preferred Alternative. A cost benefit analysis is being conducted to quantify the specific impacts of both sites independently.

A Cost/Benefit assessment was performed for the proposed action (Appendix Z). The purpose of this study was to measure the costs and benefits of Port of The Américas. The Port would be developed in the Ponce-Guayanilla region and would concentrate on export-import and transshipment activities. The study was divided into four main components:

- Demand Analysis
- Supply Analysis
- Impacts Analysis
- Social Profitability Analysis

Demand analysis includes an estimate of demand for containers in the region and possible market share to be absorbed by the Port. Demand was estimated in terms of transshipment demand and external trade activities. This analysis included a price analysis, which combined with demand estimation, allowed for the calculation of revenue streams.

Supply analysis included the estimation of construction investment and operation costs. Impact analysis considered following elements:

- Impacts of Construction Activity
- Impacts of "Value-Added" Operations

3.13.1 Socioeconomic Variables for the Municipalities of Ponce, Guayanilla and Peñuelas Compared with the Municipalities of the Region

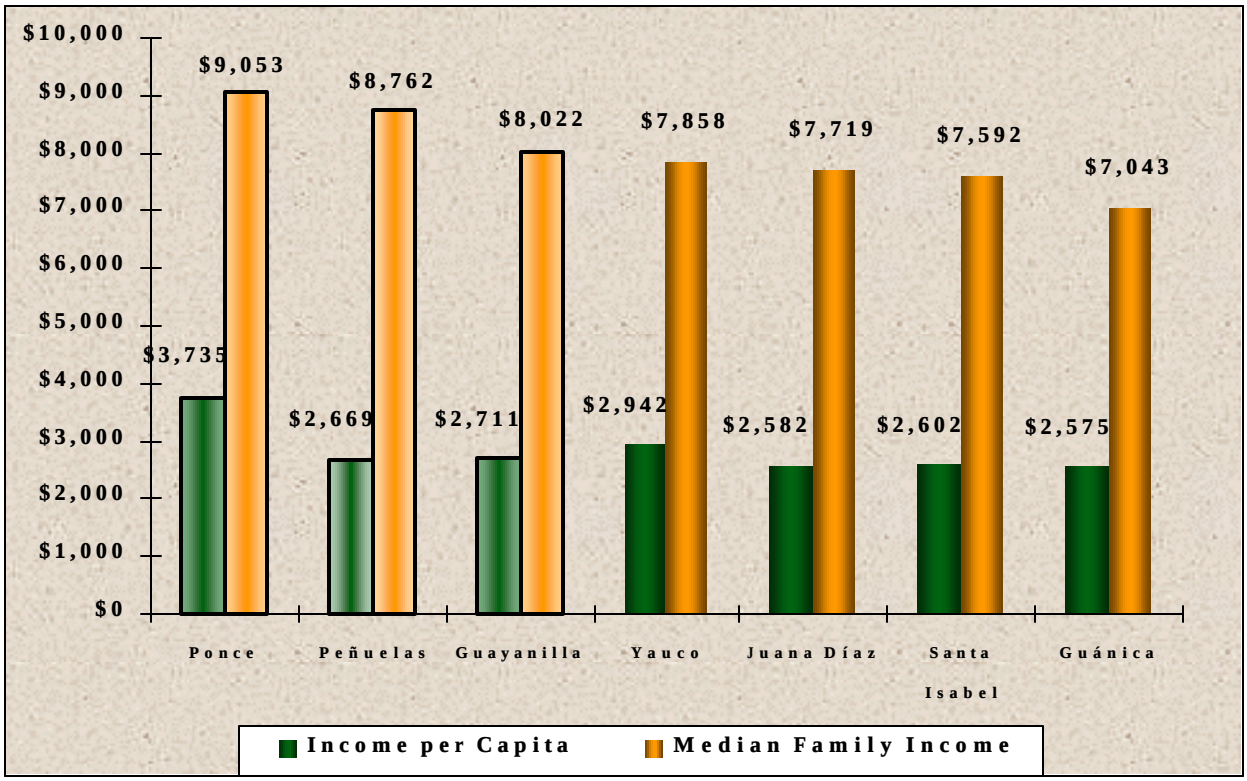
3.13.1.1 Income Indicators

Table 3-14 and Figure 3-39 show the per capita income, median family income and the families below poverty levels for the seven municipalities that compose the region.

Table 3-14: Income Indicators

Municipality	Population	Per Capita Income	Median Family Income	Families Below Poverty Level	
				Number	Percentage
Ponce	187,749	$3,735	$9,058	26,855	58.8
Peñuelas	22,515	$2,669	$8,762	3,517	67.8
Guayanilla	21,581	$2,711	$8,022	3,368	65.5
Yauco	42,058	$2,942	$7,858	7,077	67.4
Juana Díaz	45,198	$2,582	$7,719	7,170	69.4
Santa Isabel	19,318	$2,602	$7,592	3,124	67.4
Guanica	19,984	$2,575	$7,043	32,568	72.8
Region	356,403	$3,242	$8,477	54,679	63.3

Source: Population Census, 1990



Source: Population Census, 1990 from Estudios Técnicos, 2001 (**Appendix O**)

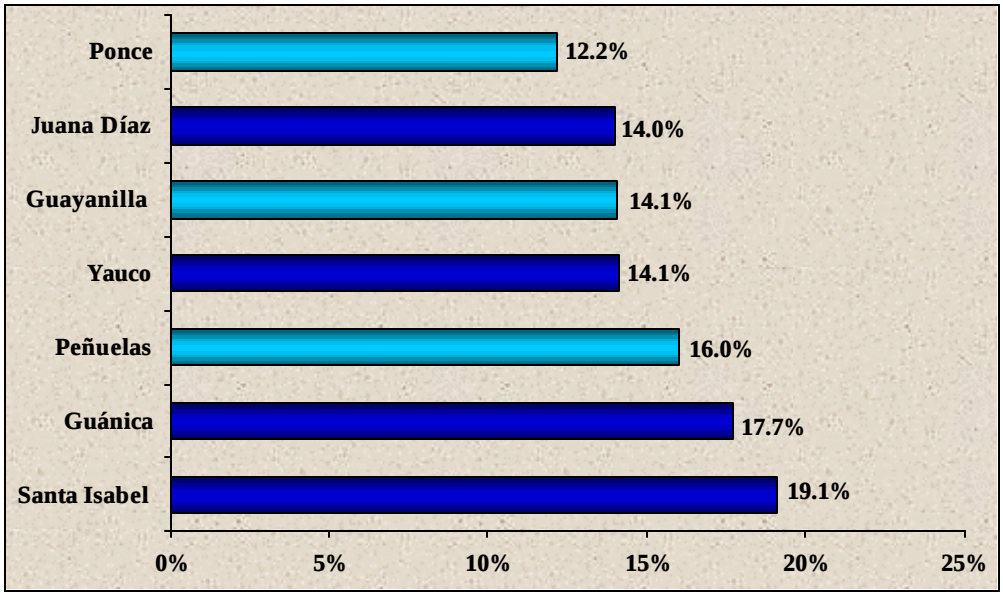
Figure 3-39: Income Indicators

- The per capita income for the region was $3,242. For the municipalities that comprise the region, Guayanilla had the third highest per capita income with $2,711, Peñuelas had the fourth one with $2,669, and Ponce had the highest per capita income with $3,735.
- The median family income for the Region was $8,477. The median family income for the Municipality of Ponce was $9,053, which was the highest in the region, followed by Peñuelas and Guayanilla with $8,762 and $8,022, respectively.
- Sixty-three percent of families in the municipalities of the region lived below poverty levels, according to federal standards. The municipalities of Ponce and Guayanilla have the lowest poverty levels in the region with 58.8 percent and 65.5 percent, respectively. Peñuelas has a poverty level higher than the municipalities of Ponce and Guayanilla with 67.8 percent.

This information was updated with the most recent (year 2001) economic information (Estudios Técnicos, 2002) (Appendix O). In Ponce, the average salary was reduced 14.23%, while in Guayanilla and Peñuelas it increased 16.67% and 12.98%, respectively. Income per capita showed almost no change compared to 1990 levels, which suggests that salaries in the vicinity of Ponce have increased in absolute terms at a higher pace that inflation.

3.13.1.2 Unemployment Rate

The work force of the municipalities that comprise the region were 116,600 people, as of June 2000. Figure 3-40 shows the unemployment rates for the seven municipalities that comprise the region.



Source: Department of Labor and Human Resources, June 2000 from Estudios Técnicos, 2001 (**Appendix O**)

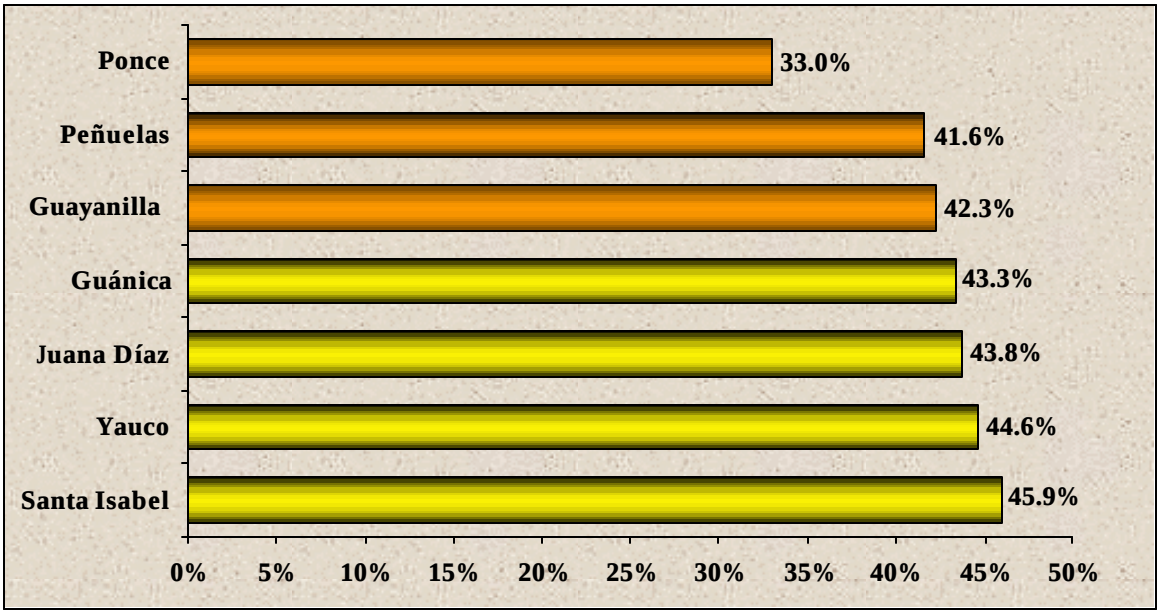
Figure 3-40: Unemployment Rate (Percentage)

The unemployment rate for the region was 13.6 percent in 1990. The study indicates that this rate is 3.5 percent higher than the rate for Puerto Rico (10.1 percent). Of the municipalities that comprise the region, Ponce reflected the lowest unemployment rate with 12.2 percent, followed by Juana Díaz with 14 percent and Guayanilla in third place, with 14.1 percent. The Municipality of Peñuelas reflected an unemployment rate of 16 percent.

In 2001, municipalities in the Ponce region experienced an average increase in unemployment rate of 8.1%. For the components of the Project (Ponce, Guayanilla, Peñuelas), the increase was lower, averaging 2%.

3.13.1.3 Households Receiving Public Assistance

Figure 3-41 summarizes the information on the households receiving public assistance for the municipalities of the region.



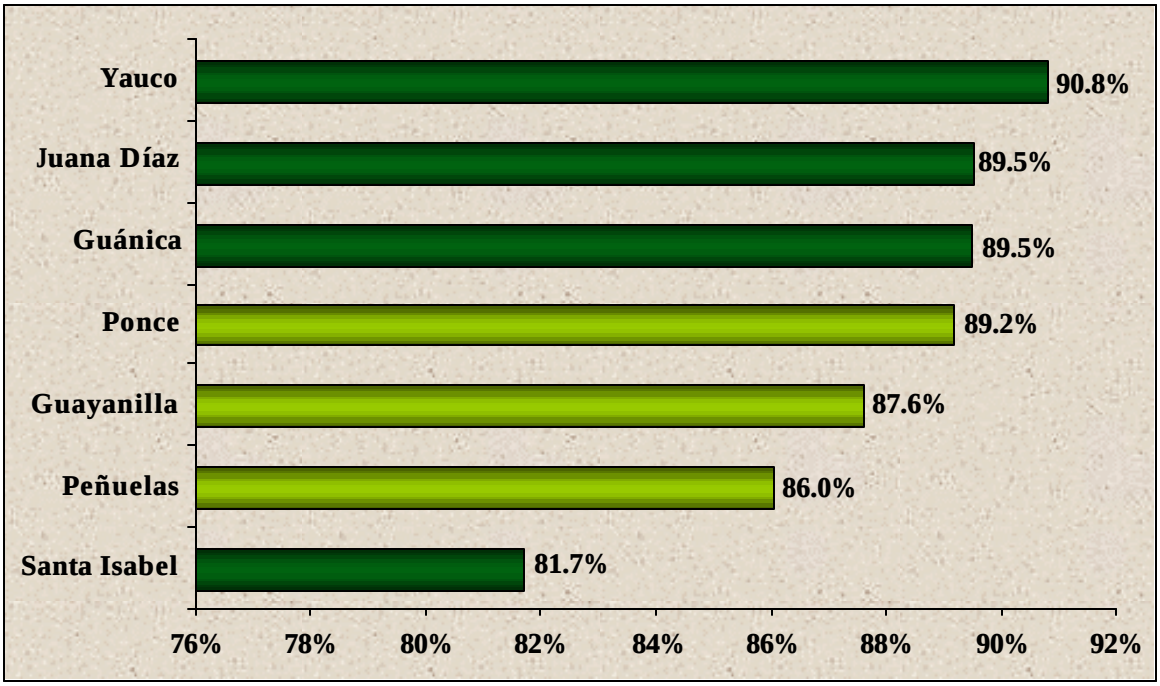
Source: Population Census, 1990 from Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-41: Households Receiving Public Assistance (Percentage)

The Municipality of Ponce reflected the lowest percentage of families that receive public assistance among the municipalities that comprise the region, with 33.0 percent. The municipalities of Peñuelas and Guayanilla with percentages of 41.6 and 42.3 percent, respectively, followed the Municipality of Ponce.

3.13.1.4 Ability to Read and Write

Eighty-eight percent of the residents of the municipalities of the region are able to read and write. Figure 3-42 summarizes the data on the population with ability to read and write.



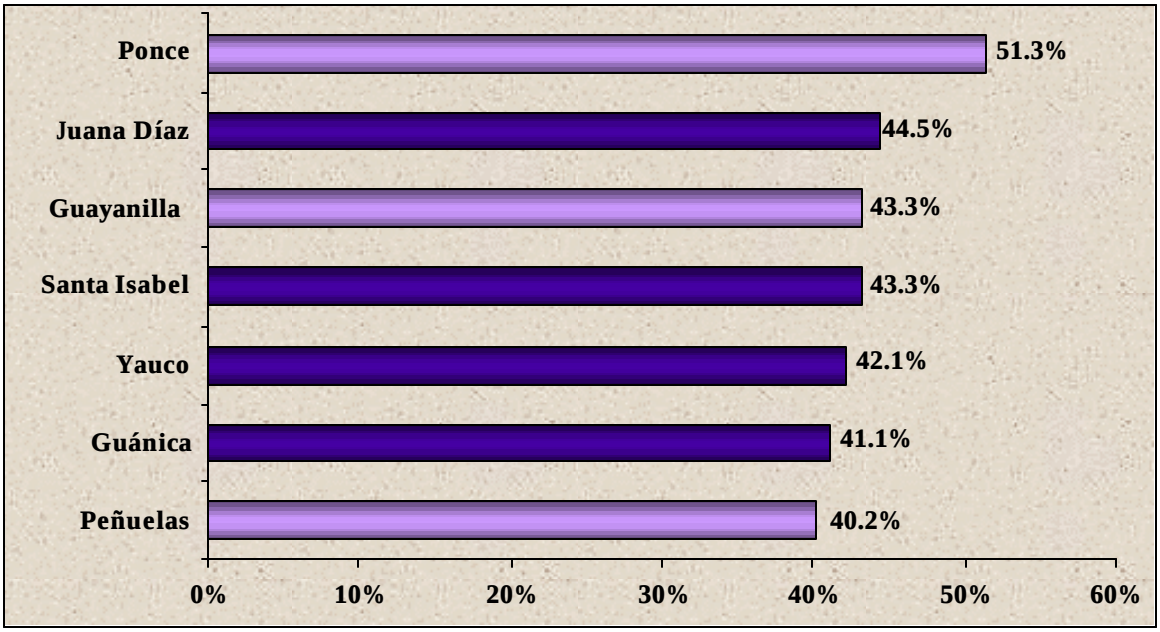
Source: Population Census, 1990 from Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-42: Population with Ability to Read and Write (Percentage)

In terms of the population with ability to read and write, the Municipality of Ponce is ranked fourth with 89.2 percent, followed by the municipalities of Guayanilla and Peñuelas with 87.6 percent and 86.0 percent, respectively.

3.13.1.5 Educational Attainment

Approximately, forty-seven percent of the population of the region, 25 years old or older, at least graduated from high school. Figure 3-43 summarizes the information on this indicator.



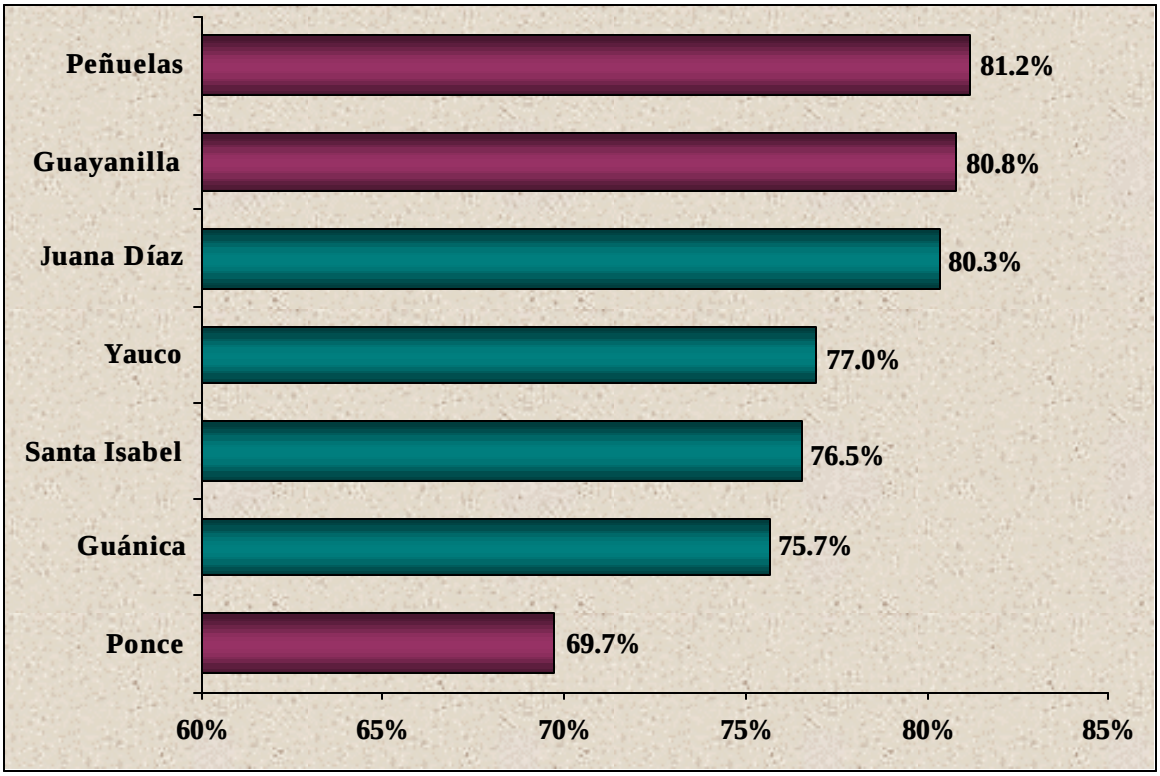
Source: Population Census, 1990 from Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-43: Graduated from High School or Higher Levels (Percentage)

The Municipality of Ponce had the highest percentage of people 25 years old or older that at least graduated from high school with 51.3 percent. Guayanilla and Peñuelas were third and seventh, with 43.3 percent and 40.2 percent, respectively.

3.13.1.6 Owned Housing Unit Incidence (Owner vs. Renter Incidence)

At a regional level, 74.2 percent of the housing units were owned. The municipalities of Peñuelas and Guayanilla had the highest percentages of owned housing units in the region, with 81.2 percent and 80.8 percent, respectively. Ponce was ranked the lowest in terms of percent-owned units with 69.7 percent. Figure 3-44 presents this information.

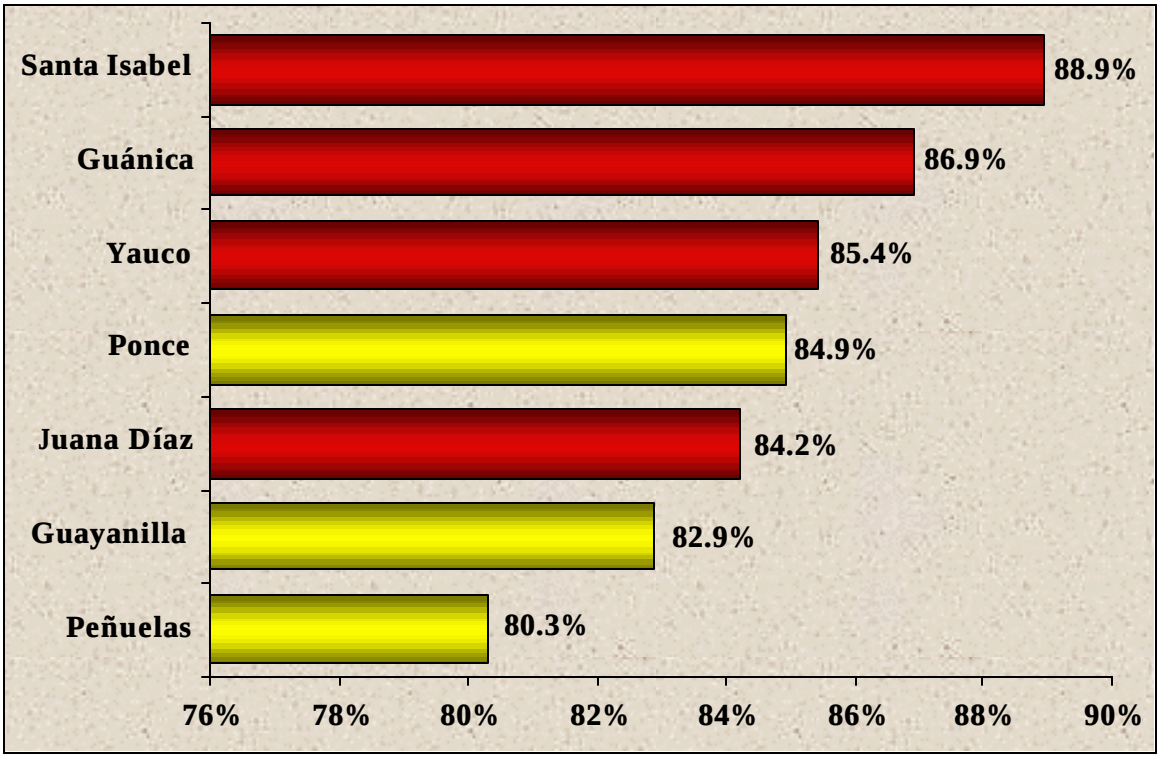


Source: Population Census, 1990 from Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-44: Owned Housing Units (Percentage)

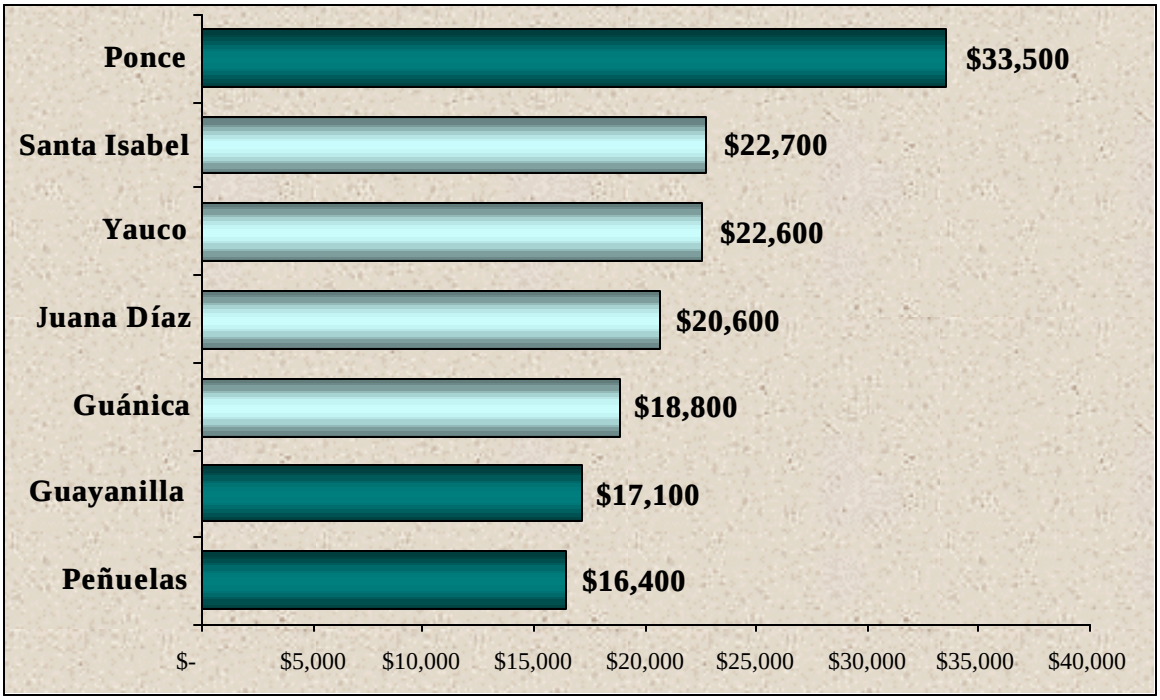
3.13.1.7 Housing Units Condition and Median Value

Eighty-four percent of the housing units in the region were in adequate conditions. The housing units median value was $26,781. Corresponding data for the region is included in the Figure 3-45 and Figure 3-46.



Source: Population Census, 1990 from Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-45: Housing Units in Adequate Conditions (Percentage)



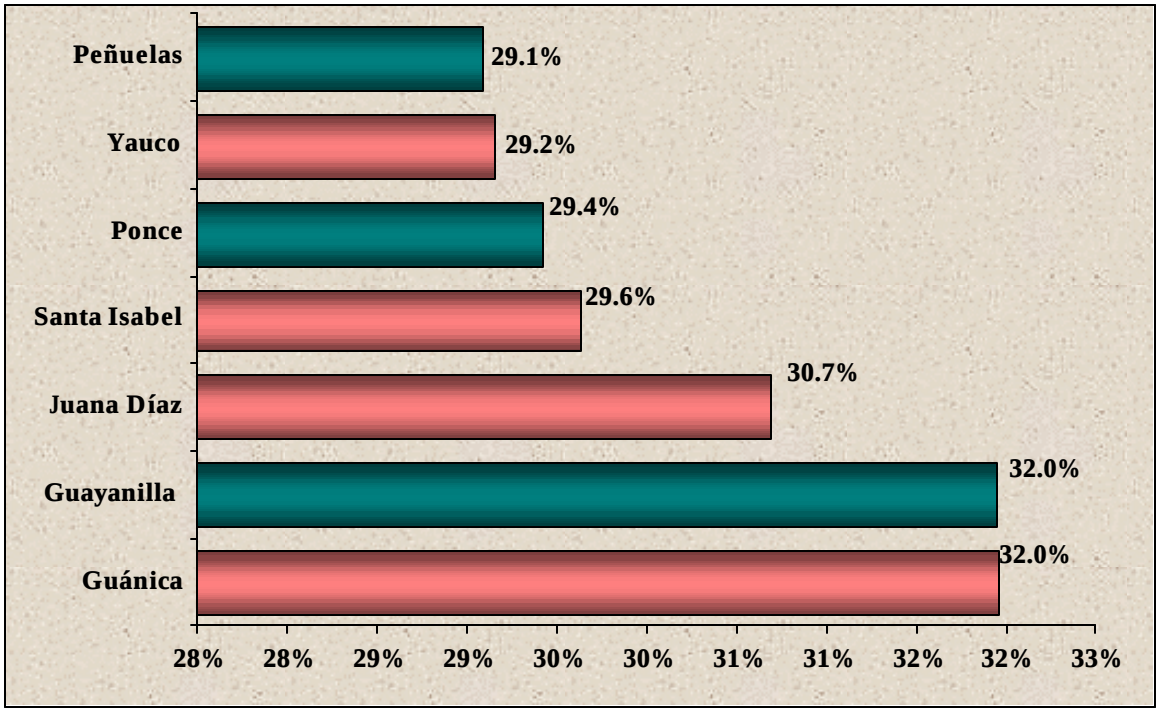
Source: Population Census, 1990 from Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-46: Housing Units Median Value

- The Municipality of Ponce had the same percentage of housing units in adequate conditions as the average for the region. For the municipalities of Guayanilla and Peñuelas, this indicator was 82.9 percent and 80.3 percent, which is 2 percent and 4.6 percent lower than the average for the region, respectively.
- The Municipality of Ponce had the highest housing units value in the region with $33,500, while Peñuelas and Guayanilla had the lowest ones in the region with $17,100 and $16,400, respectively.

3.13.1.8 Households Receiving Social Security Benefits

Approximately, twenty-nine percent of households in the region receive benefits from Social Security. Corresponding data is summarized in Figure 3-47.



Source: Population Census, 1990 from Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-47: Households Receiving Social Security Benefits (Percentage)

- Twenty-nine percent of households in Peñuelas receive benefits from the Social Security, representing the lowest rate in the region.
- The municipalities of Ponce and Guayanilla had a higher rate of households receiving these benefits, 29.4 percent and 32.0 percent, respectively.

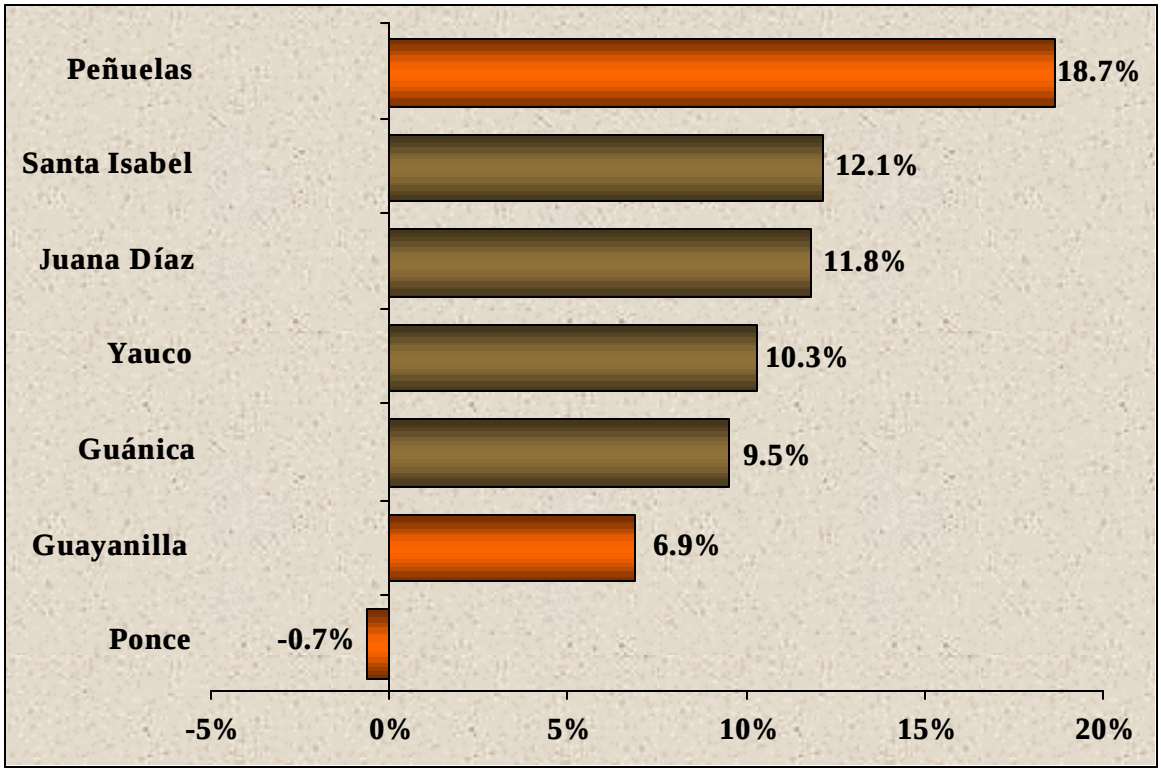
3.13.1.9 Population Growth 1990-2000

The population growth experienced by the region during the period of 1990 to 2000 was 5.1 percent. Table 3-15 and Figure 3-48 presents supporting data.

Table 3-15: Population in the Region

Municipality	Population 1990	Population 2000	Percent Growth
Peñuelas	22,515	26,719	18.7
Santa Isabel	19,318	21,665	12.1
Juana Díaz	45,198	50,531	11.8
Yauco	42,058	46,384	10.3
Guánica	19,984	21,888	9.5
Guayanilla	21,581	23,072	6.9
Ponce	187,749	186,475	-0.7
Región	358,403	376,734	5.1

Source: Population Census 1990 and 2000, from Estudios Técnicos, 2001 (**Appendix O**)



Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

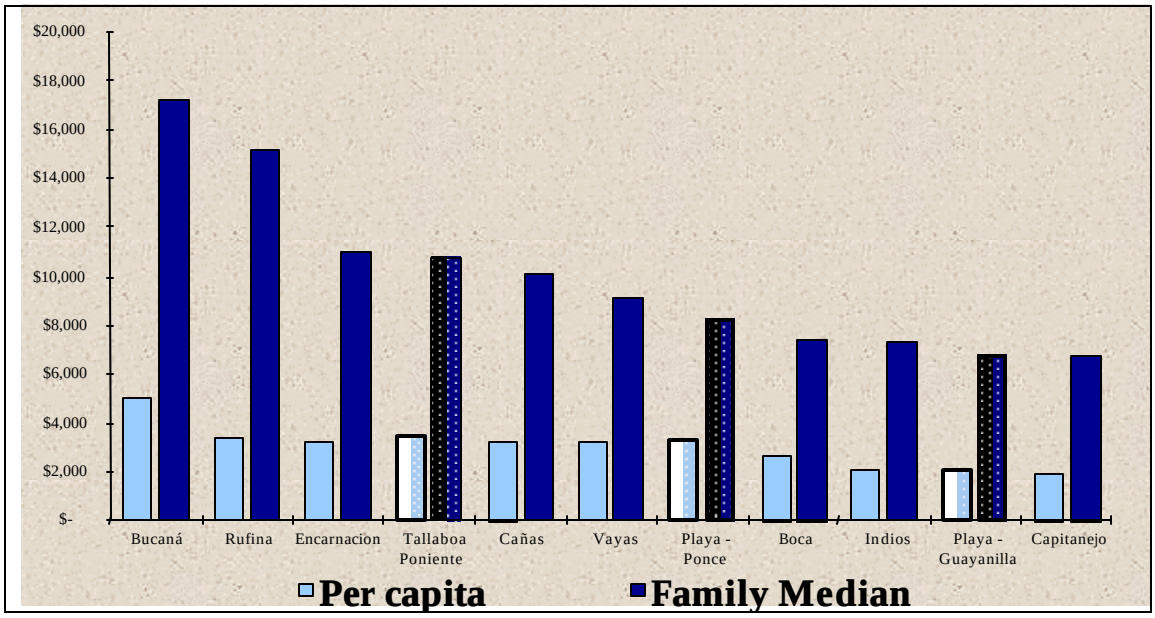
Figure 3-48: Population Growth (Percent)

- The Municipality of Ponce exhibited the lowest population growth during the last decade, with a decline of about –0.7 percent while Guayanilla exhibited a growth of about 6.9 percent.
- Peñuelas exhibited the highest population growth during the same period, with an increase of 18.7 percent.

3.13.2 Evaluation of Socioeconomic Indicators at the Ward ("Barrio") Level

3.13.2.1 Income Indicators

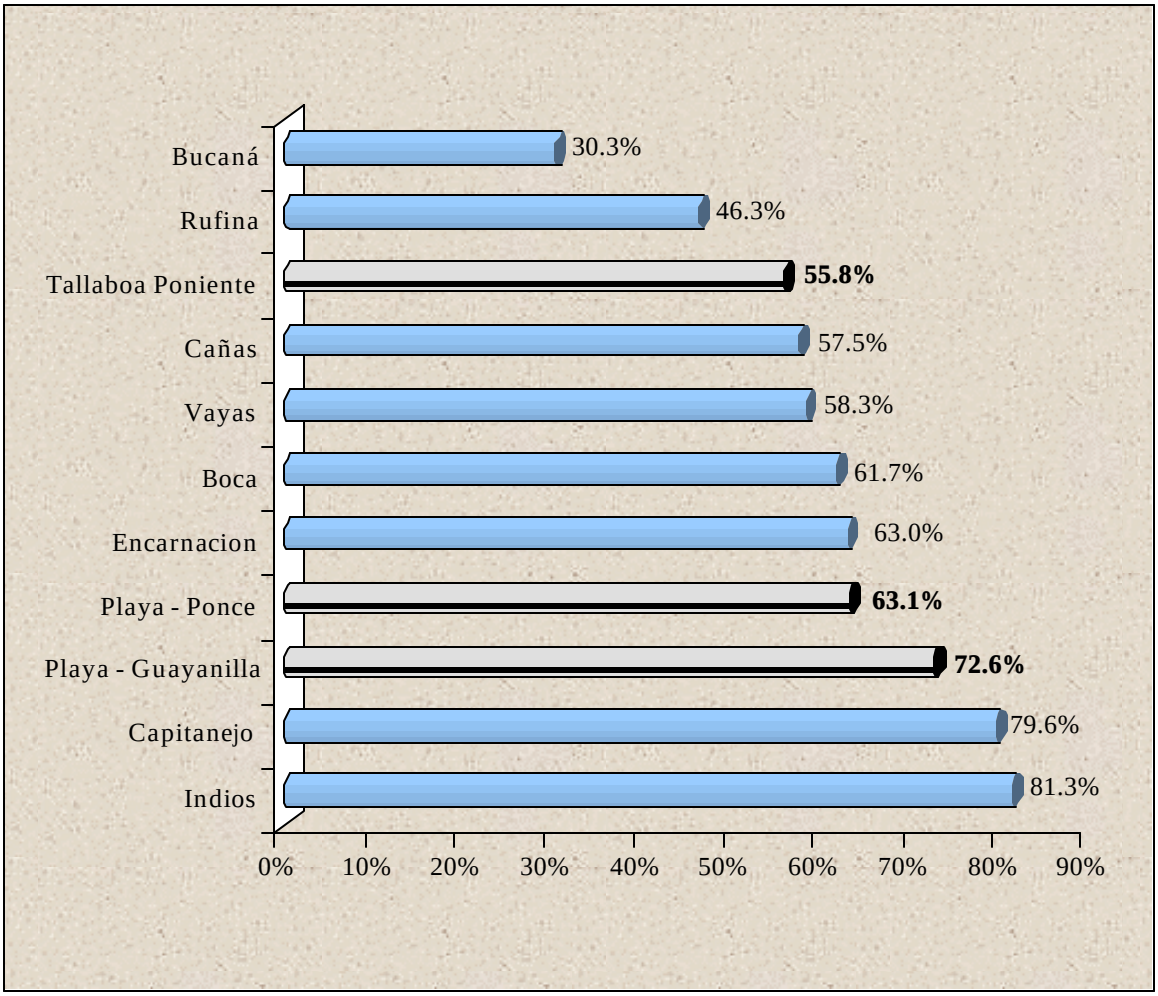
The per capita income in the study area as a whole was $2,942. The information for the individual wards evaluated is as follows. Corresponding data is presented in Figure 3-49.



Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-49: Per-Capita Median Family Income

- In terms of the per-capita income, the Bucaná Ward in Ponce shows the highest value, with $5,077 per year, exceeding significantly the rest of the study area. The Playa de Ponce and Guayanilla wards exhibit per capita incomes of $3,361 and $2,177, respectively, ranking fourth and ninth respectively among all the areas considered. The Tallaboa Poniente Ward is second, with a per-capita income of $3,558.
- Relative to the median family income, the Bucaná Ward of Ponce also shows the highest value, with $17,242 per year, exceeding by a substantial margin the median income of the entire study area ($7,858).



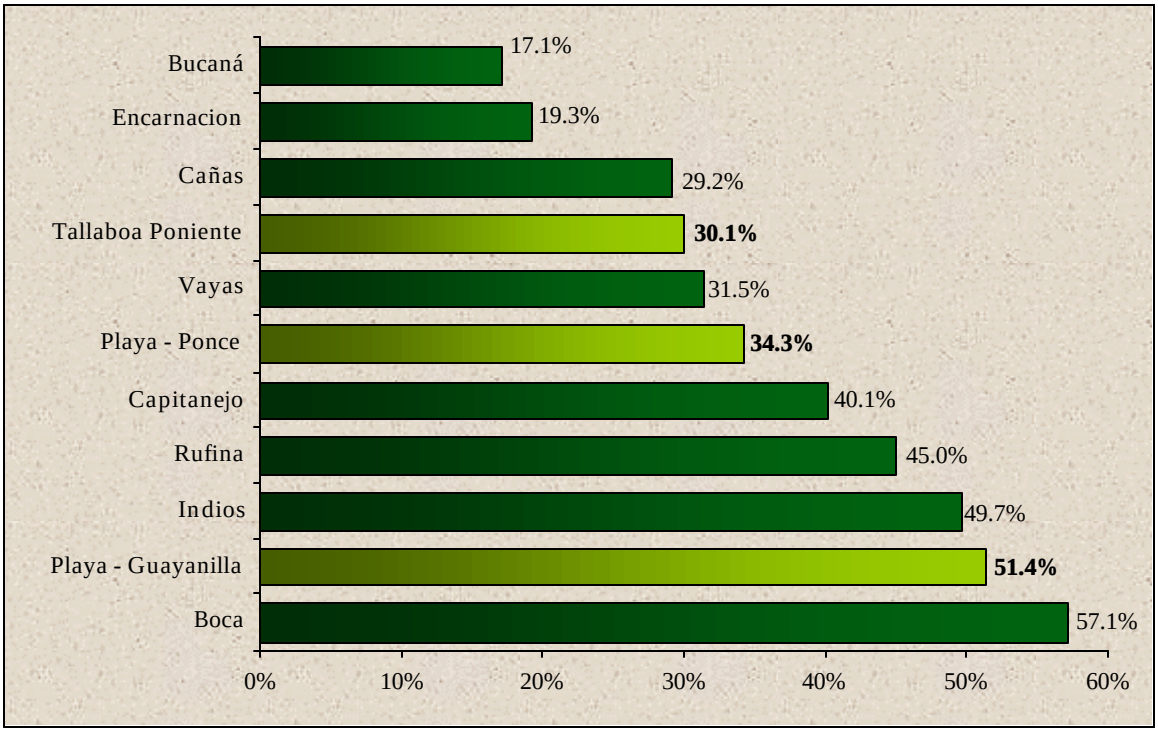
Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-50: Families Under the Poverty Level (Percent)

- The variable related to the poverty level shows a pattern similar to the income by ward, with the Bucaná Ward in Ponce showing the lowest percent of families with incomes below the poverty level, as presented in **Figure 3-50**.
- The Playa de Ponce and Guayanilla Wards show poverty levels of 63.1 percent and 72.6 percent of the population respectively. The Tallaboa Poniente Wards shows a level of 55.8 percent.

3.13.2.2 Public Assistance

As shown in the socioeconomic study, the variability by ward of the number of people receiving public assistance is a significant parameter. About 32.0 percent of the homes in the study area receive public assistance. The pertinent information about this parameter is shown in Figure 3-51.



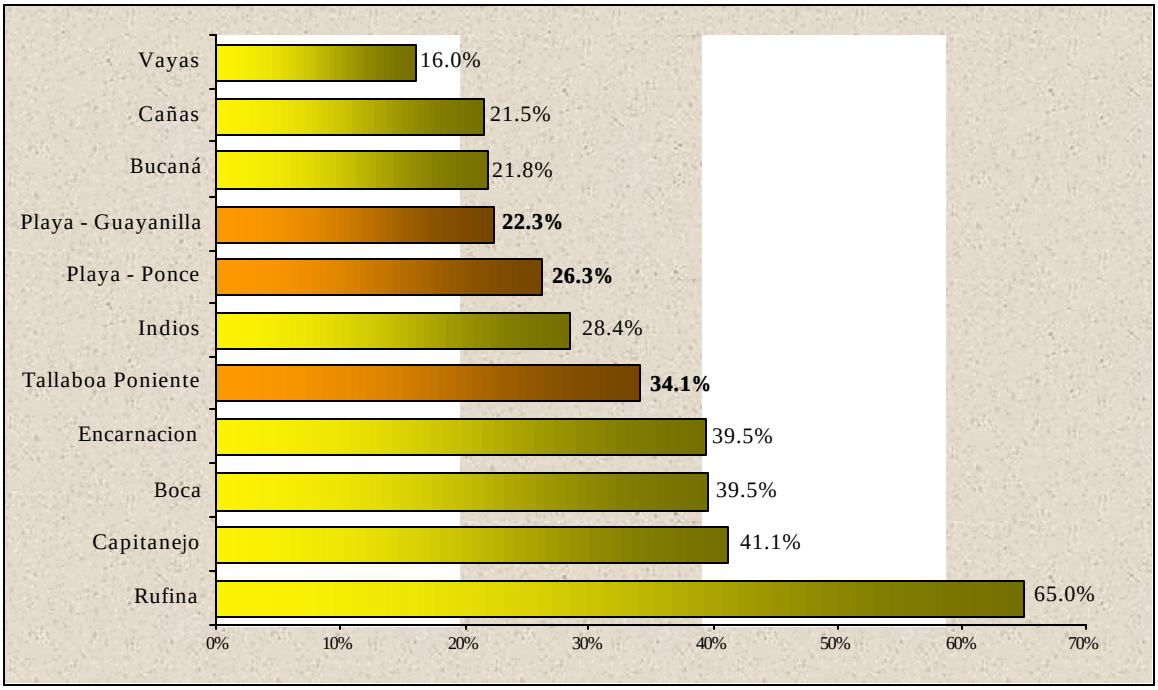
Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-51: Families that Receive Public Assistance (Percent)

- The Playa de Ponce and Guayanilla wards reflect a larger percent of families that are recipients of public assistance, when compared with the study area, with 34.3 percent and 51.4 percent, respectively. In the Tallaboa Poniente Ward (Peñuelas), the percent is lower than the average in the study area, with 30.1 percent.

3.13.2.3 Social Security

About 24.6 percent of the families in the study area receive Social Security Benefits. The information about this benefit for the municipalities in the region is as follows. Corresponding data is presented in Figure 3-52.



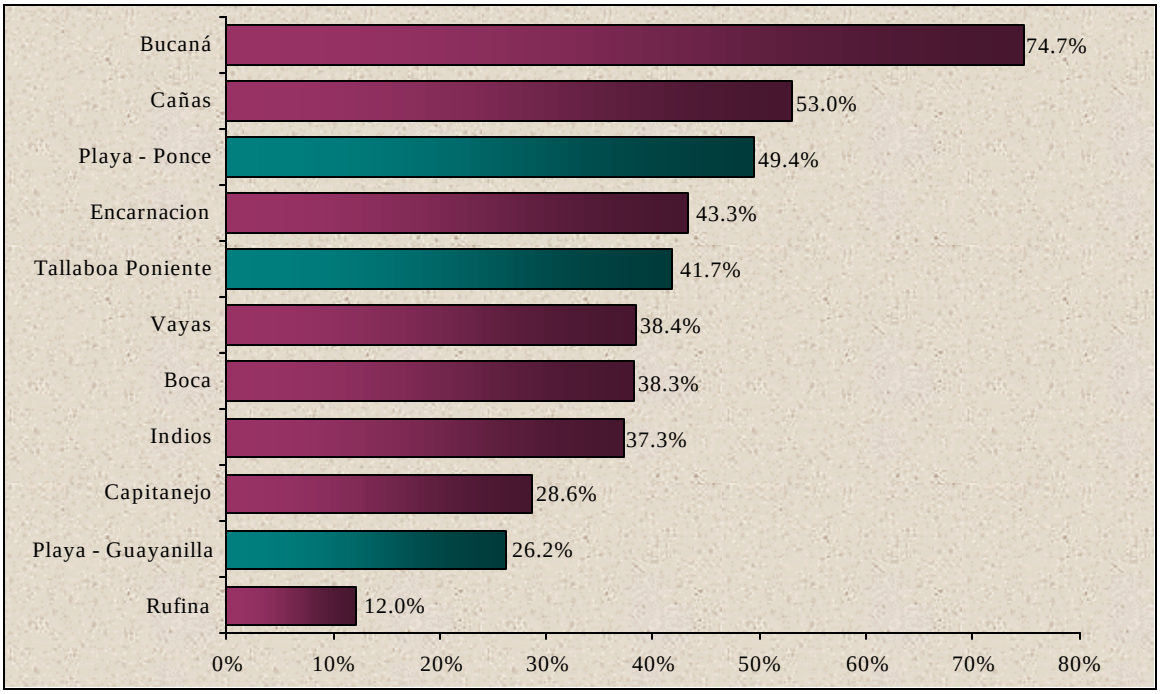
Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-52: Households that Receive Social Security (Percent)

- The Vayas Ward shows the lowest percent of families that receive Social Security benefits. The Playa de Guayanilla and Ponce Wards rank fourth and fifth respectively, with 22.3 percent and 26.3 percent of the families as recipients of Social Security benefits. The Tallaboa Poniente Ward is seventh with 34.1 percent.

3.13.2.4 Education Level

In accordance with the Population Census of 1990, about 50.6 percent of the population in the study area older than 25 years had completed high school. The information evaluated for the corresponding wards is as follows. Corresponding data is presented in Figure 3-53.



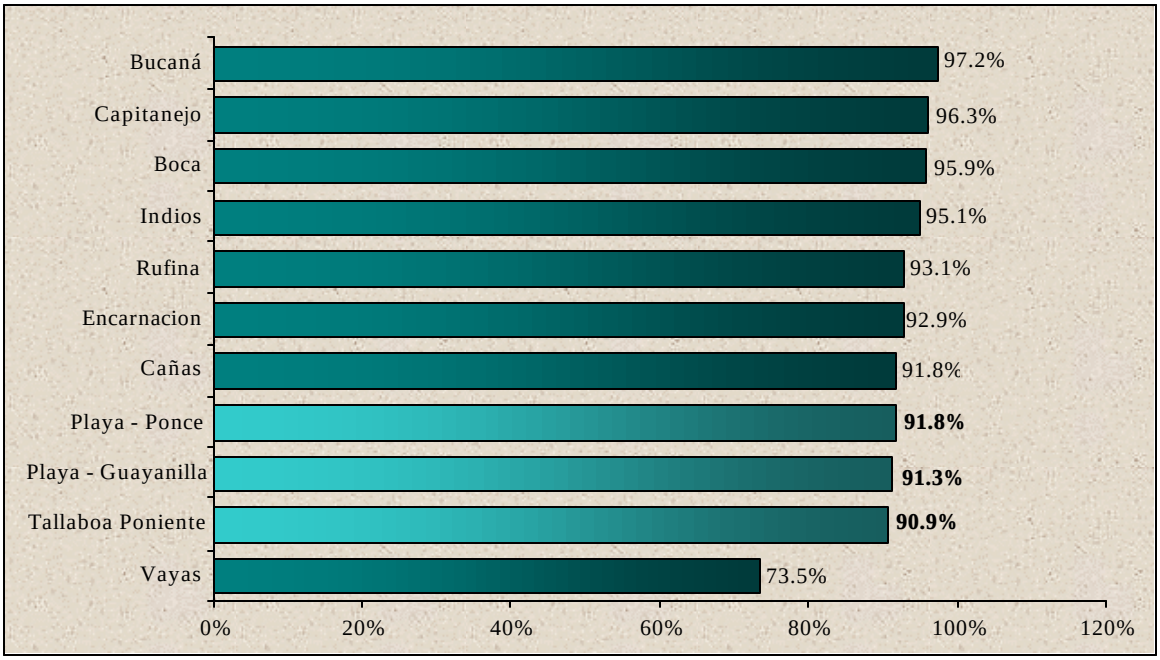
Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-53: High School Graduates (Percent)

- The Playa de Ponce Ward reflects a proportion of high school graduates similar to the study area (49.4 percent), while the Playa de Guayanilla Ward reflects an education level significantly lower than the rest of the study area (26.2 percent).
- The Tallaboa Poniente Ward reflects a level of education similar to the Playa de Ponce Ward, with 41.7 percent.

3.13.2.5 People with Ability to Read and Write

About 92.1 percent of the population in the study area older than ten years could read and write. The pertinent information is as follows. Corresponding data is presented in Figure 3-54.



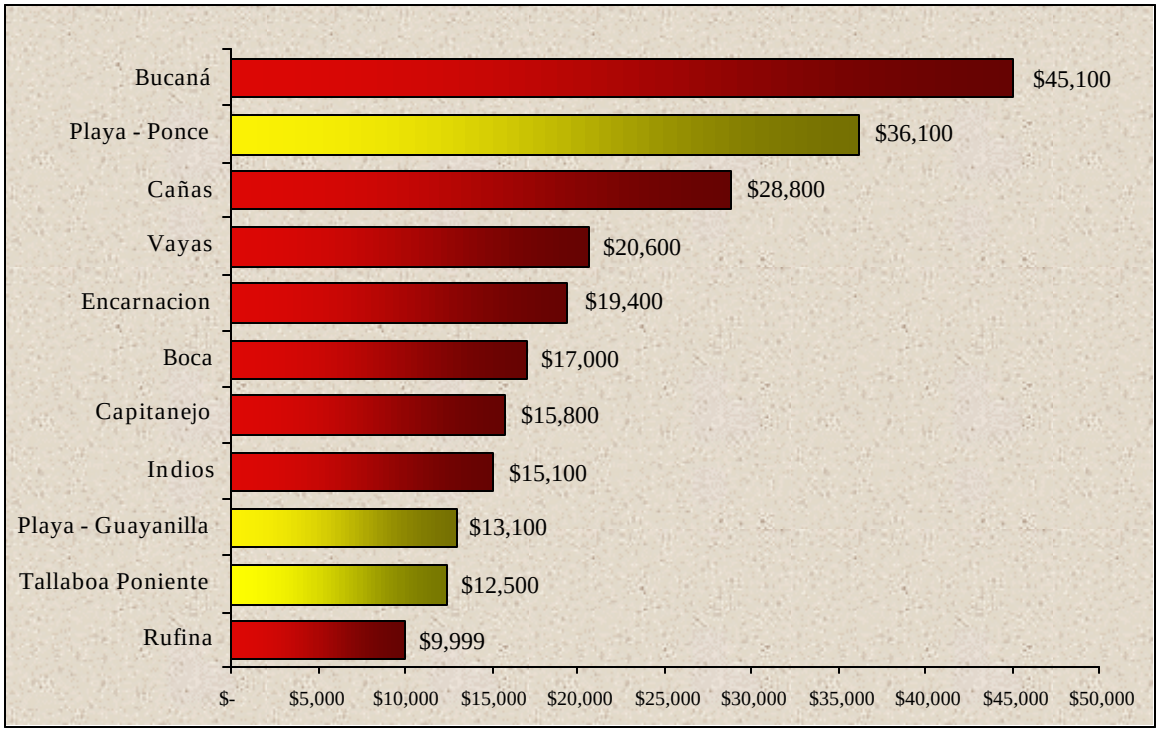
Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-54: People that can Read and Write (Percent)

- The Playa de Ponce, Guayanilla and Tallaboa Poniente wards show similar percents of the population older than 10 years that can read and write, with 91.8 percent, 91.3 percent and 90.9 percent, respectively. The percent for the three wards are similar to the average for the study area, 92.1 percent.

3.13.2.6 Median Value of Housing Units

The following illustration shows the median value of housing units among the wards considered in the study area. Corresponding data is presented in Figure 3-55.



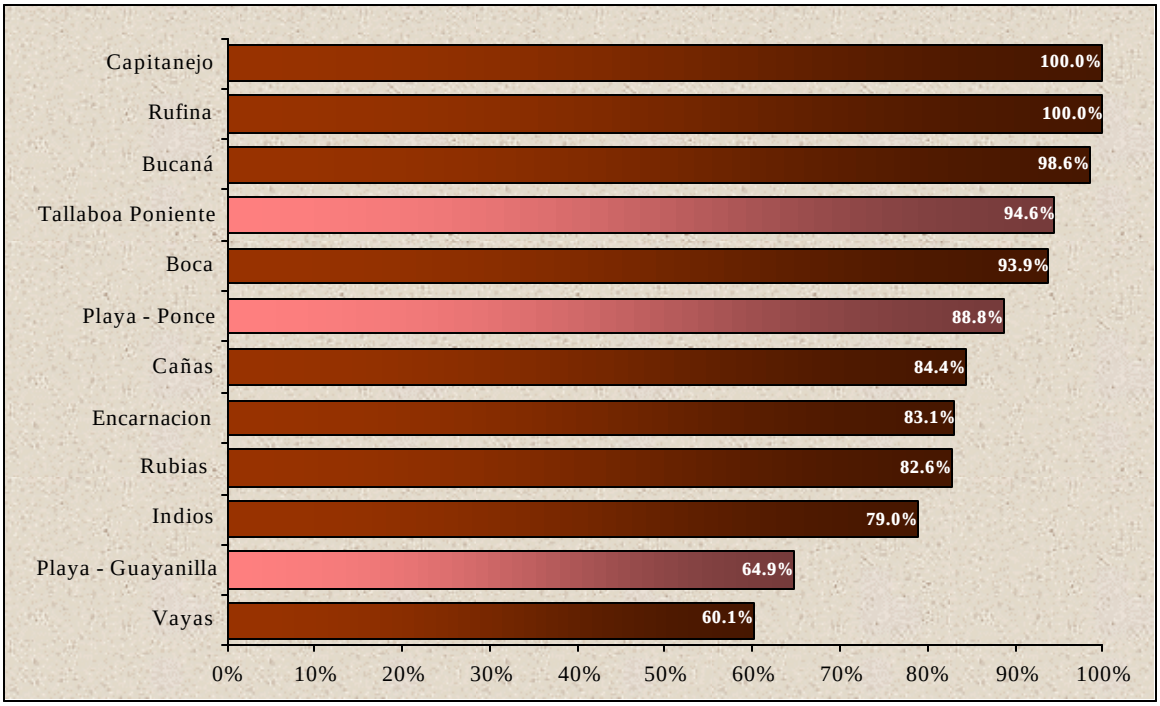
Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-55: Median Value of Housing Units

- About 33 percent of the housing units in the study area were located in the Playa de Ponce, Guayanilla and Tallaboa Poniente wards. For these wards, the median value of housing was $36,100, $13,100 and $12,500, respectively.
- The value for Playa de Ponce Ward was the second highest in the study area, while the median value of housing in the Tallaboa Poniente and Playa de Guayanilla wards were the second and third lowest.

3.13.2.7 Housing Conditions

The following section includes information about the percent of homes that are in adequate condition within the wards studied. Corresponding data is presented in Figure 3-56.



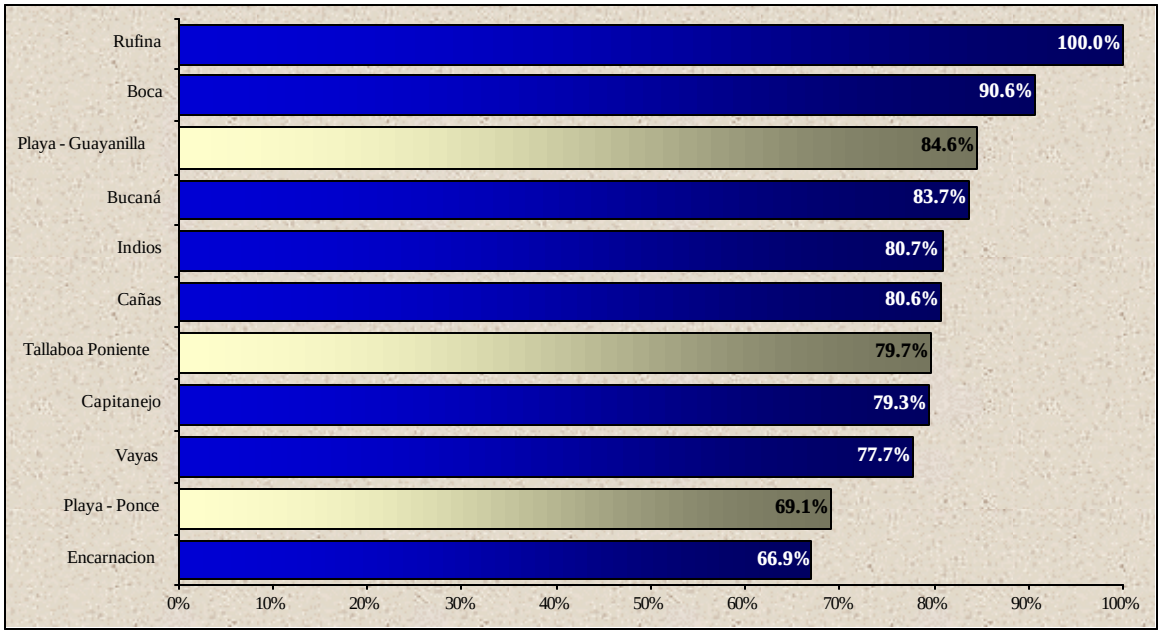
Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-56: Houses in Acceptable Conditions (Percent)

- On housing condition, the Playa de Ponce and Guayanilla wards exhibit percentages of 88.8 and 64.9 of adequate housing, respectively.
- The Tallaboa Poniente Ward reflected a percentage of adequate housing higher that the wards in Ponce and Guayanilla, with 94.6.

3.13.2.8 Housing Occupied by Owner or Rented

Related to occupancy of housing, it was observed that within the study area, about 77.3 percent of the houses were occupied by the owners, while 22.7 percent were rented. The information pertinent to the wards studied is as follows. Corresponding data is presented in Figure 3-57.



Source: Population Census of 1990 de Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-57: Housing Units Occupied by Owners (Percent)

- For this indicator, the Playa de Guayanilla Ward reflected that about 84.6 percent of the houses were occupied by its owners. In the Playa de Ponce and Tallaboa Poniente of Peñuelas wards, this distribution was 69.1 percent and 79.7 percent, respectively.

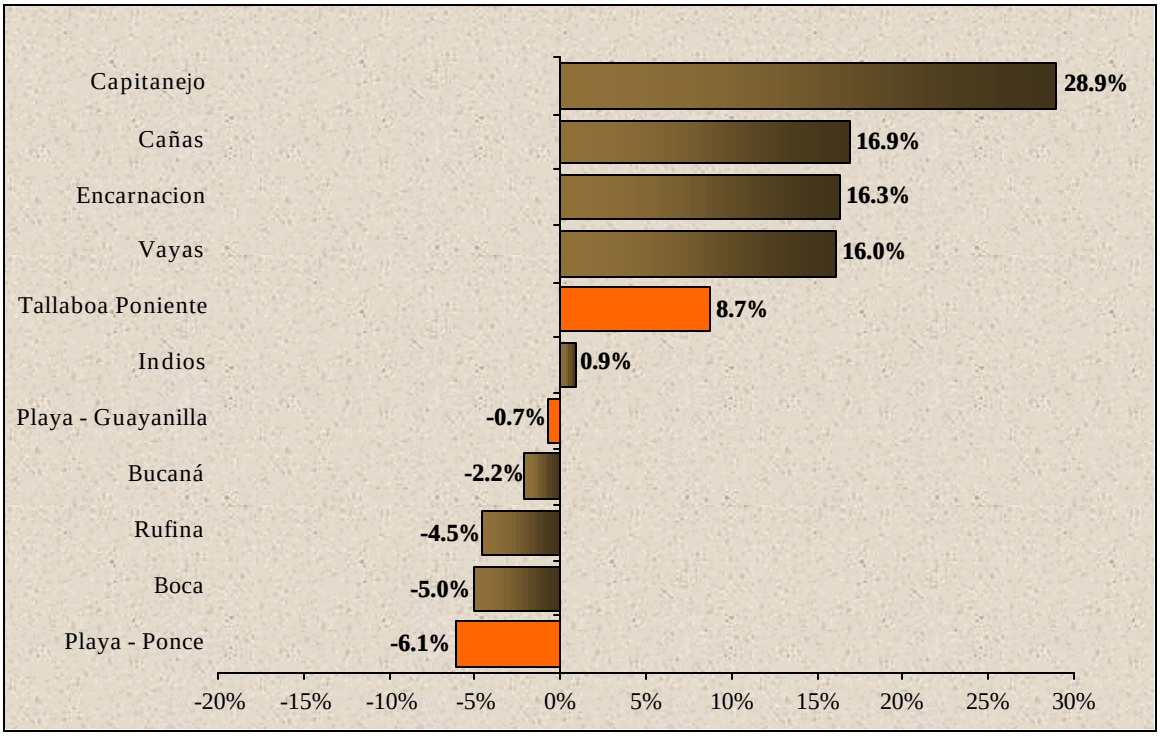
3.13.2.9 Population Growth 1990-2000

The population of the study area increased about 7.3 percent from 1990 to 2000. Data on the population growth for the wards evaluated are included in Table 3-16 and Figure 3-58.

Table 3-16: Population Growth, 1990-2000

Wards	Population 1990	Population 2000	Growth 1990-2000 (Percent)
Capitanejo	1,089	1,404	28.9
Cañas	29,146	34,065	16.9
Encarnación	1,156	1,344	16.3
Vayas	1,153	1,338	16.0
Tallaboa Poniente	641	697	8.7
Indios	2,318	2,339	0.9
Playa (Guayanilla)	1,326	1,317	-0.7
Bucaná	4,053	3,963	-2.2
Rufina	220	210	-4.5
Boca	1,330	1,263	-5.0
Playa (Ponce)	18,027	16,926	-6.1
Study Area	**60,459**	**64,866**	**7.3**

Source: Population Census of 1990 y 2000, and Estudios Técnicos, 2001 (**Appendix O**)



Source: Population Census of 1990 y 2000, and Estudios Técnicos, 2001 (**Appendix O**)

Figure 3-58: Population Growth, 1990-2000 (Percent)

- The Playa de Guayanilla and Ponce wards experimented a negative population growth of –0.7 percent and –6.1 percent, respectively. On the contrary, the Tallaboa Poniente of Peñuelas Ward reflected a population increase of about 8.7 percent, the largest in the study area.
- The lowest population growth occurred in the Playa de Ponce Ward.

3.14 Hazardous, Toxic and Radioactive Waste

The proposed Project includes several sites in Guayanilla, Peñuelas and Ponce that have been or are presently used for light and heavy industrial activities. Hazardous wastes, or chemical products that generate them, have been used or are currently used as a result of this activity. The PTA's development includes the use of land that meets local and federal requirements concerning the management and disposal of this class of materials.

3.14.1 Guayanilla-Peñuelas Area

The Guayanilla-Peñuelas area consists of the sites adjacent to Punta Gotay Peninsula, and part of the site presently owned and occupied by the Union Carbide Caribe Limited Liability Company (UCC LLC, or UCC) petrochemical complex, presently inactive, located in Tallaboa Poniente Ward, Peñuelas. This site is bounded to the north by State Road PR-127, South Pearl Chemical, Commonwealth Oil Refining Company, Inc. (CORCO) and the Gulf Chemical Corporation. Located to the east are the Río Tallaboa, vacant land lots, and sites adjacent to CORCO. Located to the south are the Tallaboa Bay, as well as the Peerless Oil & Chemicals and EcoEléctrica properties. To the west, the Guayanilla Bay and CORCO land properties bound the project area.

Land uses in the site and in the vicinity of the Guayanilla-Peñuelas area are predominantly industrial. This is a developed urban area with paved roads. Value-added manufacturing factories and future port areas are located in the UCC site, which used to be a petrochemical manufacturing facility and is presently out of operation, except for a small product distribution terminal. UCC developed approximately two thirds of the site since 1959. Most of the structures and facilities associated with previous operations have been partially or totally dismantled and removed. Some foundation structures, equipment, and demolition debris remain at the site. Paved and dirt roads that were constructed to operate the facility still exist. Five buildings are still standing, one of them accommodates the administrative offices (north of the site), two are used for the Waste Water Treatment Plant operations, and the two remaining buildings (located at the center and southwest of the site) are vacant.

At present, UCC industrial activities are limited to the operation of a groundwater recovery system, several above-ground storage tanks, and a terminal that supplies trucks with alcohols, solvents, acetates and monomers for distribution to UCC clients. These facilities are located to the southwest of the site in Punta Gotay. There are wharf, fire control, tanks and pipeline facilities, which are some in use and some out of operation. Moreover, UCC allows the right of way for pipelines transporting raw water for fire control, LNG, and other substances used for adjacent facilities. There are also three raw water tanks, located approximately at the center of the site.

According to an UCC representative, the site has active electric power and fresh water connections. The electric power system support conduits and the water pipelines that supply adjacent facilities are in operation. Approximately from six to seven electrical power substations operate throughout the facility.

Other activities at the UCC site include maintenance operations and an on-going environmental restoration effort that the company carries out under the supervision of the EPA. These activities include the removal of hydrocarbons and other petrochemical materials from the soil and groundwater, and have been in effect since the mid 1980s. EPA published for public comment the preliminary draft of the RCRA Part B Permit for the operation of hazardous Solid Waste Management Units (SWMUs) inside the UCC site. These units are being remedied

either with a groundwater collection and treatment system, or by means of physical and institutional controls. In addition, some of these areas were identified as potential candidates for undergoing Corrective Actions.

As proposed in the preliminary draft of the RCRA Part B permit issued by EPA's Region II for public comment (June 14, 2001), there are 36 Solid Waste Management Units (SWMUs) in the UCC facility, all at different action stages. All of the determinations described in the referenced preliminary draft are subject to the final approval by EPA, which is expected to occur once the public comment submittal period is finished. Figure 3-59 shows the location of these units. According to the present status of the actions described in the preliminary draft, the most relevant SWMUs for the Project are summarized in Table 3-17. Figure 3-60 shows the general remediation status of the entire UCC parcel based on a recent survey provided by the Dow Chemical Company and the latest data from EPA.

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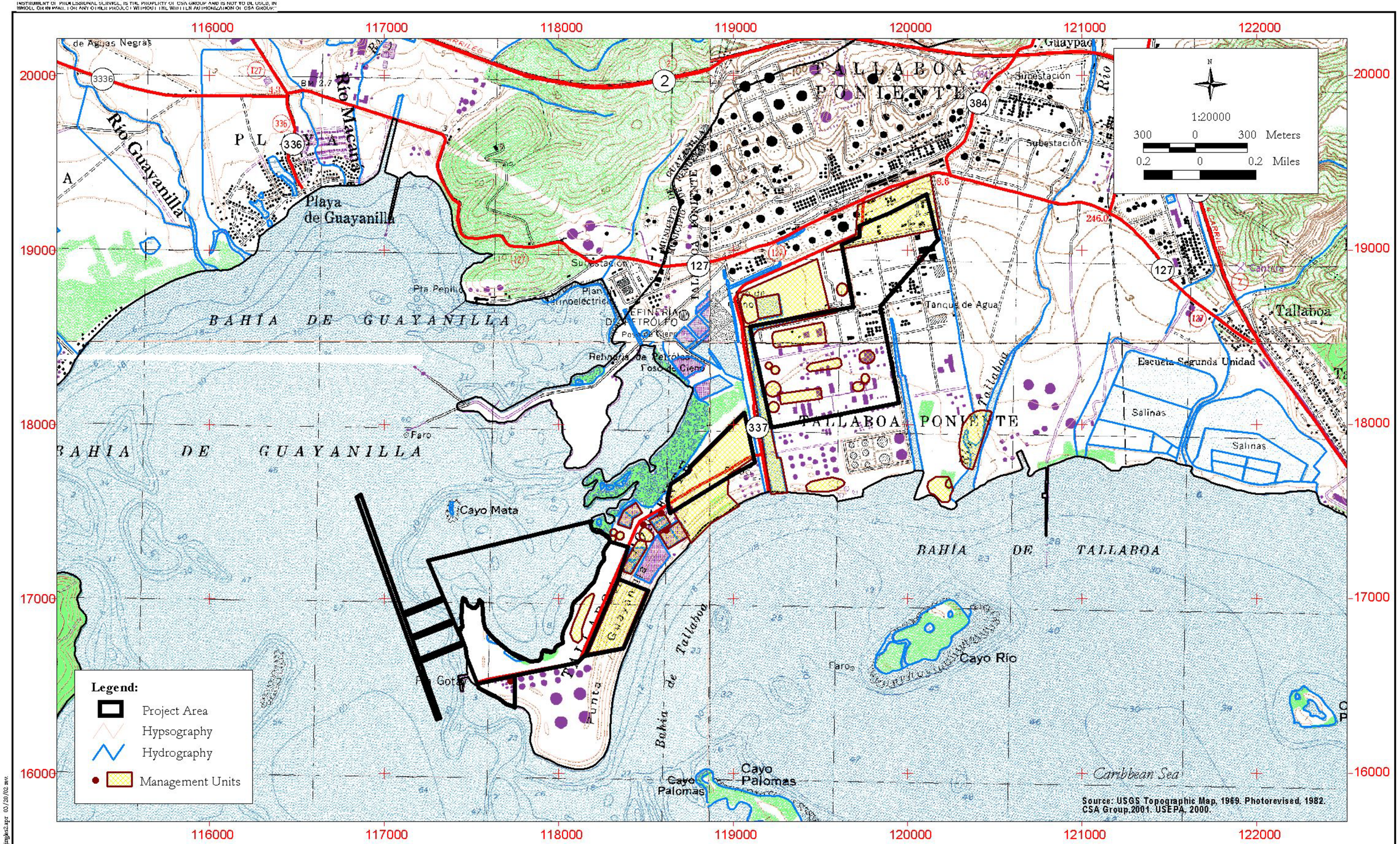


Coordinates in State Plane NAD 27

Figure 3-59 Solid Waste Management Units in the UCC: Guayanilla-Peñuelas Area

Port of the Americas

Table 3-17: Summary of SWMUs Remediation at the Union Carbide Caribe LLC Site[x]*

SWMU Number	SWMU	Status
1	Incinerator	No further corrective action required
2	Underground lines in phenol/acetone	Undergoing investigation
3	Underground lines at energy systems units	Undergoing investigation
4	Underground area of organics contamination (was taken off the SWMUs list in the 1988 application, was reclassified as AOC1)	Contamination from offsite source
5	North cooling water return lateral canal	Undergoing investigation. One section has been partially filled and is included in groundwater pumping system.
6	Polyethylene area	No further corrective action required
7	Río Tallaboa landfill	No further corrective action required
8	Carbon Ponds	No further corrective action required
9	Dredge material small boat landing– Area A	No further corrective action required
10	Dredge material energy systems – Area B	No further corrective action required
11	Dredge material north of Peerless - Area C	Institutional and physical controls are required
12	Dredge material Playa Tank / Olefin Flare - Area D	Undergoing investigation
13	Dredging material near the Río Tallaboa landfill – E area	No further corrective action required
14	Dredging material west of the wastewater treatment plant (WWTP)	No further corrective action required
15	Diprolene pond	Closed. Requires ground water pumping
16	Container storage / Warehouse area	Closed[1]
17	Environmental Protection Department residue storage tanks	Closed[1]
18	Phenol Acetone Unit residues storage tanks	Closed[1]
19	Energy Systems Unit tanks	Closed[1]

SWMU Number	SWMU	Status
20	Industrial landfill	Active. Requires ground water pumping
21	Dewatered sludge landfill	Closed
22	Primary solids ponds	Closed[2]
23	Equalization basins	Undergoing investigation
24	Filter presses	Closed
25	Aeration basin Number 1 (west)	Undergoing closure
25	Aeration basin Number 2 (east)	Undergoing closure
26	Ground burners	Closed[1]
27	WWTP influent sewer leakage	Undergoing investigation
28	Chemicals addition station sump leakage	No further corrective action required
29	Glycol unit sewer release	Undergoing investigation
30	Stormwater control pond	Active. Requires ground water pumping
31	Old anaerobic basins	No further corrective action required
32	Old ground burners	No further corrective action required
33	Puntilla disposal area	No further corrective action required
34	Puntilla tank 1501	No further corrective action required
35	Hydrotreater area	Undergoing investigation
36	WWTP effluent pipe leak	No further corrective action required

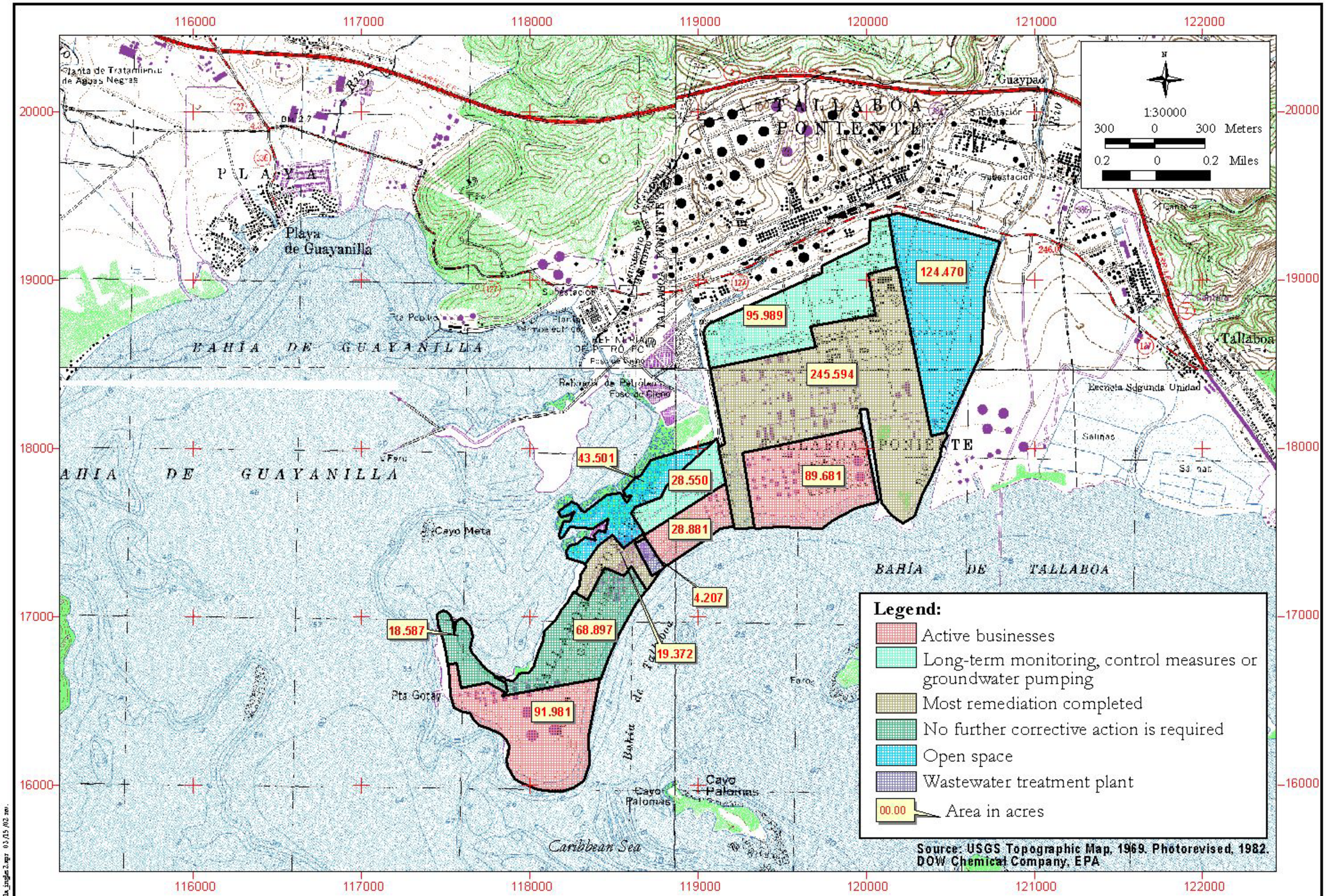
Source: CSA Group, 2000

[1] Verification sampling required. Additional action would be required only if the verification sampling shows that there is contamination.

[2] UCCLLC must continue operation of a groundwater recovery well until the applicable groundwater protection standard is met at this well location.

[×] It is expected that research, closings and additional verification sampling will be completed in a 2 to 4 year period, assuming that (1) the RCRA permit is granted in 2002, (2) the property will be developed as a “Brownfield”, (3) the relevant agencies approve work plans and reports expeditiously, and (4) no unexpected new significant concern elements are identified.

[*] SWMUs 1, 5 (open section, effluent canal), 12, 17, 21, 22, 23, 24, 25, 26, 27, 31, 33, 34, and 36 are not located in the proposed Project area.



Coordinates in State Plane NAD 27

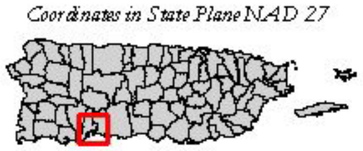


Figure 3-60 Remediation Status: Guayanilla-Peñuelas Area

Port of the Americas

Records exist on the UCC facility under the following state and federal environmental databases, as preliminarily revised:

- Toxic Substances Control Act (TSCA). This database identifies manufacturers and importers of chemical substances included in the TSCA Inventory of Hazardous Substances. The facility is registered with the physical address State Road PR-127 Km 8.5, Peñuelas, Puerto Rico.

- Underground Storage Tanks Facilities (UST) of the Commonwealth of Puerto Rico. The source of this database is the EQB. The facility is registered as UCC, Guayanilla Plant, and has ceased operations, according to the database.

- UCC shipping address (State Road PR-127, Km. 17.3) is registered twice in the Emergency Response Notification System (*ERNS*) database. The source of this database is EPA/NTIS, which compiles and records information on reported petroleum and hazardous substances releases.

- Envirofacts database list of facilities regulated by the EPA. The facility is registered twice in this database. It indicates that the facility has permitted discharges to receiving water bodies, and it also reports toxic releases and releases to the atmosphere. In addition, the database reflects that the facility has a risk management plan, and handles toxic substances.

There are petroleum products refining, processing and storage facilities, petrochemical facilities and power generation facilities in the Project vicinity. Commonwealth Oil Refining Corporation (CORCO), a petroleum refining facility currently out of service, is located adjacent to the north, east and west of the proposed project site. Present activities at the CORCO facility are limited to the storage of petroleum products. In a preliminary revision of environmental information databases, CORCO was found registered in the following lists:

- Facility Index System/Facility Identification Initiative Program Summary Report (*FINDS)*: the EPA compiles this database system. FINDS contains both facility information and links to other sources that contain additional details. Additional FINDS databases in the EDR report are: DOCKET (DOCKET Compliance System, used to search information on civil judicial compliance for all the environmental requirements), National Compliance Data Base (NCDB) and Permit Compliance System (PCS).

- Resources Conservation and Recovery Information System (*RCRIS*): RCRIS is compiled by the EPA, and it includes selective information on sites that generate, transport, treat and/or dispose of hazardous wastes as defined in the Resource Conservation and Recovery Act (RCRA). CORCO is registered as a Large Quantity Generator (LQG), as a Treatment, Storage and Disposal Facility (TSD), and as a Hazardous Wastes Transporter. This database reflects that CORCO is a high priority violator, with 12 violations registered. Violations are related to ground water monitoring requirements, TSD Closure and Post-closure requirements, and other requirements, all of them related to a TSD facility.

- Corrective Action Report (*CORRACTS*): This database is compiled by EPA, which identifies hazardous wastes handlers with RCRA corrective action activity. CORCO is classified as a high priority facility under CORRACTS, and its document submission status is summarized as follows: RCRA Facility Assessment Completed, Determination of Need for a RCRA Facility Investigation

(RFI), RFI Imposition, RFI Workplan Approved, Stabilization Measures Evaluation, Stabilization Measures Implemented.

- Underground Storage Tank (UST): CORCO owns a UST facility, facility identification number is 2-940152, and notification is new.
- Leaking Underground Storage Tanks (*LUST*): The EQB compiles this database, and its records contain an inventory of the reported leakage from underground storage tanks. The facility identification number under LUST database is the same as the identification number of the UST database (2-940152). A leak that took place on May 18, 1999 during a tank removal is registered in this database. The closing date of the LUST report is not indicated.
- ERNS: CORCO Bay, Guayanilla, Puerto Rico
- Envirofacts: CORCO is identified as a facility with permits for discharges to water bodies and a Risk Management Plan. It is also identified as a hazardous waste handling facility.

South Pearl Chemical, a now-abandoned chemical manufacturing facility was dedicated to sulfonation and oleochemical operations, is located north of the proposed site. The Company made soaps and detergents and went out of business in February 1997. Chemicals left at the facility include xylene compounds, #5 oil, diesel fuel, lab chemicals, caustics, flammables, and contaminated soil. The site is eligible for a removal action. South Pearl Chemical is registered as a facility that reported toxic substances releases under the list of facilities regulated by the EPA in Envirofacts. It is also registered in this database as a hazardous wastes handler.

The Costa Sur Power Generation Plant, owned by the Puerto Rico Electric Power Authority, is located far west of CORCO facilities. EcoEléctrica, also a power generation plant, is located south of the proposed site. This facility consists of a liquefied natural gas receiving wharf and a co-generation plant. Peerless Oils & Chemicals Inc., which is a petroleum products refining, storage, mixing, and distribution facility, is located south of the proposed site.

3.14.2 Ponce Area

The Ponce component of the PTA consists of various parcels currently occupied by the Port of Ponce, as well as approximately 132 acres of adjacent lands. The Port of Ponce is located at the end of State Road PR-14, near Punta Peñoncillo. State Road PR-52 borders this portion of land on the north; bordering to the east is a residential area known as Villa del Carmen as well as vacant lots. Several industrial warehouses, a free port zone and industrial facilities are located south of the site. The residential sector of Playa de Ponce, additional warehouses (both active and abandoned), auto and general equipment repair shops, commercial establishments, and a metal recycling facility lie to the west.

- According to the Puerto Rico Ports Authority (PRPA), the development of what today is known as the Port of Ponce began around 1911, with a basic setup to handle mostly bulk cargo. During the 1940's the port area grew significantly. During the sixties and seventies, the port expanded its land area and berthing infrastructure, and gradually shifted the type of cargo it handled to incorporate and expand container traffic, reducing the bulk cargo activities. This transition resulted in the overall improvement of the facilities to accommodate gantry cranes as well as additional storage and transit areas.

- In the Ponce project area, the land uses are predominately industrial in nature. These uses are mostly associated to the main operation of the Port of Ponce, the second largest dry-cargo commercial port in the Island. The lot includes areas for loading and unloading merchandise, storehouses, support facilities, and a metal recycling operation. These operations occupy the southwest portion of the site along with the administrative offices, parking and terminal facilities of the PRPA. A radio station and a cardboard recycling facility are located to the west of the site and just north of the port facility.

- Two vacant lots are located north and east of the parcel, respectively. These lots are mostly composed of grasslands and wetlands. A storm water drainage channel passes through these areas. Located to the southeast are the administrative facilities of the Luis Ayala Colón Sucrs. (LACS) ship and stevedoring company. Also, Empire Company Inc., which rents and repairs heavy equipment, and supports LACS, is located in this portion of the proposed area for the PTA. Chemex Corp., a company devoted to the distribution of industrial chemicals, which are handled in-house by a railway and wagon system is located to the south. A portion of a water treatment plant located at the former National Pack Company is also located at the southern sector of the parcel.

- The land located near the Ponce component of the PTA is dedicated to various uses. These uses include industrial (mostly warehousing operations), recreational areas, hotels, and residential complexes. State Road PR-52 bounds the parcels on the north. Several warehouses, areas for loading and unloading merchandise, and a free port industrial zone, are located south of the parcel.

- Some of the facilities that can be found in this sector include the receipt area of the Ponce Cement Company, Romaguera & Sons, PR Fuels (propane and molasses), Liquilux Gas Corp. (liquefied petroleum products), Aljoma Lumber (wood warehouse), Leopoldo Fontanillas (shipping and stevedoring brokerage), and the former Caribe Tuna.

- The recreational area of La Guancha and the Club Náutico de Ponce are located south of the proposed parcel. The Ponce Hilton and a residential development (Villa del Carmen) are located to the east. The Caribbean Sea and the commercial and residential sector of Playa de Ponce are located west of the property. The commercial area accommodates old warehouses that have been renovated to house car repair shops, commercial businesses, and government offices, among others.

A screening of the environmental databases of the area showed that two of the operations in the area are listed by the EPA Envirofacts database as hazardous waste handlers:

- PR Ports Authority-Ponce, 506 St. & 1, Ponce, Puerto Rico.
- Chemex Corp, State Road PR-10 Km. 1 Pier 7, Playa de Ponce, Puerto Rico.

3.15 Dredging and Disposal of Dredged Material

The proposed action contemplates both dredging and filling operations in the Ponce and Guayanilla sites, respectively. This section discusses historical actions related to these activities in the proposed parcels.

3.15.1 Guayanilla-Peñuelas Area

No recent or historical large-scale dredging operations have taken place at the vicinity of the Guayanilla-Peñuelas project site. Both CORCO and UCC have performed dredging operations in the past to accommodate their industrial operations. However, these actions have impacted areas outside the proposed project site. Additionally, the Guayanilla Bay main navigation channel has never been dredged.

Filling activities in the Guayanilla Peninsula area are documented since the 1950's when full development of what would become the south coast petrochemical complex was initiated. Historical aerial photographs show that extensive filling of wetlands located in Punta Guayanilla and Punta Gotay occurred as part of the development of the parcels now occupied by the former Union Carbide Caribe site. Also, segments of the wetlands located north of the proposed site in Guayanilla were filled as part of the development of the CORCO complex and the construction of two piers for said facility.

3.15.2 Ponce Area

A dredging project for Ponce Harbor was authorized by resolutions of the Senate and House Public Works Committees on October 1, 1976 and September 23, 1976 respectively, under provisions of Section 201 of Rivers and Harbors Act of 1925, as amended (PL 89-298). The project authorization provided for a 600-foot-wide by 36-foot-deep channel from the Caribbean Sea to Ponce Harbor, thence a 400-foot-wide by 36-foot-deep channel into the harbor. It also provided for a 36-foot-deep irregular-shaped turning basin with a diameter of 950 feet; and the de-authorization of an 18-foot project area outside the authorized project limits. About 1,200,000 cubic yards of material were excavated from the harbor and transported to Ponce's interim offshore disposal area. Excavation was by barge-mounted dragline and clamshell scoops, with material placed on bottom-mounted barges or scows for removal to the disposal area.

Dredging started in December 1988 and was completed in April 1989. The total length of the project was 3.4 miles. Modification of the harbor was considered necessary to provide safer navigation for existing traffic and to accommodate deeper draft bulk lumber vessels and containerships resulting from new port construction and expansion of existing facilities. Construction dredging was based on two vessel sizes, a 30,000 d.w.t. bulk cargo carrier 635 feet long and 84 feet wide, and a 10,000 d.w.t. containership with a length of 520 feet and a beam of 72 feet.

A site designated as the Ponce Ocean Dredged Material Dumping Site (ODMDS) for the Ponce Harbor is located at least 4 nautical miles from the nearest coastline or any significant breeding, spawning or nursery habitat of coastal living resources. There is no evidence to suggest that the site has any unique importance to feeding or passage areas of biota because it is typical of nearby well-flushed open ocean locations (EPA, 1988).

No recent or historical large-scale filling operations have taken place at the vicinity of the Ponce site.

3.16 Navigation

This section describes the physical setting for navigation at the proposed Project sites. These include port physiography, actual conditions, current industrial and port operations, transit characteristics, and safety stipulations. The Applicant also performed a Marine Safety and Risk Assessment to assess the potential risks associated with the increase in maritime traffic that would be brought about by the Project. Please refer to Appendix AA for additional details on this effort.

3.16.1 Port of Guayanilla

Guayanilla Bay, located about 25 miles east of Cabo Rojo, is considered one of the best and largest ports in Puerto Rico, and safest during a hurricane. Punta Guayanilla defines the port to the east and Punta Verraco to the west, and its entrance is protected by extensive coral reefs located more than one mile from the coast. The eastern side of the Port is part of the industrial complex of Tallaboa Bay, where large ships moor to load and unload bulk petroleum and chemical products. Most of the maritime traffic travels to four principal piers:

- Peerles Oil and Chemical
- CORCO
- Texaco
- EcoEléctrica

The navigation channel that allows passage to the bay is located in between shallow water areas that extend about one half mile from Cayo María Langa to the east, and by shallow areas that extend about 1.4 miles from Punta Verraco to the west. The channel, with a depth exceeding 53 feet, is marked with illuminated buoys and a navigation target illuminated from land and adjusted to a bearing of 358 degrees. The northern extreme of the bay includes two secondary channels that provide access to the old PPG pier and to the Texaco pier. These channels have a depth from 35 and 37 feet, respectively, and are maintained by the private sector. The CORCO pier, east of the entrance to the PPG channel, has access through water with a draft of 31 feet. The piers owned by Peerless Oil Chemical and by EcoEléctrica are located on the southern extreme of the bay, at Punta Gotay and Punta Guayanilla, respectively.

Pilot service is mandatory for all vessels, either foreign or U.S., documented at the time of entering or leaving the port. The pilot service is supervised and directed by the local Captain of the port, attached to the Puerto Rico Ports Authority (PRPA). In general, vessels are boarded by the pilot at one mile from the buoys marking the entrance to the port. It takes at a minimum two hours of prior notification to coordinate the pilot services, which can be contacted through the frequencies of 2,182 and 2,738 kilo Hertz (kHz).

The maritime traffic in the Guayanilla and Tallaboa bays consists primarily of ships, towboats and barges. During the years from 1996 to 2000, both bays experienced a traffic volume of 2,331 operations, with an annual average of 466 operations. In year 2000, Texaco transferred its operations to the CORCO pier. This same year the CORCO pier had 307 operations combined between ships, barges and towboats. Tables 3-18, 3-19 and 3-20 summarize the operations of the Port during the last few years.

EcoEléctrica began operations at the Port of Guayanilla in 1999. Currently, it operates a 1,721 feet-long pier in the southern end of Punta Guayanilla, where LNG is discharged for use as fuel for the operation of the co-generation power plant. The pier is designed to accommodate large

ships exceeding 930 feet in length, with a breath of 140 feet and drafts of 33 to 36 feet. The plant has two storage tanks, LNG with a capacity to store one million barrels each.

Currently, the installation receives an average of two cistern ships monthly. On April 27, 2001 the Coast Guard amended Section 3, Part 165 of the Code of Federal Regulations (33 CFR Part 165) to include the procedures that will be required for LNG cargo vessels docking at the EcoEléctrica pier, as well as restrictions for the facilities adjacent to this port during transfers of LNG.

The new procedures include the definition of two safety zones, a fixed one and a moving one:

- The moving safety zone defines a radius of 100 yards around the LNG cargo vessel while transiting north of Latitude 17 degree 56.0 N on approach to or departure from the EcoEléctrica waterfront facility in Guayanilla Bay. This moving safety zone remains in effect until the LNG vessel is alongside the EcoEléctrica waterfront facility in Guayanilla Bay or south of Latitude 17 degree 56.0 N.

- The fixed safety zone is established in the waters within 150 feet of a LNG vessel when the vessel is moored at the EcoEléctrica waterfront facility. This Safety Zone remains in effect while the LNG vessel is docked at the facility with product aboard or while the vessel is transferring liquefied natural gas.

Also, as a result of the September 11, 2001 attacks, the USCG has established a new measure where vessels have to give a 96-hours advance notice before arriving to port. The Coast Guard Safety Office in San Juan will be responsible for public information and will issue maritime information broadcasts or notifications to the public that specify for which periods the safety zones would be in effect.

Table 3-18: Traffic of vessels, barges and towboats in the Guayanilla and Tallaboa bays

Month	1996	1997	1998	1999	2000	TOTAL
January	-	29	43	28	30	130
February	-	25	49	48	24	146
March	-	33	39	62	35	169
April	-	37	53	58	20	168
May	38	30	59	45	42	214
June	38	49	55	42	45	229
July	56	43	46	58	45	248
August	47	34	52	29	43	255
September	45	50	43	59	37	234
October	40	51	43	43	44	221
November	37	44	47	50	-	178
December	39	47	38	45	-	169
Total	**340**	**472**	**567**	**587**	**365**	**2331**
Average	42	39	47	49	36	214

Source: PR Ports Authority

Table 3-19: Traffic of vessels, barges and towboats at the Punta Gotay Pier

Month	1998	1999	2000	Total	Average
January	5	4	4	13	4
February	4	7	4	15	5
March	5	9	4	18	6
April	7	8	5	20	6
May	9	6	5	20	6
June	5	6	8	19	6
July	6	7	6	19	6
August	9	10	7	26	8
September	4	8	4	16	5
October	8	7	5	20	6
November	9	8	6	23	7
December	6	13	-	19	6
Total	**77**	**93**	**47**	**217**	**72**
Average	6	7	4	18	6

Source: PR Ports Authority

Table 3-20: Movement of ships and barges in the CORCO Pier

Month	1998	1999	2000
January	33	15	30
February	32	14	18
March	30	13	28
April	33	19	29
May	32	27	37
June	33	31	37
July	36	31	30
August	25	30	32
September	28	24	32
October	22	23	34
November	24	29	-
December	19	20	-
Total	**347**	**276**	**307**

Source: CORCO, 2001

3.16.2 Port of Ponce

The Ponce Bay is the most important commercial port in the south coast of Puerto Rico, and the second largest in volume of commercial dry cargo in the Island. The bay is protected against the prevailing trade winds from the east by Punta Peñoncillo and Isla de Gata, and by nearby coral reefs, but is exposed to the southern swells. The port installations are located to the east of the bay, which is about 3.5 miles wide.

The principal entrance to the port is located to the east of Isla Cardona, and consists of a navigation channel 600 feet wide and 36 feet deep. An interior channel, 200 feet wide and 36 feet deep, traverses towards a turning basin of circular shape, with a diameter of 950 feet. The entrance channel is marked with navigation buoys and an illuminated navigation target adjusted to 015 degrees. A mooring area with depths that fluctuate between 30 to 50 feet occurs northeast of Isla Cardona, while a second one occurs to the northeast of Las Hojitas, with depths averaging between 30 and 40 feet.

The Port of Ponce handles principally general cargo, wood, coal, liquids, and steel. Its installations cover an area of approximately 315 acres, and include among others, 9 piers, 6 terminal buildings, parking and open areas as well as a crane to load and unload containers. The traffic is composed of ships, barges and tugboats. During Fiscal Year (FY) 1998-99, the port completed 329 combined operations, while it had 310 during the 1999-2000 FY. Cargo ships represent the largest operations, with an average movement of 16 ships per month. Table 3-21 summarizes the movement of vessels for the period 1998 to the present day.

Table 3-21: Vessels Movement at Port of Ponce during 1998-2000

Month	Ships	Barges	Tugboats	Total	1998-99	1999-2000
July	14	3	3	20	26	29
August	18	2	2	22	21	34
September	12	2	2	16	21	31
October	15	3	3	21	23	28
November	14	3	3	20	27	24
December	14	2	2	18	28	26
January	13	6	5	24	22	23
February	12	4	5	21	32	24
March	14	3	3	20	32	21
April	16	1	1	18	32	23
May	-	-	-	-	32	23
June	-	-	-	-	33	24
Total	142	29	29	200	329	310

Source: Municipality of Ponce

3.17 Infrastructure

This section describes the existing infrastructure in the Project area, including port facilities, potable water supply, wastewater, stormwater collection systems, electricity, roads and highways, solid waste and other utilities.

3.17.1 Existing Port Facilities

Guayanilla Port: The Guayanilla Port is a specialized port, located 7.5 miles to the west of the Port of Ponce, within the Guayanilla Bay. The bay offers the greatest protection against the potential impact of hurricanes on the Island, and is considered as one of the best sites for a port (Ports Authority, 1991).

The Guayanilla Port is located between Punta Verraco at the east and the industrial zone of Punta Guayanilla west. The industrial zone is protected by a vast reef, which borders the east and west sides of the entrance. These reefs extend out to sea for more than a mile. The eastern part of the bay is completely industrialized and includes the Costa Sur power plant operated by PREPA. The bay also includes a pier with two docks and anchorage buoys for the delivery of oil products shipped by CORCO, and additional piers at the UCC complex, which are basically inactive. The Punta Guayanilla Peninsula separates the Guayanilla Bay from the Tallaboa Bay to the east, and includes the Tallaboa piers, where large ships load and unload oil and chemical products in bulk.

Also, the EcoEléctrica cogeneration power plant, operates its facilities in the Punta Guayanilla Peninsula. EcoEléctrica is located in the southern part of Punta Guayanilla, and includes a new pier, with more than 1,700 feet in length at a depth between 55 and 65 feet, used for the delivery of LNG. The remaining port terminals have a draft of 30 to 46 feet. The navigation chart of the area (NOAA Chart 25681) shows variations over 100 feet depth along the channel entrance line, fluctuating more than 100 feet close to Buoy 1, up to 66 feet close to Buoy 3, at the beginning of the channel that leads to the PPG (Pittsburgh Plate Glass) industry pier, in the northern sector of the bay. During the environmental studies conducted for *EcoEléctrica* (Earth Measurements Corp., 1994), depths greater than 100 feet were recorded.

The Port Captain, under the jurisdiction of the Puerto Rico Ports Authority, controls the Guayanilla Port operations. Pilot services are offered at the port during day and night hours. The customhouse services are under the jurisdiction of the Ponce Customhouse Offices.

Port of Ponce: The Port of Ponce is the second largest commercial dry cargo port in Puerto Rico (Port Authority, 1991). The Port is protected from the trade winds from the east by reefs that surround the bay, by the Isla de Gata to the southeast, and by the Isla de Cardona to the southwest. The bay is exposed on the south side, which makes it susceptible to winds and swells under certain climatological conditions, such as hurricanes.

The Port of Ponce is property of and is operated by the Municipality of Ponce. The Port includes a 610-feet-long container dock capable of accommodating vessels up to 800-feet long, and six general-cargo berths. The port also operates two specialized berths to unload coal and to manage rail freight. These nine berths have a total linear length of approximately 4,362 ft.

The Port Captain, under the jurisdiction of the Puerto Rico Ports Authority, controls the Port of Ponce operations. Pilot services are offered at the port during day and night hours. The customhouse services are under the jurisdiction of the Ponce Customhouse Offices.

3.17.2 Potable Water Supply

Potable water is produced by PRASA at several filtration plants and deep wells in the municipalities of Guayanilla and Peñuelas. The total potable water production at these facilities (Table 3-22) is approximately 6.66 million gallons per day (MGD).

Table 3-22: Average Water Production for Guayanilla-Peñuelas Urban Areas Years 2000-2001

Municipality	Facility	Total Capacity, MGD[1]	Average Production, MGD[1]
Guayanilla	Wells	2.96	2.55
	Jagua Pasto Filtration Plant	0.25	
SUBTOTAL		3.21	2.55
Peñuelas	Peñuelas Filtration Plant (Old)	1.20	
	Peñuelas Filtration Plant (New)	1.20	
	Wells	0.00	
	Rural Water Filtration Plants	1.05	
SUBTOTAL		3.45	2.92
TOTAL		**6.66**	**5.47**

[1] Data compiled by CSA Group, 2001.

In the Municipality of Ponce, PRASA facilities supply about 34.72 MGD from filtration plants and deep wells. Table 3-23 shows the total water production at each of the Ponce facilities.

Table 3-23: Average Water Production for Ponce Urban Area, Years 2000-2001

Municipality	Facility	Average Production, MGD[1]
Ponce	Ponce Filtration Plant (Old)	5.00
	Ponce Filtration Plant (New)	20.00
	Wells	9.24
	Rural Water Filtration Plants	0.48
TOTAL		**34.72**

[1] Data compiled by CSA Group, 2001.

3.17.3 Wastewater Treatment Plants within the Region

PRASA provides treatment to all the wastewater collected in the Region from Guayanilla to Ponce through three (3) wastewater treatment plants (WWTP). The name, location, capacity and current load of each of the plants are summarized in Table 3-24, from a report prepared for PRASA by Black & Veatch (1999) and from information provided by PRASA's Yauco Area and Ponce Area Offices (2001). The existing wastewater collection systems are mainly gravity trunk systems, with pump stations available when necessary. The plants serving Guayanilla and Peñuelas are small facilities that provide secondary treatment discharging to nearby rivers, since most of these two municipalities are not serviced by sanitary trunk systems. The Ponce Regional Plant provides primary treatment discharging to the Caribbean Sea through a marine outfall under an interim waiver to the federal requirement of secondary treatment, as part of the waiver program established in Section 301h of the Clean Water Act of 1972 (amendments of 1982). Nearly 50 percent of the population in the Region uses septic tanks for the disposal of domestic sanitary wastes.

Table 3-24: Wastewater Treatment Plants at Ponce, Guayanilla and Peñuelas

Municipality	Facility	Design Capacity (MGD)	Residual Capacity (MGD)	Effluent Receiving water body
Guayanilla	Guayanilla Secondary WWTP	0.62	0.20	Río Guayanilla
Peñuelas	Peñuelas Secondary WWTP	0.75	0.15	Río Tallaboa and Río Guayanés
Ponce	Ponce Regional Primary WWTP	18.00	4.00	Caribbean Sea

Source: Black & Veatch, 1999, and PRASA, Yauco Area and Ponce Area, 2001

3.17.4 Stormwater

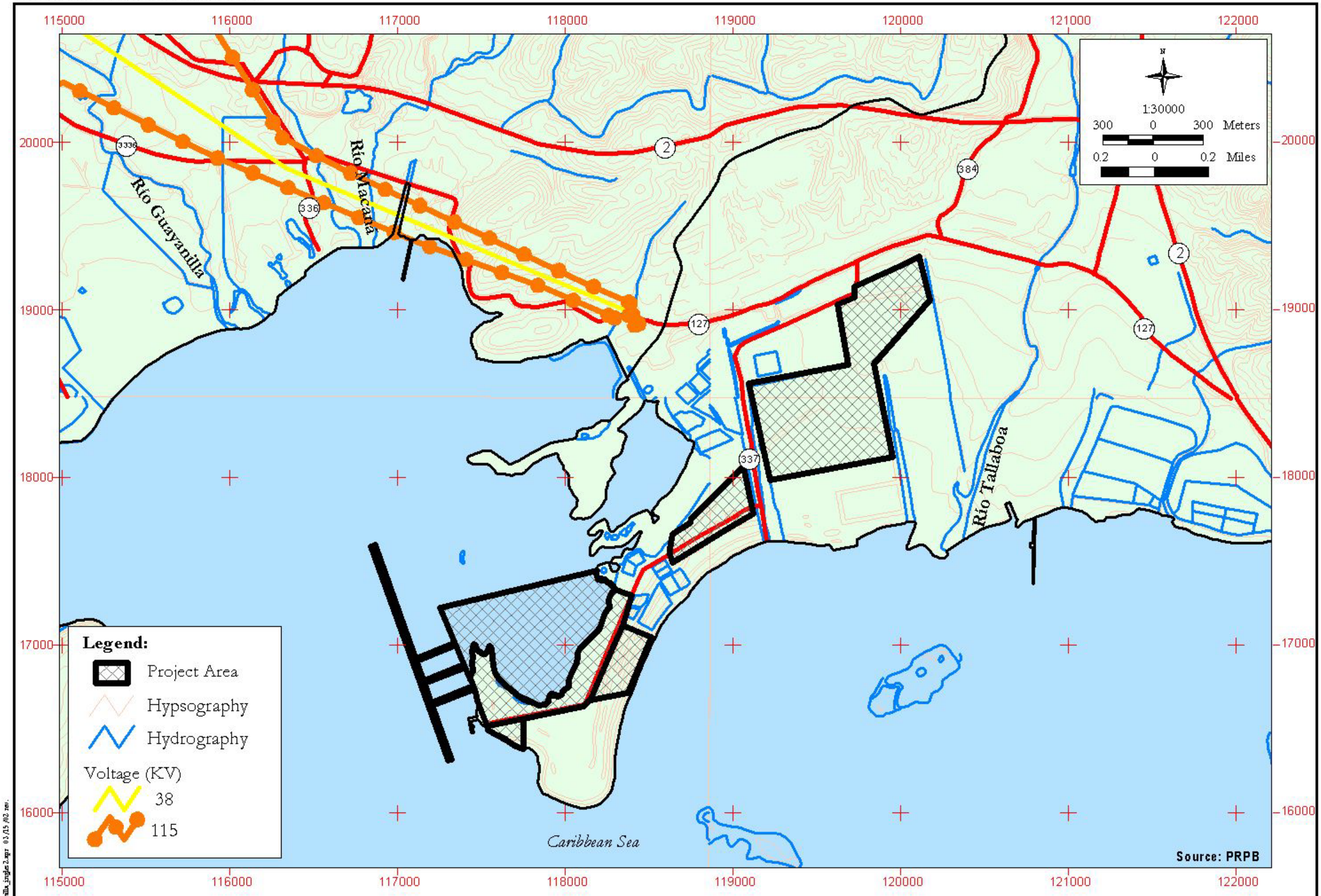
The areas at Peñuelas and Ponce proposed for development of value-added activities, and the Port of Ponce, have storm water collection systems. These systems are a combination of pipes and ditches discharging to a series of canals in the area, or directly to the coastline and the Caribbean Sea. A new stormwater collection system would be required for the area reclaimed from the Guayanilla Bay for storage of containers.

3.17.5 Electric Power System

The Puerto Rico Electric Power Authority (PREPA) operates the Central Costa Sur Power Plant south of Punta Gotay adjoining the Guayanilla Port. This facility has a generation capacity of 1,090 MW using oil of several grades as fuel. Also operating from the southern tip of Punta Guayanilla is the EcoEléctrica co-generation plant, with a capacity of 467 MW. Power to the areas of the Project at Guayanilla-Peñuelas and Ponce is supplied as described below:

Guayanilla-Peñuelas: Two main transmission lines supply the Guayanilla-Peñuelas area: line number 39,900 of 115 KV and a line of 38 KV (Figure 3-61). The transmission line of 115 KV supplied the Union Carbide Caribe facility, reaching a bank of transformer with capacity of 10 MVA.

Ponce: A radial transmission line of 38 KV serves the Port of Ponce area (Figure 3-62). Also, there is a transmission line of 38 KV, which runs along PR-52 toward the west of the site where the value-added areas would be developed, and a line of 115 KV which runs from the Río Portugués toward the north of the site.



Coordinates in State Plane NAD 27

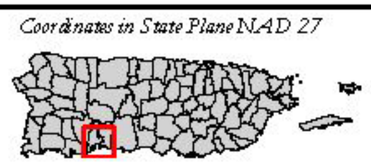


Figure 3-61 PREPA Facilities: Guayanilla-Peñuelas Area

Port of the Americas

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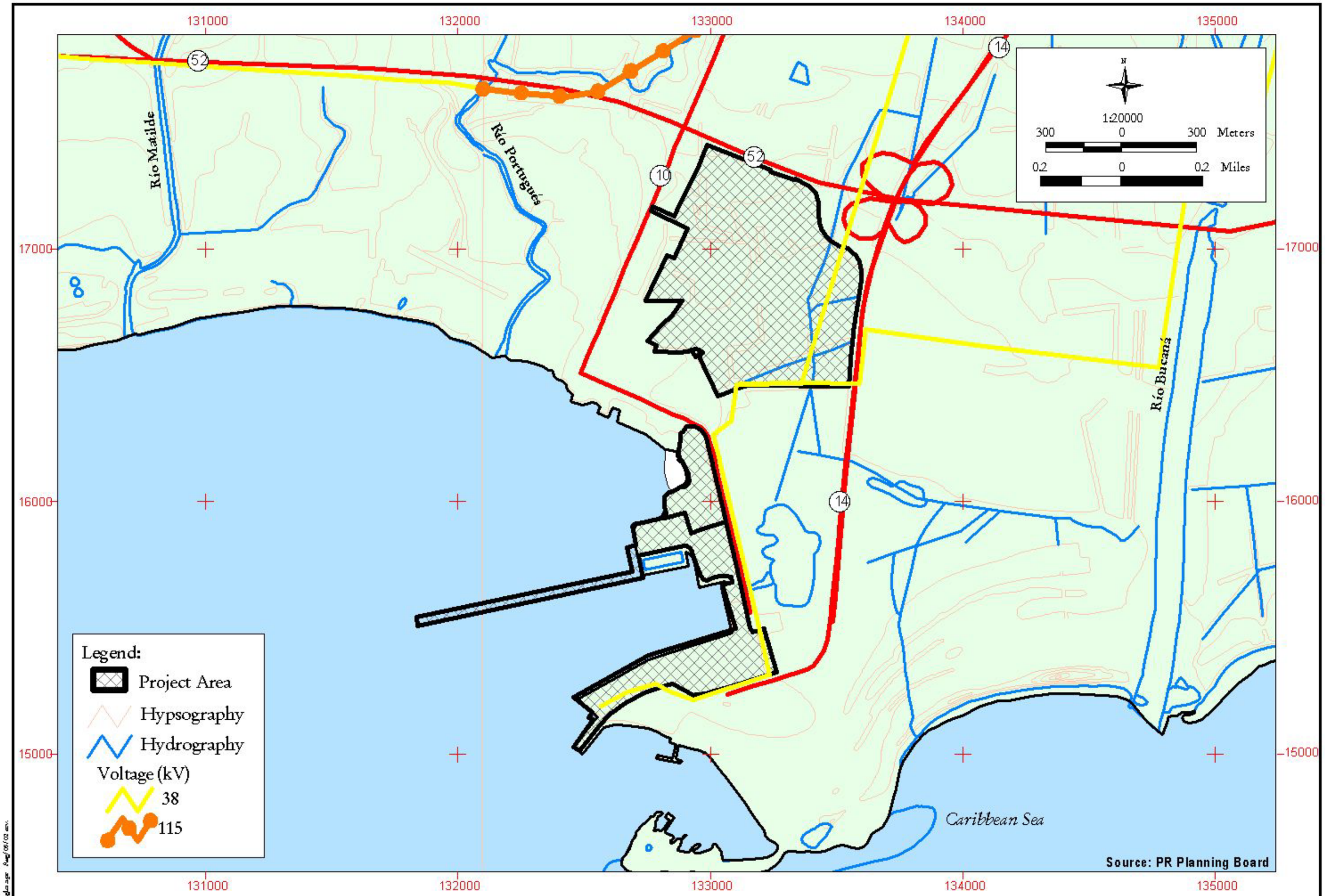


Coordinates in State Plane NAD 27

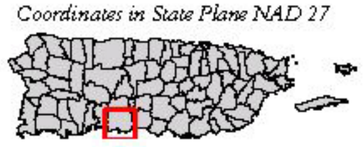


Figure 3-62 PREPA Facilities : Ponce Area

Port of the Americas

3.17.6 Roads

The Guayanilla-Peñuelas and Ponce elements of the PTA are connected with the rest of the region by two main roads: Highway PR-52 and the State Road PR-2.

- In the Guayanilla-Peñuelas area, access to the Bay is through roads PR-385 and PR-127. The local access at Guayanilla-Peñuelas area is through the roads PR-384 and PR-337 (**Figure 3-63**). Access to the Port of Ponce is through roads PR-10 and PR-14 (Malecón Avenue – Santiago de los Caballeros) (**Figure 3-64**).

- Highway PR-52 is a principal road in the region, traversing the Island from north to south connecting San Juan to the south region and Ponce. The highway is operated by the Puerto Rico Highway and Transportation Authority (PRHTA) as a toll road, with four (4) to six (6) lanes.

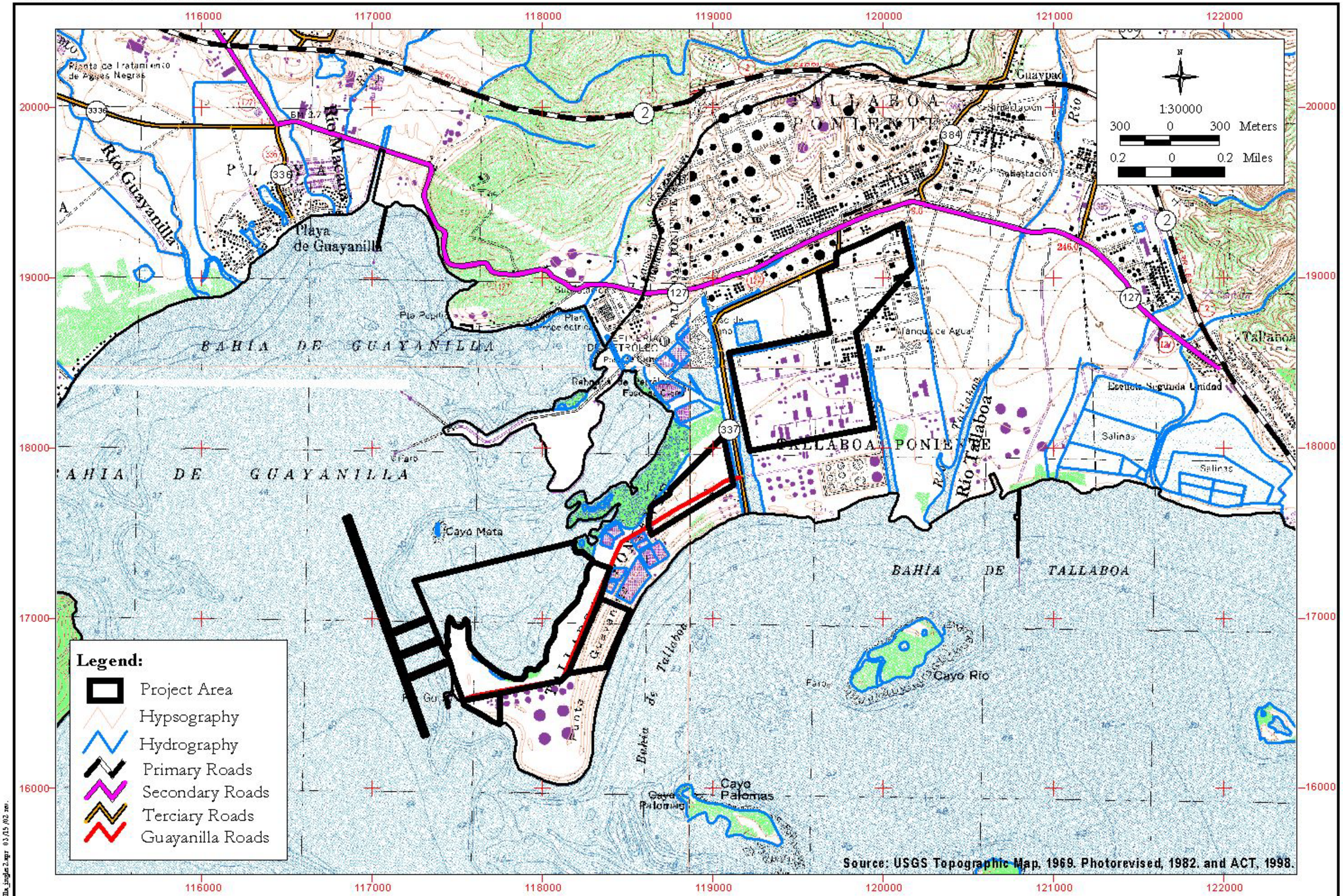
- State road PR-2 provides regional and long distance access to other southern towns and the north coast towards San Juan. In the south coast, PR-2 crosses through the urban areas from Guayanilla to Ponce.

- Another state road in the area is PR-1, which runs parallel to PR-52 from Ponce to Salinas. PR-1 runs parallel with PR-52 through the municipalities of Caguas, Cayey, Salinas, Santa Isabel and Juana Díaz, connects San Juan with Ponce and intersects PR-2 in the city of Ponce.

- PR-127, located south and adjacent to the Guayanilla-Peñuelas area, can be used to access the project area from the west region and as a local access from the Tallaboa Ward, east of the project area.

- The Municipality of Peñuelas has access to PR-2 through PR-385 and PR-384. PR-337 is a two (2)-lane road that runs along the south coast from PR-127 until the Guayanilla-Peñuelas project area. The main use of this road is to access the industrial facilities at Punta Guayanilla.

- Another local road near the project is PR-384, which runs from PR-127 at the south of the site to PR-385 at the north. The main use of this road is local transit of area residents.



Coordinates in State Plane NAD 27

Figure 3-63 Existing Roads: Guayanilla-Peñuelas Area

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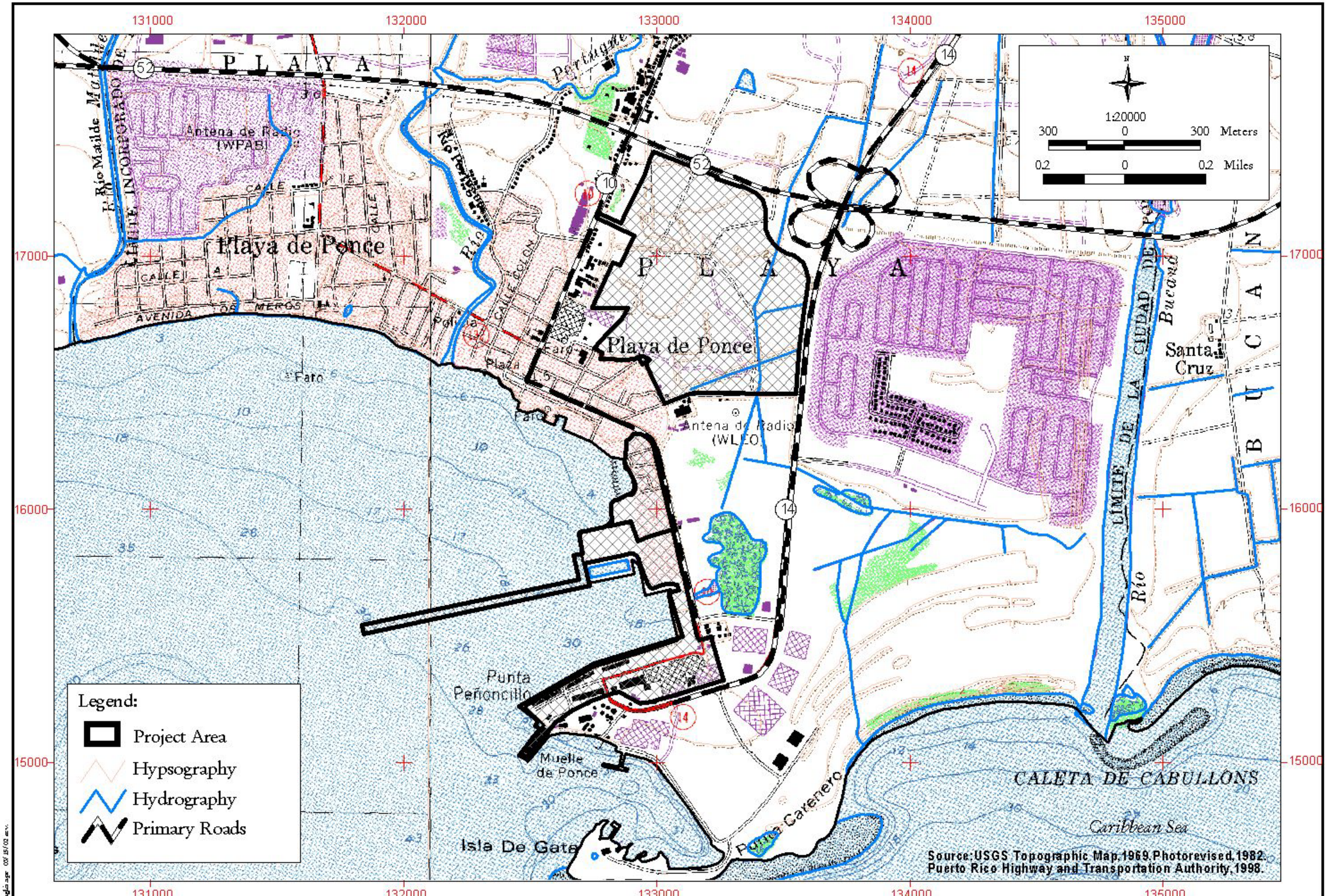

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Figure 3-64 Existing Roads: Ponce Area

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3.17.7 Non-Hazardous Solid Wastes

Sanitary landfills in the Region and its vicinity operate in the municipalities of Ponce, Jayuya, Juana Diaz and Yauco. These landfills operate under permits issued by EQB and service areas designated by the Puerto Rico Solid Wastes Management Authority (SWMA) as described in Table 3-25.

Table 3-25: Landfills in Operation at the Ponce Region

Municipality	Address	Service area	Capacity (Tons Per Day)
Jayuya	Street 140 km 10.5, Collores Ward, Canalizo Sector.	Jayuya, Adjuntas	134
Juana Díaz	Street PR-150, Amuelas Ward.	Juana Díaz, Coamo, Villalba and private companies	420
Ponce	Baramaya Final Avenue, Cañas Ward, La Cotorra Sector.	Ponce, Adjuntas, Peñuelas, Guayanilla, (Aguas Buenas and Cidra in occasions)	1,200
Yauco	Street 335, Barinas Ward, La Joya Sector.	Yauco, Santa Isabel, San Germán and Sabana Grande	425

Source: Solid Waste Management Authority, 2002

The Ponce Municipal Landfill is the preferred facility for disposal of the non-hazardous solid wastes that would be generated by the Project. Currently, a private company operates the landfill and it serves the municipalities indicated in the previous table.

3.17.8 Other Services

Telephone Services: The Puerto Rico Telephone Company provides telephone services in the Project area, and most of the rest of the Island. There are several companies that offer cellular phone services.

Medical Services: Most of the medical and hospital services are located at the Municipality of Ponce. Ponce has eight (8) hospitals and dispensaries that accommodate approximately 1,049 patients. Moreover, there are four (4) hospitals and medical private clinics that can accommodate 446 patients. Peñuelas and Guayanilla have one public hospital and one private hospital in each municipality. Yauco has one public dispensary and one private hospital, which can be accessed the project area in 15 to 20 minutes.

Emergency Medical Services: Emergency Medical Services are provided by three (3) primary sources: (1) Licensed ambulance service is provided by the large regional hospitals located in Ponce; (2) Ponce Fire Department provides the emergency rescue services (these emergency services can be reached by dialing the 9-1-1 phone number); (3) Emergency disaster relief in cases of large local accidents/emergencies, storms or earthquakes is provided by the Civil Defense regional offices or Headquarters, depending on the magnitude of the emergency. There are four regional Civil Defense offices, one in Peñuelas and Guayanilla and two in Ponce.

Police and Fire Services: The police services nearest to the Project sites are located in Peñuelas, Guayanilla, Yauco and Ponce. The regional headquarters are located in Ponce and provide coverage to the entire south district. The towns of Peñuelas, Guayanilla and Ponce provide the fire protection services closest to the Project site at Guayanilla. The municipalities of Peñuelas, Guayanilla and Yauco have one fire department each and Ponce has two fire department offices. Based on distances, road conditions, and emergency response driving speeds, response time from Ponce to the Guayanilla project area is estimated at between 15 to 20 minutes. The Port of Ponce is reached in about 5 minutes from the main fire control garage.

3.18 Marine Currents

The North Equatorial Current, one of the principal currents in the world, is the principal oceanic current affecting Puerto Rico (Bush et al., 1995). Its flow is generally from east to west. Near the shoreline, headlands and embayments disrupt regional patterns generating local currents that may flow in any direction. Island wide, the difference between high and low water is relatively small, averaging about a foot. Tides in Puerto Rico are predominantly semi diurnal, except in the south coast where they are diurnal.

The mean tidal range in Guayanilla Bay is 0.50 feet, with a slightly higher range of 0.73 feet during the spring. The maximum predictable high tide is 0.96 feet above mean sea level and the lowest predictable tide is 0.40 feet below sea level.

Water circulation within Guayanilla Bay is determined principally by the wind and tides. In general, surface circulation results from wind driven currents, while sub-surface currents are tide-driven, following the prevalent diurnal tide pattern (Capella, 1995). Other contributing elements to water circulation patterns in the bay include countercurrents, upwelling, runoff, and the thermal discharges of the Costa Sur and EcoEléctrica power plants.

Surface currents are regulated by the wind. Wind-driven currents are generally confined to the first 10 feet of depth, and their movement is from east to west, following the prevailing wind direction. During the daytime surface waters are pushed towards the bay by the prevailing winds from the southeast, while at night, northeast winds move the water in the opposite direction towards the Caribbean Sea. Current speeds vary between 0.1 and 0.3 knots, reaching 0.5 knots on occasions (Capella, 1995). The general westward transport of surface waters induces localized upwelling along the eastern portion of the bay. This movement of subsurface waters replenishes the wind-driven westward flowing waters. The depth interval between 10 and 15 feet is a transition zone between wind-driven surface currents and tide-driven subsurface flow.

Subsurface flow below 15 to 21 feet is tide-driven. At those depths, water flows into the bay during the flood tide and out of the bay during the ebb tide. Capella (1995) estimated the speed of the tidal currents in 0.2 knots.

According to Chartock (1980), the total tidal exchange for Guayanilla Bay is 2.65×10^6 cubic meters per day (m^3/day), whereas the wind driven flows into and out of the bay were estimated

at 2.92 x 10^6 m^3/day and 1.95 x 10^6 m^3/day, respectively. The net effect of the wind, therefore, is the transport of surface waters into the bay, whereas the tidal transport of subsurface waters is out of the Bay. Capella (1995) calculated that the total tidal exchange is of the order of 15 to 40 percent of the total volume of the bay, which has been estimated in 11 billion gallons of water.

Although both the Río Guayanilla and Río Macaná discharge into the northern part of Guayanilla Bay, the effects of freshwater runoff on water circulation patterns is minimal due to their limited flow. Thermal discharges from the existing PREPA power plant result in modifications of water circulation patterns only near the points of discharge.

The Coastal and Hydraulics Laboratory of the Waterways Experiment Station (WES) was requested by the Jacksonville District of the U.S. Army Corps of Engineers (USACE) to determine how proposed deep-draft facility expansions of the harbors of Ponce and Guayanilla along the south coast of Puerto Rico may impact the hydrodynamics of the surrounding coastal environment. The ADCIRC long-wave hydrodynamic model was used to estimate tidal propagation and storm surge in each of the harbors for both pre-construction existing conditions and post-construction future condition deep-draft harbors. Impacts of the proposed harbor expansions were determined by computing surface elevation and current differences between pre-and post-construction. Events selected for simulation were a typical 28-day lunar month, Hurricane Georges, and an extra-tropical event of March 1993. The investigation was completed during the summer of 2001 by the WES staff.

Both, Ponce and Guayanilla Harbors have southern exposure that is partially protected by offshore islands and shallow regions. Offshore bathymetry drops to over 600 meters within 5-10 kilometers of the entrance to either harbor. Because of the exposure, and lack of an offshore shelf, tides and storm surges do not become well developed but remain small. For example, spring tides (without wind) in either harbor are less than 0.2 meters in amplitude and the maximum storm surge for Hurricane Georges was less than 0.4 meters. Therefore, surface elevation impacts of the proposed harbors are small. For example, the maximum project impact on surface elevation for Hurricane Georges at Port of Guayanilla was less than 0.05 meters.

Wind-driven currents within the bay represent the most potential long-wave threat to the coastal infrastructure resulting from the passage of a tropical or extra-tropical event, according to the WES investigation. For this reason, change in hurricane surge currents as a result of construction of the harbor expansions was identified as the best measure of construction impact. Pre and post-construction differences in current magnitudes were computed as a means of demonstrating reductions or increases in current as a result of the proposed landfill.

3.19 Noise

In Puerto Rico, the Environmental Quality Board, EQB, by means of the Regulation for Noise Pollution Control, establishes acceptable maximum noise levels (EQB, 1981). This regulation establishes that no one will cause or will allow, from any noise emission source, the emission of noise levels that exceed the standard limits for a period longer than ten percent (10 percent) of the time (L_{10}), in any sampling period. Table 3-26 details the noise standard limits as defined by EQB. This sampling period cannot be less than 30 minutes. Residential areas are classified as Zone I, commercial area as Zone II, industrial areas as Zone III, and tranquility areas as Zone IV.

It is expected that the major noise source related to the proposed facilities would come from the operation of the proposed cranes in the deep draft port in Guayanilla-Peñuelas and from the

loading/unloading activities at warehouse areas for the Port of Ponce. These elements are considered the most significant noise emission sources of the Project and would be classified as industrial noise sources (Zone III).

Industrial facilities, several residences and commercial facilities surround the proposed project sites. An inventory of all the noise emission sources (e.g. engines, fans, etc.) in the vicinity of these sites was conducted. In the Guayanilla-Peñuelas project site, two significant noise emission sources exist close to the Project area boundaries. These emission sources are the EcoEléctrica co-generation plant and the Costa Sur Power Plant, which is owned by PREPA. These plants contribute to the background noise level with continuous low-level noises. For the Ponce component of the PTA, the existing loading/unloading facilities are considered a stationary source of background noise level.

Table 3-26: Noise Emission Limits of the Puerto Rico Environmental Quality Board (A)]

	Receiving zones							
Noise Emission Source	**Zone I (Residential)**		**Zone II (Commercial)**		**Zone III (Industrial)**		**Zone IV (Tranquility)**	
	Day Time	**Night Time**	**Day Time**	**Night Time**	**Day Time**	**Night Time**	**Day Time**	**Night Time**
Zone I (Residential)	60	50	65	55	70	60	50	45
Zone II (Commercial)	65	50	70	60	75	65	50	45
Zone III (Industrial)	65	50	70	65	75	75	50	45

Source: Regulation for Noise Pollution Control, Environmental Quality Board, 1981.

A noise survey was conducted in the project sites vicinity to characterize the existing noise levels (Appendix N). Receptors that may potentially be affected by the Project were selected. The location of each receptor was based on sensitivity and proximity to the noise emission sources in the area. Figures 3-65 and 3-66 show the location of these receptors for which background noise levels were measured. Noise levels along the project site boundaries were also determined, besides the identified receptors, for both the Guayanilla-Peñuelas and Ponce project sites.

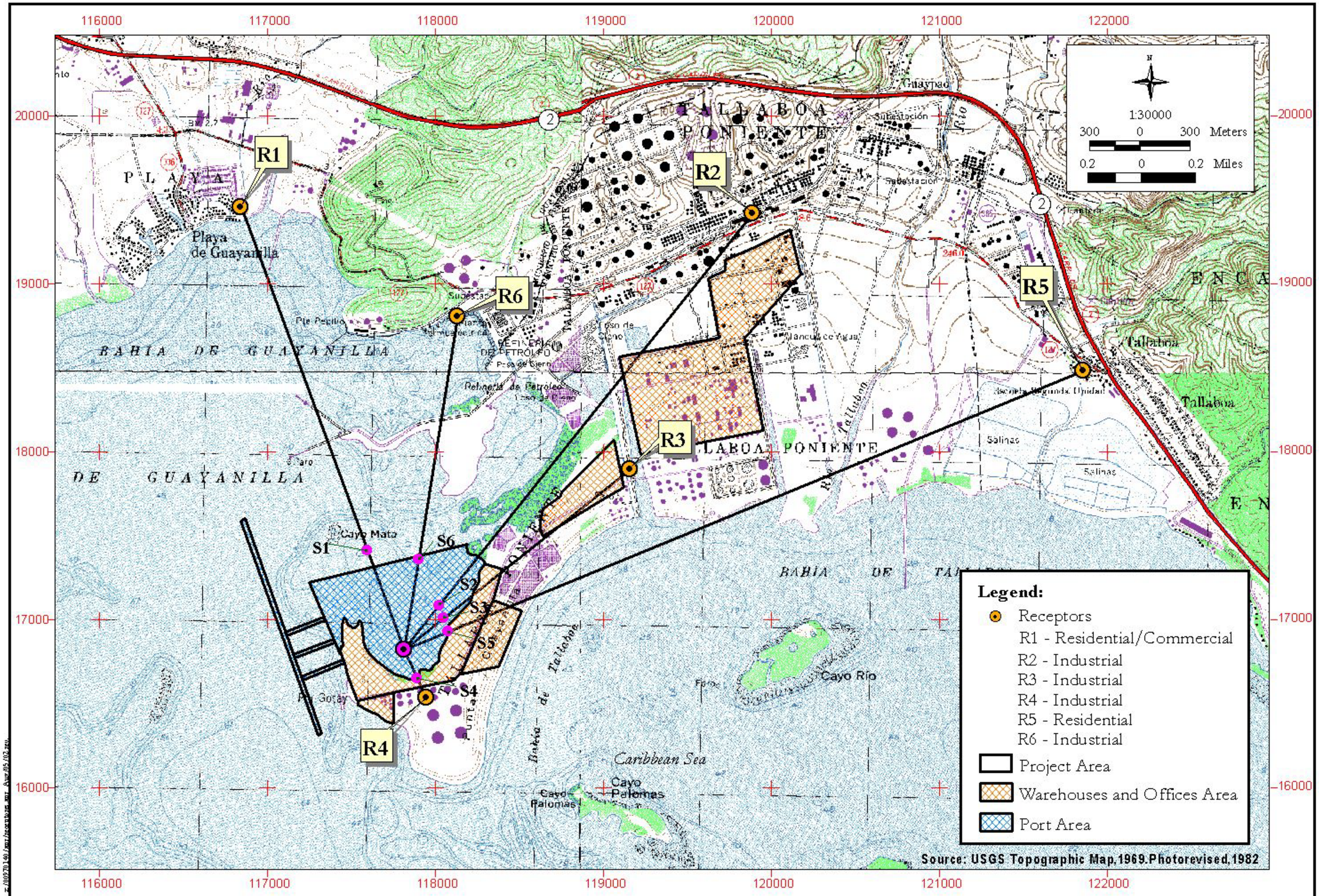
Six (6) discrete receptors were identified in the Guayanilla-Peñuelas project site as potentially sensitive to the projected noise source.

- Receptor R1 corresponds to the residential and commercial zone located in a community close to the proposed facilities.
- Receptors R2, R3, R4 and R6 are industries close to the project site.
- Receptor R5 corresponds to a school zone close to the project site.
- A tranquility zone was not identified close to the area.

Five receptors (5) were identified for the Ponce project site.

- Receptors R1 and R3 are the residential zones close to the proposed east and west site boundaries.
- R2 is the industrial zone closer to the proposed south site boundary.
- R4 represents a school zone
- R5 is a geriatric center, which represents the project site closest tranquility zone.

In general terms, noises associated to the proposed site area are characteristic of an industrial area (Zone III). The existing background noise levels in this area are between 65 - 80 dB (A). These values are close to the standard range established by the EQB, which ranges from 60 to 75 dB(A) for receptor areas classified as Zone III.



Coordinates in State Plane NAD 27

Figure 3-65 Location of Sources and Receptors Used in the Guayanilla-Peñuelas Noise Study

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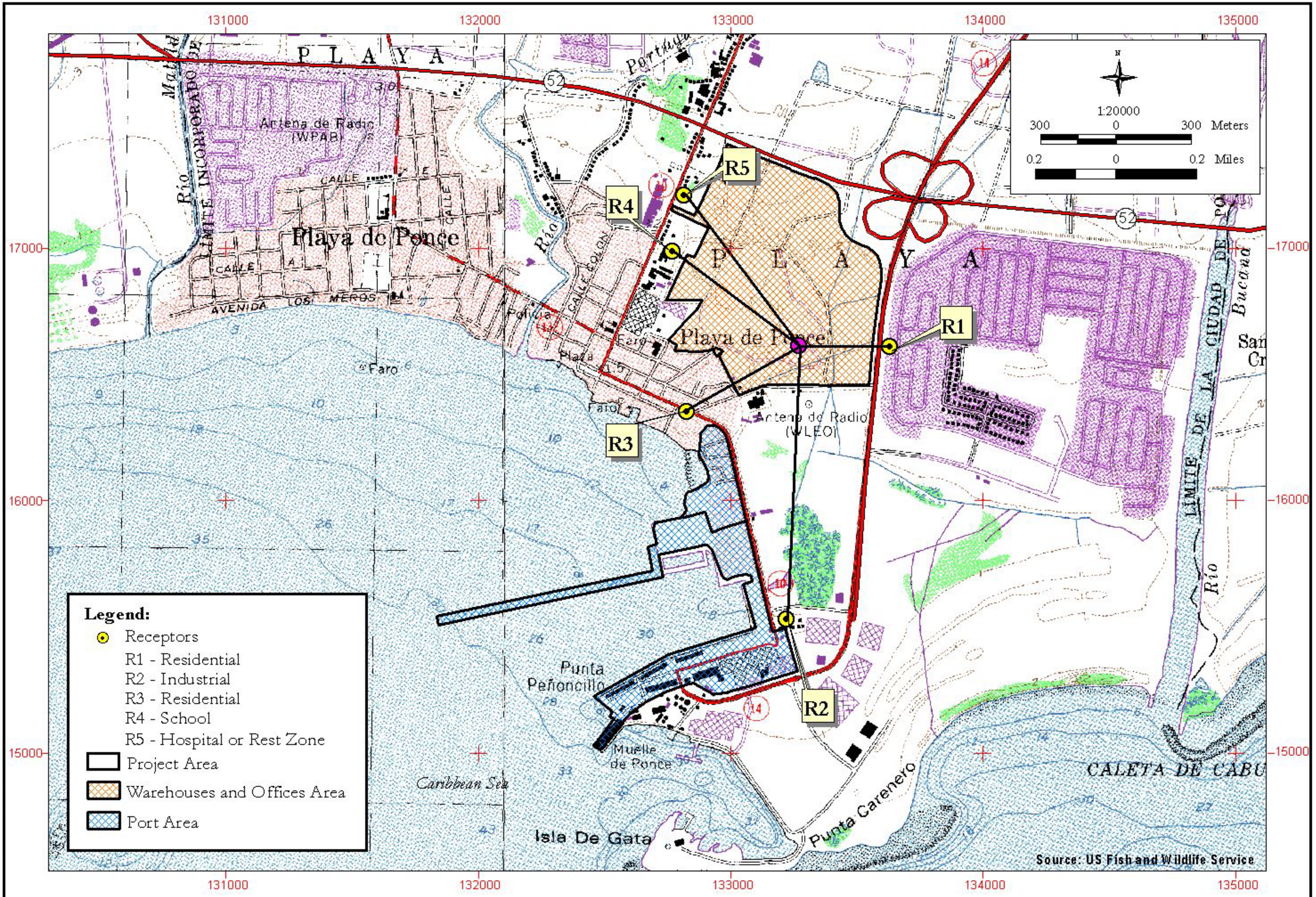

Coordinates in State Plane NAD 27

Figure 3-66 Location of Sources and Receptors Used in the Ponce Noise Study

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