

# Puerto Rico Coastal Zone Management Program

*Revision and update*

September, 2009



# CONTENTS

<b>Introduction.....</b>	<b>1</b>
2.1 Sustainable Development .....	4
2.1 Watershed as a Planning Unit .....	6
2.1 Non-point sources of pollution as a critical issue.....	6
<b>Chapter I. Overview of Puerto Rico’s Coastal Zone.....</b>	<b>9</b>
1.1 General Physical Characteristics .....	9
1.1.1 Origin and composition of the island.....	9
1.1.2 The Island’s climate .....	10
1.1.3 Natural systems.....	14
1.1.4 Description of coastal sectors .....	14
1.1.5 Coastal sectors and watersheds in puerto rico .....	21
1.2 Urban sprawl trends in the coastal sectors.....	24
1.2.1 Demand for land uses in the coastal zone .....	28
1.3 Economic impact of the coastal zone .....	33
<b>Chapter II. The PRCZMP as the coastal element of Puerto Rico’s Land Use Plan .....</b>	<b>38</b>
Background.....	38
Objectives and Public Policies in Puerto Rico’s Land Use Plan .....	39
<b>Chapter III. Coastal management for Puerto Rico: Problems and responses.....</b>	<b>57</b>
Introduction.....	57
3.1 Coastal hazards.....	57
3.1.1 Floods (storm surges and tsunamis) .....	57
3.1.2 Geological risks.....	71
3.1.3 Coastal erosion .....	78
3.1.4 Global warming and vulnerability to coastal hazards.....	83
3.2 Coastal resources.....	86
3.2.1 Wetlands.....	86
3.2.2 Reefs .....	103
3.2.3 Mangroves .....	114
3.2.4 Dunes .....	124
3.2.5 Beaches .....	127
3.2.6 Wildlife .....	149
3.2.7 Coastal Waters .....	154
3.2.8 Coastal Forests.....	172
3.2.9 Historical Monuments and Archeological sites.....	178
3.3 Coastal Development .....	181

3.3.1 Coast-dependent industry .....	181
3.3.2 Sand for construction .....	191
3.3.3 Mineral Development .....	194
3.3.4 Energy.....	197
3.4 Recreation .....	204
3.5 Transportation.....	212
3.6 Fishing .....	217
3.6.1 Commercial fishing .....	217
3.6.2 Recreational Fishing.....	222
3.6.3 Ornamental Fishing.....	223
Conclusion .....	227
<b>Chapter IV. The Coastal Management Program: Principal Elements .....</b>	<b>229</b>
4.1 Guiding Development of Puerto Rico’s Coastal Zone .....	229
4.1.1 Ongoing Activities: Four Commonwealth agencies responsible for guiding development... 229	
4.1.2 Linkages assuring consistent action in guiding development.....	239
4.1.3 Improvement of Coastal Zone Guidance .....	242
4.2 Active management of coastal resources.....	250
4.2.1 Ongoing activities: the DNER and other agencies participating in managing coastal resources.....	250
4.2.2 Improving Resource Management in Coastal Areas .....	252
4.2.3 Organizational Changes .....	253
4.2.4 Natural Reserve System.....	255
4.2.5 Clarifying and extending public property rights in coastal resources.....	255
4.2.6 Other measures to protect coastal resources .....	256
4.3 Promotion of sustainable coastal development.....	257
4.4 Research.....	258
4.4.1 Research .....	258
4.4.2 Economic viability studies.....	259
4.4.3 Inventories of Resources and Risks .....	259
<b>Chapter V. The Culebra Segment .....</b>	<b>262</b>
Introduction.....	262
5.1 Description of the island of Culebra .....	263
5.1.1 Physical Characteristics.....	265
5.1.2 Biotic ecosystems .....	266
5.1.3 Marine and coastal ecosystems.....	268
5.1.4 Protected natural areas .....	276
5.1.5 Socio-economic conditions .....	278

5.1.6 Infrastructure.....	282
5.1.7 Pollution .....	284
5.2 Culebra’s Coastal Management.....	285
5.2.1 Objectives and general policies.....	285
5.2.2 Major problems and some needed responses .....	288
5.2.3 Responsible Commonwealth agencies and some measures adopted .....	295
<b>Chapter VI. The Vieques Segment .....</b>	<b>298</b>
Introduction.....	298
6.1 Description of the island of Culebra .....	299
6.1.1 Physical Characteristics.....	299
6.1.2 Biotic ecosystems .....	303
6.1.3 Marine and coastal ecosystems.....	306
6.1.4 Protected natural areas .....	310
6.1.5 Socio-economic conditions .....	313
6.1.6 Infrastructure.....	315
6.1.7 Pollution .....	317
6.2 Vieques’s Coastal Management .....	318
6.2.1 Objectives and general policies.....	318
6.2.2 Major problems and some needed responses .....	319
6.2.3 Responsible Commonwealth agencies and some measures adopted .....	324
<b>References.....</b>	<b>326</b>
<b>Internet sites consulted.....</b>	<b>340</b>
<b>Laws.....</b>	<b>342</b>

## APPENDIXES

**Appendix 1.** Socioeconomic analysis of Puerto Rico’s coastal zone

**Appendix 2.** Economic context of the coastal zone

**Appendix 3.** The coastal zone’s economic impact

**Appendix 4.** Federal Consistency Requirements and Procedures established by the CZMA

**Appendix A.** Federal and Commonwealth agencies affecting the coast

**Appendix B.** The Puerto Rico Coastal Zone Management Program and the Coastal Zone Management Act

**Appendix C.** Description of Natural Reserves and Special Planning Areas designated by virtue of the PRCZMP

**Appendix D.** Comments received during the public participation process

## MAPS

Map 1. Puerto Rico and the Caribbean Basin .....	11
Map 2. Puerto Rico's platform and bathymetry .....	12
Map 3. PRCZMP's jurisdiction .....	13
Map 4. Municipalities and coastal sectors .....	20
Map 5. Coastal regions and principal watersheds.....	23
Map 6. Generalized land use 1999 .....	26
Map 7. Urban growth in the Metropolitan Area.....	27
Map 8. Site consultations in the coastal zone .....	32
Map 9. Floodable areas.....	61
Map 10. Tsunami hazard zone .....	62
Map 11. Landslide susceptibility.....	75
Map 12. Earthquake epicenters 1986-2003 .....	76
Map 13. Coastal barriers.....	81
Map 14. Wetlands .....	102
15. Known coral reef communities .....	110
Map 16. Natural Protected Areas.....	113
Map 17. Mangroves.....	118
Map 18. Public beaches .....	144
Map 19. Life zones and state forests .....	177
Map 20. Cultural and historical sites in coastal municipalities .....	180
Map 21. Special Planning Areas.....	188
Map 22. Coastal areas with urban characteristics .....	189
Map 23. Main Electric Energy Generators .....	201
Map 24. Major transportation facilities .....	215
Map 25. Commercial and recreational fishing facilities .....	224
Map 26. Culebra island .....	264
Map 27. Designated Critical Habitats, Federal Natural Protected Areas and Natural Reserves (DNER) in Culebra .....	269
Map 28. Culebra's benthic habitat.....	272
Map 29. Vieques island.....	300
Map 30. Vieques benthic habitats.....	307

Map 31. Designated Critical Habitats, Federal Natural Protected Areas and Natural Reserves (DNER) in Vieques.....	312
Map 32. Excluded Federal Lands .....	Appendix B- p. 5
Map 33. Natural Reserves Designated by Virtue of the PRCZMP .....	Appendix C- p. 19

## TABLES

Table I-1. Urban land in the coastal zone.....	24
Table I-2. Summary of site consultations.....	28
Table I-3. Site consultations in the coastal zone by type of project .....	29
Table I-4. Summary of site consultations by coastal sector .....	30
Table I-5. Grouping of industries for the economic analysis of the coastal zone .....	33
Table III-1. Flooding in the coastal zone.....	59
Table III-2. USACE flood control projects .....	66
Table III-3. Earthquakes registered in the Mona Passage and the PR Trench.....	72
Table III-4. Landslide categories.....	74
Table III-5. Wetlands in protected areas.....	88
Table III-6. Coastal wetlands in Puerto Rico.....	88
Table III-7. Natural Reserves in the coastal zone .....	92
Table III-8. Areas of Conservation Priority within Puerto Rico’s coastal zone .....	97
Table III-9. Total economic value by year 2007 .....	104
Table III-10. Types of mangroves in Puerto Rico and a summary of management recommendations.....	123
Table III-11. Inventory of Public Beaches districts.....	145
Table III-12. Species in Puerto Rico protected by the ESA .....	150
Table III-13. Coastal waters condition .....	156
Table III-14. Agencies collaborating with the EQB .....	158
Table III-15. EQB Water Quality Standards .....	159
Table III-16. Main oil and fuel spills in the coastal waters of Puerto Rico .....	162
Table III-17. Consumers surplus by use .....	206
Table III-18. Marinas in Puerto Rico .....	207

Table III-19. Fishing reported for coastal municipalities during the years 2001 to 2006.....	218
Table III-20. Fishermen reported in Puerto Rico .....	220
Table IV-1. Special Planning Areas.....	246
Table V-1. Mangroves in the Municipality of Culebra.....	273
Table V-2. Endangered and vulnerable species in Culebra .....	274
Table V-3. Fisheries reported in Culebra .....	281
Table VI-1. Mangroves in the Municipality of Vieques.....	308
Table VI-2. Endangered and vulnerable species in Vieques .....	309
Table VI-3. Areas recommended as coastal barriers .....	310
Table VI-4. Fisheries reported in Vieques 2002- 2006.....	314

## GRAPHICS

Graphic I-1. Projected change in urban land within the coastal zone .....	24
Graphic I-2. Projected change in developed land within the coastal zone.....	25
Graphic I-3. Employment by industrial sector for the coastal zone .....	34
Graphic I-4. Wage income by industrial sector for the coastal zone.....	35
Graphic I-5. Total production by industrial sector for the coastal zone .....	36
Graphic III-1. Changes observed on the mangrove coverage of Puerto Rico over the last 200 years .....	116
Graphic III-2. Puerto Rico's soil coverage .....	173
Graphic III-3. Production and consumption of electric energy in Puerto Rico .....	198
Graphic III-4. Distribution of Puerto Rico's electric energy consumption .....	198
Graphic III-5. Price of the fuel oil barrel .....	199
Graphic III-6. Boats registered in Puerto Rico .....	208
Graphic III-7. Visitors of Puerto Rico and their expenditures .....	209
Graphic III-8. Fishing reported for coastal municipalities during the years 2001 to 2006...	217

## Acronyms

<b>ACP</b>	Areas of Conservation Priority
<b>ADMV</b>	Housing Development and Improvements Administration
<b>AEMEAD</b>	Commonwealth Agency for Emergency Management and Disaster Administration
<b>AFC</b>	Commercial Development Administration
<b>AFV</b>	Housing Financing Authority
<b>APC</b>	Areas of Particular Concern
<b>ARCO</b>	Community Revitalization Administration
<b>ASCS</b>	Agriculture Stabilization and Conservation Service
<b>AVI</b>	Abandoned Vessel Inventory
<b>ATM</b>	Marine Transportation Authority
<b>BEACH</b>	Beaches Environmental Assessment and Coastal Health Program
<b>CAA</b>	Clean Air Act
<b>CARICOMP</b>	Caribbean Coastal-Marine Productivity Program
<b>CBRA</b>	Coastal Barrier Act
<b>CCDA</b>	Culebra Conservation and Development Authority
<b>CEQ</b>	Council of Environmental Quality
<b>CERCLA</b>	Comprehensive Environmental Response, Compensation, and Liability Act
<b>CERT</b>	Community Emergency Response Teams
<b>CFMC</b>	Caribbean Fishery Management Council
<b>CFR</b>	Code of Federal Regulation
<b>CORCO</b>	Commonwealth Oil Refining Company
<b>CRMCP</b>	Coral Reefs Management and Conservation Program
<b>CRRT</b>	Caribbean Regional Response Team
<b>CTPR</b>	Conservation Trust of Puerto Rico
<b>CWA</b>	Clean Water Act
<b>CZARA</b>	Coastal Zone Act Reauthorization Amendments
<b>CZD</b>	Coastal Zone Division
<b>CZMA</b>	Coastal Zone Management Act
<b>DCA</b>	Department of Consumers Affairs
<b>DDEC</b>	Puerto Rico Department of Economic Development and Commerce

<b>DHHS</b>	Department of Health and Human Services
<b>DNER</b>	Department of Natural and Environmental Resources
<b>DNR</b>	Department of Natural Resources
<b>DTPW</b>	Department of Transportation and Public Works
<b>DOE</b>	Department of Energy
<b>DOD</b>	Department of Defense
<b>DOI</b>	U.S. Department of Interior
<b>DOP</b>	Public Works Office
<b>DOT</b>	U. S. Department of Transportation
<b>DRS</b>	Department of Recreation and Sports
<b>DU</b>	Urbanism Office
<b>EAA</b>	Energy Affairs Administration
<b>EDA</b>	Economic Development Administration
<b>EEZ</b>	Exclusive Economic Zone
<b>EIS</b>	Environmental Impact Statement
<b>EPA</b>	Environmental Protection Agency
<b>EQB</b>	Environmental Quality Board
<b>EO</b>	Executive Order
<b>ESA</b>	Endangered Species Act
<b>FAA</b>	Federal Aviation Administration
<b>FCC</b>	Federal Consistency Certification
<b>FEMA</b>	Federal Emergency Management Agency
<b>FHWA</b>	Federal Highway Administration
<b>FIRM</b>	Flood Insurance Rate Maps
<b>FIS</b>	Flood Insurance Study
<b>FTA</b>	Federal Transit Administration
<b>FWSRA</b>	Federal Wild and Scenic Rivers Act
<b>FYIP</b>	Four Year Investment Plan
<b>GATP</b>	<i>Grupo de Apoyo Técnico y Profesional</i>
<b>GDP</b>	Gross Domestic Product
<b>GIS</b>	Geographic Information System
<b>GNP</b>	Gross National Product
<b>GSA</b>	General Services Administration

<b>HACES</b>	Sustainable Strategic Tools of Action and Coordination ( <i>Herramientas de Acción y Coordinación Estratégica Sostenible</i> )
<b>ICLEI</b>	International Council for Local Environmental Initiatives
<b>ICRI</b>	International Coral Reef Initiative
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IPRC</b>	Institute of Puerto Rican Culture
<b>ITA</b>	Integrated Transportation Alternative
<b>IUCN</b>	International Union for Conservation of Nature
<b>IWRMP</b>	Integrated Water Resources Management Plan ( <i>Plan de Aguas</i> )
<b>JOBANERR</b>	Jobs Bay National Estuarine Research Reserve
<b>JPA</b>	Joint Permit Application
<b>LA</b>	Land Administration
<b>LAS</b>	Local Action Strategies
<b>LMA</b>	Land management area
<b>LUST</b>	Leaking Underground Storage Tank Trust Fund
<b>MBA</b>	Metropolitan Bus Authority
<b>MLUP</b>	Municipal Land Use Plan
<b>MM</b>	Management measures
<b>MPA</b>	Marine Protected Area
<b>MPO</b>	Metropolitan Planning Organization
<b>MRFS</b>	Marine Recreational Fisheries Statistics
<b>NAICS</b>	North American Industrial Classification System
<b>NCP</b>	National Oil and Hazardous Substances Pollution Contingency Plan
<b>NEPA</b>	National Environmental Policy Act
<b>NFIP</b>	National Flood Insurance Program
<b>NFIRA</b>	National Flood Insurance Reform Act
<b>NGO</b>	Non-government organizations
<b>NHP</b>	Natural Heritage Program
<b>NHTSA</b>	National Highway Transportation Safety Administration
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NPC</b>	National Parks Company
<b>NPDES</b>	National Pollutant Discharge Elimination System
<b>NPS</b>	National Park Service

<b>NR</b>	Natural Reserve
<b>NRC</b>	National Research Council
<b>NRCS</b>	Natural Resources Conservation Service
<b>NWR</b>	National Wildlife Refuge
<b>OCRM</b>	Office of Coastal Resource Management
<b>OMB</b>	Office of Management and Budget
<b>OPA</b>	Oil Pollution Act
<b>OPP-PRLUP</b>	Objectives and Public Policies of the PRLUP
<b>PICA</b>	Four Year Investment Program ( <i>Programa de Inversiones a Cuatro Años</i> )
<b>PIDES</b>	Integral Sustainable Strategic Development ( <i>Plan Integral de Desarrollo Estratégico Sostenible de Puerto Rico</i> )
<b>PP</b>	Public Beach district
<b>PRASA</b>	Puerto Rico Aqueducts and Sewers Authority
<b>PRCNPCP</b>	Puerto Rico Coastal Nonpoint Pollution Control Plan
<b>PRCZMP</b>	Puerto Rico Coastal Zone Management Program
<b>PRDA</b>	Puerto Rico Department of Agriculture
<b>PRDH</b>	Puerto Rico Department of Housing
<b>PRDPH</b>	Puerto Rico Department of Public Health
<b>PREPA</b>	Puerto Rico Electrical Power Authority
<b>PRIDCO</b>	Puerto Rico Industrial Development Company
<b>PRIDP</b>	Puerto Rico Integral Development Plan
<b>PRIFA</b>	Puerto Rico Infrastructure Financing Authority
<b>PRHTA</b>	Puerto Rico Highways & Transportation Authority
<b>PRLA</b>	Puerto Rico Land Authority
<b>PRLUP</b>	Puerto Rico Land Use Plan
<b>PRPA</b>	Puerto Rico Port Authority
<b>PRPB</b>	Puerto Rico Planning Board
<b>PRSN</b>	Puerto Rico Seismic Network
<b>PRTC</b>	Puerto Rico Tourism Company
<b>PRWQSR</b>	Puerto Rico Water Quality Standards Regulation
<b>RAMS</b>	Regulatory Analysis and Management System
<b>RNCLP</b>	<i>Reserva Natural Canal Luis Peña</i>
<b>RNCT</b>	<i>Reserva Natural Caño Tiburones</i>

<b>ROTHR</b>	Relocatable Over-the-Horizon Radar
<b>RPA</b>	Regulation and Permits Administration
<b>RPC</b>	Routine Program Change
<b>SCORP</b>	Comprehensive Outdoor Recreation Plan
<b>SHPO</b>	State Historic Preservation Office
<b>SJBE</b>	San Juan Bay Estuary
<b>SJMA</b>	San Juan Metropolitan Area
<b>SPA</b>	Special Planning Area
<b>SPOC</b>	State Single Point of Contact
<b>SWA</b>	Solid Waste Authority
<b>UNESCO</b>	United Nations Education, Science and Cultural Organization
<b>USFS</b>	United States Forest Service
<b>USFWS</b>	U.S. Fish and Wildlife Service
<b>UPR</b>	University of Puerto Rico
<b>USACE</b>	U.S. of America Corps of Engineers
<b>USCG</b>	U. S. Coast Guard
<b>USDA</b>	U.S. Department of Agriculture
<b>USDOT</b>	U.S. Department of Transportation
<b>USGS</b>	U.S. Geological Survey
<b>TIZ</b>	Tourism Interest Zone
<b>TMDL</b>	Total Maximum Daily Load
<b>WQC</b>	Water Quality Certifications

### **Abbreviations**

<b>cm</b>	centimeters
<b>ha</b>	hectares
<b>gal</b>	gallons
<b>gpd</b>	gallons per day
<b>km</b>	kilometer
<b>km<sup>2</sup></b>	square kilometer
<b>l</b>	liter
<b>m</b>	meters
<b>Ma</b>	<i>Meganne</i> (one million years)
<b>nm</b>	nautical miles

Conversion Table		
Multiply	by	to obtain
<b>Area</b>		
acre	1.03	<i>cuerdas</i>
	0.40	hectares
	4 ,046.870	square meters (m <sup>2</sup> )
<i>cuerda</i> (cd)	0.97	acres
	3 ,930	square meters (m <sup>2</sup> )
square miles (mi <sup>2</sup> )	259.00	hectares
	2 .59	square kilometers (km <sup>2</sup> )
square feet (f <sup>2</sup> )	0 .09290	square meters (m <sup>2</sup> )
hectares (ha)	2.47	acres
	0.00	square miles (mi <sup>2</sup> )
square kilometers (km <sup>2</sup> )	0.39	square miles (mi <sup>2</sup> )
square meters (m <sup>2</sup> )	0.00	acres
	0.00	<i>cuerda</i> (cd)
	10.76	square feet (f <sup>2</sup> )
<b>Volume</b>		
gallons	3 .7854	liters (L)
	3 ,785.4	cubic centimeters (cm <sup>3</sup> )
million gallons (Mgal)	3.07	acres feet (acres-feet)
liters (L)	0.26	gallons (gal)
	0.04	cubic feet (f <sup>3</sup> )
cubic foot (f <sup>3</sup> )	0 .02832	cubic meters (m <sup>3</sup> )
	2 8.32	liters (L)
cubic meters (m <sup>3</sup> )	0.00	acres feet (acres-pies)
	35.31	
cubic yards	201.97	gallons (gal)
cubic kilometers (km <sup>3</sup> )	1,000,000,000,000	liters (L)
gallons per day (gdp)		
<b>Longitude</b>		
miles (mi)	1 ,609	meters (m)
	1 .609	kilometers (Km)
foot (f)	0 .30480	meters (m)
	12.00	inches (in)
<i>legua</i>	3.02	mile (mi)
kilometer (km)	0.62	mile (mi)
	3,280.84	feet (f)
meter (m)	3.28	feet (f)
	39.37	inches (in)
millimeter (mm)	0.04	inches (in)
inches (in)	2 5.4	milimeters (mm)
	0 .02540	meters (m)
nautical mile (nm)	1,852.00	meters (m)
	± 6,076.11549	feet (f)
centimeter (cm)	10.00	milimeters (mm)
<i>brazas</i>	6.00	feet (f)
<b>Weight</b>		
pound (lb)	454	gram
kilogram (kg)	1,000	gram
tonne	2 004.139	pounds (pd)
<b>Energy</b>		
kilowatt (kw)	1,000	vattios (v)
megawatt (mw)	3,600,000,000	jules/hour



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**Introduction:**  
*Puerto Rico's Coastal Zone Management  
Program*

## INTRODUCTION

The enactment of the Federal “Coastal Zone Management Act” of 1972<sup>1</sup> marked the starting point for the development of the Puerto Rico Coastal Zone Management Program (PRCZMP) which became the coastal element of the Puerto Rico Land Use Plan (PRLUP)<sup>2</sup> on July 12, 1978 with the approval of Resolution PU-002 by the Puerto Rico Planning Board (PRPB) and the Governor of Puerto Rico. The plan was certified by the U.S. Department of Commerce through the National Oceanic and Atmospheric Administration (NOAA) in September 1978.

PRCZMP’s development process began in 1972 with an analysis from various perspectives, including the input from citizens and interest groups. This exercise paved the way for the publication of “Puerto Rico and the Sea”, a first-of-its-kind look at harmonizing socioeconomic development with the conservation of natural resources. Another document, the Culebra Segment, took the same approach, but paying particular attention to the rational use of coastal resources. This document was eventually adopted in March 1977 as the first component of the PRCZMP.

Planning efforts for the comprehensive management of the coastal zone continued and the results were integrated to the Declaration of Objectives and Public Policies of Land Use issued by the PRPB in 1975. This was the first element of the Land Use Plan which was established as a mandate in the “Organic Law of the Puerto Rico Planning Board” or Law No. 75 of 1975.

The Objectives and Public Policies of the PRLUP (OPP-PRLUP) were adopted by the PRPB on June 8, 1977, and approved by the Governor in June 22, 1977. The OPP-PRLUP became the basis in which the state’s legal authority over the PRCZMP was established. In 1995, the OPP-PRLUP was updated in order to include three components relevant to the PRCZMP: elements of sustainability, comprehensive management of watersheds as well as the management of coastal areas and resources.

The OPP-PRLUP has been amended in recent years to include further state regulations for the protection of natural and environmental resources, which has forced a needed revision and actualization of the PRCZMP as well as a need to clarify its function at the local and federal levels.<sup>3</sup> Included in these new laws are the “Commonwealth of Puerto Rico Land Use

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<sup>1</sup> P.L. 92-583, as amended.

<sup>2</sup> Over the years, in different laws and regulations as well as in formal PRPB and Commonwealth of Puerto Rico agencies documents there are small variations to the name of the “Puerto Rico Land Use Plan”. Among the variations that can be found: Land Use Plan, Use of the Land Plan, and Uses of the Land Plan. It is understood that, in spite of the small differences in the names, it refer to the same legal or practical concept included in the “Organic Law of the Puerto Rico Planning Board”, *supra*, as amended, the “Law of Autonomous Municipalities” of 1981, as amended, and the “Law for the Land Use Plan of the Commonwealth of Puerto Rico” of 2004.

<sup>3</sup> This revision and update does not establish additional public policies, it only incorporates the ones already established in the OPP-PRLUP (1995), which were added by means of routine program change (RPC) to the PRCZMP in 2003.

Plan Act”, Law No. 550 of 2004; the “Puerto Rico Environmental Public Policy Act”, Law No. 416 of 2004<sup>4</sup>; and the “Public Policy Law on Sustainable Development”, Law No. 267 of 2004.

The public policies established in the PRCZMP are applicable to the geographic, land and maritime areas determined as the *coastal zone* of the Puerto Rican archipelago, legally defined as:

*Strip of coastal land one thousand linear meters (1,000 m) inland, measured from the coast line, as well as additional distances needed to include key coastal natural systems. It also includes territorial waters of Puerto Rico and the marine or ocean floor (three marine leagues, nine nautical miles or 10.35 land miles), the islands of Vieques, Culebra, Mona, Monito, Desecheo, Caja de Muertos and all the keys and islets within them.*

At the federal level, the process of updating and revision of the PRCZMP, includes: (1) mechanisms provided in the CZMA, (2) the Bylaws of the Coastal Management Program included in Section 923 of Title 15 of the Code of Federal Regulation (15 CFR 923)<sup>5</sup> and (3) federal guidelines issued by the NOAA to these effects. These mechanisms provide for two types of updates or revisions: (1) amendments and (2) Routine Program Changes (RPC).<sup>6</sup>

NOAA’s guidelines establish the administrative procedures that the Government of Puerto Rico should follow in order to amend or execute changes to the PRCZMP. They also establish the mechanisms to incorporate other programs, as in the case of the “Puerto Rico Coastal Nonpoint Pollution Control Plan” (PRCNPCP). The Plan was approved by the NOAA and the Environmental Protection Agency (EPA) in October of 2000, under the dispositions of the Section 6217 of the amendments to the CZMA.<sup>7</sup>

This process uses the three mechanisms previously mentioned (RPC, incorporation and amendments) and reflect all the legal authorities or state public policies firmly established, some of which have not been recognized by the CZMA.

This process of revision and update will serve various dependencies of the federal, state and municipal governments as well as non-government organizations (NGO) and community-based groups. At the federal level, NOAA is the agency in charge of certifying the PRCZMP. Once approved by NOAA, the federal agencies will be subject to the Federal Consistency Requirements<sup>8</sup> established in the CZMA for all authorities or state public policies included in the same. These are applicable to projects owned by the federal agencies, the permits they

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<sup>4</sup> In compliance with the first two stages of the law, the PRPB is preparing a new “Land Use Plan for Puerto Rico”.

<sup>5</sup>The federal regulation in 15 CFR 923 can be accessed through the Web at the address: [http://ecfr.gpoaccess.gov/cgi/t/text/textidx?c=ecfr&sid=2477ca7ecb2c56b4661e856f40407210&rgn=div5&view=text&node=15:3.1.2.2.12&idno=15].

<sup>6</sup>Previously known as RPI, for “Routine Program Implementation”.

<sup>7</sup>In spite of having been approved both by NOAA and EPA in 2000, the PRCNPCP has not been incorporated to the PRCZMP. For this reason, the dispositions of the Plan are not necessarily subject to the dispositions of Federal Consistency of the PRCZMP.

<sup>8</sup>Refer to the CFR Part 930, that could be accessed through Internet in the address: [http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr;sid=702edba681e10e1e0c534beb3d0a78dc;rgn=div5;view=text;node=15%3A3.1.2.2.13;idno=15;cc=ecfr].

concede, as well as other federal agency activities in Puerto Rico, including the appropriation of federal funds.

At the Commonwealth level, the Department of Natural and Environmental Resources (DNER), through its Coastal Zone Division, is the agency responsible for the implementation of the PRCZMP. The PRPB is responsible for the approval of the PRCZMP at the local level as well as the administration of the Federal Consistency Requirements process. Other commonwealth agencies with direct and fundamental responsibilities associated with promoting and overseeing that sustained development takes place in the coastal zone are the Regulation and Permits Administration (RPA) and the Environmental Quality Board (EQB).

Likewise, there are administrative and area management responsibilities which fall on different agencies of the Commonwealth of Puerto Rico and its municipalities. Therefore, in this process of update and revision, the emphasis is on updating the legal base, the clarification of the institutional structure and the clear establishment of the agencies' responsibilities at the commonwealth and municipal levels.

During this process, consultations and informal interviews were conducted with key agency officials for the administration of coastal resources, members of the academia, groups of users and NGO. This consulting process was complemented with the results of public meetings, geared toward presenting the document and collecting comments from the community, held on the Main Island, Culebra and Vieques, during the month of September of 2008. Since the objective of this revision and update is to have a dynamic document, any pertinent information will be added as it becomes available.

The information included in this document is presented in six chapters. Chapter 1 covers a general view of the coasts of Puerto Rico; Chapter 2 presents the PRCZMP as the coastal element of the PR-LUP, and Chapter 3 presents the main issues which impact coastal management and includes some suggestions to address them. Chapter 4 presents the elements of the PRCZMP, and Chapters 5 and 6 present the segments of Culebra and Vieques, respectively.

The segments of Culebra and Vieques include public policies, actions, recommendations and maps, and with the revision and update, become an integral part of the PRCZMP<sup>9</sup>. These segments complement the set of established public policies established for the scope of application or jurisdiction of the Program.

The appendixes and maps that support the analysis have been revised as well as the proposed actions and recommendations included on the PRCZMP.

This PRCZMP incorporates some substantive issues relevant to the adequate management of the coastal resources that were not taken into consideration at the time of the PRCZMP's initial approval in 1978. Among these issues are sustainable development, the watershed as a planning unit and non-point sources of pollution as a critical issue.

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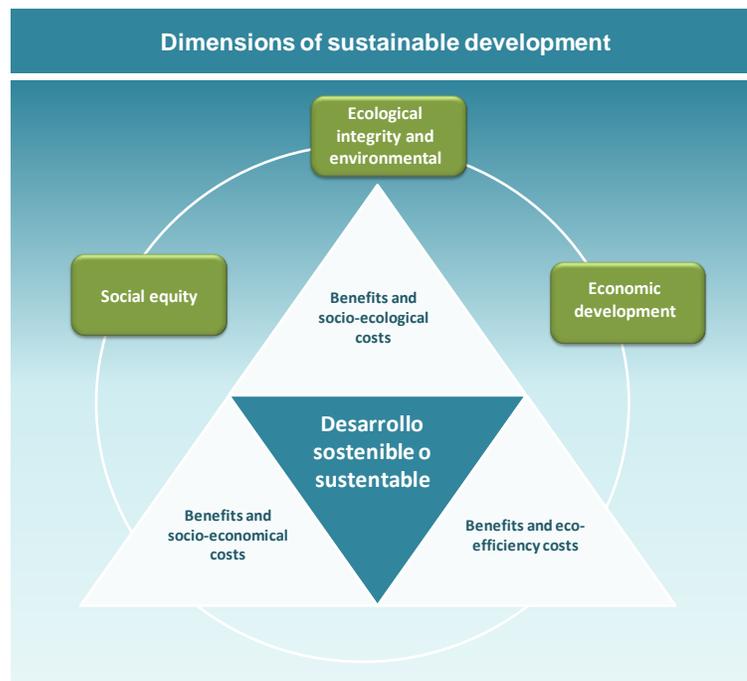
<sup>9</sup>The Segment of Culebra was a separate document because it had been approved prior to the PRCZMP document.

## 2.1 SUSTAINABLE DEVELOPMENT

As a philosophical or technical concept, the term “sustainable development” is defined by the International Council of Local Environmental Initiatives (ICLEI) as “the development which offers basic environmental, social, and economic services to all the members of a community without endangering the feasibility of the natural, man-made or social environments vital to offering these services to present and future generations.” In addition, it is an intelligent, scientific, planned, systematic, long range, participative and inter-generational process of justice. Sustainable development implies improvement in the quality of life within the limits of the ecosystems (IUCN, 1991).

Several models about the philosophical or technical conceptualization of this term recognize three dimensions in the sustainable development: the economical, the social and the ecological.

ILLUSTRATION 1. SUSTAINABLE DEVELOPMENT DIMENSIONS<sup>10</sup>



Each dimension has its own objectives. Ecological sustainability [or environmental protection] pretends to maintain the essential processes of sustaining life, taking into consideration the capacity of regeneration and recovery of the ecosystem.

Economic sustainability [or economic development] attempts to maintain the volume of natural and artificial capital and its flow in appropriate levels in order to guarantee

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<sup>10</sup> The three components of the [IDEAL] concept of sustainable development: the priority of the action should take place after visualizing the consequences of movements clockwise, as well as counterclockwise departing from each vertex. The focus emphasis of each participant should consist in looking for the long term balance according to the nature of the project or action, and of each one's mission.

productivity of assets while taking into account the investment required to compensate for depreciation.

Social equity [or justice] highlights the investment in human knowledge and other forms of social investment that sustain organizational and institutional structures. The social element refers to the idea that the protection of the environment and economic sustainability cannot take place at the cost of the population, and special attention should be taken to avoid circumstances in which specific groups could end up on the fringe or physically, politically or socio-economically displaced. In other words, sustainable development should guarantee social equity. The main idea behind sustainable development is the integration of these three dimensions in order to satisfy present needs without affecting the capacity of future generations to satisfy their own needs.

The term *sustainable development*, as a legal concept in Puerto Rico, was adopted in three laws approved in 2004:

- “Puerto Rico Environmental Public Policy Act”, *supra*, defines sustainable development in Title VII (Of the National Day of Environmental Awareness and Reflection, Article 64, Definitions):

“a development that satisfies present needs without endangering the needs of future generations. It is a process in which the economic, fiscal, commercial, energetic, agricultural, industrial, and other pertinent public policies, are formulated in order to achieve a development sustainable from the economic, social and ecological points of view. Forms of economic development and activities that do not degrade or exhaust the natural resources needed for life as well as present and future economic development.”

- “Public Policy Law on Sustainable Development”, *supra*, establishes the public policy of sustainable development in Article 2:

“The Commonwealth of Puerto Rico declares that it is a continuous policy of the Government, including the municipalities, in cooperation with the interested public and private organizations, the use of all means and practical measures, including technical and financial assistance, as well as the best available practices and technologies, with the purpose of encouraging and promoting the sustainable development of Puerto Rico. Human beings should be the focal point of this development as they have the right to productive and healthy lives in harmony with nature”.

- “Commonwealth of Puerto Rico Land Use Plan Act”, *supra*, integrates the concept of sustainable development in its public policy, in such a way that the PR-LUP serves as the main instrument in the planning of the Commonwealth and is conducive to sustainable development, complying with the “Puerto Rico Environmental Public Policy Act”, *supra*, in the context of Section 19, Article VI of the Constitution of the Commonwealth of Puerto Rico.

## 2.1 WATERSHED AS A PLANNING UNIT

The coastal area is not disassociated from the rest of the Island, particularly, from those decisions and activities that take place within its interior. Therefore, adequately planning for the coastal zone needs to integrate all the elements that, in any way or form, have a bearing on the territory.

The watersheds, comprising from the interior areas of Puerto Rico to the coastal zone, are considered an adequate planning unit. This is the reason why it is important to include the watersheds as the planning unit within the sectors that comprise the coastal territory. From this perspective, the watersheds provide an adequate framework to address the issue of non-point sources of pollution.

## 2.1 NON-POINT SOURCES OF POLLUTION AS A CRITICAL ISSUE

A critical subject that will require major attention in the revision and update of the PRCZMP is the pollution by non-point sources in the coastal zone. The Coastal Nonpoint Source Pollution Control Program was established by the U.S. Congress in 1990 and it requires the states and territories receiving federal funds to manage local coastal zone programs to establish programs to control pollution from non-point sources on the zones.

As part of the aforementioned effort, on February 8, 1999, the Governor of Puerto Rico signed Executive Order (EO) 1999-08, to establish a public policy for the control of pollution from non-point sources in the coastal zone of Puerto Rico, to adopt obligatory management measures and to require the departments and agencies of the Commonwealth to comply with the EO. At the same time, the EO dictates the establishment of an Interagency Committee for the Control of Pollution from Non-point Sources, whose responsibilities include the creation and implementation of the plan called, "Puerto Rico Coastal Nonpoint Pollution Control Plan" (PRCNPCP). This Plan was approved by NOAA and the EPA in October of 2000, and is jointly managed by the DNER and the EQB.

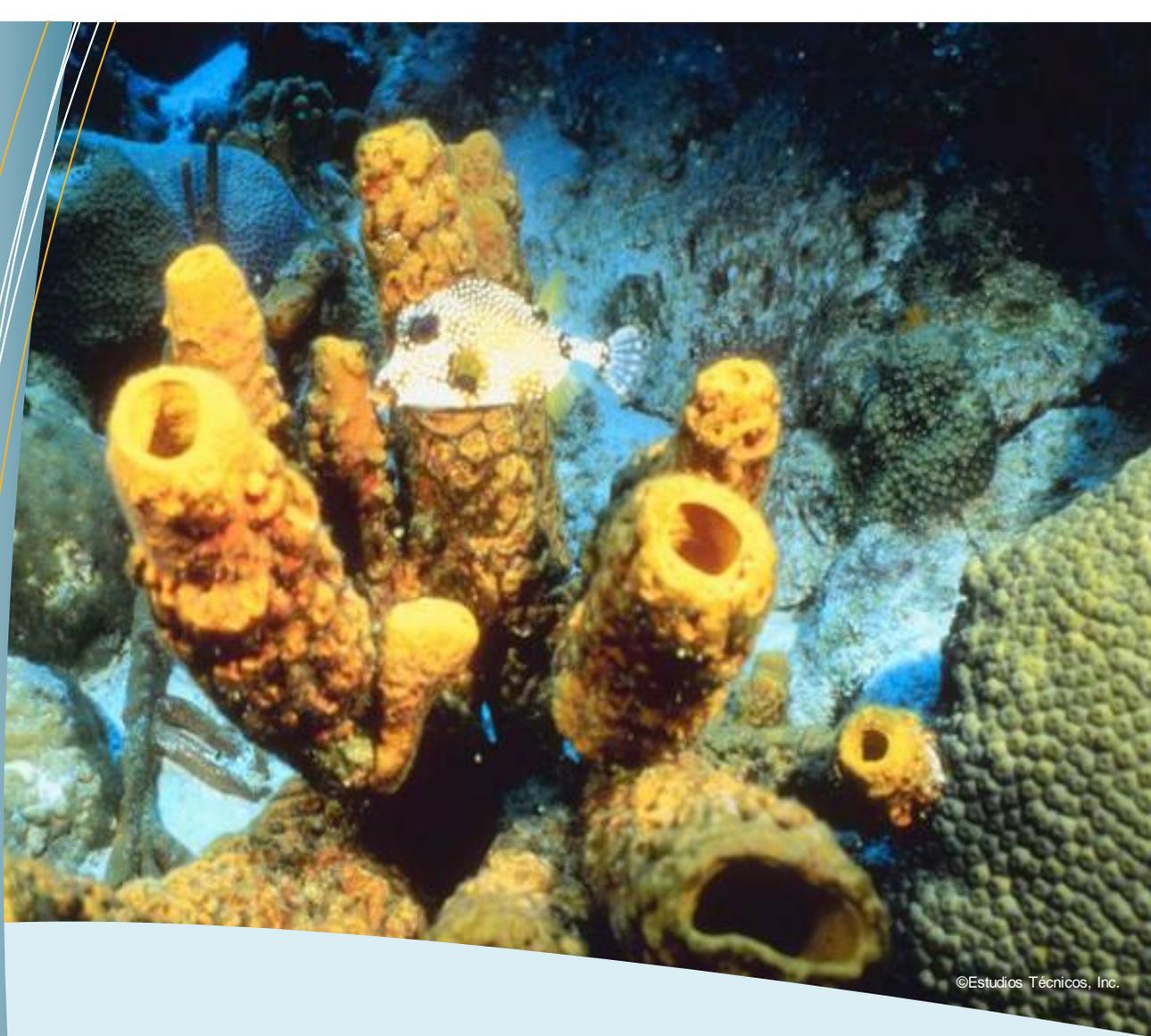
In August of 2002, an Executive Report known as *Coastal Zone Pollution by Nonpoint Sources Control Plan: Report of Accomplishments Three (3) Years After Signing Executive Order No. 1999-08*, stated the following:

"Due to the size of the island of Puerto Rico and its mountainous terrain, everything that takes place in high areas will eventually have an impact or will affect coastal areas. The Plan is being implemented and developed across the island. This way, control of pollution caused by the categories of nonpoint sources [urban, agricultural, marine, hydro-modification, and mining] generated in the island's interior regions or areas is promoted. Regarding agriculture, the Plan is being implemented based on geographic priorities, especially on the most polluted hydrographic basins with a greater need of restoration."

The limits of land management area (LMA) or applicability of management measures (MM) for soil erosion control and the prevention of sedimentation of water sources by the PRCNPCP is the entire island. The ground scope applicability of the PRCNPCP covers 1,000 inland linear meters, measured from the coast line, as well as additional length needed to include key coastal natural systems.

When the PRCNPCP was developed, it was considered and proposed to expand the LMA of the PRCZMP to the entire island. The proposal represented a major change to the PRCZMP, due to the implications to extend the process of coastal management to the whole island. As a result, the Government of Puerto Rico successfully asked for approval of the PRCNPCP as a separate plan.

Nevertheless, due to implications of extending the coastal management process to the whole island, this revision and update process of the PRCZMP does not contemplate the expansion of the ground scope of the PRCZMP. Therefore, topics associated with the nonpoint sources of pollution are detailed in the Coastal Waters section of this report.



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**Chapter 1:**  
*Overview of Puerto Rico's Coastal  
Zone*

# Chapter I. OVERVIEW OF PUERTO RICO'S COASTAL ZONE

## 1.1 GENERAL PHYSICAL CHARACTERISTICS

Puerto Rico is an archipelago comprised of a main island, two lesser inhabited islets and a series of cays and reefs located in the northeastern corner of the Caribbean region, just to the east of the Greater Antilles and between the Atlantic Ocean and the Caribbean Sea. The coordinates that define its center are 18°15' North and 66°30' West.

The island of Puerto Rico has an approximate area of 903,900 hectares<sup>11</sup> with dimensions of 191.5 km long by 62.7 km wide, covering a total area of 8,928 km<sup>2</sup>. Aside from the Main Island, there are two other islands in the archipelago that are inhabited: Vieques and Culebra. Other uninhabited smaller islands are Mona and Monito and the islets of Desecheo, Caja de Muertos, Isla Piñeros, Palominos, Sardinera, Cayo Icacos and Isla de Cabras.

According to the 2000 Census, Puerto Rico's population was 3,808,610 with a population density of 429 inhabitants per km<sup>2</sup>.

### 1.1.1 ORIGIN AND COMPOSITION OF THE ISLAND

Puerto Rico was formed as a result of volcanic activity about 135 million years ago, and has never been physically united to a continent. In geological terms, Puerto Rico is considered a young island.

Geologically, the Island is composed of three igneous provinces: North igneous province (~112-55 Ma<sup>12</sup>), Central igneous province (~65-144 Ma) and South igneous province (~144-195 Ma). These are distinguishable by their composition and geological age, being the South province where the oldest rocks are found (*Complejo Sierra Bermeja*). These provinces have their origin in volcanic eruptions during the Caribbean's development.

Moreover, the Island has three geomorphological, or of distinguishable embossment, provinces or regions: the central mountainous interior (upland province), the karst region and the coastal plains.

The central mountainous interior arises from tectonic activity during the Island's evolution. This is the largest of the three geomorphological regions since it covers approximately 40% of the Island.

The karst region is located north and south of the Central Mountain Range and covers about 27.5% of the Island's surface, although other scattered limestone deposits can be found. Nevertheless, the most significant limestone formations are found in the Northern Karst Region.

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<sup>11</sup> This is the equivalent of 23 million *cuerdas*. A *cuerda* equals 0.9712 of an acre or 0.3930 of a hectare.

<sup>12</sup> Ma=Megannum or one million years

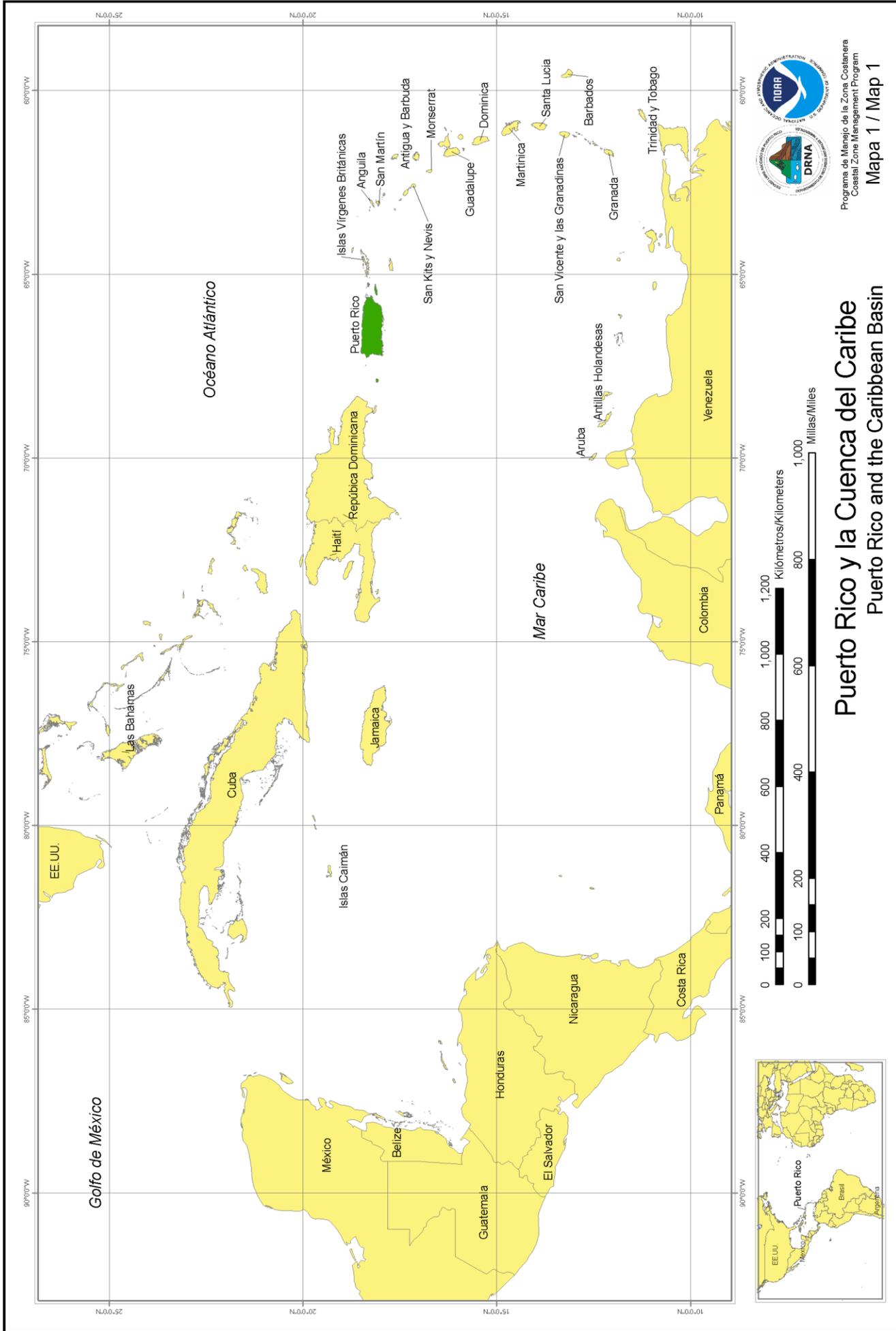
The coastal plains were formed as a result of various factors, including: the successive inclinations of volcanic mass, the mountains' erosion, the accumulation of alluvium in the rivers' mouth and its eventual redistribution by the waves' actions and marine currents, reef formation and sea level variations through geological time. The coastal plains comprise about a third of the Island's total area.

### 1.1.2 THE ISLAND'S CLIMATE

Precipitation in Puerto Rico is determined by wind patterns that blow from the northeast and by the mountainous topography. The highest precipitation is registered in the Central Mountain Range, specifically in the Luquillo Range (*Sierra de Luquillo*), a spur from the Central Mountain Range located to the east. Rainfall in the area can reach up to 150 inches a year, particularly in the National Rain Forest, known as *El Yunque*, with an average of more than 200 inches annually.

Rain activity is mainly concentrated in the coastal plains of the West, Southeast and North which have a higher reported rainfall than the Southern and Southwestern plains. In the North coastal plains, and in the East and West coastal valleys, rainfall is moderate averaging between 60 and 70 inches a year. In the Southern coastal plains, the rainfall pattern is low with less than 40 inches a year. The Lajas Valley (*Valle de Lajas*) can be found there, which, generally, receives less than 30 inches of rain annually.

Rainfall patterns influence the distribution of vegetation, thus making the typical vegetation in the north to be of a humid subtropical forest while in the West and Southwest the vegetation is representative of a subtropical dry forest.



# Puerto Rico y la Cuenca del Caribe

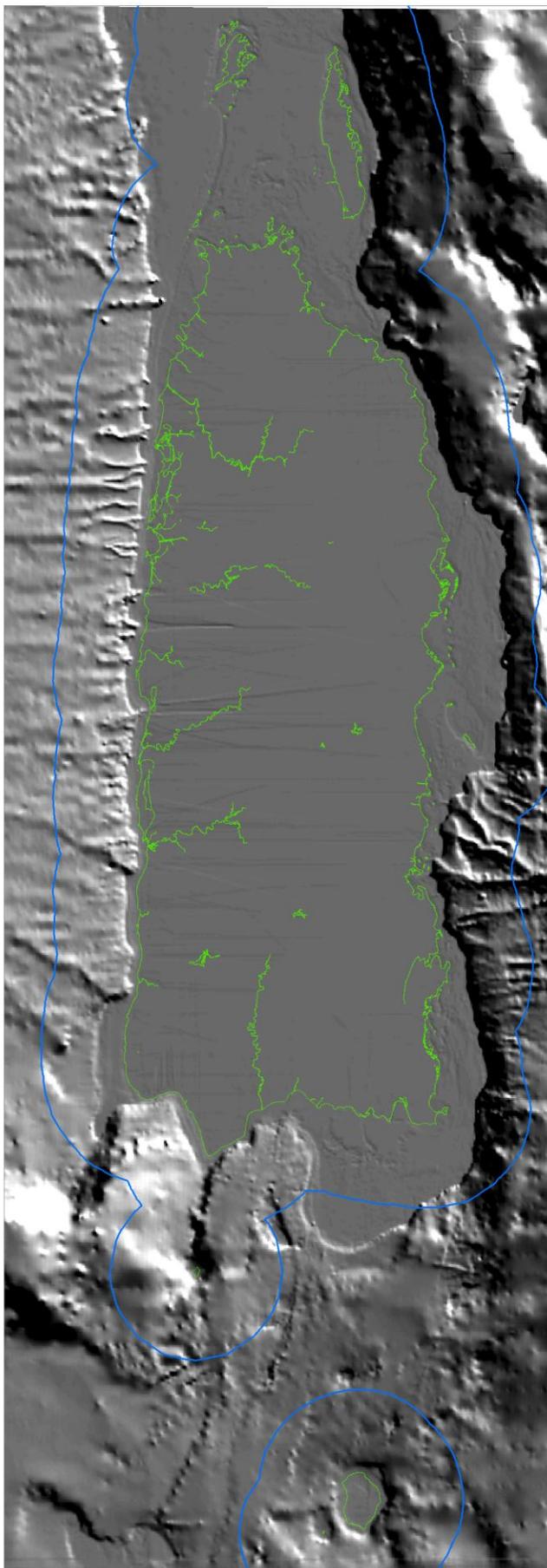
## Puerto Rico and the Caribbean Basin

Mapa 1 / Map 1

Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program



Escala - Scale 1:830,691



Fuente de Información - Source:  
National Oceanic And Atmospheric Administration  
Departamento de Recursos Naturales y Ambientales



# Plataforma insular y batimetría de Puerto Rico

## Puerto Rico's Platform and Bathymetry

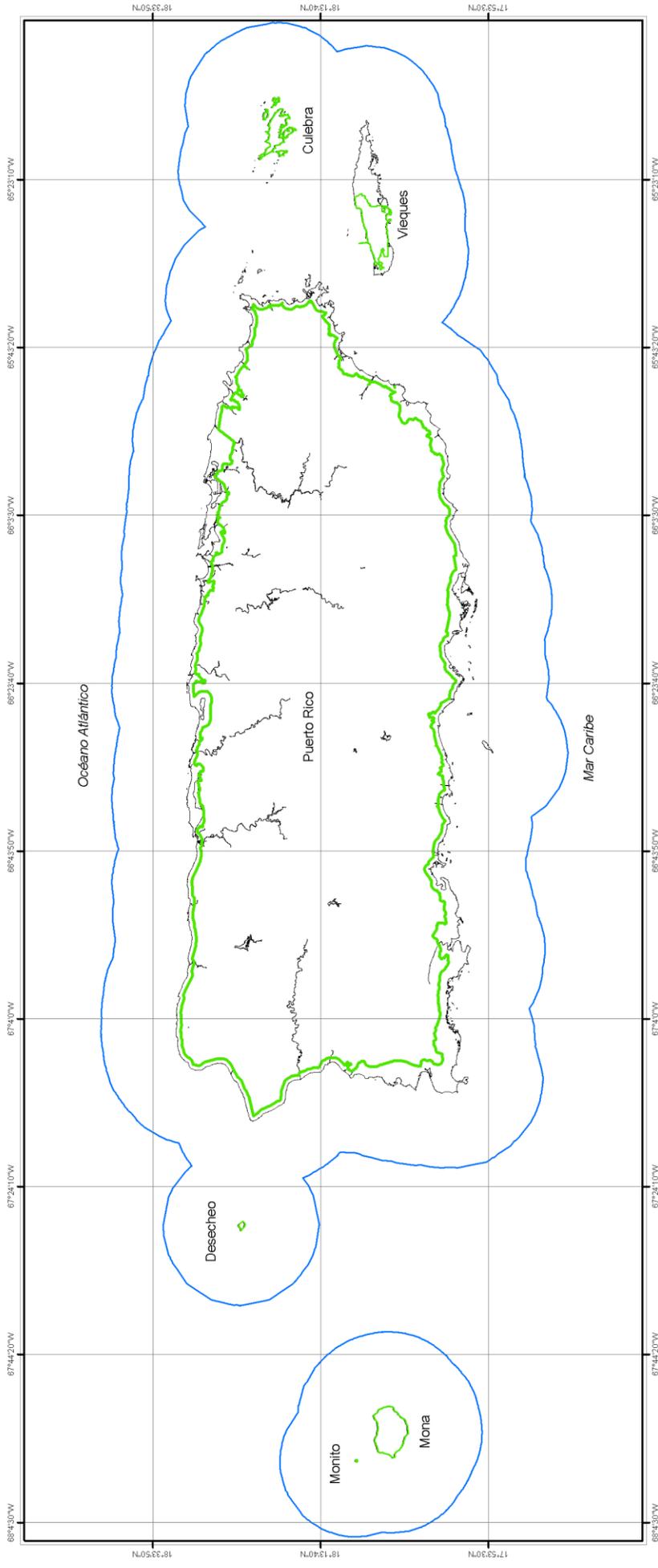
Mapa 2 / Map 2

Leyenda - Map Key:

-  Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
-  Limite de la zona costanera marina (9 millas náuticas)- Coastal Zone Maritime Boundary



Escala - Scale 1:860,000



# Jurisdicción del Programa de Manejo de la Zona Costanera de Puerto Rico

## Puerto Rico Coastal Zone Management Program Jurisdiction



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 3 / Map 3

Fuente de Información - Source:  
Departamento de Recursos Naturales y Ambientales

### 1.1.3 NATURAL SYSTEMS

Aside from the afore-mentioned meteorological factors, Puerto Rico's shape and location, and the extension of its insular platform, influence the type and location of the natural systems located throughout the coast.

Water conditions – salinity, temperature, clarity and currents– of the southeast, northeast and southwest zones, favor the development of coral reefs and mangroves along the coast.

In the southern coast, the island shelf is wider and there are islands and islets that protect the coast from the direct impact of waves and allow the formation of mangroves and coral reefs.

In the North coast, however, the littoral is exposed to the open sea where ocean currents are stronger and the waters are deeper and less clear, thus coral reef formations are scarce. In this coast, mangroves occur in smaller proportion to the South and are observed in the river margins, bordering brackish water lagoons and where there are sand dunes to cushion the impact of waves. Another factor limiting the growth of coral reefs in the North coast is the sediments washed from the interior by the rivers of major flow.

The coastal zone is marked by very productive biological systems, particularly where land and sea meet. In these areas, the wave action, the silt – found in the alluvial material drawn from the interior – and shallow waters, create highly productive biological systems. Estuaries, which are areas where rivers meet the sea, are also highly productive coastal ecosystems.

Other resources and systems found on the coasts are: dunes, beaches, forests, fresh and saltwater lagoons, mangrove swamps, salt marshes, bays, islets and cays. Moreover, in some of the Island's coastal lagoons, the presence of micro-organisms which exhibit the phenomenon of bioluminescence can be observed.

In the coastal zone of Puerto Rico there is also a variety of features of karst topography, particularly in the north, northwest and southwest, among which are: cliffs, caves, haystack hills (*mogotes*), littoral cavities, sinkholes and ramparts.

### 1.1.4 DESCRIPTION OF COASTAL SECTORS

According to the socioeconomic, ecological, geological and topographic characteristics, the coast of Puerto Rico can be divided into eight coastal sectors. Seven are located on the Main Island: North, Northeast, Southeast, South, Southwest, West and Northwest, while the eighth sector corresponds to the adjacent islands.

#### **North Sector: from the Río Grande de Arecibo to Boca de Cangrejos in Carolina: 37,097 hectares**

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The northern sector of Puerto Rico's coastal zone includes the San Juan Metropolitan Area (SJMA) and neighboring cities. The SJMA is located in the eastern part of the northern sector, being the largest urbanized area in the Commonwealth. Its main economic axis is the capital city of San Juan, with the highest population density of 3.509 inhabitants/ km<sup>2</sup>. This has generated a continuous demand for the use of flat lands.

This sector also includes some of the major-flowing rivers on the Island and the largest groundwater system. These factors have precipitated the settlement of a large number of pharmaceutical and chemical plants in this sector.

Much of the land in the sector is low and flat, and periodically flooded, leading to the formation of swamps, marshes, freshwater and saltwater ponds and extensive mangroves. Among the most important wetlands in the sector – which have been designated as natural reserves – are *Caño Tiburones*, *Laguna Tortuguero*, *Cibuco* and *Las Cucharillas*.

Caño Tiburones and Laguna Tortuguero are composed mostly of freshwater biological communities. Laguna Tortuguero is an ecosystem of great importance since it is the largest freshwater lagoon on the Island and features a vast array of flora and fauna. Within the range of plant species (600), some are rare and endemic to this place (35). In the northern sector, a *Pterocarpus* forest (*Pterocarpus officinalis*) can also be found in Dorado.

The topography of the North Coast sector is mostly flat with extensive haystack hills. In the past, the fertility of these flat lands encouraged a great deal of agricultural activity including the intensive cultivation of sugarcane and pineapple.

The northern coastal plains consist, predominantly, of sand with minor amounts of clay. These sedimentary deposits gradually descend from the mountainous interior and from the northern karst, to the Atlantic Ocean. Most deposits are encountered along the alluvial plains and old river tributaries. In rivers mouths, and areas near them, beach sand consist mostly of quartz particles and rock fragments and exhibit significant magnetite content, which accounts for their dark gray color.

To the east of the northern sector, in the Dorado area, the sand is mainly composed of calcareous detritus (shells, coral, etc.), quartz and volcanic rock fragments.

#### **Northeast Sector: from Boca de Cangrejos in Carolina, to Río Demajagua in Ceiba: 36,900 hectares**

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This sector includes the most extensive mangrove forests on the Island (about 1,963 hectares) and several saltwater lagoons (approximately 381 hectares) conducive to commercial and sport fishing. Its topography is predominantly flat, from Boca de Cangrejos to Punta Percha in Luquillo, with some hills and valleys formed by the extensions of the Luquillo Mountain Range which slopes toward the coast. This is the only coastal sector that contains four lagoons: *Piñones*, *Torrecilla*, *Aguas Prietas* and *Grande*. Among the mangrove areas, the Piñones mangrove forest is the most significant.

To the east, the wide insular platform favors the proliferation of coral reefs. In it lies a chain of small islands and cays that are part of the *Arrecifes de la Cordillera Natural Reserve*. Other natural reserves in this sector are: *Piñones State Forest*, *Corredor Ecológico del Noreste*, *Cabezas de San Juan* and *Río Espíritu Santo*.

The rocky and coral reefs protect this sector's coastlines. Their presence makes for calm waters and the conditions are favorable for the formation of sandy beaches. In the Northeast coast, 78% (45.8 km) of coastline is composed of white sand beaches. The conditions of the sector – wide insular platform, and the presence of reefs and mangroves – sustain an ideal

environment for recreational activities. Another tourist attraction in this sector is the El Yunque National Forest.

The potential for tourism development and the continued demand for private housing have led to the construction of hotels and resorts as well as other residential zones in this coastal sector. Currently, the systematic growth of the SJMA heading eastward continues to generate increased demand for lowlands. Moreover, this is the sector Puerto Rico's coast with the greatest number of nautical facilities, which historically has transformed it into one of the most attractive spots for nautical tourism.

#### **Southeast Sector: from Río Demajagua in Ceiba, to Río Grande de Patillas: 1,570 hectares**

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The Southeast coast alternates between rocky lands formed by marine erosion and valleys or alluvial material that produce extended beach plains as a result of waves and marine deposits. North of Punta Lima, the coastline consists of mangroves, rocky lands, several small coastal plains and hidden beaches. This part of the Island is surrounded by an insular platform, with an abundance of coral and marine organisms that extend eastward to near the Virgin Islands.

The average annual rainfall is high, fluctuating between 55 to 80 inches. Rivers abound and pass through narrow valleys. The Maunabo valley, located between the mountain ranges of *Cuchilla de Panduras* and *Sierra de Guardarraya*, is of particular significance.

This sector is home to four natural reserves: *El Pantano*, *Bosque de Pterocarpus* and *Lagunas Mandry and Santa Teresa*; *Punta Yeguas*; *Humedal Punta Tuna* and *Punta Viento*.

Also, the Natural Protected Area *Daguao y Medio Mundo* is located in this sector. This area occupies 40% of the former Roosevelt Roads Naval Base. This area is comprised of 3,480 hectares for which there are government initiatives focused on tourism. The Port of Yabucoa, which includes facilities to receive crude oil and for the shipment of fuel oil, can also be found in this sector.

#### **South Sector: from Río Grande de Patillas to Río Tallaboa in Peñuelas: 56,136 hectares**

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This is an arid sector consisting essentially of an alluvial plain. There is one exception, a narrow mountain strait between Tallaboa and Punta Cuchara, where the mountains stretch towards the coast, which has been formed by erosion from the waves and the reefs that line it. The rest of the coast is composed of beach plains and mangroves. The rivers in this sector have short banks and carry large amounts of sediments that are deposited on the coast.

Gravel and boulders are typical materials of these alluvial fans, which are concentrated along the shore line, where smaller particles are removed and transported to other places by the waves or littoral currents. Unlike the beaches of the north, the southern coastal plains consist of rocks and lack sand and longitudinal dunes. Also, the absence of large lagoons in the South coast is noticeable.

West of Ponce, the plains are highly fragmented, interrupted by rocky points mostly composed of limestone material.

The following natural reserves can be found in this sector: *Punta Petrona*, *Arrecifes de Guayama*, *Caja de Muertos* and *Punta Cucharas* in Ponce, as well as the Jobs Bay National Estuarine Research Reserve (JOBANERR).

The municipality of Ponce is in this sector and has a population density of 620 inhabitants per km<sup>2</sup>. This is considered the second most important port city in Puerto Rico, after San Juan.

#### **Southwest Sector: from Río Tallaboa in Peñuelas to Punta Guaniquilla in Cabo Rojo: 44,359 hectares**

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The topography in this area is generally mountainous, with the exception of the plains near Tallaboa, Guayanilla, Guánica, Pole Ojea, west of La Parguera and Boquerón. The rainfall is very low (35 inches per year), which promotes a xerophytic vegetation<sup>13</sup> that is abundant along the coast.

In this sector, the insular platform is relatively wide and there are no water bodies with major flow discharging in these shores. This environment creates conditions conducive to the development of coral reefs and bioluminescent lagoons. In the coastal waters of this sector there are fishing areas, where the catch is more abundant than the rest of Puerto Rico.

The Southwest sector has significant natural resources, among which are: the *Guánica State Forest*; the mangrove swamps of *La Parguera*, *Boquerón* and *Pitaya*; the bioluminescent bay in La Parguera; the reefs of *Margarita* and *Turumote*; the Cabo Rojo National Wildlife Refuge; and the beaches of *Caña Gorda*, *Bahía Ballena*, *El Combate*, *Caleta Salina*, *Punta Ventana* and *Boquerón*. Approximately 16 km of this sector's coastline consist of sandy beaches.

The scenic attractions of this sector have generated a high demand for land for the construction of second homes, hotels, condo-hotels and other facilities for tourism and recreational activities. This development tendency is mainly seen in the western portion of the sector. Meanwhile, the eastern part of the sector, in the Municipality of Peñuelas, is home to the facilities of an abandoned oil refinery, known as the Commonwealth Oil Refining Company (CORCO), and a petrochemical manufacturing complex. Some of these facilities are in disuse, while others are utilized as a terminal for maritime transportation and storage of crude oil and derivative products.

#### **West Sector: from Punta Guaniquilla in Cabo Rojo to Río Culebrinas in Aguada: 28,657 hectares**

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The western sector is characterized by valleys defined by mountain ranges descending to the coastline. This sector receives the highest amount of rain per year, between 65 to 90 inches. For this reason, the main valleys of the area, like Añasco, Guanajibo and Culebrinas, have great agricultural value.

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<sup>13</sup> Desert type vegetation

In the south portion of this sector, beach plains are predominant. North of Punta Guanajibo, there are other coastal features among which are rocky shores, mangroves and reefs. In this sector, the coasts are sandy because the rivers supplying them are longer and with channels which are less steep. Therefore, more sand and fewer rocks are carried into the sea. Among the natural areas found in this sector are *Caño la Boquilla* and *Tres Palmas*.

The Municipality of Mayagüez is located in this sector, between Punta Guaniquilla and Río Culebrinas. Mayagüez is considered the third most important port city in Puerto Rico, after San Juan and Ponce.

#### **Northwest Sector: from Río Culebrinas in Aguada to Río Grande de Arcibo: 25,909 hectares**

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This sector is characterized by having a mountainous interior and cliffs along the coast. Some of these cliffs have a height of more than 91 meters and are a major tourist attraction due to the beauty of the landscape. Sand dunes and sandy beaches are also a major part of this.

In the Northwest sector, there are cliffs that have been shaped by erosion caused by the wave break. Throughout most of the coast, the cliffs stretch hundreds of meters inland with beach plains separating them from the sea. In the area of Isabela there are extensive areas of sand dunes. However, the area has been subject to the removal of large quantities of sand, which has adversely impacted these resources.

East of Isabela, the beaches are generally narrow and consist of thin layers of sand found on the rocky coast (eolianite). Despite the existence of numerous rock formations that separate these beaches, adjacent sand dunes supply most beaches.

#### **Adjacent Islands: Vieques, Culebra and Mona are Puerto Rico's main adjacent islands: 21,983 hectares**

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The main islands that make up the archipelago of Puerto Rico are Vieques (13,335 hectares), Culebra (2,818 hectares) and Mona (5,491 hectares). Vieques and Culebra are located east of the island of Puerto Rico and Mona is located to the west. Within this sector, the islands of Vieques and Culebra are the only ones inhabited. In both, the topography is very similar and characterized by small hills.

Culebra is considered an archipelago; composed of the main island and cays: *Luis Peña*, *Lobo*, *Lobito*, *Culebrita*, *Norte*, *Botella*, *Geniquís*, *Pirata*, *Pelá*, *Matojo*, *Alcarraza* and *Stevens Rock*.

Precipitation in Vieques and Culebra is low and vegetation is semiarid, much like the south coast of Puerto Rico. Part of its coastlines, are lined with mangroves and clear coastal waters contribute to the presence of coral reefs. These coastlines provide favorable conditions for marine life and recreational activities. To the south of Vieques is a bioluminescent bay, which has been designated a Nature Reserve.

Both Vieques and Culebra were used as firing ranges by the U.S. Navy to carry out their military practices. In Culebra, the Navy's departure became effective in 1975 and, as a result, nearly 25% of its land was designated as a National Wildlife Refuge. Another protected area in the Municipality is the *Canal Luis Peña Natural Reserve*.

Military activities in Vieques ceased in 2003. Most of the land was designated as a National Wildlife Refuge and others were transferred to the Puerto Rico Conservation Trust (PRCT). Portions of these lands were included in the EPA's Superfund Program in 2005, due to contamination caused by decades of military exercises.

Mona Island is, predominantly, a limestone plateau surrounded by uninterrupted cliffs and stretches of beaches. The low rainfall and the soil's extreme porosity contribute to the existence of dry forest vegetation. The island is uninhabited and, both, the flora and fauna include many endemic species. This island has a great natural value recognized by several designations, including: Natural Reserve, Insular Forests, National Natural Landmark, National Historic Landmark and Historic Site, among others.

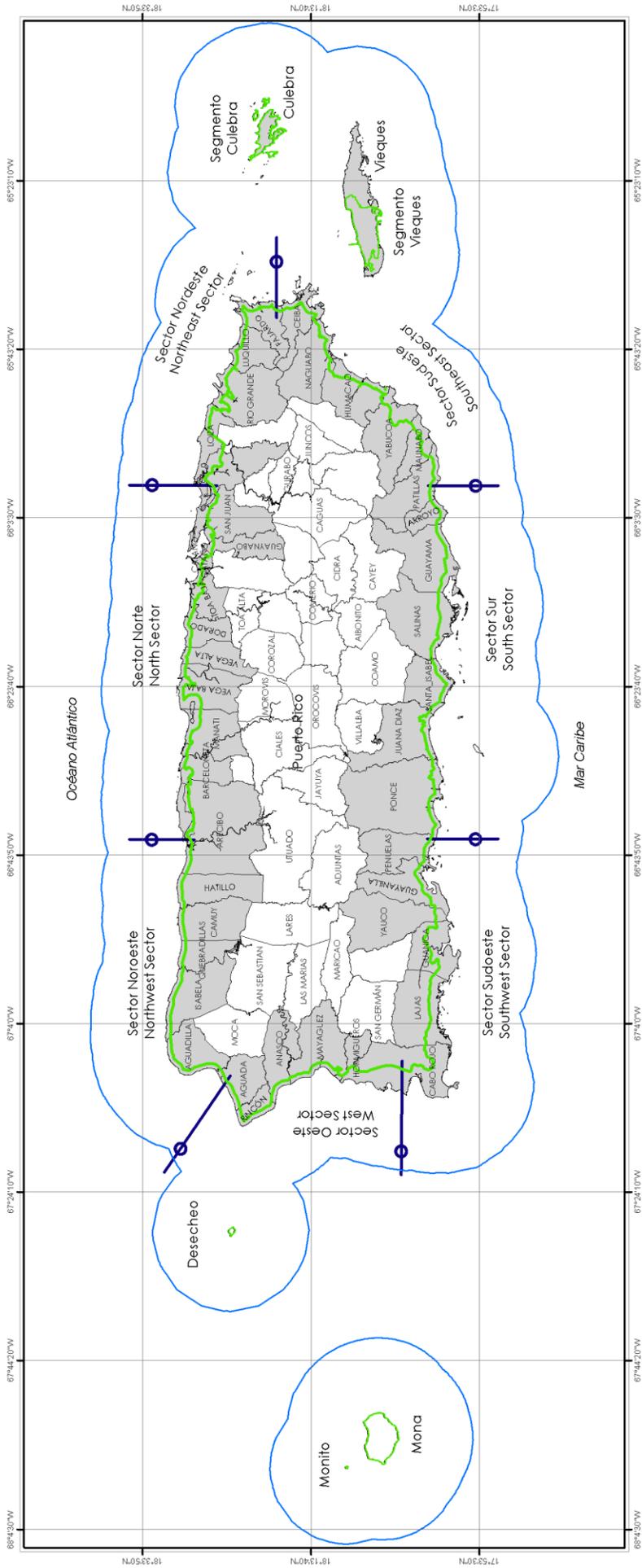
Facing the Northwest coast, there is a segment of the Central Mountain Range submerged millions of years ago, and the island of Desecheo is a peak of that ancient mountain range. South of Ponce, the island of Caja de Muertos has a volcanoclastic composition and is covered with limestone. The other small islands, which are of predominantly coral origin, are uninhabited and possess similar natural conditions to the islands listed above.

- Leyenda - Map Key:**
- Municipios costeros - Coastal Municipalities
  - Límite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
  - Límite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary

Océano Atlántico

Mar Caribe

Escala - Scale 1:860,000



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

# Municipios y Sectores costeros (PMZC, 1978)

## Municipalities & Coastal Sectors (CZMP, 1978)

Fuente de Información - Source:  
Puerto Rico Coastal Zone Management Program - Final EIS, 1978  
Junta de Planificación de Puerto Rico

### 1.1.5 COASTAL SECTORS AND WATERSHEDS IN PUERTO RICO

The topography of the Island is characterized by its descent from the higher parts in the central mountainous interior, through the karst area consisting of haystack hills and other geomorphological features, to the coastal plains. In these littoral plains, the coastal zone is closely related to the interior of the Island. In episodes of rain, waters are displaced along topographic contours until they reach the fluvial drainage network defined by rivers and streams that carry water into the sea. These drainage areas that are surrounded by highlands or mountains, which serve as limits or boundaries, are known as watersheds. Therefore, in order to conduct the proper planning of the coastal zone, it is essential to integrate all elements that somehow affect the territory. This condition highlights the importance of including the watersheds as planning units within the sectors that comprise the coastal territory.

#### Watersheds

---

Within eight coastal sectors, a total of 15 watersheds can be defined for the main rivers that carry rainwater from the Island's interior to the sea. The measurement of the watersheds was done according to the classification made by the U.S. Geological Survey (USGS). It is important to highlight that the territorial extension corresponding to the islands of Vieques and Culebra is included as a watershed.

The watersheds contained within each sector are listed below.

1. **The Northern sector** is known for its abundance of precipitation and for having rivers of great volume that flow into the Atlantic Ocean, some with underground segments. This sector includes the area from the basin of the *Río Grande de Arecibo* to the basin of *Río Puerto Nuevo-Río Piedras*. This territorial segment also includes the basins of the *Río Grande de Manatí*, *Río Cibuco*, *Río La Plata* and *Río Bayamón-Río Hondo*.
2. **The Northeast sector** ranges from the basin of *Río Grande de Loíza*, to the basin of the *Río Antón Ruiz*. The *Río Herrera* basin is found in this sector.
3. **The Southeast sector** includes the area from the *Río Humacao* basin to the *Río Seco*. The topography in the eastern part of the Island is mountainous and basins are close to the shore. In this sector, the flow of the rivers has cut narrow triangular valleys.
4. **The Southern sector** has shorter rivers because of the proximity of the mountainous interior to the coastal zone. The volume of many rivers in the south coast that flow towards the Caribbean Sea is small and some are dry because of the scarce precipitation. This South sector extends from the basins of the *Río de Salinas* to the *Río Jacaguas* and the basin from *Río Inabón* to the *Río Loco*.
5. **The Western sector** stands out because of its abundant rainfall. Its rivers are long and the basins are of greater length. This coastal sector includes the basins of *Río Guanajibo*, *Río Yagüez* to the *Río Grande de Añasco* and the basin of *Río Culebrinas*.

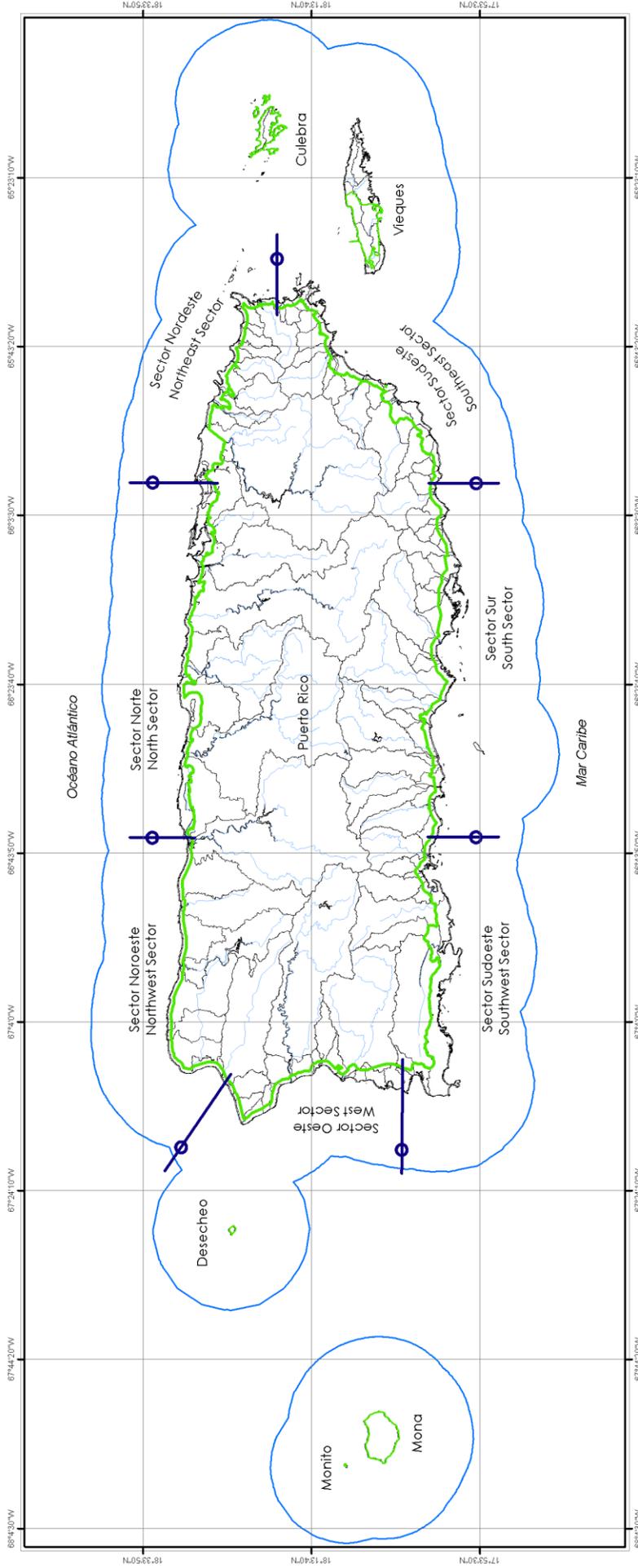
6. **The Southwest sector** is comprised of the *Río Guanajibo* basin. More than 50% of the basin is dominated by rugged wet soils which are well-drained and have shallow depth.
7. **The Northwest sector** covers from the *Río Guajataca* basin to the basin of *Río Camuy*. In this sector, limestone formations abound, among which are canyons, haystack hills, caves systems and caverns, sinkholes and palisades. Portions of the *Río Camuy* flows underground through this sector.
8. **The Adjacent Islands Sector.** The basins of the islands of Vieques and Culebra are considered independent basins given the lack of perennial rivers. However, they do possess groundwater and surface water bodies, such as lagoons, streams and coastal wetlands.

Leyenda - Map Key:

-  Ríos principales - Main Rivers
-  Límite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
-  Cuencas - Watersheds
-  Límite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary



Escala - Scale 1:860,000



0 10 20 30 40 50 60  
Millas (Miles)

0 10 20 30 40 50 60  
Kilómetros (Kilometers)

# Regiones costeras (PMZC, 1978) y cuencas hidrográficas principales

## Coastal Regions (CZMP, 1978) and Major Watersheds



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 5 / Map 5

Fuente de Información - Source:  
Departamento de Recursos Naturales y Ambientales  
Oficina del Plan de Aguas

## 1.2 URBAN SPRAWL TRENDS IN THE COASTAL SECTORS

During a 22-year period extending from 1977 to 1999, Puerto Rico experienced an increase in land development in the seven sectors<sup>14</sup> that make up the coastal territory.<sup>15</sup>

**TABLE I-1. URBAN LAND IN THE COASTAL ZONE**

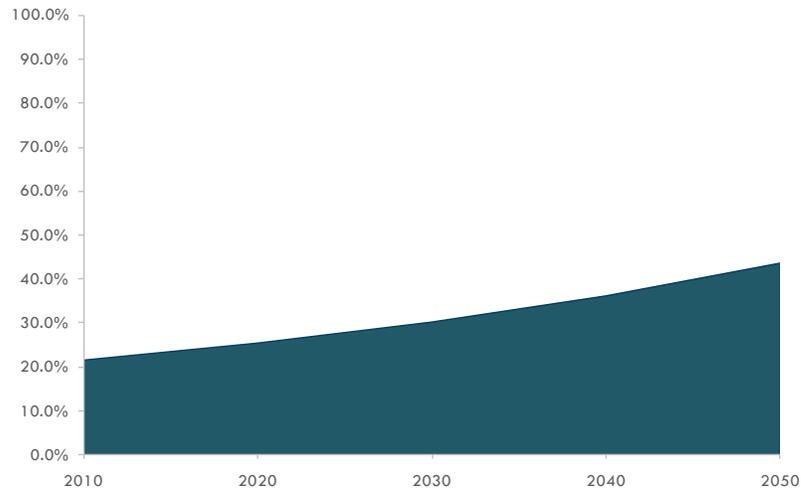
Urban land in the coastal zone							
Region	Coastal sectors area (m <sup>2</sup> )	Urban land area (1977)		Urban land area (1999)		Rate of change	Average annual growth rate
		Area (m <sup>2</sup> )	%	Area (m <sup>2</sup> )	%		
North	167,797,679	42,947,711	25.59%	53,165,940	31.68%	23.8%	0.97%
Northwest	61,231,344	15,140,631	24.73%	17,370,779	28.37%	14.7%	0.63%
West	90,028,210	13,213,305	14.68%	17,464,825	19.40%	32.2%	1.28%
Southwest	255,098,667	13,977,796	5.48%	18,352,233	7.19%	31.3%	1.25%
South	121,324,731	13,910,916	11.47%	23,205,660	19.13%	66.8%	2.35%
Southeast	118,026,973	11,029,286	9.34%	17,415,125	14.76%	57.9%	2.10%
Northeast	103,421,957	9,705,450	9.38%	19,361,420	18.72%	99.5%	3.19%

Note: The Adjacent Islands Sector was not included because of insufficient data.

Source: UPR, Mayagüez Campus. "Mapas de usos de suelo 1977 y 1999". Projections are from the PRPB and estimates are from Estudios Técnicos, Inc.

If this tendency prevails, by the year 2050 developed land in the coastal zone will have doubled, reaching 44% of the total territory.

**GRAPHIC I-1. PROJECTED CHANGE IN URBAN LAND WITHIN THE COASTAL ZONE**



Note: The Adjacent Islands sector was not included in this analysis because of insufficient data.

Source: UPR, Mayagüez Campus. Mapa de usos del suelo 1977 y 1999. Projections are from the PRPB and estimates from Estudios Técnicos, Inc.

<sup>14</sup> The Adjacent Islands Sector was not included because of insufficient data.

<sup>15</sup> The trend in urban development was calculated using maps from the UPR, Mayagüez: "Land Use Change Analysis for USGS Coastal Quadrangle" (1999). The growth of urban land area was calculated based on the trend and projections of population growth for each coastal sector.

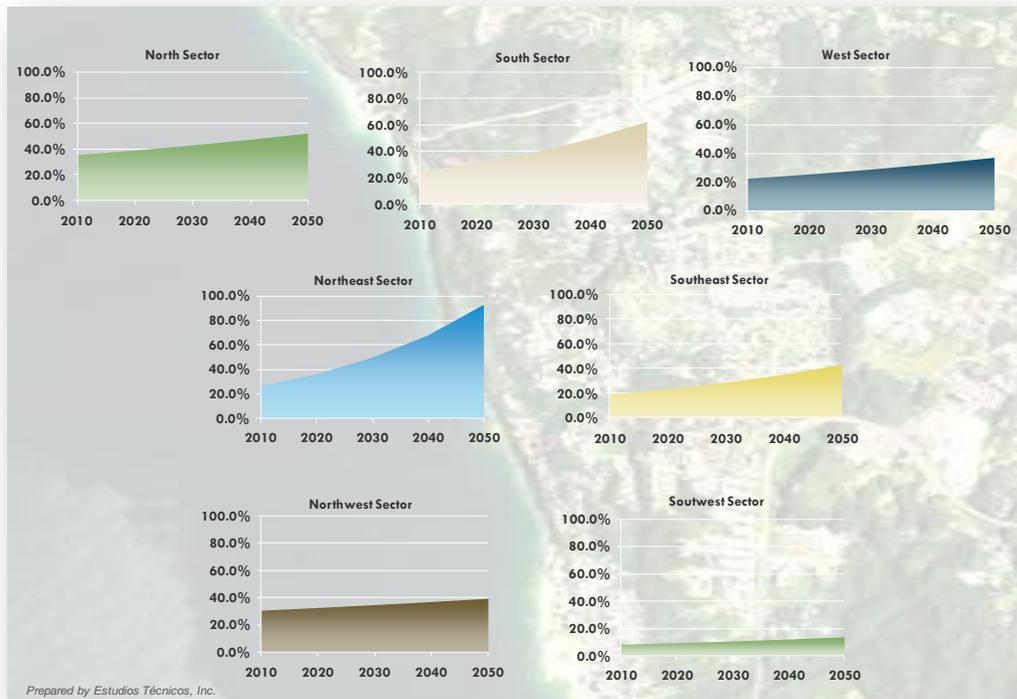
When examining the development tendency for each of the coastal sectors, the Northeast sector presents the sharpest increase in urbanization. Over a period of 22 years – from 1977 to 1999 – the area of urban land doubled (from 9% to 19%). The rate of change for this period was 99%. If this average annual growth rate persists (3%), it is expected that almost this whole sector (93%) will be urbanized by 2050.

The Southern sector is also experiencing an intense urbanization process. In 1977, only 11% was urbanized. By the year 1999, 19% had been urbanized. If this trend continues, by 2050, about 67% will be urbanized.

In 1977, 25.6% of the North sector was already urbanized, being the sector with the largest proportion of developed territory. If the pattern of urbanization in the latter remains constant (an average annual growth rate of 0.97%), it is projected that about half of its territory (52%) will be urbanized by 2050.

Meanwhile, the Southeast sector presents an average annual growth rate (2.1%). Until 1977, 9.3% of the territory had been urbanized. By the year 1999, 14.8% was urbanized. It is projected that, if the current urbanization pattern in the area persists, by 2050, 43% of the sector will be urbanized.

**GRAPHIC I-2. PROJECTED CHANGE IN DEVELOPED LAND WITHIN THE COASTAL ZONE**



Leyenda - Map Key:

- Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
- Limite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary

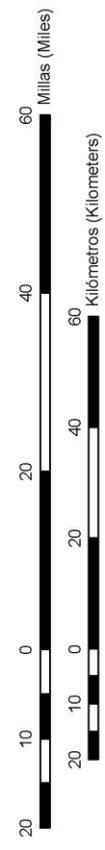
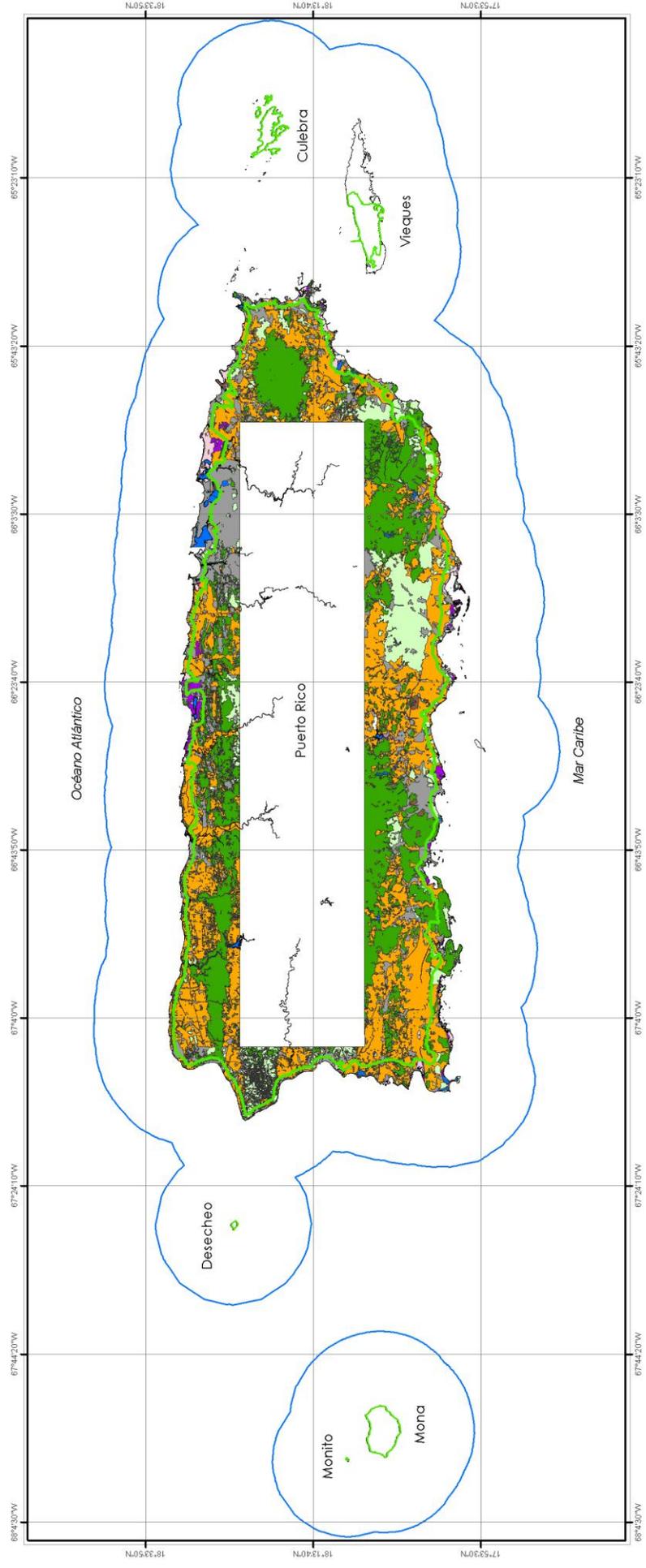
Usos de suelo 1999 - Land Use 1999

- Agua - Water
- Bosque abierto - Open Forest
- Bosque cerrado - Closed Forest
- Cocales - Coconut Trees
- Humedales forestados - Forested Wetlands
- Humedales sin forestar - Unforested Wetlands
- Pasto y agrícola - Agricultural Lands and Pasture

- Suelo sin vegetación - Barren Land
- Urbano - Urban
- No hay datos - No Data



Escala - Scale 1:860,000



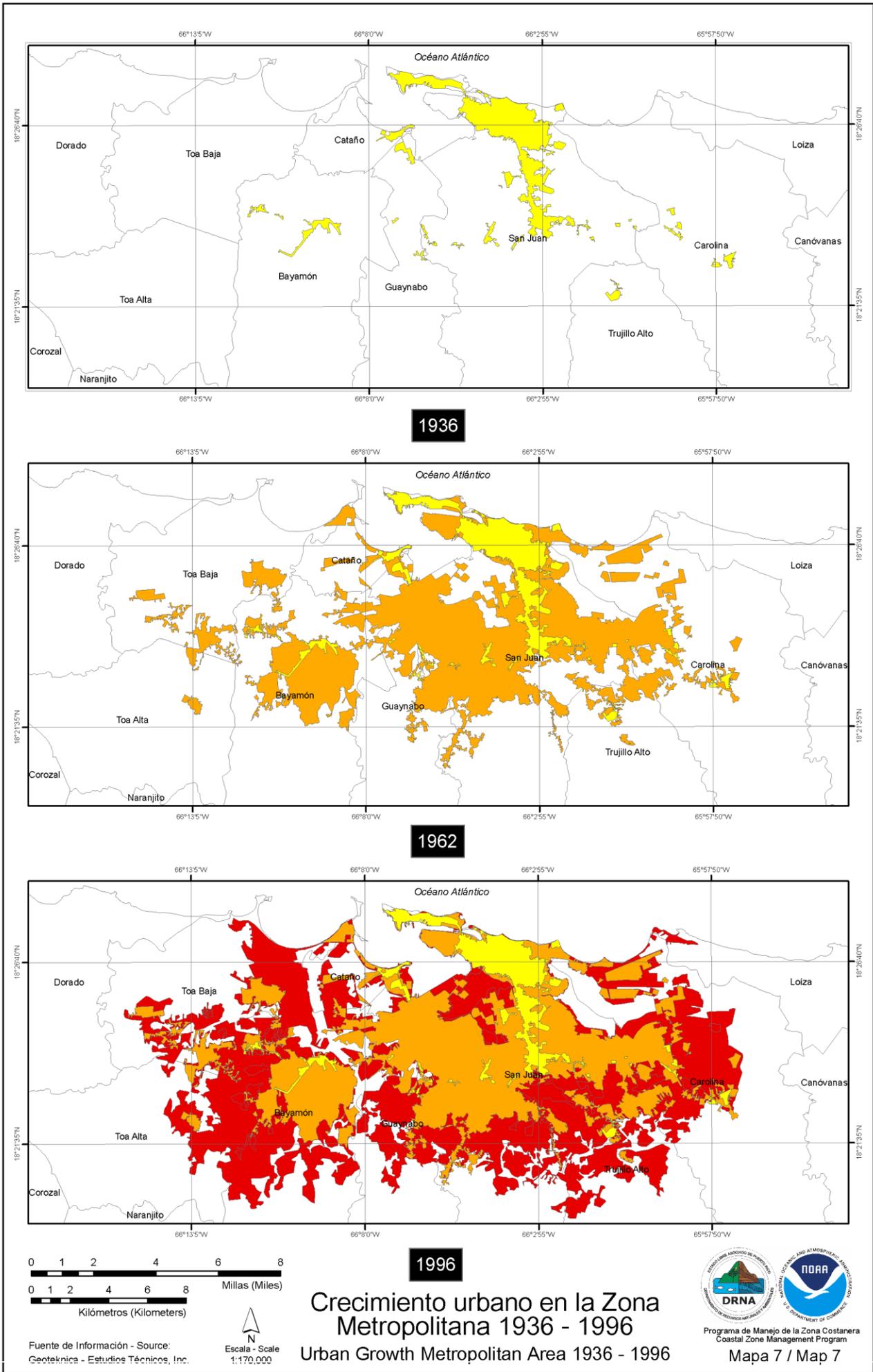
Fuente de Información - Source:  
 Departamento de Recursos Naturales y Ambientales  
 U.P.R. - Mayaguez - Land Use Change  
 Analysis for U.S.G.S. Coastal Quadrangles (1989)

# Usos dominantes del terreno 1999

## Generalized Land Uses 1999



Programa de Manejo de la Zona Costanera  
 Coastal Zone Management Program  
 Mapa 6 / Map 6



1936

1962

1996

**Crecimiento urbano en la Zona Metropolitana 1936 - 1996**  
**Urban Growth Metropolitan Area 1936 - 1996**

Fuente de Información - Source:  
 Geoteknica - Estudios Técnicos, Inc.

Escala - Scale  
 1:170,000

Programa de Manejo de la Zona Costanera  
 Coastal Zone Management Program  
 Mapa 7 / Map 7

### 1.2.1 DEMAND FOR LAND USES IN THE COASTAL ZONE

This section provides an analysis of the *site consultations* submitted to the PRPB regarding land use proposals in the kilometer within the Coastal Zone from the 1981-2007. The site consultations analysis is commonly used as an indicator to determine the demand for construction activity on the territory.

Site consultations are a procedure by which the PRPB evaluates a land use proposal not explicitly permitted under current zoning guidelines, but which falls under the jurisdiction of the agency’s bylaws. The PRPB evaluates, passes judgment and determines if the proposed project is viable. In areas not zoned, land uses or proposed land developments for which the PRPB did not reserve exclusive jurisdiction, are included.<sup>16</sup> The site consultation process also evaluates extensive development projects and those of regional character or which are in accordance with the powers that the PRPB retains under the provisions of the “Law of Autonomous Municipalities”, *supra*.

The analysis was conducted for the period from 1981 to 2007.<sup>17</sup> For comparative purposes, submitted site consultations were grouped by decades: between 1981 and 1990, from 1991 to 2000, and a final set of queries from 2001 to October 2007.

The period with the greater number of site consultations submitted to the PRPB was from years 1991 to 2000. In fact, compared with the first period, from 1981 to 1990, the number of site consultations submitted tripled in Puerto Rico, while they doubled in the coastal zone. The proportion of approved site consultations in the coastal zone was also higher, 46% in the second period versus 31% in the first.

**TABLE I-2. SUMMARY OF SITE CONSULTATIONS**

Summary of site consultations						
Submitted site consultations	1981-1990	%	1991-2000	%	2001-2007	%
Puerto Rico	4,159	100%	12,380	100%	5,295	100%
Coastal Zone	549	13%	1,298	10%	849	16%
Approved	169	31%	594	46%	356	42%

Source: PRPB

During the period from 2001 to 2007, the number of site consultations submitted decreased by almost half compared with the previous period. In addition, there was an increase in the percentage of site consultations submitted in the coastal zone. While the proportion is lower when compared with the second period, the demand for development these site consultations places on the coastal zone and its resources is significant.

<sup>16</sup> In accordance with the “Regulation to Delegate Responsibilities to the Regulations and Permits Administration for Evaluating Projects of Development, Construction and Land Uses in Areas Not Zoned”, Regulation 27 of 2002.

<sup>17</sup> The data belonging to the site consultations between 1978 and 1980 in the coastal zone was insufficient to perform a comparative analysis.

When analyzing site consultations by type of project, project-related transactions - which are basically trading or lease of land by the government - constituted the majority of the site consultations approved (177 site consultations or 50%). It is important to highlight that a significant percentage of those transactions – especially those where the private sector is the purchaser or renter – eventually become development projects, some of great magnitude.

After site consultations for transactions, the greater proportion of those approved corresponds to the residential type, 86 (24%). Of these, 29 (34%) were for single-family residences, 26 (30%) for multi-family residences and 23 (27%) for residential lots. The remaining eight (9%) are divided between social interest housing (4 or 5%) and commercial residential (2 or 2%). There were, also, other two site consultations approved for a mixed residential type project and for a touristic residential.

**TABLE I-3. SITE CONSULTATIONS IN THE COASTAL ZONE BY TYPE OF PROJECT**

Site consultations in the coastal zone by type of project 2001-2007			
		Number	%
Total submitted		849	100%
Total approved		356	42%
Commercial		32	9%
Government/Improvements		7	2%
Industrial		8	2%
Institutional		11	3%
Recreational		10	3%
Recreational Commercial		3	1%
Residential		86	24%
Service		10	3%
Transaction		177	50%
Touristic		12	3%

Source: PRPB

Regarding tourism, projects of this type (12) submitted during the last examined period, represent 3% of total approved projects. This proportion is less than in previous periods. Tourism projects are usually accompanied by marinas, docks, buoys, and other elements associated with water-dependent uses. These amenities or uses are located in the Territorial Waters of Puerto Rico, which are, also, Navigable Waters of the U.S. and public domain lands. Therefore, the location or construction of such facilities in these areas also requires a permit from the U.S. Army Corps of Engineers (USACE) and a concession from the DNER Secretary, according to the “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters and Submerged Lands Thereunder and the Maritime Zone”, Regulation No. 4860 of 1992.

## Analysis of the site consultations by coastal sector

Submitted and approved reviews were examined for each of the coastal sectors.

Historically, the North Sector is where the largest number of site consultations have been submitted and approved. From 1981 to 2007, 614 site consultations had been submitted, of which 270, or 44%, were approved.

**TABLE I-4. SUMMARY OF SITE CONSULTATIONS BY COASTAL SECTOR**

Summary of site consultations by coastal sector												
Coastal sector	1981-1990			1991-2000			2001-2007			Total		
	S	A	%	S	A	%	S	A	%	S	A	%
Islands and cays	4	1	25%	61	35	57%	54	26	48%	119	62	52%
Northeast	1	1	100%	138	69	50%	72	26	36%	211	96	45%
Northwest	90	38	42%	150	76	51%	122	54	44%	362	168	46%
North	83	22	27%	317	145	46%	214	103	48%	614	270	44%
West	150	45	30%	257	108	42%	133	52	39%	540	205	38%
Southeast	50	16	32%	90	49	54%	60	24	40%	200	89	45%
Southwest	119	29	24%	162	63	39%	113	39	35%	394	131	33%
South	52	17	33%	123	49	40%	81	32	40%	256	98	38%
<b>Total</b>	<b>549</b>	<b>169</b>	<b>31%</b>	<b>1,298</b>	<b>594</b>	<b>46%</b>	<b>849</b>	<b>356</b>	<b>42%</b>	<b>2,696</b>	<b>1,119</b>	<b>42%</b>

Source: PRPB

S= Submitted

A=Approved

During the first period, from 1981 to 1990, the sectors with the highest number of approved site consultations were the West and Northwest (45 and 38 site consultations, respectively).

According to data provided by the PRPB, in the Northeast sector only one site consultation was submitted and approved during the 1980s. It is likely that more than one consultation was submitted during the first period. Nevertheless, the vertiginous increase in submitted and approved site consultations during the period from 1991 to 2000, with 138 consultations submitted, and 69 approved, it is still impressive.

In the Northeast sector there is a trend of building second homes or vacation homes along the coast. While these types of homes do have building permits, in some cases, they pose a problem of access to the coast. However, it was not until 1992 that the DNER's "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters and Submerged Lands Thereunder and the Maritime Zone", *supra*, was approved and many of these housing units were already developed.

Moreover, for the periods 1991-2000 and 2001-2007, the North sector reported the largest number of site consultations approved.

### Islands and cays

During the first period, tourism and residential projects predominated. During the second period, 75% of residential projects were simple division of lots. Whereas, in the last period,

and particularly in Vieques, single-family residential projects predominated, representing a total of 1,218 housing units.

### Northeast

Touristic projects predominated during the second period. In the past six years, land transactions were for governmental improvements and residential projects (853 housing units).

### Northwest

The approval of commercial projects and single-family housing dominated during the first period. In the second period, the majority of the site consultations were for residential projects. While in the past six years, site consultations have been approved for construction of 389 housing units.

### North

The simple division of prevailed during the first period, particularly in the eastern zone of the sector. The second period was characterized by land transactions (50 or 34%). In the past six years, residential projects totaled 1,563 new housing units. Of these, 742 (47%) were in the municipalities of Vega Alta and Vega Baja.

### West

Commercial and tourism projects predominated during the first period. In the second period, aside from tourism projects (7), site consultations were mostly for residential projects (65), in what was considered a moment of great activity in construction. During this second period, simple lot division accounted for 60% of all approved site consultations in this sector. In the last six years, 994 housing units have been approved in this sector, of which 191 were for low-income housing.

### Southeast

This sector has always been characterized by simple lot division, in the first as well as in the second period, when 9 out of every 10 residential projects were of this type. These residential type site consultations were for the construction of 101 housing units, all of them in the Municipality of Yabucoa.

### Southwest

In this sector, the residential or simple lot divisions and tourism projects predominated during the first two periods. The approval of residential projects in the past six years has been the highest among the sectors, with 2,140 housing units.

### South

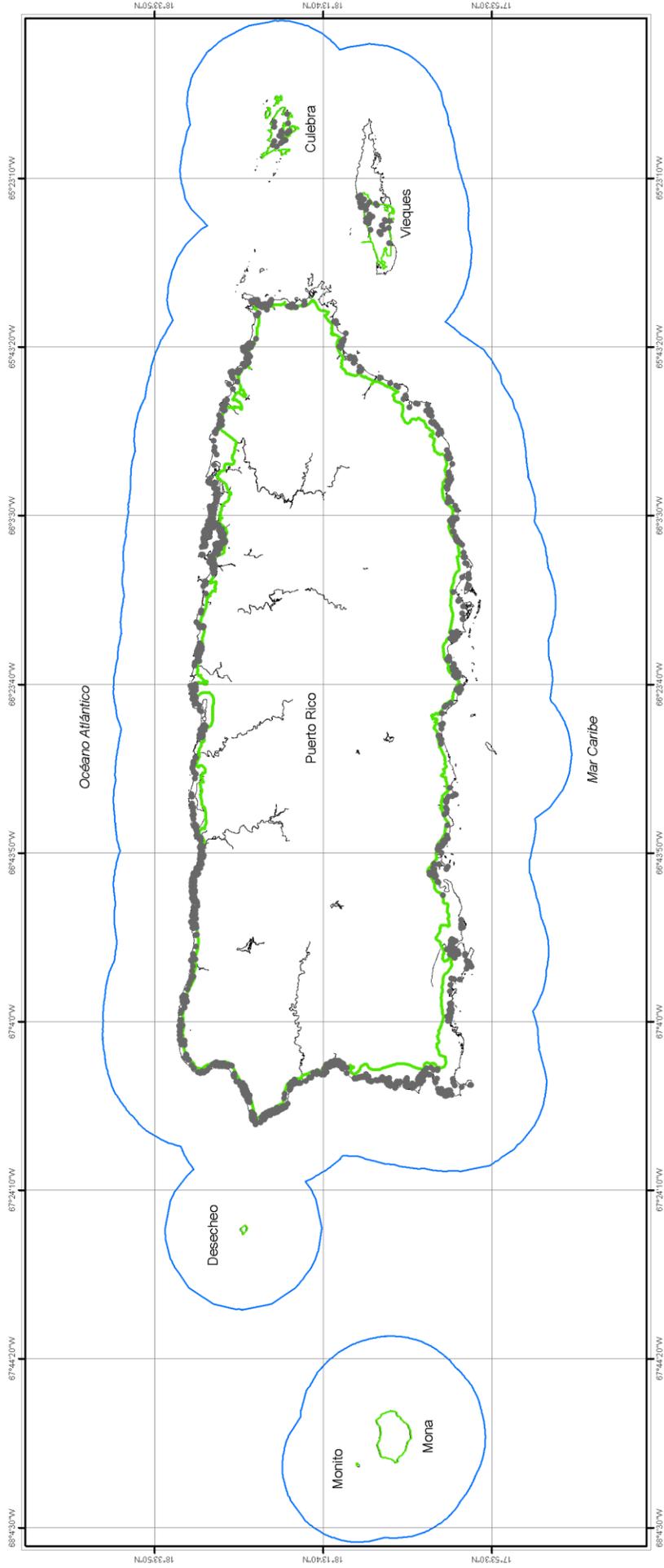
This region stands out for its industrial projects throughout all periods, compared with other regions or sectors. In the past six years, projects of institutional character have predominated. Likewise, there are other residential projects, in which 631 housing units were proposed.

**Legenda - Map Key:**

-  Límite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
-  Límite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary

-  Consultas de ubicación (1975 - 2007) - Site Consultations (1975 - 2007)

Escala - Scale 1:860,000



# Consultas de ubicación en la zona costanera Site Consultations in the Coastal Zone

Fuente de Información - Source:  
Departamento de Recursos Naturales y Ambientales  
Junta de Planificación de Puerto Rico



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 8 / Map 8

### 1.3 ECONOMIC IMPACT OF THE COASTAL ZONE

Economic activity in Puerto Rico’s coastal zone has a significant impact on the Commonwealth’s economy. This section intends to analyze the importance of the coastal zone in the economy, based on data from production, employment and salary income by industrial sector.

For this analysis, data was estimated for the kilometer that includes the inner boundary of the coastal zone for each of the coastal municipalities. The industries were classified into eight major sectors, according to North American Industrial Classification System (NAICS), as presented in the following table.

**TABLE I-5. GROUPING OF INDUSTRIES FOR THE ECONOMIC ANALYSIS OF THE COASTAL ZONE**

Grouping of industries for the economic analysis of the coastal zone		
NAICS	Industry	New Classification-Sector
11	Agriculture, Forestry, Fishing and Hunting	Agriculture, Forestry, Fishing and Hunting
21	Mining, Quarrying, and Oil and Gas Extraction	Construction, Mining, Electricity, Water and Gas
22	Utilities	
23	Construction	
31-33	Manufacturing	Manufacture
42	Wholesale Trade	Trade
44-45	Retail Trade	
48-49	Transportation and Warehousing	Transportation, Warehousing and Information
51	Information	
52	Finance and Insurance	Finance, Insurance and Real Estate
53	Real Estate and Rental and Leasing	
54	Professional, Scientific, and Technical Services	
55	Management of Company and Enterprises	Services
56	Administrative and Support and Waste Management and Remediation Services	
61	Educational Services	
62	Health Care and Social Assistance	
71	Art, Entertainment and Recreation	Public Administration
72	Accommodation and Food Services	
81	Other Services Except Public Administration	
99	Others	
92	Public Administration	

Source: NAICS. Prepared by Estudios Técnicos, Inc.

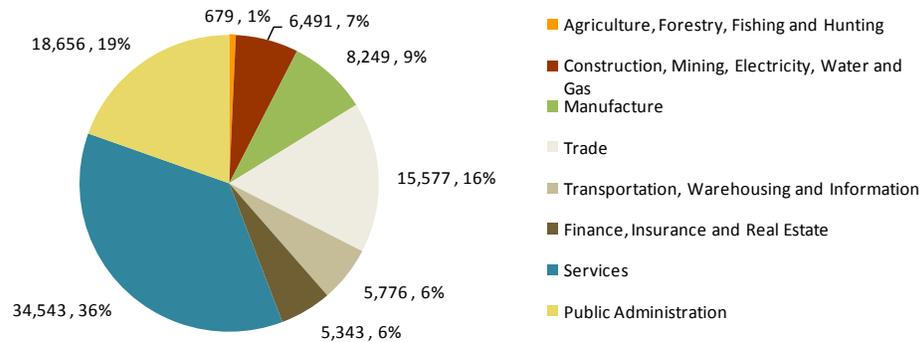
In the following sections we discuss results for employment, wage income and production. The municipalities in which economic activity is concentrated are identified as well as the most important industrial sectors and economic activities. The methodology used to obtain the estimates, the adjustments made and the sources of primary data used are detailed in Annex 2

## Employment

By 2006, employment in the coastal zone was estimated at 169,453 persons, representing 16.2% of total employment in Puerto Rico. It should be highlighted that 28.5% of the employment in the Commonwealth's services sector, in which tourism plays a role, is within the coastal zone. The other sectors maintained represent about 10% of employment in Puerto Rico's coastal zone.

The most important industrial sectors in employment generation in the coastal zone were services and public administration. Together, they represented 76% of employment in the zone (65% and 11% respectively).

**GRAPHIC I-3. EMPLOYMENT BY INDUSTRIAL SECTOR FOR THE COASTAL ZONE**



Source: DLHR. 2006. *Composición Industrial*. Prepared by Estudios Técnicos, Inc.

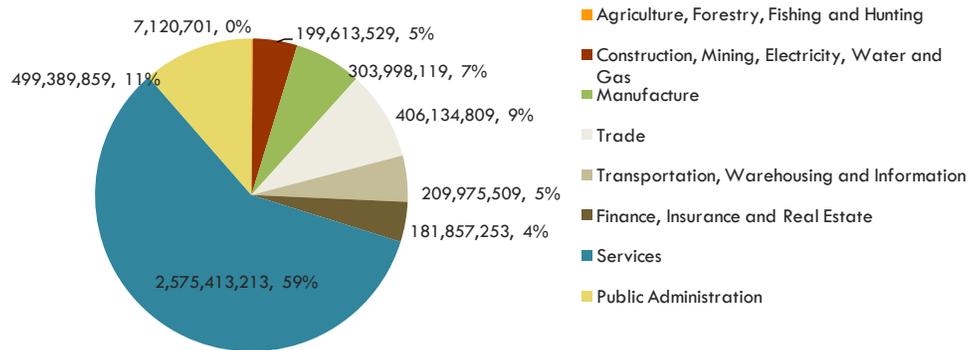
The municipalities with a higher proportion of jobs in the coastal zone are San Juan, with 71,991 employees, which represents about half the jobs in the coastal zone (42.5%), and Carolina with 16,502 workers (9.7%). The other 68.2% of municipalities (30 of 44) originate, less than 1% of employment in the coastal zone.

## Wages

Wage income is defined as the estimated income related to the jobs created in the coastal zone. This is not necessarily the income of people living in the coastal zone, but those working in it. In 2006, about 16.3% of wages in Puerto Rico were generated in the coastal zone or about \$ 4,383 million.

Analyzing the same data by industrial sector, services, public administration and trade stand out as the most important sectors in generating wage income. Together, they comprise 79% of the income in the coastal zone (59%, 11% and 9% respectively). However, sectors such as agriculture; transportation, warehousing and information; construction and mining; and finance, insurance and real estate, generate a small proportion of wage income in the coastal zone. These four industrial sectors represent just over 10% of the income in the area.

**GRAPHIC I-4. WAGE INCOME BY INDUSTRIAL SECTOR FOR THE COASTAL ZONE**



Comparing the wage income of the coastal zone by industry with that of Puerto Rico, it was found that more than one fourth of the income of employees in the services industry in the Commonwealth is generated in the coastal zone. The remaining sectors hold a 10% share of wage income of Puerto Rico’s coastal zone.

The majority of wage income in the coastal zone is generated in the municipalities of San Juan and Carolina. In San Juan, with \$2,140 billion, is where almost half the income of the coastal zone (49%) is generated. In Carolina, \$390.3 million (8.9%) are generated.

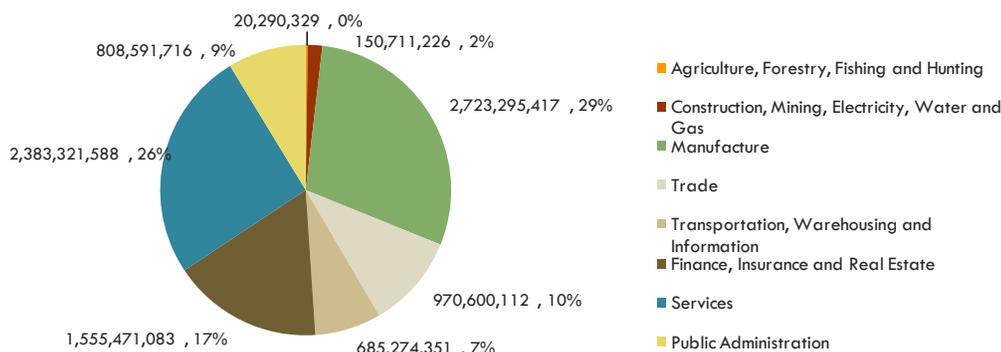
### Production

The estimated production in Puerto Rico’s kilometer of coastal zone is close to 10% of the total production of the Commonwealth. According to the estimates calculated, in 2006, production in the coastal zone was about \$ 9,297 million.

The data by sector shows that the manufacturing; services; and finance, insurance and real estate sectors stand out as the most important in the coastal zone’s production. These constitute 71.7% of production in the area (29.3%, 25.4% and 16.7% respectively). However, agriculture; transportation, warehousing and information; and construction and mining, generate a small proportion of the coastal zone’s production. Together, they have less than 10% of the area’s production.

It is important to highlight that manufacturing is not among the industry sectors that create more jobs and wage income, however, it is the sector with the highest level of production for the area, as for all of Puerto Rico.

**GRAPHIC I-5. TOTAL PRODUCTION BY INDUSTRIAL SECTOR FOR THE COASTAL ZONE**



Source: DLHR. 2006. *Composición Industrial*. Prepared by Estudios Técnicos, Inc.

The production of the coastal zone by industrial sector compared with that of the rest of Puerto Rico, demonstrates that more than a quarter of the production of services in Puerto Rico is generated in the coastal zone, as well as employment and income. In the case of other industrial sectors, between 6% and 12% of the production of Puerto Rico is conducted in the coastal zone.

The bulk of production of the coastal zone is generated in the Municipality of San Juan, with \$3,379 million, representing 36.4% of the production in the area. Some 56.8% of municipalities (25 of 44) generate less than 1% of the production of the coastal zone.

In summary, the main findings of the analysis presented above reveal several important aspects:

- Much of the economic activity in the coastal zone is concentrated in three municipalities: Carolina, Ponce and San Juan. This may be due largely to the port activity in San Juan and Ponce; activity that is within the services sector.
- 16.2% of total employment in Puerto Rico, particularly in the public administration and services sectors, is concentrated in the coastal zone.
- 16.3% of income by means of wages in the Commonwealth is generated within the coastal zone.
- Tourism activity – in terms of hotels and casinos – plays an important role in employment in the coastal zone since it represents 23% of employment in the coastal zone.<sup>18</sup>

<sup>18</sup> The municipalities of San Juan and Carolina have the bulk of employment in this sector, keeping in mind that some on the hotels in these municipalities are not on the beach.



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## **Chapter 2:** *The PRCZMP as the Coastal Element of Puerto Rico's Land Use Plan*

## Chapter II. THE PRCZMP AS THE COASTAL ELEMENT OF PUERTO RICO'S LAND USE PLAN

### BACKGROUND

Over the last three decades, the Government of Puerto Rico has established several programs geared toward the appropriate planning and management of its natural resources. These programs are applicable to the entire Puerto Rican archipelago, including coastal waters under the Government's jurisdiction.

Although the extent of the PRCZMP's implementation is the coastal zone as previously defined, it is important to recognize that the coastal zone is not a separate entity from the rest of Puerto Rico. For the reason, the PRPB adopted the PRCZMP as the "coastal element" of Puerto Rico's Land Use Plan (PRLUP) in 1978.<sup>19</sup>

The PRCZMP of 1978 incorporated the Objectives and Public Policies of Puerto Rico's Land Use Plan (OPP-PRLUP) of 1977 and with that action established a uniform public policy framework for the management of all natural resources, including those located in the coastal zone. At the same time, it shaped the foundation on which many of the public policies and additional elements of the PRCZMP would be established.<sup>20</sup>

In 1995, the PRPB revised and adopted a new version of the OPP-PRLUP document for the purpose of<sup>21</sup>:

- incorporating the concept of integral and sustainable development;
- incorporating the concept of ecologically sustainable action;
- extending the concept of risk to add flooding, susceptibility to landslides and geological faults;
- incorporating wetlands;
- identifying the tourism sector as a new target of the Land Use Plan
- converting into the public policy the concept of decentralization contained in the "Law of Autonomous Municipalities", *supra*.
- In 2003, NOAA approved the integration of the OPP-PRLUP-1995 to the PRCZMP, by means of RPC.

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<sup>19</sup> Ordered by the PRPB Statutory Law No. 75 of 1975.

<sup>20</sup> This revision and update does not establish new enforceable policies, additional to those incorporated in the original PRCZMP. It exclusively adds those that have been approved by the NOAA, by means of RPC.

<sup>21</sup> This document was approved by the Governor by EO on October 30<sup>th</sup>, 1995. The EO stated that the OPP-PRLUP will serve as a guide to public agencies in developing policies, plans and programs and in making decisions and actions on public and private projects, as well as in the process of land use planning, and for other public purposes.

The OPP-PRLUP, in its original and subsequently revised document, OPP-PRLUP-1995, establishes the public policy of the Government of the Commonwealth of Puerto Rico for the entire territory, including the coastal zone. These, included in this chapter, are divided into eight areas or fundamental aspects:

1. General goals regarding land use;
2. Goals and objectives for public policy in urban development;
3. Goals and objectives for public policy in industrial development;
4. Goals and objectives for public policy in agricultural development;
5. Goals and objectives for public policy in tourism;
6. Goals and objectives for public policy regarding natural risks;
7. Goals and objectives for public policy for infrastructure; and
8. Goals and objectives for public policy in natural, environmental and cultural resources.

## OBJECTIVES AND PUBLIC POLICIES IN PUERTO RICO'S LAND USE PLAN

### General goals regarding land use

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- Manage the planning process toward achieving a sustainable integral development, assuring the sensible use of the land resources and promoting the conservation of our natural resources for the enjoyment and benefit of current and future generations.
- Prepare and execute a land use model within an action plan that is ecologically sustainable.
- Establish education, orientation, and dissemination programs on land use to create social awareness on the use of sustainable land development instruments and techniques that satisfy the needs of our current generation and future generations.
- Accomplish a balance between rural and urban development by sensibly planning land uses that are compatible with the surroundings and demographic growth dynamics in communities, municipalities, and regions of the Island as well as promoting the accessibility and benefits of a sustainable development.
- Protect the environment by planning urban development in a compact fashion within designated locations according to intensity of uses, protecting the land and water quality, maintaining strict air quality standards, and providing the population with mass transportation alternatives.
- Identify, protect, and preserve lands of high natural value that are part of the natural patrimony of all Puerto Ricans and promote the development of activities that encourage the sensible use of these lands for the benefit and enjoyment of current and future generations.

- Achieve intensive land use in urban areas by encouraging the creation of urban centers.
- Protect lands of high agricultural productivity and promote agro-industrial activities in those lands featuring the highest potential for said use.
- Provide incentives for the construction of affordable housing by planning housing developments targeted for low- and moderate-income families.
- Identify, protect, preserve, and restore historical sites and zones, public spaces, recreational areas, and those structures and resources that are part of the historical-cultural patrimony.
- Achieve investments in infrastructure which include the maintenance or replacement of existing systems to ensure their efficiency.
- Minimize the risk for loss of life, property, and deterioration of natural resources due to the effect of natural disasters, establish mitigation plans in the event of such disasters in areas that are vulnerable to them, and plan the development of high density land outside the areas identified as susceptible to such risks.
- Coordinate municipal, state, and regional investments in infrastructure in order to establish a more efficient use of public funds by strengthening the maintenance of existing systems with the goal of protecting the environment and the land resource.
- Achieve the establishment and operation of mass transportation systems as an alternative for the use of private cars, lowering the investment in new roads and strengthening maintenance programs for existing roads.
- Achieve healthy social coexistence and harmony through education and the creation of opportunities for every citizen through citizen participation, access to information, and reasonable distribution of the benefits of an integral and sustainable development among the Island's regions.
- Promote the achievement of municipal autonomy in the preparation of Municipal Land Use Plans, defining general public policies on land use and providing the necessary information for the transfer of planning rights.
- Achieve greater fairness in land taxation mechanisms, offering intelligent information that may be used as the basis of a scientific valuation of properties in accordance with experiences acquired through urban development.

## Public policy goals and objectives regarding urban development

### GOAL

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*Foster communities, towns and cities that are densely populated, compact and attractive which allow for the intensive use of the lands within urban perimeters, achieving greater efficiency in the installation and operation of public services and facilities, and facilitating the population's fast and safe movement by setting feasible means of mass transportation and improving the quality of urban life.*

### OBJECTIVES

#### 1.00 Order and manage urban areas' physical-spatial growth

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1.01 Identify – using Land Use Plans at a different scale, Municipal Land Use plans, Urban Expansion Maps, and the application of establishment guidelines such as zoning – the places where it may be desirable to concentrate urban growth, as per the following criteria:

- Provide enough and adequate land to accommodate population growth according to each municipality's particular need.
- As a top priority and for urban purposes, select land with the following features: land in developed areas capable of fostering re-development, vacant lot pockets (that do not constitute open spaces), land that is not high in agricultural productivity or susceptible to flooding and land with existing infrastructure already in place which can be improved or maintained at a reasonable cost.
- Rule out for urban use land that includes important natural resources that are environmentally critical or where an environmental pollution condition already exists and may represent a health risk, as well as land that is too steep, susceptible to erosion and landslides, and at high risk for natural disasters.
- Condition the development of projects beyond the limits set in the official instruments, only to tend to the needs of the sector's resident population. This includes projects of an urban nature allowed by exception or variation, only when they comply with the following criteria:
  - Discourage the urban use of land where endangered species have been identified, places for environmental and historical preservation, and ecosystems.
  - Promote and ensure growth that is perpendicular to the coast and discourage lateral expansion parallel to main roads and with direct access to the coast or where coastal barriers have been identified.
  - Use infrastructure programming and construction as a planning instrument to promote the integral development of suitable identified land.

1.02 Avoid and discourage urban sprawl and the development of isolated urban centers as per the following criteria:

- Require the location of development projects and land use take place in areas identified as capable of accommodating population growth and where infrastructure is in place to meet the needs of the urban population as specified in Policy 1.01.
- Condition the development of projects beyond the limits identified in official guidelines to tend to the needs of the sector's resident population and allowing projects of an urban nature, only when they comply with the following criteria:
  - That it is a small project that will not undermine the policy to guide and manage urban growth (does not create pressure or precedent);
  - That the project can be integrated to the existing urban centers;
  - That the project does not distort or interfere with the purposes for which the district zoning where it is located was created;
  - That the land is accessible and already has adequate infrastructure
  - That the land where the project will be located is not high in agricultural productivity, not prone to floods, steep, does not contain natural or archeological resources, is not susceptible to significant erosion and landslides, and/or is not environmentally critical.

## 2.00 Intensify the use of land in urban areas

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2.01 Encourage density maximization in the development of urban residential areas using the following criteria, among others:

- Construction of medium-density housing for a more intensive use of the land.
- Promote high-density housing construction in urban centers.
- Establish measures directed at the demand or preference for high- or medium-density residential projects.
- Complement the proposed density with the sector's conditions and the land's characteristics.
- Limit the development of lots to the number of units that can be served by the existing and programmed infrastructure systems, concentrating them in a portion of the lot so it responds to the density recommended by a plan or to an average density, and postponing the development of the remainder of the lot until the necessary capacity can be given to the infrastructure systems in accordance with the development's original preset density.

2.02 Intensify use for commercial and service purposes, both public and private, following these criteria:

- Require that projects for commercial and service purposes are located on land that has been identified and intended for commercial and service use.

- Revitalize towns' traditional urban centers so they continue to be important places and a dynamic focus of activity by locating commercial uses in this area, providing parking, improve access roads, protect and restore structures of historical, architectural or cultural value, and stimulate the location of residential uses within the sector.
- Establish a good traffic flow system.
- Encourage the creation of pedestrian walkways in commercial areas located within traditional urban centers.
- Maintain a balance between regional, sub-regional, community, and neighborhood shopping centers with small and midsize businesses in each municipality.

2.03 Encourage, through incentives, the creation of urban industrial parks for light industries that may generate jobs for the area.

3.00 Improve the design of communities, towns and cities and that of their different components, traditional urban centers, businesses, institutions, and residences in order to turn them into an instrument that can improve the inhabitants' quality of life and allow them to become attractive places to live and work, and foster social coexistence.

3.01 Promote citizens' general health and wellbeing by providing an urban development that is in harmony with the environment.

3.02 Promote accessibility between residences, public services, and commercial and recreational facilities.

3.03 Wisely use or preserve natural resources, sites of tourist interest, and places of historic, architectural, and cultural value in urban design.

3.04 Promote the development of functional, efficient, livable, and safe neighborhoods and communities by encouraging the creation of residents' associations that will be incorporated to the municipality's decision-making process and establishing effective crime prevention measures.

3.05 Promote planting and conserving trees and urban forests within the city and discourage the indiscriminate cutting down of trees in order to alleviate climatic conditions and environmental pollution.

3.06 Stimulate planned tree planting within the urban road system, parks, and other public spaces in the city.

3.07 Foster the use of urban ornaments in open spaces to foster pedestrian activity and a better social coexistence.

4.00 Foster an integral planning process that translates to a better use of land resources, preserving natural resources, revitalizing urban centers, protecting the quality of the environment and providing housing and associated services to the population at a reasonable cost in constant coordination between central, regional, and municipal planning.

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- Encourage the implementation of a planned development process at a regional level pertaining to urban and rural development demarcation and to areas that will be preserved and protected, so that it complements the central government's planning efforts.
- Identify regional development poles, foster their development and planning so as to encourage population retention and increase their attractiveness and economic activity.

### **Public Policy goals and objectives regarding industrial development**

#### **GOAL**

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*Locate our industrial developments in places that allow the use of lands that - because of their location, characteristics, or to the services and infrastructure available within them - better adapt to this use, in harmony with the general objectives of attaining the full and wise use of the lands' and natural resources' total potential. Achieve the distribution of the development's benefits between the island's different municipalities and geographic sectors, and create and maintain the conditions under which man and nature can coexist in productive harmony.*

#### **PUBLIC POLICIES**

5.00 Concentrate industrial developments in land that is most appropriate for this use and at the same time promote the most intensive use possible for this land.

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5.01 Locate light industries which do not cause adverse effects to the environment and require minimal infrastructure facilities, in industrial parks located within urban zoning limits.

5.02 Avoid the establishment of polluting industries with the exception of those whose exclusion would seriously affect the Island's economic development.

5.03 In the exceptional cases where establishing polluting industries (as defined by the EQB) is essential to the Island's development, they will be located in pre-selected sites and the adequate provisions will be taken to mitigate their adverse impact on the environment.

5.04 Locate light, heavy, and semi-heavy industries and the so-called atypical industries in land adapted to these uses in compliance with the following regulatory criteria:

- Primarily use land that is well served by expressways or primary roads, that have electrical energy sources, water supplies, and sanitary treatment facilities, which are near airports, and have a central location in relation to labor sources.

- Do not use major land with high agricultural productivity for industrial endeavors.
- Concentrate the location of these industries within regional industrial parks, designing lands in advance that meet the aforementioned characteristics, avoiding industry scattering in individual locations as much as possible, and making an exception on atypical industrial projects that may require special locations.

5.05 Discourage other uses on lands selected for industrial use following the criteria listed in public policies 5.01, 5.02, and 5.03, that could significantly reduce the extension of available land for industries, and in cases where locations are deemed appropriate, according to the criteria, for locating atypical industries and/or major atmospheric pollution generators, exclude the other types of industries except those that necessarily have to be located next to them.

5.06 Avoid the establishment of industries featuring a high consumption of infrastructure and services (water, electrical power, treatment plants, and land) and low performance in terms of income and direct and indirect jobs, by promoting the establishment of labor industries and local industries.

5.07 Concentrate the location of recycling plants and other complementary satellite industries in one location so they serve as a source and recipient of consumables and raw materials.

6.00 Decentralize industrial development by providing, as much as possible, a light industrial park in each municipality, regional parks on the Island's different sectors, and allowing, in rural zones, small-scale industries that are in tune with the rural zone's socioeconomic development.

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### Public policy goals and objectives regarding agricultural development

#### GOAL

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*Develop agricultural activity in all lands with the potential for said use, so as to attain as much self-sufficiency as possible in the production of our food, applying proven modern techniques in this practice that allow for reasonable prices for the consumer, attractive profits for farmers, and fair wages for workers, while at the same time fully using the climate, land, and water resources in a productive manner without harming them.*

#### PUBLIC POLICIES

7.00 Encourage and maintain agriculture as a main activity in the use of available land with the potential for this use, promoting the necessary programs and measures to make this a feasible activity.

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- Identify land for agricultural use through rural zoning districts.
- Discourage the displacement of agricultural uses by introducing residential uses next to places where agricultural activities are taking place, so as to avoid conflict between them and guarantee the farmer's right to maintain his agricultural activity.

8.00 Locate the development of required infrastructure to stimulate and foster farming in lands with agro-industrial potential that are not being fully exploited due to lack of services such as: irrigation, access, marketing system, and others

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- Emphasize agricultural diversification in production, intensify farming to obtain maximum benefit of every a *cuerda* of land, increase efficiency, and foster agricultural products' industrialization as much as possible.
- Encourage the establishment of companies and agricultural techniques based mainly on the climate, land, and water resources with a minimum of imported consumables.

9.00 Retain for agricultural use as much as possible the land that is better suited for the production of harvests and animal products, protecting it from the practices and activities that unnecessarily abate the potential for agricultural development.

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9.01 Emphasize on preservation of the most productive lands for agricultural purposes, complying with the following criteria:

- Retain high agricultural productivity land exclusively for agricultural use. Use this land for other uses only when there is proof that there is no alternate land for the location of non-agricultural activity that is pressing and important for the development of the Island.
- Use the Soil Survey for Puerto Rico, carried out by the Soil Conservation Service, as a base and designate all land classified by this study in categories I to IV, as highly productive.
- Promote the use of high agricultural productivity land exclusively for that purpose.
- Discourage housing construction, the main competitor of agricultural use, in totally flat land that is optimal for agricultural production.
- Stop the indiscriminate division of agricultural land lots into smaller lots or farms so as to preserve adequate-size farms so their agricultural operation is economically feasible, using the following regulatory criteria:
  - Determine the desirability of a proposed division of lots by evaluating and giving much deliberation to the uses contemplated for the lots or farms that will be created.
  - Promote the integration of new division of lots to the existing residential areas in order to discourage the creation of new population centers that will increase the cost of infrastructure and public services.
  - Encourage that lots created for non-agricultural activities be as small as possible, as per the proposed use, the land's condition, and available facilities.
  - Use as main criteria the fact that the land to be separated for non-agricultural use should be the one with lesser impact on the farm's production level.
  - Discourage the practice of agricultural land loss as a product of division of lots in farms that constitute agricultural production units.
  - Promote the location of complementary activity to agricultural uses in less productive land in or around the farm, so as to minimally affect its agricultural production level.

10.00 Promote the practice of measures and programs geared toward land preservation so as to avoid erosion, protect the land's productivity, and cause the least adverse impact on the quality of our water supplies and the deterioration of other natural resources as a result of a agricultural activity.

### **Public policy goals and objectives regarding tourism**

#### **GOAL**

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*Promote tourism development that brings about an economic and social activity of great competitiveness before the international market's dynamics by using land that, due to its characteristics, has the maximum potential for tourism usage without harming existing natural resources.*

#### **PUBLIC POLICIES**

**11.00 Promote tourism as an essential economic activity for a sustainable economic development process.**

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- Establish an inter-agency program that involves financial commitments in tune with the sector's priorities.

**12.00 Promote, stimulate, and establish tourism incentives to bring about capital investments from local and foreign companies.**

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12.01 Identify land apt for sustainable tourism development, promoting environmental conservation.

12.02 Demarcate zones of tourism interest.

12.03 Balance the development of tourism facilities with corresponding infrastructure provisions.

12.04 Promote the development of ecotourism as a complement to the development of traditional tourism making sure that the necessary infrastructure facilities are provided.

**13.00 Promote Puerto Rico's image as a tourism destination**

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13.01 Encourage programs directed at managing and correcting existing problems of pollution, environmental quality, and safety within touristic areas so as to ensure that a visitors' stay is an enjoyable experience.

13.02 Intensify the use of advertising campaigns that promote tourist visits to areas of great ecological value.

13.03 Reorganize and improve transportation and reception services to visitors who arrive at different tourism facilities.

13.04 Promote regional tourism offices and improve road signage along touristic routes.

#### 14.00 Promote tourism development by improving the quality of touristic facilities

- Decentralize tourism activity by promoting a regional balance of said activity throughout the whole island.
- Foster the development of an efficient internal transportation system that makes dispersion of tourism activity a viable endeavor.
- Promote touristic facilities such as hotels, *paradores* (country inns), and gastronomic *mesones* (restaurants) by intensifying promotional campaigns aimed at attracting local and foreign population. On the other hand, ecotourism should be developed along with a resources conservation policy.
- Identify alternative strategies and models to the traditional concept of tourism, in which we promote the attractiveness of the natural environment within the tourism industry while taking into consideration the capacity of involved natural resources.

#### **Public policy goals and objectives regarding risk due to natural disasters**

##### GOAL

*Minimize the danger of loss of life and material damages on the Island as a result of flooding, land susceptible to landslides, geological faults, swells, and other natural risks while at the same time recognize and promote land uses and activities that are not compatible with these conditions.*

##### PUBLIC POLICIES

#### 15.00 Identify risks of flooding, landslides, geological faults, and swells in regional plans, ordinance plans, and other physical planning documents.

15.01 Verify that the Land Use Plans and Municipal Land use Plans identify these types of lands.

15.02 Select compatible uses with lands' flooding conditions on the Land Use Plans and Territorial Ordinance Plans.

15.03 Use transference of development rights mechanisms, voluntary conveyance, and lot redistribution to keep land that is susceptible to these risks free of construction that could be exposed to said risks.

#### 16.00 Protect the population currently residing in flood susceptible zones or in areas affected by swells.

16.01 Create awareness among the population residing in flood-prone zones about the dangers of living in said zones and comply with regulations by promoting the installation of signs and by identifying areas susceptible to natural risks.

16.02 Support construction of flood-control works aimed at protecting life and property, also taking into consideration the chemical and physical characteristics of nearby water bodies and adjoining land.

16.03 Prepare and implement mitigation plans aimed at protecting life and property.

16.04 Promote relocation plans for the population affected by floods when flood-control works are not socially, economic and environmentally viable.

16.05 Prepare watershed management plans that foster the fast recuperation of water bodies.

17.00 Discourage land development and construction of properties for urban expansion in flood zones unless they are providing flood control works that guarantee the protection of life, property, and natural and environmental resources.

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18.00 Promote agricultural development in flooding areas with a potential for said use.

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- Promote recreational uses and other activities deemed appropriate in flood-prone areas.

19.00 Support the construction of flood control works where deemed necessary, aimed at obtaining a better agricultural production for the Island's benefit.

### **Public policy goals and objectives regarding infrastructure**

#### **GOAL**

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*Develop infrastructure to achieve sound socioeconomic expansion which stimulates a harmonious relation and mutual complement between the Island's regions and improves Puerto Rico's overseas image, using the programming and construction of infrastructure as one of the instruments that, together with land use planning, serves to promote and manage the Island's integral development.*

#### **PUBLIC POLICIES**

20.00 Promote infrastructure to solve the relative potable water shortage and stimulate efficient management of this water resource so as to improve quality of life and achieve:

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- The development of each of the components that integrate socioeconomic activities, including among others: tourism, industry, commerce, construction, and agriculture.
- Increase the capacity of the Potable Water Supply System giving priority to the rehabilitation and preventive maintenance of existing reservoirs and protecting the watersheds that provide the supply flow to potential reservoirs.
- Increase and improve the potable water distribution infrastructure aimed at interconnecting the systems and integrating them in feasible areas.
- Reduce river sedimentation and prolong the reservoirs' usable life by leaving a strip of vegetation parallel to the bank of every river and stream.
- Protect aquifers by avoiding land impermeability that leads to recharging volume reduction.

- Provide a complete treatment infrastructure in those sectors where only partial treatment is available, mainly in rural areas, and thus improving the rural population's life conditions.
- Provide a potable water service that complies with the parameters established by current laws and regulations.
- Establish, rehabilitate, expand, and integrate potable water filtration plants' systems for the San Juan Metropolitan Area.
- Conserve the capacity and quality of artesian and phreatic (water table) wells through the sound management of these supplies and avoiding the use of artesian wells, except for human consumption.

21.00 Satisfy the needs of the population by providing a residual water treatment plant infrastructure with the capacity to offer an efficient service that:

- Guarantees health levels that comply with the parameters established by current laws and regulations.
- Establish a program for the discharge of residual waters to superficial and underground water bodies as receptor bodies to reduce health risks and pollution.
- Establish a program for the construction of treatment plants based on regional priorities and lateral constructions to connect rural communities and urban sectors lacking sewer systems to main regional plants.
- Reduce the number of residual water treatment plants under arrest by the court.
- Avoid connections that affect the system's effective capacity.

22.00 Direct electrical energy infrastructure so it stimulates and favors an energetic policy geared to cogeneration and diversification of energy production so as to:

- Ensure energetic supplies, thus increasing public trust in the system and reducing the dependency on oil as a primary source of fuel.
- Stimulate private sector intervention in the production of energy.
- Guarantee a distribution, production, and maintenance system that will increase public trust in the system.
- Minimize risks that occur as a consequence of international crises, economic factors, and fuel costs.
- Promote the fact that usage of the electrical energy infrastructure requires a special location that is in tune with the surroundings in which they are to be located, thus fostering the protection, conservation, and improvement of the environment.
- Develop an effective program to improve the efficiency of electrical power production and distribution.
- Promote and make viable the development of recycling and non-dangerous use of solid waste projects, including silts produced by Puerto Rico Aqueducts and Sewers Authority treatment plants as fuel to generate electricity.
- Foster development of pilot energy projects featuring renewable and alternate sources.
- Promote the better use of energetic resources to favor and stimulate a reasonable reduction in the continuous energy demand increase on the Island.

23.00 Promote a transportation system that fosters the implementation of an integrated balanced and competitive multi-modal system with a capacity for growth and development.

- Emphasize that collective transportation should include all means and elements of feasible and efficient transportation.
- Stimulate a transportation system in compliance to modern technological concepts that takes our needs, capacities, and means into consideration.
- Promote private sector participation in offering transportation services and facilities.
- Develop the public sector's abilities to manage the system.
- Complement maritime, aerial, and ground transportation so it corresponds to actual demand.
- Establish Master Plans for developing ports and airports on the Island.
- Foster the development of airports that have the potential to turn into international centers for transporting cargo and passengers.
- Reserve the land adjacent to the sea for port use towards expansion, improvements, and execution of future plans.
- Promote road reconstruction, maintenance, and conservation program so as to keep roads in optimal and attractive conditions.
- Attain the physical integration of the city through a road network that actively links the city's new developments.
- Foster the development of collective transportation systems in metropolitan areas.
- Foster the expansion of parking facilities only where necessary and in strategic locations.
- Foster and make viable the multiple uses of parking areas by promoting intensive occupation of these facilities.

24.00 Promote the implementation of management and solid waste disposal systems that include a detailed and extensive inventory of the amount of this type of waste generated on the Island.

- Establish a plan for regional facilities.
- Develop integrated disposal systems that include recycling, incineration, and sanitary landfills, taking the effectiveness, costs, and environmental impact of these technologies into consideration.
- Build strategically located sorting facilities that ease and reduce the costs of collection, transportation, processing, and final disposal of waste.
- Foster an alliance between the government and the private sector to privatize, as much as possible, waste disposal.
- Stimulate recovery of material by classifying and separating waste that can be reused or recycled.

25.00 Develop a plan for handling and disposing toxic and dangerous waste that includes a detailed and extensive inventory of the amount of toxic waste generated on the Island and the location of centers for the recovery, recycling and disposal of this type of waste.

- Demand that industries that generate highly polluting toxic or dangerous waste minimize pollution risks through the use of advanced technology so that they reduce generated waste volume.

- Establish a massive education campaign aimed to residents, advising them on the possible adverse effects of inadequately disposing of toxic waste.

**26.00 Promote a modern, reliable, wide and secure telecommunications infrastructure and a modern island-wide digital network that helps foster Puerto Rico’s economic and social development.**

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- Foster an efficient and top-quality telephone service that includes public telephones, rural services, and all others that offer the required conditions for the Island’s economic development.
- Stimulate the use of technologies and innovations that can offer a greater efficiency level, such as one- or two-way wireless communications and a top quality service under the most reasonable terms and with lower costs for the user.
- Foster the best long distance telecommunications service possible, establishing diverse high quality routes toward all foreign countries by combining different types of technologies, such as land analog and digital stations, underwater analog or fiber optic cables, and digital microwave radio.

**27.00 Identify telephone service and its derivatives as one of the essential elements of Puerto Rico’s infrastructure, so as to develop an economy and industry that is in tune with the present and the future.**

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- Stimulate and coordinate planning telecommunications development so that Puerto Rico may become the central telecommunications axis in the Caribbean.
- Keep telecommunications development on the cutting edge by establishing a modern and reliable system that is attuned to the Island’s physical, social, and economic growth.

**28.00 Use programming and construction of the telecommunications infrastructure as an essential component in the land use planning that may guide integral development.**

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- Ensure the best coordination between public agencies responsible for providing the telecommunications infrastructure so as to make sure it is provided at the most appropriate moment and placed to attain the maximum use of the land in urban areas as well as in rural areas.
- Demand developers of new constructions for space dedicated to installation of telephone facilities in new neighborhoods, public roads, industrial, municipal, and regional parks, special buildings, and commercial areas.

**Public policy goals and objectives regarding natural, environmental and cultural resources areas**

**GOAL**

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*Maintain and protect our environment by promoting the conservation, preservation and sound use of our natural, environmental, historic and cultural resources, recognizing that they represent a variety and wealth of options for our development and an opportunity to promote the integral and sustainable development of all geographic sectors since these resources are distributed throughout the Island.*

## PUBLIC POLICIES

### 29.00 Protect, preserve and restore natural environmental and cultural resources.

- Identify resources location, characteristics, and potential and their susceptibility to damage or extinction by preparing and keeping an inventory of natural, environmental, and cultural resources.
- Foster the sound use of the resources identified in this inventory, in a manner compatible with the preservation of renewable resources and, when deemed opportune, in cases that deal with non-renewable resources.
- Bring about the population's awareness of these resources so that they keep gaining importance to our integral development, fostering accessibility to resources that can tolerate it, through compatible uses capable of attracting public to the appropriate places.
- Foster the preservation and sound use of coastal resources, water resources, and other natural resources that are important to the Island by preparing, revising, and establishing regulations for this purpose.
- Foster reforestation aimed at preserving forest resources and also to improve environmental quality in developed areas.
- Foster planting trees in urban areas so as to create a pleasant urban environment that contributes to the improvement of quality of life.
- Prepare and implement acquisition, restoration, and management plans and programs geared towards conservation and sound use of ecosystems and natural resources, promoting the securing of funds for the acquisition of land whenever necessary.
- Preserve and protect structures of historic, architectural, and cultural value, as well as the resources of archeological value by implementing and supervising regulations towards this goal.
- Prepare and implement restoration plans for deteriorated natural, environmental, and cultural resources.
- Identify natural, environmental, and cultural resources by promoting their sound use so they can be developed as tourist attractions for the benefit of the Island and foreign visitors.

### 30.00 Protect natural, environmental and cultural resources from destruction or irreparable damages caused by inappropriate use or lack of vision to mitigate adverse impact caused by other activities.

30.01 Reduce pollution's negative impact on natural resources by identifying and controlling the causes and sources of pollution.

30.02 Control land development, construction, and lot division activities that could negatively affect the quality of waters, particularly in aquifers' recharge areas and in immediate basins of lakes and reservoirs, including, among others, activities such as excessive paving that increases the flow of runoff waters, indiscriminate use of fertilizers and pesticides that damage the quality of our water bodies, leveling, removal of topsoil, and movement of soil that causes erosion and sedimentation.

30.03 Avoid activities that could deteriorate or destroy natural systems that are critical for preserving the environment, such as mangrove swamps, wetlands, forests, reefs, sinkholes, dunes, and habitats of endangered species.

30.04 Protect and preserve natural sinkhole areas, careful to avoid deviating runoff waters that flow toward them.

30.05 Protect wetland areas by allowing uses that are compatible with the preservation and conservation of their natural state.

30.06 Demand that the development impacts in nesting areas are minimized through manipulation of lighting and building location.

30.07 Prevent that establishing new activities, or authorizing the division of lots, results in the unnecessary loss of resources' future use options, keeping in mind the following objectives, among others:

- Avoid uses near the reservoir collecting areas that generate pollution, waste disposal into the water, or erosion.
- Avoid negatively affecting the eventual use of water resources by authorizing activities or division of lots in places where new reservoirs may be built.
- Avoid underground water pollution by not approving harmful uses and activities in their collection areas.
- Preserve and improve the quality of waters by providing an adequate treatment of used waters and by minimizing land movement and controlling sedimentation and erosion.
- Avoid uses and activities capable of harming the sand resource and resources related to the coastal zone, estuary systems, and others.
- Avoid the construction of structures on beach areas and discourage activities or division of lots in adjoining lands which have the effect of preventing or hindering free access to them by promoting free access to their panoramic views, free access to the sun, and their enjoyment by all.
- Integrate and harmonize residential settlements (and other projects) with the existing natural environment by promoting reforestation and maintaining the harmony with natural features such as the vegetation and topography.

30.08 Avoid the demolition, mutilation, destruction, and deterioration of natural resources, archeological sites, and historic zones.

30.09 Reduce the negative impact of natural disasters and other activities on natural, environmental, and cultural resources by preparing and implementing mitigation plans.

31.00 Foster protection of areas with karsts soil that due to calcareous formations and their hydrological characteristics, provide benefits to the aquifers, protect superficial waters, and maintain the ecological integrity of natural systems.

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- Stimulate the preservation of haystack hills (*mogotes*) of a karsts nature.
- Maintain the natural integrity of the drainage systems within karsts soil, discouraging alterations to the water bodies and superficial watersheds' charge and recharge areas.
- Avoid hydromodifications in karsts areas of vital importance.

- Foster the preparation of studies that include geological, morphological, hydrological, and hydraulic aspects, carried out by entities that have the necessary expertise and by agencies with jurisdiction over this matter.
- Avoid altering the ecological and hydrological equilibrium in karsts areas where edaphological and geological studies recommend protecting these formations.
- Implement scientific management measures as part of the procedures to grant permits for underground water well driving in karsts areas whose supplies require protecting this resource's quantity and quality.

32.00 Develop control and management plans for aquatic and marine pollution by non-point sources of pollution associated to the categories of urban development, agriculture, construction and operation of marinas, hydromodifications and the destruction or alterations to wetlands.

- Adopt and implement general management measures that allow for the selection and implementation of a variety of individual management practices to control all categories of non-point sources of pollution that affect or could affect water quality and the aquatic, riverside, or marine ecological systems.
- Evaluate and establish special zoning in reservoirs' upper watersheds and water bodies that serve as potable water supply sources, to: avoid the conversion of land that is particularly susceptible to erosion and the generation of sediments, preserve areas that provide important benefits to the quality of the waters and/or are necessary to maintain the aquatic or riverside biota, and to control land development to protect the natural integrity and the drainage systems of those water bodies.

33.00 Stimulate the preservation of land use in its natural state beyond the field of urban expansion or in rustic soil, granting additional recognition to their social and economic benefits and promoting mechanisms that adequately value such resources.

34.00 Develop plans for managing and preserving non-renewable resources (minerals) that guarantee environmental quality.

- Determine which mineral resources have economic development potential and net benefits that would be positive for the Island.
- Determine, by way of feasibility studies, different alternatives for mineral exploitation—including elements such as development, processing, financing, and selling—thus guaranteeing environmental quality.
- Gather more information on mining resource areas so as to establish zoning districts that indicate their location.
- Avoid excessively increasing the cost on eventual exploitation of mineral resources by authorizing activities or division of lots in places where there are mining deposits.



**Chapter 3:**  
*Coastal Management for Puerto Rico:  
Problems and Responses*

# Chapter III. COASTAL MANAGEMENT FOR PUERTO RICO: PROBLEMS AND RESPONSES

## INTRODUCTION

This section examines the major issues associated with the coastal zone. They fall into three general categories: Coastal Hazards, Coastal Resources and Coastal Development. The discussion of each category one begins with a description and analysis of the aspects that make it important for the PRCZMP.

Each section then presents the applicable public policies of OPP-PRLUP-1995 and those additional policies that were established by the PRCZMP (1978)<sup>22</sup> and then the legal framework of commonwealth and federal programs related to the implementation of public policy are presented. Finally, we identify the needs to address conflicts in these policies in order to create a more effective coastal management program.

## 3.1 COASTAL HAZARDS

The location of Puerto Rico in the Caribbean and its physical characteristics expose it to various natural hazards that can be classified into: hydrological, geological and meteorological factors.

The patterns of human settlements in risk areas increase the vulnerability of people to events such as floods, landslides and earthquakes, among others. Moreover, it is necessary to consider the effects of global warming and how these may influence the increase in the vulnerability of coastal populations. In this section, we discuss the natural hazards to which Puerto Rico's coastal zone is exposed to, including the possible effects of global warming and climate change.

### 3.1.1 FLOODS (STORM SURGES AND TSUNAMIS)

#### **Findings**

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The topography and location of communities in the drainage areas and river banks causes that the floods that developed during significant rain events induce considerable damage to life and property. In Puerto Rico, rivers originate in the central mountainous interior region of the island where the valleys are narrow, relatively short and steep, especially those leading to the South coast. Large areas of the coast are also subject to storm surge impact generated by the passage of weather events.

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<sup>22</sup> These detailed public policies were established in the PRCZMP (1978) to strengthen existing ones. As noted previously, in this revision and updating there are no additional public policies to those specified in the original PRCZMP and to those which have subsequently been included through RPC.

The greatest danger of flooding is that these events affect large areas of the coastal plain. Floods periodically impact urban and rural areas of Puerto Rico. These, in addition to landslides and droughts are among the main geological hazards which affect Puerto Rico and the Virgin Islands (USGS, 1999b).

According to maps which identify flood risk areas in Puerto Rico – known as Flood Insurance Rate Maps (FIRM) –, there are approximately 21,772,419 ha., with a population of 254,166 living in those areas, subject to flood risk in the coastal zone.<sup>23</sup>

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*A relatively recent event which caused extensive damage in Puerto Rico was Hurricane Georges, in September 1998. The maximum rainfall reported during the event was 26 inches in municipalities in the interior of the island. Three deaths were attributed directly and nine indirect and approximately \$2 billion in losses were reported.*

Estimates indicate that there are 1,769,887 ha. subject to flooding from storm surge (Zone VE), which has a 1% chance of being equaled or exceeded in any particular year. About 17,688 people live in these areas. Storm surge is the rise in sea level caused by a hurricane or other atmospheric disturbance. Zone VE is highly dangerous and comprises the area from offshore to where the wave height (distance between crest and trough) is reduced to less than 3 feet. According to FEMA, studies show that in the area where the waves are this high, currents and floating material can reach such speeds that they can cause significant structural damage and great potential to cause significant effects of erosion (Mercado, 2003).

Storm surge also has the effect of causing coastal erosion and destruction. In Puerto Rico, the effects of this surge are most severe in the South and East coasts due to the shallowness of the coast and that the path of hurricanes usually heads in a West-Northwest direction.

Zone A is also important when dealing with coastal hazards because it corresponds to the inland floodable area in a flooding event of 100 years, where the Zone V ends. The same effects mentioned earlier for Zone VE can be experienced, but with less intensity.

The following table shows the zones that identify the Special Areas of Flood Risk in the coastal zone, which have been adopted by the PRPB as subject to the provisions of the “Special Flood Hazard Areas Regulation”, Planning Regulation No. 13.

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<sup>23</sup>These computations were carried out by Estudios Técnicos, Inc. using layers of geographic information in digital format (*shapefiles*) of FEMA in 2004. For the population located in flood areas, each FIRM zone was selected, which were combined with Census 2000 *shapefiles* designed in the State Plane coordinate system NAD83. Then, we calculated the proportion of the area of each census block by flood zone. This ratio was used to estimate the amount of population within each census block. Importantly, it should be noted that population data could be over or underestimated, since the analysis assumes that the population is evenly distributed throughout the census block.

**TABLE III-1. FLOODING IN THE COASTAL ZONE**

Flooding in the coastal zone						
Zone	Definition	Flooding areas (hectares)		Population in flooding areas within the coastal zone		
		Puerto Rico	Coastal zone	Population	% of Puerto Rico's population	% of coastal zone's population
<b>AE</b>	Identifies the flooding area for a 100 year storm through a detailed analyses that includes the flooding base level.	17,640,439	7,050,731	164,576	4.3%	34.7%
<b>D</b>	Areas with possible, but undetermined flood hazards. No flood hazard analysis has been conducted.	1,825	N/A	11,939	0.3%	2.5%
<b>VE</b>	Identifies coastal areas with a high risk of storm waves in a 100 year storm.	1,769,887	1,769,887	17,688	0.5%	3.7%
<b>A</b>	Identifies the flooding area for a 100 year storm through methods of approximation, without the determination of the flooding base level.	5,949,225	1,008,674	26,025	0.7%	5.5%
<b>0.2% annual</b>	Also known as the 500 years flood.	1,772,813	406,496	26,158	0.7%	5.5%
<b>AO</b>	Areas of shallow flooding risk. The flooding area is identified for the 100 year storm where average water depths range from 1 to 3 feet.	242,734	69,639	7,780	0.2%	1.6%
<b>Total</b>		<b>222,324,366</b>	<b>21,772,419</b>	<b>254,166</b>	<b>6.7%</b>	<b>53.6%</b>

Source: FIRM. 2004. Calculations made by Estudios Técnicos, Inc. employing GIS.

The vulnerability to flooding events has increased over past decades due to poor practices in land use. First of all, hydromodifications have altered the behavior of water in the flooded valleys. Likewise, removal of vegetation in the upper parts of watersheds has contributed to soil erosion, causing sedimentation of water bodies. Consequently, it has compromised its storage capacity during rainy periods, thus aggravating flooding. The replacement of vegetation for pavement or concrete has also waterproofed the ground, increasing and accelerating the rate of drainage of the storms and intense rainfall events.

The elimination of coastal wetlands exacerbates this situation, since they reduce the surge impact and runoffs. During rain events, wetlands regulate and retain water flow, preventing flooding in other areas. However, their removal has increased the areas subject to flooding; causing properties which rarely suffered extensive flooding to now being vulnerable to severe damage in a flood event.

The location of housing developments, new residential complexes and industrial activities in flood areas of the coastal zone is another factor that has increased the potential for property damage in flood events.

Damage caused by flooding can be reduced by the continuation and expansion of inter-governmental programs. Government action of various types can reduce the amount of flooding and flood damage. For this purpose, it is possible to:

- take flood control measures, including construction works, carefully designed and implemented to reduce environmental damage and mitigate loss of benefits caused by the them (i.e.: nutrient distribution);

- reforest the upper parts of watersheds and implement measures to reduce the rate of runoffs;
- train people living in areas susceptible to flooding risk on how to evacuate these areas, and
- take into consideration the potential for coastal flooding when planning land use.

The flood hazard areas, according to the Flood Insurance Rate Map, are represented on Map 9.

### Floods caused by tsunamis

In addition to floods caused by torrential rains and storm surge, the coasts of Puerto Rico are subject to flooding caused by tsunamis. According to the Puerto Rico Seismic Network (PRSN), tsunamis can be caused by different factors, including: local earthquakes, regional and distant earthquakes and submarine landslides or impact of a celestial body.

An article that examines the effects of a tsunami on the U.S. East Coast, the Gulf of Mexico, Puerto Rico and the Virgin Islands, caused by an earthquake in the Caribbean Plate (in which Puerto Rico is located), pointed out that waves of at least 12m high could be generated, and its effects could spread over distances up to 2,200 km inland (Grindlay et al., 2005).

Tsunamis can also be generated by landslides on the seabed. The Puerto Rico Trench is located in the subduction zone<sup>24</sup> between the North American Plate and the Caribbean Plate and is the deepest portion of the Atlantic Ocean. In the South slope of the Trench, about 37km north of Puerto Rico, marks or cavities that are products of submarine landslides have been identified.

It is believed that the sliding material of these cavities may have caused significant tsunamis hundreds of years ago. One of them was identified north of Arecibo and is

believed to have been the product of a slope failure that caused the release of 910-1500km<sup>3</sup> of material (Schwab et al., 1991 in Mercado et al., 2002). It is estimated that this could have created a tsunami with a "runup"<sup>25</sup> of up to 30-55m and a "runup" greater than 10m along the Northern coast of Puerto Rico (Mercado et al., 2002).

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*Historical data show that Puerto Rico has been impacted by three tsunamis since 1867. Two of these occurred in 1867 and 1918, producing substantial damage, including loss of life.*

*The most recent tsunami occurred in 1918, and was caused by an earthquake of magnitude 7.3, whose epicenter was located in the Mona Canyon, 25 miles off the coast of Aguadilla. The maximum height of the waves reached six meters inland, impacting the West of the Island, and causing loss of life. The estimated time between the earthquake and the arrival of the first wave was of only one minute in the Punta Borinquen Sector in Aguadilla, and it affected all the West of Puerto Rico with waves of up to 20 feet.*

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<sup>24</sup> Subduction is the sinking of a lithospheric plate beneath another, in this case is the displacement of the North American plate beneath the Caribbean Plate.

<sup>25</sup> "Runup" is defined as the maximum elevation reach by the water at some point inland.

**Leyenda - Map Key:**

0.2 % ANNUAL CHANCE FLOOD HAZARD

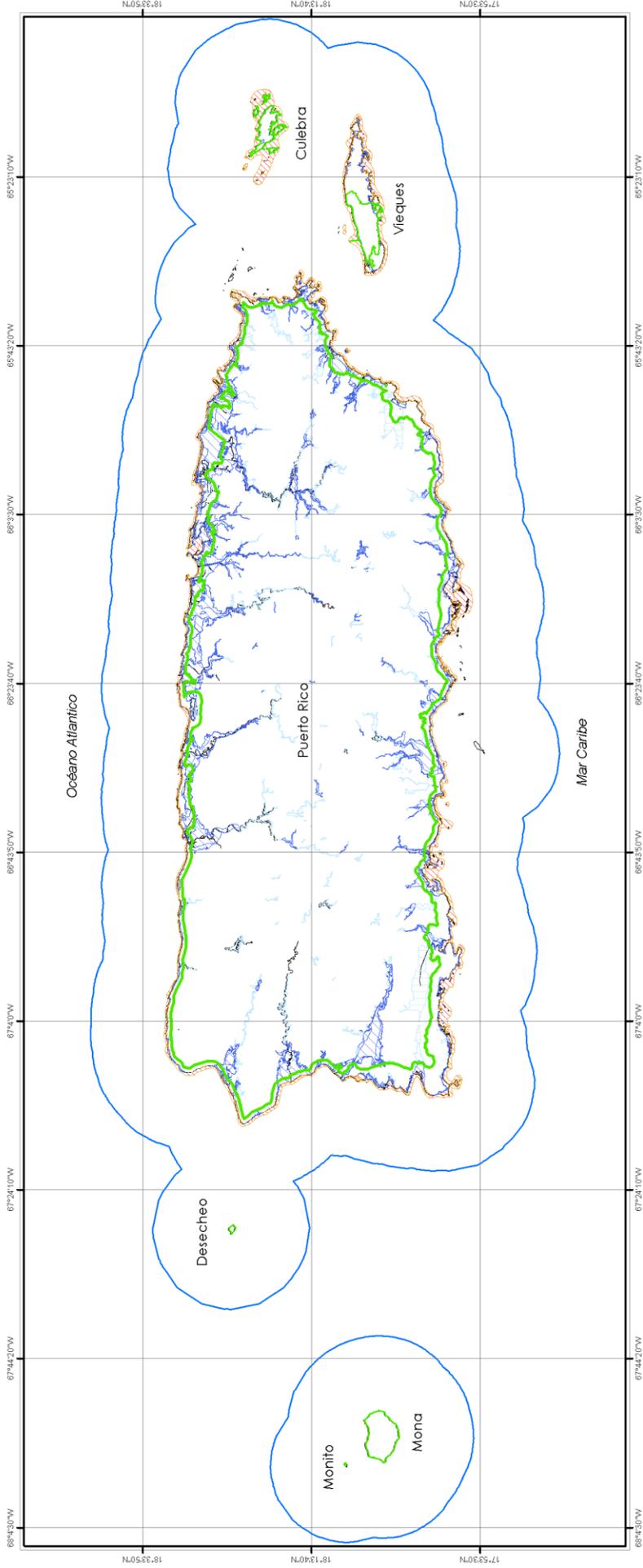
- A
- AE
- VE

Limite de la zona costanera tierra adentro -  
Coastal Zone Inland Boundary

Limite de la zona costanera marina (9 millas náuticas)-  
Coastal Zone Maritime Boundary



Escala - Scale 1:860,000



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

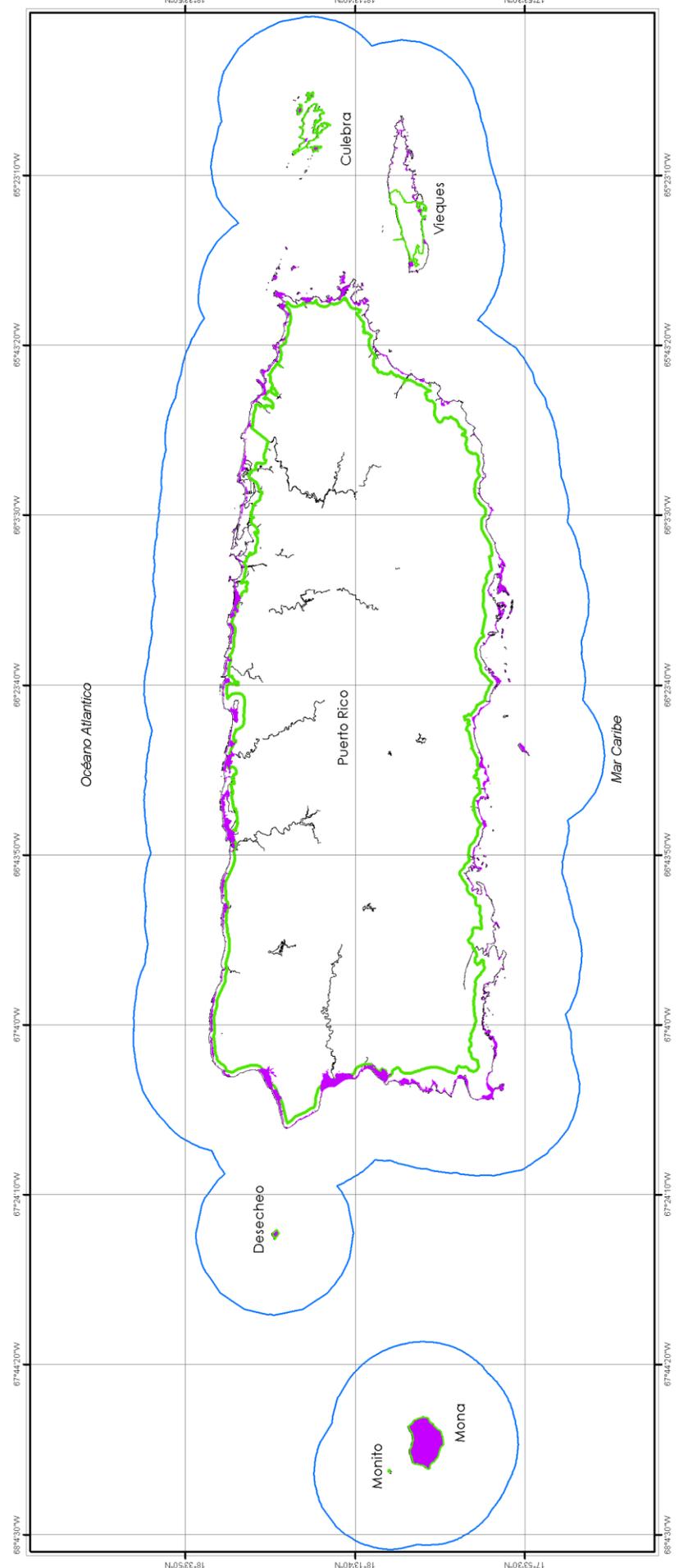
Mapa 9 / Map 9

# Terrenos Inundables Floodable Lands

Fuente de Información - Source:  
Federal Emergency Management Agency  
FIRM (2005)


  
 Escala - Scale 1:860,000

**Leyenda - Map Key:**
  
 Límite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
   
 Zona de riesgo a tsunamis - Tsunami hazard zones
   
 Límite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary



Fuente de Información - Source:  
 The Puerto Rico Tsunami Warning and Mitigation Program



# Zonas de riesgo a tsunamis

## Tsunami Hazard Zones

There is evidence that shows other smaller scale events rock fractures up to 35-40 km in length. Some of these fractures have been observed in the Mona Passage, where there is an active earthquake fault, which can accelerate the collapse of rocks at the seafloor and generate a tsunami.

Over the years, studies have been conducted to find out the implications of the sliding of these materials, particularly if it occurs in one event. These studies respond to the urgent need for monitoring measures in the face of this possibility. In particular, it was found that the North of Puerto Rico has all the necessary conditions for submarine landslides to occur accompanied by a tsunami, among which are:

- steep slopes near the coast;
- history of previous landslides (including a very large one);
- gradual reduction in the stability of the slope due to tectonic movements and the continuous sedimentary overload coming from the largest rivers in Puerto Rico;
- the presence of multiple underwater canyons;
- the presence of active geological faults; and
- the increase in the intensity of the surge that occurs every year as a result of extra tropical storms – which has the effect of destabilizing the sediments along the slopes – as well as the surge produced by hurricanes.<sup>26</sup>

### **Public Policy**

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Public policies related to the issue of flooding, including coastal flooding, are listed as sections 15.01, 16.00, 17.00 and 30.02 of the OPP-PRLUP of the PRPB. These range from identification of land subject to flood risk in the PRLUP and the POT (15.01), to protection of the residents of these areas through the construction of works for flood prevention and, thus, prevent damage and loss of life, property and, where necessary, the relocation (see Policy 16.00). For future development, the public policy statement reads:

"To discourage land development and construction of structures for urban expansion in flood zones unless they provide flood control measures to ensure the protection of life and property and natural and environmental resources" (See Policy 17.00).

Public Policy 30.02, which regulates land leveling and paving which can reduce the natural retention capacity of rainwater and thus increase flooding, points out the need to: "Control land development activities, construction and subdivisions which may adversely affect water quality, particularly in aquifer recharge areas and in the immediate basins of the lakes and reservoirs, including among others, activities such as overbuilding that increases the flow of runoff..."

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<sup>26</sup> See Mercado et al. (2002). Investigation of the Potential Tsunami Hazard on the North Coast of Puerto Rico due to Submarine Landslides along the Puerto Rico Trench.

## Implementing the Policy

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### 1. Flood prevention

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There are several Local and Federal government agencies sharing the responsibility for flood prevention. At the local level, are: the DNER, the PRPB and RPA. At the federal level, the responsibility rests with FEMA, the USACE and the Natural Resources Conservation Service (NRCS).

With the passing of the “Organic Law of the Department of Environment and Natural Resources”, Law No. 23 of 1972, as amended, the responsibilities for flood prevention and conservation of rivers and beaches, which previously fell on the Secretary of Transportation and Public Works, were transferred to DNER. The DNER coordinates the research, planning and resource management associated with the implementation of the Program, including coordination with the PRPB. As part of its responsibilities, the agency enforces a number of laws associated with flood prevention.

One of these is the "Law for watersheds protection and flood prevention", Law No. 47 of 1963. It empowers the Government of Puerto Rico to acquire and declare as public utility those properties that are necessary or appropriate to carry out projects for hydrographic basin protection and flood prevention.

The "Law to establish public policy on the prevention of floods in Puerto Rico, the conservation of rivers and streams and the dedication of green belts for public use", Law No. 49 of 2003, establishes the policy for flood control works which are publicly funded. This law declares that DNER will perform flood control works and river channeling conditioned to: (1) the need to prevent or lessen the risk of flooding in areas with a history of damage to life and property, (2) the purpose of such action is public; and (3) the cost does not exceed other methods such as expropriation, relocation, filling or removal. This law was amended by Law No. 83 of 2006<sup>27</sup>, to authorize the DNER to use funds for cleaning proprietary streams in emergencies or in special cases where – if the work is not conducted – the situation could become a hazard and cause damage.

DNER is working on several structural works for flood control in rivers Guayanilla, Fajardo, Santiago in Arecibo, Puerto Nuevo-Río Piedras and Portugués and Bucaná in Ponce. In the last two – Portugués and Bucaná – the agency is also working on maintenance work.

Another local agency that works to prevent flooding is the PRPB. This agency coordinates FEMA’s National Flood Insurance Program (NFIP). It is also responsible for developing, adopting and administering the "Special Flood Hazard Areas Regulation", *supra*, and works to promote education and public awareness in order to minimize risk.

The PRPB is responsible for the management of the floodplains in Puerto Rico. To that end, on 8 April, 2005 the agency adopted the Flood Insurance Rate Maps (FIRM) to replace the

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<sup>27</sup> Act No. 83 of 2006, “To amend Article 1 of Law No. 49 of 4 January 2003: Public Policy on flood prevention and conservation of rivers and streams”.

Maps of Areas Susceptible to Flooding in Puerto Rico.<sup>28</sup> Thus the new FIRM maps will be used in Puerto Rico for floodplain management.<sup>29</sup>

Furthermore, RPA is the agency responsible for enforcing the regulations adopted by the PRPB on the use of land and to implement all provisions of the "Special Flood Hazard Areas Regulation", *supra*. It is also responsible for carrying out the monitoring of areas susceptible to flooding in all urban and rural areas of Puerto Rico.

Another mechanism that was adopted by the PRPB and RPA is the "Subdivision and Urbanization Regulations", Planning Regulation No. 3. This regulation sets standards for the leveling of soil so as to promote appropriate development that will contribute to reduce the amount of drainage water and, consequently, flooding.

At the federal level, FEMA is the agency responsible for making changes to the FIRM. Meanwhile, the USACE works closely with the DNER in the development of flood control works. This federal agency provides technical assistance to municipal governments and provides protection through the management of floodplains. In Puerto Rico, the USACE has constructed – aside from port facilities – facilities for flood control in the Guanajibo, Matilde, Juan Méndez and Cibuco rivers. The agency also has other projects in various stages of development (See Table III-2).

The NRCS is another federal agency that has worked in coordination with the Government of Puerto Rico and with local groups to develop flood control measures under the Watershed Protection and Flood Prevention Program. This program focuses on the creation of conservation measures and the identification of nonstructural measures in order to address problems related to flooding and erosion, among others.

In coordination with other agencies such as the DNER, the NRCS has worked in the construction of two dams, canals and dykes in the Añasco River basin and the construction of a canal in the Guayanés River basin, in the Municipality of Yabucoa (Rosa Sánchez Channel). In addition, works are underway in the basins of the *Río Grande de Loíza*, *La Plata* and *Toa Vaca*.<sup>30</sup>

The NRCS also works with the Government of Puerto Rico under the Emergency Watershed Protection. This program works in the implementation of emergency measures, including the purchase of easements in floodplains in order to retard runoff and prevent soil erosion. The purpose is to safeguard life and property against floods and other natural events that can cause the deterioration of basins. This agency also has a variety of programs that will provide technical and financial assistance to local groups working on the preservation and development of natural resources.

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<sup>28</sup> The FIRMS are obtained using statistical analysis of reports of river flow, storm tide and rainfall; information obtained through community consultation; information of the topographic measures of the floodplain; and analysis of hydrological and hydraulic studies developed by FEMA; this is known as the Flood Insurance Study (FIS).

<sup>29</sup> Taken from [<http://jpop02.jp.gobierno.pr>].

<sup>30</sup> Interview to Mrs. Damaris Medina and Marisol Morales of the NRCS. Caribbean Division. Monday, July 28, 2003.

TABLE III-2. USACE FLOOD CONTROL PROJECTS

USACE flood control projects					
Flood control projects	Status				
	Study of recognition	Study of viability	Restoration of the ecosystem	Plat & specifications	Construction
1 Río Grande de Arecibo					✓
2 Río Ojo de Agua (Aguadilla)					
3 Río Culebrinas					
4 Río Yagüez		✓			
5 Road 102 (Mayagüez)					
6 Río Guanajibo (Mayagüez, San Germán)				✓	
7 Río Guanajibo (Sabana Grande)					
8 Boquerón WLR					
9 Río Loco					
10 Río Matilde	✓\$				
11 Río Matilde					
12 Río Jacaguas					
13 Río Grande de Jayuya					
14 Portugués y Bucaná					✓
15 Río Descalabrado					
16 Jauca					
17 Río Orocovis					
18 Río Guamaní					
19 Río Nigua in Salinas					
20 Río Nigua in Arroyo					
21 Río Patillas					
22 Las Carolinas					
23 Río Antón Ruiz					
24 Police station					
25 Río Fajardo					
26 Piñones Road 187					
27 Río Grande de Loíza				✓	
28 Quebrada Juan Méndez					
29 Río Puerto Nuevo					✓
30 Laguna de Condado					
31 Río Bayamón	✓\$				
32 Dredging of Caño Martín Peña			✓		
33 La Esperanza					
34 Río La Plata					
35 Río Cibuco					
36 Playa Puerto Nuevo					
37 Río Grande de Manatí (Cachete y Palmas)		✓			
38 Río Grande de Manatí (Barceloneta)					✓

Legend: ✓ Major construction projects ; \$ Projects depending on Congressional funding

Source: DNER & USACE .

## 2. Protecting people who live in flood-prone areas

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The warnings and the coordination of evacuations in the face of flood danger is coordinated with government agencies at the local and federal level. The National Weather Service (a division of NOAA) issues watches and warnings in flood and hurricane events while the Commonwealth's Office of Civil Defense, which is part of the Commonwealth Agency for Emergency Management and Disaster Administration (AEMEAD, by its Spanish acronym) is responsible for managing and coordinating evacuation and other emergency services required during a flood emergency.

FEMA's Caribbean Regional Office has been established in Puerto Rico since 1992. This division is responsible for managing the agency's programs, planning, preparing, responding and carrying out recovery activities under the Federal Response Plan.<sup>31</sup> It also has a link to the American Red Cross and serves as the command center in times of disaster.

Regarding floods caused by tsunamis, the Department of Marine Sciences at the UPR, Mayagüez Campus, has prepared flood maps for tsunamis and other coastal phenomena. These were prepared as part of the Program for Tsunami Warning and Mitigation in Puerto Rico, which is sponsored by FEMA and the UPR. These maps provide government agencies and municipalities the work related to mitigating the impact of a possible tsunami in Puerto Rico. The areas identified cover all the coastal municipalities of Puerto Rico, including Vieques and Culebra.<sup>32</sup>

The PRSN works in education and operates the Tsunami Warning Center in the Caribbean, which is the key component for the warning system for tsunamis and other coastal hazards in the Caribbean and adjacent regions.<sup>33</sup> The Center operates several programs including a system known as the "*EarlyBird*", which detects earthquakes that have the potential to generate tsunamis and also discloses information regarding the event. This system monitors the PRSN seismic stations and 35 other stations in the Caribbean and its surroundings. Its results are available in real time, so that it can detect all earthquakes of magnitude 5 or greater in the Caribbean early and accurately. Once detected, the system locates earthquakes and notifies the PRSN if the earthquake has exceeded the parameters established for the region.

In addition, for the early detection of tsunamis and the acquisition of critical data in real time projections, the PRSN installed six mareograph stations throughout Puerto Rico that complement another 10 similar stations operated by NOAA. These allow the collection of data from the growth of the tide in this and other regions. The mareographs, in conjunction with a system of buoys – which was installed in the Caribbean – and a satellite receiver located in Mayagüez, allow the confirmation and identification of tsunamis and the

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<sup>31</sup> This is the plan for responding to national emergencies, including natural disasters. It is administered by the *Department of Homeland Security*, agency to which FEMA is ascribed. Currently, this agency is working on the *National Response Framework*, which will eventually render the Plan. For more information, refer to: [<http://www.fema.gov/emergency/nrf/mainindex.htm>].

<sup>32</sup> These maps can be accessed through the web page: [<http://poseidon.uprm.edu/>].

<sup>33</sup> See the Puerto Rico Seismic Network web page: [<http://redsismica.uprm.edu/>].

evaluation of their impacts.<sup>34</sup>

Similarly, the PRSN has developed tsunami evacuation maps for six coastal municipalities: Lajas, Mayagüez, Añasco, Carolina, Dorado and Rincón. Funds have also been allocated for the development of maps for the municipalities of Manatí, Ponce and Aguadilla.<sup>35</sup>

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*Need: Monitoring the accuracy of the maps of areas susceptible to flooding.*

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FEMA performed studies on flood areas in much of Puerto Rico and generated preliminary maps of Special Areas of Flood Risk in 2007. It is expected that they be finally adopted in 2009. Together, they make corresponding amendments to the “Special Flood Hazard Areas Regulation”, *supra*, to adjust them to the maps and their nomenclature. However, one should consider that these maps are developed as part of the NFIP for setting flood insurance premiums. However, they are used in land use planning, for being regarded as the best scientific information available on this subject.

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*Need: Public education program.*

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The loss of lives as a result of weather events strengthens the need for an intense public education program. The purpose of this program would be to instruct residents of the danger areas on the coast regarding evacuation and other safety measures to be taken in times of emergency, including hurricanes, significant rain events and tsunamis. The disclosure of information about the dangers of flooding is also essential to ensure awareness and understanding by those who could be potentially affected.

Also, people should be made aware of how the destruction of natural systems, which protect against flooding, may increase vulnerability to natural phenomena. Despite numerous works for construction of flood control, the occurrence of flooding in areas not commonly considered as flooded is more frequently observed. The alteration of the topography, land sealing for construction, and expansion of buildings on the floodplains of water bodies, are factors that aggravate the flooding situation.

During fiscal 2002, Puerto Rico, through AEMEAD, received an allocation from the Department of Homeland Security for the Emergency Preparedness and Response, in order to train citizens to respond to emergencies in their communities through Community Emergency Response Teams (CERT). Its purpose is to prepare citizen groups interested in providing immediate assistance to victims in the event of a disaster, organize volunteers and provide support to rescuers. In Puerto Rico, aside from the municipalities, private and community groups have been certified under this program.

Regarding floods caused by tsunamis, the Puerto Rico Tsunamis Mitigation and Warning Program includes the preparation of coastal populations that could potentially be affected by this phenomenon so they can recognize natural warnings in the face of a possible threat. This

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<sup>34</sup> This is a DART buoy system, which are monitoring stations for early detection of tsunamis and to acquire critical data for real time projections. The letters correspond to Deep-Ocean Assessment and Reporting of Tsunami (DART™) and are located in regions with a history of occurrence of destructive tsunamis. For more information see: "NOAA's National Data Buoy Center".

<sup>35</sup> Personal communication with Dr.. Christa G. von Hillebrandt-Andrade, Director of the PRSN, February 20, 2008.

Program has worked with drills, educational seminars and a catalog of *tsunamis*. Educational materials have been prepared on safety for boaters and information for children. It has also developed and distributed a protocol for responding to a possible tsunami and prepared 250 tsunami hazard signs that have been placed in areas vulnerable to these phenomena.

However, we need an education campaign about the real danger of a tsunami, particularly for the residents of the coastal municipalities of the North, Northwest and East. Similarly, a massive orientation campaign to recognize the signs is needed, and about how to respond in the event of this type of incident; for example, to recognize that the withdrawal of the sea is a sign of a tsunami.

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*Need: Preventively relocate people who reside in areas subject to recurrent floods.*

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Although people living in flood risk areas can be oriented for evacuation and other emergency measures, relocation is the most suitable and secure long-term alternative.

The "Law to establish public policy on flood prevention in Puerto Rico, the conservation of rivers and streams and the dedication of green belts for public use", *supra*, provides that when evaluating alternatives for flood control, DNER should estimate the direct, indirect and cumulative costs and environmental impacts caused by the flood control works, including mitigation. If the cost of works is determined to exceed the costs of expropriation, relocation or removal of structures and improvements built in a flood zone, the DNER shall expropriate, relocate or remove such structures. In the case of works which have been constructed in violation of the "Law for the Control of Buildings in Areas Susceptible to Flooding", Law No. 3 of 1961, as amended, DNER shall act under its provisions, which establish that the relocation of families impacted in these areas shall be coordinated with the Puerto Rico Department of Housing (PRDH) and, eventually, these areas must remain free of residential, commercial or industrial development.

### 3. Preventing inappropriate developments in flood hazard areas

RPA is the Commonwealth government agency charged with regulating and granting all building permits, except in the cases where it has delegated the power to municipalities, under the provisions of the "Law of Autonomous Municipalities", *supra*. RPA also has a responsibility to safeguard the environment and preserve natural resources, implement building codes and auditing mechanisms necessary for the compliance with laws and planning regulations.

The "Special Flood Hazard Areas Regulation", *supra*, provides that RPA has the responsibility to review all development permit applications in a coastal area of risk to determine whether the proposal will alter wetlands or dunes, so it may increase the risk of flood damage. The regulation also states how changes to the natural hydrology of the floodplain must be avoided.<sup>36</sup> However, the implementation of the regulation has been ineffective in preventing inappropriate development in flood plain areas, mainly due to the fact that the avoidance of construction in areas identified as floodplains has not been established as a priority in development.

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<sup>36</sup> Section 3.02 No. 7.

Another agency linked to the prevention of developments in areas of risk is the PRPB, which, aside from evaluating and granting or denying land use permits, is responsible, through its Coastal Zone Unit, for the determination and certification of compatibility with the PRCZMP for projects which are proposed within the coastal zone. The review of Federal Consistency with the PRCZMP applies only to federal projects, projects that are federally funded or require a permit from a federal agency. Also, the PRPB, along with NOAA, deliberates on appeals regarding Federal Consistency determinations with the PRCZMP.

Those proposed projects in the coastal zone which do not require this certification, are reviewed by the division of consultation and endorsement of the PRPB and RPA. These circulate the majority of plans to other agencies, including DNER, which has the responsibility to make appropriate recommendations to the PRPB and/or RPA on steps to be taken for flood protection. Also, the PRPB, based on its policies and recommendations, may require the developer to take the necessary measures to control floods.

Efforts to improve the monitoring of developments in flood plains are associated with the Flood Insurance Program. These will be described later.

Aside from the protection that the previously described mechanisms provide, the development control process outlined in the fourth chapter provides another measure of extra protection.

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*Need: To seriously examine the hydrographic impact of the projects proposed in river basins and their effects on flood-prone zones.*

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It is recommended to examine the potential impacts of developments in flood areas for each project in the context of the hydrographic basins. At present, the hydrological and hydraulic studies (H-H study) focus only on the hydraulics of the water body and not on the hydrology of the hydrographic basin where the proposed action is located. Thus, each project is evaluated separately; however, their evaluation should no longer be carried out individually, but as part of the hydrological environment.

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*Need: Reexamine the focus of structural alternatives for flood control.*

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It is necessary to transform the structural approach that incorporates the construction of flood control works as a first alternative. It is recommended, as a first alternative, to maintain water bodies in their natural state in conjunction with an appropriate buffer zone. The reforestation of watersheds upper parts and the preservation of rivers in their natural state are non-structural measures that can be used for prevention and mitigation of the effects caused by floods.

An alternative to traditional canalization of rivers is bioengineering and design with nature. This is a creative and environmentally safe option which employs materials and construction systems alive and close to nature. This technique aims to maintain the structure of the river and its functions unchanged. Moreover, it allows the inter-relationship between the river and its flood valley (CEMPES, 2003). This is a viable medium-term practice which is also in tune with the approach of conservation and sustainability.

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*Need: Rigorous adoption of regulations to prevent excessive land leveling and paving.*

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The existing legal framework has regulations which restrict or prohibit development in flood plain areas, while controlling actions such as filling, leveling or dredging, which can increase damage from flooding or swells. However, it is necessary to enforce these measures in order to protect citizens from flood events.

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*Need: Incorporate the various risk factors in land use planning.*

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The officials responsible for decision making must be educated and informed about the urgent need to consider coastal hazards in the planning of land use. There are additional measures such as further coastal withdrawals, in addition to the regulations, which may be incorporated in the territorial plans at the municipal level as a protection measure for coastal life and property.

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#### 4. Insurance for owners of property in flood prone areas

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The NFIP, established by the "U.S. National Flood Insurance Act" in 1968 and expanded by the "Law on Flood Disaster Protection" in 1973, was designed to provide affordable flood insurance through federal grants. This program covers buildings in areas of low, moderate and high risk. Currently, there are maps of areas subject to flood hazard (FIRM) for the Island's 78 municipalities, as part of the Flood Insurance Study.

It should be noted that the NFIP excludes areas which have been declared as coastal barriers under the "Coastal Barriers Act" of 1982 (CBRA), administered by the USFWS. These are environmentally sensitive areas which receive the first impact of the wind and waves during storm events. In these areas, the purchase of flood insurance for structures which have been constructed or improved after the passage of the Law is prohibited (See the Coastal erosion section).

Moreover, in 1994, U.S. Congress expanded the scope of the aforementioned laws, leading to the "National Flood Insurance Reform Act" (NFIRA). It establishes, among other things, a Program of Assistance for Disaster Mitigation. The purpose of this program is to assist states, territories and communities in developing mitigation plans and implement measures to reduce future flood damage. This program is administered by the FEMA Mitigation Division.

#### 3.1.2 GEOLOGICAL RISKS

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##### Findings

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Puerto Rico is located in an area of high seismic activity. Puerto Rico is surrounded by geological faults that are the result of the convergence of the Caribbean Plate, which is where the Puerto Rican archipelago is located, with the North American plate. Moreover, there are multiple faults within the Island.

A study conducted by the U.S. Geological Survey (USGS) in 2003 on the probability of seismic activity in Puerto Rico, revealed how the West and Southwest part of the Island are the most vulnerable to earthquakes. Tectonic plate movements are responsible for seismic activity in Puerto Rico except for a few low magnitude incidents caused by faults in the interior of the Island which have distinct patterns and are not associated with earthquakes. Geological

surveys show that in the Great Rift of Southern Puerto Rico, as well as in the one in the North, there has been no movement over millions of years.<sup>37</sup>

There are four zones of seismic activity around Puerto Rico. They are: Mona Canyon, the Puerto Rico Trench, the Pit of Anegada and the Pit of the Dead. The strongest earthquakes recorded in the Mona Canyon and the Puerto Rico Trench are:

**TABLE III-3. Earthquakes registered in the Mona Passage and the PR Trench**

<b>Earthquakes registered in the Mona Canyon and the Puerto Rico Trench</b>		
<b>Area</b>	<b>Year</b>	<b>Degrees Richter</b>
Mona Canyon	1943*	7.75
Mona Canyon	1918	7.5
Mona Canyon	1917	7.0
P.R. Trench	1915	7.0

*\*Close to the union with the P.R. Trench*

The seismic activity recorded in Puerto Rico or near the Island during the past decades is presented in Map 12.

In Puerto Rico, there have been three documented earthquakes over the last centuries which have caused major damage. The first one happened on May 2, 1787 with intensities of 7-8 on the Richter scale and damage throughout the Island, except the South coast. Subsequently, on 18 November 1867, an earthquake occurred with intensity of 7-8 on the East coast of Puerto Rico, and an intensity of nine in the Virgin Islands. The same earthquake was accompanied by a tsunami of 3 to 5 feet and damage to the east of the Island. Meanwhile, the latest earthquake which caused major damage occurred on October 11 of 1918 in the Mona Canyon. It measured 7.5 and caused damages in Northwestern Puerto Rico. This earthquake was accompanied by a tsunami wave of 3 to 5 feet height.

In recent years there have not been earthquakes which have produced serious damage, although there are frequent seismic movements on the Island. Earthquakes with an intensity of less than four have produced little or no damage, although the land movements related to these events have been felt.

Unfortunately, susceptibility to earthquakes has not had the importance it deserves in development proposals in the Commonwealth. As an example, the site proposed for the nuclear plant in Aguirre, proved inadequate due to geological hazards. In addition, other hazards associated with earthquakes such as liquefaction, seismic-wave amplification, landslides and tsunamis, are often not taken into consideration. In the coastal area, between Condado and Isla Verde, construction has been carried out on top of sand deposits of marine origin which, in addition to its low elevation with respect to the average sea level (less than

<sup>37</sup> See PRSN link: [<http://redsismica.uprm.edu/spanish>].

three meters), are saturated with water, which makes the area susceptible to liquefaction in the event of a strong earthquake, compromising the safety of their structures (Estudios Técnicos, Inc. & CEDES, 2001).

Moreover, the collapse of sinkholes in areas of karst topography is another potential geological risk. Most of the karst territory is porous and fractured; therefore, the infiltration of rain results in the dissolution of limestone, increasing its porosity, which can lead to its collapse.

Limestone presents at least three problems for construction projects: differential compaction due to the irregularity of the bedrock, tunneling<sup>38</sup> and the collapse of underground cavities (Lugo et al., 2001). However, projects – such as buildings, roads and urban development – have been constructed which could be in danger of collapsing. Also, inadequate management of these lands, including over-pumping of aquifers, usually results in altering the flow and quality of groundwater that eventually discharges into the coastal zone.

The coastal plains are susceptible to landslides, predominantly along water bodies' canals or where they emerge from the tower karst or steep haystack hills through young sediments. If these sediments are exposed to earthquakes, lateral displacement can occur in the coastal plain based on liquefied sediment. Younger sediments, which form the coastal plains that surround the Island, have gentle slopes. Therefore, landslides on the coastal plains are limited – usually – to the river banks, which may threaten structures built on these plains (DeGraff et al., 1989).

Monroe (1979) documented four categories of susceptibility to landslides in Puerto Rico. These areas are classified as: very high susceptibility areas, including areas of active and recent landslides; areas of high susceptibility; areas of moderate susceptibility and low susceptibility areas. It should be noted that more than 80% of the population of the coastal zone is found in areas of low susceptibility to landslides. These are described below.

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<sup>38</sup>The formation of tunnels or tubular cavities below the surface by the action of water.

**TABLE III-4. LANDSLIDE CATEGORIES**

Landslide categories				
Susceptibility	Definitions	Areas occupied within the coastal zone (hectares)	Population	Proportion of the population within the coastal zone
<b>Very high</b>	Areas consisting of landslide materials and a few appear to have been recemented into a fairly stable terrain. Because of the danger of disturbing present stability, these areas should either be avoided or special precautions should be taken to prevent new movement during excavation. Excavations in these areas almost invariably causes new slides in old slides deposits.	0.21	3	0.0%
<b>High</b>	Almost all areas having slopes greater than 50 percent, areas of slide-prone rock and soil types mapped as areas of high susceptibility such as the Formations Cibao and San Sebastián.	9.97	58	0.0%
<b>Moderate</b>	Areas considered as stable, except when disturbed by steep-sided excavations.	9,931	47,180	9.1%
<b>Low</b>	Nearly flat or are underlain by unweathered stable rock. It is mostly composed of alluvium, coastal deposits, such as beach deposits and swamp deposits. Includes extensive deposits of dune sand and eolianites along the Atlantic coast. Excavations into these materials may lead to slide.	87,799	440,179	84.8%

Source: Monroe (1979). Calculations made by Estudios Técnicos, Inc. employing GIS.

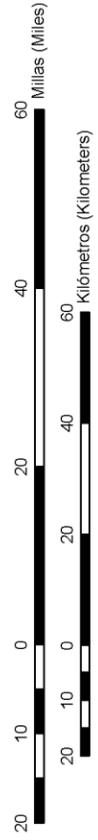
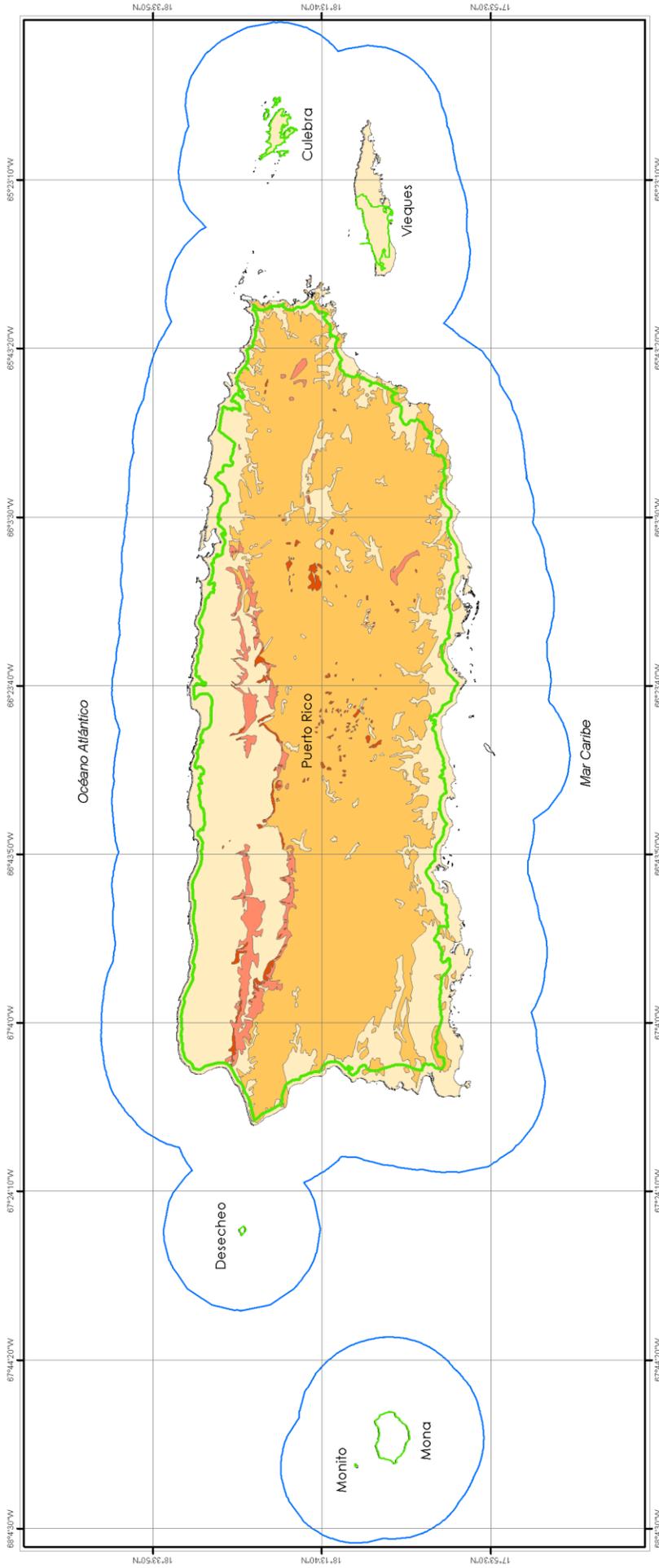
Leyenda - Map Key:  
 Límite de la zona costanera tierra adentro - Coastal Zone Inland Boundary  
 Límite de la zona costanera marina (9 millas náuticas) -  
 Coastal Zone Maritime Boundary

Susceptibilidad a deslizamientos -  
 Landslide Susceptibility

Muy alta / Highest  
 Alta / High  
 Mediana / Medium  
 Baja / Low



Escala - Scale 1:860,000



Programa de Manejo de la Zona Costanera  
 Coastal Zone Management Program

# Susceptibilidad a deslizamientos Landslide Susceptibility

Fuente de Información - Source:  
 US Geological Survey

Mapa 11 / Map 11

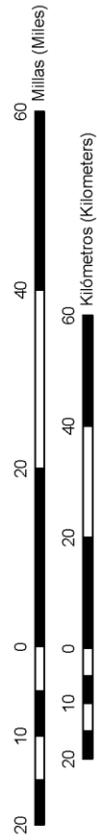
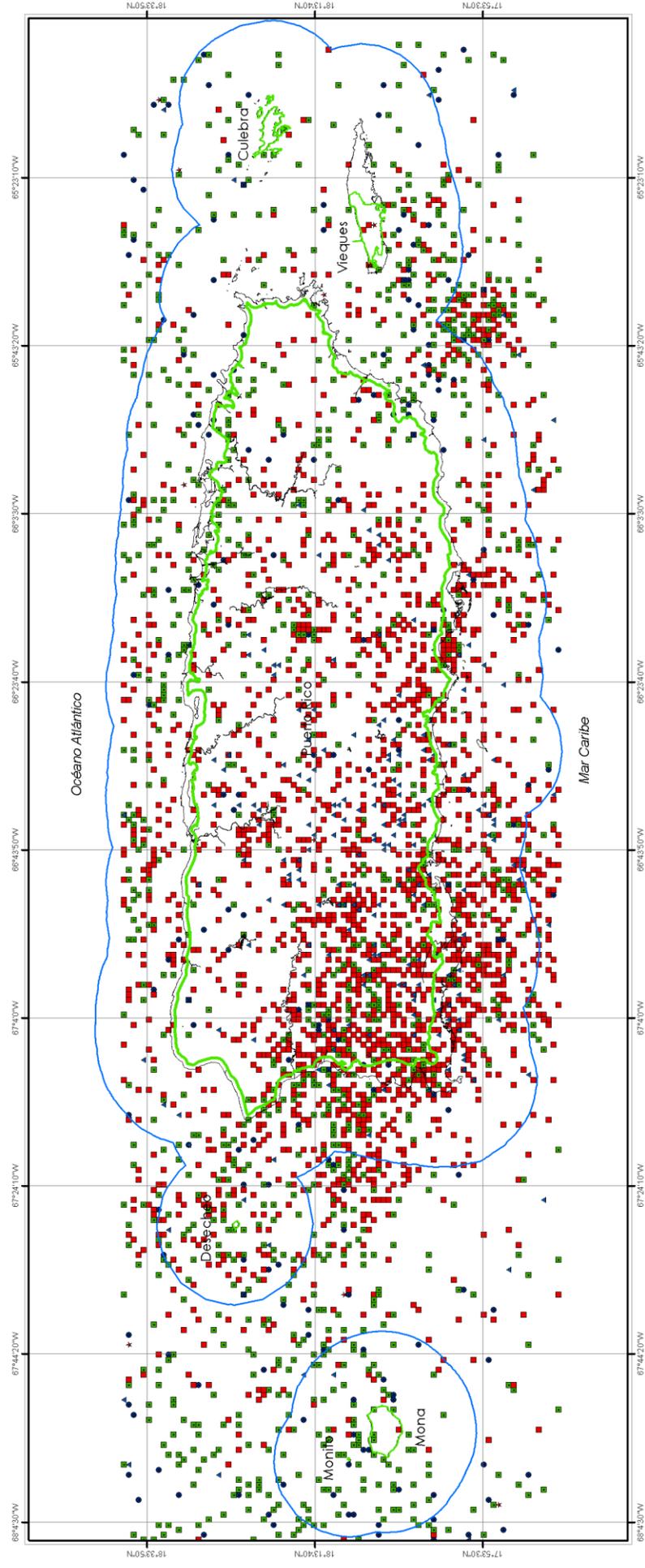
Leyenda - Map Key:

- Magnitud - Magnitude (Richter)
- ▲ 0.00 - 1.99
  - 2.00 - 2.90
  - ★ 4.50 - 5.00
  - 2.91 - 3.50
  - 3.51 - 4.49

- Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
- Limite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary



Escala - Scale 1:860,000



Fuente de Información - Source:  
 US Geological Survey  
 -Earthquake Hazards Program  
 -National Earthquake Information Center  
 World Data Center for Seismology, Denver  
 -[http://neic.usgs.gov/neis/states/puerto\\_rico/](http://neic.usgs.gov/neis/states/puerto_rico/)

# Actividad sísmica 1986-2003

## Seismic Activity 1986-2003



Programa de Manejo de la Zona Costanera  
 Coastal Zone Management Program

Mapa 12 / Map 12

## Responding to findings

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The PRSN was installed in 1974 by the USGS. It was established with funds from the former Fluvial Resources Authority (now Puerto Rico Electrical Power Authority (PREPA) for the primary purpose of assessing the local seismicity for the construction of two nuclear power plants: Aguirre and Islote. Between 1982 and 1987, the PRSN was operated by the Center for Energy and Environment Research. Subsequently, in 1987, it was transferred to the Department of Geology, UPR Mayagüez.

The PRSN currently operates 25 seismic stations in Puerto Rico and the U.S. and British Virgin Islands. The technology used by the PRSN, in coordination with the USGS, is based on two types of networks: strong motion, which records the events of greater intensity, and smooth, which detect events of lesser intensity. The Strong Motion Network is part of the USGS Earthquake Hazards Program. The PRSN has 30 stations in different parts of the Island (two of them belonging to USACE). Another 78 stations and five instrumented structures belong to the USGS. The information offered by the PRSN is also used to define the location of land displacements or landslides more accurately.

The USGS has prepared seismic hazard maps in Puerto Rico which serve as a standard to regulate building codes and the insurance industry. These geological maps warn of the presence of unstable areas, mass displacements and large landslides. They provide information from the field, faults and sinkholes.

In addition, the NRCS has inventoried most soil types in Puerto Rico. These were digitalized so that they can serve as a tool in spatial planning, particularly for the identification of risk areas.

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*Need: Study of losses and damages in earthquake events.*

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Although there are maps and models which identify areas in Puerto Rico subject to greater risk of earthquakes, there is still no study that incorporates the potential damage and loss of life in the case of an event of great magnitude.<sup>39</sup> This study should consider the potential generation of a tsunami and the point on the coast nearest to the epicenter.

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*Need: Absolute prohibition of activities such as sinkhole filling and urban development on karst formations.*

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While Puerto Rico has laws protecting limestone formations, the practice – both legal and illegal – of activities such as filling and construction on such unstable ground, continues. This jeopardizes public safety as well as ecosystems and resources associated with these formations.

These problems have increased despite the fact that there are special laws prohibiting the destruction of delicate ecosystems and their formations. These are the "Protection and Conservation of Puerto Rican Caves, Caverns and Sinkholes Act", Law No. 111 of 1985, and the "Protection and Conservation of Puerto Rican Karst Physiography Act", Law No. 292 of

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<sup>39</sup> PRSN. Telephone interview to Dr. Víctor Huérfanos. August 21 of 2003.

1999. Both laws establish as public policy the protection and conservation of these natural formations. However, they do not include the absolute prohibition of activities such as filling and construction of structures on limestone formations, which could cause the collapse and detachment of the land.

Following the provisions of the "Protection and Conservation of Puerto Rican Karst Physiography Act", *supra*, in 2008 the DNER prepared the Karst Study (*Estudio del Carso*). This document identified and delimited areas, based on their importance and geological, hydrological and ecosystem function cannot be used, under any circumstance, for the extraction of earth crust materials for commercial purposes, including commercial exploitation.

The Act also provides that the "Rules governing the extraction, excavation, removal and dredging of Earth crust components", Regulation No. 6916, must contain the prohibitions resulting from the study. It also establishes that the areas delimited to be preserved, should be zoned using districts directed or related to conservation in the zoning maps, which were identified in the study, following Planning Regulation No. 4, "Puerto Rico Qualification Regulation".

### 3.1.3 COASTAL EROSION

#### Findings

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Coastal erosion is attributed to natural or humans causes. It occurs when wave action, due to rising sea levels, changes the position of the coast, displacing it inland. Sandy shores are morphodynamic systems that circulate sand to dissipate wave energy and to maintain balance. They are subject to erosion and deposition; therefore, periods of severe erosion are followed by periods of expansion of the beach. Erosion is part of the mechanics of adjustment to the changes in coastline due to the regime of wave energy (Cintrón, 2004). However, this natural process is perceived as a harmful event when it affects structures located on the coast.

Natural causes of erosion include the action of ocean waves, ocean currents and burrowing organisms. However, other variables such as loss sediment sources and severe storms cause the displacement of the coast inland. Another factor is global warming, which has the potential to substantially increase erosion rates due to increases in sea levels and in the frequency and intensity of weather events.

Coastal erosion occurs in many parts of Puerto Rico. However, in coastal areas such as the shores of Guajataca and parts of the Old San Juan, erosion rates are practically zero (Bush et al., 1995). Meanwhile, other beaches, such as in Loíza and Rincón, have been



**Coastal erosion in Loíza**  
Picture by: C. Olmedo, Estudios Técnicos, Inc.

narrowing through the process of erosion.

The process of coastal erosion can cause serious damage to terrain and structures. Some of the damage includes loss of the fertile layers of soil, loss of recreational value of some beaches and the undermining of buildings, houses, bridges and roads.

In addition to natural causes, human activities have become a coastal erosion risk factor. This process has been aggravated by the proliferation of rigid structures along the coast in a highly mobile and changing environment. Other engineered rigid structures located on the coasts are presented as measures to protect property – like embankments and breakwaters – have the effect of accelerating the process of coastal erosion, in addition to high costs.

Activities which occur in watersheds' upper parts also contribute to the processes of coastal erosion, changing the sediment supply reaching them. For example, when damming a river, sand is trapped behind the gates and starts settling, as has occurred in the La Plata and Carraízo Dams. While downstream, on route to the sea, the river picks up materials such as clay and silt. This causes less sand to reach the mouth of the rivers and beaches and, instead, the sand reaching the coast is thinner and prone to be removed more rapidly out to sea by wave action (Bush et al., 1995). These actions hinder the natural erosion process – necessary for some of the beaches that do not have coral reefs – because the sediments contribute a part of the materials needed to keep it stable.

Other actions exacerbate the erosion process, among which are: the illegal extraction of sand from river mouths, dunes and beaches; agricultural practices without proper controls; the paving and excessive urbanization and the removal of mangroves. These actions increase the amount of sediment reaching coastal waters, destroying the protective reef offshore. Although these situations represent physical and economic damage, no quantitative estimates for Puerto Rico have been inventoried.

Different types of measures can be taken to address the problem of coastal erosion. Some include: (1) protection of natural systems such as mangroves and coral reefs, which protect the coast and slow erosion; (2) redirect development outside the erosion hazard areas; (3) monitor compliance with the statutes governing the activities that can accelerate erosion, like sand extraction; (4) feeding the beaches; and (5) the construction of structures at an angle, rip raps or jacks which allow energy dissipation.

### **Public Policy**

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The OPP-PRLUP, establishes policy related to urban development. Objective 1.02 points to the need to "Prevent and discourage urban sprawl and the development of isolated urban centers using as criteria ... that the land where the project is located not be ... susceptible to significant erosion, landslides, and/or environmentally critical." (See policies under Objective 1.02.)

### **Implementing the Policy**

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The "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters and Submerged Lands and the Maritime Zone", *supra*, states that every application for granting an authorization or concession on public property will be done by assessment of

the likely impact, including cumulative impact, of the proposed activity on the public interest. To determine the suitability of uses, the regulation states that it must evaluate several factors, including erosion. This regulation also identifies areas with severe problems of erosion among the sites unsuitable for authorizations or concessions.

The "Regulations for the Extraction, Excavation, Removal and Dredging of Earth Crust Components", *supra*, states that a permit from the Secretary of the DNER is also required for removing material from the Earth's crust for commercial purposes. Among its evaluation criteria, this regulation states that the effects of the proposed activity on erosion of the maritime zone have to be considered when evaluating a permit application.

Moreover, the PRPB's Coastal Zone Unit is in charge of the Federal Consistency Procedure with the PRCZMP, which seeks, among other things, to prevent inappropriate development in areas subject to coastal erosion. Also, the PRPB, empowered by the "Special Flood Hazard Areas Regulation", *supra*, has the power to restrict or prohibit developments which have the potential to increase flood waters or speeds resulting in increased erosion. This agency also has other laws and regulations which indirectly work with the erosion problem. RPA, meanwhile, has the responsibility of ensuring that no building on the Island is constructed, altered, eliminated, or transferred, nor any land developed or altered, unless the action has been approved by the agency in compliance with planning laws and regulations.

Moreover, in 1982 the CBRA law was passed, which is intended to discourage development in vulnerable and high risk coastal areas designated as coastal barriers, particularly those conducted with federal funds.

Areas considered as coastal barriers, being composed mainly of consolidated sediments, are highly unstable for construction and are susceptible to erosion. These form the first line of defense against the winds and tides caused by weather events and may consist of mangroves, sand bars or islets and cays.

Through the CBRA, undeveloped areas are designated to serve as protection against high winds and wave energy, in order to protect life and property from hurricane ravages, as well as the conservation of natural areas. Currently, in Puerto Rico there are 8,431 ha declared as coastal barriers (Zinn, 2003). These are located primarily in the Southwestern portion and Northeast portion of the Island (see Map 13).

Another measure to discourage development in areas designated as coastal barriers is their ineligibility for flood insurance through NFIP. Insurance is only available if the structure was built or the development was approved prior to the approval of this law. However, insurance will not be renewed if an existing structure is substantially rehabilitated or if it is deteriorated.<sup>40</sup>

It should be noted that this law does not restrict activities carried out with private funds or other non-federal funds.

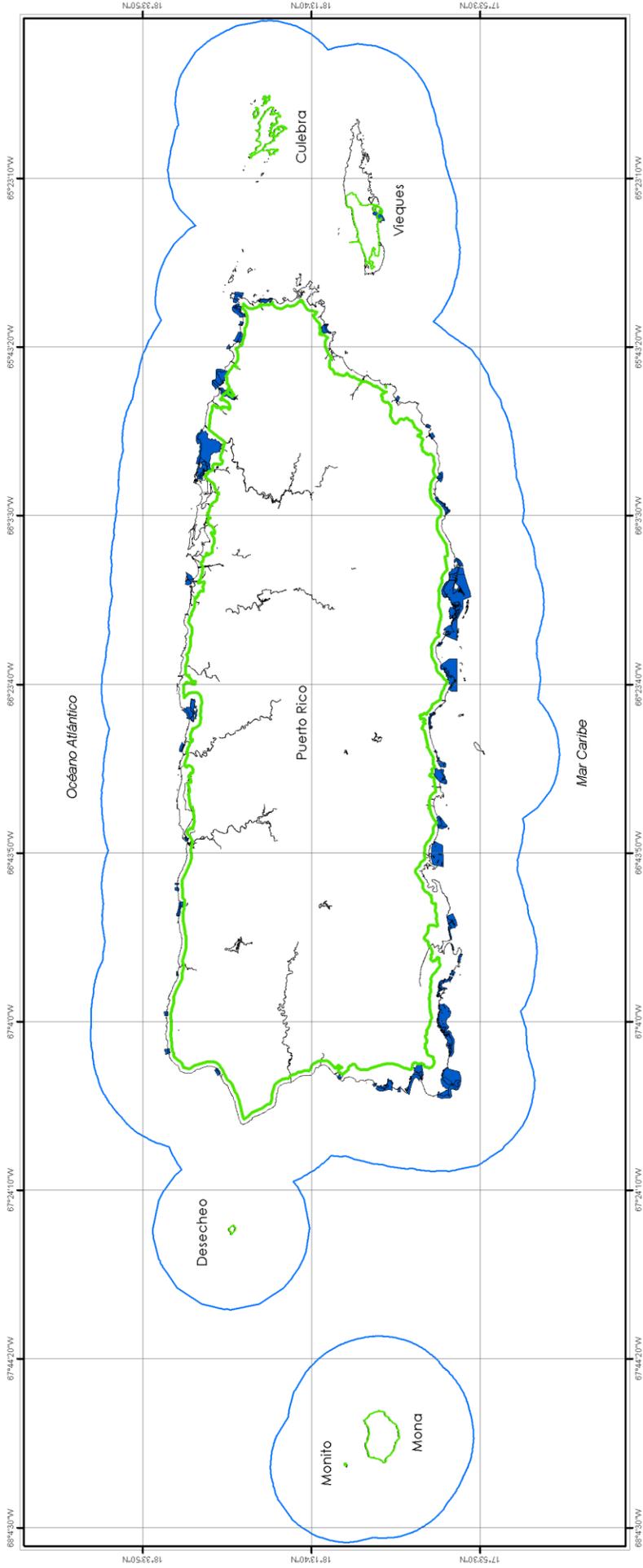
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<sup>40</sup> There are exceptions for certain activities that can be carried out in areas designated as coastal barriers, among which is research related to fisheries and wildlife, and national wildlife refuges.

Leyenda - Map Key:

-  Barreras Costeras - Coastal barriers
-  Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
-  Limite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary

Escala - Scale 1:860,000



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 13 / Map 13

# Barreras costeras Coastal Barriers

Fuente de Información - Source:  
US Department of the Interior

Although some measures to prevent erosion are already established in Puerto Rico, in part by the PRCZMP, more information is needed regarding the importance of shoreline change due to coastal erosion as well as the benefits of addressing this issue.

Studies exist on coastal erosion in some areas of Puerto Rico. For example, studies have been conducted on erosion in the coastal municipality of Rincón. In 2003, the USGS published a study of erosion in a segment of this coast during a period of 44 years (1950-1994). The results of this study showed how the construction of a small marina in 1993, of a system of breakwater/embankment, and the continued removal of dredged material for the entrance to the marina, accelerated the process of coastal erosion. This problem has grown over the past years prompting the agency to carry out another study on changes in the coastline of this municipality for a period of 70 years (from 1936 to 2006). A significant finding of this study is that, for the past 70 years, portions of the coast of Rincón have been reducing at a rate of one (1) meter per year. This is not a recent phenomenon, rather, it responds to the combination of natural factors which have been aggravated by anthropogenic factors, such as sand extraction and the proliferation of structures along the coast.

The USGS also conducted a study on the impact caused by Hurricane Hugo on Puerto Rico's coasts and the recovery of the shoreline after the event. The beach profile observed for this event showed that in some beaches of higher elevation there was more erosion, while in the lower areas there was deposition. However, the study reported how most beaches, except those with engineering structures, showed a rapid recovery. This study also demonstrated the importance of information to help track the sediment load in significant weather events. Prior to the study, in Puerto Rico there was little information on the movement of sand during storms or hurricanes, whether it was recoverable and whether the environmental damage was permanent. However, the study showed that the sand was moved from one place to another and that other geological factors were involved in the process (Schwab, 1996).

On the other hand, private institutions have joined government agencies to conduct studies on erosion processes and their impacts. The Heinz Center published the "Evaluation of Erosion Hazards" in 2000, which considered the causes and economic impact that this process has for the government and individuals. This study, commissioned by FEMA, points out the measures adopted in several coastal regions, including Puerto Rico, in coastal zone management (The H. John Heinz III Center for Science, 2000).

In 2002, Jack Morelock and Maritza Barreto, of the Department of Marine Sciences at the UPR at Mayagüez, worked on updating the study on coastal erosion carried out in 1978. In the update, the areas considered in the original study were analyzed to assess changes in the position of the coast between 1977 and 1999. The areas evaluated were on the shores of Arecibo, Punta Salinas, Isla de Cabras, Punta Iglesia, El Tuque and Añasco. The results of the study showed that areas with more severe erosion since 1971 were Isla de Cabra and Punta Iglesias. Similarly, it reflected that erosion is not constant in these areas and reported periods of acceleration (particularly during hurricane events), slowdown or even reversal in the erosion process. In addition, it demonstrated how the structural measures taken in some areas with erosion problems have worsened the problem instead of solving it. It also found that among the factors exacerbating erosion events are hurricanes, erosion of natural

barriers, mangrove loss and reduction in the sediment load of rivers (many rivers in Puerto Rico have dams). Another significant finding was that the areas where there was no erosion process were those fringed by mangroves and reefs (Morelock & Barreto, 2002).

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*Need: Extensive study on coastal erosion.*

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In 1971, the USACE conducted an inventory of areas with severe erosion problems. Subsequently, there have been several studies on coastal erosion in many areas; however, the Puerto Rico Government lacks an inventory of current information on coastal areas that are in a state of critical erosion (Bernd & Gordon, 1998). Therefore, it is necessary to conduct a study to incorporate the causes and the damage caused by coastal erosion and the costs and benefits of possible solutions. Such a study should include quantitative estimates of the economic and physical damage caused by coastal erosion. This could be the basis for the development of measures that remove new developments from areas with erosion potential.

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*Need: Study the process of erosion and deposition of sand in different coastline areas.*

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Such a study would help in the formulation of public policies related to the reconstruction of structures along the coast, to beach feeding initiatives and to the future uses of marine resources (Schwab, 1996).

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*Need: Protection of the coast through creative, environmentally safe and cost-effective measures.*

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The USACE has developed several measures to control erosion in different parts of the Island, including Condado and Ocean Park in San Juan, on road PR-187 in Loíza and in Puerto Nuevo beach in Vega Baja. However, as was noted above, some structural measures have the effect of aggravating the situation of erosion by influencing the natural dynamics of the coast. Therefore, we recommend measures to promote the withdrawal of coastal structures.

A cost-effective long-term measure to manage coastal erosion is establishing a *setback*. This will require that new construction and structures are made at some distance from the coastline, as determined by a rate of erosion formula (Sea Grant, 1995). Studies have shown the likelihood of erosion reaching a structure which has not been built using the measures of distance from the coast or setback for 30 years is 91%. Considering the lifetime of a building to be 70 years, it can be assumed that most of the structures built recently along the coast will be threatened and must be removed.

The demarcation of the maritime zone, as well as the establishment of continuous stripes of surveillance, rescue or additional protection as needed, can serve as a minimum setback for all new development on the shores of Isla Grande, Culebra and Vieques.

#### 3.1.4 GLOBAL WARMING AND VULNERABILITY TO COASTAL HAZARDS

##### **Findings**

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Global warming is defined as the increase in average temperature of Earth's atmosphere. It is directly associated with climate change, a phenomenon in which the climate varies across the centuries, influenced by factors such as solar cycles, relative humidity in the atmosphere

or by changes in greenhouse gases. While some scientists suggest that these changes are the result of natural causes, the position of the majority of the global scientific community is that climate change is associated with the emission of greenhouse gases, mainly, from burning fossil fuels.

In past decades, concentrations of greenhouse gases in the atmosphere increased significantly as a result of industrialization, increasing the temperature of the Earth's surface and oceans. According to the Intergovernmental Panel on Climate Change (IPCC) (2007), in the past 100 years the average global temperature of Earth's surface has increased by  $0.74 \pm 0.18^{\circ}\text{C}$  ( $1.3 \pm 0.32^{\circ}\text{F}$ ).<sup>41</sup> The mathematical models used by the IPCC predict that global average temperatures will rise between  $1.1$  and  $6.4^{\circ}\text{C}$  ( $2.0$  to  $11.5^{\circ}\text{F}$ ) between 1990 and 2100.

The IPCC, and most of the scientists involved in climate research worldwide, believe the trend and acceleration of global average temperatures this century is associated with the emission of greenhouse gases. Increases in global average temperatures are the cause of the rise in average sea levels, among other possible consequences and impacts on the natural and socioeconomic systems of the planet. Globally, there has been a rise in sea level of 1 to 2.5 millimeters (mm) a year, and during the last decade this has increased to 4-6 mm year. It is expected that the average sea level worldwide will increase between 0.09 and 0.88 meters between 1990 and 2100.<sup>42</sup> This will occur as a result of thermal expansion and loss of mass from glaciers and polar ice caps.

It has been pointed out that even though islands are not major emitters of greenhouse gases, they are more vulnerable to the effects of global warming. These include rising sea levels, increased frequency and intensity of extreme natural events and the destruction of essential dwellings to protect coastlines and provide livelihoods.

Puerto Rico, being a tropical island, is exposed to multiple risks associated with climate change. In particular, there is the risk of an increase in the frequency and intensity of tropical storms, hurricanes, rising sea levels, exposure to drought, decline in water supplies – particularly in the underground water reserves – desertification and possible loss of agricultural land and increase in disease vectors and health problems. Moreover, the consequences can be devastating to natural systems (i.e. bleaching of coral reefs) and for coastal communities and infrastructure, due to increased risks to life and property caused by the increased frequency and intensity of weather events.

### **Responding to findings**

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At the international level, efforts have been made to reduce greenhouse gas generation. The Kyoto Protocol (1997) has been a complex and ambitious effort to assign maximum emission

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<sup>41</sup> The IPCC is a global intergovernmental organization created by the World Meteorology Organization and the United Nations' Environmental Program. The organism intends to provide objective scientific information to policy and decision makers.

<sup>42</sup> Based on the emission scenarios of the IPCC's Special Report of Emission Scenarios (IE-EE).

levels of greenhouse gases to nations which ratify it.<sup>43</sup> However, not all countries signed it, and temperatures are expected to continue rising even while reducing or eliminating greenhouse gas emissions, due to the persistence of CO<sub>2</sub> in the atmosphere.

Moreover, even when climate change requires international cooperation, it is necessary that governments be responsible for addressing these issues locally. Mathematical models predict possible scenarios based on the best information available. However, there is an element of uncertainty, reason why the forecast could be conservative. In this situation, it is recommended to use the wariness or precautionary principle, based on prevention.

The "Puerto Rico Environmental Public Policy Act", Law No. 416 of 2004, states that the precautionary principle should be applied in situations of uncertainty where the environment could be degraded. It also points that one should not use lack of full scientific certainty as a reason for postponing cost-effective measures to prevent environmental degradation.

Locally, there are legal and regulatory tools to be used in land planning to safeguard coastal life and property, including essential infrastructure. These include:

- The "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone", *supra*, whereby utilization of terrestrial maritime public goods is permitted;
- The "Zoning Regulation for the Coastal Zone and the Access to Beaches and Coasts of Puerto Rico" Regulation No. 17<sup>44</sup>, which provides, among other issues, the separation between coastal development and the maritime zone; and
- The "Special Flood Hazard Areas Regulation", *supra*, which establishes controls for edifications in zones susceptible to flooding.

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*Need: Incorporate, for planning purposes, the possibility of a rise in sea levels as a result of global warming.*

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There are some non-traditional mechanisms which could be used as tools to protect life and property from the impacts of climate change. These include policies of right of way that allow development on the condition that they may be removed in the future to allow wetlands and beaches to migrate inland; the elimination of phased developments; the elimination of government subsidies, among others (United Nations Environmental Programme & World Meteorological Organization, 2001).

According to Diaz (2007), other strategies for prevention and protection from coastal hazards are:

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<sup>43</sup> The Protocol and its annexes provide responsibilities for the developed and developing nations and assigns targets for the countries' reduction of greenhouse gas emissions between 5-15% below the 1990 levels.

<sup>44</sup> This Regulation was incorporated to the PRCZMP in the year 1988 through RPC.

- Provide for separation from the coastline, observing criteria such as the geomorphologic, ecological and oceanographic characteristics for each coastal sector, the presence of communities and infrastructure;
- adjust the structures vertically as a cost effective measure and for those dependent on water, like docks, ports and port facilities; and
- protect the coastline through structural measures such as dikes, seawalls and energy dissipaters in areas with existing structures where it is strictly necessary, the use of removable structures, sand of the same zone contained in geotextiles or placement of artificial reefs and, where possible, the construction of angled structures and *rip-rap* or *jacks*, allowing the energy dissipation and sediment retention *in situ*.

## 3.2 COASTAL RESOURCES

### 3.2.1 WETLANDS

#### Findings

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Wetlands are natural areas defined by their hydrology, soil and vegetation. Water saturation is the key element that determines the nature of wetlands development, as well as the development of communities of flora and fauna that live in its soil and surface (Cowardin et al., 1979) (See Map 14.).

The " Puerto Rico's Wetlands Public Policy Act ", Law No. 314 of 1998, as amended, defines wetlands as those saturated by surface water and groundwater systems at an interval and duration sufficient to support vegetation typically adapted to conditions of soil saturation, flooding or stagnation.<sup>45</sup> These systems include swamps, marshes, coastal plains (saltpeter beds and mud holes), open water bodies, salt marshes and similar areas.

Wetlands have important functions and economic, social and scientific value. They serve to control floods, provide water and recharge areas for aquifers, feed springs, modify climate, improve water quality, maintain the salt balance needed for estuarine life and stabilize and protect coasts. In the economic area, wetlands are a highly productive resource by being a source of food, timber resources, energy, providing aesthetic elements, recreational opportunities, and influence the quality and ecological status of water bodies including rivers, aquifers, lakes, reservoirs and estuaries.

According to the *Puerto Rico Gap Analysis Project*, it is estimated that Puerto Rico has 34,000 ha (4%) of coastal wetlands, of which 42% are saline wetlands and 58% are freshwater wetlands. Among the freshwater wetlands, 74% (25,100 ha) are dominated by herbaceous vegetation and 92% (23,000 ha) are seasonally flooded. Of herbaceous wetlands, 77% (19,300 ha) are not saline and 23% (58,000 ha) are salty. Forested coastal wetlands cover

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<sup>45</sup> It should be pointed out that the Commonwealth adopted the federal definition of wetlands from USACE. This definition corresponds to the regulatory definition for that federal agency's permit program, under Section 404 of the CWA.

approximately 1% of the Commonwealth's territory, of which 6,700 ha are mangroves and 300 ha are *Pterocarpus* swamps (Gould, et al. 2007).

Through a NOAA initiative, in 2004 approximately 160,000 ha of benthic niches in the territorial waters of Puerto Rico were mapped.<sup>46</sup> Approximately 87,578 ha of wetlands were inventoried. It is estimated that 25% of them are found within marine protected areas (Lopez, 2007). Marine protected areas<sup>47</sup> can be natural reserves, marine reserves, coastal state forests, national estuarine research reserve or seasonal fishing closures.

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<sup>46</sup> This does not include Puerto Rico's entire seabed. The characterization study of benthic niches considered 160,000 ha, representing only a quarter of the Puerto Rico's insular platform, measured from the coastline to the edge of the platform. The accuracy of the maps was estimated at 93.6%. The maps were produced by visual interpretation of benthic features using orthorectified aerial photographs and GIS. The areas not inventoried were: most of the North coast, due to the turbidity associated with river discharges and strong waves; the central portion of the West coast, because of the darkening of certain areas by the Guanajibo River and Río Grande de Añasco's sediment discharges; Monito Island, because it was not photographed; a large portion between the islands of Vieques and Culebra, which extends eastward along the shelf to the territorial boundary of the U.S. Virgin Islands, because the depth in the area – by being over 20 meters – did not allow the detection of the composition of the seabed through aerial photos.

<sup>47</sup> Marine protected areas are legally designated areas which have coastal or marine ecosystems, can contain terrestrial components and have different approaches to conservation, protection levels and/or zoning.

TABLE III-5. WETLANDS IN PROTECTED AREAS

Wetlands in protected areas						
Protected area	Coral reefs	Mangroves	Seagrass beds	Bioluminescent bay	Bays and estuaries	Other wetlands
<b>Wetlands in Natural Reserves (NR) designated through administrative mechanisms</b>						
1 Punta Petrona NR	•	•	•		•	•
2 La Parguera NR	•	•	•	•	•	•
3 Laguna Tortuguero NR					•	•
4 Ceiba Commonwealth Forest NR		•	•		•	•
5 Piñones Commonwealth Forest NR	•	•	•	•	•	•
6 Laguna Cartagena NR					•	•
7 Arrecifes La Cardillera NR	•	•	•			•
8 Isla Caja de Muertos NR	•	•	•			•
9 Arrecifes de Guayama NR	•	•	•			•
10 Laguna Joyuda NR		•	•	•	•	•
11 Boquerón <sup>1</sup> Commonwealth Forest NR	•	•	•	•	•	•
12 Río Espíritu Santo NR	•	•	•		•	•
13 Guánica Commonwealth Forest NR	•	•	•		•	•
14 Cabezas de San Juan NR	•	•	•	•	•	•
15 Islas de Mona y Manito NR	•	•	•			•
16 El Pantano, Bosque de <i>Pterocarpus</i> , Lagunas Mandry y Santa Teresa NR		•			•	•
17 Hacienda La Esperanza NR			•			•
18 Bahía Bioluminiscente de Vieques NR	•	•	•	•	•	•
19 Cueva del Indio NR	•		•		•	•
20 Pantano Cibuco NR	•	•			•	•
21 Arrecifes de Tourmaline NR	•		•			•
22 Caño Tiburones NR		•			•	•
23 Canal Luis Peña NR	•		•			•
24 Punta Yeguas NR		•				•
25 Caño La Boquilla NR		•	•		•	•
26 Punta Guaniquilla NR	•	•	•		•	•
27 Finca Belvedere NR	•	•	•		•	•
28 Caño Martín Peña NR		•			•	•
29 Corredor Ecológico del Noreste NR	•	•	•	•	•	•
30 Ciénaga Cucharillas NR		•			•	•
<b>Wetlands in protected areas designated through legislation</b>						
31 Finca Seven Seas NR	•	•	•		•	•
32 Aguas Costeras Isla Desecheo Marine Reserve	•		•			•
33 Humedal Punta Tuna NR	•	•	•			•
34 Ecosistemas adyacentes a la Laguna Joyuda NR	•		•		•	•
35 Punta Viento NR		•				•
36 Punta Cuchara NR		•				•
37 Tres Palmas Marine Reserve	•		•			•
38 Bosque Estatal Costero de Aquirre <sup>2</sup>	•	•	•		•	•
39 JOBANERR Estuarine Reserve	•	•	•		•	•
40 Bajo de Sico (seasonal closure)		•				•
41 Abril la Sierra (seasonal closure)		•				•
42 Banco Tourmaline (seasonal closure)		•				•

Source: DRNA, 2008.

<sup>1</sup> Cayo Ratonés is part of Reserva Natural Bosque Estatal de Boquerón.

<sup>2</sup> The Bosque Estatal Costero Aquirre is a Forest Reserve. A segment of Punta Petrona NR is part of the Aquirre Commonwealth Forest.

In Puerto Rico, the majority of coastal wetlands are classified as marine, estuarine and palustrine, according to the Cowardin classification system used by the USFWS.

TABLE III-6. COASTAL WETLANDS IN PUERTO RICO

Coastal wetlands in Puerto Rico	
System	hectares
Marine	23,642
Estuarine	31,947
Palustrine	31,555
<b>Total</b>	<b>87,144</b>

Source: NOAA. (1999). *Benthic Habitat Mapping of Puerto Rico and the U.S. Virgin Islands*.

- *Marine wetlands* are those areas exposed to sea waves and sea currents with a water salinity greater than 30-35 parts per thousand (ppt). Coral reefs (described in the next section) and seagrass beds are examples of this type of wetland. In Puerto Rico there are approximately 23,642 ha of marine wetlands. Approximately, some 2,586 ha (11.07%) are found within protected areas (Diaz & Dragoni, 1999).

Seagrass beds are subaquatic wetlands located in shallow coastal regions and bays (Cerame, 2000). Puerto Rico has one of the most diverse seagrass bed floras in the North Atlantic Ocean. In Puerto Rico, seven species of seagrasses have been documented. The presence of these submerged beds of aquatic vegetation are seen in the East, South and Southwest, and in other areas such as the San Juan Bay and the Condado and Torrecilla Lagoons. About 33.3% of seagrass beds are found within some of the marine protected areas.

Seagrass beds significantly alter the physical, chemical and biological properties of coastal areas; provide nutrients, primary energy and niches that sustain fish stocks and provide land for fodder for some endangered species like sea turtles and manatees (*Trichechus manatus*). The main factors that degrade or threaten seagrass are sedimentation and uncontrolled recreational activities.



**Marine wetland**

Picture by: C. Olmedo, Estudios Técnicos, Inc.

- *Estuarine wetlands* are affected by the tide with low energy waves, where the water salinity is greater than 0.5 parts per million (ppm), but may vary due to evaporation and the mixing of seawater with fresh water. Examples of such wetlands are saltpeter beds, mangroves and coastal rivers. The salt marshes or saltpeter beds are sand or mud areas with high concentrations of salts. In Puerto Rico, there are several protected areas which contain this type of wetland, among which are *Salinas de Cabo Rojo*, which are part of the Boquerón Natural Reserve-State Forest and La Parguera Natural Reserve in Lajas and the Ceiba Natural Reserve-State Forest. In Ceiba, there are also areas of saltpeter beds within the grounds of the former Roosevelt Roads naval base.

Another protected area which contains this type of wetland is the Jobos Bay National Estuarine Research Reserve (JOBANERR) which also contains other wetlands, among there are mangroves, lagoons, seagrass beds and coral reefs.

Similarly, the San Juan Bay Estuary (SJBE) is a large area within the metropolitan area that contains various types of wetlands.<sup>48</sup> In the estuary, there are several rivers and coastal

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<sup>48</sup> Since 1992, the SJBE participates in the EPA's National Estuary Program. This system was designated as an "estuary of national significance" for its value to the economy and ecology and has a Comprehensive Plan for Management and Conservation. It is the only participant on the Island and the only one within the program that is located in a tropical region. The estuary, which stretches from the island of Isla de Cabras, to the west, to Punta Vacía Talega, to the east, is comprised of the Puerto Nuevo River, the streams Juan Méndez, San Antón, Blasina and the Malaria Channel. Seawater enters the system through the Boca del Morro in the San Juan Bay; the Boquerón in

water bodies where fresh water enters the system. Some 89.6 ha of mangroves associated with the Caño Martín Peña are protected as a Natural Reserve (NR).

- Finally, *palustrine wetlands* are found in freshwater and may be subject to the ebb and flow of tides. Trees, shrubs, herbaceous plants in persistent development, upright and entrenched or submerged and/or floating plants predominate in them. The variety of palustrine wetlands includes swamps, marshes, wet meadows and small and shallow ponds. In this type of wetland there are also some open water bodies which cover less than 8.1 ha and their depth does not exceed 6.6 feet.

In Puerto Rico there are approximately 31,555 acres of palustrine wetlands, of which approximately 4.08% is protected (Diaz & Dragoni, 1999). Some NR which contain this type of wetland are: *Reserva Natural Laguna Tortuguero*; *Reserva Natural El Pantano, bosque de Pterocarpus y lagunas Mandri y Santa Teresa* between Humacao and Naguabo; *Reserva Natural Caño Tiburones*; *Reserva Natural Laguna Cartagena*; *Reserva Natural Pantano Cibuco* and *Reserva Natural Caño Boquilla*.

The PPRCZMP (1978) also proposed the designation of other palustrine wetlands which have not yet received the corresponding designation. These are: *Bosque de Pterocarpus de Torrecilla Alta*, *Bosque Pterocarpus de Dorado* and *Pantano Espinar*. The extension of *Pterocarpus* swamps in Puerto Rico is estimated to be of 260 ha (Gould et al., 2007).

Other coastal wetlands included in the list of Areas of High Natural Value with Conservation Priority from DNER's Natural Heritage Program (NHP), among which are: *Ciénaga Baja* in Río Grande, the *Ensenada Comezón* in Las Picúas (important for possessing a *Pterocarpus* and mangrove swamp), the swampy area of the wetland *Lluveras* in Guayanilla, *San Jacinto* in Guánica and *Anegado de Cayures* in Aguada.

Similarly, other important herbaceous wetlands or swamps part of the SJBE, particularly in the area of *Torrecilla Alta*, are *Canal Suárez* and the Special Planning Area (SPA) and NR *Ciénaga Las Cucharillas*. The latter is considered the largest wetland in the SJMA.<sup>49</sup>

In Puerto Rico, 36 NRs have been designated through various mechanisms, as presented in the following table. Those recommended by the PRCZMP, and which are an integral part of it through RPC, are discussed in Annex C.

Coverage of wetlands in Puerto Rico has reduced substantially over the past centuries. Technological factors and government incentives led to the progressive destruction of wetlands in the first decades of the twentieth century in which both, the government of Puerto Rico and the U.S., encouraged activities such as dredging, drainage, the "rescue" and the deposition of the landfill, among other activities incompatible with the nature of the system.

Important wetland areas which once sustained a variety of wildlife – like the Laguna de

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the Condado Lagoon; and Boca de Cangrejos, between Carolina and Loíza. The system also includes the lagoons San José, Los Corozos, Torrecilla and Piñones, as well as the interconnecting cays San Antonio, Suárez Channel and Martín Peña.

<sup>49</sup> The area has a Management Plan adopted by the PRPB.

Guánica and the Anegado en el Valle de Lajas – were drained for agricultural purposes. However, geological and hydrological characteristics of these wetlands were not suitable for agriculture.

In Puerto Rico, coastal wetlands have been the most impacted. The wetlands in the East part of the Island have experienced the most damage as a result of tourism, urban-residential and commercial developments. Meanwhile, the Northern Area has been most affected by the mitigation process (Perez, 2003).

Another activity which has had a detrimental impact in Puerto Rico's wetland areas has been the excessive extraction of aquifer groundwater on the North coast, which nourishes the *Laguna Tortuguero* and the *Caño Tiburones*. In these areas, the reduction in aquifer water supply to these wetlands has affected the ecosystem's balance.

The perception of wetlands as system with little value has changed in recent decades. This has led to the enactment of various laws and statutes, both local and federal. However, even with the existence of laws and regulations aimed at protecting wetlands, certain practices continue that reduce and alter these ecosystems.

TABLE III-7. NATURAL RESERVES IN THE COASTAL ZONE

Natural Reserves (Reservas Naturales) in the coastal zone designated through administrative mechanisms									
	Natural area	Municipal extension	Date of designation	PRPB resolution number	Reference	Ownership	Management	Extent (cuerdas)	Observations
1	<b>Punta Petrona</b>	Santa Isabel	Septiembre/20/1979	Second Extension Resolution PU-002	Designation document (brochure) <i>Master Plan Bosques</i>	DNER	DNER	572.80 cds.	A segment of this area is part of the <i>Bosque Estatal de Aguirre</i> .
2	<b>La Parguera</b>	Lajas, Cabo Rojo, Guánica	Septiembre/20/1979  January/15/1986  May/14/1998  October/4/2000	Second Extension Resolution PU-002  First Amendment to the Second Extension Resolution PU-002 Resolution PU-002-98-57-01 (Amendment to marine limits 9nm)  Resolution PU-002-2000-57-01 (Amendment to the terrestrial limit)	Technical supplement <i>Plan de Manejo APE</i>  Designation document to extend the boundaries through Punta Jorobado  Designation Document Extension of the terrestrial limit	DNER, DTPW, Commonwealth	DNER	13,290.57 cds.	A segment of this area is part of the <i>Bosque Estatal de Boquerón</i> . It has a buffer zone.
3	<b>Laguna Tortuguero</b>	Vega Baja, Manatí	Septiembre/20/1979	Fifth Extension Resolution PU-002	<i>Plan de Manejo APE</i>	DNER, PREPA, PRLA, Private	DNER	19,080 cds.	
4	<b>Bosque Estatal de Ceiba</b>	Ceiba, Naguabo, Fajardo	Septiembre/20/1979	Second Extension Resolution PU-002	<i>Master Plan Bosques</i>	DNER	DNER	849 cds.	
5	<b>Bosque Estatal de Piñones</b>	Loiza	Septiembre/20/1979	Second Extension Resolution PU-002	<i>Plan de Manejo APE</i> , Land Use Plan, Technical Supplement, Master Plan	DNER	DNER	1,965 cds.	
6	<b>Laguna Cartagena</b>	Lajas	January/19/1990	Eighteen Extension Resolution PU-002	Designation document, Technical Supplement	PRLA	USFWS	795.77 cds.	The LA leased the area to the USFWS for 50 years.
7	<b>Arrecifes La Cordillera</b>	1.5nm northeast of Fajardo	January/2/1980	Third Extension Resolution PU-002	Technical Supplement, Management Plan	Commonwealth, PRIDCO, DTPW, Maritime public domain	DNER	224.27 cds.	The Management Plan is been updated.
8	<b>Isla Caja de Muertos</b>	8.6nm south of Ponce	January/2/1980	Third Extension Resolution PU-002	Management plan	Commonwealth	DNER	188.36 km <sup>2</sup>	Includes Cayo Berbería.
9	<b>Arrecifes de Guayama</b>	Approx. 1nm south of Punta Figuras in Arroyo	January/2/1980	Third Extension Resolution PU-002	Designation document (brochure)	Commonwealth	DNER	1,312 cds.	
10	<b>Laguna Joyuda</b>	Cabo Rojo	January/2/1980	Third Extension Resolution PU-002	Designation document (brochure)	Commonwealth	DNER	308 cds.	
11	<b>Boquerón</b>	Cabo Rojo	January/2/1980  May/14/1998  22/febrero/2005	Third Extension Resolution PU-002  Resolution PU-002-98-55-02 (Amendment to marine limit)  Resolution PU-002-2005-55-01 (Amendment to the terrestrial limit to incorporate lands to the northeast and northwest of the <i>Refugio de Vida Silvestre de Boquerón</i> and parcels 2, 3 and 4 of <i>Salina Candelaria</i> (transferred by the USFWS))	Designation document (brochure) Technical Supplement <i>Plan de Manejo APE</i>  Designation document for extending the limits of the NR.	DNER, Public domain	DNER	499 ha. (Approx. 1,269 cds.)	Includes lands from the <i>Refugio de Vida Silvestre</i> and the <i>Bosque Estatal de Boquerón</i> .

**TABLE III-7 (CONT.)**

Natural Reserves (Reservas Naturales) in the coastal zone designated through administrative mechanisms									
	Natural area	Municipal extension	Date of designation	PRPB resolution number	Reference	Ownership	Management	Extent (cuerdas)	Observations
12	Rio Espiritu Santo	Rio Grande	February/11/1985	Extension to Resolution PU-002	Designation document Technical Supplement	Commonwealth, Private	DNER		
			September/14/1995	Twenty-Sixth Extension to Resolution PU-002 (To exclude Punta Miquillo from the NR)					
			May/14/1998	Resolution PU-002-98-22-01 (Amendment marine limit 9nm)					
13	Bosque Estatal de Guánica	Guánica, Yauco, Guayanilla	October/16/1985	Sixth Extension to Resolution PU-002	Designation document (2) Technical Supplement, Master Plan	DNER, Public domain	DNER, PRTC	9,212.27 cds.	
			January/22/1997	First Amendment to the Sixth Extension to Resolution PU-002 (Extending limits to include Bahía Ballena (Law No. 150 of 1988)					
14	Cabezas de San Juan	Fajardo	January/29/1986	Eight Extension to Resolution PU-002	Designation document	DNER, CTPR, USCG, Public domain	PRTC	447.22 cds.	2.95 cds. are property of the USCG (Lorán Station).
			May/14/1998	Resolution PU-002-98-24-01 (Amendment to marine limit 9nm)	Technical Supplement				
15	Islas de Mona y Monito	50nm west of Mayagüez	June/4/1986	Ninth Extension to Resolution PU-002	Designation document Management plan	DNER, Public domain	DNER	14,043 cds.	This area was proclaimed Insular Forest.
			October/15/1997	First Amendment to the Ninth Extension to Resolution PU-002 (Amendment to marine limit 9nm)					The Management Plan is been updated.
16	El Pantano, Bosque de Pterocarpus, Lagunas Mandry y Santa Teresa	Humacao/ Naguabo	June/4/1986	Tenth Extension to Resolution PU-002	Designation document	DNER, CTPR, Private, PRLA, LA	DNER	2,583 cds.	Title deed and lease contract. It has a buffer zone. The Management Plan is under the consideration of PRPB.
			May/14/1998	Resolution PU-002-98-51-01 (Amendment to exclude NR's lands and integrate them to the buffer zone)	Management plan				
17	Hacienda La Esperanza	Manatí	March/3/1987	Eleventh Extension to Resolution PU-002	Designation document Technical Supplement	DNER, CTPR, LA	CTPR	2,529.55 cds.	It has a buffer zone.
			June/11/1998	Resolution PU-002-98-08-01 (Amendment to marine limit 9nm)					
18	Bahía Bioluminiscente de Vieques	Vieques	June/1/1989	Fifteenth Extension to Resolution PU-002	Designation document	DNER, NPC, PRIDCO, Public domain	DNER	1,119.15 cds.	Lease contract and the management agreement
			May/14/1998	Resolution PU-002-98-76-01 (Amendment to marine limit 9nm)	Management plan draft				
19	Cueva del Indio	Arecibo	March/11/1992	Nineteenth Extension to Resolution PU-002	Designation document	Public domain	DNER	11.1 cds.	
			June/11/1998	Resolution PU-002-98-06-01 (Amendment to marine limit 9nm)					
20	Pantano Cibuco	Vega Baja	December/2/1992	Twenty-first Extension to Resolution PU-002	Designation document	LA, Public domain	DNER	1,000 cds.	The LA made the compromise to transfer the title deed to the DNER free of charge.
			5/noviembre/1998	Resolution PU-002-98-09-01 (Amendment to marine limit 9nm)	Technical Supplement				
21	Arecifes de Tourmaline	7.5nm west of Mayagüez	May/14/1998	Resolution PU-002-98-55-01	Designation document	Public domain	DNER	19.43 nm	

**TABLE III-7 (CONT.)**

Natural Reserves (Reservas Naturales) in the coastal zone designated through administrative mechanisms									
	Natural area	Municipal extension	Date of designation	PRPB resolution number	Reference	Ownership	Management	Extent (cuerdas)	Observations
22	Caño Tiburones (RNCT)	Arecibo	October/16/1998	Resolution PU-002-98-06-02	Designation document	LA	DNER	3,428 cds.	Agreement for the Protection and Management of the RNCT and the PRLA and the DNER for 99 years.
					Technical Supplement Restoration Plan				The Management Plan is been created.
23	Canal Luis Peña	Culebra	June/1/1999	Resolution PU-002-99-77-01	Designation document	Public domain	DNER	1,208 cds.	The Management Plan is been created.
24	Punta Yeguas	Yabucoa	December/22/2000	Resolution PU-002-2000-75-01	Biological Inventory	DNER, CTPR	CTPR	289.77 cds.	Lease deed
					Designation document				
25	Caño La Boquilla	Mayagüez	August/21/2002	Resolution PU-002-02-29-01	Technical Supplement Designation document	Private Maritime public domain		120 cds. Include lands on the maritime zone	
					Report about the Methodologies and Alternatives for the Delimitation				
26	Punta Guaniquilla	Cabo Rojo	October/30/2002	Resolution PU-002-2002-55-03	Designation document	DNER, CTPR	CTPR	431.92 cds.	
27	Finca Belvedere	Cabo Rojo	February/21/2003	Resolution PU-002-2003-55-4	Designation document			255.34 cds.	
28	Caño Martín Peña	San Juan	June/18/2003	Resolution PU-002-2003-18 -01	Designation document	PRPA, DTPW, Municipality of San Juan		227. 94 cds.	
29	Corredor Ecológico del Noreste	Luquillo-Fajardo	October/4/ 2007	Resolution PU-002-2008-24	Management Plan and Land Use Plan	Public, Private		3,240 cds.	The Management Plan and the Land Use Plan have not been approved by the PRPB.
30	Ciénaga Cucharillas	Cataño	August/27/2004	Resolution PU-002-2008-14-02	Designation document	Public, Private		1,236 acres (Approx. 1,272 cuerdas)	This Resolution adopts the NR and the <i>Area de Planificación Especial Ciénaga Las Cucharillas</i> .
Natural Reserves in the coastal zone designated through legislation									
	Natural area	Municipal extension	Date of designation	PRPB resolution number	Reference	Ownership	Management	Extent (cuerdas)	Observations
1	Finca Seven Seas	Fajardo	August/21/1999	Law No. 228 of 1999	Special Law	NPC	DNER	110 cds.	There is a Coopertative Agreement between the NPC and the DNER for the protection and management of this NR. This Agreement was signed on November 9th of 2000.
					Management Plan was adopted by the PRPB in 2007				
2	Aguas Costeras Isla Desecheo	<i>Isla de Desecheo is west of Mayagüez's coast</i>	March/10/2000	By Law No. 57 of 2000, half of a nautical mile (0.5nm) around <i>Isla de Desecheo</i> was designated as a NR.	Special Law	Public domain			
3	Manglar de Punta Tuna	Maunabo	August/21/2000	Senate Joint Resolution No. 1824 of 2000	Special Law	DNER			
					Mangement Plan draft				
4	Ecosistemas aledaños a la Laguna Joyuda	Cabo Rojo	August/25/2000	Law No. 201 of 2000	Special Law	Public, private			Cabo Rojo
		Salinas	September/1/2000	Law No. 283 of 2000	Special Law	Private		20 cds.	
5	Tres Palmas	Rincón	January/8/2004	Law No. 17 of 2004	Special Law	Public domain			The Management Plan is been completed.
6	Humedal Punta Viento	Patillas	June/16/2008	Law No.92 of 2008	Special Law			254.8 cdas.	
7	Reserva Natural Punta Cuchara	Ponce	August/9/2008	Law No. 227 of 2008	Special Law			698 cdas.	

Source: DNER. Revised on August of 2009.

## Public Policy

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In the OPP-PRLUP, a policy is established to "avoid activities which might cause deterioration or destruction of natural systems critical to preserving the environment, such as mangroves, wetlands, forests, reefs, sinkholes, dunes and ecological niches (habitat) of endangered species" (See Public Policy 30.03).

### Implementing the Policy

#### 1. Protection of wetland areas

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The provisions of the statutes related to the protection of wetlands in Puerto Rico should be adopted in practice by all government agencies. However, the specific field agencies with jurisdiction over the decision-making process related to wetlands in the local area are: the DNER, the PRPB and the EQB. At the federal level, the agencies are: the U.S. Environmental Protection Agency (EPA), the USACE, the USFWS and NRCS.

Locally, the "Puerto Rico's Wetlands Public Policy Act", *supra*, provides for the protection of wetlands as Commonwealth's public policy. To this end, it promotes the preservation, conservation, restoration and management of these natural resources.

The Act also declares how the Land Authority (PRLA) and the DNER shall establish an agreement for the designation as natural reserves, of wetlands and lands which are kept dry by pumping action or dams or other drainage methods, belonging to the PRLA.

It also stipulates that the DNER shall, within a period not exceeding two years from the adoption of the law, identify and delineate areas flooded, or flood-prone not flooded because of human actions, to be designated as natural reserves, and to submit their nomination to the PRPB.<sup>50</sup>

The "Organic Law of the Department of Natural and Environmental Resources", Law No. 23 of 1972, as amended, states that DNER has the power to regulate the protection, management and conservation of wetlands in Puerto Rico. It serves as a legal basis to the "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands and the Maritime Zone", *supra*. This regulation's goal is to avoid or significantly reduce the damage natural systems, which are public property, can experience, among which are: the sea shore and estuaries<sup>51</sup>, marshes, mangroves, swamps and lowlands which are flooded as a result of the tide's flow and ebb of and that are part of the maritime zone.

DNER also enforces other laws (along with its associated regulations) which provide for the protection of wetland systems, including: the "Spanish Law of Rivers and Harbors", 1886; "Water Pollution Control Act", Law No. 142 of 1950, as amended; "Public Policy on Flood Prevention and River and Beach Conservation", Act No. 6 of 1968; " Puerto Rico Ports and

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<sup>50</sup> Following the provisions of this Act, in 2008, the DNER under Task 309 of PRCZMP prepared the document "Geographical Distribution of wetlands to be designated as natural reserves."

<sup>51</sup> This concept is used as a translation from Spanish to English of the term *rías*

Piers Law ", Act No. 151, 1968, as amended; "Puerto Rico Forests Act", Law No. 133 of 1975, as amended; the "Law for the extraction and excavation of Earth's crust components", Law No. 144 of 1976, as amended; the "Act for the Conservation, Development and Use of the Water Resources of Puerto Rico"(also known as the "Water Act"), Law No. 136 of 1976, as amended; the "Department of Natural and Environmental Resources Rangers Corp Act", Law No. 1 of 1977, as amended; the "Law to create the Reforestation, Management and Conservation of Living Resources Program in the Natural Resources Administration", Act No. 195 of 1998, as amended; the "Puerto Rico Fisheries Act", Law No. 278 of 1998, as amended; the "Coral Reef Protection, Conservation and Management Act" (also known as the "Coral Reef Conservation Act"), Law 147 of 1999, as amended; the "New Wildlife Law of Puerto Rico", Law No. 241 of 1999, as amended; the "Puerto Rico Navigation and Aquatic Safety Act", Act No. 430 of 2000, as amended; the " Law to establish public policy on the prevention of floods in Puerto Rico, the conservation of rivers and streams and the dedication of green belts for public use", *supra*, and the "Law on the Control of the *Melaleuca quinquenervia species*", Act No. 28 of 2008.

An important statute is the "Puerto Rico Natural Heritage Program Act" (NHP), Law No. 150 of 1988, which is an integral part of the PRCZMP, being included by RPC in 1991. It aims to identify and delineate land of natural value, to prepare plans for its acquisition and protection, and to empower nonprofit organizations to share the responsibilities of acquiring, restoring and managing the land. This law, also, authorizes the Secretary of the DNER to recommend to the PRPB the designation as a NR of any area included in the inventory of Areas of High Natural Value identified by the NHP.

The areas identified are included in an inventory, which establishes priorities for land acquisition of Areas of Conservation Priority (ACP), including wetlands. The ACPs in the coastal zone are presented in the table below:

**TABLE III-8. AREAS OF CONSERVATION PRIORITY WITHIN PUERTO RICO'S COASTAL ZONE**

Areas of Conservation Priority within Puerto Rico's coastal zone			
	ACP	Municipality	Hectares
1	Bahía Ballena	Guánica	20
2	Bahía Montalva	Guánica and Lajas	794
3	Bosque Costero de Dorado	Dorado	34
4	Cabezas de San Juan	Fajardo	225
5	Caño Boquilla	Mayagüez	292
6	Caño Corazones	Mayagüez and Cabo Rojo	499
7	Caño Tiburones	Arecibo, Barceloneta and Manatí	4,836
8	Charca La Tembladera	Arecibo	6
9	Ciénaga Las Cucharillas	Cataño, Guaynabo and Bayamón	396
10	Corredor Ecológico del Nordeste	Luquillo and Fajardo	1,184
11	Culebra	Culebra	1,722
12	Finca La Jungla	Guánica	82
13	Hábitat del Guabairo	Lajas, Guánica, Sabana Grande, Yauco, Guayanilla, Peñuelas and Ponce	11,229
14	Humedal de Cayures	Aguada	89
15	Joyudas - Lagunas Cabo Rojo	Cabo Rojo	3,983
16	Laguna Guánica	Cabo Rojo, Lajas and Guánica	6,091
17	Laguna Tortiguera, Cabo Caribe and Ciénaga Prieta	Manatí, Vega Alta, Vega Baja and Dorado	4,876
18	Lagunas de Humacao	Humacao and Naguabo	2,082
19	Llveras - Punta Verraco	Guayanilla	1,218
20	Manglar de Carrizales	Harillo	46
21	Piñones - Río Mameyes	Carolina, Loiza, Canóvanas, Río Grande and Luquillo	9,758
22	Playa de Fajardo - Cayo Algodones	Fajardo, Ceiba and Naguabo	3,648
23	Punta Cabuyones	Ponce	1,006
24	Punta Cucharas	Ponce	278
25	Punta Pozuelo	Salinas and Guayama	5,124
26	Punta Tuna	Maunabo	59
27	Quebrada Bellaca	Quebradillas and Camuy	300
28	Río Guajataca	Quebradillas and Isabela	2,678
29	Vieques	Vieques	3,619

Source: DNER. (2007). List of ACP from the NHP.

For its part, the PRPB, under the “Organic Law of the Puerto Rico Planning Board”, Law No. 75 of 1975, as amended, is empowered to develop and manage the regulations associated with land uses, including wetlands, through its regulations and site consultations. The PRPB is also responsible for evaluating the territorial plans that the municipalities prepare under the provisions of the “Law of Autonomous Municipalities”, *supra*.

Another mechanism related to the protection of wetlands is the process of Federal Consistency with the PRCZMP, administered by the PRPB. In this case, any proposed use in wetlands areas requires a notification of conformity with the CZMA or a waiver of such notification.

For its part, the responsibility of the EQB with respect to the protection of wetlands is framed in the implementation of the provisions of the “Environmental Public Policy Act”, *supra*, and in the process of evaluating environmental impact statements. The EQB also is responsible for evaluating and making determinations on water quality certifications (WQC), under Section 401 of the CWA. These certifications are issued for those proposed actions on wetlands which require a federal permit from the USACE and comply with local water quality regulations.

The USACE is the agency with jurisdiction over the activities carried out in U.S. navigable waters, including wetlands. The USACE also issues permits for discharges of fill material into U.S. Navigable Waters under Section 404 of the CWA, as well as the required permits for work in Navigable Waters, under Section 10 of the “Rivers and Harbors Act” (RHA), which regulates any activity affecting the location and flow of a body of navigable water.

Under Section 404 of the CWA, the discharge of materials, including fill material, pile driving, dredging and land movement in water bodies and wetland areas is regulated. As part of this process, the USACE has the authority to require compensatory mitigation. This mitigation refers to the restoration, creation, enhancement and even the preservation of other wetlands. Section 404 exempts from compliance those wetlands which are used for agricultural purposes, allowing their filling or draining.

For its part, EPA is responsible for drafting environmental guidelines for evaluating permit applications in wetlands. It also enforces the prohibition of discharges which have adverse effects on ecosystems, sets the jurisdictional reach of U.S. Waters, interprets the exemptions required by Section 404 of the CWA and is responsible for compliance with them.

Both federal and commonwealth agencies have managed to unify their licenses or certifications associated with wetlands through one process known as “Joint Permit Application for the Water Resource Alterations in Water, including Wetlands, of Puerto Rico”, managed by the USACE. It consists of an application which integrates various applicable permits for activities with the potential to affect aquatic resources, including Puerto Rico’s wetlands. Among the permits applying are: permits administered by the USACE; to fill U.S. Waters under Section 404 of the CWA; working in U.S. Navigable Waters and/or transportation of dredged material to be deposited in the ocean; a certificate of Federal Consistency with the PRCZMP of the PRPB; the WQC of the EQB, under Section 401 of the CWA; concessions of submerged land uses for the DNER; water franchises, water intakes and formal permits for extraction of materials from the earth’s crust.

Moreover, the adoption of the *Puerto Rico Coastal Nonpoint Pollution Control Plan (PRCNPCP)* is another critical step for the protection of wetland systems, by controlling land erosion and siltation of water bodies.

Other federal statutes critical to the conservation of wetlands in Puerto Rico are: “Endangered Species Act” (ESA), the “Marine Mammals Protection Act” in 1972; the “Food Safety Act” 1986, the “Emergency Wetlands Resources Act” of 1986, EO No. 11,990 of 1977, which establishes as presidential public policy the protection of wetlands, and *Protecting Americas’ Wetlands, an Action Agenda*. The latter incorporates federal public policy related to wetlands and led to the creation of programs aimed at the preservation of wetlands, among which are the Swampbuster Program and Wetlands Reserve Program.

The federal Department of Agriculture’s (USDA) *Swampbuster* Program, arising under the “Farm Bill”, is intended to dissuade farmers from converting wetland areas into arable land, denying economic benefits and financial subsidies to those who cultivate crops on former wetlands (Lopez-Feliciano, 1999). The Wetlands Reserve Program, administered by the NRCS, is voluntary and provides technical and financial assistance to landowners for restoration, enhancement and protection of wetlands.

Moreover, in 1989, former U.S. President George H. W. Bush established a federal public policy of no net loss of wetlands, both in area and function of these systems.<sup>52</sup> This policy states that each acre impacted must be mitigated with 1.01 acres. In Puerto Rico, the wetland systems' mitigation strategy is being met minimally, according to the findings of an investigation conducted by Pérez (2003). In Puerto Rico, every acre impacted is mitigated with .79 acres. This means there is a progressive loss of these systems, rather than an increase, which is contrary to public policy objectives.

This study reported, further, how in Puerto Rico the most common practice is the creation of wetlands, followed by the improvement, restoration and, finally, preservation. This implies that these systems are under constant threat, even with mitigation, considering the time it takes to reach its former functionality and productivity, if they succeed in achieving it.

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*Need: Investigate the impact caused by the mitigation process on wetlands and apply more effectively, efficiently, and consistently the existing permit, consult, and endorsement mechanisms provided by laws, regulations, and processes geared towards protecting wetlands, particularly over coastal wetlands.*

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As previously stated, in Puerto Rico, wetland mitigation is carried out in areas smaller than the ones being impacted and the degree of functionality reached by these systems is unknown. This raises the need to investigate the actual effect achieved through the mitigation requirements set on permits in wetland areas. Thus, insights into the reason as for why the policies and regulations are not being met could be provided, in order to reassess strategies for monitoring and reporting of compliance by proponents.

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*Need: Establish in Puerto Rico a mechanism that allows for the reliable measurement of wetland mitigation in function and area.*

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The USACE has a database of regulatory and management analysis – known as RAMS<sup>53</sup> –as part of its permit program for wetlands development under Section 404 of the CWA. However, entities such as the U.S. National Research Council (NRC) Committee on Mitigating Wetland Losses, have indicated that the RAMS database does not record adequately the information about the space and function of the ecological systems lost and recovered on actions authorized through permits from USACE. Therefore, it is not possible to determine with certainty the effectiveness of compensatory mitigation of wetland loss.

Given this, the aforementioned Committee submitted in 2001 a series of recommendations that will allow for the accounting of the gains and losses of wetlands for future projects approved by the USACE. These recommendations include: (1) the regular monitoring of

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<sup>52</sup> This public policy was a recommendation adopted by the administration of then U.S. President George Bush and has been retained and supported by the federal government since then. It arises from a forum cited in 1987 by the federal government at the behest of the EPA to define a public policy on wetlands. In its final report (National Wetlands Policy Forum), among the recommendations was a national policy to achieve that net loss of remaining wetlands will not occur in the in the U.S., as well as the creation and restoration of wetlands to replace those which have been destroyed and increase the quality and quantity of the endowment of remaining wetlands.

<sup>53</sup> RAMS is an acronym for Regulatory Analysis and Management System.

wetland gains and losses through a database, (2) improved measures for testing the quality of data that are incorporated into the RAMS database, as well as the formulation of clear and defined mitigation targets containing indicators to measure the feasibility of mitigation and restoration of adversely impacted ecological functions. A similar project could be adopted in Puerto Rico, so that the effectiveness of wetland mitigation could be measured with certainty.

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*Need: Standardize information criteria required to proponents of projects in areas containing wetlands or located near them.*

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According to Pérez (2003), there has been no uniformity in the way that proponents provide information of the wetlands that will be impacted by their projects. For example, they often do not identify the specific location or the exact space of the terrain, making it impossible to know the extent of wetland areas which will be impacted. Given this, it is recommended that the criteria for the application for information allow obtaining clear information on the likely impact on wetlands by the proposed activity.

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*Need: Assure the acquisition or transference of land declared as Natural Reserves to the DNER management jurisdiction.*

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Contrary to state forests, where lands managed by the DNER are public, terrains which have been designated as a Natural Reserve can be public or private (Pérez, 2003). This presents a limitation for the protection of wetland areas already designated as Natural Reserves and could present conflicts in the applications given to them.

However, it should be highlighted that recent PRPB public policy has been not to designate Natural Reserves until their lands are acquired or are in process of acquisition by the DNER.

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*Need: Assure the designation of Natural Reserves in representative areas and in sufficient amounts to guarantee protection for all types of wetlands.*

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It is important for wetland areas which have been proposed as Natural Reserves to be designated as soon as possible. The urgency responds to the growing demand for coastal land for construction activities. The DNER has identified the wetland areas to be designated as Natural Reserves, as stipulated in the “Puerto Rico Wetlands Public Policy Act”, *supra*. However, this law does not provide additional mechanisms to evaluate and protect wetland areas in the hands of other agencies and public corporations.

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*Need: Broaden interagency collaboration to protect all wetland systems.*

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Although the responsibility for the protection of wetlands lies with several commonwealth and federal agencies, the integration and collaboration of other agencies is necessary, specifically those owning land containing wetland systems.

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*Need: To prepare an inventory of the extension of wetland areas under active protection, those which are yet to be, and those which, in one way or another, have been destroyed.*

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There is a need to inventory the specific extension of wetland areas protected in Puerto Rico. Through various efforts, the extent of wetlands on the island has been identified (Gould et al., 2007), as well as portions of the seabed in Puerto Rico's waters. However, the specific extension and condition of wetland systems in Puerto Rico is not known with certainty. This is a necessary starting point to establish specific management and protection measures for the different types of wetlands.

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*Need: To protect of watersheds and water resources.*

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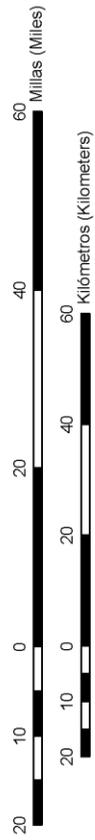
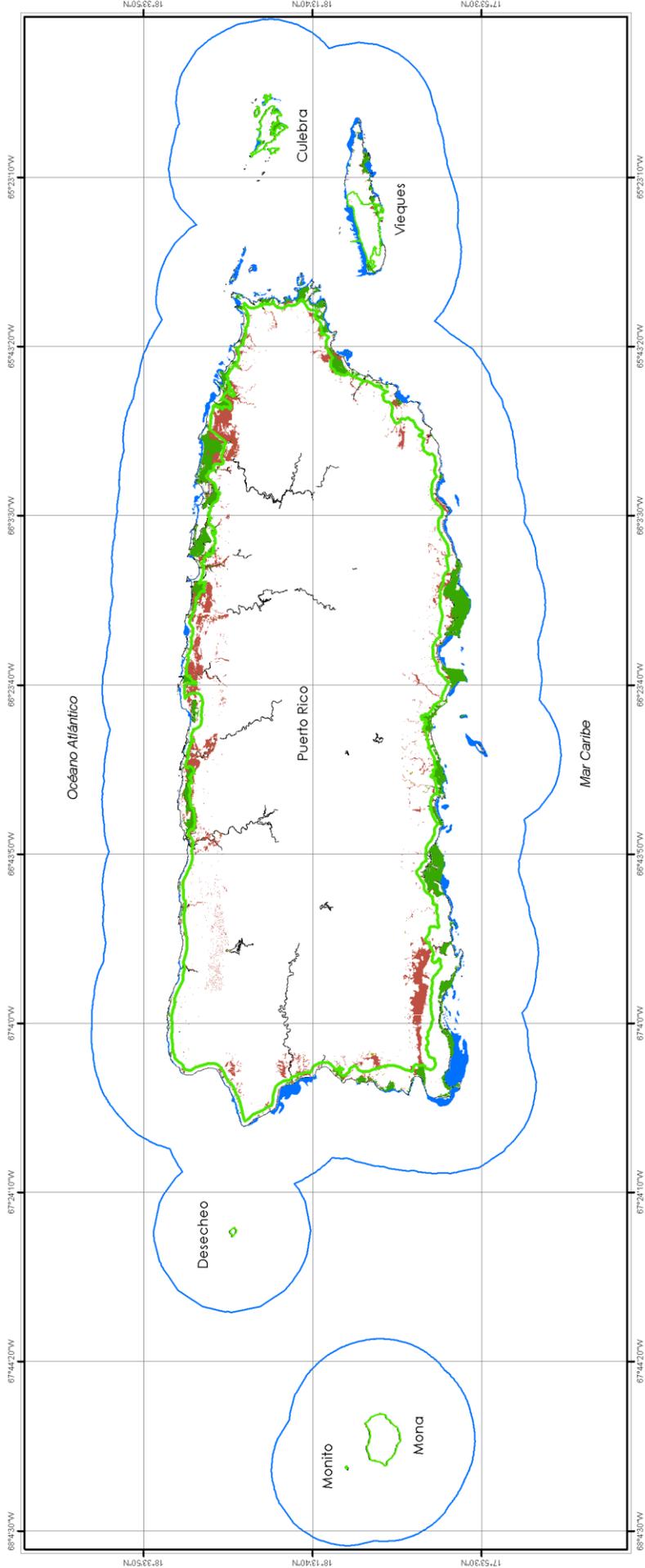
Wetlands are susceptible to hydrological conditions and are vulnerable to changes in their watershed. Coastal wetlands are affected by the volume and quality of fresh water that comes from rivers and other discharges from land based sources (Ramsar, 2002). Their effective protection requires the protection and proper management of water bodies, ensuring the supply of groundwater that feeds coastal wetlands as well as the critical areas of watersheds.

**Leyenda - Map Key:** Sistema

- Estuarino - Estuarine
  - Lacustrino - Lacustrine
  - Marino - Marine
  - Palustrino - Palustrine
  - Ribereño - Riverine
- 
- Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
  - Limite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary



Escala - Scale 1:660,000



# Humedales Wetlands



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 14 / Map 14

Fuente de Información - Source:  
US Department of the Interior

### 3.2.2 REEFS

#### Findings

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Reefs- both coral reefs and rock reefs- are valuable resources serving multiple values and functions. Areas where coral reefs are exposed to extremely low tides are considered wetlands (Adams & Hefner, 1999). These are a major component of the coastal systems in tropical waters and offer protection to inland waters and coasts. They are among the most biologically productive ecosystems because they provide a conducive environment for a large number and variety of fish and invertebrates.

The most extensive development of coral reefs in Puerto Rico is found in the Southwest and Northeast of the island shelf, although coral communities can be found in other areas. In the Northeastern coast of Puerto Rico, the insular platform is partially protected from waves by a chain of emerging rocky reefs which provide protection to the coasts, thus creating calm waters and favorable conditions for the formation of sandy beaches. In the North and Northwest, the coral reef formations are less because coastal waters on both coasts receive substantial amounts of sediment and nutrients from the unloading of the largest and fastest flowing rivers in Puerto Rico. This inhibits appropriate growth or development by reducing the photosynthesis process and increasing respiration and mucus production. Similarly, the island shelf on these coasts is narrow, exposing the coasts to strong waves.

However, on Puerto Rico's North coast – in the municipality of Vega Baja – a substantial population of coral reefs has been identified which has maintained itself in excellent condition because strong wave action has allowed for its survival. For example, in the 2005 bleaching episode, which caused a massive mortality of corals in the Caribbean, the currents allowed them to survive, by facilitating their oxygenation and providing them with food (Hernandez et al., 2007).

Puerto Rico is surrounded by approximately 500,000 ha of easy access coral reef ecosystems, where depth does not exceed 20 meters (CSOR, 2005). Some 228 species of corals have been identified in the territorial waters, including: 117 scleractinian corals (rocky), 99 antipatharia corals (black or spiny), 13 corallimorpharia (fungi type coral), three fire corals and five hydrocorals (DNER, 2000). These coral reefs are formed mainly by three types of structures: fringing or marginal reefs (which are the most common), bank reefs and barrier reefs. (Map 15 shows the coral reef communities.)

For their part, rocky reefs, although considered less productive than coral reefs, provide an important habitat for fish and macroinvertebrates. They also allow the development of coral communities which succeed in adapting and growing under harsh conditions in which surge and strong currents prevail.

Rocky reefs, like coral reefs, provide protection against the onslaught of waves on the shore and influence deposition rates of sand on beaches. The calm waters and deposits of sand from the beach of Luquillo, for example, would be lost if these protective reefs disappear (Beller et al., 1999).

Coral reefs are an important source for fish production and for the manufacturing of drug products. Coral reefs also protect coastlines from wave action, are the primary source of carbonate sand, serve as buffers against coastal erosion, affect the deposition of sand on the beaches they protect, which promotes their formation, as well as the formation of seagrass beds and mangroves.

In 2007, the DNER’s Coral Reefs Management and Conservation Program (CRMCP), commissioned a study to determine the economic value of coral reefs and associated environments<sup>54</sup> in Eastern Puerto Rico, specifically in Fajardo, Arrecifes La Cordillera, Vieques and Culebra. According to estimates, it was found that the value of these resources was \$1.6 billion, being tourism and recreation the activities which derive more value from these resources.

It should be further noted that according to this study Puerto Ricans acknowledge that coral reefs and associated environments have values and functions of great importance. These values are known as passive values, which accounted for 56% of the total economic value.<sup>55</sup>

**TABLE III-9. TOTAL ECONOMIC VALUE BY YEAR 2007**

Total economic value by year 2007		
	Estimated values	Annual value
Goods	Artisan fishing value	\$407,415
	Turistic and recreational value	\$692,027,166
Services	Protection value	\$9,969,258
	Educational and research value	\$928,758
	Existential value	\$305,555,937
Pasive values	Future value	\$192,535,517
	Heritable value	\$210,258,467
	Biodiversity value	\$190,885,562
<b>Total economic value</b>		<b>\$1,602,568,080</b>

Source: DRNA. (2007). *Valoración económica de los arrecifes de coral y ambientes asociados en el Este de Puerto Rico: Fajardo, Arrecifes La Cordillera, Vieques y Culebra.*

<sup>54</sup> Associated resources include beaches, bays, mangroves, seagrass beds, saltpeter beds, coastal lagoons, among others.

<sup>55</sup> Passive values: (1) existential value: value that people gave coral reefs and associated resources by only knowing they exist, although they have never seen them and understand they will never see or enjoy them, (2) future value: value of conserving the resource for potential use in the future, (3) heritable value: the value of conserving the resource for future generations, and (4) biodiversity value: value of the intrinsic ecosystem functions.

Coral reefs are fragile and can be easily destroyed by marine or land-based activities. Colonies of corals are living organisms and, like other tropical marine communities, are extremely sensitive to environmental changes.

Unfortunately in Puerto Rico, coral reefs have been degrading rapidly during the past decades due to natural and anthropogenic factors. Their current state rated among the most critical of the Caribbean, particularly due to the unchecked urban and industrial development on the coast during the past 40 years (Causey et al., 2002). Natural factors associated with the degradation of reefs have been well documented. These include, but are not limited to, torrential rain, hurricanes and mass mortality of sea urchins (*Diadema antillarum*), which promote the overgrowth of algae. Other natural factors which have caused mass mortality of coral reefs are diseases such as the white band, black band and white plague, and bleaching.

It is anticipated that these natural factors which affect coral reefs will be exacerbated by the impact of climate change. In 2005, we saw a bleaching episode which caused the mass death of coral reefs in the Caribbean. This resulted from increased sea temperatures which reached 31.8°C at depths of 30m and about 33.1°C on the crest of the corals. In late 2005, the coral bleaching in the south and west of Puerto Rico was devastating, being more evident on the reef where the *Montastraea annularis* complex was the dominant species in terms of substrate coverage (Hernández-Delgado, as quoted in García-Sais et al., 2008). This bleaching episode was followed by a massive outbreak of white plague, which caused deaths and a reduction of between 20-60% of live coral cover in Eastern Puerto Rico, during a sampling period that lasted six months.

This bleaching episode has alerted about the susceptibility of coral reefs to the impact of climate change as it is predicted that increases in sea temperatures will increase bleaching episodes. While corals can recover from these events, the frequency and severity of exposition to it will increase their mortality.<sup>56</sup>

It is further noted how the increase in greenhouse gases, particularly CO<sub>2</sub>, directly impacts coral reefs due to its sea acidification effect, which prevents sea corals from calcifying their skeletons. Meanwhile, other factors deteriorating reefs, such as storms and hurricanes, are expected to increase, which could amplify the frequency and intensity of the damage.

Moreover, some of the anthropogenic factors causing the deterioration of coral reefs and associated ecosystems in Puerto Rico are: water quality degradation, sedimentation (due to clearing of vegetation, land movements or dredging), domestic discharges, coastal development, overfishing, recreational uses without adequate controls and the absence of management plans for coral reef areas (Beller et al., 1999). Other factors causing detachments, cracks and abrasions in the biotic components of the reef are: the anchoring of

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<sup>56</sup> Rising sea temperatures creates stress on coral polyps, causing bleaching, which occurs by the expulsion of a symbiotic algae that live in their tissues, but without which the coral cannot support itself.

vessels, ship groundings, military exercises and thermic and toxic pollution coming from industrial, agricultural or domestic sources (DNER 2001a).

The extraction of corals also poses a danger to Puerto Rico's reefs. Although the removal of coral is banned by the "Regulation to Control the Extraction, Possession, Transportation and Sale of Coralline Resources", Regulation No. 2577, some people destroy them by removing corals for ornamental or commercial purposes.

The process of regeneration of coral reefs, if it occurs, is slow. After a reef dies, the waves' action progressively destroys the cortex, removing the layer or protective level. Once destroyed, the reefs slowly regenerate, but it is uncertain if the reef community restores by itself.

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## Public Policy

The PRPB's OPP-PRLUP, establishes a general policy to "avoid activities which might cause deterioration or destruction of natural systems critical to preserving the environment, such as ... reefs ..." (See Public Policy 30.03).

### Implementing the Policy

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#### 1. Coral Reefs Protection

In 2008, approximately 1,383 miles<sup>2</sup> (3,582 km<sup>2</sup>) around the Main Island, Vieques and Culebra were designated as critical habitat for two species of coral: the staghorn coral (*Acopora cerviconis*) and elkhorn coral (*Acropora palmata*).<sup>57</sup> The objective of this designation was to facilitate an increase in the incidence of sexual and asexual reproduction of these species, which were included as threatened on the federal list of endangered species in 2006, under ESA provisions. Both were the most abundant and important in many Caribbean coral reefs for their importance as reef builders and providers of habitat for other organisms associated with them.

Locally, the "Coral Reef Protection, Conservation and Management Act", *supra*, establishes mechanisms to penalize activities which may be detrimental to these systems, highlights the need to educate the public about their importance, provides for the establishment of a program to conserve these resources and proposes the development of a management plan for coral reefs.

Following the provisions of this Act, the CRMCP was established under the DNER's Living Resources Area. The program is divided into two main categories: (1) conservation and management and (2) coral reef monitoring. Under the first, strategies are developed in order to address local issues such as education, over-fishing, pollution from non-point sources and over-use from recreational activities. Meanwhile, the second category maintains a database of reef characterization and monitoring of their associated communities in different areas of

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<sup>57</sup>See: Federal Register. *Endangered and Threatened Species; Critical Habitat for Threatened Elkhorn and Staghorn Corals*. 50 CFR Parts 223 and 226. Vol. 73, No. 229. Final Rules and Regulations. Wednesday, November 26, 2008.

the Island. This program is part of the U.S. Coral Reef Initiative, which in turn is part of an international initiative. The International Coral Reef Initiative (ICRI) is an agreement between governments, international organizations and nongovernmental organizations to preserve coral reefs and associated resources through the implementation of Chapter 17 of *Agenda 21*, and other international agreements.

Under the Coral Reef Initiative, in the context of local action strategies (LAS), the Puerto Rico Coral Reefs Management and Conservation Plan is being developed, as provided by the “Puerto Rico Coral Reefs Protection, Conservation, and Management Act”, *supra*.

Another mechanism that tends to protect the reef resources is the “Puerto Rico Navigation and Aquatic Safety Act”, *supra*, and the “Regulation for the registration, navigation and water safety in Puerto Rico”, Regulation No. 6979. These establish measures to protect coral reefs and associated environments, mangroves and seagrass beds, by prohibiting the anchoring, tying or holding of boats or motor vehicles to any of these resources.

The “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands and the Maritime Zone”, *supra*, contains provisions relating to coral reefs and associated systems. The regulation defines as an inappropriate use, in Article 6-b, “the excavation, dredging, removal or soil alteration of seagrass, coral reefs and other ecologically valuable niches”.

An additional mechanism for the protection of these resources was the adoption of the “Recovery of 3% of the Puerto Rico Insular Platform Act”, Law No. 307 of 2000. It empowers the DNER to identify and establish marine reserves in areas of priority to be conserved for their recovery, in three percent (3%) of the insular platform of Puerto Rico and adjacent islands in a period of three years (DNER, 2001a).

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*Need: Develop effective mechanisms to ensure compliance with the control measures for erosion and sedimentation and non-point sources of pollution which affect coral reefs.*

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Erosion and sedimentation are among the main problems that degrade water quality and impact coral reefs. While the “Regulations for erosion control and sedimentation prevention”, EQB Regulation No. 5754, was adopted in order to avoid land erosion and sedimentation which could result from human activities, it continues to deteriorate the health of the coral reefs. Therefore, an evaluation of implementation and enforcement effectiveness of this regulation is recommended, as well as the development of effective mechanisms in addressing the problem.

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## 2. Protecting reefs against extraction of coral

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In Puerto Rico, the removal of corals is banned by the “Puerto Rico Coral Reefs Protection, Conservation and Management Act”, *supra*, and the “Regulation to Control the Extraction, Possession, Transportation and Sale of Coralline Resources”, *supra*. However, there is a permit granted to those *bonafide* craftsmen for the collection and/or removal of dead coral.

### 3. Management and protection

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#### *Natural Reserves (NR)*

The PRCZMP (1978) identified and recommended the designation of 12 areas as Natural Reserves, selected by the quality and extent of its coral reefs. The areas which were designated by the PRPB are:<sup>58</sup>

- Arrecifes La Cordillera NR
- Guánica Commonwealth Forest NR
- Mona & Monito Island NR
- Arrecifes Tourmaline NR
- Arrecifes de Guayama NR
- La Parguera NR
- Ceiba Commonwealth Forest NR
- Boquerón Commonwealth Forest NR
- Piñones Commonwealth Forest NR
- Isla Caja de Muertos NR
- Cabezas de San Juan NR
- Punta Petrona NR

The PRCZMP (1978) also recommended the Jobos Bay and Mar Negro area – between the Salinas and Guayama Municipalities – to be designated as NR. The proposal for this designation is before the PRPB consideration.

It should be pointed out that approximately 50.19% of coral reefs in Puerto Rico are within a Marine Protected Area (MPA) (López, 2007).<sup>59</sup>

Other NRs which include coral reefs are: Las Cabezas de San Juan, Caja de Muertos, Boquerón, Punta Petrona and Canal Luis Peña while Tres Palmas and Desecheo are marine reserves which also contain coral reefs.

These marine reserves, as in the Canal Luis Peña NR (RNCLP, for its Spanish acronym) in Culebra, incorporate areas of a permanent fishing ban, which is also a mechanism to protect corals and the benthic habitation of the area. These areas, declared as no extraction, include 4.8 km<sup>2</sup> or 0.4% of total MPAs (Díaz & Dragoni, 2000).

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<sup>58</sup> All of these NRs were added to the PRCZMP through RPC in 1988, except *Arrecifes de Tourmaline*, which were included in 1997.

<sup>59</sup> According to López (2007), MPAs are classified as those legally designated areas that have coastal or marine ecosystems, that may include terrestrial components, and that have different approaches to conservation, protection and/or zoning levels.

The RNCLP in Culebra was the pioneer in incorporating a permanent fishing ban area and in which about 83 species of corals have been identified (Puerto Rico Coral Reef Initiative, 1999-2004). This has allowed for, among other things, the gradual recovery of the ichthyofauna with recreational and commercial value, which will, in turn, protect and conserve coral reefs in the area.<sup>60</sup>

For its part, half a mile (0.5 miles) of territorial waters around the island of Desecheo was designated as a marine reserve. In this perimeter fishing is prohibited, as provided in the "Regulation on Puerto Rico Fisheries of 2004," Regulation No. 6768.

Meanwhile, Tres Palmas Marine Reserve includes, among its marine resources, the elkhorn coral (*Acropora palmata*) which is on the federal list of endangered species.<sup>61</sup>

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*Need: To designate Island areas containing reef systems as Special Planning Areas (SPA).*

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Coral reefs are resources which provide varied and important benefits. However, they are located in areas subject to conflicts of current and potential use, and therefore require special planning.

Similarly, the conformation of the *Acropora cerviconis* critical marine habitat demonstrates the need to take action to protect marine resources, as it would be the designation as SPA, which constitutes an additional mechanism to address conflicts of current and potential use of these resources.

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*Need: Evaluate the benefits of the designation of Bahía de Jobos y Mar Negro area as Natural Reserve.*

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As was stated previously, the PRCZMP in 1978 recommended that Bahía de Jobos y Mar Negro be designated as a NR. Subsequently, the area received the designation of National Estuarine Research Reserve and currently has a management plan. Therefore, it is necessary to assess the additional benefits that would be entailed if it is designated as a NR by the PRPB.

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*Need: Prepare and adopt management plans for the areas designated as Natural Reserves.*

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Management plans should incorporate, among other things, mechanisms to control pollution from non-point sources affecting these ecosystems.

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*Need: Develop an education initiative about conservation, management and restoration of coral reefs.*

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<sup>60</sup> The Management Plan for this NR was completed in 2008.

<sup>61</sup> The Management Plan for this Marine Reserve was completed in 2008.

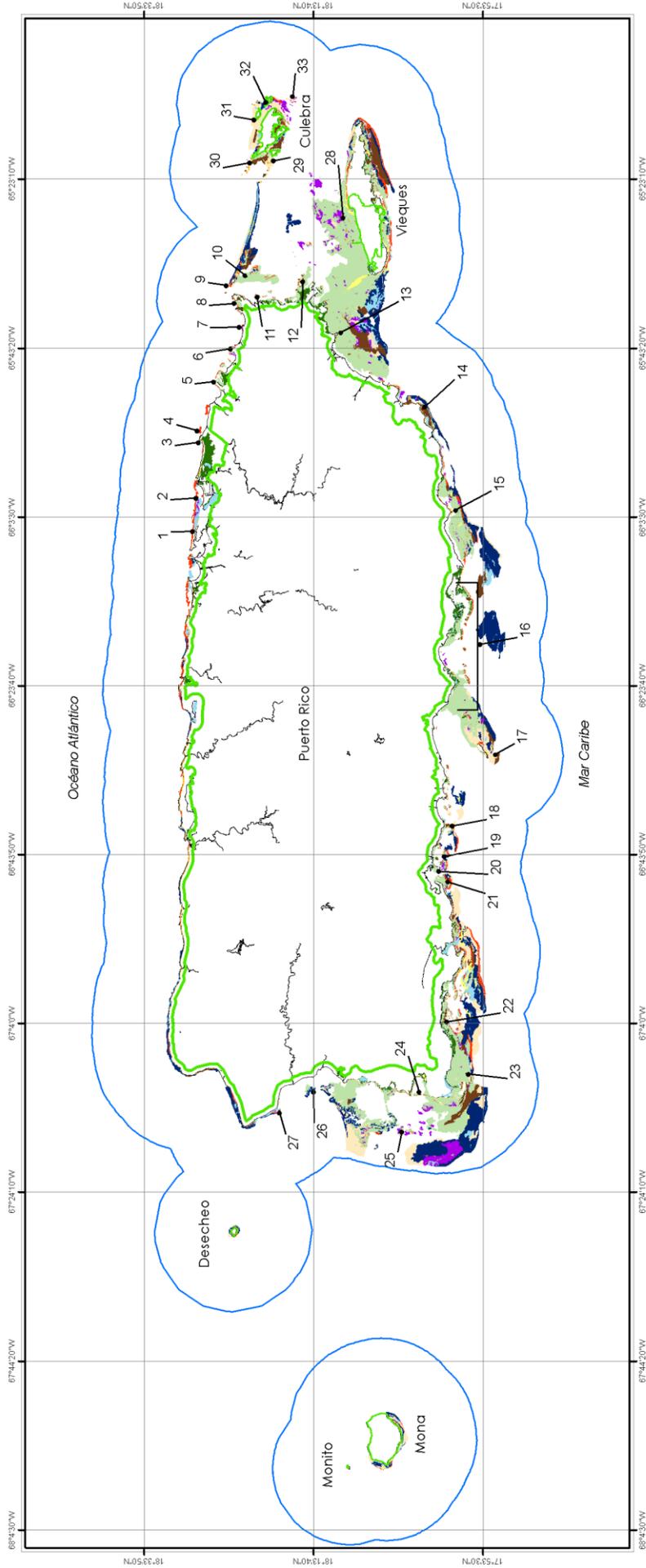
Leyenda - Map Key:

- 1- San Jorge
- 2- Las Marias
- 3- Vacia Talega
- 4- Iglesias - Uvero
- 5- Miqullo
- 6- Enbarcadero
- 7- Borrás
- 8- Las Cabezas
- 9- La Cordillera
- 10- Palomino
- 11- Zancudo
- 12- Medio Mundo
- 13- Humacao
- 14- Maunabo
- 15- Guayama
- 16- Pastillo - Santa Isabel - Aguirre
- 17- Caja de Muertos
- 18- Ratonés
- 19- Fanduco
- 20- Unitas
- 21- Guayanilla
- 22- Media Niche
- 23- Margarita
- 24- Boquerón
- 25- Tourmaline
- 26- Mayaguez
- 27- Rincon
- 28- Milás
- 29- Luis Peña
- 30- Flamenco
- 31- Norte
- 32- Botella
- 33- Manzanilla

- Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
- Limite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary



Escala - Scale 1:860,000



- Parcho de coral (individual) - Patch reef (individual)
- Parcho de coral (agregado) - Patch reef (aggregated)
- Fango - Mud
- Mangle - Mangrove
- Macroalgas - Macroalgae
- Yerbas Marinas - Seagrass
- Lecho roco no colonizado - Uncolonized bedrock
- Camelones - Spur and groove reef
- Coral roco disperso en sedimento no consolidado - Scattered coral rock in unconsolidated sediment
- Arena - Sand
- Arrecifes muertos e inestables - Reef rubble
- Coral lineal - Linear reef
- Pavimento colonizado con canales de arena - Colonized pavement with sand channels
- Pavimento colonizado - Colonized pavement
- Lecho roco colonizado - Colonized bedrock
- Artificial - Artificial



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 15 / Map 15

# Formaciones conocidas de arrecife de coral

## Known Coral Reef Formations

Fuente de Información - Source:  
Departamento de Recursos Naturales y Ambientales

#### 4. Research (high priority)

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In Puerto Rico, countless research efforts are conducted in association with coral reefs, of which the DNER is a part.

The NOAA, in collaboration with the DNER, the National Park Service (NPS) and the USGS have worked on mapping the distribution of coral and other related benthic niches (Matos, Díaz & García, 2000).

Puerto Rico, also, is part of the Caribbean Coastal-Marine Productivity Program (CARICOMP). This is a regional effort which aims to provide appropriate scientific information for managing coastal resources. The initiative has a program for monitoring changes in the ecological health of coral reefs and associated systems through a network of laboratories and marine reserves. In Puerto Rico, the participating CARICOMP institution is the Department of Marine Sciences at UPR-Mayagüez.

Other research efforts are conducted by the Coral Reef Caribbean Institute and the Department of Marine Sciences at UPR-Mayagüez, as well as by the Center for Applied Tropical Ecology and Conservation at UPR-Río Piedras.

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*Need: Generate a database in the DNER that collects all the research and recovery efforts on coral reefs and associated environments.*

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Although information has been generated on the distribution and conditions of coral reefs, existing information on these resources is scattered among various organizations, government agencies and academic institutions. Therefore, the establishment of a mechanism to consolidate all research, studies and publications on the subject is recommended.

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*Need: Promote research on coral reefs and associated environments.*

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The scientific community in Puerto Rico has identified additional research needs, among which are:

- Review and update the Inventory of the Puerto Rican Coral Reefs, report that was prepared by Goenaga & Cintrón in 1979.
- Develop an inventory of spatial distribution patterns and current status of the corals *Acropora* and the *Montastraea* complex, whose populations have declined significantly over the past years.
- Implement ecological monitoring of coral reefs including benthic communities, fish, environmental parameters and ecosystem-level processes, in order to assess the effectiveness of current management strategies as well as the resilience of the ecosystem.
- Perform paleoecological studies of coral reefs, particularly in paleoclimatology and reconstruction of environmental history of coral reefs in Puerto Rico, which would allow

for the recording of environmental changes and the impact of climate change on these ecosystems.

- Develop an initiative directed toward the recovery of coral reefs that identifies priority areas for ecological restoration and the spatial distribution of priority species. This will support the development of strategies for propagation and reintroduction of coral reefs.
- Develop research leading to increasing juvenile survival success, gamete fertilization and recruitment of coral larvae.
- Develop more comprehensive studies on the current status of deep coral reefs.



### 3.2.3 MANGROVES

#### Findings

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Mangroves are important due to their variety of functions and benefits. These plant formations, endemic to tropical coastlines, are composed of tree species with accessory organs for respiration which allow them to colonize wetlands subject to salt water intrusion (DNER, 1992). Among their adaptation characteristics are: tolerance to high salinity levels, aerial roots which allow them to stabilize the tree on soft ground, floating seeds (*plántulas*) and specialized structures allowing the entrance of oxygen and exit of carbon dioxide (lenticels and pneumatophores).

Four of the 10 mangroves which develop in the Atlantic Coast of the New World grow in Puerto Rico. These species are red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), button mangrove (*Conocarpus erectus*) and white mangrove (*Laguncularia racemosa*). These four species of mangroves are represented in the types of mangroves: coastal, basin, islets and river bank.



**Estuarine wetland**

Picture by: Estudios Técnicos, Inc.

Historically, mangroves have been perceived as areas of low economic productivity providing mainly wood and charcoal. The filling of mangroves was largely seen as a positive public health activity since these areas tend to serve as nurseries for mosquitoes, the primary carriers of the malaria virus. In fact “Joint Resolution No. 7 of 13 May 1927”, authorized the Government to sell mangroves to the People of Puerto Rico to be dried out. However, modern medicine has provided alternatives to control this disease and malaria no longer represents a menace to the people of Puerto Rico. Finally, in 2005 the “Law to abolish Joint Resolution No. 7 of 13 May 1927”, Law 60 of 2005, was passed since it was understood that the older law was moot and against the best interests of Puerto Rico’s public policy on the environment.

Today, as a result of growing ecologic awareness, the important value and functions of mangroves are recognized. Among these functions are to serve as a buffer against the onslaught of wind caused by weather events, serve as wildlife refuges and nurseries, including marine life, fisheries, and serve as sources and natural filters to purify water. These characteristics distinguish mangroves as coastal systems of high ecologic and economic values.

Some species of fish of commercial importance live among the roots of the mangroves. Other species spend part of their life cycles, such as spawning and breeding, within the mangroves. Between 70% and 90% of marine life of commercial or recreational value uses the mangroves for at least part of their respective life cycles (DNER, 2003). Mangroves are also part of the habitat for native and migratory birds, including hunting birds and birds which are on the federal list of endangered species.

Mangroves can be harmed or destroyed by drainage, dredged, filling, sedimentation and oil spills among other polluting activities. The “rescue” of lands by filling represents the most serious direct threat against mangroves. Furthermore, the “rescue” of land adjacent to mangroves could indirectly affect these areas by altering horizontal flow of the waters. While true that mangroves can trap a great concentration of pollutants, it has yet to be determined to which points these contaminants (with the exception of oil spills and sedimentation) contribute to their degradation and/or the threat to microscopic life in the estuarine areas.

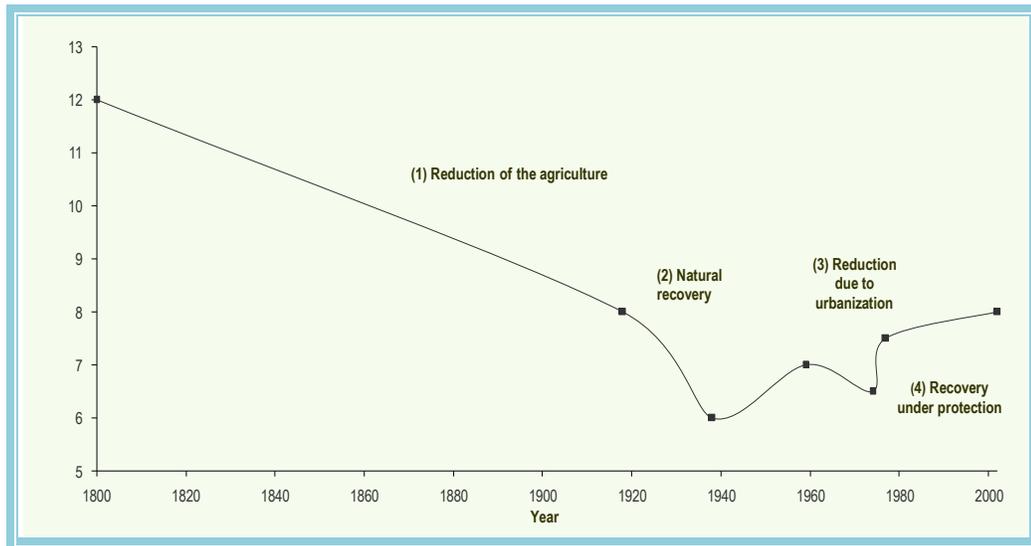
Despite the massive destruction of these systems in the first decades of the 20th Century, mangrove coverage has been recuperating. In the first inventory of mangroves made on the Island, by mandate of the 1870 “Land Act”, some 11,790 ha were counted. Since then, a great deal of Puerto Rico’s original mangroves were destroyed or “rescued” by filling them or by drainage and were dedicated to other agricultural uses, such as piers, industrial or residential sites. An inventory done in 1972 found that the mangrove population had been reduced to 7,074 ha. Two years later, in 1974, it was observed a reduction of the mangrove population to 6,485 ha (DNER, 2003) Meanwhile, a more recent study analyzing land coverage using satellite images from 1999 to 2003 reflected 6,700 ha of mangroves (Gould 2007).<sup>62</sup>

An investigation done by Martinuzzi, et al. (2009) documented how the change in mangrove coverage in Puerto Rico was directly linked to the economic activity of the era: the agricultural era, the industrial era and, over the last couple of decades, the era of urban expansion. During the agricultural era (1800-1940) a 45% reduction in mangrove coverage was observed. With a change toward an industrial economy, an increase in mangrove coverage was observed, but in the era of urban expansion between 1969 and 1970, it began to decline once again. However, this trend ended in the 1970s with the passage of the DNER’s Organic Law in 1972, which has precipitated a recovery under the guidelines and protection of environmental laws, at both the local and federal levels, passed in that time period. However, uncontrolled urban expansion has emerged as the biggest threat against wetlands.

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<sup>62</sup> The coverage of mangroves varies depending on the methodology used for the analysis. For example, the study “The Status of Puerto Rico’s Forests 2003” reported that mangrove forests occupy approximately 7,920 ha of the coastal areas in Puerto Rico (Brandeis, 2003). In this case, the estimated area for the mangrove forests is based on a soil coverage map and forest formations produced by Kennaway & Helmer (2006) in 2000. Said map classified mangrove forest with 82% precision.

**GRAPHIC III-1. CHANGES OBSERVED ON THE MANGROVE COVERAGE OF PUERTO RICO OVER THE LAST 200 YEARS**



Source: Martunizzi, S., Gould, W., Lugo, A. & Medina, E. (2009). *Conversion and recovery of Puerto Rico mangroves: 200 years of change*. International Institute of Tropical Forestry.

Depending on their type and location, remaining mangroves are subject to major reduction or destruction caused by humans. Currently, mangroves in the Eastern sector of Puerto Rico are the ones under the largest threat of development which have the greater potential of affecting them.

### Public Policy

In the PRPB's OPP-PRLUP, included in Chapter 2, the public policy is established to "avoid activities which could deteriorate or destroy natural systems critical to the preservation of the environment, such as mangroves..." (See Public Policy 30.03)

### Additional established policies

In order to complement the previously established policies and increase their effectiveness, the following additional policies were established:

#### 1. Mangrove protection

All existing mangroves, as well as all the buffer zones needed to protect their water resources, vegetation, aquatic birds, fish and other wildlife, should be protected in the following manner:

... Restrict new development in mangroves, except those which are destined for the general wellbeing and are done by Puerto Rico's Government. New development, including the construction of dikes, dredging and filling of existing or restorable mangroves should only be permitted if the following criteria are met:

... Natural Reserves. Any alteration to mangroves designated as NR should, in all possibility, (a) maintain or improve the functional capacity of the existing wetland, for example, even if there is an alternation, there should not be any reduction in the quantity or quality of species, and (b) should be in conformity with a mangrove management plan approved by the PRPB and the presentation of an environmental impact statement in compliance with the “Environmental Public Policy Law”; and (c) be limited to incidental installations of public service facilities, restoration measures or natural research.

... Other mangroves. Any alteration of other mangroves should, in all possibility: (a) conform to the “Special Planning Area Management Plan for Puerto Rico’s Mangroves”; (b) be limited to: (1) essential military installations, (2) expansion of commercial ports, airports or bays, (3) have the minimal entry canal needed for a marina or any other nautical installation excavated from firm land, (4) those energy installations depending on the coast which cannot be located inland or out to sea, (5) minor incidental public service facilities, such as cables or underground transmission lines, (6) takes measures to restore the biological productivity of degraded mangroves and (7) have research done regarding the nature, aquaculture or any other related activity which could be impacted by the alteration.

## **Implementing the Policy**

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### **A. Protecting mangroves against filling, dredging and land development**

#### **1. Public property and its custody**

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DNER currently manages four coastal forests which are home to important mangrove areas. These are: (1) *Bosque de Aguirre*, near the *Bahía de Jobos* on the South coast (969.7 ha); (2) Boquerón Commonwealth Forest, on the West coast and to the South of Mayagüez (1878.3 ha); (3) Ceiba Commonwealth Forest on the East coast and to the South of Fajardo (142.6 ha); and (4) Piñones Commonwealth Forest on the North coast between San Juan and Loíza (1,271.9 ha, including the *Laguna de Piñones*).

Other extensions with significant mangroves are found in the land which comprises the former Roosevelt Roads Naval Base. After the base closed operations, some 1,346.6 ha, the bulk of which were mangroves and other wetlands, known as the *Dagao y Medio Mundo* Natural Protected Areas, were transferred to the DNER. These lands are managed by the PRCT, entity which is currently preparing a management plan for these lands.

Other military installations which have closed and contain important mangroves are in Vieques and Culebra, whose land is not part of the National Wildlife Refuges System belonging to the DOI.

**Leyenda - Map Key:**

-  Límite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
-  Límite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary
-  Manglares - Mangroves

Puerto Rico	
1	Nombre Nuevo
2	Marín Peña
3	Laguna San José
4	Las Culebras
5	Piñones
6	Rio Herrera Suro
7	Rio Manatí
8	La Piedad
9	Rio Manatí
10	Rio Manatí
11	Rio Juan Martín
12	El Convento
13	Laguna Aguas Piedras

Área (Ha)	Nombre
82.60	14 Laguna Grande
156.00	15 Río Pajaro
2,029.92	16 Puerto Moreno
172.79	17 Río Caguaya
232.02	18 Bahía Algodones
50.68	19 Río Manatí
16.36	20 Río Manatí
22.75	21 Río Manatí

Área (Ha)	Nombre
76.62	26 Puerto de los Cabos
128.42	27 Pta. Ponce-Cayos Caribe
454.35	28 Mar Negro
197.95	29 Pta. Arenas
132.88	30 Cayo de Raton
19.76	31 Pta. Ponce y Cayos
190.74	32 Pta. Manatí
14.77	33 Bahía de Jauca
29.13	34 Pta. Vieja
44.69	35 Cayos Sabana
49.45	37 Pta. Cabañero

Área (Ha)	Nombre
110.04	38 Laguna de las Salinas
338.08	39 Bahía de Tibalzo
237.03	40 Bahía de Guayama
63.65	41 Cabañero
17.56	42 Pta. de Guayama
14.77	43 Enramada los Pinos
190.74	44 Pta. Manatí
29.13	45 Bahía Fontecada
114.92	46 La Parguera

Área (Ha)	Nombre
11.17	48 La Cerna y Bahía Surra
54.47	49 Rincón de arena y Cabañero
19.15	50 Bahía de Boguán
51.19	51 Pta. Cabañero y Pta. Osbornes
5.19	52 Cabañero
3.59	53 Cabañero
132.70	54 Cabañero
34.32	55 Cabañero
14.77	56 Cabañero
14.77	57 Cabañero
14.77	58 Cabañero
14.77	59 Cabañero

Área (Ha)	Nombre
35.11	60 Carreras (Pta. Maricao)
35.54	61 Tourones - Lince
19.15	62 Palomas Altas
60.25	63 La Esperanza
94.97	64 Río Chico
123.70	65 Marañón
34.32	66 Río Chico
14.77	67 Las Cochinas
14.77	68 Las Cochinas
14.77	69 Las Cochinas
14.77	70 Las Cochinas

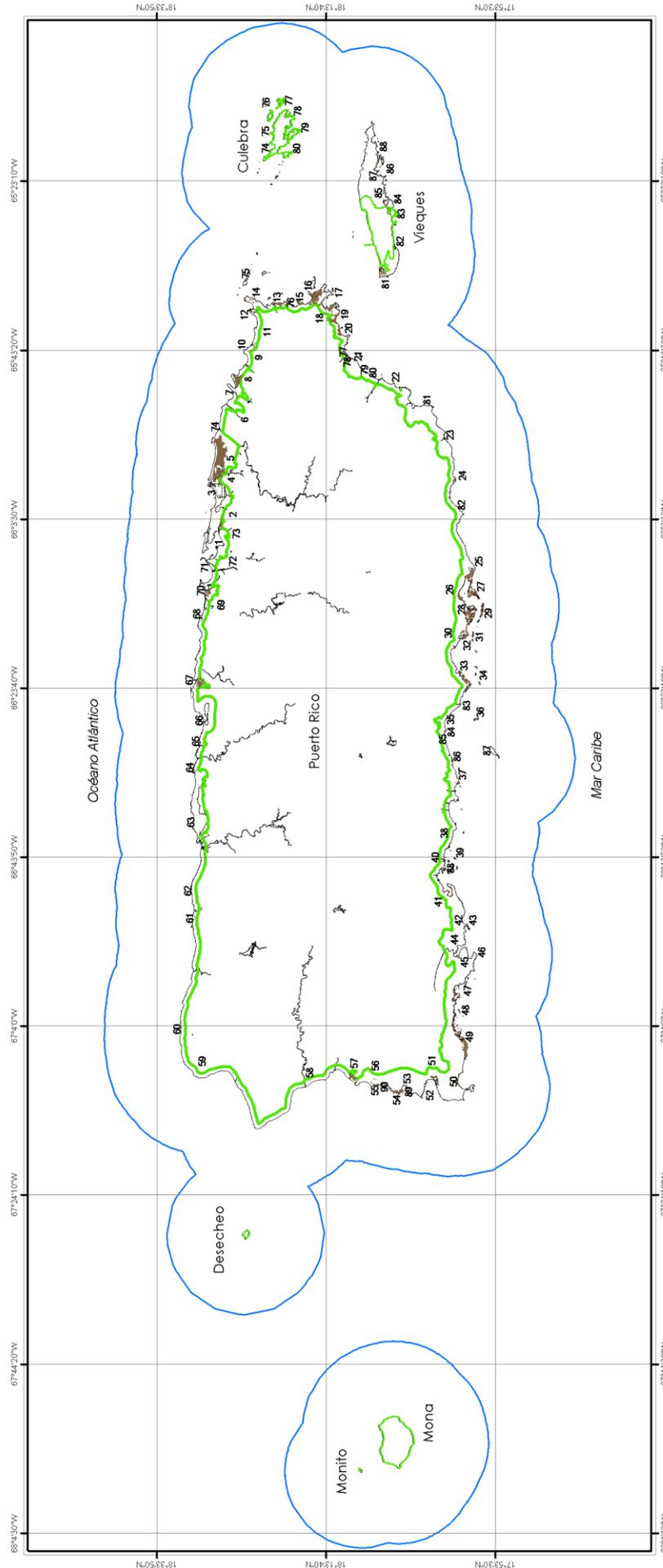
Área (Ha)	Nombre
14.77	71 Playa Resaca
136.08	72 Playa Resaca
75.53	73 Playa Brava
3.99	74 Puerto del Manglar
154.43	75 San Isidro
50	76 Enramada del Corral y del Cementerio
7.18	77
166	78
64.29	79
45.99	80

Área (Ha)	Nombre
81	81
2.39	82 Playa Laguna Grande
2,564.00	83
35.91	84
13.97	85 Bahía Tajón
19.52	86 Bahía Tajón
8.78	87 Bahía Chiva
17.56	88 Bahía Chiva
3.79	89 Enramada Honda
65.44	90

Área (Ha)	Nombre
14.77	91
2.39	92
2,564.00	93
35.91	94
13.97	95
19.52	96
8.78	97
17.56	98
3.79	99
65.44	100



Escala - Scale 1:860,000



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

# Manglares Mangroves

Fuente de Información - Source:  
Departamento de Recursos Naturales y Ambientales

Other mangrove areas exist, but many of them are privately owned and are being subjected to or count with proposals for conflictive uses.

However, DNER, aside from recommending important mangroves to be designated as NR, can use other mechanisms to destine public land for protection, among which is the establishment of conservation easements. These constitute imposing an obligation on a property to guarantee its protection and management as disposed in the “Puerto Rico Natural Heritage Program Act,” *supra*<sup>63</sup>, and the “Puerto Rico Conservation Easement Law,” Law No. 183 of 2001.<sup>64</sup>

The *SPA Management Plan for Puerto Rico’s Mangroves*, states that public ownership is not the only means available for the protection of these resources. Said Plan identifies other mechanisms, which includes, notification, transfer of deed or administration, management agreements, donation, rent, exchange, transfer of development rights, dedication, mitigation and zoning.

## 2. Management and protection

### *Natural Reserves (NR)*

In the PRCZMP (1978), 12 areas were recommended to be designated as NRs due to the importance of their mangroves, specifically for their size, singularity and complexity. The PRPB has designated 11 of these areas as NRs. They are:

- Caño Martín Peña NR (recommended as Reserva Natural Lodazales del Puente La Constitución)
- Piñones Commonwealth Forest NR
- Río Espíritu Santo NR
- Ceiba Commonwealth Forest NR
- Punta Petrona NR
- Guánica Commonwealth Forest NR
- La Parguera NR
- Boquerón Commonwealth Forest NR
- Laguna Joyuda NR
- Bahía Bioluminiscente de Vieques NR
- Cabezas de San Juan NR

The PRPB designated all the candidates as NRs, with the exception of *Bahía de Jobos y Mar Negro*. Other natural reserves which include mangroves are identified in Table III-10.

### *Special Planning Areas (SPA)*

With the adoption of the PRCZMP in 1978, all of Puerto Rico’s mangroves were designated as SPA by the PRPB. Through Resolution *PU-002-2003-Mangle PR*, the PRPB adopted the

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<sup>63</sup>This law was included in the PRCZMP in 1991 using the RPC process.

<sup>64</sup> This law defines conservation easements as: “imposed obligation on a property for the benefit of one person or location which imposes obligations, rights and conditions on the property and its owner for the purpose of protection or conservation of an area of high natural value or a property with natural or agricultural value.”

“Special Planning Area Management Plan for Puerto Rico’s Mangroves”, whose preparation and content are based on the OPP-PRLUP and the Integral Development Plan adopted by PRPB in 1979 and other laws, regulations and commonwealth and federal statutes regarding their protection.<sup>65</sup>

The purpose of the Management Plan is to harmonize the preservation and conservation of mangroves with Puerto Rico’s social and economic activity. This plan is geared toward taking advantage of the potential these systems have for scientific research, education, recreation and tourism while their natural, environmental and cultural aspects, which make this resource unique, can be protected.

### 3. Development control

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Some 25 statutes have been approved in Puerto Rico, along with their respective regulations, while there nine laws at the federal level providing mechanism for the protection of mangrove systems (DNER, 2003).

Federal law provides even further protection against dredging and filling of the majority of mangroves in Puerto Rico. All filling of swampland, including the depositing of dredged material requires a permit from USACE, along with the supervision and veto power of the EPA<sup>66</sup>. The legal dispositions regarding permits are contained in Section 404 of CWA.<sup>67</sup> In Puerto Rico, the USACE permit is solicited following a procedure known as the *Federal and Commonwealth Joint Permit Application for Water Resource Alterations in Waters, Including Wetlands, of Puerto Rico* of 1999, described in the section regarding wetlands.

Federal permits require the endorsement of commonwealth agencies with jurisdiction. It should be noted that without an endorsement from any of the commonwealth agencies, the federal permit is null. However, the cutting of mangroves is not subjected to any permitting process. At the local level, the “Puerto Rico Forests Act,” *supra*, protects mangroves designated as commonwealth forests and prohibits cutting, or affect trees in public or private property whose characteristics are indispensable or necessary for forest use, including the protection of watersheds, control of erosion or maintaining the ecological balance of the environment. Following the dispositions in this law, the PRPB adopt the “Planting, Cutting and Foresting Regulations for Puerto Rico,” Planning Regulation No. 25, which requires a DNER permit for cutting and grooming trees on public or private land in Puerto Rico.

The PRPB has also protected some mangroves by imposing certain conditions during the development control process. These conditions are commonly recommended by the EQB during revision of environmental impact statements.

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<sup>65</sup> These legal statutes are presented in detail in the section regarding Wetlands.

<sup>66</sup> See 33 U.S.C.A. §1344.

<sup>67</sup> The rules and regulations under Section 404 are: 40 CFR Parts 230-237 (EPA) and 33 CFR Parts 320-330 (USACE). These rules establish specification guidelines for conforming with Section 404 (b) (1) of the CWA, the restrictions to permits, the regulatory policy which applies to all types of USACE permits and its relation to applicable Federal law. It also disposes the aspects which should be considered at the time of evaluating permits, describes permit procedures to fill or dredge wetlands and describes the types of penalties and applicable procedures for public meetings, among other aspects.

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*Need: Study to determine the exact impact of mitigation activities and the extension of the types of mangroves on the Island*

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Currently, no agency, department or environmental entity knows exactly what percentage of the mangroves belongs to what species. In the absence of a systematic monitoring of mitigation projects, the failure or success of mitigation or reforestation actions is also unknown (Pérez, 2003).

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*Need: Apply policies established by the Special Planning Area Management Plan for Puerto Rico's Mangroves in an effectively, efficiently and coherently manner.*

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The Special Planning Area Management Plan for Puerto Rico's Mangroves provides mechanisms for the acquisition of land through donation, management agreements, leasing, exchanges or the administration of public land. The *donation* provides for private landowners who have mangroves, to cede them to the DNER. *Management Agreements* can be established between private owners and the DNER. These agreements allow for the conservation of the area, while the owner can keep the deed to the land. DNER can also enter into a *lease* agreement with deed holders for a determined period of time, with the purpose of using the land for conservation purposes. DNER can also *exchange* land of natural value for other land of natural value, such as mangroves.

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*Need: Promote the use of the planning instruments established in Chapter 13 of the "Law of Autonomous Municipalities"*

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Some of the planning instruments established in Chapter 13 of the "Law of Autonomous Municipalities", *supra*, such as transfer of development rights, open an opportunity for protection of lands in private property or belonging to other government agencies or public corporations. One of the established mechanisms, known as *dedication*, allows for the donation of land of natural value to a Puerto Rico government agency (DNER) as part of the implementation of a Municipal Land Use Plan.

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*Need: Promote a mechanism for transferring to DNER all mangroves in hands of other Puerto Rico Government agencies or corporations*

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It is recommended that DNER solicits the transfer of all government-owned land which contains mangroves.

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*Need: Achieve the transfer to DNER of all mangrove areas currently located in former military installations which have been declared surplus.*

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Other cases could require placing a claim on lands declared as surplus and which may contain areas with mangrove systems.

## **B. Protecting mangroves against sedimentation and oil spills**

One of the most significant measures to avoid damage caused by sediments, as well as other pollutants, in the coastal zone, has been EO 1999-08. This EO orders all government entities

to develop and implement the *Puerto Rico Coastal Nonpoint Pollution Control Plan* (PRCNPCP). This Plan establishes management measures by categories, including dispositions related to agricultural activities, urban, marine, recreational boating, wetlands, river Banks and vegetation treatment activities.

Other measures to reduce damage caused to mangroves due to sedimentation and oil spills are discussed in other parts of this report related to “reduction of erosion and sedimentation” and the “reduction of damages caused by oil spills” in the section dedicated to Coastal Waters.

### C. Protecting mangroves against solid waste disposal

Another cause for the deterioration of mangroves is the fact that some of these areas have been used for waste disposal, particularly solid waste. For example, the Cabo Rojo’s landfill was located in a mangrove, constituting an activity that threatens the mangroves in *La Garra*, *Bahía Sucia*, the Bird Refuge and *Caño Boquerón*.

**TABLE III-10. TYPES OF MANGROVES IN PUERTO RICO AND A SUMMARY OF MANAGEMENT RECOMMENDATIONS**

Types of mangroves in Puerto Rico and a summary of management recommendations				
Classification	Location	Ecological value	Management recommendation	Detrimental activities
Mangrove Isle  Border mangrove	South Coast	Wildlife refuge. Water quality control. Dissipates sea energy. Its roots and bottom are habitat and nursery for youth species. Offers protection and nourishment to many marine organisms.	Selective cuts with recreational purpose. Fishing and wildlife refuge.	Excessive marine pollution, oil spills, levee around the isle, excessive dredging, sedimentation and excessive cutting.
a. Coastal	Throughout the length of canals, rivers, lagoons, coasts; predominates en la in the Southern Coast of the Island	Coastal protection. Exports high amounts of organic materials to ecosystems located downstream. Soil formation capacity. Mostly dominated by red mangrove, where the waves energy is major.	Wood production with short rotation intervals. Oysters and seafood production. Recreational facilities and housing, but in a way that they would not interfere with maritime currents or terrestrial runoff.	Discharge of sanitary water systems, levee, excessive dredging and sedimentation.
b. Interior	South Coast; bordering, canals and lagoons.	Nursing ground for maritime organisms. The interior is dominated by black mangrove. Coastal protection and regulates the exportation rate of organic materials to water bodies.	Recreation, fishing; research and selective cutting.	Susceptible to activities involving canalization, filling, dredging and levee construction.
Dwarf Mangrove	South Coast	Basin protection. Water storage. Water quality control. Abundance of aquatic birds (wildlife).	Landscape view (no alteration).	Highly susceptible to any human activity.
Riverine mangrove	Predominates in the Northern Coast of PR	Water quality control. Habitat for high and low grounds species. Flood control. Regulator of regional environmental quality.	Wood production with 20 years rotation. Processing of domestic effluents from nearby urban systems. Have precautions with river flow management and control with mangrove's water depth.	Prolonged flooding. Excessive sedimentation.
Basin mangrove	North Coast	Effective sediment trap.	In theory, ideal sanitary water treatment. Wood for clear-cut harvest. Recreational activities.	Water level should not exceed pneumatophores' height.

Source: DRNA (2003). Plan de Manejo para el Área de Planificación Especial de los Manglares de Puerto Rico.

### 3.2.4 DUNES

#### Findings

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Dunes provide an important barrier against the onslaught of waves during weather events along Puerto Rico's North Coast. Despite been reduced in numbers and extension, dunes provide protection to life and property and are a natural mechanism to limit coastal erosion.

In Puerto Rico, dune remnants can be found in the municipalities of Isabela, Quebradillas, Camuy, Arecibo, Barceloneta, Loíza and Carolina. Of these places, the largest concentration of sand can be found in Isabela, followed by Carolina and Loíza. However, the height and size of these dunes are insufficient for protection of life and property in the long term.

Due to the massive extraction of sand, very few dunes remain. The extraction of sand as a result of the construction industry has eliminated many kilometers of protective dunes. In areas where extraction has reached critical levels, saline intrusion and coastal erosion problems has been created. This has been the case of the *Tres Palmitas* beach in Loíza and the coast along Isabela. It is estimated that approximately 2.5 million cubic meters (m<sup>3</sup>) of sand were extracted from points to the west of *Punta Jacinto* in Isabela.

With the destruction of the dunes, the potential for damage due to coastal storm surge has increased, although the magnitude of that potential is still unknown. The actual conditions of some of the dunes are inadequate since their height, width and stability offer neither security nor protection to life or property located in the coastal zone (Martínez et al., 1983, as cited by Valeiras, 2007). Furthermore, the destruction of the dunes has contributed to coastal erosion.

The use of all-terrain vehicles along the beach has been an activity with negative consequences on the sand dunes among other coastal resources. These vehicles destroy dunes and rips out vegetation, which alters the stability of the dunes.

#### Public policy

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The OPP-PRLUP establishes as the general policy to "avoid all activities which could cause a deterioration or destruction of natural systems which are critical to the preservation of the environment, such ... sand dunes." (See Policy section 30.03).

#### Implementing the Policy

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##### A. Preventing excessive extraction of sand from protective dunes

##### 1. Commonwealth regulation governing sand extraction

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Commonwealth law prohibits the extraction of sand from protective dunes. The "Sand and Stone Law", Law No. 132 of 1968, was approved with the purpose of establishing in DNER a clear procedure for granting and renovating permits for the extraction, excavation and dredging of crust components. This law includes the principal mechanism which prohibits extraction of sand from dune areas. It also establishes that DNER's Secretary will not grant permits for excavations, extraction or dredging of crust components when, among other conditions, the activity proposed is located in area of dunes.

The “Law for the extraction and excavation of Earth’s crust components”, *supra*, establishes prohibitions for the excavation, extraction, removal or dredging of crust components in dune areas and it stipulates that the effects of this activity should be considered when it is proposed in dune areas in the maritime zone.

Also, the “Special Flood Hazard Areas Regulation”, *supra*, prohibits the alteration of dunes or wetlands which could increase the potential for damages from flooding due coastal surge. It also proposes the review of all development permit application in the coastal zone to determine if the proposed action will alter wetlands or dunes in such a way that it could increase the risk of damage due to flooding.

Coastal dunes are land deposits caused by wave action. With the help of the wind, the dunes are deployed along the coast in the maritime zone, therefore, they are under the jurisdiction of the “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands and the Maritime Zone,” *supra*.

Another mechanism for protection is Administrative Order No. 2-93 (AO-2-93), issued by the DNER Secretary in 1993 to “establish public policy regarding the conservation of sand resources in Puerto Rico.” This mechanism was created as an attempt to promote balance between supply and demand of this resource from the construction industry as well as its conservation. The Order prohibits all extraction from beaches and the mouths of rivers, specifically in Puerto Rico’s maritime zone. This order was issued after it was recognized that extraction of sand from the beaches and coastal dunes can cause substantial changes to the terrain, affect the balance of sediments and cause severe erosion, substantially degrading the environment.

The extraction of sand from navigable waters (river mouths and underwater deposits) requires a federal permit from USACE (see discussing regarding dredging in the Coastal Waters section).

## 2. Compliance with regulations regarding sand extraction

Two problems related to the compliance with the “Regulations for the Extraction, Excavation, Removal and Dredging of Earth Crust Components”, *supra*. The first problem surfaces when those who have been granted permits exceed the quantity of material they were allowed to extract.

The second problem is the cumulative impact of sand extraction without permits. These extractions generally happen in a smaller scale, typically one or two men with a shovel and a truck. Often, these individuals extract sand from public beaches and some of them have been doing this for years without realizing that this is stealing. This numerous small-time operators represent a difficult obstacle to enforce the regulation.

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*Need: Rigorously enforce the regulation of the extraction of Earth crust components and enforce limitations imposed on extraction permits.*

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The responsibility for enforcing these statutes falls on the regional offices of DNER’s Rangers Corp.

### 3. Special Planning Areas (SPA)

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The remaining dunes are subjected to intense conflicts between the competitive demand for sand extraction, the need for protection against floods, recreational use and tourism. Dunes should receive attention from the government through the assignment of resources to take inventory and careful planning.

With the adoption of PRCZMP in 1978, the Boca Cangrejos-Piñones and Isabela areas were designated as SPA. The SPA in Piñones has a Land Use Plan adopted by the PRPB in 1992 and approved the Governor in 1995. Meanwhile, in Isabela, remnants of sand dunes, product of intense sand extraction, still remain. These remnants are part of a SPA which has been named SPA Isabela-Aguadilla and includes other important ecosystems such as palisades and diverse wetlands.

DNER prepared a Management Plan for the SPA Isabela-Aguadilla which is currently under consideration by the PRPB for its approval. Meanwhile, the area continues to experiment a considerable increase in construction activity. Furthermore, the zone is still being intensely used for recreational activities with the potential of further degrading the dune remnants. Walking access to some areas of the beach runs through the dunes which lead to other activities, such as the parking of vehicles on, or very close, to the dunes, an activity with the potential of further destabilizing them.

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*Need: Adopt a Management Plan for the SPA Isabela-Aguadilla*

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#### B. Providing sand for the construction industry

The protection of the dunes (and the beaches) by means of regulations will continue to be difficult (at both the policy and enforcement levels) until the industry develops or is given alternatives for the acquisition of aggregate material from other sources at reasonable prices. The report "Puerto Rico and the Sea" (1999) recommends the use of incentives, tax credits, loans and technical assistance to promote sand manufacturing through the recycling of concrete, plastic, glass and rock demolition. Help in the development of these sources is a key recommendation included in the PRCZMP, discussed in the section dedicated to Sand for Construction.

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*Need: Seek alternative sources for the construction industry.*

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It is necessary to adopt alternatives to supply the demand for sand by the construction industry. Among the alternatives are: the manufacturing of artificial sand and the recycling of materials, among other environmentally safe measures to meet the current demand.

Another alternative which has been used by other coastal countries for the regeneration of these systems is the extraction of sand from the seabed using suction tubes. This activity should be done in proximity with the coastal zone to be benefitted. Research done on the insular platform by the USGS identified three underwater deposits of sand and gravel of economic importance: to the west of Vieques, to the north of Isabela and to the south of Cabo Rojo (Rodríguez, 1996). However, although it may seem viable from an environmental and economic perspective, this would only be a temporary solution to the critical situation of sand supplies for construction.

Faced with this situation, the Solid Waste Authority (SWA) should take the lead in the development of recycling plants to process plastic, glass and concrete for the manufacturing of artificial sand. Meanwhile, DNER, as the lead agency responsible for the regulation of extraction of crust components, should examine the estimates of sand reserves available to be extracted and, if feasible, use its leadership to formulate legislation to prohibit sand extraction from the maritime zone and coastal areas which are property of the government (Beller et al., 1999).

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*Need: Establish a program or take measures to restore and stabilize the dune remnants.*

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According to the Management Plan for the SPA Isabela-Aguadilla, after decades of massive extraction, there are still residual dunes with potential to be restored.

A measure to protect these dunes from the erosion process is the reforestation of the dunes and adjacent areas. This should be done with plants resistant to sand movements and to high salt concentration and require little water. However, for this measure to have any success, it needs to be accompanied by other measures to protect the beach.

A study done by Nichols & Cerco (1983) regarding the function of coastal dunes for the protection of sand resources, proposes various measures in order to protect and restore this resource. The study was done in response to the decay of sand dunes and its fundamental purpose was to manage the dune remnants through a scientific base and engineering principles in order to minimize future damage and assure their stability. Also, this study provided some direction for future sand extraction, which permits protection to a certain degree, by reducing the height of some coastal areas and reserving the capacity of the sand to “feed” adjacent beaches.

Among the measures presented in the mentioned study was the natural restoration by erecting barriers between the dunes and human activities, in order to allow for the natural process and dynamics to gradually rebuild the dunes. To achieve this, a barrier of between 60-70 meters in width would need to be built and deployed along the existing coastal dunes (Nichols & Cerco, 1983).

Other alternatives are the construction of beach fences, as suggested by the Management Plan for SPA Isabela-Aguadilla and the construction of accesses or boardwalks much like those built by DNER in Loíza.

### 3.2.5 BEACHES

#### **Findings**

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The beaches of Puerto Rico are coastal resources of great importance. Beaches are defined as banks along the sea or ocean formed by non-consolidated sand – occasionally by gravel or pebbles – on level surfaces with smooth leanings and which could have characteristic vegetation.<sup>68</sup> In Puerto Rico, including Vieques, Culebra and other islets and cays, there are

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<sup>68</sup>Definition taken from “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone,”

approximate 998.6 km of coasts, of which 208 km. (41%) are beaches. That extension of the coast line is divided into 231 beaches in 42 of the 44 coastal municipalities. Of these, 97 have been classified as accessible or swimmable beaches by DNER (CPN, 2002).

Beaches are resources of incalculable value for the protection of other natural resources. For example, beaches are spawning ground for some marine turtles including some endangered or threatened species (see section on Wildlife). Beaches are also important for recreation and tourism activities.

The composition of individual beaches depends of the source of materials. Sand for beaches primarily comes from the sediment carried by rivers from the interior of the island; coastal erosion from cliffs, dunes, nearby rocks and material transported by currents, such shells and corals.

There are three dominant groups of minerals characteristic of Puerto Rico's beaches: quartz sands with feldspar; volcanic rock, serpentine and mineral group; and sands from calcium carbonate.

The color of the beach sand reflects its composition and this depends on the composition of the origin rock. In general, the rivers carry sediments comprised of dark minerals (magnetite), clear minerals (quartz) or rock fragments. For example, beaches which are located near river mouths and which receive sand from the interior are commonly grayish or black in color. Beaches with white or yellowish sand, which are sands with calcium carbonate, are composed of fragments of calcified skeletons from marine organisms which grow in the insular platform. In most beaches, both sediment and calcium carbonate contents are found, but what varies is the proportion of these elements.

In Puerto Rico, there are few places where the same type of sand composition persists. Beaches with different types of sand are observed within small distances since each one, no matter how small, is a system which receives its sand from a different source.

Most beaches in Puerto Rico are assets of public domain. This is a legacy from Roman and medieval law which was transferred to Puerto Rico by the Spanish government as part of its port system and has remained despite the changes in sovereignty.

The "Law of Waters" of 1866, under which Spain sought to uniformly regulate waters in Spanish territory, is a precursor of current legal concepts for the management and monitoring of public domain assets. These include the definition of beaches, their components and criteria for their demarcation (Cerra & Salles, 2007).

The "Law of Spanish Ports" of 1880, was extended to Puerto Rico in 1886 under the name of "Law of Ports for the Island of Puerto Rico" and declared as public domain assets and for public use the maritime zone and the coast. In 1898, after the Treaty of Paris was ratified, Spain ceded the Puerto Rican territory, including its public domain assets and its administration, to the United States. The administration of these assets was transferred to

the Government of Puerto Rico by the Foraker Act (1900) and the Jones Act (1917)<sup>69</sup>, with the exception of the navigable waters and beaches belonging to the Caribe Hilton Hotel.<sup>70</sup>

In 1968, the “Puerto Rico Ports and Piers Law”, *supra*, went into effect and it adopted the definition of maritime zone included in the “Law of Ports for the Island of Puerto Rico,” *supra*. It is not until 1980 that the United States government recognizes that the Puerto Rican government owns the rights to the underwater land up through a limit of three marine leagues, equivalent to 10.35 nautical miles.<sup>71</sup>

DNER, as stipulated in its Organic Law, Law No. 23 of 1972, as amended until 1999, is Puerto Rico’s government agency responsible for monitoring and conserving Puerto Rico’s territorial waters, the underwater land in them and the maritime zone, as well as manage its use and enjoyment. Said law also transferred to DNER the responsibility of demarcation of the maritime zone.

The demarcation of the maritime zone is a critical component for the implementation of laws and policies regarding the coastal zone, in particular the “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone,” *supra*, which stipulates the operational framework for the agency’s mandate to conserve, oversee and manage the maritime public domain assets.

Management of Puerto Rico’s beaches falls under several government agencies. Through the passage of the “Law to create the Interagency Board for the Management of Beaches in Puerto Rico”, Law No. 293 of 1999, an organism responsible for establishing public policy for the management of Puerto Rico’s beaches was created.<sup>72</sup> The responsibility to coordinate efforts as well as public and private resources in order to promote safety, conservation and adequate use of the beaches was delegated on this Board. The Board is also responsible for the compliance of laws as well as commonwealth and federal regulations regarding beach resources, among other responsibilities.

Extraction of sand from the beaches, which caused severe damage for a long period of time, no longer represents a grave danger. In the past, many beaches were intensively exploited to extract sand for construction purposes. The problem of extraction without proper authorization still persists (see discussion about this topic in the Dunes section), but the problem is more focused on river mounts rather than beaches.

Erosion and contamination affects beaches as well as other parts of the coast. Erosion has drastically reduced the size of some beaches (in the section dedicated to Coastal Erosion, measures to respond to this problem are discussed). Furthermore, water contamination interferes with the recreational use of some beaches.

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<sup>69</sup> Foraker Organic Law, April 12, 2000 and Jones Act, Organic Letter of Puerto Rico, 1917

<sup>70</sup>The legal status of the site of the Caribe Hilton hotel was originally part of the San Juan Naval Base and today belongs to a Puerto Rico Government agency which leased it to the Federal government for 999 years (an unusual lease). (See the opinion of the Puerto Rico’s Solicitor General of Nov. 25, 1970 and Haba Vs. el Trib. de Contribuciones, 76 DPR 923 (1954); the right to exclude the public from the beaches in that area is upheld.

<sup>71</sup> Public Law 96-205, 1980.

<sup>72</sup> The same is composed of seven members from government agencies: DNER, EQB, PRPB, Department of Sports and Recreation, Office of the Commissioner of Municipal Affairs and representatives from the private sector associated with the tourism industry.

With the purpose of protection the health of beach users, the EQB established the Beach Monitoring and Public Notification Program. Under this Program, EQB samples water from 24 beaches throughout Puerto Rico every two weeks in order to monitor the presence of fecal contaminants in the water.

Aside from monitoring, the Program includes notifying the public about results and possible health risks. Public announcements are made through press releases, signage on the beaches and the placement of flags which notify beach users regarding the conditions of the waters.

A series of additional obstacles exist which impede the public's optimum enjoyment of recreational facilities in the beaches. Among these are:

- Legal barriers which impede access to some areas.
- Some beaches, although legally public, are not accessible because people cannot cross properties adjacent to the beach. The obstacles can be legal (access is prohibited) or practical (i.e. cars or parking are not permitted).
- When people arrive at the beach (or other parts of the coast) they find the lands have been invaded.
- Tall buildings form shadows which affect visually the beaches.
- Some beach areas are too small in proportion to the level of recreational use on them, which may lead to over usage and subsequent deterioration.
- Absence of facilities, services or adequate infrastructure (patrols, lifeguards, restrooms, parking, facilities for handicapped and signage).
- Poor water quality or coastal waste.
- Possible conflicts between beach users such as, salespeople, fishermen, swimmers, surfers, among others.

These obstacles, that should be overcome in order to assure maximum use in the present and the future, will be discussed in the following section.

## A. Securing the public's rights to use the beaches

### **Findings**

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The majority of Puerto Rico's beaches are legally open to be used by the general public. The coastal space touched by the sea flow is included within the maritime zone<sup>73</sup>, and it is part of the public domain.<sup>74</sup>

The "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone," *supra*, establishes four fundamental aspects related to the management of these resources. They are:

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<sup>73</sup> Puerto Rico Ports and Piers Law" of 1968.

<sup>74</sup> Puerto Rico Civil Code (1930). 31 LPRA Art. 254.

- The beaches are not for private use and their access will be public, except in justified cases for safety reasons, among others;
- Usage of assets of public domain in the maritime zone will be free, public, and at no cost for common uses;
- Uses which require facilities or what special circumstances will require the authorization granted by DNER and
- Said activities or facilities will have to be related to the use of the waters.

However, over the last decades, conflicts regarding the use of the maritime zone for non water activities and the zone’s occupation, legally or illegally, have proliferated. This could be a result of the diverse interpretations in the application of the criteria at the moment of doing the demarcations, which are done on an individual basis in the absence of a general demarcation of the zone.

In some cases, access to the beaches can be restricted by the government for safety reasons. This is the case of the former training grounds that were property of U.S. Navy in the Eastern part of Vieques, where a large part of the coast is restricted for safety reasons and belongs to the Wildlife Refuge under the administration of the USFWS. Within this area, some beaches, such as “blue beach” (*Bahía Corcho*) and “red beach” (*Bahía de la Chiva*) were opened for public use.

By the same token, a number of beaches which were formerly reserved for the recreational use for military personnel (Crash Boat in Aguadilla and Punta Salinas in Toa Baja) are now open to the general public. Others, such as the case of the former Roosevelt Roads Naval Base, will be opened to the public once the transfer process to DNER is completed.

Another factor which can limit public access to the coast are land concessions granted by the Spanish Crown. These concessions were granted before the “Law of Ports for the Island of Puerto Rico”, *supra*, went into effect in 1886 and there are some landowners who claim their rights under these concessions. These concessions can authorize certain private landowners to exclude the public from using beaches allegedly on their property. However, it is still unknown how many beaches are subject to these concessions and/or their legal validity.

## Responding to findings

### 1. Demarcation of the maritime zone

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In order to be able to execute the surveillance and conservation of the maritime zone, as stipulated by its Organic Law, DNER adopted the “Manual of Procedures for the Demarcation of Inland Limits of Public Domain Assets in the Maritime Zone.” Said manual establishes the criteria, indicators and provides uniform methodology for making decisions associated with demarcations, among other aspects.

DNER is also working on a project known as the “Development of the baseline for the demarcation of the Maritime Zone for Puerto Rico, Culebra and Vieques.” This project

constitutes an official reference system for the demarcation of the maritime zone which is based on: data and information obtained from computer models and simulations of the maximum tide associated with metonic cycles<sup>75</sup>;

- The most recent ortophotogrametry;
- Sequential geographical analysis to detect changes in the coastline using historical aerial photographs (since 1936);
- Official historic land boundaries in the maritime zone and contiguous conformities on record in DNER and DTPW archives ;
- Analysis of the permanent vegetation line, which serves as an indicator for the coastal line to be demarcated as part of the Maritime Zone and natural systems with different characteristics to those which constitute the Maritime Zone
- models and simulations of waves associated with historic recurring storms in Puerto Rico;<sup>76</sup> and
- field work from the traditional work done by land surveyors.

Prior to the beginning of any project within the Maritime Zone, DNER's Land Surveying Division must establish the boundary of the zone in order to assure the usage of maritime public domain asset in free, public and with no cost for common use of the resources. However, for projects which require construction of facilities which are dependent on water, DNER can grant a concession to authorize its enjoyment.

## 2. Registration of Spanish Crown concessions

More information is needed in order to determine if concessions made by the Spanish Crown represent a potential threat to Puerto Rico's beaches. It is not known with certainty which coastal lands are subject to those concessions. For example, the PRCT counts with land, known as *Salinas Fortuna* in la Parguera (Debbie Boneta, 2003; personal communication) under these concessions. There is no inventory of agencies, public corporations or citizens who may own lands under these concessions.

In order to deal with a similar issue regarding water resources, the Government of Puerto Rico approved the "Water Act", *supra*, which requires a registry of Spanish Crown concessions for water sources. There is, however, no similar law to deal with concessions which may authorize landowners to exclude the general public from the Maritime Zone.

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*Need: Law which requires a registry of concessions which may exclude the general public.*

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In order to have an inventory of coastal lands which may be subject to Spanish Crown concessions, a law which requires a registry of these concessions, which may authorize the exclusion of the general public from the Maritime Zone, must be passed. The law should also establish in a reasonable period of registration, maybe a year, after which 1) concessions

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<sup>75</sup> 19-year cycles.

<sup>76</sup> Pressure and winds of 55 mph and winds associated with a Category 2 hurricane.

which are not registered will be invalidated and 2) the validity of said concessions will be determined in a manner determined by law.

### 3. Federal lands declared to be surplus

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Established policy. The federal government has declared some of its lands on the coast as surplus. This presents an opportunity to expand and optimize access to the beaches. The following public policy is established in order to take advantage of opportunities which may arise:

Appropriate access to federal beaches declared surplus from now on.

*If any of Puerto Rico's beaches, which are property of the federal government, were declared surplus for the needs of said government, then those beaches will be made accessible to the maximum extent to which it is practical for the permanent recreational use of the general public, unless a more appropriate use, and for the general wellbeing of the Puerto Rico Government, is found.*

### B. Public access to the coast

#### Findings

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Some beaches are not accessible because people cannot pass through contiguous properties in other to reach them. In certain places, there is no legal access to pass through contiguous properties. In other places, rights to pass exist, but there are different obstacles impeding access as well as obstacles for pedestrians, vehicles or lack of parking.

Lack of access to the coast has become a problem of great importance. In towns and cities, generally, the streets are used to provide access to the coast. By the same token, fishermen and others who needed access could, often, cross through properties along the shore, sometimes with or without the legal right to cross.

However, access has become a significant problem in recent years mainly due to changes in development patterns along the coast. Starting in the 1990s, controlled access to urbanizations and residential complexes along the coast has proliferated. Many of these control access using security guards or rigid structures, such as fences or gates. This has also created psychological barriers since they create the perception that free access is not permitted. The resort community of *Palmas del Mar* in Humacao is the most vivid example of this practice in Puerto Rico (Francisco J. Quintana, 2003; personal communication).

Furthermore, the substantial increase in the use of private cars causes vehicular congestion and stuns access due to the improvisation of parking areas along the roads, situation which further damages adjacent coastal systems. Another problem is the fact that mass transportation on the island provides access to a few beaches mainly in the SJMA. The rest of the beaches (the majority) are used by a growing population which access the beaches using private vehicles.

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*Need: Establish transportation requirement for the beaches for special events and days where most visitors are expected.*

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The problem of access due to vehicular congestion can be experimented throughout the complete coast of the island. The establishment of requisites for collective and/or alternate methods of transportation is recommended when special events are programmed for beach area in order to control excessive levels of vehicles in the beaches. Access to the beaches can be provided through a series of facilities which would make viable, as is the case of public beaches. It is important to ensure, however, that access to the beaches does not interfere with the enjoyment of said resource, since, for example, people can park inadequately and harm the resource and impede access for other people. An alternative would be to provide parking areas and that people can access the beach as pedestrians.

For this alternative, the establishment of priorities should be considered since it would not be practical to provide facilities to all 97 beaches categorized as accessible and swimmable by DNER (CPN, 2002).

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*Need: Maximize public access to Puerto Rico's coast and beaches in compliance with the current laws and regulations.*

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In Puerto Rico, the "Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico", *supra*, requires adequate accesses to beaches which should be free of obstruction with adequate signage. There has been great conflict in the implementation of this Regulation, particularly in matters dealing with the granting of exceptions and variations for reasons and justifications which are not necessarily clear.<sup>77</sup> This has had negative social consequences in the sprawling of communities including fishing communities which have displaced due to the construction of residences and condominiums on what used to be their work area (Ruiz, 2002).

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*Need: Strengthen the development of coastal communities by making them more productive and resistant to coastal risks.*

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EO-12898 requires from federal government agencies and those projects which use federal funding to incorporate environmental justice concepts into their proposals and plans. The EPA's Region 2, of which Puerto Rico is part, developed guidelines for environmental justice. Locally, the "Regulation for presentation, evaluation and procedures of environmental documents," Regulation No. 6510, requires that, as part of an Environmental Impact Statement (EIS), an environmental justice study is done which incorporates population distribution by ethnic group and by socioeconomic parameters. However, it is recommended that more specific guidelines be developed at the local level in order to include other evaluation criteria to avoid exclusion and displacement situations, particularly of workers who depend on access to the beach for their livelihood.

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<sup>77</sup> See NOAA's document "Final Evaluation Findings, Puerto Rico Coastal Zone Management Program, March 2001 through May 2005".

## Public policy

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In the OPP-PRLUP, the following public policy regarding access to public beaches is established.

"Avoid, that by the establishment of new activities or by lot authorization, the unnecessary loss of future use options of the resources, keeping, among others, the following objectives:

–Avoid construction of buildings in beach areas and dissuade those activities or lot divisions in land contiguous to the beach which have an effect of impeding: free access to beaches, the free enjoyment of its scenery and the free access to the sun and enjoyment by all of the citizens" (See Policy 30.07).

## Additional Policy established

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The PRCZMP established the following policy:<sup>78</sup> Public access to beaches. Development in front of the coast, be they public or private, should, in the measure in which it is practical, be designed to facilitate instead of obstructing access to the coast by the general public. It is recognized that the general wellbeing, on occasions, requires restriction of access (i.e. to areas of environmental crisis or endangered species or for public safety reasons). However, the de facto segregation of public beaches, as a result of development patterns, for the enjoyment of private landowners by preventing access by the general public is prohibited in Puerto Rico.

## Implementing the Policy

### 1. Inventory of beaches and access plans

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DNER's Coastal Zone Division counts with a component known as Public Access to the Coast, under which an inventory of public accesses to the coast, an evaluation of coastal activities and recreational activities and the creation of strategies for improvement of accesses have been established.

The "General Plan for Public Access to the Coast" is currently being prepared for all seven coastal sectors. At the moment, "Guidelines for Public Access to Puerto Rico's Coasts" have been prepared for the West and Northwest Sectors.

Other initiatives, such as creating a uniform signage system for beach access, risk areas and those areas deemed hazardous for swimmers, are also underway. The Division has also participated in access improvement projects which also help protect critical natural resources. For example, a boardwalk was built over the sand dunes in Piñones in such a manner that beach users could have access to the beach without having to walk over the dunes.

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<sup>78</sup> This policy was established by the PRCZMP of 1978 and was taken from the document "Puerto Rico and the Sea" of 1972. As previously stated, this revision does not include new public policies.

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*Need: Beach Access Plan.*

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The “General Plan for Public Access to the Coast” contains information regarding public access and regarding places of interest where sporting and recreational activities take place along the coast. However, it is necessary a plan with broader information, which aside from identifying accesses, recognizes the following:

- The varied characteristics of the coast – for example, in some areas beaches are long and contiguous while in others the beaches are small and rocky;
- The uses and functions of the coastal characteristics – this refers to the different ways people can enjoy the coast and an opportunity to establish restrictions in some areas to promote less intensive use;
- The different means by which accesses can be established – an alternative would be, in cases in which road parallel to the coast exists, that beach access can be secured by restricting construction to the south of the road and limiting construction parallel to the coast.
- The need for public facilities such as rest rooms, parking, pedestrian accesses, among others, after a need assessment is completed.

The beach access plan hereby recommended should also: 1) establish accesses to beaches containing structures which currently impede it or where access is confusing and 2) determine possibilities of providing access attune with public safety needs and the protection of resources.

## 2. Require that all new coastal developments provide access

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The PRPB, according to the dispositions included in its “Organic Law”<sup>79</sup>, adopted the “Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico,” *supra*. Its purpose is to protect and guide the development of coastal lands according to their potential as well as provide access to Puerto Rico’s beaches and coasts. This regulation requires the provision of coast and beach access from new projects developed in the Maritime Zone. These accesses can be provided either through the project or bordering them and should observe a maximum separation of 800 meters in urban areas, if they are for vehicular access, and 400 meters for pedestrian accesses.<sup>80</sup> In non-urban zoned areas, the separation will be 1,600 meters for vehicular access and 400 meters for pedestrian or any other access. According to the Regulation, all accesses must include correct signage with the name of the beach or the sector.

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<sup>79</sup> Said law establishes that the PRPB must adopt a regulation on control of use of beaches, public beaches and other bodies of water to control the development and use of beaches, public beaches and other water bodies in protection of the public’s interest, for the concessions which were granted for recreational and touristic purposes in a manner that it assures that entities which have such concessions offer adequate installations to the public which guarantee and do not pose an obstacle for public use of those portions of the beaches.

<sup>80</sup> In the case of lots segregated prior to approval of this regulation, the separation for vehicular access can be incremented to 1,200 meters and to 600 meters for pedestrian or any other accesses.

The Regulation also establishes that for all construction, lot division or urbanization of land in front of the coast, the PRPB will require a buffer zone of at least 20 meters wide, measured from the delimitation of the Maritime Zone towards inland. The Regulation further establishes that no edification will be built in an area 30 meters wide contiguous to said buffer zone.

At the municipal level, the “Law of Autonomous Municipalities,” *supra*, also incorporates the topic of beach access pointing out that “the municipalities will not approve developments which could limit or impede free public access to coasts or beaches, which would entail private or exclusive enjoyment of the resource by jeopardizing the people of Puerto Rico’s legitimate right to use and enjoy said areas.”

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### 3. Government acquisition of access easements

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The beach access plan previously recommended could demonstrate that the acquisition of land (right of passage) is appropriate in order to provide access to some portions of the coast. This could be done in rural areas where access has been blocked and where no coastal development has been planned.

Through the “Land and Water Conservation Fund Program” which is administered by NPS, the commonwealth or municipal governments can acquire lands through matching of federal funds. These lands could be used for the development of facilities for recreational use, including access to the coast.

Furthermore, Section 306A of the “Coastal Zone Management Act” establishes that funds can be assigned to eligible coastal jurisdictions which comply with, among other objectives, the establishment of public accesses to the beach and other coastal areas.

However, each one of these alternatives including the use of federal funds, requires that these funds are matched with local funds.

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*Need: An element of the plan which evaluates the acquisitions needed in order to provide access.*

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The beach access plan previously recommended, should evaluate the need to acquire additional access routes and identify those which have priority.

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### 4. Protecting and clarifying existing accessways

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The law and habitual use have created important access rights to the coast. The protection, signage and clarification of these rights comprise an opportunity to secure these accesses and their use. Among those access rights are:

- a. Rights-of-way from “time immemorial”– This is a legal access right which is created when the general public has been crossing a particular property for as long as anyone can remember,<sup>81</sup> and before 1889, when the Civil Code went into effect.<sup>82</sup>

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<sup>81</sup> Laws of Castille (Las Siete Partidas).

<sup>82</sup> González Avilés, p. 90.

The beach access inventory should recognize accesses which have been used for “as long anyone can remember.” If the affected properties are subsequently developed, these accessways should be protected. In some cases, these accesses should be sufficiently important so as to use judicial processes or other measures in order to protect or clarify their status. However, the burden for proving immemorial usage is difficult, ergo the opportunities to guarantee accesses by this mean are limited.

b. Other rights-of-way- With the exception of habitual use, prolonged public access through a private property rarely results in legal right of access in Puerto Rico.<sup>83</sup> The claiming of rights through legal prescription therefore presents few opportunities to secure access to the coast.

c. Easement and surveillance- The “Law of Ports” of 1886 established a surveillance easement in order facilitate patrolling of the coast by government authorities.<sup>84</sup> This easement of surveillance on the coast is a legal obligation which consists of leaving a strip of land six (6) meters wide contiguous to the line of high tide, or the line determined by wave action after major storms where use of the line of high tide is not sensible. In places of difficult or dangerous passage, the strip could be placed further inland but without exceeding that which is strictly necessary. In areas where it is impossible to create this strip, owners of the contiguous land must allow access to authorized personnel as long as this access is necessary.

The salvage easement is another legal obligation on private property contiguous or on the Maritime Zone. This easement is defined by a strip twenty of (20) meters wide measured toward the interior line of demarcation of the Maritime Zone.

This easement was created to benefit fishermen who may need to enter private property when they are at the coastline due to an emergency, due to mechanical problems or problems with their vessel.<sup>85</sup> This easement is often used by governmental authorities to maintain public order.

### C. Removal of squatters from the coast

#### **Findings**

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Squatters have built structures on public property, on both land and in the water, in various places along the coast. Squatters who have settled along the Maritime Zone constitute one of most critical problems in the management of the coastal zone. The illegal construction of marine structures, residences, touristic and recreational facilities is sprawled along Puerto

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<sup>83</sup> Only the rights of passage which are continuous and evident can be obtained without a deed. (See Civil Code, Art. 475 312 LPRA 1653.)

<sup>84</sup> The same law apparently establishes a salvage easement which extends 14 meters inland for the benefit of sailors and fishermen forced out of the sea by storms. Even if this easement is still legally valid, it does not appear that it creates rights of access which allow the general public reach the coasts from the roads. The rights of access which are created apparently are from sea to land.

<sup>85</sup> Spanish “Law of Waters” of 1866 and “Law of Ports” of 1886.

Rico's coast. Examples of these squatter invasions along the coastal zone are residences in El Combate, Buyé and Joyuda in Cabo Rojo, Culebra, La Parguera and Patillas.

Squatter invasions create exclusion and pollution problems. Squatters, generally few in numbers, exclude the general public from the spaces they occupy and affect adjacent areas causing problems such as inadequate disposal of solid waste.

The squatter invasion problem along Puerto Rico's coast has various origins. First of all, the problem is not limited to public lands along the coast and it is an effect of the acute shortage of attainable house on the Island. The problem is also caused by the desire of people with more buying power to obtain a vacation residence. Ultimately, some people have the perception that regulations can be adjusted for a particular interest through informal mechanisms. Therefore, the problem of removing established squatters is extremely complex and requires interagency coordination.

The conflict that the proliferation of illegal structures along Puerto Rico's coast represents has been difficult to resolve. This, along with the way these activities have affected the people's right to use and enjoy their beaches, was recognized by RPA and DNER in an interagency agreement signed in 1984. Both agencies agreed to work together to dissuade illegal structures in the Maritime Zone, territorial waters and submerged lands. The agreement also included patrolling and enforcement of regulations on new projects along the zone.

Even though squatter invasions are illegal, the removal of existing residences represents a problem which needs to be handled very carefully.<sup>86</sup> Some squatter communities have existed for years and they expect to continue in existence. Removal becomes even more difficult when many of these people do not have other means for housing (Beller et al., 1999).

The possession of public domain lands for periods longer than 30 years does not constitute acquisition by extraordinary prescription. The slowness of the legal process to remove these structures from beaches, estuaries, lagoons and wetlands throughout the Island has slowed the rescue of public domain lands. (Beller et al., 1999).

## **Responding to findings**

### **1. Control future land invasions**

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DNER should establish a process to impede future development in the Maritime Zone, without previous authorization or which have a potential to lead to a privatization or destruction of these areas. For this purpose, it counts with the "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone," *supra*, which establishes the guidelines so developments incompatible to Puerto Rico's Maritime Zone or territorial waters do not occurs.

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<sup>86</sup> Puerto Rico Penal Code, Law No. 115 of 1974.

## 2. Invasion or rescues by people who do not possess other housing

The “Law for Residences built on another’s land”, Law No. 132 of 1975, allows some squatters to be granted a deed to the land they invaded. These deeds are only available to those who built their residences prior to passage of the law and who do not have other means for housing.

Despite the fact that the majority of Puerto Rico’s beaches (Maritime Zone) are of public domain, they cannot be used by individuals in their private character. Therefore, the granting of deeds of land is not possible in squatter invasions along the Maritime Zone.

In Culebra, squatters on land of public domain can be removed, but generally alternate housing should be provided for those who have no other place to go. However, there is no comparable statute which grants replacement housing for squatters removed from other lands of public domains in other parts of Puerto Rico.

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*Need: Removal of existing squatter invasions*

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After Hurricane Hugo, a law was passed which allowed Maritime Zone squatters in Culebra to reconstruct their residences until the DNER expropriate. Almost a decade later, after Hurricane Georges, most of these residences were destroyed, causing a significant loss of public funds invested in the reconstruction. This created an ideal opportunity to implement a policy to prohibit reconstruction unless the squatters could prove ownership of the land and the structure was their primary residence (Beller et al., 1999).

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*Need: A Housing Program for squatters.*

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In order to allow for the removal of squatters who do not have other means of housing, it is necessary to actively promote the establishment of an ample program for the relocation of existing squatter invasions by providing adequate housing in other locations.

## 3. Other invasions of coastal lands and waters

Providing housing for squatters, who do not own another property, although essential, does not constitute an adequate government response to the problem created in the squatter communities.

For example, in La Parguera Natural Reserve, there is a problem with residences built on assets of maritime public domain, including boat houses whose legality and ownership have been under dispute. In 1978, the Government of Puerto Rico and the USACE signed the “Memorandum of Agreement of the La Parguera Recreational Area,” which includes a commitment from both agencies to work in coordination toward the conservation and optimum use of La Parguera’s natural environment. The Government of Puerto Rico made a commitment to develop a recreational community for the use and enjoyment of all and to the remove all abandoned, unstable or dangerous structures from the waters and wetlands in La Parguera. Furthermore, there was a commitment in which Puerto Rico’s Government would, in a period of 12 years since the signing of the agreement, remove all private holdings from the lagoon embankment. For its part, USACE made a commitment to not grant permits for residences or private piers to be built on navigable coastal waters in La Parguera or near the

islets and cays after 1977. All permits granted by USACE to private owners of houses, piers and other structures would be void after 1980 (DRNA, 1992).

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*Need: Sensitive regulation of established squatter communities*

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According to the dispositions included in "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters and Submerged Lands Thereunder and the Maritime Zone", *supra*, the only uses for maritime assets of public domain are those dependent on the water, therefore, residential use is not permitted. However, the regulation establishes an exemption, due to consideration of social interest, for the use and enjoyment of an existing structure of value no more than \$30,000 which is also the occupant's primary residence, as long as said structure is not causing harm to the environment. In order for an individual to be eligible for this exemption, they must show legal evidence proving they are in the process of relocating their residence outside of maritime public domain assets. This process was created in order to phase-out residences and eventually have these assets freed of housing structures. However, in the majority of cases, this has not happened.

#### D. Protecting beaches against the shadows and visual domination of high-rise buildings

##### **Findings**

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High-rise buildings on shorefront property cast shadows on some beaches and dominate them visually. In areas such as Condado, Isla Verde and the SJMA, tall buildings cast their shadows over beaches preferred by sunbathers. During the winter tourist season, shadows cover the beaches for most of the day, thus diminishing the beaches' touristic value.

Future development need not to cast shadows on public beaches and other coastal areas. At the winter solstice shadows in the north are at their longest between 10:00 a.m. and 4:00 p.m. This means shadows can be up to 2.9 times the height of the structure. If future buildings are constructed further from the Maritime Zone, it would minimize the impact on the recreational potential of the beach since they would not cast their shadow over public areas on the Maritime Zone.<sup>87</sup>

Visual domination by buildings can also be avoided. There is a subjective element to determine if buildings visually dominate beaches. If structures exceed the height limit of a person's natural visual cone, then it is perceived as a reduction in space since the visual cone has approximate 1:2.1 ratio. If future buildings, along with its grounds, are set-back from the beach at a distance 2.5 times its height, its shadow will neither interfere nor cover the beach.

##### Public Policy

In the OPP-PRLUP, general public policy states the avoidance of "... the construction of buildings in beach areas and discourage activities or land subdivisions in neighboring areas which would ... prevent free access to and enjoyment of the sun by the citizenry."

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<sup>87</sup> In some cases, a front or rear patio is necessary for other purposes, especially to protect buildings from waves during storms. See section on Floods (including floods caused by hurricanes)

### Implementation of public policy

The "Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico", *supra*, establishes as a requisite that "all buildings to be constructed, transferred or expanded within a distance of 400 meters from the Maritime Zone, as determined by DNER, will observe a minimum distance from the Maritime Zone measured horizontally from its base or closest wall of 2.5 times its height" (Section 8.01).

### E. Protecting and enlarging public beach holdings

#### **Findings**

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The narrow strip of beach accessible to the public is often too small for optimum recreational use. In rural beaches of scant use, recreational activities could be improved if public access to areas beyond the line of vegetation can be secured. Furthermore, popular beaches need more space for parking and basic infrastructure. However, there are narrow accessible beaches which on many occasions are insufficient to satisfy these needs.

#### **Responding to findings**

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##### Acquiring shorefront land and facilities at coastal developments

Developers have dedicated properties for the Government of Puerto Rico as compensation, mitigation or as part of making a project viable for development. Developers have done this, for example, when establishing coastal roads (i.e. Levittown). This donation of land can be specifically earmarked for recreational uses (i.e. Parque Barbosa in Santurce; recreational areas in the Vacía Talega project, were approved by PRPB in 1975).

Diverse mechanisms exist by which better coastal facilities can be provided:

The "Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico", *supra*, establishes that when a project requires the dedication of a certain quantity of land for recreation, as part of the common use facilities, these are to be located in the area contiguous to the 20 meters which constitute the separation zone. These facilities should be in harmony with the use of the coast and beaches or the adjacent water body.

Chapter 13 of the "Law of Autonomous Municipalities", *supra*, provides, through the mechanism of dedication, the provision to a community of basic services for its development and general wellbeing, which could come in sporting, cultural or recreational facilities, among others.

By the same token, the "Subdivision and Urbanization Regulation," *supra*, requires developers to provide recreational facilities in new projects.

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*Need: Fitting the "Subdivision and Urbanization Regulation" for coastal cases.*

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Said Regulation provides an opportunity to require developers of projects contiguous to the Maritime Zone to provide facilities for general public use close to their project.

## F. Providing services and facilities for beach users

### Findings

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Puerto Rico has 12 public beaches with complete facilities, which are the property of the NPC. The minimum of facilities which are already in place are parking spaces, showers, rest room and green areas. Other public beaches have lifeguards, concessions and areas for handicapped, among others.

These public beaches (*balnearios*) are located in areas designated by the “Puerto Rico Qualification Regulation”, *supra*, as Public Beaches (PP, by its Spanish acronym). Its purpose is to designate coastal sectors appropriate for sea bathing, passive recreation or anything related to this activity.

Puerto Rico has 52 PP districts distributed among 29 municipalities and includes 34 km of the coast. Each area counts with diverse facilities and is administrated by one of the following dependencies: DNER, NPC or municipal governments (DRNA, 2007a).

The coastal segments apt to be zoned as public beaches are determined by their morphological characteristics, type of permitted activities and available facilities on each beach (See Map 18).

These PP districts are distributed in the following manner:

- 16 public beaches in the North (13.3 km. of coast),
- 12 public beaches in the East (9 km. of coast),
- 11 public beaches in the South (4.9 km. of coast), and
- 13 public beaches in the West (7.2 km. of coast).

The areas reserved for swimmers are marked by buoys or other floating markers as are high risk areas or areas for the protection of natural resources.

The installation of the buoys falls under the responsibility of DNER’s Commissioner for Navigation as stated in the “Puerto Rico Navigation and Aquatic Safety Act,” *supra*.

However, many beaches exist in Puerto Rico, including some of popular use, which have little or no services. There are vast areas of beach which are simply common properties accessible to the general public, but have neither facilities nor services. These beaches are located in both urban and rural areas.

**Leyenda -  
Map Key:**

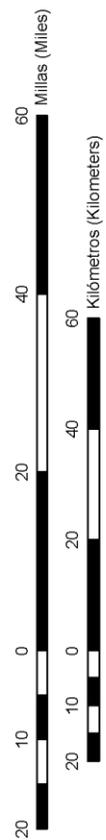
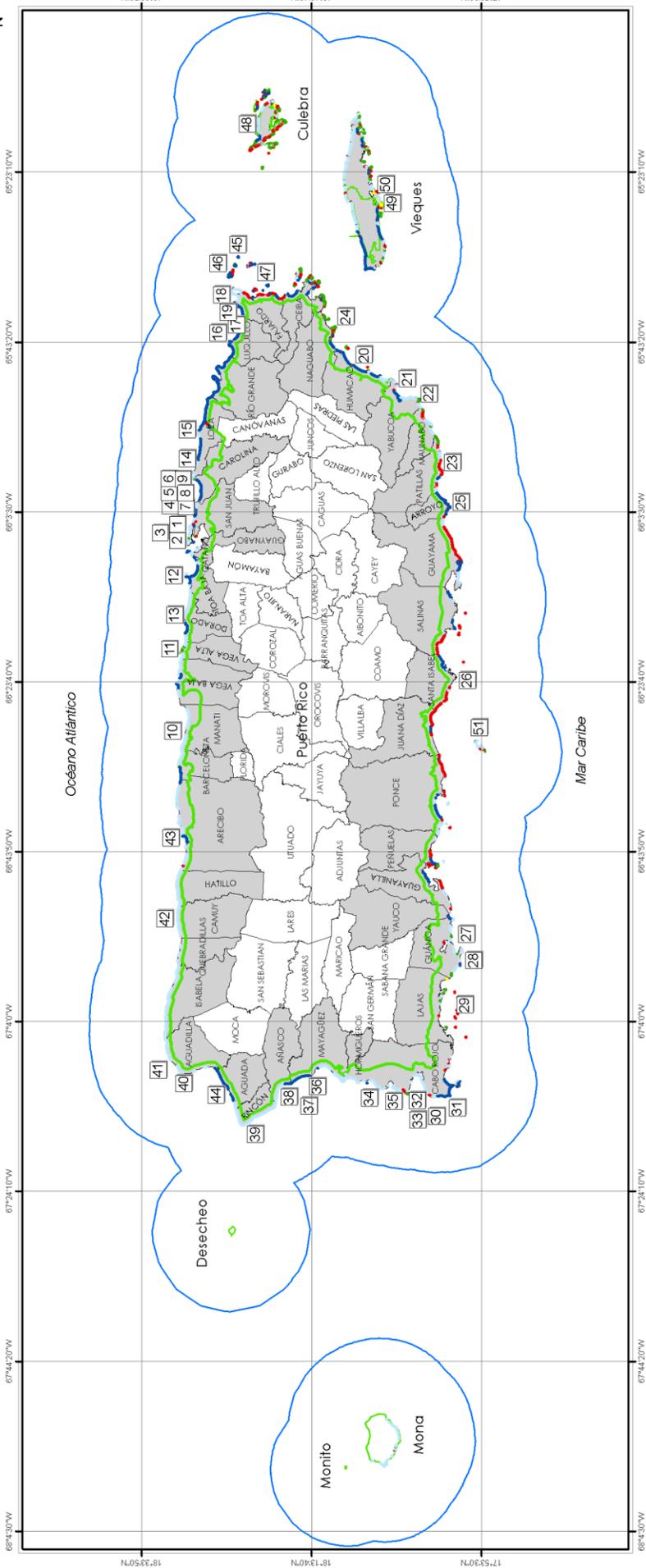
- 1- Laguna Condado
- 2- Poca del Condado
- 3- Escambrón
- 4- Officer's Park
- 5- Ocean Park
- 6- El Alambique
- 7- Punta El Medio
- 8- Isla Verde (Holiday Inn)
- 9- Balneario Isla Verde
- 10- Mar Chiquita
- 11- Balneario Centro Gordo
- 12- Balneario Punta Salinas
- 13- Balneario Dorado
- 14- Boca de Cangrejos
- 15- Punta Vacía Talega
- 16- Balneario La Monserrate
- 17- Costa Azul
- 18- Seven Seas
- 19- Kiosko Luquillo
- 20- Balneario Punta Santiago
- 21- Guayanés
- 22- Balneario Lucia
- 23- Balneario Los Bajos
- 24- La Fanduca (Húicare)
- 25- Balneario Punta Guillarte
- 26- Jauca
- 27- Balneario Caña Gorda
- 28- Playa Santa
- 29- Playita Rosada
- 30- Combate
- 31- Balneario Combate
- 32- Moja Casabe
- 33- Balneario Boquerón
- 34- Buyé
- 35- Punta La Mela
- 36- Tres Hermanos Balneario Añasco
- 37- Villas de Añasco
- 38- Caguabo (Almirante)
- 39- Balneario y Parque Rincón
- 40- Parque Colón
- 41- Crash Boat
- 42- Perón Brusí
- 43- El Muñile
- 44- Balneario Pico de Piedra
- 45- Cayo Obispo
- 46- Cayo Icacos
- 47- Palominos
- 48- Balneario Flammenco

- 49- Balneario Sun Bay
- 50- Media Luna
- 51- Caya de Muertos
- Playas de grano de arena fina y mediana -  
Fines to medium grained sand
- Playas de arena de grano grueso -  
Mixed sand and gravel
- Playas muías de arena y grava -  
Rocky shores
- Playas rocosas protegidas -  
Rocky shores
- Playas de arena y grava -  
Gravel beaches

Limite de la zona costanera tierra adentro -  
Coastal Zone Inland Boundary

Limite de la zona costanera marina (9 millas náuticas) -  
Coastal Zone Maritime Boundary (9 nautical miles)

Escala - Scale 1:860,000



Fuente de Información - Source:  
Hazardous Materials Response Division  
Office of Response and Restoration  
National Ocean Service  
National Oceanic and Atmospheric Administration  
June 2001

# Playas públicas Public Beaches

Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 18 / Map 18



TABLE III-11. INVENTORY OF PUBLIC BEACHES DISTRICTS

Inventory of the Public Beach districts																														
Name	Municipality	Region	Management	Erosion	Currents	Pollution	Buoys	Gezebo	Fishing	Diving	Camping	Surfing	Boat access	Keyaks	Marina	Vacational center	Boat ramp	Fishing village	Deck	Lodge	Food	Pier	Camping area	Handicapped access	Showers & bathrooms	Lifeline	Fee	River / Lagoon	Beach line [m]	
1	Peñón Brusi	Camuy	North	Municipal	*	*	*	*	*																				177	
2	Muelle de Arecibo	Arecibo	North	Municipal		*	*	*	*					*	*	*		*	*	*		*			*					293
3	Mar Chiquita	Manatí	North	Commonwealth					*																				249	
4	Puerto Nuevo	Vega Baja	North	Municipal	*	*	*	*	*												*	*			*	*	*	*	642	
5	Cerro Gordo	Vega Alta	North	NPC	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	585	
6	Balneario de Dorado	Dorado	North	NPC				*	*	*								*	*	*	*	*	*	*	*	*	*	2,268		
7	Punta Salinas	Toa Baja	North	NPC				*	*	*										*	*	*	*	*	*	*	*	1,481		
8	El Escambrón	San Juan	North	NPC	*	*	*	*	*		*								*	*	*	*	*	*	*	*	*	282		
9	Playa del Condado	San Juan	North	NPC		*	*	*	*										*	*	*	*	*	*	*	*	*	171		
10	Laguna del Condado	San Juan	North	Commonwealth			*	*	*					*					*	*	*	*	*	*	*	*	*	85		
11	Ocean Park	San Juan	North	Municipal	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1,988	
12	Alambique	San Juan	North	Municipal	*	*	*	*	*					*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1,604	
13	Hilton Pine Grove, Casa Cuba	Carolina	North	Municipal		*	*	*	*				*						*	*	*	*	*	*	*	*	*	625		
14	Balneario de Carolina	Carolina	North	Municipal	*	*	*	*	*									*	*	*	*	*	*	*	*	*	*	*	2,006	
15	Boca de Cangrejos	Loiza	North	Municipal	*	*	*	*	*										*	*	*	*	*	*	*	*	*	87		
16	Vacía Talega	Loiza	North	Commonwealth	*	*	*	*	*											*	*	*	*	*	*	*	*	*	758	
17	La Monserrate	Luquillo	East	NPC		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1,669	
18	Playa Azul	Luquillo	East	Municipal	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	360	
19	Seven Seas	Fajardo	East	NPC		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	545	
20	Cayo Obispo (Isleta Marina)	Fajardo	East	Private		*	*	*	*					*	*	*	*	*	*	*	*	*	*	*	*	*	*	127		
21	Cayo Palomino	Fajardo	East	Private		*	*	*	*					*	*	*	*	*	*	*	*	*	*	*	*	*	*	203		
22	Cayo Icacos	Fajardo	East	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	214	
23	Flamenco	Culebra	East	Municipal		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1,347	
24	Sun Bay	Vieques	East	NPC		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1,334	
25	Media Luna	Vieques	East	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	434	
26	Hócares	Naguabo	East	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	349	
27	Tropical Beach	Naguabo	East	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	403	
28	Punta Santiago	Humacao	East	NPC	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	2,033	
29	Guayanés	Yabucoa	South	Municipal		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	493	
30	Lucía	Yabucoa	South	Municipal	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	690	
31	Balneario de Patillas	Patillas	South	Municipal		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	478	
32	Punta Guilarte	Arroyo	South	NPC	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1,871	
33	Balneario de Salinas	Salinas	South	Municipal	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	174	
34	Jauca	Santa Isabel	South	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	89	
35	Playa de Ponce	Ponce	South	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	208	
36	Caja de Muertos	Ponce	South	Municipal	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	100	
37	Caña Gorda	Guánica	South	NPC		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	341	
38	Playa Santa	Guánica	South	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	438	
39	Playa Rosada	Lajas	South	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	48	
40	Bahía Salinas	Cabo Rojo	West	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1,022	
41	Combate	Cabo Rojo	West	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	622	
42	Moja Cazabe	Cabo Rojo	West	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	256	
43	Balneario de Boquerón	Cabo Rojo	West	NPC	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1,390	
44	Buyé	Cabo Rojo	West	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	708	
45	Villa La Mela	Cabo Rojo	West	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	818	
46	Cayo Ratones	Cabo Rojo	West	Commonwealth	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	254	
47	Balneario de Añasco	Añasco	West	NPC		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	703	
48	Almirante	Añasco	West	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	250	
49	Balneario de Rincón	Rincón	West	Municipal	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	129	
50	Pico de Piedra	Aguada	West	Municipal	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	319	
51	Parque Colón	Aguadilla	West	Municipal		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	299	
52	Crash Boat	Aguadilla	West	Commonwealth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	474	
																										<b>Total</b>	<b>34,486</b>			

Source: DRNA. (2007, draft). Inventario de áreas para balistas.

The Interagency Board for the Management of Beaches in Puerto Rico runs the *Program for the Promotion, Protection and Conservation of the Beaches of Puerto Rico Aspiring to the Blue Flag*.<sup>88</sup> The *Blue Flag* campaign is an international initiative by *Foundation for Environmental Education* which provides a certification to beaches which comply with established safety, services and water quality criteria established by the Foundation. The Foundation also seeks to establish environmental committees on the beaches to include recycling and planning programs as well as monitoring of nesting areas of species, if they exist.<sup>89</sup> The *Blue Flag* designation indicates that these beaches have the necessary infrastructure for users (rest rooms, showers, etc.) and are spaces in which environmental education is promoted.

In Puerto Rico, the following public beaches, belonging to the NPC, are certified by the *Blue Flag Program*<sup>90</sup>

- El Escambrón in San Juan
- La Monserrate in Luquillo
- Punta Salinas in Toa Baja
- Seven Seas in Fajardo
- Balneario de Isla Verde in Carolina

It is neither feasible nor desirable to provide a full range of recreational services and facilities at all beach areas accessible to the public. The cost of providing services and facilities to all the beaches would be prohibitive.<sup>91</sup> Many people enjoy (and some even prefer) beaches without facilities. Therefore, it is essential to establish priorities to decide in which beaches facilities and services would be provided.

In 2002, the NPC did a study known as *Preliminary Analysis of the Operation of Beaches in Puerto Rico*. For this study, 54 beaches classified as accessible and swimmable were selected with the purpose of evaluating current operations and make recommendations for improvements in management and operation. Among the findings of this analysis was the need to provide minimal facilities and services in the evaluated beaches. Among those minimal services needed were: surveillance, lifeguards and janitors to tend to showers, bathrooms and offices. Among the basic facilities needed were: buoys, trash cans and signage.

Early attention needs to be given to the problem of beach litter. This is a problem which detracts the enjoyment of many beaches, particularly those of intense use. However, the problem is seen even in less used beaches, since litter is tossed into the waters or carried-out by the flow of rivers from the interior of the Island.

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<sup>88</sup> Created for the "Law to Establish the Program for the Promotion, Protection and Conservation of Puerto Rico's Beaches which Aspire to the Blue Flag", Law No. 173 of 2000.

<sup>89</sup> Blue Flag: Caribbean Beach Criteria: Recovered online October 12, 2004  
[http://www.blueflag.org/Caribbean\\_criteria.asp](http://www.blueflag.org/Caribbean_criteria.asp).

<sup>90</sup> Taken for the organization's web page: <http://www.blueflag.org>.

<sup>91</sup> La extension of installations and services could, aside from costs, submit the government to additional responsibilities and thus, costs for personal damages for beach users. The legal aspects, among others, need to be explored.

Aside from the solid waste disposal, the proliferation of dumped material and abandoned structures has become a problem.

Erosion has caused significant changes to some parts of the coast, forcing owners of affected or threatened structures to take measures – among which is the construction of containment walls – to protect their property. While erosion has been advancing, protection mechanisms in place have lost their effectiveness and some of these structures have been abandoned. This situation created a problem affecting citizens' enjoyment due to the loss of coastline and the occupation of space by trash or dumped materials.

### **Responding to findings**

#### 1. Establishing clear responsibility for beach cleaning

The shared responsibility between different agencies is one of the principal obstacles for the cleaning of the beaches. DNER's Organic Law delegated on this agency the responsibility for the conservation, cleaning and maintenance of the Maritime Zone, whose operational aspects are stated in "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters and Submerged Lands and the Maritime Zone", *supra*. For the cleaning of beaches, DNER counts with the routine work of beaches brigades.

DNER also counts with the "Adopt a Beach" program, created by the "Adopt a Beach Program Law," Law No. 250 of 1999. The purpose of this Program is to integrate non-government organizations (NGO) and the municipalities into programs for cleaning and beautifying beaches. The Program counts with a "Regulation to Implement the Adopt a Beach Program," Regulation No. 6767, which contains the public policy for beautification, maintenance and restoration of beaches and the administrative processes which regulate activities promoted under this program (DRNA, 2001b).

The topic of solid waste management in beaches is also contemplated in the "Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico," *supra*. This Regulation establishes that any person who deposits trash on Puerto Rico's coasts or beaches will have incurred in a violation, which is considered a misdemeanor criminal offense.<sup>92</sup>

The responsibility of cleaning the beaches is shared with the NPC, which is responsible for cleaning public beaches under its jurisdiction. Meanwhile, the Puerto Rico Tourism Company (PRTC) has a brigade in-charge of cleaning the beaches from *El Escambrón* to the area behind the Isla Verde Cemetery (Arce, 2004; personal communication).

It should be noted that NGOs, community



**Citizens collaborating on beach cleaning**

*Picture by: CPN.*

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<sup>92</sup> All persons accused of a misdemeanor will be levied a fine no greater than \$500 or incarceration for a term no longer than six months, or both, at the discretion of the Court.

organizations, private businesses and individuals have supported beach-cleaning efforts by organizing efforts to clean beaches and other bodies of water year round.

One of the most significant efforts is the “International Coastal Cleanup”, an international initiative headed by the Ocean Conservancy organization and locally coordinated by Scuba Dogs. This massive cleaning effort, aside from removing trash from Puerto Rico’s coasts, compiles information regarding the kind of trash to identify its sources. It also incorporates educational aspects to the beach-cleaning efforts.

## 2. Providing adequate funds for beach cleaning manpower and equipment

DNER’s fiscal problems have kept it from complying with its duties of cleaning and maintaining Puerto Rico’s beaches. Its seven regional offices have the responsibility of maintaining 138 beaches throughout the island and they often lack the equipment needed to perform their duties.

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*Need: Equipment and personnel to clean beaches*

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The Legislature and the Office of Management and Budget (OMB) should assign additional funds for the cleaning of beaches and hire additional personnel to operate them.

## 3. Promote the reduction of solid waste generation on the beaches and provide opportunities to develop recycling programs

Solid waste cannot be collected frequently in all the beaches, especially those which are in remote areas and whose topography and/or vegetation impede the use of machinery for this purpose. Furthermore, the disposition of solid wastes in Puerto Rico is a problem that is progressively getting more complex; therefore, it is essential to take measures to reduce the amount of solid waste being generated. These measures should include:

- Awareness: There should be a continuing, public and massive education campaign.
- Assistance: More trash cans should be placed in beaches to optimize trash pick-up.
- Monitoring compliance: Ensure coastal installations are complying with the dispositions of the “Regulation for the Management of Non-Hazardous Solid Waste” approved by the EQB, Regulation No. 5717.
- Incentives: Recycling should be promoted through clearly identifiable depositing areas.

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*Need: Promotion of adequate management of solid and marine waste*

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A large portion of the solid waste found on the coast is dragged by rivers and streams from Island’s interior. Therefore, it is necessary to promote adequate management of solid waste in the interior and make people aware of the impact this has on coastal sectors.

#### 4. Observe the regulatory set-backs from the coast

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Observing regulatory set-backs between structures and Maritime Zone have the benefit of protecting residences and new installations. This way, their potential conversion into dumping sites or abandoned structures is avoided.

#### 3.2.6 WILDLIFE

##### Findings

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Due to its island characteristics, Puerto Rico has less biodiversity than other continental countries. Still, Puerto Rico has a great variety of endemic species. According to the “Puerto Rico Comprehensive Wildlife Conservation Strategy” a document published in 2005, some 5,847 species of native wildlife has been identified. Of these, 51 are reptiles (Rivero, 1998), 18 are amphibians (Rivero, 1998), 5,573 are insects (Torres & Medina-Gaud, 1998), 190 are birds (Raffaele, 1989) and 15 are mammals (García, Burgos, Ventosa & López, 2005).

The federal list of endangered species maintained by the USFWS, under dispositions of the ESA, includes species and subspecies endangered or threatened in Puerto Rico. In Puerto Rico, there are 61 species currently on the federal list of endangered species of which five are mammals, two are amphibians, eight are birds, 10 are reptiles and 36 are plants. The inclusion and removal of species and subspecies from the federal list is a continuous process. The local species and subspecies included in the list as of May 2000 are indicated in Table III-12.

DNER maintains a list of species protected under the “New Wildlife Law of Puerto Rico”, *supra*. The list of species in need of protection and recuperation is part of the “Regulation on vulnerable and endangered species in the Commonwealth of Puerto Rico,” Regulation No. 6766. This list includes 132 species of which eight are mammals, eight are amphibians, 27 are birds, 17 are reptiles, 20 are invertebrates, four are fish and 48 are plants.

Of the vulnerable species included in the local list, 30 species and two subspecies are endemic to Puerto Rico.<sup>93</sup>

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<sup>93</sup>Information obtained from the “Regulation on vulnerable and endangered species in the Commonwealth of Puerto Rico”

TABLE III-12. SPECIES IN PUERTO RICO PROTECTED BY THE ESA

Species in Puerto Rico protected by the Endangered Species Act (ESA)	
Common Name	Scientific Name
<b>Species Endemic to Puerto Rico</b>	
1. Yellow -shoulder Black Bird ( <i>mariquita</i> )	<i>Angelaius xanthomus</i>
2. Puerto Rican Parrot ( <i>cotorra puertorriqueña</i> )	<i>Amazona vittata vittata</i>
3. Puerto Rican Nightjar ( <i>guabairo</i> )	<i>Caprimulgus noctitherus</i>
4. Puerto Rican Boa ( <i>boa puertorriqueña</i> )	<i>Epicrates inornatus</i>
5. Monito Gecko ( <i>salamanquita de Monito</i> )	<i>Sphaerodactylus micropithecus</i>
6. Puerto Rican Sharp-shinned ( <i>falcón de sierra</i> )	<i>Accipiter striatus venator</i>
<b>Non-endemic Species</b>	
1. Puerto Rican Plain Pigeon ( <i>paloma sabanera</i> )	<i>Columba inornata wetmorei</i>
2. Hawkbill Turtle ( <i>carey de concha</i> )	<i>Eretmochelys imbricata</i>
3. West Indian Manatee ( <i>manatí antillano</i> )	<i>Trichechus manatus manatus</i>
4. Latherback Turtle ( <i>tinglar</i> )	<i>Dermochelys coriacea</i>
5. Brown Pelican or Alcatraz ( <i>pelícano pardo</i> )	<i>Pelecanus o. occidentalis</i>
6. Humpback Whale ( <i>ballena jorobada</i> )	<i>Megaptera novaeangliae</i>
7. Sei Whale ( <i>ballena sei</i> )	<i>Balaenoptera borealis</i>
8. Fin Whale ( <i>ballena de aleta</i> )	<i>Balaenoptera physalus</i>
9. Sperm Whale ( <i>cachalote</i> )	<i>Physeter macrocephalus</i>
10. Broad-winged Hawk ( <i>guaraguao de bosque</i> )	<i>Buteo platypterus brunnescens</i>
11. White-neck crow ( <i>cuervo pescueciblanco</i> ) <sup>1</sup>	<i>Corvus leucognaphalus</i>
<b>Endangered Species</b>	
1. Golden Coquí ( <i>coquí dorado</i> )	<i>Eleutherodactylus jasperi</i>
2. Cook's Robber Frog or Rock Coquí ( <i>coquí guajón</i> )	<i>Eleutherodactylus cooki</i>
3. Puerto Rican Crested Toad ( <i>sapo concho de Puerto Rico</i> )	<i>Peltophryne lemur</i>
4. Green Sea Turtle ( <i>peje blanco</i> )	<i>Chelonia mydas</i>
5. Loggerhead Sea Turtle ( <i>cabezón o caguama</i> )	<i>Caretta caretta</i>
6. Mona Island Ground Iguana ( <i>iguana de Mona</i> )	<i>Cyclura cornuta stejnegeri</i>
7. Mona Island Boa ( <i>boa de Mona</i> )	<i>Epicrates monensis monensis</i>
8. Roseate Tern ( <i>palometa</i> )	<i>Sterna d. dougallii</i>
9. Piping Plover ( <i>playero melódico</i> )	<i>Charadrius melodus</i>
<b>Species that inhabited Puerto Rico and are thought to have disappeared</b>	
1. Culebra Island Giant Anole ( <i>lagartijo gigante de Culebra</i> )	<i>Anolis roosevelti</i>
2. Puertorican Iguana ( <i>iguana de Puerto Rico</i> )	<i>Cyclura pinguis</i>
3. Baboya de Etheridge ( <i>baboya de Etheridge</i> )	<i>Leocephelus etheridgei</i>
4. Puertorican Baboya ( <i>baboya de Puerto Rico</i> )	<i>Leocephelus partitus</i>
5. Mona's Terrestrial Turtle ( <i>tortuga terrestre de Mona</i> )	<i>Monachelys monensis</i>

Source: USFWS.

<sup>[1]</sup> Enlisted as extinct on the Fishing and Wildlife Conservation Service's Endangered Species List of May, 2002.

All wildlife, including all species whether endangered or not, represent a significant natural resource. The “New Wildlife Law of Puerto Rico”, *supra*, recognizes the importance wildlife has for Puerto Rico, reason why it declares that “it is the public policy of the Government of Puerto Rico to protect wildlife and particular natural habitat of all species.”

Although the decline of wildlife in Puerto Rico may be attributed to several causes, habitat destruction is the most important. The conversion of forest areas has had adverse effects on

birds and land vertebrates. The loss of habitats or their fragmentation has increased the threat against plants and animals in weather events such as hurricanes and storms. Also, the reduction of wetlands has resulted in a fragmentation of what at one point was an extensive and continuous coastal corridor (García, Burgos, Ventosa & López, 2005). Currently, the majority of remaining wetlands serve as a habitat to many aquatic bird species. However, the occupation of these areas by invasive species, such as the *Typha dominguensis*, could limit access for these aquatic birds for feeding and nesting (Weller & Fredrickson, 1974 and Kaminski et al., 1985, in García, 2005). Also, activities such as the dredging of the marshlands in the Lajas Valley, for example, damaged the rich aquatic environment sustaining wild birds' populations.

The degradation of different habitats, along with the colonization by invasive species, could threaten remaining natural areas which in some way serve existing wildlife. This is significant considering the fact that 86% of Puerto Rico's land is under private ownership.

The introduction of exotic species constitutes another threat for wildlife. Exotic species causes the loss of native species, changes the structure and function of local ecosystems and alters the physical structure of the system (Money & Drake, 1986, Drake et al., 1989 in García, 2005).

Other threats against wildlife include overfishing, illegal or clandestine hunting and the use of chemicals. These activities occur both in the coastal zone and on the rest of the Island.

## Public policy

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In the OPP-PRLUP, the general public policy is established as "avoid activities that would cause the degradation or destruction of natural systems which are critical to the preservation of the environment, such as ... habitats for endangered species." (See public policy 30.03.)

## Implementing the Policy

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### A. Protecting habitat against disruption

#### 1. Public ownership and custody

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In the "Regulation on the conservation and management of wildlife, exotic species and hunting in the Commonwealth of Puerto Rico," Regulation No. 6765, DNER presents a list of areas under its jurisdiction which are protected and considers being natural wildlife refuges.

The USFWS manages five National Wildlife Refuges (NWR) in Puerto Rico: the Cabo Rojo NWR (743 ha) that includes the Cabo Rojo Salt Flats (*Salinas de Cabo Rojo*), the Culebra NWR (4,181 ha), the Desecheo NWR (146 ha), the Laguna Cartagena NWR (428.6 ha), the Vieques NWR (7,152 ha) and portions of the La Fortuna salt marshes in Lajas.

There are other protected natural areas, among which are those lands owned by the PRCT providing protection and serving as wildlife habitat.

While high costs may hamper the acquisition of private lands, the current legal framework allows for its protected. However, it could be possible to transfer to the DNER the custody of publicly-owned coastal lands deemed of importance to existing wildlife.

## 2. Management and protection

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Wildlife in Puerto Rico is protected by federal and commonwealth laws. At the local level, DNER is the only agency with jurisdiction over matters related to wildlife through the implementation of commonwealth laws and regulations. Among those laws and regulations is “New Wildlife Law of Puerto Rico”, *supra* which has the purpose of protecting, conserving and promoting the survival of species, both native and migratory; declares that all species under its jurisdiction are property of Puerto Rico; regulate hunting and establishes parameters for the introduction of exotic species; among other matters.

Under the framework provided by this law, the types of habitats and their value for wildlife is evaluate to determine the required level of protection. In cases were high value is determined and endangered or threatened species are present, proceeds to designate the area as a critical or essential habitat for the conservation of the area and to make viable the recovery of the species.

Other statutes available to DNER for protection of wildlife are: the “Department of Natural and Environmental Resources Rangers Corp Act”, *supra*; the “Puerto Rico Fisheries Act”, Law No. 278 of 1998, as amended; the “Regulation on Puerto Rico Fisheries of 2004”, *supra*; the “Regulation on the conservation and management of wildlife, exotic species and hunting in the Commonwealth of Puerto Rico”, *supra*; the “Regulation on vulnerable and endangered species in the Commonwealth of Puerto Rico”, *supra* and the "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters and Submerged Lands Thereunder and the Maritime Zone", *supra*.

Through the “Puerto Rico Natural Heritage Program Act,” *supra*, the DNER identifies priority conservation areas containing recognized critical biotic elements<sup>94</sup> and prepares plans for land acquisition and protection. The Law establishes the creation of a fund to be used for land acquisition and nourished by legislative assignments or any other sources as disposed by law or regulation, as well as funds received from private donations. Likewise, for the acquisition, conservation and maintenance of lands deemed to have a high ecological value, the “Fund for Acquisition and Conservation of Land in Puerto Rico Act”, Law No. 268 of 2003, was approved. This fund is nourished by 50% of the surplus of the Used Oil Management Fund, federal assignments and donations.

At federal level, NOAA and USFWS count with various programs geared toward the protection of wildlife and manage a series of federal statutes, among which are: the ESA<sup>95</sup>, the “Marine Protection, Research and Sanctuaries Act” of 1972<sup>96</sup>; the “Marine Mammal Protection Act” of 1972<sup>97</sup> and the “Fish and Wildlife Conservation Act” of 1980<sup>98</sup>.

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<sup>94</sup> Critical elements are those species of flora and fauna whose risk of extinction is high, very high or extremely high in the wildlife, reason for which special protection and conservation efforts are needed. These are recognized as species of singular value due to one or various of the following attributes validated by the scientific community: patrimonial value in Puerto Rico, its sporadic disappearance due to exploitation of the species or its habitat, rarely or its legal designation as vulnerable or endangered by the ESA.

<sup>95</sup> 16 U.S.C.A. §§ 1531-1544

<sup>96</sup> 33 U.S.C.A. §§ 1401-1445

<sup>97</sup> 16 U.S.C.A. §§ 1361-1407

Through the implementation of the ESA, a cooperative program between DNER and USFWS was established in Puerto Rico. Federal funds assigned to this program are used for the protection of habitats, the establishment of programs geared toward the recovery of species, land acquisition, management, patrol, research and public awareness.<sup>99</sup>

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*Need: Develop strategies to optimize sustainable management of Natural Reserves so they incorporate the protection, knowledge and enjoyment of wildlife.*

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Designated Natural Reserves serve as habitat for a large number of wildlife species. However, the lack of adequate funding and human resources makes their management difficult. Options exist to tend to this situation, among which are joint management efforts, and ecotourism, among others.

### 3. Development Controls

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The PRPB's public policy against the disruption of the habitats of endangered species is to be applied, to public as well as private property via the development control system described in Chapter 4, as well as in evaluating applications for Federal and Commonwealth permits.

It is impractical to identify in advance every site to which this policy applies. For this reason, it is essential that evaluations are made on a case-by-case basis regarding the impact on wildlife of proposed developments.

Another protection mechanism is found in the ESA, which requires federal agencies to ensure that authorized activities, funded or subsidized by these agencies, do not degrade the habitats of threatened or endangered species or cause the destruction of these critical habitats. For some species included in the list, formal procedures have been established to designate a specific geographical area considered critical for the survival of said species.

### 4. Zoning

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"The Puerto Rico Qualification Regulation", *supra*, contains zoning districts which allow for the protection of lands requiring resource conservation, among which wildlife resources are included.

#### B. Protecting wildlife against illegal or clandestine hunting

##### 1. Regulation

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In Puerto Rico, game hunting is regulated by laws and regulations enforced by the DNER.

The "Regulation on the conservation and management of wildlife, exotic species and hunting in the Commonwealth of Puerto Rico," *supra*, has among its purposes the rigorous regulation of the granting of hunting licenses, registration of weapons as well as the revocation and suspension of these permits for violations of the "New Wildlife Law of Puerto Rico", *supra*, or any other statute. The Regulation establishes areas where hunting is permitted among which

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<sup>98</sup> 16 U.S.C.A. §§ 2901-92911

<sup>99</sup> Information obtained from [www.drnpr.net](http://www.drnpr.net).

are the Boquerón and Humacao's wildlife reserves, and determines which species are subject to hunting.

DNER created the Hunters Education Program as a measure improve hunting practices in Puerto Rico and create better awareness among sportsmen regarding this topic.

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## 2. Enforcement of regulations

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DNER's Bureau on Fishing and Wildlife has the responsibility of enforcing all related regulations. For its part, the Rangers Corp has jurisdiction over enforcement of laws and regulations regarding conservation and development of natural resources.

At the federal level, the USFWS has an Office of Compliance, located in the municipality of Guaynabo. Other offices, such as Boquerón and Río Grande, are dedicated to activities regarding protection and recovery of endangered species and wildlife.

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*Need: Strengthen the enforcement of laws and regulations geared toward the protection of wildlife.*

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The Government of Puerto Rico should consolidate efforts to enforce laws and regulations geared toward the protection of wildlife in Puerto Rico. For this purpose, it will need to assign more resources to recruit more agents for the Rangers Corp, train and equip them with the necessary materials so that they can perform their duties.

### 3.2.7 COASTAL WATERS

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#### Findings

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Puerto Rico's coastal waters are a resource of incalculable importance. They are essential for the transportation of goods to and from the island, constitute an important resource for recreation and tourism, support resources with economic potential such as fishing, is the habitat for the reproduction of species of high ecologic and economic value and help form coastal resources such as dunes, beaches, reefs and mangroves, among other wetland areas.

Coastal waters include rivers, swamps, fresh water lagoons, salt water bays and the sea. Puerto Rico's coastal waters cover a territory of approximately 885 km (549.9 miles) (EQB, 2006). There are 224 rivers and 553 ravines, many of which are tributaries

of one another. Of these, 55 rivers discharge their waters to see (DNER, 2008). There are also some 1,556 ha in estuaries and 20 lagoons which cover another 1,930 ha. Some 9,296 ha are covered by salt water wetlands while another 32,010 ha are covered by fresh water wetlands (EQB, 2006).

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#### Puerto Rico's coastal waters

- Coastal waters- 885 km
  - Estuaries- 1,556 hectares
  - Lagoons-1,930 hectares
  - Salt water wetlands - 9,296 hectares
  - Fresh water wetlands -32,010 hectares
  - 55 rivers
- 

Among the most relevant fresh water bodies are: *Laguna Tortuguero, Caño Tiburones* and the *Pterocarpus* swamps. Salt water lagoons include: *Laguna Torrecillas, Laguna de Piñones, Laguna Grande, Laguna Aguas Prietas* and *Laguna Joyuda*. Bays located in the North coast include: *Bahía de San Juan, Ensenada Boca Vieja, Ensenada Comezón* and *Bahía Las Cabezas*.

Other important commercial bays include: Jobos, Guánica and Guayanilla, among others. There are also various bioluminescent bays in the South and Northeast sectors as well as in Vieques.

To assure that coastal waters keep serving their varied essential functions, it is necessary to identify and stop their sources of contamination. The EQB has classified sources of coastal pollution as either point or non-point sources of pollution. Some point sources of pollution are industrial and municipal discharges and underwater offshore discharge pipes from water treatment plants. Non-point sources of pollution come from five main areas: agricultural areas, urbanization, marinas, hydromodifications and mining.

The main coastal water pollution problems are discussed in the following sections:

- A. Reduction of pollution caused by municipal and industrial discharges;
- B. Reduction and prevention of damages caused by fuel spills;
- C. Reduction of non-point sources of pollution, mainly contamination sources associated with soil erosion and sedimentation of water bodies.
- D. Reduction of environmental damages caused by dredging and filling.
- E. Reduction of environmental damages caused by abandoned vessels in coastal waters.

#### A. Reducing pollution from municipal and industrial waste discharges

#### Findings

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In Puerto Rico, approximately 20% of the coastal waters comply with quality standards of use for which they were designated, among which are directed or indirect contact and sustaining marine life.<sup>100</sup>

The most recent report (2006), highlights that out of a total of 549.9 miles of coast, 109.8 (20%) complied with their designated use (Category 1). In another 30.4 miles (5.5%), at least one of the water quality standards was not met, reason why it was considered necessary to develop measures known as Total Maximum Daily Load (TMDL).<sup>101</sup>

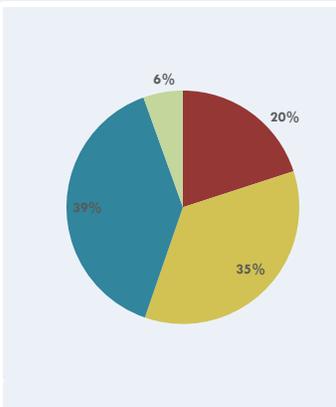
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<sup>100</sup> This data is published every two years in the “Puerto Rico 305(b)/303(d) Integrated Report” in which the EQB, in compliance with Section 305 (b) of the CWA evaluates the quality of diverse water resources in Puerto Rico with the purpose of determining if they comply with water quality standards.

<sup>101</sup> TMDL is a calculation of the maximum amount of a single pollutant a water body can receive and still comply with water quality standards and location of polluting source. A TMDL is the sum of all quantities of a single contaminant from a point and non-point source of contamination. The calculation should include a safety margin to insure that the water body can be used for the designated purpose under the Regulation on Water Quality Standards by the EQB.

TABLE III-13. COASTAL WATERS CONDITION

Condition of coastal waters			
	Miles	%	Description
Category 1	109.8	20.0	Waters that meet the standards for all designated uses
Category 2	194.2	35.3	Waters that meet some of the standards, but there is not sufficient data to determine compliance for all uses.
Category 3	215.5	39.2	Waters for which the information available is not sufficient to determine compliance with any of the designated uses.
Category 5	30.4	5.5	Evaluation units where, at least, one of water quality standards is not fully met and is considered necessary to develop a TMDL for all parameters.
<b>Total</b>	<b>549.9</b>	<b>100</b>	



Source: JCA. (2007). Water Quality Assessment and List of Impaired Waters 2006 303(d)/305(b) Integrated Report.

Many bays and estuaries monitored do not comply with water quality standings for their designated use. Some 1,876.6 ha and 207 km (128.9 miles) of water currents which comprise the estuaries were monitored. Of these, 66% (1,238 ha) did not comply with at least one of their designated uses. Meanwhile, 84% (108.6 km) of the water currents did not comply with their designated use.

In the specific case of the SJBE<sup>102</sup>, none of the 970 ha, or the 103.8 miles of water area which comprise it, complied with quality standards to support their designated use. This area has experienced the impact of inadequate land use, particularly due to the location of human settlement combined with illegal discharge pipes, water waste and used water discharges.

The SJBE is part of the EPA’s National Estuary Program sponsored under the CWA. Said Program later served as the foundation of the “Estuary Restoration Act” of 2000, which seeks to promote the restoration of estuarine habitats, develop strategies to establish and maintain communication between federal agencies and the private sector, provide federal aid for promotion and financing of projects, among others.

Municipal waste discharges are a major source of pollution. The Puerto Rico Aqueducts and Sewers Authority (PRASA) operates 60 water treatment plants which serve approximately 55% of the population located in Puerto Rico’s urban areas. Of these, six plants (Arecibo, Bayamón/Puerto Nuevo, Carolina, Ponce and Aguadilla) provide primary treatment to water and discharge directly to the sea.<sup>103</sup> For the 2004-2005 period, the EPA certified that these plants complied with requirements for operation and validated their discharge permits (EQB, 2006).

<sup>102</sup>The SJBE includes a complex combination of lagoons (San José, Torrecillas and Piñones), two rivers (Río Piedras y Río Puerto Nuevo), San Juan Bay and various bodies of water and canals, including Caño Martín Peña.

<sup>103</sup>In the year 2000, the Government of Puerto Rico signed an agreement with the EPA under Section 301(h) of the CWA which exempted the water treatment plants in Bayamón, Carolina, Aguadilla, Arecibo and Puerto Nuevo from having to provide secondary treatment for used waters until 2020 (EPA, 2003). In return, said section of the CWA allows these five plants to offer a primary depuration process for used waters.

Primary plants are limited to the separation of solids and chlorine treatment to kill bacteria. Once treated, these waters are discharged to sea, assuming they would be diluted within an area known as the mixing zone.<sup>104</sup> However, these areas are typically close to the coast and bathers areas (i.e. *Vacía Talega*) and the chlorine used in the treatment processes and the contaminants prevailing in these waters (metals and nutrients) constitute a threat to users, coral communities and marine life.

Another 52 plants provide secondary treatment to residual waters. As of 2005, 95% of these complied with requisites established by the EPA and the EQB regarding discharges to the Island's water bodies. Another three plants in the municipalities of Caguas, Aibonito and Fajardo provide tertiary treatment to residual waters.

Nonetheless, in most of Puerto Rico's rural areas individual, commercial and industrial septic tanks discharge into soil. The EQB's 2006 "Report on the State and Condition of Puerto Rico's Environment" estimated there are more than 2,500 structures operating septic tanks to dispose of used waters and/or processed commercial or industrial waste. In Puerto Rico, inadequate septic tank management has the potential to affect the quality of water bodies due to the topography, the proximity of housing to water bodies (which are abundant), as well as the geology and soil composition.

Industries (including plants for generation of energy) are also principal dischargers. In Puerto Rico, 73 industries count with the "National Pollutant Discharge Elimination System" (NPDES) permits. This permit is administered by the EQB as disposed by Section 402 of the CWA, which authorizes point source discharges into coastal waters. The NPDES Program also regulates, through permits, rain water discharges coming from industries and municipalities, better known as run-off or pluvial water.

By the same token, discharges of thermal waters coming from Puerto Rico's thermoelectric complexes (Puerto Nuevo and Palo Seco) in the SJMA, and Guayanilla and Aguirre in the South, are potential polluting sources for coastal waters and marine life.

## **Public Policy**

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All liquid waste discharges must comply with Federal and Commonwealth regulations. Federal and Commonwealth water quality standards, as wells as all regulations and programs to achieve them, are incorporated into the PRCZMP.

## **Implementing the Policy**

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The EQB, which has principal responsibility within the Commonwealth government for implementing this policy locally, works in coordination with the following Commonwealth and Federal agencies:

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<sup>104</sup> Mixing zones are discharge areas for water treatment plants as defined by the EQB. Water quality standards for these areas are measures along the borders while in their interior, high concentrations of pollutants can be found.

**TABLE III-14. AGENCIES COLLABORATING WITH THE EQB**

Agencies that collaborate with the EQB in the compliance with the water quality standards	
Agency	Responsibility
<p><b>Puerto Rico Aqueducts and Sewers Authority (PRASA)</b></p> 	In charge of installing and maintaining residual water processing plants
<p><b>Puerto Rico Infrastructure Financing Authority (PRIFA)</b></p> 	In charge of developing and improving the residual water processing systems' infrastructure
<p><b>Puerto Rico Planning Board (PRPB)</b></p> 	Approves the location for processing plants and sewer lines.
<p><b>Environmental Protection Agency (EPA)</b></p> 	Federal agency that administers the potable water programs, NPDES permits for municipal and industrial discharges, funds for infrastructure developments, non-point sources of pollution, control over underground water pollution, control of underground injections, pesticides, marine protection and wetlands.

For its part, DNER is the agency assigned to plan and regulate the use and enjoyment, conservation and development of Puerto Rico’s water and to implement public policy and norms associated with this resource in conformity with the “Puerto Rico’s Waters Act,” Law No. 136 of 1979. Following the dispositions under this statute, the “Integrated Water Resources Management Plan” (IWRMP) (*Plan de Aguas*) was adopted in April 2008.

The IWRMP purpose is to identify current use of Puerto Rico’s water bodies and project future use. The Plan also establishes public policies as well as measures which will guide future management of this resource in Puerto Rico.

Establishing water quality standards and discharge limitation

The EQB is the Puerto Rico’s Government agency with the legal responsibility to oversee that all water bodies maintain the quality needed to comply with their designated uses, which are: primary contact recreation, secondary contact recreation, aquatic life and source of potable water. For this purpose, the “Puerto Rico Water Quality Standards Regulation” (PRWQSR), Regulation No. 6616, was adopted and establishes water quality standards for the five categories comprising waters in the coastal zone:

**TABLE III-15. EQB WATER QUALITY STANDARDS**

EQB Water Quality Standards	
<b>Class SA</b>	<p>Highest level. Includes bioluminescent lagoons and bays such as <i>La Parguera</i> and <i>Mansio José</i> in the south coast, <i>Bahía Mosquitos</i> in Vieques and any other coastal or estuarine waters of exceptional quality or major ecological or recreational value that can be destined by the EQB for this classification. This also applies to the waters 500 meters offshore of the physical and geographical limits of water bodies under this classification.</p>
<b>Class SB</b>	<p>Applies to the coastal waters dedicated to direct use, such as swimming. Includes lagoons not classified under other class. This classification extends from the maritime zone (average sea level) until 500 meters offshore of this zone. Outside of this zone, it will be rule by the next less restrictive classification until a maximum of 10.3 nm offshore.</p> <p>This class includes, also, those areas where seafood grows. To this classification applies the current standards established by the Department of Health and Human Services and the ones by the PRDPH. This classification will be extended 100 meters outside of the physical and geographical limits defining the growth areas.</p>
<b>Class SC</b>	<p>Applies to coastal waters dedicated to indirect uses, such as fishing or boat trips. Most of the ports are under this classification. The classification of these waters will be applied from the maritime zone (average sea level) until 10.35 nm offshore. Some areas with this classification are:</p> <ul style="list-style-type: none"> <li>Mayagüez Bay- From <i>Punta Guanajibo</i> to <i>Punta Algarrobo</i></li> <li>Port of Yabucoa</li> <li>Guayanilla and Tallaboa's bays - From <i>Cayo Parguera</i> to <i>Punta Verraco</i></li> <li>Port of Ponce - From <i>Punta Carenero</i> to <i>Punta Cuchara</i></li> <li>Port of San Juan - From the river mouth of <i>Río Bayamón</i> to <i>Punta El Morro</i></li> </ul>
<b>Class SD</b>	<p>Applies to superficial waters used as source of natural water for public supply and the propagation and preservation of certain species.</p>
<b>Class SE</b>	<p>Superficial water bodies of exceptional ecological values as designated by the EQB, among there are <i>Laguna Tortuguero</i>, <i>Laguna Cartagena</i> and any other designated water body</p>

Source: JCA. (1990). *Reglamento de Estándares de Calidad de Agua de Puerto Rico*.

The EQB's water quality standards also include the following anti-degrading policy:

"It is the policy of the Government of Puerto Rico to conserve and protect current uses of Puerto Rico's water bodies. The water quality necessary for those uses will be protected and conserved. In those water bodies where water quality is beyond recommended levels to sustain the propagation of fish, wildlife and recreation above or below the surface, those levels will be conserved and protected. Inferior water quality could be permitted if the EQB determines, after satisfying all the public participation and governmental coordination requirements under the EQB's Process for Constant Planning, that it is necessary to permit said water quality in order to make a social or economic development viable for the area where the waters are located. In order to permit said inferior water quality, the EQB will require an adequate level of water quality in order to protect current use. Furthermore, the EQB will require that: (1) in all sources, new and existent, all statutory and regulated requirements are achieved and (2) in non-point sources, the best management, cost-effective and reasonable practices are implemented. In places where high quality standard waters which constitute an exceptional resource, such as the waters in the El Yunque National Forest and other state forests, wildlife refuges and waters of exceptional recreational or ecological value, water quality will be preserved and protected. In those places where deterioration of the water quality is associated with a thermal discharge, said thermal discharge must comply with Section 316 of the CWA (EQB, 2004).

Aside from the water quality standards established by the EQB, Puerto Rico's coastal waters are protected by Federal regulations against residual waters discharges. The EPA establishes

minimum effluents for municipal treatment installations and industrial sources under the CWA. However, the EQB retains the faculty to establish stricter standards.

The EQB, in coordination with the EPA, administers the Beaches Environmental Assessment and Coastal Health (BEACH) Program created at the Federal level by the “Beach Act” of 2000. Under this Program, the EQB is responsible for: (1) bacteriological monitoring of all beaches deemed swimmable, (2) notify the results of the monitoring, done every two weeks in the beaches included in the Program and (3) protect the health of users who visit those beaches.<sup>105</sup>

The EQB also operates the Coastal Zone Monitoring Network all year round. This network consists of 99 stations located in different segments of the coast around the Island and whose reports are included in the Bi-Annual Integrated Report 305 (b)/303(d). The analytical results are evaluated conforming to uses designated for coastal waters as established by the PRWQSR.

**ILLUSTRATION 2. EQB’S PUBLIC NOTIFICATION MAP REGARDING BEACH CONDITIONS**



<sup>105</sup> Samplings are done to monitor fecal coliforms and enterococcus – bacteria used by the EQB as indicators of possible fecal contamination – every two weeks on 23 beaches. The results are notified to the public as required by the CWA.

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*Need: Reevaluate the treatment given to residual waters in order to provide better depuration options that are safer for bathers and marine resources.*

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Information presented in the IWRMP states that the quality of superficial and underground water in Puerto Rico is affected by high concentrations of fecal bacteria and nutrients. Among sources of contamination identified in the document are domestic discharges coming from semi-treated PRASA waters, non-point sources and industries.

Primary treatment plants are insufficient in order to effectively purify waters discharged to the sea, even when they comply with water quality standards. This results in the deposit of nutrients, organic matter and metals which affect water quality, thus affecting marine life, including coral reef communities. In order to address this issue, the PRASA will need more funding to allow the expansion of current treatment to possible a secondary or tertiary treatment.

## B. Reducing damages from oil spills

### Findings

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Oil spills are a serious hazard to coastal waters. Over the last decades, hundreds of environmental emergencies have been created due to spills of chemical substances. Many of these spills – particularly oil spills – have directly affected Puerto Rico’s coasts, constituting a serious danger to coastal waters. The most common sources of oil contamination in coastal waters are bilge pumping, deballasting on tankers, ship accidents and the operation and cumulative impact of fuel spills in small vessels.

Damage caused by oil spills depends on the location, the quantity and the type of material as well as the wind and conditions of the current and waves. Typically, the more serious damage occurs on waters close to the coast, enclosed bays and estuaries.

Since 1960, some 12 significant fuel spills have occurred in Puerto Rico. In 1968, the tanker *Ocean Eagle* sailed from San Juan Bay seeping 3.7 million gallons of oil which affected beaches in the tourist zone, the beaches from Loíza to Arecibo and causing damage to the marine flora and fauna in the sector. In 1973, the *Zoe Colocotroni* vessel spilled 1.5 million gallons of oil near the Cabo Rojo coast impacting flora and fauna in the region as well as the fishing industry. In 1991, *Vista Bella* vessel spilled enough oil near St. Kitts affecting the waters around Vieques, Culebra and up to Cayo Berbería and Caja de Muertos. In January 1994, the Morris J. Berman barge spills 750,000 gallons of Bunker 6 diesel in front of the San Juan touristic zone causing serious damages to tourism activities as wells as marine flora and fauna. The most recent spill - still of unknown origin - occurred in waters south of Guánica, in August 2007. This spill substantially impacted the wetlands in the South coast, including coral reefs, plant life and mangroves in the region.

**TABLE III-16. MAIN OIL AND FUEL SPILLS IN THE COASTAL WATERS OF PUERTO RICO**

Main oil and fuel spills in the coastal waters of Puerto Rico				
	Date	Location	Origin	Quantity and type
1	July/16/1962	Guánica Bay	<i>Argea Prima</i>	10,000 ton. crude oil
2	March/3/1968	San Juan	Vessel <i>Ocean Eagle</i>	1.5 millions gal crude oil
3	1973	Cabo Rojo	Vessel <i>Zoe Colocotroni</i>	1.5 millions gal crude oil
4	January/13/1974	Guayanilla	Vessel <i>Zannis</i>	1.5 millions gal crude oil
5	March/1977	Guayanilla Bay	Unknown	42,000 gal of Venezuelan crude oil
6	December/19/1978	Ceiba and Yabucoa	Barge <i>Peck Slip</i>	460,000 gal Bunker C
7	February/15/1985	Mona Passage	Ship <i>A. Regina</i>	6,000 gal diesel No. 2
8	November/27/1986	Ensenada Honda, Roosevelt Roads, Ceiba	Tank #85	59,000 gal JP-5
9	December/12/1993	San Juan	Barge <i>BGI Trader</i>	10,000 gal Fuel Oil No. 6
10	January/7/1994	San Juan	Barge <i>Morris J. Berman</i>	800,000 gal Fuel Oil No. 6
11	October/18/1999	Roosevelt Roads, Ceiba	Tank	100,000 gal Jet Fuel No. JP5
12	August/30/2007	Guánica	Unknown	Unknown

Source: USCG/ DNER & USFWS. (2007). *Guánica Oil Spill Preassessment. Memorandum.*

Some cleaning procedures may be more destructive than the spill itself, such as the use of detergents or techniques that coagulate and sink oil to the ocean floor.

Long-term effects of oil spills in tropical environment are unknown. Monitoring systems indicate there is very little or no decomposition of remnant oil after cleaning operations concluded. For example, 11 years after the fuel spill from the *Zoe Colocotroni* in Puerto Rico's southwest, samples were taken of the sediment in the mangroves directly impacted by the incident. The results indicated concentrations of 10,000-100,000 ppm of hydrocarbons six centimeters below a surface of sedimentation which looked clean. Furthermore, oil was found, possible from a spill occurred in 1962 (*Argea Prima*), some 14-16 cm below the surface.<sup>106</sup>

More spills should be anticipated. Despite the fact today there are fewer refineries than 25 years ago, the ones which do exist, along with power generating plants, require the traffic of tankers filled with oil and other derivative products. Furthermore, Puerto Rico's coastal waters serve as part of the routes other vessels use to transport fuel to different destinations. Such is the case of the Mona Passage, west of the Island.

## Responding to findings

### 1. Preparing oil spill contingency plans

Spilling or depositing oil in coastal waters is a violation of the "Oil Pollution Act" (OPA), approved with the purpose of preventing spills in coastal waters. In Puerto Rico's particular

<sup>106</sup> Recovered online from NOAA's Office of Response and Restoration on April 12, 2008: [http://response.restoration.noaa.gov/book\\_shelf/32\\_mangrove\\_chapter5.pdf](http://response.restoration.noaa.gov/book_shelf/32_mangrove_chapter5.pdf).

case, spilling or depositing oil represents a violation of the “Puerto Rico Environmental Public Policy Act”, *supra*.

Due to the economic and environmental impact these spills may have, the OPA establishes that companies transporting oil through the United States Territorial Waters must have a prevention plan for these events as well as a contingency plan to contain and clean the material in case of an emergency.

The EPA and the USCG administer the Caribbean Regional Response Team (CRRT), whose jurisdiction includes Puerto Rico, the U.S. Virgin Islands, Navassa and adjacent waters belonging to the Exclusive Economic Zone (EEZ). These agencies are responsible for designing and implementing the *Caribbean Regional Contingency Plan* as established by the OPA and the “Comprehensive Environmental Response, Compensation, and Liability Act” (CERCLA) of 1980.

At the local level, the EQB counts with the “Contingency Plan to tend contamination due to oil spills or hazardous substances,” as part of the legal framework which includes the “Puerto Rico Environmental Public Policy Act”, *supra*, “Law on Hazardous Substance Spills”, Law No. 13 of 1973, “The Puerto Rico Environmental Emergency Fund Act,” Law No. 81 of 1987, and in accord with the Federal government “National Oil and Hazardous Substances Pollution Contingency Plan” (NCP). The NCP contains the measures and provisions needed to address - in an integral and coordinated manner - an oil spill or a spill of any other hazardous substance. According to the Plan, the EQB is the lead agency in collaboration with other Commonwealth agencies, such as DNER and federal agencies such as NOAA and the USCG.

DNER has multiple functions in these situations. For example, the Rangers Corp serves as a “first responder” in many of these cases and provides logistical support for the chain of command established in each case. Moreover, DNER, as custodian of assets under public domain in the maritime zone and administrator of Puerto Rico’s natural resources, has the capacity to evaluate damages caused to natural resources as a result of oil spills. DNER also actively integrates itself into the chain of command in answering environmental emergencies which include oil spills, or spills of any other hazardous substance, as a scientific advisor, technical advisor and as a provider of logistic support for coordinated interagency operations.

## 2. Establish oil spill liability measures

Several Federal government trusts exist and are used to handle matters of environmental pollution. Perhaps, the most relevant ones are the *Hazardous Substances Superfund*, the *Leaking Underground Storage Tank Trust Fund* (LUST), and the *Oil Spill Liability Trust Fund*.

The OPA establishes an ample accountability scheme similar to CERCLA, but applicable to cases involving oil spills. The owner or operator (or the responsible party) of a vessel or an establishment where a discharge occurs, or that represents a substantial threat of a

discharge on or near navigable waters adjacent to the coast or the EEZ, is responsible for the costs of removal and damages.<sup>107</sup>

The *Oil Spill Liability Trust* was established by the OPA<sup>108</sup>. This Trust reimburses some cleaning costs stated in the NCP: the costs incurred by Federal and Commonwealth authorities in the evaluation of damages to natural resources and the implementation of plans geared toward restoration. All this conditioned to implementing these plans in accordance to NCP stipulations. However, the Trust will not reimburse the costs of those responsible for the spill if the accident was a result of negligence.<sup>109</sup>

For its part, EPA can impose fines for oil spills which are a result of probable negligence.

At the local level, under the EQB's water quality standards, owners of establishments or industries which include a supply of oil are obligated to take measures to control any spill, whether oil or any other hazardous substance. Through what is established by the "Puerto Rico Environmental Public Policy Act", *supra*, the EQB can order the reimbursement of expenses incurred in the removal or mitigation of any damage or adverse effect on the environment caused by an unauthorized discharge, be it an accident or not.

Said law also established a fund to start judicial or administrative action geared toward ordering a party responsible for a spill to take the necessary actions to protect the environment and the general public.<sup>110</sup> This law also gives the government the authority to recover any cost in which it may incur in containment and clean-up of a spill.

Furthermore, the "Law on Mining in Puerto Rico," Law No. 6 of 1954, requires companies who exploit mineral resources in Puerto Rico to pay for clean-up cost of any oil spill they may cause.

### C. Reducing non-point sources of pollution, such as erosion and sedimentation

#### Findings

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Non-point sources of pollution are found to be among the main causes for the degradation of coastal waters. Inadequate land uses in coastal areas increase the problems caused by erosion and sedimentation in water bodies. These include sedimentation and erosion emanated mainly from hydromodifications, agricultural activities and construction without implementation of adequate land use management practices. Non-point sources of pollution are divided in five categories: urban areas, agriculture, hydromodifications, marinas and mining.

Sedimentation which occurs as a result of soil erosion due to different activities is carried to the water bodies and deposited by means of run-off and pluvial currents. The effect of sedimentation has grave consequences on coastal waters as well as the resources there. The

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<sup>107</sup>US Code, Title 33, Sec. 2702(a).

<sup>108</sup> US Code, Title 26, Sec. 9509.

<sup>109</sup> US Code, Title 33, Sec. 2712(b).

<sup>110</sup> This law abolished the "Law for the Environmental Emergencies Fund of Puerto Rico."

sloped topography, strong rainfall, the removal of vegetation, deforestation and winds – particularly over soils which erode easily – are factors which contribute to erosion in Puerto Rico.

Among the agricultural methods increasing soil erosion and sedimentation are the incorrect practicing of tilling and indiscriminate deforestation. On the other hand, rapid urban sprawl is another principal factor contributing to land erosion and the sedimentation of water bodies. Inappropriate land leveling practices in construction areas also helps increase erosion. Also contributing to erosion are poor declines of lands and lack of forestation and vegetation.

Sedimentation alters the quantity and quality of water supplies. The turbidity of these water supplies affects the physical and biological characteristics of the superficial waters and coastal waters in which they discharge. Therefore, the high concentration of suspended solid parts reaching water bodies as a result of sedimentation, are an obstacle to the health and development of communities of organisms and coral reefs which depend on light for growth. Meanwhile, nutrients transported by sediments contribute significantly to the eutrophication of the water bodies. This situation affects the scenic value and water bodies' ability for other uses, such as recreational.

Resulting impacts include flooding, reduced water quality, and an increase need for dredging. Increases in run-off, due to modifications of the landscape, amplify the risk of flooding. This has had a cumulative impact and, therefore, land which were not prone to flooding are now exposed to great damage due to floods.

Turbidity affects the chemical and biological characteristics of superficial and coastal waters unto which they discharge. The use of cleansers and pesticides, among other toxic substances in superficial and underwater also increases. Also, sedimentation and increased turbidity destroy coral reef communities.

Excessive sediment discharges into rivers, tributaries and lakes reduce the capacity of their channel and create obstacles at river's mouth. This has translated into more frequent dredging of water bodies such as the Río Grande de Loíza basin and San Juan Bay.

### Public Policy

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The “Law to authorize the creation of the Soil Conservation District,” Law No. 211 of 1946, found that improper land-use practices were causing erosion of farm and grazing lands. This law establishes a policy of preserving and protecting these lands which it found to be basic assets of the Island.

The OPP-PRLUP establishes public policies relevant for the whole Island in the section regarding Natural, Environmental and Cultural Resources:

“Control land development, construction and subdivisions which could adversely affect water quality, particularly in areas for aquifer recharge and in watersheds contiguous to lake and reservoirs, including, among others, activities such as excessive use of paving resulting in increased run-off; the indiscriminate use of pesticides or fertilizers which

degrade the quality of our water bodies, deforestation or removal of vegetation and land movements which lead to erosion and sedimentation” (see Policy 30.02).

## Implementing the Policy

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### 1. Implement education and awareness programs to help reduce non-point sources of pollution.

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In 1990, the U.S. Congress passed Section 6217, known as the Coastal Zone Act Reauthorization Amendments (CZARA) requiring all states and territories with coastal zone management plans to also develop plans to control pollution emanating from non-point sources. The main purpose of these plans was to strengthen the communication between local and federal coastal zone management programs and water quality. At the federal level a “Coastal Nonpoint Pollution Control Program” was created under the jurisdiction of EPA and NOAA.

Locally, in order to comply with these dispositions, Executive Order EO-1999-08, “To establish the public policy for the control of non-point sources of pollution on Puerto Rico’s coastal zone, to adopt obligatory management measures and to order the compliance by all government departments and agencies of the Government of Puerto Rico” was signed. By virtue of this EO, the “Committee for the Control of Non-point Source Pollution in the Coastal Zone” was created to implement the management of the plan by 16 different government agencies.<sup>111</sup> The Committee developed the Puerto Rico Coastal Nonpoint Pollution Control Plan (PRCNPCP) which was approved by EPA and NOAA in 2000.<sup>112</sup>

Following the dispositions of Section 6217 of the CZARA, the plans establishes how Puerto Rico will implement controls, known as Mandatory Management Measures (MMs), in accordance with the measures established as guidelines by the EPA, known as “Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters”. It also contains additional MMs established by Puerto Rico, as long as they are necessary to obtain and sustain applicable water quality standards and MMs to protect wetlands and river banks. Implementation of MMs is done through the Best Management Practices in construction and vegetation and the best available technology.

Through the PRCNPCP, five categories of activities were identified which results in pollution from non-point sources. The categories are: 1) agriculture, 2) urban, 3) marinas, 4) hydromodifications and 5) protection of wetlands and river banks.

Under the PRCNPCP several initiatives have been implemented among: the elimination of motor vehicles (all terrain vehicles) along water bodies and amendments to the “Water Act” and its regulations. Also, through the “Watershed Stewardship Program”, which focuses on

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<sup>111</sup> The Committee is constituted by the DNER, the EQB, the RPA, the Districts for Soil Conservation, the Agricultural Experimental Station and the Agricultural Services Extension of the UPR, the PRDPH, the Highway and Transportation Authority, PRASA, PREPRA, PRPA, the Sea Grant Program and other entities eventually identified by the designated agencies to be part of the Committee. The Committee also receives collaborations from federal agencies such as the NRCS, the USFWS, the Federal Highway Authority, the USGS, the Federal Agricultural Service and the EPA.

<sup>112</sup> The implementation of this Plan is fundamentally geographic due to the limitation of resources to tend the whole Island. For this reason, geographical regions selected by the EQB as priority watersheds are used as parting points.

the management of watersheds, work is being done on two problems which negatively alter water quality: the use of cleansing agents with high concentration of phosphates and the design, construction, use and maintenance of septic systems in single family homes.

Another initiative has been the “Clean Watershed Needs Survey”, a tool to take an inventory of the structural needs to conserve water resources and includes topics related to point and non-point sources of pollution.<sup>113</sup> The DNER is cooperating with this initiative through its Non-Point Sources of Contamination, in the area of management of watersheds, marinas and hydromodifications. This program can be implemented in both public and private lands.

Another area in this program is the “Coral Reef Management Support”. This part is being implemented in Vieques and Culebra and includes the creation of computerized estimates of the amount of sediments produced by non-paved roads which are transported to coastal waters by rain, wind and gravity impacting coral reefs, marine ecosystems and the coast.

The USDA, through two agencies: the NRCS<sup>114</sup> and the Agriculture Stabilization and Conservation Service (ASCS)<sup>115</sup>, is also implementing soil and water conservation efforts.

The NRCS operates various programs in Puerto Rico to deal with problems related to sedimentation and run-off. Some of the programs operated by this agency include demonstrative projects in conservation practices which includes conferences and publications, among others. This agency has also performed soil studies in Puerto Rico in order to facilitate conservation efforts and as aide for future developments. These studies include the classification of soils by hydrologic groups representing their capacity for infiltration. The NRCS also provides technical support to land owners and operators in order to executive locally-adopted land and water conservation programs.

The 17 Land Conservation Districts in Puerto Rico were authorized by “Law No. 211 of 1946” to establish regulations for the control of erosion in their districts and impose fines on violators.<sup>116</sup> These districts are also affiliated under the Association of Districts of Land Conservation of Puerto Rico. The function of this Association is to coordinate efforts to establish education and information programs for the Districts and the work that they do. Each District’s priority is to establish and direct programs geared toward land and water conservation as well as improve the quality of these resources. To help in the implementation of its programs and in providing services for land users, the Districts coordinate technical and financial assistance through NRCS and the Farmers Services Agency (USDA-FSA), as well as other federal agencies.

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<sup>113</sup> This is a federal program coordinated by EPA and led locally by the ASA and the EQB. The program is being implemented through an Interagency Committee coordinated by the EQB.

<sup>114</sup> *Code of Federal Regulations (CFR)*, Title 7, Pts. 600-699.

<sup>115</sup> *Code of Federal Regulations (CFR)*, Title 7 Pts. 700-799.

<sup>116</sup> The Districts for Soil Conservation were created by Law #211 of 1946 and are the legal subdivision of the Puerto Rico Government and directed by a Board of five Supervisors. Each District is comprised by various municipalities with the purpose of planning and applying wise use to the land. The 17 Districts are divided in: Atlántico, Caonillas, Caribe, Cibuco, Culebrinas, Este, Nordeste, Noroeste, Norte, Oeste, San Juan, Sudeste, Sur, Sudoeste, Torito, Torrecillas and Turabo. The Districts are part of the Department of Agriculture and guided by the Committee for Soil Conservation in Puerto Rico. The function of this Committee is to organize and direct the work of the Districts.

Over the last years, the EQB has been collaborating with other agencies in various initiatives in order to achieve better management of water resources. Among these initiatives are the Basin Restoration Plan, the development of a TMDL on the basins which deems necessary, the development of an intensive monitoring and public notification project in most used beaches, the development of a water quality criteria for nutrients which will permit a reduction in the eutrophication of water supplies and a rotating monitoring schedule along the watersheds, of which current information is insufficient (JCA, 2002).

## 2. Regulating the sources of sedimentation

The key purpose of the EQB's Regulation No. 5754, "Regulations for erosion control and sedimentation prevention", is to prevent and control contamination in Puerto Rico's waters, among other resources.

The regulation applies to those human activities which could cause, or have the potential to cause, erosion of the soil, including: deforestation, removal of vegetation, construction or demolition of structures, extraction of materials, disposal of soil, soil deposits, including material from dredging or any other activity which includes alteration of current land or soil, among others.

Other agencies have taken affirmative action, such as the DTPW and Puerto Rico Highways and Transportation Authority (PRHTA), which as part of their Environmental Policy, approved in October 2002, established that all transportation projects would be developed in compliance with all integral plans for the management of watersheds in order to reduce erosion and sedimentation and improve the quality of water and the environment.

At the federal level, several laws promote the conservation of soil and water quality. The "Soil and Water Resources Conservation Act"<sup>117</sup> of 1977, states that the USDA should evaluate soils and water in agricultural lands, develop conservation and protection plans and evaluate their annual performance in order to move forth and achieve conservation objectives prescribed in the law. The "Soil Conservation and Domestic Allotment Act"<sup>118</sup> of 1936 pays farmers who adopt better agricultural practices. According to these laws and agricultural laws passes in 1985, 1990 and 1996, the Federal government has established diverse programs geared toward the conservation of soils and water.<sup>119</sup> For its part, the "Federal Wild and Scenic Rivers Act" (FWSRA)<sup>120</sup> establishes that administrative plans should be developed to regulate activities in lands adjacent to rivers designated under the dispositions of this law prior to 1985.

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<sup>117</sup> U.S.Code, Title 16, Secs. 2001-2009.

<sup>118</sup> Pub. L. 74-461, 46 Stat. 11438, U.S. Code, title 16, Secs. 590a-590q-3) (Pub. L. 74-461, 46 Stat. 11438, U.S. Code, title 16, Secs. 590a-590q-3)

<sup>119</sup> Among these are: Environmental Conservation Acreage Reserve Program (ECARP), Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP) and the Environmental Quality Incentive Program (EQIP); Conservation Compliance Program, Sodbuster and Swampbuster Programs, Environmental Easement Program and the Resource Conservation and Development Program.

<sup>120</sup> U.S.Code, Title 16, Secs. 1271-1287.

## D. Minimizing environmental damage from dredging, diking and filling

### Findings

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Maintenance and harbor-improvement dredging are essential, continuing activities in Puerto Rico for commerce, reason for which they must be executed in a continuous manner. Said dredging activities should be done in order to combat the effects of natural erosion and sedimentation, which are intensified by human activities.

The USACE has conducted various dredging projects in the past, is developing some in the present (dredging of San Juan Bay) and plans others in the future.

Dredging and filling could cause environmental problems. Dredging can cause contamination at both the point of removal as well as at the point of deposit. Its direct effects, especially those limited to the area of the project, are generally short-term and include: effect of turbidity, increase in sedimentation, removal of substratum materials and suspension of solid particles. In shallow lagoons along the coast, however, experience has evidenced that these effects could be more long-term and more serious (i.e. Laguna de Piñones).

Long-term, effects could include the destruction of organisms, which could cause changes in water quality in the immediate area and the destruction of adjacent flora and fauna.

### Responding to findings

#### A. Regulating dredging, filling and construction in navigable waters.

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Dredging, filling and construction on navigable waters is subject to a permitting program managed by the USACE in accordance to two federal laws: RHA and CWA. Under Sections 9 and 10 of the RHA, the USACE requires permits for the discharges to submerged lands under the average high tide in coastal waters, or in rivers, lakes or bodies currently or historically used for navigation. Under Section 404 of the CWA<sup>121</sup>, federal permits are required for activities which implicate the dredging or filling of material in navigable waters, including lakes, water currents, rivers, canals, tributaries and wetlands. Permits under Section 404 must be adjusted to the discharge norms established by the EPA. Furthermore, the EPA can prohibit the granting of a permit under Section 404 if the proposed discharge has an unacceptable adverse effect on certain environmentally sensitive areas.

The DNER also has the responsibility of participating in the evaluation process under the criteria established by the "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters and Submerged Lands Thereunder and the Maritime Zone", *supra*.

It is important to note that according to the "Puerto Rico Ports and Piers Law", *supra*, dredging activities and the disposal of material in the port zones require approval from the Ports Authority (PRPA).

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<sup>121</sup> Amendments to the CWA, P.L. 92-500.

## B. Establishing criteria for dredging

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In order to guide decision making in the process of granting or denying a permit application by USACE, the DNER establishes the following criteria as part of the PRCZMP:

### Criteria for diking, filling, dredging and deposit of dredged sediments:

...Criteria for diking and filling- Diking or filling of coastal waters (other than shoreline structures)<sup>122</sup> will be limited to the maximum that is practical and permitted when it is necessary and when no other less environmentally harmful alternative is available to: (1) the expansion of ports and airports, national defense of installations dependent on the coast; (2) restoration of land (i.e.: diking to control sedimentation or restore lands previously lost to coastal erosion).

...Criteria for dredging – Dredging on coastal waters to the maximum limit to which it is practical (a) will minimize interruption of the natural system and (b) will be limited to the following: (1) ports, energy installations or national defense, (2) navigable canals, turning dams, anchor zones, ramps for launching small vessels, (3) canal entrances or minor dredging of port areas for recreational vessels; (4) commercial fishing installations, (5) flood control projects (6) extraction of sand, gravel and minerals; (7) other public service purposes (i.e.: restore water circulation) keeping in mind that results are carefully revised and evaluated on their restorative value. The need to dredge will be minimized by careful design and location of installations in relation to existing water depths, circulation patterns and efforts to reduce controllable sedimentation. In places where material is contaminated, dredging or mining will be avoided to maximum limit to which it is practical.

...Criteria for the disposal of dredged sediment – Dredged sediments which comply with criteria established by the EPA for fresh water, estuaries or the sea, can be deposited in designated areas to minimize potential adverse results for marine organisms or to fill areas authorize by the DNER. Dredged material cannot be transported from coastal waters to mangroves, estuarine areas or fresh water for its disposal. Dredged material which exceeds approved norms for water quality and whose disposition on land is not possible or not environmentally acceptable should be placed – be it on dry land or in such a manner that it prevents marine contamination (on the bottom or on the surface) in deep locations of the sea already designated and approved by EPA.<sup>123</sup>

## E. Reducing damages caused by vessels abandoned in coastal waters.

### Findings

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Abandoned vessels constitute a significant threat to coastal resources. These vessels suppose a series of risks, among which are: fuel spills and other contaminants, including the infusion of nutrients into coastal waters and physical destruction of habitats. Some of these vessels are also used as deposits for illegal waste, create an obstacle for navigation and constitute a health and safety risk for humans.

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<sup>122</sup> Coastal structures are considered as part of the erosion process in accordance to Section 305 (b)(g) of the CZMA.

<sup>123</sup> This policy was taken by the PRCZMP (1978) from California's CZMP.

In 2002, a study commissioned by NOAA examined more than 100 abandoned vessels in the Caribbean. Many of these were vessels ran aground due to hurricanes and from which little information is known about their original owners.

This study identified and evaluated 34 vessels abandoned in Puerto Rico of which 17 were recreational, 14 were commercial and three were military (Michel et al., 2002). Some of these vessels were found in areas typically used by yachts or where vessels are anchored for prolonged periods of time, such as in Puerto Rico's Southwest.

Approximately 20 of the 34 vessels were found in ecosystems associated with coral reefs, particularly in sea grass areas or mangroves. Of these, only one vessel was directly on top of a coral reef. On the other hand, six of the vessels were found to be a contamination threat for coastal waters. Some of the contaminants identified in these vessels were fuels, oil barrels, batteries and possibly ammonia. In this situation, the study found that the USCG has been proactive in investigating these vessels and removing material which could constitute an immediate threat.

However, this problem goes beyond the potential impact on ecosystems associated with the coral reefs. For example, many urban ports have problems associated with these vessels. Some of the identified vessels constitute a threat to navigation. These were identified along Puerto Real, Cabo Rojo and in Roosevelt Roads. Even if these vessels are not in active navigation canals, they are near marinas, ports and other areas used for recreational navigation.

Certainly, the most important danger these vessels present is related to public safety due to the potential of debris coming off these vessels and impacting coastal water users.

### **Responding to findings**

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NOAA's Damage Evaluation Center is currently undergoing a series of tasks which, once completed, will establish a coordinated strategy to address the risks these abandoned vessels present to coastal waters. These strategies respond to the National Action Plan of the U.S. Coral Reef Task Force. NOAA's efforts are comprised of three principal components:

- 1) Development of a database of the abandoned vessels;
- 2) Revision of current legal authority which will permit the removal of these abandoned vessels; and
- 3) Field visits, evaluation of the vessels and setting of priorities of those vessels which represent a higher risk, thus they can be removed faster.

One of the tasks is the creation of the *Abandoned Vessel Inventory (AVI)*, a database of abandoned vessels which could constitute a potential risk to the coral ecosystems in the U.S. states and territories. Through this initiative, some 35 vessels have been inventoried in

Puerto Rico, but estimates place the actual number of abandoned vessels at between 60 and 80.<sup>124</sup>

Aside from those identified by AVI, the USCG counts with the Abandoned Vessel Program, through which it has been able to remove abandoned vessels. One of the most outstanding cases under this program was the M/V Kimton, removed from a beach in the Municipality of Fajardo in year 2000. This vessel was being used for the illegal deposit of more than 15,000 gallons of used oil, explosives and batteries. The USCG, through the *Spill Liability Trust Fund*, removed this vessel which represented a potential health and safety threat for the ecosystems and the population. This action also permitted the renovation of this maritime front for the Municipality of Fajardo and a boardwalk was built to allow public access to the coast.

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*Need: Study the available legal option to address the problem of abandoned vessels along Puerto Rico's coastal waters and resources.*

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It is recommended to evaluate available legal options in Puerto Rico to address the problem of abandoned vessels. These vessels, in general, after running aground or not, are abandoned by their owners who have knowledge of the coastal ecosystems.

### 3.2.8 COASTAL FORESTS

#### **Findings**

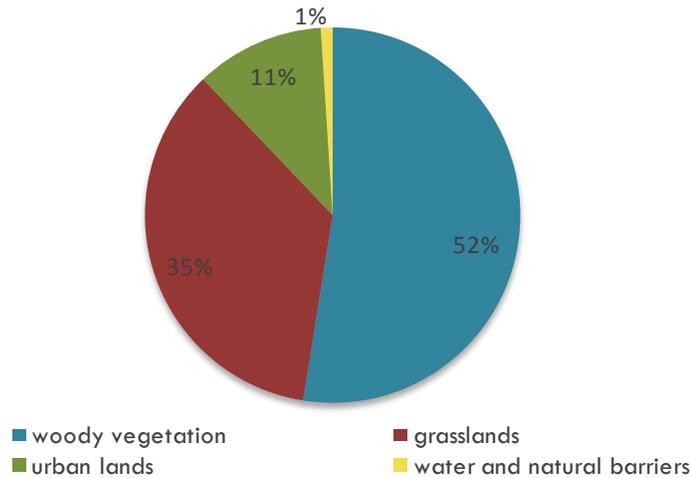
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The forests that once covered Puerto Rico's coast are now greatly reduced. In the 16<sup>th</sup> Century, forest coverage in Puerto Rico neared 890,000 ha. At the beginning of 19<sup>th</sup> Century, forest areas covered 587,000 ha and by the end of that same century, coverage had been reduced to 182,000 ha (Birdsey & Weaver, 1987 in CPN & UMET, 2005). During this time, the intense deforestation in the coastal plains was due, principally, to economic activity based on the harvesting of sugar cane while in the interior of the Island, it had to do with agricultural activity associated with coffee plantations.

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<sup>124</sup> NOAA. Office of Response and Restoration. Recovered online in May 2009: [http://response.restoration.noaa.gov/av\_subregion.php?RECORD\_KEY%28subregions%29=subregion\_id&subregion\_id(subregions)=PR.

GRAPHIC III-2. PUERTO RICO'S SOIL COVERAGE



Source: Gould et al., 2007. Graphic made by Estudios Técnicos, Inc.

The removal of forests was so intense that by 1940, only 6% of the forest territory remained.<sup>125</sup> However, economic transformation of agricultural activities has given way to some recuperation allowing for former agricultural land to be covered by secondary vegetation. Currently, it is estimated that 52% of Puerto Rico is covered by wooded vegetations and 35% by grasslands (Gould et al., 2007).

The majority of coastal forests are mangroves. Other coastal forests of particular interest include: (1) *Pterocarpus forest* and (2) the dry forest in Guánica (see Map 19).

*Pterocarpus forests (Pterocarpus officinalis)* exist in several locations in Puerto Rico although they do not grow naturally in any of the states. The *Pterocarpus* has an impressive system of roots and is part of swamp forests, mostly in the most inland portions of these mangroves. Some of those which exist in Puerto Rico's coastal zone are:

- Torrecilla Alta - Loíza
- Close to the Río Espíritu Santo
- *Pterocarpus forest* in Humacao
- Palmas del Mar- Humacao (small)
- Pantano de Espinar – Aguadilla (small)
- *Pterocarpus Forest* in Dorado
- Patillas- Punta Viento
- Luquillo- Valle del Río Mameyes
- Caño Boquillas- Mayagüez



***Pterocarpus officinalis***  
Picture by Estudios Técnicos, Inc.

<sup>125</sup> Ibid.

The Bosque Seco de Guánica is an area of unique resources. This forest, located in Southwest Puerto Rico is an exceptionally fragile and unique natural area in the Island's most arid region. Various designations recognize this area's natural and scientific importance. In 1919 it was declared a Commonwealth Forest (*Bosque Estatal*) and in 1981, the United Nations Education, Science and Cultural Organization (UNESCO) designated the area as a Biosphere International Reserve and in 1985 it was designated as a Natural Reserve by the PRPB. This forest was also recognized by the PRCZMP of 1978 as an SPA as part of the Southwest, Sector Guánica and SPA Southwest, Sector La Parguera designations.

The forest extends some 4,000 ha including a marine extension of some nine nautical miles. More than 80% of the soil is karst rock. Rain in this sector is scarce and temperatures are generally hot.

Its soil is rich in flora adapted to the extreme conditions. More than 550 species of plants and close to 180 species of trees, both native and introduced, have been identified of which 19 are endemic to Puerto Rico. At least 45 of these species are considered threatened or endangered.



**Bosque Seco de Guánica**  
Picture by: Estudios Técnicos, Inc.

This forest is also home to great variety of wildlife, both marine and terrestrial of which 15 species are considered rare, threatened or endangered. Close to 136 different species of birds have been identified here, 12 of which are endemic of which three are endangered and eight are in the list of threatened species. One of these species is the *guabairo* which in 1951 was considered an extinct bird, but was rediscovered in the Guánica Commonwealth Forest NR. The guabairo is still in the federal list of endangered species.

Furthermore, 21 species of reptiles and six amphibians have been identified. Among the amphibians is the *sapo concho*, and endemic endangered. As far as marine fauna, more than 1,000 species, including, coral, mollusks, sponges and fish, have been found.

Recreational use is putting increased pressures on the Guánica Forest. Recreational use of the Forest has increased drastically since the 1960s. It is an accessible location preferred by people who like to enjoy "virgin" beaches for snorkeling, swim and enjoy the day.

Other coastal forests with significance in Puerto Rico are the Piñones Commonwealth Forest NR, Ceiba Commonwealth Forest NR and the Boquerón Commonwealth Forest NR. The Piñones Commonwealth Forest, located in the Island's northeast, has approximately 12.70 km<sup>2</sup> and was designated as a Natural Reserve by the PRPB. Some 70% of the flora is comprised of mangroves and it has a bioluminescent lagoon, beaches, dunes and bays, among other resources. This forest is used intensively for tourism and recreation due to its proximity to the SJMA.

The Ceiba Commonwealth Forest was designated as a Natural Reserve in 1979 by the PRPB. This forest, located in Puerto Rico's East coast, is made up of 1.43 km<sup>2</sup> of land. Among the

habitats found here are mangroves, sandy beaches and coral reefs. This forest is home to a vast array of wildlife such as the *mariquita*, which is considered to be an endangered species.

The Boquerón Commonwealth Forest is part of the Boquerón Natural Reserve designated by the PRPB in 1980. This forest is comprised of approximately 18.76 km<sup>2</sup> in Puerto Rico's southwest. The forest is divided into eight segments: the mangroves of Barrio Guanajibo in Mayagüez, the mangroves at Laguna Joyuda, Puerto Real in Boquerón, the Bird Refuge, the Lighthouse, Molinos Pitahaya and Bahía Montalva. This forest includes six types of habitats considered important for wildlife, among which are: islets, coastal mangroves, coastal plains, and marine vegetation. This forest is also home to the largest mariquita population in Puerto Rico.

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## Responding to findings

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### A. Protecting and using the coastal forests resources

#### 1. Public ownership and custody

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In 1918, all mangroves on Puerto Rico's coast and adjacent islands which belonged to the people of Puerto Rico were declared Insular Forests, according to a proclamation signed by then governor of Puerto Rico, Arthur Yager.

Currently, some of those coastal forests are in private hands or are owned by Puerto Rico's government agencies or corporations. For example, some 0.195 cuerdas (0.0008 km<sup>2</sup>) of the Guánica Commonwealth Forest are owned by the Government of Puerto Rico and managed by DNER. Another 2.36 km<sup>2</sup> are included in the area adjacent to Bahía Ballena, associated to the Guánica Commonwealth Forest NR and were recommended for public acquisition in the PRCZMP (1978), along with other adjacent areas.

Also, some of the *Pterocarpus* forests in the coastal zone are privately owned.

#### 2. Management and protection

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Due to their unique natural characteristics, the importance of their habitats and their high recreational potential, the PRCZMP (1978) recommended the following *Pterocarpus* forests be designated as Natural Reserves. The recommendation was accepted and executed by the PRPB:

- Natural Reserve Río Espíritu Santo and
- Natural Reserve El Pantano Bosque de *Pterocarpus* and Lagunas Mandry y Santa Teresa in Humacao.

Other recommended areas which have not been designated are:

- *Pterocarpus* forest in Torrecilla Alta
- *Pterocarpus* forest in Dorado

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*Need: Designate the Pterocarpus forest at Torrecilla Alta as a Natural Reserve.*

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This area was recommended for designation as a Natural Reserve by the PRCZMP of 1978 as it included mangroves, a *Pterocarpus* forest, the Juan Pérez islet and other wetlands not

included in the original Proclamation in 1918. Portions of this land were designated as part of the Piñones Commonwealth Forest NR. The remaining lands, which were not included in the designation, were recommended by the DNER to the PRPB in 1983 to be designated and named Torrecilla Alta NR.

This area is comprised by the *Pterocarpus* forest, mangroves and some limestone formations in the marshes. Currently, most of these lands have been acquired by the DNER<sup>126</sup>, which should facilitate the process to solicit the PRPB the designation of this area as a NR.

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*Need: Evaluate the viability and desirability of designating the Pterocarpus Forest in Dorado as a Natural Reserve.*

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The PRCZMP of 1978 also recommended the designation of *Pterocarpus* forest in Dorado as a NR. Currently, these lands belong to the PRCT and are part of its Protected Areas system, reason why an evaluation of the benefits of designating the last as a NR by the PRPB is recommended.

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*Need: Officially adopt and implement management plans for the forests which have been designated as Natural Reserves.*

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Puerto Rico's forests count with a *Master Plan for the Commonwealth Forests of Puerto Rico* since 1976. This Plan only provided a preliminary structure for the forest system. Subsequently, preliminary master plans were prepared by individual units.

Today, these areas are subjected to diverse uses among which are research and passive and active recreation. Therefore, it is necessary to create management plans which respond to the growing recreational activity while protecting the unique natural value of these forests.

## B. Research

Coastal forests can be used as field laboratories for an ample variety of scientific and applied research

The PRCZMP recommended research associated with the following topics:

- a. Ecology of the life forms found in these areas,
- b. Interrelation between the diverse ecosystems, including wetlands and land habitats,
- c. More complete evaluation of flora and fauna, and
- d. Effects of pollution of plants and animals, particularly the effects on insects.

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<sup>126</sup> Approximately 1,200 cuerdas of land known as Finca PFZ were acquired by the DNER, another 200 cuerdas, known as Finca Cardenson Fund, are being acquired by the PRCT for donation to the PRLA along with another 700 cuerdas, which includes the *Pterocarpus* forest and a small mason tower for which the area is named after.

**Legenda - Map Key:**

- Bosque subtropical seco  
Sub-Tropical Dry Forest (dt-S)
- Bosque subtropical húmedo  
Sub-Tropical Moist Forest (mt-S)

- Bosque pluvial montano bajo  
Lower Montane - Rain Forest (rf-LM)
- Bosque pluvial subtropical  
Sub-Tropical Rain Forest (rf-S)

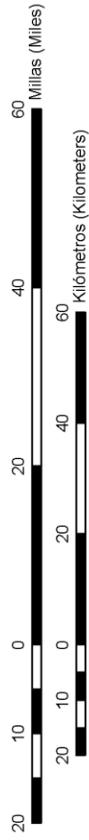
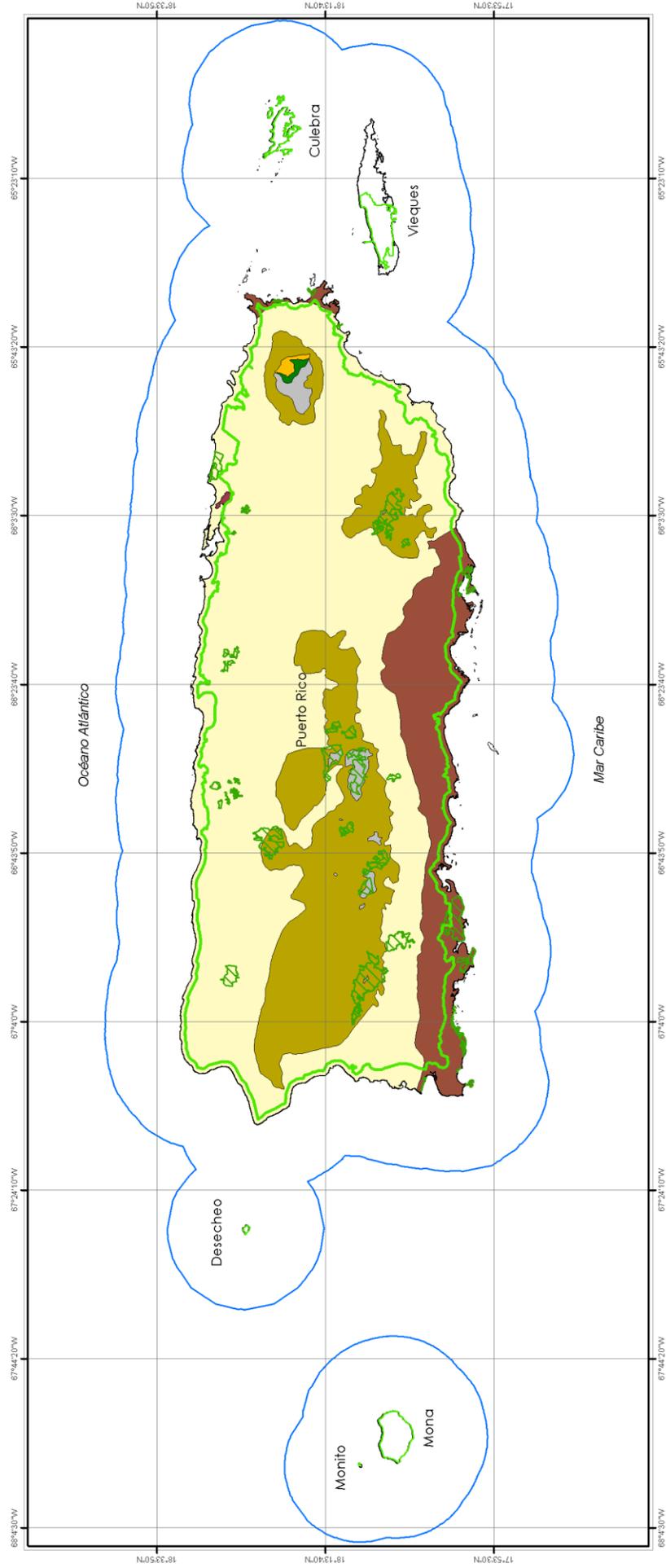
- Bosque subtropical muy húmedo  
Sub-Tropical Wet Forest (wf-S)
- Bosque muy húmedo montano bajo  
Lower Montane - Wet Forest (wf-LM)

- Límite de la zona costanera tierra adentro -  
Coastal Zone Inland Boundary
- Límite de la zona costanera marina (9 millas náuticas) -  
Coastal Zone Maritime Boundary

- Bosque Estatal -  
Commonwealth Forest



Escala - Scale 1:860,000



Fuente de Información - Source:  
Holdridge Life Zones Classification according to Ewel and Whitmore  
Departamento de Recursos Naturales y Ambientales

# Zonas de vida y bosques estatales

## Life Zones and Commonwealth Forests



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 19 / Map 19

### 3.2.9 HISTORICAL MONUMENTS AND ARCHEOLOGICAL SITES

#### Findings

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Puerto Rico's coast includes a rich heritage of historic sites. The Institute of Puerto Rican Culture (IPRC) has designated numerous historical monuments in Old San Juan and in other parts of the coast. The list of historical monuments and archeological sites has grown over the years.

The *National Register of Historic Places*, maintained by the NPS, includes 262 sites in Puerto Rico.<sup>127</sup> Of these, a significant amount is located in the coastal plains, among which are lighthouses still in use for navigation.

The archeological richness on the coast has reached at least 408 sites, including ruins from the pre-Columbus era<sup>128</sup> (See Map 20). Also, several sunken vessels in Puerto Rico's waters are part of the list of archeological sites and historic monuments.



**Punta Tuna Lighthouse, Maunabo**

Picture by: Estudios Técnicos, Inc.

#### Public Policy

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In the OPP-PRLUP, the general policy has been established as: “Conserve and protect structures of historic, architectural and cultural value as well resources of archeological value, through the implementation of regulations for those purposes” (see Policy 29.00). “Avoid the demolition, mutilation, destruction or decay of the natural resources, archeological sites and historic zones” (See Policy 30.08).

#### Implementing the Policy

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##### A. Protecting and managing key sites

##### 1. Public ownership and custody

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The IPRC is the Puerto Rico's government agency which carries the bulk of the responsibility over historical monuments and archeological sites. The majority of the historical monuments on the IPRC's official list belong to this agency while others belong to other government agencies or the municipalities. The rest belong to either the Federal government or the Catholic Church. At the federal level, the NPS manages the El Morro and San Cristobal forts as well as historic city walls surrounding Old San Juan. The majority of the lighthouses are property of the USCG<sup>129</sup>, with the exception of Punta Figuras, which is property of DNER and the Fajardo Lighthouse which was transferred to PRCT.

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<sup>127</sup> Information obtained from the National Register of Historic Places: [[http:// http://www.nr.nps.gov/](http://www.nr.nps.gov/)].

<sup>128</sup> Information obtained from the GIS layer, using geo-referenced information from the PRPB.

<sup>129</sup> See *Maritime Heritage Program* from the NPS: Inventory of Historic Light Stations Puerto Rico Lighthouses: [<http://www.nps.gov/history/maritime/light/pr.htm>].

## 2. Development of controls and regulations

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The IPRC implements the regulations in the Historical Districts which are applied to both public and private property in the Historical Districts of Old San Juan and Ponce.

Sites mentioned in the National Register of Historical Places are protected against any alteration by the “National History Preservation Act” of 1966<sup>130</sup> through programs financed by the Federal government under the “Federal Law on Historic and Archeological Preservation” of 1974.

At the local level, other laws of great significance exist. The “Law on Historic, Ancient or Touristic Interest Zones,” Law No. 374 of 1949, has jurisdiction over ancient or historic zones and over areas of touristic interest. This law orders the RPA to protect structures and special places in accordance to recommendations from the IPRC, prior to granting any permits within the designated historic zone.

The “Law on the Protection, Conservation and Study of Underwater Sites and Archeological Resources,” Law No. 10 of 1987, created a Council for the Conservation and Study of Underwater Sites and Archeological Resources within the IPRC. The Council is the only government entity exclusively dedicated to underwater archeology. It has the responsibility of protecting underwater archeological resources and promoting exploration, location, discovery and preservation of these sites for further study.

The “Law for the Protection of Land Archeological Patrimony in Puerto Rico,” Law No. 112 of 1988, created the Council for the Protection of Land Archeological Patrimony within the IPRC. This council regulates of archeology in Puerto Rico and establishes public policy for the protection of archeological patrimony. Under this law, the sites, findings, artifacts, documents or archeological material recovered are declared patrimony. The law also establishes certain obligations regarding all excavation, construction or reconstruction done in Puerto Rico.

Another law associated with the conservation and best use of cultural patrimony in Puerto Rico is the “Law on Public Policy for the Development of Sustainable Tourism in Puerto Rico,” Law No. 254 of 2006. This declares tourism as an instrument for education and creation of awareness regarding conservation and appreciation of natural, environmental, cultural and historical resources of great value in natural areas, both public and private. It also promotes active participation from the community in conservation efforts for enjoyment as well as social en economic wellbeing of present and future generations.

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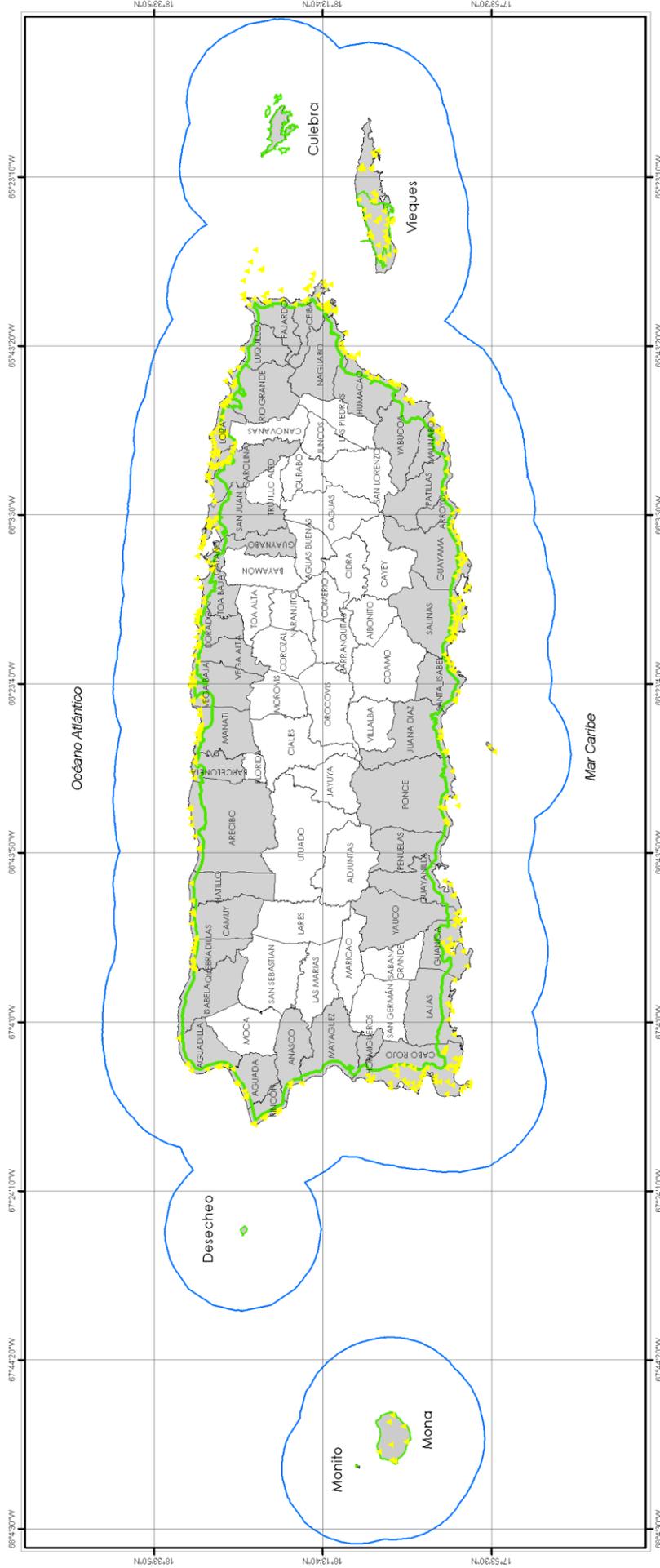
<sup>130</sup> (PL 87-665)

**Leyenda - Map Key:**

-  Monumentos históricos y yacimientos arqueológicos - Cultural and historical sites
-  Municipios costeros - Coastal Municipalities

-  Límite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
-  Límite de la zona costanera marítima (9 millas náuticas) - Coastal Zone Maritime Boundary

Escala - Scale 1:860,000



Fuente de Información - Source:  
 Hazardous Materials Response Division  
 Office of Response and Restoration  
 National Ocean Service  
 National Oceanic and Atmospheric Administration  
 June 2001  
 Banco de Datos de Estudios Técnicos Inc., estudio de campo 2004

# Monumentos históricos y yacimientos arqueológicos en municipios costeros Cultural and Historical Sites in Coastal Municipalities



Programa de Manejo de la Zona Costanera  
 Coastal Zone Management Program

Mapa 20 / Map 20

There are places of archeological significance in Puerto Rico which are still not inventoried, many of which are found in private lands. This situation may cause important research areas to never be discovered until a development project goes into its construction phase, in which case the developer is obligated to report the finding to the IPRC and coordinate the best option to protect it.

### 3.3 COASTAL DEVELOPMENT

#### 3.3.1 COAST-DEPENDENT INDUSTRY

##### **Findings**

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Some development critical to Puerto Rico's future is likely to be coast-dependent. Certain installations and activities should be located on the coast in order to function. Examples of these types of activities are ports and dockyards. Others, significantly benefit if they are located near the coast. These include: (1) energy plants and other industries which need water for cooling and use great quantities of imported material and (2) industries which are supplied or serve by industries related to the water and therefore, seek a location near the coast.

Appropriate places for industrial uses dependent on the coast (ports and marinas) are limited due to the configuration of the coast and the depth of the waters. Some of the places appropriate for ports are found in the south and west of the Island between Yabucoa and Punta Rincón.

Natural values, 8in particular, would conflict with industrial development at some of these locations. Some coast-dependent developments, if carefully planned, could occupy portions of these coastal areas with relatively minor impact over their natural value. However, local and federal environmental laws, as well as contamination problems presented by certain areas, could restrict the location of coast-dependent installation in certain places.

All analysis regarding coastal development should take into account the real threats faced by coast-dependent activities, including climate changes, in particular the rise in sea levels and the increased frequency and intensity of weather events. Planning processes in Puerto Rico should anticipate this phenomenon in order to avoid future economic and social costs.

Certain activities which do not depend on the coast tend to be located in these areas. Puerto Rico's coastal zone is home to important natural, commercial, recreational and industrial resources of actual value or potential value for present and future generations. Important economic activities, essential infrastructure and important urban centers have been located on the coast. However,



**Uses not dependent on the coast**

*Picture by: Estudios Técnicos, Inc.*

the demand for coastal land and water for uses not depending on the coast has impacted natural systems and reduced space for public use on the coast.

The evidence is clear, residential projects have occupied coastal areas along with industries and commerce which do not depend on the waters. If allowed, these projects will occupy the existing areas for coast-dependent uses. The coast along La Parguera in Lajas, Loíza, Boquerón, Punta Picúa, Condado and Isla Verde, are some coastal areas occupied by structures for touristic, recreational and residential purposes without adequate planning. This has created conflictive situations among which are: the problem with access to the coast, visual obstruction of resources, degradation of coastal resources and increased location of developments and infrastructure in risk areas.

Construction tendencies in the coastal territory have created a need to pay special attention to coastal areas with urban characteristics in order to: (1) avoid, or at least put a stop to, the loss of coast due to activities or uses not dependent or unrelated to water resources, (2) protect life and property and (3) protect coastal resources.

There are urban areas on the coast with the potential to be redeveloped in order to maximize public use. Coastal areas with abandoned structures or rarely used, especially those located in the maritime zone, present an opportunity to recover transition spaces between the coast and developed areas. By optimizing coastal space for urban use, it is possible to take advantage of these zones and redevelop them for public enjoyment. The *Ventana al Mar* project in Condado is an example of a redevelopment which provided a space for public use for recreation and socialization along the coast. This transition area also helps protect life and property by providing a buffer zone in for potential damages caused by weather events.



**Ventana al Mar: transition area  
between the coast and urban  
development**

*Picture by: DNER*

## **Public Policy**

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The OPP-PRLUP establishes as one of its general goals:

"Locate our industrial developments in strategic areas which permit the use of those lands which, due to their location, characteristics or the services and infrastructure already within them, best adapt to this use in harmony with the general objective of achieving the best possible use in order to take advantage of the potential of their natural resources, achieve a distribution of benefits of development between the municipalities and geographical sectors and create and maintain conditions under which man and nature can coexist in harmonious and productive manner."

The objectives also establish that:

“Avoid that new activities or subdivisions create unnecessary losses of options for future use of the resources” (See Policy 30.07).

- “Avoid the construction of structures on beach areas and dissuade those activities or subdivisions on contiguous lands which can create obstacles for free access to the beach by promoting free access to their panoramic views and enjoyment by all citizens.”
- “Integrate and harmonize residential development (and other projects) to the existing natural environment, promote forestation and maintaining harmony which other natural characteristics, such as vegetation and topography” (See Section 30.07).
- “In those exceptional cases where it is inevitable the development of polluting industries (as defined by the EQB), those industries must be located in pre-selected locations and that all adequate provisions are taken in order to assure that adverse environmental impact is kept to a minimum. (See Policy 5.03).

*Additional Policies established by the PRCMZP.* Attune to the aforementioned general policy, the following detailed policies are established:

#### ***Locations for coast-dependent developments***

...Urban development, including those industries not requiring (or substantially benefit) of a location in front of the coast, should whenever possible be located away from the coastline. This is in accord with the policy established by the PRPB, which seeks to promote development “perpendicular to the coast” in coastal cities.

...Coastal areas designated by the PRPB as apt for development of coast-dependent industries should: (1) be protected from other types of developments and (2) be reserved for industries which depend on the coast, except in those instances where the destruction of natural systems is unacceptable.

... Those locations reserved for coast-dependent industries which are also important because of their natural value, should be developed only after careful consideration and designed with the best available alternatives in order to protect natural systems.

### **Implementing the Policy**

#### **A. Protecting sites for coastal-dependent industry against other kinds of development**

##### **1. Public ownership and custody**

The Government of Puerto Rico, through its agencies and corporations, is the deed holder of various costal lands apt for development of coast-dependent activities. The majority of the government’s coastal properties have been developed.

However, it is important that the Government of Puerto Rico retain the deeds to those lands in order to execute and integral management plan for coastal resources and optimize the use of coastal resources.

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*Need: Create an inventory of the lands owned by agencies or public corporations apt for coast-dependent development.*

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The Government of Puerto Rico should evaluate the lands property of its agencies or public corporations to see if they are apt for coast-dependent uses and reserve their use for those purposes.

## 2. Development Controls

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The PRPB bases its development control process, described in Chapter 4, to prevent developments inconsistent with locations deemed apt for coast-dependent use. The adoption of the OPP-PRLUP strengthens the PRPB in the management of proposals incompatible with said purpose.

### B. Resolving conflicts among industrial development, natural systems and air and water quality objectives

#### 1. Development controls and regulations

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In order to deal with conflicts in the development and use of coastal lands, several fundamental statutes, including the “Public Policy Law on Sustainable Development”, *supra*, have been passed. This law was approved with the purpose of incorporating an element of sustainability into the Government’s public policy. The statute orders the use of all means and practical measures with the purpose of promoting sustainable development in Puerto Rico.

The adoption of sustainable development as a guide serves as a mean to resolve conflicts which may arise from economic and social needs as well as protection of the natural infrastructure. The effective combination of regulations, programs and laws – framed as an integrated action by the PRPB – is one of the principal foundations to harmonize the needs for coastal development with the most advanced protection of natural systems and goals set for water and air quality. At the same, citizen participation should be promoted in the decision-making process by the Government since it has proven to be a very useful tool.

Agencies have laws, programs and regulations to control coastal development. The PRPB counts with a development control process, described in Chapter 4, to solve usage conflicts in the coastal zone.

Through its Organic Law, the PRPB must prepare and adopt land use plans in order to comply with its reason for being, which is to guide the integral development of Puerto Rico in a coordinated fashion so as to promote, among other things, efficiency and the economic and social wellbeing in the process of population distribution, use of lands and other natural resources.

The PRPB is also responsible for implementing the “Commonwealth of Puerto Rico Land Use Plan Act”, Law No. 550 of 2004, which establishes the preparation of said plan as the Government’s public policy. The plan will serve as a planning tool to promote sustainable development in Puerto Rico and guide public policy associated with land use, development

and the conservation of natural resources.<sup>131</sup> The PRPB also evaluates the Municipal Land Use Plans following the dispositions of the “Law of Autonomous Municipalities.”

This agency, through the “Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico”, *supra*, has the responsibility of protecting natural reserve areas and natural resources by not allowing new subdivisions or development which could deteriorate or destroy them.

The PRPB also designates some of Puerto Rico’s coasts as Tourism Interest Zones (TIZ). The TIZ’s purpose is to identify areas with touristic potential and stimulate their protection and development through the application of current regulation regarding land use in such a manner that it promotes uses in harmony with touristic resources within the zone and limit uses not permitted or conflictive. However, in practice, permitted touristic uses do not comply with current regulations, leading to many of them being approved by means of exceptions of variations through site consultations.

An integral part of the PRCZMP is the "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters and Submerged Lands Thereunder and the Maritime Zone", *supra*, of the DNER. This statute has among its purposes the establishment of criteria and mechanisms for granting of authorizations and concessions for the use and enjoyment of the maritime zone, territorial waters and submerged lands. It establishes that the enjoyment of these resources should be conditioned to, in first instance, that the proposed use is dependent on the water. Parting from that consideration, the DNER is evaluating the viability of granting authorization or concession for its use.

For its part, the EQB is responsible for implementing the “Law Puerto Rico Environmental Public Policy Act”, *supra*, through the incorporation of the sustainability element in its public policy. The EIS required by said law should consider the location of projects and propose alternatives to avoid conflictive uses in the coastal zone. Along with its operational element, the “Regulation on procedure, presentation and evaluation of environmental documents”, Regulation No. 6026 of the EQB, pursues the protection of resources, life and property, including those in Puerto Rico’s coastal zone.

This agency also contains other dispositions associated with the quality of the environment which should be considered at the moment of evaluating a location, use on industry proposal on the coast. Among these regulations is the “Regulation for Control of Atmospheric Pollution” and the RECA.

## 2. Special Planning Areas (SPA)

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The protection of critical areas is a planning effort which has been an important element within the PRCZMP since its inception. These joint efforts between the DNER and the PRPB includes the designation of areas as NR and SPA and the development of management plans for these and other areas which require special planning.

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<sup>131</sup> Currently, there is a first draft of the PRLUP dated to 2006. The PRPB, agency responsible for the preparation of the PRLUP, is in the process of restructuring the land use plans at the regional level.

The SPA are areas which include important coastal resources subject to present and future conflict, reason for which they require detailed planning. There are eight areas designated as SPA since 1978 with the approval of the PRCZMP. These areas are:

- Piñones
- Southwest - (divided in three sectors - La Parguera, Guánica and Boquerón)
- Laguna Tortuguero
- Puerto Rico's mangroves
- Isabela-Aguadilla
- Vieques
- Bahía de Jobos
- Pandura-Guardarraya

These SPAs should have their corresponding management plans with the purpose of harmonizing preservation and conservation of these natural resources with Puerto Rico's socioeconomic activities.

Four of these SPA (Tortuguero, La Parguera, Piñones and Mangroves) have management plan officially adopted by the PRPB and incorporated into the PRLUP's draft.<sup>132</sup> The management plans for the Southwest-Boquerón SPA and Isabela-Aguadilla SPA, are currently under consideration by the PRPB. Meanwhile, there are drafts of the Vieques and Pandura-Guardarraya's management plans.<sup>133</sup> Currently, management plans for the Guánica and Bahía de Jobos's SPAs are being drafted.

There is an Interagency Committee working to identify conflicts in the SPA. This Committee is headed by the DNER and it is composed of representatives from the PRPB, EQB, EPA, USFWS and USACE. The main goal of this committee is to identify conflictive uses which could affect areas with coastal and marine resources.

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*Need: Officially adopt management plans for the SPAs and develop strategies for their implementation with the goal of minimizing conflict of use*

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While many management strategies have been implemented, in some places designated as SPA – such as La Parguera – there has been pressure felt for the demand of urban activity along with the proliferation of sporadic development. Another area which has felt pressure for development and counts with an adopted management plan is SPA Laguna Tortuguero. This area has been under pressure for industrial and urban development related to the pharmaceutical industry, quarries, and the construction of residential projects in the zone which comprises the basin for this water body.

The SPA Jobos and Southwest, La Parguera in Lajas, are subject to constant research efforts to provide the basis and other information needed to facilitate the evaluation of future

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<sup>132</sup> Written communication from the PRPB's Subprogram on Land Use from November 8, 2007.

<sup>133</sup> The draft for the management plan for this area will be sent for PRPB's consideration.

development proposals. The research is being conducted as part of the PRCZMP in cooperation with Puerto Rico's Government agencies directly committed, such as DNER, EQP, PRPB, the Department of Economic Development and Commerce and the PREPA as well as researchers and universities.

3. Pay special attention to the maritime front with the goal of avoid (or at least detain) their loss due to activities deemed non-dependent or non-related to the water resource.

The proliferation of uses not dependent on the coast obstructs physical and visual access to the coast, aside from the fact that they constitute a risk to life, property and natural resources. Therefore, it is of utmost importance to dissuade coastal urban sprawl and avoid the development of structures on the coast not dependent on the water.

For decades, marine fronts have been subjected to misuse and even abandonment. In those areas where changes in industrial processes or abandonment has occurred (as is the case of *Brownfields*) now presents an opportunity to establish other uses which could benefit the public.

Recently, many cities have recognized the development potential of maritime fronts and have concerted efforts in renovating and strengthening their redevelopment. These efforts are supported by certain conditions such as the existence of essential infrastructure, vacant land with functional and aesthetic value due to their proximity to the water and in the center of the city.

**Leyenda - Map Key:**

■ Áreas de Planificación Especial - Special Planning Areas

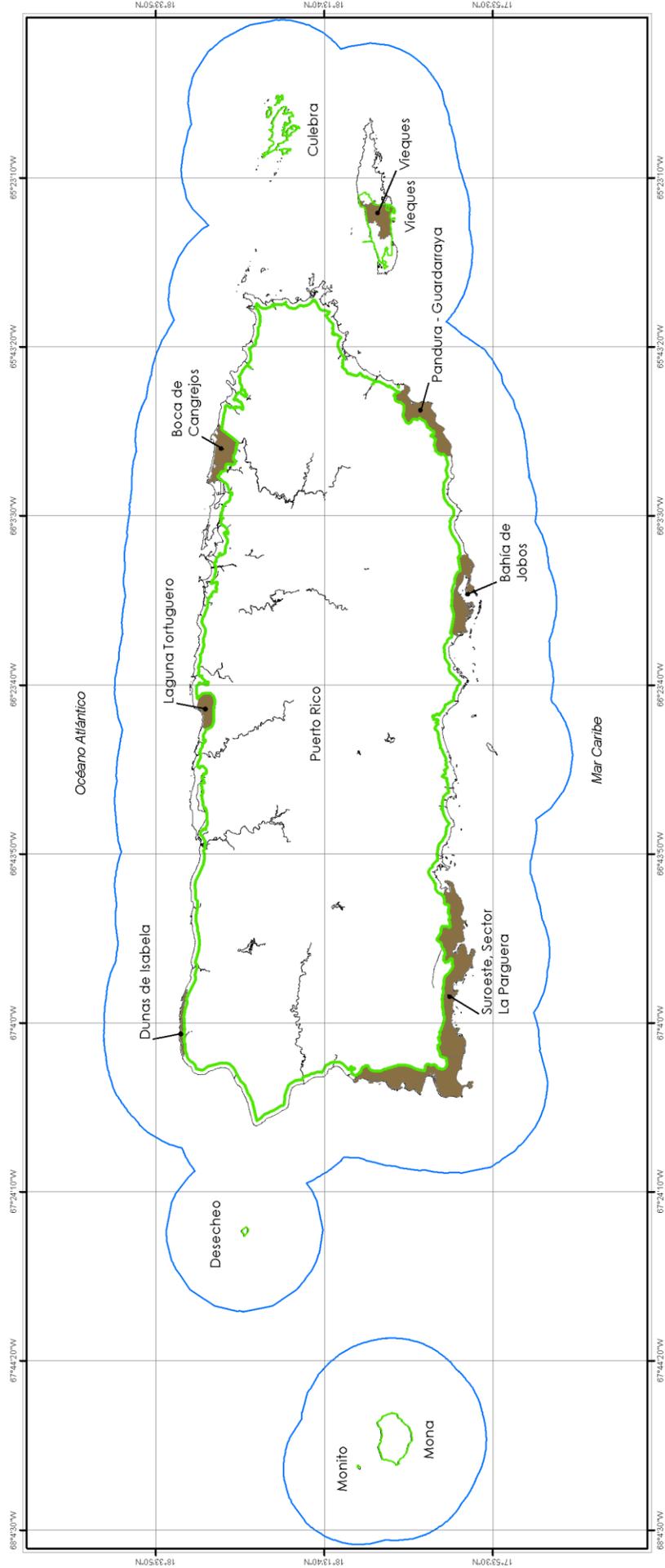
— Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary

Nota - Note  
Todos los manglares de Puerto Rico son Áreas de Planificación Especial  
All the mangroves in Puerto Rico are Special Planning Areas

— Limite de la zona costanera marina (9 millas náuticas)- Coastal Zone Maritime Boundary



Escala - Scale 1:860,000



# Áreas de Planificación Especial Special Planning Areas



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 21 / Map 21

Fuente de Información - Source:  
Departamento de Recursos Naturales y Ambientales

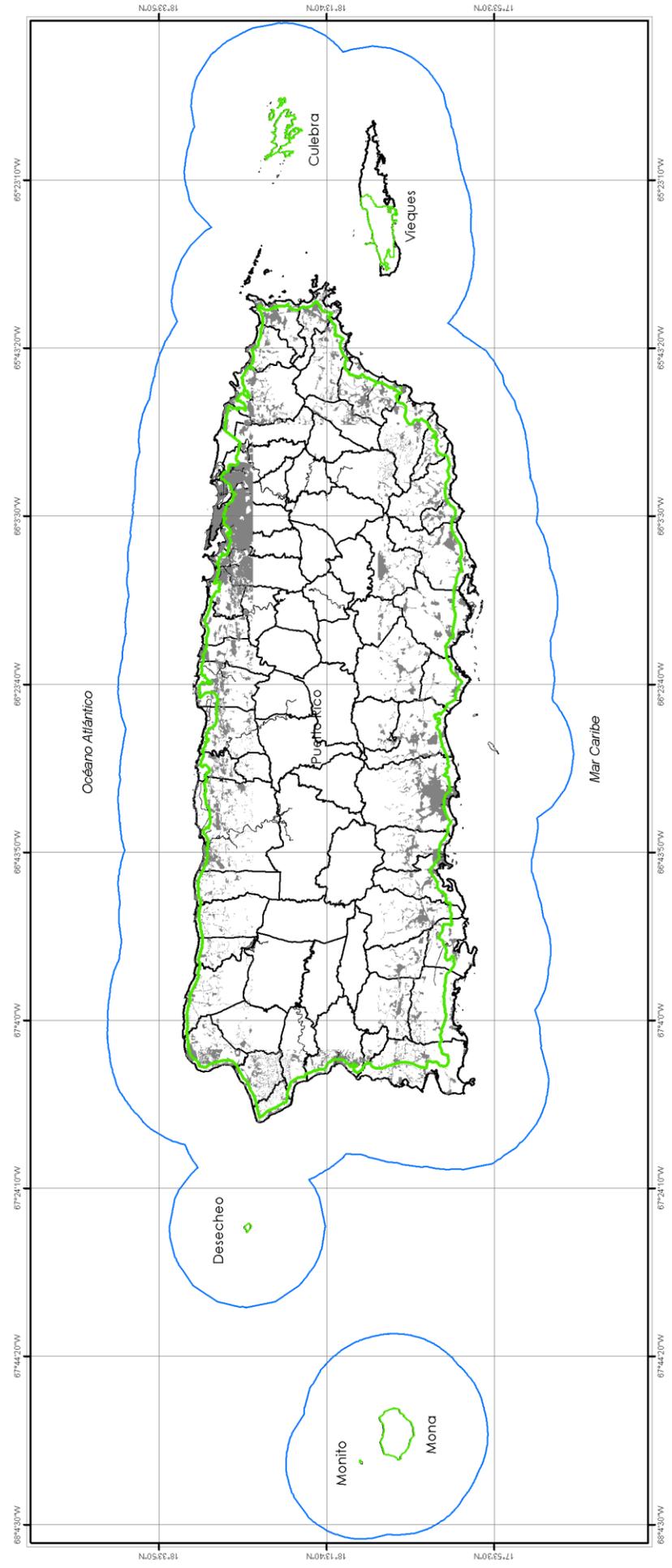
Leyenda - Map Key:

- Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
- Limite de la zona costanera marina (9 millas nauticas) - Coastal Zone Maritime Boundary

- Uso de suelo 1999 - Land Use 1999
- Urbano - Urban
- Municipios - Municipalities



Escala - Scale 1:860,000



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

# Suelos urbanos en la zona costanera

## Urban Lands in the Coastal Zone

Fuente de Información - Source:  
UPR Mayagüez - Land Use Change Analysis  
for USGS Coastal Quadrangles (1999)

Cities in the United States such as San Francisco and Portland, on the Pacific Coast and Boston and New York, on the Atlantic coast, have proven how the image and functionality of the areas in which industries are located or uses dependent on the coast can be transformed if carefully planned so they respond to the public's best interest. In that direction, Puerto Rico has set forth efforts to complete the transformation of the Port of San Juan.

The redevelopment of maritime fronts can be executed in diverse ways depending on the area's characteristics which include: the revitalization of communities by incorporating public access's strategies which include boardwalks, piers, parks, green areas, redevelopment of mixed uses, the improvement of marine transportation infrastructure for ports and providing space for employment traditional to the coast (i.e. fishing villages).<sup>134</sup>

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*Need: Open transition spaces between the coast and developed areas.*

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When it comes to considering redevelopment of these areas, it is of utmost importance to incorporate elements of public safety, the protection of coastal and marine resources and prevision of future changes due to climate change. In that direction, it is important to establish transition zones between the coast and urban development that are free of structures, that they facilitate the use and enjoyment of natural resources related to the coast, assets of public domain and common areas by citizens. Therefore, it is essential that regulations which set space limits for development are rigorously enforced.

These spaces should focus on the improvement of access to the coast, control the long-term quality of the environment and the protection of life and property. Also, these spaces should be based on the economic, social and environmental improvement of existing communities.<sup>135</sup>



**Lineal park at the SJBE**

*Picture by: CPN*

It is important to continually provide public access to the maritime front. The system of open spaces should also be strengthened with the use of connectors and lineal parks.

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<sup>134</sup> See: Carver et al. (2007). Waterfront Redevelopment under the National Coastal Zone Management Program. *Proceedings of Coastal Zone 07. Portland, Oregon.*

<sup>135</sup> For more information refer to Coastal Council NSW, (2003). Coastal Design Guidelines for NSW: [<http://www.planning.nsw.gov.au/plansforaction/coastaldesign.asp>] y Urban Land Institute, (2004). Remaking the Urban Waterfront: [[www.uli.org](http://www.uli.org)].

### 3.3.2 SAND FOR CONSTRUCTION

#### Findings

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Puerto Rico' construction industry needs huge quantities of sand. The accelerated increase in the construction of new residential complexes, roads and, in general, an ample infrastructure in Puerto Rico has elevated consumption of sand on the Island beyond extraction possibilities.

The construction industry depends on raw materials for production of aggregates, especially for uses related to cement, concrete products, asphalt and derivatives. For example, production of one cubic yard of cement requires between .50 a .55 m<sup>3</sup> of sand and between .43 a .46 m<sup>3</sup> of gravel.<sup>136</sup>

For many years, natural sand and gravel deposits were used to satisfy nearly all needs. The deposits along the beach and dunes were exploited to satisfy much of the demand. The rest came from primarily rivers, floodable plains and run-off plateaus.

The beaches were the principal source of sand for construction until 1965 when the Government suspended extraction due to the severe erosion exhibited by the coasts. Quarry operators moved their operations from the beaches to the rivers and along run-off deposits.

Residual soils were among other sources of sand that were exploited locally. Washing this material to remove small clay particles produces fine-quality sand. However, this trench mining practice could bring serious soil erosion and water contamination problems.

These traditional sand sources are now running out. In 1969, a study done by the U.S. Bureau of Mines warned that many of the deposits in use would be depleted by 1975. According to the study, by 1990, the only conventional sources remaining would be those naturally replenished. Today, as indicated in the section regarding dunes, the dune deposits along the Northwest are practically empty.

The deposits in Isabela, where Puerto Rico's most developed dunes could be found, were severely impacted by this activity (Castillo & Cruz, 1980, in Valeiras, 2007). In this area, low prices were the main incentive to stimulate sand extraction which supplied demand not only in the West, but also in municipalities as far away as Fajardo and Ponce.

By the same token, sands from deposits along river canals (which are located at the bottom of rivers and are of public domain) have been extensively exploited. The best deposits have disappeared. Even if natural processes continue to replenish some of the deposits in the canals, the future volume of sand and gravel of these sources will be even more reduced for the anticipated needs.

The sands in floodable plains and plateau deposits (formed during periods when rivers overflowed their banks) still present considerable quantities. However, the most of these deposits are located on private lands and are available only at high prices. Some of Puerto Rico's best agricultural lands are located in these floodable plains and run-off plateaus.

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<sup>136</sup> Information obtained from the Estudios Técnicos Inc. database

Excessive extraction of remaining natural deposits would accentuate problems of erosion and landform alterations. Sand extraction has increased coastal erosion and contributed to the erosion of lands in the interior along the rivers (i.e. substantial excavation along the rivers cause their margins to plummet during rain periods). The extraction along the run-off plateau and other alluvium deposits have altered the landscape, giving way to the formation of lagoons and depressions which sometimes remain for a long time after extraction has terminated. Excessive extraction of these natural deposits will probably aggravate the problem.

Manufactured sand, already produced in several quarries, represents a possible alternative to natural sand. Crushed stone for the manufacturing of sand in Puerto Rico is available in certain quantities. Aside from limestone rock, volcanic rocks is crushed in various sizes to substitute gravel, sand for concrete and fine sand in order to meet the needs for the construction industry. However, the quarries can cause certain environmental and health problems among which are: destabilization of the soils, deforestation, erosion, sedimentation of water bodies, dust and excessive noise (DRNA, n.d.).

Submerged sand deposits are another potential source of sand for construction. Geologists have identified three submarine sand and gravel deposits which could be economically important. The biggest of these is the *Escollo de Arenas*, to the northwest of Vieques, which is estimated to contain 90 million m<sup>3</sup> of sand and gravel. The second submerged deposit is found in Isabela, to the northwest of Puerto Rico. This sand and gravel deposit counts with between 20 and 25 million m<sup>3</sup>. This deposit, according to the USGS, is not considered economically viable because it is composed of relatively fine sand lenses extending over high depth waters. Furthermore, Puerto Rico's Northwest coast is a high-energy environment which would present an obstacle for the recovery of sand and gravel.

A third deposit can be found in Cabo Rojo, about one kilometer from the Southwestern tip of the Island. It is estimated that this deposit contains between 8 and 12 million m<sup>3</sup> of sand. Of the three submerged deposits mentioned, extraction from this submerged deposit poses the least risk of impacting the beaches (Nichols, Maynard & Cerco, 1983). The combination of the three deposits can yield an estimated 74.5 to 83.5 million m<sup>3</sup> of sand and gravel.

However, the report "Puerto Rico and the Sea" (1999) points out that DNER did analysis to evaluate the environmental impact of the three deposits mentioned and found the best option for exploitation, in environmental terms, would be the Escollo de Arenas. But, as the report also points out, this would be a temporary solution to a critical situation with the supply of sand for construction.

## **Responding to findings**

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### **A. Controls for extraction**

The "Law on Sand, Gravel and Stone", Law No. 132 of 1968, establishes as the Government of Puerto Rico's public policy the requirement of permits for excavations, extractions, removals or dredges of earth crust components on public or private land in Puerto Rico. This law also prohibits the granting of permits when certain circumstances occur in the maritime zone that could affect natural resources in the area.

Following the disposition of the law, the “Regulations for the Extraction, Excavation, Removal and Dredging of Earth Crust Components”, *supra*, was adopted. This regulation establishes that to grant or deny permits several factors must be taken into consideration among which are the effect of the activity on adjacent areas, erosion in the maritime zone and river banks in Puerto Rico, impact on rivers and the sea, changes in topography, tides, sand dunes, navigation and access to public roads, among others.

#### B. Determine possibilities for alternate sources of aggregates for construction

The indiscriminate extraction of sand from beaches for the construction industry has depleted deposits to the point that it is necessary to consider other alternatives. The granulation of beach sand makes it a preferred material for cement cover. Sand manufactured in several of Puerto Rico’s quarries and “talc” o marble residue have proven to be adequate substitutes. However, there still sand wholesalers in Puerto Rico who are selling beach or river sand for construction uses.

Submarine deposits are another potential source of sand for construction. However, it is necessary to consider the economic viability of extraction and environmental impact this activity may have. Sand extraction from submarine deposits suggests potential environmental damages such as: the creation of sedimentation lagoons, physical damage to reefs caused by dredging equipment, sedimentation or removal of reefs and damage to marine vegetation on or near the areas of extraction.

Since sand for concrete requires less refining, other sources such as manufactured sand or gravel have been identified as alternatives to satisfy demand. However, these alternatives are obtained from grinding limestone, which is protected under the dispositions of the “Protection and Conservation of Puerto Rican Karst Physiography Act”, *supra*.

In compliance with that law, the DNER prepared the Karst Study (*Estudio del Carso*) in 2008 identifying the areas where extraction of crust materials is prohibited and is currently working on amendments to the “Regulations for the Extraction, Excavation, Removal and Dredging of Earth Crust Components” to include the prohibitions resulting from the study.

The law also disposes that as part of the study, the DNER must incorporate appropriate alternatives within the karst zone to relocate activities subject to the prohibition.<sup>137</sup>

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*Need: Evaluate available technologies and innovations to find alternative sources of material to supply industry demand.*

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The recycling of various materials, such as glass, plastic and concrete, is an area which should be explored. Concrete has proven in other parts of the world to be an appropriate material for building roads, non-structural walls and trenches, among others. Such is the case that the Federal Highway Authority has begun studies in various states to determine the

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<sup>137</sup> This law was amended by Law No. 200 of 2007 with the purpose of establishing that the DNER must prepare and approve a regulation geared toward protecting caves, caverns and sinkholes no later than January 1, 2009.

possibility of implementing the use of recycled concrete aggregate for road construction.<sup>138</sup> The goal is to convert this into a program administered by the state transportation authorities.

Another product which would help reduce the volume of refined aggregates and the reduction of cement in the mortar mix is ash. Several companies around the world have dedicated their business to the distribution of ash. These companies specialize in the sale of ash prepared with additives which increases the material's resistance. These materials must be imported.

The importation of sand can also be an alternative, but for this to be seriously considered economic viability studies will be needed and reassurances that this practice is not adversely impacting the material's origin. The same should also be applied to sources of sand previously mentioned.

### 3.3.3 MINERAL DEVELOPMENT

#### Findings

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Puerto Rico has limited commercial mineral resources. In the past, mine development in Puerto Rico had a certain degree of success. The first colonists dedicated themselves to the search for gold and it is estimated that approximately 1,200,000 ounces of gold were mined from year 1509 to 1579, when gold mining ceased because the deposits, and the work force, were depleted.

In the Southwestern coast there was salt production by evaporation of the sea water. Over the last years, the only local salt production has occurred in the *Salinas de Cabo Rojo*. However, supplies were not sufficient to satisfy demand for this product. Today, these lands are part of the Boquerón Commonwealth Forest NR and the Cabo Rojo Wildlife Refuge.

Metals have not been exploited in Puerto Rico since the iron mines in Juncos were closed in year 1953 and currently, rebuilding the mining industry does not seem probable. As mentioned in the previous section, the extraction of earth crust material to supply demand for the construction industry has become the most important mining activity in Puerto Rico.

Among the most important metallic minerals found in Puerto Rico are copper, nickel and some iron. Currently, many of the natural deposits of these minerals are scant and only have importance in terms of scientific research, although there are some which may be of economic interest. However, the majority of these mineral resources do not have the condition, quantity or quality to be exploited commercially.<sup>139</sup>

These are the most important, or best known, metallic minerals:

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<sup>138</sup> The study is being done in conjunction with the EPA, the *American Concrete Institute (ACI)* and the *American Association of State Highway Transportation Officials*.

<sup>139</sup> In the region of Utuado Lares and Adjuntas deposits of copper, silver, gold and other minerals associated with copper exist. The exploitation of these mineral deposits was a subject for debate in the 1960s, 1970s and 1980s. In the mid 1990s the Government of Puerto Rico prohibited exploitation.

## ***Copper***

Copper is the most abundant mineral in Puerto Rico and is found mainly in Puerto Rico's mountainous interior.<sup>140</sup> Geologists have found other deposits along the coastal regions in Lajas, Guánica and Aguada. However, their exploitation would cause an ecological disaster, reason why proposals to extract these resources were denied.<sup>141</sup>

## ***Fuels***

Fuels are divided into organic fuels such as oil, gas and carbon and radioactive fuels such as uranium and thorium. The future of fuels is not as promising as that of metallic resources since very little exploration regarding their existence has been done.

## ***Gas and oil***

Oil is a liquid hydrocarbon mineral which is found in places rich with sedimentary rock and is created by the decomposition and accumulation of plants remnants and animals which lived millions of years ago.

In Puerto Rico, two possible oil deposits have been found beneath the interior volcanic complex.<sup>142</sup> The quantity of oil available in both places is not significant, but its mere existence indicates the possibility of other deposits beneath the limestone formations along Puerto Rico's Northern and Southern coasts.

Between the years 1959 and 1969, the Kewanee Inter-American Oil Company punctured three exploration wells along the South coast with depths of 2,280 meters, 1,500 meters and 1,265 meters. In 1956 the Mining Commission granted A.D. Fraser a permit for exploration in the North coast, who after performing aeromagnetic studies contracted Kewanee to puncture one well on a property at Barrio Islote in Arecibo and reached a depth of 1,960 meters through 1,706 meters of tertiary rock. Although neither oil nor the natural gas that usually accompanies it was found, valuable information was obtained which was thought would be useful for future exploration.

Information gathered up to this point is not sufficient to determine if indeed there is oil beneath Puerto Rico's surface, but if those prove that the nature of the rock beneath the Island is appropriate for the accumulation of oil or natural gas.

## **Public Policy**

The OPP-PRLUP establishes public policy regarding renewable and non-renewable resources. In order to insure proper management and prudent enjoyment of these resources,

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<sup>140</sup> There are sites in the central mountainous region which includes Utuado, Jayuya, Adjuntas, Lares, Barranquitas, Morovis, Ciales and Corozal. Copper sites also exist in Humacao, Gurabo, Juncos and Caguas.

<sup>141</sup> Three areas of high copper content, known as Piedra Hueca, Cala Abajo y Tanamá, were discovered by the American Climax Inc. and the Kennecott Copper Corporation in a period of exploration between 1958 and 1965. After perforating 336,011 feet in 371 drills, the companies estimated the deposit at 243.5 million tons of copper. The Mining Commission estimated approximately 300 million tons of copper ore with a minimal cut of 0.3%, using the design of the proposed mine for the company.

<sup>142</sup>The USGS reported about the existence of oil filling some of the limestone creases seen around the municipalities of Coamo and Aibonito and an emanation of oil along a fault zone off the Northeast coast of Ponce.

the declaration of policy requires that these resources be identified and their potential to be damaged or depleted be evaluated. For the development of these resources, the declaration of policy establishes:

"...promote the prudent use of the different identified resources in this inventory in a manner consistent with the conservation of those renewable resources and at the appropriate time in the case of non-renewable resources" (See Public Policy 29.00).

"Develop management and conservation plans for non-renewable resources (minerals) which guarantee environmental quality." (See Public Policy 34.00).

As previously explained in the section about coast-dependent industries, the PRPB also proclaimed that options for future use of these resources should also be explored.

### **Implementing the Policy**

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The Administration for the Conservation of Water and Mineral Resources, a DNER dependency, is responsible for establishing and implementing policy regarding these resources and advises the PRPB and RPA regarding mineral, geological and archeological resources, among other topics. It also advises the Secretary of DNER in the formulation of public policy regarding mineral resources and is responsible for implementing the laws associated with those resources.

The "Law on Mining in Puerto Rico", Law No. 6 of 1954, establishes the Government of Puerto Rico's public policy on exploitation and use of mineral resources. This law establishes as the Government of Puerto Rico's policy the exploitation of minerals in a manner compatible with the conservation of other resources and with the protection of their environmental value. Under this law, the "Regulation for the exploration, leasing and production of Commercial Minerals in Puerto Rico", Regulation No. 499-A, was adopted.<sup>143</sup>

The "Law for the Development of Puerto Rico's Mineral Resources," Law No. 145 of 1975, established the Puerto Rico Corporation for the Development of Mineral Resources which was a public corporation with the financial and operational capacity to execute the development of mining policy as established in the "Law on Mining in Puerto Rico", *supra*.

Due to the Government of Puerto Rico's public policy of prudent development of its natural resources, it is necessary to identify the places where mineral resources exist, evaluate their impact, viability and need for the future. The section on Uses Dependent on the Coast discusses the means to respond to this need.

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<sup>143</sup> Amended by DNER Regulations 957 and 1367.

### 3.3.4 ENERGY

#### Findings

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Puerto Rico depends almost exclusively on imported oil to satisfy its energy requirements. Puerto Rico depends on limited energy sources to satisfy a continually growing demand, while other more abundant energy sources are not being proportionally used.

Oil is the principal source of energy in Puerto Rico. Aside from oil, other energy products, such as natural gas and gasoline derivatives are imported and used as fuel for generation of energy and transportation. Approximately 77% of electricity is produced by the PREPA through burning fossil fuels. Close to 13% of the electricity is produced by natural gas imported and processed by a private company (Ecoeléctrica) which sells it to PREPA. Applied Energy System (AES) is another private company which produces closet o 14% of the electricity by burning coal and only 1% of the electricity is produced by hydroelectric plants in Puerto Rico.<sup>144</sup>

PREPA is the main provider of electricity in Puerto Rico. PREPA is a public corporation established in 1941 to produce, transmit and distribute practically all of the electricity consumed in Puerto Rico.

The electric energy is generated by five principal power plants: Costa Sur, Complejo Aguirre, Palo Seco, San Juan and Arecibo. The installed generating capacity is 4,397 MW. There is a geographic imbalance in distribution capacity in the electric system since 62% (2,600 MW) of the total generation comes from plants located in the South coast: Guayanilla (Central Sur) and Salinas (Central Aguirre). These plants are far from the area of most demand, making the system vulnerable to weather events and earthquakes.<sup>145</sup>

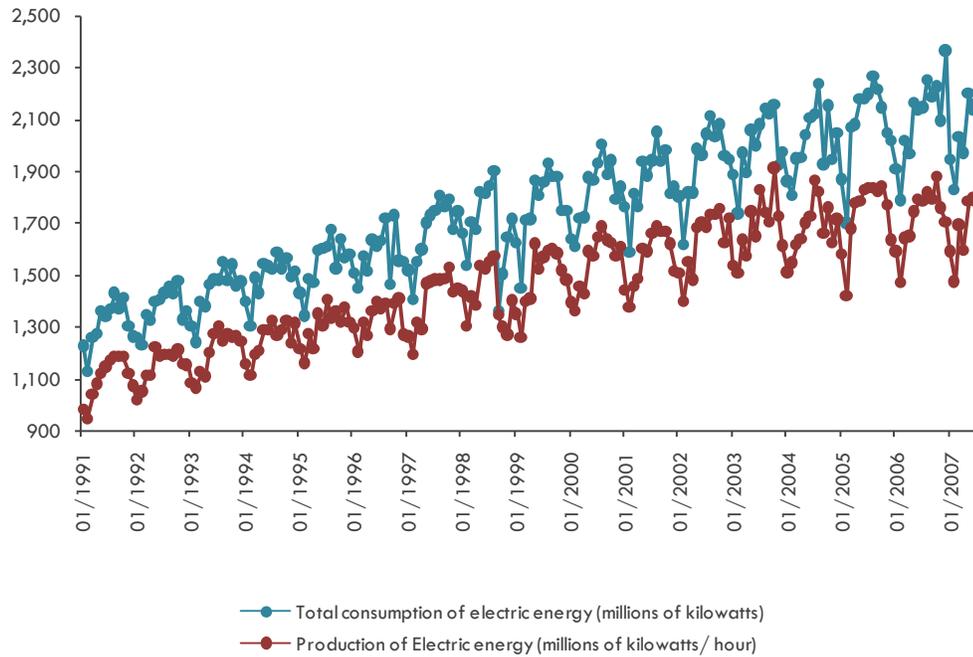
As a consequence of the investment in infrastructure, consumption and production of electricity in Puerto Rico, it has showed a growing trend in the past 15 years. The area which has gained most ground is residential consumption which represented 37% of the total electricity consumption for 1991, while increasing to 43% by 2007. During this period, commercial consumption remained stable averaging about 37% of consumption, while industrial consumption went down from 24% in 1991 to 20% in 2007 (See Appendix 2).

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<sup>144</sup> Puerto Rico's Energy Market. Ecoeléctrica: Retrieved online on April 16, 2008 from: [<http://www.ecoelectrica.com/electricmarket/index.html>].

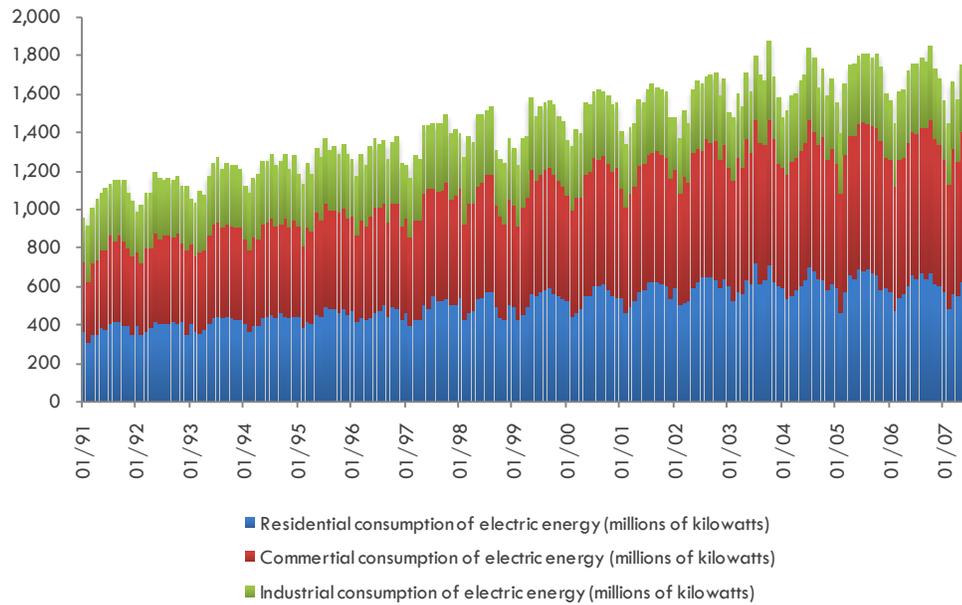
<sup>145</sup> The transmission system is composed of 3,512 km of transmission lines of 230KW. It counts with 174 transmission centers. Distribution lines add up to about 44,800 aerial kilometers and 1,732 km underground. Part of that system includes 308 substations.

**GRAPHIC III-3. PRODUCTION AND CONSUMPTION OF ELECTRIC ENERGY IN PUERTO RICO**



Fuente: PREPA. Graphic made by Estudios Técnicos, Inc.

**GRAPHIC III-4. DISTRIBUTION OF PUERTO RICO'S ELECTRIC ENERGY CONSUMPTION**



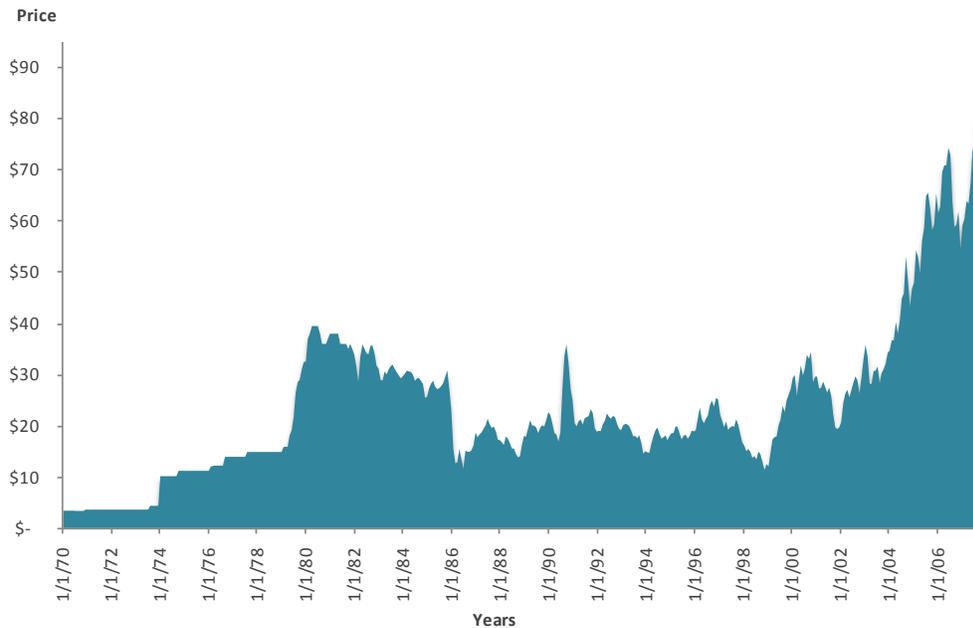
Source: PREPA. Graphic made by Estudios Técnicos, Inc.

Puerto Rico's energy problem takes on a new dimension due to the high cost of oil. Historically, Puerto Rico has depended and benefitted greatly from importing cheap foreign oil, mainly from Venezuela.<sup>146</sup> The availability of cheap energy was one of the key elements for the industrial promotion program in Puerto Rico.

Cheap oil also attracted three refineries to the Island: *Caribbean Gulf Oil* in Bayamón, on the North Coast; *Sun Oil*, in Yabucoa on the Southeast coast; and the *Commonwealth Oil Refining Company (CORCO)* in Peñuelas, on the South coast. These refineries satisfied all of the Island's needs and also produced refined derivatives for exportation. The refining industry and the production of oil derivative products, on whose vigorous impulse rested the hope of economic development in 1960s and 1970s, vanished when in the middle of an energy crisis, then-U.S. President Richard Nixon implemented oil reforms in 1974. With the end of the advantages which favored refineries in Puerto Rico, by 1982, the most important refinery, CORCO, had ceased operations on the Island.

Today, the price for the barrel of oil is continuously increasing. In the last two fiscal years (2006-2007) the average price for a barrel of oil has been \$63.78, an increase of 31% or \$15.06 per barrel.

**GRAPHIC III-5. PRICE OF THE FUEL OIL BARREL**



Source: Federal Reserve Bank of St. Louis.

<sup>146</sup> Puerto Rico received special treatment in 1959 and then in 1965 under the U.S quota system to import crude oil from foreign sources.

Puerto Rico counts with limited options to continue importing fossil fuels for generating electricity. Importing energy is not a viable solution, reason why searches for viable options for energy sources continue. Nuclear energy was a possible alternative, but its high cost and the potential environmental risks and public safety risks hindered its use. Other alternate sources have been studied through pilot programs since 1970s.

Over the last decades, emphasis has been placed on the development of alternate mechanism for the generation of energy due to the rises in oil costs, the development of new technologies and a rise in environmental awareness. Among those new efforts is the use of bio-diesel, solar energy, wind power, thermal energy and energy recovery through solid waste. The search for energy from the ocean, such as oceanic gas could prove to be an option since Puerto Rico counts with 805 km of coastline.

## **Public Policy**

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### **A. Established policies**

#### **1. OPP-PRLUP**

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In the OPP-PRLUP-1995 of the PRPB a series of general policies applicable to energy-generating installations are established. Among these are:

“Avoid by the establishment of new activities, or by the authorization of subdivisions, the unnecessary loss of options for future use of resources”(See Policy 30.07). (This policy, for example, has the purpose of avoiding the loss of options which could come with the location of residential projects in areas apt for location of energy installations).

“Concentrate industrial developments on lands more appropriate for that use and promote the most intensive use of those lands” (See Policy 5.00).

“Avoid the establishment of polluting industries with the exception of those whose exclusion would seriously affect Puerto Rico’s economic development” (See Policy 5.02).

“In those exceptional cases where it is necessary for the development of Puerto Rico to establish polluting industries (as defined by the EQB), those industries would be located in pre-selected areas and taking into account adequate provisions so the adverse impact to the environment is minimal” (See Policy 5.03).

“Concentrate the location of these industries in regional industrial parks, previously designating lands meeting the before-mentioned characteristics, avoiding possible sprawl through individual locations, separated one from the other, making an exception for atypical industrial projects which could require particular special locations” (See Policy 5.04)

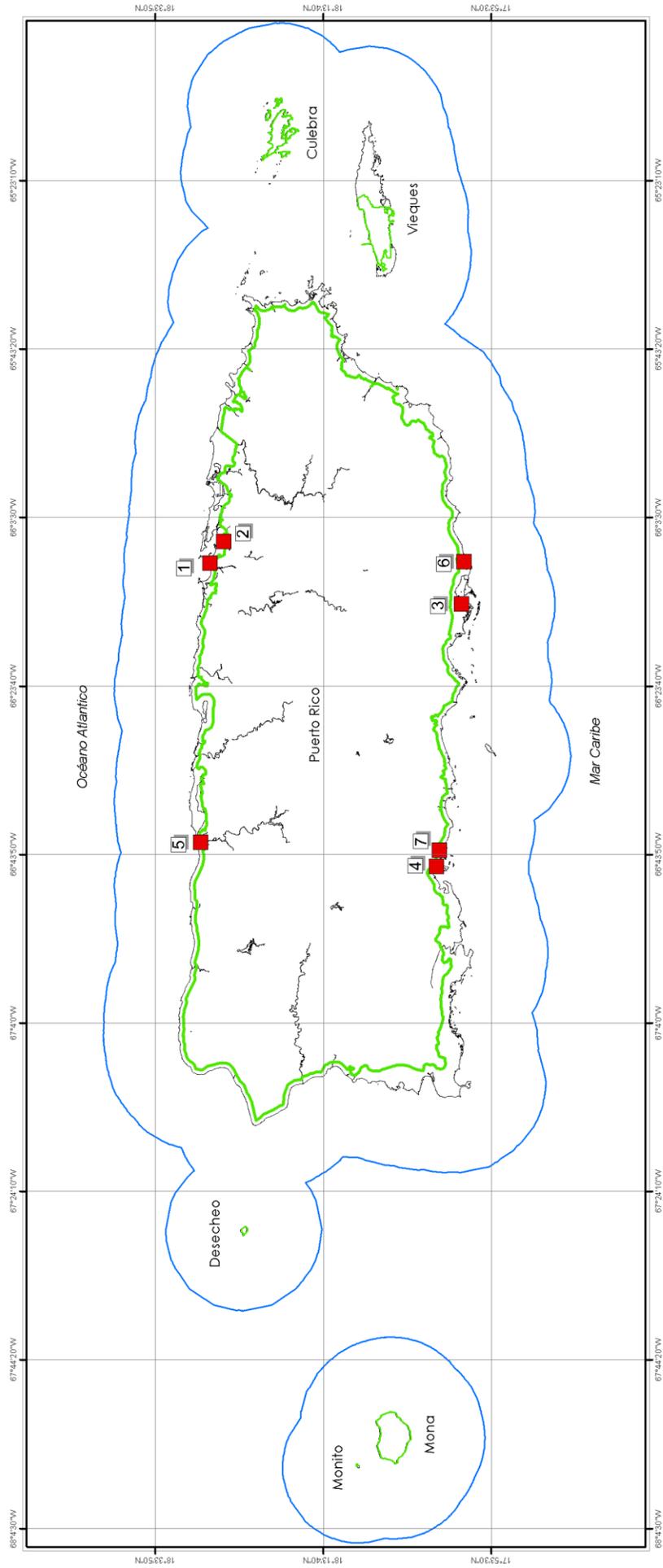
"Direct infrastructure regarding electricity in such a manner that it stimulates and promotes energy policy geared toward cogeneration and diversification of energy production" (See Policy 22.00)

**Leyenda - Map Key:**

- 1** Central Palo Seco - Capacidad / Capacity (MW) 602
- 2** Central San Juan - Capacidad / Capacity (MW) 400
- 3** Central Aguirre - Capacidad / Capacity (MW) 900
- 4** Central Costa Sur - Capacidad / Capacity (MW) 1,090
- 5** Central Arecibo - Capacidad / Capacity (MW) 248
- 6** Eco Eléctrica - Capacidad / Capacity (MW) 540
- 7** AES - Capacidad / Capacity (MW) 454

-  Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
-  Limite de la zona costanera marima (9 millas náuticas) - Coastal Zone Maritime Boundary

  
 Escala - Scale 1:860,000



# Centrales principales de generación de energía eléctrica

## Main Electric Energy Generators

Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 23 / Map 23



Fuente de Información - Source:  
 Autoridad de Energía Eléctrica de Puerto Rico  
 Eco Eléctrica Inc.  
 AES Puerto Rico, LP

## 2. Policies on coastal-dependent development

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Attune with the policies previously discussed, the PRCZMP established more detailed policies which affect energy-producing installation. (See section on *Uses dependent on the coast*)

...Urban development, including those industries which do not require (or substantially benefit) from a locating in front of the coast, should, at all possible extent, be located away from the coastline. This is in accordance with PRPB policies which aim to stimulate development “perpendicular to the coast” in coastal cities.

...Coastal areas designated by the PRPB as apt for industries which depend on the coast should, at all possible extent: (1) be protected from other types of development and (2) be reserved for industries which depend on the coast, except those instances in which destruction of natural systems is deemed unacceptable.

... Those places reserved for industries dependent on the coast, but which are also found to be important due to their natural value, should be developed only for that industry after a careful evaluation of its location and the design of available alternatives for the protection of natural systems.

## 3. Additional policies

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“Law No. 128 of 1977” created the Energy Affairs Administration (EAA) and orders the formulation of energy public policy for Puerto Rico. This policy was adopted by the Government of Puerto Rico in 1993 through Executive Order OE-1993-57. This policy orders PREPA, DNER, the DTPW and EAA to establish strategies for management of energy sources.<sup>147</sup>

### Implementing the Policy

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#### A. Institutional framework

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“Law No. 128 of 1977” established the Office of Energy and established its functions, duties and objectives. These functions and faculties were transferred to the EAA<sup>148</sup> and include:

- (2) Recommend, develop and implement Puerto Rico energy public policy, which should be updated at least every four years;
- (3) Promote energy efficiency;
- (4) Promote diversification of conventional and renewable sources;
- (5) Recommend to the Secretary of DNER the approval or disapproval of an increase in energy-generating capacity in excess of one MW;
- (6) Promote alternative sources of energy;

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<sup>147</sup> See: Committee on Cogeneration for the Puerto Rican government (1993). Energetic Public Policy for Puerto Rico.

<sup>148</sup> The faculties of the Office of Energy were transferred to the Secretary of Consumer Affairs in 1993, through the Reorganization Plan of 1993, known as the Reorganization Plan No. 1, the DNER was created along with the EAA.

(7) Identify Puerto Rico's energy needs

In compliance with the responsibilities delegated upon it, the EAA promotes and performs studies and investigations, determines the importance of Puerto Rico's energetic needs; coordinates policies of general application which could be put into effect and develops energy conservation plans, among other duties.

The EAA commissioned UPR-Mayagüez a study entitled "Achievable Renewable Energy Targets for Puerto Rico's Renewable Energy Portfolio Standard", completed in 2008. The purpose of the study was to provide a guide regarding the minimum reachable amount of renewable energy needed to be integrated into the portfolio of resources for energy production in Puerto Rico. According to the authors, this study could serve for the inclusion of a substantial amount of renewable energy resources in the production of electricity as part of Puerto Rico's public policy on energy.

This study included, among other renewable sources: waste-to-energy, micro-hydroelectric, oceanic energy (waves, tides, submarine currents, thermal), solar radiation and wind.<sup>149</sup>

Currently, there two projects in development which are the biodiesel project and the wind energy project.<sup>150</sup> PREPA financed the *Biodiesel for Puerto Rico Project*<sup>151</sup>. In 2004, Biodiesel of Puerto Rico began operations in Guaynabo with a target production of 50,000 gallons a day of that fuel. The company reached agreements with four other municipalities (Bayamón, Caguas, Toa Baja and Juncos) in which the agency will cover the difference in cost between biodiesel and regular diesel.

The EAA is also the proponent agency for the first commercial scale wind farm in Puerto Rico. The project by the Windmar Company, consists of 25 windmills in a 725-cuerdas property in Barrio Boca in Guayanilla. It is estimated that this wind farm will have the capacity to generate 110 million kWh/year, the equivalent of the electricity consumed by 23,000 families. However, its contiguous location to the Guánica Commonwealth Forest NR, is reason for concern for some sectors, particularly due to the scale of the project and its location next to an area of such sensitive natural resources.

## B. Puerto Rico energy plan

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To comply with the Public Policy on Energy for Puerto Rico, PREPA adopt the "General Strategic Plan for Generation" in 2002, which aimed to guarantee energetic growth in Puerto Rico, reduce energy costs, diversify sources of fuel, diversify geographical location of sources of generation, minimize environmental impact and diversify the agency's sources of income.

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<sup>149</sup> Recovered from webpage: <http://www.uprm.edu/aret/>. The estimate is produced by using realistic restrictions such as: the availability of the resource considering its variables, superficial area needed for conversion technology "footprint"), state of technology for conversion and investment costs

<sup>150</sup> Information on EAA comes from written communication from the agency on October 25, 2007.

<sup>151</sup> Biodiesel is a renewable fuel which can be produced from vegetable oils and used fats. This fuel is biodegradable, reduces polluting agents such as: particles, carbon monoxide, hydrocarbons and others. Biodiesel mixture with regular diesels could be used in diesels motors without modifying them.

As part of this plan, PREPA has been in contact with proponents of projects for generation of energy through the ocean. PREPA is also studying the use of biodiesel in its generation plants while several “waste to energy” proposal are being evaluated.

### **C. Protecting sites suitable for power plants and other energy related facilities**

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In the early 1970s, PREPA was forced to abandon plans for a nuclear power plant in Aguirre, on the South coast, mainly because of environmental and geological problems with the location. As a result of this experience, PREPA revised locations with potential for building energy-generating facilities and submitting a list of 16 locations with the EQB, which finally approved five: Costa Sur, Complejo Aguirre, Palo Seco, San Juan and Arcibo.

Currently, due environmental criteria and population density in the coastal areas, locating facilities of this nature in Puerto Rico is not viable. However, it is necessary to identify areas with the potential to locate installations for sources of renewable energy.

In 2008, the EAA presented the “Puerto Rico Wind Source Mapping” project, which included maps of wind resources for the whole Island. These were part of a study done by *AWS Truewind*, and commissioned by the US Department of Energy. The study found that Puerto Rico counts with areas with wind potential along coastal zones and atop mountain ranges.

## **3.4 RECREATION**

### **Findings**

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The coast of Puerto Rico offers a rich variety of recreational opportunities.<sup>152</sup> The diverse characteristics of Puerto Rico’s coasts offer alternatives for everyone’s enjoyment. The beaches are the most recognizable attractions, but the coasts also offer other resources such as lagoons, bioluminescent bays, coral reefs, islets, cays and the open sea.

The diverse recreational activities – or those which are potentially accessible – include: swimming, sun bathing, underwater activities such as deep sea diving and snorkeling, recreational fishing and surfing, among others. Aside from the activities based on the beach and the sea, there are other opportunities which take advantage of the unique characteristics of the coast including camping, mountain climbing and bird watching.

According to the “Study of Comprehensive Outdoor Recreation in Puerto Rico” (SCORP) of



**Recreational use of coastal resources**

*Picture by: Estudios Técnicos, Inc.*

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<sup>152</sup> Detailed information regarding recreation can be found in the "Commonwealth of Puerto Rico State Comprehensive Outdoor Recreation Plan" 2008-2013, prepared by Estudios Técnicos, Inc.

2008, prepared by the NPC, there are 3,919 outdoor recreation facilities inventoried in Puerto Rico. Twelve of these are public beaches with complete facilities and 201 are open beaches.<sup>153</sup> Also, 52 places where underwater activities are practiced, 27 marinas, 47 anchoring zones and 73 boat ramps were identified.

Although statistics related to outdoor recreation are limited, there is some data available regarding the participation and preferences of Puerto Ricans in these types of activities. This information can be considered even more important than economic statistics because it deals with physical and emotional wellbeing of the population (Chaparro, 1998). The SCORP (2008-2013) compiled information of this nature and among its principal results reported that among the aspects people enjoy most about outdoor activities are: being able to spend time with family and friends, improvement of physical health, contact with nature and strengthening of emotional health.

According to that study, for the majority of people the enjoyment of outdoor recreational activities is “very important” or “pretty important.” However, many people expressed dissatisfactions, among which were: little available information about places for recreation and activities which can be practiced in those places, the lack or ineffectiveness of security measures established by authorities to protect users, the lack of facilities for the handicapped, lack of public transportation, the problems with access to recreational areas for the general population and the lack of parking facilities.

Recreational development in Puerto Rico has traditionally been concentrated on active recreation and competitive sports. Many recreational installations concentrate on sports such as baseball, basketball or track and field. This has been a reflection of governmental initiatives<sup>154</sup> and the requisites of local planning regulations, particularly the “Subdivision and Urbanization Regulation”, Regulation No. 3 of the PRPB.<sup>155</sup>

Practically half of the installations inventoried by SCORP (1,955 out of 3,919) were municipal or community parks. This has resulted in more recreational opportunities for the youth than for other segments of the populations, including the handicapped and the elderly.

However, Puerto Rico still has a recreational potential to develop since public beaches only respond to part of that potential. Excellent opportunities exist to develop outdoor recreation activities associated to the coast that, if carefully planned and developed, have the potential to protect associated natural resources. Some examples are: sightseeing, study of nature and other means to appreciate natural resources along the coast in their original state.

Participation in recreational aquatic activities, both active and passive, has increased significantly in recent years. According to the SCORP, water activities were the most popular among all outdoor activities in Puerto Rico.<sup>156</sup>

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<sup>153</sup> Beaches visited to practice some sort of outdoor recreational activity which are not public beaches nor count with basic facilities.

<sup>154</sup> Starting in the 1960s, the Recreation Development Company began construction of several vacation centers throughout Puerto Rico which included public beaches, villas and sports complexes.

<sup>155</sup> This regulation requires all new residential projects to include basic common spaces for recreation, education and cultural and commercial activities.

<sup>156</sup> This and walking occupied first place in the survey.

It should be noted that aside from their social importance, recreational activities on the coastal zone has economic benefits for Puerto Rico. According to the study “Economic Valorization of the coral reefs and associated environments in the East of Puerto Rico: Fajardo, Arrecifes La Cordillera, Vieques and Culebra”, commissioned by the DNER, it is estimated that nearly 394,269 people visited the area of the study in 2007 and spent \$192,027,166 in nautical and water activities, among others.

**TABLE III-17. CONSUMERS SURPLUS BY USE**

Consumers surplus by use		
	Users on the east side of Puerto Rico <sup>(3)</sup>	Users expenditure
Enjoyment of beaches	394,269	\$2,974,542
Nautical activities: Including sport fishing, boat trips and multiple activites utilizing a boat	138,796	\$188,578,916
Kayak trips	10,782	\$233,776
Underwater activities: Including snorkeling and diving	2,126	\$239,932
<b>Total</b>		<b>\$192,027,166</b>

<sup>(3)</sup> This column cannot be added because users could have practiced more than one activity in the study area during the 12 months previous to the survey.

Source: DRNA. (2007). *Valoración Económica de los Arrecifes de Coral y Ambientes Asociados en el Este de Puerto Rico: Fajardo, Arrecifes La Cordillera, Vieques y Culebra.*

The study also evidenced that nautical activities, including sports fishing, are practiced with intensity in Puerto Rico (See section on fishing). In Puerto Rico, there are approximately 27 nautical installations with more than 3,007 piers.

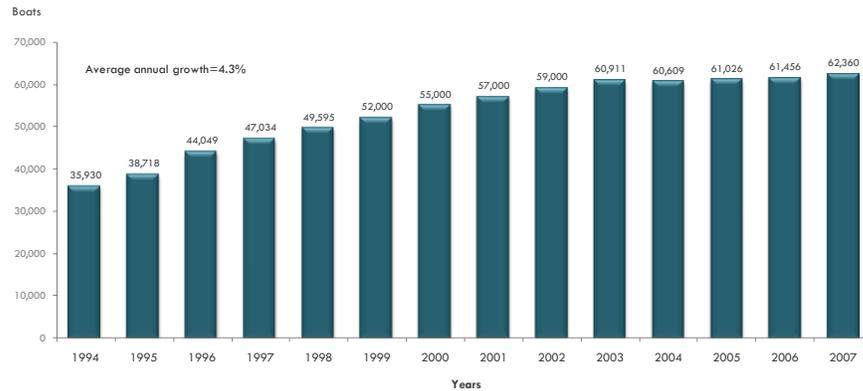
TABLE III-18. MARINAS IN PUERTO RICO

Marinas in Puerto Rico		
Name of the Marina	Municipality	Quantity of docks
Aguadilla Yacht Club	Aguadilla	100
Club Náutico El Parterre	Aguadilla	
Arecibo Yacht Club	Arecibo	85
Club Náutico de Arecibo	Arecibo	
Club Náutico de Boquerón	Cabo Rojo	111
Bahía Marina Boquerón	Cabo Rojo	
Boca Cangrejos Yacht Club	Carolina	150
Isleta Marina	Fajardo	306
Conquistador Marine	Fajardo	21
Marina Puerto del Rey	Fajardo	750
Puerto Chico Marina	Fajardo	280
Sea Lovers Marina	Fajardo	150
Villa Marina Yacht Harbour	Fajardo	250
Club Náutico de Guayama	Guayama	
Club Náutico Pozuelo	Guayama	42
Karollette Charter	Humacao	33
Marina de Palmas	Humacao	17
Palmas Shipyard Marine	Humacao	
Marina Harborside	Humacao	170
Club Deportivo del Oeste	Joyudas- Cabo Rojo	60
Club Náutico de la Parguera	Lajas	
Club Náutico de Mayagüez	Mayagüez	
Club Náutico de Ponce	Ponce	160
Marina de Salinas	Salinas	101
Salinas Marine & Posada El Náutico	Salinas	
Club Náutico de San Juan	San Juan	96
San Juan Bay Marina	San Juan	125
<b>Total</b>		<b>3,007</b>

Source: Data compiled by Estudios Técnicos, Inc. (2007).

The intensity of nautical activities in Puerto Rico is also evidenced by the abundance of vessels on its waters. According to data submitted by the Commissioner of Navigation of DNER, there were 62,360 registered vessels in Puerto Rico. Between 1994 and 2007, there was an average yearly growth of 4.3% in the number registered vessels. This data also includes commercial fishing vessels, recreation vessels and charters.

### GRAPHIC III-6. BOATS REGISTERED IN PUERTO RICO



Source: DNER, Commissioner of navigation.

However, it is estimated that the number of recreation boats in Puerto Rico is greater than the numbers reflected in government statistics. From interviews with industry insiders, it is considered that there are at least 300 boats – the majority of which are over 40 feet – which regularly anchor in Puerto Rico’s piers and marines. These boats however, are registered in Miami where it is likely that they were purchased.

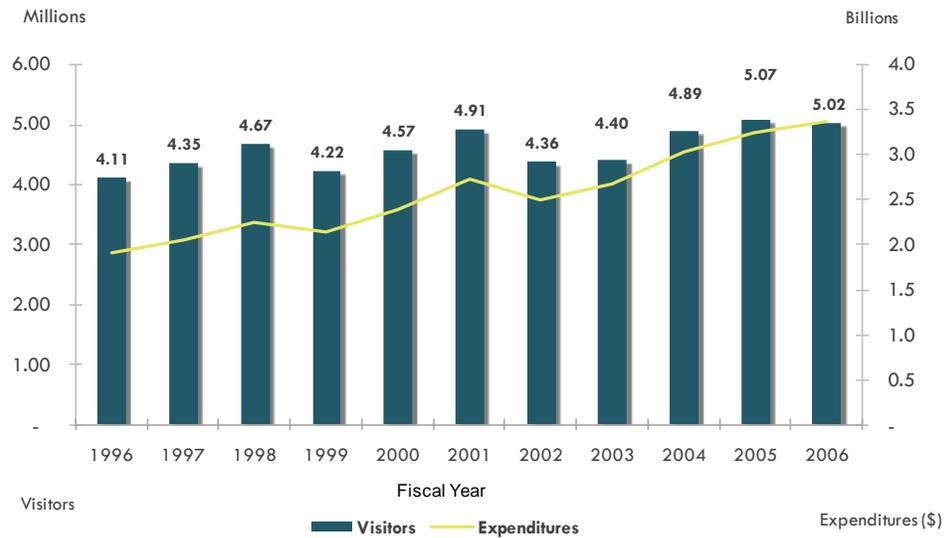
Puerto Rico’s tourism industry, which makes an important contribution to the economy, depends on marine and coastal resources. In Puerto Rico, much of the tourism activity takes place in the coastal zone. Traditionally, Puerto Rico has promoted tourism through the sun and beach, resulting in great demand on marine and coastal resources. Data from the PRTC reflects that for 2006, Puerto Rico received more than five million people who spent \$3 billion. Of these visitors, 28% stayed in hotels, 45% stayed in other places, 26% were visitors in transit, including 1.3 million<sup>157</sup> who were cruise ship passengers or military personnel. (See Appendix 2).

It should be noted that there are more than 170 places for lodging with approximately 14,684 rooms.<sup>158</sup> It is evident that this is a stable industry which presents moderate growth, making it of utmost importance the need to enforce existing laws and regulations in order to conserve the resources which this economic activity depends upon.

<sup>157</sup> Source: PRPA. *Maritime Statistics Report*. 2006.

<sup>158</sup> Data from the PRTC. 2006.

### GRAPHIC III-7. VISITORS OF PUERTO RICO AND THEIR EXPENDITURES



Source: PRTC, 2006. Graphic made by Estudios Técnicos, Inc.

The “Puerto Rico and the Sea” (1999) report recognized the problem created by the fact that, while there is economic growth (due to the growth of the tourism industry) the coasts and beaches receive the impact of multiple conflicts between uses and users. The report points out that while beaches are the focal point for promotional material directed toward the tourism market, the government has not adequately invested resources on them. At the same time, the report states that this practice eventually will result in the loss of: visitors, commercial opportunities, income generated by tourist expenditures, diversity of recreational opportunities that contribute to the quality of life as well as physical and emotional wellbeing, jobs related to tourism, marine recreation and related industries and in last instance, the loss of physical and visual access to the beaches (Beller et al., 1999).

Recreational activities without controls have a negative impact on marine and coastal resources. The amount of resistance for recreational activities associated with the coastal zone is unknown. Some of the activities which have an impact on the health of the resources include, overfishing, anchoring on top of coral reefs and marine vegetation, the breakage of corals caused by carelessness from visitors and the contamination of water due to trash and fuel from vessels, among other substances.

There are multiple underwater activities, such as snorkeling and harpoon fishing, which tend to happen in areas with fragile ecosystems and great ecological and scenic value like coral reefs. Harpoon fishing is particularly threatening to these systems due to the fact that it is an activity highly invasive on the ecosystems and often results in damage to coral structures by direct impact with the surface of the coral or instruments left in the area. This practice in zones of public use also represents a health and safe risk for other users. Also, the excessive use of motor vehicles on the water causes the stirring of sediments, contributing to turbidity in the water.

## Responding to findings

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### A. Planning, developing and operating of public facilities

The NPC, administrative unit of the Department of Recreation and Sports (DRS) in the Puerto Rico Government agency responsible for overseeing outdoor activities. The NPC manages recreation installations, including urban parks, theme parks, public beaches, camping areas and vacation centers.

It is also the agency responsible for formulating and updating the SCORP every five years, which is a planning instrument to determine the needs for outdoor activities and establishes priorities directed toward the protection of resources used in this type of recreation. Through the SCORP, Puerto Rico is eligible to receive funds from the *Land and Water Conservation Fund* for the planning and development of installations for outdoor recreation.

The SCORP has a component which recognizes the important of wetlands as a resource for outdoor recreation.<sup>159</sup> The DNER is responsible for identifying and including those wetlands with potential for outdoor recreation which should be acquired for their conservation.

The NPS also intervenes in SCORP since it is responsible of revising and approving the document. Other government agencies which manage recreational installations or which contribute to formulate or implement public policies regarding recreation include – at the federal level – the USFS and the USFWS and at the local level the PRPB, the PRDH, the Department of Education and IPRC. The municipalities also have responsibilities in this matter. The DNER, for its part, regulates activities and recreational development in the forests and reserves under its custody.

### B. Access to the coasts: beach facilities and services

Access to the coasts needs to be improved in order to optimize recreational opportunities for these areas. It is also necessary to improve facilities and maintenance on the beaches, particularly cleaning, security and safety, including lifeguards. (Both topics are discussed in the section regarding Beaches). As mentioned in the section “Coast dependent uses,” there are coastal areas with urban characteristics which can be transformed into spaces for public use for passive recreation by using boardwalks and piers, among others. In this manner, spaces are provided for recreation, secures access for the public to the coast and basic facilities are provided, including trash cans and ramps for the handicapped.

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*Need: Provide more opportunities for public access through the promotion of installations with access to the sea and recreational fishing in Puerto Rico.*

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The rise in cost of public spaces on the coast, particularly in the North, has made it difficult to identify spaces for the development of infrastructure projects geared toward recreation. This evidences the need to designate areas to promote installations with access to the sea and for recreational fishing in Puerto Rico. This exercise can be considered through plans to

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<sup>159</sup> The *Land and Water Conservation Fund Act* de 1965 (Public Law 99-645) was amended by the *Emergency Wetlands Resources Act* to the wetlands component to SCORP.

acquire lands for this specific use or as a result of negotiations from mitigation in large-scale projects.

### C. Regulations and safety for recreation

By virtue of the “Puerto Rico Navigation and Aquatic Safety Act”, Law No. 430 of 2000, the “Regulation for the registration, navigation and water safety in Puerto Rico”, Regulation No. 6979, was adopted.

This regulation’s purpose is to oversee the registration and enumeration of vessels, establish safety equipment and measures, protection, the enjoyment of marine recreational practices in Puerto Rico’s waters, establishment of measures geared toward protecting flora and fauna as well as other natural resources which could be affected by aquatic recreational activities, among other matters.

With the purpose of reducing discharges of used waters from recreational vessels, the U.S. Congress passed the “Clean Vessel Act” in 1992. This law paved the way for the establishment of the *Clean Vessel Program*, whose primary purpose is to provide funds for the construction, operation, installation and maintenance of pumping stations thus vessels in the U.S. waters can properly dispose used waters. This subsidy would cover to a maximum of 75% of the cost of purchase and installation of the equipment. Due to the fact that the funds were available until 1997, marinas have been responsible for this expenditure since that date.

Another law is the CWA, which disposes that since 1996, recreational boat owners cannot discharge used waters from their vessels onto bodies of fresh water or into coastal waters.<sup>160</sup>

### D. Promotion of sustainable recreation and tourism practices

The “Law on Public Policy for the Development of Sustainable Tourism in Puerto Rico”, *supra*, recognized the importance of wisely using Puerto Rico’s cultural and natural resources in a manner that economic activity in the long-term remains viable. Through this law, the public policy for development and promotion of sustainable tourism is established as is the Office for the Development of Sustainable Tourism. This office is responsible for, among other things, prepare the *Master Plan for the Development of Sustainable Tourism in Puerto Rico*, currently in the process of being drafted.

This office also works in coordination with the PRPB in the establishment of parameters for planning and development of tourism projects, makes recommendations, if necessary, regarding new zoning districts or changes to existing ones thus lands ideal for this activity are reserved. Other responsibilities of this office include the identification of natural and environmental resources with ecotourism potential and promote the participation of diverse sectors of the population in this aspect.

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<sup>160</sup> In Puerto Rico, all vessels larger than 26 feet and with a closed cabin must have on board a functional toilet while navigating Puerto Rico’s territorial waters.

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*Need: Require prior to the approval of any tourism proposal, even if it is traditional tourism, an analysis of factors such as: limits of acceptable change, the ecological footprint of the development and the capacity to manage the natural and environmental resource.*

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While the “Law on Public Policy for the Development of Sustainable Tourism in Puerto Rico”, requires an analysis of the afore-mentioned factors for any sustainable tourism project, there are multiple existing projects in the coastal zone making intensive use of coastal and marine resources. Therefore, it is recommended that these projects are asked to submit an analysis of the afore-mentioned factors in addition to the traditional requisites.

#### **E. Stimulate multi-sector collaboration in order to provide recreational opportunities**

Recreational opportunities can be provided through multi-sector collaboration. For example, in the Humacao Natural Reserve, the community organization PECES, the DNER and the PRTC are working together through a collaboration agreement in the development of facilities and the creation of small businesses.

Public investment in recreation should satisfy diverse groups, particularly those with no economic means to cover certain activities. Some specialized installations for certain groups (i.e., installations for nautical activities) can be provided through private investments. However, these must be subjected to the compliance of regulatory requisites regarding access to the coast. The possibility of granting such concessions should be evaluated in the interest of enriching recreational opportunities without jeopardizing rights of access, safety and the conservation of coastal and marine resources.

### **3.5 TRANSPORTATION**

#### **Findings**

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The transportation network is a major determinant influencing the location of urban and industrial developments. This situation is magnified in an Island with 3.89 million inhabitants where, in 2005, the automobile density was 0.72 registered vehicles per person.<sup>161</sup> The road network has expanded significantly in response to the constant demand from private vehicles. The total dependency on private vehicle, as a result of the lack of mass transportation options and urban sprawl in Puerto Rico, represents a serious economic, environmental and social problem. Highways and avenues increase mobility and accessibility in many parts of the coast. However, these roads have also contributed to urban sprawl and the dependency on automobiles to gain access to work, residential and recreational areas.

The main network of roads has been built around the Island’s periphery and through the coastal plains. Despite the fact that the principal expressways connect the North and South coasts, an extensive network of roads has been expanded throughout the island. It is estimated by in the year 2003, the density of roads was 3.4 km per km<sup>2</sup> of surface (Lugo in López & Villanueva, 2006). Avenues, expressways and roads fragment habitats affecting and

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<sup>161</sup> DTPW. Bureau of Driver Services. Division of Statistics.

eliminating flora and fauna, increasing volumes of run-off water, altering flow in water bodies and the level pollutants that these receive and lead to their degradation.

Buses, *públicos*<sup>162</sup> and taxis provide public transportation. In the SJMA, bus service is provided by a public corporation known as the Metropolitan Bus Authority (MBA). The SJMA also counts with the Urban Train which transits through Bayamón, Guaynabo and San Juan. It is contemplated it will eventually be part of a multi-modal system, the Integrated Transportation Alternative (ITA) in the SJMA, which will integrate other means of transportation which include ferries, taxis, *públicos* and the MBA. Private companies which offer transportation service between the Island's main cities also exist.

The use of *públicos* as a transportation alternative has been substantially reduced in recent years. These constituted practically the only means of transportation between communities and work and service areas for those who did not have access to an automobile. Starting in 1980, however, *públicos* service has been greatly reduced as a result of an increase in private automobiles, urban sprawl and operation costs, particularly the increase cost for gasoline (DTPW, 2005). Private taxis complement transportation services on the Island.

The bicycle is envisioned as an important part of the transportation network. The need to integrate non-motored transportation means into Puerto Rico's transportation network has been recently recognized. At the federal level, the following laws have been approved: "The Intermodal Surface Transportation Efficiency Act" of 1991 (ISTEA); The "Transportation Equity Act for the 21st Century" of 1998 (TEA-21) and the "Safe, Accountable, Flexible and Efficient Transportation Equity Act" of 2003 (SAFETEA).

At the local level, DTPW counts with the "Policies and strategies for the development of the Transportation System in Puerto Rico" and is responsible for preparing the "Long-term Plan for Intermodal Transportation in Puerto Rico." The agency has also implemented programs for the integration of transportation with the environment by promoting walking and bicycling as means of transportation. Through the "Brighten Transportation Program" the development of lineal parks, such as Paseo de Piñones, is in the process.

Meanwhile, the Program for Pedestrian and Cyclists is also working with the "Plan for non-motorized means" which is a component of the "Metropolitan Transportation Plan San Juan 2025." As part of this plan, the DTPW and DNER work in the identification of routes and corridors to provide access through trails for cyclists and pedestrians to the principal natural and recreational areas (Bravo, 2005). The DTPW is also working with the municipalities to identify corridors with potential to develop trails for pedestrians and cyclists to facilitate access to the principal urban centers in Puerto Rico.

The DTPW also proposes the development of the Pedestrian Walkway Network in the SJMA which seeks to connect various recreational areas, parks, natural reserves and bodies of waters and eventually continue along the Atlantic Ocean's maritime front.

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<sup>162</sup> *Publicos* or *carros publicos* are a local form of shared taxi.

All of these projects seek to improve conditions of mobility and non-motorized access while contributing to the improvement of quality of life in the communities. However, in Puerto Rico many of these open spaces are often focused on recreation and do not constitute a transportation alternative.

Water-based transportation, already an important part of the transportation network, is envisioned to play an even more important role in the future. Currently, the Maritime Transportation Authority, which is part of DTPW under the concept of “Integrated Transportation,” is responsible for developing, maintaining, operating, managing and maximizing the use of maritime transportation from the East of Puerto Rico to islands of Vieques and Culebra. This public corporation is also responsible for operating the maritime transportation service known as “Acuaexpreso” which offers ferry service between Old San Juan, Hato Rey and Cataño.

Another effort to complement maritime transportation in the SJMA is the cleaning and dredging of the Caño Martín Peña which will eventually allow maritime transportation through this water body.

Ports and airports are critical elements of the transportation system. Puerto Rico imports the majority of its food and manufactured products as well as raw materials. Airports are important elements of the system, especially for the tourism industry. Luis Muñoz Marín International Airport, Puerto Rico’s principal airport is located in the coastal zone. In fiscal year 2008-2009, this airport moved 8.4 million passengers and 445.9 million pounds of cargo.

Escala - Scale 1:860,000



Límite de la zona costanera tierra adentro -  
 Coastal Zone Inland Boundary  
 Límite de la zona costanera marina (8 millas náuticas)-  
 Coastal Zone Maritime Boundary

Aeropuerto internacional - International airport  
 Aeropuerto público - Public airport

Rampa para botes - Boat ramp  
 Puerto Industrial - Industrial port  
 Puerto comercial - Commercial port

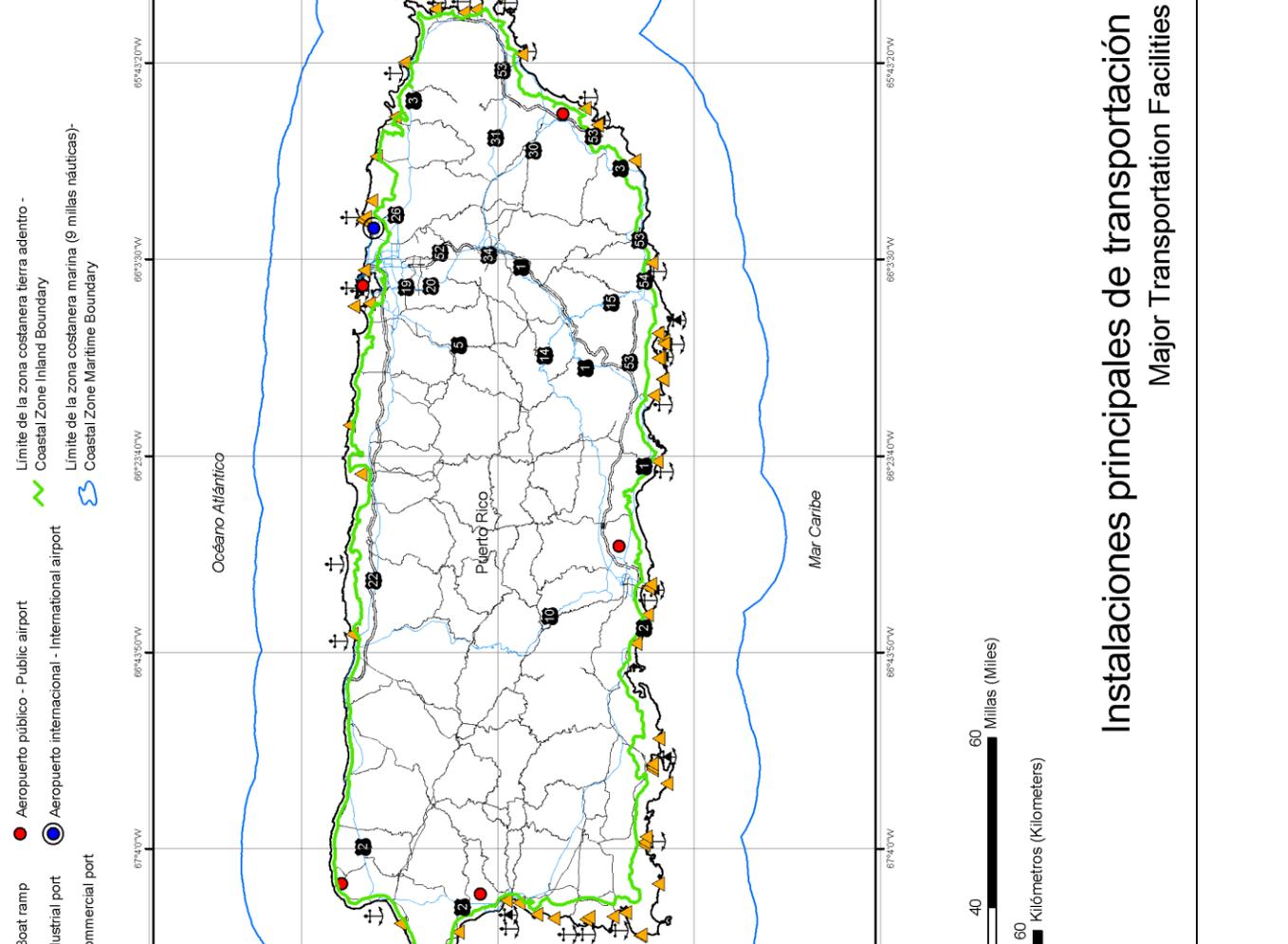
Carreteras - Roads  
 Autopistas - Highways  
 Primarias - Main  
 Secundarias - Secondary

Desecheo  
 Monito  
 Mona  
 Vieques  
 Culebra

Océano Atlántico  
 Mar Caribe  
 Puerto Rico

68°45'00"W  
 67°45'00"W  
 67°30'00"W  
 67°15'00"W  
 67°00'00"W  
 66°45'00"W  
 66°30'00"W  
 66°15'00"W  
 66°00'00"W  
 65°45'00"W  
 65°30'00"W  
 65°15'00"W  
 65°00'00"W

17°53'00"N  
 18°03'00"N  
 18°13'00"N



20 10 0 20 40 60  
 Millas (Miles)

20 10 0 20 40 60  
 Kilómetros (Kilometers)



Programa de Manejo de la Zona Costanera  
 Coastal Zone Management Program

Mapa 24 / Map 24

# Instalaciones principales de transpantación

## Major Transportation Facilities

Fuente de Información - Source:  
 National Oceanic and Atmospheric Administration  
 June 2001  
 Departamento de Transportación y Obras Públicas

## Responding to findings

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### A. Planning and developing transportation facilities

The Government of Puerto Rico's responsibility regarding planning and development of transportation falls on various agencies.

... The PRPB is responsible for guiding the planning of transportation, in general, as part of its responsibility in planning the territory for the Commonwealth. The OPP-PRLUP recognizes the importance of infrastructure to the efficient use of Puerto Rico's resources (See Chapter 2).

... The DTPW is the agency with the responsibility to oversee land, air and maritime transportation in Puerto Rico.<sup>163</sup> As such, it is responsible of formulating public policy and detailed long-term planning.

...Public Corporations - The PRHTA, the PRPA, the Maritime Transportation Authority, the MBA and the Integrated Transportation Alternative act as DTPW's operational arms. The PRPA manages and executes the "Puerto Rico Ports and Piers Law", Law No. 151 of 1968, through which it regulates navigation, maritime traffic in Puerto Rico's navigable waters, Puerto Rico's piers and ports as well as in lands which include port zones.

...Interagency coordination is achieved through the policy committees in the Metropolitan Planning Organization (MPO), which revise transportation programs and main projects. Three MPOs exist in Puerto Rico under DTPW: the San Juan MPO which has jurisdiction over 38 municipalities according to the 2000 Census, the Aguadilla MPO and a third MPO which oversees the other urbanized areas. These MPOs count with a committee on public policy, a technical committee and a task force which meets on a daily basis.

### B. Preparing transportation plans

The DTPW is responsible for the preparation of a *Long-Term Transportation plan for Puerto Rico (2030)*, which identifies transportation needs, promotes efficient use of resources, protects natural patrimony, supports economic development strategies and promotes safety in transportation. As part of this plan, regional plans, non-motorized transportation plans are also developed as are plans for ports, airports and cargo terminals.

### C. Transportation safety measures and programs

Two federal agencies – The Federal Aviation Administration and the USCG – are responsible for maintaining safety standards in transportation while the National Highway Transportation Safety Administration (NHTSA) and the Federal Transportation Authority (FTA) is responsible for similar programs related to road and highway safety.

At the local level, the Traffic Safety Commission, which is part of the DTPW, is in charge of planning, coordinating, managing and communication traffic safety programs at the Commonwealth level.

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<sup>163</sup> With Reorganization Plan No. 6 of 1971, the Highway and Roads Authority, MBA and PRPA became part of the DTPR.

## 3.6 FISHING

In Puerto Rico, fishing activity can be divided into three categories: commercial fishing, recreational fishing and ornamental fishing.

### Findings

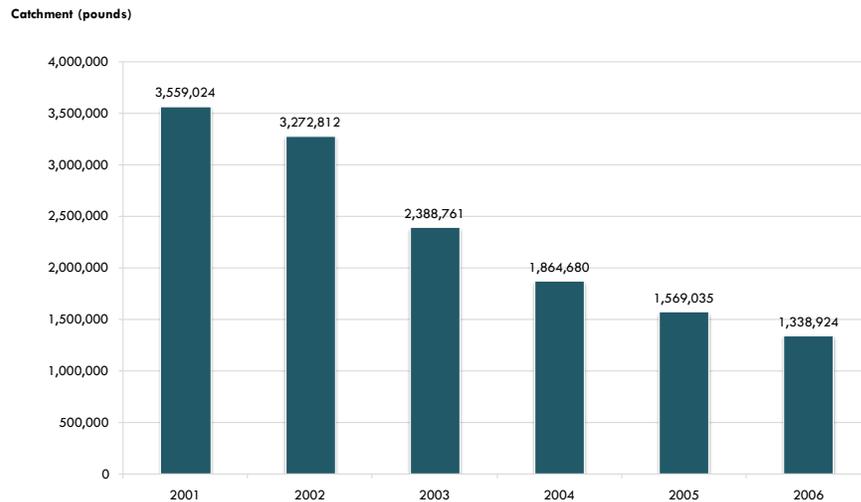
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#### 3.6.1 COMMERCIAL FISHING

Puerto Rican waters cannot sustain high biological productivity. Puerto Rico is located in tropical fishing zone characterized more for its diversity of species than for commercially important quantities of a particular species. This is due to the deep waters low in nutrients and slim insular platform which lacks the necessary marine vegetation.

Local fishing is one of low productivity which captured 1.34 million pounds in 2006. According to the PRDA, the fish and seafood consumed in Puerto Rico are primarily imported.<sup>164</sup> Puerto Rico's territorial waters yield about 10% of the quantity of fish and seafood consumed locally. According to statistics from the DNER's Laboratory on Fishing Research, landings from fishing vessels in Puerto Rico have experienced a dramatic decrease of 44% over the last 25 years.<sup>165</sup>

**GRAPHIC III-8.** Fishing reported for coastal municipalities during the years 2001 to 2006



Source: DNER Fisheries Research Laboratory.

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<sup>164</sup> Personal communication from the PRDA's Director of Fishing, Mr. Walter Padilla.

<sup>165</sup> Landings are defined as the quantity of catch that each fisherman brings to port.

The quantity and size of some important species have decreased. Fisheries along coral reefs, in particular, have drastically decreased over the last decades showing typical signs of overfishing: reduction of total port landings, reduction in the capture by unit, and a change in size of the fish captured (Matos, 2005).

**TABLE III-19. FISHING REPORTED FOR COASTAL MUNICIPALITIES DURING THE YEARS 2001 TO 2006**

Fishing reported for coastal municipalities during the years 2001-2006												
Municipality	2001		2002		2003		2004		2005		2006	
	Pounds	Price/ pounds*										
<b>North coast</b>	<b>569,893</b>	<b>2.14</b>	<b>407,614</b>	<b>1.97</b>	<b>284,444</b>	<b>1.75</b>	<b>168,048</b>	<b>1.7</b>	<b>117,990</b>	<b>1.7</b>	<b>62,121</b>	<b>2.1</b>
Isabela	11,735	3.56	14,194	1.97	2,437	0.87	854	3.1	968	3.7	928	4.0
Quebradillas	-	0.00	-	-	-	0.00	0	0.0	0	0.0	0	0.0
Camuy	4,060	2.68	2,961	1.56	4,150	1.15	4,070	1.9	7,237	2.4	1,639	1.8
Hatillo	4,232	2.28	1,799	1.30	1,464	1.22	993	1.3	0	0.0	55	3.5
Arecibo	73,812	2.47	27,627	2.43	31,816	2.13	20,771	2.4	22,091	1.6	9,657	1.0
Barceloneta	36,736	2.26	10,400	2.11	10,262	1.76	5,435	1.9	4,423	1.8	3,821	1.8
Manati	17,361	2.04	9,797	2.00	2,711	1.84	0	0.0	1,565	2.0	0	0.0
Vega Alta	28,694	2.15	18,665	1.80	14,020	1.41	5,962	2.1	5,144	1.7	1,995	1.8
Vega Baja	68,169	2.41	44,046	1.99	7,694	2.57	5,518	2.5	1,899	2.4	773	3.0
Dorado	28,069	2.70	19,829	2.27	16,215	2.04	5,938	2.2	4,679	2.0	3,650	2.0
Tea Baja	1,010	1.49	494	1.90	560	1.18	766	2.5	0	0.0	0	0.0
San Juan	133,003	2.10	90,814	2.12	83,735	1.90	55,475	2.1	35,858	2.2	22,882	2.2
Cataño	23,769	2.34	36,575	2.34	30,644	1.90	19,407	2.3	12,330	2.3	8,113	2.8
Carolina	56,785	1.73	18,775	1.21	100	3.75	0	0.0	748	0.5	1,326	3.1
Loiza	43,752	1.97	63,302	1.38	57,966	1.42	20,381	1.3	10,357	1.4	2,011	2.2
Rio Grande	34,254	2.08	33,791	1.74	18,845	1.47	19,976	1.6	10,321	1.7	5,228	2.1
Luquillo	4,452	2.05	14,545	2.15	1,826	1.52	2,502	2.0	370	2.5	43	5.4
<b>East coast</b>	<b>948,758</b>	<b>2.37</b>	<b>862,484</b>	<b>2.06</b>	<b>464,623</b>	<b>2.07</b>	<b>356,183</b>	<b>2.2</b>	<b>237,840</b>	<b>2.2</b>	<b>194,174</b>	<b>2.5</b>
Fajardo	179,003	2.20	148,734	1.81	124,849	1.87	92,087	2.1	77,691	2.1	54,425	2.4
Ceiba	139,003	2.42	67,367	1.99	51,836	1.94	43,386	1.9	25,086	1.9	15,930	1.9
Naguabo	178,003	2.53	119,255	2.20	83,516	2.04	66,529	2.5	44,422	2.5	18,756	2.5
Humacao	111,003	2.71	84,357	2.51	91,798	2.40	57,314	2.4	35,290	2.4	41,300	2.5
Yabucoa	39,869	2.03	48,592	1.74	28,502	1.68	7,995	1.2	18,756	1.8	20,682	1.8
Masabo	23,120	2.20	13,776	1.65	6,754	1.82	5,116	2.7	3,925	2.3	3,788	2.9
Culebra	21,754	2.39	22,602	2.45	15,800	2.52	6,833	2.8	425	2.6	1,437	3.8
Vieques	257,003	2.47	357,801	1.86	61,568	1.78	76,923	1.9	32,245	1.9	37,856	2.3
<b>South coast</b>	<b>1,040,871</b>	<b>2.43</b>	<b>1,030,570</b>	<b>1.99</b>	<b>750,457</b>	<b>1.90</b>	<b>479,828</b>	<b>2.1</b>	<b>368,923</b>	<b>2.1</b>	<b>346,389</b>	<b>2.8</b>
Patillas	47,939	3.17	31,840	2.47	23,673	2.32	19,438	2.8	10,016	2.4	789	4.9
Guayama	106,592	2.26	106,913	2.02	97,657	2.16	80,128	2.2	50,127	2.3	59,417	2.5
Salinas	83,597	2.40	71,047	2.04	58,830	2.04	57,482	2.4	51,031	2.6	47,449	2.8
Santa Isabel	54,992	2.77	47,100	2.54	29,904	2.29	17,428	2.5	21,055	2.4	9,557	3.1
Arroyo	56,950	2.15	61,279	1.95	44,674	1.35	42,530	1.9	9,697	1.7	9,019	1.9
Juana Diaz	143,003	2.60	133,992	1.95	77,855	1.74	64,785	1.9	50,969	2.0	35,700	2.0
Ponce	103,003	2.16	87,322	1.83	98,058	1.51	45,079	1.8	71,734	1.9	56,112	2.0
Guayanilla	69,747	1.53	60,270	1.13	28,771	0.94	16,087	1.4	13,874	1.8	16,406	3.2
Penuelas	69,042	2.42	31,149	2.81	57,015	2.77	49,456	2.5	32,630	2.6	68,366	3.1
Guánica	107,003	1.99	149,206	2.18	64,439	1.94	22,121	2.0	8,368	1.9	22,307	2.7
Lajas	199,003	1.99	250,452	1.79	169,580	1.73	65,294	1.7	49,422	1.7	21,267	1.9
<b>West coast</b>	<b>999,502</b>	<b>2.14</b>	<b>972,144</b>	<b>1.67</b>	<b>889,237</b>	<b>1.65</b>	<b>860,621</b>	<b>1.8</b>	<b>844,282</b>	<b>1.8</b>	<b>736,240</b>	<b>2.0</b>
Añasco	44,847	2.68	37,938	1.78	19,713	1.31	17,736	1.9	18,489	1.5	4,735	1.7
Mayaguez	87,763	2.04	100,485	1.67	82,421	1.74	84,606	2.0	88,283	2.2	71,210	2.3
Cabo Rojo	491,062	2.27	450,820	1.93	403,108	1.92	440,399	2.1	404,978	2.3	358,517	2.6
Agua Dulce	157,003	1.54	140,832	1.09	131,286	1.00	116,566	1.3	115,919	1.3	106,187	1.5
Aguada	96,824	1.71	94,536	1.48	76,507	1.48	87,595	1.5	31,301	1.7	56,210	1.7
Rincón	122,003	2.58	147,533	1.52	176,202	1.44	113,719	2.0	185,312	1.9	139,381	2.2
<b>Total</b>	<b>3,559,024</b>	<b>2.27</b>	<b>3,272,812</b>	<b>1.93</b>	<b>2,388,761</b>	<b>1.84</b>	<b>1,864,680</b>	<b>2.0</b>	<b>1,569,035</b>	<b>2.0</b>	<b>1,338,924</b>	<b>2.4</b>

Source: Data from years 2002 and 2003 proceed from the report: DRNA. (2005). "Overview of Puerto Rico's small scale fisheries statistics 2002-2004." Data from years 2004 to 2006: DRNA. (2007) "Puerto Rico/NMFS Interjurisdictional Fisheries Program, July 1, 2004- June 30, 2007 NAD4NMF4340063" by Daniel Matos. September of 2007.

Other factors which contribute to the decrease in fish populations have been the lack of compliance with fishing regulations, lack of marine reserves and the loss of essential coastal marine habitats such as mangroves, marine vegetation plains and coral reefs.<sup>166</sup>

<sup>166</sup> Various factors apply to the reported decrease. According to Matos (2007), the approval of the *Fishing Regulation* generated the perception among fishermen that the regulation would have the effect of eliminating commercial fishing. This led many fishermen to not report information regarding their catch to the DNER. Other factors were the rise in fuel prices in the spring of 2005 – since 90% of the fishermen use this type of fuel in their vessels – and the implementation of a sales tax in October 2006. This last event led to the retirement of many fishermen while chose not to renew their licenses, thus becoming illegal fishermen.

According to a census done by the DNER's Laboratory on Fishing Research in 2002, 92 fishing centers or landing zones were identified in Puerto Rico's coastal municipalities. There were some 1,163 commercial fishermen in Puerto Rico of which 36% were full-time fishermen and 64% were part-time fishermen. The majority of the fishermen were concentrated on the West coast, particularly in Cabo Rojo. Some 82% of the fishermen had DNER licenses and 66% were members of a fishermen organization.

Fishermen who participated in the census indicated they exploited, at least, two fishing locations since this would allow them to capture multiple species using diverse methods. A total of 17% of the fishermen indicated they fish only from the shore, while 83% said they fish on the insular platform and 48% fish offshore. The fishermen said that 87% of their catches are reef species (including lobster and conch), 36% are pelagic fish, 37% fished deep water snapper and 56% practiced fishing with bait.

This census also asked fishermen their perception of local fishing situation. Some 67% of the fishermen feel the situation has worsened mainly due to pollution (50%), destruction of habitats (28%) and overfishing (22%).

It is important to point out that between the 1996 and 2002 census there was a reduction of 595 fishermen. A reduction from 72% in 1996 to 64% in 2002 of full-time fishermen was also observed. The reduction in the amount of commercial fishermen reflects the existence of problems with the fishing resource, reason for which many fishermen have opted to abandon their trade and take refuge in the construction or agricultural industries, while others have migrated to the United States to participate in the manufacturing industry.

Another finding which evidences problems in the fishing industry is the reduction in size of commercial fishing vessels. Maintenance of vessels with larger than 12.19 meters is too costly for fishermen who are exposed to limited production.

TABLE III-20. FISHERMEN REPORTED IN PUERTO RICO

Fishermen reported in Puerto Rico Year 2002						
Municipality	Full-time	Part-time	Total	Average age	License	Associated
<b>North coast</b>	68	198	265	50	233	212
Isabela	5	15	20	45	12	15
Camuy	5	8	13	50	11	13
Hatillo	0	4	4	43	3	0
Arecibo	3	29	32	49	31	29
Barceloneta	2	10	12	54	8	8
VegaBaja	7	29	36	51	31	22
Vega Alta	8	5	13	51	12	11
Dorado	1	8	9	55	8	9
Cataño	5	20	25	44	21	19
San Juan	22	20	41	54	40	40
Carolina	1	13	14	52	13	10
Loíza	6	14	20	50	19	19
Río Grande	3	23	26	55	24	17
<b>East coast</b>	106	148	253	49	225	181
Fajardo	20	30	50	53	47	52
Ceiba	3	12	15	53	15	12
Naguabo	13	17	30	56	30	28
Humacao	29	21	50	50	43	46
Yabucoa	10	3	13	54	11	10
Maunabo	7	4	10	41	7	4
Culebra	4	20	24	42	16	12
Vieques	20	41	61	40	56	17
<b>South coast</b>	136	182	317	47	257	192
Patillas	8	3	11	34	8	7
Arroyo	2	19	21	47	16	11
Guayama	6	25	31	48	30	11
Salinas	11	15	26	53	16	8
Santa Isabel	13	19	32	49	30	30
Juana Díaz	6	9	15	41	10	7
Ponce	29	17	46	51	42	42
Peñuelas	11	10	21	45	17	19
Guayanilla	7	13	20	57	16	14
Guánica	17	15	32	41	20	15
Lajas	26	37	62	51	52	28
<b>West Coast</b>	113	212	325	47	240	177
Cabo Rojo	37	88	125	46	86	49
Mayagüez	12	36	48	51	37	38
Añasco	12	22	34	53	29	18
Rincón	23	12	35	38	19	21
Aguada	15	9	24	47	19	17
Aguadilla	14	45	59	48	50	34
<b>TOTAL</b>	<b>423</b>	<b>740</b>	<b>1,160</b>	<b>193</b>	<b>955</b>	<b>762</b>

Source: DRNA. (2004). Job 3. Comprehensive Census of the Marine Fishery of Puerto Rico, 2002.

Over the last years, an aquaculture has been developing in Puerto Rico to complement the traditional fishing industry. For many years hope has been placed on live marine resources as a solution to economic problems. However, human activity has been directed, for the most part, toward the exploitation of diverse marine environments resulting in a combination of fishing, destruction and contamination. Due to this reality, other forms of commercial fishing such as aquaculture of marine organisms on both land and sea have been considered.

Aquaculture is defined by NOAA as the propagation of aquatic organisms in a controlled or selected environment for commercial, recreational or public purposes. This definition was established in 1998 as part of the policy on aquaculture established by that agency, which seeks that all U.S. states and territories become more self-sufficient in fishing production.

NOAA, through its aquaculture program has put forth diverse initiatives among which are researching and subsidizing pilot programs. One of those experimental pilots was *Snapperfarm, Inc.* in Culebra which was established in 1998 by the University of Miami's "Puerto Rican Commercial Aquaculture Research and Development Center". Today, this is a commercial establishment operating one nautical mile from Cayo Luis Peña and it includes a culebran cobian nursery from which 70% to 75% of the stock is exported to New York and Florida and the remaining fish are sold to the Culebra Fishermen Association for resale. This farm has tried to cultivate snapper, but without success and is currently trying to cultivate lobsters and *dorado* (mahi mahi) in order to increase revenue due to the fact that this operation is costlier than traditional fishing (close to \$4.00/ lb). Annually, this farm yields about 40,000 to 45,000 lb of fish (Griffith et al., 2007).

Aquaculture can have certain environmental impact due to the fact that the nutrients administered and fish waste could contaminate waters and degrade marine resources. Therefore, it is necessary to control contamination in order to minimize its impact on marine ecosystems.

Puerto Rico has means for an aquaculture industry through the use of ponds or interred tanks, as is the case of shrimp nurseries. There are around 160 ponds in Puerto Rico of which less than half are in use. In their majority, these ponds are located in the mountain region near Jayuya, Adjuntas, San Sebastián and Lajas. Aside from these ponds, there two farms dedicated to the cultivation of ornamental fish, one in Aguirre which dedicates itself to cultivating marine fish and another in Sabana Grande which cultivates fresh water species.

As in the case of aquaculture, these cultivations have the potential to degrade the ecosystem due to the intrusion of salt water into fresh water aquifers and salinization of soils. Also, conducting waters into shrimp tanks could cause leakage and drain pesticides from agricultural farms near coastal waters. The pumping of water for the shrimp farms can increase salt concentration in the water bodies which may have a potential impact on fisheries and live organisms. The viability of this type of cultivation requires prudent management of the environmental impacts it may originate, as well as of the ecosystem. This is particularly important due to the fact that the cumulative impacts of multiple human activities near a watershed can lead to long-term degradation of the base of the natural resource the cultivation of species depend, especially the shrimp.

Puerto Rico has three protected marine areas permanently closed to fishing. These are the Natural Reserve Canal Luis Peña (RNCLP for its Spanish acronym), half nautical mile around Desecheo Island and half nautical mile around Mona and Monito. Also, in the coastal waters of the West coast, three seasonal closings are implemented in order to protect the spawning seasons for some species. The closings occur in three specific places along the coast. They are: Bajo de Sico, Abril la Sierra and Banco Tourmaline.

The positive impact of the restrictions has been felt in RNCLP. Some of these effects have an increment in the biomass of the fish and herbivores (Hernández et al., 2003).

Other countries have documented how protected marine areas with fishing prohibitions can influence the economic performance of fishing activities through their effect on catches, fish prices and cost of fishing (Ansuategi et al., 2006). The prohibitions allow for fish, mollusks and crustaceans to develop, therefore benefitting fishermen since the catches, and the size of the species both increase as does the production of eggs and larvae.

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*Need: Monitor the closings of Marine Protected Areas*

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It is important to establish monitoring in areas of permanent and seasonal fishing prohibitions thus this can serve as an effective strategy and, if necessary, design and implement corrective measures.

### 3.6.2 RECREATIONAL FISHING

According to NOAA's *Marine Recreational Fisheries Statistics (MRFS)*, Puerto Rico had close to 213,005 recreational fishermen in 2006.<sup>167</sup> Approximately 10% of these fishermen travel to participate in the close to 25 fishing tournaments celebrated each year in Puerto Rico.

According to MRFS, the total recreational fishing catch was reduced from 4,601,748 lb in 2000 to 1,261,000 lb in 2006 while overall capture per unit decreased by an average of 40% a year for the period between 2000 and 2005.

An analysis of the recreational fishing tendencies done by Lilyestrom (2007) showed that in 2005 there were a total of 866,723 fishing trips. The majority of these excursions were done by bait-and-hook fishermen (58%). Between 35% and 40% of these recreational fishing excursions were done by private boats and 1% by rented boats. Between 16% and 21% of the catch were reef species.

Puerto Rico also counts with 16 sport fishing clubs. Many of these clubs have integrated the practice of catch-and-release to their tournaments. This practice not only adds to the challenge of the sport, but also helps in the restoration of sport fishing species. These tournaments also provide an opportunity for the scientific community to do research on the state of fishing and gather information of the relevant characteristics of fishermen in order to achieve improved management of fishing resources.

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<sup>167</sup> Personal communication with the *National Marine Fisheries Service, Fisheries Statistics Division, Silver Spring, MD.*

### 3.6.3 ORNAMENTAL FISHING

Ornamental fishing includes the capture and exportation of fish and invertebrates for the sale to pet stores and fish tank enthusiasts. According to a study done in 2002, this type of fishing in Puerto Rico occurs at a very small scale in both economic terms and in the amount of legal participants (Mote Environmental Services, Inc., 2002).

Historically this activity has been done on the coast of Arecibo in the North and La Parguera in the South, but the bulk of this type of fishing is done in the West due to the fact that this activity was originated by surfers in the Rincón area.

According to this study, there are 12 people in Puerto Rico who capture these organisms and three major exporters. However, recent information in the DNER's "List of Permits for Marketing Ornamental Fish" shows that as of October 5, 2007, there were only two people in Puerto Rico with active permits for the capture of ornamental fish, 15 import permits and two export permits.

In Puerto Rico, some 100 species of ornamental fish and 100 species of invertebrates are collected. The royal gramma fish is the most captured and exported followed by the yellowhead jawfish. Between 1998 and 2000, 37,000 grammas and more than 8,400 yellowhead jawfish were exported by three major exporters. Also, marine invertebrates are captured in Puerto Rico among which are anemones (*Condylactys*), blue-legged hermit crab, feather suter worm and starfish, among others (*Mote Environmental Services, Inc., 2002*).

MRFS data estimates that there could be between 6,000 and 8,000 people who capture ornamental organisms for their own aquariums (Lilyestrom, 2007).

According to certain ornamental fish collectors, some commercial fishermen incidentally catch ornamental fish in the nets and market them. This practice has been observed close to Culebra and it is assumed that the fish are sold locally.

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*Need: Investigate fluctuations in population's reproductive behavior and recuperation after exploitation of populations or physical damage, effects of environmental variables, among others (LeGore et al., 2006).*

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It is recommended to develop a monitoring program for fish communities independently of monitoring for fisheries. More studies are needed to identify potential areas for spawning aggregations of fish species.

In light of the fact that collection of organisms for aquariums is an activity which occurs more on an individual level than as a formal activity, it is necessary to take measures to insure the conservation of these resources, as well as recreational fishing.

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*Need: Create an educational program about marine reserves for fishermen*

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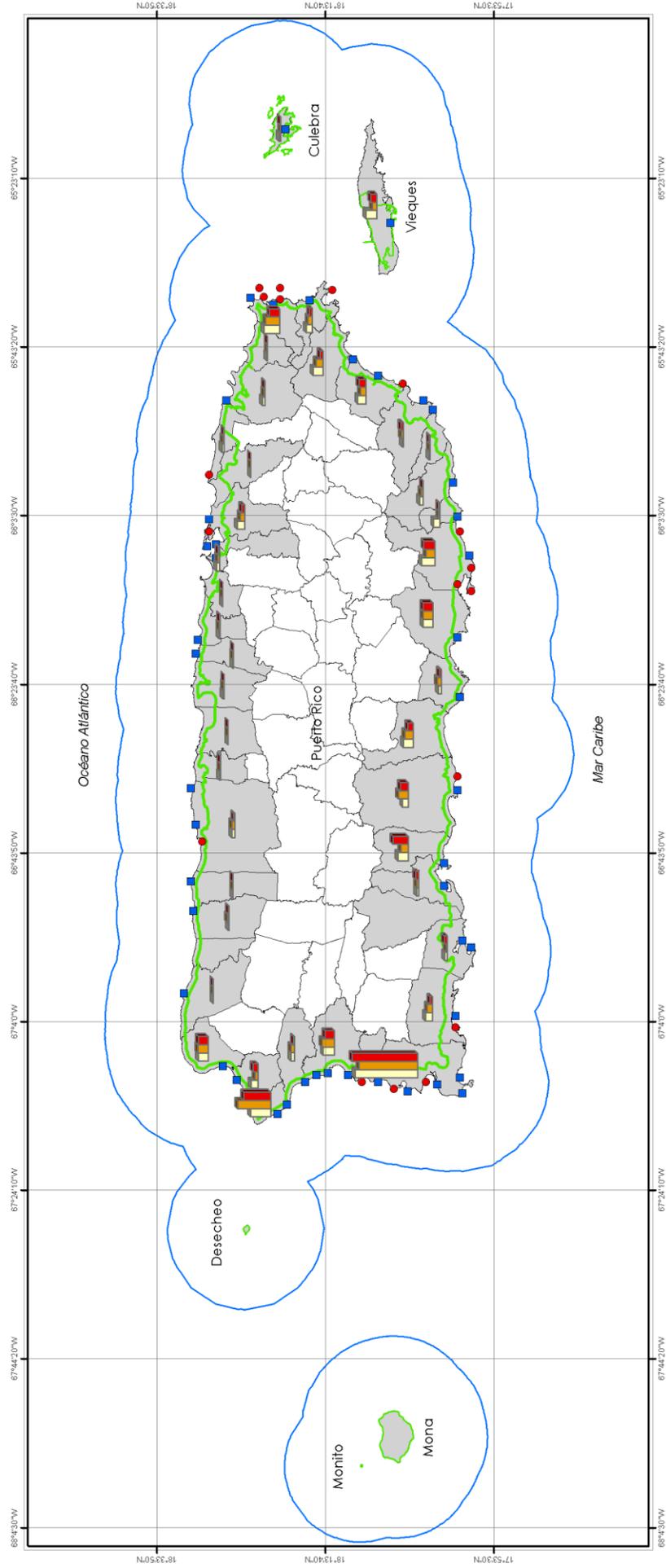
This program should cover information about the benefits posed by permanent or seasonal fishing bans on fish reproduction, and the benefits for surrounding fisheries.

Leyenda - Map Key:

- puertos pesqueros / fishing ports
- marinas recreativas / recreational marinas
- Municipios costeros - Coastal Municipalities
- ↗ Limite de la zona costanera tierra adentro - Coastal Zone Inland Boundary
- ⬇ Limite de la zona costanera marina (9 millas náuticas) - Coastal Zone Maritime Boundary



Escala - Scale 1:860,000



Fuente de Información - Source:  
 Departamento de Recursos Naturales y Ambientales  
 Laboratorio de Investigaciones Pesqueras

# Instalaciones de pesca comercial y recreativa Commercial and Recreational Fishing Facilities



Programa de Manejo de la Zona Costanera  
 Coastal Zone Management Program

Mapa 25 / Map 25

## Responding to findings

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There are various programs which promote and aid Puerto Rico's fishing industry. The DNER promotes fishing in various ways according to the dispositions on the "Law for the Promotion and Development of the Fishing Industry," Law No. 61 of 1990. This law orders the creation of the Aquaculture and Fishing Industries Council<sup>168</sup>, and the Council for the Fishing Research Laboratory.<sup>169</sup> This law seeks to promote and develop Puerto Rico's fishing industry through the sponsorship of research program, the development of fishing resources in Puerto Rico, the establishment of educational programs, the formulation of plans and strategic alternatives for the promotion and integral development – including training for fishermen– and promotion for consumption of local fish, interagency coordination regarding aspects associated to fishing and executing transfers and leases of fishing installations.

The DNER's Fishing Research Laboratory is an institution dedicated to scientific investigations and studies about Puerto Rico's fisheries with the fundamental purpose of obtaining necessary information that will allow the prudent use of the Island's fishing resources. The laboratory counts with the Fishing Statistics Program which compiles data regarding fishing production in Puerto Rico, produces a periodical census which provides a profile of Puerto Rico's fishing communities, and performs a bio-statistic study in which it compiles weight and size of catches of fish to determine, among other things, the composition of the catch. Other programs are: Fishing Monitoring Program, which compiles information regarding species; the Research Program which has the purpose of studying basic biological data regarding species of commercial importance and the Administration and Coordination Program, which includes a library to provide necessary information for scientific and technical personnel in the Laboratory and offer services to fishermen, students, other government agencies and the general public.

The "Regulation on Puerto Rico Fisheries of 2004", *supra*, adopted as part of the "Puerto Rico Fisheries Act", *supra*, establishes dispositions for activities associated with recreational, commercial and ornamental fishing and creates mechanisms for the registries and fishing statistics regarding catches, efforts, sizes and frequencies as well as any necessary biological information.

The "Puerto Rico Fisheries Act", *supra*, was amended to establish the Fishing Advisory Board.<sup>170</sup> This Board has the duty to advise the Secretary of DNER in the formulation public policy related to commercial and recreational fishing, formulate recommendations regarding administrative mechanisms to be implemented for the management of fishing resources and recommend possible amendments to the "Regulation on Puerto Rico Fisheries of 2004", *supra*.

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<sup>168</sup> This Council is comprised by of the PRDA, DNER, Puerto Rico Economic Development Bank, the Director of the Marine Sciences Department at UPR-Mayagüez and the Economic Development Administrator in charge of Puerto Rican Industries.

<sup>169</sup> This Council includes the DNER Secretary, the Secretary of Agriculture, the Director of Program for Fishing Management, Promotion and Development, the Director of the Fishing Research Laboratory, a representative for the Department of Marine Sciences at UPR-Mayagüez that is a fisheries specialist, the Deputy Secretary for Commercial Agriculture from the PRDA and the Director of DNER's Bureau of Hunting, Fishing and Wildlife.

<sup>170</sup> Through Law No. 5 of 2005.

In regard to recreational fishing, the DNER created in 1987 the Education on Aquatic Resources Program, subsidized by funding from the USFWS under the “Sport Fish Restoration Act”. This program seeks to promote interest for recreational fishing, educate, train and communicate information regarding this activity in Puerto Rico.

Another approved statute is the “Law for the promotion and development of sport and recreational fishing”, Law No. 115 of 1997. The implementation of this Law will theoretically strengthen maritime sport fishing and create incentives in particular for the development of recreational fishing in fresh water lakes, reservoirs and lagoons. This legislation has the purpose of contributing to Puerto Rico’s effort of receiving exposure as a destination which supports sports and recreational fishing.

Starting in 2000, NOAA’s NMFS began compiling statistical data regarding recreational fishing in Puerto Rico. The Recreational Marine Fishing Statistics Program is in charge of polling recreational salt water fishermen to compile data on effort, participation and catches in the different fishing modalities of private boat, rented boat and shore fishing and monitor fishing tournaments.

At the federal level, the Caribbean Fishery Management Council (CFMC) is one of eight regional councils which oversee the North American fishing industry. Established by “Fishery Conservation and Management Act” of 1976, the council is responsible for the preparation of fishing management plans for an area of 322 km between Puerto Rico and the U.S. Virgin Islands. Following the dispositions of the “Magnuson-Stevens Fishery Conservation and Management Act” of 1996, the CFMC has the responsibility of working toward conservation and adequate use of resources with the fishing industry. For its part, the Government of Puerto Rico is responsible for adopting legislation that is compatible with the measures of conservation set forth by the Council.

At the Academic level, two campuses of the UPR have programs directly related to fishing and marine resources. UPR-Mayagüez has a postgraduate degree academic program on Marine Sciences. The University has also been contracted by the PRDA to develop an aquaculture program for fresh water fish. UPR-Humacao also offers and Marine Sciences program, but only at the undergraduate level. NOAA’s Sea Grant program operates in both institutions and its focus is mainly to educate members of the coastal communities in regards to conservation and use of natural resources.

Despite the ample legal structure and the creation of programs to manage the fishing industry and its associated resources, there are still that need to be addressed in order to lift obstacles which currently hinder this practice in Puerto Rico. Some of these obstacles are associated with problems accessing the coast, the contamination of waters, among others. For example, the dispositions for improving coastal accesses (See section on Beaches), will help fishermen, who find many of the traditional access points blocked for development. Also, the designation of special planning areas will help in the careful location of areas for fishing and address other needs.

## CONCLUSION

While examining the principal coastal problems in Puerto Rico, this chapter has identified a series of needs related to possible modifications of established programs or new measures and actions which need to be designed and implemented. This is about giving some continuity to recommendations contained in the PRCZMP of 1978 which were not achieved. It is also sought to formulate new recommendations which rise from the new challenges of the last decades related to development policies and efficient and sustainable management of coastal resources.

The complexity of the problems discussed in Chapter 3 clearly requires solutions in a variety of areas and, above all, coherent articulation in those responses. The PRCZMP, described in the following chapter, pretends to satisfy many of these identified needs. Therefore, while reading the next chapter, all the needs identified in the different sections of the Program need to be taken into consideration.



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## **Chapter 4:** *The Coastal Management Program: Principal Elements*

## Chapter IV. THE COASTAL MANAGEMENT PROGRAM: PRINCIPAL ELEMENTS

The purpose behind the PRCZMP is to provide guidelines to extend, refine and improve Federal and Commonwealth programs already in place which deal with issues related to the coastal zone in a way that these programs can effectively respond to problems related to coastal zone management.

Several measures needed to attend coastal zone issues were described in Chapter 3. This Chapter presents these measures divided into four key elements of the Program:

- Guiding Development on Public and Private Property in the Coastal Zone
- Active management of natural resources,
- Promotion of sustainable coastal zone development, and
- Research

The first section in this chapter, *Guiding development of Puerto Rico's Coastal Zone*, includes an ample description of the four Puerto Rico government agencies directly related to the process of development, along with the regulations associated with these agencies.

The second section describes activities related to the active management of coastal resources and the elements of the Program created in recent years to improve efficiency. Meanwhile, the third and fourth sections deal with the promotion of sustainable coastal zone development and research.

### 4.1 GUIDING DEVELOPMENT OF PUERTO RICO'S COASTAL ZONE

The development of public and private property is an important element of the PRCZMP due to the conflicts which arise from the use of coastal zone resources. The responsibility of guiding and directing this development falls mainly on four Puerto Rico Government agencies: The Puerto Rico Planning Board (PRPB), the Regulations and Permits Administration (RPA), the Environmental Quality Board (EQB) and the Department of Natural and Environmental Resources (DNER).

#### 4.1.1 ONGOING ACTIVITIES: FOUR COMMONWEALTH AGENCIES RESPONSIBLE FOR GUIDING DEVELOPMENT

##### **Puerto Rico Planning Board (PRPB)**

The PRPB was created in 1942 with the purpose of guiding urban and economic development in Puerto Rico. In 1975, the Organic Law which created the PRPB was revised and replaced with a new "Organic Law of the Puerto Rico Planning Board", Law No. 75 of 1975. This legislation put the PRPB in charge of guiding and overseeing the economic, social and physical development of Puerto Rico. The new law also left the PRPB under de jurisdiction of the Office of the Governor.

The operational functions which until then were handled by the PRPB were transferred to the RPE through Law No. 75 (See Section 4.1.2). In particular, the authority over planning regulations and activities related to that function were transferred.

Later, Law No. 75 was amended<sup>171</sup> to make changes in the composition of the members of the PRPB. This change increased the number of associate members of the PRPB nominated by the Governor of Puerto Rico, with the consent of the Senate, to seven (7), with three (3) alternate members. The Chairman of the PRPB is nominated by the First Executive. The Chairman, who also serves as the PRPB's Executive Director, has the authority to designate one of the associate PRPB members as Vice President and to delegate administrative functions to a Deputy Executive Director.

Law No. 75 requires the PRPB to prepare three main planning documents: the Puerto Rico Integral Development Plan (PRIDP), the Puerto Rico Land Use Plan (LUP) and the Four Year Investment Program (PICA for its Spanish acronym). The law also states that all improvements, acquisition, sale or change in land uses will be authorized as long as they are not in conflict with what is stated in these documents.

#### The Puerto Rico Integral Development Plan (PRIDP)

The “Integral Development Plan: Public Policies and Specific Objectives” was adopted by the PRPB and approved by the Governor in 1979. Its objective is to delineate policies for the integral development of Puerto Rico and guide government entities in the formulation of plans, programs and projects. According to Law No. 75, the PRIDP should be periodically revised to make changes attune to the times and Puerto Rico's needs.

In response to this mandate, the PRPB is currently in the process of reviewing the policies for integral development in a document known as “Integral Sustainable Strategic Development” (PIDES, for its Spanish acronym). The PIDES, in conjunction with the Sustainable Strategic Tools of Action and Coordination (HACES, for its Spanish acronym), will constitute the Integral Development Plan for Puerto Rico. The HACES is a document which compiles action plans for the three fundamental development sectors: physical, social and economic.

#### Land Use Plans (LUP)

Law No. 75 also orders the PRPB to prepare and adopt a LUP. The agency can also adopt plans that are prepared by governmental organisms and/or entities designated by the PRPB. By the same token, Law No. 75 states that all construction or project proposed in Puerto Rico should be in compliance with the recommendations established in the LUP, which serves as the basis for qualification maps.

The PRPB adopted the OPP-PRLUP (approved by the PRPB in 1977 and revised in 1995) with the purpose that they serve as guides for agencies and public corporations in the formulation of policy, plans, programs and decision-making regarding public and private projects as well as the zoning process.

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<sup>171</sup> Through Law No. 26 of 2002.

Later, the PRPB adopted land use plans at the regional level and for particular areas. Furthermore, the PRPB has adopted, as a component of the LUP, management plans for Natural Reserves and those which correspond to Special Planning Areas (SPA).

Other plans adopted by the Planning Board are the Municipal Land Use Plans (MLUP) prepared by the municipalities under the dispositions of the “Law of Autonomous Municipalities”, Law No. 81 of 1991.

Currently, Puerto Rico lacks a LUP that includes the totality of Puerto Rico’s territory.<sup>172</sup> However, sheltered under its legal faculties, the agency adopted the PRCZMP as the coastal element for the LUP in 1978, via the approval of Resolution PU-002. The PRPB will also compile Regional Land Use Plans. These plans, which will serve as support for the actions being taken by the municipalities, will be developed in the seven regions in which Puerto Rico has been divided.

#### Four Year Investment Program (FYIP)

The PRPB will use the FYIP, in conjunction with the afore-mentioned planning instruments, to comply with its responsibility of guiding and supporting the actions of those agencies which intervene with Puerto Rico’s development. The FYIP recommends that capital improvements and infrastructure investments needed in the short and medium term in accordance with the public policies, goals and objectives of the Government of Puerto Rico.

Law No. 75 requires that all government organisms submit to the PRPB their respective four-year functional and/or operating programs. The PRPB has the responsibility of integrating these programs to the FYIP. The law also stipulates that no government entity can move forward with works, projects or investments if it is not contemplated in the FYIP, unless authorized by the Governor.

#### Regulations

Law No. 75 gives the PRPB ample quasi-legislative powers for the preparation, adoption and amendment of planning regulations. Furthermore, it establishes that the PRPB “is empowered to deny authorization to projects it deems undesirable, if the project affects factors such as health, safety, order, public works, adequate use of land or esthetics or the environment”, even if the project proposed complies with applicable regulations.

This law also states that the PRPB must prepare zoning regulations, regulations regarding the controlled use of beaches, public beaches and other water bodies and a subdivision regulation. In order to comply with its duties, the PRPB has adopted multiple regulations, among the most important are:

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<sup>172</sup> With the purpose of creating a LUP for all of Puerto Rico (PRLUP), the “Commonwealth of Puerto Rico Land Use Plan Act,” Law No. 550 of 2004, was approved and created an Office for the LUP in the PRPB, defined substantive and procedural requisites for its elaboration, consideration, approval and implementation; established a procedure for resource inventory; established procedures for the designation of reserves; required a Special Plan for the Municipalities of Vieques and Culebra to be elaborated; established dispositions related to special planning zones and established a process for a transition toward the new Plan. The PRPB prepared a final draft as well as classification maps that are currently in a public meeting process which should be completed by 2010.

### **The Subdivision and Urbanization Regulation, Planning Regulation No. 3 of 2005**

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This regulation oversees land subdivisions in Puerto Rico and establishes guidelines and controls for this purpose. This regulation includes dispositions related to the proposed development project and requires basic and recreational infrastructure in new developments. This regulation also states that the PRPB should avoid subdivisions in areas which lack facilities or infrastructure and should also avoid the propagation of isolated developments. An important disposition in this regulation is the prohibition of simple subdivisions in land located in the coastal zone, as defined in this PRCZMP.

### **Puerto Rico Qualification Regulation, Planning Regulation No. 4 of 2008**

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According to Law No. 75, the PRPB must adopt Zoning Regulations which would apply within Puerto Rico's territorial limits. The PRPB can also adopt zoning maps for all of Puerto Rico's urban, sub-urban and rural areas when it deems it convenient or necessary to comply with its duties. For that purpose, the agency adopted the "Puerto Rico Zoning Regulation."

The "Puerto Rico Zoning Regulation" was originally approved on June 22, 1955 and was later revised on several occasions to adapt it to Puerto Rico's economic, social and physical reality. In June 2008, this zoning regulation was abolished and substituted by the "Puerto Rico Qualification Regulation", *supra*.<sup>173</sup> This regulation has the fundamental purpose of establishing, by use of zoning, the essential norms regarding and how and where social and economic activities should be located in Puerto Rico.

### **Regulation on Zoning in the Coastal Zone and Access to Beaches and Coasts in Puerto Rico: Planning Regulation No. 17 of 1983**

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The purpose of this Regulation is to provide the means to achieve adequate access to Puerto Rico's coast and beaches and the optimum use of these resources by the general public. The main objectives are: provide new accesses to the coast and beaches through the requirement of accesses in new projects facing the maritime zone and protection of Natural Reserves and natural resources by not permitting new subdivisions or development which could endanger or destroy them.

### **Special Flood Hazard Areas Regulation, Planning Regulation No. 13 of 2005**

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This Regulation stipulates the security measures for buildings and developments in lands declared to be at risk of flooding as well as pertinent prohibitions. The Regulation's purpose is to restrict or prohibit developments which pose a threat to health, safety or property when these induce an increase in flood levels or speed of currents, due to an increase in erosion. It also has the purpose of avoiding the alteration of valleys naturally prone to flooding, protecting river beds or naturally-occurring barriers which guide floodwaters or currents. The Regulation also seeks to avoid or control the construction of barriers that can alter the flow of waters which could lead to an increased risk of flooding in other areas.

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<sup>173</sup> In this last revision, zoning districts were consolidated; permitted uses were established for each one them (in concept and by nature of their operation); difficulties in mechanisms regarding public meetings were tended to in such a manner as to not jeopardize public participation in the planning process, among other matters.

## **Regulation for the Designation, Registration and Conservation of Historic Sites and Zones: Planning Regulation No. 5 of 2002**

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Among the purposes of this Regulation is to protect, improve and perpetuate those places or zones of historical value for the enjoyment of the community, research, education and for cultural and tourism development. This Regulation also seeks to ensure that the uses of the land lead to the conservation of historical patrimony.

### **Coastal Zone Unit**

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The PRPB's Coastal Zone Unit is responsible for implementing the Federal Consistency Certification process, which entails a process to evaluate if a proposed activity complies with the enforceable policies dictated in the PRCZMP as established in Appendix B.

Activities which must comply with the requisite of Federal Consistency with the PRCZMP are:

- activities which have an impact on the coastal zone and have not been expressly excluded by the PRCZMP,
- activities which include the use of federal funds in their development and
- activities which require a federal license or permit.

All commonwealth and federal agencies, organizations and individuals are subject to Federal Consistency Processes and requirements as established by the CZMA, as well as subject to all authorities or commonwealth public policies (See Appendix 4)

### **State Single Point of Contact (EO- 12372)**

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In Puerto Rico, the PRPB, through its State Single Point of Contact (SPOC), is responsible for the revision of all requests for federal funds.

EO-12372, issued by President Ronald Reagan, delegated on all states and territories the creation and development of their own processes to coordinate and revise proposals seeking federal funding. In Puerto Rico, the SPOC uses EO-12372 in conjunction with EO-4763 issued by the Governor of Puerto Rico.

### **Judicial review of PRPB decisions**

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PRPB decisions are subject to judicial revision as described in the "Process for control and development of RPA and PRPB" section.

### **Regulations and Permits Administration (RPA)**

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RPA, created in 1975, derives its power from its Organic Law, Law No. 76 of 1975. This agency, which is also part of the Office of the Governor, is responsible for enforcement and application of planning laws and regulations. Furthermore, it has the power to evaluate and issue determinations regarding permits for construction, usage, re-construction, alteration, expansion, demolition, relocation of buildings or structures, development or subdivision of lots and urbanization works.

Law No. 76 states that this agency will be directed by an Administrator nominated by the Governor and confirmed by the Senate. Moreover, the agency can adopt and submit regulations, which need approval from the PRPB, except for those emergency regulations which will be approved by the Governor. This agency will be responsible for compliance and enforcement of its own regulations adopted by the PRPB for development, subdivision and land use and for construction and building of structures. Furthermore, RPA will be responsible for the compliance of all Commonwealth laws, ordinance or regulation by all governmental entities which have jurisdiction over construction in Puerto Rico. Therefore, RPA should establish close coordination with the PRPB, DNER, EQB and any other government organism in order to watch over the compliance with environmental public policy and all public policy related to Puerto Rico's economic, social and physical development.

Some of the Regulations adopted by RPA are:

**Regulation on the Adjudicating Process of Regulations and Permits Administration: April 16, 2002**

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This Regulation was adopted after the passing of the "Uniform Administrative Process Act," Law No. 170 of 1988. Its purpose is to promote a uniform and efficient decision-making process for both, the different agency components and general public, as states in Law No. 170. Among the dispositions included in this Regulation are the process to revoke authorizations and an informal process to settle controversies or claims by citizens, in both the adjudication process for authorizations and in cases of citizen complaints, and to speed up the process of adjudication of complaints stemming from violations to the Regulation and presented applications.

**Puerto Rico Building Code: December 8, 1999**

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This Code was adopted in 1999 with the purpose of regulating everything related to construction of structures, expansion, alteration, repairs, movement, removal, demolition, signage, outdoor advertising, equipage, usage, height, area and maintenance.

**Regulation for the Certification of Works and Permits, Planning Regulation No. 12 of 2002**

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Its purpose is to promote a uniform and efficient process, for both professionals and the general population. The Regulation establishes a process to follow in the cases the Agency oversees in its function as a monitor for certified permits. The process requires all professionals involved in a certification to ensure the plats for construction projects be prepared in compliance with the applicable laws and regulations and that the finished work is completed under their inspection and was executed in accordance with the permit originally granted.

**The development control process of the RPA and PRPB (Autonomous Municipalities)**

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PRPB regulations, statutes and resolutions are instruments which serve as guidelines for Puerto Rico's development. Usually, a proposed project should begin by evaluating:

- Zoning – If the Project complies with the established zoning in the plats adopted by the PRPB;

- Environmental impact - In one part, the proposing agencies can determine if the action can be classified as a categorical exclusion under EQB Administrative Order R-03-30-8, or if it requires an environmental impact statement. An action can be classified as a categorical exclusion if it is predictable or routine and if its execution will not have a significant impact on the environment or if its purpose is of a remedial nature.

RPA is empowered to grant the permit if it is determined that the proposed action will not have significant environmental impact and if it complies with the established zoning. However, the action must comply with all applicable laws and planning regulations.

If an action complies with the zoning, but it is determined that it could have a significant impact on the environment, then the proposing agency must present an environmental impact statement to the EQB in order to comply with Article 4-B-3 of the “Puerto Rico Environmental Public Policy Act,” Law 416 of 2004. On the other hand, if the action does not comply with zoning specifications in regards to usage or density, then the permit will not be granted and the project will have to be revised by the PRPB.

The PRPB counts with a process for site consultations in which the PRPB evaluates and makes the determination it deems pertinent regarding the proposed land use which are not statutorily permitted by the applicable regulations in zoned areas, but that dispositions in agency bylaws provide for the action to be considered by the Agency. In non-zoned areas, proposed development or land use for which the PRPB has not reserved exclusive jurisdiction is also included. The consultation process also includes extensive developments to be considered under the disposition of bylaws and those of regional character or that fall between the parameters of the powers that the PRPB retains under the dispositions of the “Law of Autonomous Municipalities”, *supra*.

For non-zoned areas, the PRPB counts with the “Regulation to Delegate Responsibilities to the Regulations and Permits Administration for Evaluating Projects of Development, Construction and Land Uses in Areas Not Zone”, Regulation No. 27 of 2002. This regulation delegates on RPA the granting of construction, development or usage permits in non-zoned areas which the PRPB considers could be served by RPA with more agility and efficiency.

For those individuals, corporate or governmental entities in disagreement with the decisions made by RPA, the PRPB, the Autonomous Municipalities, the municipal consortiums or, in some cases in the Puerto Rico Aqueducts and Sewers Authority (PRASA) have a forum in the “Construction and Lots Appeals Board,” created by a mandate in RPA’s organic law. This is an appellate organism that has jurisdiction over permit decisions made by the RPA and the PRPB. Among the issues attended by this Board are: technical aspects such as engineering calculations, planning, design and technical-legal aspects.

This Board is comprised of five members designated by the Governor of Puerto Rico. None of these can be members of the PRPB or the RPA.

Furthermore, PRPB resolutions which deny a permit for a public work can be appealed to the Governor, who has the authority to amend, alter or revoke the PRPB resolution. Moreover, some PRPB decisions can be appealed to the Superior Court via the process of administrative revision, but only if a petition for reconsideration has already been denied.

## **Environmental Quality Board (EQB)**

The EQB derives its authority, power and responsibilities from the “Puerto Rico Environmental Public Policy Act”, *supra*. According to this law, the EQB will have the authority to regulate activities which could pollute the environment, enforce compliance and impose sanctions. The EQB is comprised of three members nominated by the Governor and confirmed by the Senate. One of these members is nominated as Chairman of the EQB.

Among the issues regulated by the EQB are:

- Evaluations of environmental impact - The “Puerto Rico Environmental Public Policy Act”, *supra*, requires the preparation of an environmental impact statement (EIS) for those actions which have the potential of significantly affecting the environment. The responsibility to oversee this requisite falls on the EQB. It is important to note that this legal requisite is practically identical to the one established in the “National Environmental Policy Act” (NEPA) and that the EQB’s administrative responsibilities regarding environmental impact are similar to those which fall under the *Council of Environmental Quality* and the EPA.
- Pollution control -EQB is the Puerto Rico government agency responsible for controlling pollution of the island’s air and water. The agency adopts and oversees plans for pollution control, regulations and standards and is the recipient of federal aid under the Clean Water Act (CWA) and the Clean Air Act (CAA). EQB also certifies federal National Pollutant Discharge Elimination System (NPDES) permits previous to final approval by the EPA. EQB is also responsible for the control of solid waste.

The “Puerto Rico Environmental Public Policy Act”, *supra*, gives the EQB ample powers to adopt and enforce regulations including the power to issue orders of cease and desist as well as solicit the execution of those orders if they are not complied with.

The coordination between EQB and PRPB is a mandate under the PRPB’s Organic Law. Said law states that the public policies and plans formulated by the EQB will be submitted to the PRPB after their preliminary approval to determine if said public policies and plans conform to the public policies and strategies for integral development adopted by the PRPB. If the agencies are not agreement, then the Governor has the power to intervene.

In recent years, the EQB has used its quasi-legislative and quasi-judicial powers to adopt regulations to tend evaluations and EIS, the management of hazardous and non-hazardous solid waste, water and air quality, noise and the erosion and sedimentation of land.

## **Department of Natural and Environmental Resources (DNER)**

This Agency was created by “Law No. 23 of June 20, 1972” as the Department of Natural Resources (DRN) and, later renamed the Department of Natural and Environmental Resources through Reorganization Plan No. 4 of 2003. DNER’s main purpose is to ensure that the Government of Puerto Rico’s public policy is executed and to protect, conserve and manage, the natural and environmental resources, in a balanced manner, in order to guarantee Puerto Rico’s sustainable development.

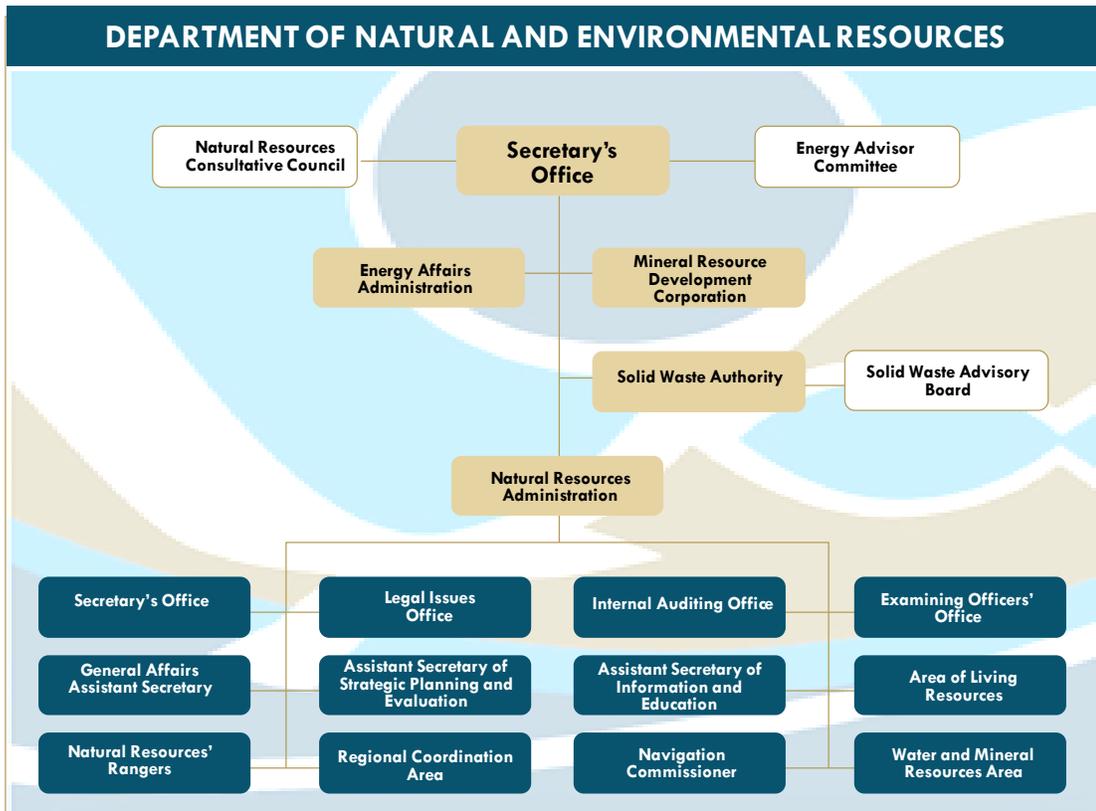
Among the responsibilities delegated to DNER are the economic mineral resources, including the mining concessions; water, including the granting of franchises for the use of Puerto Rico's waters; sand and other materials which are part of the crust, including regulating sand extraction; wildlife, including the regulation of fishing and hunting; the forests, including the administration and operation of the Puerto Rico Government's forests; territorial waters, submerged land and the maritime zone, including the granting of authorization and concessions for activities in this area.

While it is understood that the efforts of the DNER are geared toward the management and protection of resources, this agency also participates in the guidance of development by:

- The evaluation of construction projects in navigable waters as part of USACE's Joint Permit Application (JPA) for piers, dredging and wetland areas.
- Participation in the revision process and comments regarding environmental impact statements referred by the PRPB and RPA.



ILLUSTRATION 4. DNER Structure



#### 4.1.2 LINKAGES ASSURING CONSISTENT ACTION IN GUIDING DEVELOPMENT

Various interrelations exist between the four agencies presented (PRPB, DNER, EQB and RPA) and among other agencies of the Government of Puerto Rico that allow for consistent actions in the guidance and direction of Puerto Rico’s coastal development.

These interrelations can be classified in three categories:

- (a) Interrelations at the planning and policy level,
- (b) Interrelations in adopting and amending regulations and
- (c) Interrelations in permit applications and project review.

#### Linkages at the level of policies and plans

The PRCZMP constitutes the coastal element of the PRLUP and as such, establishes the commonwealth’s public policies regarding the management of the coastal zone. Said public policies should implemented by the Government of Puerto Rico’s agencies in the formulation of their respective policies, plans, programs and concrete actions. Some of the more significant interrelations are contained in the organic laws of the PRPB and the EQB.

The PRPB, according to what is stipulated in its organic law, has the obligation to advise, coordinate and help the different government organisms in the preparation, adoption and implementation of their respective plans and functional and regional programs. This obligation includes coastal zone management, a primary responsibility which falls under DNER.

DNER, according to its organic law, is responsible for implementing programs for the usage and conservation of Puerto Rico's natural resources, always within the parameters established by the EQB. Meanwhile, the PRPB's organic law requires of this agency, and all of the other Puerto Rico Government agencies, to submit their four-year functional and operational programs to be integrated in the FYIP. The PRPB is also responsible for elaborating the norms and criteria that should be utilized by the agencies in the preparation of their respective functional and operational programs.

The PRPB's organic law requires the EQB to submit public policies and plans that this agency formulates to the PRPB immediately after their preliminary approval. Those public policies and plans must conform to the policies and integral development strategies adopted by the PRPB.

The interagency coordination between PRPB and RPA is insured due to the fact that the fundamental responsibility of the latter is to administer the regulations adopted by the PRPB. Furthermore, the regulations adopted by the RPA need the approval of the PRPB. By the same token, it is required of the RPA to execute the duties delegated on this agency conforming to the public policies and plans adopted by the PRPB and to maintain close coordination with other government agencies, such as the EQB and DNER.

### **Linkages at the regulatory level**

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At the regulatory level, the four Government agencies responsible for the direction of development have the authority to amend regulations. By the same token, the informal consultation between agencies – at the executive level or between technical personnel – provides for a continuous interrelation that is completed by technical consultations through required public meetings.

Among the interrelations at the regulatory level are:

PRPB: PRPB's LUP and its coastal element (the PRCZMP), in conjunction with the MLUPs, serve as a base for zoning maps. Furthermore, all of PRPB's regulations and their corresponding amendments are effective once they are signed by the Governor.

RPA: Regulations adopted by RPA are effective once they are approved by the PRPB. However, emergency regulations are effective only if they are signed by the Governor.

EQB: The EQB has the power to adopt regulations, grant permits and emit orders. This agency counts with an Environmental Protection Consulting Council aside from the three members who comprise the EQB. This council is constituted by the DNER Secretary, the Secretary of the Department of Public Health, the Secretary of the Department of Agriculture, the PRPB's Chairman and three at-large members who represent the public's interest. The purpose of this council is to advise the EQB's Chairman on environmental public policy,

serve as an advisory council and advise on areas related to regulation and inter-agency coordination.

DNER: The majority of the regulations adopted by the DNER do not require the approval of other agencies. However, according to what is stipulated in DNER's organic law, DNER must work in conjunction with other Puerto Rico Government agencies in the formulation and adoption of determined regulations.

### Linkages at the level of permitting and project review

At the permitting and project review level, formal and informal interrelations between the PRPB, RPA, EQB and DNER also exist.

As was previously described, various legal dispositions require that the agencies' projects conform to the plans and programs adopted by the PRPB. To ensure compliance, public projects are individually reviewed by the PRPB, which evaluates the aspects related to its location. For its part, RPA, which is the operating arm of the PRPB, evaluates other elements and grants or denies the construction permit.

RPA, according to its organic law, has the responsibility of working in coordination with the PRPB, DNER, EQB and other government organisms to achieve compliance with the environmental public policy regarding Puerto Rico's economic, social and physical development. This revision process requires that many of the proposals be referred to government agencies so that these can submit their comments regarding the proposed project.

In Puerto Rico, project revision and issuance of public and private permits require certification by the EQB which indicates compliance with the "Puerto Rico Environmental Public Policy Act", *supra*.<sup>174</sup> Meanwhile, projects which are deemed to have a significant environmental impact are required to present an EIS, as mandated by said law.

Furthermore, the PRPB, through Administrative Bulletin 4763-A by the SPOC is responsible for reviewing and certifying federal proposals prepared by state agencies, the municipalities and the private sector. The proposals for federal funds are for projects that are to be developed directly by the United States Government in Puerto Rico's jurisdiction.

PRPB, through its Coastal Zone Unit, evaluates the consistency of applications with the PRCZMP and issues Certificates of Federal Consistency. This Unit jointly processes through NOAA any appeals regarding determinations of federal consistencies with the Program.

DNER is the agency locally responsible of evaluating and issuing endorsements necessary for permits issued by the USACE. The requests for these endorsements are processed by the PRPB as part of the proposal revision process for projects.

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<sup>174</sup> Through the "Law to Amend the Law of Uniform Administrative Procedures of the Commonwealth of Puerto Rico," Law No. 295 of 1998, the inclusion, within all informal procedures, of all the steps regarding environmental documents established by Article 4-B.3 of the "Puerto Rico Environmental Public Policy Act", *supra*, was achieved.

### 4.1.3 IMPROVEMENT OF COASTAL ZONE GUIDANCE

Current procedures for guidance in the development of the coastal zone provide the foundation for adequate management of the zone. Despite this fact, in this revision process and updating several needs have been identified (mentioned in Chapter 3), the majority of which are related to the development and implementation of the current legal framework.

These diagnosed needs are included in the Coastal Management Program described in the next section. By the same token, the Program includes other measures that establish changes in the organization, procedures and measures to increase and improve the effectiveness of personnel.

#### Refining the policies and regulations that guide development

The purpose of this Management Program is to fine-tune those current public policies, laws and regulations so that they provide clear guidance for the development of Puerto Rico's coastal zone. Moreover, it aims at more effectiveness in the procedures as well as a decrease in problems which may affect the area.

As was previously presented, the PRPB, RPA, EQB and DNER are responsible for guiding development in the coastal zone. However, these agencies also have discretionary authority which has been used on many occasions in the application of public policies for proposed developments. Due to this situation, the PRCZMP was approved and adopted in order to resolve conflicts that could arise in the application of these policies in regard to the coastal zone and the continuous transformation of Puerto Rico's economic, physical and social reality. The PRCZMP is the instrument whose purpose is to refine policies and regulations in such a manner that they can serve as a guide in the early stages of a development.

In 1978, the PRCZMP included a series of recommended actions, policies and proposed a revision of several regulations. The proposed policies later became part of the Program once it was approved and adopted. Some of the laws and regulations which have been adopted over the last decades have been incorporated into the PRCZMP through the mechanism offered by NOAA known as RPC. Other recommendations were dealt with by Section 306 of the CZMA, which provides funding for the implementation of the PRCZMP. In some circumstances, there could be other funds available under other sections of said law.

#### 1. Policy making in more detail

The PRCZMP (1978) established more detailed policies than those contained in the OPP-PRLUP, mainly due to the fact that it was the coastal element of the PRLUP. The topics for which these policies were established are:

- Mangroves (Section 3.3.3)
- Access to beaches (Section 3.2.5)
- Coastal development (Section 3.3)

The public policies included in the OPP-PRLUP of 1995, which have already been incorporated by NOAA, through its RPC process in 2003, have been included in the PRCZMP for this revision.

## 2. Refining regulations and criteria for improving development guidelines

The Program also identified the need to refine existing regulations regarding the following topics:

- Coastal risks: Absolute prohibition of activities associated with urban development in environmentally and geologically sensitive areas in the coastal zone.
- Beaches: Law which would require the registration of concessions which tend to limit access to the beaches.
- Installation of basic and recreational facilities in front of the coast.

## 3. Site specifications: Special Planning Areas and Natural Reserves

The PRCZMP (1978) designated Special Planning Areas (SPA) and recommended other areas to be designated as Natural Reserves (NR).<sup>175</sup>

### *Special Planning Areas*

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Special Planning Areas of (SPA) are defined as areas with important resources subject to conflicts due to actual or potential usage – reason for which they require detailed planning. Upon approval of the PRCZMP, eight areas were automatically designated as SPA. They are:

- Boca de Cangrejos- Piñones
- Suroeste<sup>176</sup> (Southwest): Sector La Parguera, Sector Boquerón and Sector Guánica
- SPA – Manglares de Puerto Rico
- Laguna Tortuguero
- Bajura de Isabela-Aguadilla
- Vieques
- Bahía de Jobos
- Pandura-Guardarraya

For this revision, it is recommended that all areas which include coral reefs within Puerto Rico’s territorial waters be designated as SPA.

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<sup>175</sup> In this document, the terms “Special Planning Areas (SPA)” and “Natural Reserves (NR)” are used in substitution of the terms “Areas of Particular Interest” and “Areas of Preservation and Restoration”, terms which are used in applicable federal regulations (15 CFR 923.21-22).

<sup>176</sup> It was divided into three sectors (Lajas, Guánica and Cabo Rojo) only with the purpose to facilitate its planning and management since, ecologically, they are continuous system with a very close interrelation.

## *Natural Reserves*

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Natural Reserves (NR) are areas with important coastal resources subject to conflict due to its actual or potential usage and which should substantially preserved in the actual condition (or in cases where restoration is viable, restore them to the previous natural condition). In 1978, some 26 areas were proposed for this designation or which 21 were designated:

- Caño Martín Peña NR
- Piñones Commonwealth Forest NR
- Río Espíritu Santo NR
- Cabezas de San Juan NR
- Arrecifes La Cordillera NR
- Ceiba Commonwealth Forest NR
- El Pantano, Bosque de *Pterocarpus*, Lagunas Mandry y Santa Teresa NR
- Arrecifes de Guayama NR
- Punta Petrona NR
- Isla Caja de Muertos NR
- Guánica Commonwealth Forest NR
- La Parguera NR
- Boquerón Commonwealth Forest NR
- Laguna Joyuda NR
- Arrecifes Tourmaline NR
- Caño Tiburones NR
- Cueva del Indio NR
- Hacienda La Esperanza NR
- Laguna Tortuguero NR
- Mona & Monito NR
- Bahía Bioluminiscente de Vieques NR

Later, the following areas were designated as Natural Reserves and incorporated into the PRCZMP by way of the RPC mechanism:

- Caño La Boquilla NR

- Pantano Cibuco NR
- Laguna Cartagena NR
- Canal Luis Peña NR
- Aguas Costeras de Desecheo NR
- Punta Guaniquilla NR
- Punta Yeguas NR
- Finca Belvedere NR

Other NRs in the coastal zone have been designated by special legislation or by EO (See Table III-7). Other areas were recommended in the PRCZMP, but have yet to receive the corresponding designation, reason why their designation is still recommended. These are:

- Bosque de *Pterocarpus* de Torrecilla Alta
- Pantano Espinar in Dorado
- Bosque de *Pterocarpus* in Dorado
- Bahía de Jobos y Mar Negro

The application to designate the Bosque de *Pterocarpus* de Torrecilla Alta was sent to the consideration of the PRPB by DNER due to the fact that the land which comprises the NR was acquired. Other areas, such as Bahía de Jobos y Mar Negro<sup>177</sup> and the Bosque de *Pterocarpus* in Dorado are currently protected under other mechanisms, reason which the evaluation of the desirability and viability of its protection is recommended.

It is important to note that SPA and NR designations have their advantages when formulating regulations. Furthermore, these designated areas should have priority when funds are assigned and for the installation of public services and facilities.

Another byproduct of designating these areas as NR is that the dominant public policies in these areas are preservation and restoration. Therefore, activities that are not consistent with conservation and preservation should be excluded, except in those instances where there's and urgent public need.

The designations as NR should be formalized by way of statutes or by amendments to the PRPB's PRLUP since the PRCZMP is the coastal component of the PRLUP.

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<sup>177</sup>This NR is part of the Jobos Bay National Estuarine Research Reserve (JOBANERR). This was the first natural area protected under DNER's jurisdiction to count with a management plan approved by the PRPB and the Governor. Even though this area does not have an official designation as a NR, JOBANEER is on the list of recommended sites in the original PRCZMP document to be designated as an NR. To that effect, DNER and the PRPB, in practice, treat this area as an NR, since it meets the criteria and already has a management plan.

#### 4. Detailed policies, plans and regulations for SPA and NR areas

Aside from the SPA and NR designation for these areas, it will be necessary to formulate and adopt mechanisms for their protection and adequate management. One of the essential elements for the management of these areas is the fine-tuning of public policies, plans and regulations to guide development in these areas.

Policies: Additional public policies to strengthen the process to control development and to protect SPA and NR are presented in the PRCZMP. A continuous element in the preparation of additional policies to guide the development of other resources designated as SPA or NR. Through Section 306 of the CZMA, other financial resources are available for these purposes.

Plans: The elaboration of detailed plans, based on the inventory of the resources and the complete consideration of alternative uses presents additional opportunities to optimize the use of areas designated as SPA and NR.

At this moment, management plans exist for several SPA and NR.

**TABLE IV-1. SPECIAL PLANNING AREAS**

Special Planning Areas (SPA)		
SPA	Designation Date	Management Plan
1 Boca de Cangrejos-Piñones	Adopted on July/14/1992 Twentieth Extension Resolution PU-002	There is a Land Use Plan for the <i>Piñones</i> SPA (valid since June 14 of 1995)
2 Suroeste: Divided in three sectors:		
Sector La Parguera	Adopted on October /25/1995 Twenty-seventh Extension Resolution PU-002	Valid since December 5th of 1995. Twenty-seventh Extension Resolution PU-002. Divided in three sub-areas: (1) <i>Guánica</i> , (2) <i>Bahía Montalva y La Parguera</i> and (3) <i>Boquerón</i>
Sector Boquerón	Final Document	
Sector Guánica	Draft	
3 Laguna Tortuguero (Vega Baja-Manatí)	Adopted (Valid since September of 1993)	October/ 20/ 1993. There is a Special Regulation for the Laguna Tortuguero Watershed (Valid since October /28/ 2000)
4 Manglares de Puerto Rico	Adopted by the PRPB on August/ 5 /2003	2003
5 Bajura de Isabela-Aguadilla	Draft	
6 Vieques	It has not been elaborated	
7 Bahía de Jobos	Draft	Prepared by the DNER's Coastal Zone Division
8 Pandura-Guardarraya (Yabucoa-Patillas-Maunabo)	It has not been elaborated	

Source: DNER, (2008). Land Resources Planning Division

It is advisable that plans approved for SPA and the process of execution of these plans is re-evaluated to verify their effectiveness.

The DNER is the agency responsible for preparing management plans for the NRs and the SPAs. Besides, the DNER is responsible for developing plans for the acquisition of lands

when private lands are involved, as well as to conduct the corresponding negotiations for transfers, if lands are owned by other agency or public corporation.

Management plans for the SPAs are submitted under the consideration of the PRPB and are subject to public meetings and the approval of the Governor in office because these are areas containing private lands. The management plans of the NRs and the SPAs are an integral component of the PR-LUP.

Regarding the NR, DNER has prepared management plans for many of these areas, many of which are in use. However, due to the fact that the management plans include zoning by categories (conservation, preservation and restoration), those plans are sent for consideration of the PRPB before they are adopted.

Currently, the Seven Seas NR has a Management Plan adopted by the PRPB in its own right.<sup>178</sup> The SPA and NR Ciénaga Las Cucharillas also has a plan adopted by the PRPB.<sup>179</sup>

Other NR which have management plan, some of which are under consideration by the PRPB include:

- Arrecifes La Cordillera
- Canal Luis Peña
- Bahía Bioluminiscente de Vieques
- El Pantano Bosque *Pterocarpus*, Lagunas Mandry y Santa Teresa
- Caño Tiburones
- Mona & Monito
- Corredor Ecológico del Noreste
- Humedal Punta Tuna

It is recommended that NR designation is accompanied by a budget assignment to cover costs associated with their management. For the preparation of management plans for those areas which have no budget assignment, it is possible to obtain and assign funds through Section 306 of the CZMA.

Regulations: Current regulations to guide coastal development in Puerto Rico are applicable to the entire coastal zone. Within the coastal zone, these regulations could and should be applied to land belonging to any agency or organism of the Government of Puerto Rico as well as any private property.

In the process of evaluating environmental impact and determining Federal Consistency with the PRCZMP, the analysis could be extended to activities or projects proposed outside

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<sup>178</sup> Through Resolution P.U.-002-2007-24-1 October 2007.

<sup>179</sup> Through Resolution P.U. -002-2008-14-02 December 2008.

of the coastal zone limits when it can be predicted that these activities or projects have the potential to eventually have an impact on the coastal zone.

Through its permitting system, the Government of Puerto Rico has the authority to guide and direct development in private property in the coastal zone, even if those lands are not designated as SPA or NR. In some instances, it could be necessary to complement current measures with special zoning regulations so that all types of development can be controlled.

The PRCZMP includes the preparation of special zoning that could be necessary to further promote SPA and NR.

Section 306 of the CZMA provides, through the management program, for an inventory to be taken with the purpose of identifying and for the designation of areas of particular interest within the coastal zone and for those areas which contain one of more natural resources of national importance. Furthermore, it provides for the establishment of specific standards which could be implemented to protect those resources.

### **Procedural and organizational change: the Coastal Management Unit**

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The PRCZMP (1978) recommended the creation of an Office of Coastal Management to evaluate the impact of proposed developments in the coastal zone. Currently, these duties are jointly shared by DNER and the PRPB.

DNER, as the lead agency in the implementation of the PRCZMP, executes these duties through several bureaus and agencies, including its Coastal Zone Division (CZD) which is under DNER's Bureau of Coasts, Reserves and Refuges.

In its part, the PRPB, through its Coastal Zone Unit, evaluates the compliance of proposed developments with the Program.

DNER has personnel specialized in the evaluation of impact that development activity may have on natural systems. The agency has a series of responsibilities of which four are fundamentally associated with the control of development in the coastal zone. These are:

1. Preparing detail policies and plans for SPA and NR

The Land Resources Planning Division, which falls under the jurisdiction of DNER's Deputy Secretary for Integral Planning, has the responsibility of preparing management plans for SPA and NR to support the PRCZMP. The Natural Reserves, Refuges and Wildlife Division, which falls on the Bureau of Coasts, Reserves and Refuges also prepares management plans for NR.

According to the PRCZMP (1978), these plans can be submitted to the PRPB so they can be incorporated as elements of the PRLUP. In 2007, the DNER began submitting its NR management plans for consideration by the PRPB. However, the management plans previous to this date are valid since they represent DNER's public policy even if they have not been adopted by the PRPB.

Regarding the management plans for SPA, those are prepared by DNER and submitted for PRPB consideration. PRPB is responsible for their adoption. Once adopted by the PRPB,

these documents need to be approved by the Governor of Puerto Rico since they implicate use of land, part of which is private property.

During the revision and updating process, the need to establish a mechanism for coordination between DNER and the PRPB to solve the problem of delays in the preparation and adoption of Management Plans for SPA and NR was identified. DNER should prepare its drafts expeditiously and the PRPB should make its determinations in a reasonable and timely manner.

## 2. Proposing additional SPA and NR

DNER is the agency which recommends areas to be designated as SPA or NR. This recommendation should be accompanied by an inventory of the resources and studies needed to support it (known designation documents). These documents are presented to the DNER's Secretary, whom after evaluating and, if necessary, modifying them, submits them to the PRPB, which in turn makes its determination.

The "Natural Heritage Program Act", Law No. 150 of 1988, which is part of the PRCZMP, provides for the identification of their land of high ecological value and for the creation of mechanism, such as NR designation, for their protection, including their acquisition.<sup>180</sup> The Natural Heritage Division is the administrative unit under the jurisdiction of DNER's Deputy Secretary for Integral Planning responsible for implementing this Law.

## 3. Participating in the review of development proposals

DNER, through its Deputy Secretary for Permits, evaluates permit proposals for developments in the coastal zone.

(a) *Within NR and SPA*: None of Puerto Rico's Government Agencies responsible for the guidance of development (PRPB, RPA, EQB and DNER), will authorize or grant any permits (including revisions for proposals seeking federal funds) for the following projects unless DNER's Secretary has had a reasonable period of time (no less than 30 days) to evaluate the impact of the proposed development on natural systems.

- In SPA (except mangroves)- This mandate applies previous to the approval of any lot subdivision, urbanization, industrial project, commercial center, hotel or tourism villa and previous to the approval of any development in the maritime zone, coastal waters or submerged land.
- In mangroves and NR – This mandate is effective previous to the approval any type of development.

In the DNER, applications for development proposals in SPA or NR are referred to the Bureau of Coasts, Reserves and Refuges.

DNER's Secretary should cooperate with the proposing agencies in the evaluation of the impact of the proposed project on the natural resources. After its evaluation, the proposing

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<sup>180</sup> These areas include lands which are habitats to endangered species or migratory birds, wetlands, areas with special designation or not, such as state forests, NR, among others.

agency will make its decision following the laws, regulations, plans and public policies applicable, including the PRCZMP as part of the PRLUP.

In other parts of the coast: Proposals for development in the coastal zone, including those referred by other agencies, will not be approved if it determined that they are not in compliance with the PRCZMP.<sup>181</sup> Compliance is evaluated by the Coastal Zone Unit, which is the entity which grants or denies the Federal Consistency Certification.

#### 4. Continuing consultation

The CZD has the responsibility of maintaining continuous communication with the agencies and corporations of the Puerto Rico Government and the general public.

## 4.2 ACTIVE MANAGEMENT OF COASTAL RESOURCES

Active management of Puerto Rico's coastal resources is the second issue of importance in the Coastal Management Program. The Program includes measures to protect and maintain resources through permits, franchises, patrolling and compliance, among others. It also includes measures to promote the use of these resources by the public through mechanisms such as the acquisition of properties, the cleaning of beaches and the installation of appropriate recreational facilities.

DNER has the primary responsibility of managing Puerto Rico coastal resources. This section describes said responsibilities as wells as other Puerto Rico Government which participate in the management of the coastal zone. Furthermore, this section incorporates improvements included in the Coastal Management Program.

### 4.2.1 ONGOING ACTIVITIES: THE DNER AND OTHER AGENCIES PARTICIPATING IN MANAGING COASTAL RESOURCES

The primary responsibility of managing Puerto Rico's natural resources falls under DNER. However, other agencies often contribute to managing some parts of coasts of which they have jurisdiction.

#### **DNER**

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Aside from its responsibilities in the control of development, DNER has ample responsibilities regarding the management of coastal resources. These include the power of regulating and administrating permits systems, franchises, concessions and other authorities given to DNER by Commonwealth statutes as well as the authority which comes from the custody of extensive coastal areas.

DNER's regulating and franchising responsibilities are related to four types of principal resources: minerals, sand and stone, waters and fish and wildlife. (See DNER's organizational diagram).

- Minerals: As explained in Chapter 3, the minerals identified in Puerto Rico are important for research rather than for exploitation.

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<sup>181</sup> Consistency and federal consulting process are discussed in Appendix B.

- **Sand and other crust materials:** DNER is also responsible for these resources. As indicated in Chapter 3, regulations which oversee the extraction of these materials from public property are adopted and implemented by DNER.
- **Waters:** DNER is responsible for the integral planning for Puerto Rico's waters. Water management is controlled through a system of franchises and permits for the building of wells and/or take-ins which administer the amount and extraction rate of underground and above ground sources. Furthermore, applicable federal regulations require a favorable endorsement from DNER as the state agency responsible for this resource regarding projects proposed on superficial waters, including wetlands and those which entail dredging and/or land deposits which require an USACE permit.
- **Fishing and Wildlife:** DNER is responsible for the management of fishing resources and the conservation of the habitat, inventory of species and their populations and recreational fishing and hunting activities.

DNER also has jurisdiction over extensive public lands, including:

- Commonwealth Forests- As indicated in the section regarding mangroves and forests in Chapter 3, some Commonwealth Forests are completely or partially located within the coastal zone. These include Guánica Commonwealth Forest NR, Boquerón Commonwealth Forest NR, Ceiba Commonwealth Forest NR, Piñones Commonwealth Forest NR, among others.
- Territorial waters, submerged lands and the maritime zone, including public beaches which are administered by the NPC.

### **Other agencies**

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Other agencies have responsibilities regarding the management of coastal resources. Some of them have under their jurisdiction certain public portions of the coast: These include:

- National Parks Company (NPC) – manages 12 public beaches (See section regarding Beaches and Recreation in Chapter 3)
- Puerto Rico Ports Authority (PRPA) - comprised of the Maritime Bureau, Aviation Bureau and that Maritime Transportation Authority, which manages 15 ports and 11 airports. (See section on Transportation in Chapter 3)
- Puerto Rican Culture Institute (PRCI) - manages numerous historical and cultural monuments along the coastal zone which belong to the Puerto Rican Government (See section on Historical Monuments and Archeological sites in Chapter 3).

Other agencies, corporations and municipalities operate public installations, some of which are located in the coastal zone. These include, the Puerto Rico Electrical Power Authority (PREPA) (energy plants), the PRASA (treatment plants and other facilities), the Puerto Rico Land Authority (PRLA) (agricultural lands), the Puerto Rico Tourism Company (CTPR) (supports in the cleaning of beaches, manages concessions along the coastal zone and promotes tourism development in the coastal zone), Land Administration (LA) (agricultural

lands and others). Meanwhile, some municipalities, such Carolina and Culebra, manage public beaches in the coastal zone.

### **Non-profit organizations**

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The Puerto Rico Conservation Trust (PRTC), organized as a private non-profit institution, dedicates its resources to the purchase of land of great ecological, esthetic, historical and cultural value for perpetual conservation and the development of educational programs in order to create awareness regarding the need to protect them.

The PRTC is the deed holder of protected natural areas in the coastal zone including NR Punta Yeguas and the *Pterocarpus* in the Humacao Natural Reserve<sup>182</sup>. This organization also maintains a collaboration agreement with DNER to manage some of this agency's protected areas such as *Área Natural Daguao y Medio Mundo*.

### **4.2.2 IMPROVING RESOURCE MANAGEMENT IN COASTAL AREAS**

Opportunities to improve the effectiveness of programs established in Puerto Rico to adequately manage coastal resources exist. Some of these improvements were identified in the needs presented in Chapter 3. However, additional measures are needed, especially institutional changes to improve the skills of the personnel and create mechanism from compliance with the current legal framework geared toward better management of these resources. Both of these types of improvements are included in the Coastal Management Program and a described in the following sections.

### **Building up field services and facilities**

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Among the fundamental elements of the PRCZMP is the development of services and facilities on the beaches, forests, coral reefs, dunes and other key areas along the coast. The services needed range from the maintenance and patrolling of the coastal resources to the educational and recreational programs for children and adults. It is also necessary equipment and facilities for: machinery needed to clean the beaches, parking, trails, land and marine access.

The Program places emphasis in services and facilities which promote de use and enjoyment of coastal areas by the general public. The use of the coast for recreation and education is perceived as a mechanism to increase awareness regarding natural resources and increase demand for the protection of natural resources. On the other hand, the management measures which need to be implemented are labor-intensive, which represents an opportunity for the creation of jobs.

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182 The Humacao Natural Reserve is another name for the NR El Pantano Bosque *Pterocarpus*, Lagunas Mandry y Santa Teresa

The Program includes the following proposed components for development of services and facilities:

Training and enlarging field staff: DNER needs to increase its personnel trained in the management of coastal resources. Training personnel is a component which has top priority and funds can be solicited through the CZMA.

Providing equipment for field staffs: Much of the personnel assigned to watch over and maintain NR, forests and coastal resources in general lack the appropriate equipment to perform their duties. This Program calls for supplying basic equipment needed to increase the productivity of the available personnel responsible for coastal resources (Section regarding Beaches in Chapter 3).

Instructing children and adults about natural systems of the coast. The understanding of the natural systems which affect coastal resources contributes to their appreciation. The most effective education for this purpose is the one provided physically in coastal areas. In accordance with this purpose, the Program includes education in the areas of coastal resources, particularly in the Natural Reserves and coastal forests.

Planning for field services and facilities. The previous recommendations regarding personnel training, supplying equipping and education require en continuous planning process detailed for each natural resource. This process is closely related with the guidance of development previously described. The process will consider the following aspects: the necessary field services (personnel, building and maintenance of facilities, including the NR), educational and recreational services.

Establishing concentrated management areas. Budget and personnel limitations in DNER impose limitations on the agency's capacity to adequately manage protected natural areas and beaches under its jurisdiction. Therefore, it is recommended that the available resources be concentrated in key areas selected in order of important due to the intensity of its uses or for the demand for development to which these areas subjected. For this reason, the Program includes the establishment of concentrated management areas. The two recommended areas, due to the concentration of protected natural areas, the quantity and diversity of users and the demand for development (expressed in Chapter 1) are: Northeast and Southeast of Puerto Rico.

### 4.2.3 ORGANIZATIONAL CHANGES

The PRCZMP (1978) proposed the creation of the Coastal Zone Division (CZD) and the Rangers Corp in DNER and both organizational structures were created. As previously indicated, the responsibilities for policing development control are dispersed through several Bureaus and Offices within DNER, particularly de CZD and Coastal Zone Unit in the PRPB. For its part, the Rangers Corp was created by the "Natural Resources Rangers Corp Act", Law No. 1 of 1977.

The faculties and obligations of the CZD and the Rangers Corp are:

## **1. Coastal Zone Division**

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Aside from development guidance responsibilities already described, the CZD also has responsibilities over the active management of coastal resources. These responsibilities include:

- a. Preparing detailed plans for field services and facilities. As previously indicated, DNER - through its Natural Reserves, Refuges and Wildlife Division and the Deputy Secretary for Integral Planning - works in the preparation of management plans for NR. In respect to SPA, those plans are prepared by the Deputy Secretary for Integral Planning in coordination with the PRPB.

The management planning process for these areas includes the identification of necessary resources (personnel, facilities and services) and the preparation of planning strategies to guide development.

Currently, DNER has prepared management plans for many NR, some of which are under consideration by the PRPB for their adoption as components of the PRLUP. However, the management plans, even if they haven't been adopted officially by the PRPB, constitute DNER's public policy for the management of these protected areas.

In respect to SPA, it is necessary to prepare and adopt management plans for areas which do not already have one (See Table 4-1), due to the fact that there is continuous pressure to develop in these coastal areas.

Through this process of revision and updating, aside from indentifying the need to prepare management plans, the need to speed up the revision and adoption process by the PRPB was also identified.

- b. Coastal overview, monitoring and grant administration. The CZD has the responsibility of developing initiatives for the management of coastal resources. Among other responsibilities are: coordinate and monitor progress in the implementation for the PRCZMP, recommend priorities in regard to expenditures to DNER's Secretary and obtain and administer federal funds for coastal management.

## **2. Rangers Corp**

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The Rangers Corp was constituted as a civil force for public order under the jurisdiction of DNER's Secretary. Among the responsibilities assigned to this organism are to protect, supervise, conserve, defend and safeguard the natural resources by implements laws and DNER regulations. Furthermore, this body is authorized to offer any type of orientation, guidance or aid to the general public as stated by the different laws managed by DNER.

The "Natural Resources Rangers Corp Act", *supra*, was amended in 1998 to include Youth Rangers Corp and charge of Voluntary Environmental Ranger. According to the law, it is the duty of DNER's Secretary to establish, by means of regulations, the functions, duties and responsibilities of both corps.

Many of the needs identified in Chapter 3 are associated by the compliance with environmental laws and regulations. For this reason, the improvement of the Rangers Corp's performance, by means of continuous training, is recommended. Furthermore, the organization and training of the two volunteer bodies presented is recommended in order to make up slack for the absence of human and fiscal resources needed for patrolling and education, particularly in protected natural areas.

#### 4.2.4 NATURAL RESERVE SYSTEM

The Program establishes that administrative actions, without legislation, are enough to improve the management of coastal resources and protect them from inappropriate development, particularly in the NR. However, NR designation through legislation may be desirable only if those statutes are accompanied by budget assignments for acquisition (in cases which is necessary) and management of the area.

#### 4.2.5 CLARIFYING AND EXTENDING PUBLIC PROPERTY RIGHTS IN COASTAL RESOURCES

The measures previously discussed for the management of coastal resources focus on lands and waters which are of public domain. The extension and clarification of public property rights presents an opportunity to expand on the benefits of the PRCZMP.

##### 1. Buying additional coastal property

Diverse mechanisms geared toward the acquisition of lands on the coast exist. Over the last decades, several laws have been passed which make the acquisition and protection of lands possible, some of these are:

- “Fund for Acquisition and Conservation of Land in Puerto Rico Act”, Law No. 268 of 2003. This law creates a fund in the Treasury Department which is administered by DNER. The fund is nourished by 50% of the remnants of the Used Oil Management Fund, donations, interests earned on investments with the fund's deposits, federal funds and any other funds obtained by DNER.
- “Puerto Rico Natural Heritage Program Act”, *supra*. This law gives DNER the authority to identify land for conservation and create plans for the acquisition and protection for those purposes. It allows, among other things, DNER to enter into contractual agreements with the Government of Puerto Rico and United States or with non-profit organizations for the transfer or management of lands, accept monetary donations, receive Legislative donations for acquisition or management, acquire lands by purchase, legacy, exchange, expropriation or by any other legal means, borrow money for acquisition of lands of high natural value and recommend to the PRPB its designation as a NR of any area included in the inventory or of areas of high natural value.
- “Puerto Rico Conservation Easement Law”, Law No. 183 of 2001. This law creates a legal mechanism which allows owners of private land to impose permanent restrictions on the use of that property for its protection or perpetual conservation

in exchange for tax benefits. The easements can be made in the name of the Government of Puerto Rico or non-profit organizations.

The Program recommends the use of these mechanisms and others suggested in laws and plans – such as the transfer of development rights and exchanges, among others – for the acquisition of coastal lands for conservation and to provide improved access to the coast. Also, the application of the statutes previously discussed is recommended in order to transfer lands which are currently, or potentially, part of a NR and owned by the Government of Puerto Rico to DNER.

It is also recommended that the process of planning for the protection of NR and SPA. Funds could be attained through the CZMA for these purposes.

## **2. Clarifying public property rights**

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The Program recommends that legislation be drafted and submitted to the Puerto Rico Legislative Assembly with the purpose of eliminating doubts that currently exist regarding the extension of public property rights to coastal resources. Further information is also needed in order to determine if concessions made by the Spanish Crown represent a potential threat to public domain for Puerto Rico’s beaches.

In order to have an inventory of coastal lands in Puerto Rico subject to Spanish Crown concessions, the approval of legislative measures to require the registration of all Crown concessions which authorize the exclusion of the general public to any part of the maritime zone should be approved. This new law should also allow for a reasonable period of time for this registry to be completed.<sup>183</sup>

## **3. Obtaining public access rights to surplus Federal beaches**

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The PRCMZP includes the establishment of the following public policy regarding access to beaches. “If any of Puerto Rico’s beaches which belong to the federal government is declared as surplus for the needs of said government, those beaches will become accessible to the maximum possible extent for the general public’s recreational use”. (This public policy was presented in the section about Beaches in Chapter 3).

This Program, as a component of the PRLUP, establishes said policy.

### **4.2.6 OTHER MEASURES TO PROTECT COASTAL RESOURCES**

Through the process of revision and updating, additional measures to protect coastal resources have been identified. Some of these measures are associated with the evaluation of certain current statutes.

#### **Adopting additional regulations**

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The Program includes the evaluation and adoption of regulations regarding the following topics:

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<sup>183</sup> The need for this legislation was explained in Chapter 3 in the section regarding Beaches.

- Geological risks: activities such as the filling of sinkholes and urban development in environmentally sensitive areas in lands within the karst lands in the coastal zone.
- Beaches: Regulation regarding access to beaches in communities of squatters within the maritime zone and an actualization of the “Subdivision and Urbanization Regulation”, *supra*, to provide facilities for the beaches.
- Historical Monuments and Archeological Findings: Protection of archeological findings, including those sites which are underwater.
- Natural Reserves: Desirability that Puerto Rico adopts a law regarding protected natural zones which includes NR in its dispositions.

The adoption and evaluation of these regulations should be done periodically so that an adequate management of coastal resources can be sustained.

#### 4.3 PROMOTION OF SUSTAINABLE COASTAL DEVELOPMENT

Promotion of sustainable coastal development is the third element in the PRCZMP. The coastal environment is under great pressure, as a result of unbalanced use of resources, particularly by urban development and by the impact caused by land and marine pollution. For Puerto Rico, conservation and sustainable use of the coastal zone is of particular importance due to the fact that it represents a significant resource for its economy.

Sustainable coastal development should contemplate the promotion of the development of areas which are already impacted that do not have significant sensitive natural resources and that are outside of the zones of risk. At the same time, measures should be taken to promote improvements and/or mitigation leading to the restoration, recuperation, conservation, protection, improvement and enjoyment of the coastal resources and protection of the environment.

The following needs were identified in Chapter 3. These needs will have to be attended in order to bring about coastal development. The responsibility of tending to these needs falls on various Puerto Rico government agencies. Others require inter-agency coordination or rigorous implementation of current laws and regulations:

Protection of the maritime zone: In order to protect the maritime zone, it is imperative to start with its demarcation, more importantly, utilize uniform criteria to execute this exercise.

Guarantee access to the beaches: Despite the fact that the management of maritime public domain assets falls under DNER, RPA and the municipalities have a responsibility to ensure that development proposals they approve do not jeopardize public access to the coast. <sup>184</sup> In order to solve the problems regarding public access to the beaches and coasts, it is recommended that legal accesses to the beaches and coasts are identified by signs for the benefit of users. Legal accesses already in place should be restored and clarified. Other accesses which have been established by repeated use should be respected and identified. Furthermore, the removal of physical obstacles which could exclude citizens from the

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<sup>184</sup> Only some beaches have access controlled by the Commonwealth to maintain control, patrolling, safety and protect natural resources, among others.

enjoyment of this resource is recommended. (Signage measures to clarify accesses can be performed by CZMA funds).

Provide housing to squatters who do not own another home: This is an ongoing problem which falls under the jurisdiction of the Puerto Rico Department of Housing (PRDH). Due to the fact that CZMA does not provide funding for the construction of housing, funds under this Program could be destined to activities associated with the demarcation and cleaning of the zone.

The promotion of controlled commercial fishing and the development of the market for fish farms are ongoing activities under the PRDA and other agencies which receive funds under federal and Commonwealth programs. Fishing to a lower scale, like the fishing practiced in Puerto Rico, is a viable cooperative or communal activity. For these reasons, it is an economic segment which should be developed and strengthened.

Urban and transportation changes will contribute to the adequate enjoyment of the maritime zone: Taking advantage of urban areas and repopulation should be the principal strategy for land use. Structures which are built on the maritime zone – ports, jetties, among others – should integrate the community in order to promote the enjoyment of the water resource. These strategies can be developed in conjunction with DNER, the PRPB and the PRPA. Other recommendations regarding transportation and space use were identified in Chapter 3.

Promotion of coastal development should contribute to the growth of sustainable tourism on the Island. This should be focused in promoting and creating awareness of tourism activities at a scale which represents a lesser impact on ecosystems while benefitting regional communities in the most balanced way possible. The primary responsibility of evaluating tourism proposals falls under the PRTC.

The PRCZMP includes measures which respond to other needs identified in Chapter 3. The need to assure sources for sand for the construction industry, for example, is one of many high priority issues which need to be resolved in order to reduce pressure for the extraction of sand from beaches, dunes or any other place where this activity is not appropriate. Chapter 3 identifies the specific need for studies to determine the economic viability of alternate sources for the construction industry and the urgency to develop renewable sources to produce energy and meet the Island's needs in this category.

## 4.4 RESEARCH

Research is the fourth element of the Coastal Management Plan. Research, deemed as necessary by the Program, represents the beginning of possible solutions to make front to the difficulties which the coastal zone currently presents. A large part of the research needed has been identified in Chapter 3.

### 4.4.1 RESEARCH

The following research and monitoring activities are recommended for coastal risk areas, coastal resources and coastal development. Some of the research needs were presented in Chapter 3 are:

- Extensive study of coastal erosion,
- Impact of the mitigation of wetlands,
- Investigations regarding coral reefs and associated environments, among which are: paleo-ecologic investigations of coral reefs which could lead to knowledge conducive to helping younger reefs succeed, breeding of gametes and recruiting coral larvae; the development or other, more extensive studies about the actual conditions of deep water corals, among others.
- Fluctuations in the fish population, reproductive patterns, recuperations after exploitations and physical damage and effects over environmental variables, among other factors.
- Investigation regarding the state of estuaries in Puerto Rico. DNER should promote investigations regarding the conditions of estuaries in Puerto Rico, in particular the condition of their flora and fauna.

These investigations could be completed using funding available through the CZMA.

#### 4.4.2 ECONOMIC VIABILITY STUDIES

Economic viability studies are the second type of investigations included in the Program. As previously mentioned (in Chapter 3), federal funds can be available through the “Coastal Zone Management Act” to fund the viability studies for alternative energy and alternate resources for materials to supply the demand for sand from the construction industry.

Furthermore, Section 309 of the CZMA projects the evaluation of policies and plans to promote public and private fish farms along the coastal zone.

#### 4.4.3 INVENTORIES OF RESOURCES AND RISKS

Inventories of resources and risks are the third type of research essential to find solutions to some of the critical problems which affect the coast. The PRCZMP includes the following inventories:

##### Inventories of coral reefs:

- a. Revise and update the *Inventory of the Puerto Rican Coral Reefs prepared by Goenaga & Cintrón in 1979*.
- b. Create an inventory regarding the special distribution patterns of the *Acropora reefs* and the complex *Montastraea*, which populations have been significantly reduced over the last several years.
- c. Generate a database in DNER that lists all the investigations and recovery efforts made regarding coral reefs and related environments.

Wetlands: Prepare an inventory of the extension of the areas of wetlands that are under active protection and those which are not under protection.

Archeological resources:

- d. Prepare an inventory of important archeological sites

Coastal development

- e. Prepare an inventory of lands belonging to government agencies and public corporations which are apt for developments dependable of the coast.

These, and other similar tasks which will be identified in the future deemed necessary to create solutions for known coastal problems, should be executed in an expeditious manner.



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## **Chapter 5:** *The Culebra Segment*

## Chapter V. THE CULEBRA SEGMENT

### INTRODUCTION

The island of Culebra is located to the East of Puerto Rico and to the West of St. Thomas. The island was inhabited in the 1880s when Puerto Rico was a possession of the Spanish Crown. As a result of the Spanish-American War, Culebra, like the rest of Puerto Rico, was ceded to the United States under the terms of the Treaty of Paris. The lands which owned by the Spanish Crown – approximately one third of land in Culebra – were also transferred to the United States. During this period, Culebra’s residents were transferred from the founding city of San Ildefonso to Dewey, which today is still Culebra’s main town.

In 1901, President Theodore Roosevelt transferred federal land in Culebra to the U.S. Navy. From 1902 until 1975, the Navy maintained military operations by land and sea. Some of the lands were transferred to the USFWS. Other lands were ceded to the Government of Puerto Rico in 1982 under the condition that they be designated for public and recreational uses.

The end of military practices and the transfer of lands created a need to examine the possible and most adequate uses for these properties. Various plans were created with the purpose of establishing the policies which should guide Culebra’s development. One of those plans was the Joint Report: *Culebra: A plan for conservation and development*, submitted in 1973 by the U.S. Secretary of the Interior and the Government of Puerto Rico to the U.S. Senate Committee on Insular and Interior Affairs. This document recognized the opportunity that the transfer of lands and the Navy’s exit represented for Culebra. The report emphasized the need for Puerto Rico to be prepared to manage and preserve the natural resources in Culebra. Out of this need, various plans were prepared, among which is the Culebra Segment of the Puerto Rico Coastal Zone Management Program (PRCZMP).

The Government of Puerto Rico, for its part, presented other plans and special legislation to deal with Culebra’s needs and the concerns of its residents before the possible pressures of development and eventual impact on the population. Among the plans are the *Culebra Master Plan* adopted by the PRPB in 1971 and revised in 1975 (also known as the Regulating Plat) and the zoning map, which were created as guides for the use of lands in Culebra.

In 1975, with the support of Culebra’s residents, the “Law for the Conservation and Development of Culebra”, Law No. 66 of 1975, was approved. This Law created the Culebra Conservation and Development Authority (CCDA), an entity which is part of the Municipal government and has the responsibility of conserving natural, environmental and energy resources in Culebra and promote its economic development in accordance with norms and regulations formulated by the EQB, DNER, RPA, the Master Plan and the current zoning map adopted by the PRPB.

Over the last three decades, Culebra’s physical and socioeconomic context has changed as a result of the approval of new laws related to its development and the creation of plans and investigations which make a revision of the PRCZMP a necessity.

The revision of this document is exposed in the following sections. First, the island of Culebra is described in physical (environmental and infrastructure) and socioeconomic terms. The second section describes the coastal management for Culebra while the third section identifies current needs and provides some means to improve coastal management in Culebra.

It is important to point out that the policies and recommendations established in the PRCZMP are also applicable to Culebra. However, this Segment establishes specific policies to attend matters particular to the island of Culebra.

## 5.1 DESCRIPTION OF THE ISLAND OF CULEBRA

Culebra is located approximately 27.4 km East of Puerto Rico and 14.5 km North of Vieques. The territorial expansion of this group of islands and keys is 3,311 ha. Culebra is the main island and is surrounded by 24 small keys among which are Culebrita, Luis Peña, Lobo, Lobito, Cayo Norte, Botella, Geniquís, Pirata, Pelá, Matojo, Alcarraz and Stevens Rock. The island of Culebra extends 11.27 km from East to West and 8 km from North to South. The two main towns, Dewey and Clark, are located in the south.

Culebra presents an irregular topography and its slopes are moderate being Monte Resaca its highest point at 192 m. The Western portion of the island exhibits two peninsulas. The Flamenco Peninsula points to the North while Peninsula Fulladosa points to the South, forming Ensenada Honda, which is Culebra's largest bay. Other bays include Dákity, Mosquito, Tamarindo, Sardinias, La Pelá, El Almodóvar and Flamenco.

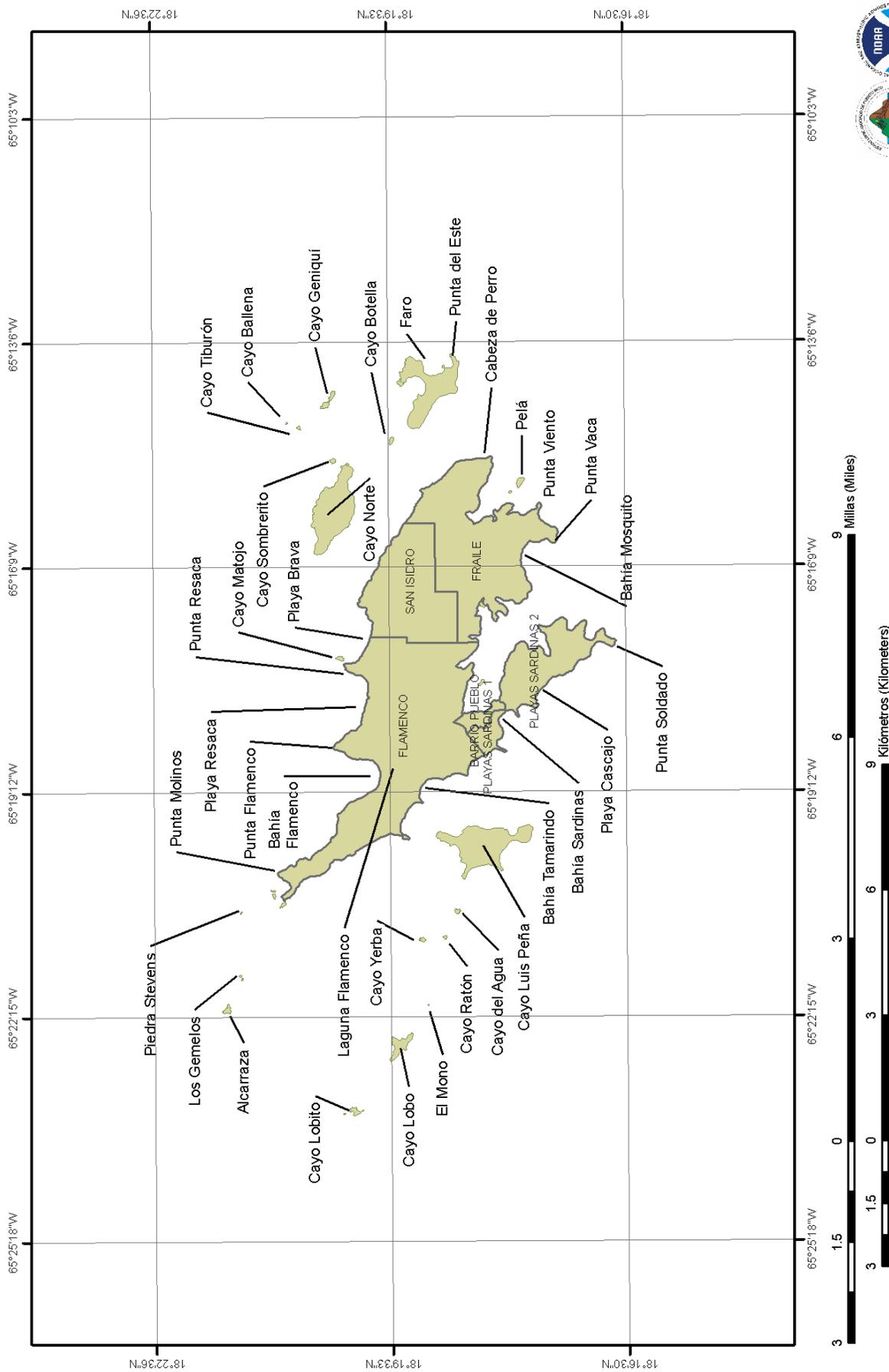


Escala - Scale 1:130,000

Leyenda - Map Key:

Municipio / Municipality

Barrios / Wards



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program  
Mapa 26 / Map 26

# Isla de Culebra

## Culebra Island

Fuente de Información - Source:  
Departamento de Recursos Naturales y Ambientales

## 5. 1.1 PHYSICAL CHARACTERISTICS

### a. Climate

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Culebra is constantly subjected to the trade winds and its climate is predominantly dry. Precipitation is scarce averaging between 25 and 30 inches (635-762 mm) a year. The minimum average temperature registered during the winter is 74°F (23°C) and 90°F (32° C) during the summer.

Culebra is susceptible to weather events such as hurricanes, tropical storms and water spouts between the months of June and November.

### b. Soils

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The soils in Culebra are predominantly of the Descalabrado series, particularly Descalabrado Clay and Descalabrado Rock Land Complex. These soils are susceptible to erosion, which presents serious limitations for agricultural and urban uses. Their composition is volcanic with slopes ranging between 5% and 60%. The water retention capacity of these soils is moderate as is their expansive potential. The natural fertility of these soils, which for years had been covered by bushes and grasslands, is moderate. Run-off currents are moderate and fast.

Descalabrado Clay soils are known to be located on mountain slopes. In Culebra, these soils are found in the Flamenco Peninsula, the Luis Peña islet and a portion of the South of the San Isidro and Fraile wards, the latter found in the island's East. Small portions of Descalabrado – rock land complex soils are found particularly in Cayo Norte, Culebrita, Luis Peña and in the interior of the island of Culebra. These soils are on the slopes and summits of the mountains.

Soils belonging to the Rocky Land series are found. These present rocky formations in 50-70% of the surface and are found in the mountainous parts with slopes of 60-70%. These characteristics limit the soil's use to cultivation and engineering. These soils are mostly found in the Flamenco ward, Fulladosa Peninsula, Punta Vaca and other parts of the island.

The Daguao Clay soils, due to the fact that they are found on sloped surfaces of the Northeast coast, need to be managed with conservation practices in order to control superficial run-off currents. Other soils which are found in Culebra but show limitations for agricultural use but are apt for wildlife, are Amelia gravelly clay loam, Cataño loamy sand, Jacana clay, Tidal flats and Moist alluvial soil.

### c. Geology

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Culebra is composed mainly for volcanoclastic extrusive rock dating to the Cretaceous period. By the same token, there is intrusive rock and wash along with other non-consolidated material. Alluvial deposits are predominantly composed of clay, limestone, sand and, in lesser quantities, gravel. These soils are concentrated in the Valle de La Pelá. These alluvial deposits can also be found in some portions of the coastal areas in which the sands are composed of reef material and where clay and limestone are deposited into the mangroves.

In the majority of the island, andesite volcanic rock formations can be found. Along the Southwest coast, andesite, lava and *brecha* can be found. On the other hand, the pores in the majority of rock formations in Culebra have been filled with calcite and quartz deposits, limiting their permeability. The only permeable areas within Culebra's volcanic layer are the few fractures in the intrusive volcanic formations. However, these fractures are reduced by increased depths. Weathering of the diorite intrusions have resulted in the formation of large rocks. These rocks cover a large part of the North central region of the island.

Culebra also lacks mineral resources with the exception of the sandy beaches and gravel.

#### **d. Hydrology**

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Culebra lacks fresh water bodies due to climactic, topographic and geological reasons. Some of those factors are the scarce precipitation and the high rate of evaporation (approximate 95%), to low porosity of the soil to retain water and the sloped terrain.

##### **1. Superficial water bodies**

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Lagoons are the only superficial water resource in Culebra. Culebra has three salt water lagoons: Zoní, Flamenco and Cornelio. Culebra also has a number of natural coves which are: Cementerio, Fulladosa, Malena, Dákity, Honda and Comezón. Besides, this island counts with three existing bays: Flamenco, Mosquito, Sardinias, Tamarindo and Almodóvar.

##### **2. Underground water bodies**

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Culebra contains underground waters, albeit in limited quantities. Also, small quantities of water are deposited in the fractures and unions of plutonic and volcanic rock formations. However, the majority of these fractures decrease in size at lower depth and end at 300 feet (91.4 m) under the surface (USGS, 1996).

Some private wells have been punctured along the coastal areas to extract underground water. However, these wells yield small quantities of potable water and is used to irrigate cattle.

#### **5.1.2 BIOTIC ECOSYSTEMS**

Culebra is located in a zone known as a dry sub-tropical forest. Despite the fact that this is a dry ecosystem, during periods of precipitation, the soil is hydrated due to the occasional rainfall and the presence of run-off currents.

The island sustains various habitats within a relatively small area. Over the last decades, uses of the territory have substantially impacted original plant and animal communities, leaving only remnants of some of these habitats. Some of the remaining ecosystems which can still be found in Culebra are:

- Grasslands
- Secondary forests
- Coastal forests
- Lagoons
- Swampy mangroves

- Coral reefs
- Beaches

#### a. Flora

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The characteristic vegetation in Culebra is mainly deciduous. The species are spiny with small and succulent leaves. The vegetation in the zone is composed of small, dense bushes and grassy knolls. In Culebra's lands of high elevation the vegetation observed is typical of a semi-humid forest.

It is estimated that less than 20% of Culebra's original forests remain. Only two communities of unique plant species remain: the *cupey-jaguey* and a forest of royal palms. These communities are particular to the slopes of Monte Resaca and hills which form Punta Flamenco.

Some 410 plant species can be observed in Culebra: 131 are trees and 104 species are herbs. There are also 10 different species of epiphyte plants of which three are orchids, three are bromeliads and four are parasitic.

There are 33 native species of trees in Culebra of which three are endemic to the island. These three are: a bromeliad species whose scientific name is *Tillandsia lineatipspica*, a woody shrub known as *Caesalpinia culebrae* and an herbal plant known as *Peperomia wheeleri*. There is another herb, *Justitia culebritae*, which is endemic to the island of Culebrita.

Some of these species have been categorized as "endangered" by the "Endangered Species Act". These are:

- *Peperomia wheeleri*, an herbal species found around Monte Resaca and Playa Brava.
- *Leptocereus grantianus*, a cactus found in the rocky coast around Punta Melones.

#### b. Fauna

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The natural systems present in Culebra serve as a habitat for an extensive variety of wildlife. The vegetation in the mangroves provides resting and nesting areas for a large number of birds. Culebra's lagoons are home to other bird species, some classified as vulnerable by the "Regulation on vulnerable and endangered species in the Commonwealth of Puerto Rico", Regulation No. 6766. Some of these species are: the ruddy duck (*Oxyura jamaicensis*), the white-cheeked pintail duck (*Anas bahamensis*) and the Antillean hen (*Fulica caribaea*).

Culebra has three species of amphibians: the white-lipped frog (*Leptodactylus albilabris*), a native species, the coquí churi (*Eleutherodactylus antillensis*), an endemic species, and the common frog (*Bufo marinus*), which is an exotic species.

Six species of reptiles found in Culebra have been classified as threatened or endangered, of which four are marine turtles. These are:

- The Virgin Islands boa (subspecies of *Epicrates monensis granti*) - classified as endangered at both the Commonwealth and Federal levels. The DNER has proposed critical natural habitat and essential critical natural habitat designations for three

segments in Culebra: the North-central segment (between Punta Flamenco and Monte Resaca) the South-central segment (north of Ensenada Cementerio) and the South segment (Punta Soldado). The North central segment includes the Culebra National Wildlife Refuge (DRNA, 2009).

- The Culebra's giant lizard (*Anolis roosevelti*), for which an essential critical natural habitat has been designated under the ESA in the area of Monte Resaca. According to the USFWS (2007b), this species is found in Culebra's forested areas;
- The loggerhead sea turtle (*Caretta caretta*), declared threatened under the ESA;
- the leatherback sea turtle (*Dermochelys coriacea*), designated by the ESA;
- the green turtle (*Chelonia mydas*), considered threatened at the local and federal levels. This specie counts with a critical habitat designated by NOAA in the waters bordering Culebra. The habitat extends three nautical miles from the high tide line on the island. This border includes the cays around Culebra.
- The hawksbill turtle (*Eretmochelys imbricata*), counts with a critical habitat designated in 1982 by the USFWS. This habit begins 150m inland starting from the average high tide in the sandy beaches along Culebra's North coast (Playa Resaca, Playa Larga and Playa Brava), the beaches south of Cayo Norte and the beaches of Culebrita (USFWS, 2007b).<sup>185</sup>

### 5.1.3 MARINE AND COASTAL ECOSYSTEMS

#### a. Beaches

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Culebra's beaches are mainly pockets of sand bordered by rocky promontories (Bush et al., 1995). The island has more than a dozen sandy beaches, mainly locates to the west and north, among which Playa Flamenco stands out as the largest. Playa Flamenco is a public beach managed by the Municipal government with facilities for camping and is considered among one of the most beautiful beaches in the world.



Other beaches include: Playa Larga (also known as Zoní), Resaca, Brava, Carlos Rosario, Tamarindo, Melones, Sardinias, Cascajo, Mosquito, Manzanilla and Dátiles.

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<sup>185</sup> Federal Register/ Vol. 47, No. 122 / Thursday, June 24, 1982. (27295, 27298).

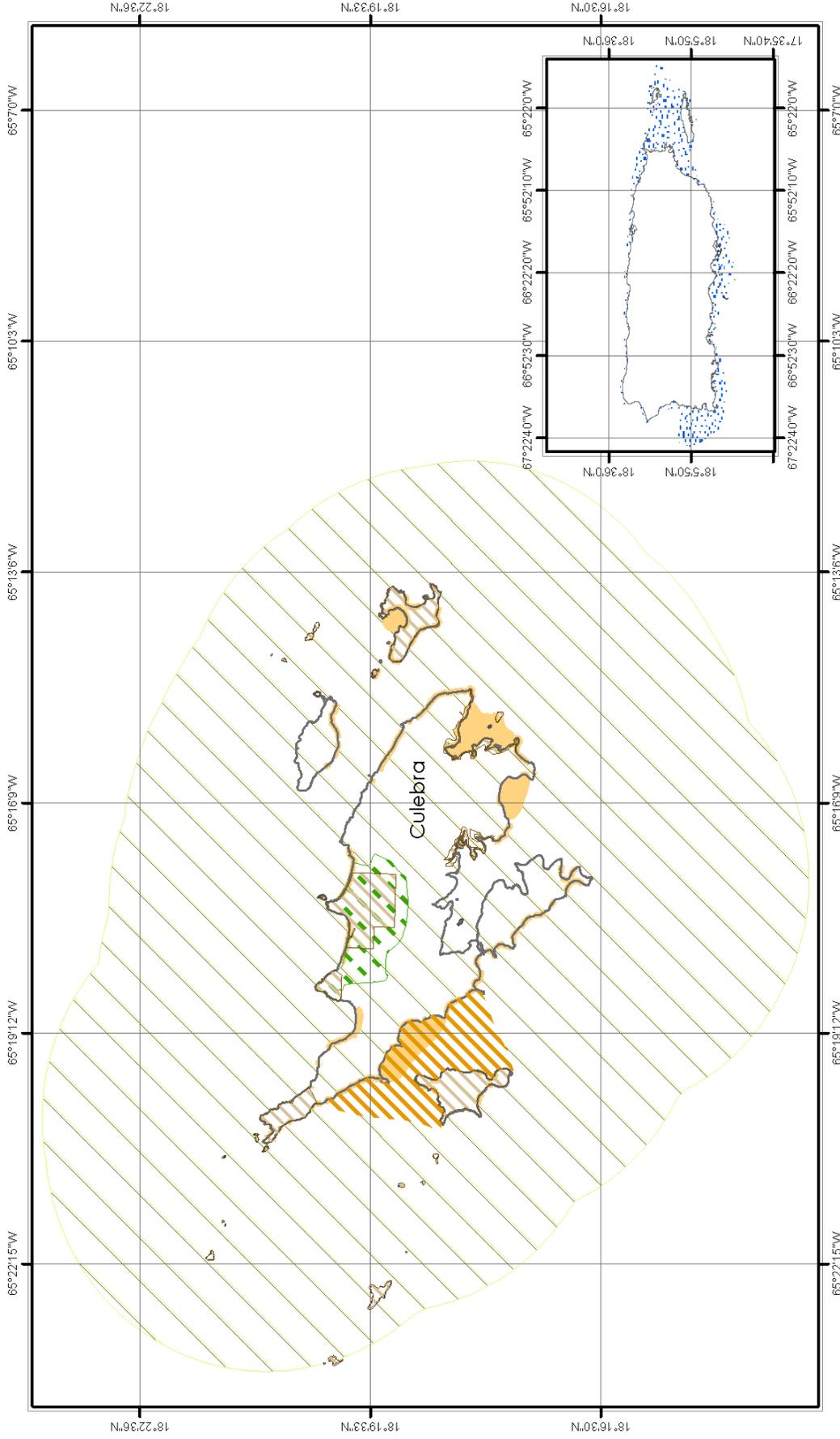
**Leyenda - Map Key:**

-  Reservas Naturales - Natural Reserves
-  Refugio Nacional de Vida Silvestre - National Wildlife Refuge

-  Hábitats crítico *A. palmata* y *A. cervicornis* - *A. palmata* and *A. cervicornis* critical habitats
-  Hábitat crítico lagarfito gigante de Culebra / *Anolis roosevelti* critical habitat

-  Hábitat crítico tortuga verde o peje blanco / *Chelonia mydas* critical habitat (USFWS)
-  Hábitat crítico tortuga verde / *Green turtle critical habitat* (NOAA)

Escala - Scale 1:140,800



# Hábitats críticos designados, áreas naturales protegidas federales y Reservas Naturales (DRNA) en Culebra

## Designated Critical Habitats, Federal Natural Protected Areas and Natural Reserves (DNER) in Culebra

Fuente de Información - Source:  
Critical Habitats U.S.F.W.S.  
NOAA  
Departamento de Recursos Naturales y Ambientales

Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 27 / Map 27

## b. Reefs

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The waters and submerged lands in Culebra sustain an extensive array of diverse types of coral reef communities in good health. According to Hernández (2005), Culebra has some of the best developed border reefs to the east of Puerto Rico.

Close to 80% of Culebra's coast is protected by coral reefs which serve as habitats for invertebrates, algae, hundreds of fish species and marine turtles. The reefs are concentrated along the Southeast in areas commonly known as Piedra Ahogá and La Meseta. Another reef community known as Los Corchos is found in front of Culebrita while in the submerged lands to the west of the island, the important reef habitats known as Carlos Rosario and Melones are found.

In the Western portion of the island, in the Canal Luis Peña, extensive areas of coral communities can be observed. The average coral cover fluctuates between 55% and 60% with a minimum of 40% and a maximum of 90% in this zone (CIEL, 2008). These reefs are considered to be the most structurally developed and count with the most coverage of live reefs when compared to other coral reef areas in Puerto Rico.

However, Culebra's reefs have significantly deteriorated in the past years due to natural and anthropogenic causes. Among the anthropogenic causes which impact the reefs are erosion and sedimentation – caused principally by construction activity without adequate controls – septic tanks, small fuel spills coming vessels which anchor off of Culebra's coast, the construction of structures along the coast and unexploded ordnance.

Meanwhile, some of the natural causes for reef deterioration are diseases and bleaching – situation which has worsened as a result of climatic change. According to *The State of Coral Reef Ecosystems of Puerto Rico*, a report published by NOAA in 2008, the bleaching episode which affected Caribbean coral reefs in 2005 was more prolonged and severe along the reefs of Puerto Rico's East coast. This bleaching episode was followed by a massive breakout of white plague which lasted approximately six months. In Culebra, this caused the partial death of close to 100% of coral colonies which build reefs such as *Montastraea annularis*, *M. faveolata*, *M. franksi* and *Acropora cervicornis*.

The frequency of white plague episodes, in both shallow and deep water reefs in Culebra as well as other reefs to the west of Puerto Rico, has been increasing since 1999. The white plague disease is one of the most harmful to coral reefs because its breakouts are frequent, with an ample range of carriers and is highly viral. This disease can kill the coral fabric at a pace of 1-2 cm/day (Weil, 2002; Weil et al., 2002; Weil, 2004, in García et al., 2008).

Another disease which has impacted Culebra's reefs is the white band disease, which has been the main cause of death in the Caribbean's Acroporid corals. An even more harmful form of this disease was documented in *A. cervicornis* (staghorn coral) in Culebra in 2003. This white band strain affected 45% of the colonies in seven reefs.<sup>186</sup> The most virulent form

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<sup>186</sup> See: AGRRA (Atlantic and Gulf Rapid Reef Assessment). 2003. AGRRA surveys in Eastern Puerto Rico, including Fajardo, Culebra, and Vieques. Final report submitted to Office of Office of Habitat Conservation, NOAA National Marine Fisheries Service. 25 pp.

of the white band disease was documented in *A. cervicornis* farms and in other reefs around Culebra (E. Hernandez-Delgado, pers. comm.).

It is important to point out that Culebra's coastal waters, along other areas around Puerto Rico (of 98 feet in depth or less) were designated as critical habitat by NOAA in 2008 for the coral species *Acropora palmata* and *A. cervicornis*.<sup>187</sup>

### **c. Marine grasslands**

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Marine tall grasslands constitute highly productive systems which can be found in areas with little wave action and are at a depth of 10m (32.8 feet) or less. Five of the seven species documented in Puerto Rico can be found in Culebra's waters. These are:

- *Thalassia testudinum* (turtle grass)
- *Syringodium filiforme* (manatee grass)
- *Halodule wrightii*,
- *Ruppia maritima* and
- *Halophila decipiens*.

Marine grass extends to form plateaus or prairies which function as a trap for sediments to avoid erosion. Likewise, detritus, or decomposed matter which is produced in these prairies, enrich shallow coastal waters, sustaining a substantial variety of organisms which give these areas a great commercial value. In these systems, commercially important species such as a queen conch (*Strombus gigas*) and the spiny lobster (*Panulius argus*) can be found.

In Culebra, marine grasses can be found in estuarine areas such as Ensenada Honda, in the north coast, the offshore water of playa Resaca and in the Canal Luis Peña. In this area, which was designated as a Natural Reserve, marine grasses cover about 32% of the Reserve's surface (Hernández et al., 2003). The waters of Ensenada Fulladosa also sustain extensive marine grass prairies. However, it has been observed that the piles used for pier construction are the biggest physical factor which has impacted these communities (Hernández et al., 2003).

Furthermore, a recently-completed study by NOAA and the USACE, reported that 63% of the piers in Ensenada Fulladosa did not count with the corresponding construction permits and their use was causing the loss of at least 5% of the marine grass prairies in the bay (Shafer et al., unpublished data as cited in García et al., 2008).

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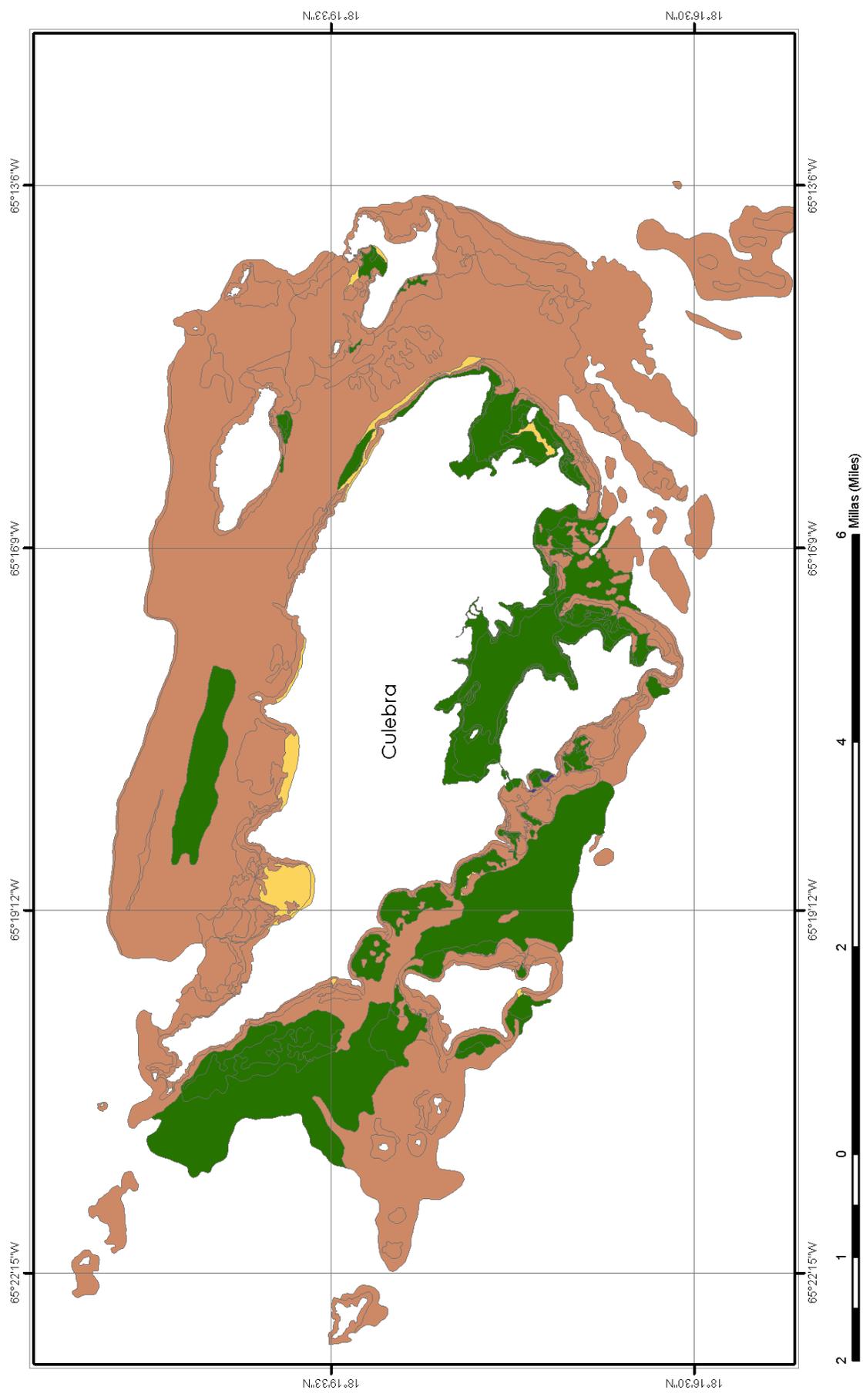
<sup>187</sup> 50 CFR Parts 223 and 226. Vol. 73, No. 229. November, 2008.

**Leyenda - Map Key:**

- Arrecifes de coral y fondo sólido colonizado / Coral Reef and Colonized Hardbottom
- Vegetación Sumergida / Submerged Vegetation
- Sedimentos sin consolidar / Unconsolidated Sediments



Escala - Scale 1:86,000



Kilómetros (Kilometers)

Millas (Miles)



**Fuente de Información - Source:**  
Benthic Habitats of Puerto Rico  
and the U.S. Virgin Islands - 2001

# Hábitats bénticos en Culebra

## Benthic Habitats in Culebra

Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program  
Mapa 28 / Map 28

#### d. Mangroves

Culebra has extensive areas covered by mangroves which protect the coast from the impact caused by weather events. Mangroves can be found in the areas around Playa Flamenco and in Puerto del Manglar as well as in the area of San Ildefonso, the coast of Ensenada Honda and Laguna Flamenco and in the beaches of Resaca, Brava and Larga (See Table IV-1).

The mangroves of Punta Flamenco were identified by the DNER as critical mangrove areas in the “Special Planning Area Management Plan for Puerto Rico’s Mangroves”. These mangroves, divided into two small sections, are found in the North portion of the island. One section includes the mangroves around Laguna Flamenco where the button mangrove (*Conocarpus erectus*) and white mangrove (*Laguncularia racemosa*) stand out. The other section, which also has these two mangrove species, is found in the interior of the Flamenco Peninsula. This system is protected by the USFWS due to its importance as a wildlife habitat (DRN, 1990).

**TABLE V-1. MANGROVES IN THE MUNICIPALITY OF CULEBRA**

Mangroves in the Municipality of Culebra		
Mangroves	Size	
	Cuerdas	Hectares
Flamenco	58.89	23.14
Playa Resaca	6.09	2.39
Playa Brava	35.54	13.97
Cayo Norte	2.03	0.80
Playa Larga	22.34	8.78
Culebrita	3.05	1.20
Puerto del Manglar	49.68	19.52
San Ildefonso	44.68	17.56
Ensenada del Cementerio	8.12	3.19
Ensenada Honda	17.26	6.78
Laguna Cornelio	4.06	1.60

Source: DNR flyer. (1990).

Among the mangrove areas important for wildlife and as such have been recognized by the DNER is the document “Critical Wildlife Areas” (2005) is Puerto del Manglar. This area, which covers approximately 23 ha located in the Southwest of the Island, is part of the Culebra National Wildlife Refuge managed by the USFWS. These mangroves serve as resting and nesting areas bird species such as the cattle heron (*Bubulcus ibis*), the brown pelican (*Pelecanus occidentalis*), the yellow-crowned night heron (*Nyctanassa violacea*), the scaly-naped pigeon (*Patagioenas squamosa*) and the white-headed dove (*Patagioenas leucocephala*). The waters of Puerto del Manglar also show the bioluminescent phenomenon and is one of the most important areas of nesting for the green turtle.

At Puerto del Manglar, the development of private properties has caused the loss and degradation of the habitat. It has also been a factor in the contamination of the bay due to sedimentation due to erosion and run-off currents. To address this matter, Cardona & Rivera (1988) recommended the preparation of a sedimentation plan along with other the

consideration of other aspects which could result in further detriment of the ecological area before permitting additional development around this natural area.

For its part, in the Canal Luis Peña Natural Reserve (RNCLP by its Spanish acronym), mangrove representation is scarce. These mangroves are located mainly in the narrowest part of Cayo Luis Peña at Punta Rompeanzuelos and at Punta Tamarindo Chico.

**e. Other habitats important for wildlife**

In 2005, the DNER prepared the “Puerto Rico Comprehensive Wildlife Conservation Strategy” (CWCS). In this document, the following were established as objectives: 1) identify the situation of the species and their habitats, 2) identify the conservation priorities of said species and their habitats and 3) establish a regular monitoring process directed at maintaining information regarding the first two objectives up to date.

In the above-mentioned document, the following areas critical for wildlife were established: Laguna de Flamenco, Laguna Zoní and Laguna Cornelio. The document also mentions the endangered and vulnerable species classified by areas:

**TABLE V-2. ENDANGERED AND VULNERABLE SPECIES IN CULEBRA**

Endangered and vulnerable species in Culebra	
Area	Specie
Península de Flamenco	<i>Mabuya mabouya</i> , <i>Sterna dougalli</i> <i>Anas bahamensis</i> , <i>Oxyura jamaicensis</i> ,
Laguna Flamenco	<i>Fulica caribaea</i> , <i>Tachybaptus dominicus</i> , <i>Patagioenas leucocephala</i>
Laguna Cornelio	<i>Anas bahamensis</i> , <i>Oxyura jamaicensis</i> , <i>Nomonyx dominicus</i> , <i>Pelecanus occidentalis</i>
Monte Resaca	<i>Anolis roosevelti</i>
Playa Resaca	<i>Dermochelys coriacea</i> , <i>Eretmochelys imbricata</i>
Playa Brava	<i>Dermochelys coriacea</i> , <i>Eretmochelys imbricata</i> , <i>Dermochelys coriacea</i> , <i>Eretmochelys imbricata</i> ,
Playa Larga and Laguna Zoní	<i>Pelecanus occidentalis</i> , <i>Anas bahamensis</i> , <i>Oxyura jamaicensis</i> , <i>Fulica caribaea</i> , <i>Falco peregrinus</i>
Laguna Mailux	<i>Anas bahamensis</i>
Puerto del Manglar	<i>Pelecanus occidentalis</i> , <i>Patagioenas leucocephala</i> , <i>Sterna dougalli</i>
Cays	<i>Anas bahamensis</i> , <i>Patagioenas leucocephala</i>
Bahía Cementerio	<i>Patagioenas leucocephala</i>
Cays surrounding Culebra	<i>Sterna dougalli</i> , <i>Mabuya mabouya</i> , <i>Eretmochelys imbricata</i> , <i>Chelonia mydas</i>

Source: DRNA. (2005). Puerto Rico Comprehensive Wildlife Conservation Strategy.

Among the most important areas for wildlife in Culebra are the lagoons because these offer resting areas and provide nourishment for migratory and local birds. These lagoons and natural entrances are described below:

- Laguna Flamenco- is located to the northeast of Dewey and it is named after the visit of the American Flamingo (*Phoenicopterus ruber*) to this body of water. It is Culebra’s lagoon with an extension of 30 ha. The white mangrove and the button mangrove can be found on its shores. In its water, populations of bass (*Centropomus sp.*) and tarpon (*Megalops atlanticus*) can be found.

Many aquatic birds nest along this lagoon including the white-cheeked pintail duck, identified as an endangered species. According to Raffaele & Duffield (1979), up to 400 white-cheeked pintail ducks have been observed on the lagoon along with the species of aquatic birds. The white-headed dove has also been observed around the lagoon's banks. In 1987, the Land Resources Division reported more than 300 species of the ruddy duck and 600 of the white-cheeked pintail duck.

Due to the importance of this lagoon to the native and migratory aquatic birds, it has been classified as a *critical wildlife area* by DNER since 1979. In 1986, the USFWS recognized this lagoon as a wetland with priority of acquisition under the "Emergency Wetlands Resources Act" of 1986. In 2005, those designations were certified in the document "Critical Wildlife Areas" by the DNER.

Despite the recognition of natural value for this lagoon, it is still subjected to impact caused by the development of recreational facilities around Playa Flamenco. Furthermore, waste discharges into areas adjacent to the lagoon as well as the construction of houses between in land the lagoon and the bay have factored into the negative impact on the area as has the increase use by humans of accesses which border the lagoon's waters.

- Laguna Resaca- It is located to the northeast of Laguna Flamenco and has an extension of 0.91 ha. The dominant vegetation on its banks are the white and red mangroves (*Rhizophora mangle*). The beach to the north of the lagoon serves as nesting area of the leatherback sea turtle and the hawksbill turtle.
- Laguna Playa Brava- It is located 1 km east of Laguna Resaca and is separated from the sea by a sandbar. On its coast, the mangrove is the dominant vegetation, particularly the black mangrove (*Avicennia germinans*) and button mangrove.
- Laguna Zoní- Located in Culebra's northeast, this lagoon expands in an area of 4.54 ha and its drainage canal is generally obstructed by a sand dune. On the inland side is a band which includes white and black mangroves. This lagoon serves as a habitat for white-cheeked pintail duck and, on the north shore of lagoon, marine turtles lay their eggs. This area is classified as an area of primary value for aquatic birds including the white-cheeked pintail duck, the ruddy duck, and the Antillean hen (*Fulica caribaea*).
- Laguna Ensenada Dákity- Located in Culebra's southeast with a surface of 1.82 ha. The flora on its coast is composed mostly of black and white mangroves and bird species, such as the black-winged stilt (*Himantopus himantopus*).
- Laguna Punta Maguey- Located on Culebra's southwest with a surface of 0.91 ha. Its coast is covered by *Sesuvium sp.* and *Puridum sp.*, while inland areas of button mangrove

can be observed. White-cheeked pintail ducks and white-crowned pigeons can be observed on the lagoon.<sup>188</sup>

- Laguna Lobina- is located in Culebra's southeast and has a surface of 3.63 ha. This lagoon connects to the sea in two channels: one which drains into Ensenada Honda and another drain into Bahía Sardinias where red mangroves can be observed on its coast. This lagoon is used as a wharf and on its shores there are several houses with piers.
- Laguna Cornelio- is located in Culebra's west region and has a surface of 4.54 ha. It contains white mangroves and behind these a small xerophytic forest can be found where the gumbo limbo tree (*Bursea simaruba*) thrives. The isolated condition of this lagoon makes it an excellent habitat for three bird species designated as threatened: the white-cheeked pintail duck, the ruddy duck and the masked duck (*Nomonyx dominicus*). However, this lagoon is currently threatened by the development of residences. In order to address this, and other issues, the development of strategies to acquire this area and the declaration of this lagoon as a Wildlife Refuge have been recommended as part of the "Critical Wildlife Areas" document published by DNER.
- Laguna Playa Sardinera- is located in Culebra's west and the development of residences can be observed.

Other superficial bodies of water in Culebra important for wildlife are:

- Charca Maillux- This is an artificial pond created for domestic purposes. This pond is important as a place for nesting, nourishment and rest for the white-cheeked pintail duck. In a visit by the DNER personnel, some 400 individuals were observed. This pond has been included by the DNER in the inventory of *critical wildlife areas* (2005).
- Los Caños- This body of water, which is part of the Culebra National Wildlife Refuge, is located to the east of Dewey between Puerto del Manglar and Bahía Cementerio. Its surface is approximately 29 ha and is composed of mangroves and interconnected channels. This area is classified as primary for wildlife due to its importance for the nesting of the white-crowned pigeon and white-cheeked pintail duck.

#### 5.1.4 PROTECTED NATURAL AREAS

The lands protected by designation in the Municipality of Culebra are: the Culebra National Wildlife Refuge, under the USFWS, and the Canal Luis Peña Natural Reserve, under the DNER.

##### a. Culebra National Wildlife Refuge

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The Culebra National Wildlife Refuge, the oldest refuge in the Caribbean, was established in 1909. This refuge is comprised of approximately 6.35 km<sup>2</sup> which include: a portion of Monte Resaca, one third of the Peninsula de Flamenco and various wetlands systems which include

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<sup>188</sup> The Encyclopedia of Puerto Rico's Natural Resources does not specify if this is the common or royal yaboa, reason why its scientific name is not included.

the mangroves and lagoons of Flamenco and Zoní. It also includes some 22 cays adjacent to Culebra, except for Cayo Norte, which is private property. The lands which comprise the Refuge are managed by the USFWS (See Map 27).

The cays and the Flamenco Peninsula which are part of the Refuge serve as nesting areas for migratory birds, mainly the sooty tern (*Sterna fuscata*). Aside from the sooty tern, 13 other species, local and migratory, nest in the cays adjacent to Culebra. Among these are: the masked booby (*Sula dactylatra*), the roseate tern (*Sterna dougalii*), which is endangered, the bridled tern (*Sterna anaethetus*), the brown noddy (*Anous stolidus*) and the laughing gull (*Larus atricilla*).

The presence of unexploded ordnance and the erosion of the cays due to wave action during hurricanes and storms have restricted access in order to monitor the populations of these birds. In the most recent census done in 2004, it was estimated that 84,500 individuals from the 13 different species used the Culebra archipelago and the northwest point of the Flamenco Peninsular as a nesting habitat (Saliva, in print).

The Refuge also includes beaches where the hawksbill and leatherback turtles nest, mainly in Playa Brava and Playa Resaca. However, nesting activity from these species has been documented in small pockets along the beaches of Cayo Luís Peña and Culebrita, among others.

In Monte Resaca and Playa Brava the presence of *Peperomia wheeleri* (USFWS, 2007a), an herb endemic to Culebra, has been documented. By the same token, part of the critical habitat designated for the Culebra's giant lizard (*Anolis roosevelti*) is within the area managed by the USFWS along with the habitat which includes the Virgin Islands Boa (*Epicrates monensis granti*).

#### • Canal Luis Peña Natural Reserve

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The Canal Luis Peña Natural Reserve (RNCLP by its Spanish acronym) was designated on June 1, 1999 through the approval of Resolution PU-002-99-77-01 by the PRPB. The Reserve is located on Culebra's southwest coast between the Flamenco Peninsula and Punta Melones, and the South and North points of Canal Luis Peña. The Reserve extends inland covering the public domain lands in the maritime zone toward the south until reaching the coastline of Cayo Luis Peña. The total area covered by RNCLP is approximately 4.8 km<sup>2</sup> (See Map 27).

This NR, which is managed by the DNER has a Management Plan which counts with a designation as a "no fishing zone," whose purpose is to protect coral systems and restore local fishing.

The RNCLP is a zone high in biodiversity judging from the amount of coral species, fish and invertebrates that have been found in scientific investigations. The area sustains an extensive and diverse development of healthy coral reef communities.

A total of 83 species of coral have been identified in the RNCLP. Of this total, 47 species are Scleractinea corals and four species are hydrocorals, among which is *Acropora prolifera*, a hybrid species of the elkhorn coral (*A. palmata*) and the staghorn coral (*A. cervicornis*). Also, 31 species of octocorals were identified (Hernández & Rosado, 2003). The Reserve also

contains prairies of marine tallgrass, rooted algae and communities associated with rocky environments. The marine tallgrass prairies cover approximately one third of surface of the sea floor (Hernández, 2004).

According to its Management Plan, a total of 862 species of flora and fauna inhabit the RNCLP, the majority of which are fish. The 260 species of fish observed are distributed in two classes, 70 families and 144 genuses. This data suggests that RNCLP could be the fish management unit of most biologic diversity under the DNER's jurisdiction.

Additional documented species in the RNCLP have been: mollusks (192 species) and cnidaria (124 species); arthropods (54 species); sponges (48 species) and equinoderms (37 species) (Hernández & Rosado, 2003). Other grounds of organisms identified in the RNCLP are: three species of reptiles (marine turtles) and three species of mammals (whales, dolphins and manatees).

It is important to point out that the fishing prohibition inside the NR allows fish propagation in adjacent areas where fishing is allowed. This was documented by Hernández & Sabat (2002), who in their investigation compared preliminary data from 1999 and 2002 which showed a 38% increase in the quantity of fish in the area.

## 5.1.5 SOCIO-ECONOMIC CONDITIONS

### a. Population

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After the U.S. Navy's exit in the 1970s, Culebra experienced a significant increase in its population. According to population projections from the PRPB, Culebra had a population of 2,020 inhabitants in 2009 with a population density of 67 persons/km<sup>2</sup>. It should be pointed out that this statistic does not take into consideration a floating population which is estimated to be about 1,500 visitors.

According to PRPB data, the population of Culebra is expected to increase to 2,151 inhabitants by year 2025, suggesting that Culebra's resident population will not increase significantly in the next few years.

There are seven principal communities in Culebra: Dewey, Fulladosa, Clark, Villa Flamenco, Resaca, Las Delicias and San Ildefonso.

Both the Culebra Master Plan (1971) and "Law for the Conservation and Development of Culebra", *supra*, establish mechanisms directed at the management and distribution of the island's population. Said law establishes in its Article 7, that the Culebra Conservation and Development Authority (CCDA), in the exercise of its powers and obligations should:

*"stimulate normal growth with the purpose of elevating the levels of life in Culebra to the average levels of life in Puerto Rico's main island. Excessive growth, which could result in population increase at a faster rate than Puerto Rico's main island will not be promoted."*

The Plan and the Law also establish that Culebra's future population should be concentrated, if necessary, in two or three towns in order to avoid pressure on the island's coastal zone as a result of future population growth.

However, over the past decades in Culebra, isolated residences have been developed in areas where the landscape is attractive and the beaches are sandy (Grana, 1997).

## **b. Housing**

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According to the 2000 Census, Culebra had 1,024 units of housing of which 68.3% (699) were reported to be occupied and 31.7% (325) were vacant. The occupied residences were concentrated in Flamenco and Dewey (432 and 352 units of housing, respectively).

Of the occupied residences, 76% were inhabited by their owners; while 60% of the housing units identified as vacant were used for vacation purposes. The wards of Fraile, Playa Sardinas II and San Isidro are highlighted, were 85% of the vacant housing units were used for vacation purposes.

The Culebra Segment of 1976 identified two problems associated with housing which are still present. These are: absence of an adequate system for the recollection of used waters and the proliferation of structures along the maritime zone.

A USGS report (1990) found that Culebra is the municipality with the largest proportion of residences (91%) using septic tanks, since only the housing units of Punta Aloe count with a communal water treatment system. Despite the fact that the “Law for the Conservation and Development of Culebra”, *supra*, had set January 1, 1983 as the deadline for the elimination of discharges into Culebra’s waters, the construction of a water treatment plant was begun in 2002 and completed in 2006. It will go into use, however, when the construction of a sanitary line, began in 2007, is completed. Once operational, about 90% of Culebra’s residences will be connected to this system.

Houses and structures built illegally in Culebra’s maritime zone has become a problem since these are blocking public access to the beaches. Among the areas where this problem is present are Ensenada Honda and Bahía Ensenada Malena, in the South section of the Fulladosa Peninsula (Grana, 1997). This is occurring despite the fact that the Master Plan for Culebra and the “Law for the Conservation and Development of Culebra”, *supra*, proposed that by 1983, the problem of invasions of land would have been attended.

## **c. Recreation**

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In response to the lack of recreational facilities on the island, the original Culebra Segment recommended projects which were suggested in the Master Plan (1971), the majority of which were developed. These included a public beach, plazas and parks, among others.

The public beach developed at playa Flamenco is managed by the Municipal government. The beach is 1,290m in length and counts with facilities such as bathrooms, camping grounds, parking and trash cans, among others.

Other recreational facilities built in Culebra include a baseball field, two basketball courts and two parks.

Meanwhile, the Government of Puerto Rico built recreational facilities in Cayo Pirata which included gazebos, barbecue areas and restrooms. These, however, are abandoned and require restoration.

Facilities which were proposed, such as the marina at Laguna Lobina, the outdoor theater and an aquarium at Cayo Pirata, were never developed. However, facilities seeking to integrate recreation with conservation efforts have been proposed, some of which have been included in the draft for the management plan. Among these is the development of ecotourism facilities in the Flamenco Peninsula and in Zoní.

#### **d. Tourism**

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Over the last decades, and especially since the exit of the U.S. Navy, tourism has substituted cattle ranching, agriculture and fishing as primary economic activities in Culebra. At least 35 lodging business, with some 300 rooms, have been identified in Culebra.<sup>189</sup> Among these, predominate vacation villas, hostels and inns, which are small in size and are concentrated around Dewey, Fulladosa and the beach at Flamenco.

The only large scale tourism project on the island is Costa Bonita, which is composed of villas and apartments on the slopes contiguous to Ensenada Honda. According to data from the PRTC, the only hotel endorsed by that agency in 2009 in Culebra is Club Seaborne, which has 14 rooms.

It should be noted that environmental conservation is a priority among Culebra's residents, who recognize the island's potential for tourism, but at the same time have expressed concern regarding existing geographic, physical and infrastructural limitations. Facing this reality, the residents have suggested the development of ecotourism and cultural tourism as epicenters of the island's economic activity (Estudios Técnicos, Inc., 2004).

#### **e. Fishing**

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In economic and statistical terms, fishing in Culebra can be classified as a marginal activity although it remains important in cultural terms (CIEL, 2008). Data from the Census of marine fisheries done by the DNER's Fishing Investigations Laboratory reported 24 fishermen in Culebra of which only four worked full-time and 20 worked part-time.

These fishermen reported that they capture reef fish, only 4% did their fishing in deep waters and only 25% did it from shore. Table V-3 shows Culebra's landings along with the price per pound (lb) of fish.

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<sup>189</sup> Data base - Estudios Técnicos, Inc.

TABLE V-3. FISHERIES REPORTED IN CULEBRA

Fisheries reported in Culebra 1998-2006			
Year	Pounds	Value	Price per pound
1998	451	\$771	\$1.71
1999	28,997	\$59,734	\$2.06
2000	24,179	\$52,468	\$2.17
2001	24,754	\$59,162	\$2.39
2002	22,602	\$59,333	\$2.45
2003	15,800	\$41,405	\$2.52
2004	6,833	\$19,773	\$2.78
2005	425	\$1,256	\$2.55
2006	1,437	\$5,297	\$3.77

Source: Data for years 2002 and 2003 come from the report: DRNA. (2005). Overview of Puerto Rico's Small Scale Fisheries Statistics 2002-2004.

Culebra counts with a Fishermen's Association which was established in 1966 with the purpose of developing facilities for the sale of their catches, develop a dry-dock and a gasoline station at Laguna Lobina, which today is the association's primary revenue earner (CIEL, 2008). Currently, the Association has 35 part-time members, none of which is considered a *bonafide* fisherman. In 2005, only four fishermen sold their catches to the Association while also selling to area's restaurants and to the community. Besides, the Association has two fishermen with "six-pack for hire" licenses which allow them to transport tourists between cays and beaches.

In 2002, the first open sea aquaculture venture in Puerto Rico, known as *Snapperfarm*, was established in Culebra. This project uses large cages to cultivate black salmon (*Rachycentron canadum*), a species of commercial value.<sup>190</sup> The majority of the production is exported to the Eastern United States and another part is sold locally, mainly to restaurants. This enterprise recruits divers who are members of the Fishermen Association to work in the cages.

These cages, which do not represent a potential danger to the environment, are located in territorial waters, around one nautical mile from Cayo Luis Peña. Entities such as NOAA, the UPR Marine Sciences Department and the Sea Grant Program collaborated with this project.

#### f. Land ownership

From 1901 until 1971, close to 40% of Culebra's territory was managed by the U.S. Navy. In 1975, 65% of these lands were declared as surplus and distributed in the following manner:

- Some 6.3 km<sup>2</sup> are comprised of federal lands which are part of the Culebra National Wildlife Refuge.

<sup>190</sup> See: <http://www.snapperfarm.com/>

- Another 4.9 km<sup>2</sup> (487 ha.) were transferred to the Government of Puerto Rico conditioned that these lands be used for public or recreational purposes. The transfer of these lands was completed in 1982 with the exception of Cayo Norte, whose approximate 1.2 km<sup>2</sup> are privately owned.

### 5.1.6 INFRASTRUCTURE

#### a. Energy

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Electricity is provided by PREPA to Culebra and is transmitted from Puerto Rico's main island through a submarine cable which crosses the Vieques Sound. This cable, which also has a 1.2 km aerial segment, has a transmission capacity of 38kW and it connects to a connecting tower at Punta Maguey.

The distribution sub-station, which is located in Dewey, has a transmission capacity of 4,000kW and actual consumption is 1,500kW, which leaves a 2,500kW surplus. In addition, a turbine generator is available for emergencies or in case problems arise with the submarine cable.

In April 2009, PREPA announced its intention of separating Culebra from the rest of Puerto Rico's grid by making it independent in energetic terms. Plans include a project with renewable energy using wind mills to be established on the North of the island near Flamenco. This wind farm will be able to produce some 300 megawatts while island's energy demand is only six megawatts. The surplus electricity will be transmitted back to Puerto Rico's main island. This project also contemplates interring all of Culebra's transmission lines.

#### b. Sewer system

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Residences and businesses in Culebra discharge their used waters into septic tanks or directly in the coastal waters. Most of the residences in Dewey discharge directly in Laguna Lobina or Ensenada Honda. Only residences of Punta Aloe count with a communal water treatment facility.

In order to address this situation, a water treatment facility was built in Culebra which expects to connect close to 90% of the residences once the sanitary line which will connect them is completed.

#### c. Potable water system

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Culebra's potable water comes from Naguabo's Río Blanco, but before it reaches Culebra it goes through the pumping stations in Vieques which then transmits to Culebra through a submarine line.

There are five warehousing tanks distributed throughout the island along with a pumping station, all of which are operated by PRASA.

Currently, construction is being done for a new desalinization plant with the capacity to process 200,000 gpd (757,082.4 liters) on the site which holds the current desalinization. The existing plant has a capacity for 150,000 gallons, but has been out of service.

In past years, Culebra's water came from six wells in the San Isidro sector, but these wells were abandoned because water quality does not meet standards set by the EPA.

#### **d. Solid waste management**

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The solid waste management system in Culebra is located in a 0.6 km<sup>2</sup> farm in the Tamarindo sector to the west of the island. The farm is located on PR-25 and it borders areas of great natural value such as Laguna Flamenco to the west, and Punta Tamarindo, to the northeast. The system is owned and operated by the municipal government.

Data from the Solid Waste Authority (SWA) (2007) indicates that this landfill receives some 218,000 lbs. weekly, which equates to about 15 lbs. of trash per person per day. Culebra's floating population substantially contributes to the generation of trash on the island. It has been estimated that on peak tourism weeks and weekends, the generation of non-hazardous solid waste increases by 33% (Wehran, 2003).

The SWA proposed the closing of this installation in 2008 to build a transshipment station thus Culebra's solid waste could be transported to Fajardo (ADS, 2007).

#### **e. Transportation**

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Transportation to and from Culebra can be by land or sea. Approximately 80% of the people who travel to and from Culebra use maritime transportation while the rest do it by air.

Culebra's airport, known as Benjamín Rivera Noriega Airport, is located in Valle La Pelá, is managed by the Ports Authority and handles 78,435 passengers per year.<sup>191</sup> Flights landing in Culebra come from Fajardo, San Juan and Vieques.

Port installations are located in Bahía Sardinias, to the extreme southwest of the urban zone. It consists of a passenger terminal and cargo zone for all merchandise. Ferry service is operated by the Maritime Transport Authority<sup>192</sup> with trips between Fajardo-Culebra-Vieques routes. Around 142,659 people, many of which are tourists, use this service each year. The space in this port is limited, which inhibits the promotion of commercial development.

Maritime transportation to and from Culebra is one of the areas which impacts Culebra's residents and businesses the most. Due to its condition of a small island which depends from the Main Island to satisfy many of its needs, maritime transportation is vital for Culebra (Estudios Técnicos, Inc., 2004). Any interruption in the service, be it for inclement weather or mechanical problems with the ferries, provokes a trickle-down effect of high costs which gravely affects the economy and creates difficulties in the services the population demands and needs.

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<sup>191</sup> Data taken from the Ports Authority for fiscal years 2007-2008. See: <http://www.prpa.gobierno.pr/uploads/Estadisticas/Estadísticas%20septiembre%202009/Culebra%20Pax.pdf>.

<sup>192</sup> The Maritime Transport Authority, which falls under DTPW under the Integrated Transportation concept, operates and oversees ferry service to and from Vieques and Culebra and between Cataño and San Juan.

As far as ground transportation is concerned, there is no established public transportation system with established routes in Culebra. However, there are 12 vehicles authorized by the Public Service Commission which function on a demand basis.

#### 5.1.8 POLLUTION

The most significant pollution problems in Culebra have been the degradation of its soil and the contamination of its bodies of water. Run-offs produced by rain over the island's soils susceptible to erosion have caused the sedimentation of water bodies and wetlands. Among these are the lagoons, the coasts and the mangroves. The natural process of erosion has been altered by deforestation, inadequate agricultural practices and the lack of compliance with regulations regarding construction.

It has been observed that the water body receiving the highest volume of sediment is Ensenada Honda. This is due to the fact that it receives all the run-off from the principal urban areas. Laguna Lobina also receives a large quantity of sediment because it is bordered by two communities.

A report from the DNER which evaluates the cumulative impacts on the island of Culebra, concludes that deforestation, cattle ranching and maneuvers by the U.S. Navy were the activities which, historically, generated the majority of the cumulative impact on the island. Meanwhile in the present, construction, urban growth and the absence of a water treatment system are the activities responsible for the majority of the cumulative impact detected. The document identifies tourism as the activity with the most potential of generating negative impact in the future.

Residual fluids leaking from the municipal landfill are another source of potential contamination of the adjacent soils and bodies of water. As well, there are septic tanks, latrines and drainage ponds built along constructions to pick material which seeps from septic tanks and percolate into the soil, thus aggravating the soil contamination problem.

The construction of residences along the coast contributes to the degradation of water bodies due to the fact that some of these structures discharge used waters without any sort of treatment and often overflow their septic tanks. This situation has been observed, particularly in Ensenada Honda where there has also been small fuel spills from some of the vessels which anchor in its waters. Also, the building of structures is causing the destruction of natural systems such as mangroves, marine grassland prairies and coral reefs, among other marine resources.

A contamination problem particular to Culebra is that of unexploded ordnance left behind by the U.S. Navy from military practices between 1902 and 1975. These artifacts constitute a source of contamination which could represent a threat to the health of the land and aquatic ecosystems.

In 1995, the USACE held a partial cleaning of the Flamenco public beach. However, other parts of the island and its territorial waters have not been cleared of unexploded ordnance. The most recent report on remnants of material left from military practices was published in September 2007 and was prepared by Parsons Infrastructure & Technology Group, Inc. for USACE under the title "Final Site Inspection Report Culebra Island Site". In the inspection,

according to the report, the presence of munitions and explosives, among other components, is recognized. The study recommends an evaluation of the viability of mitigation initiatives for 12 of the 13 areas identified as having this potential.

## 5.2 CULEBRA'S COASTAL MANAGEMENT

### 5.2.1 OBJECTIVES AND GENERAL POLICIES

The Culebra Segment (1976) pointed out that the Government of Puerto Rico's policies regarding Culebra's development were established by the "Law for the Conservation and Development of Culebra", *supra*, and the *Master Plan for Culebra*. Both instruments were created using the recommendations from the Joint Report by the Government of Puerto Rico and U.S. Department of the Interior (DOI) published as *Culebra: A Plan for Conservation and Development*. That report was the parting point for the establishment of goals and objectives specific to Culebra.

Over the last decades, a series of law and plans have been passed which guide the island's future development and need to be integrated into the Culebra Segment of the PRCZMP. Those laws and reports are presented in the following section:

#### **Joint Report by the Government of Puerto Rico and the U.S. Department of the Interior - Culebra: A Conservation and Development Plan (Joint Report)**

In 1971, the U.S. Senate's Interior and Insular Affairs Committee passed a resolution commissioning a study regarding the best uses for Culebra's lands. In this Joint Report, the development and conservation strategies for the lands transferred to the Government of Puerto Rico were established. Those priorities were based on conservation and the island's economic development. The report also established the necessary public policy for the Municipality to take into account measures to protect the physical environment.

The Joint Report concluded that the U.S. Navy's exit from Culebra was an opportunity and a new responsibility for the residents to improve and preserve Culebra's natural resources. In response to that opportunity, various documents were approved among which are: the revision of the Master Plan for the Use of Culebra's Soil, the "Law for the Conservation and Development of Culebra", *supra*, and this Segment on Culebra.

#### **Master Plan for the Use of Culebra's Soil, adopted by the PRPB in 1971 and revised in 1975 (also known as the Regulating Plat)**

The Culebra Master Plan (Master Plan) established a land use plan for the island which included recommendations on infrastructure, commerce, agriculture, housing, recreation and services. This document also designated Monte Resaca and Culebrita for conservation, which later led to transfer of these areas to the USFWS (Grana, 1997).

The Culebra Segment (1976) mentions that nothing included in the Master Plan represented inconsistencies with the "Coastal Zone Management Act" of 1972. However, the Plan identified agriculture as one of the most important resources in Culebra for the generation of jobs and income, thus giving importance to agricultural conservation and zoning. Currently, however, tourism has positioned itself as an important sector for the island's economy. This

activity has generated strong pressure over the island's resources, making it necessary to consider management and conservation alternatives in the coastal zone. The policies, laws and regulations associated with the protection of this zone are contemplated the laws and regulations of agencies such as the DNER, the PRPB and the EQB, described in the Coastal Resources section (Chapter 3).

#### **Law for the Conservation and Development of Culebra”, Law No. 66 of 1975**

Through the “Law for the Conservation and Development of Culebra”, *supra*, an entity known as the Culebra Conservation and Development Authority (CCDA) was created. This entity received ample powers with the purpose of implementing public policy to preserve and conserve Culebra's ecological integrity. The responsibility of assuring the island's continuous development as well as overseeing the protection and conservation of the natural resources was also delegated on this entity.

CCDA is ruled by a Board of Directors composed of seven people: an *ex officio* member who would be the Mayor of the Municipality of Culebra, who will have a voice and vote and six other members who would be recommended by the Mayor and confirmed by the Municipal Assembly. Four of the members should be specialists in the environmental field, beaches and natural resources; two of the members should represent, preferably, Culebra's private sector and be residents of the island. These members should have the capacity to analyze and interpret all of the tendencies and information related to Culebra's geography and environment as well as have knowledge of the island's economic, social, cultural and aesthetic needs and interests. Two of the members would be named for one-year terms and the rest would serve five-year terms.

Among CCDA's roles is the formulation, adoption and management of plans and programs for the conservation, use and development of Culebra in accordance with the norms and regulations approved by the EQB, the Master Plan and the zoning map adopted by the PRPB. Furthermore, once the Government approved the Municipal Land Use Plan, this will have prevalence over the Master Plan of 1975 authorized by the PRPB.<sup>193</sup> CCDA will also have the responsibility of endorsing all projects to be developed in Culebra and certify that these do not interfere with plans or projects approved for the island.

Among the powers conferred to CCDA are:

- **Property management.** CCDA can acquire assets through purchase, donation, expropriation, among other means. It will have the power to negotiate and sign agreements with the DOI and other U.S. Government agencies relative to the transfer of properties or the administration of lands or areas under the jurisdiction of the U.S. Government or any of its agencies.
- **Regulations.** CCDA can approve, amend or revoke regulations to implement public policy on preservation and conservation in Culebra as established in the Law.

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<sup>193</sup> The Municipality of Culebra is in the final phase of developing its Land Use Plan (personal communication from technical personnel from the East Region of the Subprogram for Land Use of the PRPB on September 25, 2009).

- Application. CCDA can dictate orders of cease and desist so that control measures it deems necessary can be taken in order to achieve the goals of the law. The CCDA can also take judicial action including, but not limited to, *injunctions*, *mandamus*, or any other action which it seems necessary in order to comply with its purposes of conservation and preservation as well as order the destruction of existing illegal structures or those in process of construction in accordance to established procedures.
- Facilities. CCDA can build, operate, concede subsidies, incentives or economic aid for building and operation of facilities in Culebra including commercial, agricultural or fishing enterprises to benefit inhabitants and visitors.

The “Law for the Conservation and Development of Culebra”, *supra*, establishes standards to guide the development of the island of Culebra and points out that any development which poses an obstacle for public access to the sea and beaches will not be approved. It also states that the operation phase of the adoption and administration of plans and programs for the conservation, use and development of Culebra will be centered on the Municipality.

On March 30, 2004, a Cooperative Agreement was signed between DNER and CCDA with the purpose of integrating the capacities of both entities to oversee, plan, protect and manage existing resources in Culebra. The agreement will have a life of 10 years in which the DNER will participate and cooperate in activities such as:

- Deployment of personnel to the island for the registration and renovation of vessel registries;
- Train CCDA members and the municipal police regarding environmental laws and regulations enforced by the DNER and
- Designate personnel to be part of a committee which evaluates projects that are submitted for CCDA’s consideration.

For its part, ACCD committed to provide the necessary facilities so that DNER personnel can perform their duties, pay for the cost of training and coordinate the presentation of projects to be evaluated by DNER, among others.

#### **Cooperative Management Agreement for the Conservation and Development of Cultural and Natural Resources in the Island of Culebra of 1982**

This agreement was signed by the Government of Puerto Rico and the DOI to establish a cooperative effort to management of the federal lands in Culebra which were destined for conservation. The Agreement transferred 3.78 km<sup>2</sup> of land to the DNER which were mainly comprised by the maritime zone, the inferior half of the Fulladosa Peninsula, the Romana Peninsula, San Ildefonso, the lands around the airport, Punta Resaca and other portions of Dewey, Fulladosa and Punta Carenero.

This document also establishes management goals, including the removal of squatters and handling of the problem of discharges of used waters into the sea. Currently, neither issue has been completely resolved, although a water treatment plant has been completed and the sanitary line is under construction.

### **“Law to create the Vieques-Culebra Special Economic Development Zone”, Law No. 153 of 2002**

This Law establishes the Vieques-Culebra Special Economic Development Zone and recognizes that both island municipalities have been left behind to their isolation the past presence of military practices by the U.S. Navy. In response to this situation, the Law offers tax incentives, creates an Interagency Committee and assigns funds for the development of the islands.

The Law points that “by converting Vieques and Culebra into a Special Economic Development Zone, a legal structure and an adequate planning structure would be provided for the different government agencies regarding all that is related to economic development of both islands.” The Law also creates a Consulting Group composed of a team of professionals and the Interagency Committee integrated by various public officials to evaluate the economic conditions of Vieques and Culebra and design an integral economic development plan for both municipalities. This Law contemplates granting tax credits on properties, incentives for job creation, incentives for business and industries as well as accessible financing.

### **Master Plan for Culebra’s sustainable development**

The Interagency Committee and the Consulting Group created by the “Law for the creation of the Vieques-Culebra Special Economic Development Zone” commissioned the preparation of a *Master Plan for Culebra’s sustainable development*. The Plan was prepared and approved on December 2004 and aims to achieve the island’s economic development by means of active participation from residents to ensure social equity and the protection of the island cultural and natural resources. The Plan aims to be a tool so that the different agencies can channel their efforts and initiatives. At the moment, the result of the implementation of the *Master Plan for Culebra’s sustainable development* is unknown.

### **Law of Autonomous Municipalities, Law No. 81 of 1991 and the Municipal Land Use Plan**

The “Law of Autonomous Municipalities” expands the municipalities’ range of functions through the transfer of certain competencies regarding planning and regulation in their territory, among other responsibilities previously carried out by the Government of Puerto Rico. In order for this to occur, it is necessary that the municipality establish an Office of Permits and has a current Municipal Land Use Plan (MLUP).

The MLUP is the planning instrument used at the municipal level. Once Culebra’s MLUP is approved by the PRPB and adopted by the Governor, it will guide the use of soils in the island.

## **5.2.2 MAJOR PROBLEMS AND SOME NEEDED RESPONSES**

The Culebra Segment of the PRCZMP, approved in 1976, identified some problems which needed attention in order to achieve the objectives established by the “Law for the Conservation and Development of Culebra”, *supra*. The two issues that said law is after, conservation and development, continue to be priority issues due to the fact that new factors

have risen which threaten the islands natural assets. Many of these new problems have risen from the rapid and spontaneous occupation of Culebra over the last 20 years.

While some of the issues originally presented have been tended to, others remain unresolved. Mentioned problems with the management of the coastal zone, along with necessary measures to be taken, are presented in the section below. Moreover, policies included in Chapter 3 are the PRCZMP enforceable policies to solve the problems identified in the following section. Also, Appendix B includes the means of exerting Commonwealth Control over the coastal zone.

#### **a. Restoration of disrupted natural conditions**

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Some problems such as illegal constructions, discharges of untreated waters and unexploded ordnance product of military practices on the island, are situations which have not received attention in Culebra.

##### **1. Squatters**

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Illegal constructions in Culebra have been a problem for decades. In 1975, there were close to 137 squatter residencies, many built on lands which belonged to the Federal government. At that moment, many of the squatters had no other housing options. However, the proliferation of second homes for vacationing purposes on land of public domain or owned by the Government of Puerto Rico (Grana, 1997) has been observed. This practice has generated a serious problem with the access to the coast and pollution, particularly in the disposal of solid waste and sedimentation of the bodies of water.

The “Law for the Conservation and Development of Culebra” disposes that the CCDA has the faculty to avoid or end an occupation of public lands. The procedural structure to take these actions is detailed in Article 7. The Law establishes that CCDA has the power and responsibility to order the destruction of illegal structures or those in process of being built, as wells as the destruction or cease of an expansion of an existing structure. This law also orders that by January 1, 1983, all illegal possession, use or enjoyment of public land must be eradicated in Culebra. However, a unit of housing must be provided to those, who on October 1973 had their structures located illegally in federal lands that were transferred to CCDA.

Other DNER and PRPB’s regulations designed to avoid construction of new illegal structures on the maritime zone are the “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone”, Regulation No. 4860 and the “Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico”, Regulation No. 17 of the DNER and PRPB, respectively.

Despite the current legal and regulatory framework, the measures which have been taken have not resulted efficient and conclusive to stop the construction of illegal structures on the coast. After the passage of Hurricane Huga in 1989, many of these squatter residences built on the maritime zone were destroyed. Following this event, the “Law for the Conservation and Development of Culebra”, *supra*, was amended to authorize the reparation and reconstruction of houses on the maritime zone in Dewey which were affected by the passing of the hurricane. These persons had to show that this was their primary residence for a continuous period since or before June 22, 1975 until September 18, 1989. Many of the

rebuilt houses, which cost upwards of \$80,000, were again destroyed by Hurricane Georges (Beller et al., 1999). This situation cost a significant loss of public funds and perpetuated the problem of accesses to the coast and degradation generated by this action.

As has been observed in other areas of Puerto Rico, owners of these illegal structures sell them to third parties despite not having the deed to land on which the structure is constructed.

Facing the situation, the following measures are presented:

Enforce to prevent and remedy violations. Although it is not known exactly how many squatter residences function as primary homes, it is a known fact that many of these residences are used as vacation homes. Therefore, the destruction of structures on the maritime zone due to the passage of significant weather events creates an opportunity to implement existing regulations and prohibit their reconstruction.

The CCDA should work with the Department of Housing in order to relocate people who are using these structures as their primary home.

Demarcation of the maritime zone throughout the island of Culebra. In order to establish effective patrolling of the maritime zone it is necessary to complete its demarcation. The DNER establishes the manner in which this process needs to be executed as instructed in the "Procedure manual for the demarcation of the interior limit of land inside de assets of maritime public domain", approved in November 1999.

The DNER has already demarcated the maritime zone in Las Delicias, Clark, Dewey and Fulladosa and it is currently working on project known as the "Development of the base line for the demarcation of the maritime zone for all of Puerto Rico, Culebra and Vieques," which will eventually become a single system of official reference for the demarcation of the maritime zone. (See section on Beaches in Chapter 3).

Inventory of houses to determine which ones are used as primary residences. It is necessary to identify which houses located on the DNER land or in land of public domain are primary residences, in order to assign enough resources so that the relocation of these residences can be executed.

The DNER has completed an inventory of the units of housing along the maritime zone in Ensenada Honda using data from electric power connectors. This has allowed the identification of houses which were built legally and if a person is a full-time resident or uses the residence for vacationing, depending on electricity consumption. The inventory needs to be updated and expanded to include the rest of the island.

Aside from the faculties given to CCDA, according to the "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone", *supra*, the DNER has the faculty to do inventories or registries of existing structures in the assets of public domain along the maritime zone. Said inventory or registry will be a public document.

## 2. Access to beaches and coasts

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The problems of access to the coasts and beaches of Culebra are caused by illegal constructions by some constructions which, although legal, impede the general public from enjoying this resource.

The “Master Plan” in preemption of the transfer of lands conceded by the Spanish Crown to the Government of Puerto Rico as part of the Agreement on Cooperative Management of Culebra’s Resources established that: “*it is proposed that these lands are maintained as property of the Government of Puerto Rico in perpetuity to ensure free and easy public access to all the beaches on the island.*”

The “Organic Law of RPA” and the “Regulation for the Zoning of Coastal Zone and Access to Puerto Rico’s Beaches and Coasts” should be instruments which guarantee the public access to assets of public domain. Said regulation requires to all development in front of the maritime zone to provide access to the beaches prior to the construction permit issued by the RPA. The regulation also requires protection of important natural areas and prohibits new subdivisions of development which could deteriorate or destroy these resources.

Identification of coastal accesses. It is necessary for Culebra’s residents and visitors to clearly know the accesses to the island’s coasts and beaches, reason why it is important that these be identified clearly with proper signage.

It is important that routes be accessible, free of vegetation, objects or structures which can block traffic through these accesses. On the other hand, accesses established by habitual use for ‘as long as anyone can remember’ should be respected and identified.

## 3. Pollution of coastal waters

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The disposal of residual waters and the sedimentation of water bodies due to urban activity are the two issues which have contributed the most to the degradation of the quality of Culebra’s coastal waters. It can be estimated that residences located on the coast of Ensenada Honda discharge 77,100 gallons (291,854 liters) of residual waters every day (PT, 2001).

The problem caused by the inadequate disposal of sanitary waste is expected to be solved to a great extent with the new treatment plant. It is expected that this treatment facility will be sufficient to meet water treatment demand until 2015.

The presence of two tanks of residual water to the south of Laguna Flamenco represents a public health risk and impacts the landscape. These tanks discharge seepage into the lagoon, limiting its use for recreational purposes. To deal with this issue, the *Master Plan for the Sustainable Development of Culebra* recommends the relocation of the tanks.

Another issue which adds to the contamination of the waters has been the use of poor construction practices. Due to the fact that Culebra’s soil is sloped and susceptible to erosion, construction activities should take strict measures to prevent erosion and sedimentation. The proliferation of unpaved roads and roads which, although paved, lack adequate erosion controls, are issues which have substantially worsened sedimentation problems in coastal waters.

Among the suggested measures to deal with the contamination of Culebra's waters are:

Removal of squatter structures. It is necessary to stop the illegal occupation of lands and remove structures illegally located in the maritime zone since many of them are discharging directly into the coastal waters. The measures needed to tend to this problem were presented in the previous section (a).

Adopt measures to control erosion and sedimentation. It is necessary to enforce the "Regulations for erosion control and sedimentation prevention", Regulation No. 5754 of 1998, by the EQB and the corresponding Control of Erosion and Sedimentation (CES) permit which has the purpose of control erosion caused by human activity and prevent sedimentation and contamination of Puerto Rico's water bodies. It is recommended that CCDA personnel be trained and enforce the compliance or the norms and regulations directed to controlling erosion and sedimentation.

It is recommended that measures controlling non-point sources pollution as established by the "Management Plan for the Control on Non-Point Sources of Pollution in Puerto Rico's Coastal Zone" is extended throughout Culebra. The measures described under this Plan serve as a guide for municipalities and jurisdictions in implementing management programs for said sources of pollution and contains information on methods which are economically viable to reduce this type of contamination of superficial and underground waters.

It is recommended that CCDA coordinates with EQB so that Best Management Practices are required for construction activity on soil susceptible to erosion. Personnel from CCDA can supervise that the practices are implemented. However, for this action to have positive results, CCDA personnel will need to be appropriately trained.

Evaluate the cumulative impact of construction projects, their effect on coastal bodies of water and associated ecosystems. Some characteristics of the island, such as its high susceptibility to erosion, the sloped soil close to the coast and the arid climate combined with the rising demand for construction of housing, particularly in the coast, make it necessary to do an analysis particular to Culebra. This analysis should incorporate measures which allow for the evaluation of the cumulative impact of projects and the capacity of the island's natural systems along with coral reefs, prairies of marine grasslands which have been significantly affected by sedimentation.

## **b. Solid waste management**

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The current situation regarding the management of solid and residual waste in Culebra was discussed in Section 5. 1.7. The estimated amount of waste generated per capita, which is three times higher than that considered on the Main Island, exposes a problem which, if not addressed, could create great conflicts over the use of lands, coastal resources and public safety.

Currently, the land which holds Culebra's landfill is contiguous to the mangroves adjacent to the RNCLP. This location represents a threat, particularly to the marine ecosystems which act as receptors of run-off currents and seepage. Seepage from landfills contain a high degree of organic pollution, thus its drainage into coastal water has the potential of degrading existing flora and fauna.

In order to address the solid waste disposal problems in Culebra, the following alternatives are presented:

Work in coordination with the Solid Waste Authority to promote a recycling program and lead the plans to construct a transshipment station to transport solid wastes from Culebra to Fajardo to a successful conclusion. As well, prepare and execute a Closing Plan for Culebra's landfill in accordance to EQB's "Regulation for the Management of Non-Hazardous Solid Waste", Regulation No. 5717. The Municipality of Culebra's Public Works Division counts with a recycling program which includes cardboard, newsprint, glass, aluminum and plastics. However, the sanitary fill-in system is still receiving substantial amount of material with the potential to be recycled. Therefore, it is recommended that an ample awareness campaign regarding recyclable materials be executed along with the distribution of canisters to residences and businesses and the establishment of consistent pick-up program.

### **c. Incompatible uses in the Canal Luis Peña Natural Reserve (RNCLP)**

Some activities currently being held within the RNCLP are incompatible with the Reserve's designated use. Among these is the illegal fishing within its limits. This activity was banned in 1999 by an Administrative Order from the DNER, which established a prohibition on fishing within the Reserve's boundaries.

Another problem affecting the marine bottom of the RNCLP is unexploded ordnance left behind by military practices. This has become an important issue of safety for visitors to the area as well as an issue of conservation of marine life, since many of those who visit the Reserve practice underwater activities.

Another issue affecting the RNCLP is the fact that the Culebra landfill is contiguous to the Reserve and has been identified as a possible source of contamination due to seepage of fluids and the waste blown into the Reserve by winds.

These, among other concerns are contained in the RNCLP Management Plan, completed in 2008. The Plan integrates concerns from various sectors regarding the problems directly affecting the Reserve and proposes a plan of action in where Culebra's community is committed, in conjunction with the Government of Puerto Rico, of guaranteeing the conservation, preservation and restoration of the Reserve's natural resources.

### **d. Contamination of areas used for military practices**

The main risk posed by areas formerly used for military practices is the presence of unexploded ordnance left on the island, cays and coastal waters. This is a danger to not only the residents, many of whom are aware of areas of risk, but also for visitors and tourists who may not be properly informed of this situation.<sup>194</sup>

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<sup>194</sup> Information obtained from USACE's webpage:  
[[http://www.saj.usace.army.mil/Divisions/ProgramProjectMgt/Branches/Interg\\_IntSvc/FUDS/culebra\\_overview.htm](http://www.saj.usace.army.mil/Divisions/ProgramProjectMgt/Branches/Interg_IntSvc/FUDS/culebra_overview.htm)].

According to USACE, the substances of most concern are the explosives in the bombs, among other incendiary substances which could be found within the shell casings in these projectiles. More than any potential toxic substance, however, the biggest risk here is the accidental detonation of these bombs. Exposure of people to these bombs could occur due to forces of nature or by excavation activities since, once discovered, the handling of these explosives by untrained personnel could bring about their detonation.

The USACE has done several partial clean-ups and is currently undergoing another effort to remove superficial munitions and explosives through the Program for Formerly Used Defense Site (FUDS). This program is executed in accordance to CERCLA and the National Contingency Plan.

Superficial clean-up is being done in the following areas:

- Cerro Balcón - 0.12km<sup>2</sup> to its west
- Isla Culebrita - 0.33 km<sup>2</sup> at its extreme North
- Close to 0.16 km<sup>2</sup> which includes the following cays:
  - Cayo Botella
  - Cayo Tiburón
  - Los Gemelos
  - Cayo del Agua
  - Cayos Génequi
  - Cayo Lobo
  - Cayo Alcarraza

The USACE plans to do more clean-up efforts in other parts of Culebra in the near future.

The “Law for the Conservation and Development of Culebra”, *supra*, in its Article 7, establishes that the Board of Directors of the CCDA will make the necessary decisions in order to remove all unexploded ordnance for the areas formerly used for military practices.

Some of the measures which the CCDA could undertake include an information campaign and signage regarding risk areas.

#### **e. Management of public lands and waters**

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The CCDA has the responsibility of working with Commonwealth and Federal agencies in the adequate management of Culebra’s lands. In order to comply with the general goals established for Culebra in the Joint Report, the CCDA must guide its efforts toward preservation and development.

Preservation includes the protection of endangered species, coral reefs, sand deposits, mangroves, and coastal waters as well as other resources currently in a degradation process. In order to achieve this, it is necessary to work with the deteriorating conditions previously mentioned. Furthermore, other issues, such as the discharges from boats, anchoring of vessels on coral reefs and trash left behind by users must be addressed.

Development includes the building of public facilities in order to promote tourism activities and other objectives which will allow improvement of conditions of life for Culebra's residents. In order to execute proper management, it is necessary to designate necessary funding and trained personnel to deal with the environmental monitoring the area needs. It is important to:

Do an analysis on the Limits of Acceptable Change (LAC) for Culebra: It is recommended that a study be done regarding the LAC for the island. This concept involves determining the intensity of use or volume of exploitable natural resources in the island, through a process that considers the degree of environmental change derived from the intensity of environmental impacts that are considered tolerable, depending on the objectives of conservation and development and under specific management measures.

Protection of natural areas: There are two entities with the power to acquire land of high natural value: the CCDA and the DNER.

Through the "Law for the Conservation and Development of Culebra", *supra*, mechanisms are provided so that CCDA can acquire properties to promote development, enjoyment and conservation of outdoor areas in their natural state, in order to protect waters or bodies of water, conserve soils and forests, preserve natural beauty for public enjoying, including green areas and public parks, and facilitate the use and development of areas reserved for projects of public interest.

The "Puerto Rico Natural Heritage Program Act", Law No. 150 of 1988, allows the DNER to acquire lands through purchase, donation, legacy, exchange, expropriation or any other legal means from any person, Commonwealth or Federal government agency.

#### **f. Guidance of development on public and private property**

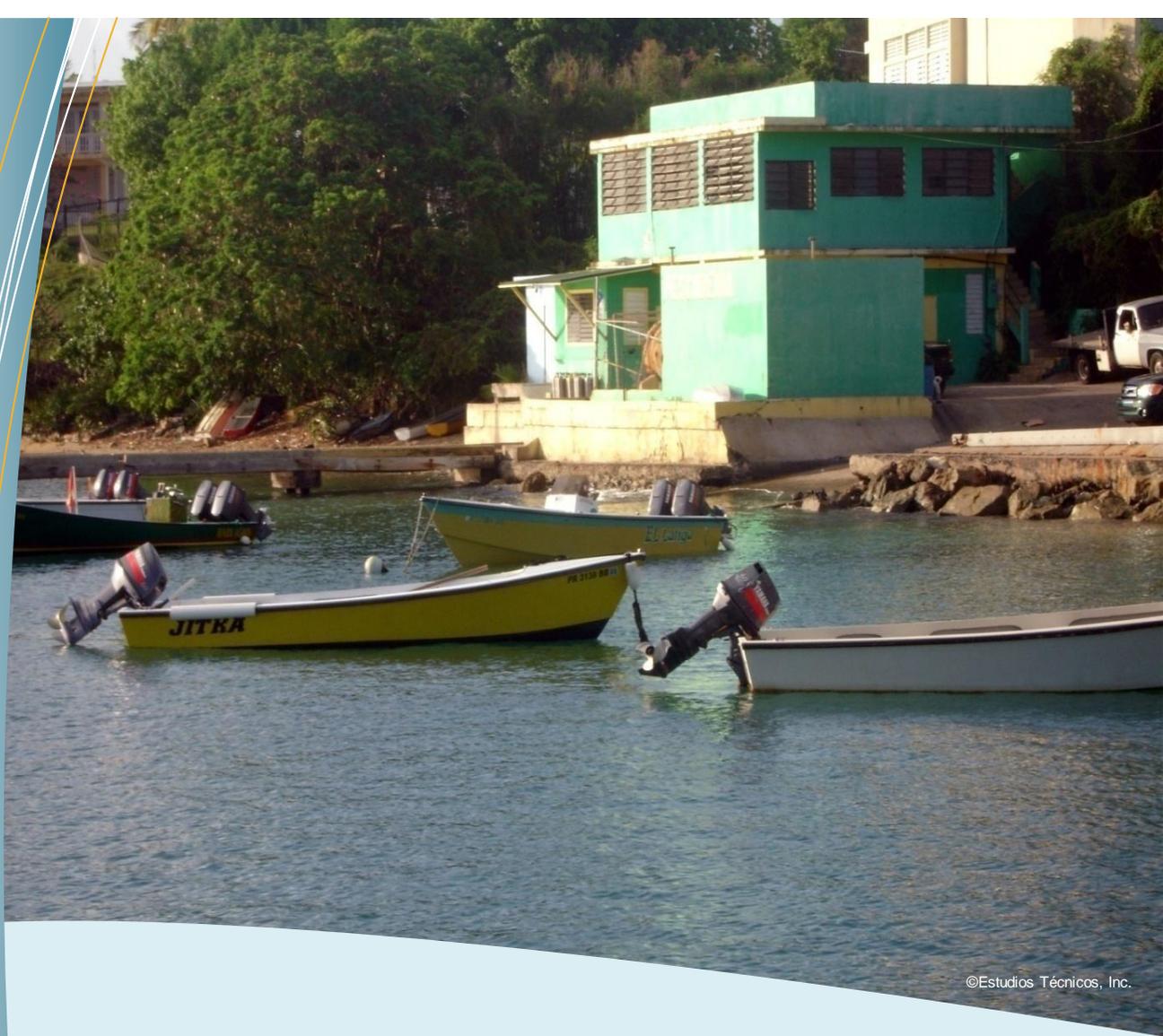
The two objectives established for Culebra – conservation and development – may appear to be conflictive in their implementation. Therefore, it is necessary to create measures which would allow for the implementation of the dispositions established under the "Law for Conservation and Development of Culebra", *supra*.

The re-structuring of the CCDA, through amendments made possible by "Law 76 of 2002", opens an opportunity for that balanced development everyone wants. The knowledge of CCDA's members regarding environmental affairs will allow this organism to exercise better judgment when it comes time to formulate and adopt plans for conservation, use and development of Culebra.

### **5.2.3 RESPONSIBLE COMMONWEALTH AGENCIES AND SOME MEASURES ADOPTED**

The responsibility of guiding Culebra's development and address needs previously identified falls mainly on the following Puerto Rico Government agencies as they were described in Chapter 4. These are: the PRPB, RPA, EQB and DNER.

Culebra also counts with CCDA which has ample responsibilities delegated to it by the “Law on the Conservation and Development of Culebra”, *supra*. The CCDA has regulatory powers which complement the powers of the agencies previously mentioned.



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## **Chapter 6:** *The Vieques Segment*

## Chapter VI. THE VIEQUES SEGMENT

### INTRODUCTION

The island of Vieques is an integral part of the Puerto Rican territory and is located some 10 km east of Puerto Rico's main island. With a surface area of 136 km<sup>2</sup>, Vieques is surrounded to the north and west by the Vieques Sound and to north and east by the Caribbean Sea.

Vieques was also intensely used for military practices. Its territory, as it was the case for the rest of Puerto Rico, was ceded by Spain as a result of the Spanish-American War. On September 21, 1898, troops from the United States took possession of Vieques but it was not until the start of World War II that construction of military facilities in Vieques intensified. At the start of the 1940s, Congress passed Public Law No. 247 which stipulated that the U.S. Navy will immediately take possession of lands expropriated in Vieques.

At that moment, the U.S. Navy expropriated 800 families in approximately 76.2% (105.21 km<sup>2</sup>) of Vieques. Since the beginning of the expropriations, Vieques' population was restricted to a strip of land crossing the middle of the island due to the fact that portions of the East and West were occupied and used by the U.S. Navy as areas for warehouses and firing ranges.

At the conclusion the U.S. Navy's practices in 2003, about 80% of those lands were transferred to the USFWS. The federal government also retained the deed to another 97.1 acres (0.39 km<sup>2</sup>) where the Relocatable Over-the-Horizon Radar (ROTHR) is located. Other lands were transferred to the Municipality and the Puerto Rico Conservation Trust (PRCT).

The island is currently facing the challenge of re-directing economic and social development efforts as well as other initiatives for the conservation of its natural resources and decontamination of the lands formerly used for military maneuvers. The totality of the island of Vieques, as is the case of Culebra and Puerto Rico's other islets and keys, is considered part of the coastal zone. This situation offers an area of opportunity for the balanced development of the island and the management of its natural resources, which are fundamental aspects of the PRCZMP.

The Vieques Segment is being developed with the purpose of carefully examining the island's situation from the perspective of the PRCZMP. The Segment describes the island's situation, establishes the management of the coast and identifies key problems and some necessary responses to address them. It is important to point out that this segment does not establish specific policies for Vieques since the OPP-PRLUP and the specific policies presented in Chapter 3 and Appendix B are sufficient in order to guide the island's development.

## 6.1 DESCRIPTION OF THE ISLAND OF VIEQUES

Vieques is an oceanic island with a territorial extension of approximately 136 km<sup>2</sup>. The island extends 33 km from East to West and 7.2 km in its most extensive portion (DRN, 1972). Puerto Diablo is the island's largest ward with an extension of 46.42 km<sup>2</sup> and is located in the island's Northeast. To the south are the wards of Puerto Real and Puerto Ferro while Punta Arenas, Mosquito and La Llave are located to the west. Isabel Segunda is located on the North part of the island.

Vieques' topography is predominantly flat characterized by low hills and small valleys. The median elevation is 61m above sea level. There is a mountainous region extending from East to West. The island's highest point, Monte Pirata, is located on the West and its elevation is approximately 305m. The second highest point, Cerro Matías, is located to the East and has an elevation of 128m (420 feet). On the extreme Western part of the island limestone palisades which contain some caves can be observed while the Southern coast of Vieques is marked by small indentations which form small bays (See Map 29).

### 6.1.1 PHYSICAL CHARACTERISTICS

#### **b. Climate**

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Vieques' climate is arid due to its topography, location and shape. Vieques is located among the Lesser Antilles subjecting its surface to the trade winds which influence a marine-tropical climate and, for the most part, blow from the East while in the summer move from the East-southeast. Local coastal breezes as well as breezes associated with the hills and valleys can be felt, but do not influence the island's climate (GATP, 2003).

Annual precipitation in Vieques is scarce due to the territory's low elevation and its limited territorial extension which inhibits the occurrence of rain due to convection, which is limited to periods of low duration in afternoon hours. The other type of rain which is more common is frontal, or cyclonic, rain. Overall, average annual rainfall in Vieques ranges between 660 to 1829 mm (26 to 72 inches) (Frank, 1972).

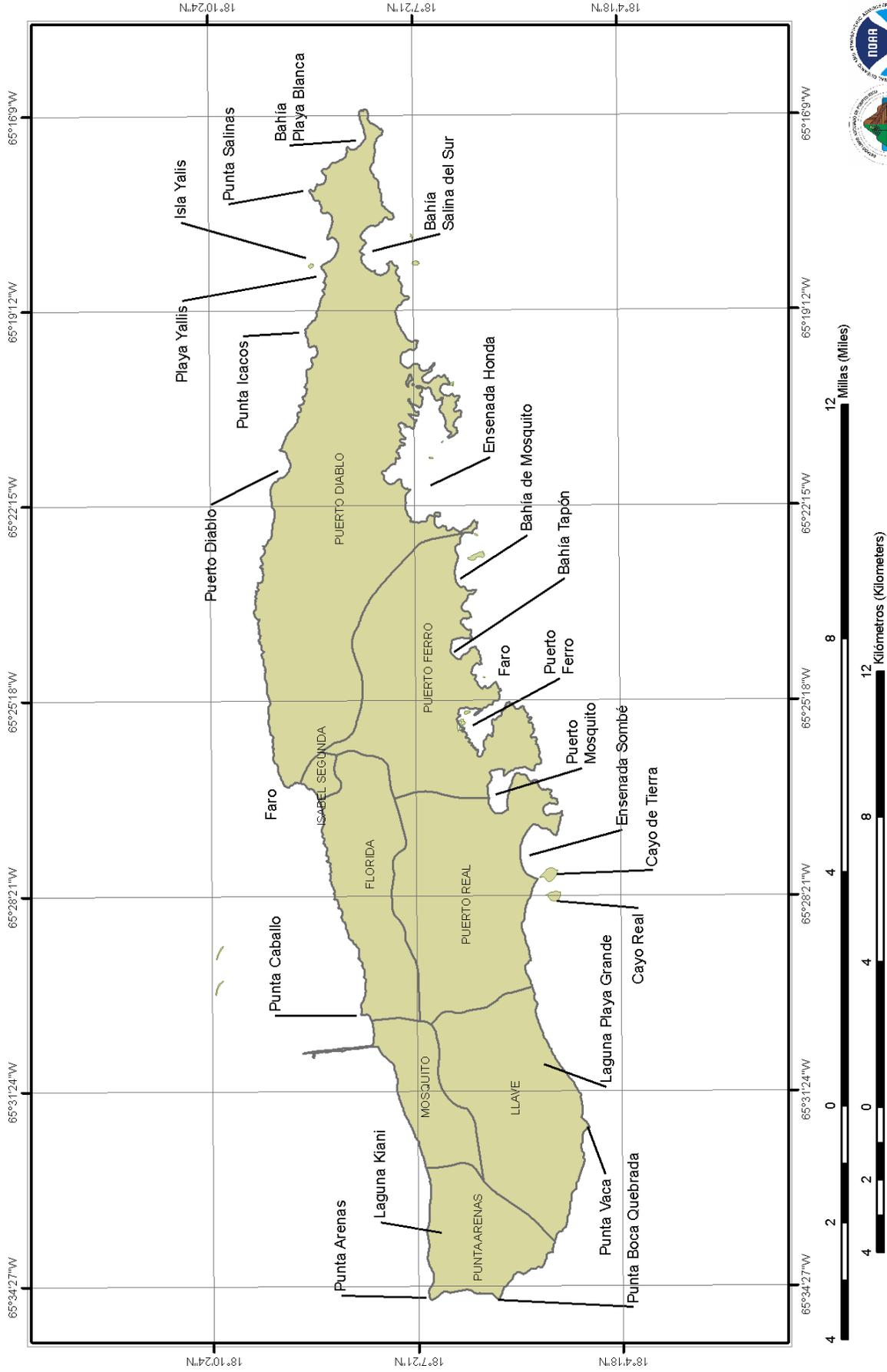
Vieques' dry season occurs from December until July, being the months of March and April when it rains the least. The rainy season falls between August and November being the months of September or November when it rains the most.

The constant exposure to wind circulation and scarce rain makes for an arid and hot climate. The average annual temperature is e 27°C (80°F), which places the Vieques in the "hot belt" with some of Puerto Rico's hottest temperatures.

**Leyenda - Map Key:**

- Municipios / Municipalities
- Barrios / Wards

Escala - Scale 1:150,000



Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program  
Mapa 29 / Map 29

# Isla de Vieques

## Vieques Island

### c. Soils

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Vieques' soils are predominantly arid and its slopes are varied with fluctuations from 0 to 60%. Close to 30% of the territorial extension is covered by three types of soils: Descalabrado and Guayama, Descalabrado clay loam and the complex Descalabrado-rock land. These soils cover ragged territorial extensions with slopes varying from 5% to 60% and cover rocky terrains useful almost exclusively for forests, grazing, wildlife and recreation. Close to 8% of the territory has rocky soil and another 5% is comprised of wetlands and swampy soils.

Close to 26% of the territory is comprised of soils from the Vieques series. These soils are moderately deep, have good drainage and rapid permeability while being highly susceptible to erosion and are found in points of higher elevations. Soil from the Coamo series covers another 16% of the Vieques territory. These soils are soft, deep and apt for a great variety of uses if managed adequately.

The remaining 15% of Vieques is covered by soils from nine different series whose qualities are varied. These are: Amelia, Cartagena, Cataño, Coastal Beaches, Fraternidad, Jacana, Pandura, Paso Seco, Ponceña, Pozo Blanco Rock Land and land fillings. The Amelia series is characterized for having moderate slopes (2-20%), good drainage and deep soils. These are found along run-off basins and on hillsides. The Cartagena series covers flatlands (0-5%), they are deep and with little drainage. It is formed with sediments of fine texture from volcanic or lime rock.

The Cataño series is found in level lands (0-5%), are excessively drained, are deep and aligned along the sea. Soils of the Coastal Beaches series is made up of grains of sand which are under constant motion due to the wind and are saturated by salt. Vegetation in those areas is limited to palm trees and coastal morning glories, among other beach flora.

Soils of the Fraternidad series are deep with good to moderate permeability. They form from fine sediments as well as lime and volcanic rock derivatives. They are observed on the coastal plains with almost level slopes. These soils are usually used for sugar cane planting, but are not apt for any other type of agricultural activity.

Jacana soils are found in level to moderate slopes (2-20%) and are derivatives from volcanic rock, have good drainage and its depth is moderate, but have serious limitations for agricultural and non-agricultural use. Meanwhile, land filling is found where normal soil has either been covered or destroyed by construction activity.

The Pandura series contains plains with good drainage and moderate to fast permeability. The Paso Seco series contains alluvial soil with small slopes (0-5%), good drainage and is deep. The Ponceña series has slopes which vary (0-12%) has good drainage, is deep and is a derivative of volcanic rock. The Pozo Blanco series also has moderate slopes, is deep and has good drainage. These soils have limitations for agricultural uses.

Soils classified as Rock Land cover close to 8% of Vieques' territory. These soils have rock formations which cover 50-70% of the surface.

Soils classified as Pantanos-Ciénagas are considered inadequate for agricultural use as well as for urban development. Salt water swamps are commonly flooded by water with high concentrations of salt which comes from adjacent mangroves during periods of heavy rains.

#### **d. Geology**

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The island of Vieques belongs to the mountainous interior of Puerto Rico due to the fact that it is an extension of Puerto Rico's Central Mountain Range which has reached the surface thanks to natural erosion processes.

The oldest rocks found in Vieques belong to the Superior Cretaceous period. The bedrock varies in width from five centimeters to more than five meters and more. Plutonic rock formations from the Superior Cretaceous and Inferior Tertiary periods can be observed.

In the Superior Tertiary period, dolomite rocks and limestone were deposited over extensive portions of Vieques, followed by the rising and erosion of the Quarternary era. The most significant limestone formations can be observed at Punta Este, where submarine caves have formed.

The Quarternary deposits are divided into swamps, alluvial deposits and beaches. The existing alluvial deposits are found on the South coast from Esperanza to area of Camp García and in Ensenada Honda and Laguna Playa Grande while on the North coast, these deposits can be found at Valle de Resolución and Hacienda Arcadia.

Puerto Rico largest deposit for submarine sand, known as Escollo de Arenas, can be found off the coast of Vieques. This accumulation of submarine sand is of great economic importance and potential and extends along the extreme Northwestern shore of Vieques. It is estimated that it contains close to 90 million m<sup>3</sup> of sand and gravel. Geologic evidence shows that the composition of this sediment is principally terrigenous<sup>195</sup> close to the coast and biogenic<sup>196</sup> as it goes further away from the coast. This could suggest that removal of this sand would have little significance to the beaches due to the fact that they are naturally nourished by sand created by erosion. However, other geologic evidence suggests that under this embankment is an old sand deposit and that Punta Arenas is under continuous erosion and in currently moving 6 km to the northwest of its current location (USGS, 1996).

#### **e. Hydrology**

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Vieques, like Culebra, has superficial and underground water bodies, but lacks rivers. Two hydrogeographic areas in Vieques are defined by the points of highest elevation to the East and West. The area to the north has small rivers of short length while in the South has longer ravines which flow to the Southwest toward Puerto Real.

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<sup>195</sup> This is a material derived from erosion of an area located outside of a sedimentation basin and arrives in a solid state by means of transport.

<sup>196</sup> Biogenic sediment is formed by decomposing plants and animals which after death are incorporated are preserved through accumulated sediment. Sediment formed by corals, algae and other colonial organisms are known as calcareous. Other sediments can form from the partial decomposition of organic matter

## 5. Superficial water bodies

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Vieques possesses a number of ravines which form a small basin to the south with a capture area of approximately 2.6 km<sup>2</sup>. The reduced size of these ravines makes permanent water flow impossible except during long periods of rain. During the dry season, the channels of these ravines remain dry and those fed by springs tend to form small ponds.

The island also has around 12 coastal lagoons, many bordered by mangroves. These lagoons are: Playa Grande, Ensenada-Sombe, Puerto Ferro, La Chiva, Yanuel, Anones, Bahía Mosquito and Tapón. The last two lagoons present a bioluminescent phenomenon (Tapón shows some bioluminescence in some periods of the year).

To the north of the island are three more lagoons, which are Monte Largo, el Pobre and Kiani and to the east is Laguna Arenas.

## 6. Underground water bodies

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Vieques' hydrology includes two great aquifers used to supply the potable water demand for the island. To the West is the Valle de Resolución aquifer while in the South, covering an area of 10.36 km<sup>2</sup>, is the aquifer for Valle de Esperanza (between the communities of Esperanza and old Camp García). This aquifer recharges some five or six times a year during periods of heavy rain.

In past decades, after the installation of the pipe which transports water from the Main Island to Vieques, a re-establishment of the quality of the underground water has been observed. This is due to a substantial decrease in the water extraction, which was causing a rise in the aquifers' salt levels. The reduction in water extraction has also led to increased quality of the underground waters feeding the island's springs.

### 6.1.2 BIOTIC ECOSYSTEMS

Vieques possesses a great variety of land and aquatic ecosystems which includes vegetation associated to forests, grasslands, bushes, lagoons, wetlands, mangroves, coral systems and marine tall grass prairies.

The fact that the island's platform is relatively shallow on the North and relatively deep to the South affects the presence of diversity in marine life.

#### a. Flora

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Vieques is located in a sub-tropical region. It is believed that a great part of the island was once covered by a large sub-tropical humid forest (U.S. Navy, 2000). It is estimated that approximately 80% of Vieques' vegetation cover has been altered due to the agriculture, cattle ranching and military interventions. Since the end of agricultural activity in Vieques in the 1940s, vegetation has been resurging and is currently in diverse stages of this resurgence.

Vieques' vegetation is classified into 781 species of plants, many of which are resistant to high concentrations of salt and small amounts of water such as cacti, gramineae, xerophytes and semi-xerophytes bushes of which 660 are native and 221 are introduced.

Certain differentiation can be established between the diverse types of vegetation in Vieques. These are: beach grassy fields, evergreen fields on limestone areas, mangroves, highland forests and lowland forests. Vieques also counts with a black olive tree forest and other native humid vegetation can be observed.

The forests and highland grassy fields can be observed along the slopes of the hills at El Buey, the slopes near the Marungüey ravine and Monte Pirata. This latter is characterized for having the most diversity with larger trees which are rarer and aged. The vegetation which characterizes this type of forest is mesophyte with the palm tree (*Coccothrinax alta*), endemic to Puerto Rico and the U.S. Virgin Islands, being the most representative species of this type of vegetation.

A forest and highland grass field unique to Puerto Rico can also be observed at Punta Este while in the calcareous promontories near Puerto Mosquito and Puerto Rico, a vast array of species can be found as a result of diverse degrees of exposure to wind and salinity. Among there are: the shortleaf fig (*Ficus citrifolia*), gumbo-limbo (*Bursera simaruba*), puckhout (*Coccoloba microstachya*) and the locustberry tree (*Byrsonima lucida*).

Another natural vegetative community in Vieques is the evergreen grass land. These occurred in limestone rock formations and under arid conditions observed only in Puerto Mosquito, Puerto Ferro, extreme Eastern portions of the island and in Bahía Corcho in Vieques' south.

Another type of community observed in Vieques in the beach grass land, which can found in areas more or less stable. The existing vegetation in these areas can tolerate high concentrations of salinity as well as strong winds. The typical vegetation in these areas is composed of bushels and dwarf bushes whose main purpose is to keep sand in place and form dunes: Among these are: the railroad vine (*Ipomoea pes-caprae*), beach bean (*Canavalia maritima*), beach sandmat (*Chamaesyce buxifolia*), coastal searocket (*Cakile lanceolata*) and bushes or small trees such as the seaside tansy (*Borrichia arborescens*), sea grape (*Coccoloba uvifera*), blacktorch (*Erithalis fruticosa*) and the bay cedar (*Suriana maritima*).

Among Vieques' vegetative communities are diverse mangrove areas and other types of vegetation associated with lacustrine systems. This is observed primarily in the extreme East and in Punta Arenas to the West of the island. The species found in these lands are the red mangrove (*Rhizophora mangle*), button mangrove (*Conocarpus erectus*), white mangrove (*Laguncularia racemosa*) and black mangrove (*Avicennia germinans*). Other species of plants capable of tolerating high concentrations of salt are found on the island, among which are the black olive tree (*Bucida buceras*), of which a forest exists near Laguna Yanuel and the cóbana negra (*Stahlia monosperma*).

Some plants species classified by the USFWS and the DNER as threatened or endangered exist in Vieques. These are: thoma's lidflower (*Caliptranthes thomasiana*), which is found in Monte Pirata, the beautiful goetzae (*Goetza elegans*) and the cobana negra (*Stahlia monosperma*).

Some 42 species of marine algae have also been documented on the island. Among which are *Acanthophora spicifera*, *Acetabularia sp.*, *Agardhiella ramosissima*, *Agardhiella tenera*,

*Amphiroa fragilissima*, *Anadyomene stellata*, *Avrainvillanigricans* and *Bryothamnion triquetum*.

## **b. Fauna**

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Ecosystems in Vieques sustain an ample diversity of wildlife. The island serves as a habitat for 114 species of birds, three species of amphibians and 16 species of land reptiles (Naval Energy and Environmental Support Activity, 1984).

Among the bird species documented in Vieques are the white-crowned pigeon (*Patagioenas leucocephala*), considered as a critical element in DNER's Natural Heritage Program as is the white-cheeked pintail duck (*Anas bahamensis*) and the ruddy duck (*Oxyura jamaicensis*), both classified as threatened species at the Commonwealth level. The West Indian whistling duck (*Dendrocygna arborea*) has also been documented in the areas surrounding Kiani, Boca and Quebrada lagoons. This species is classified as critically endangered at the Commonwealth level (DRNA, 2008a).

Other bird species, such as the brown pelican (*Pelecanus occidentalis*) and the yellow-shouldered blackbird (*Agelaius xanthomus*), have been classified as endangered at the local and federal level. Also, the roseate tern (*Sterna dougallii*) is classified as threatened at both local and federal levels (USFWS, 2007b; DRNA, 2008a).

Among the land mammals found in Vieques is the red fig-eating bat (*Stenoderma rufum darioi*), while marine mammals include the bottle-nosed dolphin (*Tursiops truncatus*), the Antillean manatee (*Trichechus manatus manatus*), which is classified as endangered at both the federal and local levels, and the humpback whale (*Megaptera novaeangliae*), classified as an endangered specie.

Some 350 species of fish have been documented in Vieques of which 102 species are reef fish. Meanwhile, among the marine invertebrates found on the island are: two species of the fiddler crab (*Uca burgersi* and *U. rapax*), the conch (*Strombus gigas*), the mangrove oyster (*Crassostrea rhizophorae*), shells (*Littorina angulifera* and *Fasciolaria tulipa*), the tree oyster (*Isognomon alatus*), the ghost crab (*Ucides cordatus*), the black land crab (*Gecarcinus ruricola*) and swimming blue crabs (*Callinectes danae* and *C. bocourti*).

Among the reptiles documented in Vieques are the loggerhead sea turtle (*Caretta caretta*), the green turtle (*Chelonia mydas*), threatened species at the local and federal levels; the hawksbill turtle (*Eretmochelys imbricata*) and the leatherback turtle (*Dermochelys coriacea*), both considered endangered at the Commonwealth and federal levels. Another reptile documented in Vieques is the Culebra's giant lizard (*Anolis roosevelti*) (DRNA 2004c).

In two of Vieques' bays, in the Southern part of the island, the development of a high quantity of the microorganism *Pyrodinium bahamense* has been documented. This dinoflagellate is the cause of a condition on the water body known as bioluminescence, observed at Puerto Mosquito and Bahía Tapón.

### 6.1.3 MARINE AND COASTAL ECOSYSTEMS

#### a. Beaches

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Vieques' beaches are, for the most part, white sand beaches with clear waters – a main reason why they attract a large number of users. Among Vieques' most visited beaches are: Sun Bay, Media Luna, Navío and Esperanza. In the old Camp García, are Playa Caracas and Bahía de la Chiva, which are open to the public until 6:00 p.m.

To the west of the island, in lands formerly owned by the military, is the “Mosquito Pier,” a one-mile long road into the ocean with a pier at its end. This pier is used for diving activities as well as for night fishing.

#### b. Reefs

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The clarity of Vieques' coastal waters contributes to the presence of coral reefs, especially in portions of the East and South (See Map 30). These waters provide for favorable conditions for marine life as well as for aquatic recreation. Despite interventions from development activities, Vieques still home to the most unperturbed and healthiest coral reefs in Puerto Rico (DRNA, 2001a). NOAA has documented the presence of barrier reefs, patch reefs and disperse corals.<sup>197</sup>

A total of 13 different species of corals have been documented in Vieques including *Colpophyllia*, *Millepora*, *Montastrea*, *Diploria*, *Manicina*, *Porites*, *Siderastrea* y *Acropora* (GATP, 2003).

Vieques' coastal waters, as well as others around Puerto Rico with depths of less than 98 feet, were designated by NOAA in 2008 as critical habitats for the coral species staghorn coral (*Acopora cerviconis*) and elkhorn coral (*Acropora palmate*).<sup>198</sup>

#### c. Marine grasslands

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The presence of various species of marine grasses have been documented in Vieques, among which are the tortoise grass (*Thalassia testudinum*), the manatee grass (*Syringodium filiform*) and the shoal grass (*Halodule wrightii*). It is important to point out that in the West and Northwest areas of Vieques, the shallow waters has allowed for the development of submerged vegetation dominated by algae and marine grass. In fact, the marine grass prairie to the northwest of Vieques is considered to be the largest in all of Puerto Rico (USFWS, 2007c). This prairie extends for approximately 20.23 km<sup>2</sup> inside Puerto Rico's waters which are managed by the DNER, until reaching the Main Island between Punta Lima in Naguabo and Punta Algodones in Ceiba.

These prairies are an important habitat for threatened and endangered species such as the brown pelican, the green turtle and the Antillean manatee as well as species of great commercial and recreational value such as the conch.

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<sup>197</sup> See: NOAA Office of Response and Restoration. Vieques Island, Puerto Rico. Database and Mapping Project: [<http://mapping2.orr.noaa.gov/portal/vieques/habitat.html>].

<sup>198</sup> 50 CFR Parts 223 y 226. Vol. 73, No. 229. November, 2008.

**Leyenda - Map Key:**

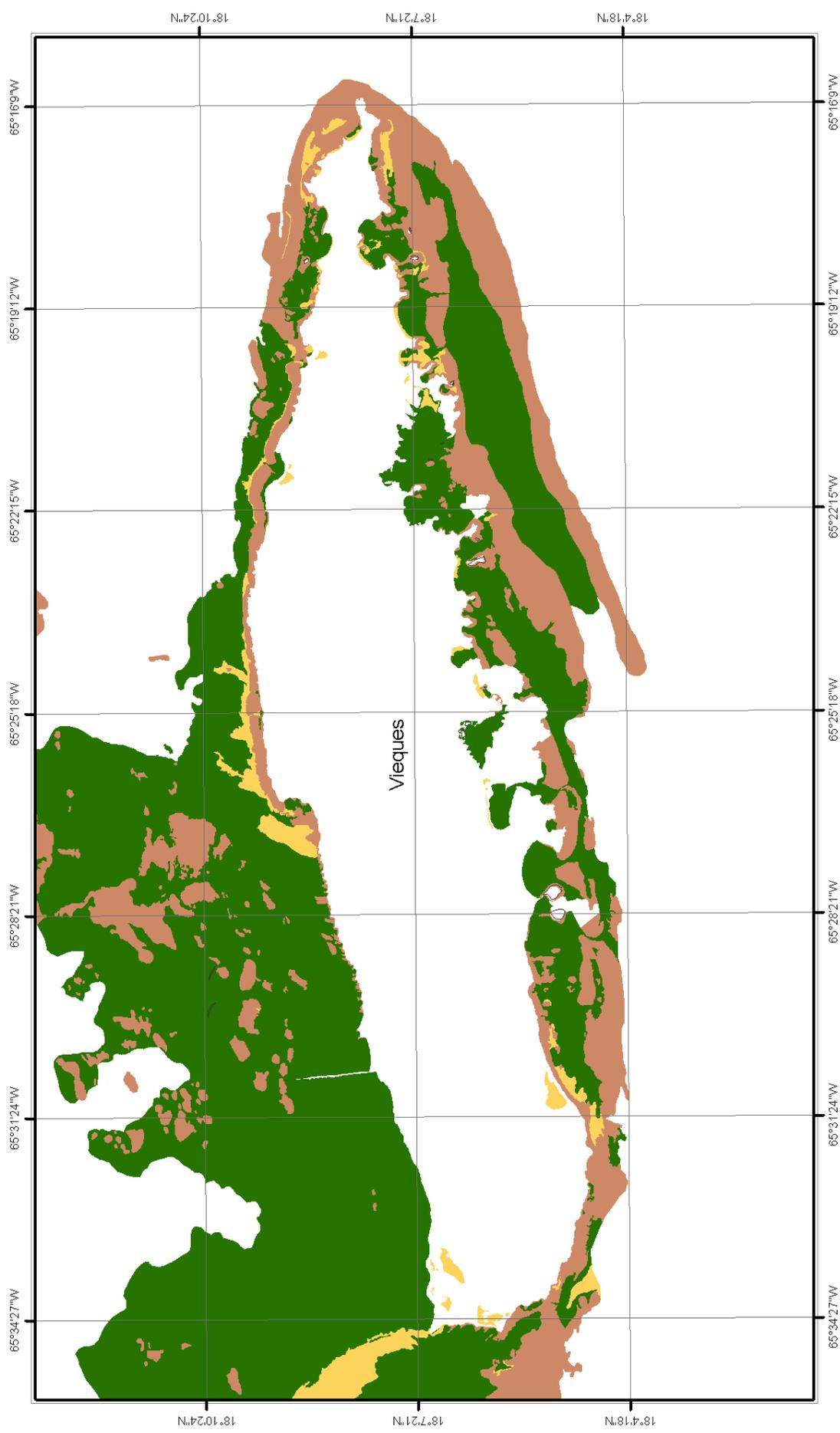
Arrecifes de coral y fondo sólido colonizado/  
Coral Reef and Colonized Hardbottom

Vegetación Sumergida /  
Submerged Vegetation

Sedimentos sin consolidar /  
Unconsolidated Sediments



Escala - Scale 1:1,500,000



# Hábitats bénticos en Vieques

## Benthic Habitats in Vieques

Fuente de Información - Sources:  
Benthic Habitats of Puerto Rico  
and the U.S. Virgin Islands - 2001

Programa de Manejo de la Zona Costanera  
Coastal Zone Management Program

Mapa 30 / Map 30

#### d. Mangroves and other wetlands

Vieques counts with highly productive natural systems such as the mangroves, as well as lacustrine and marine systems. Punta Arenas, to the west and the South coast are areas where diverse wetland systems can be observed. To the south, two bays protected from the open sea and bordered by mangroves and rocky formations are of particular significance. These mangrove systems, some of them directly on the coast, serve as a protective barrier against erosion during storms and high tides.

The most extensive mangrove areas are observed in Punta Arenas while other areas can be found in Puerto Mosquito and Puerto Ferro.

**TABLE VI-1. MANGROVES IN THE MUNICIPALITY OF VIEQUES**

Mangroves	Size	
	Cuerdas	Hectares
North of Vieques	69.1	27.1
Salinas Sur Cayo Conejo	12.2	4.8
Ensenada Honda	166.5	65.4
Laguna Yanuel	23.4	9.2
Bahía Chiva	22.3	8.8
Bahía Tapón	21.3	8.4
Puerto Ferro	66.0	25.9
Puerto Mosquito	91.4	35.9
Playa Laguna Grande	65.0	25.5
Punta Arenas	139.1	54.7

Source: DRN. 1990. Informative flyer.

#### e. Other habitats important for wildlife

In 2005, the DNER prepared the *Puerto Rico Comprehensive Wildlife Conservation Strategy*. In this document, the following objectives were established: 1) identifying the situation of species and their habitats, 2) identifying priorities for the conservation of these habitats and 3) establishing a process of regular monitoring directed at maintaining updated information regarding the two previous objectives.

In the afore-mentioned document, the following areas were identified as critical for wildlife in Vieques: the island's West coast, the mangroves at Ensenada Honda, Laguna Yanuel, the swamplands at Laguna Chiva, Bahía Tapón, Bahía Ferro, Bahía Mosquito, Bahía Sombé, Punta Este and Cayo Conejo. Vulnerable and endangered species in these areas are mentioned below:

TABLE VI-2. ENDANGERED AND VULNERABLE SPECIES IN VIEQUES

Endangered and vulnerable species in Vieques	
Area	Species
Western coast	<i>Patagioenas leucocephala</i> , <i>Anas bahamensis</i> , <i>Dendrocygna arborea</i> , <i>Dermochelys coriacea</i> , <i>Eretmochelys imbricata</i> , <i>Chelonia mydas</i> , <i>Caretta caretta</i> , <i>Trichechus manatus</i> , <i>Stahlia monosperma</i> , <i>Calyptanthus thomasiana</i>
Laguna Kiani	<i>Anas bahamensis</i> , <i>Oxyura jamaicensis</i> , <i>Dendrocygna arborea</i> , <i>Pelecanus occidentalis</i> , <i>Patagioenas leucocephala</i>
Laguna Playa Grande	<i>Anas bahamensis</i> , <i>Oxyura jamaicensis</i> , <i>Nomonyx dominicus</i> , <i>Stahlia monosperma</i> , <i>Goetzia elegans</i>
Mangroves of Ensenada Honda	<i>Trichechus manatus</i> , <i>Stahlia monosperma</i>
Laguna Yanuel	<i>Patagioenas leucocephala</i> , <i>Anas bahamensis</i> , <i>Stahlia monosperma</i>
Swamplands at laguna Chiva	<i>Anas bahamensis</i> , <i>Eretmochelys imbricata</i> , <i>Sterna antillarum</i>
Bahía Tapón	<i>Patagioenas leucocephala</i> , <i>Anas bahamensis</i>
Bahía Ferro, Bahía Mosquito and Bahía Sombe	<i>Anas bahamensis</i> , <i>Pelecanus occidentalis</i> , <i>Trichechus manatus</i> , <i>Falco peregrinus</i>
Punta Este de Vieques	<i>Anas bahamensis</i>
Cayo Conejo	<i>Pelecanus occidentalis</i> , <i>Sterna dougalli</i> , <i>Eretmochelys imbricata</i> , <i>Dermochelys coriacea</i> , <i>Chelonia mydas</i>

Source: DRNA. (2005). Puerto Rico Comprehensive Wildlife Conservation Strategy.

The DNER recommended 13 places to be designated as coastal barriers by virtue of the “Coastal Barrier Act”, *supra*. These coastal barriers are formations which provide protection for diverse habitats and serve as a first line of defense against weather events and erosion.

Their designation has the purpose of dissuading development by means of budget assignments in coastal areas which are fragile and of high risk. These areas are considered to be highly unstable for construction and susceptible to erosion. After their designation, these areas become ineligible for federal funds for the purpose of urban development, including flood insurance. Fishing and wildlife research would become the only activities permitted in these areas.

The areas recommended by the DNER were not adopted due to the fact that those lands belonged to the U.S. Navy. However, according to FEMA flood risk zone maps, the area around Sun Bay is identified as a protected area (Undeveloped Coastal Barriers- Otherwise Protected Areas Identified 1991 or later<sup>199</sup>) (Vieques MLUP, 2000).

<sup>199</sup> “Otherwise protected areas” is a category of coastal barriers already held for conservation purposes.

TABLE VI-3. AREAS RECOMMENDED AS COASTAL BARRIERS

Areas recommended as coastal barriers	
Name	Recommendation
Punta Arenas	Military (NAVY): Not adopted
Playa Grande	Military (NAVY): Not adopted
Puerto Negro	Military (NAVY): Not adopted
Bahía Playa Blanca	Military (NAVY): Not adopted
Anones Lagoon	Military (NAVY): Not adopted
Ensenada Honda	Military (NAVY): Not adopted
Yanuel Lagoon	Military (NAVY): Not adopted
Bahía La Chiva	Military (NAVY): Not adopted
Bahía Tapon	Military (NAVY): Not adopted
Ferro Port	Military (NAVY): Not adopted
Cayo de Tierra	Military (NAVY): Not adopted
Playa Grande Lagoon	Military (NAVY): Not adopted
Sun Bay Inlet	Commonwealth: Not adopted

Source: Department of Natural and Environmental Resources, Scientific Division, 1993.

#### 6.1.4 PROTECTED NATURAL AREAS

##### a. Vieques National Wildlife Refuge

The Vieques National Wildlife Refuge consists of two pieces of land to the east and west of the island. The Refuge includes an approximate area of 71.91 km<sup>2</sup> or about 54% of the island’s territorial extension and is managed by the USFWS.

The Eastern part of the Refuge was established in 2001 and consists of 12.54 km<sup>2</sup> of land. This land was used by the U.S. Navy since year 1943 as an area of management and disposal of munitions, communication installations and other areas of military support.

The Western unit was established in year 2003 and consists of 59.36 km<sup>2</sup> of land. This area was once the location of the Vieques Naval Firing Range. The area was transferred to the U.S. Department of the Interior (DOI) so it could be included in the Refuge. Within this area is the area formerly known as the area of live impact where no public access is allowed do to the dangers posed by possible unexploded ordnance and the clean-up process.

The Refuge sustains habitats important for native, migratory, rare and protected species. Six vegetation communities can be found in this refuge. They are: beaches, coastal forests, mangroves, dry forests, mixed evergreen forests and grasslands. The Refuge is also known for its pockets of white-sand beaches among which are: Playa Grande and Punta Arena (*green beach*) to the west and Playa Caracas (*red beach*) and Playa La Chiva (*blue beach*) to the east.

Four species of flora and 10 species of fauna currently in the federal list of endangered species have been identified in the Refuge. Among the flora species are: *cóbana negra (Stahlia monosperma)*, *Calypttranthes thomasi*, *Chamaecrista glandulosa var. mirabilis*, and the beautiful *goetzea (Goetzea elegans)*. Among the 10 species of animals, four are marine

turtles: the hawksbill turtle, the leatherback turtle, the green turtle and loggerhead turtle, the latter has been seen around Vieques but no nesting activity has been documented on the island. Among the bird species in the Refuge are: the brown pelican, the yellow-shouldered blackbird, the white-cheeked pintail duck, the peregrine falcon (*Falco peregrinus*) and the broad-winged hawk (*Buteo platyterusy*) while some of the marine mammals documented include the Antillean manatee, the blue whale, the humpback whale, the finned whale and the sei whale.

This Refuge counts with a management plan known as the “Comprehensive Conservation Plan”, approved in 2007. The Conservation Plan should serve as a management guide for the Refuge and parts from the premise that the lands will be eventually cleaned from whatever contaminants may pose a danger to wildlife or visitors to the refuge.

#### **b. Vieques Bioluminescent Bay Natural Reserve**

This area received the designation as a Natural Reserve (NR) on June 1, 1989 and is located to the south of the island and is comprised of 4.40 km<sup>2</sup> and a marine extension of nine nautical miles.

The Vieques Bioluminescent Bay Natural Reserve is managed by DNER. The lands belong to the National Parks Company (NPC), the Puerto Rico Industrial Development Company (PRIDCO) and DNER while other assets are of public domain.

This Natural Reserve is characterized for the presence of the dinoflagellate *Pyrodinium bahamense* which creates the bioluminescent effect on the waters of Bahía Puerto Mosquito, Bahía Tapón and Bahía Puerto Ferro. These bays are protected by mangroves, particularly Puerto Mosquito, which serves as a transition between land and marine ecosystems.

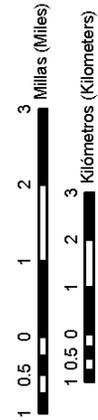
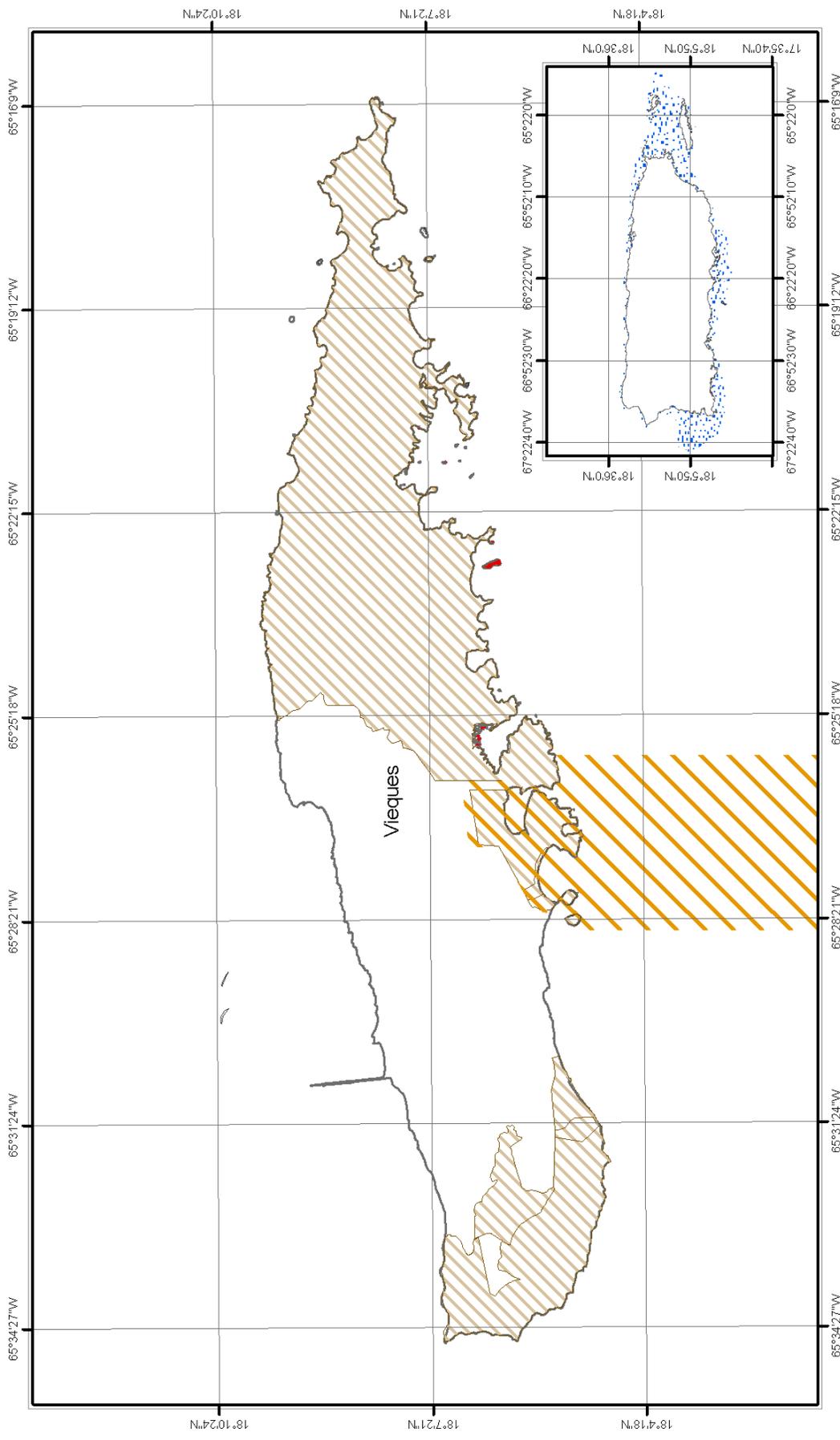
Other marine communities of interest in this area are the mangrove strip developing along the bays, the salt water swampland near Bahía Tapón, the salt deposits to the north of Puerto Mosquito and coral reefs (DRNA, 1988). Endangered species such as the key west quail dove (*Geotrygon chrysia*), the white-cheeked pintail duck, the manatee, the leatherback turtle and the hawksbill turtle have been observed in this area.



Escala - Scale 1:150,000

Reserva Natural Bahía Bioluminiscente de Vieques /  
 Natural Reserve Bioluminescent Bay of Vieques  
 Hábitat crítico *Agelaius xanthomus* -  
 Critical habitat yellow shouldered blackbird  
*Agelaius xanthomus*

Refugio Nacional de Vida Silvestre /  
 National Wildlife Refuge  
 Hábitats crítico *A. palmata* y *A. cervinolis* -  
*A. palmata* and *A. cervinolis* critical habitats



# Hábitats críticos designados, áreas naturales protegidas federales y Reservas Naturales (DRNA) en Vieques

## Designated critical habitats, federal natural protected areas and Natural Reserves (DNER) in Vieques



Programa de Manejo de la Zona Costanera  
 Coastal Zone Management Program  
 Mapa 31 / Map 31

Fuente de Información - Source:  
 NOAA National Marine Fisheries Service  
 DRNA - Coastal Zone Division  
 USFWS

## 6.1.5 SOCIO-ECONOMIC CONDITIONS

### **a. Population**

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The island municipality of Vieques is home to 9,106 inhabitants and has a population density of 69 inhabitants/km<sup>2</sup>. The 2000 Census identified eight wards in Vieques: Florida, Isabel Segunda, Llave, Mosquito, Puerto Diablo, Puerto Ferro, Puerto Real and Punta Arenas. When the Census was held neither Mosquito nor Punta Arenas had any inhabitants since these wards were part of the lands owned by the U.S. Navy at the time. In Llave only eight inhabitants were registered at this time.

Population projections by the PRPB indicate that in 2009, Vieques' population is 9,385. According to this data, it is estimated that Vieques population in 2025 will be 9,715 inhabitants, which suggests that no significant population increase is expected in the next few years.

### **b. Housing**

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In the 2000 Census a total of 4,388 housing units were reported of which 75.6% were occupied and 24.4% were vacant. Of the occupied residences, a total of 80.1% (2,657) were occupied by their owner while rented residences represented one fifth (19.9%) of the units. The wards which proportionally had more houses occupied by their owners were Puerto Ferro (87.6%), Puerto Real (87.3%) and Puerto Diablo (86.2%).

In regards to vacant residences (1,069 units), 46.6% were used for vacation purposes, 5.7% were up for rent and 2.9% were up for sale. The majority of these vacant housing units for vacation, recreational or occasional use (18.7%) were located in Puerto Diablo.

### **c. Recreation**

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Vieques counts with a great number of beaches, among which is the Sun Bay public beach on the South coast, managed by the NPC. This beach counts with facilities such as restrooms, camping grounds and parking areas.

South of Vieques, in the bays part of the Vieques Bioluminescent Bay NR, passive recreational activities are held, including night visits to observe the water's bioluminescent effect. Meanwhile, the coastal waters to the west of the island, in Punta Arenas, are intensely used to hold nautical and aquatic activities. In the Punta Mosquito area, aquatic activities, including fishing are held.

Another area used for recreation is the pier along the coast at Esperanza.

### **d. Tourism**

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Over the last decades, economic activities such as cattle ranching, agriculture and fishing have been substituted by the tourism industry. Villas, hotels, hostels and inns are plentiful on the island with over a dozen in operation accounting for 250 hotel rooms. The largest

hotel is the “W Retreat & Spa-Vieques Island” with 157 rooms. This installation will commence operation in 2009. Other smaller-scale facilities have been proposed for La Esperanza and La Hueca.

Currently, Vieques is part of tourism development activities which include facilities in Ceiba, Vieques and Culebra.

It should be pointed out that among the priorities of Vieques’ residents is the environmental conservation and protection of cultural and archeological patrimony. While the residents recognize the island’s potential for tourism, they have also expressed concern associated with current geographical, physical and infrastructure limitations. Faced with this reality, it is been suggested the development of ecotourism and cultural tourism as driving forces of the island’s economic activity (Estudios Técnicos, Inc., 2004).

### e. Fishing

Fishing is an important activity in Vieques. In fact, Vieques has the largest proportion of fishermen within its inhabitants in all of Puerto Rico. Vieques counts with two fishing associations and a significant amount of non-affiliated fishermen. There are two fishing villages: one located at Isabel Segunda next to the ferry terminal and another at Esperanza in Vieques’ South coast.

Fishing is Vieques’s primary agricultural activity with a production of more than 100,000 lb in 2000. However, in year 2006 the amount of pounds reported was 37,856 which marked a substantial decrease in productivity due to a reduction of the number of fishermen. This reduction is a consequence of the lack of profitability and the increasing number of permits required to fishermen by the government.

In Vieques, the majority of fishermen use nets as their principal technique, but a reduced group uses lobster traps while another smaller group dives for conch.

**TABLE VI-4. FISHERIES REPORTED IN VIEQUES 2002- 2006**

Fisheries reported in Vieques 2002-2006			
Years	Pounds	Value	Price per pound
2,002	357,801	886	1.86
2,003	61,568	149,722	1.78
2,004	76,923	190,669	1.88
2,005	32,245	78,920	1.86
2,006	37,856	108,511	2.29

Source: Data for years 2002 and 2003 came from the report: DRNA. (2005). "Overview of Puerto Rico's small scale fisheries statistics 2002-2004."

Data from the years 2004-2006: DRNA. (2007) "Puerto Rico/NMFS Interjurisdictional Fisheries Program, July 1, 2004- June 30, 2007 NA04NMF4340063" by Daniel Matos. September of 2007.

## **f. Land ownership**

---

The Municipality of Vieques has nine settlements with land owned by the general population, which are delimited by the Navy's land occupation on the island. These settlements are located in the central part of the island, and combined they occupy about one fourth of the island's territory.

The U.S. Navy held 105.23 km<sup>2</sup> of land in Vieques (76%) until year 2001 when it began to transfer its lands. Close to 12.55 km<sup>2</sup> were transferred to the DOI while 17.0 km<sup>2</sup> were transferred to the Municipality of Vieques and 3.24 km<sup>2</sup> were transferred to the PRTC. Later, another 59.37 km<sup>2</sup> were transferred to the DOI for a total of 71.91 km<sup>2</sup> under the jurisdiction of the USFWS.

The Federal government also retained ownership of around 0.39 km<sup>2</sup> on which the ROTH is located.

### **6.1.6 INFRASTRUCTURE**

#### **a. Energy**

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Vieques receives electricity by means of a 16 km submarine cable which travels from the Municipality of Ceiba to Punta Arenas.

Data submitted by PREPA included in the Vieques Land Use Plan indicates a gradual increase in consumption to a maximum of 10,084 kWh. Based on that consumption data and actual demand, it is estimated that the system will not need to be expanded any time soon.

In April 2009, PREPA announced its intention to make Vieques self-sufficient in energetic terms over the next one to three years. Plans include renewable energy projects with wind power to be established along the Bastimento and Punta Borinquen sectors. The main purpose of this initiative is to make the island independent, in energetic terms, and produce low-cost energy in order to make the island more attractive to the establishment of industries.

According to PREPA, Vieques has even more wind power potential than Culebra so, if necessary, it could transmit its surplus electricity to satisfy any energy demand for Culebra.

#### **b. Potable water**

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Potable water for Vieques is transferred by a 16-inch submarine pipe from Naguabo to a storage tank in Arcadia. From there, water is pumped to various storage tanks and pumping stations to later feed the distribution system.

Vieques' potable water system consists of 13 storage tanks, a pumping station and two relay stations which also supply water to Culebra via submarine pipe.

### **c. Sewer System**

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Vieques counts with a sewer system consisting of a treatment plant, nine pumping stations and main recollection system for the villages of Isabel Segunda and Esperanza.

This plant has sufficient capacity to meet demand and is located in the community Martineau to the north, and discharges its effluent 750 meters to the north of Punta Martineau.

### **d. Landfill System**

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Vieques' landfill is located on a 0.10 km<sup>2</sup> farm along PR-200 in the village of Santa María de Vieques. This landfill has been active since year 1997 and is operated, along with the trash collection, by the Municipal government.

The landfill is contiguous to lands formerly owned by the U.S. Navy on the north, south and east and to the west it is contiguous to lands owned by the Government of Puerto Rico. The landfill is also next to an unnamed ravine.

According to data from the Solid Waste Authority (SWA), the landfill receives about 246,000 lb of trash weekly (Wehran, 2003), which is equivalent to about 3.85 lb/person/day.<sup>200</sup> It is estimated that the volume of non-hazardous solid waste increases by 29% as a result of the floating population which visits the island on holidays and long weekends.

According to a report issued by the SWA, Vieques' landfill has the capacity to accommodate the island's needs for the next 18 years, making 2025 the year in which the landfill will have to be closed (ADS, 2007). SWA projects building a trans-shipment station to transport solid waste to Fajardo's landfill.

It should be noted that although Vieques' landfill appears to have no short-term problems, it is fundamental that the island's recycling program be intensified in order to prolong the landfill's active use. The island's geographic position, condition and size impose a serious limitation in locating another landfill (Estudios Técnicos, Inc., 2004).

### **e. Transportation**

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Transportation to and from Vieques is by air and sea. Vieques' airport, known as Antonio Rivera Rodríguez Airport, maintains routes to Fajardo, Luis Muñoz Marín International Airport, Isla Grande airport in San Juan and the U.S. Virgin Islands. Air transportation services are used by approximately 169,383 people each year.<sup>201</sup>

Port installations are located on the coastal zone of Isabel Segunda. The port serves routes between Vieques, and Culebra. The maritime route between Fajardo and Vieques is 18 miles

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<sup>200</sup> This generation of waste is three times higher than the mean of 5lb (2.3 kg) per person per day used by SWA for Puerto Rico.

<sup>201</sup> Data taken from the Ports Authority for fiscal years 2007-2008. See: [<http://www.prpa.gobierno.pr/uploads/Estadisticas/Estadísticas%20septiembre%202009/Vieques%20Pax.pdf>].

long with the average trip lasting about one and a half hours. According to the Municipal Land Use Plan (MLUP), close to 240,000 people use the ferry service and about 44,974 lb of cargo are handled each year.

Improvement work has been done at Punta Mosquito, to the northeast of Vieques, with the purpose of using it for commercial cargo and passengers between Ceiba and Vieques. The maritime route from Puerto Mosquito to what once were the installations of the Roosevelt Roads Naval Base would significantly save time and transportation costs.

Land transportation, meanwhile, is not structured in Vieques and consists exclusively of *publicos*<sup>202</sup> whose service is offered in accordance to passenger demand.

### 6.1.7 POLLUTION

The principal source of pollution in Vieques was military activity. For that reason, various areas of Vieques and its coastal waters which were used by the U.S. Navy were included in the Superfund Program, as stipulated by CERCLA, in 2005.<sup>203</sup>

Among the pollutants and threats identified in these areas - aside from unexploded ordnance- are remnants of explosives and dangerous contaminants such as mercury, copper, iron, lithium, magnesium, TNO, napalm, reduced uranium, PCBs, solvents and pesticides, among others.

In Vieques, the area which included military practices covered about 60.40 km<sup>2</sup> along with adjacent coastal waters and cays. The landfill was not included in the inventory since it is still being used by the Municipal government. The U.S. Navy originally identified 66 places (16 to the west and 50 to the east) were either polluted or had the potential to be polluted. After an investigation, 24 areas were identified as deposits of toxic and dangerous contaminants, other areas were suspected that dangerous materials were deposited and areas where spills occurred. Another 62 locations were marked as having explosives, munitions and one place on the West served as an area to dispose of munitions. All of these are being investigated and cleaned under the “Munitions Response Program”. Once all munitions are removed, then these places will be investigated to determine the extent of environmental contamination and determine which remedial action will be taken.

In 2008, the U.S. Navy, EPA, EQB and the USFWS, signed an agreement regarding Vieques’ environmental clean-up. Its purpose is to insure that environmental impacts are rigorously investigated and remedial actions are taken in order to protect the health and wellbeing of humans and the environment. Under this agreement, although the responsibility for the clean-up falls under the U.S. Navy, the activities must be done under the supervision of the EPA, EQB, USFWS and DNER.

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<sup>202</sup> *Públicos* is a term used in Spanish that could be translated as a “shared taxi”.

<sup>203</sup> See: <http://public.lantops-ir.org/sites/public/vieques/RegOverview/MR.aspx>].

In April 2009, the activities have concentrated on the investigation of certain areas, the development and implementation of a remedial investigation in certain areas of concern in Vieques and the removal of explosives and superficial munitions on the east of the island.

## 6.2 VIEQUES'S COASTAL MANAGEMENT

Since 1999 and after the end of military practices in 2003, the situation in Vieques has received particular attention from the Government of Puerto Rico with the purpose of addressing and providing solutions to the diverse and complex problems previously described. These initiatives, directed toward the development of the island, are described in the sections below.<sup>204</sup>

### 6.2.1 OBJECTIVES AND GENERAL POLICIES

#### **"Law to create the Vieques-Culebra Special Economic Development Zone", Law No. 153 of 2002**

This Law established the Vieques-Culebra Special Economic Development Zone. It recognizes the economic challenges to which the islands were subjected due to their isolation and the presence of military practices by the U.S. Navy. In response to this situation, the law offers tax incentives, creates an Interagency Committee and assigns funds for the development of the islands. The law states that "by converting Vieques and Culebra into a Special Economic Development Zone, a legal basis and an adequate planning framework will be provided for the different government agencies regarding the economic development of both islands". The law also created a Consulting Group composed of a team of professionals and an Interagency Task Force which includes various public officials to evaluate the economic conditions of Vieques and Culebra and design an integral economic development plan for both municipalities. This law contemplates the granting of tax credits on property, incentives for job creation, incentives for businesses and industries and access to financing.

#### **Master Plan for the Sustainable development of Vieques**

The Interagency Group and the Consulting Group created by the "Law to create the Vieques-Culebra Special Economic Development Zone" commissioned the preparation of a "Master Plan for Vieques' sustainable development." The Plan was prepared and approved on December 2004 and aims to achieve the island's economic development by means of active participation from residents to ensure social equity and the protection of the island cultural and natural resources. The Plan aims to be a tool thus the different agencies can channel their efforts and initiatives. At the moment, the result of the implementation of the Master Plan is unknown.

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<sup>204</sup> These initiatives, although formulated to guide the development of Vieques, do not constitute part of the mandatory public policies of the PRCZMP since they have not been incorporated through RPC.

## **“Law of Autonomous Municipalities”, Law No. 81 of 1991 and the Municipal Land Use Plan (MLUP)**

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This law, recognizing the Government of Puerto Rico’s policy of promoting orderly, rational and integral development of the lands and establishes that planning at the municipal level will be done with the use of MLUPs. These plans should contain strategies and dispositions to classify and qualify the lands as urban, developable, and rustic. Currently, Vieques counts with a MLUP approved by the PRPB in 2000. It is expected that, according to Law No. 81, competencies currently held by the PRPB and RPA are eventually transferred to the Municipality.

### **6.2.2 MAJOR PROBLEMS AND SOME NEEDED RESPONSES**

The Vieques Segment of the PRCZMP presents some of the problems of the island municipality whose resolution is important in order to achieve the conservation of natural resources and sustainable development of the island. Below, some of the principal problems affecting Vieques’ coastal management are presented.

It should be said, that Policies included in Chapter 3 are the PRCZMP enforceable policies to solve the problems identified in the following section. Also, Appendix B includes the means of exerting Commonwealth control over the coastal zone.

#### **a. Restoration of disrupted natural conditions**

##### **1. Squatters**

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Illegal constructions in Vieques have been a problem for decades since many of these are built on lands which once belonged to the Federal government. This practice has generated a series of problems with coastal access and contamination, particularly with the handling of discharges.

The MLUP for Vieques recognizes this practice and contains dispositions for those purposes. This document includes among its objectives the re-ordering of some of its informal settlements and their densification in order to create satellite settlements between its clearly defined population coastal poles in the traditional urban center of Isabel II and what will be known as the new urban center in Esperanza.

The DNER and the PRPB regulations which oversee that no new illegal structures are built on the maritime zone are the “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone”, Regulation No. 4860 and “Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico”, Regulation No. 17.

The elements of this program needed to tend to the problem with squatters are presented below:

**Enforce current laws and regulations to prohibit reconstruction:** Although the number of illegal houses used as primary residences is not exactly known, it is known that many of

these are used for vacation purposes. Therefore, the destruction of structures on the maritime zone due to significant weather events offers an opportunity to implement current regulations prohibiting the reconstruction of these structures. The prohibition of reparation or expansion of these structures is stated in the “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone”, *supra*.

Demarcation of the maritime zone. In order to establish effective patrolling of the maritime zone it is necessary to complete its demarcation. The DNER establishes the manner in which this process needs to be executed as instructed in the “Procedure manual for the demarcation of the interior limit of land inside de assets of maritime public domain,” approved in November 1999.

Inventory of houses to determine which ones are used as primary residences. It is necessary to identify which houses located on DNER land or in land of public domain are primary residences in order to assign enough resources so that the relocation of these residences can be executed.

According to the “Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone”, the DNER has the faculty to do inventories or registries of existing structures in the assets of public domain along the maritime zone.

## 2. Access to beaches and coasts

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Access problems to the coasts and beaches in Vieques are caused by squatters and for the general concern that some developments, illegally built, impede the enjoyment of public of this resource.

The RPA “Organic Law” and the “Zoning regulation for the Coastal Zone and Access to Beaches and Coasts in Puerto Rico” should be instruments which guarantee the public access to assets of public domain. This last regulation asks all development in front of the maritime zone to provide access to the beaches prior to the construction permit issued by RPA. The regulation also requires protection of important natural areas and prohibits new subdivisions of development which could deteriorate or destroy these resources.

By the same token, the “Law of Autonomous Municipalities”, *supra*, contemplates a guarantee of access to the beaches by pointing out that the municipalities will not endorse projects which imply private or exclusive enjoyment of the resources in jeopardy of the general public.

Identification of coastal accesses. It is necessary that Vieques’ residents and visitors clearly know the legal access points to the island’s coasts and beaches, reason why it is important that these be identified clearly and with proper signage.

It is important that routes be accessible, free of vegetation, objects or structures which can block traffic through these accesses. On the other hand, accesses established by habitual use for as long as anyone can remember should be respected and identified.

### 3. Pollution of coastal waters

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Due to its territorial extension, topography and soil characteristics, urban activities which occur in Vieques, as well as agricultural activities, have the potential of impacting waters and coastal resources. Sedimentation and erosion problems are such that it can be concluded that all development in Vieques has a direct and significant impact on its coastal waters.

Among the suggested measures to tend to these problems in Vieques are:

Adopt measures to control erosion and sedimentation. It is necessary to enforce the “Regulations for erosion control and sedimentation prevention”, Regulation No. 5754 of 1998 by the EQB and the corresponding Control of Erosion and Sedimentation (CES) permit which has the purpose of control erosion caused by human activity and prevent sedimentation and contamination of Puerto Rico’s bodies of water.

It is recommended that measures controlling non-point sources pollution as established by the “Management Plan for the Control on Non-Point Sources of Pollution in Puerto Rico’s Coastal Zone” are extended throughout Vieques. The measures described under the Plan serve as a guide for municipalities in implementing management programs for said sources of pollution and contains information on methods which are economically viable to reduce this type of contamination of superficial and underground waters.

Evaluate the cumulative impact of construction projects, their effect on coastal water bodies and associated ecosystems. Some of Vieques’ characteristics, such as the high susceptibility to erosion, contaminated lands as a result of military practices and arid climate, combined with an increase in construction demand that an analysis particular to the island municipality be completed. This analysis should incorporate measures which allow for the evaluation of the cumulative impact of projects and the capacity of natural systems on the island.

#### a. Solid waste management

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Although it was pointed out that Vieques’ capacity to handle solid waste is adequate until year 2025 and trans-shipment station is planned for transporting solid waste to Fajardo, it is important to address this matter since expansion of the current landfill is not a sustainable development alternative for Vieques.

In order to attend this problem, the island needs to strengthen recycling programs and adopt measures for reduction and re-use. To attend issues regarding solid waste, the following measures are recommended:

Work in coordination with the SWA to develop a recycling program. The solid waste handling system continues to receive a substantial amount of material with the potential to be recycled. It is necessary that the Municipality be more aggressive in creating awareness

about its recycling program and with the distribution of bins to businesses and residences and strengthen pick-up of these materials. This goal can be achieved in coordination with the SWA.

#### b. Pollution of areas used for military practices

The U.S. Navy is currently working on clean-up efforts as well as other remedial actions in the lands impacted by military activity and included in the Superfund. Data provided by this federal agency states that in three years, the U.S. Navy has removed 15,000 live munitions from 630 acres of land and removed 1,900 tons of trash for recycling. In the west, these removals have been done in the areas of deposits near a mangrove close to Laguna Kiani, among other areas.

Recently, the U.S. Navy asked the EQB for a permit to do a controlled burn of vegetation as part of “Plan for the Removal of Munitions from the Live Impact Area and East Conservation Area”. After completing the superficial removal of munitions due to the risk these pose for the public, the U.S. Navy proposes to do a controlled burn of dense vegetation for removal, since cutting it runs a risk of coming into contact with the remaining munitions. This controlled burn will facilitate visibility for personnel working on the removal and avoid accidental contact with these munitions (JCA, 2008). The EQB granted the permit to do the controlled burn as long as air quality standards are not altered and the health of residents is not placed at risk. However, some concern has been raised regarding the impact this burn may have on the island’s ecosystems.

According to Navy personnel, it is estimated that it will take five more years to remove all of the explosives left behind after decades of live fire practices to later concentrate solely soil decontamination activities.

#### c. Management of public lands and waters

The DNER is the Puerto Rico’s government agency responsible for the management of assets of public domain in the maritime zone and coastal resources, except for those considered excluded federal lands. In Vieques, the USFWS has entered into cooperation agreements with the DNER and the PRCT to manage coastal resources separated as conservation zones by the Federal government.<sup>205</sup>

In 2001, the USFWS and the Government of Puerto Rico, represented by the DNER and the PRCT signed an agreement for the management of lands in the Western portion of the island transferred to the USFWS and the PRCT. According to the agreement, the lands transferred to the PRCT must be protected and preserved for perpetuity and managed by a cooperative agreement between PRCT and USFWS. This agreement also included the marine grasslands to the west of Punta Mosquito. Other aspects of the agreement were:

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<sup>205</sup> According to the “Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001”, which orders the transfer of the lands on the West of Vieques, designated as Conservation Zones. The agreement is known as the “Cooperative Management Agreement Among the Commonwealth of Puerto Rico, the Puerto Rico Conservation Trust, and the U.S. Department of the Interior to Manage Lands on the Island of Vieques”.

- The preparation, in a term no longer than nine months, of a management plan to protect and preserve coastal, land and historic resources in the area subject to the availability of funds and applicable federal and local law and
- The application of federal and local laws

It should be noted that the implementation of this agreement is subjected to the availability of funds of each part.

Since the U.S. Navy's exit, the amount of visitors to Vieques has significantly increased and, therefore, the amount of users of the coastal resources. As was previously discussed, one of the frequented areas for aquatic activities is the area to the west of the island at Punta Arenas. Considering these factors, it is recommended that:

Prepare a management plan, as prescribed in the agreement for the management of the land and coastal waters in the Western part of the island which should include the marine grass prairies, considered to be the most extensive in Puerto Rico. The plan should plan the use of the beaches for recreational purposes and consider the needs for wildlife, a topic particularly important for the beaches used for nesting by marine turtles. The plan should also consider the diversity of users who will be using the area's resources.

Transfer protected lands to the DNER. Some 3.81 km<sup>2</sup> of land at Finca La Esperanza, part of the Vieques Bioluminescent Bay NR, are property of PRIDCO. These lands have been managed by the DNER since year 1989 through a lease agreement.

As stipulated in the "Puerto Rico Natural Heritage Program Act", Law No. 150 of 1988, the DNER can acquire lands through purchase, donation, legacy, exchange, expropriation or by any other legal means from any person, Puerto Rico government agency or the U.S. government. Currently, the Natural Heritage Program is doing a series of studies with the purpose of acquiring these lands.

Rigorously enforce local and federal laws for the adequate management of lands which are assets of public domain. The DNER is responsible for the management of territorial waters, submerged lands and the maritime zone as stipulated in the "Regulation for Use, Surveillance, Conservation, and Management of the Territorial Waters, Submerged Lands Thereunder and the Maritime Zone", *supra*.

Request the designation of mangrove areas that were recommended as coastal barrier or as "otherwise protected areas". These can be re-nominated by the Commonwealth for inclusion as full coastal barriers or "otherwise protected" units".

#### d. Guidance of development on public and private property

Coastal natural resources are a fundamental part of Vieques' patrimony making it essential that it is rationally used and well guarded. Vieques' MLUP, the Plan for Vieques' Sustainable Development and this Program provide guides for the development of the island municipality.

Some of the problems and answers associated to Vieques' development are:

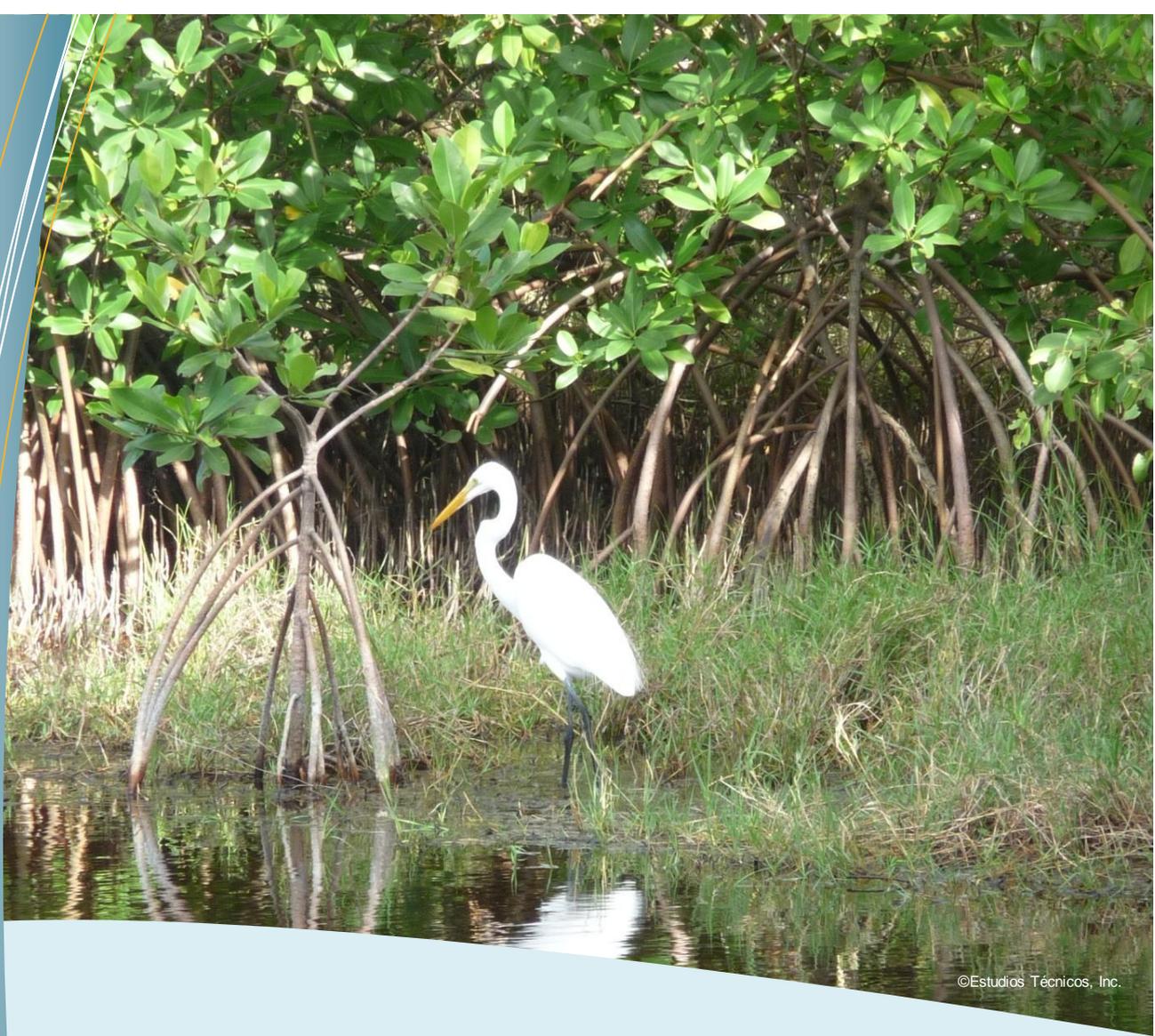
Avoid sprawl of coastal communities. A problem which has surfaced since the U.S. Navy's exit has been speculation with land. In order to address this problem, it is necessary to articulate a government intervention that puts a stop to rise in prices for land on the island, reduce speculation and insure that reasonable costs prevail to tend to future needs for housing and economic development. In coastal areas, this has an effect of dislocating local populations for one with more buying power. Therefore, it is necessary that measures be adopted to deal with the speculation problem, especially those which have been acquired through programs to promote the construction of social interest housing.

Do an analysis regarding Vieques' Limit of Acceptable Change (LAC): LAC concepts will help in the changes of uses for the territory, particularly with the process of urbanization that the municipality faces. It is recommended that a study be done where the degree of modification tolerable for Vieques' resources under specific management is determined. This exercise requires a permanent monitoring and feedback process which will allow for more adequate management measures and to maintain desirable conditions.

### 6.2.3 RESPONSIBLE COMMONWEALTH AGENCIES AND SOME MEASURES ADOPTED

The responsibility for guiding Vieques' development and to attend the needs previously identified falls on the following Puerto Rico's Government principal agencies as they were described in Chapter 4. These are: PRPB, RPA, EQB and DNER.

The Municipality of Vieques and the Interagency Group has the responsibility of working with federal and local agencies in the adequate management of the lands on the island. With the approval of the MLUP in 2000, the PRPB adopted the zoning established by the Municipality which will guide the use of the land for the next eight years after its approval.



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DRNA  
<http://www.drna.gobierno.pr>

Departamento de Estado  
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Junta de Calidad Ambiental  
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National Parks Service

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National Register of Historic Places

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NOAA

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