Manejo Integrado de Cuencas Hidrográficas en el Suroeste de Puerto Rico: Guanajibo y las Cuencas Costeras de Cabo Rojo

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Puerto Rico del Monte al Mar
Centro Interpretativo Salinas de Cabo Rojo
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¿Quienes Somos?

- Organización sin fines de lucro, no gubernamental y de base comunitaria.
- Dedicada a establecer proyectos de conservación desde una perspectiva de manejo integrado de cuencas hidrográficas.
- Oficinas en Yauco
- Fundada en enero de 2012

Protectores de Cuencas

Recursos y capacidades

Native Plants Nursery:

- More than 60,000 plants produced yearly
- Restoration Projects across the Island

Monitoring Equipment

- HACH 2100Q Portable Turbidimeter
- HACH SL1000 Portable Nutrient Multiparameter
- YSI Multiparameter
- HANA Ammonia Medium Range Portable Photometer - HI96715
- IDEXX Quanti-Tray System for bacteria

Restoration Equipment:

- 12 4x4 Pick up trucks
- 6 4x4 6m Dump Trucks
- 1 4x4 Service Truck
- 2 20m Dump Trucks
- 2 Backhoes
- 2 Crawler Dozers
- 2 Compacting Rollers
- 2 Skid Steer
- 6 water trucks
- 6 trailers
- Hydromulcher
- 2 Mini excavators
- 1 Mid Excavator
- 2 Boats

Staff:

- 8 Technical Personnel
- 30 General Labor experts in BMP and Green Infrastructure
















Colaboradores:

Puerto Rico Wire

MACCAFERRI

sartorius stedim biotech

CEFI
Equipándote para crecer.

NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

DRNA

U.S. Fish & Wildlife Service

Yauco

Guánica

Guayanilla

Lajas

hispanicfederation

DISTRITO DE CONSERVACION DE SUELOS
Y
AGUAS DEL SUROESTE, INC.

National Fish and Wildlife Foundation

NRCS
Natural Resources Conservation Service

AEE
Autoridad de Energía Eléctrica
Estado Libre Asociado de Puerto Rico

Universidad de Puerto Rico
Utuado
19 79

Universidad de Puerto Rico
Recinto de Río Piedras
1903

Recinto Universitario de Mayagüez
CAAM
Universidad de Puerto Rico

United States Environmental Protection Agency

GLM Engineering-Coop

Horsley Witten Group

ridge to reefs

Autoridad de Acueductos y Alcantarillados

CBSV
Coalición Pro Bosque Seco
Ventanas Verdaco

Vigilantes del Planeta
Capitolio de Gerbera

Ferretería Maderas 3C

Forest Service
U.S. Department of Agriculture

USGS

NASA
Ames Research Center

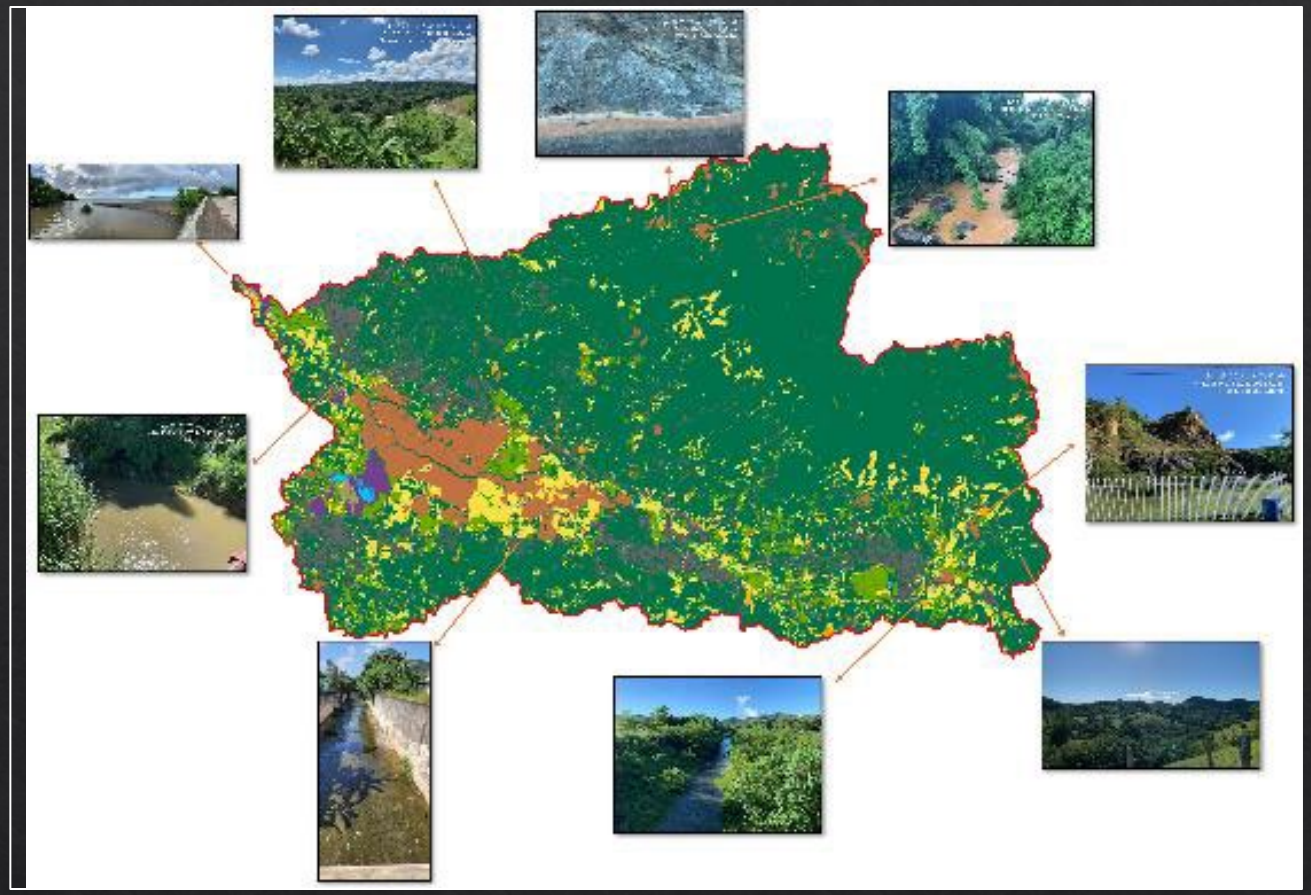
The University of Texas at Austin
Teresa Lozano Long Institute
of Latin American Studies

Fundación Comunitaria de Puerto Rico

Fundación Toyota

USDA

Association of Zoos & Aquariums



Manejo Integrado de Cuencas Hidrográficas

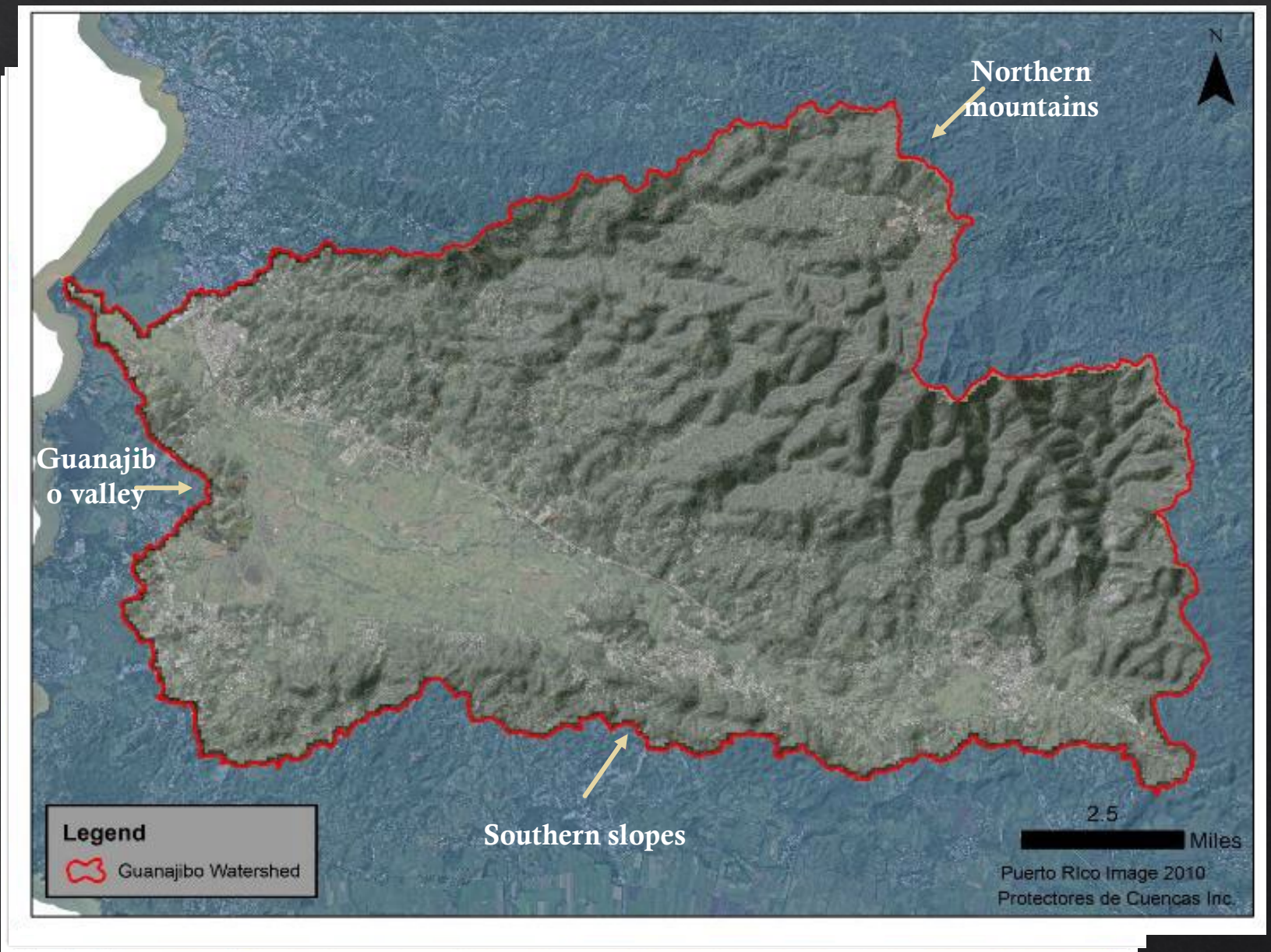
Ciclo del Plan de Manejo de Cuenca

- Definir limites geográficos
- Integración de partes interesadas
- Conocer Cuenca
- Identificar y priorizar problemas
- Proponer proyectos
- Implementar
- Medir efectividad
- Adaptar

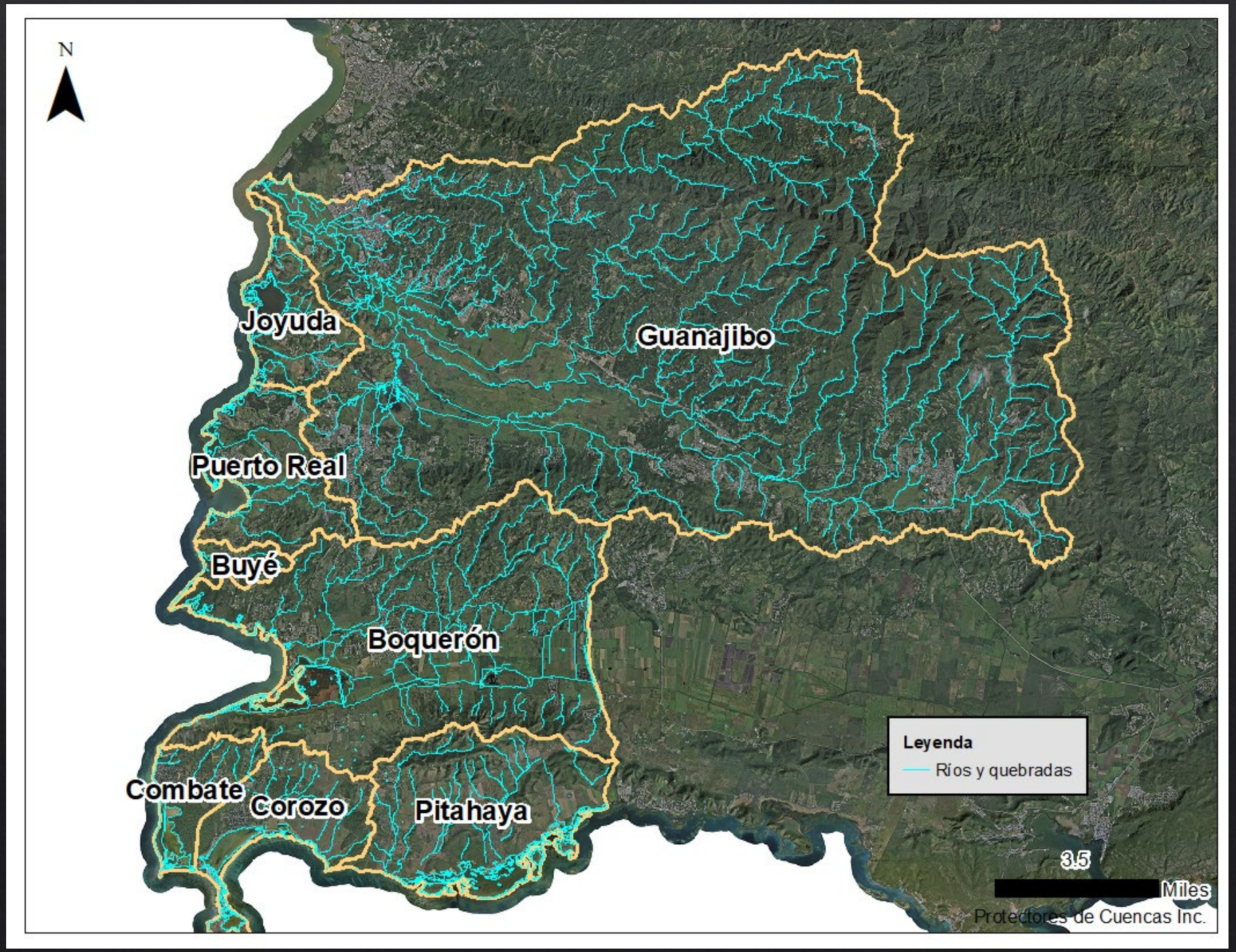
La Cuenca Hidrográfica como unidad de planificación

- La Cuenca hidrográfica conecta nuestros recursos sin considerar límites administrativos.

- Acciones que se llevan a cabo en una localidad afectan localidades aguas abajo.

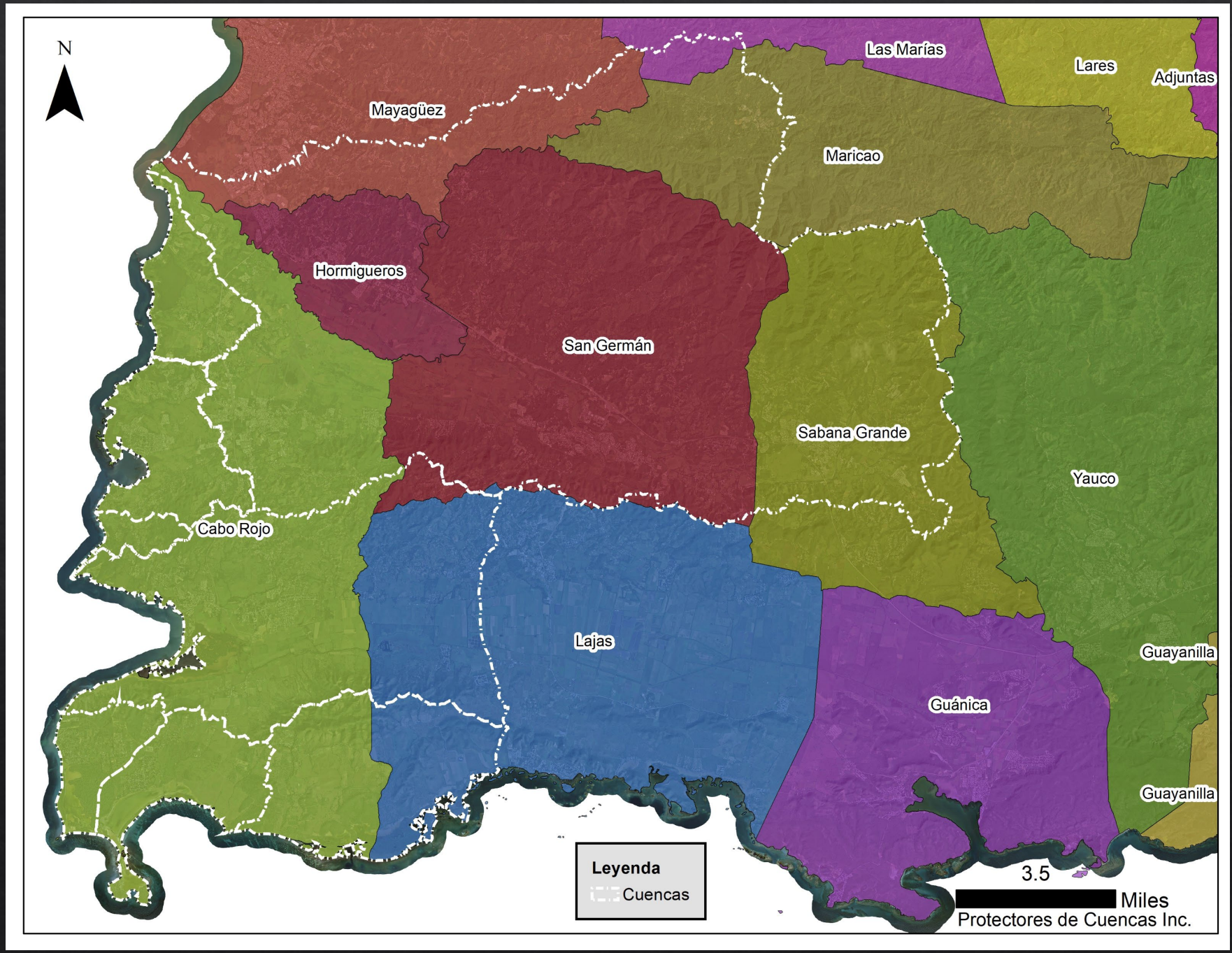


Área de Interés



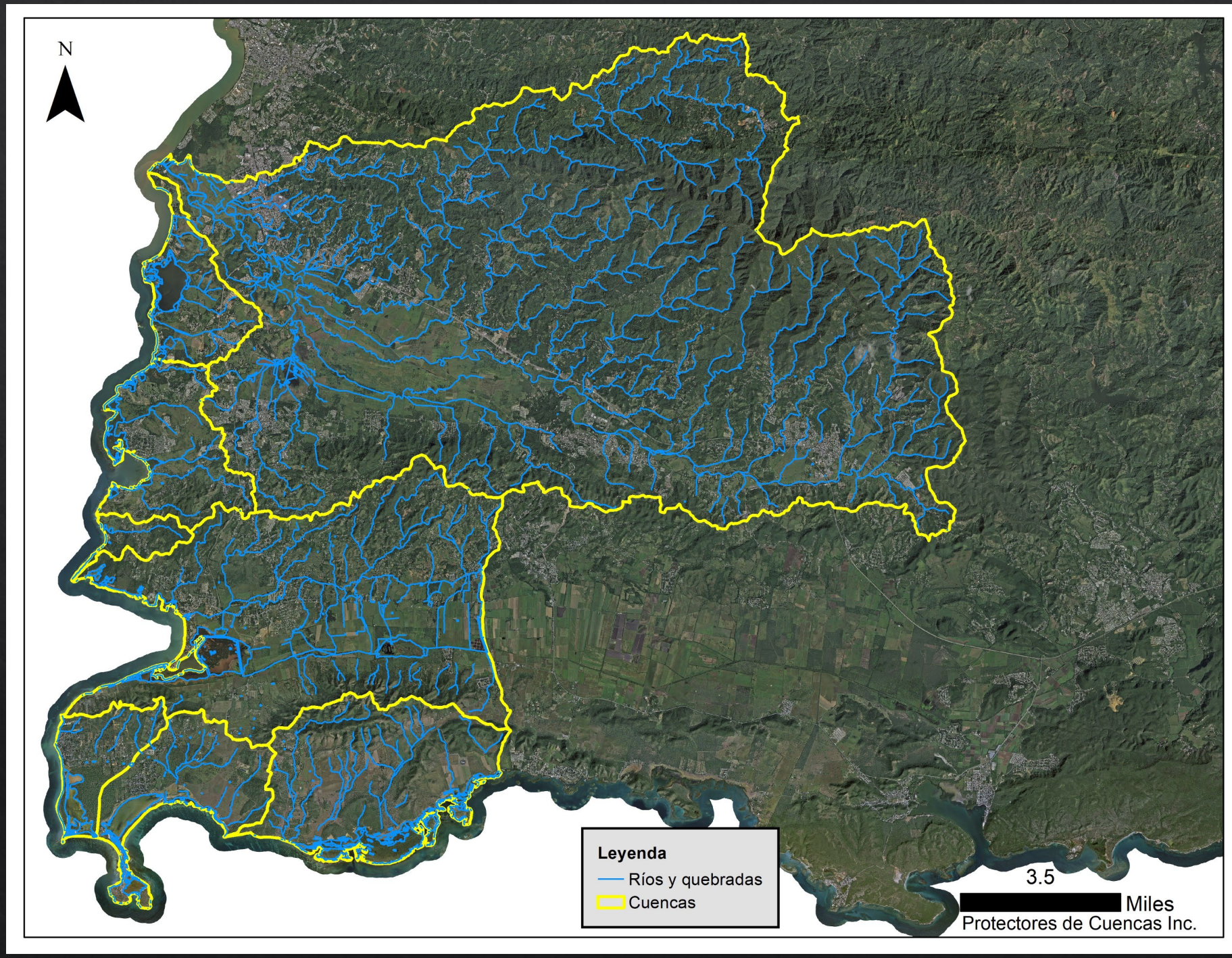
Municipios en las Cuencas

- Ocho municipios dentro de los límites de las cuencas.



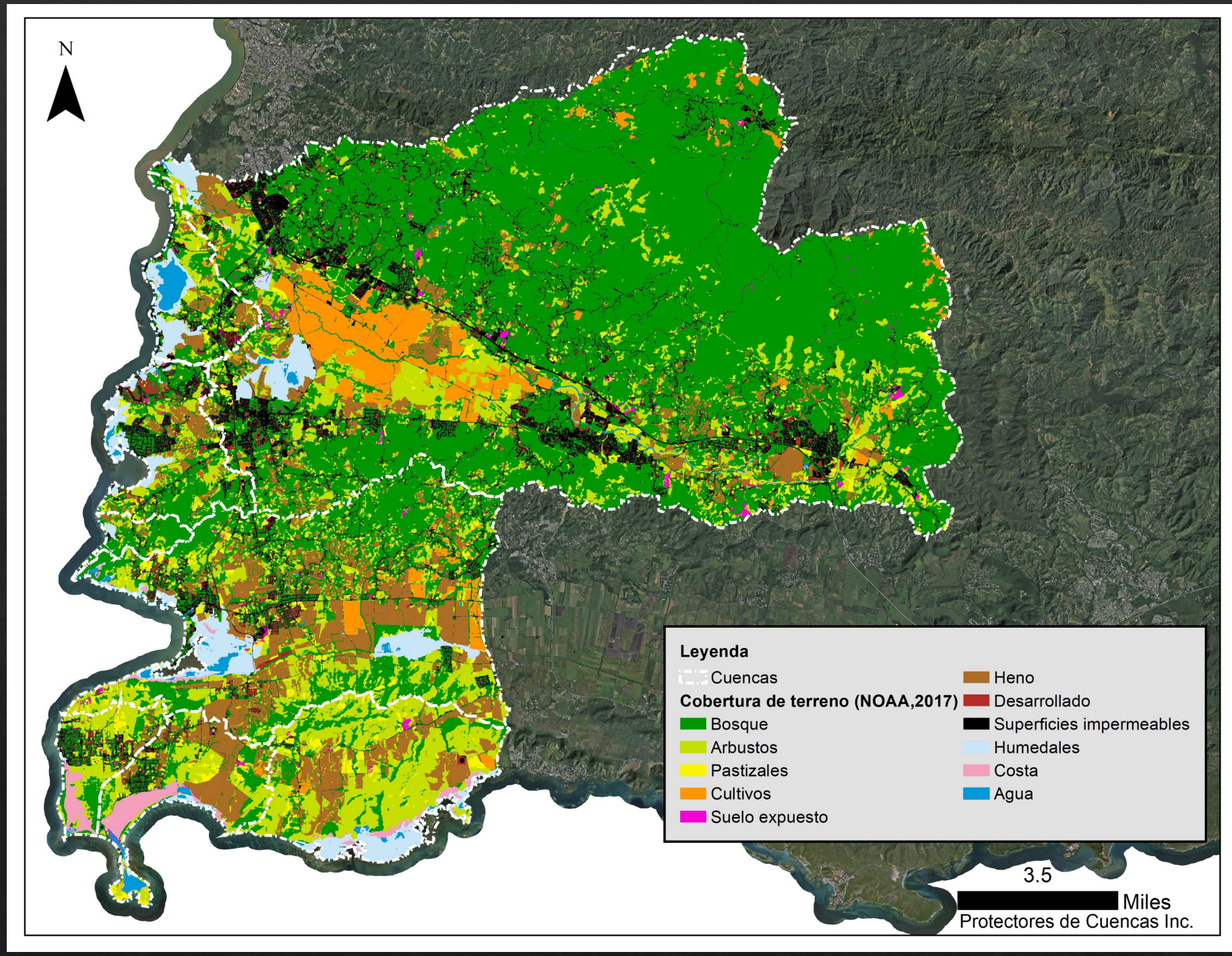
Hidrología en las cuencas

- Ríos Principales:
  - Río Guanajibo
  - Río Rosario
  - Río Caín
- Dominan las quebradas intermitentes en las cuencas costeras.
- Múltiples Ríos Patrimoniales en Área de Bosque de Maricao



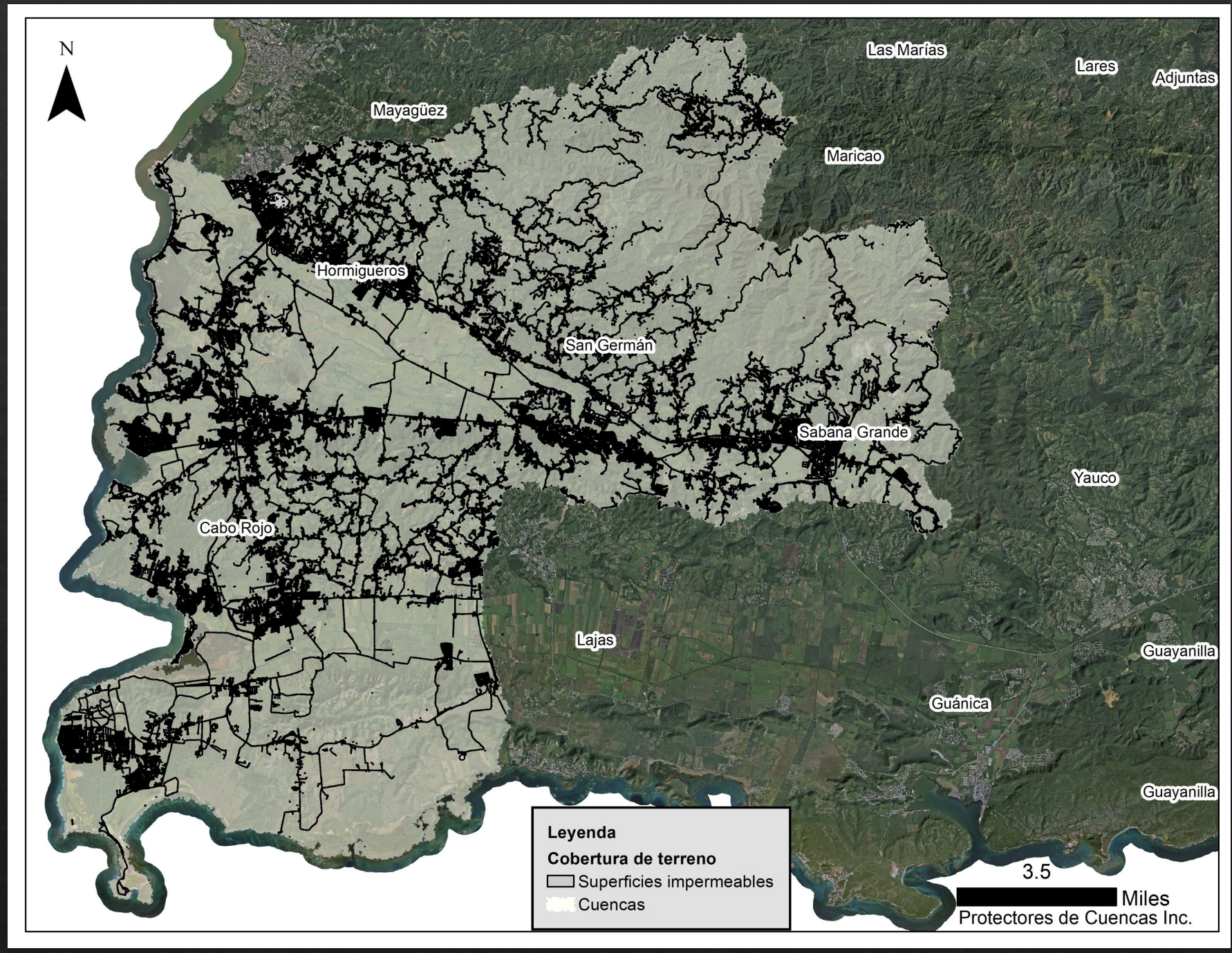
Cobertura de Terreno 2017 NOAA C-CAP

- Domina la cobertura forestal.



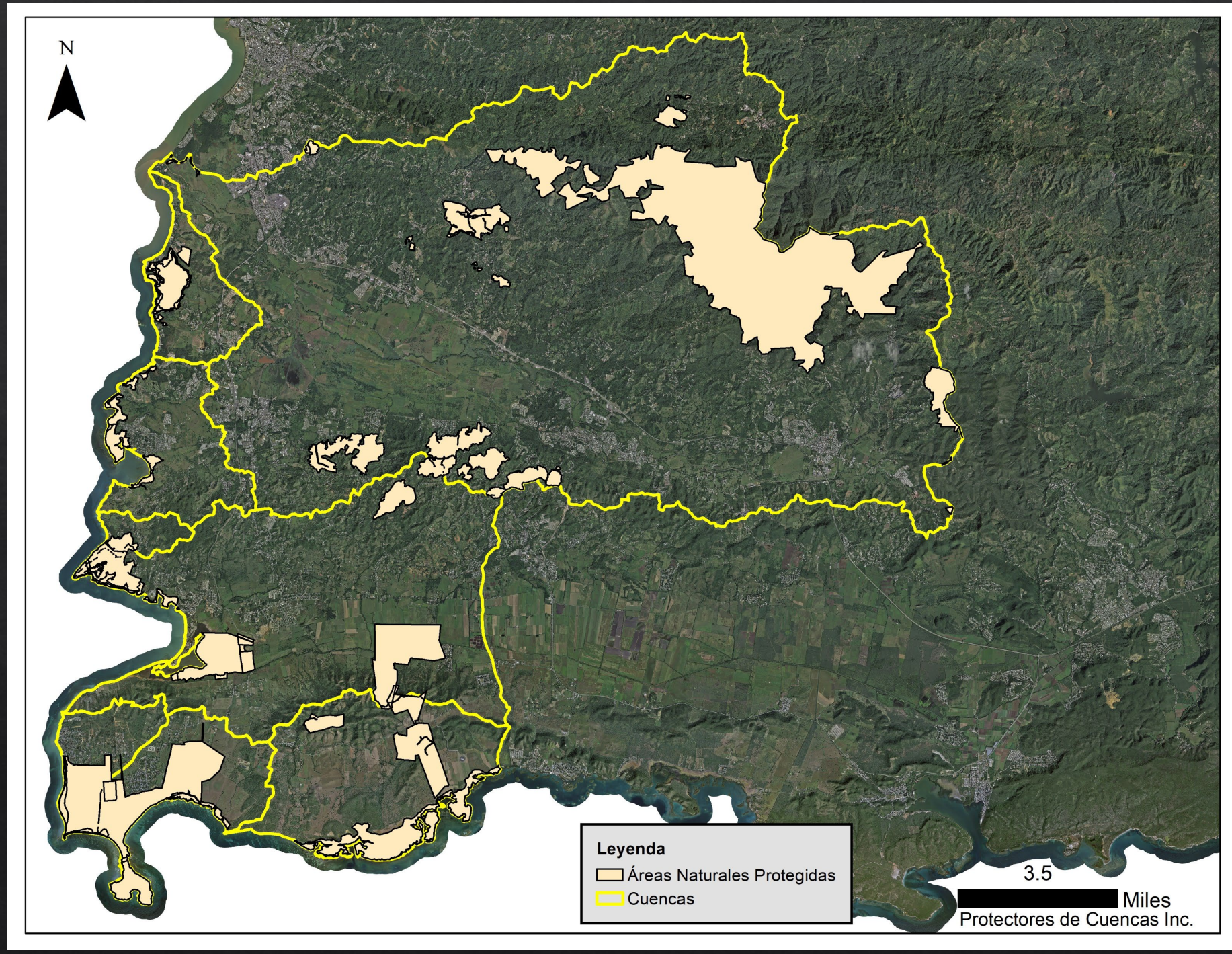
Superficies Impermeables

- Casco Urbano de:
  - Cabo Rojo
  - San Germán
  - Hormigueros
  - Sabana Grande
  - Porciones de Mayagüez

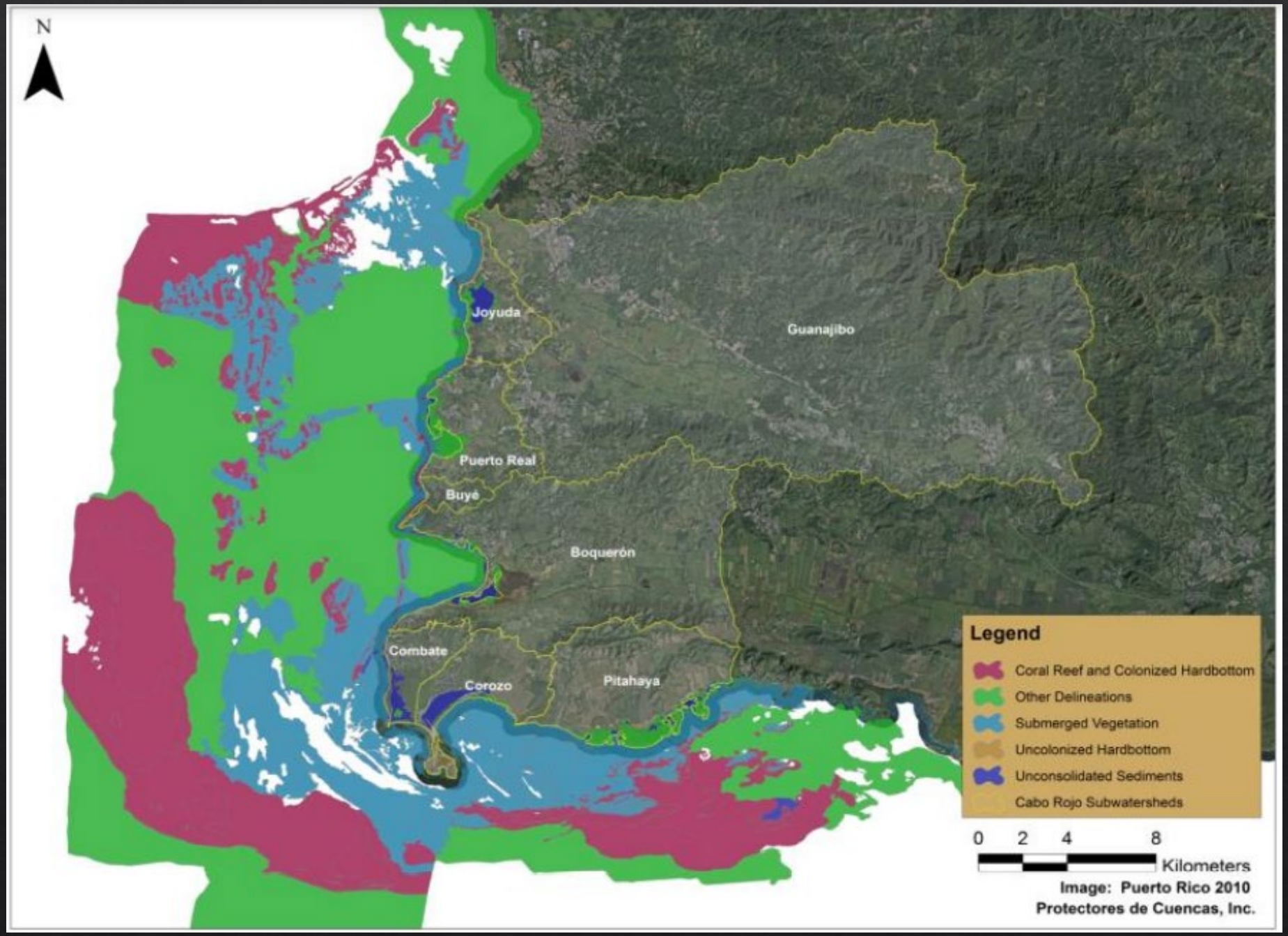


Áreas Naturales Protegidas

- Bosque Estatal de Maricao
- Bosque Estatal de Susúa
- Bosque Estatal de Boquerón



Ecosistemas Marinos Importantes



Esfuerzos de Manejo Integrado de Cuencas Hidrográficas

Plan de Manejo de Cuencas de Cabo Rojo 2014

- Plan de Manejo que traza el curso de acciones de prioridad para mejorar calidad de agua para consumo humano y salud de ecosistemas coralinos.
- Estudio de investigaciones pasadas.

CABO ROJO

COMMUNITY WATERSHED ACTION PLAN FOR WATER QUALITY AND CORAL REEFS

PREPARED FOR

NATIONAL FISH AND WILDLIFE FOUNDATION

NOAA CORAL REEF CONSERVATION PROGRAM

PUERTO RICO DRNA

MUNICIPALITY OF CABO ROJO

PREPARED BY

Paul Sturm

Ridge to Reefs

Roberto Viqueira –Rios

Jeiger Medina

Glenis Padilla

Protectores de Cuencas

Coral Reef Summaries

Edwin A. Hernández-Delgado

Carmen González-Ramos

Alfredo Montañez-Acuña

Abimarie Otaño-Cruz

Gerardo Cabrera-Beauchamp

University of Puerto Rico, Center for Applied Tropical Ecology and Conservation

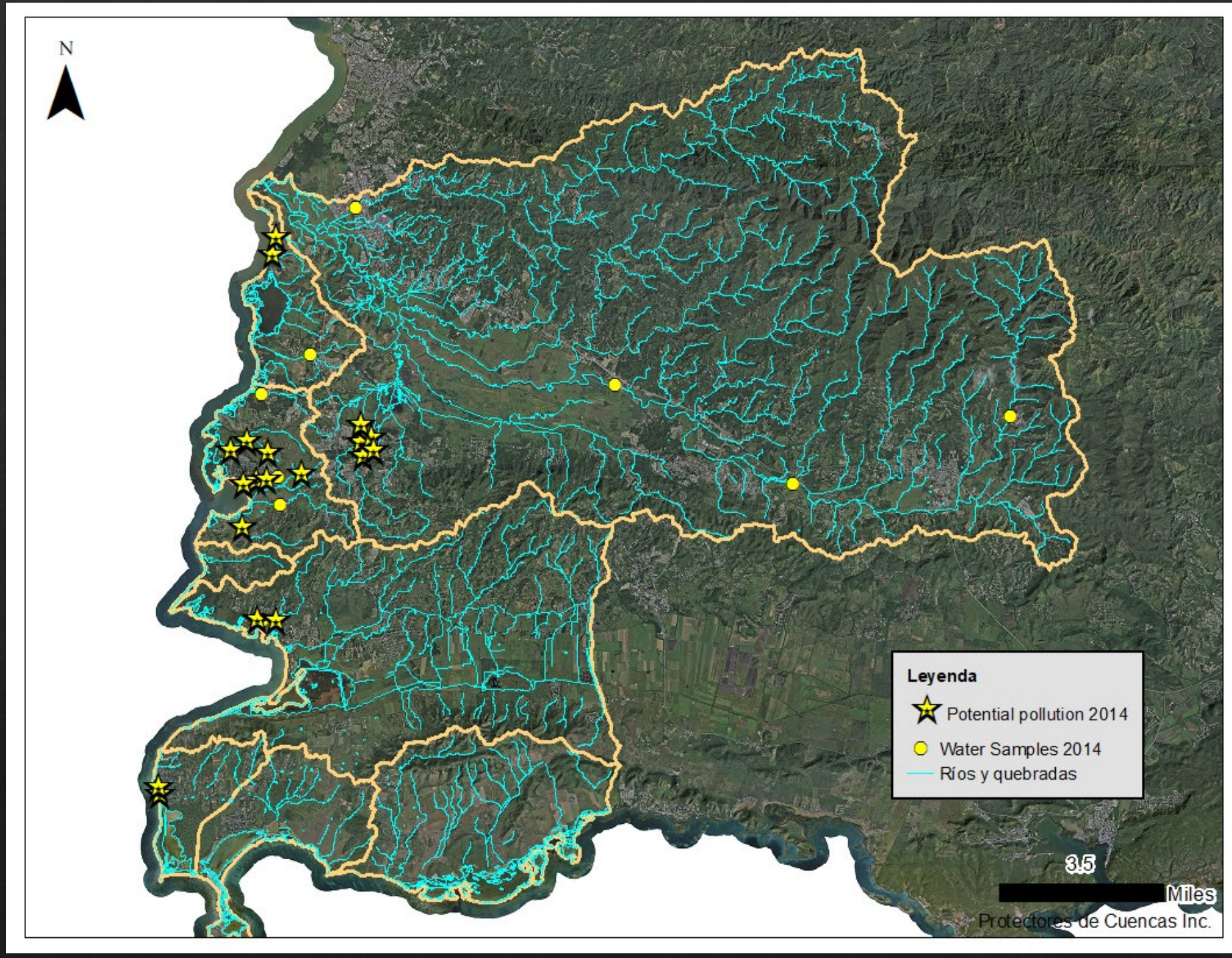
Sociedad Ambiente Marino

Proceso de consulta con partes interesadas/"stakeholders".

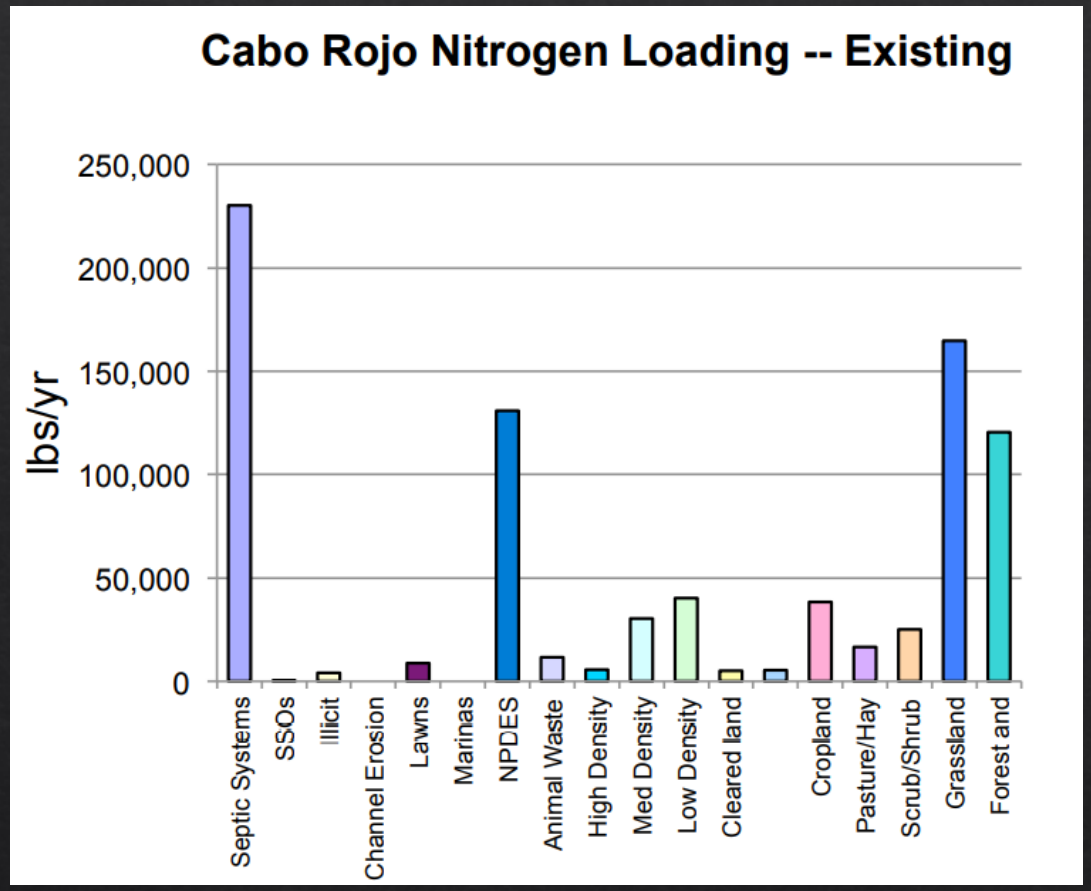
Figure 6. Stakeholder Meeting; Small Groups Setting Goals and Priority Areas

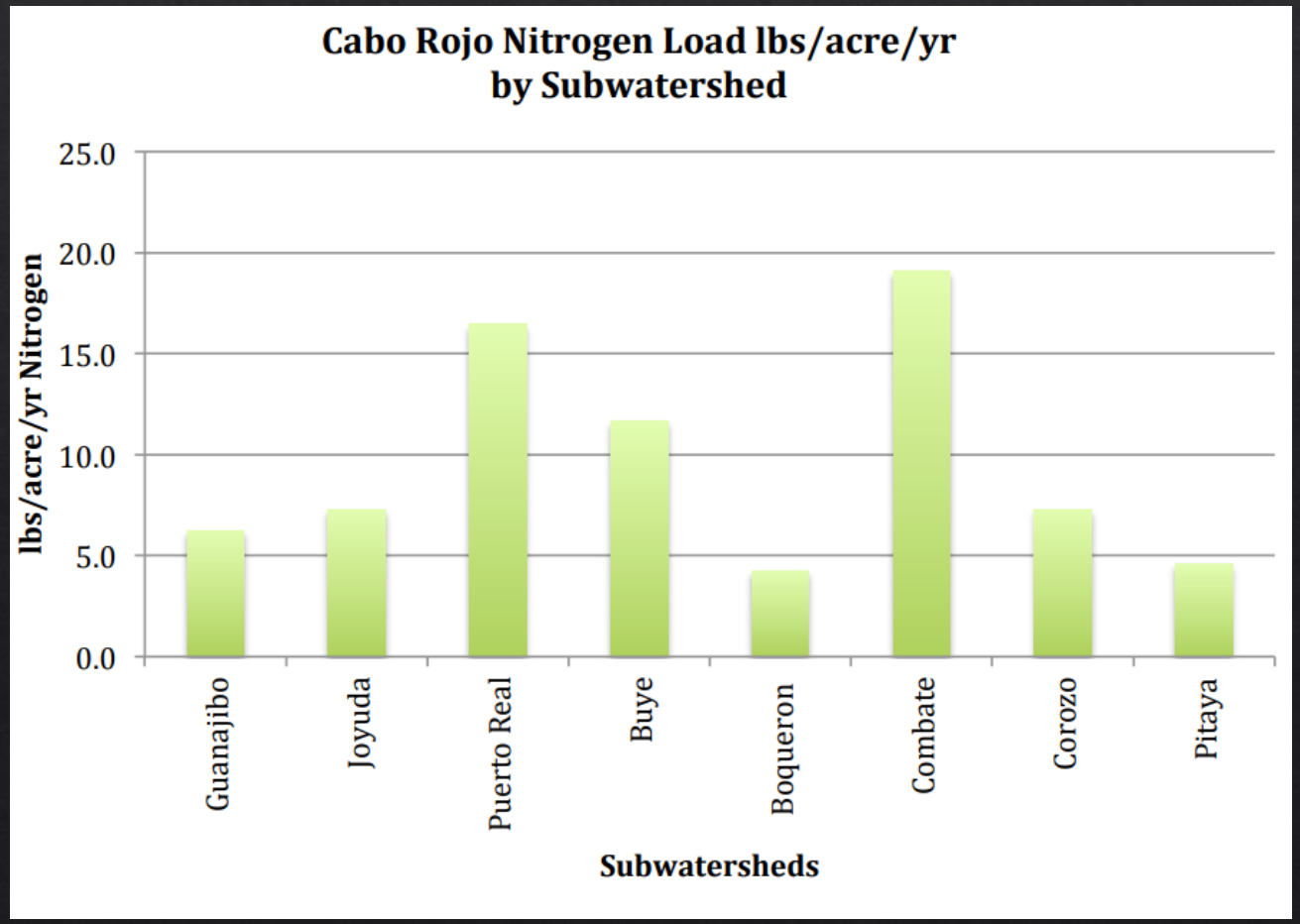
- Control de Inundaciones y escorrentías urbanas.
- Reducir contaminación de alcantarillados y pozos sépticos.
- Atender descargas ilegales en las costas.
- Estabilizar suelos expuestos.
- Proteger arrecifes de coral.
- Control de erosión de áreas urbanas y rurales.
- Proveer Educación Ambiental a través del sistema público.
- Fortalecer comunicación entre diferentes sectores.
- Implementar y monitorear beneficios de plan de manejo de cuencas.
- Crear plan de monitoreo de calidad de agua.
- Mejorar y expandir sistema de alcantarillado sanitario.
- Promover reforestación.
- Aumentar bosques ribereños.
- Promover practicas de restauración para beneficio estético de comunidades.
- Identificar fuentes de financiamiento.
- Prevenir disturbios en áreas naturales.

Calidad de Agua en 2014



Modelaje de fuentes importantes de contaminación





Identificación y priorización de proyectos de restauración

- Proyectos prioritarios mayormente relacionados a contaminación de agua por infraestructura sanitaria, erosion y sedimentación.

Appendix A-7. Priority Ranking of Restoration Projects in Cabo Rojo

Site	Description	Priority	Estimate	Water Quality	Education	Feasibility	Impact	Total
PR-1 Puerto Real Connections	Connect all homes and businesses along the waterfront to sewer as well as in other targeted locations were septic failures were obvious	Very High	$200,000	5	4	4	10	23
CBR-1 Illicit Connections Cabo Rojo	Fix illegal connections and sewer leaks	Very High	$15,000	5	4	4	10	23
COM-3 Large sediment trap	Create a large sediment trap downstream of the eroding ATV (4-track) trails -- determine if any of the existing trails can be shut down to reduce the overall impact	Very High	$200,000	5	4	4	10	23
PR-2 Stormwater Treatment Wetlands	Runoff from the town area is conveyed through a ditch in an adjacent farm into a stream and them the coastal environment	Very High	$100,000	5	3	4	10	22
PR-4 Illicit Connections	Track down and address other water quality issues and illegal connections/ sources of pollution	Very High	$20,000	5	3	4	10	22
CBR-2 Urban Drainage GI	Integrate green infrastructure and vetiver into the urban drainages and the river -- the help address infow of stormwater runoff and other pollutants	Very High	$50,000	5	3	4	10	22
COM-1 Reduce impact of septic systems	Fully funded sewer connections throughout Combate, or vetiver and beach berm buffer restoration to intercept flow of nutrients to coastal waters	Very High	$1,000,000	5	3	4	10	22
COM-6 Beach monitoring	Set up monitoring program working with the community to monitoring beaches around Cabo Rojo and specifically Combate beaches	Very High	$15,000	4	5	5	8	22
GUA-2 Extraction/Industrial Sites	Creation of a program to address runoff from quarries and aggregate plants and distribution centers	Very High	$200,000	5	4	3	10	22
GUA-4 Erosion on dirt roads and coffee farms	Address erosion from dirt roads and sun coffee farms in the Upper Guanajibo	Very High	$75,000	5	4	5	8	22
JOY-2 Sewer Connections	Work with homes and businesses that are not connected to the sewer to get connected -- this may require extension of sewer in some areas -- where and if extension is not possible alternative treatment systems should be investigated (pump and treat)	Very High	$150,000	5	4	3	10	22
PR-4a Illicit Connections	Additional area of needed connections to sewer/IDDE	Very High	$50,000	5	4	4	8	21
CBR-4 Treatment wetland at Public Works	Reduce the impact of the public works yard and create a model for addressing runoff from a large industrial site -- treat first flush separately from flood flow	Very High	$75,000	5	4	4	8	21
COM-2 Dirt Road Stabilizations	Reduce impact of dirt roads on water quality in the Combate area -- implement runoff controls and sediment traps	Very High	$60,000	5	4	4	8	21
BOQ-1 Sewer connection for Balineario	Provide a direct connection to the sewer line for the Balineario beach area rather than having the effluent pumped and transported to WWTP -- leaks/clogs have been noted in the current system	Very High	In process*	5	4	4	8	21
BOQ-5 IDDE in Boqueron	Elevated bacteria concentrations were noted adjacent to the businesses and oyster farming in Boqueron as well as in some of the more rural drainages	Very High	$10,000	5	4	4	8	21
BOQ-11 Sediment traps	Construct sediment traps to capture runoff and soil before it enters mangroves and protected areas	Very High	$100,000	5	4	4	8	21
JOY-1 IDDE	Track down and address water quality issues and illegal connections/ sources of pollution in areas identified in monitoring (See water quality data)	Very High	$10,000	5	4	4	8	21
COR-1 Reforestation	Reforestation of critical areas in the headwaters of the drainage to Corozo (various unforested parcels in headwaters)	Very High	$40,000	5	3	5	8	21
COR-2 Address stormwater	Integrate a green infrastructure project with the Municipality for flooding control (point represents a potential project area -- though multiple exist)	Very High	$30,000	5	4	4	8	21
COR-4 Sediment Traps	Construct sediment traps and address flow from adjacent dirt and paved roads -- use vetiver and dirt road practices	Very High	$80,000	5	4	4	8	21
COM-7 Septic Education	Septic education and pumping in the entire area of Combate	High	$20,000	4	4	4	8	20
BOQ-3 Sediment Traps in the Poblado	Sediment trap and raingarden in the dirt parking lot for Boqueron to reduce sediment transport to the mangroves	High	$30,000	4	4	4	8	20
BOQ-8 Implement Oysteria Streets or Bahia Calles	Implement a sea streets approach in Boqueron to address stormwater runoff and reduce threats to shellfish populations	High	$100,000	4	4	4	8	20
BOQ-9 Stormwater wetlands on farms	Locate stormwater wetlands in areas with contaminated flow	High	$100,000	4	5	5	6	20
BOQ-10 Partnerships and outreach with oyster farmers	Work on a conservation and education program with oyster farmers and the public	High	$15,000	4	4	4	8	20
GUA-3 IDDE/ Guanajibo	Track additional sources of contamination including areas around Guanajibo River	High	$15,000	5	3	4	8	20
COR-3 Wetland Construction	Construct wetland or landscape treatment systems to address failing septic systems	High	$40,000	4	4	4	8	20
PIT-1 Stabilize Roads	Stabilization of dirt roads running perpendicular to shoreline (investigate additional locations)	High	$20,000	4	4	4	8	20
PR-3 Pilot Oyster Restoration Project	Pilot a project for dock owners to grow oysters after the connections to sewer are done -- the goal primarily would be to improve water quality and filtration	High	$20,000	3	5	5	6	19
COM-5 Park area	Integrate GI into the new park area	High	$20,000	5	4	2	8	19
ELF-2 Road stabilization	Stabilization of roads to El Faro	High	$150,000	3	4	4	8	19
CBR-3 School GI project	Create a pilot Green Infrastructure stormwater retrofit at a local school	High	$15,000	3	5	4	6	18
B-1 Impact of septics in Buye	Determine the impact of septics in Buye and determine a strategy to address the likely impacts of nitrogen moving to the coastal enivronment	High	$25,000	5	3	4	6	18
COM-4 Boat Ramp	Runoff from the boat ramp area is currently not being effectively treated due to a clogged BMP -- fix the BMP or replace the practice with Green Infrastructure -- considered a grassed or paver lot for a portion of the site	High	$15,000	4	4	4	6	18
BOQ-2 Oxidation Ponds around manholes	Place rain garden type oxidation ponds with vetiver and other plants known for uptake around manholes that have overflow issues	High	$15,000	4	4	4	6	18
BOQ-4 Raingarden at scuba shop	Construct a raingarden to capture and treat the 1st flush of runoff from the adjacent street in Boqueron	High	$12,000	5	3	4	6	18
BOQ-7 DNER Nursery	Install sediment traps, rain gardens and rainwater harvesting practices at the nursery to reduce sediment runoff from the site which has been considerable	High	$35,000	4	4	2	8	18
GUA-1 Buffer Zones	Establish buffer zones along the Guanijibo River	High	$60,000	3	4	3	8	18
PR-5 Local Volunteer Water Quality Monitoring Program	Engage the community in a volunteer monitoring program to track conditions in Puerto Real	High	$10,000	3	4	4	6	17
ELF-1 Marine Debris	Reserva Bosque Los Murillos – Marine Debris Control Project and Wetland Restoration to increase connectivity	High	$40,000	3	4	4	6	17

Proyectos Implementados

Evaluación de Proyecto de Control de Erosión en Los Pozos en 2014

ridge to reefs

Retrofit Investigation Form **RIF**

DATE: 5-13-14	**SUBWATERSHED:** Boqueron	**UNIQUE SITE ID:** COM-3

SITE DESCRIPTION Sediment basin in area North of Combate/Los Pozos

Name/Address: Los Pozos

Ownership: ☐ Public ☒ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 21 acres
Imperviousness ≈ — %
Impervious Area ≈ —

Land Use: Scrub/Shrub bare soil

EXISTING STORMWATER MANAGEMENT/INFRASTRUCTURE

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Potential Conflicts/Permitting

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:

≅ 20+ acre drainage w 4-track usage conveying large amounts of sediment to nearshore waters

Existing Head Available and Points Where Measured:

Need survey

PROPOSED RETROFIT

Retrofit Volume Computations - Target Storage:

Suggest sizing for 3in rain event
4.2 ac/ft on 1.25 acres

Retrofit Volume Computations - Available Storage:

Would need survey + precise D.A. Calc

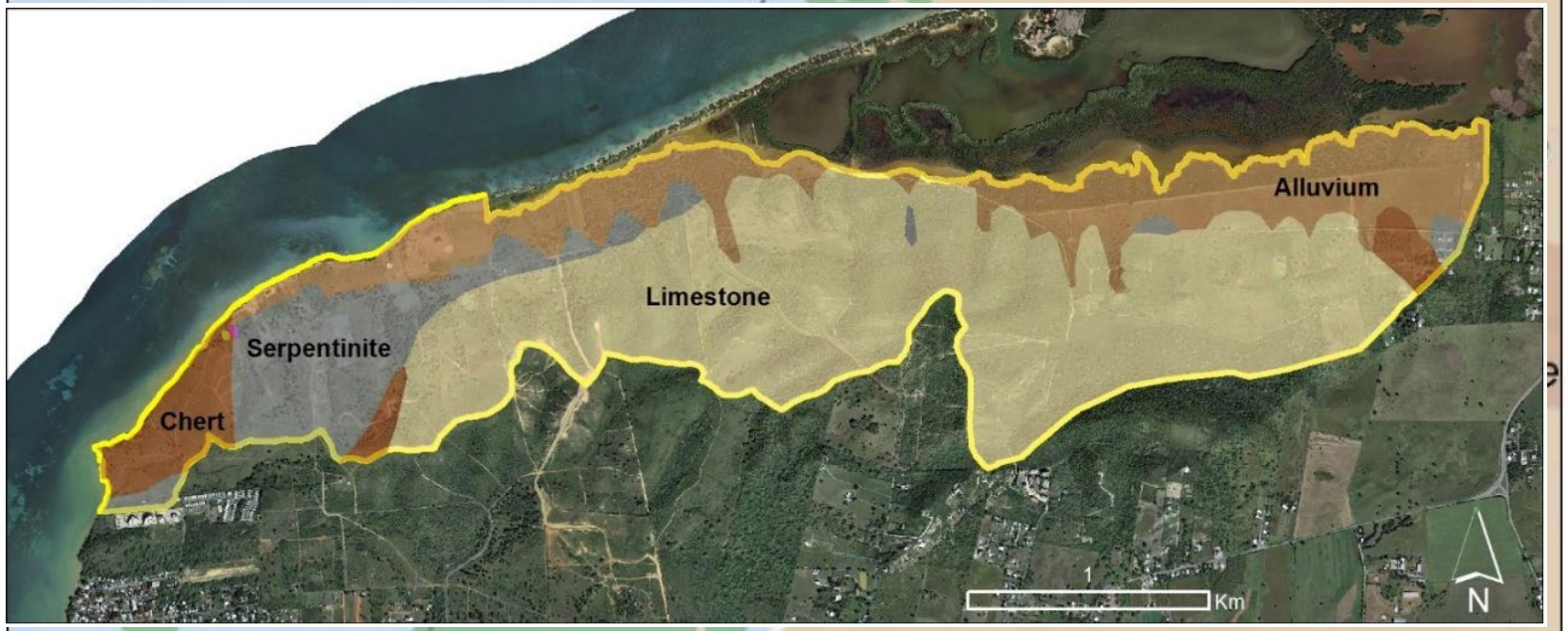
Proposed Treatment Option:
☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other: Sediment basin

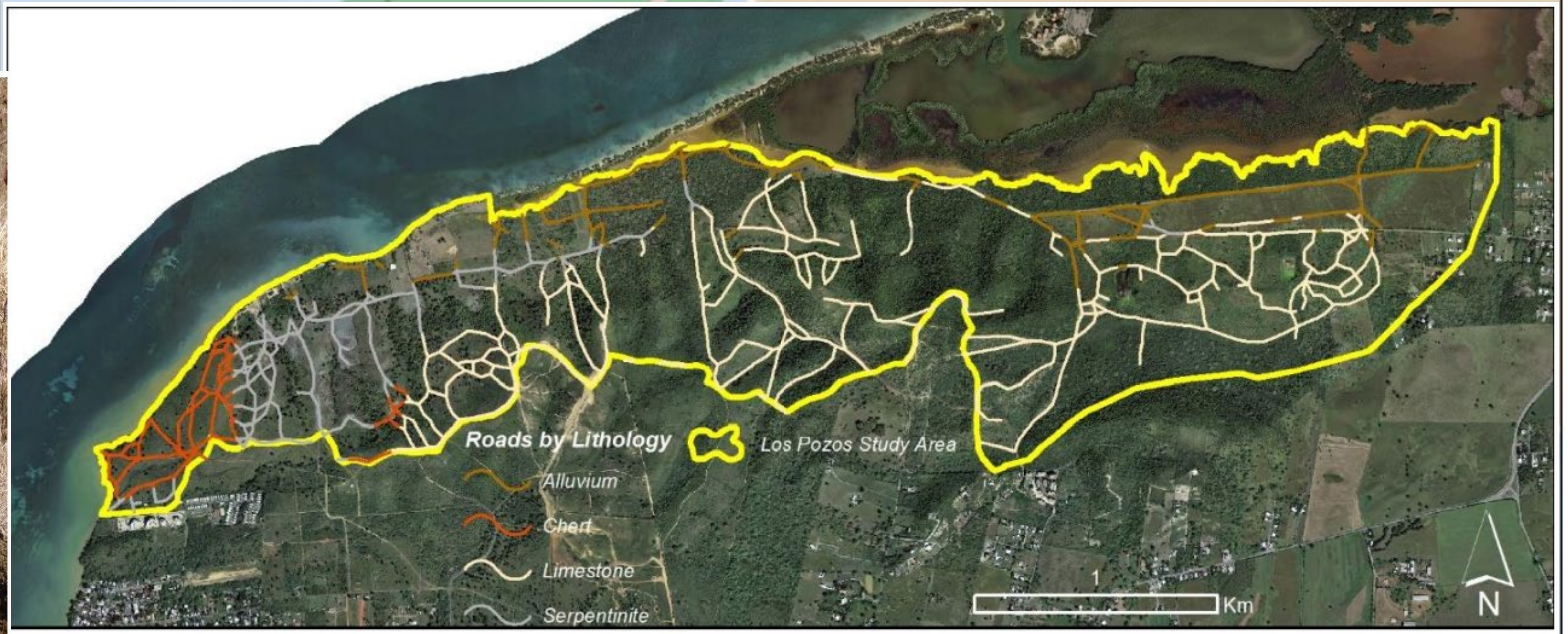
Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

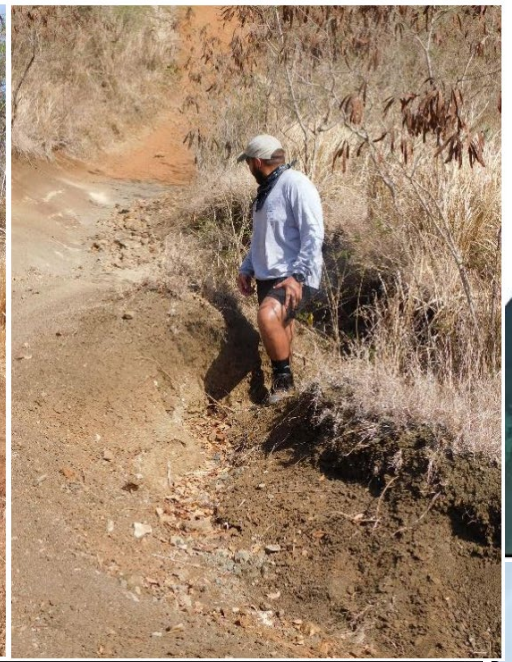
Surface Area Est. 1.25 acres
Max Depth 4-6ft

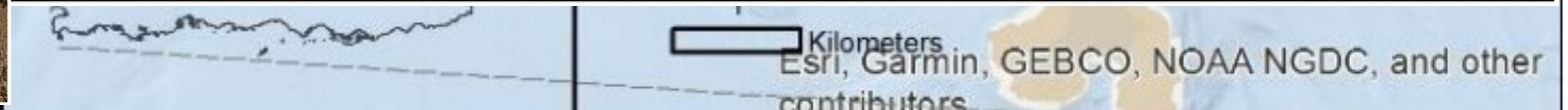
Red de caminos ORV en Los Pozos

- En Los Pozos se cuantificaron 57.8 km de caminos ORV para una densidad general de senderos de 12.7 km km-2 , y esto es alto en comparación con otras cuencas hidrográficas en entornos tropicales secos similares, como como Culebra-PR y St. John-USVI.
- La geología de cerca del 52% de la red de caminos ORV es roca caliza. El 11%, 19% y 18% de la red está sustentada por pedernal, serpentinita y aluvión, respectivamente.





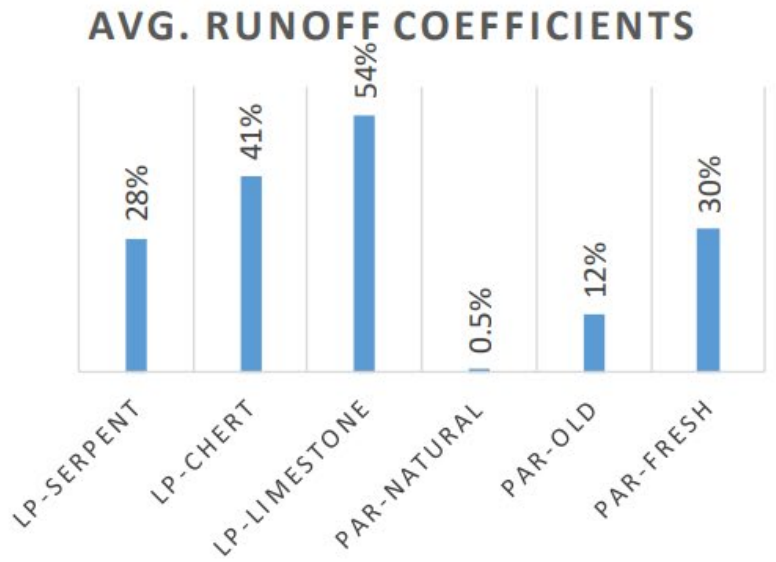


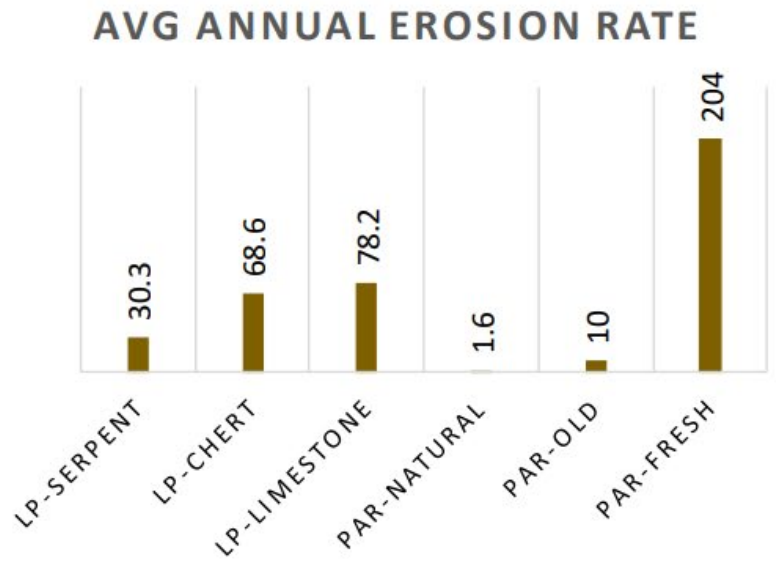


Metodologías aplicadas en Los Pozos

- Simulaciones de Lluvia para medir escorrentías y erosion.
- Medición topográfica de alta resolución usand un GPS diferencial.

Resultados de Simulaciones de Lluvia





Chert

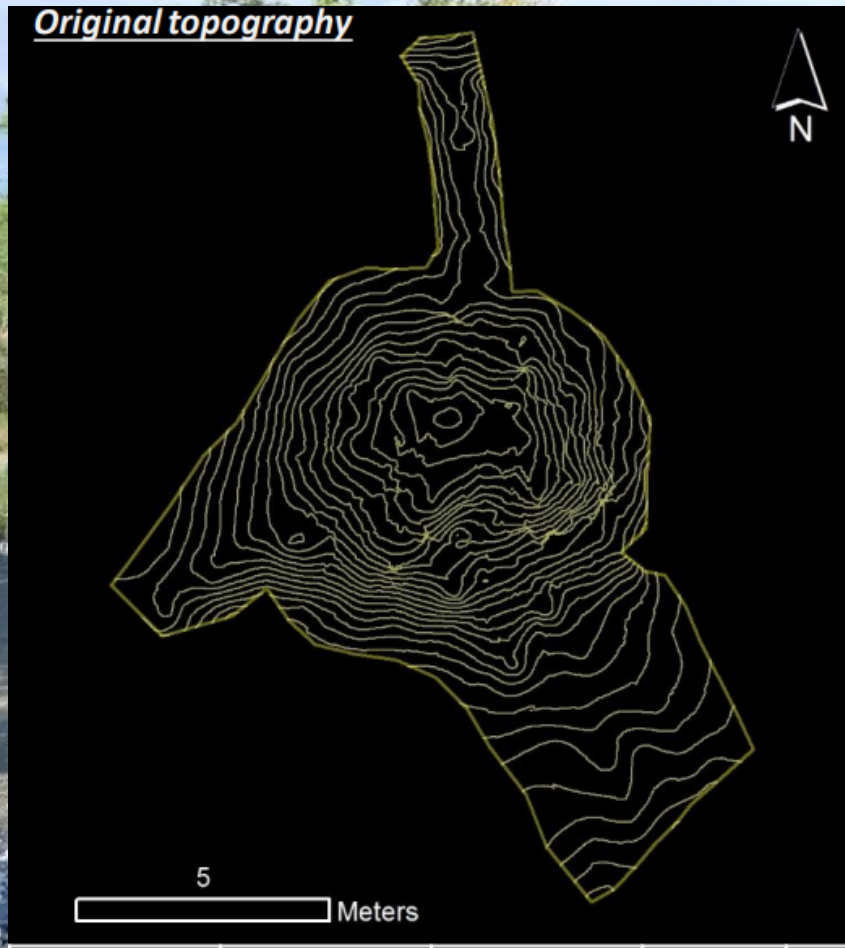
Serpentinite

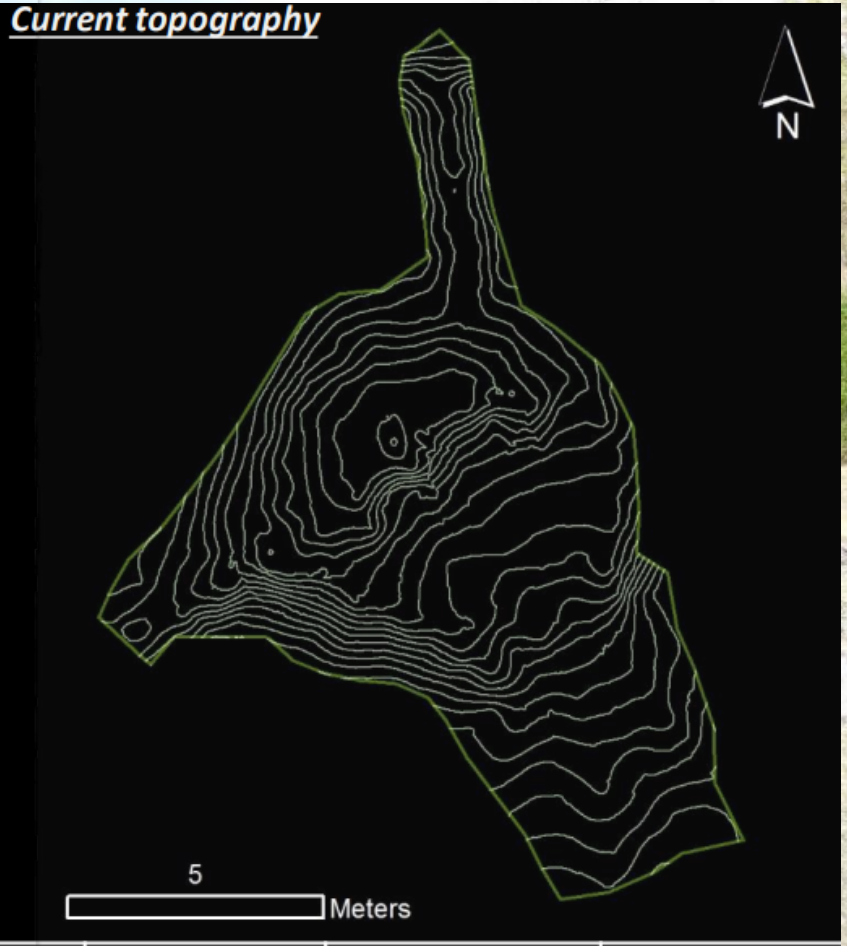
Limestone

Charcas de Retención de Sedimentos

Charcas de Retención de Sedimentos

Charcas de Retención de Sedimentos

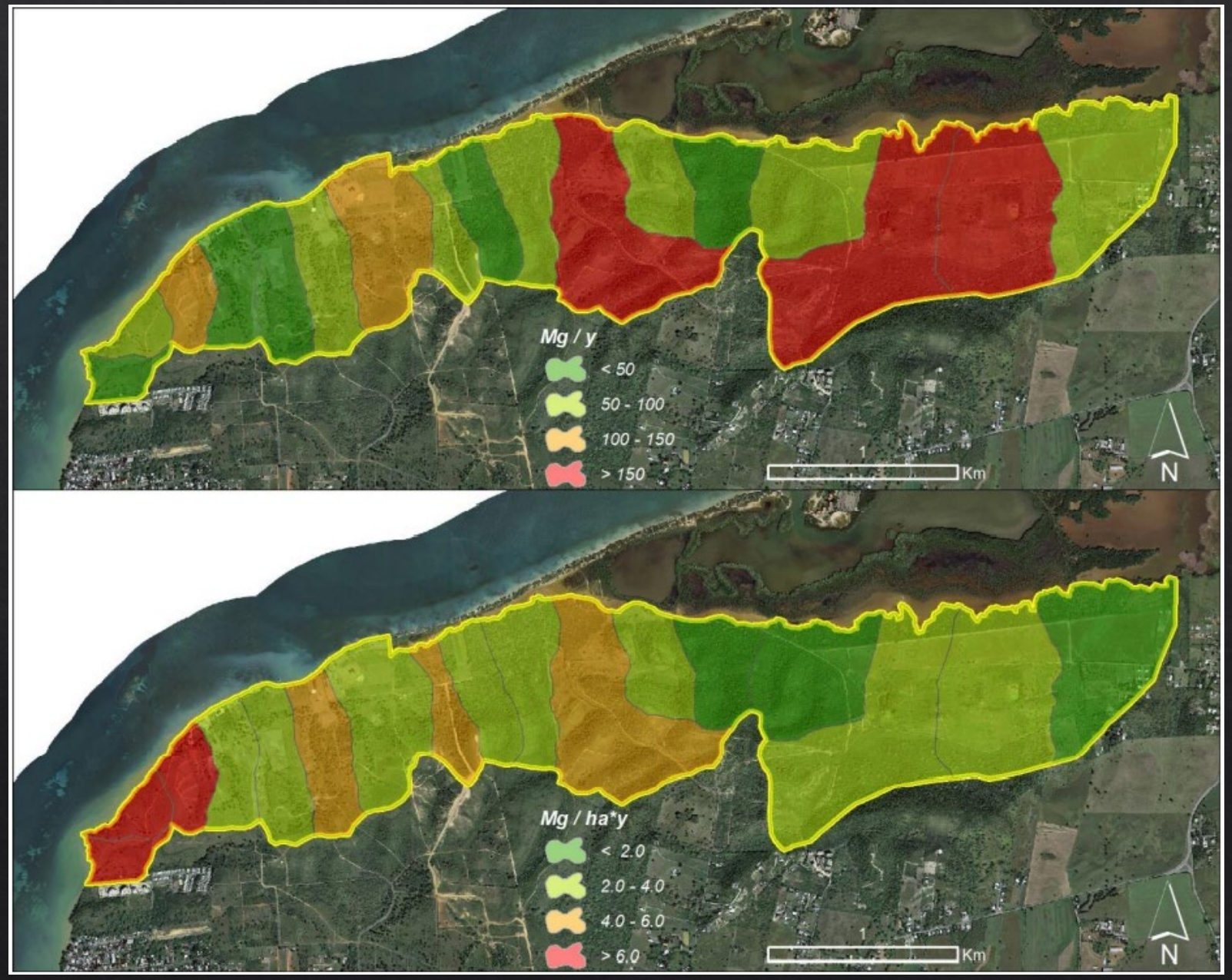




Original Volume (m^3)	Current Volume (m^3)	Original – current; (m^3)	Source area (ha)	Total rainfall (mm)	Accum. rate (m^3 or Mg per mm)	Area-normalized accum. rate (Mg/ha mm)	Annualized accumulation rate (Mg/ha yr)
16.0	13.0	3.0	1.19	145.8	0.021	0.017	19.3

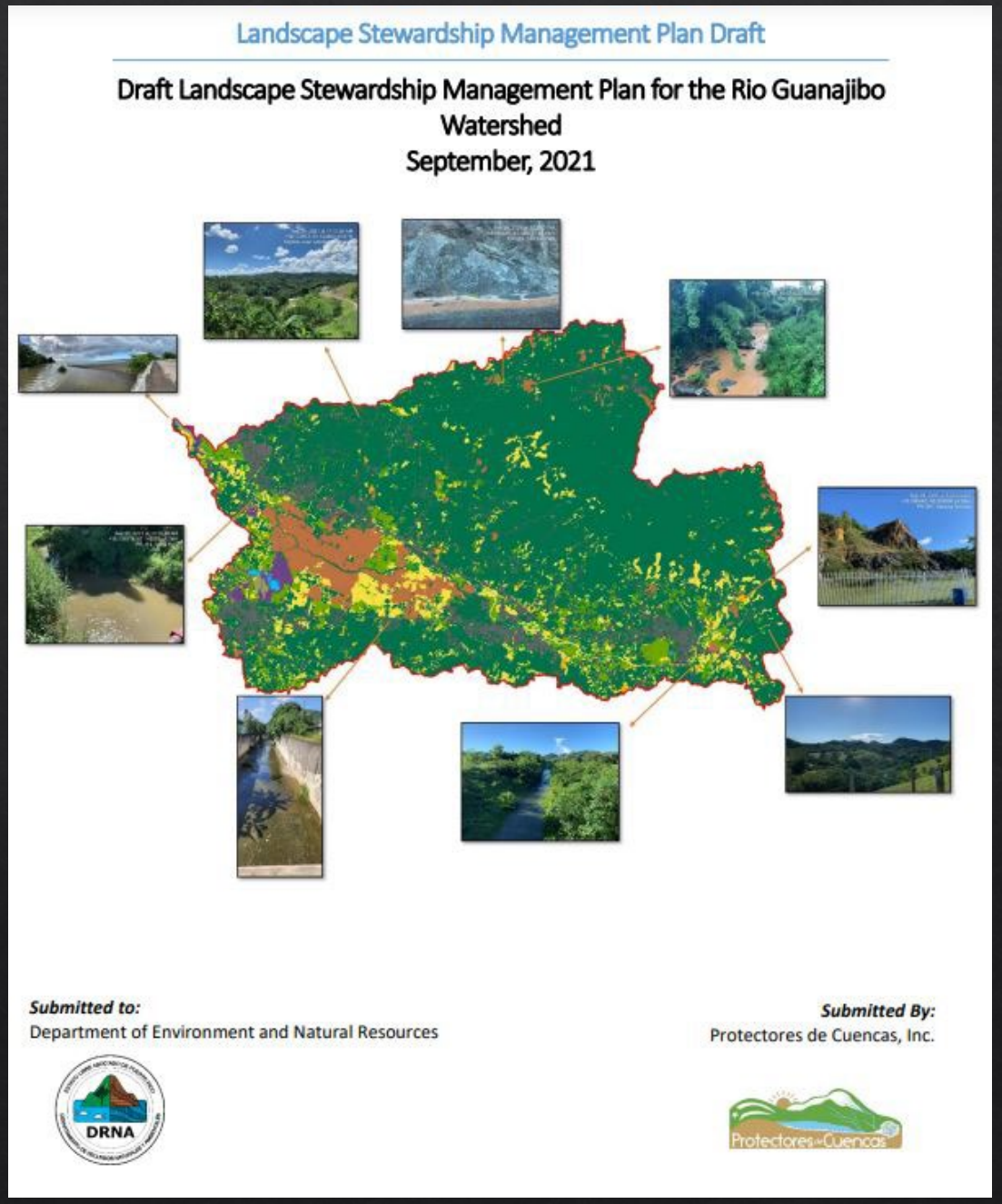
Control de Erosión en los Pozos en Combate

- Los resultados de las simulaciones de lluvia establecieron que las tasas de erosión anualizadas de los senderos ORV en Los Pozos oscilan entre 30 y 78 Mg ha-1 año-1, y son entre 20 y 50 veces superiores a la erosión natural estimada.
- Se estima que las cuatro charcas de retención de sedimentos establecidas en Los Pozos retienen alrededor de 81.4 Mg de sedimento cada año. Esta cantidad es solo alrededor del 5.3% del sedimento total que se estima que se genera en el área de Los Pozos cada año.
- Las charcas de retención de sedimentos son una forma eficiente de reducir el transporte de sedimentos a las aguas costeras, ya que las charcas establecidas en el área de Los Pozos parecen ser capaces de capturar alrededor del 56% del sedimento que se estima que producen las subcuencas donde se construyeron las charcas.



Guanajibo Landscape Stewardship Management Plan

- Plan de Custodios del Paisaje.
- Ya publicado en portal del DRNA.



Proceso Participativo

1. Tracking of point sources of pollution in urban areas served with sanitary sewers.

2. The elimination of herbicide application by municipalities to maintain public green

areas, especially road-side vegetation. This action requires legislative changes at the

municipal level.

3. Promote the use of incentives provided y NRCS to produce organic crops and

products.

4. Assess the process of certifying users to apply pesticides and herbicides.

5. Provide capacity-building workshops for municipal public-work employees and

sub-contracted companies regarding best practices for heavy machine usage, public

green-area maintenance, cleaning of ditches and drainages among other critical

tasks.

6. Implementation of water quality monitoring programs at the community level and

re-establish water quality monitoring by USGS and other public agencies.

7. Use bio-engineering techniques to prevent bank erosion instead of hard structures

such as riprap or concrete-lined channels.

8. Restore channelized rivers and streams

Identify areas of springs with excellent water quality to serve as community oasis in

emergency situations.

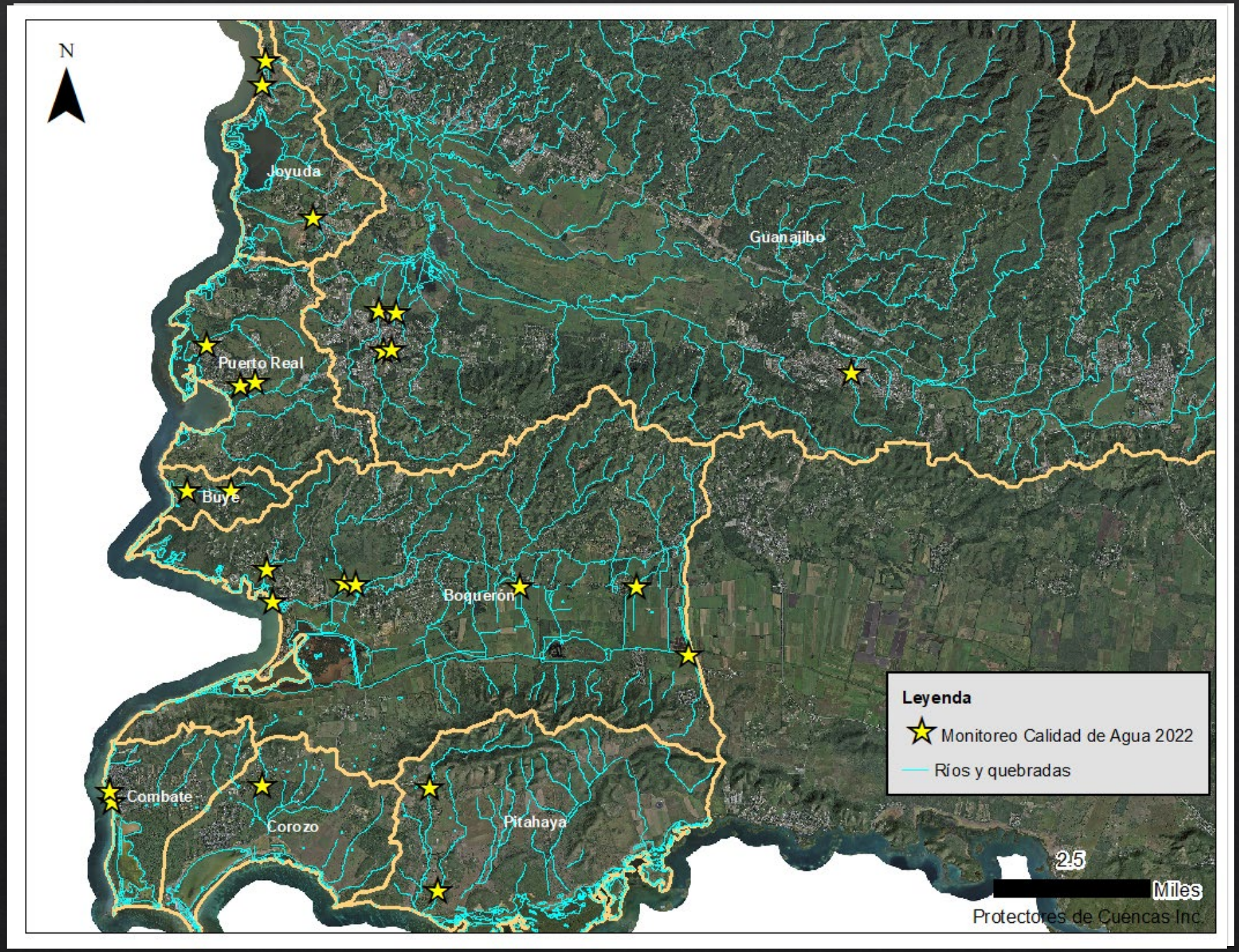
10. Assess aquaculture operations and their impact to water quality.

11. Assess the impact of quarries and asphalt production sites to water quality.

Proyectos de control de escorrentías

ID	Observations	Estimated Impervious Cover Area (%)	Est. Drainage Area (acres)	GPS Coordinates	Type	Ownership	Existing Land Use	Sewer Infrastructure Service
RGW-SWT-1	Asphalt production site. Treat runoff prior to draining to the Guanajibo River.	90	5.4	18° 4'56.61"N 67° 1'10.77"W	Asphalt production	Private	Asphalt production	Yes
RGW-SWT-2	Stormwater from parking site of municipal sports complex.	100	3.8	18° 4'39.38"N 67° 1'49.23"W	Parking Area	Public	Public sports facilities	Yes
RGW-SWT-3	Stormwater from parking of shopping mall. Multiple parkings. (Plaza del Oeste, San Germán)	100	11	18° 5'25.32"N 67° 1'50.08"W	Parking Area	Private	Commercial	Yes
RGW-SWT-4	Stormwater from parking of shopping mall (Mayaguez mall)	95	81	18° 9'24.62"N 67° 8'34.91"W	Parking Area	Private	Commercial	Yes
RGW-SWT-5	Stormwater from medical products facility in Maricao.	80	9	18°11'8.83"N 66°59'10.58"W	Parking and medical facilities	Private	Industrial	Yes
RGW-SWT-6	Stormwater from urbanization Valle Hermoso.	52	85	18° 8'58.21"N 67° 8'52.72"W	Residential impervious surfaces	Private	Residential	Yes
RGW-SWT-7	Stormwater from asphalt production site.	16	100	18° 8'24.76"N 67° 8'37.85"W	Asphalt production site	Private	Industrial	No

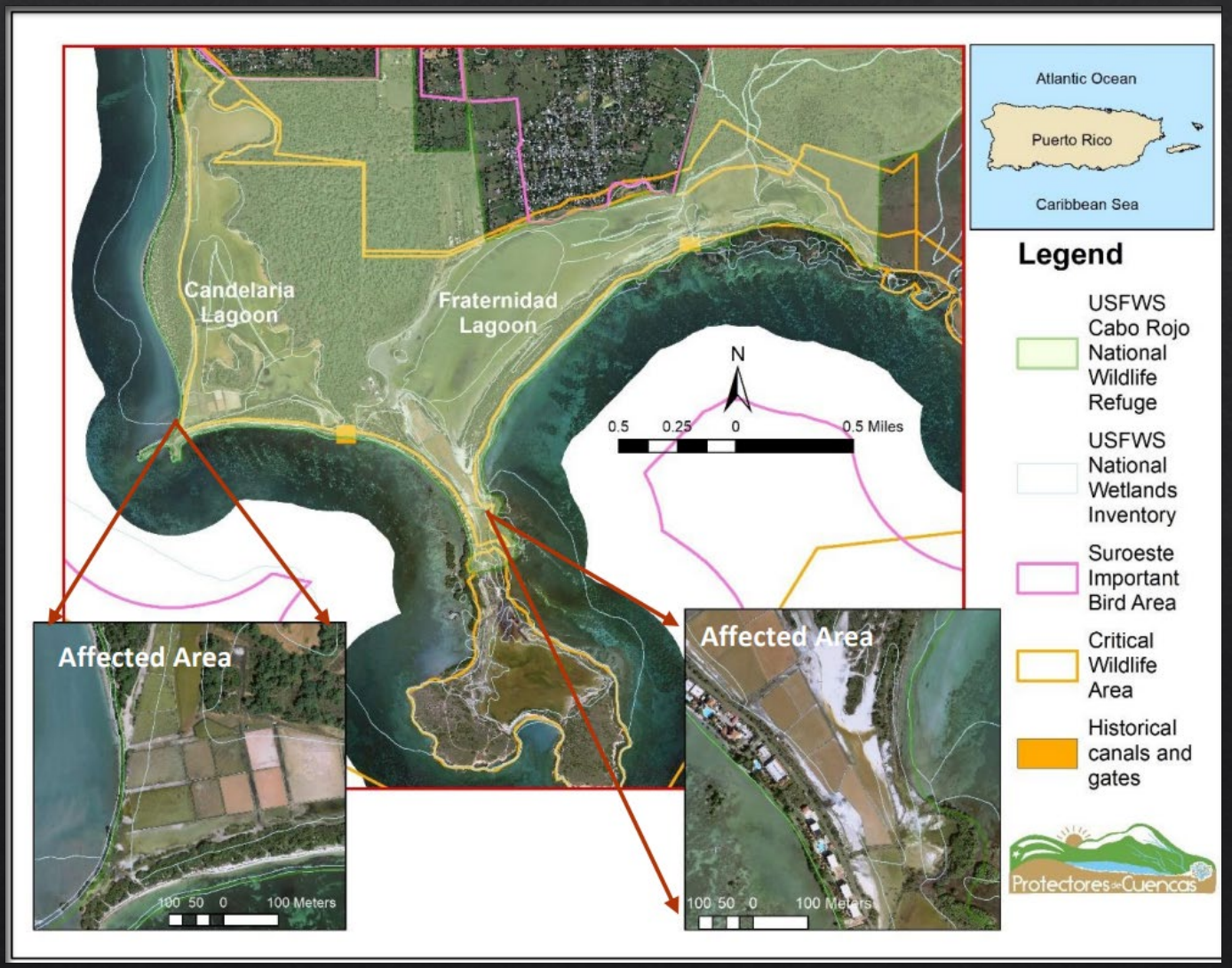
Calidad de agua en la zona



Proyecto de Restauración en las Salinas de Cabo Rojo

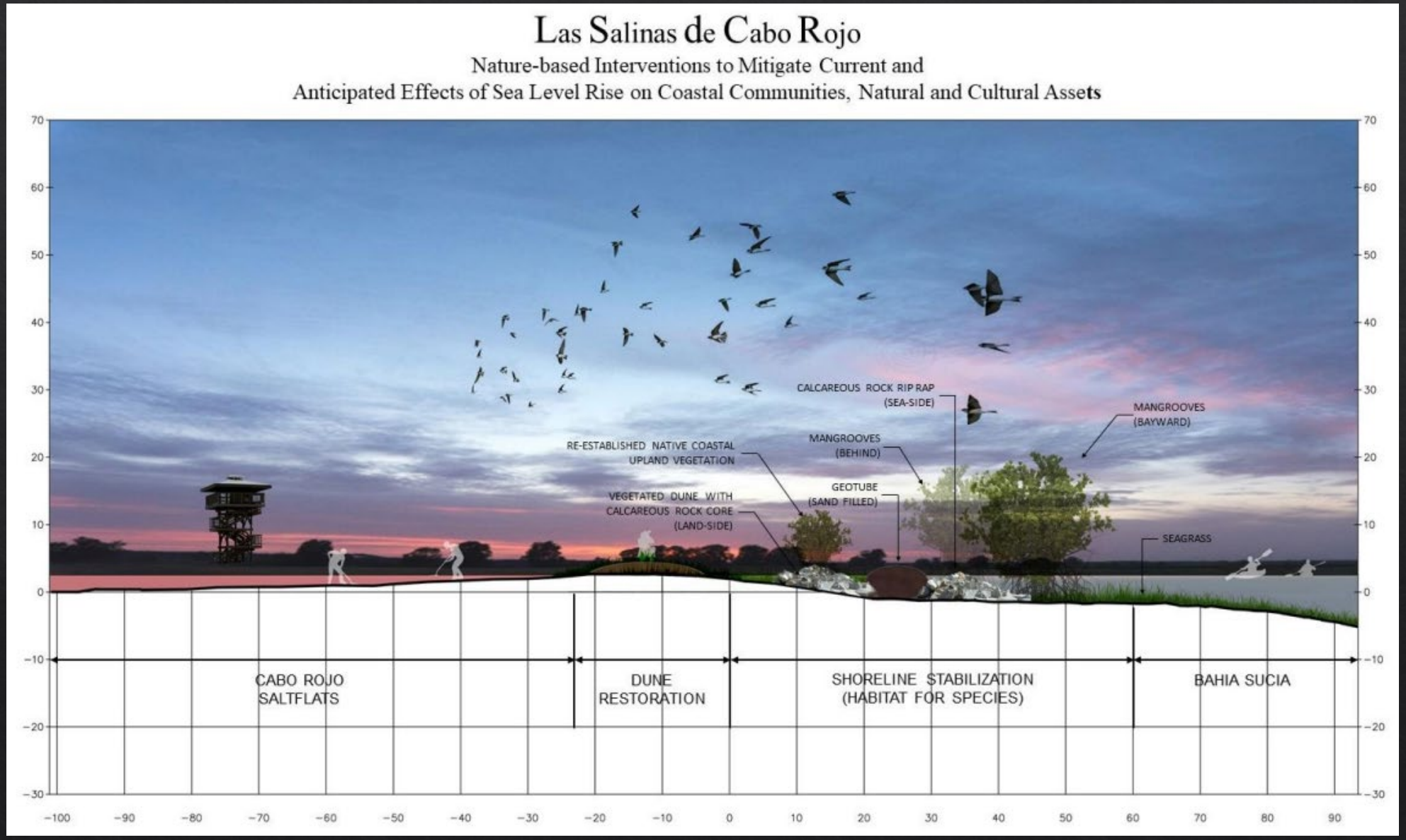
Proyecto de Restauración Costera en las Salinas

- El Huracán María, comprometió las características costeras que protegen estas lagunas por erosión y mortalidad masiva de manglares.
- Se afectaron las operaciones artesanales de salinas y los hábitats intermareales a lo largo del refugio de vida silvestre.



Diseño Preliminar de Implementación

- El USFWS ha identificado la necesidad urgente de gestionar los niveles y la calidad del agua, incluidos los gradientes de salinidad.
- Este proyecto se basa en el Plan Integral de Conservación del Refugio Nacional de Vida Silvestre de Cabo Rojo (2011) y el Estado de Emergencia declarado para Las Salinas en 2019.
- El Proyecto tiene un costo estimado de $4,148,433.17.
- Se ha identificado $1M en fondos.



Gracias