



# HABITAT AND BIODIVERSITY MAPPING, FOR THE DETERMINATION OF ALGAL BIOMASS AQUACULTURE SITES IN THE COSTAL AREAS OF PUERTO RICO



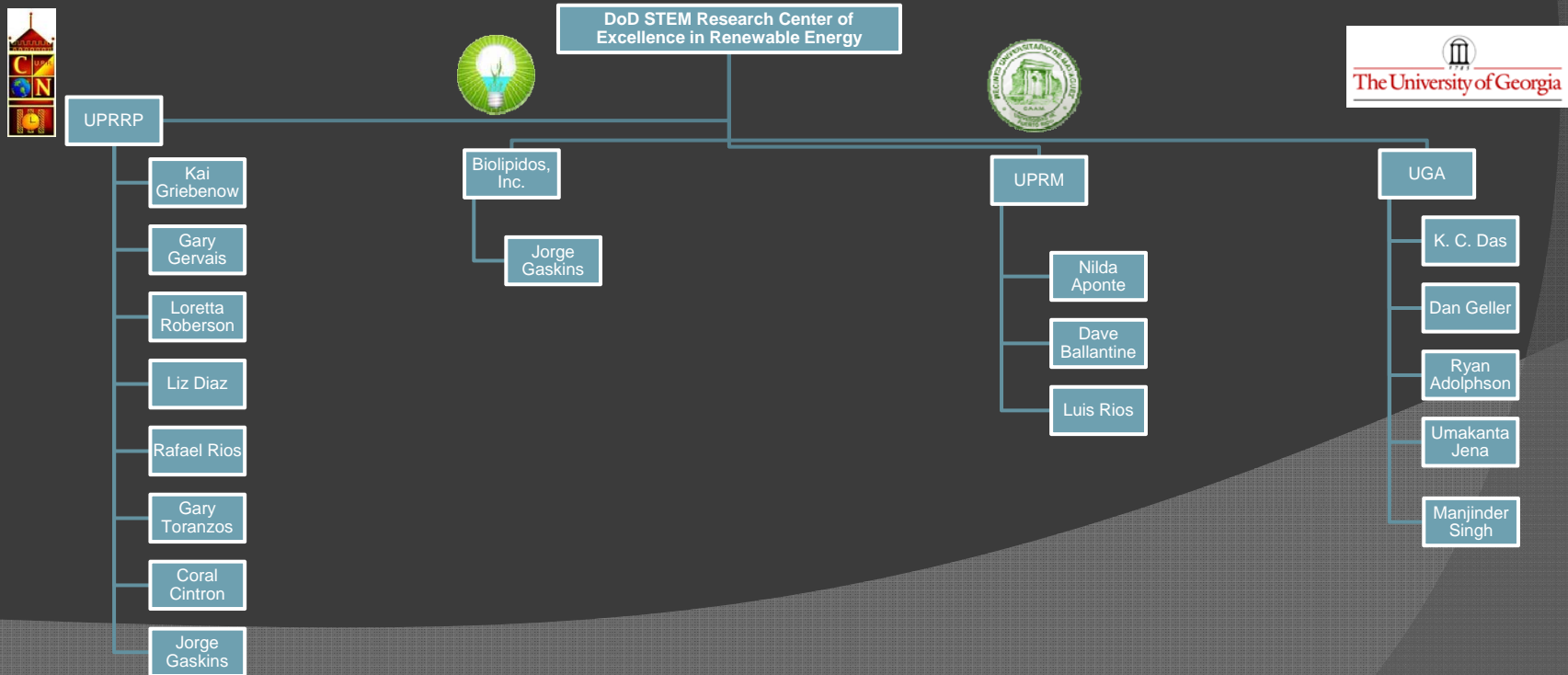
By: J. Melendez, N. Quiñones-Vilches, A. Rodriguez, K. Ruiz,  
G. Gervais, L. Roberson

**Center for Renewable Energy and Sustainability** <http://renewable.uprrp.edu/>  
*A UPR-UGA DoD STEM Research Center of Excellence in Renewable Energy*



**The Center for Renewable Energy has four broad research areas:**

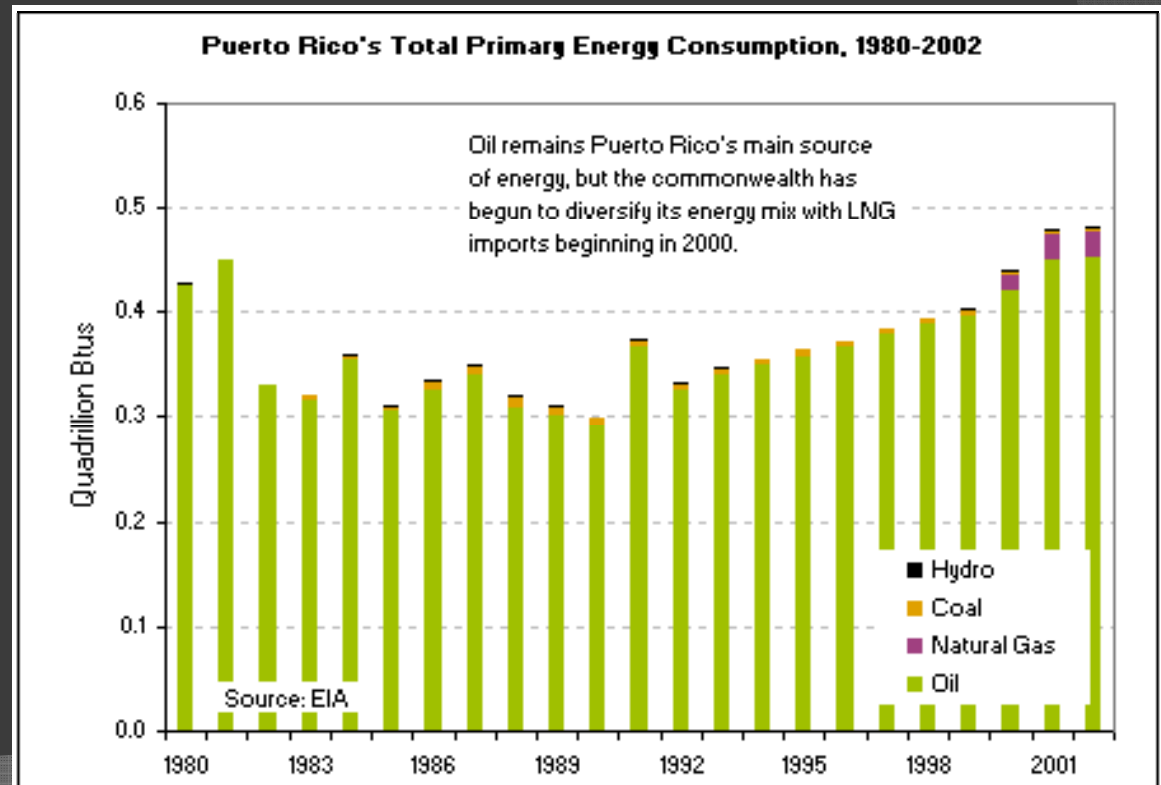
- Algal biomass production
- Conversion of algal biomass into biogas by anaerobic digestion
- Thermochemical conversion of algal biomass into a liquid fuel
- Analysis of the technology transfer potential and financial feasibility for each of the broad research areas

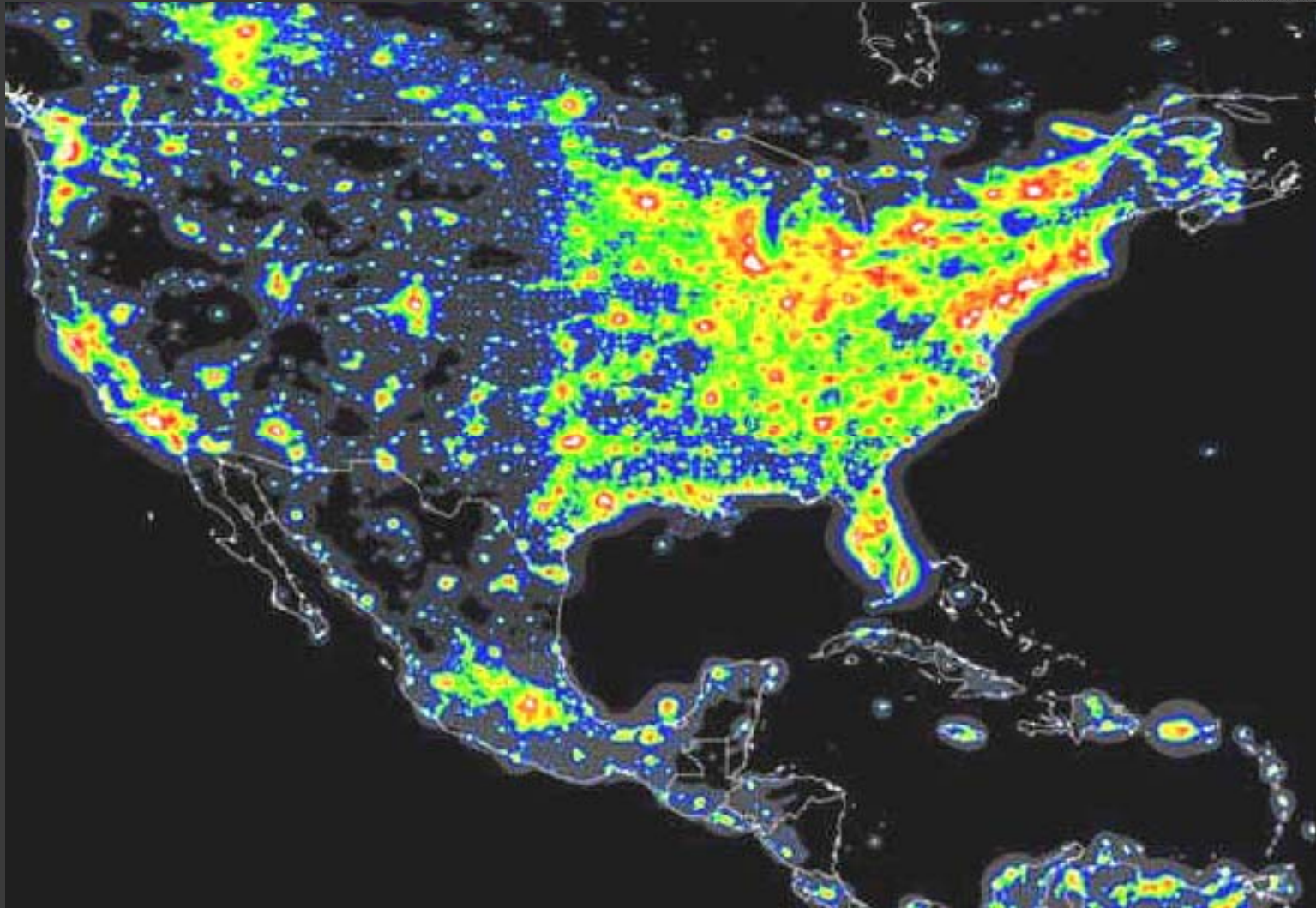


# Problem



- Puerto Rico is dependent on energy from non-renewable resources.
- Approximately 98% of the energy consumed comes from thermoelectric plants that use 70% petroleum / 15% gas / 15% charcoal (López, 2006).
- For 2015 – 12% renewable energy
- For 2020 - 15% renewable energy





- [http://www.businessweek.com/investing/green\\_business/archives/2008/03/lights\\_out\\_tonight\\_save\\_a\\_watt\\_save\\_a\\_ton\\_save\\_a\\_bird.html](http://www.businessweek.com/investing/green_business/archives/2008/03/lights_out_tonight_save_a_watt_save_a_ton_save_a_bird.html)

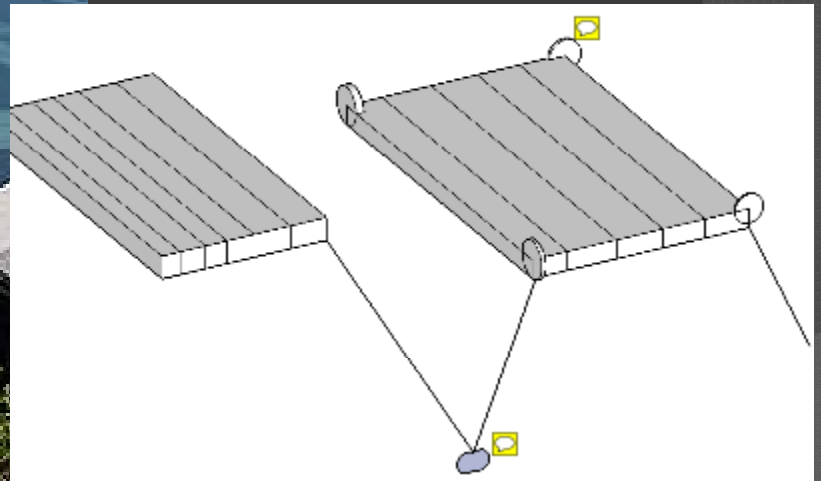
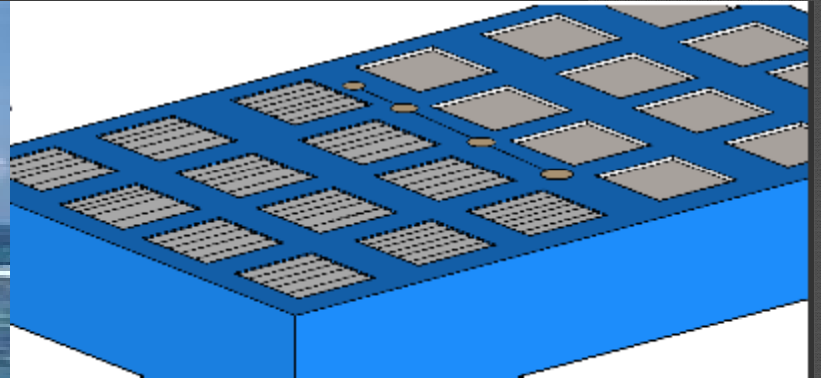
# Open Ocean Aquaculture

- ◎ “Blue Revolution”
- ◎ U.S. Exclusive Economic Zone (EEZ; generally 3 to 200 nautical miles from shore)
- ◎ Critics raise
  - environmental protection
  - potential impacts on existing commercial fisheries.
- ◎ January 28, 2009
  - Gulf of Mexico Fishery Management Council approve a plan to issue aquaculture permits and regulate aquaculture in federal waters of the Gulf of Mexico
  - September 3, 2009, the plan took effect

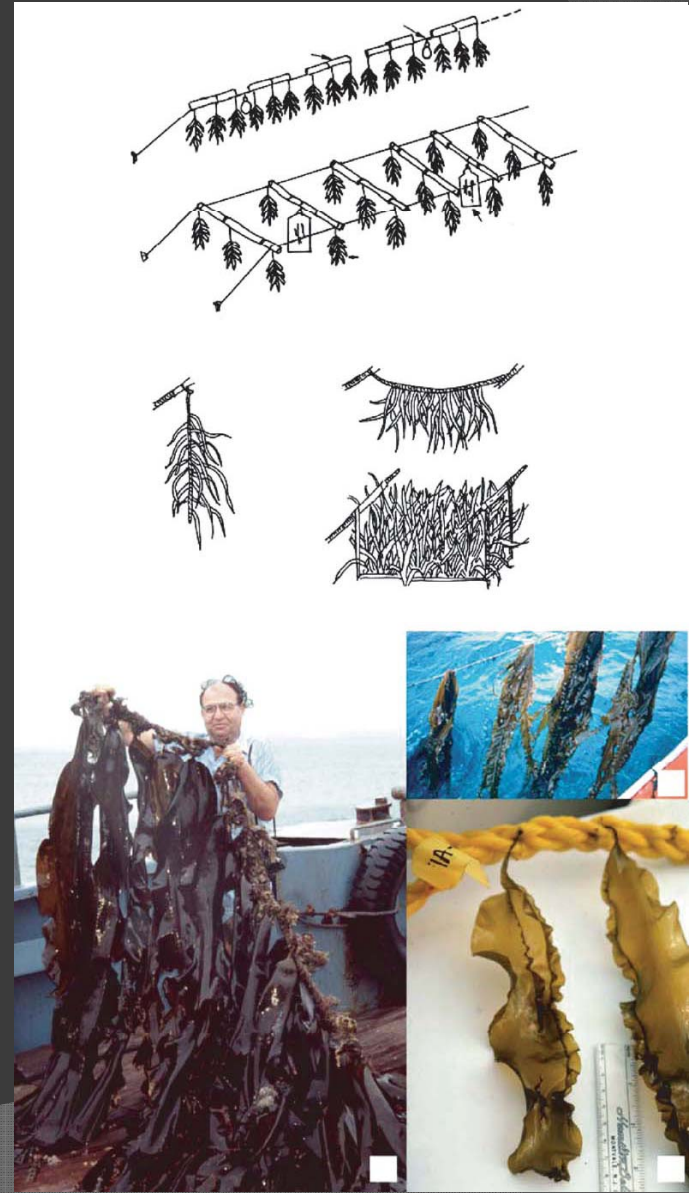
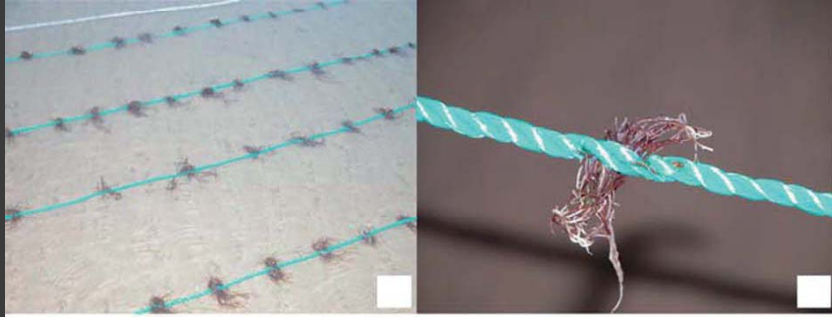
# Open Ocean Aquaculture

- **September 8, 2009**, H.R. 3534, the Consolidated Land, Energy, and Aquatic Resources Act of 2009. Section 704 - authority of the Secretary of Commerce to develop or approve fishery management plans to permit or regulate offshore aquaculture
- **December 16, 2009** the National Sustainable Offshore Aquaculture Act of 2009 establish a regulatory system for offshore aquaculture in the U.S. Exclusive Economic Zone
- **May 25, 2010** - the Research in Aquaculture Opportunity and Responsibility Act of 2010 prohibit offshore aquaculture until 3 years after the submission of a report on the impacts of offshore aquaculture.

# AQUACULTURE SITES



# AQUACULTURE SITES







Economic

Social

Environmental

• Norberto Quiñones

Marine Biomass Industry Viability

• Agnerys Rodriguez

Analysis of the Regulatory Framework

DETERMINATION OF ALGAL BIOMASS AQUACULTURE SITES Implementation

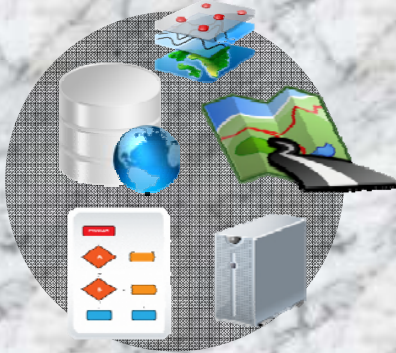
• Joel Melendez

Case Study of the Environmental Impact of the Aquaculture Sites

• Norberto Quiñones

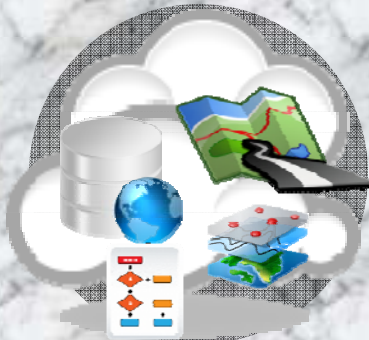
## Geographic Data Base

Contruccion



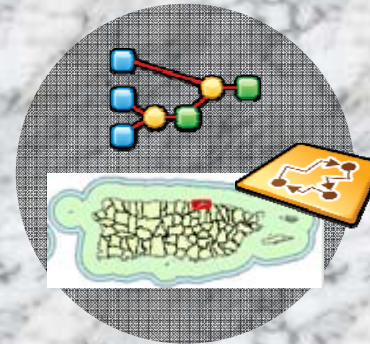
## Information Sharing

Documentation



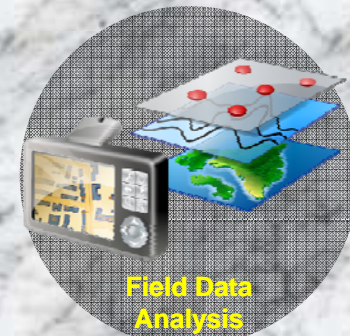
## Analysis of possible sites

In Puerto Rico



## Field Data Validation

Analysis

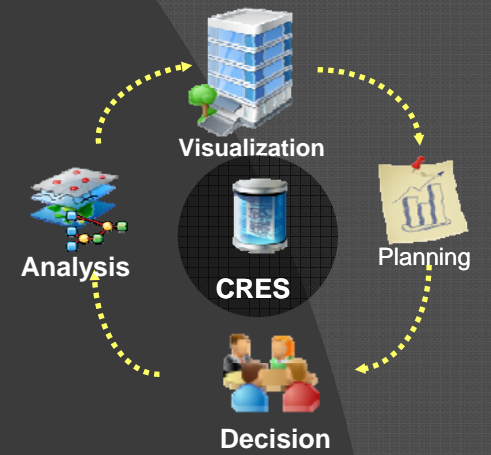


# Geographic Data Base

## Construction



Geographic Data Base construcción



- + profundidad.gdb
- SiembraAlgas.gdb
  - + Algas
  - + AreasConflicto
  - + Cuadriculas
  - AreaEstudio25M
  - areasbanistasconflicto
  - boyas\_pr\_2010conflicto
  - Converted\_Graphics
  - DRNAhabitabentico
  - limite\_12millas\_nauticas
  - Limite\_9millas\_nauticas
  - Profmenor10m
  - Profmenor30m
  - ProfRecomendada
  - Profundidad
  - rutaMaritimaConflicto
  - submarineCables
- Algas.tbx
  - AreaEstudio25M
  - benticadrna
  - boyas&rutas
  - Conflictos

# Geographic Data Base

## Construction



Geographic Data Base construcción



Analysis

Visualization

CRES

Planning

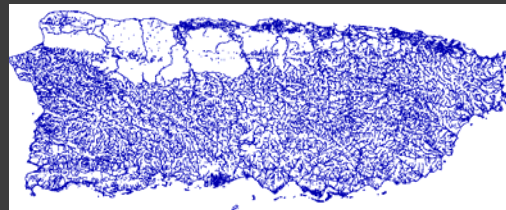
Decision

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  - Conflictos

Cuencas\_Hidrograficas\_20k



Rios\_Quebradas



# Geographic Data Base

## Construction



### Geographic Data Base construcción

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  - benticadrna
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  - Conflictos



## Analysis

## Visualization

## CRES

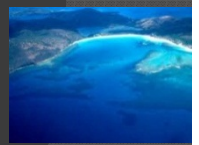
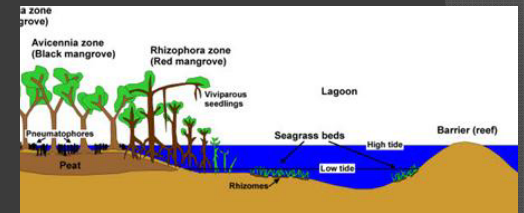
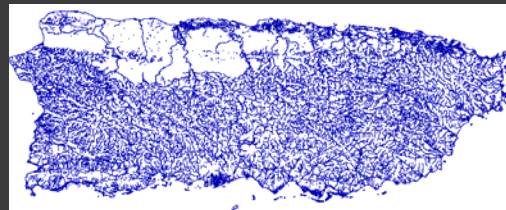
## Decision

## Planning

### Cuencas\_Hidrograficas\_20k



### Rios\_Quebradas





Support  
Information Sharing  
Documentation  
&  
Reports



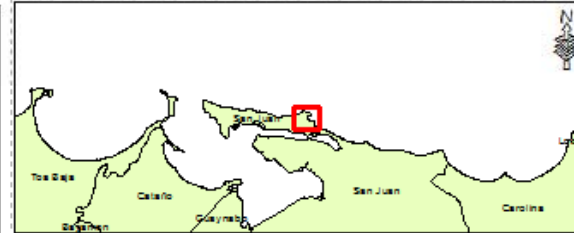
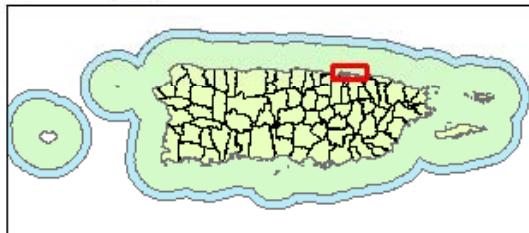
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0 25 50 100 150 200 1:6,511  
Meters

**Leyenda**

- Algas  
ESPECIES
-  Acanthophora Spp
  -  Sargassum Spp





Support  
Information Sharing  
Documentation  
&  
Reports

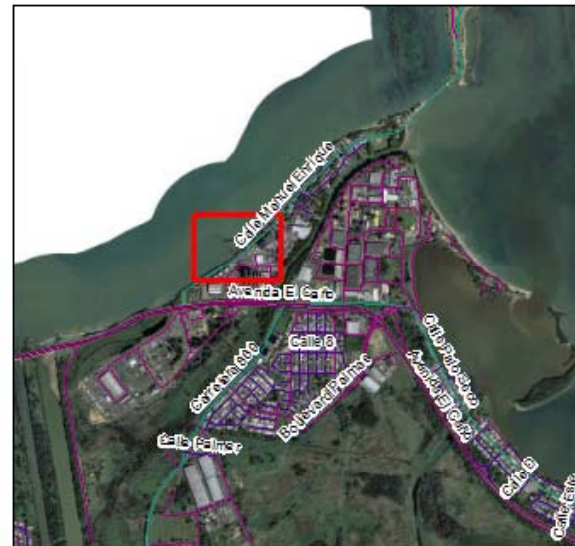


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Area de Colección:  
Central Termoeléctrica de la AEE, Toa Baja

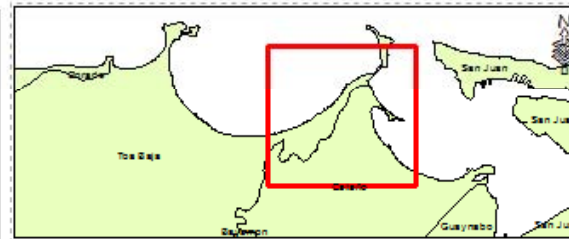
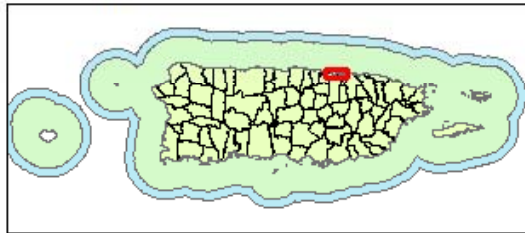


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Meters



**Leyenda**

- Algas
- ESPECIES
- Acanthophora Spp
  - Other Spp
  - Sargassum Spp





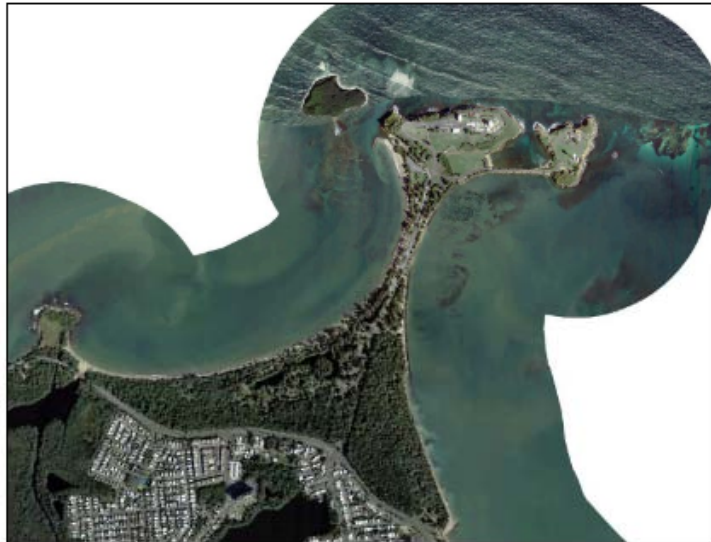
Support  
Information Sharing  
Documentation  
&  
Reports



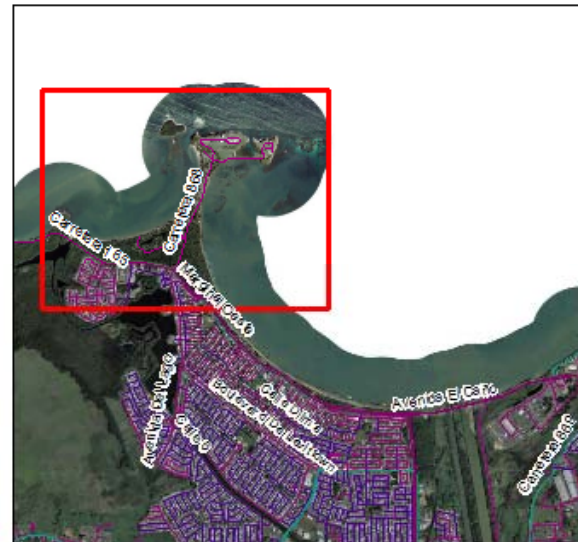
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Area de Colección:  
Central Termoeléctrica de la AEE, Toa Baja

Area de Colección:  
Playa de Punta Salinas, Toa Baja



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Meters

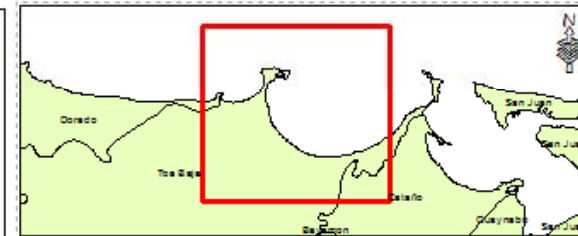


**Leyenda**

Algas

ESPECIES

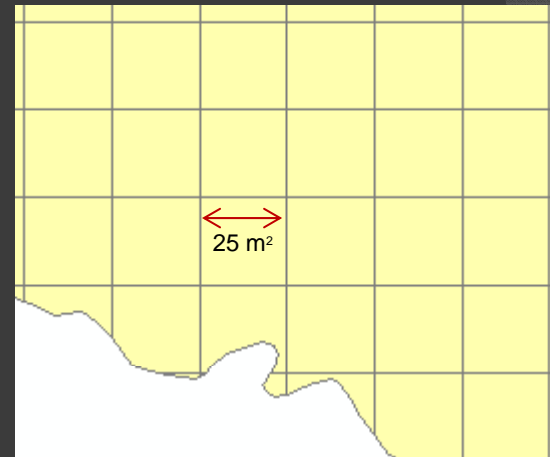
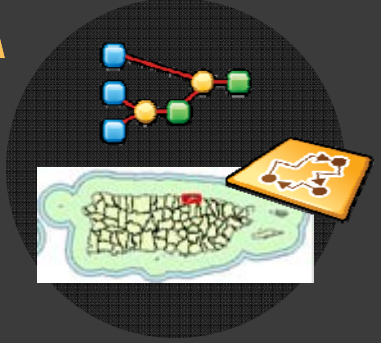
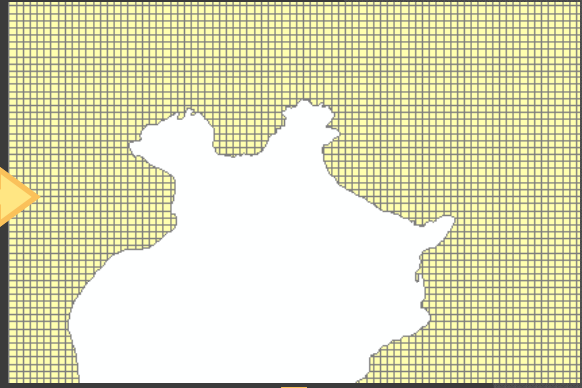
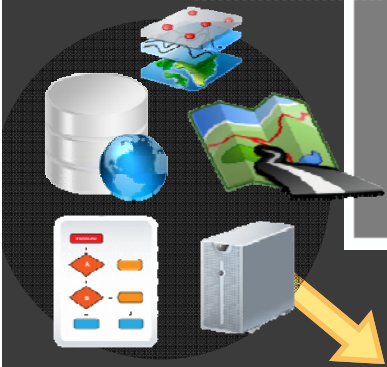
-  Acanthophora Spp
-  Other Spp
-  Sargassum Spp





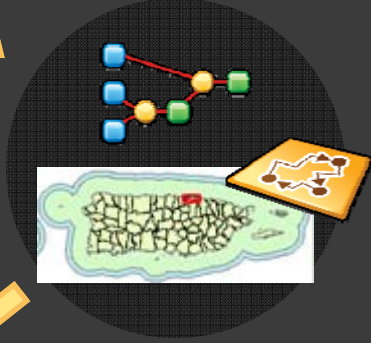
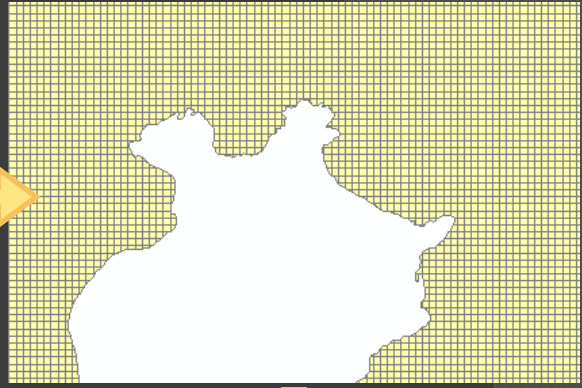
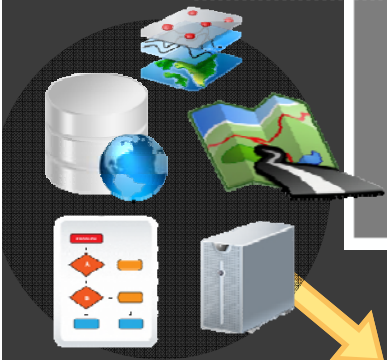
# Analysis of possible sites

In Puerto Rico

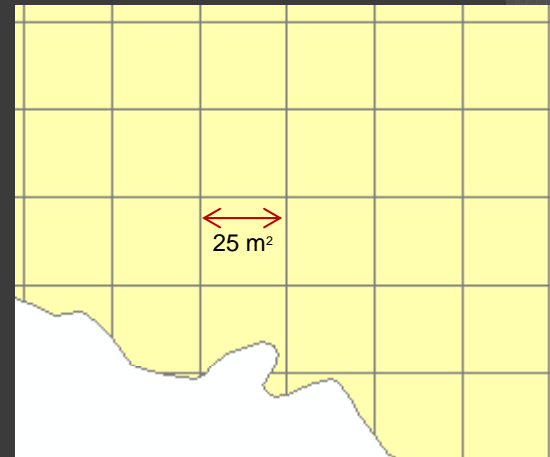


# Analysis of possible sites

In Puerto Rico

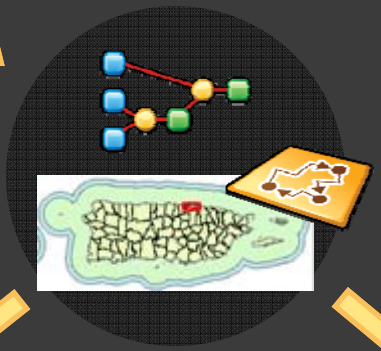
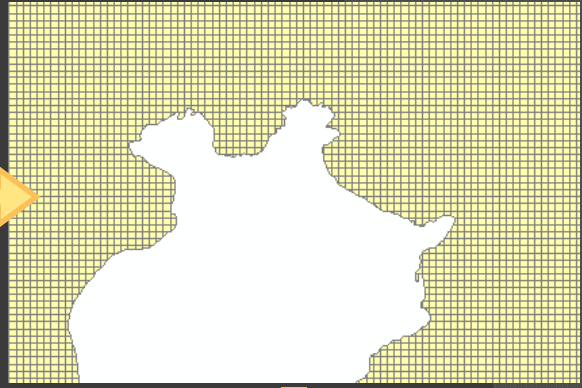
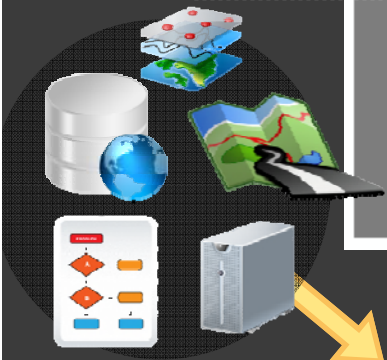


# Conflict Areas



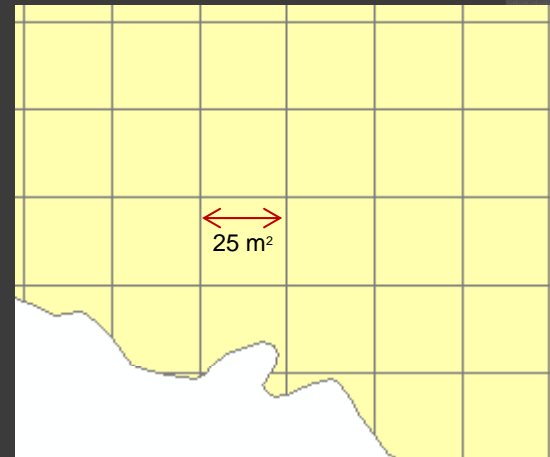
# Analysis of possible sites

In Puerto Rico



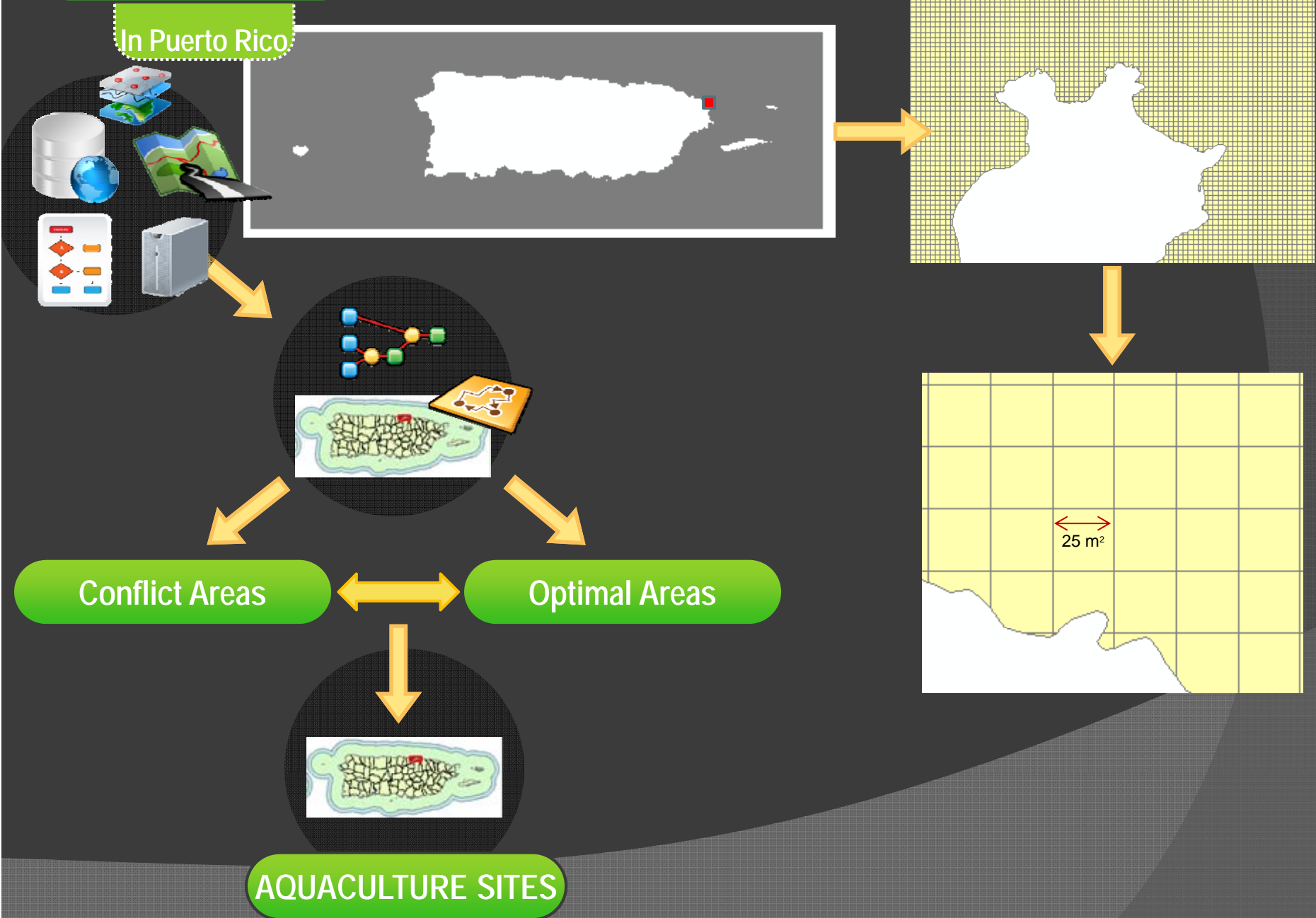
Conflict Areas

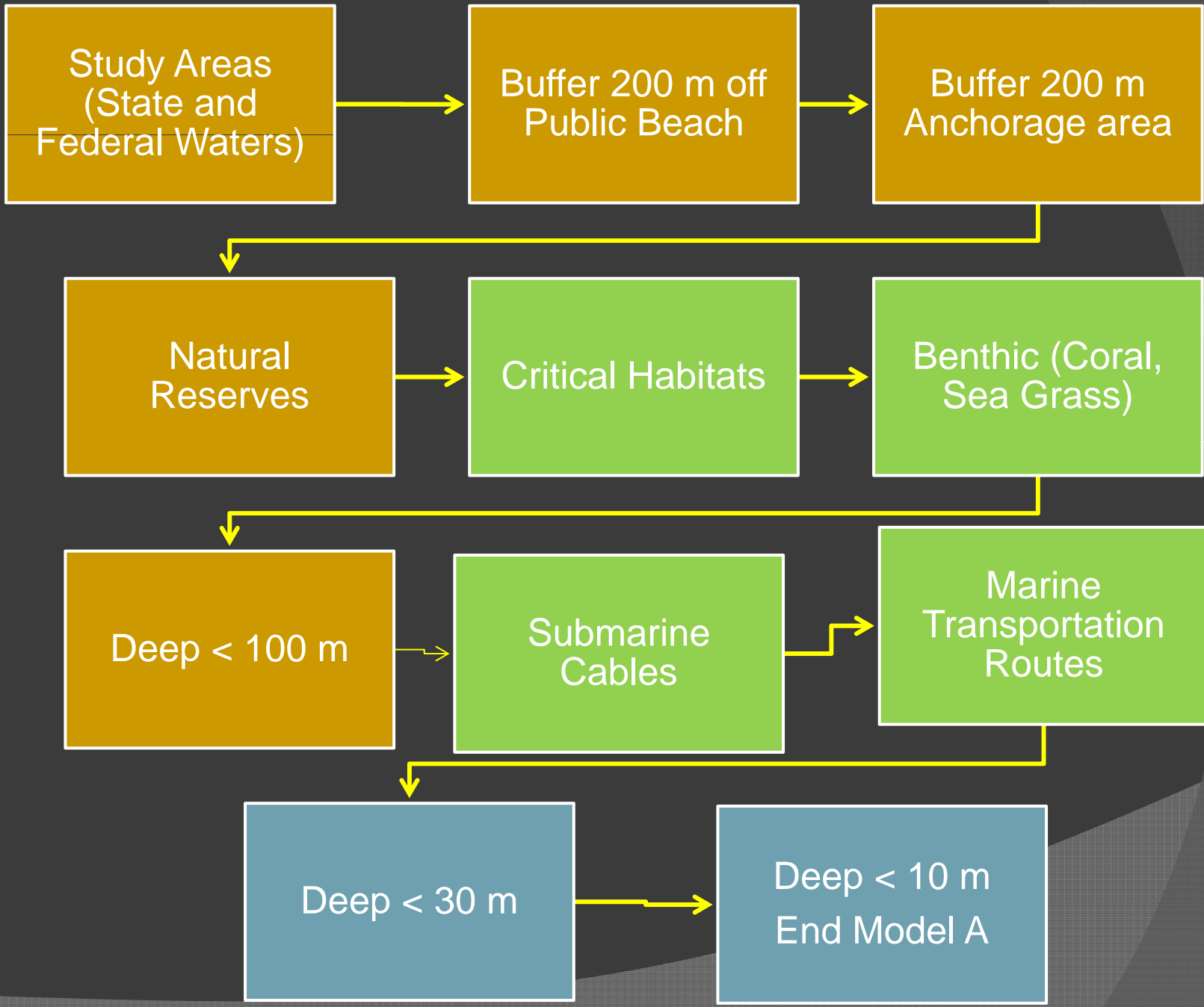
Optimal Areas

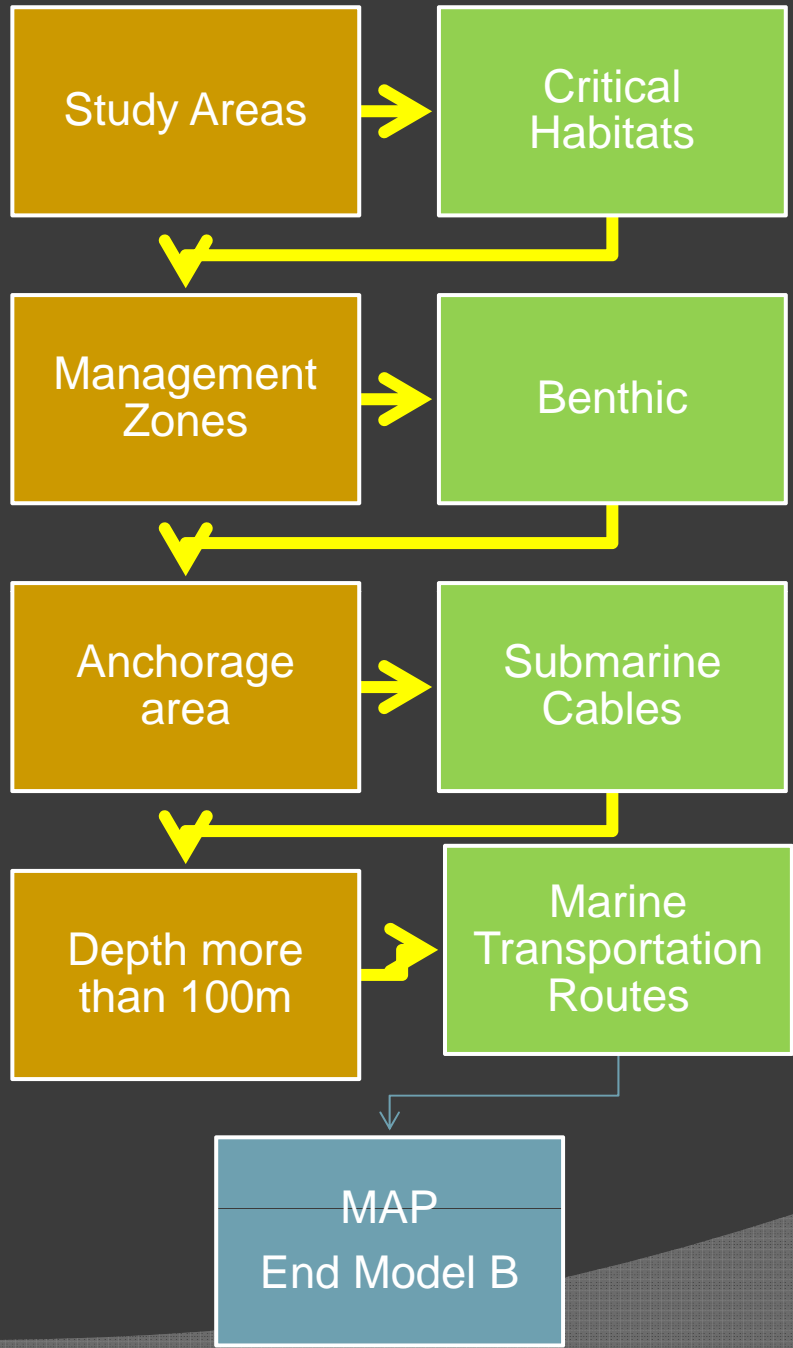


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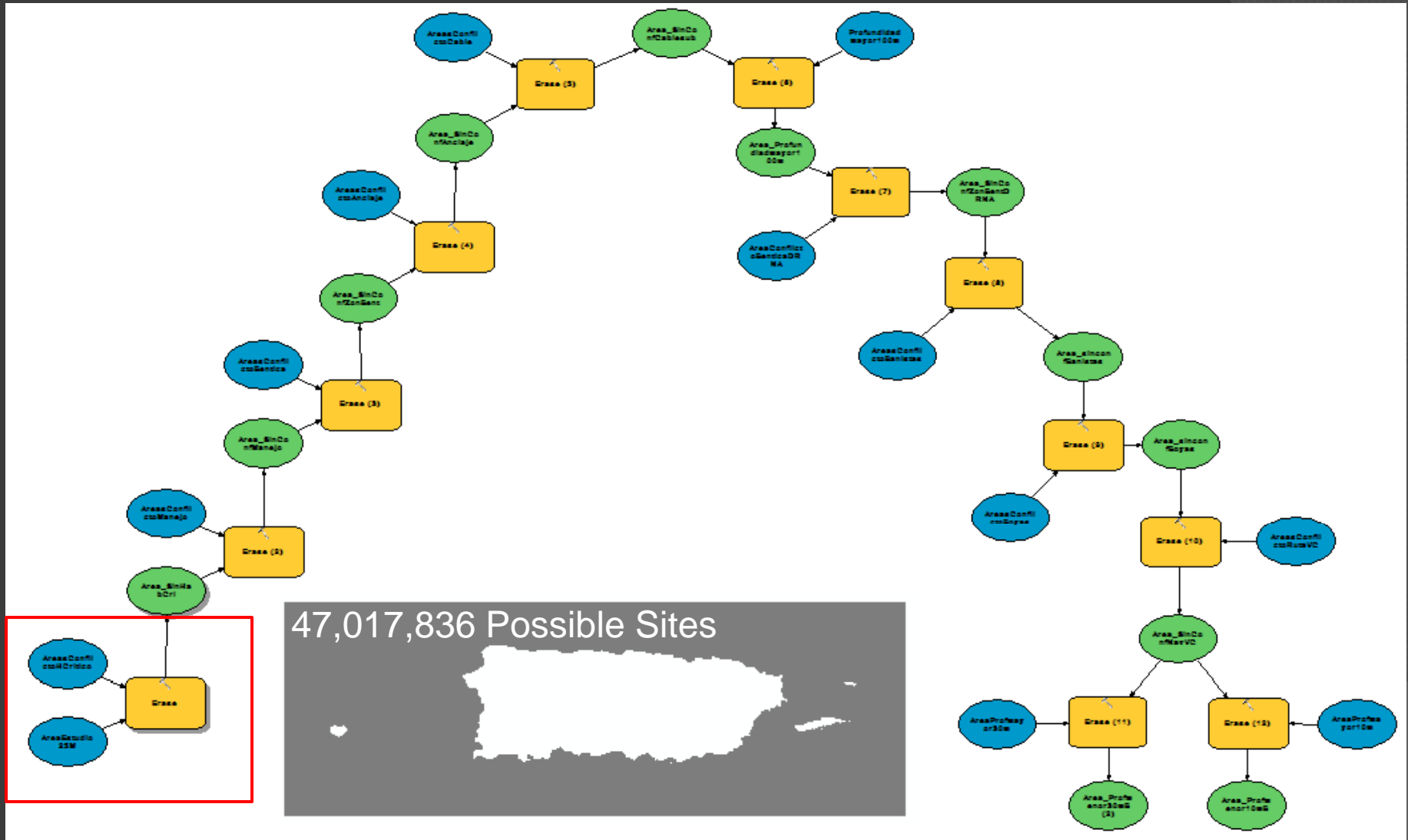
In Puerto Rico







# Conflict Areas

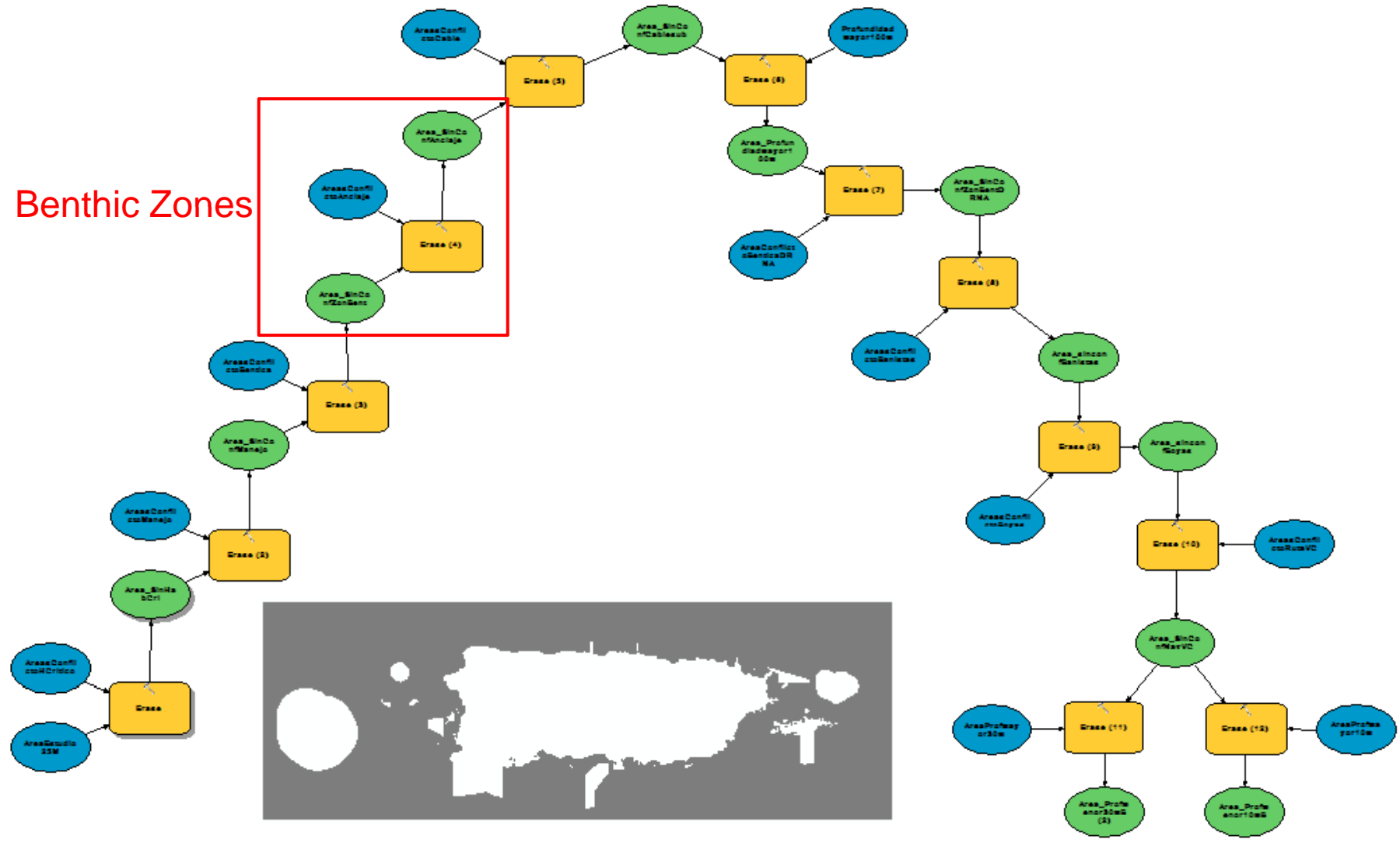


47,017,836 Possible Sites

1,175,445.9 Km<sup>2</sup> / 1,175,445,900 m<sup>2</sup> available area

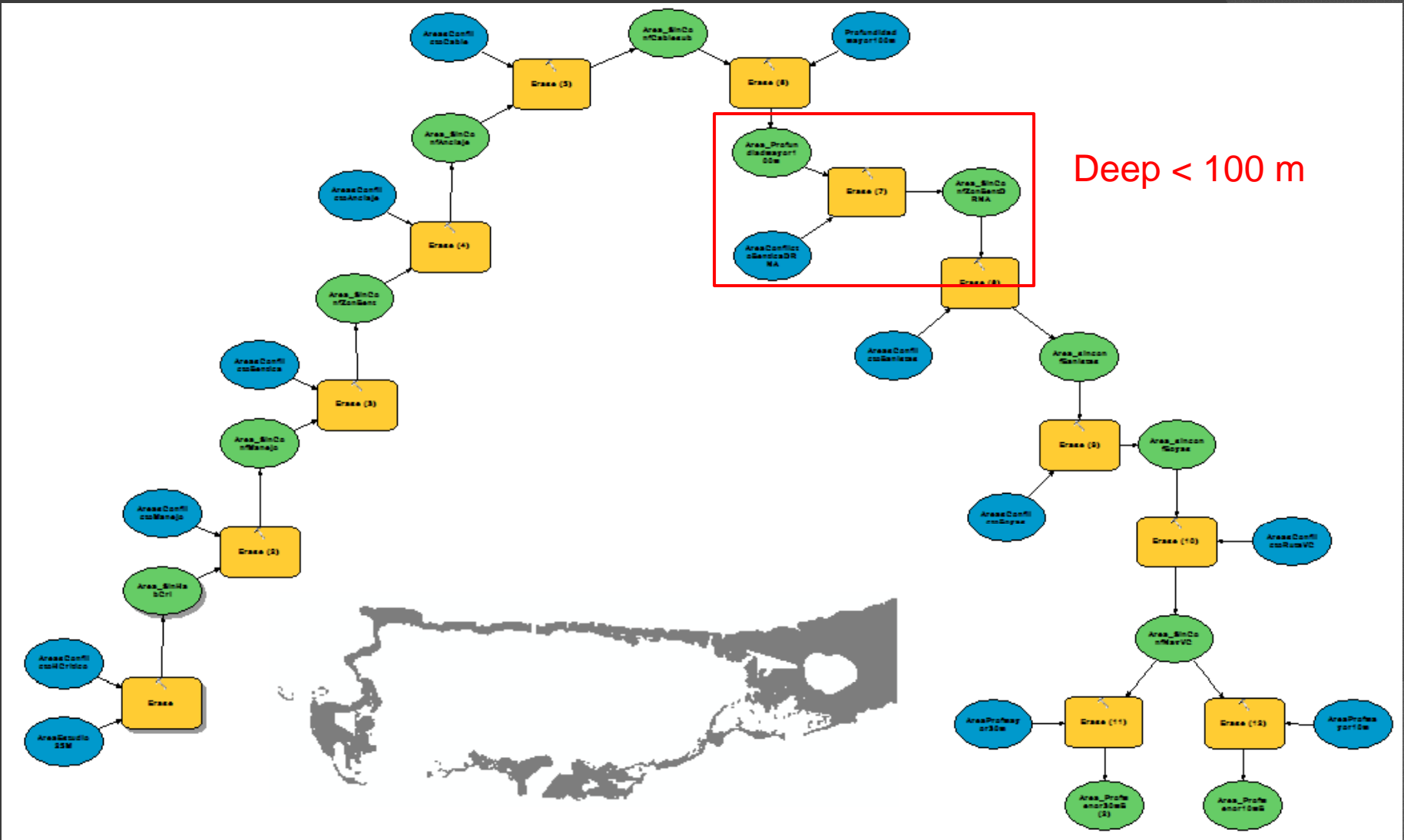
# Conflict Areas

Benthic Zones

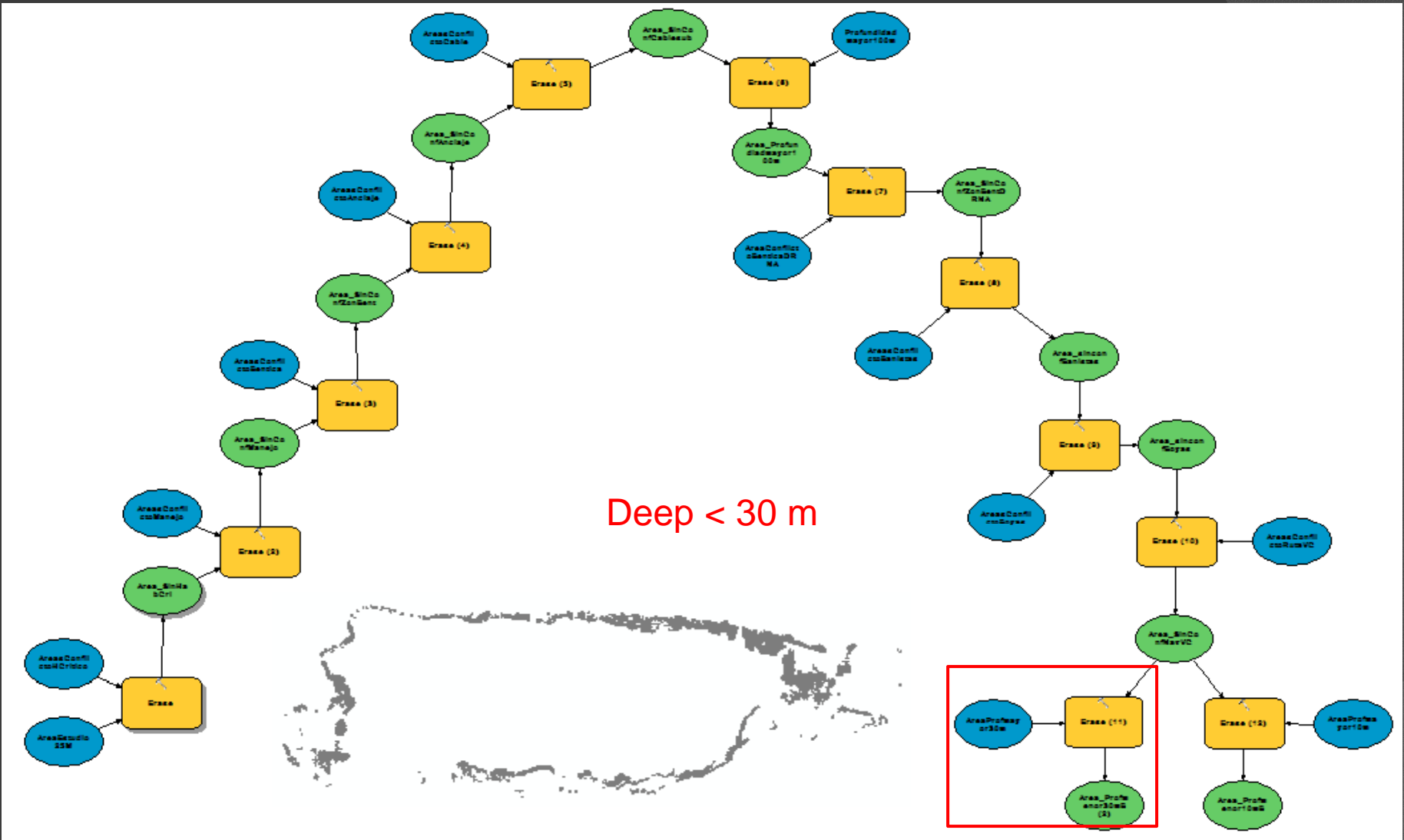




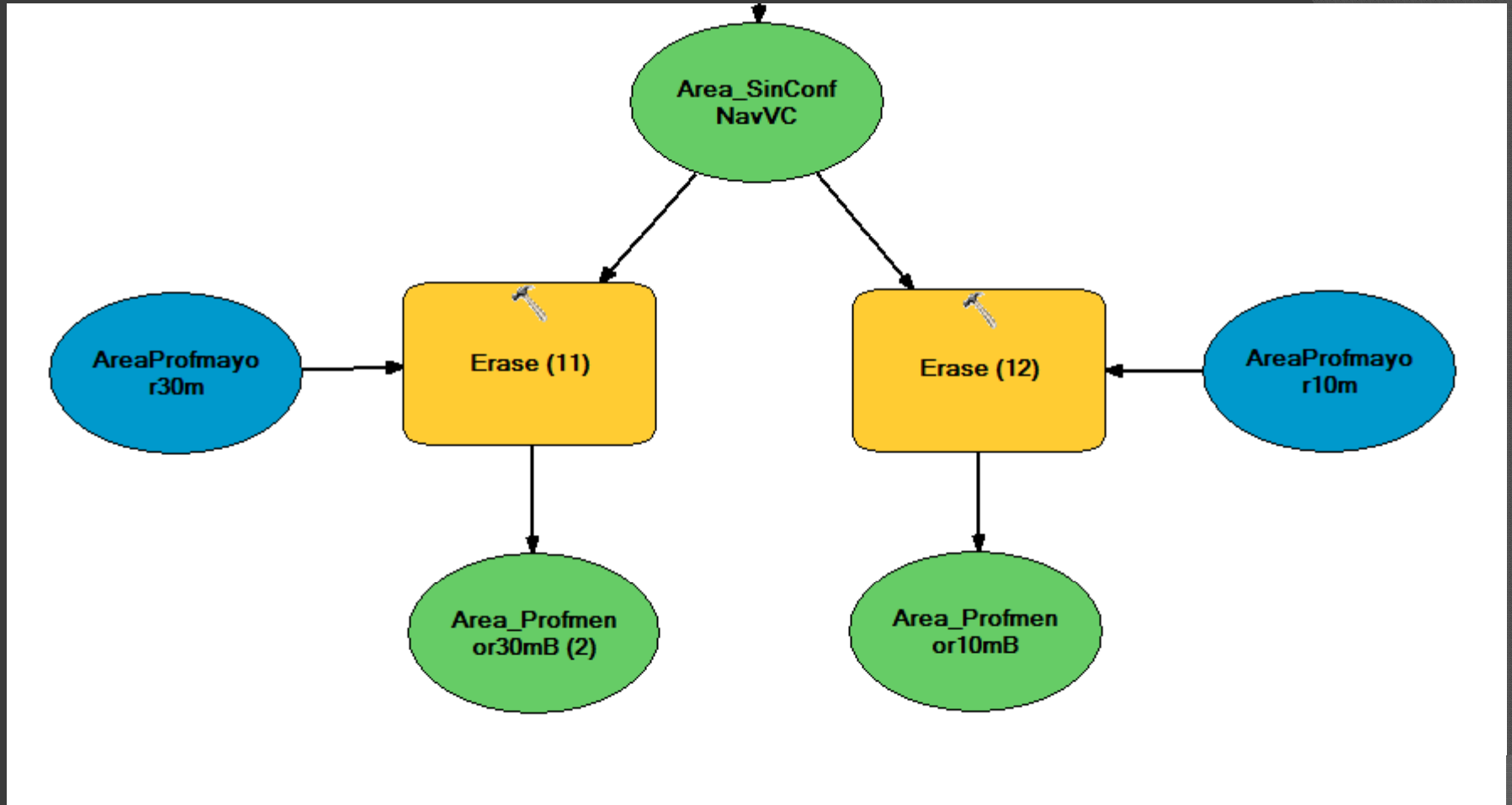
# Conflict Areas



# Conflict Areas

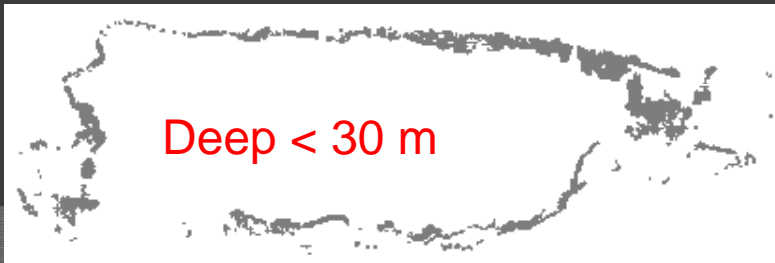


# Conflict Areas



783,533 P.S. / 19,588,325 m<sup>2</sup> / 19,588.326 Km<sup>2</sup>

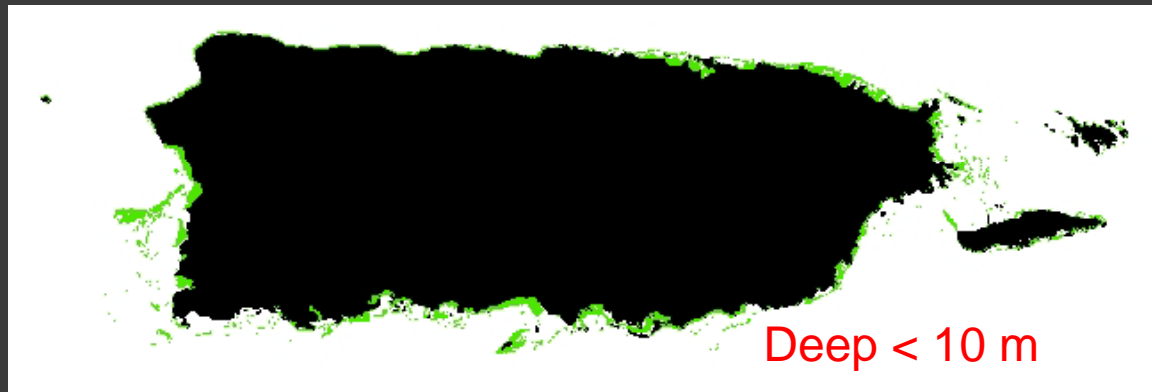
58,538 P.S. / 1,463,450 m<sup>2</sup> / 1,463.45 Km<sup>2</sup>



## Model B



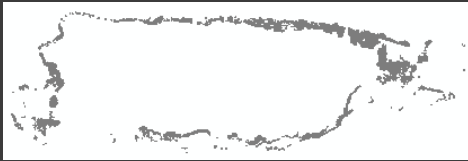
795,456 P.S. / 19,886,480 m<sup>2</sup> / 19,886.48 Km<sup>2</sup>



76,256 P.S. / 1,906,400 m<sup>2</sup> / 1,906.40 Km<sup>2</sup>

Analysis of possible sites

In Puerto Rico



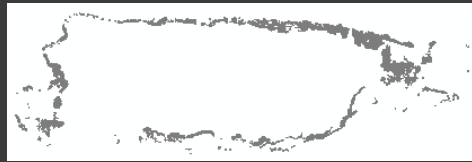
No Conflict Areas



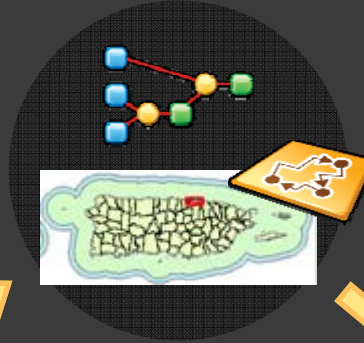
# Analysis of possible sites

In Puerto Rico

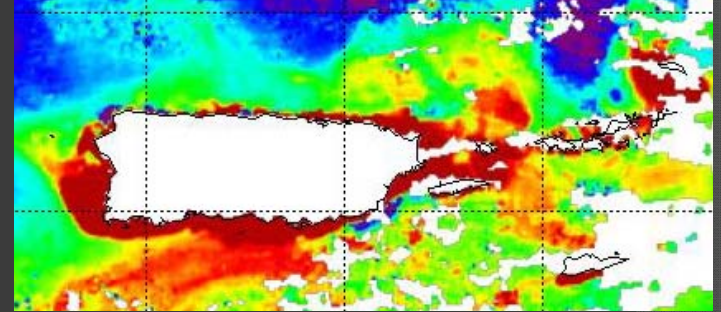
## Options



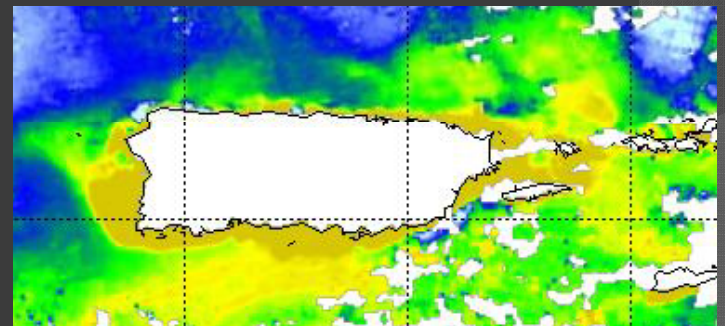
No Conflict Areas



Optimal Areas



Chlorophyll

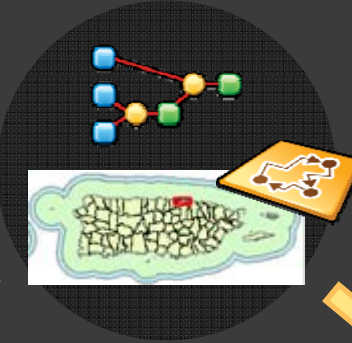


Light

# Analysis of possible sites

In Puerto Rico

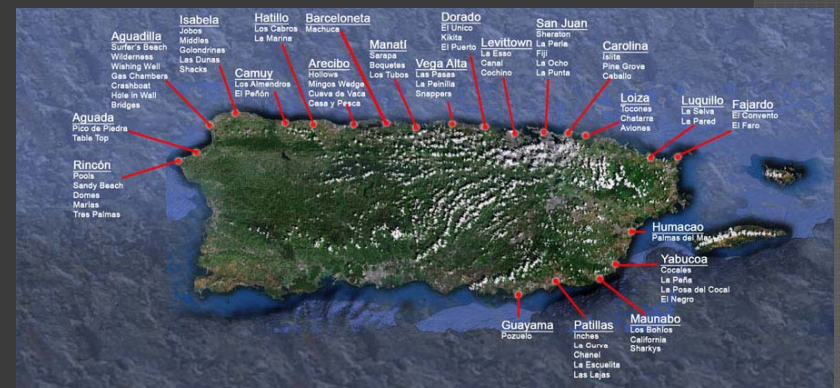
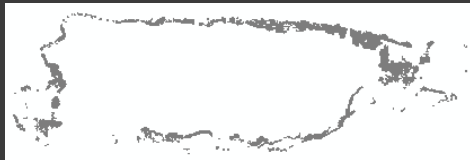
Next



Available Infrastructure

No Conflict Areas

Optimal Areas

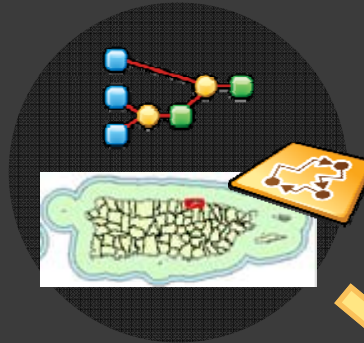
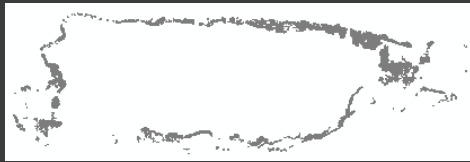


Wave Intensity

# Analysis of possible sites

In Puerto Rico

Next



No Conflict Areas

Optimal Areas



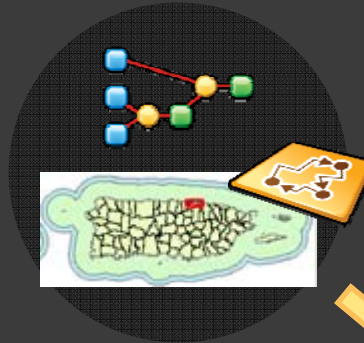
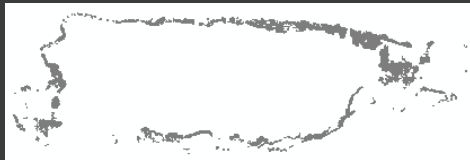
AQUACULTURE SITES



# Analysis of possible sites

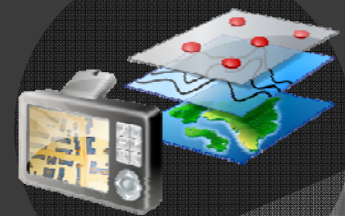
In Puerto Rico

Next



No Conflict Areas

Optimal Areas



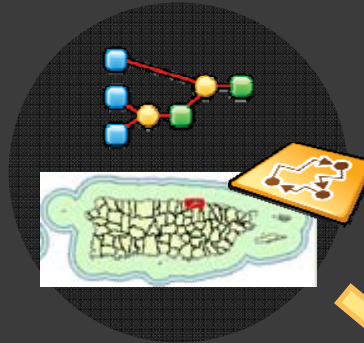
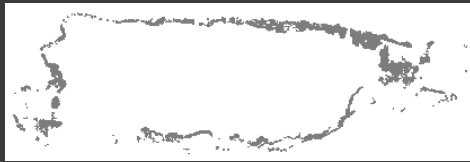
Field Data Analysis

AQUACULTURE SITES

# Analysis of possible sites

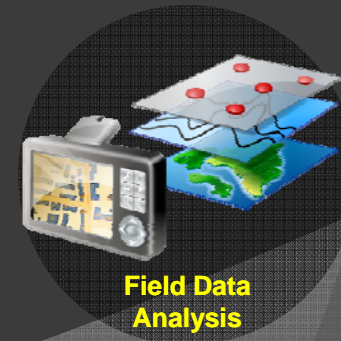
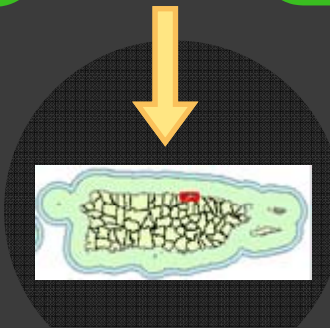
In Puerto Rico

Next



No Conflict Areas

Optimal Areas



AQUACULTURE SITES



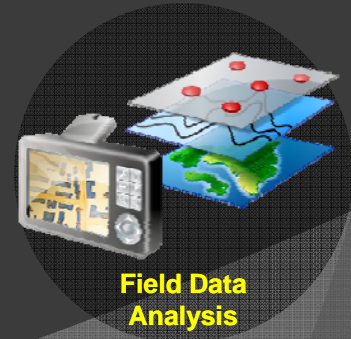
# Analysis of possible sites

In Puerto Rico



No Conflict Areas

Optimal Areas



# Thanks

## Support



## Data



# Questions?



Joel O. Meléndez Díaz

(787) 531-0613 / [jmelendez@prxtreme.com](mailto:jmelendez@prxtreme.com)

Norberto Quiñones Vilches

(787) 630-3272 / [norb0964@hotmail.com](mailto:norb0964@hotmail.com)

**Center for Renewable Energy and Sustainability** <http://renewable.uprrp.edu/>

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