# RECYCLED GLASS AS BEACH NOURISHMENT MATERIAL: A Feasibility Study

Puerto Rico Science, Technology & Research Trust

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PROJECT AIMS: This project evaluates the feasibility of using recycled glass to mitigate Puerto Rico's erosion problems, while reducing the amount of solid waste reaching the landfill. We estimate the costs of such project compared to traditional nourishment alternatives; assess the life cycle of glass going to the landfill vs. using it for beach nourishment; and evaluate the social perception of such project in the island.

## BACKGROUND/MOTIVATION

Puerto Rico experiences **severe erosion** problems. This picture was taken near the Villa Cofresí Beach area in **Rincón, PR**. Current efforts are in place to evaluate the feasibility of a beach nourishment program in the area, yet sand sources to replenish the beach are scarce.

Recycled Glass as Beach Nourishment Material

Source: Gabriela Salgado

1 bottle of glass = 147 $cm^3$ of crushed glass

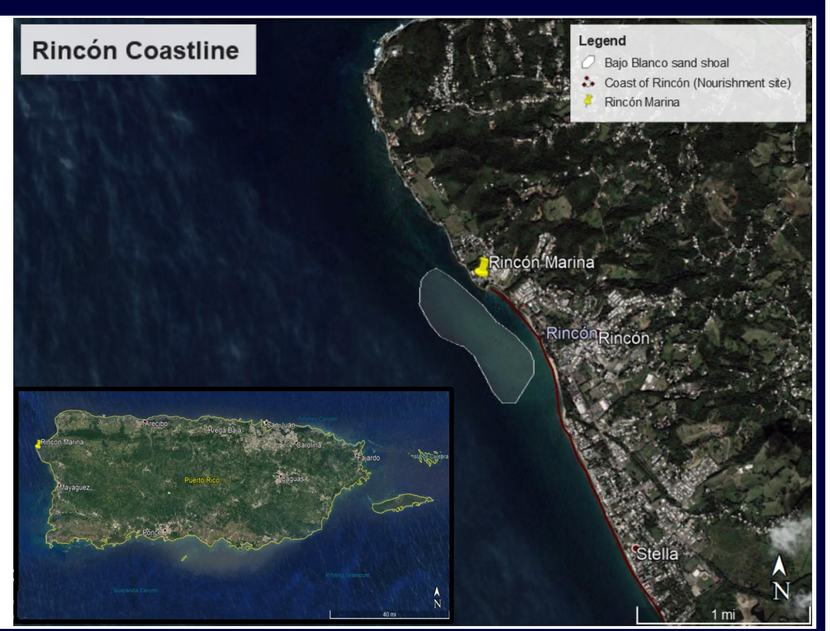
*Recycled Glass Cullet*

Same nature

*Sand*

## LOCATION MAP/SITE LOCATION

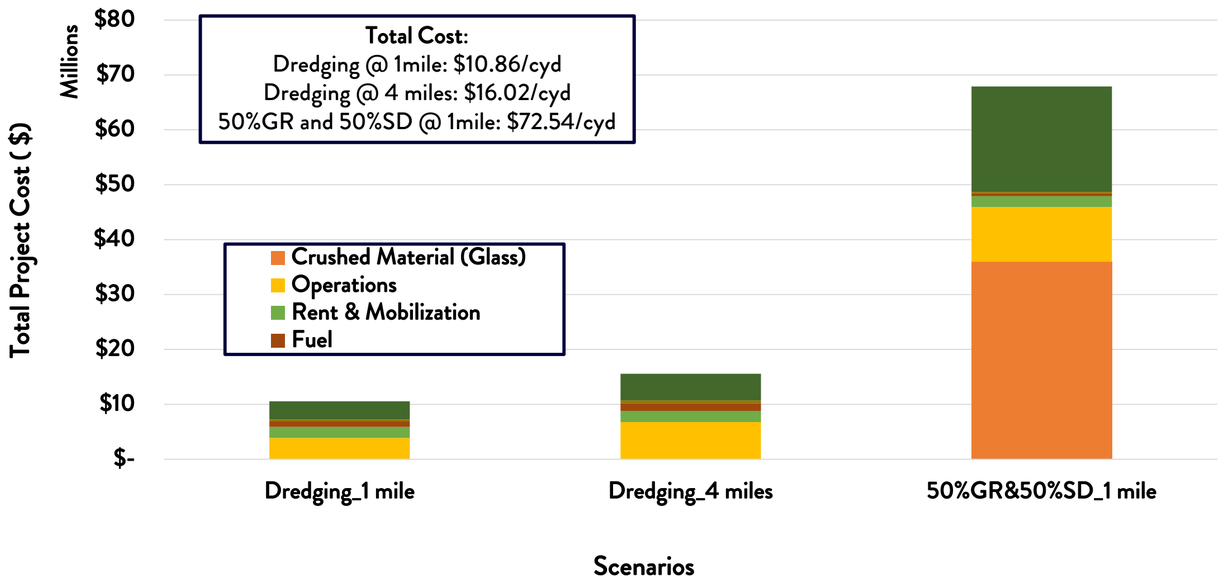
Historical shoreline changes in Rincón Puerto Rico were thoroughly studied by the USGS. The area between Balneario de Rincón and Córcega is one of the most affected, with approximately **1.1 m of shoreline retreat per year.** Using the Bajo Blanco sand shoal as a beach nourishment borrow site has been proposed, yet care must be taken as the grains are slightly smaller than the native beach sand (Rojas - Vázquez, 2016).



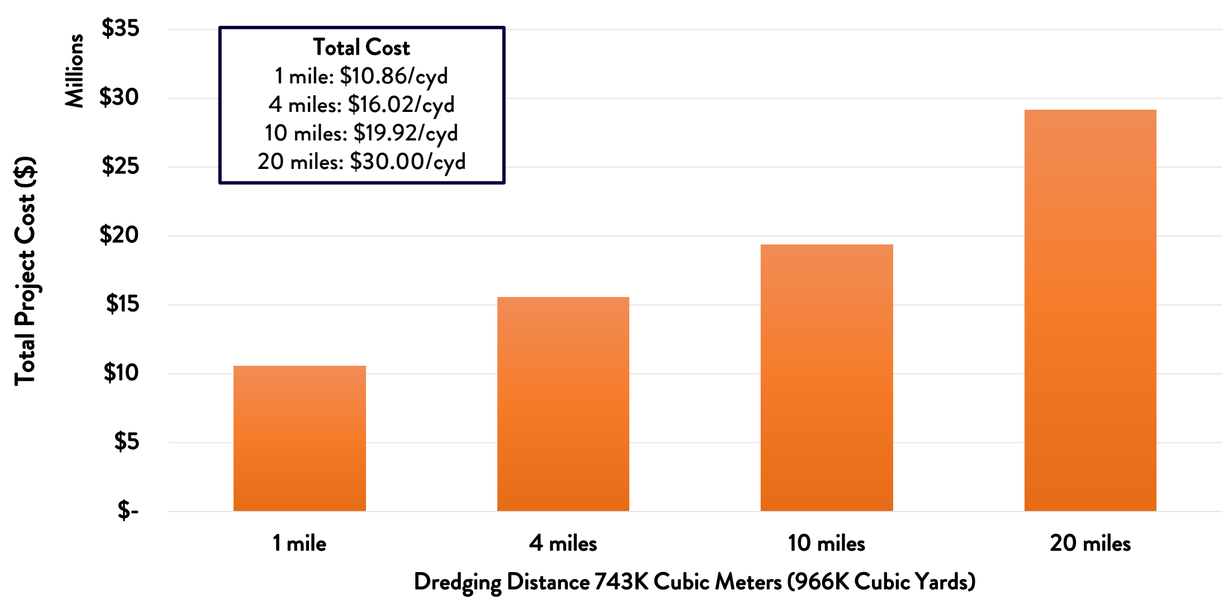

## ECONOMIC FEASIBILITY

Cost estimates of beach nourishment (**743K $m^3$ volume and 36-m wide berm**) were evaluated with three scenarios: 1) dredging from **Bajo Blanco sand shoal** within 1 mile from the beach; 2) dredging from a different sand shoal within 4 miles from the beach site; and 3) filling the beach a 50/50 percent mixture of sand from the Bajo Blanco sand shoal and **crushed glass** from Cay Clean Glass Plant. To complete the process of glass crushing, **2.5 billion of bottles** are needed ($70 – 80 per ton). A trailing suction hopper dredge was considered for all cost estimates.

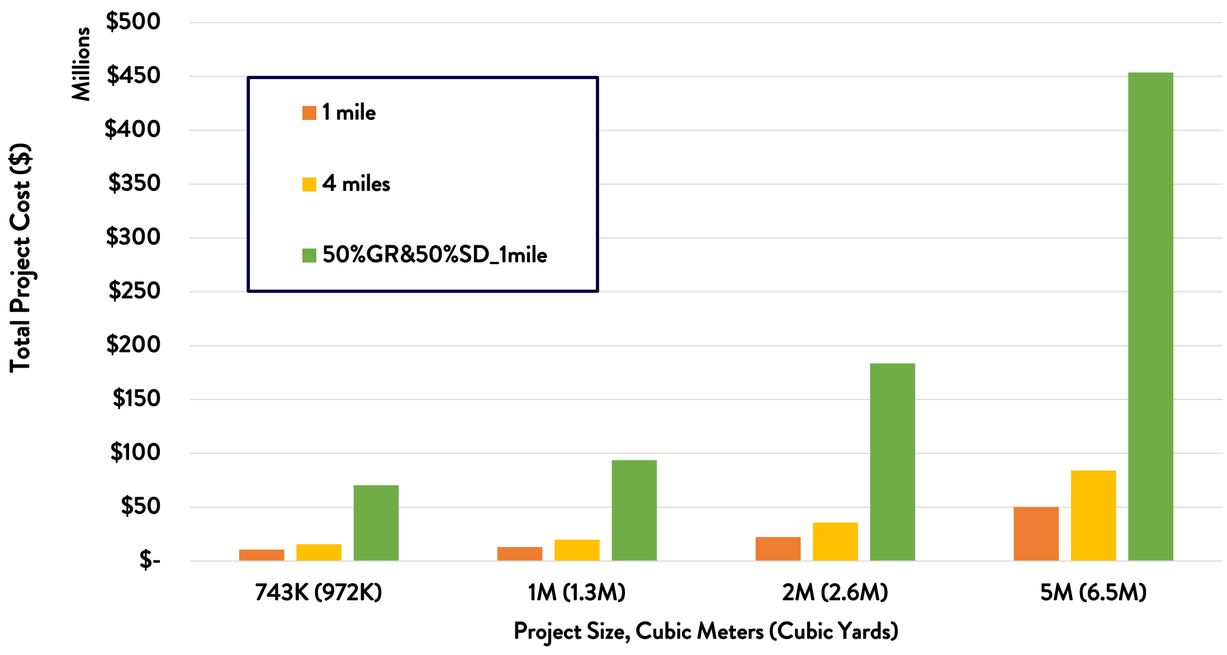
### TOTAL PROJECT COSTS




### SENSITIVITY ANALYSIS-DISTANCE FROM DREDGING SITE



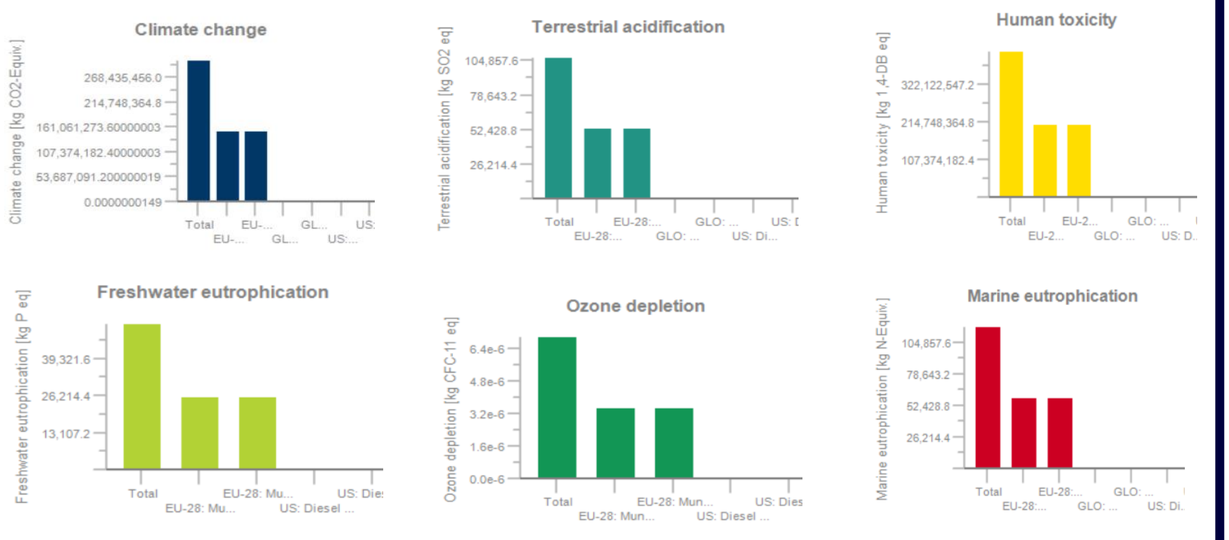

### SENSITIVITY ANALYSIS-PROJECT SIZE



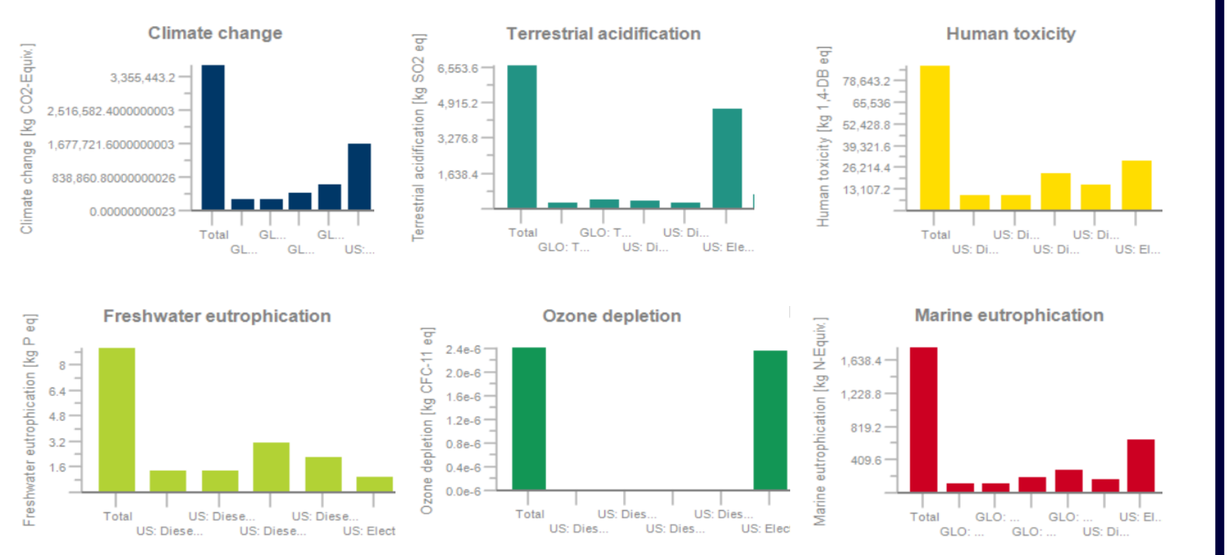

## LIFE CYCLE ASSESMENT

The Life Cycle Assessment (LCA) was conducted using GaBi (www.thinkstep.com); system boundary was considered from gate to grave: taking the bottles as a main product (gate) to the final system process (grave): eliminating the raw material and creation process.

### LIFE CYCLE ASSESSMENT OF TAKING BOTTLES TO THE DUMPSITE



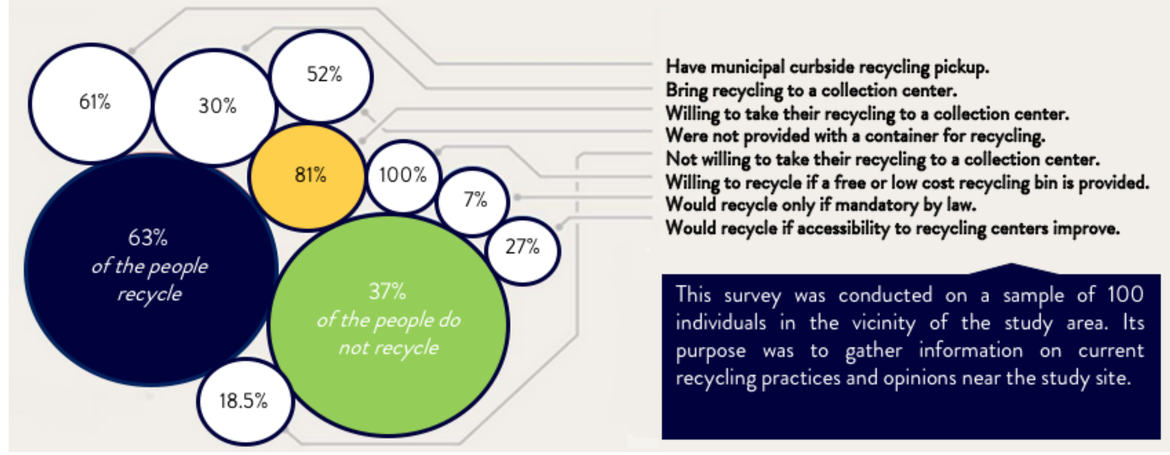

### LIFE CYCLE ASSESSMENT OF USING BOTTLES AS FILL MATERIAL




## SOCIAL FEASIBILITY

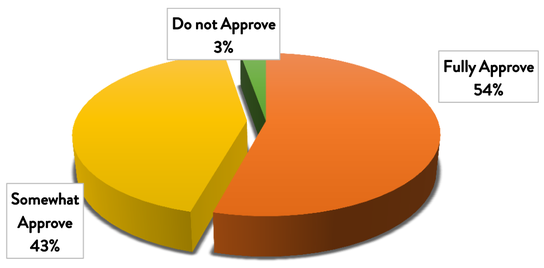
In order to analyze the feasibility of this project, the public perception of its implementation must be taken into consideration. A series of surveys concerning recycling practices and community approval were conducted to evaluate the recycling potential in the area and public perception of the project.

### RECYCLING SURVEY IN PUERTO RICO (2017) *




### GLASS BEACHES AROUND THE WORLD:

- Caribbean island of Curaçao
  - Hilton Hotel on Piscadera Bay
  - Zanzibar Park
- Town of Lake Hood, New Zealand.

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