Assessing Critical Infrastructure in Puerto Rico's Coastal Zone

an Interactive Qualifying Project Report

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Puerto Rico Coastal Zone Management

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Executive Summary

Coastal zones throughout the world are economically invaluable. Importing, exporting, harvesting natural resources, creating energy, and producing goods creates potential for the generating of trillions of dollars. Needless to say, this is one resource that must be protected and preserved. Unfortunately, a large portion of infrastructure in coastal zones is constantly subjected to Earth's changing climate. Puerto Rico, although mostly mountainous in the center, has large coastal zones in the north and south. These coastal zones not only attract residents and vacationers, but they are also places that attract the reoccurring hurricanes or tsunamis that storm through the Caribbean. Therefore, the focus of this project will be the effects of climate change on infrastructure in Puerto Rico's coastal zone.

Working with our sponsor, the Department of Natural and Environmental Resources (DNER), we determined the leading dangers to infrastructure in the coastal zone to be sea level rise (SLR), coastal erosion, storm surges, hurricanes and tsunamis. After identifying the types of climate change affecting infrastructure along the coast, the different categories of critical infrastructure in Puerto Rico were identified. The categories of infrastructure our project focused on include: power plants, hospitals, airports, seaports, schools, bridges, roads, transmission lines and aqueducts.

Extensive research has already been completed by other researchers on the extreme variability of the climate in Puerto Rico. There is also historic data on the island's infrastructure and damages it has suffered. No research, however, has been done to combine the two factors by analyzing critical infrastructure in Puerto Rico's coastal zone versus its vulnerability to the changing climate. Therefore, our project goal was to determine how the different categories of critical infrastructure would be affected by climate variability and the dangers associated with

the coastal zone. Accomplishing our goal involved achieving three main objectives. The first objective was to determine the different categories of at risk infrastructure in the coastal zone of Puerto Rico. The second objective was to determine to what extent the critical infrastructure would be affected by climate change. The third objective was to provide user-friendly visuals, in the form of maps and tables, to decision makers such as government officials and the building planners of Puerto Rico. Our final objective was to determine how the damage to these critical structures would affect Puerto Rican society.

Through extensive research on projected climate changes and critical infrastructure, we were able to meet these four objectives and ultimately our project goal. Conducting interviews with experts helped in choosing which aspects of the infrastructure to concentrate on. We made use of the Geographical Information System (GIS) database to create maps of critical infrastructure layered with the risks it is threatened by. Preexisting information in the GIS database was also analyzed to determine which structures from each category of infrastructure were at risk. With the creation of a risk assessment table for each type of infrastructure analyzed, we isolated which structures were vulnerable to climate change.

This project laid the groundwork for studying the effects of climate change on critical infrastructure. The results of our project aided in providing recommendations for an improved methodology to be utilized by future researchers, whether that be by the DNER staff or students continuing our study in the future. Lastly, the data obtained from our analysis was part of a critical infrastructure inventory and added to the Geographic Information System (GIS) database.

Abstract

Some of Puerto Rico's critical infrastructure may not be structurally fit to withstand the effects of climate change such as sea level rise, coastal erosion, storm surge and tsunamis. In an attempt to reduce the dangers of climate change, our group worked in conjunction with the Department of Natural and Environmental Resources (DNER) to assess critical infrastructure in Puerto Rico's coastal zone. The goal of our project was to provide the DNER with insight into which infrastructure was most susceptible to the hazards of climate change and variability.

Authorship Page

Caitlin Chase, **Greg Gonzalez**, **Daphne Gorman** and **Sydney Higginbottom** all contributed equally to the development of the projects goals and objectives. All group members contributed equally to the development and organization of an outline to be followed for the writing of the final report.

The Introduction was assembled through parts written by each of the group members and edited by **Sydney Higginbottom**.

Caitlin Chase contributed to "A History of Architecture" and "Current Protection Strategies" along with the "Interviews with Infrastructure Experts" and "Strategies for Protection of Vulnerable Structures" sections. Caitlin also contributed to the "Civil Engineer Interview Results" and "Interviews with Custodial Personnel" sections as well as the "Recent Interview Information" section.

Greg Gonzalez contributed to the "Dangers in the Coastal Zone" section of the background, the "Create a Critical Infrastructure/Puerto Rico Assets Inventory" section of the methodology, and the "Recommendations for Adaptation Strategies" section of the conclusions.

Daphne Gorman contributed to the "Current Mitigation Plans" and "Critical Infrastructure Assessment" sections as well as the "Using the GIS database section. Daphne also contributed to the "Geographic Selection Based on GIS Maps" section.

Sydney Higginbottom contributed to the "Coastal Zone Management" and "Mitigation" sections as well as the "Identification of At Risk Structures", "Interviews with Custodial Personnel" and "Research Projected Climate Changes" sections. Sydney also contributed to the "Tourism Company Results" section of the results chapter.

Edits and revisions to the final report were performed by all members of the group, however **Caitlin Chase** was the general editor.

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Table of Contents

List of Tables

List of Figures

List of Acronyms

A	An area inundated by 100 year flooding, for which no BFEs have been established.
AE	An area inundated by 100-year flooding, for which BFEs have been determined
AH	An area inundated by 100-year flooding (usually an area of ponding), for which BFEs have been determined; flood depths range from 1 to 3 feet.
AO	An area inundated by 100-year flooding (usually sheet flow on sloping terrain), for which average depths have been determined; flood depths range from 1 to 3 feet
BFE	Base Flood Elevation. The BEF for a flood zone is the level that flood waters are calculated to reach during a 100-year event.
CDK	Ciudados del Karso (English: Citizens of the Karst)
CZMA	1972 Coastal Zone Management Act
CZMP	Coastal Zone Management Program
DNER	Department of Natural and Environmental Resources
EPA	Electricity and Power Authority
FEMA	Federal Emergency Management Agency
GIS	Geographical Information System
IPCC	Intergovernmental Panel on Climate Change
IQP	Interactive Qualifying Project
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
OCRM	Office of Ocean and Coastal Resource Management
PRASA	Puerto Rico Aqueducts and Sewer Authority
PRCZMP	Puerto Rico Coastal Zone Management Project
PREPA	Puerto Rico Electric Power Authority
SLR	Sea Level Rise
VE	An area inundated by 100-year flooding with velocity hazard (wave action); BFEs have been determined
WTP	Water Treatment Plant
WWTP	Waste Water Treatment Plant

1. Introduction

With the growing popularity of coastal living throughout the world, construction in these areas is soaring. Due to this spike in development, coastal zones both globally and in Puerto Rico, are frequently turning out to be some of the most highly developed regions. Structures such as power plants, hospitals, airports, seaports and schools are just a few of the infrastructure types present along the coast. Unfortunately, a higher concentration of buildings translates into a higher possibility that some of the infrastructure will be damaged or destroyed by the effects of climate change produced from the nearby ocean. Sea level rise (SLR), coastal erosion, storm surges, hurricanes and tsunamis are just a few of the dangers facing critical infrastructure in the coastal zone.

Although storms and flooding occur all over the world, the severity of the storms in Puerto Rico is much greater due to its location in the Caribbean Sea. In the short time period between 1980-2005, there were twelve hurricanes or tropical storms that hit the island including Hurricane Georges, which was one of the worst storms Puerto Rico has ever seen (Garcia, 2011). These storms destroyed homes, flooded buildings and allowed erosion to eat away at roads and bridges. The inadequate structural stability of infrastructure along the coast due to previously endured hazards is a major danger facing the inhabitants of Puerto Rico.

A vulnerability assessment has been done by pervious researchers for the coast of the island using Geographic Information System (GIS) software to indicate which areas are most affected by climate change. Simultaneously, we have found that extensive research has been completed on the history of the island's infrastructure and any damages these structures may have endured. However, there has been no research to combine these two factors and analyze the critical infrastructure in Puerto Rico's coastal zone based on the changing climate.

The goal of our project was to provide our sponsor with insight into which types of infrastructure, located within Puerto Rico's coastal zone, are susceptible to the hazards of climate change and variability. Accomplishing our goal involved the completion of four main objectives. The first objective was to determine the different types of at risk structures in the coastal zone. The second objective was to determine to what extent this critical infrastructure might be susceptible to projected dangers. The third objective was to create user-friendly visuals, in the form of maps and tables, to provide to decision makers of Puerto Rico. The final objective was to determine how damage to these structures would affect Puerto Rican society. Through interviews, widespread research and data analysis, we were able to better evaluate critical infrastructure to ensure a safer environment for the inhabitants of Puerto Rico. The results of our research will act as groundwork for continuing to improve the study of critical infrastructure vulnerability in the future.

2. Background

This section is designed to provide background information regarding the management of coastal zones and mitigating the effects of climate change in these areas. First, we will discuss the types of hazards that can occur in coastal areas then followed by the types of structures that have to withstand these hazards. Different categories of infrastructure will be analyzed in order to determine which structures from each category are affected by climate variability and change. Finally we will discuss ways to mitigate the effects of climate change so they do not have as damaging of an effect on the infrastructure and inhabitants of Puerto Rico.

2.1. Coastal Zone Management

The United States' coastal zone is home to a large portion of the Nation's population, and combined with the Great Lake's coastline, it stretches over 95,000 miles (NOAA, 2011a). Not only is it a beautiful place for vacationing and living, but it is an essential zone for economic activities as well. In 2007 the coastal zone's economy contributed $6.7 trillion dollars to the U.S. economy. Forty years ago it became evident to the government that this unique resource must be protected and preserved. In 1972 the Coastal Zone Management Act (CZMA) was passed to: "protect natural resources, manage the development in high hazard areas, provide public access for recreation, and give priority to coastal dependent development". The National Oceanic and Atmospheric Administration (NOAA) established the Office of Ocean and Coastal Resource Management (OCRM) to manage and conserve the nation's oceanic and coastal resources. Various coastal management programs have been implemented in 34 states through the efforts of this office. OCRM is composed of six divisions: Coastal Programs, Estuarine Reserves, National Policy and Evaluation, Business Management, Marine Protected Areas center, and the Coral

Program. All of these divisions work together in an attempt to preserve and protect the coast. This project will be concerned mostly with the Coastal Programs, in particular with the Coastal Management Programs.

2.2. Dangers in the Coastal Zone

SLR and coastal erosion are the most common manifestations of climate change endangering infrastructure along the coast; however, storm surges, hurricanes and tsunamis represent other pressing challenges structures in the coastal zone must be able to withstand. Understanding what hazards are present in the coastal zone was vital in determining which infrastructure types were at risk.

2.2.1. Sea Level Rise and Coastal Erosion

Due to global warming, SLR poses the biggest threat to coastal regions. The rise in sea levels causes the shoreline to erode and threatens the infrastructure closest to the coast. According to the Intergovernmental Panel on Climate Change (2007), or IPCC, since 1961 the sea level has risen at an average rate of 1.8 mm per year, and since 1993 this rate has risen at an average of 3.1 mm per year. The character of coastal landforms, such as barrier islands and cliffs, often dictates the severity of SLR (Titus, 2009). Beaches with a more gradual slope will be affected to a greater degree than beaches with a steep slope. According to Lewsey et al. (2004) one centimeter of SLR can result in a shoreline loss of several horizontal meters, or several thousand hectares (10,000 m^2) of land loss. While the cause of coastal erosion is not certain, it is generally agreed upon that the most probable cause is SLR (Zhang et al., 2004). At least 70% of the world’s sandy beaches are in recession, and 86% of the United States’ East Coast beaches have experienced coastal erosion. Zhang (2004) suggests that the long-term sandy beach erosion is two orders of magnitude greater than the rate of SLR. He stressed that significant SLR will have severe consequences for the infrastructure and people on the coast. Poorly drained low-lying coastal plains will be the most affected, while mangrove forests and sea grass should be able to tolerate SLR to some extent. The effects of SLR can be seen all over the world. People living in coastal areas may be able to adapt to rising sea levels by moving inland or to higher grounds. However, critical infrastructure in the coastal zone cannot easily be moved inland. This highlights a need to protect coastal infrastructure from SLR and coastal erosion.

2.2.2. Storm Surges

Storm surges are caused by low atmospheric pressure and strong winds that push on the ocean's surface, causing water to rise above ordinary sea levels (IPCC, 2007). Surges can be intensified if they occur at high tide, since the coastal waters are already raised to their customary highest point. SLR also increases the potency of storm surges by providing an elevated base for surges to build upon, and by diminishing the rate at which low-lying areas drain (Titus, 2009). According to the United Nations 2009 climate report, storm surges often precede hurricanes and continue throughout their duration causing considerable damage and flooding (Simpson, et al, 2009). Over the last 50 years there has been a decrease in the minimum atmospheric pressure in hurricanes. The height of a storm surge is related to the reduction in atmospheric pressure in the hurricane, meaning that the lower the pressure of the hurricane, the stronger the surge. Evidence shows that atmospheric pressure in even the strongest hurricanes is decreasing; as a result storm surges associated with these hurricanes are getting stronger. Storm surges are a large danger to coastal infrastructure because of the flooding, and the high winds associated with them.

2.2.3. Hurricanes

Puerto Rico is no stranger to hurricanes. In a study done by the University of Puerto Rico storm data dating back to 1851 was compiled to assess the number of hurricanes that have come in near proximity to Puerto Rico. Using the Saffir/Simpson scale, Puerto Rico has experienced two category 5 storms, five category 4 storms, six category 3 storms, twelve category 2 storms, and fourteen category 1 storms (Mercado, 2010). Puerto Rico experienced one of the worst storms when Hurricane Georges swept through the island in September of 1998. It was reported that over fifty percent of the electrical poles and cables were damaged and roughly 28,000 homes were destroyed (Bennett and Mojica, 2011). People were without electricity and clean water for months. In general, the total damage done by Hurricane Georges in Puerto Rico was estimated at $1.9 billion. A hurricane could have detrimental effects on significant portions of infrastructure along the coast and was thus identified as a severe hazard for the purpose of this project.

2.2.4. Tsunamis

Another climatic phenomenon that affects the coastal zone is earthquakes. Puerto Rico is at a high risk of experiencing detrimental earthquakes due to its proximity to the fault line between the North American and Caribbean tectonic plates (Mueller, 2010). It is therefore understandable that Puerto Rico has a history of destructive earthquakes. Not only are these earthquakes a danger to Puerto Rico by themselves, causing structural damage from ground-motion alone, but also earthquakes trigger destructive tsunamis. This makes them especially relevant to our project because of the damaging tsunamis they trigger.

According to NOAA (2011b) a tsunami is defined as a “series of ocean waves generated by sudden displacements in the sea floor, landslides, or volcanic activity.” Waves may come to shore gently or may be a fast moving wall of turbulent water many meters high. NOAA estimates that since 1850, tsunamis have been responsible for over 420,000 deaths and trillions of dollars in damages worldwide. Mercado (2010) describes tsunamis as the "the forgotten hazard" because they are not always considered a threat in the Caribbean. However, due to earthquakes, landslides (both above water and underwater), and submarine volcanic explosions, tsunamis pose a threat to Puerto Rico and must be considered when assessing critical infrastructure. There is an active submarine volcano located north of Grenada; however, it does not pose a great threat to Puerto Rico. The biggest tsunami threat lies, in the trench north of Puerto Rico; submarine landslides and earthquakes there could easily trigger a tsunami that could hit the northern coast of the island.

2.3. Types of Infrastructure in the Coastal Zone

"The coastal zone is a transition zone, or an ecotone, lying between oceanic environments and terrestrial systems" (Beatley, 1994, p.27). For this project, the "coastal zone" is being defined by the DNER as "all land within 1 kilometer of the shoreline". The main island of Puerto Rico has about 580 kilometers of coastline. Along this coastline there are several different types of structures that are vulnerable to climate change. Those of greatest interest to our project include power plants, hospitals, airports, seaports, schools, bridges, roads, churches, hotels and government buildings.

2.3.1. Power plants

There are a variety of power plants in Puerto Rico, most of which are located within the coastal zone and are therefore at risk from coastal hazards. Electricity has become increasingly important in everyday life. If the power plants in Puerto Rico were to be damaged due to the effects of climate change, millions of residents would be left without power. Responsible for the distribution of electricity to the residents of Puerto Rico is the Puerto Rico Electric Power

Authority (2011) or PRASA. The first electric lighting system in Puerto Rico began operation in 1893. In 1908 the first power plant funded by the government was built, and then in 1992 the Energy Policy Act allowed private companies to sell electricity as well.

2.3.2. Hospitals

Hospitals are another important type of infrastructure that could be damaged if located in the coastal zone. There are around 57 hospitals in Puerto Rico, the majority of which lie within the coastal zone (Hospitals Worldwide, 2011). Due to the hazards related to climate change, there is a much greater likelihood that people would be injured and require assistance only a hospital can provide. If a hospital were to sustain substantial damage, there would be nowhere for those injured persons to be treated, making hospitals one of the greatest priorities for the protection of their structural integrity.

2.3.3. Ports

Because Puerto Rico is an island, its airports and seaports are extremely important. Without these ports, there would be a major problem with receiving supplies and transporting people from the mainland U.S. to the island, and vice versa. Ten major airports are located in various towns across Puerto Rico including Aguadilla, Arecibo, Fajardo, Isla De Culebra, Isla De Vieques, Mayagüez, Ponce, Roosevelt Roads and San Juan (Air Broker Center International AB, 2009). The sea ports of Puerto Rico are clustered mainly on the eastern side of the island; however, towns such as Arecibo, Aguadilla, Mayagüez, Guanica, Guayanilla, Tallaboa, and Ponce also house some of the major ports on the island (World Port Sources, 2011).

2.3.4. Schools

The schools in the coastal zone of Puerto Rico may also be susceptible to the effects of climate change. When dangers associated with climate change impact a school, it puts the lives of thousands of students and teachers in harm's way. There are around 1,500 mainly public schools in Puerto Rico, of which there are around 800 elementary schools, about 200 middle schools and just over 150 high schools (SchoolTree.org, 2011). Out of these schools, 310 are located in the coastal zone and were targeted by our project.

2.3.5. Roadways and Bridges

Because Puerto Rico is a relatively moderately small island, the majority of its highways and major bridges are located in the coastal zone area. There are about 740 kilometers of roadways and 240 bridges located in the coastal zone. It is very important to ensure these roads and bridges are in a condition that they could withstand the effects of climate change in order to maintain open transportation throughout the island. There are eight major freeways and three major expressways in Puerto Rico (PuertoRico.com, 2011). The freeways include PR1, PR2, PR3, PR22, PR52, PR10, PR53, and PR66. The PR1 runs from San Juan to Ponce and is now mainly used by tourists (PRroads, 2007). The PR2 is the longest road in Puerto Rico connecting Ponce, Mayagüez, Aguadilla, and Arecibo. The PR3, also known as the 65th Infantry Avenue, is also mostly used as a tourist route running from Salinas through Guayama, Humacao, Fajardo and finally to San Juan. The PR22, PR52, PR10, PR53 and PR66 are all newer freeways that are much more frequently traveled than the first three. The roads and bridges in the coastal zone provide essential transportation and were a focus to our project.

2.3.6. Churches

Churches that hold religious and historical importance should be evaluated in case the effects of climate change present an environment the structures cannot withstand. Around fifteen percent of all Puerto Ricans are Christian Protestant, about two percent are nonreligious and three percent belong to religions such as Islam and Judaism (Galvan, 2009). The remaining eighty percent are Roman Catholic. Some of the most important and beautiful Catholic churches include the Iglesia San Blas Illescas in Coamo and the Iglesia Porta Coeli in San German (GSV, 2009). Iglesia San Jose is one of the oldest churches in the Western hemisphere and is located in Old San Juan. Because so many Puerto Ricans affiliate themselves with a religion, we considered churches a critical infrastructure and therefore important to our project.

2.3.7. Hotels

The majority of hotels associated with tourism are typically located in close proximity to the coast due to the fact that people visiting Puerto Rico want to spend their time on the beach. This places a high number of hotels within the reach of severe coastal hazards. Many hotels require continuous repairs in order to maintain functionality and also to maintain a safe environment for visiting individuals. Construction of hotels first began in the 1950s with the Caribe Hilton and Hotel La Concha (Galvan, 2009). Today the industry has spread throughout most coastal regions placing hotels in high-risk areas throughout the island.

2.3.8. Government buildings

Government buildings, housing important offices, documents, and computer systems, may also be structurally vulnerable to climate-related risks. There are four main federal buildings in Puerto Rico (U.S. General Services Administration, 2011). Among these are the Federal Center in Guaynabo, the Federico Degetau Federal Building and the Clemente Ruiz Nazario U.S.

Courthouse in Hato Rey, and the Jose V. Toledo U.S. Post Office and Courthouse in San Juan. These historic buildings may be especially vulnerable to the dangers related to climate change due to their age.

2.4. Mitigation

"Mitigation refers to the elimination or reduction of the frequency, magnitude, or severity of exposure to environmental... or social risks, or minimization of the potential impact of a threat or warning" (Zelaya, et al., 2009). In order to effectively accomplish mitigation, the threat or warning must be thoroughly studied and all impacts of the hazard should be made clear. This allows for the best mitigation technique that will hopefully solve the problem. With urban development in the coastal zone of Puerto Rico, there is a greater need to mitigate potential dangers of climate variability to the critical infrastructure (Core Writing Team, 2007). The issue of coping with coastal disasters has always been present throughout the island as hurricanes and tsunamis continuously cause damage to houses, bridges and roads. Many adaptation approaches have multiple drivers, such as economic development and poverty alleviation. These approaches are rooted within broader development planning strategies such as water resources planning, coastal defense, and disaster risk reduction strategies. The ability of an area to adapt and mitigate is based on socioeconomic and environmental circumstances and also on the data and technology available. As the problem of urban development in coastal zone areas has increased, so has the variety of mitigation techniques devised to cope with it.

2.4.1. Flood Control

Early approaches to flood control attempted to hold back the water through seawalls and dikes, whereas more recent approaches have added flood proofing to buildings that are regularly exposed to storms (Godschalk, 1989). Smaller projects to control flooding include the construction of retaining ponds that hold excess storm water. Larger undertakings for the prevention of flooding are the building of dams that control the movement of water in river systems, and flood channels, which funnel and divert floodwaters away from developed areas. These techniques as well as others have been implemented along the coastline in states such as South Carolina, Texas and Louisiana. Levees and locks have been put in place in New Orleans to protect against and manage hurricane flooding. In Texas, a 16-mile long levee system was constructed along with a concrete floodwall drainage system, a closure gate, and a pumping drainage station to better protect the coastal zone from the fifteen-foot storm surges. Both New Orleans and Texas are no strangers to devastating hurricanes, storm surges and the flooding that accompanies them. Flood control techniques are currently the only strategies being implemented in Puerto Rico to protect against climate change.

2.4.2. Mitigation Tools

Use of Coastal Vulnerability Index

One of the most common methods of assessing coastal vulnerability is the coastal vulnerability index (CVI) (Doukakis, 2005). The coastal vulnerability index allows variables such as geomorphology, shoreline erosion, coastal slope, relative SLR rate, mean wave height and mean tide range to be related in a manner that expresses the relative vulnerability of the coast due to future SLR. Each variable is given a ranking on a linear scale of one to five (one being the lowest risk of vulnerability and five being the highest risk), and once combined, the index value is calculated. This value highlights the areas where the physical effects of sea-level change might be the greatest.

Use of GIS Index

A Geographic Information System (GIS) is a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information. GIS can help reveal important information that may lead to better decisions (USGS, 2007). For example, it is important to know the locations of heavy or light rainfall. This is done using a location reference system. Comparing the location of heavy/light rainfall with the location of marshes may show that certain marshes receive little to no rainfall. These facts could help indicate which marshes are likely to dry up and therefore help make decisions about how humans should interact with the marsh. This information system is of great use in coastal zone management. It has the ability to compare areas of continuous flooding, with types of infrastructure located along the coast. The ability to compare weather patterns of a particular area to the infrastructure within that area is of vital use to any coastal zone management program.

2.4.3. Current Mitigation Strategies

Current plans for mitigating the effects of climate change falls into three categories of measures: national policies, international agreements, and private or non-governmental initiatives (Working Group II, 2007). Each of these three categories has their merits and shortcomings, and they all vary depending on location due to differences in social, economic, and demographic differences.

In all three categories (international, national, and private or non-governmental) there are similar types of mitigation plans that fall into eight types (Working Group II, 2007). The first type, regulations and standards, identifies requirements for technologies and performance in order to reduce pollution and emissions. The second type, taxes and charges, involves charging a fee of persons involved in activities that could cause climate change. Tradable permits, another strategy for climate change mitigation, limits emissions by requiring each pollution source to hold a permit. Another type, voluntary agreements, involves an understanding between at least one private party and a government that are established in order to lessen climate changes. Subsidies and Incentives, the fifth type, involve a discount or payment to units that are successfully minimizing their pollution outputs. Another type of mitigation plan, called "information instruments", encourages units to reduce their emissions and pollution by requiring disclosure of all information relevant to the environment to the public. The Research and Development type plan involves investigating new and creative ways to mitigate climate change and is funded by the federal government. The last type of mitigation plan, non-climate policies, involves policies that significantly affect the climate but only as a secondary benefit. They are designed in order to accomplish something unrelated to the climate; lowering pollution output is merely a side effect.

Protection Strategies

Some common structural reinforcement techniques include post-tension systems as well as the installation of shear dowels in epoxy-filled holes (Structural Reinforcement Contractor, 2011). Post-tension systems use steel tension rods or high strength cables that increase the bending and shear strength of a beam. These reinforcements provide additional support and correct deficiencies in structural design. Another possible solution to issues facing climate change is through the use of reinforced earth (Reinforced Earth India, 2009). Reinforced earth falls within the same category as steel; however, it differs in flexibility. Its ability to resist fracturing during foundation settlements makes it the ideal material for use in coastal zone areas. Yet another possible solution to the effects of climate change on structures would be through the use of earth bag structures which are buildings made out of sand bags, filled and stacked like masonry. Earth bags have been commonly used in the military as well as for flood control. Their strength, durability and low cost make them ideal for building houses. In addition, earth bags are also fire resistant, non-toxic, and can be built to suit any climate. Houses in flood areas typically use gravel filled bags for the lower walls so that they are not swept away. Using a spherical design allows for much greater protection against hurricanes and tornados due to the lack of large flat surfaces where pressure builds up. These are just a few of the possible solutions to mitigate the effects of climate change.

2.5. Summary

It is clear that the coastal infrastructure of Puerto Rico is in danger from the hazards caused by climate variability, whether it is SLR, coastal erosion, storm surges, hurricanes, or tsunamis. There exists an urgent need to assess the dangers that may impact much of this infrastructure. In our report, we will attempt to communicate how this project assessed the different types of infrastructure at risk in the coastal zone. Our methodology was used for determining how susceptible infrastructure was to projected dangers. Additionally, we will describe the repercussions on Puerto Rican society, should these structures be damaged.

3. Methodology

The concept map depicted below was utilized to formulate our four objectives:

1. Determine the different types of at risk structures in the coastal zone.
2. Determine to what extent the critical infrastructure might be susceptible to projected dangers.
3. Create user-friendly visuals intended for the decision makers of Puerto Rico.
4. Determine how damage to critical infrastructure would affect Puerto Rican society.

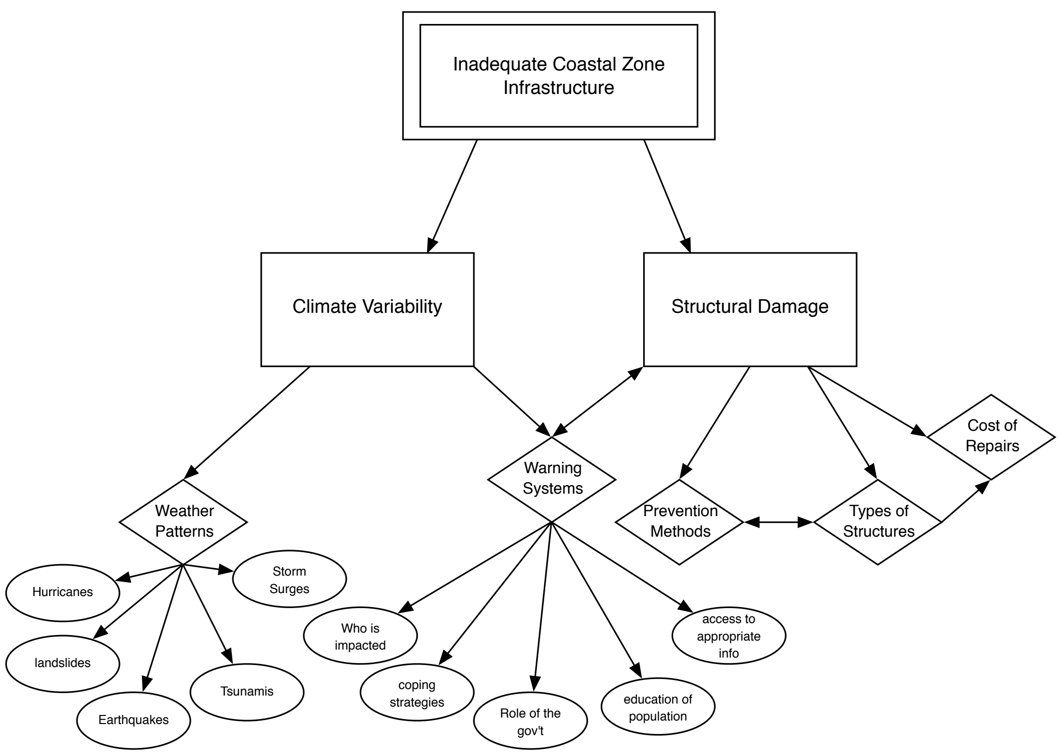

Figure 1: Our Concept Map

The main goal of our project was to provide our sponsor with insight into which types of infrastructure, located within Puerto Rico's coastal zone, are susceptible to the hazards of climate change and variability. Accomplishing our goal involved the completion of four main objectives. The first objective was to determine the different types of at risk structures in the coastal zone of Puerto Rico. We were able to accomplish this through researching projected effects of climate change, conducting interviews with infrastructure experts, and using a Geographical Information System (GIS) database. The second objective was to determine to what extent different types of critical infrastructure might be susceptible to projected dangers. This was accomplished by analyzing maps we created with GIS and interviews with experts. The third objective was to create user-friendly visuals to supply to the decision makers of Puerto Rico. This was accomplished by utilizing the GIS software to create multiple maps and tables. The final objective was to determine how damage to at risk structures would affect Puerto Rican society. Through our interviews, as well as background research, we gained a better understanding of the protection strategies that are currently in place.

In order to achieve our ultimate goal we used the methodology outlined in this chapter. The data obtained from our analysis is now part of a critical infrastructure inventory in the DNER's GIS database. The data was converted into user-friendly visuals for Puerto Rico's decision makers. And lastly, the societal impacts of the damaged infrastructure were analyzed.

3.1. Identification of At Risk Structures

This section will detail the methodology used to identify vulnerable types of infrastructure in Puerto Rico's coastal zone. First, we researched projected climate changes in order to identify which areas in Puerto Rico's coastal zone would be most affected. We also used GIS data of the critical infrastructure, layered onto areas susceptible to climate change as a way to show which specific buildings were most at risk. Next, we interviewed experts to obtain more insight into which types of infrastructure were most vulnerable. Using those data, we were able to identify structures that would be most at risk in the face of climate change.

3.1.1. Research into Projected Impacts of Climate Change

Through background research and discussions with our sponsor, we were able to determine the biggest threats due to climate change. The threats we concentrate on were: SLR, coastal erosion, storm surges, hurricanes, and tsunamis. SLR can cause erosion and flooding, which decreases the projected lifetime of coastal infrastructure. Storm surges may cause flooding, but the strong winds that accompany storm surges can also be detrimental to buildings and other infrastructure. Puerto Rico is in close proximity to the convergence of the North American and Caribbean tectonic plates, which places it at a high risk for earthquakes and the resulting tsunamis. All the above listed threats were researched prior to our arrival in Puerto Rico.

3.1.2. Interviews with Infrastructure Experts

In order to obtain more knowledge on how to conduct a risk assessment, we created an individual interview protocol, which can be viewed in Appendix C. These questions were designed specifically to help assess each of the different types of structures we selected from our list of infrastructure types deemed critical in Puerto Rico. The first interview conducted was with two architects working for Puerto Rico's Tourism Company, William Pitre and José Terrasa. This was an extremely informative interview that gave us an inside look into the tourism industry of Puerto Rico and how it is being affected by climate change. An additional interview was conducted with a recent civil engineering graduate from the University of New Hampshire, Robb Chase. Although he did not have much knowledge on climate change, his information on structural support options was very helpful. A final interview was conducted with Alberto Lazaro, executive director of infrastructure of Puerto Rico Aqueducts and Sewer Authority (PRASA). Additionally we were able to interview a concierge at La Concha resort who had been employed there for several years. She was able to give us an accurate history of damages and repairs. From these interviews we gained a more complete understanding of different types of infrastructure, how they work, and how they fail.

3.1.3. Using the GIS Database

In order to identify which infrastructure to assess, we utilized the ArcGIS program to create maps of each type of infrastructure relevant to our project in different risk scenarios. Due to licensing issues, the program could only be installed on two of the group members' laptops. Our sponsor provided the data we used to create these maps. These data can be found at:

- http://www.gis.otg.gobierno.pr/
- http://climategem.geo.arizona.edu/slr/us48prvi/index.html

Using the maps produced we determined which infrastructure was in an area that would be the most at risk given its location. The infrastructure mapped included: airports, bridges, highways, hospitals, power plants, seaports, transmission lines, aqueducts, and water treatment plants. The climate change parameters that were layered on top of the infrastructure were: SLR, tsunamis, flooding, and landslides. Some of the maps included all of Puerto Rico, while others focused on San Juan, the east coast, or the west coast. Justification for this can be found in Chapter 4. A sample map can be found in the figure below. This map depicts the flood risks layered onto airport locations in Puerto Rico. The full catalog of maps can be found in Appendix D.

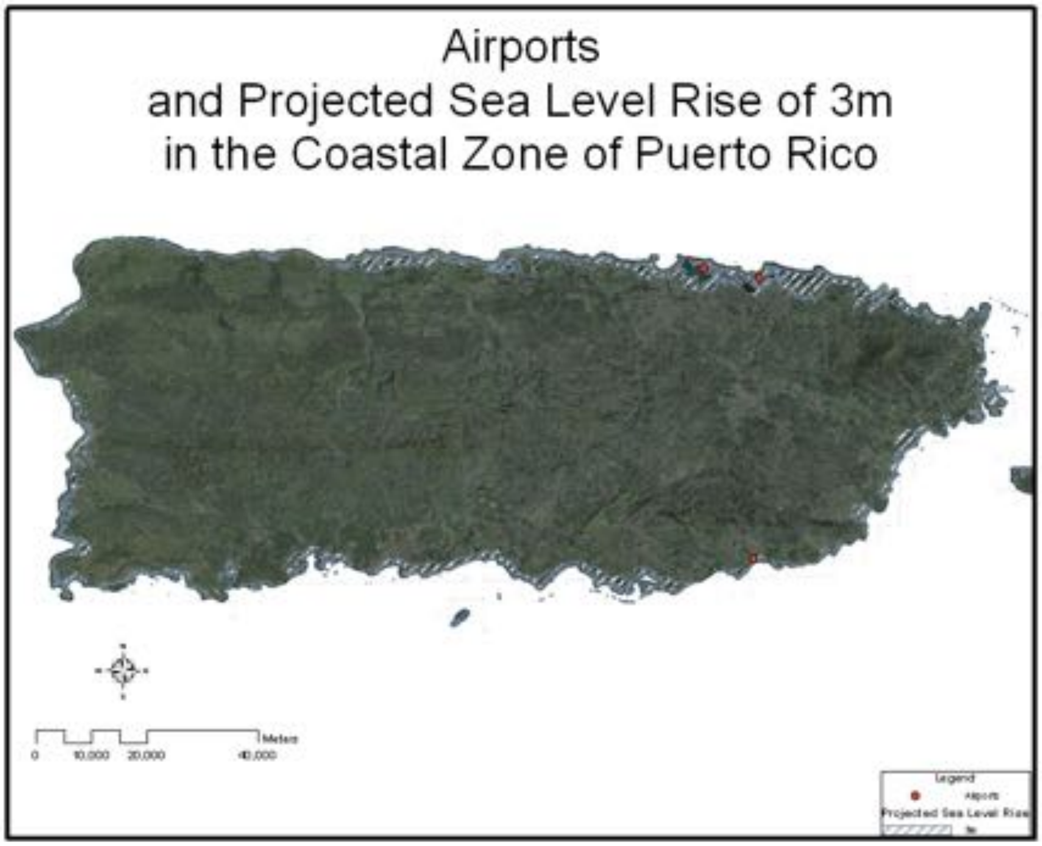

Figure 2: Map of Airports and Projected SLR of 3m in the Coastal Zone of Puerto Rico

In our research we used three sets of data to analyze SLR. One set came from a study conducted by Drs. Jeremy Weiss, Jonathan Overpeck, and Ben Strauss from their paper "Implications of recent sea level rise science for low level elevation areas in coastal cities of the conterminous U.S.A." Dr. Weiss was kind enough to provide us with the GIS shape files for Puerto Rico. They created these files using the National Elevation Dataset to portray the low elevation coastal areas. The National Elevation Dataset "has an absolute linear error of ± 4.75m (95% confidence interval) for the entire conterminous U.S.A." (Weiss et, al., 2011). However it is important to note that the coastal data is usually more reliable than nationwide data. Weiss used the mean high water as the shoreline to create the land-sea boundary. To model SLR they created an algorithm that compares the elevation data set that correspond to a particular height value, with sea elevations that are of an equal or greater value than the land values. They applied this algorithm to the National Elevation Dataset for integer values between 1-6m. This showed them areas that are at risk for SLR. Because the data is based on present day elevations it does not predict any future shorelines or actions, such as, “glacial isotactic, tectonics, subsidence, or erosion and accretion”. The data from Weiss had a relatively small error and was included in this report so we could analyze data from many sources.

Another source for our SLR data was provided by the Citizens of the Karst (CDK), a non-governmental non-profit organization who are concerned with climate change and the affect it will have on Puerto Rico (Karst, 2010). The data they utilized was provided by the 2007 Report of the IPCC. The parameters used were: a SLR from 28 to 58 centimeters on average, with a maximum of 1 meter, throughout the world over the next 100 years. These estimates do not include the movement and melting of Antarctica and Greenland. Nor do they take into account the effect of coastal erosion due to the increase in SLR. However, since this report has been published the projected SLR has been refined to a minimum of one meter with a maximum of three meters, over the next 100 years. By incorporating data from this study we gained a more comprehensive understanding of SLR in Puerto Rico.

3.2. Analysis of At Risk Structures

In addition to the more general techniques to identify at risk structures described in the previous sections, we conducted a more detailed risk analysis of different types of infrastructure. The buildings were organized into tables based on their category and the projected climate changes associated with each structure identified. Suggestions from the interviewees mentioned in the previous section were also taken into consideration when determining which aspects to focus on.

3.2.1. Creating a Critical Infrastructure/Puerto Rico Assets Inventory (GIS database)

It was important for us to keep clear documentation of data gathered from the risk analysis of affected types of critical infrastructure. The best way to do this was by creating a critical infrastructure assets inventory. This inventory was created in the form of risk assessment tables (example shown below) which includes the asset, a detailed description of the asset, the asset's useful life, the potential climate hazard that will impact the asset, potential impacts from that hazard and the financial worth of that asset to Puerto Rico. This inventory kept our records together in a manner by which we could compare and contrast one type of critical infrastructure to another. Using the data collected for the critical infrastructure inventory, as well as existing SLR, storm surge and tsunami modeling from the DNER, we calculated the projected damages to specific critical infrastructure types in the coastal zone of Puerto Rico.

Table 1: Example Risk Assessment Table of Airports

Infrastructure/ Asset	Detailed Description	Useful life	Distance from the coast (m)	Elevation (m)	History of Damages	Potential Climate Hazard	Potential Impact	Financial worth	Planned upgrades/other actions
Luis Muñoz Marín International	San Juan 18°26′22″N 066°00′07″W		25	3		3 meter sea-level rise	Flooding		$400 million expansion through 2011. [1]
Rafael Hernández International	Aquadilla 18°29′42″N 67°7′46″W		88	72					$1 billion expansion over the next 20 years. [2]
Mercedita International	Ponce 18°00′30″N 066°33′47″W		3410	8					$7 million to expand runway to 2,400 m. [3]
Fernando Luis Ribas Dominicci	San Juan 18°27′25″N 066°05′53″W		10	3		3 meter sea-level rise	Flooding		
Eugenio Maria De Hostos	Mayagüez 18°15′20″N 067°08′54″W		2125	9					
Antonio Nery Juarbe Pol	Arecibo 18°27′04″N 066°40′32″W		3450	7					
Jose Aponte de la Torre	Ceiba 18°14′43″N 065°38′36″W		62	12					
Diego Jiminez Torres	Fajardo 18°18′29″N065°39′43″W		3730	20					
Humacao	Humacao		2620						
Patillas	Patillas 17°58′56″N 066°01′10″W		27	3		3 meter sea-level rise	Flooding		
Cullingford Field	Cabo Rojo 17°58′35″N 067°10′15″W		1350	4					

**Organized by the number of commercial passenger boarding's that occurred in the 2008 calendar year from greatest to least, excluding Vieques, Culebra, and Mona Island.

**Airports highlighted in red are not within the coastal zone and may be deleted for final report.

The table was formatted in such a way so that many of the columns would correspond to an attribute in the GIS database. This allowed us to easily update the tables with information we gathered from GIS. The information that was not found in the GIS database was researched in an attempt to fill in the tables the best we could.

3.3. Summary

Determining whether the critical infrastructure in Puerto Rico's coastal zone is able to endure the impacts of hazards related to climate change is a complex process but absolutely necessary. Following the step-by-step methods explained above ensured the best results in our assessment. Organizing these results in a way that our sponsor, the DNER, could easily use and implement in other areas of Puerto Rico was a top priority throughout our data collection. Through researching climate changes to identify the infrastructure that was at risk as well as through performing interviews and conducting field observations, we created a table to organize our findings. With this information, we then provided our sponsor with user-friendly visuals that will be used to improve the endangered infrastructure, and hopefully create an overall safer environment for the citizens of Puerto Rico

4. Results and Discussion

This chapter will be dedicated to all the findings of our project. First, there will be a discussion of the results from our interviews with experts. Next, we will provide a thorough analysis of several different maps created through the use of GIS software, depicting potential dangers for each type of infrastructure. Through the examination of these maps we were able to determine which structures within each category of infrastructure were at risk. We were also able to determine the types of climate change and variability that placed each type of infrastructure at risk. Finally, we chose a few structures from each category to perform a more detailed assessment on and compiled this information into a detailed risk assessment table, to be discussed in the final section of this chapter.

4.1. Interviews with Experts

The interviews that we conducted were with infrastructure engineers and experts in the various fields that our study included. The tourism company, port authority, aqueduct and sewer authority, transportation authority, and electric energy authority are the main areas we focused on when looking for critical infrastructure. The interviews were conducted in pairs, with one person taking the lead in interviewing and asking the questions and responding to what the interviewees said. The other person was the scribe, taking detailed notes and making sure to stay on track using the questions provided in the protocol. From these interviews we were able to gain more information about the structures that may be at risk and protection strategies that are in place. The sections below describe what we gathered from the interviews with these experts. No direct quotes were taken from the individuals but each sub-section to follow is a summary, in our own words, of our conversation with the experts in each individual field.

4.1.1. Tourism Company Interview Results

This interview took place at the Convention Center in San Juan and was conducted with the head of the tourism company, Jose Terrasa, and his associate William Pitre. As recent as 50 years ago, Puerto Rico had not thought about climate change but it is definitely on its mind now. Organizations like The Tourism Company and the CZMP of the DNER have begun to share the extreme need for mitigation techniques and to spread the awareness of coastal dangers and climate change.

San Juan is considered to be an aquatic city as it was once an area that was all a wetland. This poses a great threat because as the sea level rises, this area will return to its natural state as a wetland if not be fully submerged in water. Channels and lagoons are plentiful along the coast of Puerto Rico, specifically in the San Juan area. With rising sea levels these waterways will overflow and cause flooding in the surrounding areas. Mr. Pitre provided us with maps detailing the scenarios if there was one meter of sea-level rise, two meters, and finally three meters. From these maps he showed us that in the two-meter scenario, the lagoons, the channels and Ocean Park would begin to be affected and start to overflow. With the three-meter scenario, almost all of the San Juan area would be inundated including both airports and the tourism piers.

Once a storm warning such as a hurricane or tsunami is communicated, evacuation of the immediate area is suggested. If this warning is declared too late the airports may be affected before the evacuation is complete. If this occurs, evacuation will continue once the airports are once again operational. Water and electricity need to be supplied to the affected area as soon as possible. Larger buildings such as hotels and government buildings usually house their own back-up generator so they are the first to regain electricity. The metropolitan area can recover from a storm much faster than the surrounding areas because of more resources and more manpower to clean the streets from the debris and sand.

The most severe problem regarding climate change and storm dangers affecting the tourism company is coastal erosion. We were told that in 2007 there were major beach erosion problems. On the south side of the island there was a landfill that contained mercury and other biohazardous material that was closed due to too much pollution. This landfill was located very close to the ocean and not far from the beach. As erosion ate away at the surrounding beach, the landfill was almost emptied into the ocean, mercury and hazardous material included. Similar to this landfill, other sanitary systems are being compromised. Ground water is in danger of sewers being inundated and contaminating the clean water.

There are currently no protection strategies in place on the part of the buildings of the tourism company as the government has just started to think about climate change as a danger to Puerto Rico. Depending on the damage, structures might try to implement protection strategies after a direct or indirect hit from a hurricane or storm surge. Unfortunately, there is little that can be done for buildings located on the coast, they either evacuate or prepare for what is to come. The hotels that have had the most damages from coastal erosion and storms are the ones located in Condado and Isla Verde. William informed us that specific hotels such as La Concha, the Marriott, and the El San Juan Hotel were among the few that have been affected most in the metropolitan area.

From this interview we gained a better knowledge of what structures are at risk. The interviewees were unbiased and gave an honest depiction of the problem at hand. They were also able to explain the lack of current protection strategies and a brief history of damages due to climate change. Finally, they were able to provide insight into the effects climate change has on the inhabitants of Puerto Rico.

4.1.2. Civil Engineer Interview Results

The civil engineering major we interviewed was Robb Chase, a graduate from the University of New Hampshire. Mr. Chase's knowledge on the inner workings of a building's structure was vital to our project group as none of us had civil engineering background. One of the main topics of our interview was preventative measures used to protect structures from the effects of climate change. Due to the extremely limited warning time preceding an earthquake, there isn't much that can be done to help protect against it or against the resulting tsunami should it be in very close proximity to a highly populated area. As far as storm surge and hurricanes are concerned, preventative measures include boarding up windows to protect from flying debris, moving valuables to a higher elevation and even evacuation may sometimes be necessary. Any structure either not built on stilts or with un-reinforced masonry may be more susceptible than others to the effects of climate change.

Some of the main points to focus on when determining whether a structure will fail include corrosion, levelness and distance from seawater. The lifetime of a structure is greatly reduced by its vicinity to the coast. Steel and rebar when exposed to salt will corrode at a much faster rate. Protective coatings can be used to help prevent this but there is only so much that can be done. New technology has just been introduced to help predict when a structure will fail. Ultrasonic technology in steel structures such as bridges is utilized by placing sensors along the structure to monitor stress cracks and provide advanced warning as to when the structure will fail.

Through this interview we gained an understanding of what can be done when people are alerted to an eminent danger. Some of the damages from storm surges and hurricanes can be avoided if the people are well prepared. Earthquakes and tsunamis are much harder to prepare for because of the lack of warning. Mr. Chase also gave us useful information on the structural integrity of infrastructure in the coastal zone. This interview helped us complete our second objective, which was to determine to what extent critical infrastructure might be susceptible to projected dangers.

4.1.3. La Concha Resort Concierge

La Concha Resort is an upscale resort located in the Condado area of San Juan, Puerto Rico. The interview was conducted with the front desk concierge Stephanie Rivera. This hotel was constructed about fifty years ago; however, it was closed for the past fifteen years due to a dip in the economy. Just three years ago it was reopened and is now one of the most successful and beautiful hotels in the area.

The biggest problem facing the hotel at this point in time is coastal erosion. Every few months, new sand must be added to the beach. Renace Condado is an organization working towards improving the quality of life in Condado; one of its concerns is beach erosion. People from different supporting sponsors meet regularly to discuss how to better protect the area and prevent more damage from occurring. There was even an attempt at securing the sands by planting palm trees to firm the beach; however, these trees were easily swept away right along with the sands.

Years ago the water level was a good distance from the hotel but as the years have gone by, the shore has become shorter and shorter due to the effects of sea level rise. During stronger storms, the water does hit the walls of the hotel. In an effort to protect these walls, a much stronger type of glass was used which can withstand winds of up to 120 meters per hour. This prevents the water from actually entering the building. Sandbags are also utilized in an effort to protect against flooding in the event that a larger storm impacts the area.

Hurricanes and tsunamis are not as frequent in this part of the island; however, they do still occur occasionally. In the event of a hurricane or tsunami, the hotel will lose power. Back-up generators located in the underground parking lot are used to ensure the computer systems and phone lines stay operational. However, this generator does nothing for the rooms themselves. Due to the fact that the generators are located in the basement, should there ever be a substantial amount of flooding, the generators would not be operational and the building would lose power completely.

This interview provided us with information about what is being done locally in Condado as well as what precautions are taken at La Concha Resort. We learned about the emergency backup systems that go into effect when the resort loses power. We also learned about the Renace organization that is working to improve Condado. This interview addresses our first, second, and fourth objectives. The interview helped us determine different types of at risk structures in Condado. We were also able to determine to what extent different structures might be susceptible to projected dangers. Finally we were able to determine how damage to this structure would affect the people living in it.

4.1.4. Aqueducts and Sewer Authority Interview Results

Our final interview was conducted with Alberto Lazaro, the executive director of infrastructure for PRASA. From this interview we gained a better understanding of how the aqueducts and sewer systems are affected by climate change, and what is being done. The infrastructure is composed of several key assets. A network of sewage pipes run from many different drains into a larger network of pipes. In some cases pump stations are required to assist the flow of the sewage, in other cases gravity is sufficient. The final destination of the sewage is a treatment plant. There, it is treated and returned to the population as clean water. Mr. Lazaro made it clear that not one wastewater treatment plant is more critical than the others. However, the San Juan treatment plant is the largest and if it were to be severely damaged all of San Juan would be affected. The San Juan plant is capable of treating up to 150 million gallons per day (mgd) of wastewater; the average rate is about 75 mgd. The excess capability is for when there are heavy rains. During an extreme storm or tsunami the wastewater will most likely exceed 150 mgd of wastewater, when this happens wastewater will spill out into the streets, and beaches of San Juan.

The treatment plants are usually located in flood zones because these zones are at the lowest elevations, and the plants rely on gravity. The plants are built to withstand flooding by having the pit walls of the plants raised up. The stations are sealed off so that they are capable of operating during flooding. The plants are also capable running for 8-10 hours on reserve generators. The generators must be refueled after this and if a large storm impedes roadways to the plants it will also impede the refueling of the generators.

PRASA does not have any future plans to protect against climate change. Mr. Lazaro made it clear that they do not have the money in their budget to plan for dangers that may not affect them for 50-100 years. He also acknowledged the possibility that global warming might not be happening and in that case they would have wasted money.

4.2. Geographic Information System Analysis

Using the maps we created (provided in Appendix D), we were able to determine which types of infrastructure, if any, are vulnerable based purely on their location, disregarding any physical properties of the structures themselves. The most notable result we obtained was that none of the coastal zones of Puerto Rico are at risk from landslides, as can be seen in Figure 3 below. The coastal zone is almost all in the darker green color; this color represents a low (baja) susceptibility to landslides. Red, orange and the lighter green color represent very high, high, and moderate susceptibility respectably and these areas are located more inland. After drawing this conclusion from analyzing the map shown below, we then decided not to include landslides in our further analysis of the infrastructure located within the coastal zone.

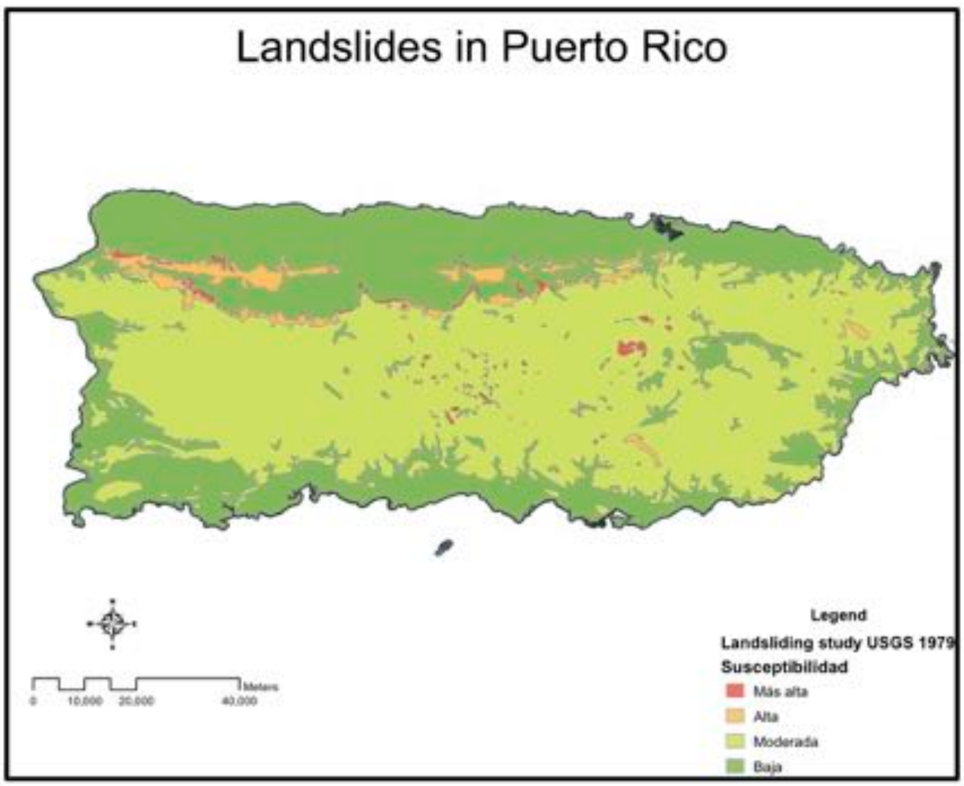

Figure 3: Susceptibility of landslides in main island of Puerto Rico

From the rest of the maps we created, along with their respective attributes tables, we could pinpoint which structures, located within the coastal zone, were at risk to the three major threats opposing the coast. Tsunamis, SLR and flooding were of greatest interest to us because after talking with our sponsor and the different experts, these three dangers were found to cause the most damage and attributed to the greatest effect coastal variability has had, and will continue to have, on the coast. The infrastructure we analyzed was based on talks with our sponsors as well as the availability of information in the GIS database.

4.2.1. Airports

Of the fourteen airports that are located in Puerto Rico, only 5 are situated along the coast. The Antonio Rivera Rodriquez Airport is located on the island of Vieques and the Culebra Airport is located on the island of Culebra. For the purpose of this project, we excluded these two islands, along with the island of Mona, and focused on the main island of Puerto Rico. There are only 3 airports situated along the coast on the main island. These Airports are the Patillas Airport located in Patillas, the Luis Munoz Marin International Airport in San Juan, and the Fernando Luis Ribas Dominicci also located in San Juan.

By layering the infrastructure layer on top of the different dangers in GIS, we could tell which of these airports were at risk for the three dangers previously mentioned. The tsunami layer showed that none of the airports located on the main island were susceptible to floods caused by tsunamis. With a 3-meter SLR, all three of these airports would be inundated. With the flooding layer, we could see that only the Patillas Airport would be susceptible to flooding. It is located in zone AE with a BFE of 2.7 MSL. Therefore, since the Patillas Airport is susceptible to two out of the three dangers, we have deemed this airport as the most at risk.

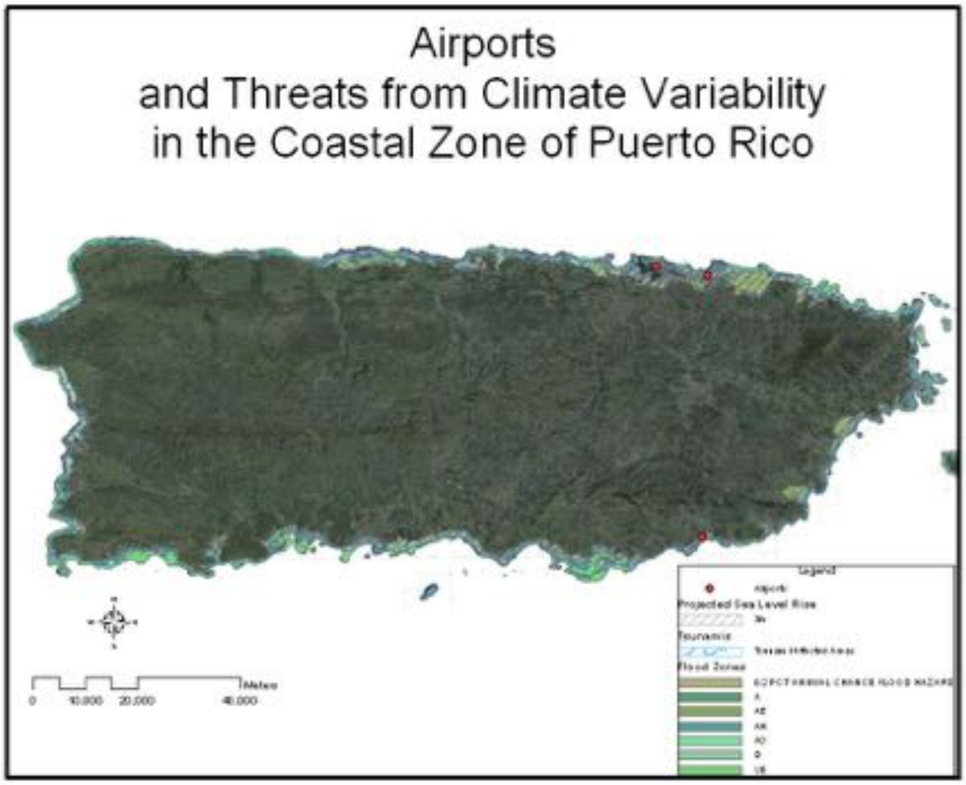

Figure 4: Airports and all three dangers

The above map consists of the airport layer, set on top of the three risk layers to show which airports are in danger of each climate change scenario. The three red dots are the three airports located along the coast of the main island and from the legend; it is depicted which color or pattern represents which type of danger. More detailed maps are provided in Appendix D, where the dangers are separated into three different maps.

4.2.2. Aqueducts

The map below shows the aqueducts located along the coastal zone as well as the three threats posed to those aqueducts. In Appendix D, there is a map with each separate danger layered on top of the aqueducts layer to show how many meters of aqueducts are affected by each threat.

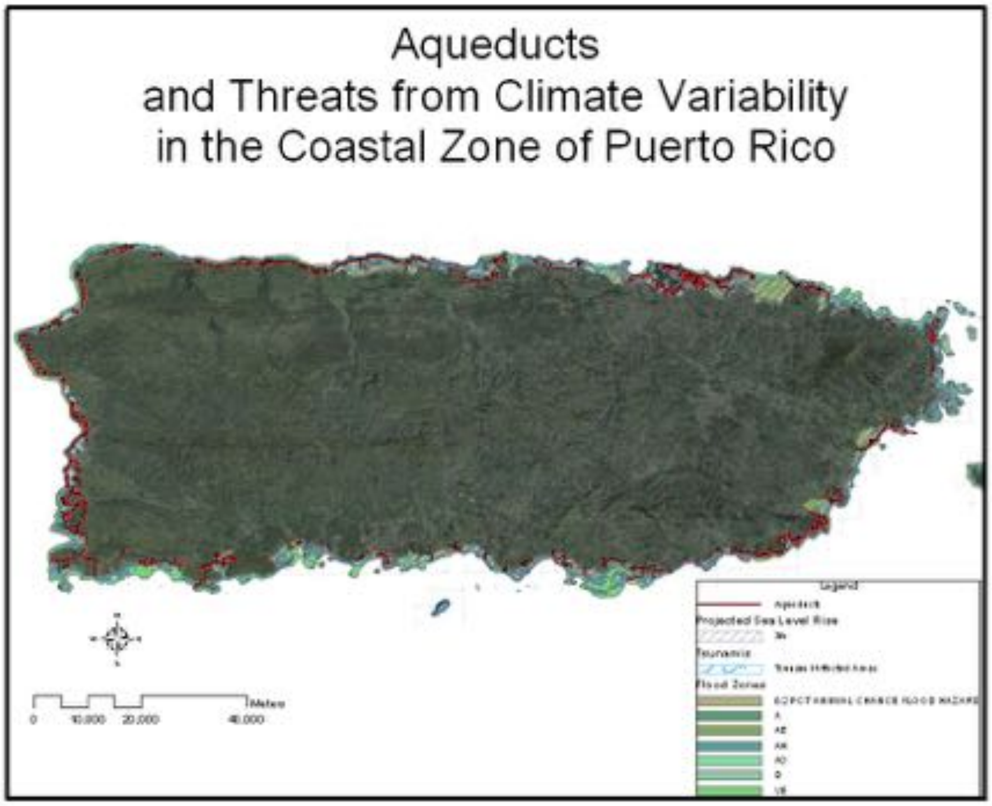

Figure 5: Aqueducts and all three dangers

From the attribute tables associated with each map created, we found how many meters of aqueducts were affected by each threat to the coastal zone. The total length of aqueducts within the coastal region is 1,095,712.55 meters. Of these, 208,632.45 meters are susceptible to flooding caused directly from tsunamis. The length of aqueducts affected by 3-meter sea-level rise is 438,969.27 meters and 369,085.42 meters are located in flood zones. Of those that are located in flood zones, 47,074.42 meters are in the 0.2% annual chance flood hazard, 16,638.05

meters are in flood zone A, 252,665.90 meters are in flood zone AE, 202.66 meters are in flood zone AH, 7,974.46 meters are in AO, and finally 44,529.97 meters are located in flood zone VE. From combining all three layers, we can conclude that the length of aqueducts located in the coastal zone that are in danger of all three threats to the coast is 116,987.95 meters which is 10.7% of the total length of aqueducts located within the coastal zone.

4.2.3. Bridges

On the main island of Puerto Rico, there are 240 bridges located within the coastal zone. These bridges can be seen on the map presented below along with the areas in the coastal zone affected by tsunamis, flooding and a scenario in which the sea-level rises 3-meters. Maps detailing each separate threat to the coast can be seen in Appendix D.

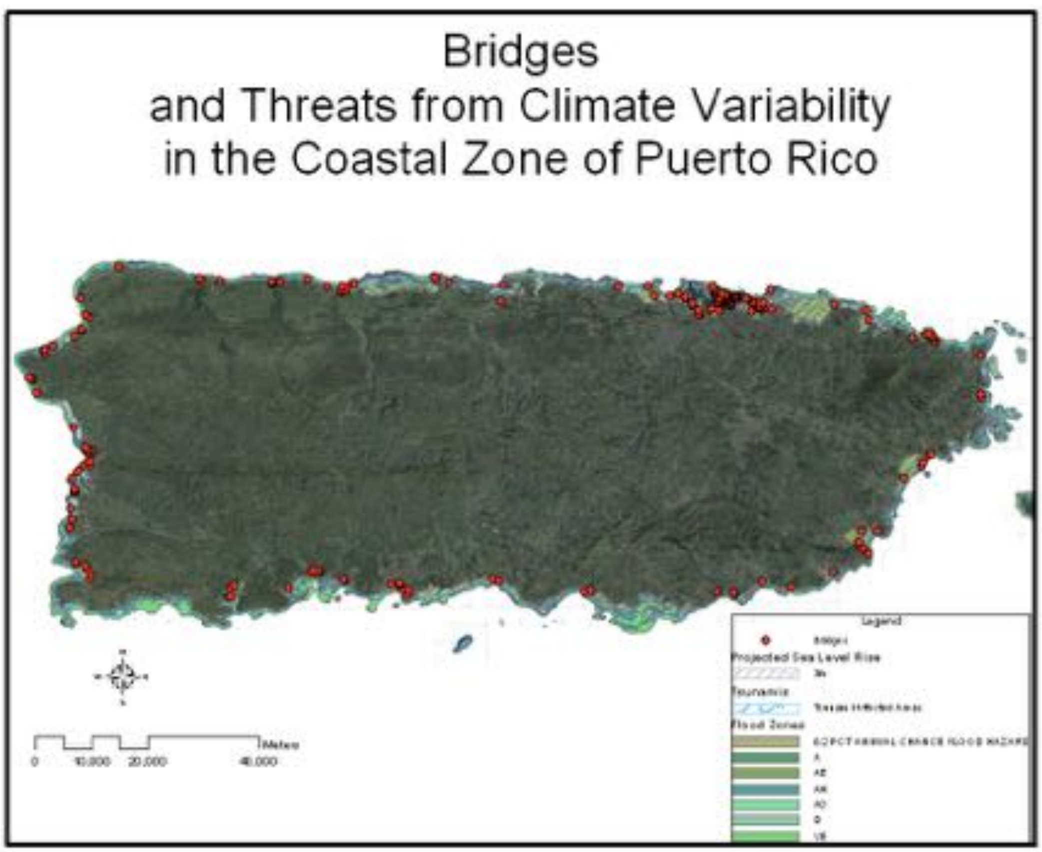

Figure 6: Bridges and all three dangers

Through analysis of these maps and their respective attribute tables, we concluded that there are 49 bridges within the coastal zone that are in danger of flooding caused by tsunamis, along with the other dangers associated with tsunamis. With the scenario of a 3-meter rise in sea level, 146 bridges in the coastal zone would be affected and ultimately underwater. 133 bridges are located in flood zones, 7 of which are in the 0.2% annual chance flood hazard zone and 6 are in the A zone. 61 bridges are located in zone AE with BFEs ranging from 1.2 – 3 MSL, 3 bridges are in the AO zone, and finally 10 are located in the VE zone with BFEs ranging from 2.4 – 4.9 MSL. When layering the bridges on top of all three dangers, we concluded that there are 30 bridges that are vulnerable. Since the heights of the bridges are not included in the attribute tables of the bridges GIS layer, a more thorough analysis of inundation is not possible.

4.2.4. Hospitals

Although there are many more hospitals located all throughout Puerto Rico, there are 62 located within the coastal zone of the main island. These are shown in the map below, represented by the red dots on top of the three dangers we investigated. Notably, most of these hospitals are located in the San Juan area. Maps of each separate threat layered with the bridges in the coastal zone can be found in Appendix D.

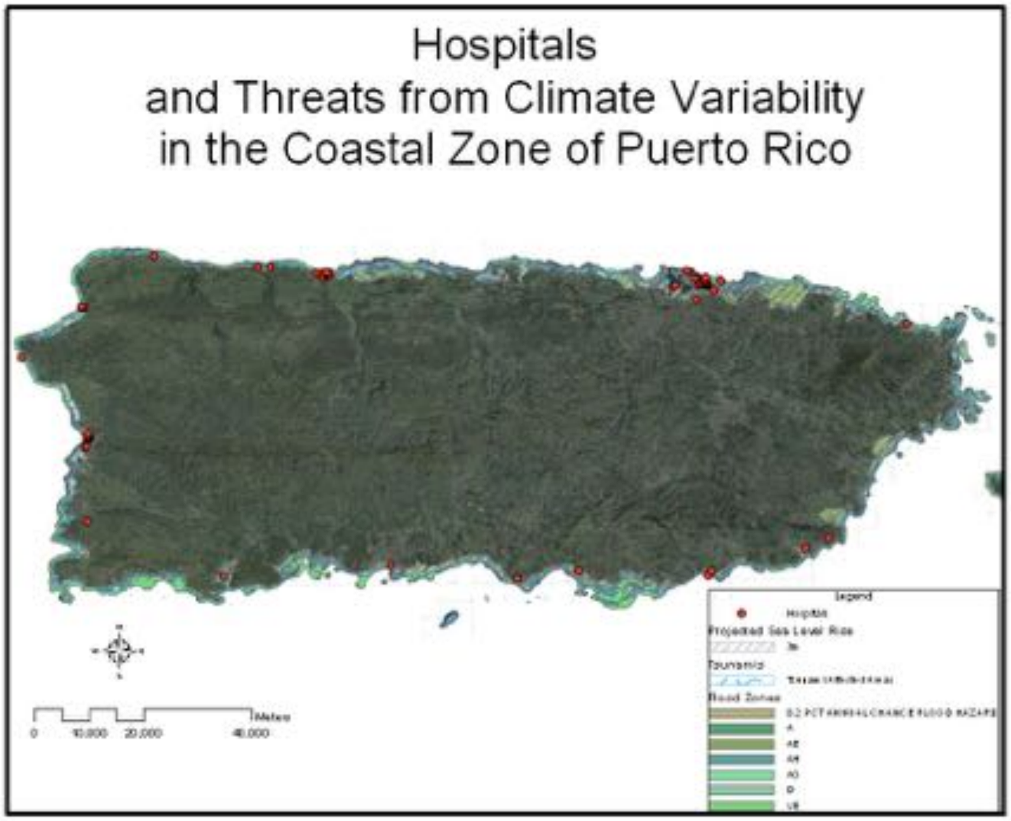

Figure 7: Hospitals and all three dangers

We can conclude from further analysis of the maps of hospitals that 10 are located in flood zones caused by tsunamis. 17 hospitals would be affected by 3m SLR and there are 25 located in flood zones. Of these 25 hospitals, the C.D.T. Dr. Arnaldo J. Garcia Hospital is the only one located in the 0.2% annual chance flood hazard zone; 10 hospitals are located in the AE flood zone with BFEs ranging from 2.1 – 2.7 MSL, 4 hospitals are in the AO flood zone and finally there are 10 located in the VE flood zone with BFEs ranging from 3.4 – 4.6 MSL. When layering all dangers, with the infrastructure layer displayed on top, we found that there are 8 hospitals vulnerable to all three threats to the coast.

4.2.5. Power (Generation) Plants

Of the 20 power generation plants located in Puerto Rico, only 5 are located on the coast. By layering the infrastructure layer on top of the different dangers in GIS, we could tell which of these generation plants were at risk to the three dangers previously mentioned. The tsunami layer showed that two of the generation plants, located on the main island, were susceptible to floods caused by tsunamis. These two power plants are the Palo Seco and Turbinas De Gas Mayaguez Power Plants. With a 3-meter sea-level rise, four of these plants would be inundated. The Costa Sur, Turbinas De Gas Mayaguez, San Juan Steam Plant and the Palo Seco Plant would all be affected by the rising sea-level. With the flooding layer, we could see that the two plants affected would be the Turbinas De Gas Mayaguez which is located in the AE flood zone with a BFE of 3 MSL and the San Juan Steam Plant, also located in a AE flood zone with a BFE of 2.1 MSL. Since the Turbinas De Gas Mayaguez Power Plant is susceptible to all three dangers, we have deemed this power plant as the most at risk.

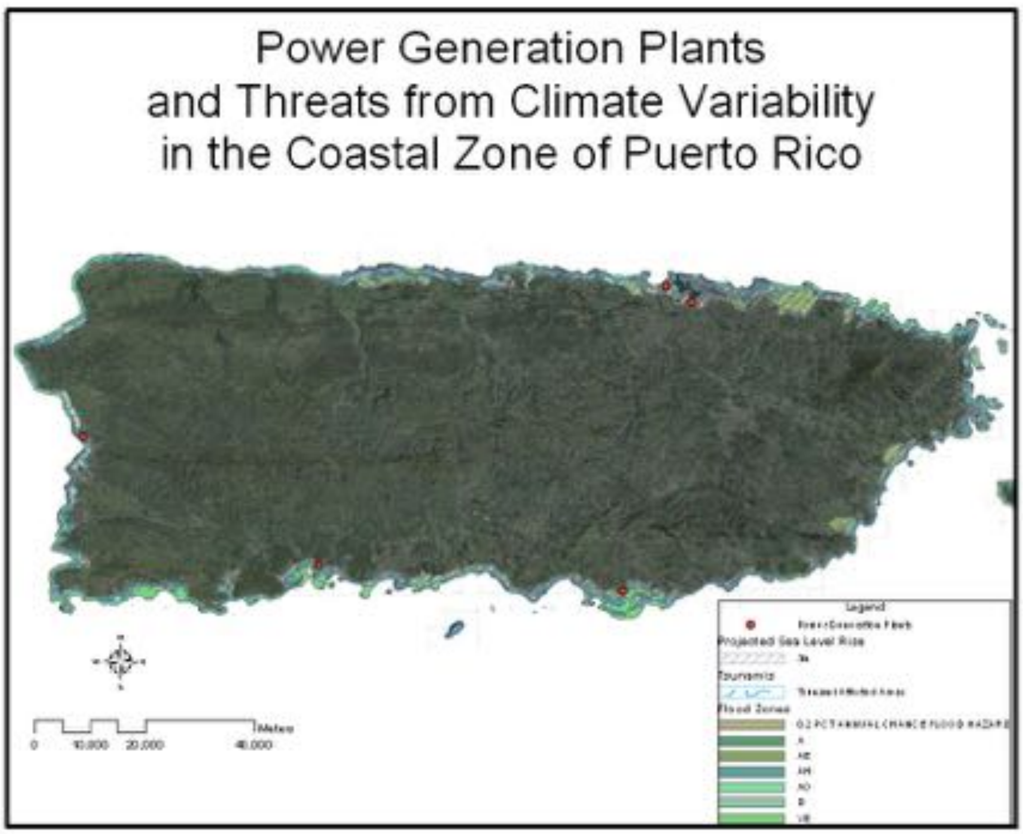

Figure 8: Generation Plants and all three dangers

The map in Figure 8 consists of the generation plant layer, set on top of the three risk layers to show which plants are in danger of each climate change scenario. The five red dots are the five plants located along the coast of the main island and as depicted in the legend; it is shown which color or pattern represents which type of danger. More detailed maps are provided in Appendix D, where the dangers are separated into three different maps.

4.2.6. Roads

The map below shows the roads, highlighted in red, located along the coastal zone as well as the three threats posed to those roads. In Appendix D, there is a map with each separate danger layered on top of the roads layer to show how many meters of roads are affected by each threat.

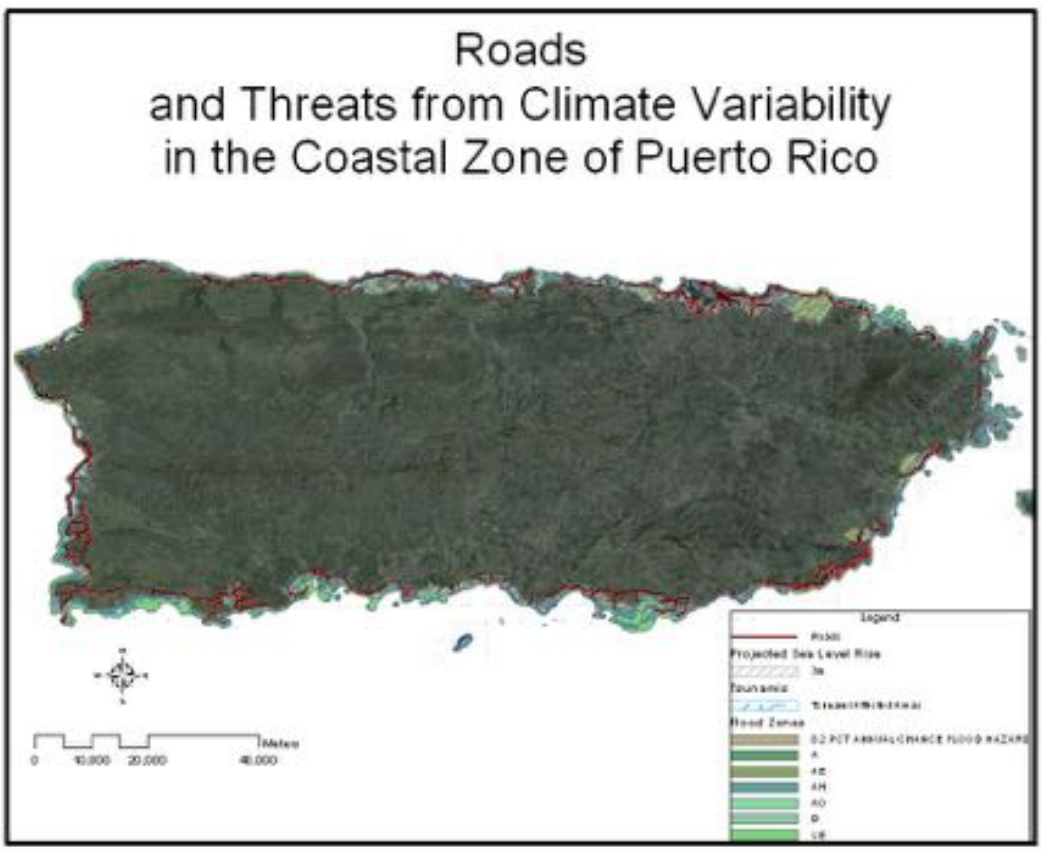

Figure 9: Roads and all three dangers

From the attribute tables associated with each map created, we found how many meters of roads were affected by each threat to the coastal zone. The total length of roads within the coastal region is 874938.25 meters. Of these, 152619.27 meters are all susceptible to flooding caused directly from tsunamis. The length of roads affected by 3-meter sea-level rise is 292470.54 meters and 262499.26 meters are located in flood zones. Of those that are located in flood zones, 28088.29 meters are in the 0.2% annual chance flood hazard zone, 15385.29 meters are in flood zone A, 165751.5 meters are in flood zone AE with BFEs ranging from 1.2 – 4.3 MSL, 166.01 meters are in flood zone AH, 6209.78 meters are in AO, and finally 46898.35 meters are located in flood zone VE with BFEs ranging from 1.8 – 6.4 MSL. From combining all three layers, we can conclude that the length of roads located in the coastal zone that are in danger of all three threats to the coast is 88603.99 meters which is 10.1% of the total length of roads within the coastal zone.

4.2.7. Seaports

On the main island of Puerto Rico, there are 10 seaports. These seaports can be seen in the map presented below along with the areas in the coastal zone affected by tsunamis, flooding and a scenario in which the sea-level would rise 3m. Maps representing each separate threat to the coast can be seen in Appendix D.

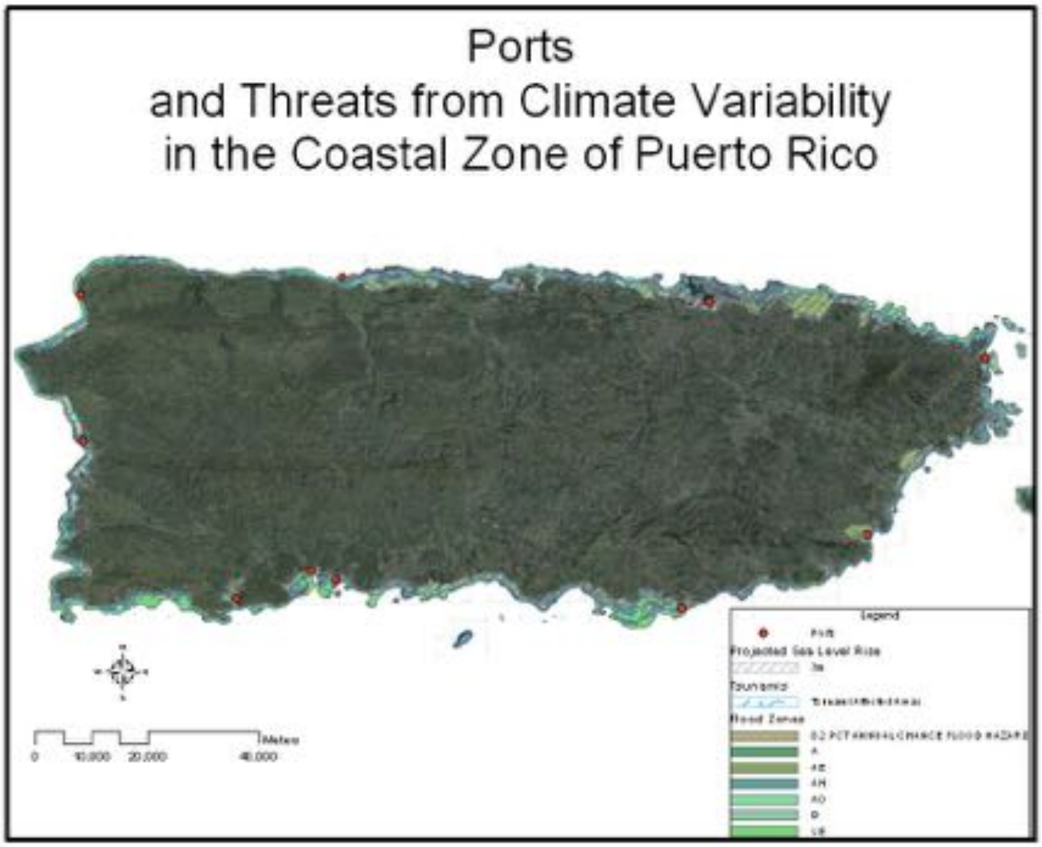

Figure 10: Seaports and all three dangers

Through analysis of these maps and their respective attribute tables, we concluded that there is only one seaport within the coastal zone that is in danger of flooding caused by tsunamis, along with the other dangers associated with tsunamis; the Port of Mayaquez. With the scenario of a 3m rise in sea level, 5 seaports in the coastal zone would be affected and ultimately underwater. 7 seaports are located in flood zones, 4 of which are in the AE flood zone with BFEs ranging from 2.1 – 3 MSL and 3 are located in the VE flood zone with BFEs ranging from 3 – 5.5 MSL. When layering the seaports on top of all three dangers, we concluded that there is only one seaport that is vulnerable to all threats and that port is the Port of Mayaquez.

4.2.8. Schools

Of the 2398 schools located in Puerto Rico, only 310 reside in the coastal zone. By layering the infrastructure layer on top of the different dangers in GIS, we could tell which of these schools were at risk to the three dangers previously mentioned. The tsunami layer showed that 48 schools, located on the main island, were susceptible to floods caused by tsunamis. With a 3m SLR, 134 schools would be underwater. With the flooding layer, we could see that 99 schools are located in flood zones. Of these at risk schools, 27 are located in the 0.2% annual chance flood hazard zone, only one is in the A flood zone and 62 are in the AE flood zone with BFEs ranging from 1.2 – 4.3 MSL. 4 schools are located in the AO flood zone and 4 are in the VE flood zone with BFEs ranging from 3- 4.6 MSL. 26 schools are susceptible to all three dangers, and therefore we have deemed these schools as the most at risk.

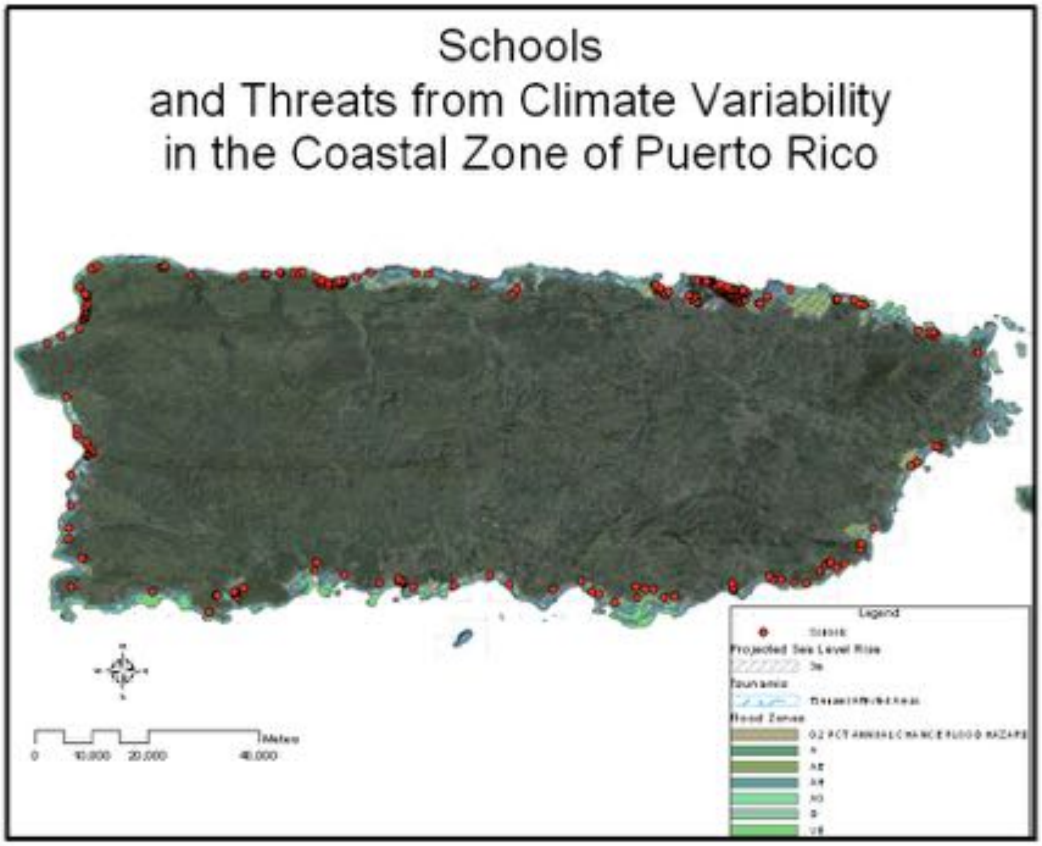

Figure 11: Schools and all three dangers

The above map consists of the schools layer, set on top of the three risk layers to show which schools are in danger of each climate change scenario. The red dots are the schools located along the coast of the main island and from the legend; it is shown which color or pattern represents which type of danger. More detailed maps of effected schools are provided in Appendix D, where the dangers are separated into three different maps.

4.2.9. Transmission Lines

The map below shows the transmission lines, highlighted in red, located along the coastal zone as well as the three threats posed to those lines. In Appendix D, there is a map with each separate danger layered on top of the transmission lines layer to show how many meters of lines are affected by each threat.

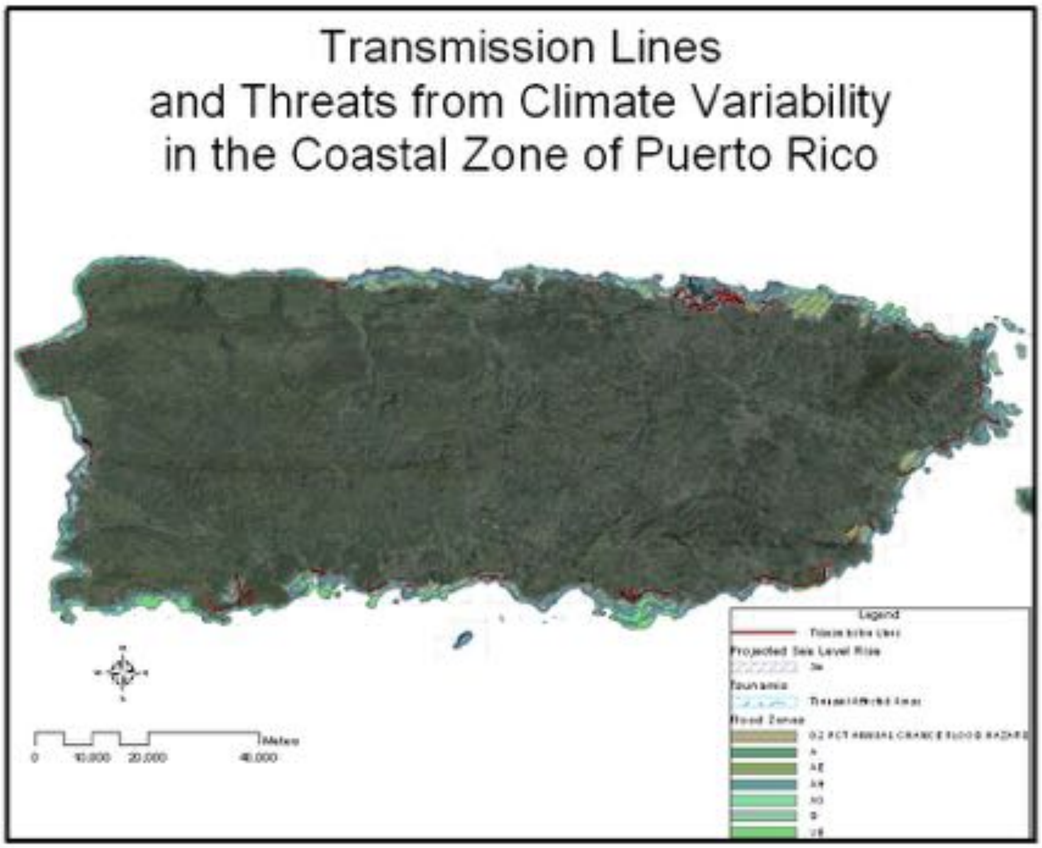

Figure 12: Transmission Lines and all three dangers

From the attribute tables associated with each map created, we found how many meters of transmission lines were affected by each threat to the coastal zone. The total length of transmission lines within the coastal region is 258759.40 meters. Of these, 13029.85 meters are all susceptible to flooding caused directly from tsunamis. The length of transmission lines affected by 3-meter sea-level rise is 112648.12 meters and 105670.94 meters are located in flood zones. Of those that are located in flood zones, 14839.75 meters are in the 0.2% annual chance flood hazard zone, 15795.8 meters are in flood zone A, 70820.28 meters are in flood zone AE with BFEs ranging from 1.2 – 4 MSL, 1923.78 meters are in AO, and finally 1817.28 meters are located in flood zone VE with BFEs ranging from 2.7 – 3.7 MSL. From combining all three layers, we can conclude that the length of transmission lines located in the coastal zone that are in danger of all three threats to the coast is 9993.46 meters which is 3.9% of all transmission lines within the coastal zone.

4.2.10. Water Treatment Plants

Of the 65 water treatment plants (WTP) that are located in Puerto Rico, only 17 are situated along the coast. By layering the infrastructure layer on top of the different threats in GIS, we could tell which of these treatment plants were at risk to the three dangers previously mentioned. The tsunami layer showed that 5 treatment plants located on the main island were susceptible to floods caused by tsunamis. With a 3m SLR, 10 plants would be underwater. With the flooding layer, we could see that there are 10 plants that would be susceptible to flooding. Of these, the Arecibo Regional WWTP is the only plant in the 0.2% annual chance flood hazard zone, 6 plants are located in the AE flood zone with a BFE of 2.1 MSL, and 3 plants in the VE flood zone with BFEs of 3, 3.4, and 4.9 MSL. After layering the WTP layer on top of all three of the risk layers, we found that only 3 plants were vulnerable to all dangers. These plants are the Arecibo Regional WWTP, La Parguera WWTP, and the Boqueron (Villa Taina).

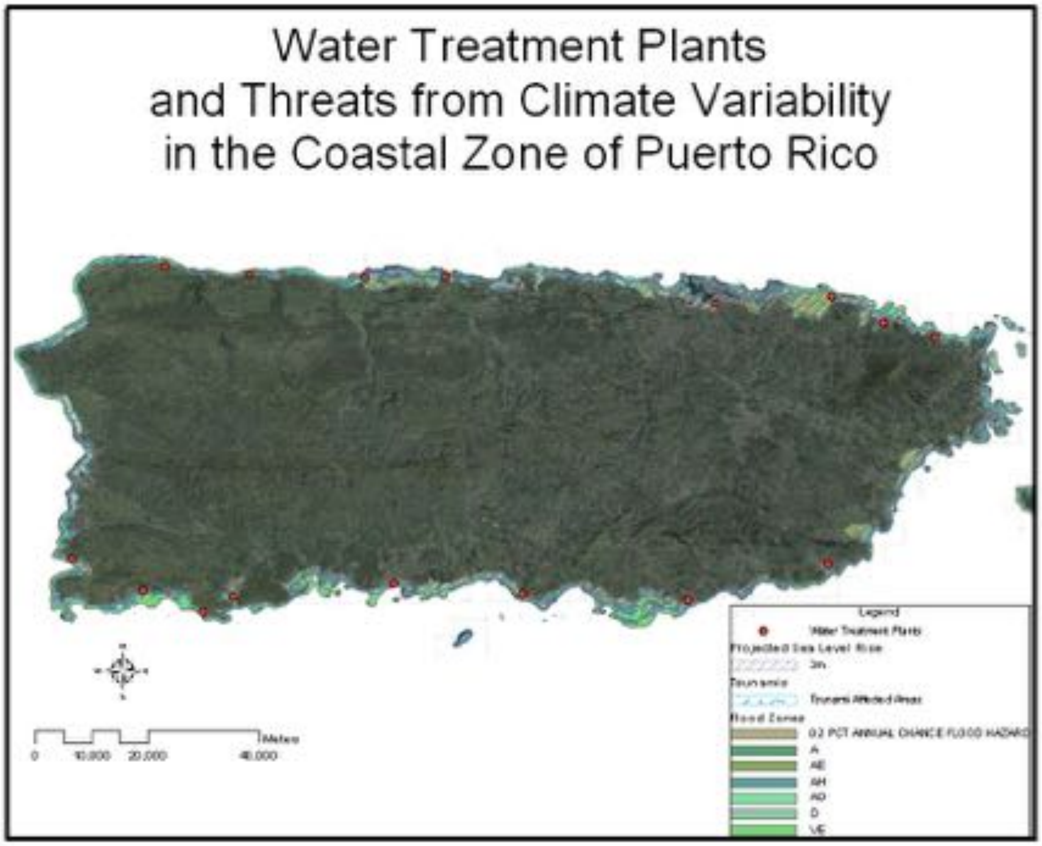

Figure 13: Water Treatment Plants and all three dangers

The above map consists of the water treatment plants layer, set on top of the three risk layers to show which plants are in danger of each climate change scenario. The red dots are the plants located along the coast of the main island and from the legend, it is shown which color or pattern represents which type of danger. More detailed maps are provided in Appendix D, where the dangers are separated into three different maps.

4.3. Detailed Risk Assessments

Once we analyzed the infrastructure using GIS, we were able to deem certain buildings and structures vulnerable due to their specific location. These vulnerable structures were then organized into a risk assessment table in which we gave a more detailed analysis of each individual structure. The name of the asset was given, along with a general description and the asset's location. Next, we included the distance from each specific structure to the shore. Since our definition for "coastal zone" includes areas within one kilometer from the shore, we provided the distance in meters. We then declared in the table what potential climate hazard each structure might face and the potential impact associated with each hazard. Finally, we included a column for planned upgrades. This table can be found in Appendix E.

4.4. Discrepancies in SLR data

One problem we had through the course of this project was that, particularly with SLR, there were multiple studies done and many discrepancies were apparent. Our two main sources of data were the results of a study from the University of Arizona and the findings of a study done by the Ciudadanos del Karso. Although the data from both sources were relatively similar, the differences yielded substantial variation in the results of our analyses. For example, an analysis of the CDK data presented us with the alarming result that both airports in the San Juan metropolitan area would be unusable should the sea level rise as little as 1 meter. However, when we analyzed the data from the University of Arizona, we found that the airports would not be at risk until the sea level had risen at least 3 meters. This is a significant difference, as 2m of SLR may take centuries. Unfortunately these were the data that were available for our analysis and that is why we used them.

After our original analyses of the aforementioned data and towards the end of our project, the DNER provided further (different) data of projected 1m SLR. These data are completely inaccurate; they show that should the sea level rise 1m, multiple locations would have more dry land than they do at present. A notable example of this would be in the San Juan area, as shown in Figure 14 below.

Figure 14: Inaccurate Data in the DNER GIS Database

4.5. Summary

The raw information we attained during the course of our project shed light on three major findings. The first and most important point is that at least some of every type of critical infrastructure in the coastal zone we analyzed is vulnerable to threats from climate variability. This was implicated both our GIS analyses and our interviews. From the interviews, we found the second major finding: coastal erosion is a bigger threat than we had originally been informed. The third notable finding was that because climate variability has not been widely acknowledged throughout Puerto Rico, there are no protection or mitigation strategies being utilized on the island.

5. Conclusions and Recommendations

This chapter will be dedicated to making the final conclusions and recommendations of our project. First, there will be a discussion of the impacts on Puerto Rican society, should any of the critical infrastructure be damaged. Also, we will provide recommendations to improve GIS. Lastly, there will be a discussion of our recommendations to improve research efforts in subsequent years.

5.1. Conclusions

This section is dedicated to the conclusions we formed after analyzing the data we gathered from interviews and GIS analysis. First, we decided to exclude the three smaller islands of Puerto Rico and an explanation of this is presented below. We then drew conclusions as to what would be the damage to Puerto Rican society from the damage of structures we found to be vulnerable.

5.1.1. Impact on Puerto Rican Society

The importance of this project revolves around one main concept, the impact that damage to critical infrastructures would have on the inhabitants of Puerto Rico. This concept provides enough justification for the hours spent researching and analyzing the critical infrastructure on the island. This section outlines the effects any damage to the different categories of infrastructure would have on Puerto Rican society based on two types of threats, slow-onset threats and rapid-onset threats. The main slow-onset threat we focused on was SLR, while all other threats were categorized as rapid-onset threats. These rapid-onset threats include storm surge, hurricanes and tsunamis. The following sections will provide suggested impacts on Puerto Rican society based on slow versus rapid-onset threats effecting critical infrastructure.

Ports

Airports and seaports are of great importance to any region of the world, especially on small islands like Puerto Rico. Being completely surrounded by water and placed a significant distance from a mainland, these ports become exponentially more important. SLR poses a very great threat to ports of Puerto Rico, however because it is considered a slow-onset threat, there is enough time to plan according and avoid any major disruptions. If the sea level were to rise only a few meters, most of the airports on the island would be consumed by floodwater. Likewise, the harbors throughout the island would also be completely submerged. In order to avoid the major effects such an event would have on the inhabitants of Puerto Rico, some measures would have to take effect well in advance. For instance, airports would need to be relocated a good distance inland to insure they are a safe distance from the flood zones associated with SLR. Some seaports could remain however docks and structures would have to be elevated to accommodate the rising waters. Rapid-onset threats cannot be so readily anticipated and prepared for and therefore have a much greater effect on Puerto Rican society. The ports of Puerto Rico provide essentials for daily life, because although some of the goods sold on the island are produced locally, the vast majority of goods are imported. These ports are also extremely important to the economy due to the money, which can be generated assuming they remain open. When a rapid-onset threat affects coastal areas, these ports have to be occasionally shut down causing a severe impact on the accumulation of supplies and commerce. Transportation to and from the mainland (or elsewhere) would also be greatly affected. Individuals would be stranded on the island with no way to travel elsewhere; those who are visiting would not be able to return home. Repairs to airports and seaports would have to be performed very quickly to ensure traffic to and from the island remains open. It is evident that life in Puerto Rico would be severely affected should climate change significantly damage the airports and seaports on the island. Our project was aimed at identifying which structures, ports included, may be at risk to prevent this damage from occurring.

Sewer and Aqueduct Infrastructure

Aqueducts are also of very significant importance to the inhabitants of Puerto Rico. Once again, the fact that Puerto Rico is an island means that the majority of the water in its vicinity is not drinkable. Aqueducts provide essential clean, drinkable water to people residing all over the island. SLR could case pipes to become rusty more quickly than anticipated and cause the supply of fresh water to become undrinkable. Desalinization is being studied on the island as well as in other areas however it is extremely expensive and therefore may not be the best option for Puerto Rico where the majority of its inhabitants are below the poverty line. Rapid-onset threats can also affect the transportation of fresh water throughout the island leaving people without drinkable water possibly for days. Since a human can only live without water for a few days at a time, the protection of these aqueducts is absolutely necessary. Another effect of rapid-onset threats would be the flooding of sewers causing wastewater to enter the streets. In order to prevent this from happening as much as possible, it is important to keep sewers away from flood zones or insure there is appropriate drainage in them. This is another aspect our project focused on to better protect the inhabitants of Puerto Rico.

Roadways and Bridges

Transportation throughout Puerto Rico depends vastly on the roadways and bridges dispersed throughout the island. A large portion of these roads and bridges exist in the coastal zone and therefore are in danger of being affected by climate change. Some of these roads are located so close to the coast that they are only a few meters away from the ocean. Due to the effects of SLR, these roads will eventually be completely inundated and need to be moved elsewhere, which raises the question of where they should be moved to? Some areas of Puerto Rico need to be preserved and protected due to their ecosystems and biodiversity. If the need to relocate major highways occurred, would they have to be place in sensitive ecological areas? Many regions of Puerto Rico are too developed to build an additional road, which may not leave too many options. SLR can also have a great impact on bridges in the coastal zone. Bridges may become rusted and fail due to high tides and storm surges or even become completely inundated. When a rapid-onset threat hits the island, water comes right up to and over the roads and after the waters have receded, large amounts of sand and debris are left behind coating the roads. Many roads are closed down completely during the stormy months to prevent people from trying to use them and being injured. This severely affects transportation throughout the island and causes traffic on open roads to be much worse than usual. One of our project's objectives was to identify which roads are in danger so that measures can be taken to better protect them or move them elsewhere.

Hospitals

Hospitals may be one of the most important types of infrastructure anywhere in the world. Their main purpose is to help people in need, those who are injured or sick. When climate change effects a region, people may be injured and require the assistance only a hospital can provide. Unfortunately, because Puerto Rico is an island, a great many hospitals are located within the coastal zone and therefore are in serious danger of threats due to the looming coast. SLR can be planned for by the relocation of hospitals lying within a zone, which will eventually be under water. However this process takes significant time and would have to be initiated long before the structure actually experienced the effects of SLR. Should a rapid-onset threat hit the island, many people would be injured and buildings destroyed, including hospitals. This leads to a significant portion of injured people left without anywhere to be treated while hospitals are out of commission. Injured personnel would have to travel much greater distances to receive treatment. Occasionally tents will be set up if hospitals are too damaged to remain functional. Due to the extreme importance of these structures, damage to hospitals may be one of the greatest factors that would negatively impact the inhabitants of Puerto Rico, and therefore it is a priority in our efforts to protect the infrastructure in Puerto Rico.

Power Plants

Another major asset to the island of Puerto Rico are the power or generation plants dispensed throughout the island. These plants provide electricity to all the inhabitants on the island. Once again SLR can be planned for by either constructing new power plants further inland or creating reinforcements to better protect these structures. Unfortunately the issue with closing down a power plant is that the nuclear waste created there will still remain long after the plant is closed. If the sea level surpasses one of these closed power plants, mass amounts of nuclear waste would be consumed by the ocean and have devastating effects. Should a rapid-onset threat hit the island and effect one or more of these plants, residences and businesses could be left without electricity for anywhere between a few days to, in more severe cases, several months. Many businesses do have generators however these generators may only serve the computer and security systems. Also important to note is that the majority of these generators are typically located in the basement and are still susceptible to the flooding that tends to accompany rapid-onset threats.

Schools

Schools, which typically house hundreds of individuals between the students and teachers, are also of great importance to our study due to the large number of young individuals whose lives would be at risk should a rapid-onset hazard hit the building while classes were in session. Even if the structure is affected while classes are not in session, damage to the building would still have a huge effect on the studies of those students attending said school. While repairs to the damaged structure were being performed, the education of the students would be seriously delayed if not dissolved completely. Students could be temporarily relocated to unaffected schools however this runs the risk of schools becoming overpopulated. In preparation for slow-onset threats, new schools could be constructed on higher grounds to prevent flooding. Again this is a very time consuming process and would have to begin long before the effects of SLR are felt on any given structure. Schools along the coast are obviously of great importance to our project as the lives of hundreds of students and faculty would be severely affected should these structures be damaged.

Summary

Needless to say there are multiple types of infrastructure in the coastal zone that are essential to Puerto Rican life. Any damage to these structures could impact the island's inhabitants for anywhere between a few days to a few months if repairs are needed. One of our project's main objectives was to determine which structures in the coastal zone were most at risk so that steps can be taken to better protect them and limit the detrimental effects any damage to these structures may have on daily life in Puerto Rico.

5.2. Recommendations for Future Studies

Although our project is completed, there remains research to be done by the DNER Office of Coastal Zone Management and possibly more students. We were able to accomplish the goals we laid out at the start of our project. However, there were limitations and setbacks we encountered while working on it. This section will outline our recommendations for future research.

5.2.1. Consideration of the minor islands of Puerto Rico

It is important to note that during this study, the islands of Culebra, Vieques, and Mona were not considered. These islands account for about 200 km out of the 700 km of total coastline in Puerto Rico. These islands were not considered for three reasons. First, our main mode of transportation was the bus and train, both of which stay in the San Juan Metropolitan area. We deemed it too difficult and costly to attempt to get to any of these islands. Second, the infrastructure on these islands is not as critical to Puerto Rico as the ones located on the main island. Last, the GIS data for these islands were incomplete; see section 5.2.1 for a full description.

5.2.2. Improving GIS Data Usability

When analyzing our maps used by GIS, some inconsistencies and errors were encountered. One of the biggest errors was found when analyzing hospitals in the San Juan area. There appears to be 4 hospitals located in the water just off the coast of San Juan. The actual hospitals are located somewhere close by but of course they are inland. This made it difficult to analyze the maps we created since we were not exactly sure where the hospitals were. For future studies we recommend the GIS data be updated to have more accurate positions for the infrastructure they include.

Furthermore, the GIS data for the islands of Culebra, Vieques, and Mona were incomplete. The climate change risks were included; however, the infrastructures were lacking. The data featured the airports, bridges, roads, and hospitals. It does not display any schools, seaports, or accurate transmission lines. The islands receive their power from transmission lines that run along the ocean floor from the mainland. These were not displayed at all, and they are a vital part of the operation of the islands.

In the initial stages of our project our sponsor made it clear to us that one of the important infrastructures to analyze would be hotels. Hotels are a critical infrastructure because they are a large source of revenue for Puerto Rico. The majority of tourists visiting Puerto Rico will stay in hotels, and many of these are located in the coastal zone. This places them at risk; however, we were unable to identify any of these hotels using GIS. The GIS software did not have any information on hotels; therefore we were unable to identify at risk hotels using GIS. We were able to visit La Concha Resort and gain some information, which is included in this report. We recommend that hotel data be collected and added to the GIS so that it may be analyzed in future studies.

From our previous discussion of the discrepancies in the SLR data we used for our analysis (see section 4.4.); we recommend the collaboration and standardization of the GIS maps and the data that they include.

5.2.3. Adding to the GIS Database

While the GIS database was instrumental in our analyses and by no means incomplete, in order to assess the vulnerability of the critical infrastructure of Puerto Rico, we would recommend that the data be updated to include our findings. We suggest adding attributes to the infrastructure tables, particularly the airport, aqueduct, bridge, generation plant, hospital, road, school, seaport, transmission line, and water treatment plant tables.

We suggest adding 11 attributes to the data on each type of infrastructure. The first attribute we would recommend adding would be one entitled "COASTAL_ZONE." The information stored in this column would be either a "yes" or a "no," identifying whether each structure is in the coastal zone or not.

The next 7 attributes we advise adding correspond to the inundation data from FEMA. The first, FID_FEMA, would be the identification number of the flood zone that contains each structure, so that a user can easily access more information about the relevant flood zone. The next column we would recommend adding would be entitled "FLD_ZONE," and would contain entries such as "AE," "AO," "X," etc., identifying which type of flood zone, if any, each structure is in. The next five attributes would be information that would describe how threatening each flood zone is. The recommended "FLOODWAY" attribute would hold the word "FLOODWAY" if the structure is in a floodway, or nothing (as in the original FEMA data). The next attribute, "SFHA_TF" would store a "T" or "F," denoting whether it is true or false that the infrastructure is in a special flood hazard area; that is, if it is inundated by 100-year flooding and the BFE or the velocity of wave action has been determined. The next attribute would be "STATIC_BFE" and hold the numerical value of the BFE. The next column would be titled "DEPTH_METERS," and it would hold a numerical value corresponding to the "DEPTH" column in the original FEMA data, normalized to meters via FEMA's LEN_UNIT attribute. Similarly, the last suggested inundation attribute would be "VELOCITY_METERS_SECOND" which would hold the velocity of the wave action from FEMA's VELOCITY normalized to meters/second using the VEL_UNIT attribute in the original data.

The following two suggested attributes pertain to areas affected by tsunamis. The 9th attribute our team recommends adding would be called "FID_TSUNAMI" and hold the identification number pertaining to the tsunami zone that contains each structure and would be used in the same way as the FID_FEMA attribute: as a key for a database user to obtain more specific information about the threats from tsunamis relevant to that structure. The next attribute we suggest is entitled "TSUNAMI_STATUS" and correlates directly to the "STATUS" column in our original tsunami data, storing the self-explanatory "Safe Zone" or "Flood Zone."

The last attribute we recommend adding is called "3M_SEA_LEVEL_RISE" it and would store the words "affected" or "unaffected." This would denote whether each structure would be affected or unaffected by 3m of SLR. Additionally, in the Aqueduct, Road, and Transmission Line tables, we suggest adding a 12th attribute called "Affected_Shape_Length" which would store the numerical value of the length of each of this infrastructure that is affected by 3m SLR.

Additional information that would help provide a more in-depth critical infrastructure vulnerability assessment in the future using GIS would be more detailed measurements and numbers pertaining to the specific structures. For bridges and roads, there could be a column for the height. This would help prove which bridges and how many meters of roads would potentially be inundated if there were a 1 meter, 2 meter and 3 meter sea-level rise. For the buildings being analyzed, the capacity of each building at peak hours of the day would be very useful. The number of people working in each building, the number of patients occupying the hospitals, and the number of students attending each school would lend insight into the range of effects that both a rapid and a slow-onset hazard would have on each specific structure. The stability of the buildings, building code information, and date of last inspection would also help when performing a more detailed risk assessment of Puerto Rico's critical infrastructure.

Partial spreadsheets of data with our recommended attributes are included in Appendix G. These include all the types of coastal zone infrastructure mentioned. We strongly recommend that these attributes be added to the comprehensive GIS database as a convenience for future researchers that will continue our studies and other studies on infrastructure in Puerto Rico.

5.2.4. Difficulties with Arranging Interviews

Throughout the course of this project we experienced many difficulties, the most expedient of which came in identifying people to interview in Puerto Rico. We planned to use snowball-sampling method to gain a variety of experts to interview. The problem we encountered right away was that the first person we had planned to interview proved to be unreliable and hard to reach. Our first potential interviewee was with Jaime Geliga, Chief of the Municipal Water Branch Program of the EPA Region 2 in San Juan. Our sponsor told us that he would be a great person to interview and provide us with contact information for more interviews. We were able to get in touch with him via email and set up a meeting time. He then postponed the interview, from March 31st at 2:00 PM to April 4th at 2:00 PM. On April 4th we tried calling his office but were told he was out of the office for the day. After that we called and emailed him several times but have not heard back from him since March 30th.

We also tried getting in contact with someone from the Ashford Presbyterian Community Hospital and were met with similar results. We were told to contact the executive director of the hospital, Pedro Gonzalez. We did, but never heard back from him. We then went into the human resources office of the hospital and were told to send an official letter from the DNER regarding our project. The letter was emailed on April 13th and we have not heard back. There were many other attempts to contact various people of all the critical infrastructures we were concerned with, but only a fraction of them were fulfilled, for a more complete list see Appendix F.

For future studies we recommend that students or researchers begin contacting interviewees well in advance. Given our timeline, we planned to begin contacting people and conducting interviews during the first two weeks of our stay in Puerto Rico. We could not anticipate on the level of difficulty in getting responses. We recommend sending emails, placing follow-up calls, and, if necessary, sending follow-up emails.

5.2.5. Conducting Critical Infrastructure Analyses

During the initial stages of our project we planned to visit some of the infrastructures we identified as being at risk and analyze them. This was our goal when we arrived in Puerto Rico; however, after the troubles we experienced in gaining responses from interviewees we knew this was not an achievable goal. The only way to conduct these analyzes would be to contact people at the infrastructures and gain their permission to analyze the buildings. Since we were not able to get in contact with many of the key people involved, we removed the critical infrastructure analysis from our goals. We embrace the notion that these analyses are crucial to gaining a better insight into which infrastructures are at risk and at which level. Therefore, we recommend that future studies place emphasis on conducting these analyses and try to overcome the obstacles faced by our group. Our work has laid the foundations for future studies in this area. The next step would be to start analyzing the infrastructures that we identified as at risk.

5.3. Summary

Our research and analysis have aided us in achieving our goal, which was to determine what structures within Puerto Rico's coastal zone are most susceptible to the hazards of climate change and variability. We were able to find the different types of at risk structures through widespread research. From there we were able to use GIS analysis to determine to what extent these critical structures might be susceptible to projected dangers. In performing our GIS analysis, we created user-friendly visuals in the form of maps and tables that justify our findings. After the analysis was complete, we were then able to determine how damage to these structures would affect the inhabitants of Puerto Rico. Research projects similar to this will help ensure a safer environment for those living and visiting the island. The vibrant culture of its people, the lush vegetation and the historical background of its buildings are all good reasons why people should continue to experience Puerto Rico for centuries to come.

Annotated Bibliography

Air Broker Center International AB. (2009). *Airports in Puerto Rico.* Retrieved 2/6, 2011, from http://www.aircraft-charter-world.com/airports/centralamerica/puertorico.htm Airports are located in towns including Aguadilla, Arecibo, Fajardo, Isla De Culebra, Isla De Vieques, Mayaguez, Ponce, Roosevelt Roads and San Juan.

Australia Department of Climate Change. (2009). *Climate Change Risks to Australia's Coasts.* (Assessment: Author. Retrieved 2/7/2011 from http://www.climatechange.gov.au/~/media/publications/coastline/cc-risks-full-report.pdf This assessment, endorsed by the Council of Australian Governments (COAG), presents the risks of climate variability on Australia's coastal zone. It describes future implications of climate change on coastal settlements and ecosystems, identifies areas that are particularly vulnerable to climate change, distinguishes obstacles that detract from the effectiveness of procedures that lessen the effects of climate variability, and outlines adaptation strategies that minimize risk in the coastal zone. We used this document as a reference for comparison of Puerto Rico's coastal zone to Australia's and identify strategies that are effective in Australia that can be adapted to be successful in Puerto Rico.

Bailey, Simon, Cheng, Franklin Y., Das, Parag C., Ellingwood, Bruce, Esteva, Luis, Frangopol, Dan M., Furuta, Hitoshi, Schuëller, G. I., Imai, Kiyohiro, Itoh, Yoshio, Kanda, Jun, Kirsch, Uri, Arora, Jasbir, Hartmann, D., Ng, See-King, Sexsmith, Robert C., Sørensen, J.D., Thoft-Christensen, P., Grierson, Donald E. (1999). In Dan M. Frangopol (Ed.), *Case Studies in Optimal Design and Maintenance Planning of Civil Infrastructure Systems* (1st ed.). Reston, VA: The American Society of Civil Engineers.
This reference is a compilation of case studies on infrastructure assessment, especially safety and risk assessments. Each case study goes in depth about assessment of various types of infrastructure and the risks associated with each type of structure. We used the case studies as examples for our critical infrastructure analyses as well as protection methods of buildings. Although this was published in 1999, all of its information is still quite valuable and relevant.

Beatley, T., Brower, D. J., & Schwab, A. K. (1994). *An Introduction to Coastal Zone Management*. Washington D.C: Island Press.
From this reference we can gain a better understanding of the hazards in the coastal zone and the different types of coastlines that exist. The book goes into detail about critical coastal management issues such as shoreline erosion and sea level rise, the protection of coastal wetlands and resource lands, and social equity in coastal planning. We used this book to identify the federal coastal policies as well as the state coastal management programs.

Birch, E. L., & Wachter, S. M. (2006). *Rebuilding Urban Places After Disaster: Lessons from Hurricane Katrina.* Philadelphia, PA: University of Pennsylvania Pr.
This book is less specific to Hurricane Katrina, but uses it as a key example. It gives strategies on making places less vulnerable, like: the physical constraints, containing water, and natural hazards science. This reference also deals with how to nurse back the hurt

economy of an urban place: how to restart the economy, rebuilding transportation, learning from past disasters, and housing displaced families. The strategies in this book give detailed preventative measures that would be useful in coastal zone management. A rebuilding plan would also be very helpful should a disaster occur.

Brinkley, D. (2006). *The Great Deluge: Hurricane Katrina, New Orleans, and the Mississippi Gulf Coast* William Morrow.
This book gives a day-by-day account of what happened when the Hurricane Katrina hit New Orleans. The author was in New Orleans and experienced everything first hand. The book contains both scientific facts and the social impacts of the hurricane. This source was useful when discussing the various effects of a hurricane destroying an urban area. Everything from the psychological, economical, physical, and political effects are discussed.

Core Writing Team. (2007). *Climate Change 2007 Synthesis Report.* (Synthesis Report No. 4). Geneva, Switzerland, IPCC: Retrieved 2/7/2011 from http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm
This reference, the synthesis report section of the Fourth Assessment Report (AR4) commissioned by the Intergovernmental Panel on Climate Change (IPCC), provides comprehensive information about changes in the climate. The report includes observed climate changes, their effects on the environment, causes of the changes, and projected climate changes. The document then goes on to address adaptation and mitigation techniques and the changes these procedures will potentially bring about. This reference was used in order to discern which climate changes are likely to occur in Puerto Rico's coastal zone as well as the effects the climate variations will have in this location.

Galvan, J. A. (2009). *Culture and Customs of Puerto Rico*. Westport, Connecticut: Greenwood Press.
We used this source in order to include the history of some general architecture in our background chapter so that we are familiar with what types of structures may still be in use from previous years and may no longer be up to date on building codes. We also used it to include in our background chapter general information about Puerto Rico.

Godschalk, D. R., Brower, D. J., & Beatley, T. (1989). *Catastrophic Coastal Storms*. Durham, NC: Duke University Press.
For our project researched the climate variability and most importantly, learned and developed a way of mitigating any further infrastructural damage done in Puerto Rico's coastal zone. This book was perfect for background research because it includes alternative approaches to mitigating coastal storm hazards and local mitigation tools and techniques. From this reference we can learned recommended mitigation policies and strategies and applied them to San Juan, Puerto Rico.

GSV. (2009). *Historical Sights: Catholic Church Landmarks in Puerto Rico.* Retrieved 2/6, 2011, from http://eyetour.com/blog/2009/04/07/historical-sights-catholic-church-landmarks-in-puerto-rico/

Catholic churches in Puerto Rico include the Iglesia San Blas Illescas in Coamo and the Iglesia Porta Coeli in San German. One of the oldest churches in the Western hemisphere is the Iglesia San Jose in Old San Juan.

Hinkel, J., & Klein, R. J. T. (2006). Integrating Knowledge for Assessing Coastal Vulnerability to Climate Change. *Elsevier Science.*
This article was great for defining what climate vulnerability is and the confusing concerning the exact definition of the term. Traditionally, climate change has been studied by three groups of scientists: geologists, ecologists and engineers. This article looks at how vulnerability is a common focus of the research done by each of these scientists. This was especially helpful for our project seeing as how we assessed which buildings and infrastructure in Puerto Rico may be vulnerable to different types of climate changes.

Hospitals Worldwide. (2011). *Puerto Rico Hospitals and Health Clinics.* Retrieved 2/6, 2011, from http://www.hospitalsworldwide.com/countries/puerto_rico.php
There are about 57 hospitals in Puerto Rico, which mainly sit in the coastal zone area.

Linkov, Igor, Wenning, Richard J., Kilker, Gregory A.. (2007). *Managing Critical Infrastructure Risks Decision Tools and Applications for Port Security.* doi:10.1007/978-1-4020-6385-5
This report includes an overview of critical infrastructure and environmental safety. This provided us with excellent background information on how to understand environmental security at ports and harbors as well as the environmental and human security in the Mediterranean, which is exactly where our study was focused. The port critical infrastructure and management frameworks section was very helpful in our study of port vulnerability in Puerto Rico. Also the lifetime earthquake vulnerability assessment helped us with our studies involving structural vulnerability due to earthquakes. Lastly, the decision making and risk assessment methods section helped us make decisions regarding safety, security, and sustainability of ports and harbors.

Marshall, R., & Schroeder, J. (1997). Hurricane Marilyn in the Caribbean: Measured Wind Speeds and Design Wind Speeds Compared. *NASA,* (19980004613)
A scientific report on Hurricane Marilyn with detailed analysis and methodology. The report describes in detail how and where all of the information was found. This source was useful in comparing the wind speeds and strengths of various hurricanes.

New York City Panel on Climate Change. (2010). *Executive Summary of Climate Change Adaptation in New York City: Building a Risk Management Response.* New York Academy of Sciences.
Sea level rise and storm surge are two severe conditions which occur frequently along the coast of Puerto Rico. We studied these to include in our background chapter as their effects on structures were of great interest to our IQP. Both risk and hazard management strategies and risk-based approach helped us evaluate the dangers facing the structures we studied. A review of the standards and codes helped us determine which structures meet the codes and which may need to be reinforced. Working with the insurance industry were a great way to promote structural reinforcements throughout the population. The climate change

monitoring program was also be very useful as the cause to structural failure in our study is a direct result of climate change.

ProVention Consortium. (2011). *Risk Analysis.* Retrieved 1/30, 2011, from http://www.proventionconsortium.org/?pageid=17
This report includes information on improving risk identification and analysis and even some risk assessment reports. As this is the baseline for our IQP it was very useful to briefly cover in the background chapter. Damage and reconstruction needs along with damage, needs and relief requirements were useful in determining which structures may need improvement. The disaster data resources section gave us some data on previous disasters in Puerto Rico. The online disaster risk resources and community risk assessment also falls into our theme of assessing structural risk/vulnerability.

PRroads. (2007). *A Guide to Puerto Rico Roads.* Retrieved 2/6, 2011, from http://www.freewebs.com/prroads/guidetopuertoricoroads.htm
Freeways include PR1, PR2, PR3, PR22, PR52, PR10, PR53, and PR66. The PR1 runs from San Juan to Ponce and is now mainly used by tourists. The PR2 is the longest road in Puerto Rico connecting Ponce, Mayagüez, Aguadilla, and Arecibo. The PR3, or 65th Infantry Avenue, is also mostly used as a tourist route running from Salinas through Guayama, Humacao, Fajardo and finally to San Juan. The PR22, PR52, PR10, PR53 and PR66 are all newer freeways.

Puerto Rico Electric Power Authority. (2011). Retrieved 2/6, 2011, from http://www.fundinguniverse.com/company-histories/Puerto-Rico-Electric-Power-Authority-Company-History.html
The Puerto Rico Electric Power Authority is responsible for the distribution of electricity to the residents of Puerto Rico. In 1893 the first electric lighting systems began operation in Puerto Rico. In 1908 the first power plant funded by the government was built, and then in 1992 the Energy Policy Act allowed private companies to sell electricity.

PuertoRico.com. (2011). *Getting Around by Car, Plane or Bus in Puerto Rico.* Retrieved 2/6, 2011, from http://www.puertorico.com/transportation/
In Puerto Rico there are eight major freeways and three major interstates. Freeways include PR1, PR2, PR3, PR22, PR52, PR10, PR53, and PR66.

SchoolTree.org. (2011). *Find Schools in Puerto Rico.* Retrieved 2/6, 2011, from ahttp://puerto-rico.schooltree.org/counties-page1.html
Schools in Puerto Rico include 1,500 public schools, 800 elementary schools, 200 middle schools and about 150 high schools.

Santos-Hernández, J. M. (2007). *Development, Vulnerability, and Disasters in the West Coast of Puerto Rico.* (Unpublished Master of Arts in Sociology Thesis). University of Delaware, Ann Arbor, MI: ProQuest Information and Learning Company. (1444691)
This document, a thesis written by Jenniffer Marie Santos-Hernández in order to obtain a Mater of Arts degree in Sociology, seeks to provide a comprehensive description the West Coast of Puerto Rico's vulnerability to disasters and the distribution of vulnerable block

groups. In the methodology section of her thesis, Santos-Hernández utilizes a geographic information system (GIS) to develop an inventory of socio-demographic characteristics of vulnerability to disasters. Although Santos-Hernández's thesis focuses on the social aspects of disaster vulnerability, our team used this thesis as an example of the use of GIS she desires as well as a reference for using GIS and ArcGIS at our liaison's request.

Simpson, M.C., Scott, D., New, M., Sim, R., Smith, D., Harrison, M., Eakin, C.M., Warrick, R., Strong, A.E., Kouwenhoven, P., Harrison, S., Wilson, M., Nelson, G.C., Donner, S., Kay, R., Geldhill, D.K., Liu, G., Morgan, J.A., Kleypas, J.A., Mumby, P.J., Christensen, T.R.L., Baskett, M.L., Skirving, W.J., Elrick, C., Taylor, M., Bell, J., Rutty, M., Burnett, J.B., Overmas, M., Robertson, R., Stager, H. (2009). *An Overview of Modeling Climate Change Impacts in the Caribbean Region with Contribution from the Pacific Islands.* (Overview) Barbados, West Indies: United Nations Development Programme. Retrieved 2/7/2011 from http://www.adaptationlearning.net/reasearch/overview-modeling-climate-change-impacts-caribbean-region-contribution-pacific-islands
This report details the impacts global warming and global SLR will have on the Caribbean region and Pacific islands. The document also provides scenarios that describe causes of climate change, specifically rises in atmospheric and oceanic temperatures that will cause sea-level rise. It then goes on to provide projections and describe the implications a rising sea level will have on the Caribbean region and Pacific islands. Our team utilized this resource as a reference for implications climate variability has on locations that are similar to Puerto Rico, and as a tool to compare the effects on the Caribbean region and Pacific islands to those on Puerto Rico.

Smith, J. M., Cialone, M. A., Wamsley, T. V., & McAlpin, T. O. (2010). Potential Impact of Sea Level Rise on Coastal Surges in Southeast Louisiana. *Science Direct, 37*(1), 37.
This article was helpful to our research because we were able to look at how hurricane surges and SLR has impacted Louisiana and then compare it to Puerto Rico. The different surge levels and wave strengths affect the various landscapes from isolated to more broad areas. Also, introduction to tools such as numerical storm surge model ADCIRC and the near shore spectral wave model STWAVE will were useful to our research.

State of Connecticut Department of Environmental Protection. (2009). *Facing Our Future: Infrastructure Adapting to Connecticut's Changing Climate.*
The points of this report relevant to our IQP are coastal flooding, dams, natural disaster planning and resources, and coastal management. While coastal management is the overall theme of our IQP, the coastal flooding and dams were some specific areas which needed further investigation in order to predict which structures are vulnerable.

State of Connecticut Department of Environmental Protection. (2009). *Facing Our Future: Natural Coastal Shoreline Environment Adapting to Connecticut's Changing Climate.*
This source gave us some insight into coastal implications such as sea level rise and shoreline erosion.

Titus, J. G., & Richman, C. (2007). Maps of Lands Vulnerable to Sea Level Rise: Modeled Elevations Along the US Atlantic and Gulf Coasts. *Climate Research.*

SLR is one of the leading causes of damage to Puerto Rican infrastructure. It was useful to have maps of the areas that could be possibly impacted my SLR. To create these maps however, information regarding the elevation and also models of shoreline erosion were necessary. This report provides the required information and shows the maps illustrating the elevations of lands close to sea level. We used these maps to compare the areas of Puerto Rico that are close to the ocean and assess the probable damage done my SLR.

U.S. Climate Change Science Program, Subcommittee on Global Change Research. (2009). *Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region.* Washington D.C.: U.S. Environmental Protection Agency.
This report, part of the U.S. Climate Change Science Program, describes the potential consequences to sea level (an effect of climate changes), focusing on the mid-Atlantic area on the Untied States coast. In addition to describing and justifying effects of a rising sea level such as flooding increases and coastal erosion, this document also provides a description of the coastal zone and how it will potentially be affected by SLR. This resource further describes preventative measures communities and property owners living in the coastal zone have taken as a response to coastal hazards as well as obstacles to minimize undesirable effects of SLR, such as government policies that encourage development in the coastal region. As our liaison emphasized SLR as the most relevant climate change to the coastal zone in Puerto Rico, this resource is directly relevant to our project, as it provides information on sea-level rise, its effects, and measures that can be taken to prepare for this particular climate change.

U.S. General Services Administration. (2011). *Puerto Rico Federal Buildings.* Retrieved 2/6, 2011, from http://www.gsa.gov/portal/content/104785
The four main Federal buildings in Puerto Rico are the Federal Center in Guaynabo, the Federico Degetau Federal Building and the Clemente Ruiz Nazario U.S. Courthouse in Hato Rey, and finally the Jose V. Toledo U.S. Post Office and Courthouse in San Juan.

Van Heerden, I., & Bryan, M. (2006). *The Storm: What Went Wrong and Why During Hurricane Katrina: The Inside Story from One Louisiana Scientist* Viking.
This book was written by a disaster scientist/hurricane researcher who tried warning about the dangers and faulty systems in place. It gives a better look into the science behind what happened, less political and social and more scientific. This was a good source when discussing preventative measures that should be in place to protect a city from a hurricane. We also used it to familiarize ourselves things that went wrong in New Orleans and how to avoid them in Puerto Rico.

Working Group I. (2007). *Climate Change 2007 The Physical Science Basis* (Assessment). Cambridge, United Kingdom: Cambridge University Press. Retrieved from http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm
This report, the first section of the IPCC AR4, presents information about climate variability from a purely scientific standpoint. The writers of this document use physical science to provide a description of the causes of climate change, an explanation of the physicality of climate variation, and a prediction of climate changes in the near as well as distant futures.

This reference was used in our proposal as a basis for creating a projection of dangerous climate changes in the coastal zone of Puerto Rico.

Working Group II. (2007). *Climate Change 2007 Impacts, Adaption, and Vulnerability* (Assessment). Cambridge, United Kingdom: Cambridge University Press. Retrieved from http://www.ipcc.ch/publications_and_data/ar4/wg2/en/contents.html
This second section of the IPCC's AR4 describes the effects of climate change on the world today. This document provides details on the effects climate changes (especially temperature increases) have on natural and human environments, adaptations already occurring in certain species due to climate changes, and vulnerability to climate variability. Furthermore, it provides evidence that the magnitude of future climate changes and vulnerability is dependent on development pathway. Our team used this reference as a resource for facts about vulnerability to climate change and the impact climate variability has on the coastal zone of Puerto Rico.

Working Group III. (2007). *Climate Change 2007 Mitigation of Climate Change* (Assessment) Cambridge, United Kingdom: Cambridge University Press. Retrieved from http://www.ipcc.ch/publications_and_data/ar4/wg3/en/contents.html
As the third volume of the IPCC's AR4, this document focuses on detailing and providing cost-benefit analyses on different approaches to mitigate and avoid changes in climate, specifically those caused by greenhouse gases. This section of the report not only details methods and technologies that would lessen emissions of greenhouse gases, but also describes techniques to remove these gases from the atmosphere. This document was used in the background portion of our proposal in as a reference for mitigation of climate changes.

World Port Source. (2011). *Satellite Map of Ports in Puerto Rico.* Retrieved 2/6, 2011, from http://www.worldportsource.com/ports/PRI.php
The ports of Puerto Rico are clustered on the eastern side of the island but other towns including Arecibo, Aguadilla, Mayaguez, Guanica, Guayanilla, Tallaboa, and Ponce also hold ports.

Appendix A: Our Sponsor the DNER

This appendix is a description of our project sponsor, the Department of Natural and Environmental Resources (DNER), in Puerto Rico. We will describe our sponsor's mission, the funding and organizational structure of the organization, and the resources our sponsor has available, as well as identifying other organizations in Puerto Rico that work on the same problem we will attempt to solve in our Interactive Qualifying Project.

The DNER (2011) is part of the Constitutional Office of the Governor. As a non-profit organization it was established in 1972 and then reorganized in 1993. Their mission is primarily to protect, conserve and manage natural resources to ensure a better quality of life for future generations. Similarly, the vision of the DNER is to promote a safe environment through the use of sustainable natural resources, management of the environment and the "transformation of Puerto Rican culture to one of conservation."

The DNER (2011) has two head administrators and four administrative assistants. There are seven employees in the Advisory Office. Each of the six divisions in the DNER has four secretarial assistants. The DNER has seven regional offices. The DNER also includes the Corps of Rangers and the Commissioner of Navigation, which were created for legal reasons. This structure meets the standards set by the Office of Management and Budget. Within the DNER, the Puerto Rico Coastal Zone Management Project (PRCZMP) is the most relevant to our project.

The Department of Natural and Environmental Resources is an organization that works with many smaller agencies to accomplish their goal of protecting and managing resources and environmental situations. Some of these smaller agencies are the Institute of Puerto Rican Culture and the Environmental Protection Agency. The amount of information and knowledge available to the DNER is extensive because it is partnered with different agencies, all specialized in their own fields. The Department of Natural and Environmental Resources alone is quite knowledgeable itself as it employs a wide range of public servants from various disciplines and skills. There are experts in the fields of educators, biologists, geologists, ecologists, planners, computer professionals, architects, engineers and surveyors, among others.

The technology available to the DNER (2011) is growing each year. The PRCZMP, which is an associate of the DNER, has made great use of the Geographical Information System (GIS) software. This system has been used to review physical, environmental, and social changes in locations and environments; locate traditional access ways through aerial photographs; and identify critical areas for wetland management (Diaz & Nieves, 2007). Other forms of technology that are very useful to the organization are digital cameras, satellite images, aerial photographs and a refined global positioning system (GPS) (National Oceanic and Atmospheric Administration, 2010).

From the many people available within the organization, to the technology present and the information and knowledge of all the agencies combined, we will have access to many resources to attack the problem we were given.

The Department of Natural and Environmental Resources has one central office in Puerto Rico and 68 work units spread out on the island. Our liaison, Kasey Jacobs, works for the DNER and is NOAA coastal management fellow. This means DNER and NOAA work together in their efforts to improve the resources in Puerto Rico. The NOAA (2011) has six line offices. Of these six, the one that concerns our project the most is the National Ocean Service (NOS). One division of NOS is the Office of Ocean and Coastal Resource Management (OCRM). OCRM oversees six programs throughout the country, they are: the PRCZMP, the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), the Coral Reef Conservation Program, the National Estuarine Research Reserve System (NERRS), the Coastal and Estuarine Land Conservation Program (CELP), and the Ocean Thermal Energy Conversion (OTEC).

In Puerto Rico, besides the coastal program, there is the Coral Reef Program and the Jacobs Bay National Estuarine Research Reserve (NOAA 2011). The Coral Reef Program works with the U.S. Coral Reef Task Force in addressing threats to the coral reef and improving its health. In 2000 Puerto Rico received full approval for the Coastal Nonpoint Program. The main goal of this program was to improve water quality and to reduce run off in coastal zones. The Coastal Zone Management Program has also partnered with the U.S. Fish and Wildlife Service in studies in Puerto Rico's coastal zones. In the 2007 report for the Coastal Management Program many partners are listed, some of which are the Caribbean Fisheries Management Control, U.S. Geological Survey, U.S. Environmental Protection Agency, and the University of Puerto Rico (National Oceanic and Atmospheric Administration, 2011).

Appendix B: What is an IQP and Our Project's Qualifications

Completion of the Interactive Qualifying Project (IQP) is required of all WPI students before graduation. Usually completed in a student's junior year, in teams of three or four students. It counts as three courses, it can be done over three terms, or during one term. IQP's that are completed abroad are done so in one term with the completion of a preparation course before the students go abroad. An IQP is commonly done in cooperation with an external sponsoring organization. It is important that WPI students are well rounded in all disciplines of learning, and that they are an active member of society. The goal of the IQP is to teach students how science and technology are integral to the foundations of society.

In order to be deemed an IQP there are several outcomes, which our project must fulfill. Before going to Puerto Rico we are required to define clear and tangible goals and objectives for the project. We have done this in our goals and objectives section. We have a tentative methodology for our work in Puerto Rico; the next step is to implement it once we arrive. In our preparatory class we have had several presentations to practice our oral communication skills and use of appropriate, effective visual aids. Once our project is completed we will deliver a final presentation to our sponsoring organization. Our final report will demonstrate the ability to write clearly, critically and persuasively. We must also properly cite information and integrate information from multiple sources to identify appropriate approaches to the project goals. The final report will analyze and synthesize results from many disciplines like: social, ethical, humanistic, and technical. By meeting these outcomes our project will be a successful IQP.

Appendix C: Interview Protocols

Civil Engineer Interview Protocol

Focus structures:

- Hospitals
- Bridges
- Government Buildings
- Churches

All interviews will be administered in pairs.
Prior to the interview, each interviewer will introduce himself and one interviewer will read the following:

- We are part of a group working with the Department of Natural and Environmental Resources, specifically the Puerto Rico Coastal Zone Management Program. Our mission is to determine if Puerto Rico's critical infrastructure in the coastal zone is vulnerable to climate variability and if so, how. For our project we have defined the coastal zone as 1-kilometer inland from the coast. We are administering this interview in order to gain more knowledge about the effects of climate change on the structures in the Coastal Zone.

After finishing reading the above, the interviewer will ask if the interviewee has any questions, or if he/she is ready to begin answering the questions.

The interview will consist of the following questions:

1. Which structures from each of the categories listed above pose the biggest threat if they were to be significantly damaged?
2. How do these structures near the coast prepare themselves for coastal dangers?
    a. Rising sea level
    b. Storm surge
    c. Earthquakes
    d. Hurricanes
3. How much damage would these structures be able to sustain and still be operational?
4. Which of these structures in the coastal zone would you consider the most at risk given their location?
5. What types of reinforcements are used to protect failing structures?
6. Are there any types of reinforcements being studied but not yet being used?
7. What aspects would you focus on when determining if a structure is failing? (i.e. corrosion, levelness, distance from sea water)
8. How can the lifetime of a structure be affected by coastal hazards? (i.e. rising sea level, storm surge, earthquakes, hurricanes)
9. What is the general lifetime of a structure on the coast? Or does it depend on the type of structure?

Water Treatment Interview Protocol
Includes:

- Levees
- Dikes

All interviews will be administered in pairs.
Prior to the interview, each interviewer will introduce himself and one interviewer will read the following:

- We are part of a group working with the Department of Natural and Environmental Resources, specifically the Puerto Rico Coastal Zone Management Program. Our mission is to determine if Puerto Rico's critical infrastructure in the coastal zone is vulnerable to climate variability and if so, how. For our project we have defined the coastal zone as 1-kilometer inland from the coast. We are administering this interview in order to gain more knowledge about the effects of climate change on the structures in the Coastal Zone.

After finishing reading the above, the interviewer will ask if the interviewee has any questions, or if he/she is ready to begin answering the questions.

The interview will consist of the following questions:

1. What precautions are necessary for sewage systems in the coastal zone?
2. Which sewage systems/levees/dikes pose the biggest threat if they were to be significantly damaged?
3. How much damage would these structures be able to withstand and still be operational?
4. Which of these structures in the coastal zone would you consider the most at risk given their location?
5. How would levees and dikes be affected by years of salt-water damage from floods and storm surges?
6. Is corrosion a factor when looking at old levees and dikes?

Sewage System Interview Protocol

All interviews will be administered in pairs.
Prior to the interview, each interviewer will introduce himself and one interviewer will read the following:

- We are part of a group working with the Department of Natural and Environmental Resources, specifically the Puerto Rico Coastal Zone Management Program. Our mission is to determine if Puerto Rico's critical infrastructure in the coastal zone is vulnerable to climate variability and if so, how. For our project we have defined the coastal zone as 1-kilometer inland from the coast. We are administering this interview in order to gain more knowledge about the effects of climate change on the structures in the Coastal Zone.

After finishing reading the above, the interviewer will ask if the interviewee has any questions, or if he/she is ready to begin answering the questions.

The interview will consist of the following questions:

1. How does flooding affect a sewage treatment plants and sewers?
2. Would storm surges affect the structure of a sewage treatment plant?
3. Would the plant be able to continue to operate under conditions such as sea-level rise, storm surges, and hurricanes?
4. Can you tell us more about the electric generators used when the power fails? Is the capacity limited during generator use?
5. Are the plants still able to produce clean drinking water under these conditions?
6. Which plants along the coastal zone do you think would be most at risk to climate change?
7. What is being done to mitigate potential dangers to the sewage treatment plant?
8. What, if anything, can be done that is not currently?

Appendix D: ArcGIS Maps

Hazards

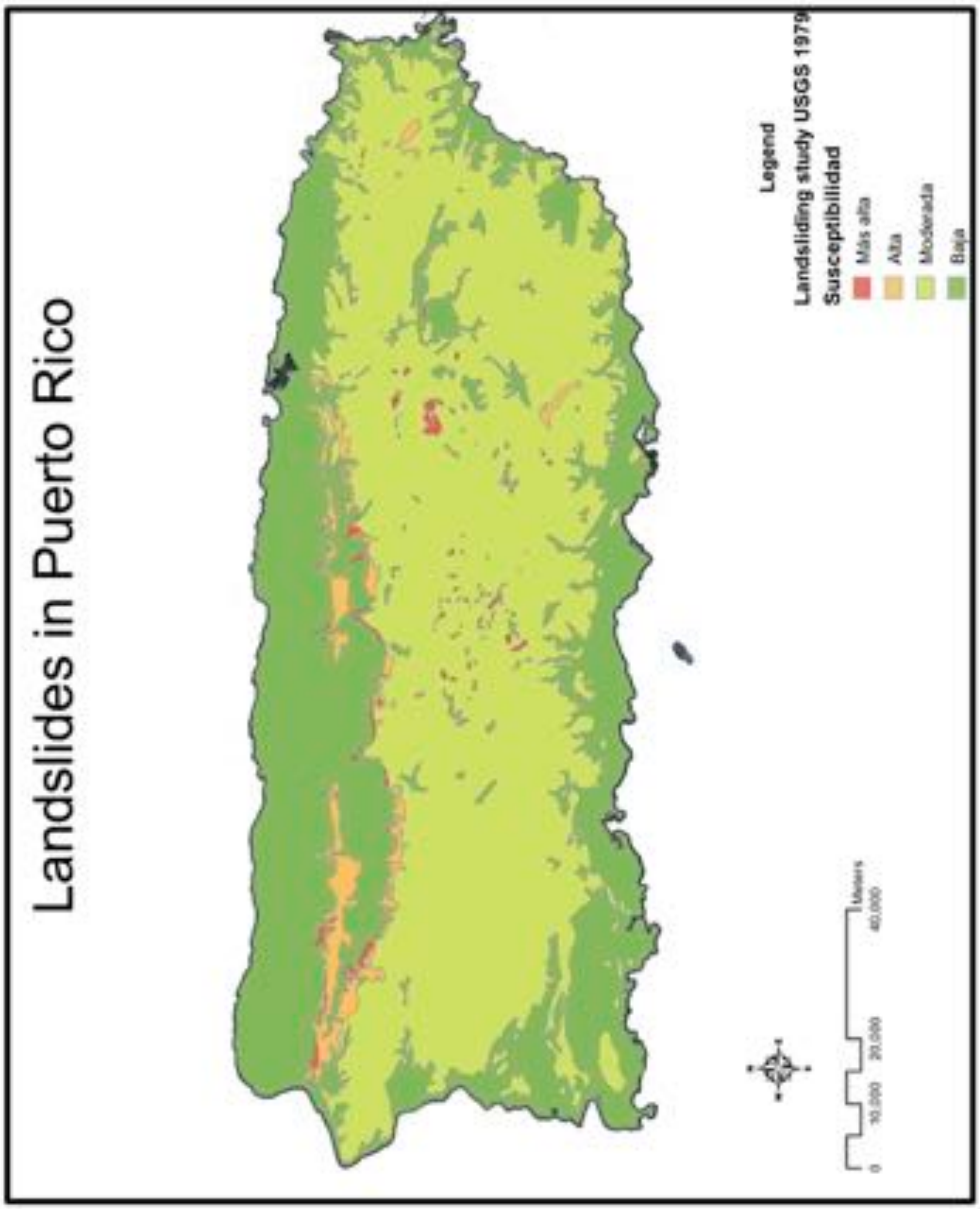

Figure 15: Landslide Risks in Puerto Rico

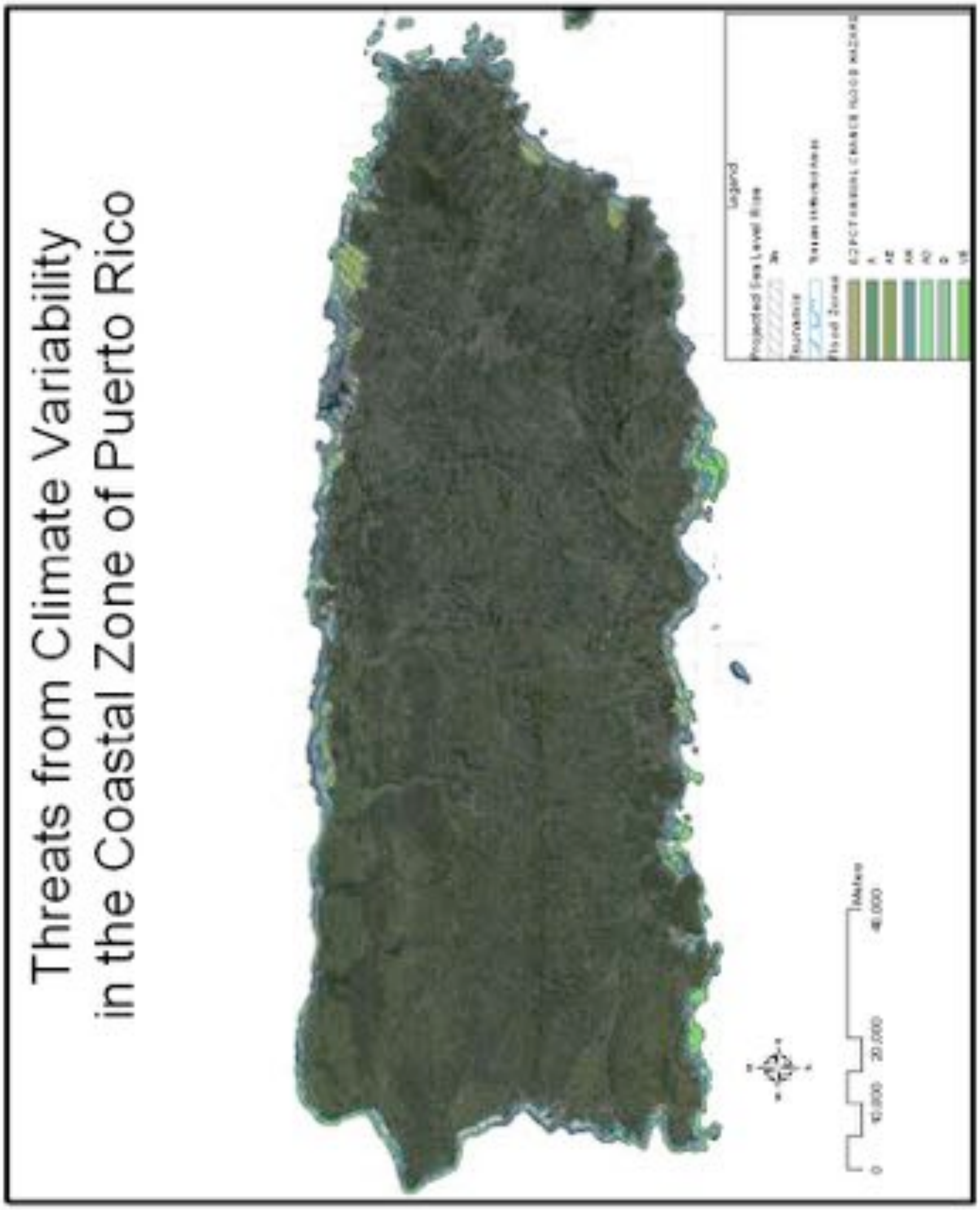

Figure 16: All Relevant Threats in the Coastal Zone of Puerto Rico

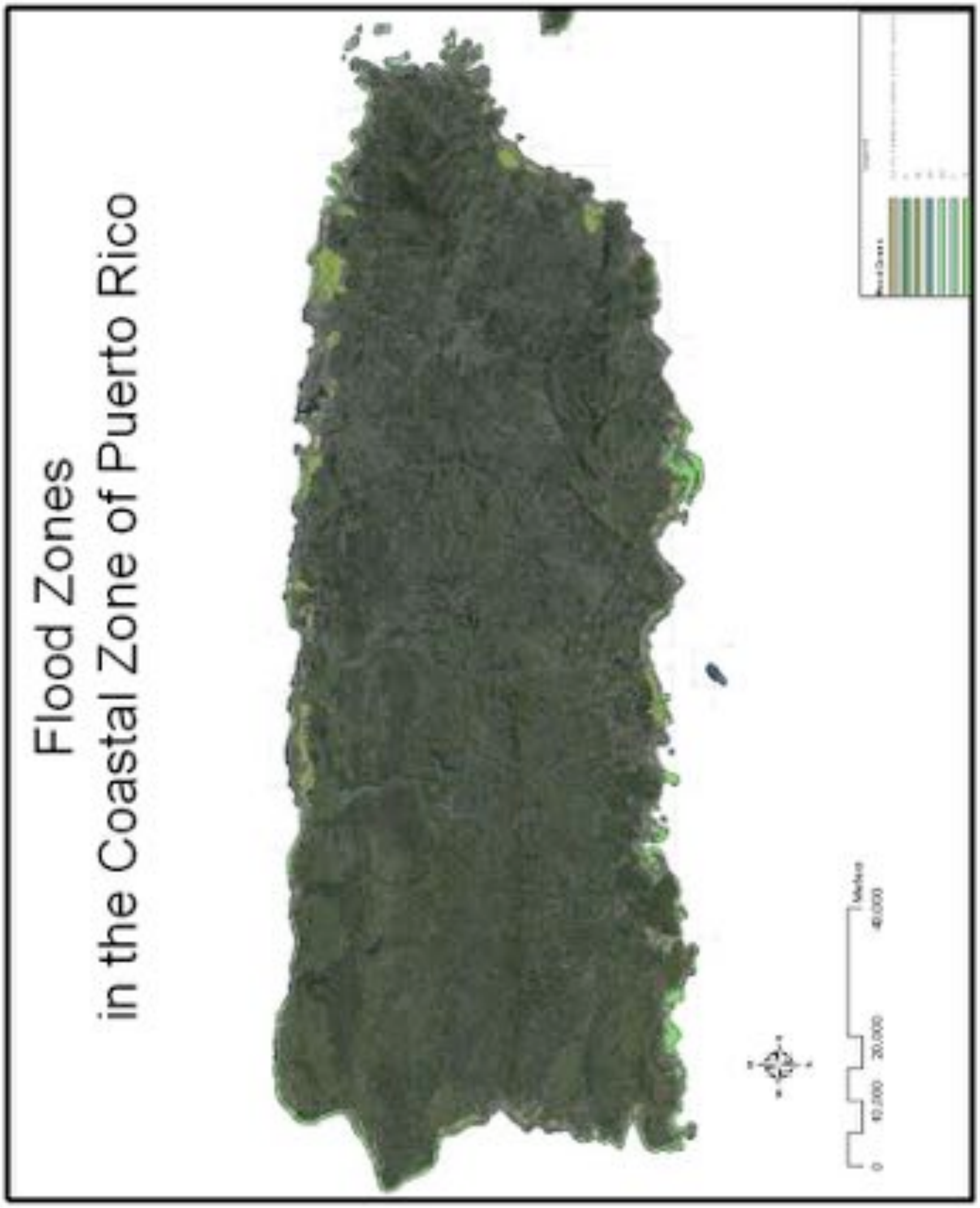

Figure 17: Flood Risks in the Coastal Zone of Puerto Rico

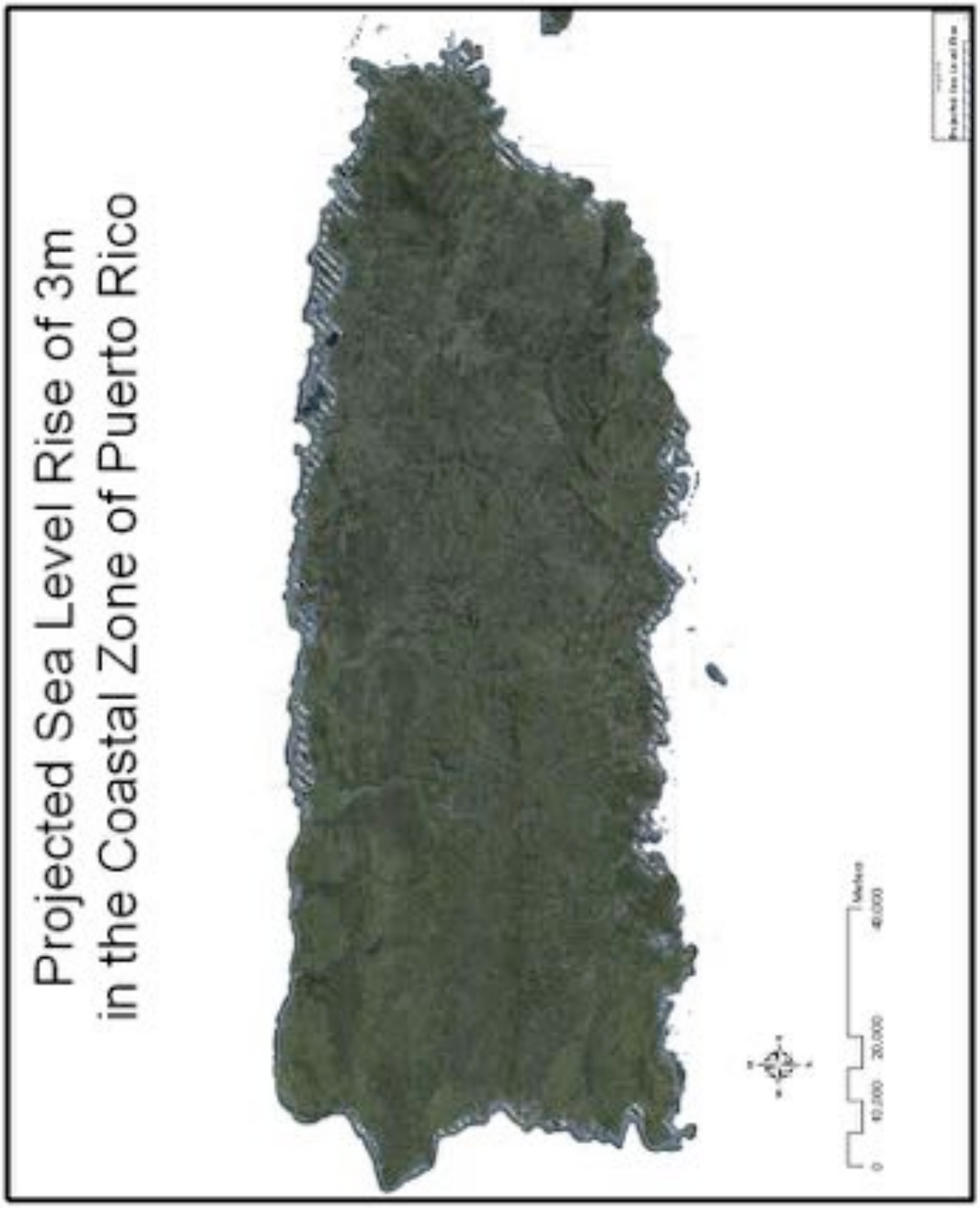

Figure 18: Projected Areas Affected by 3m SLR in the Coastal Zone of Puerto Rico

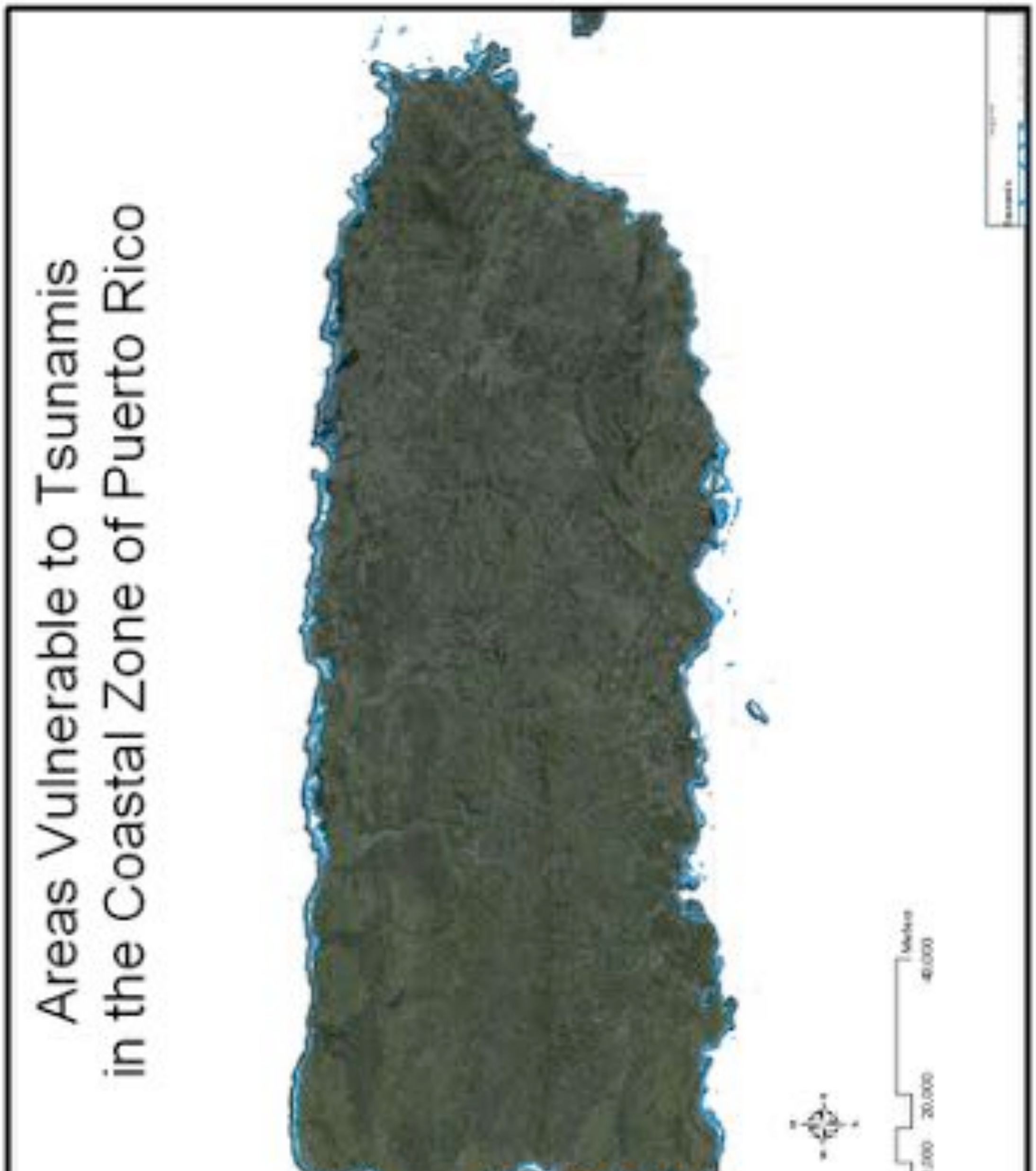

Figure 19: Tsunami Flood Zones in the Coastal Zone of Puerto Rico

Airports

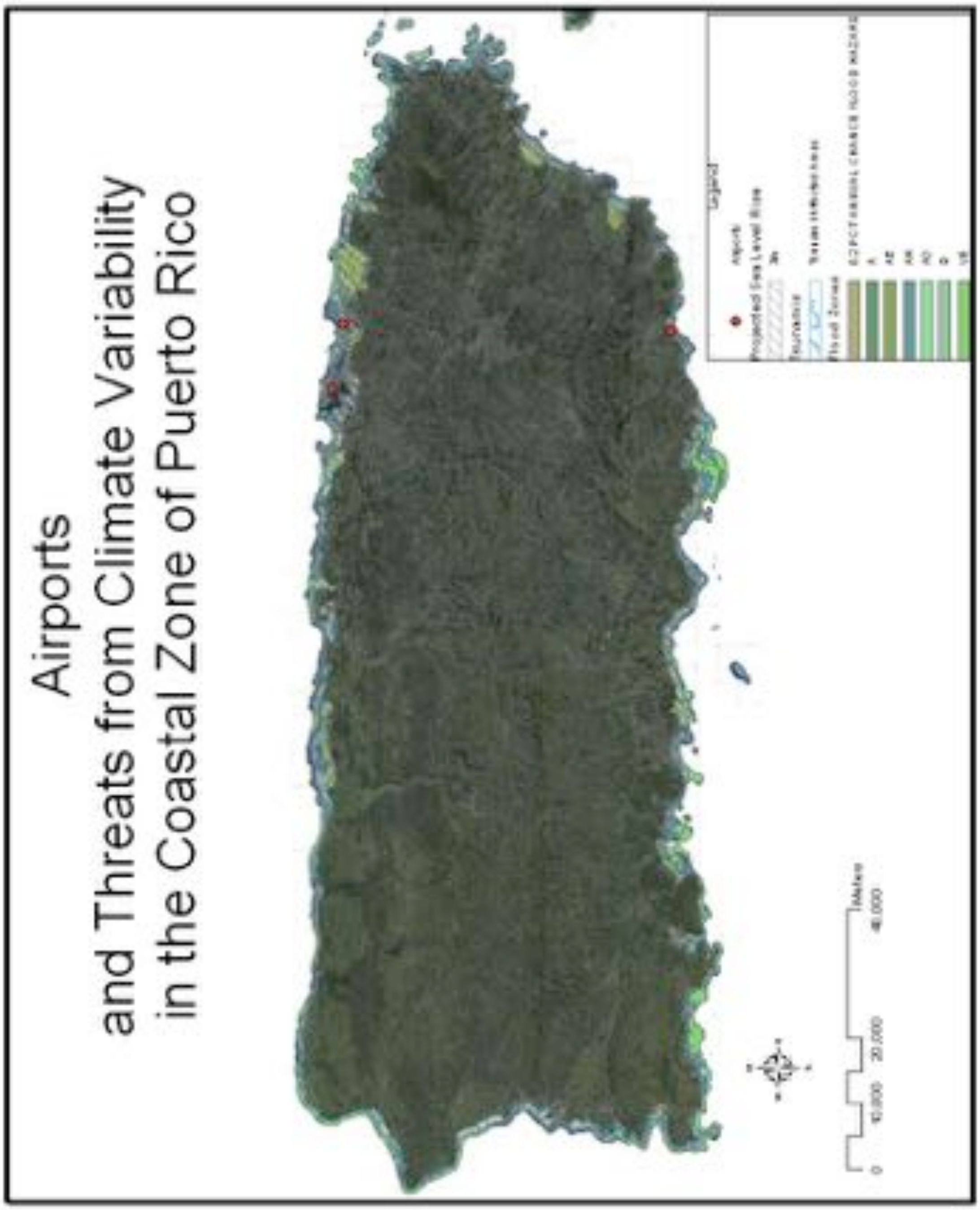

Figure 20: Airports and All Considered Threats

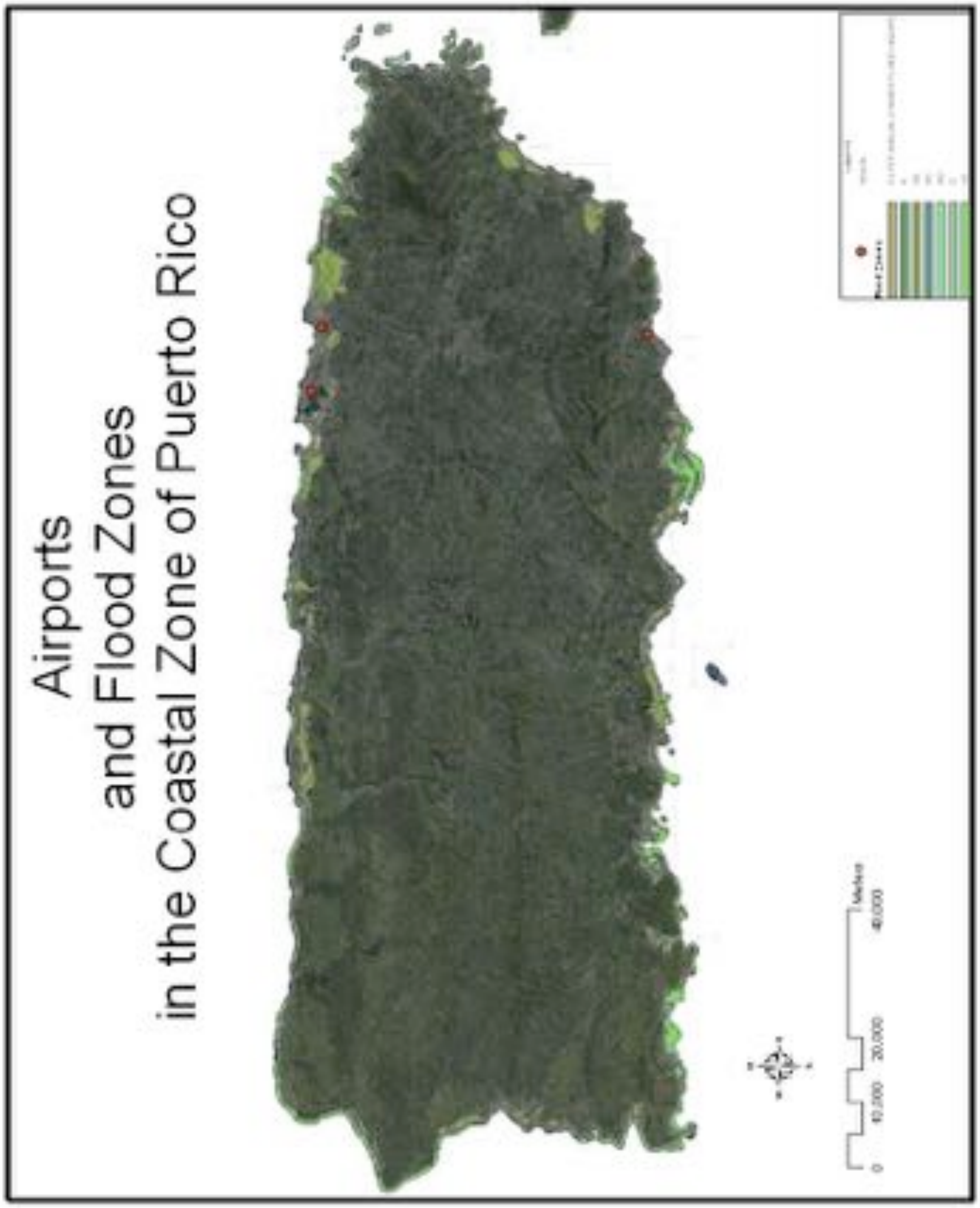

Figure 21: Airports and Flood Zones

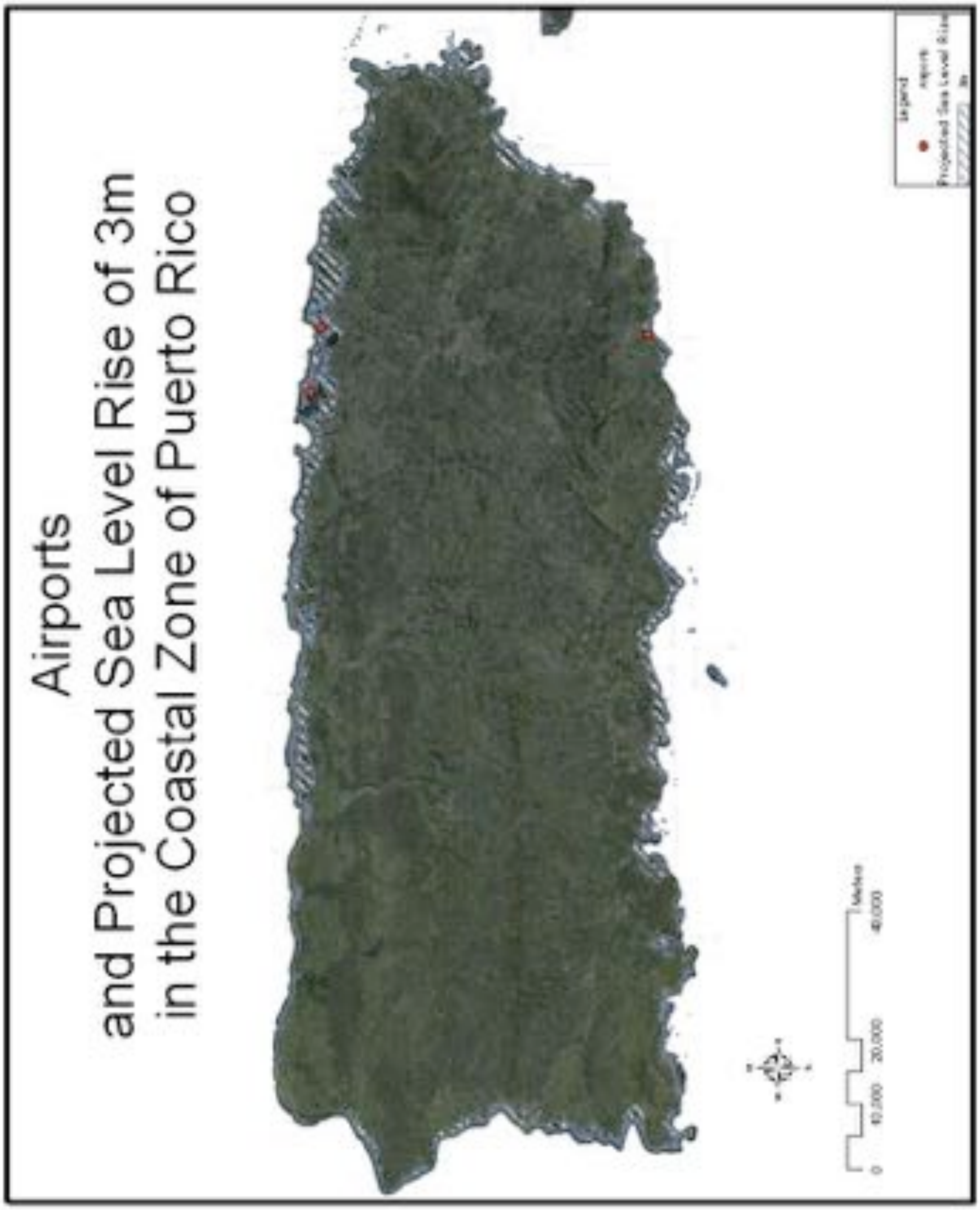

Figure 22: Airports and SLR

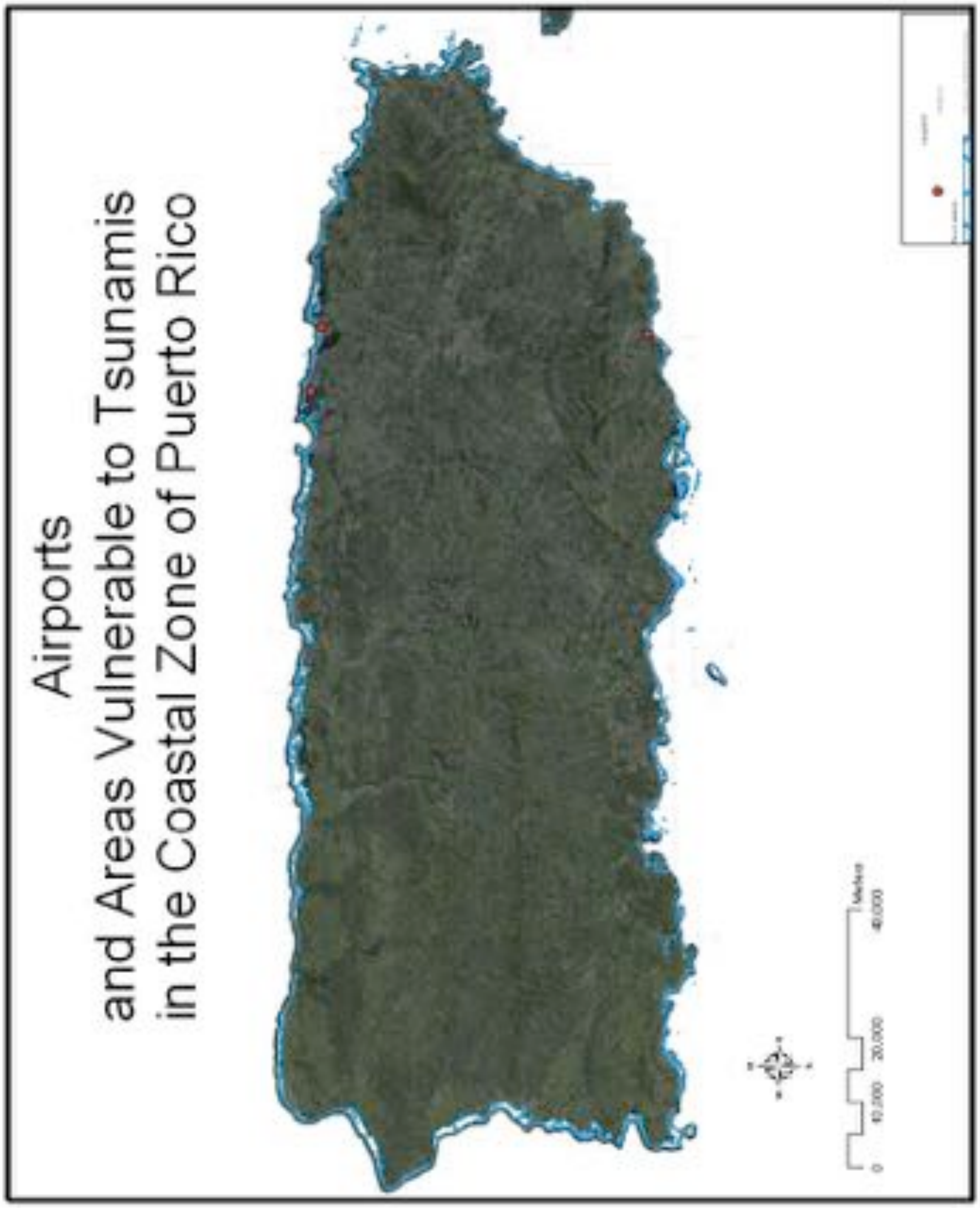

Figure 23: Airports and Tsunami Flood Zones

Aqueducts

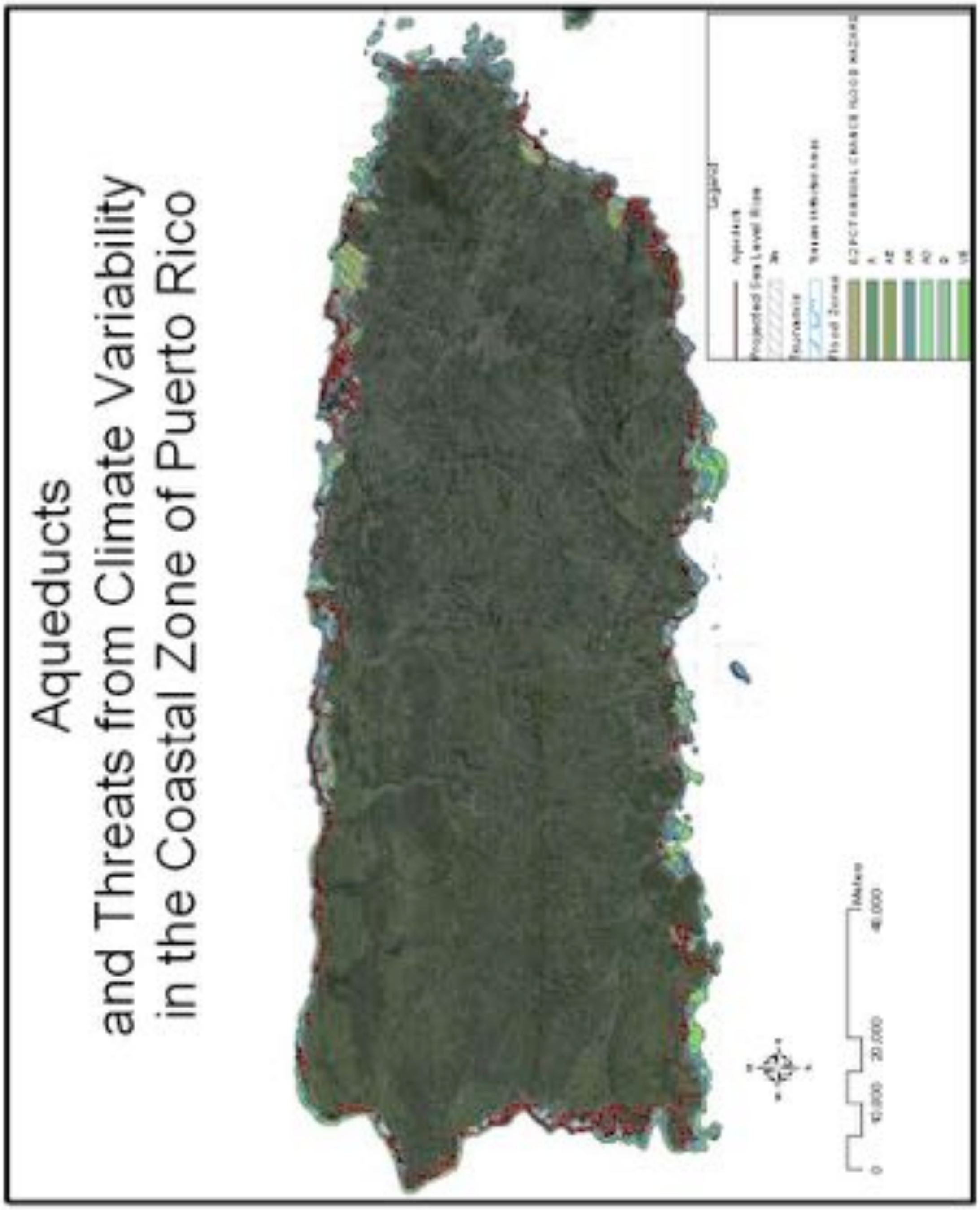

Figure 24: Aqueducts and All Considered Threats

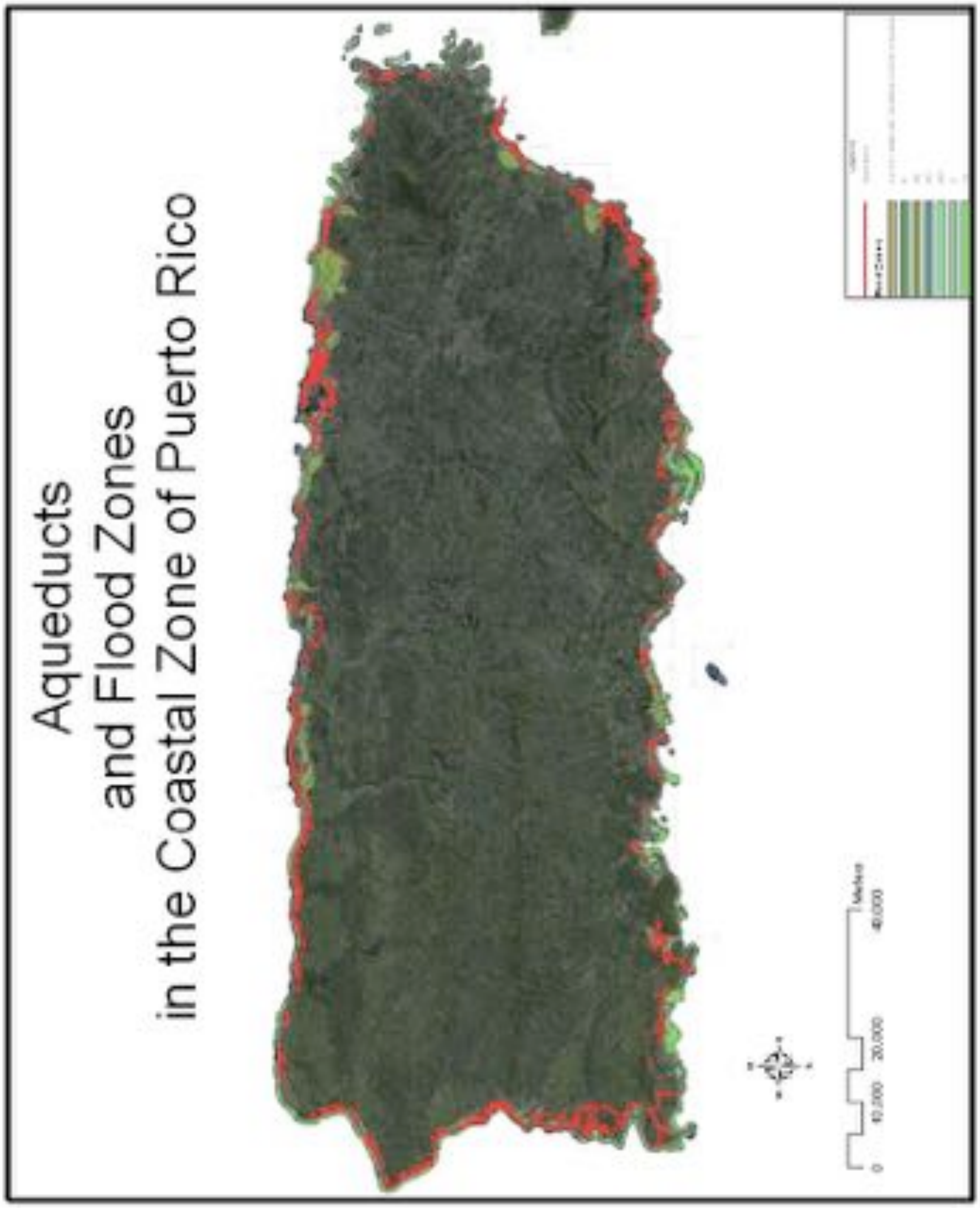

Figure 25: Aqueducts and Flood Zones

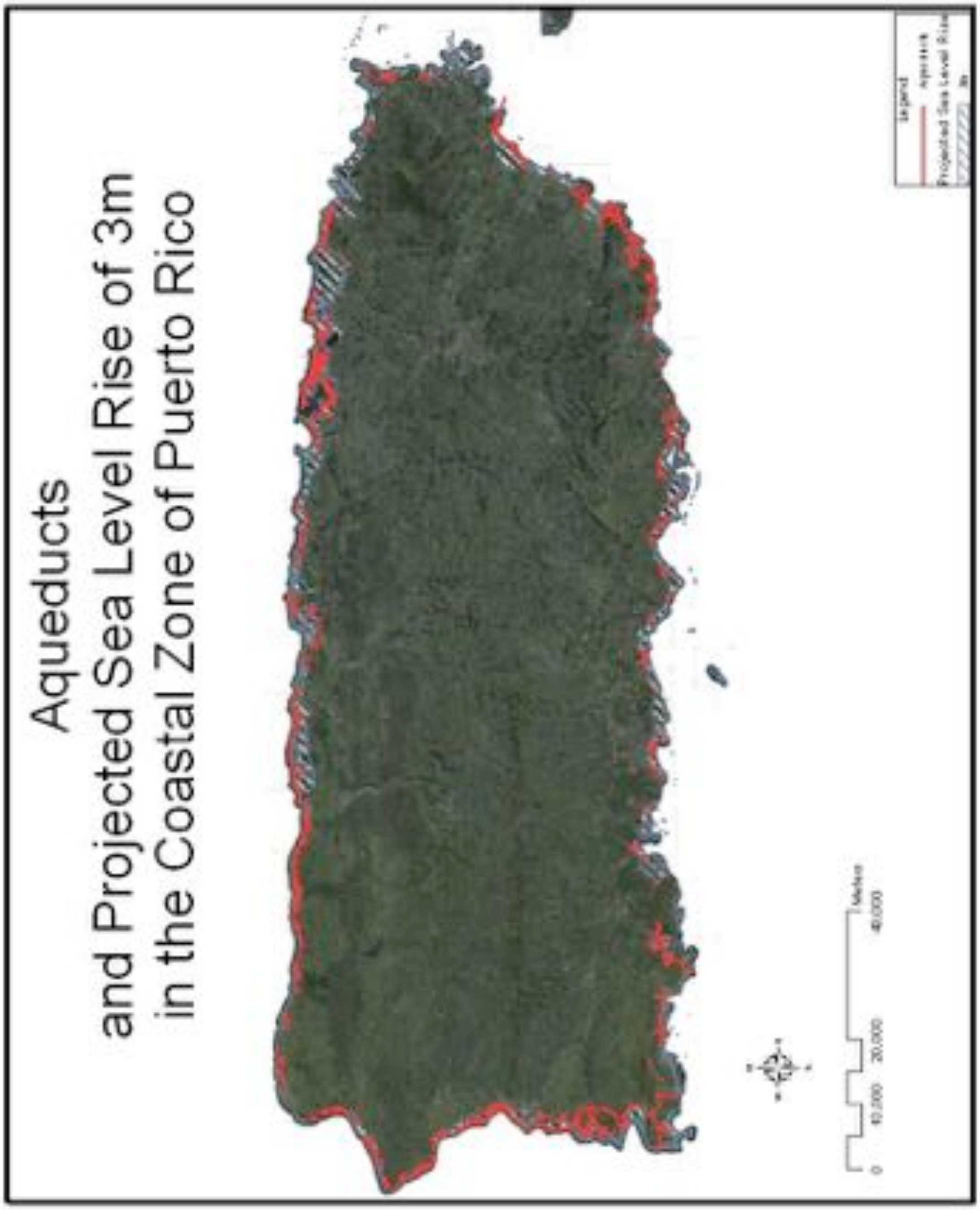

Figure 26: Aqueducts and SLR

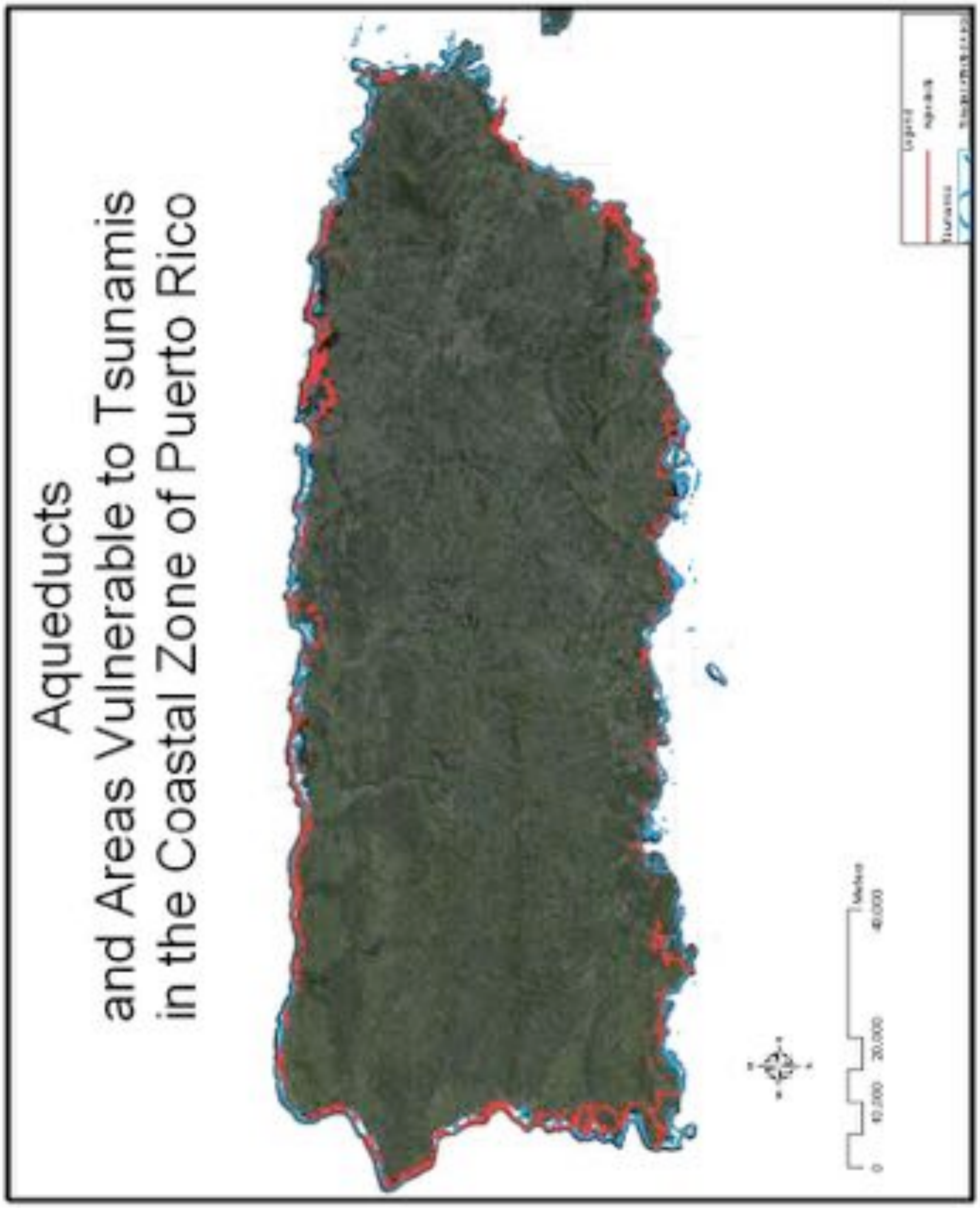

Figure 27: Aqueducts and Tsunami Flood Zones

Bridges

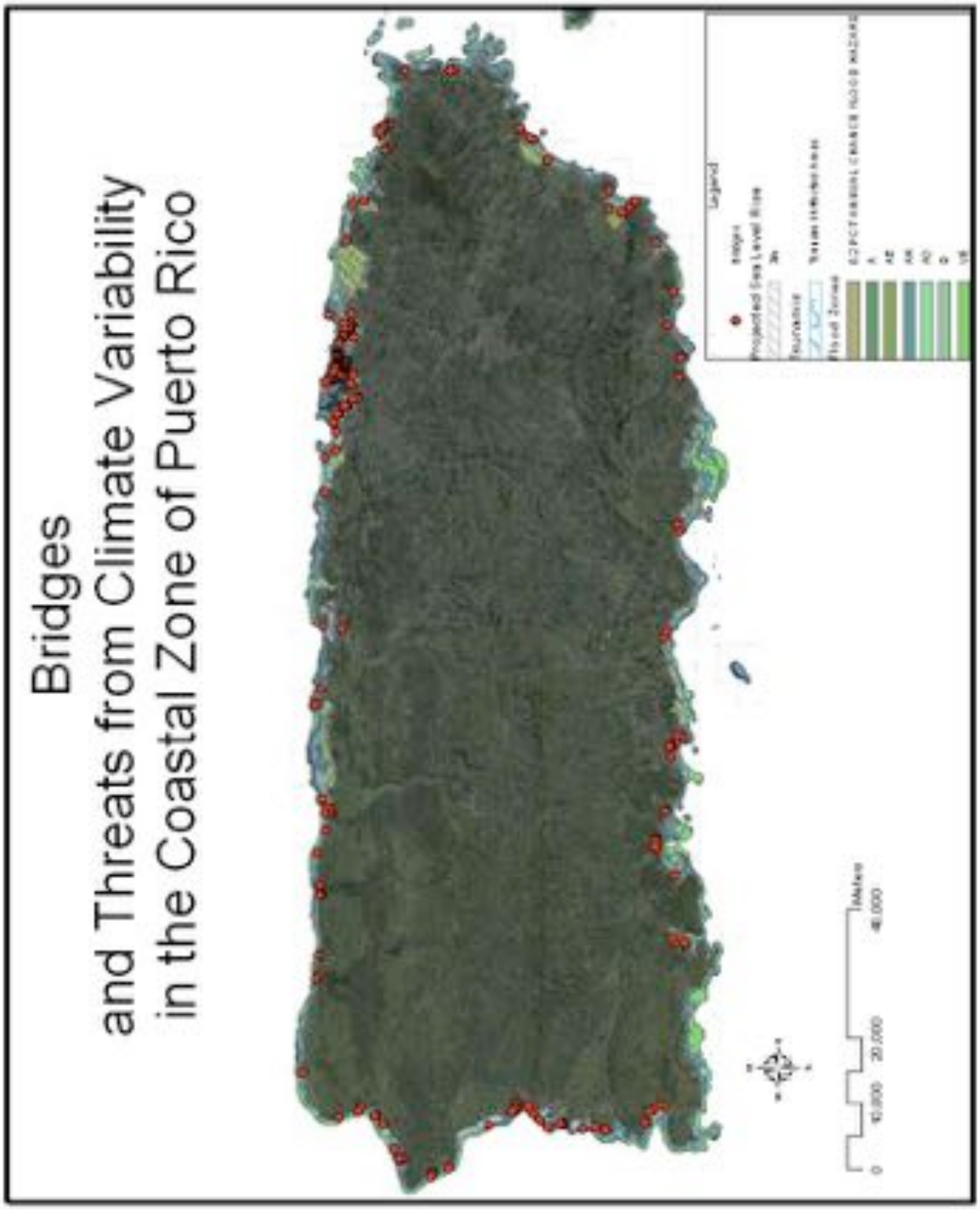

Figure 28: Bridges and All Considered Threats

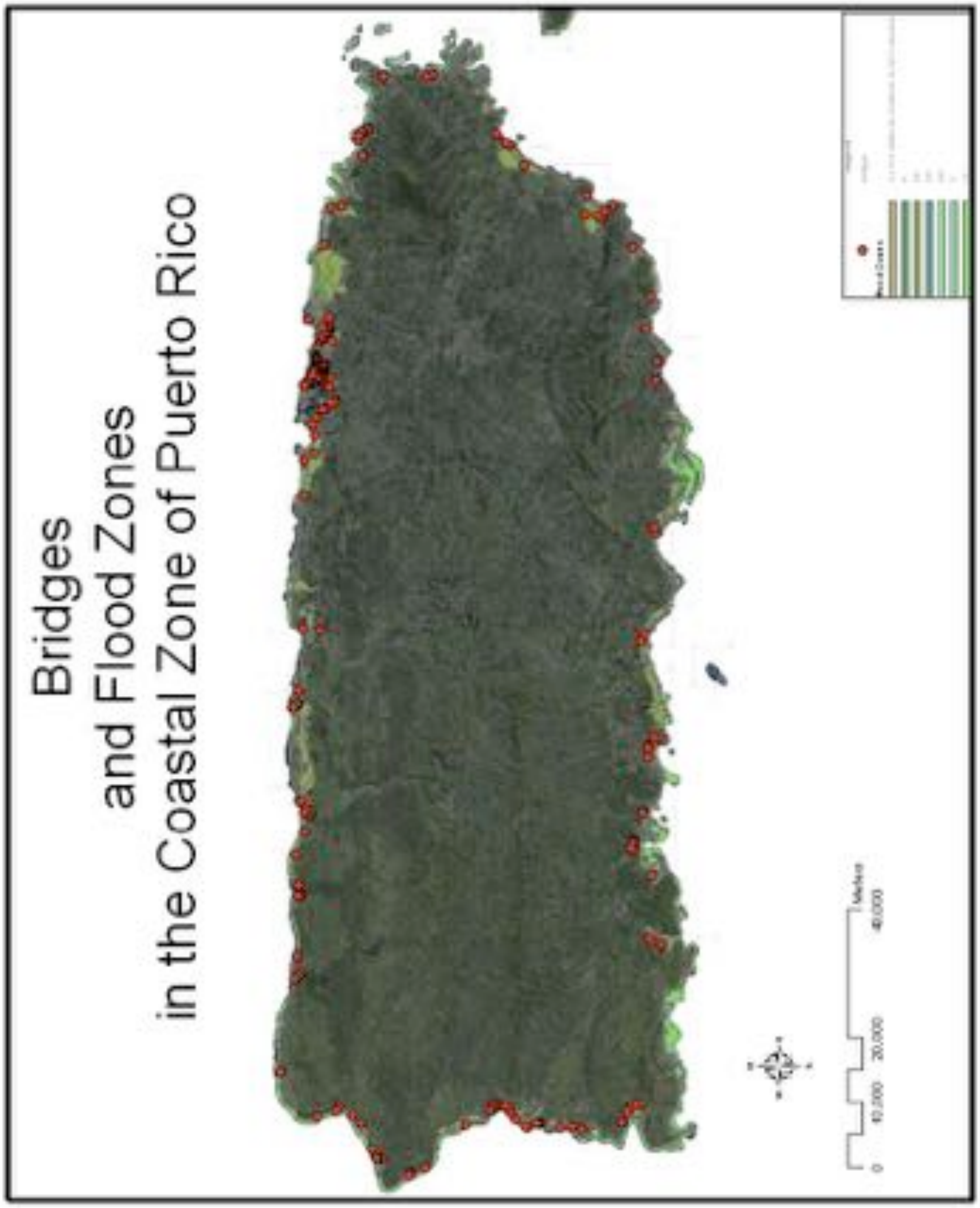

Figure 29: Bridges and Flood Zones

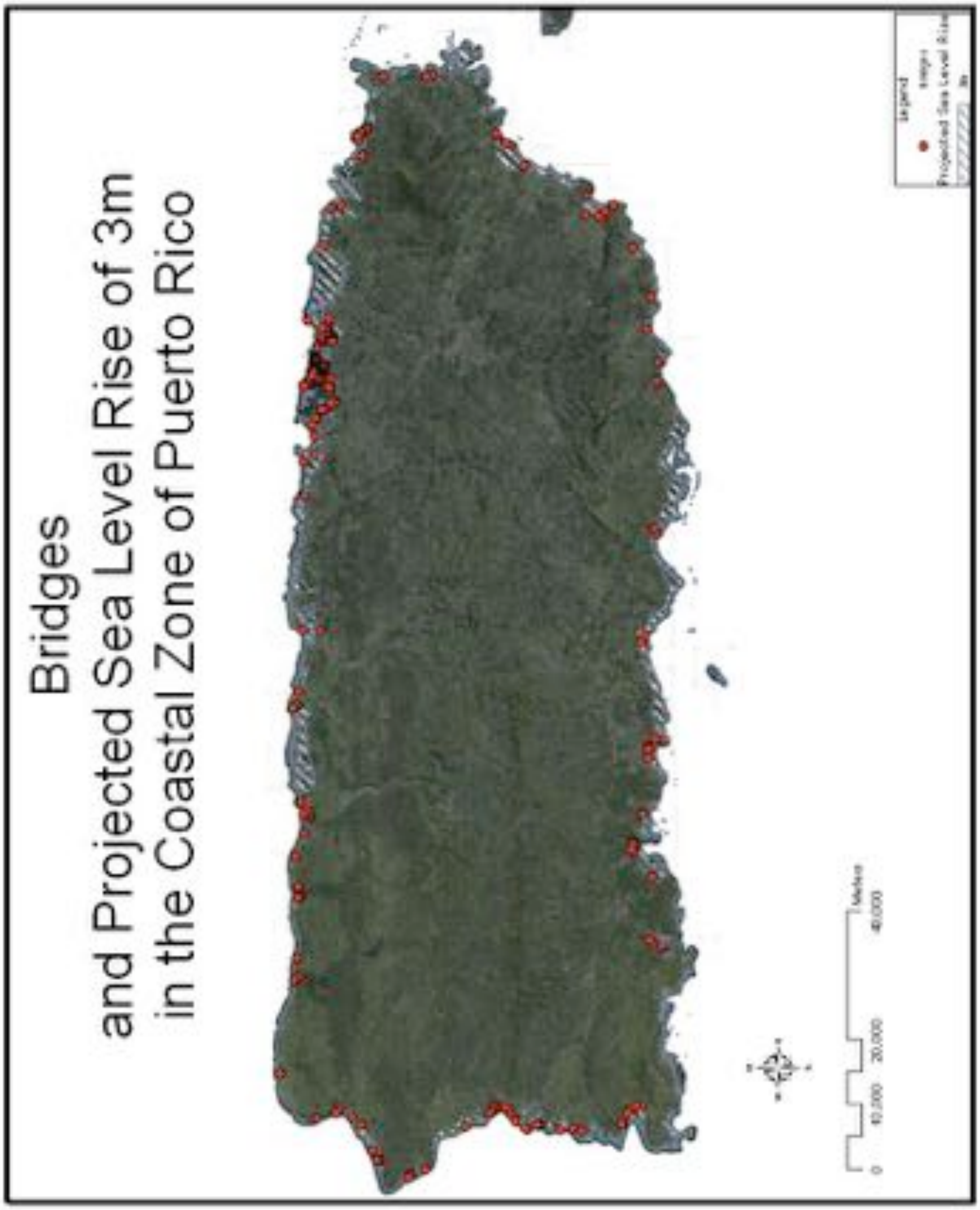

Figure 30: Bridges and SLR

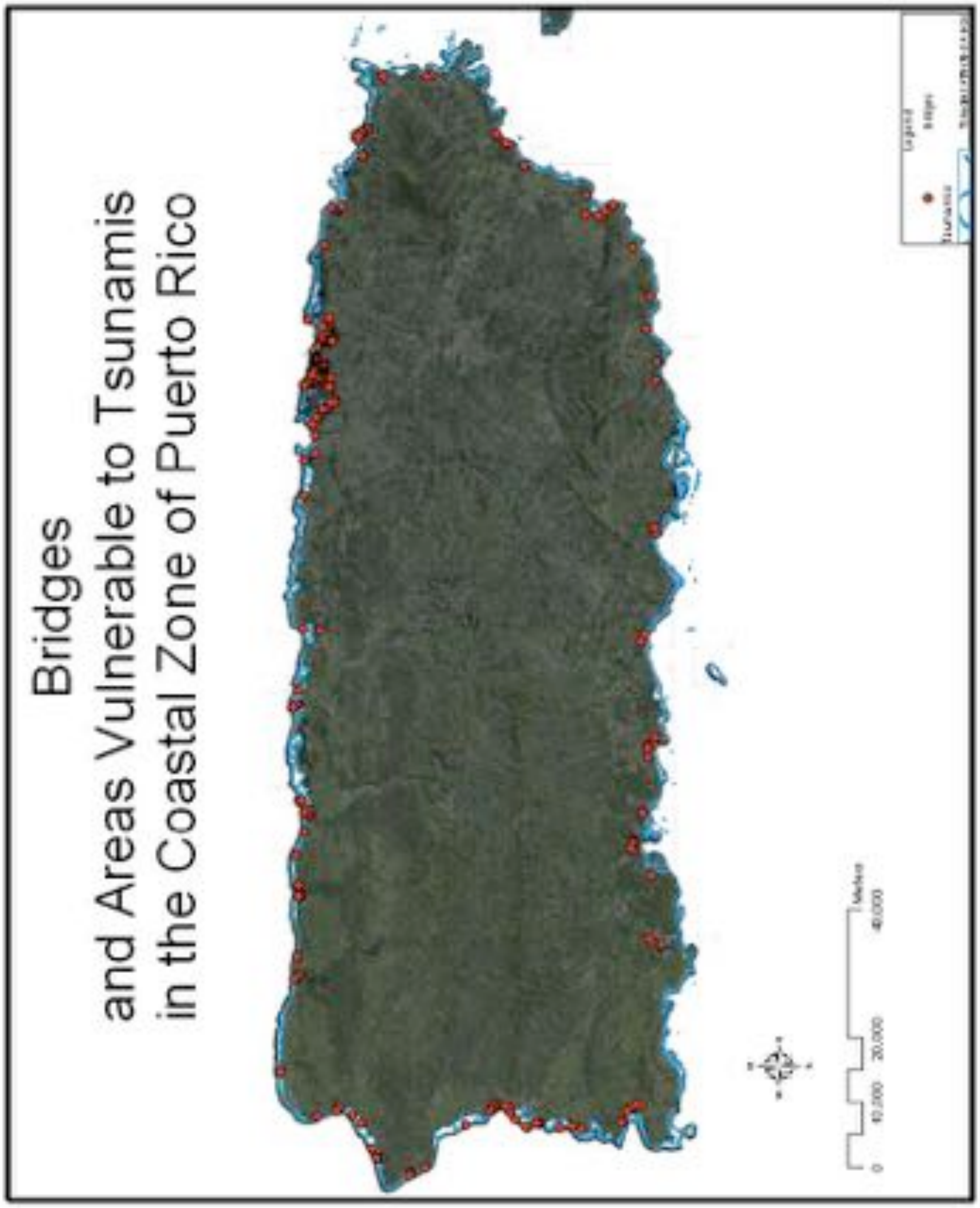

Figure 31: Bridges and Tsunami Flood Zones

Hospitals

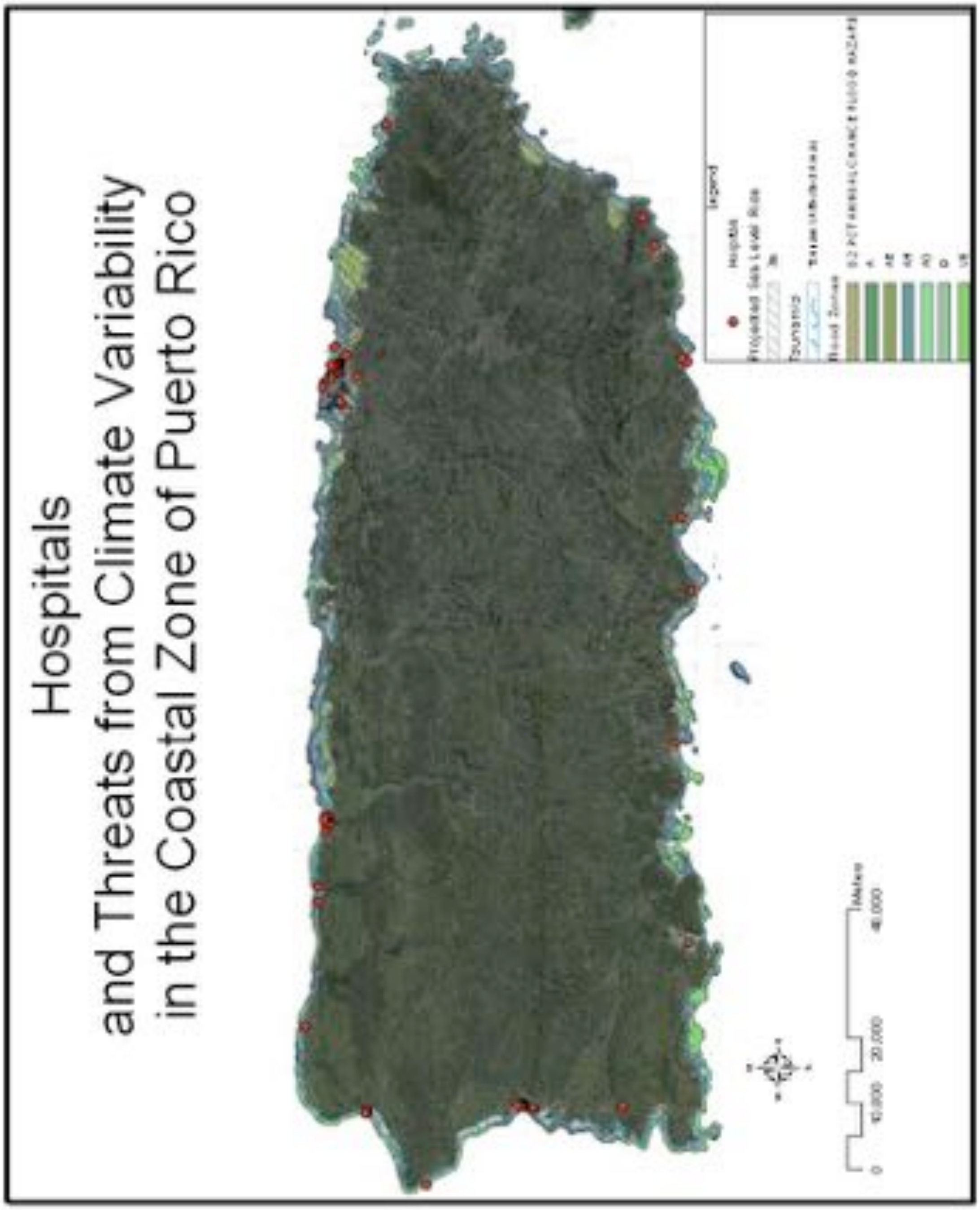

Figure 32: Hospitals and All Considered Threats

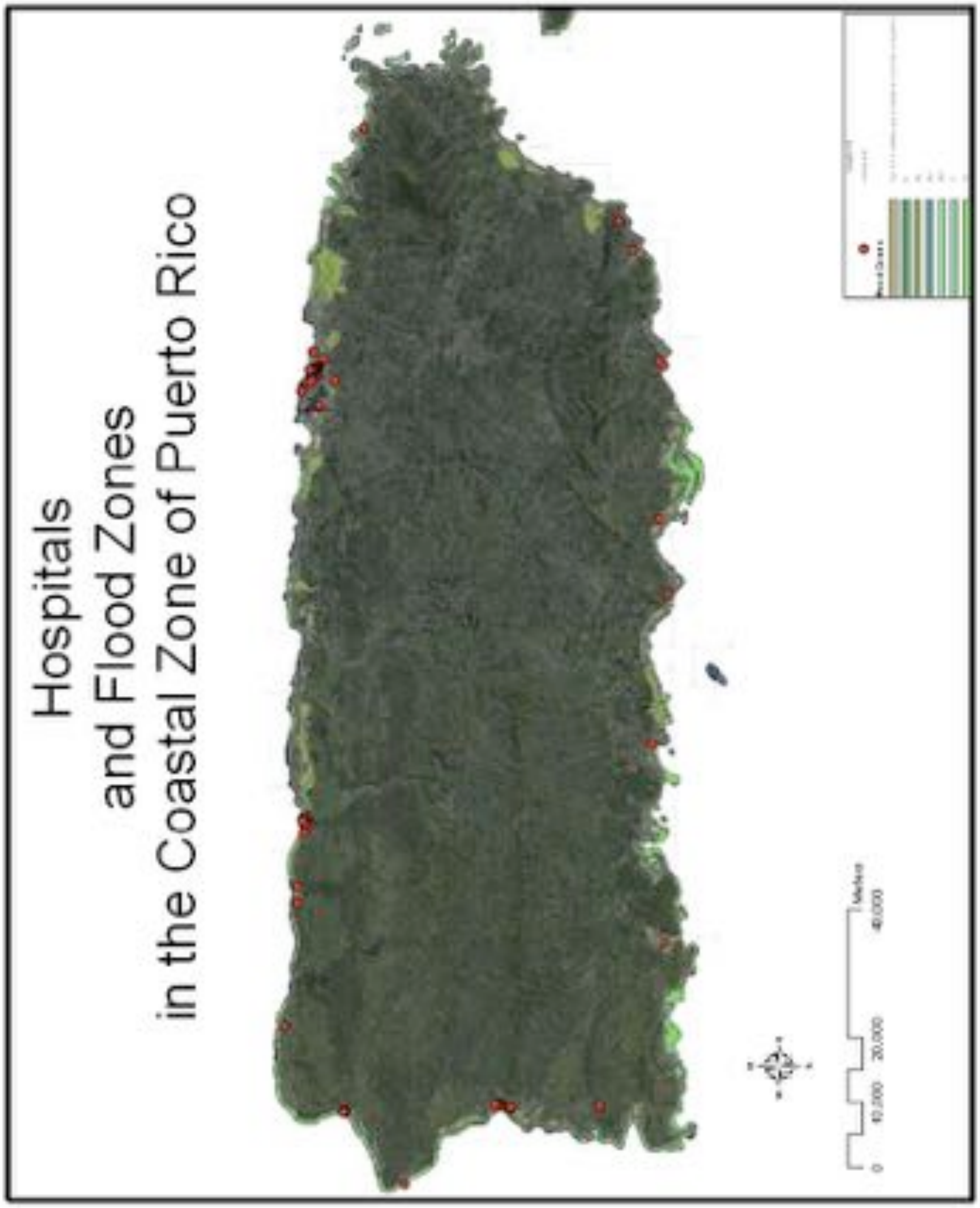

Figure 33: Hospitals and Flood Zones

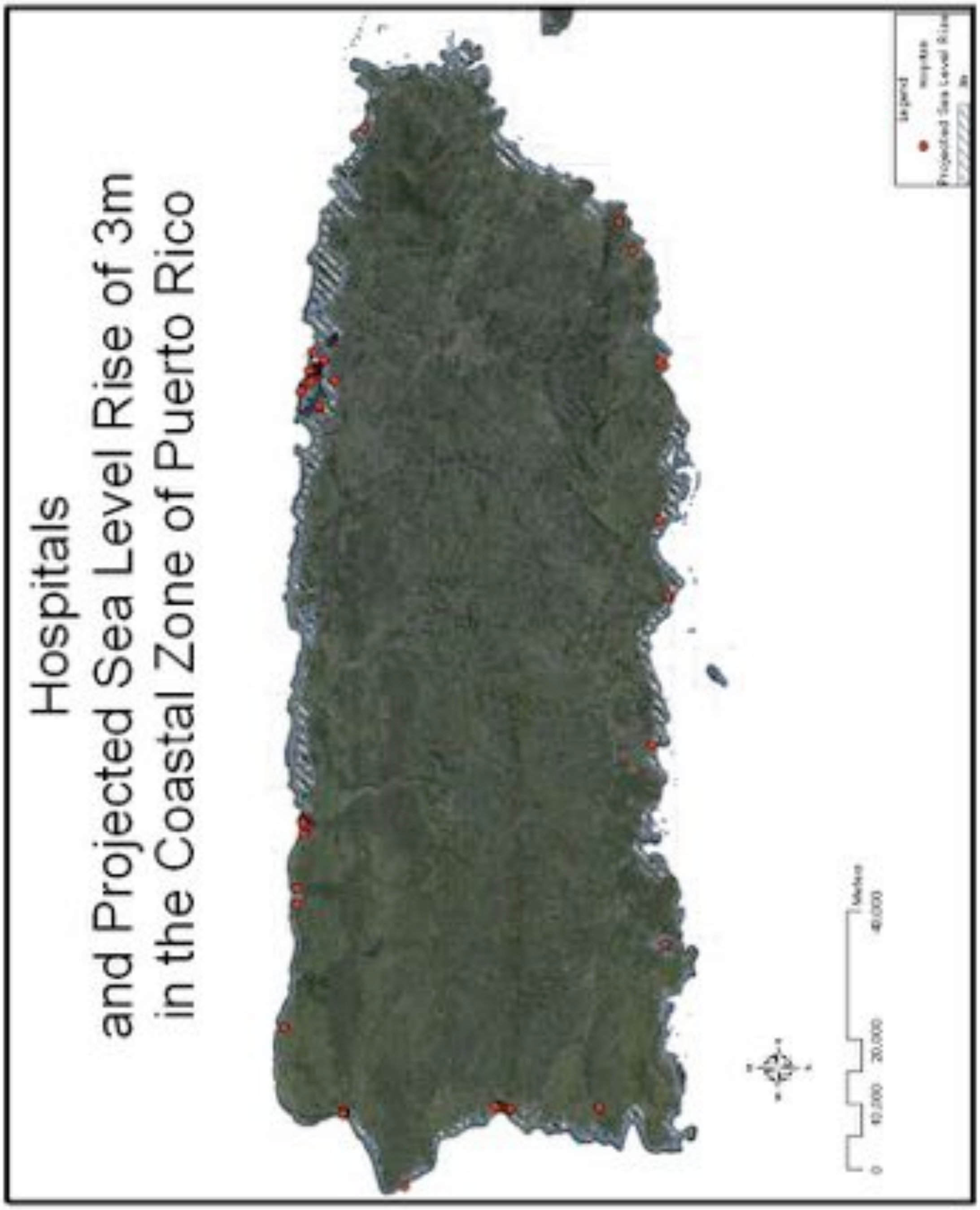

Figure 34: Hospitals and SLR

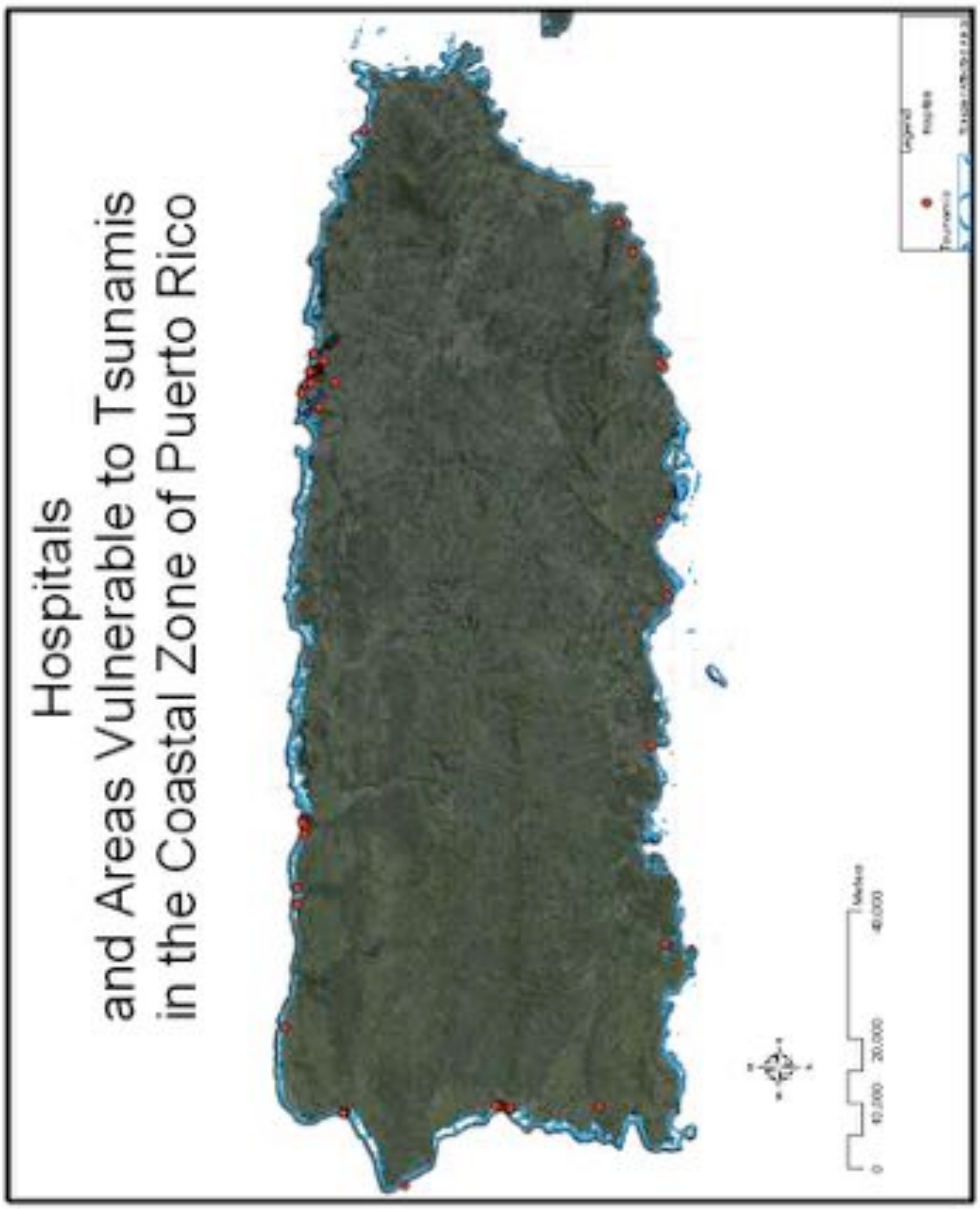

Figure 35: Hospitals and Tsunami Flood Zones

Power (Generation) Plants

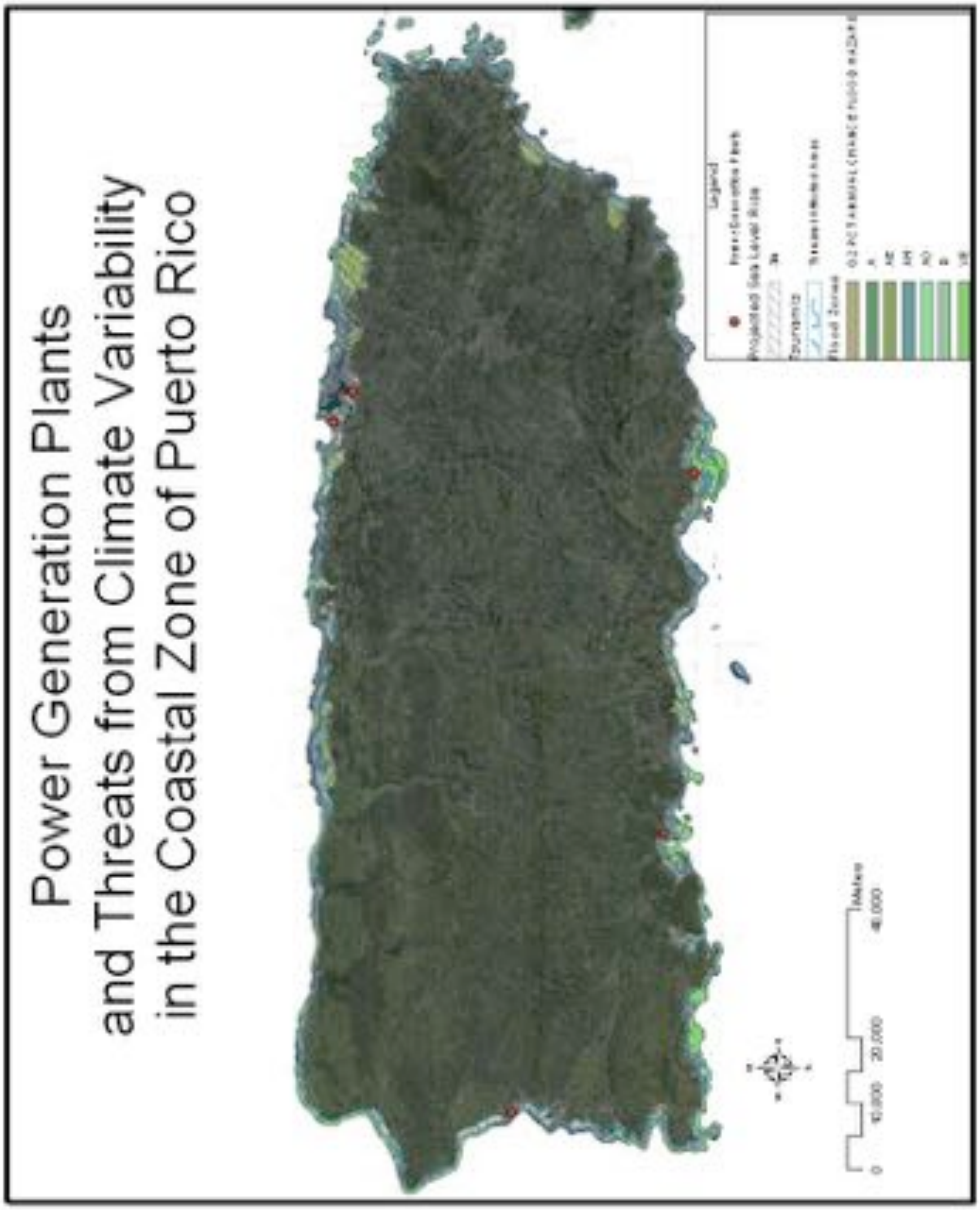

Figure 36: Power Generation Plants and All Considered Threats

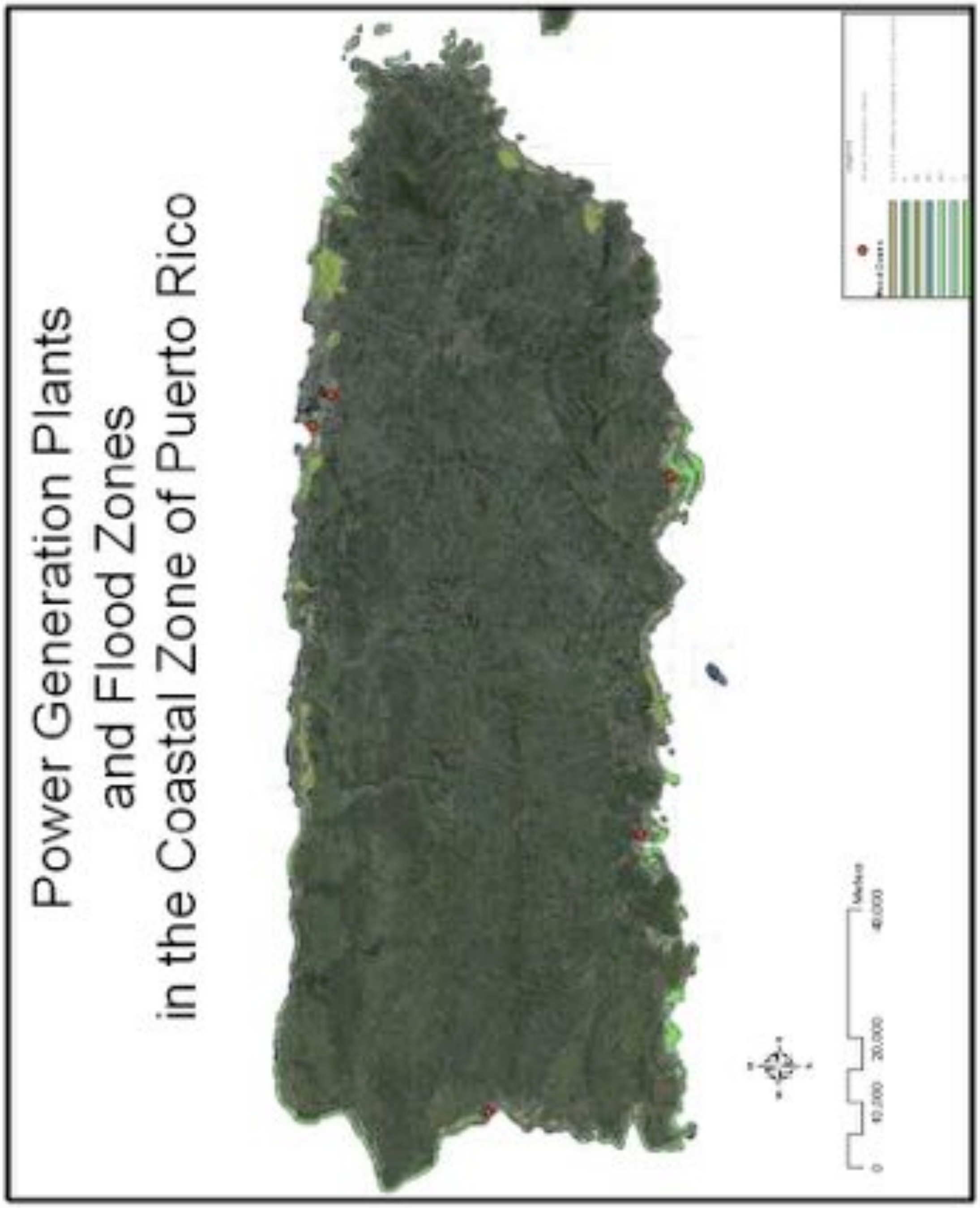

Figure 37: Power Generation Plants and Flood Zones

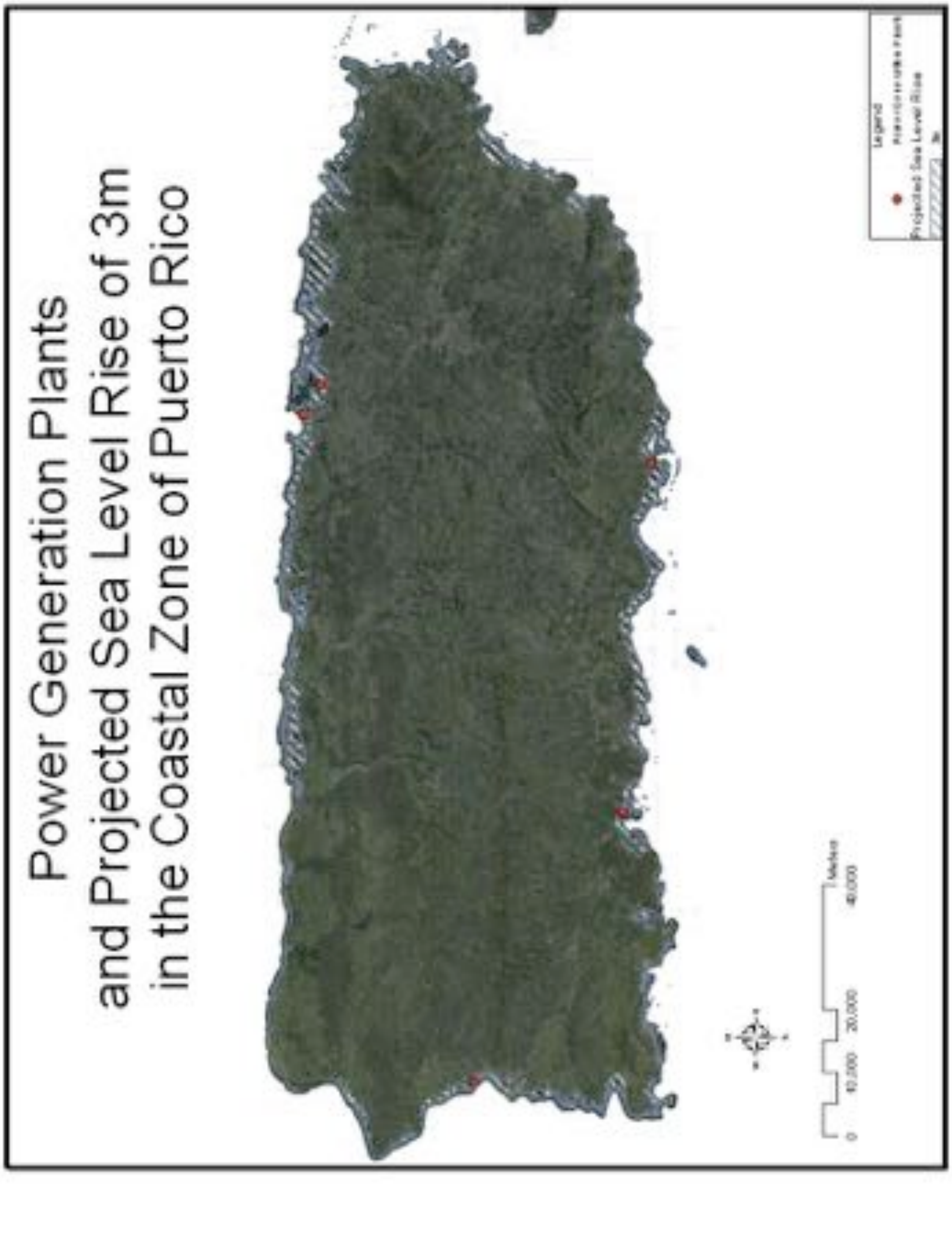

Figure 38: Power Generation Plants and SLR

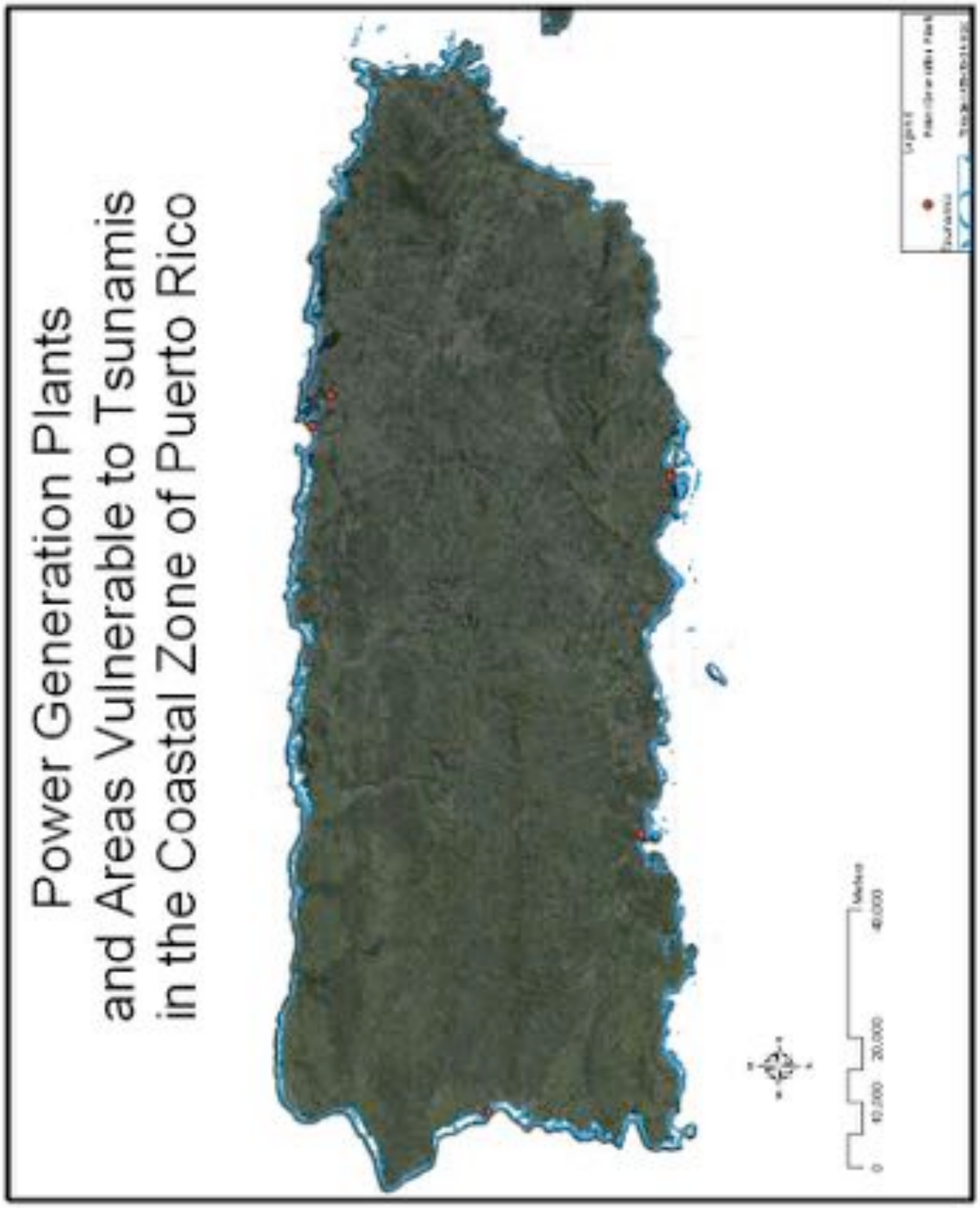

Figure 39: Power Generation Plants and Tsunami Flood Zones

Roads

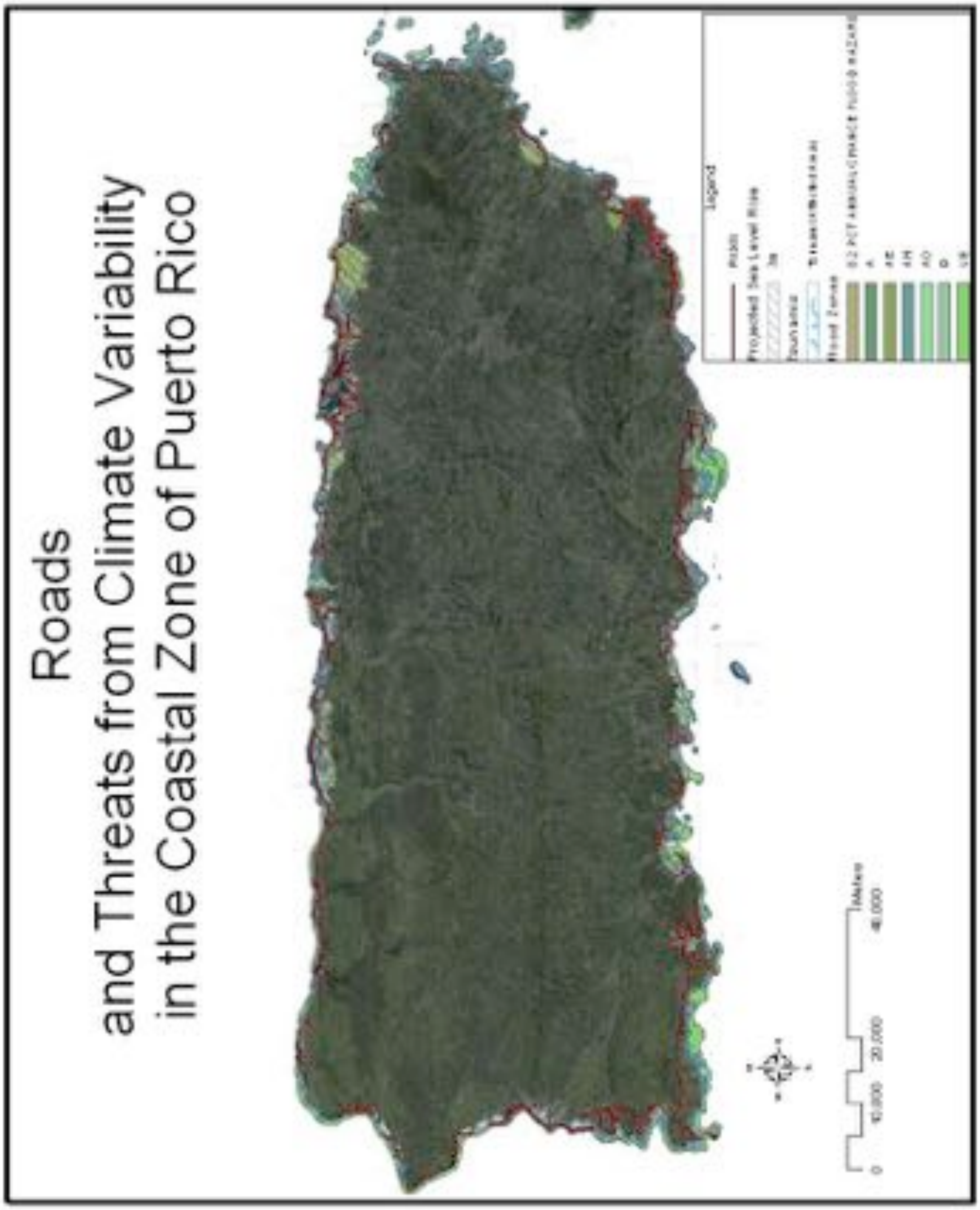

Figure 40: Roads and All Considered Threats

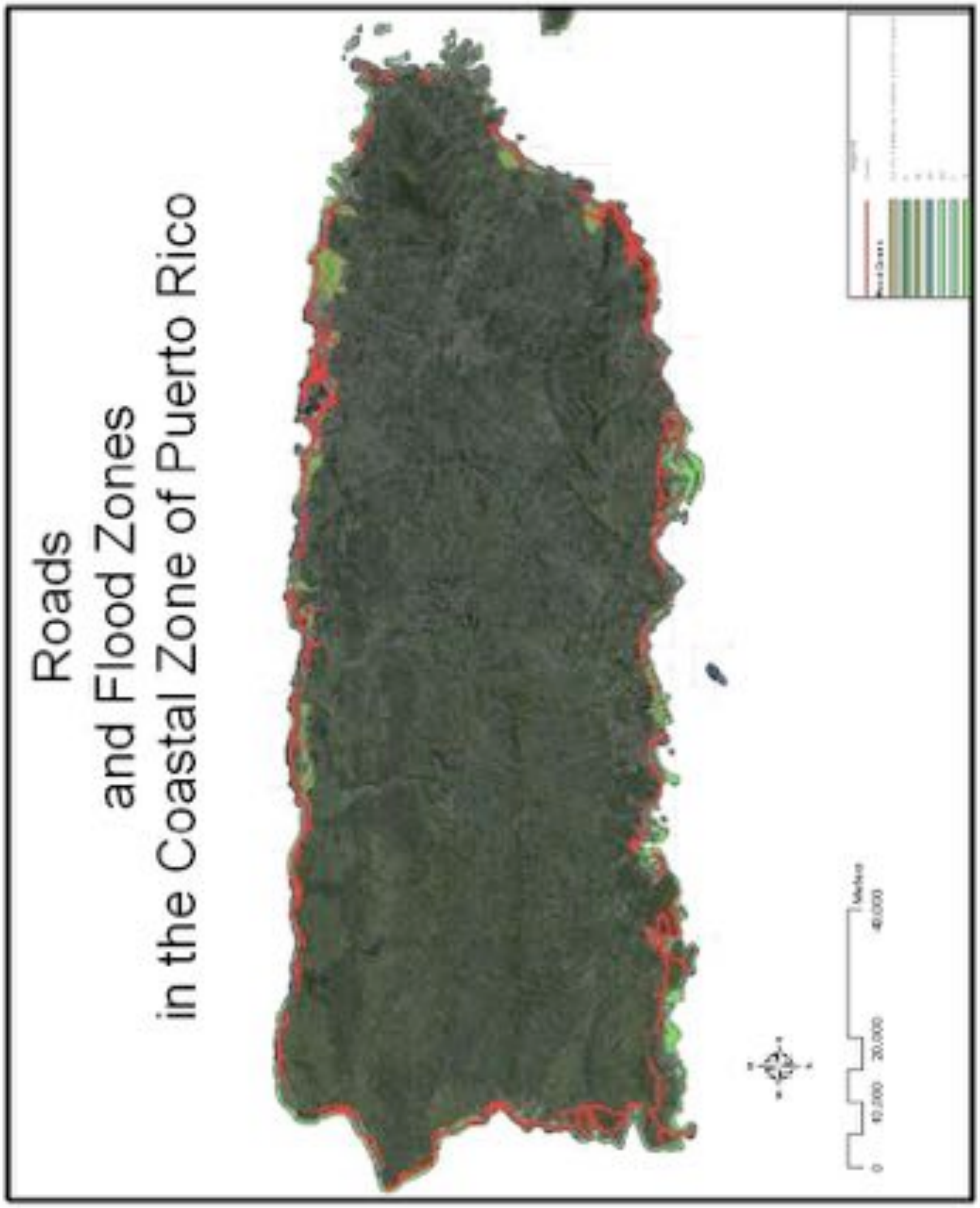

Figure 41: Roads and Flood Zones

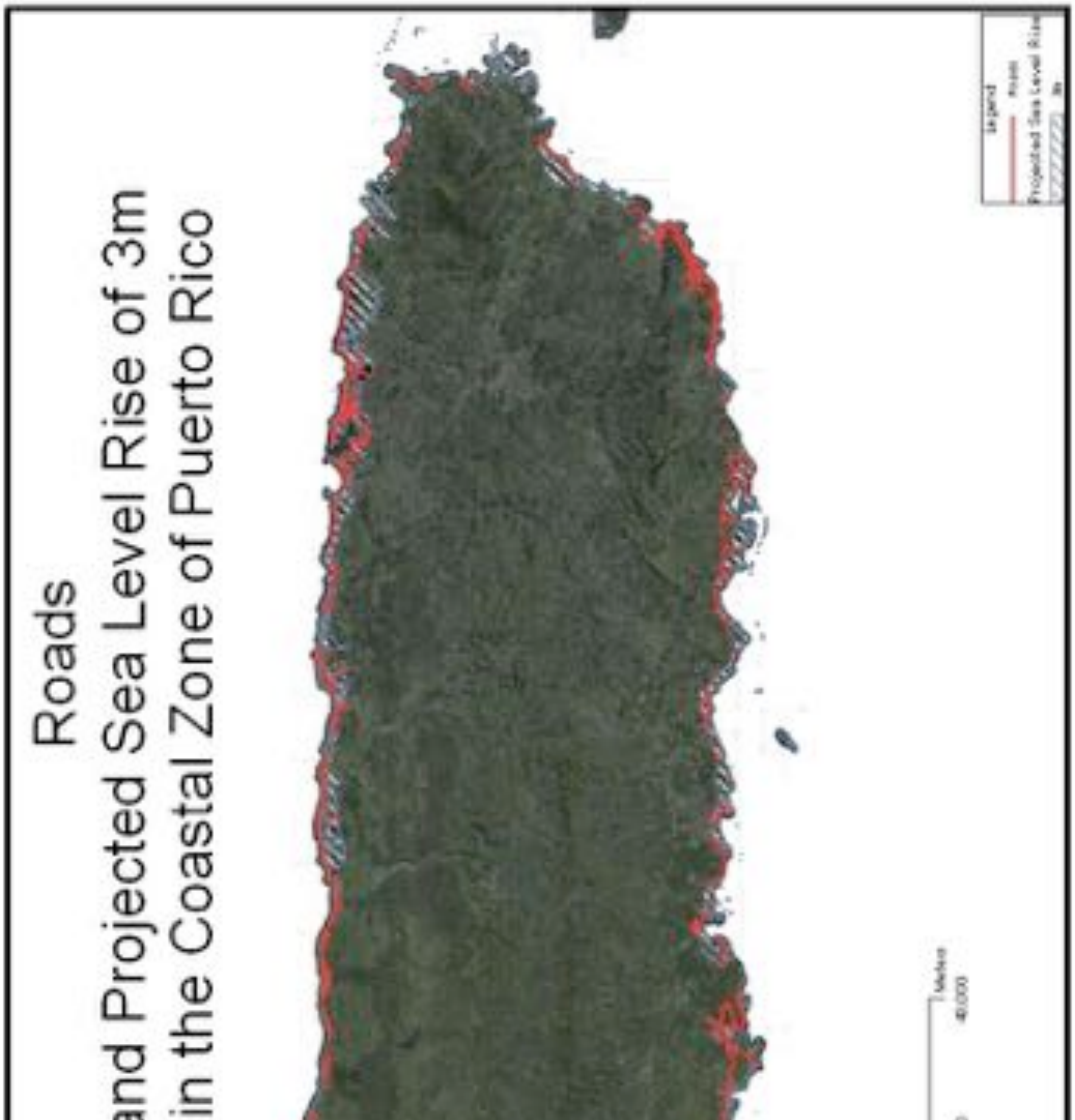

Figure 42: Roads and SLR

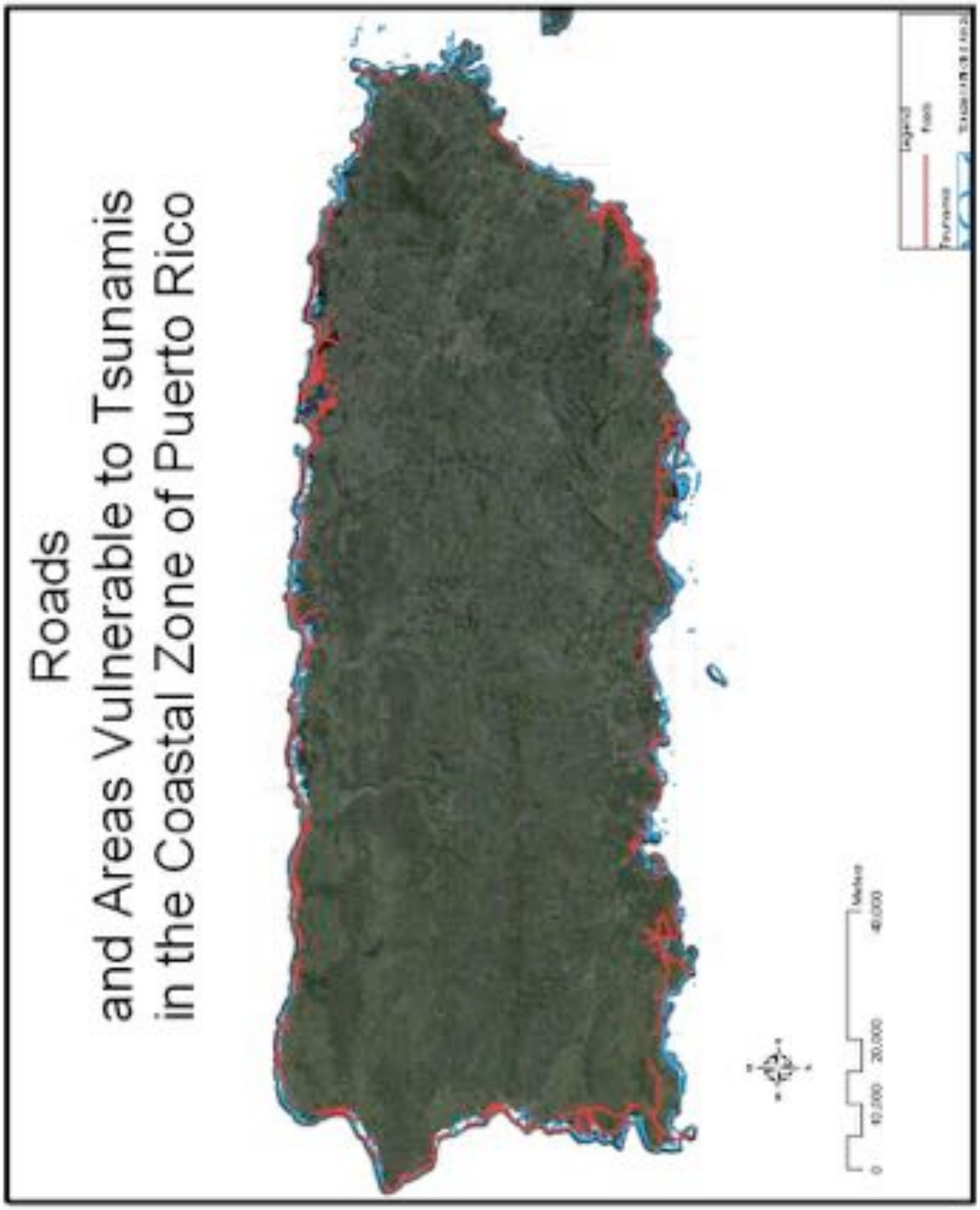

Figure 43: Roads and Tsunami Flood Zones

Seaports

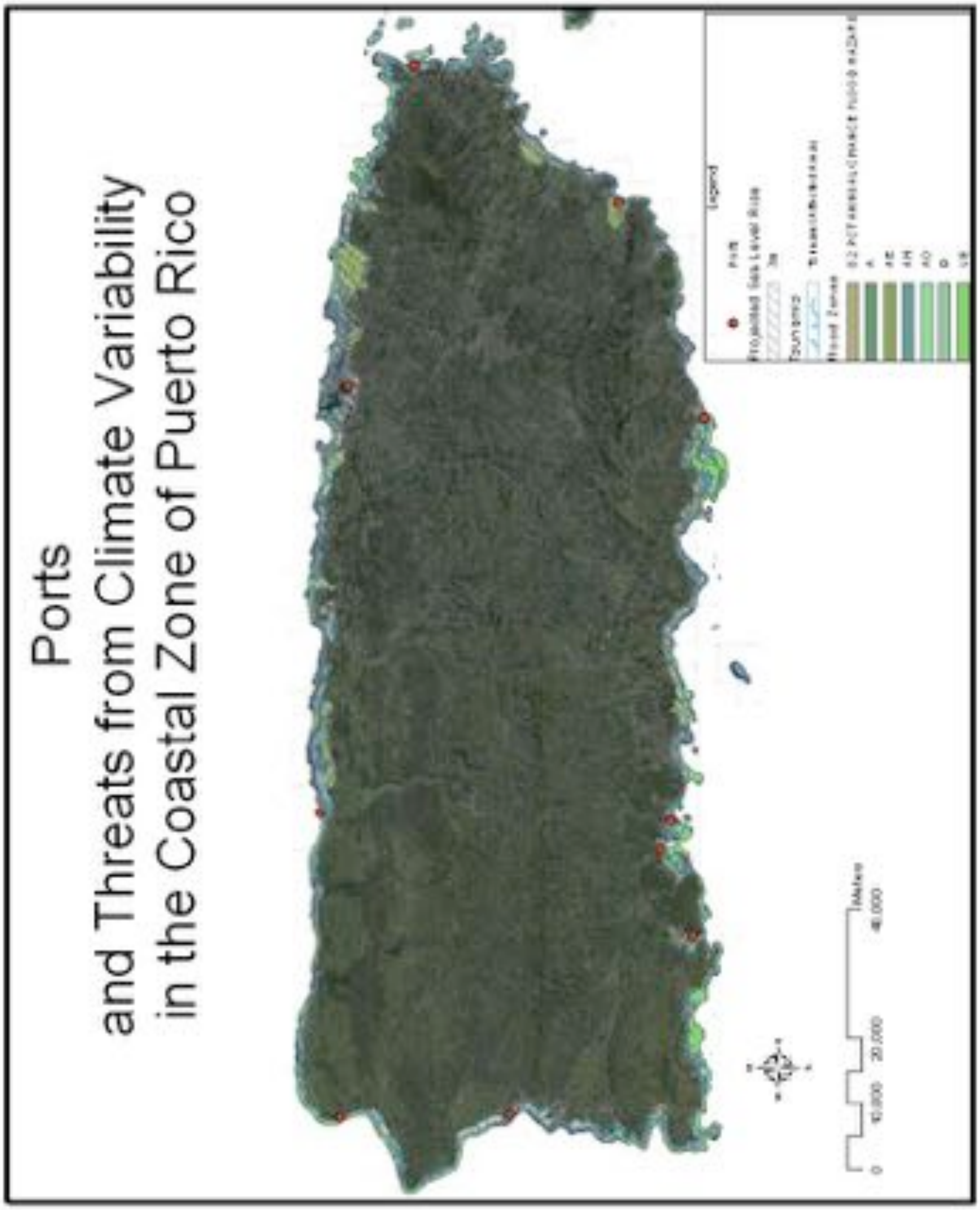

Figure 44: Ports and All Considered Threats

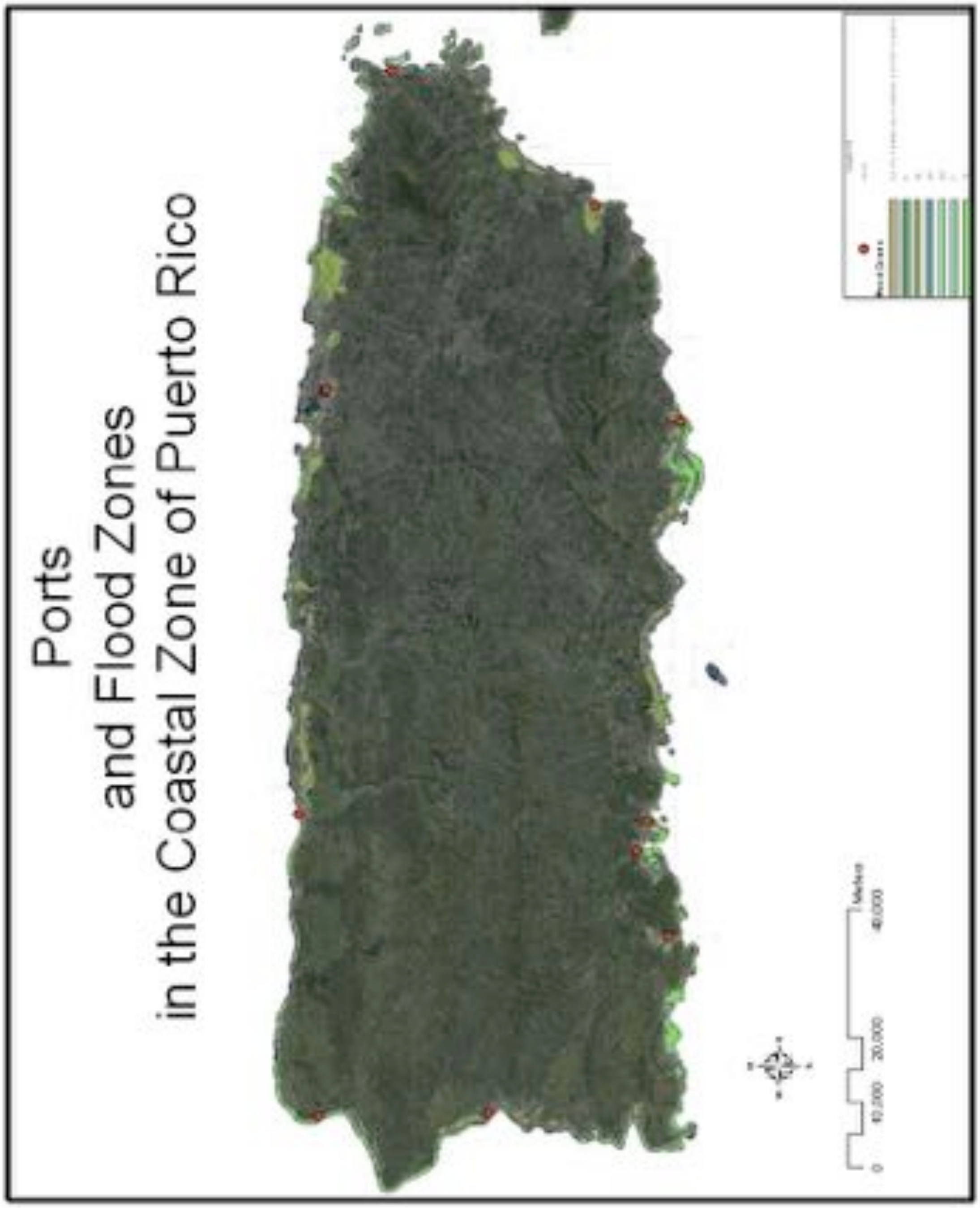

Figure 45: Ports and Flood Zones

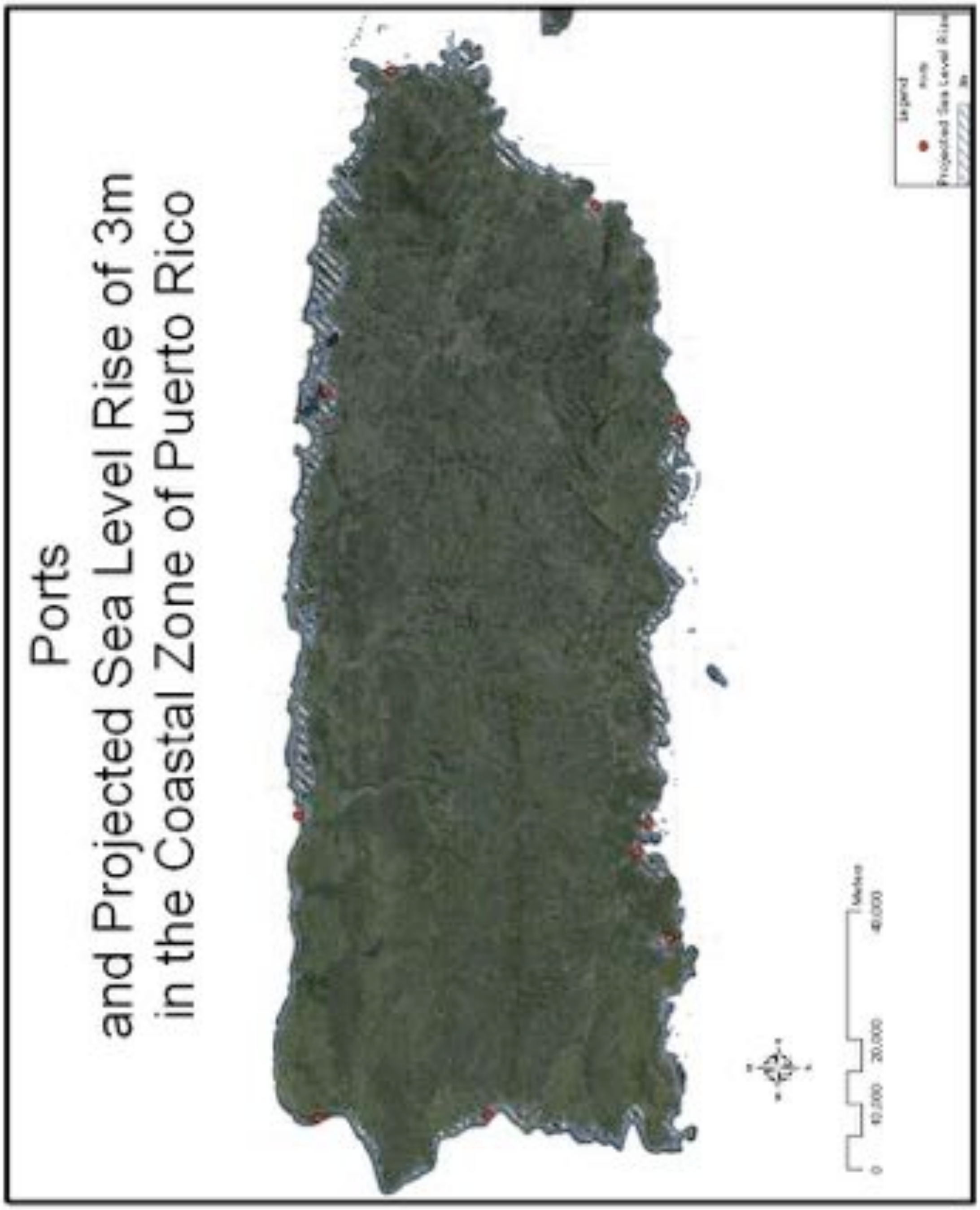

Figure 46: Ports and SLR

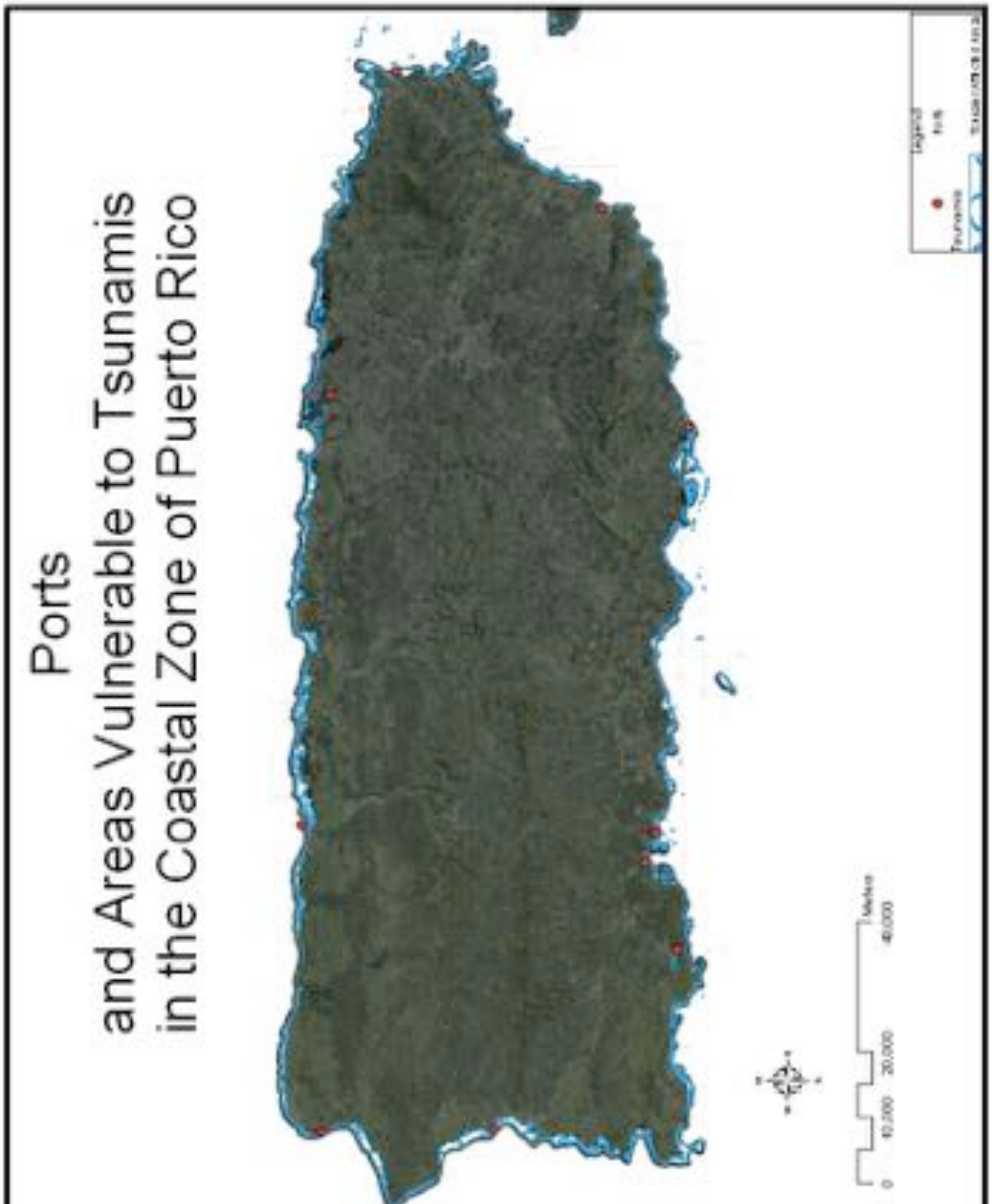

Figure 47: Ports and Tsunami Flood Zones

Schools

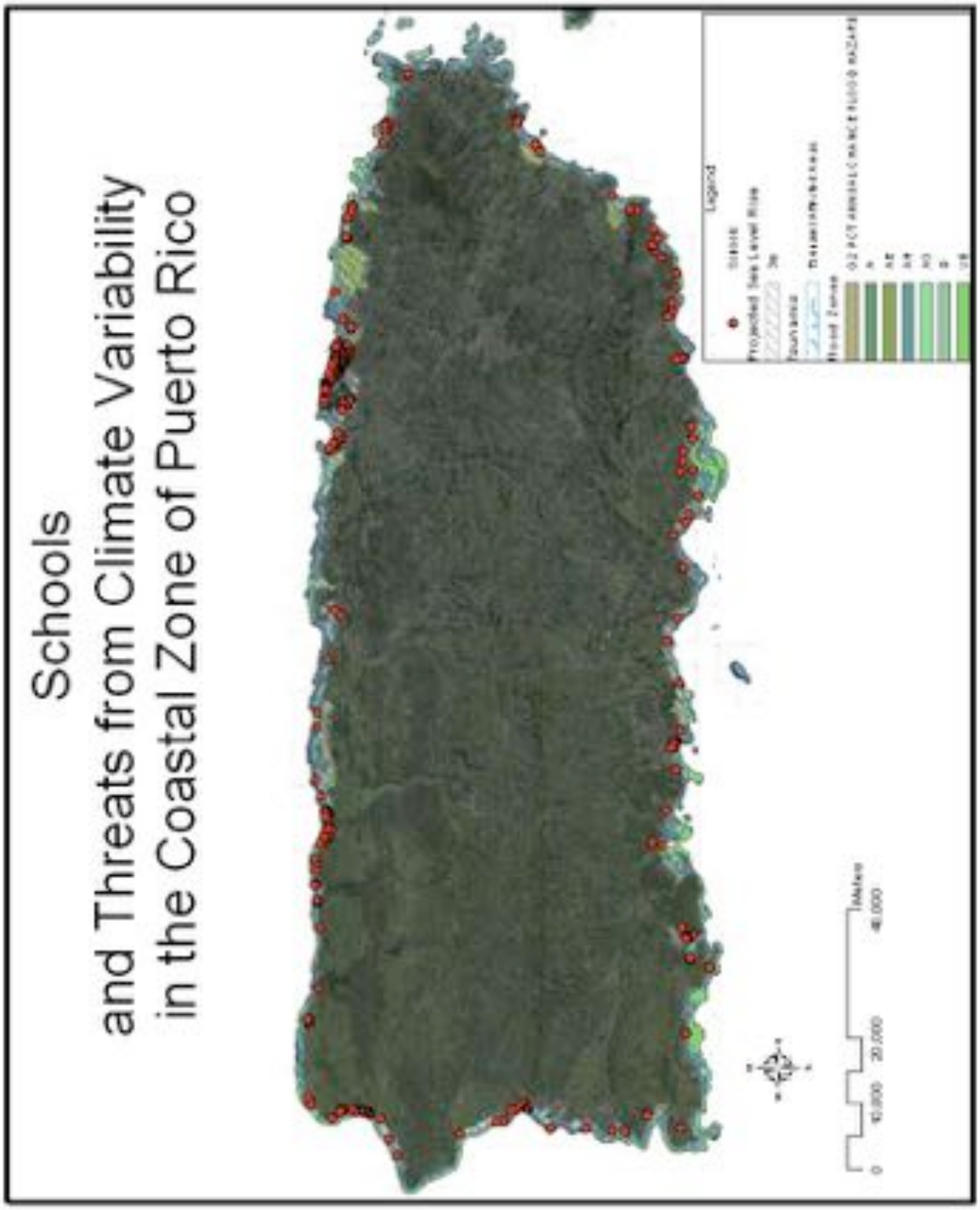

Figure 48: Schools and All Considered Threats

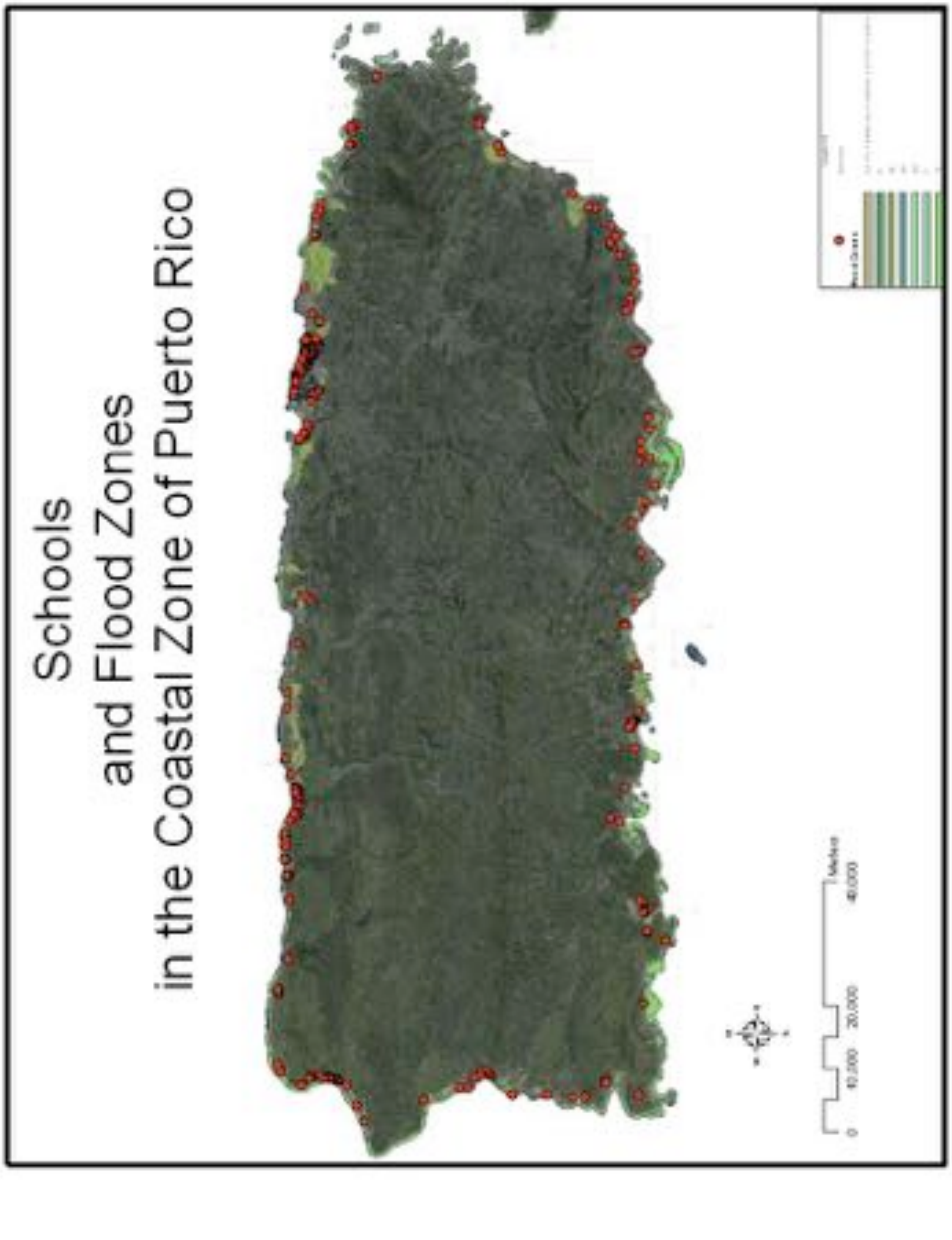

Figure 49: Schools and Flood Zones

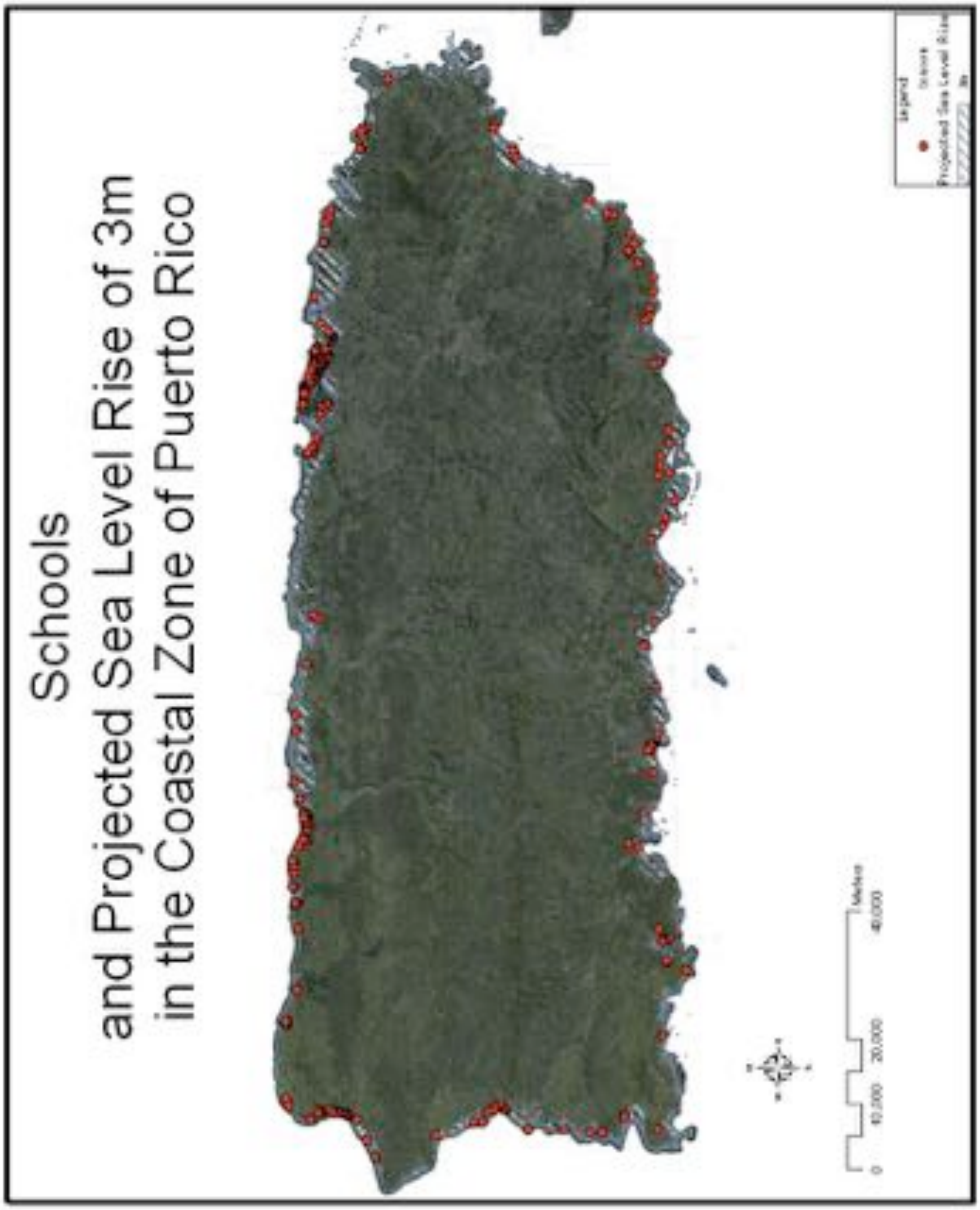

Figure 50: Schools and SLR

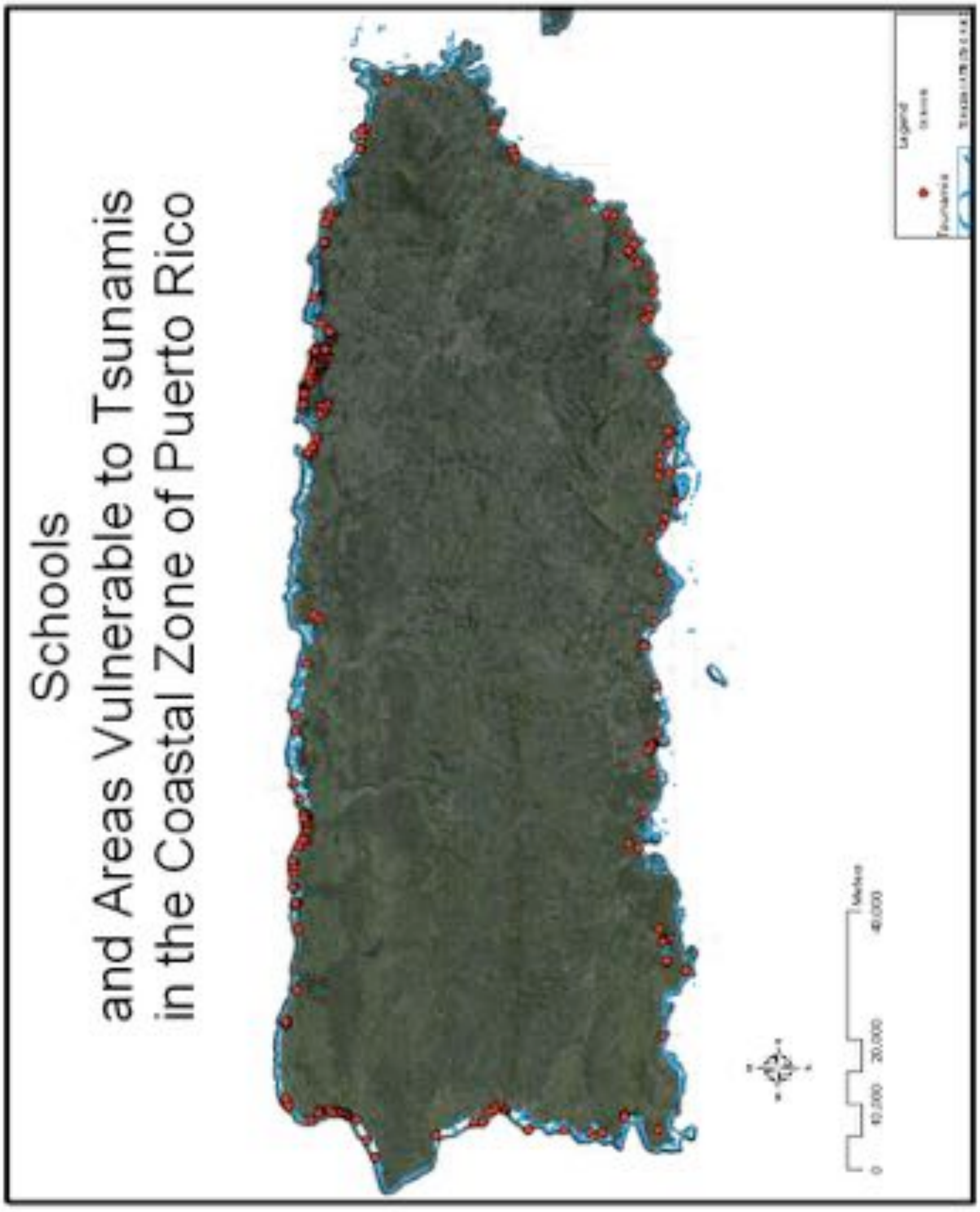

Figure 51: Schools and Tsunami Flood Zones

Transmission Lines

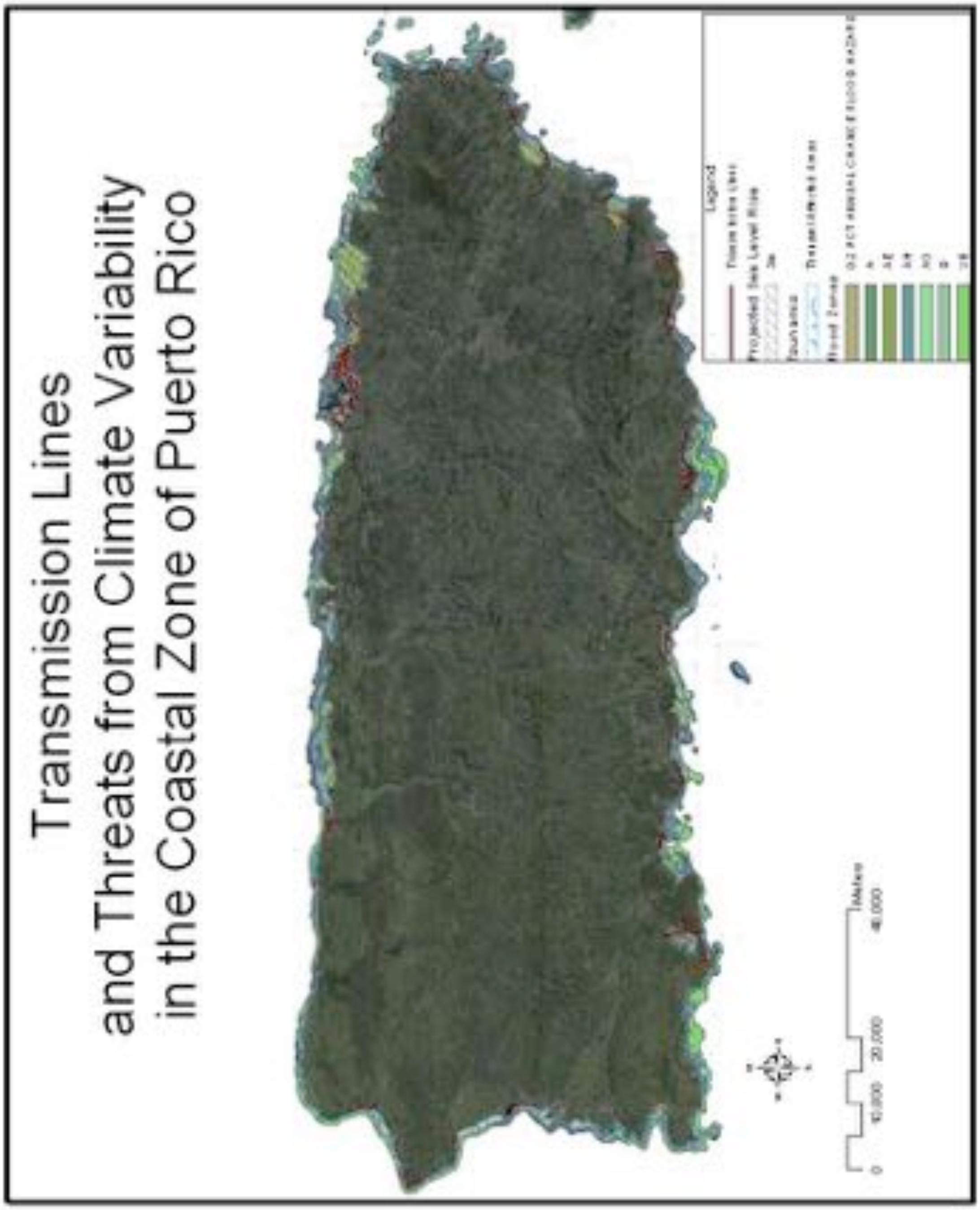

Figure 52: Transmission Lines and All Considered Threats

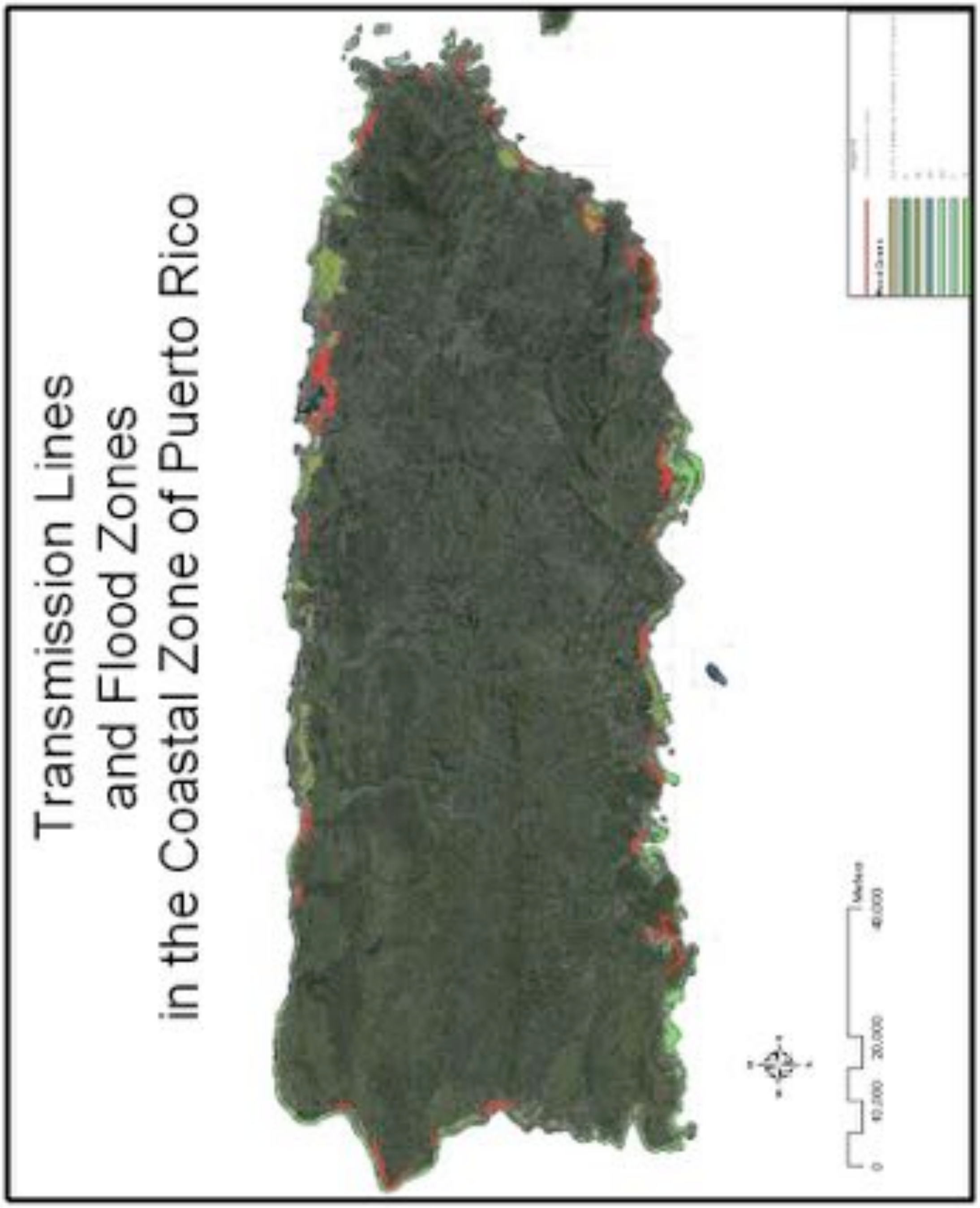

Figure 53: Transmission Lines and Flood Zones

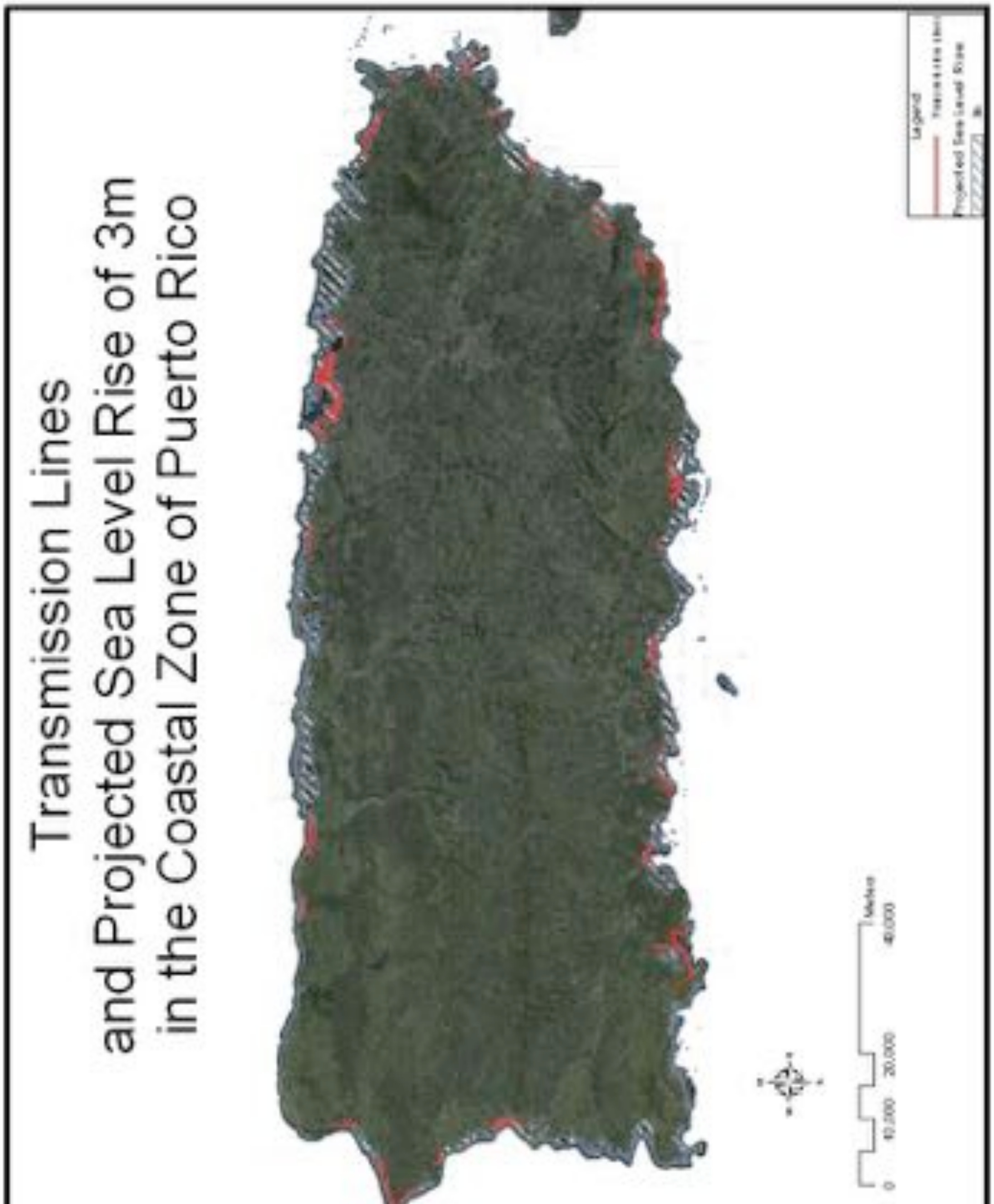

Figure 54: Transmission Lines and SLR

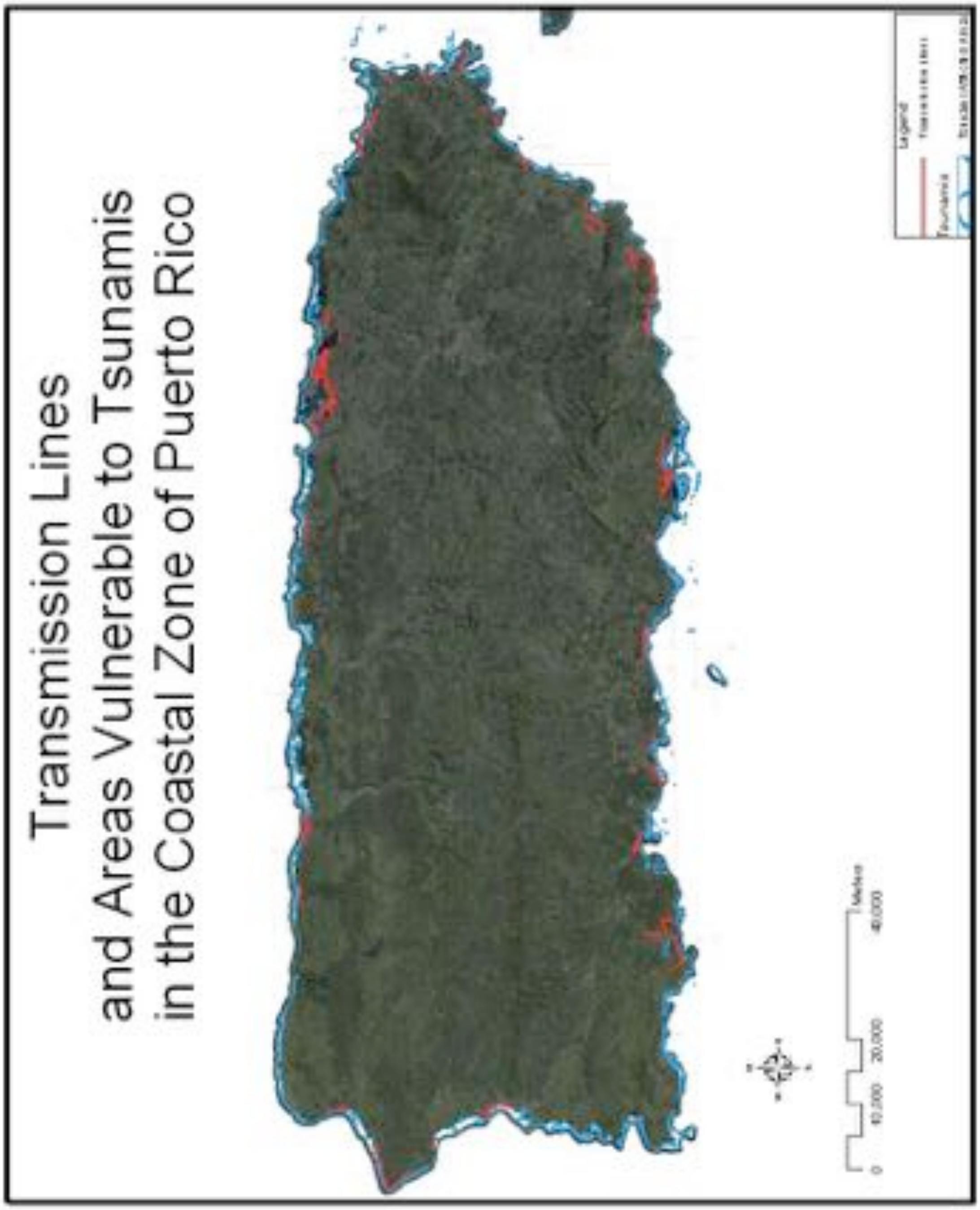

Figure 55: Transmission Lines and Tsunami Flood Zones

Water Treatment Plants

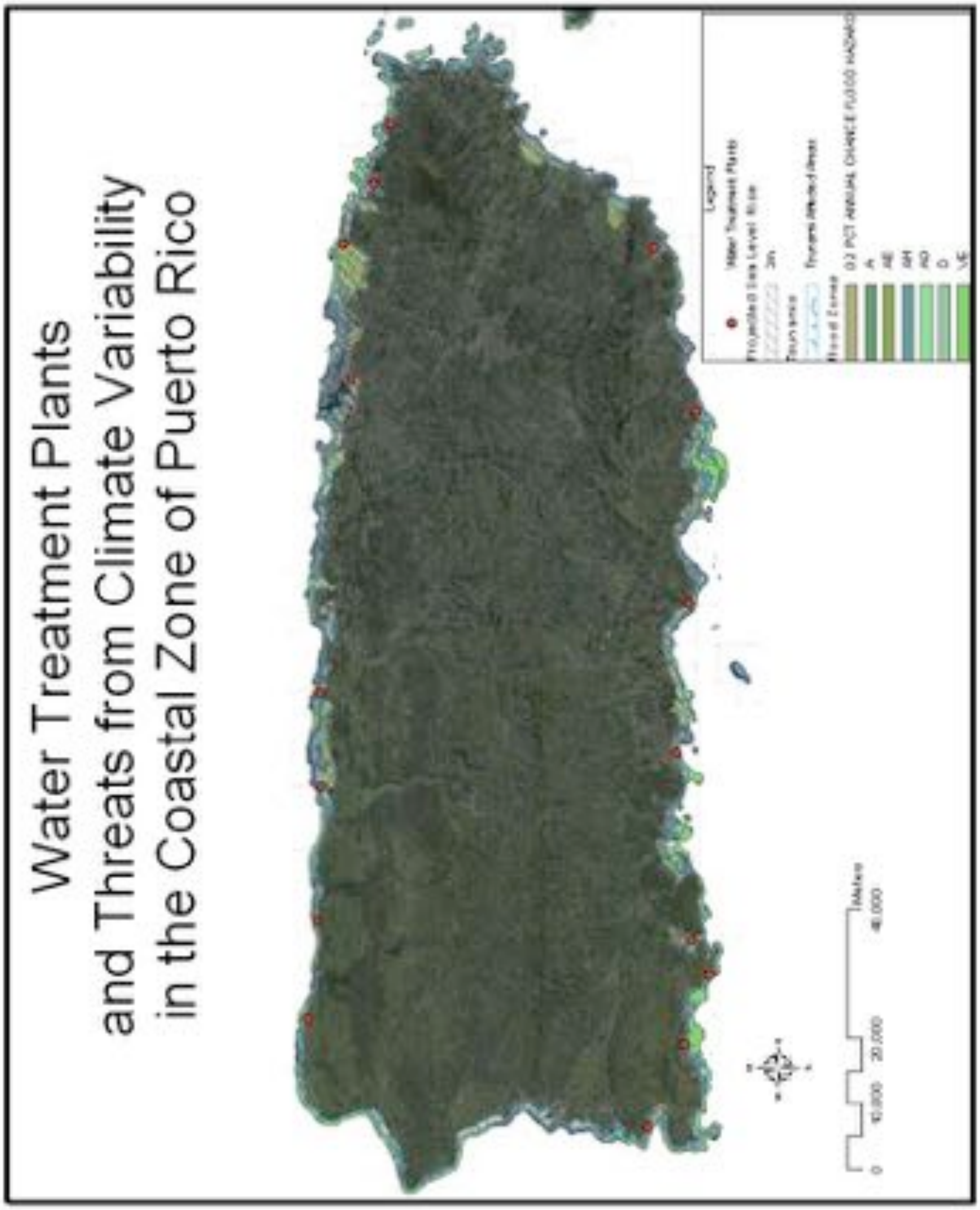

Figure 56: Water Treatment Plants and All Considered Threats

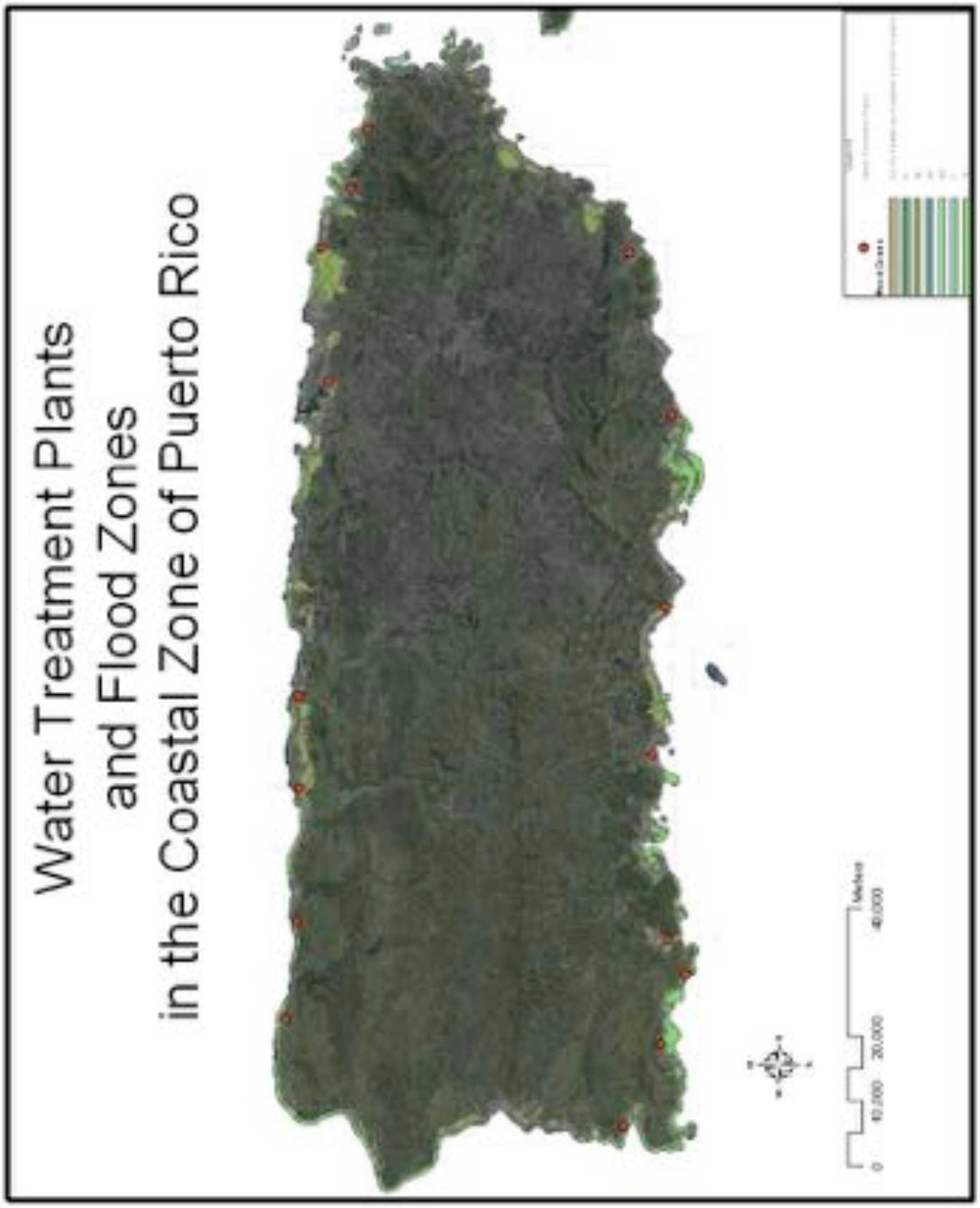

Figure 57: Water Treatment Plants and Flood Zones

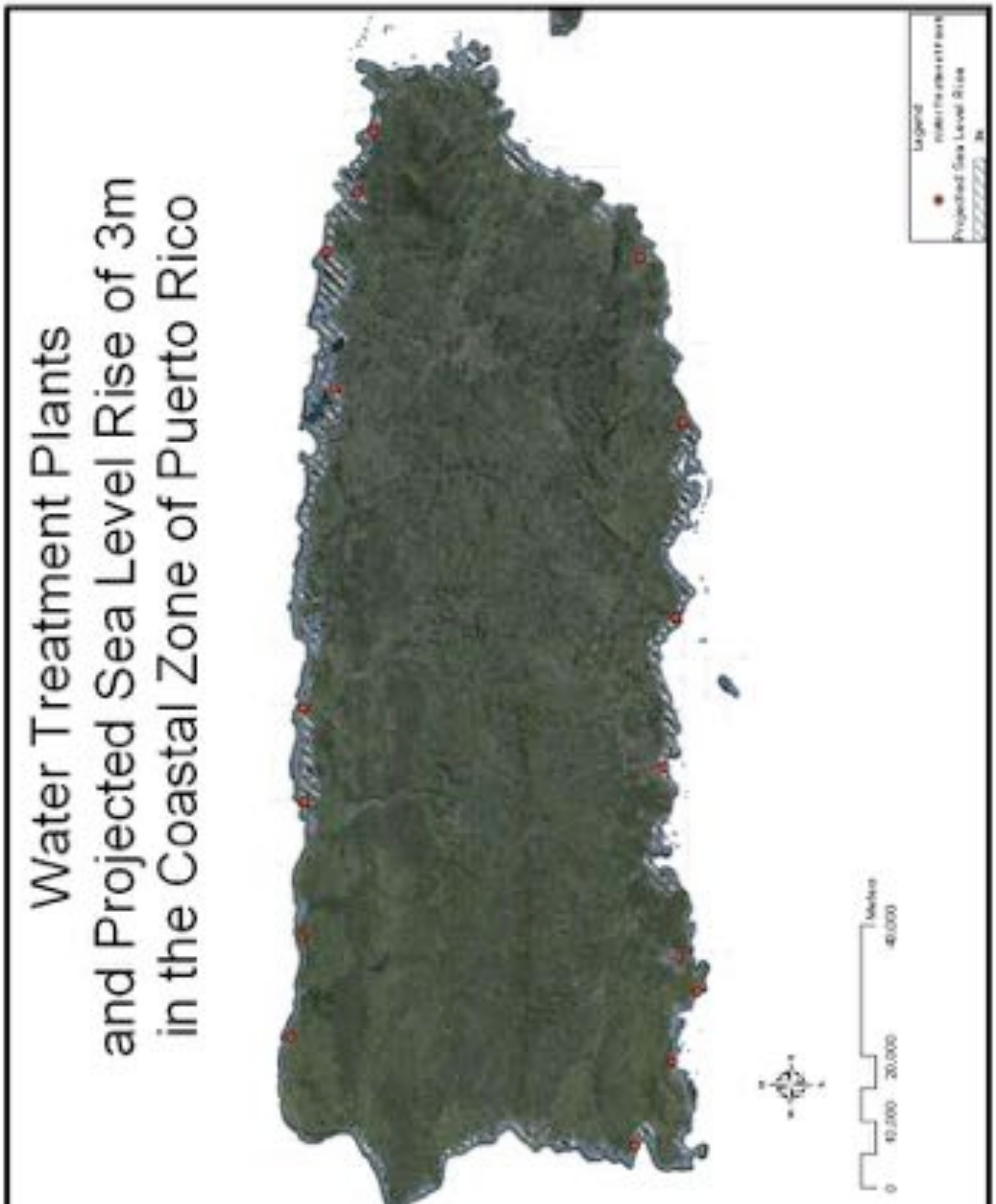

Figure 58: Water Treatment Plants and SLR

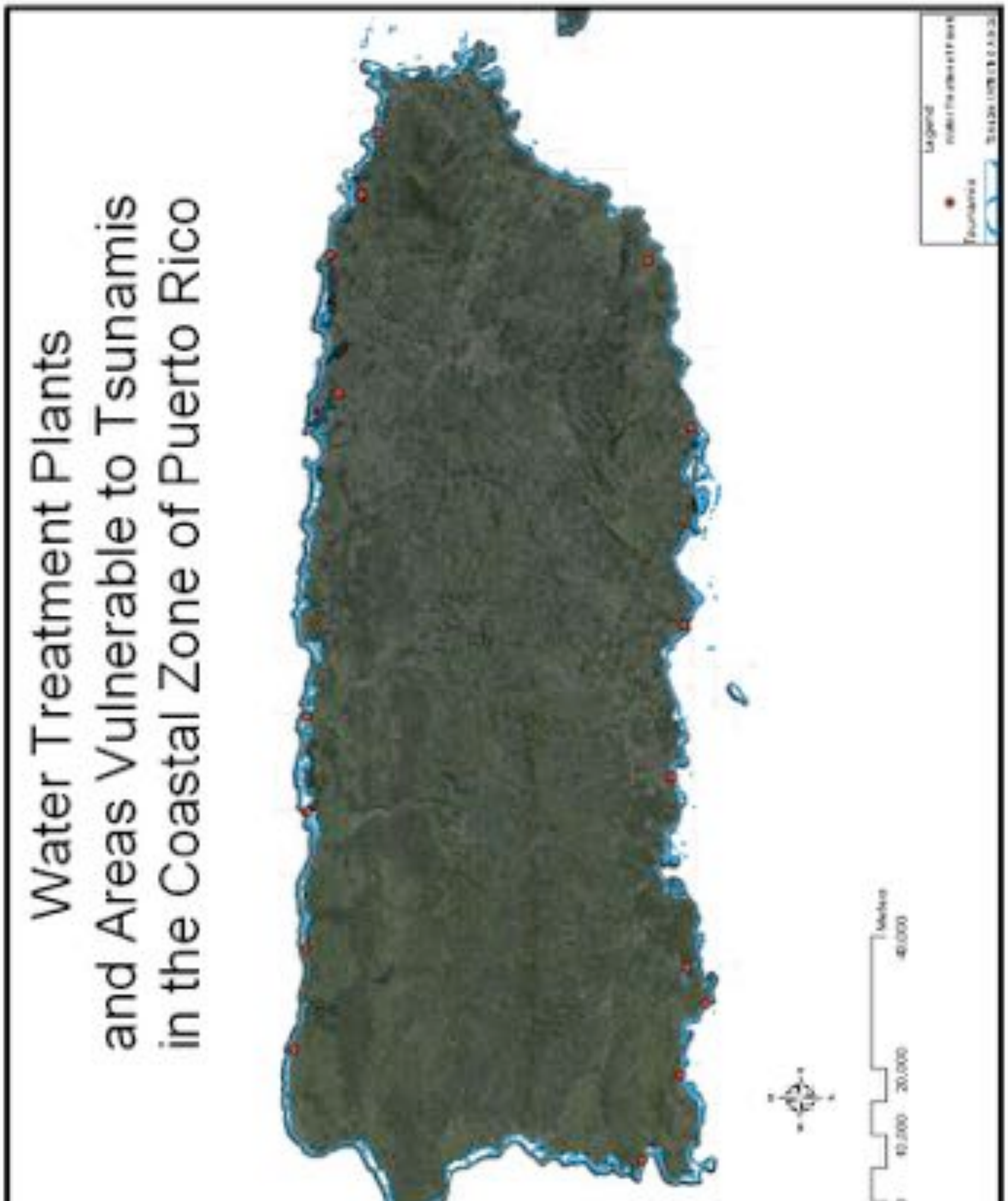

Figure 59: Water Treatment Plants and Tsunami Flood Zones

Infrastructure in Arecibo

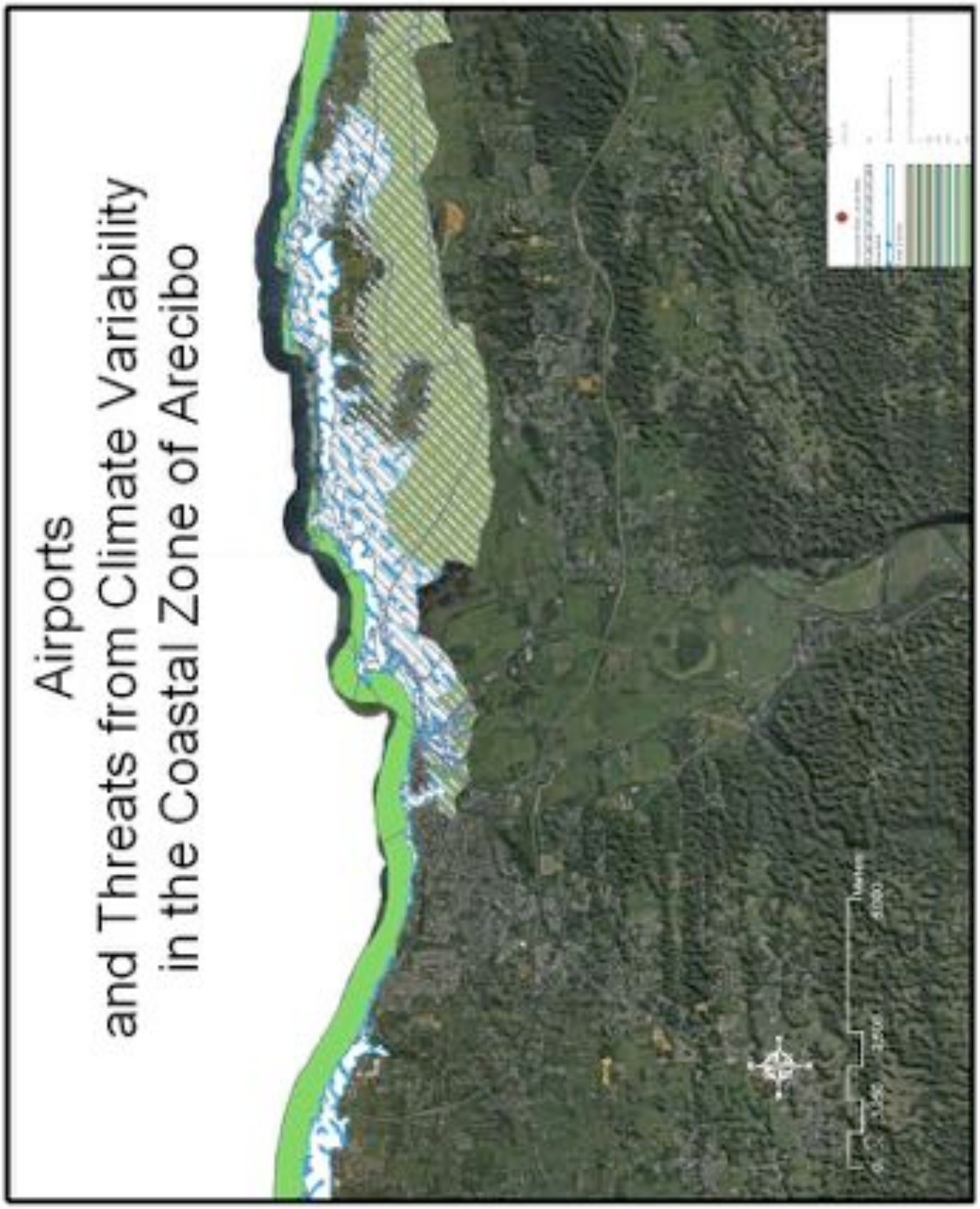

Figure 60: Airports in Arecibo

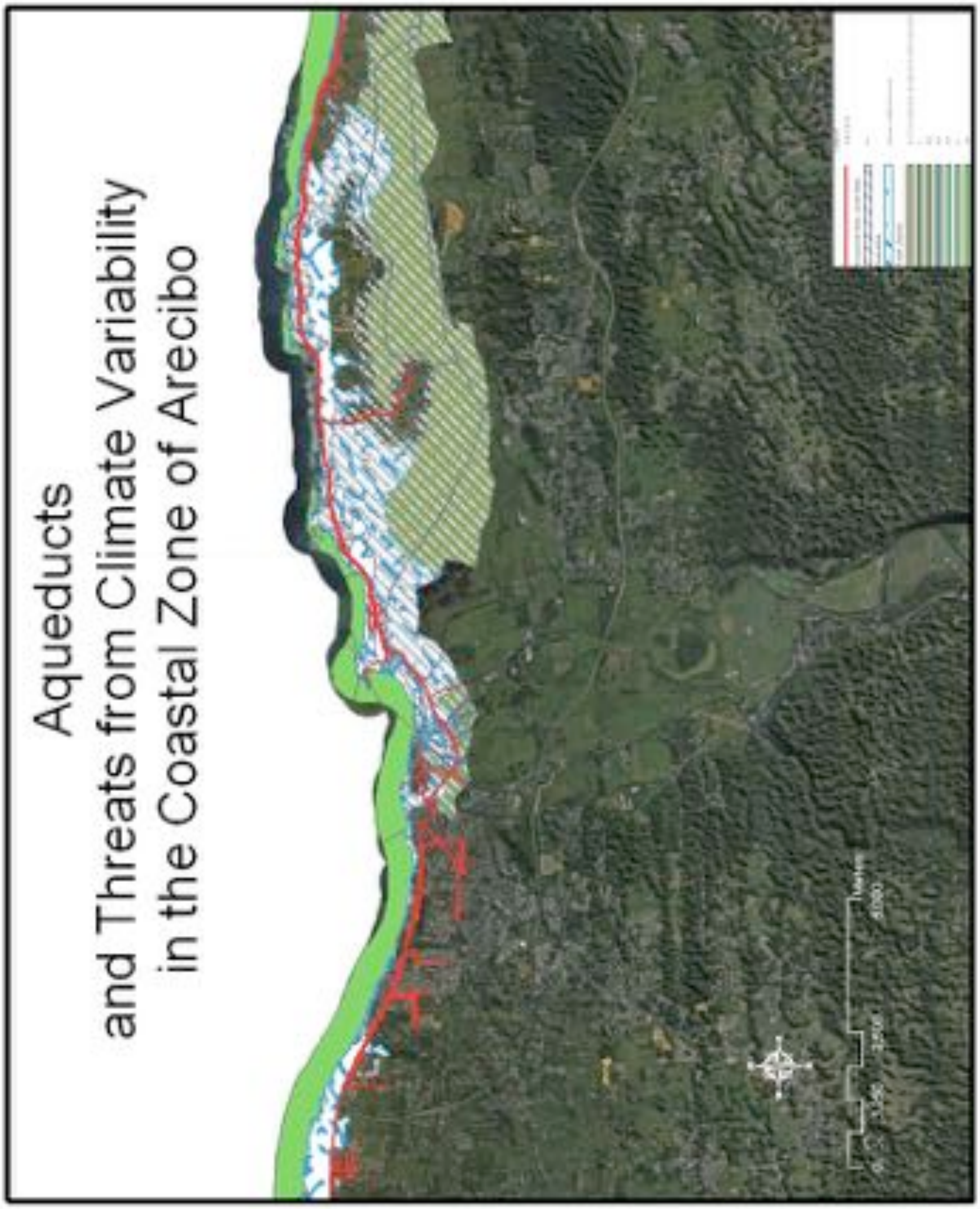

Figure 61: Aqueducts in Arecibo

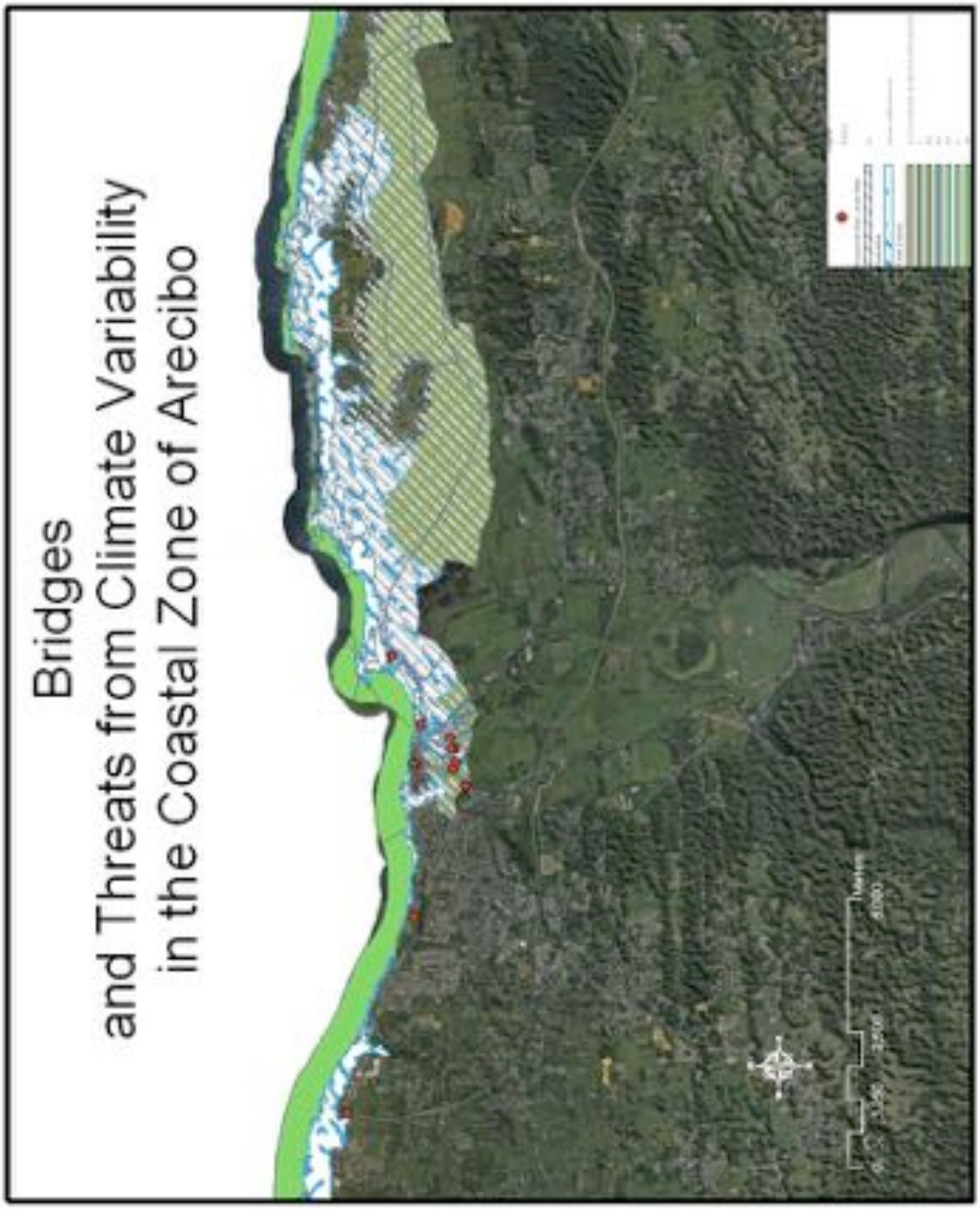

Figure 62: Bridges in Arecibo

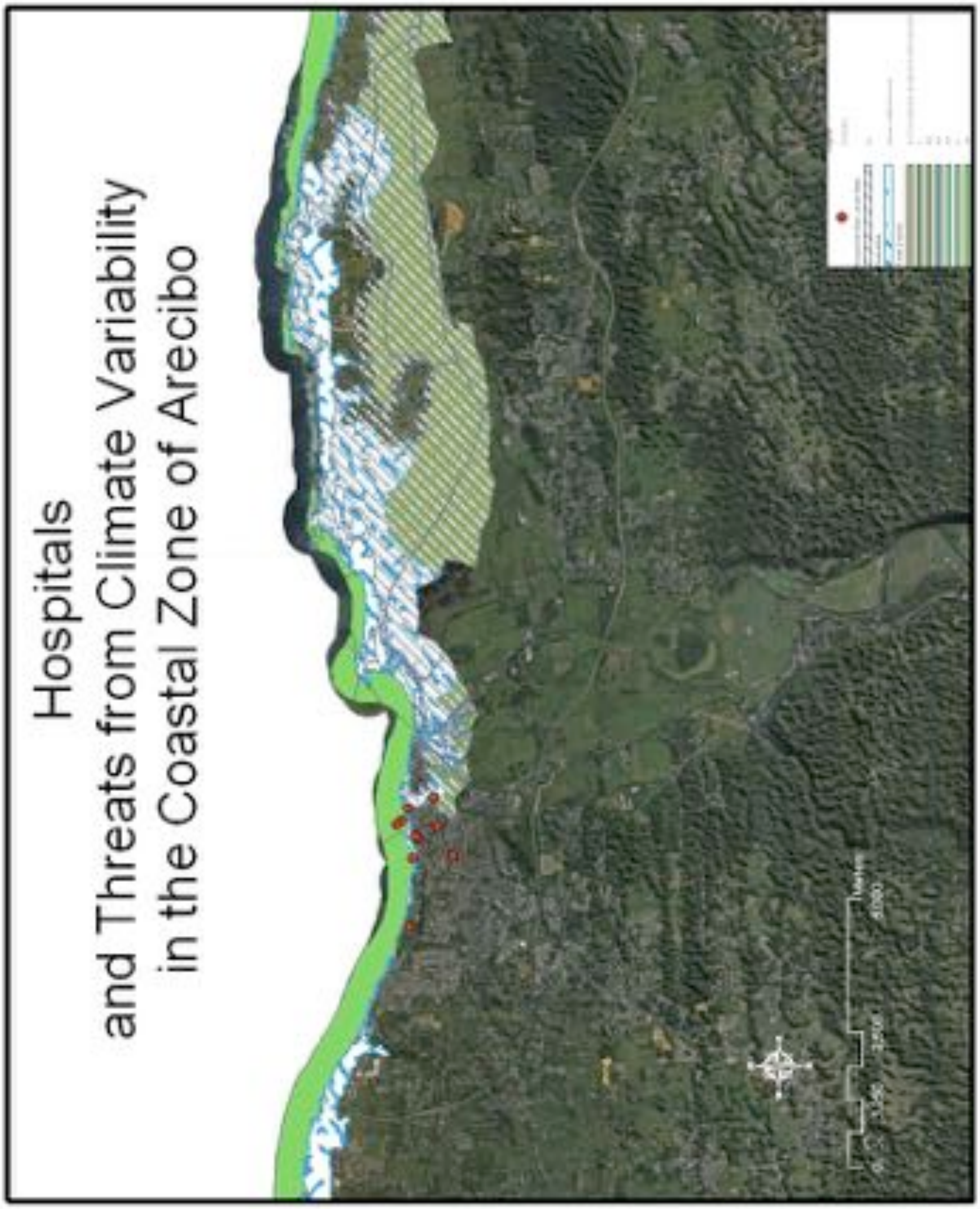

Figure 63: Hospitals in Arecibo

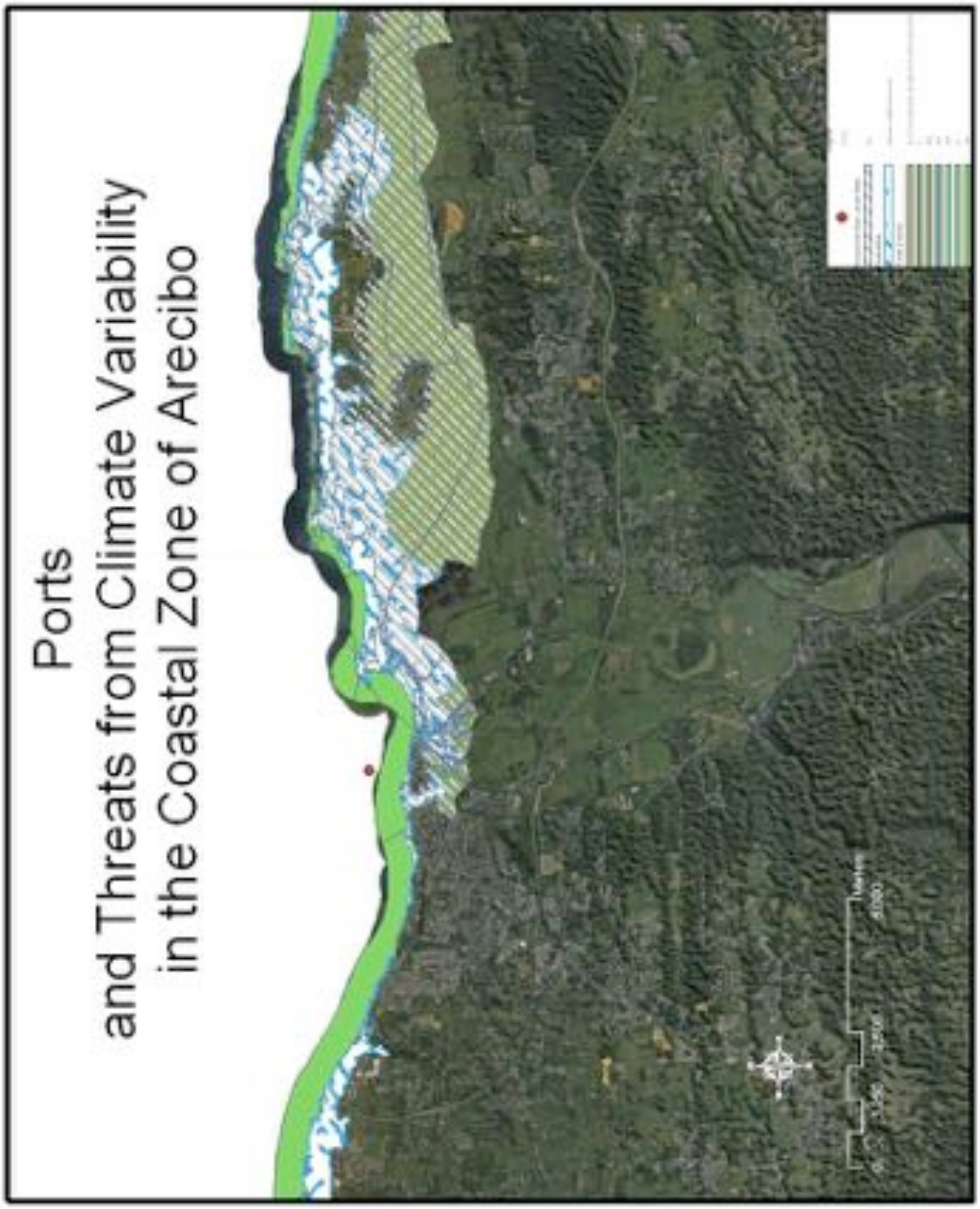

Figure 64: Seaports in Arecibo

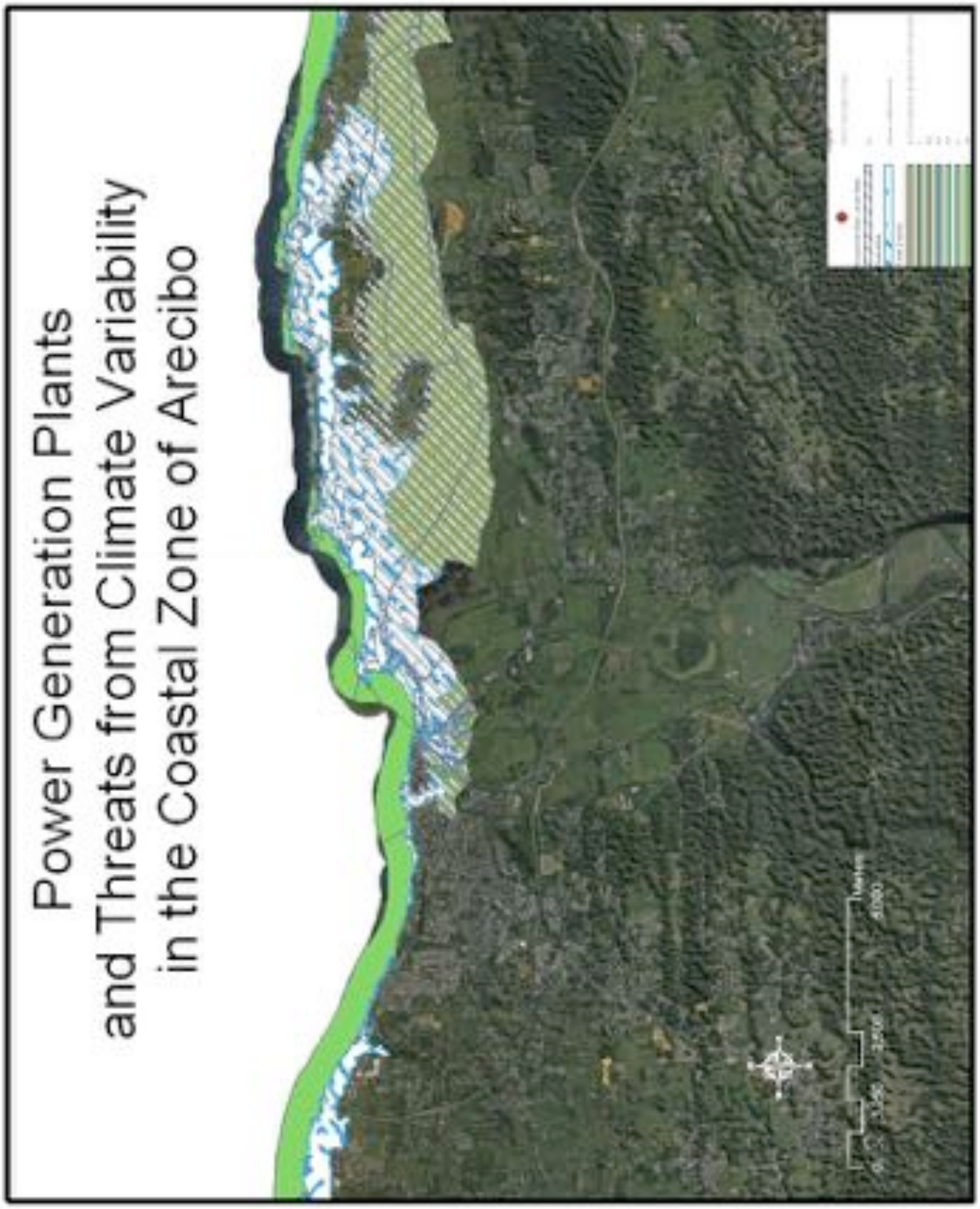

Figure 65: Power (Generation) Plants in Arecibo

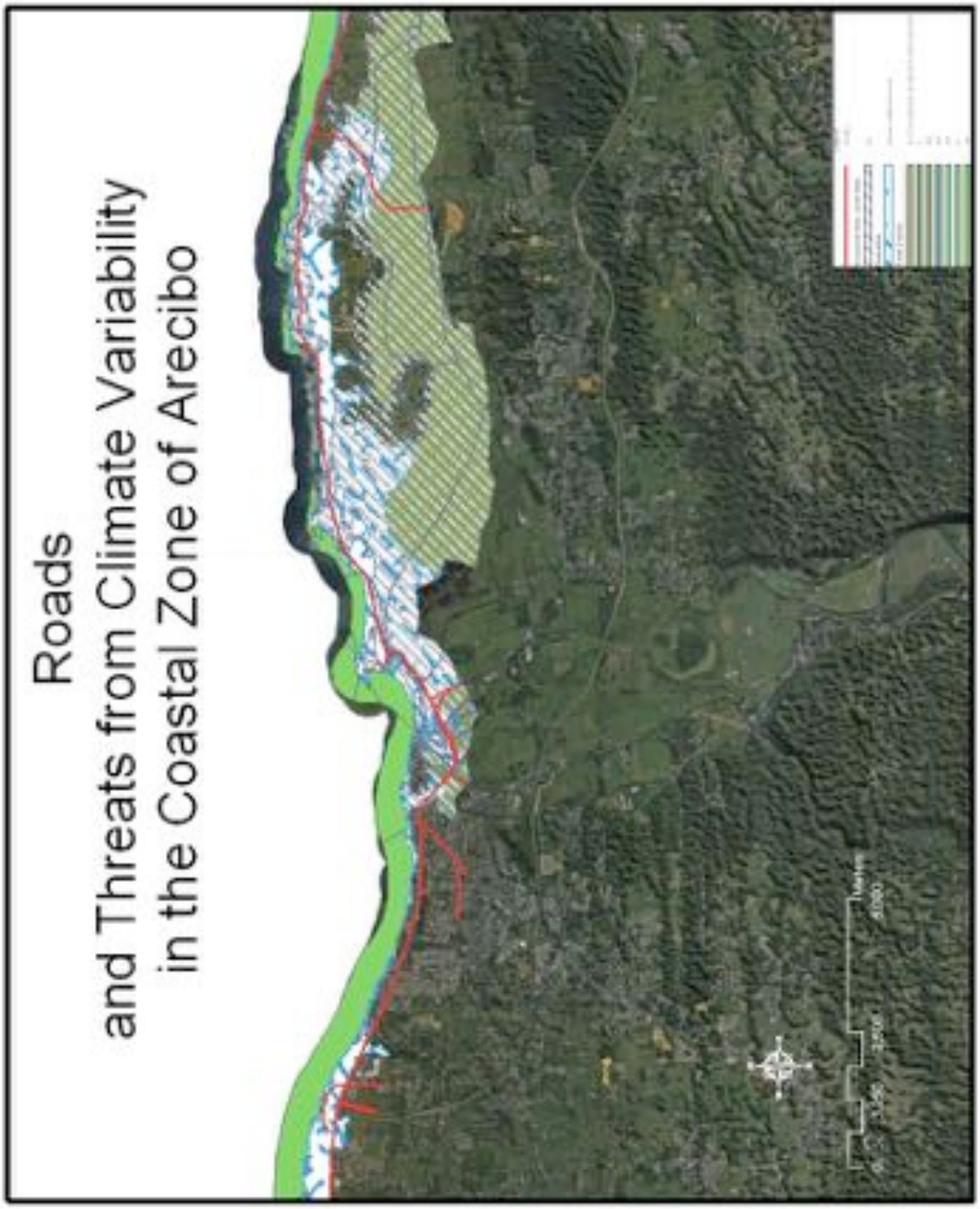

Figure 66: Roads in Arecibo

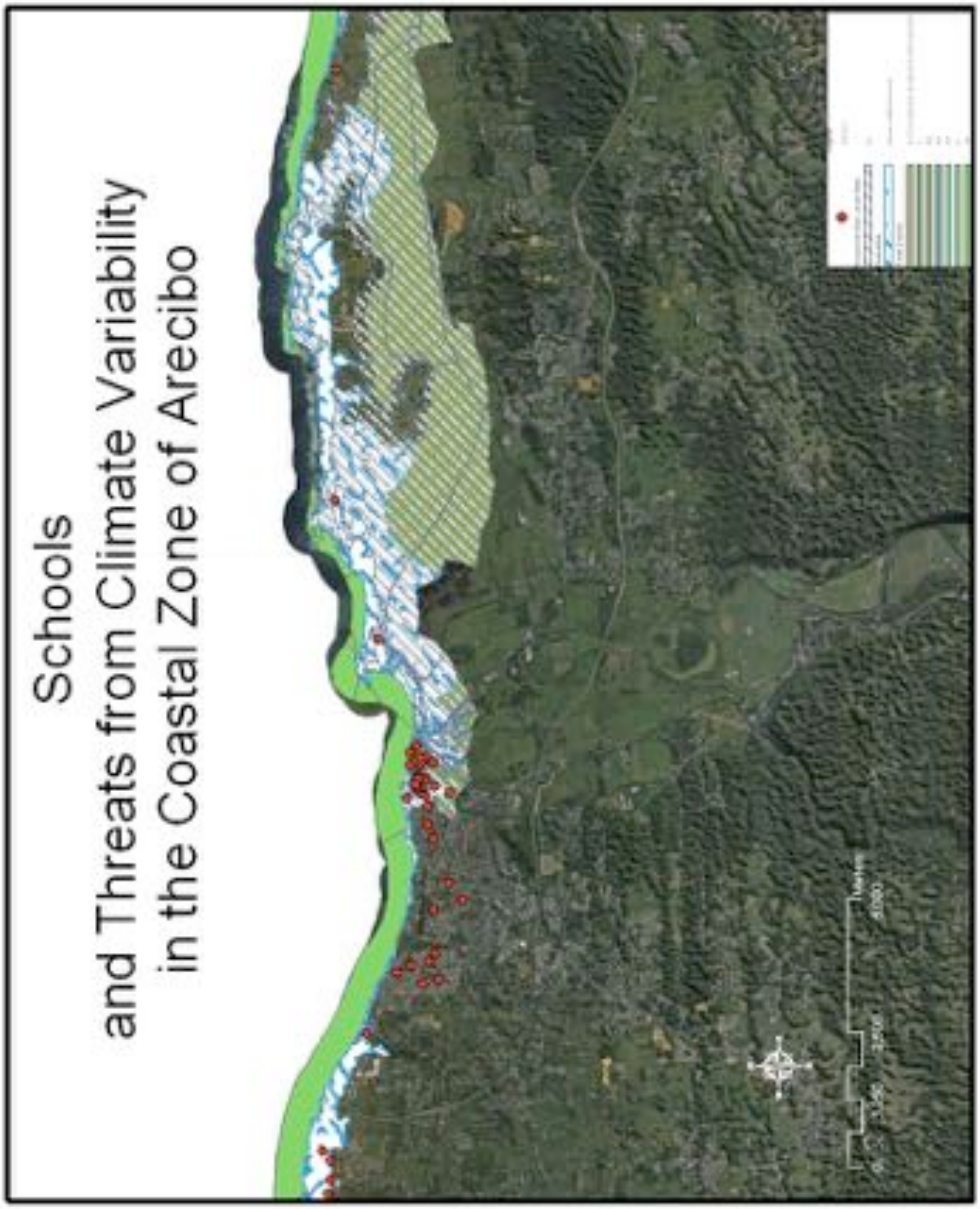

Figure 67: Schools in Arecibo

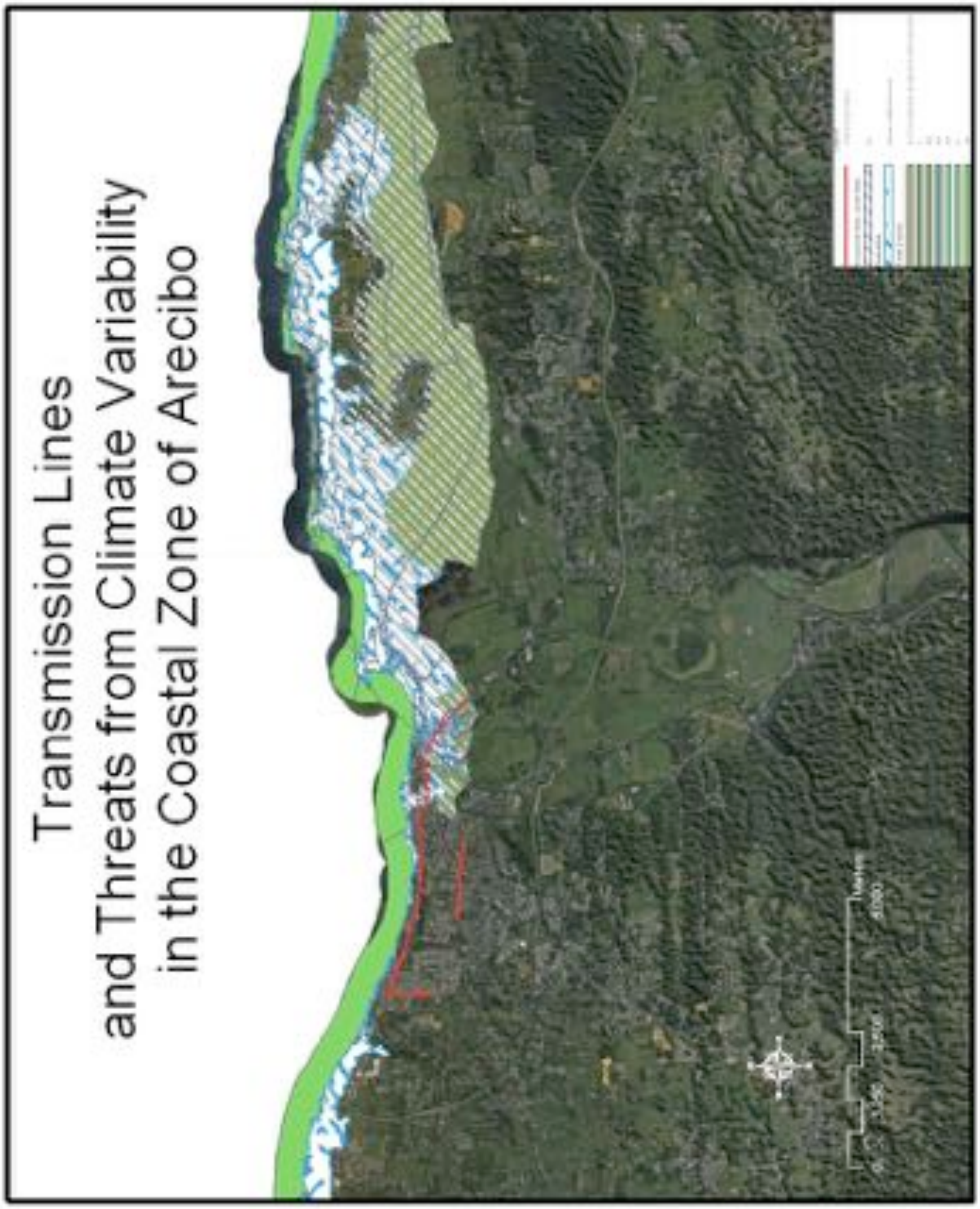

Figure 68: Transmission Lines in Arecibo

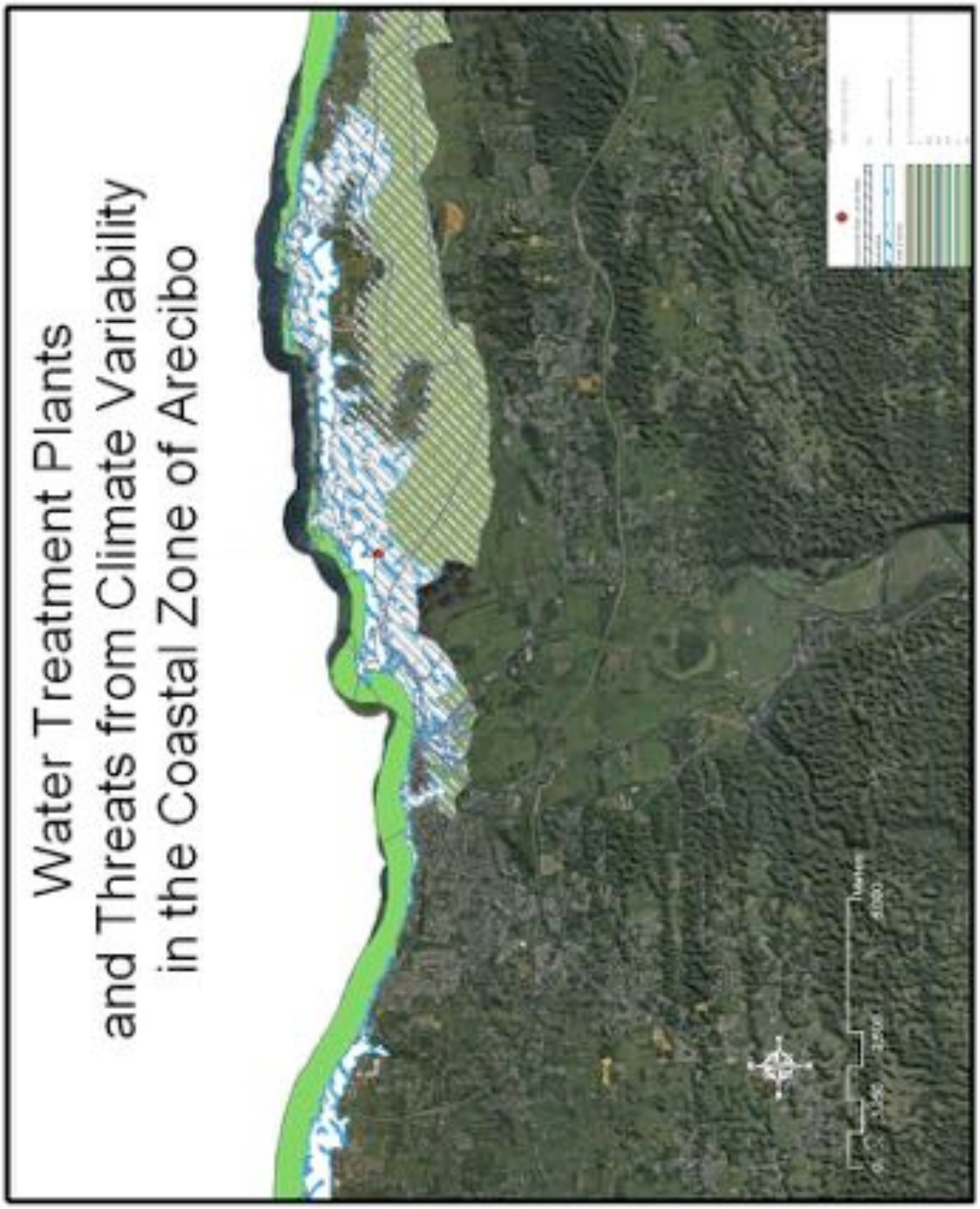

Figure 69: Water Treatment Plants in Arecibo

Infrastructure in Fajardo

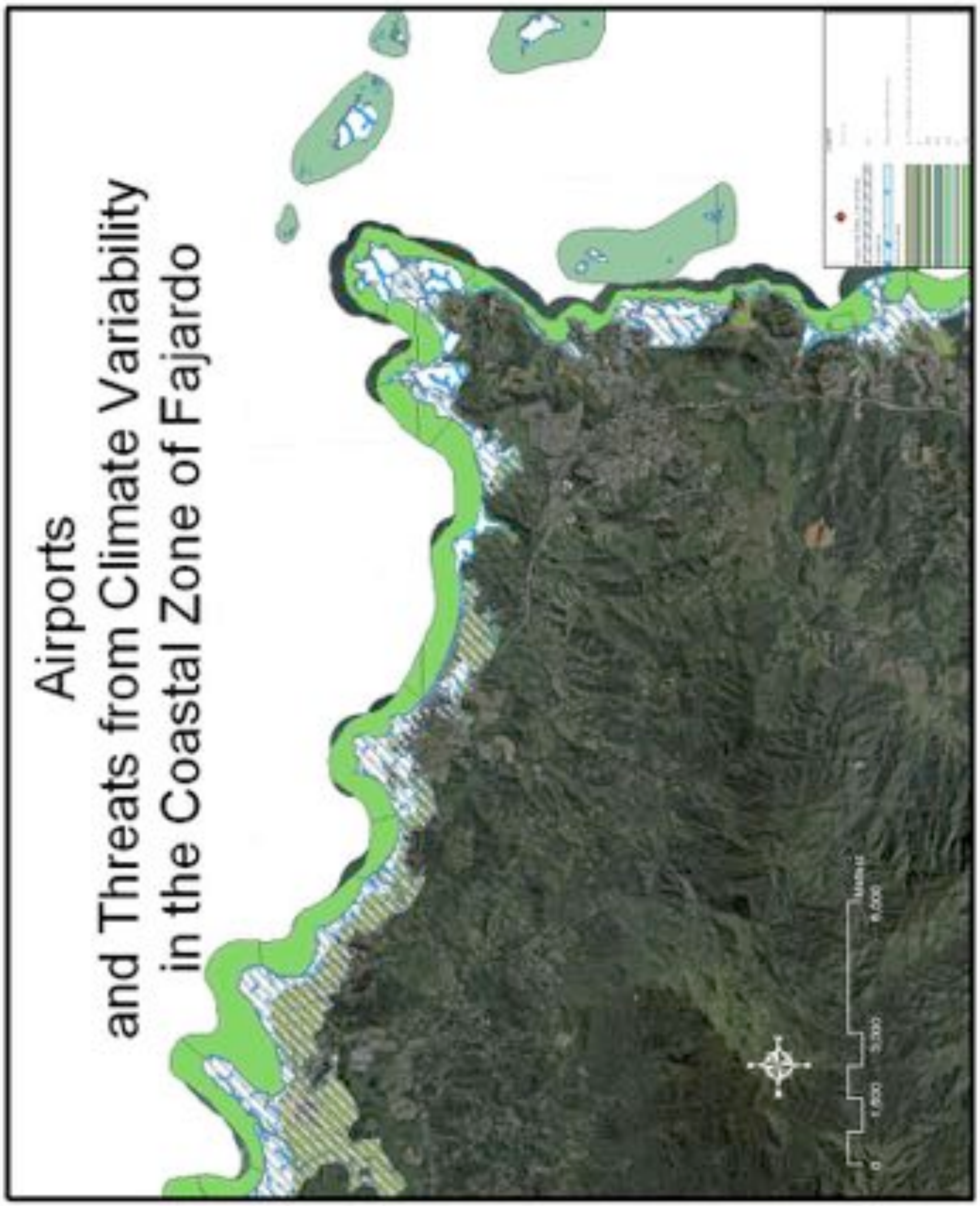

Figure 70: Airports in Fajardo

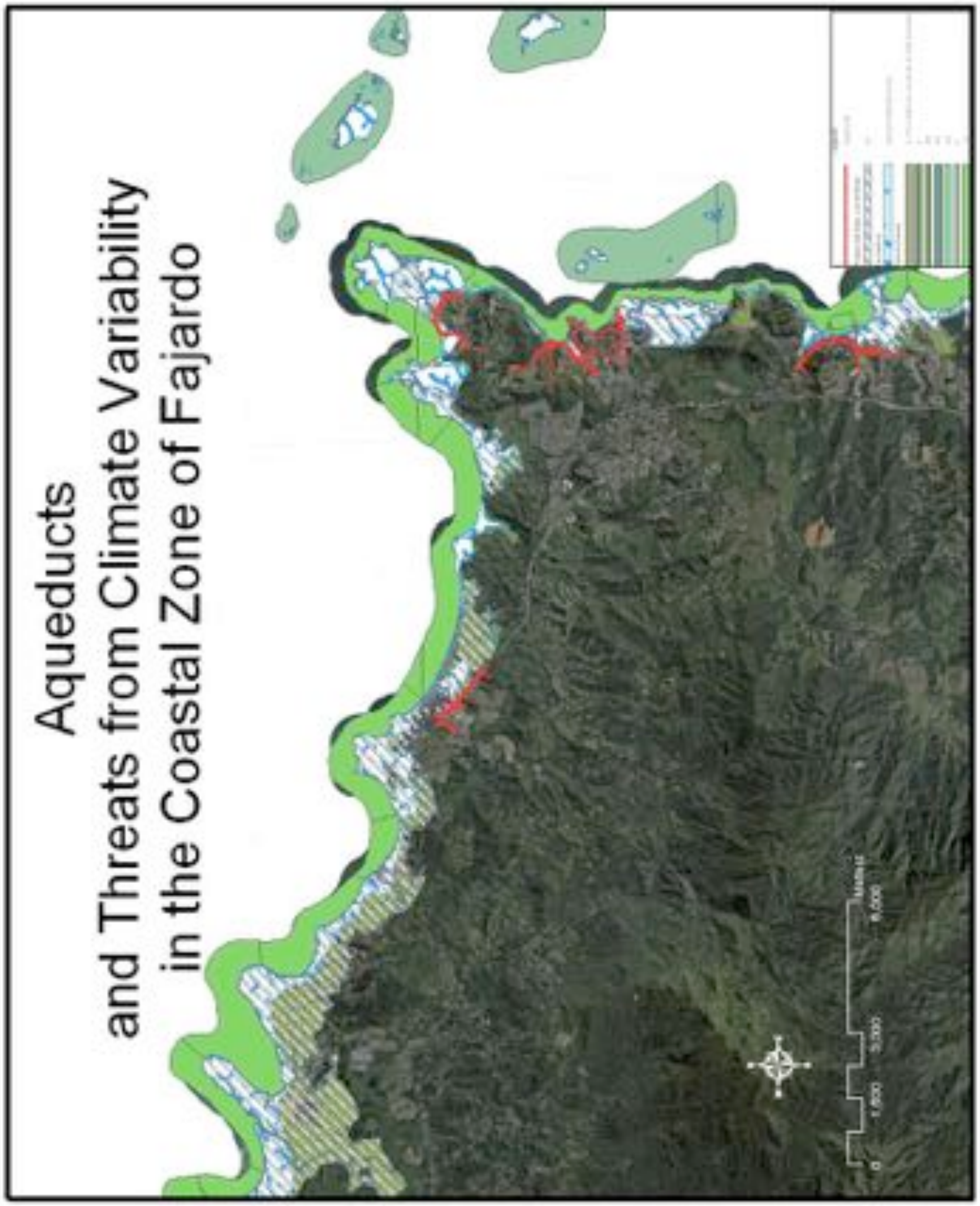

Figure 71: Aqueducts in Fajardo

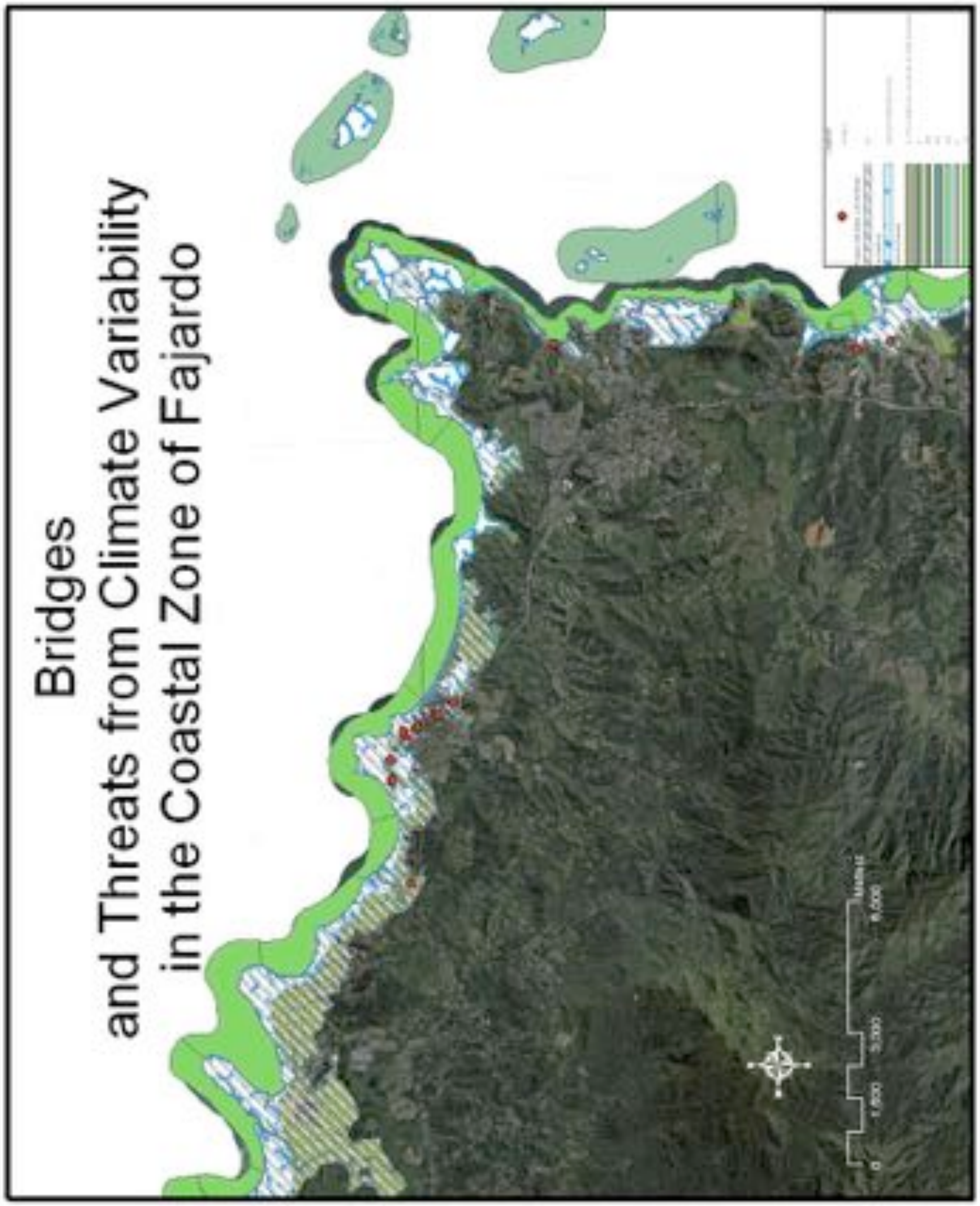

Figure 72: Bridges in Fajardo

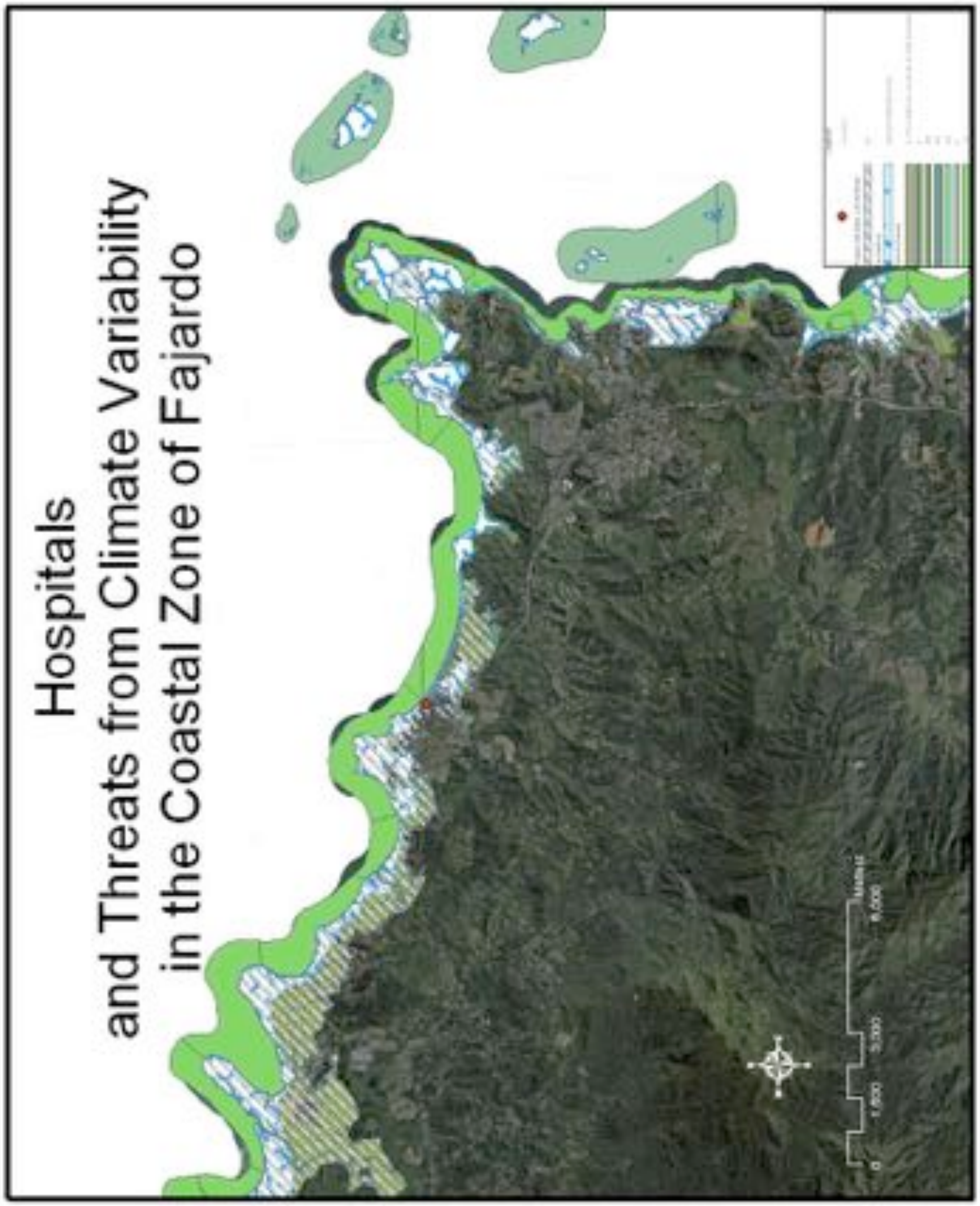

Figure 73: Hospitals in Fajardo

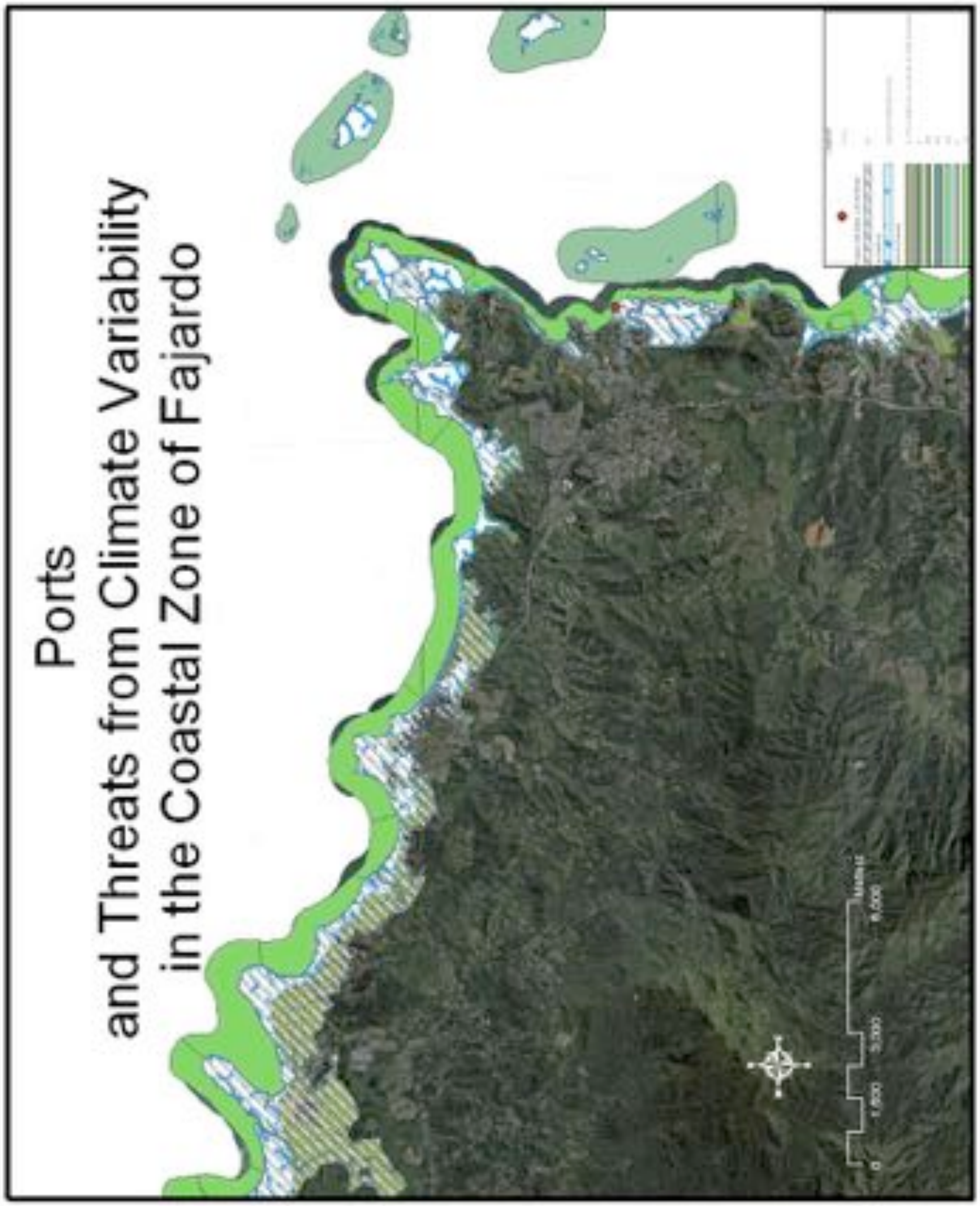

Figure 74: Seaports in Fajardo

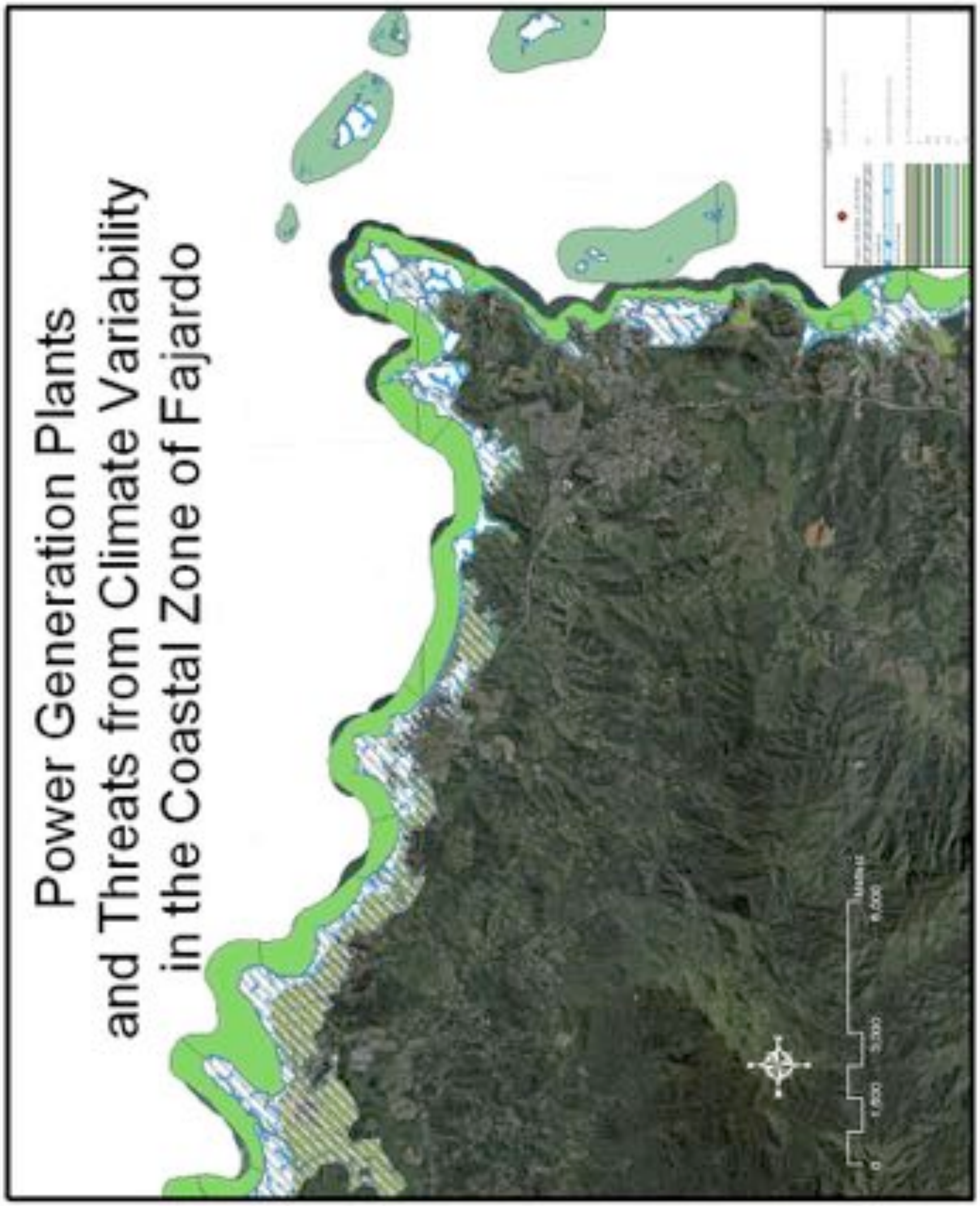

Figure 75: Power (Generation) Plants in Fajardo

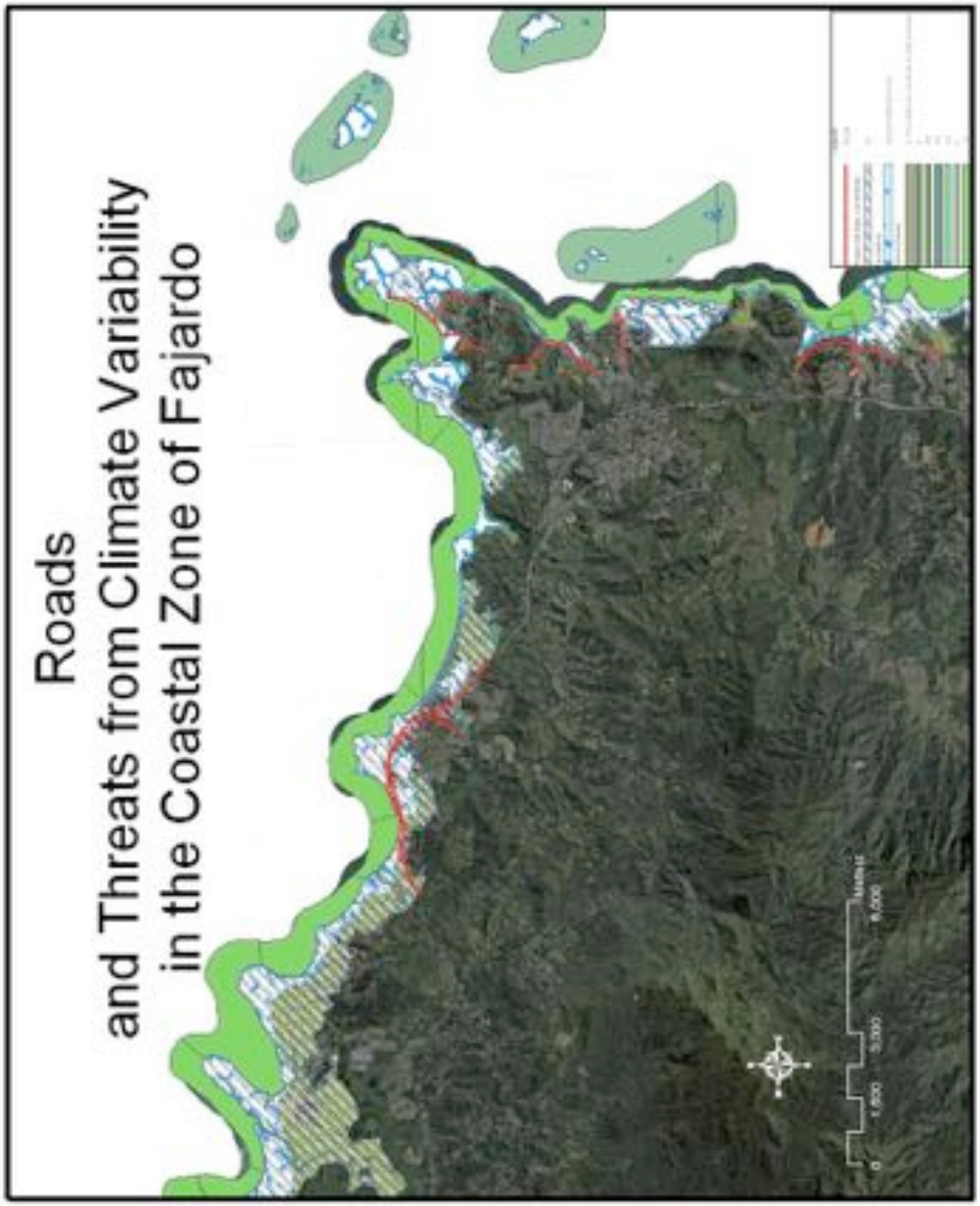

Figure 76: Roads in Fajardo

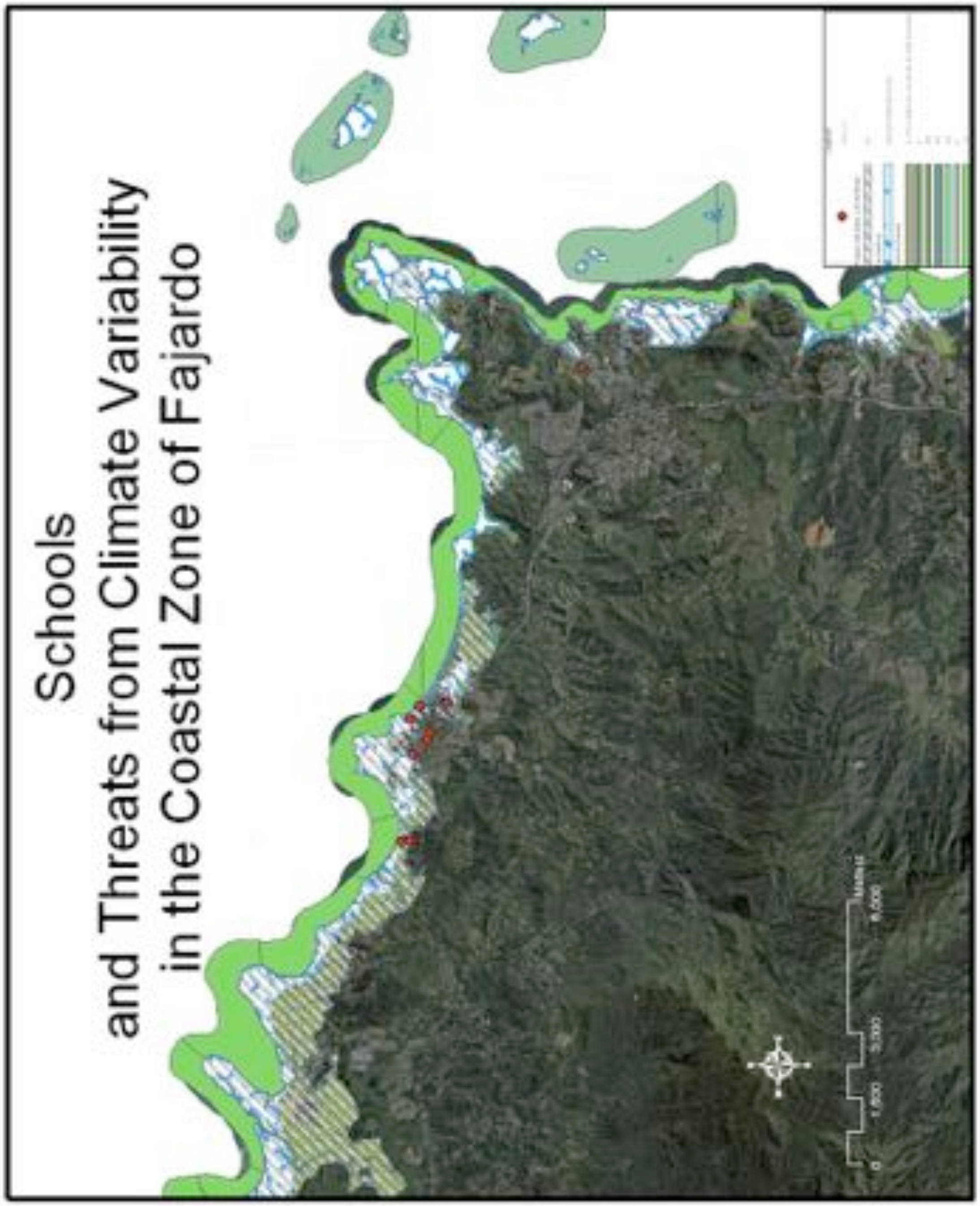

Figure 77: Schools in Fajardo

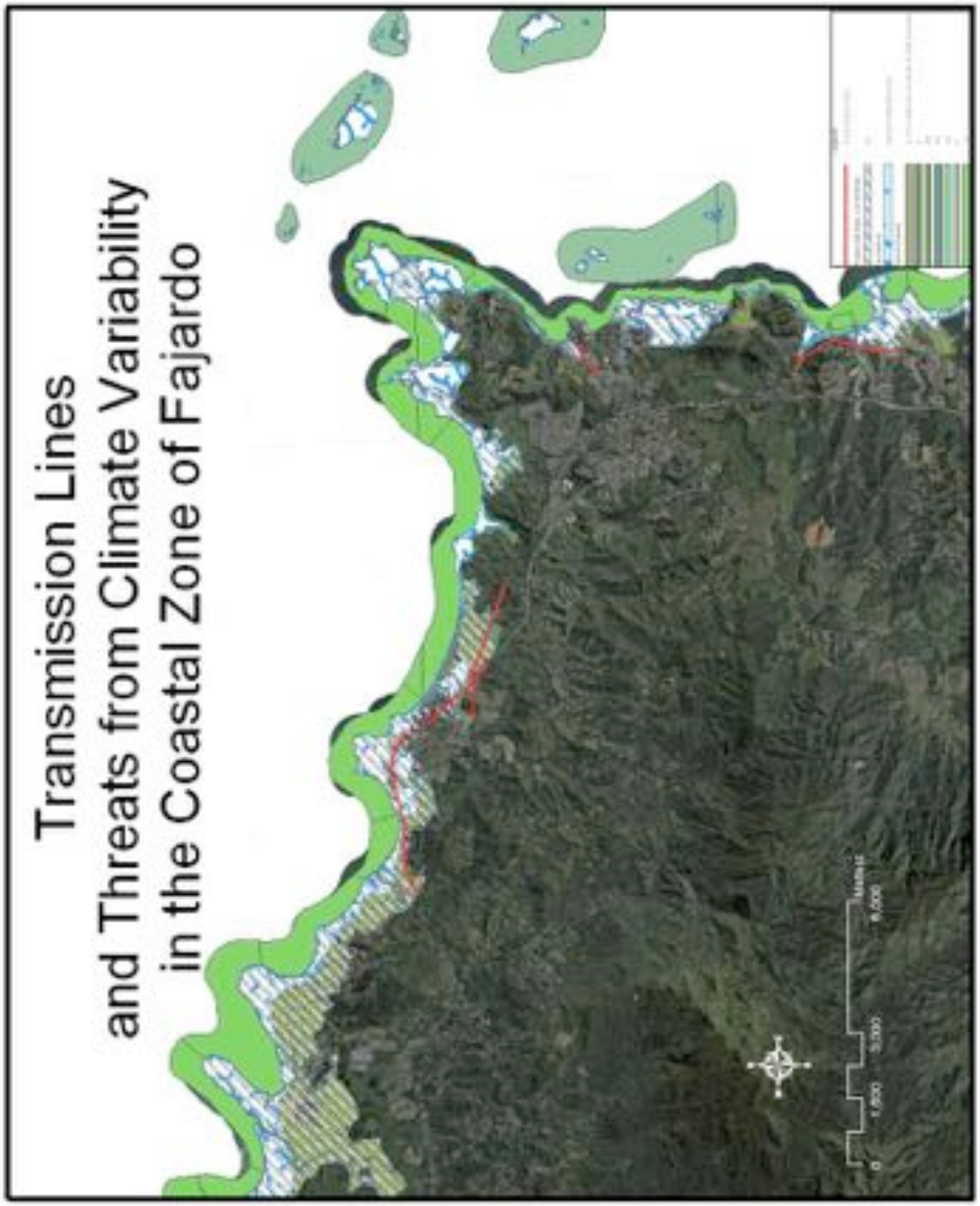

Figure 78: Transmission Lines in Fajardo

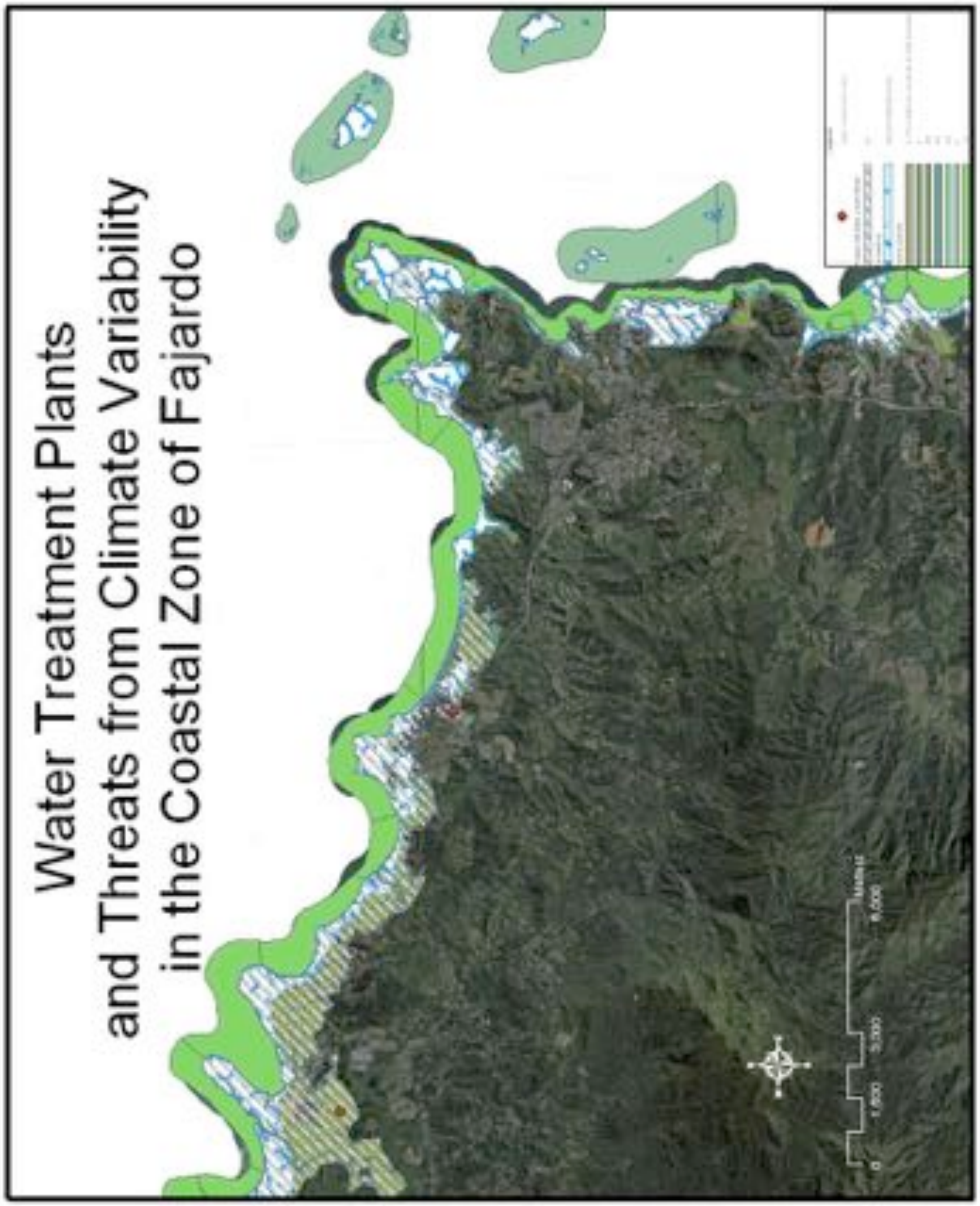

Figure 79: Water Treatment Plants in Fajardo

Infrastructure in Mayaguez

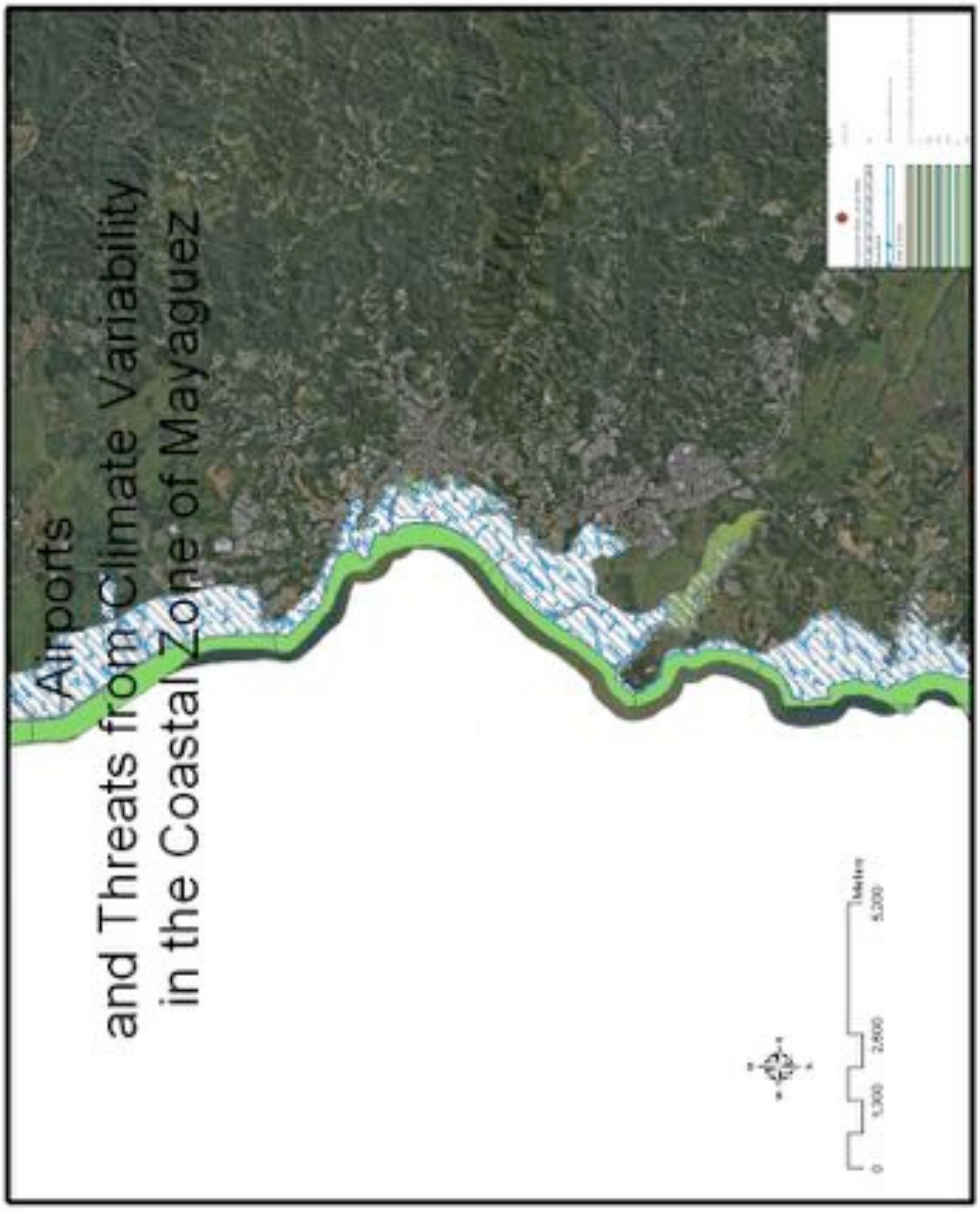

Figure 80: Airports in Mayaguez

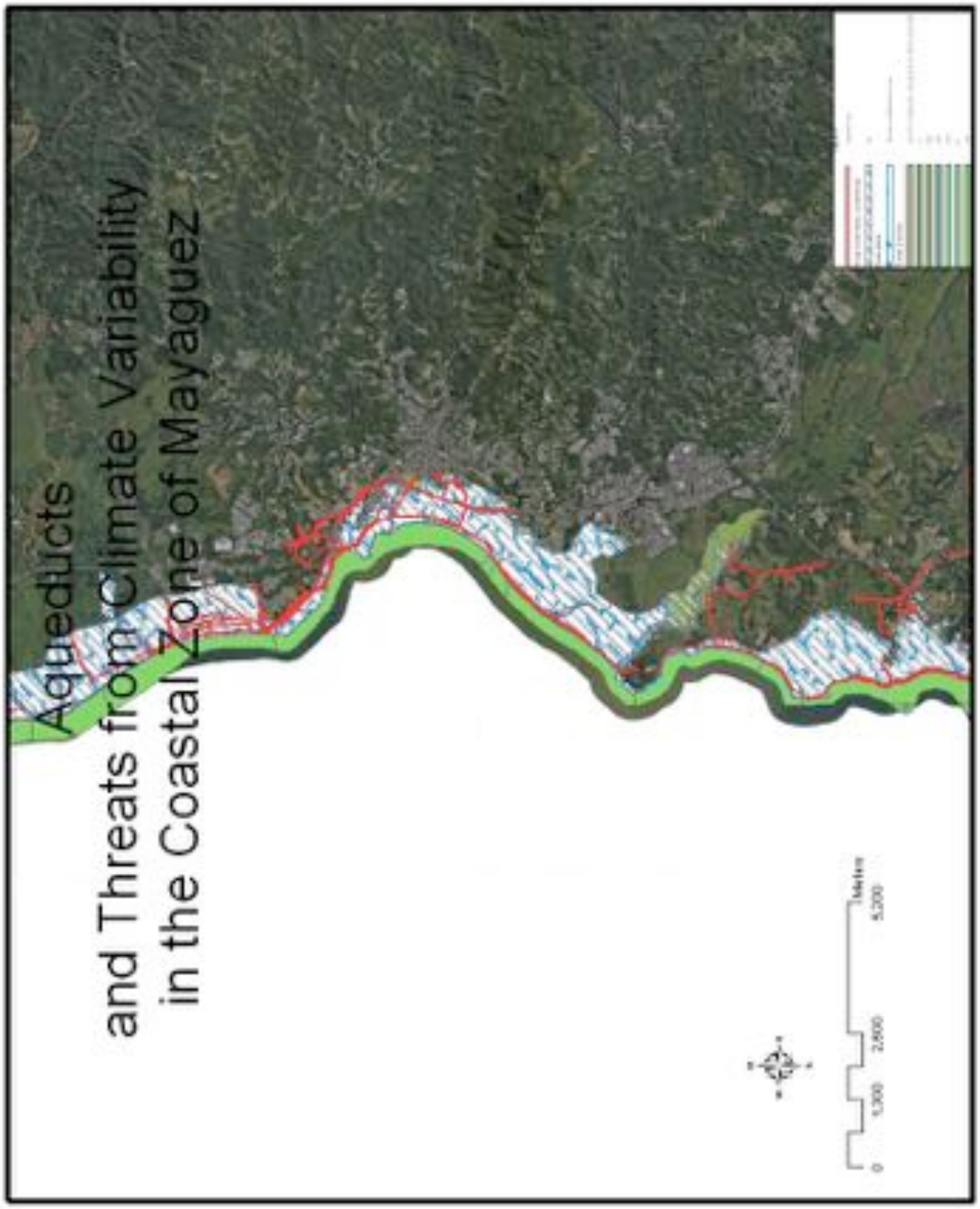

Figure 81: Aqueducts in Mayaguez

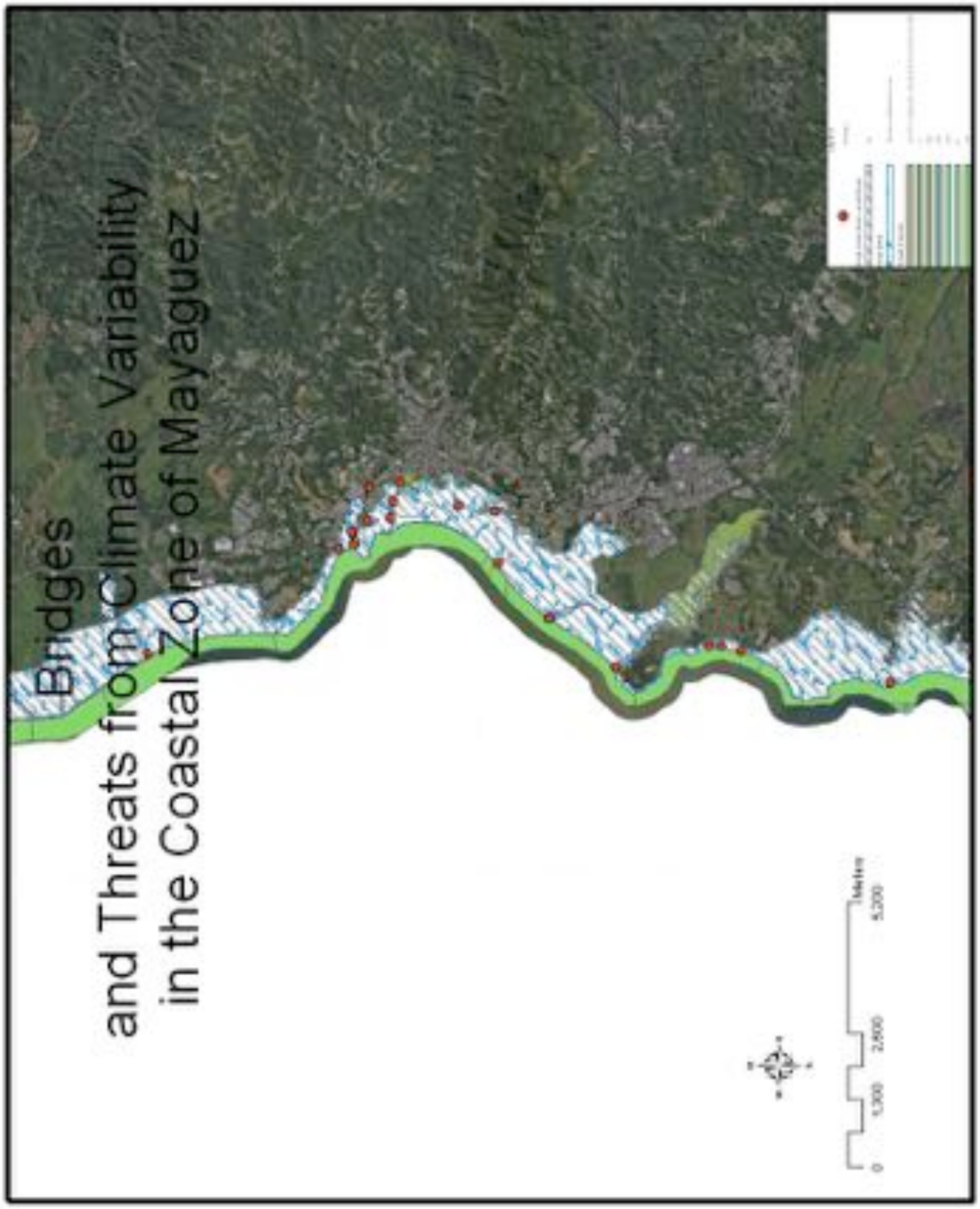

Figure 82: Bridges in Mayaguez

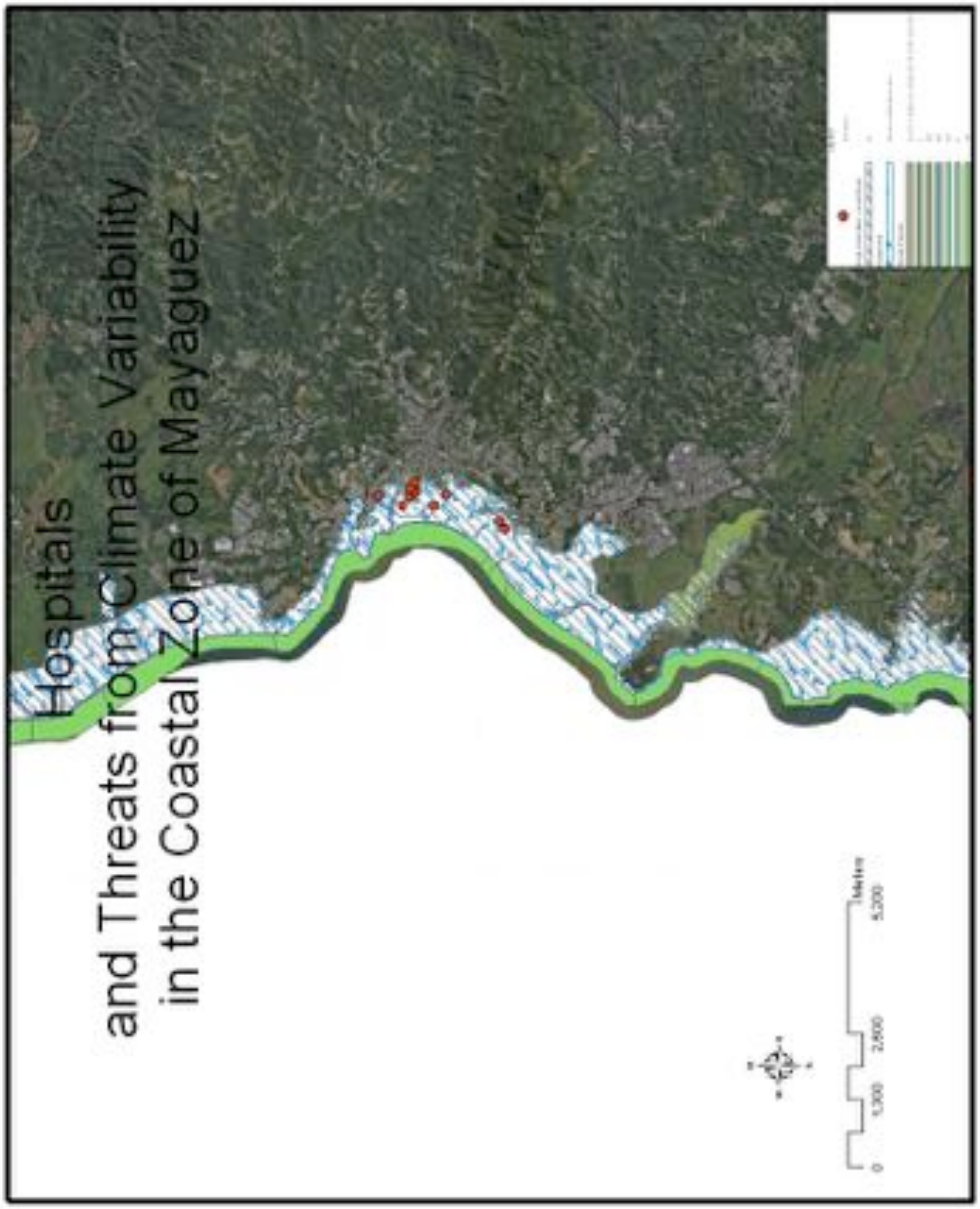

Figure 83: Hospitals in Mayaguez

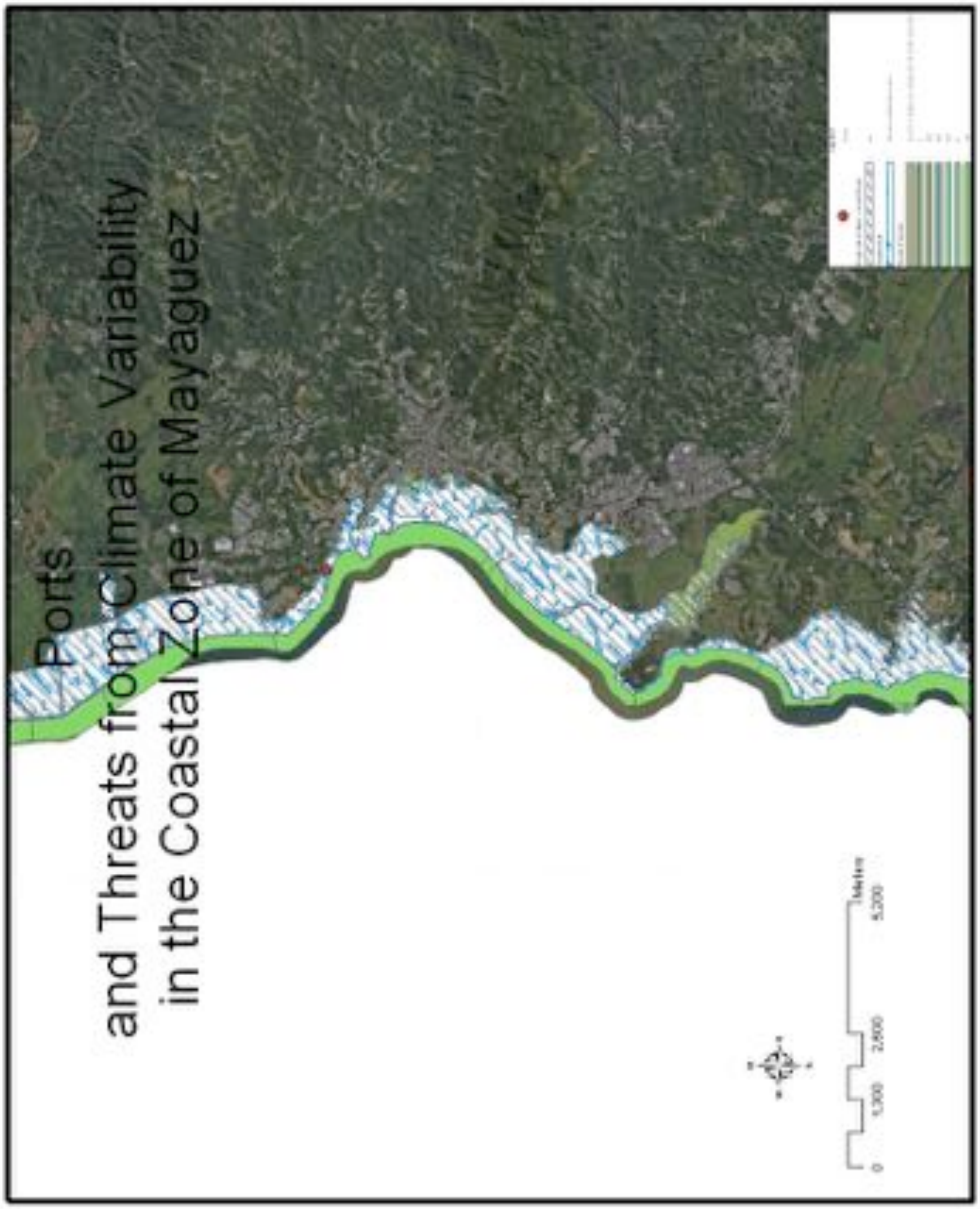

Figure 84: Seaports in Mayaguez

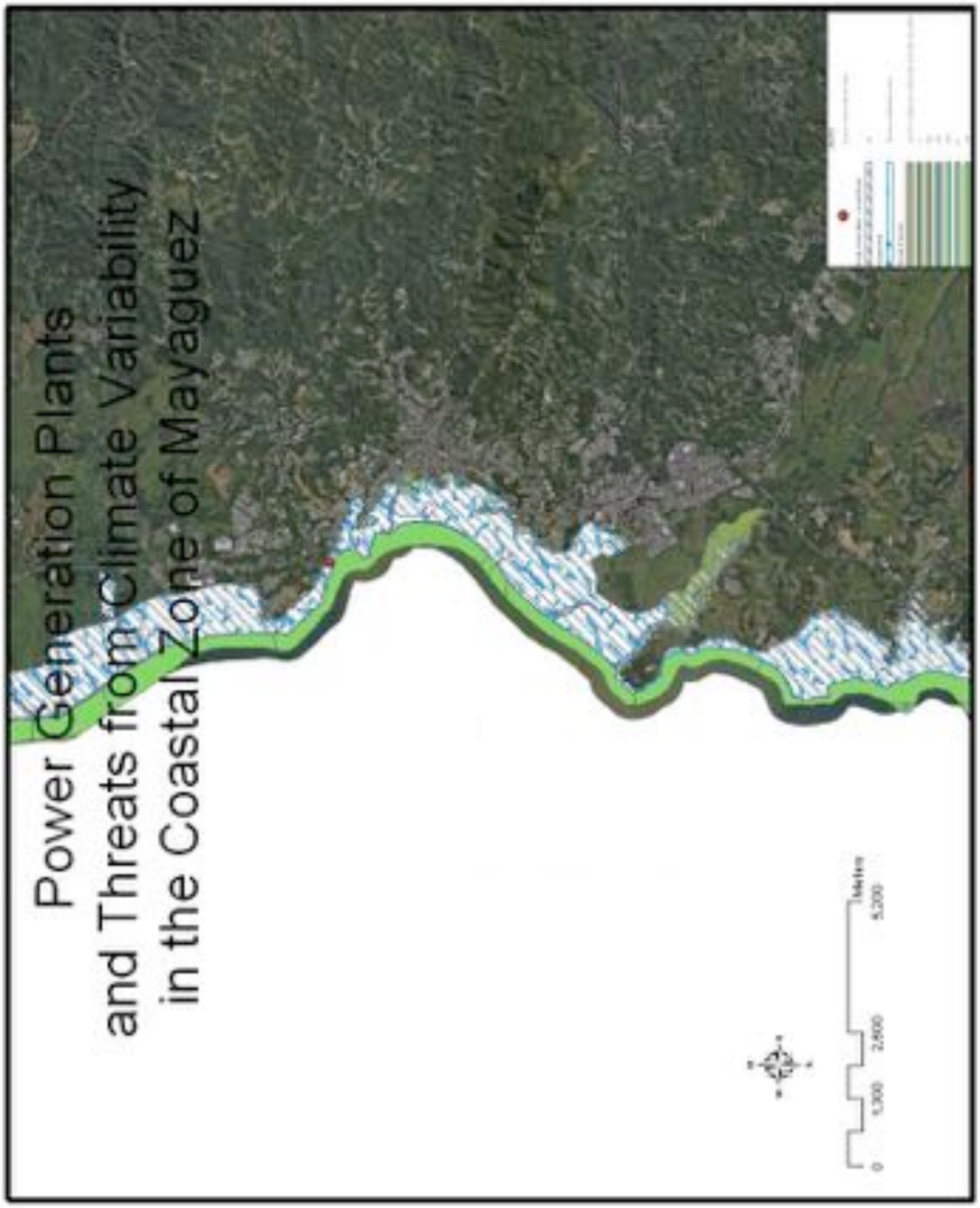

Figure 85: Power (Generation) Plants in Mayaguez

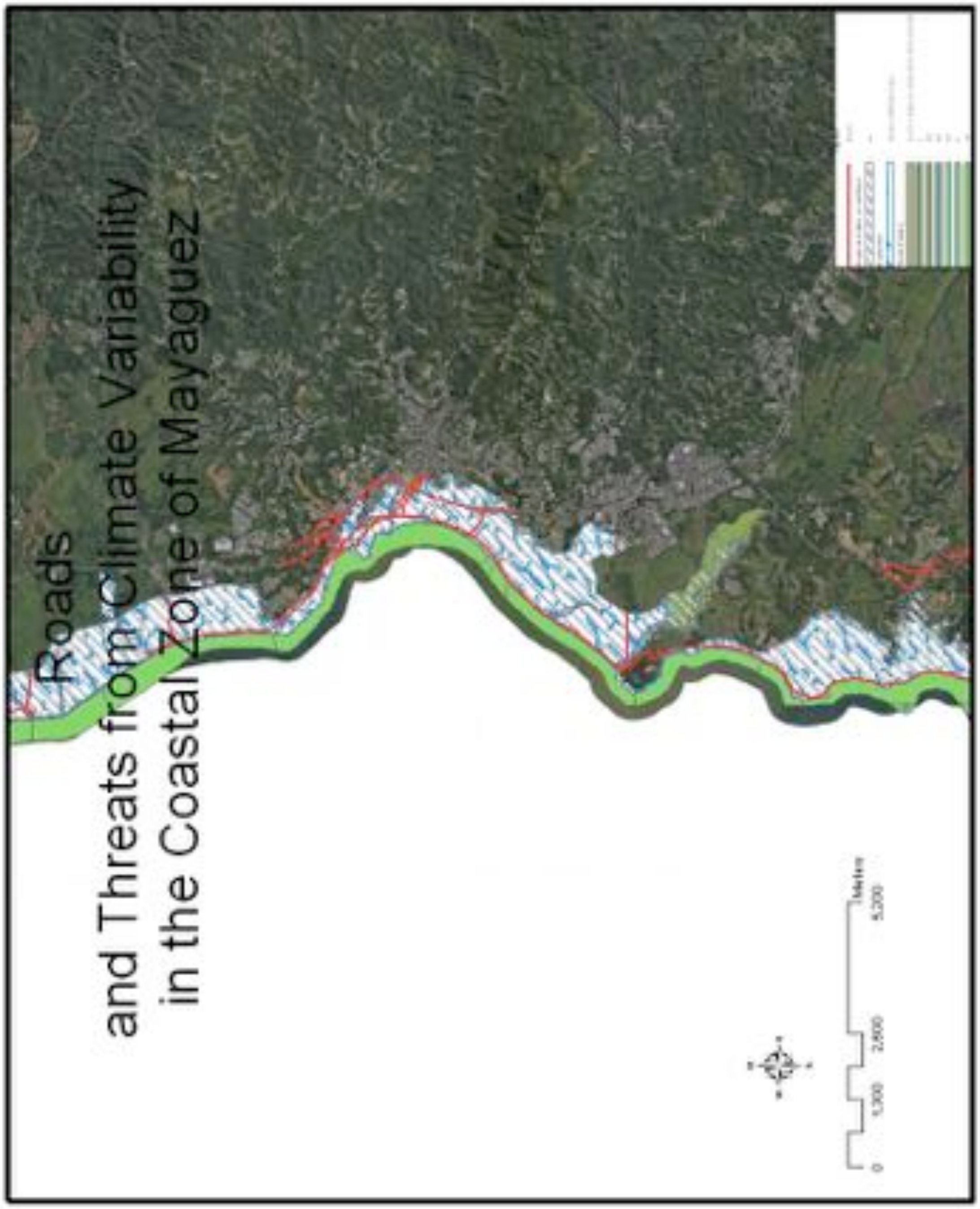

Figure 86: Roads in Mayaguez

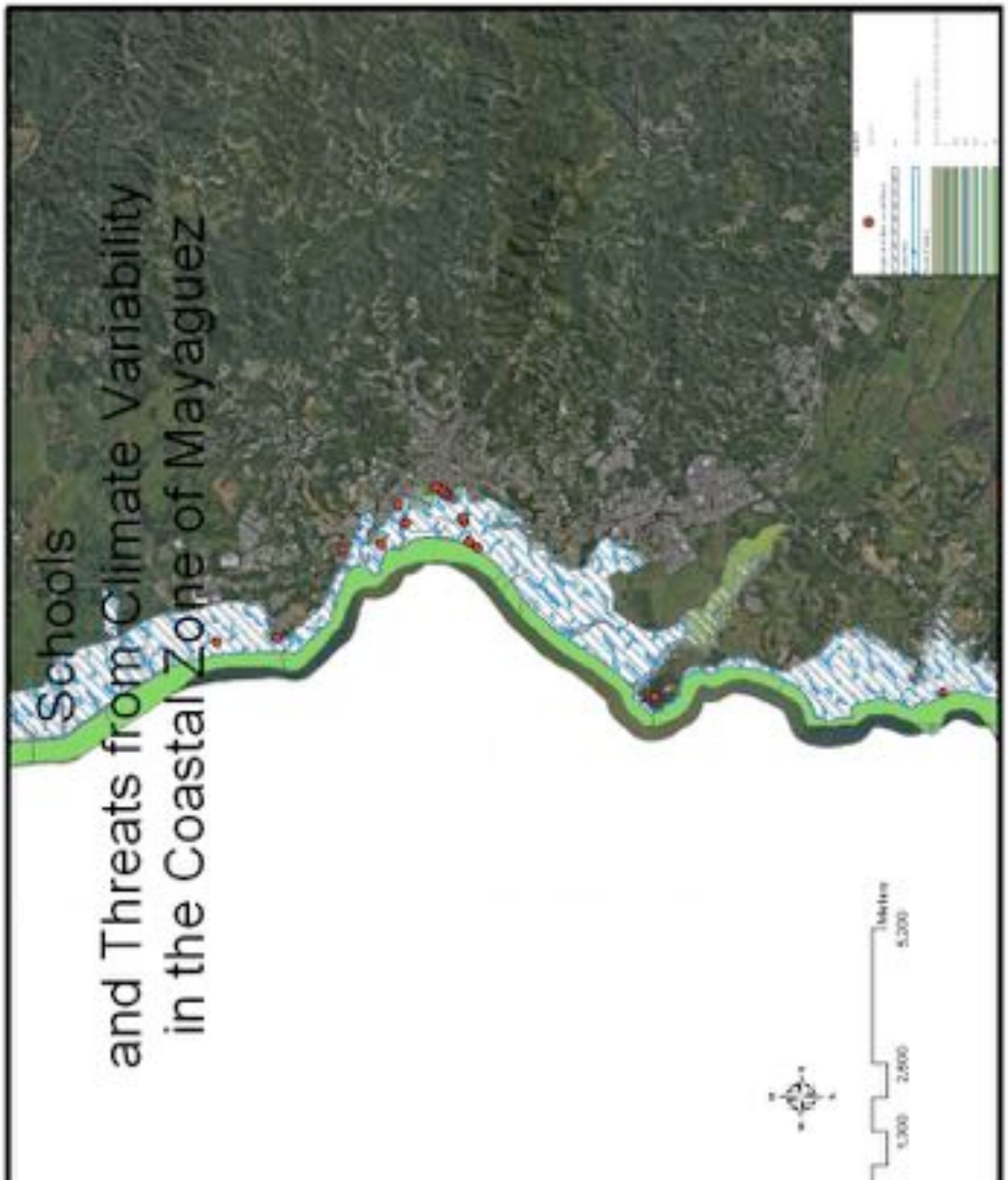

Figure 87: Schools in Mayaguez

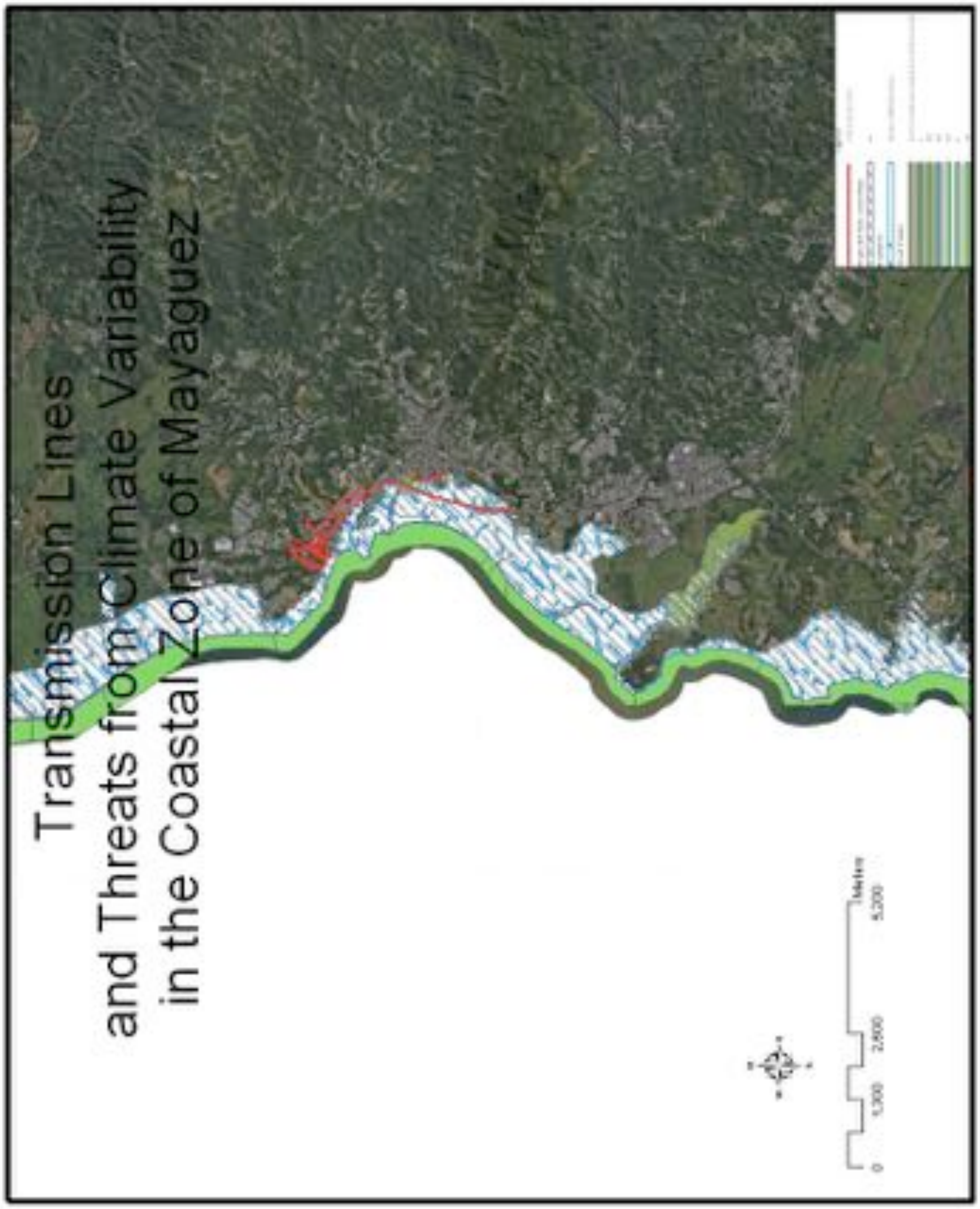

Figure 88: Transmission Lines in Mayaguez

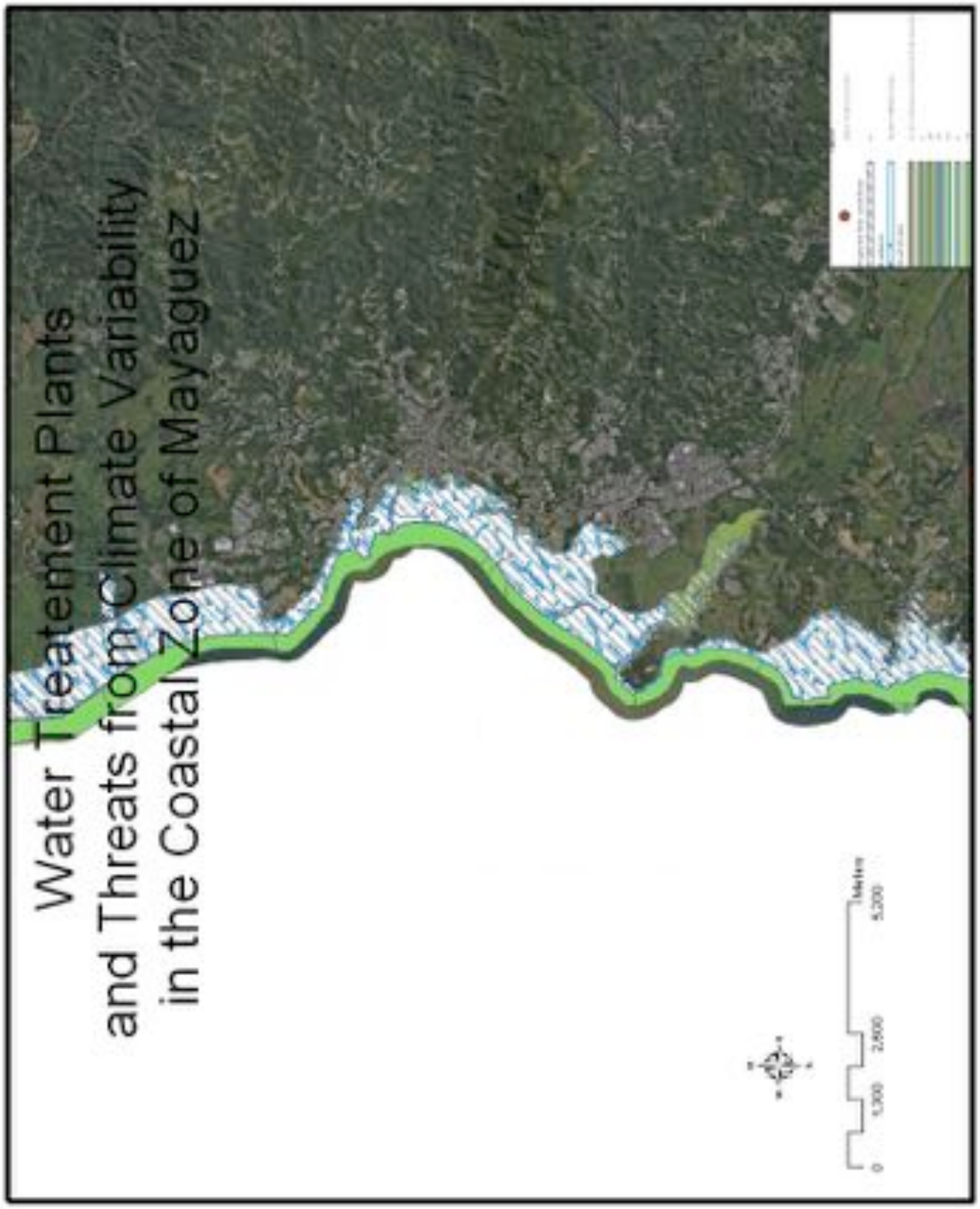

Figure 89: Water Treatment Plants in Mayaguez

Infrastructure in Ponce

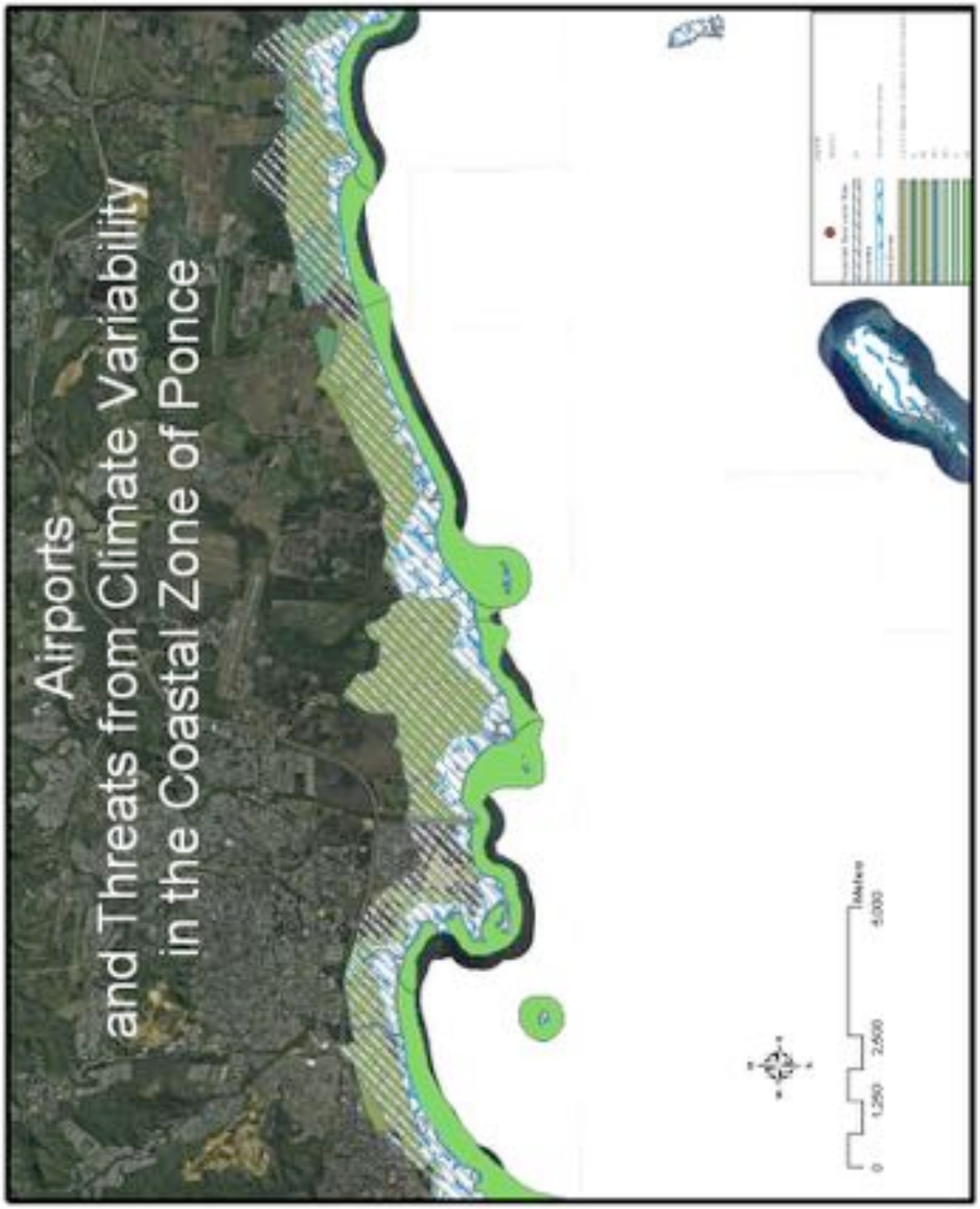

Figure 90: Airports in Ponce

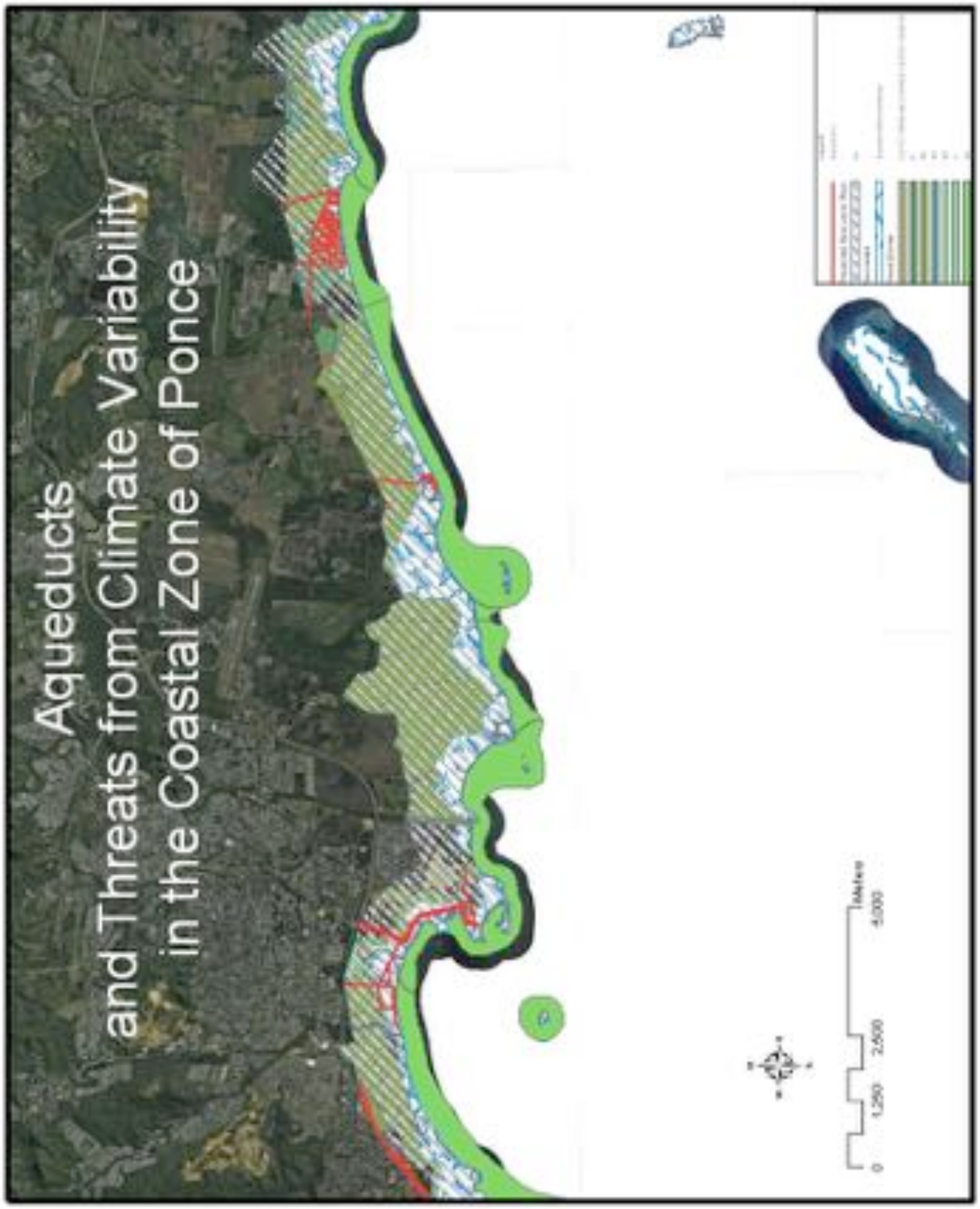

Figure 91: Aqueducts in Ponce

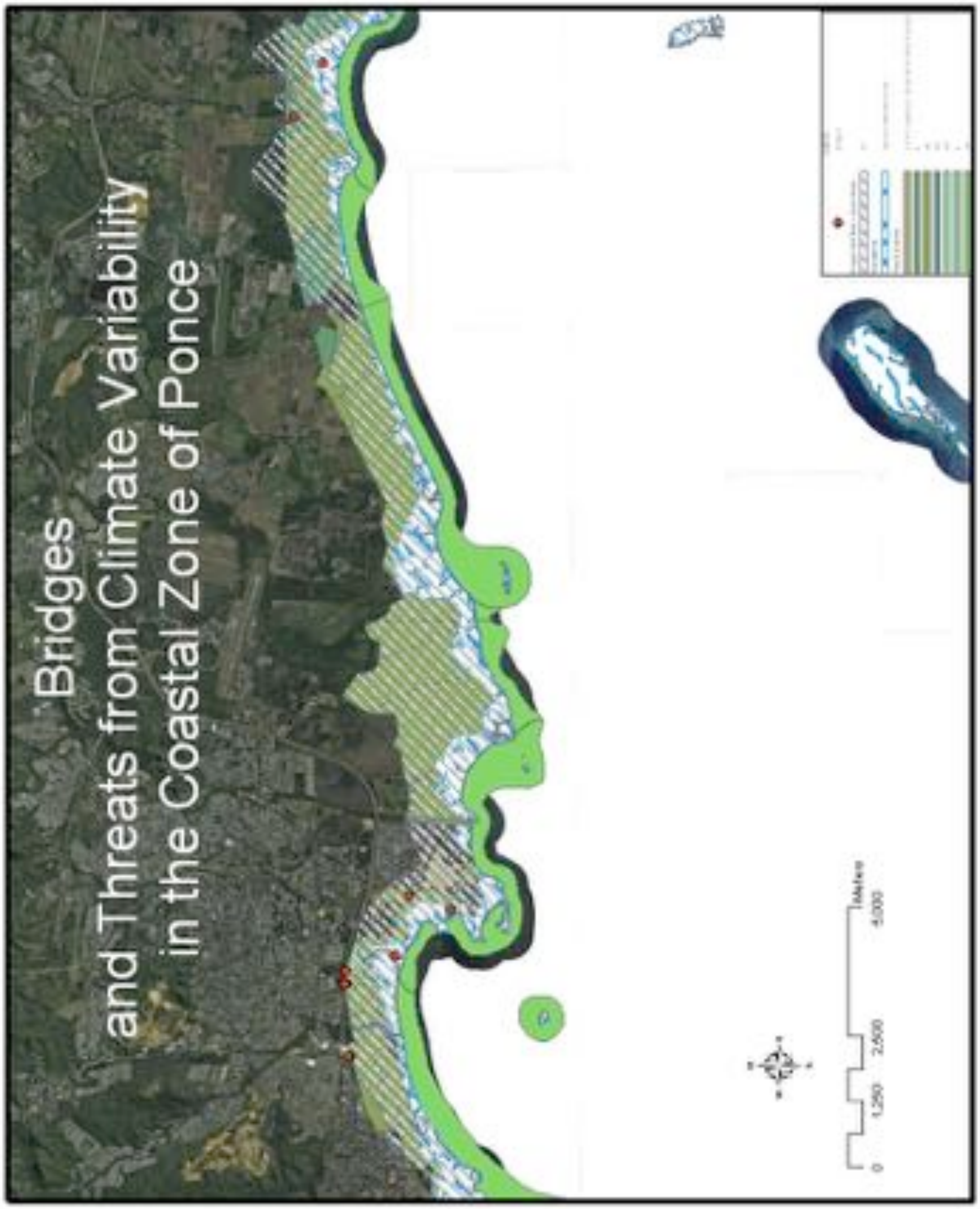

Figure 92: Bridges in Ponce

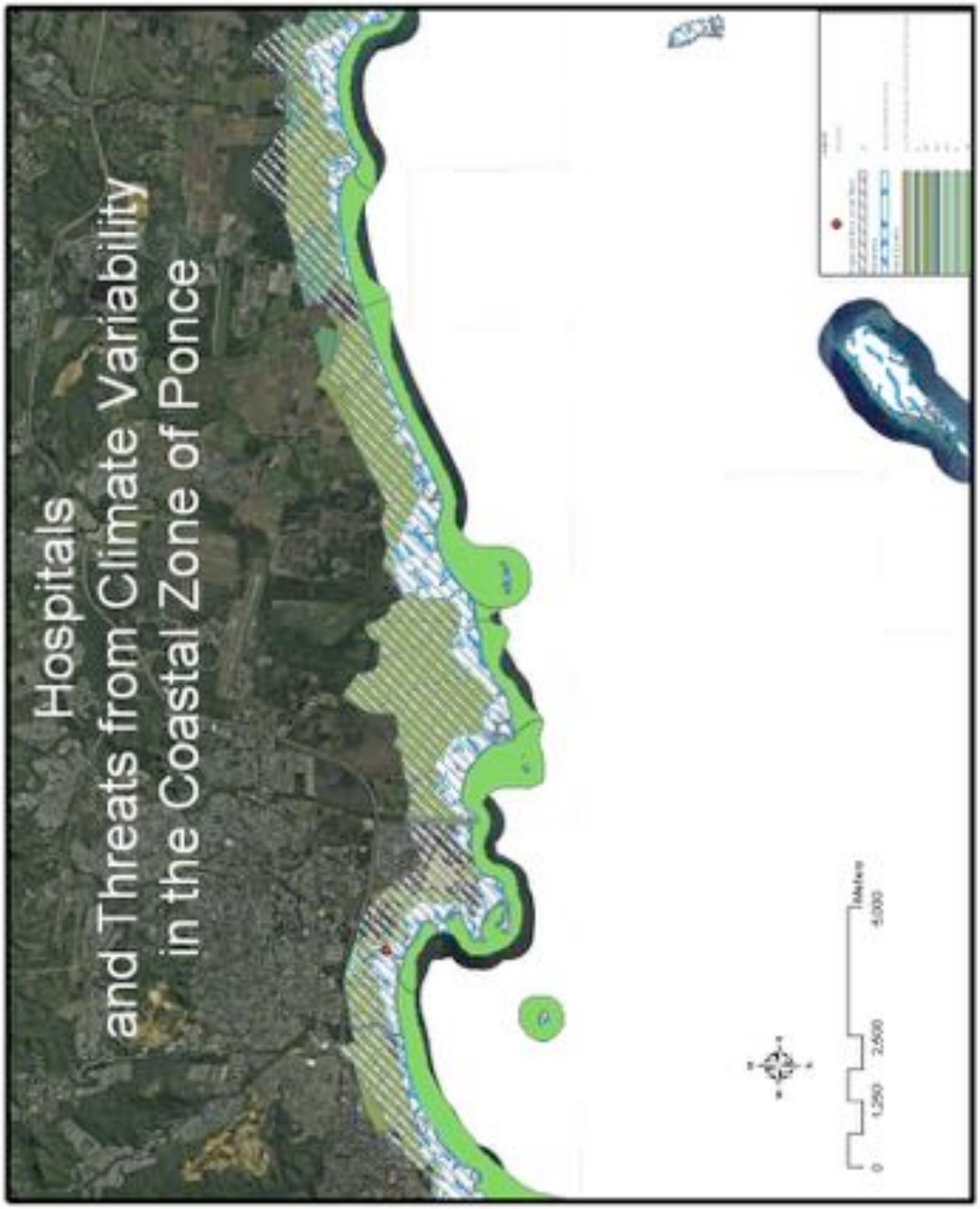

Figure 93: Hospitals in Ponce

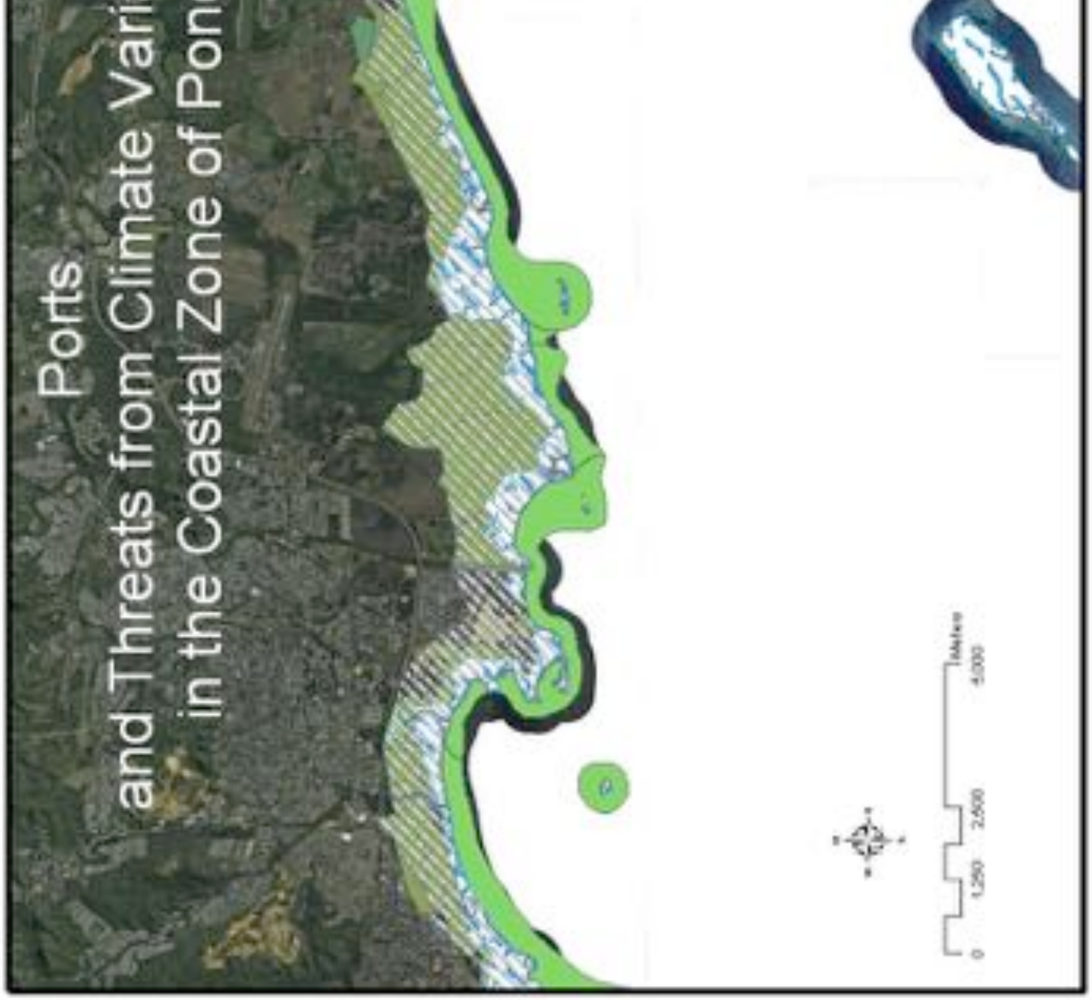

Figure 94: Seaports in Ponce

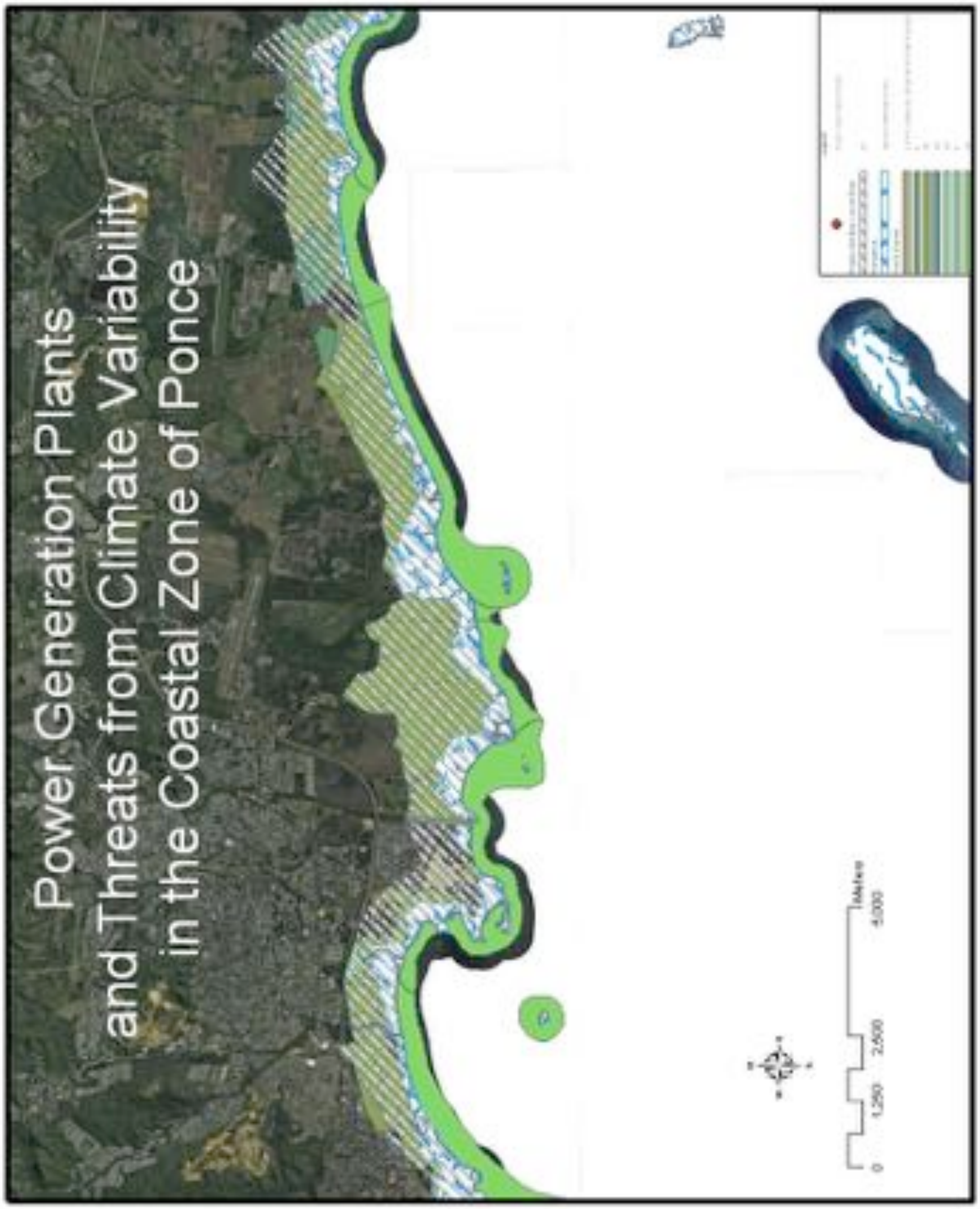

Figure 95: Power (Generation) Plants in Ponce

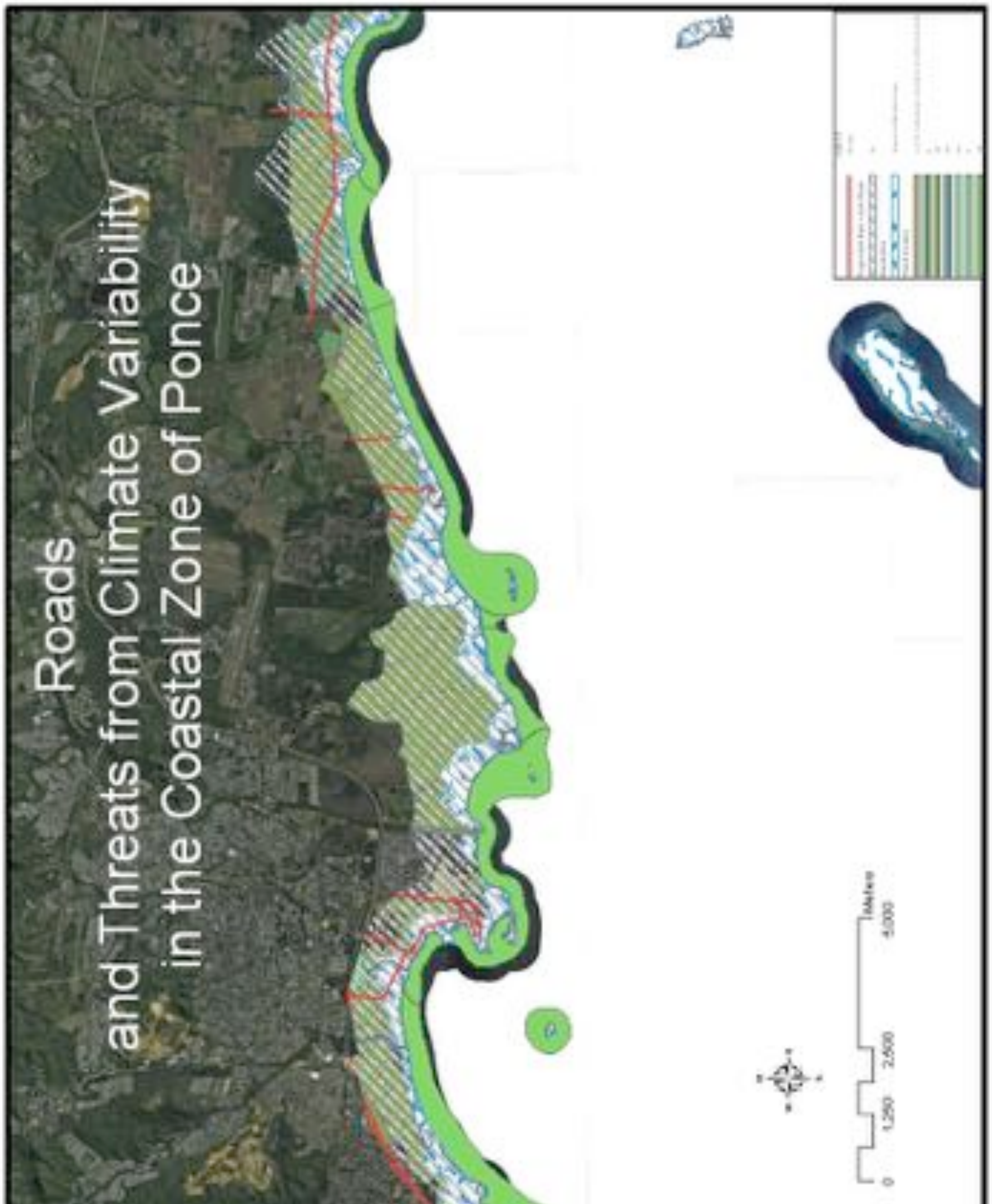

Figure 96: Roads in Ponce

Figure 97: Schools in Ponce

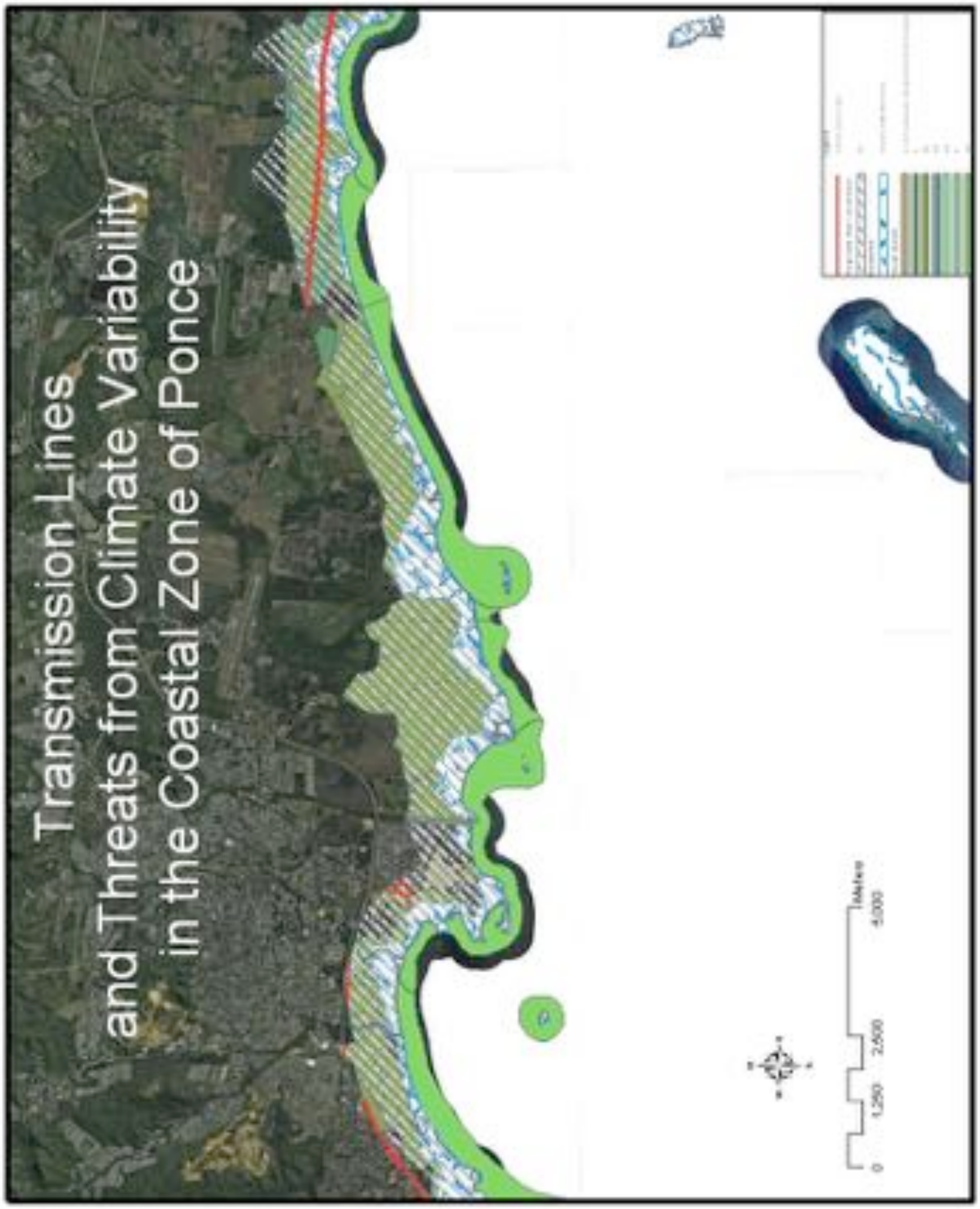

Figure 98: Transmission Lines in Ponce

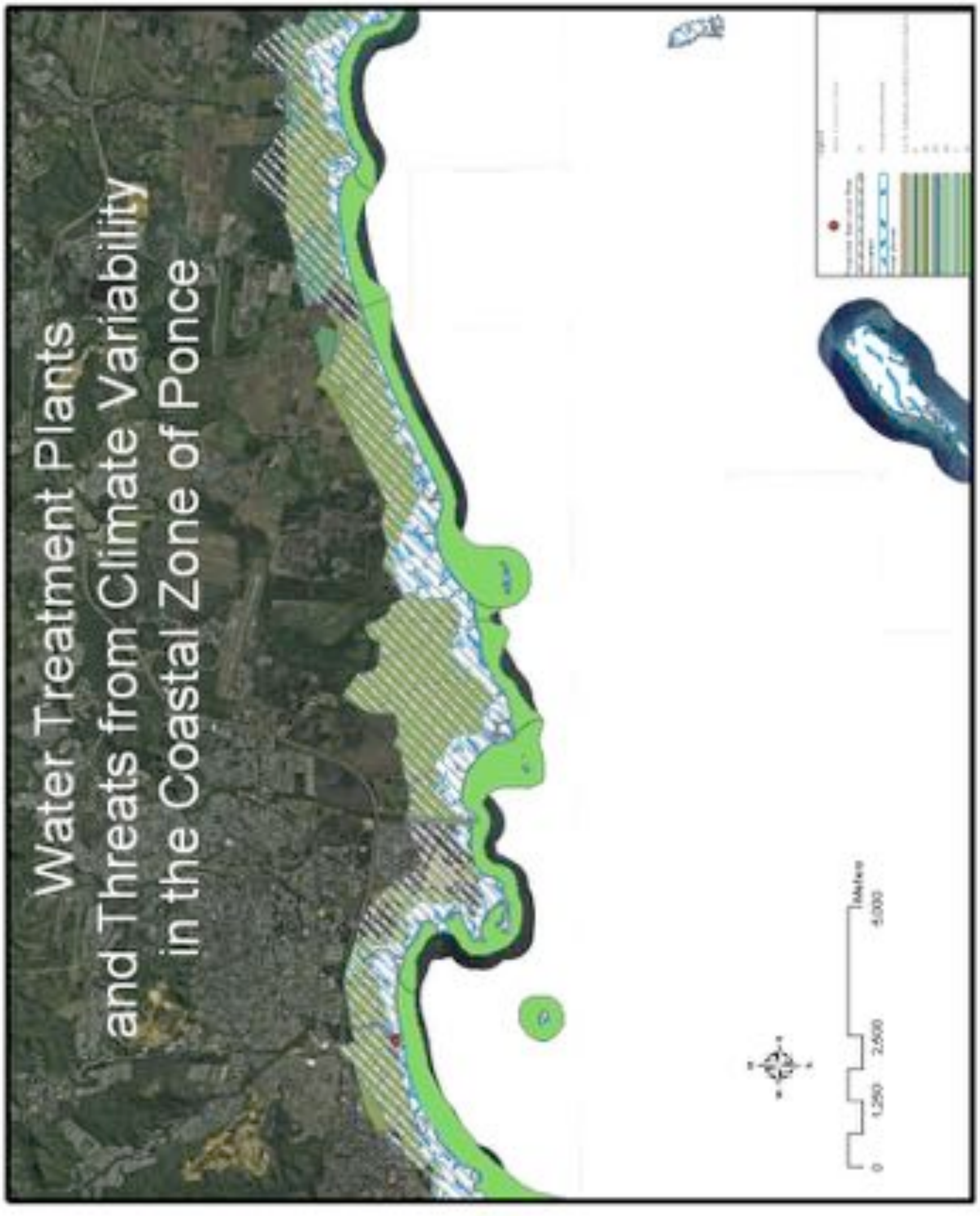

Figure 99: Water Treatment Plants in Ponce

Infrastructure in Salinas

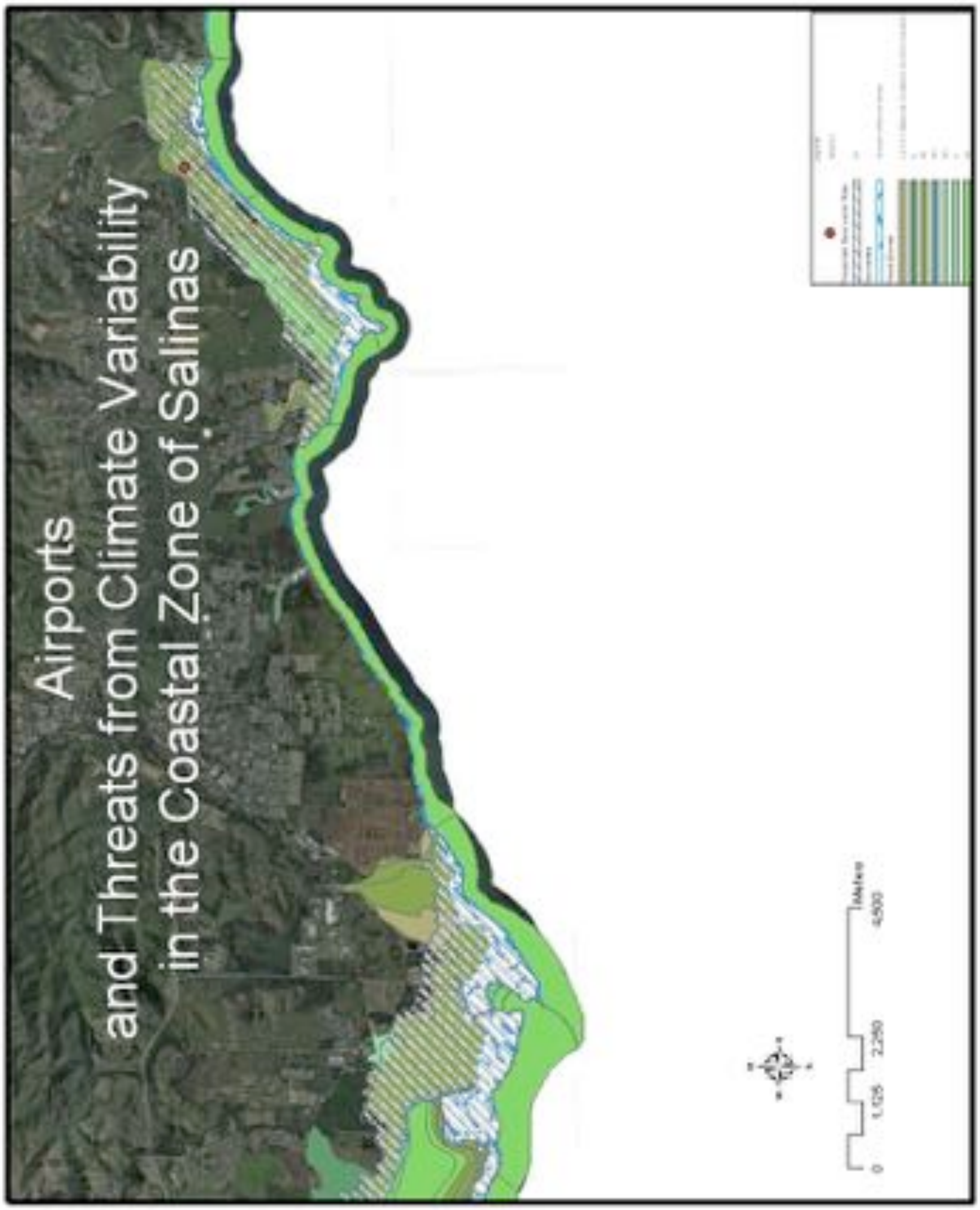

Figure 100: Airports in Salinas

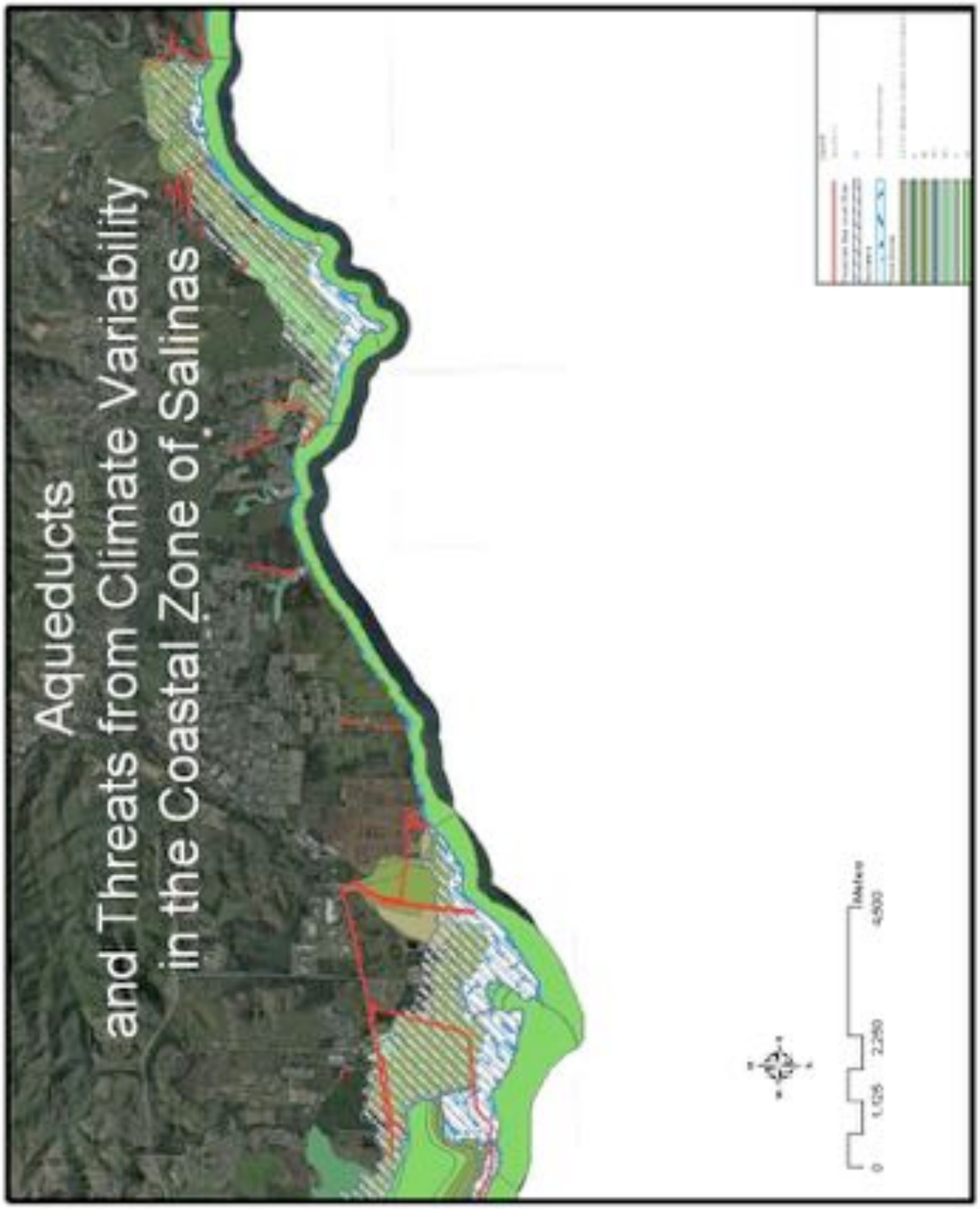

Figure 101: Aqueducts in Salinas

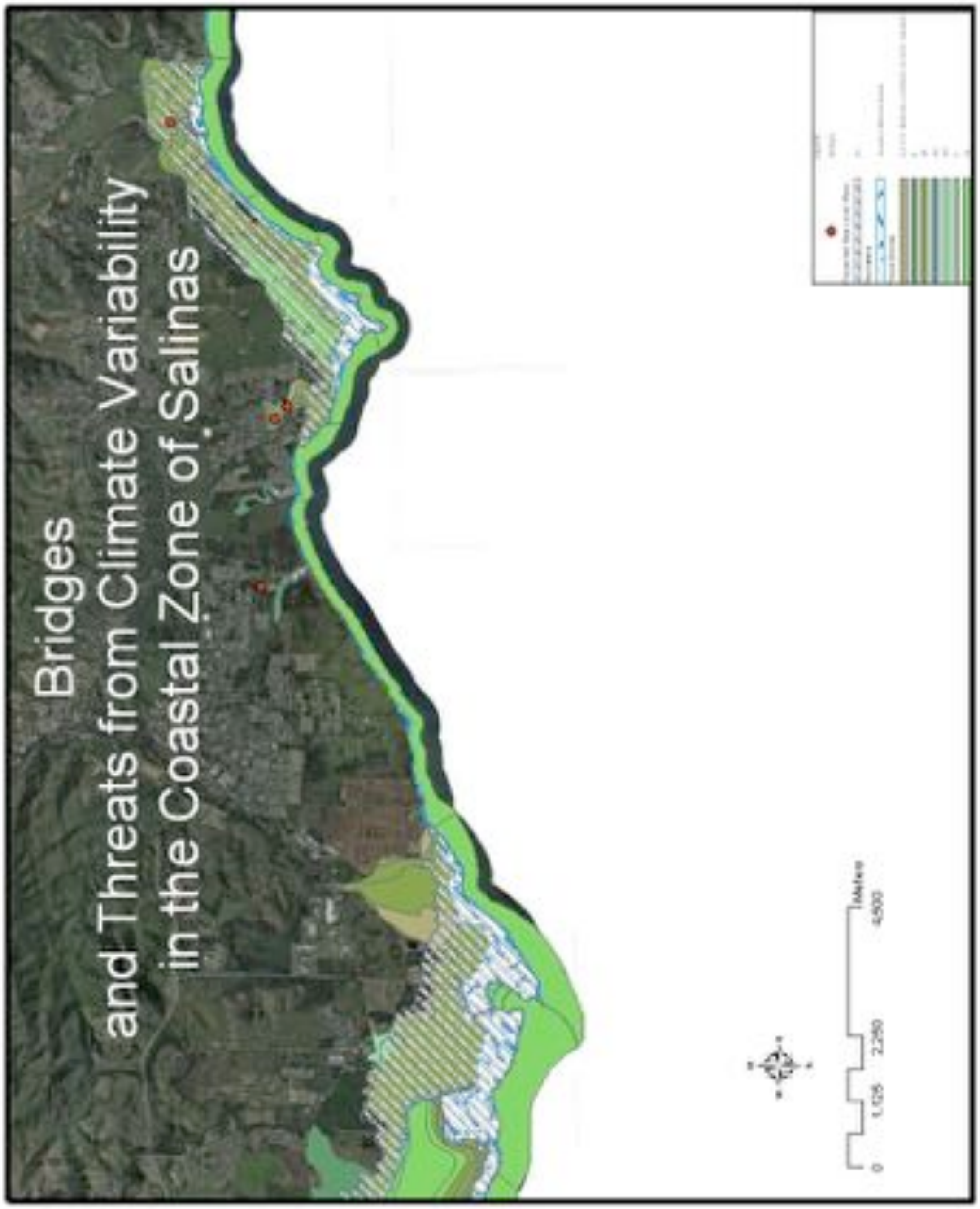

Figure 102: Bridges in Salinas

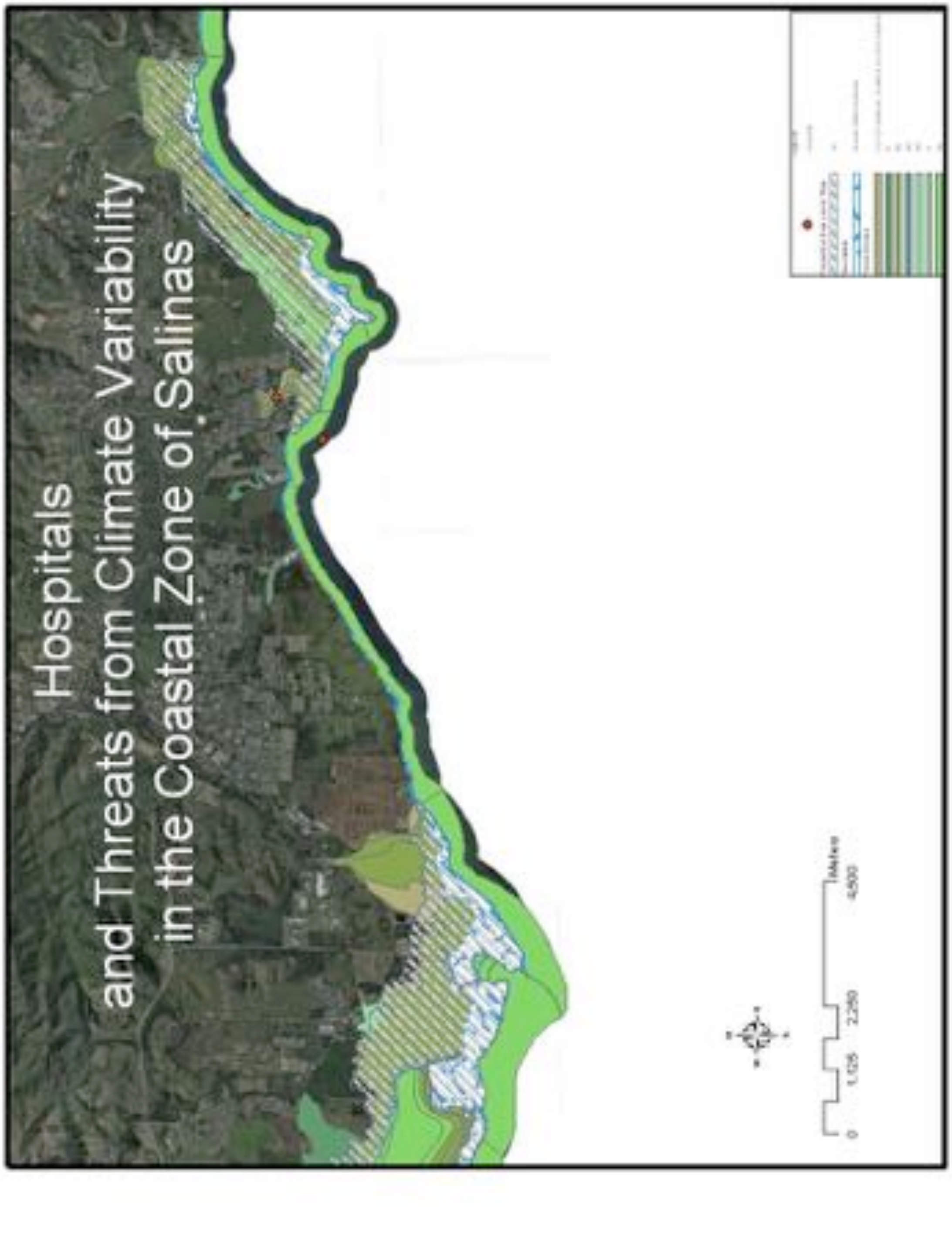

Figure 103: Hospitals in Salinas

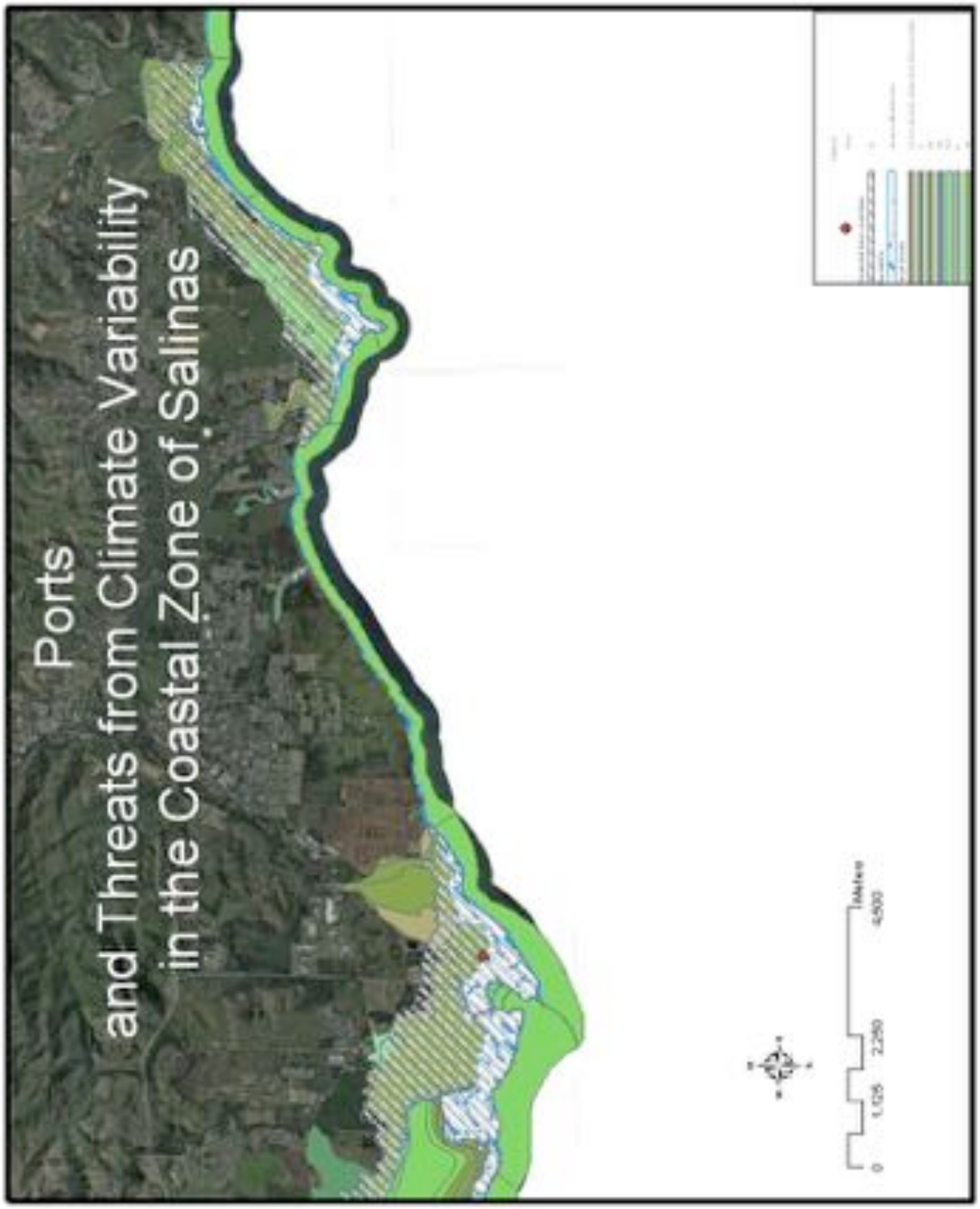

Figure 104: Ports in Salinas

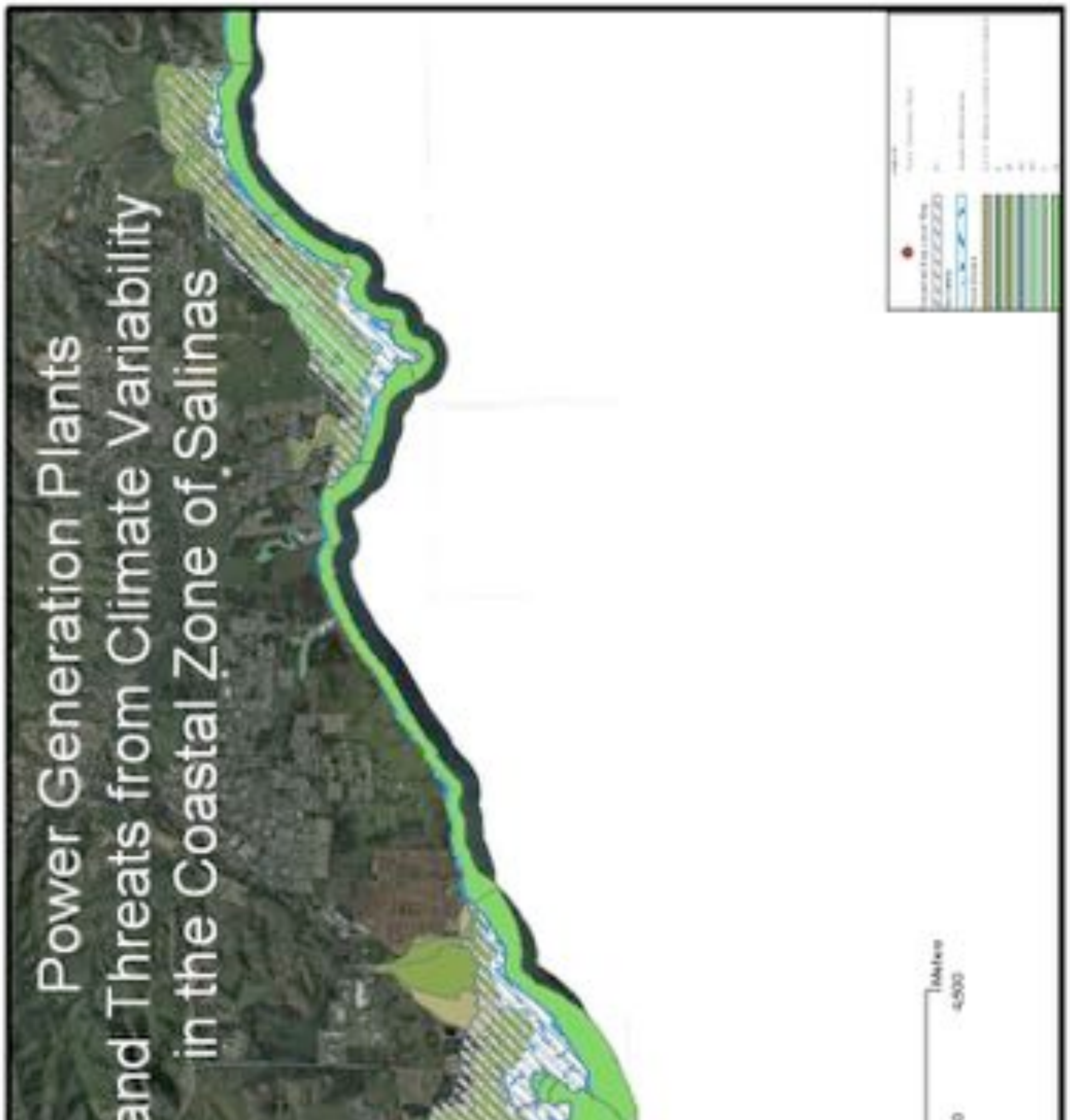

Figure 105: Power (Generation) Plants in Salinas

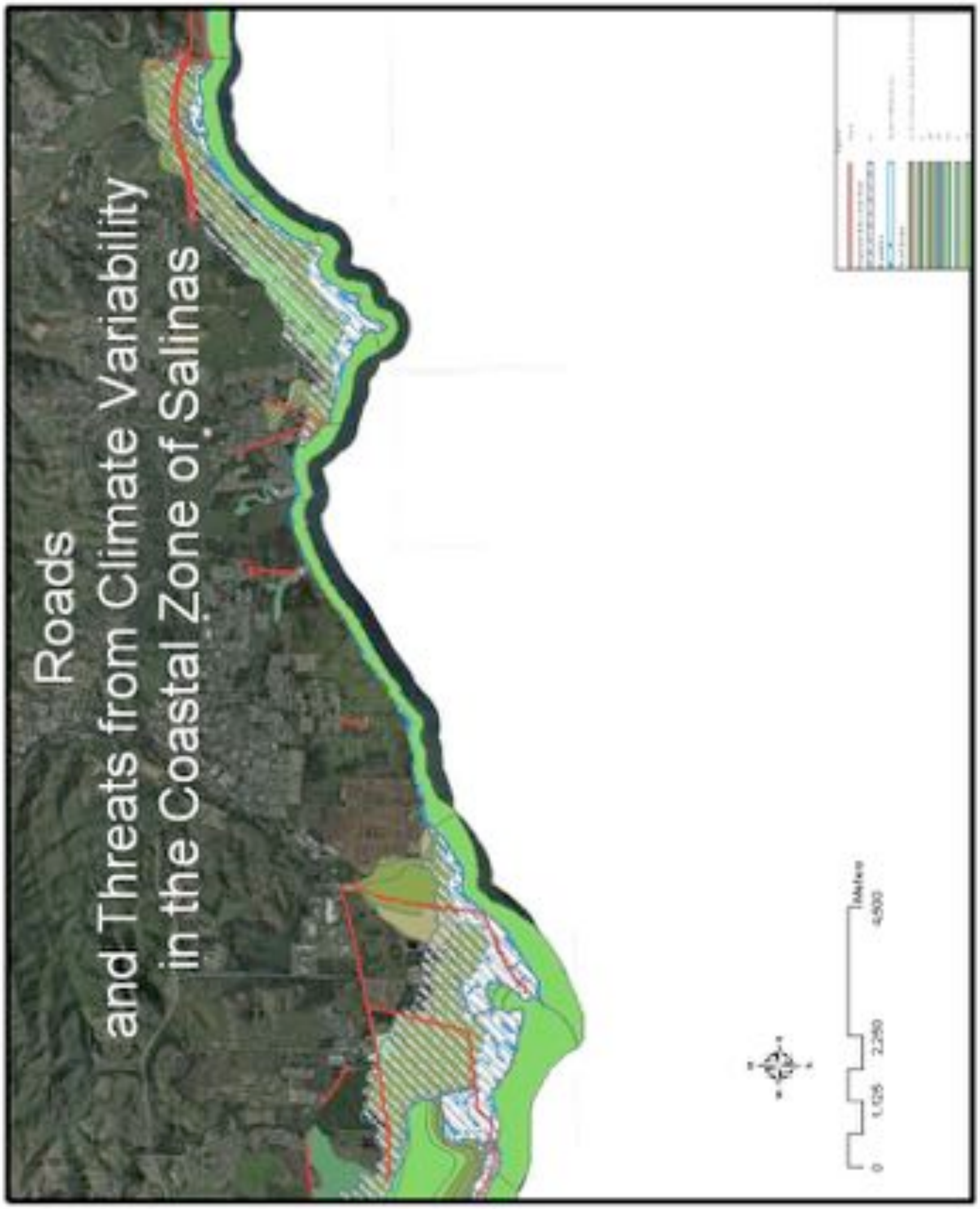

Figure 106: Roads in Salinas

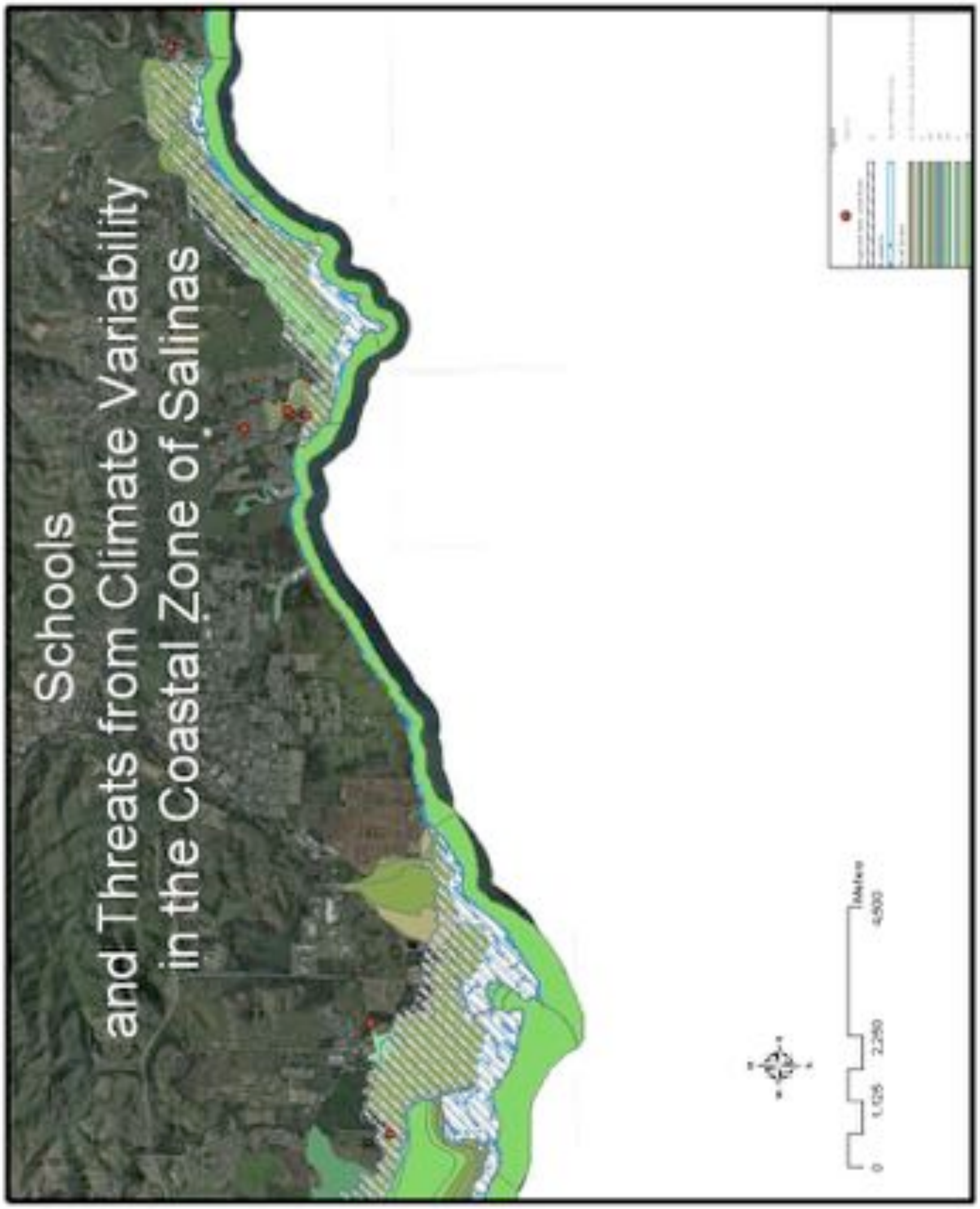

Figure 107: Schools in Salinas

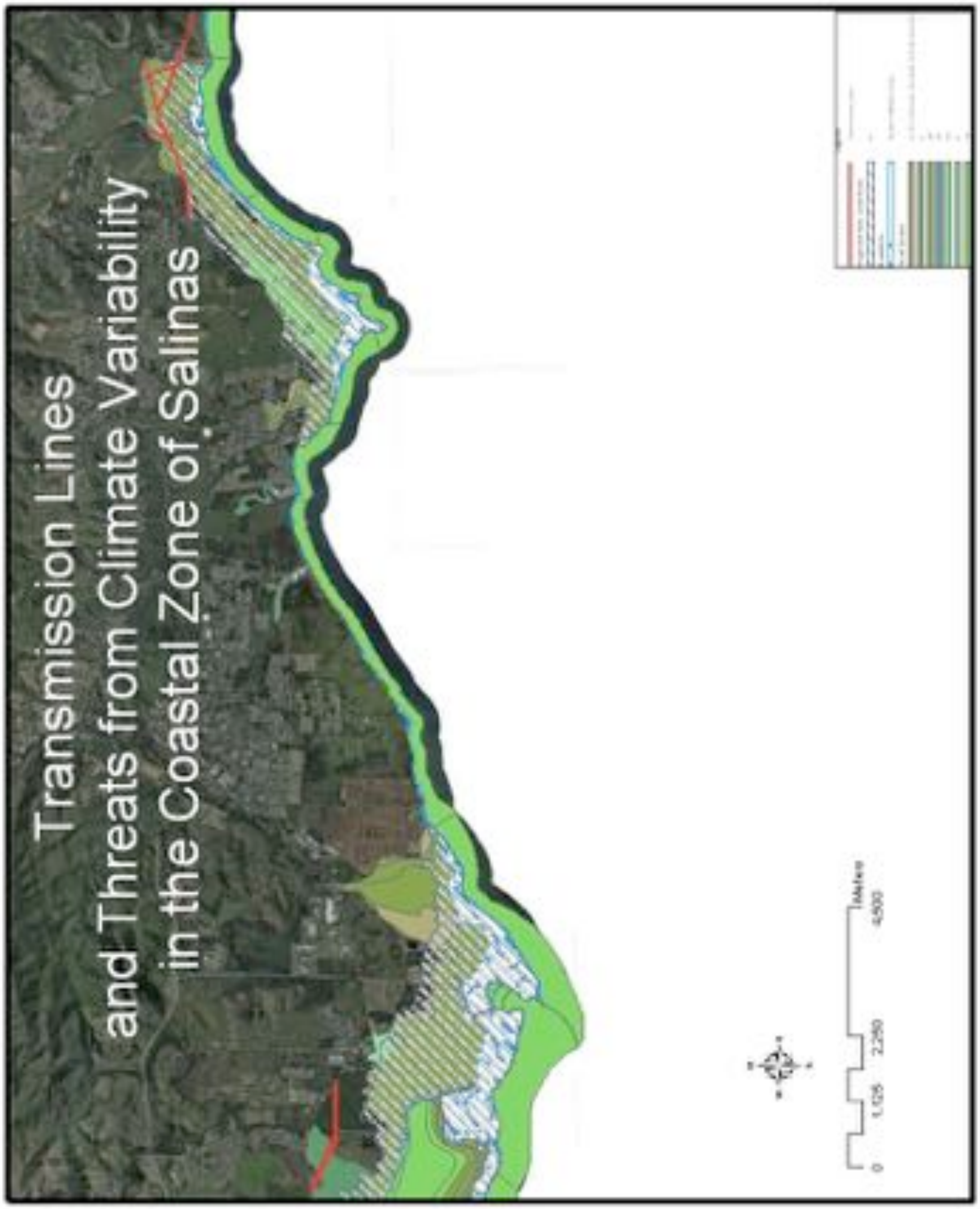

Figure 108: Transmission Lines in Salinas

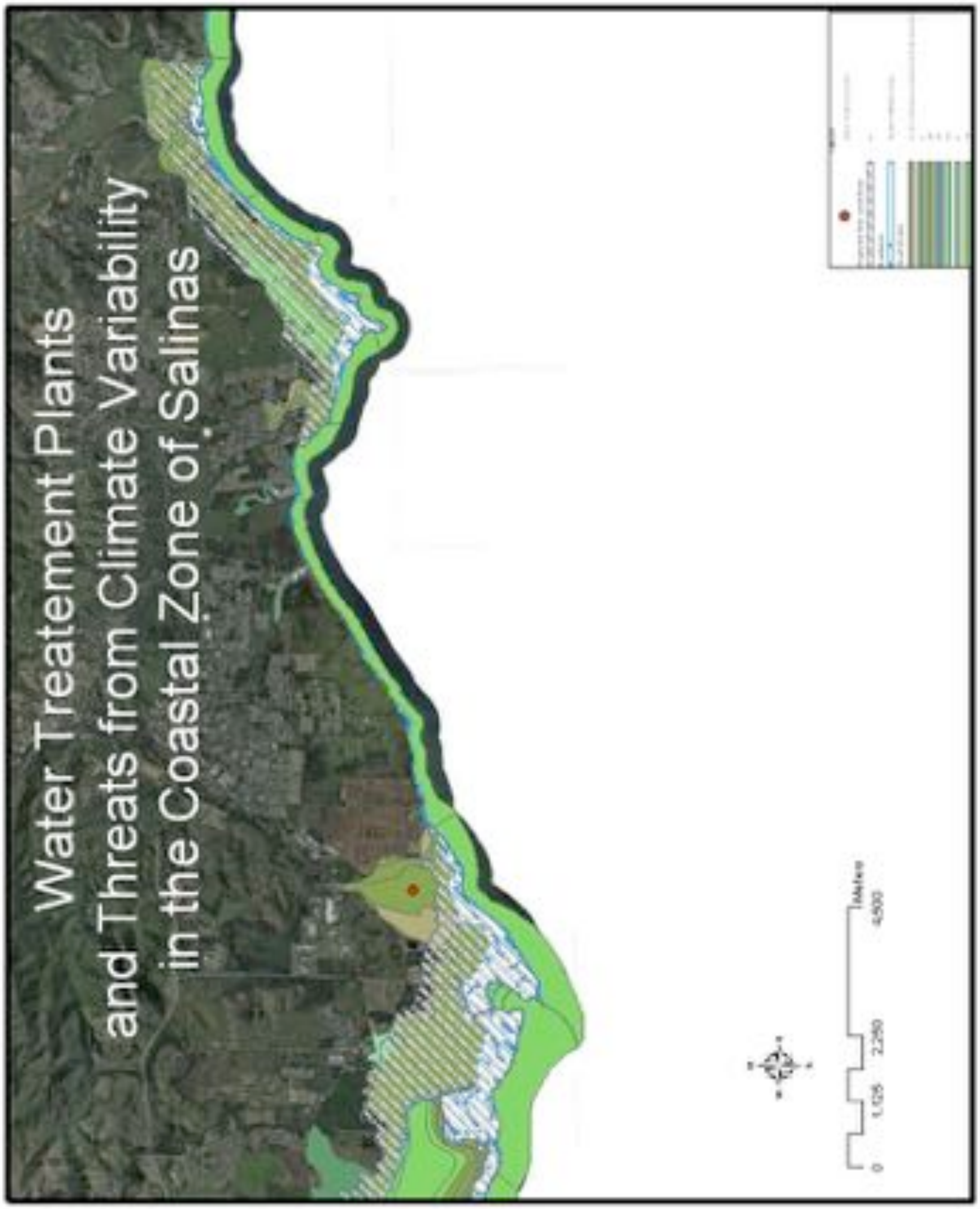

Figure 109: Water Treatment Plants in Salinas

Infrastructure in San Juan

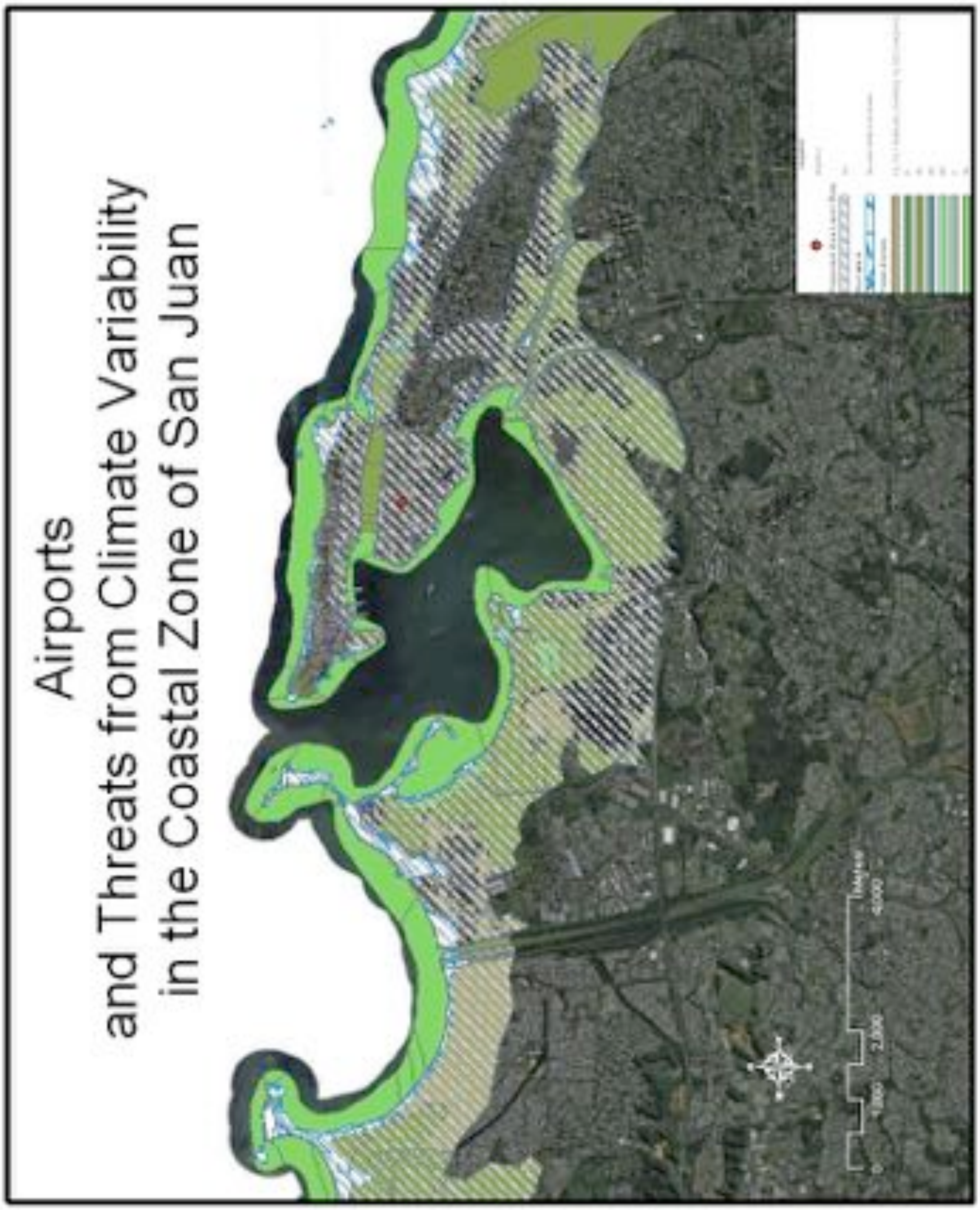

Figure 110: Airports in San Juan

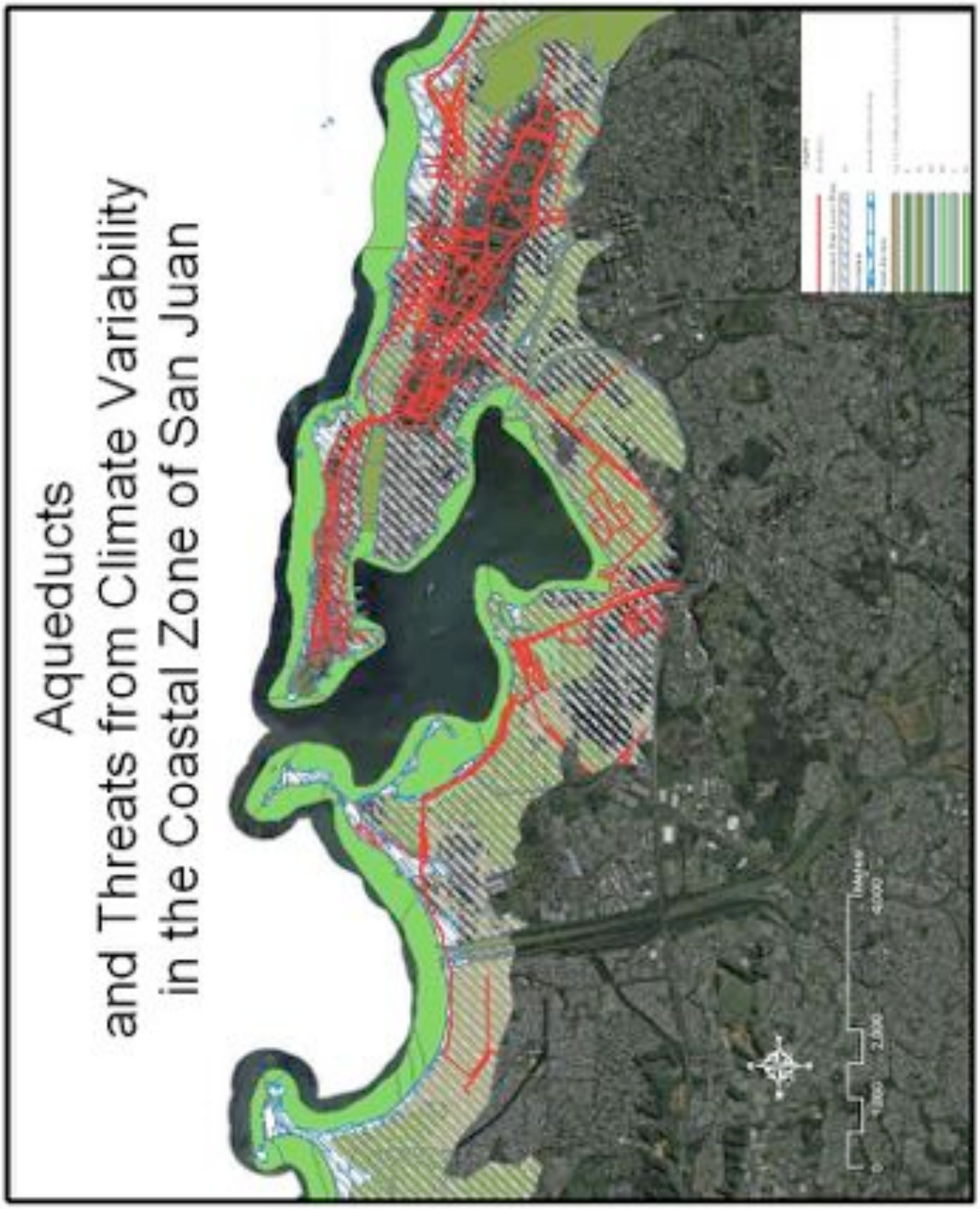

Figure 111: Aqueducts in San Juan

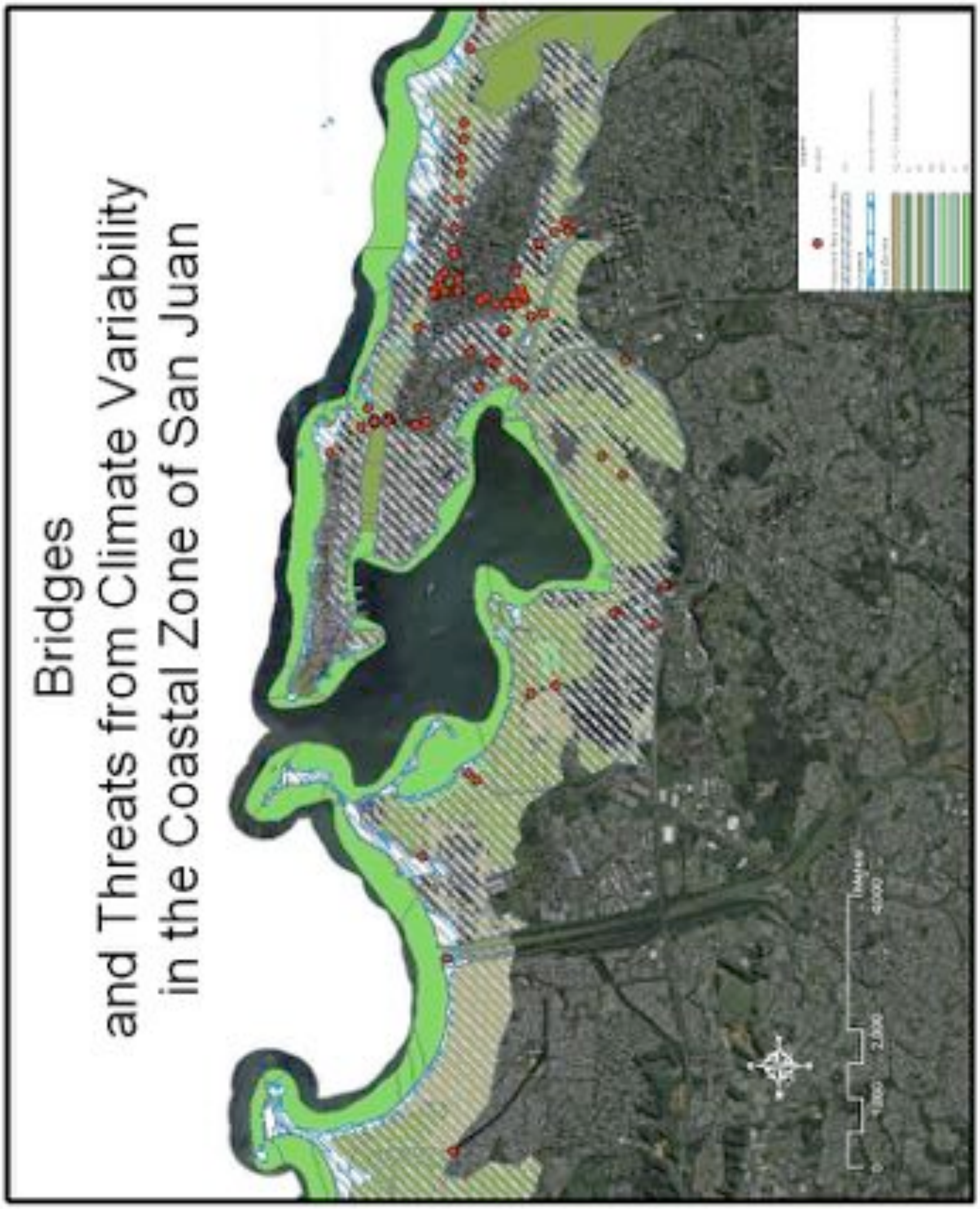

Figure 112: Bridges in San Juan

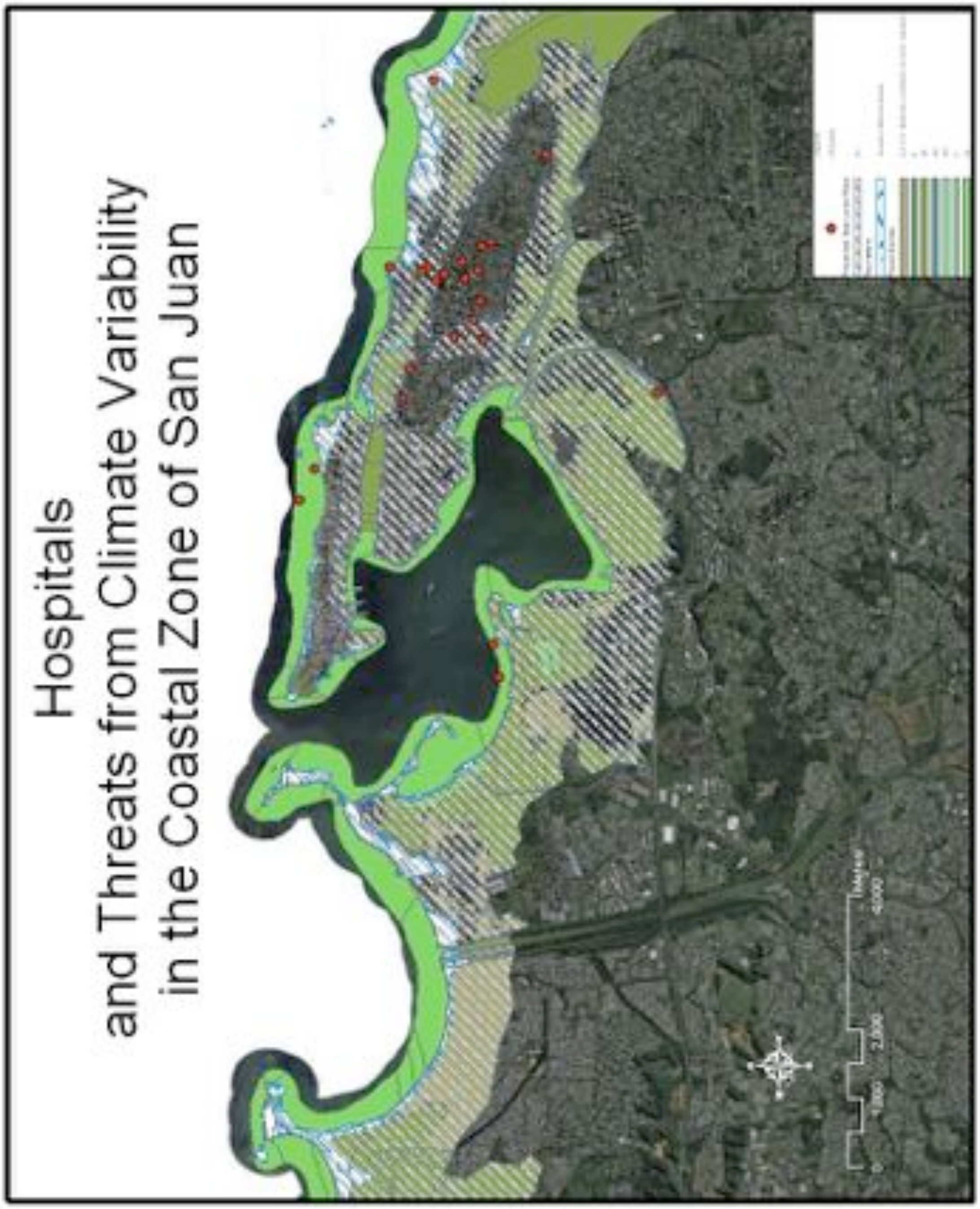

Figure 113: Hospitals in San Juan

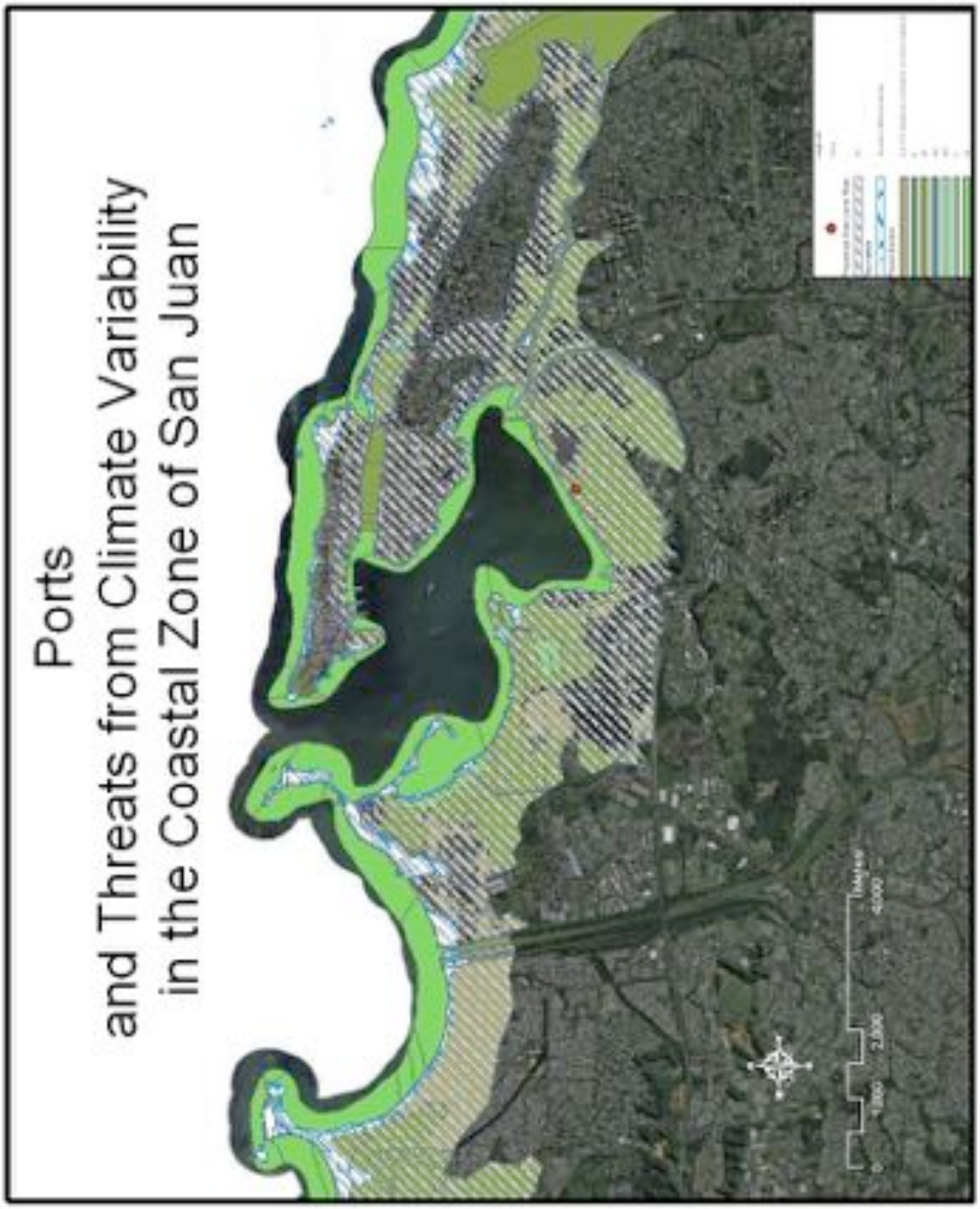

Figure 114: Seaports in San Juan

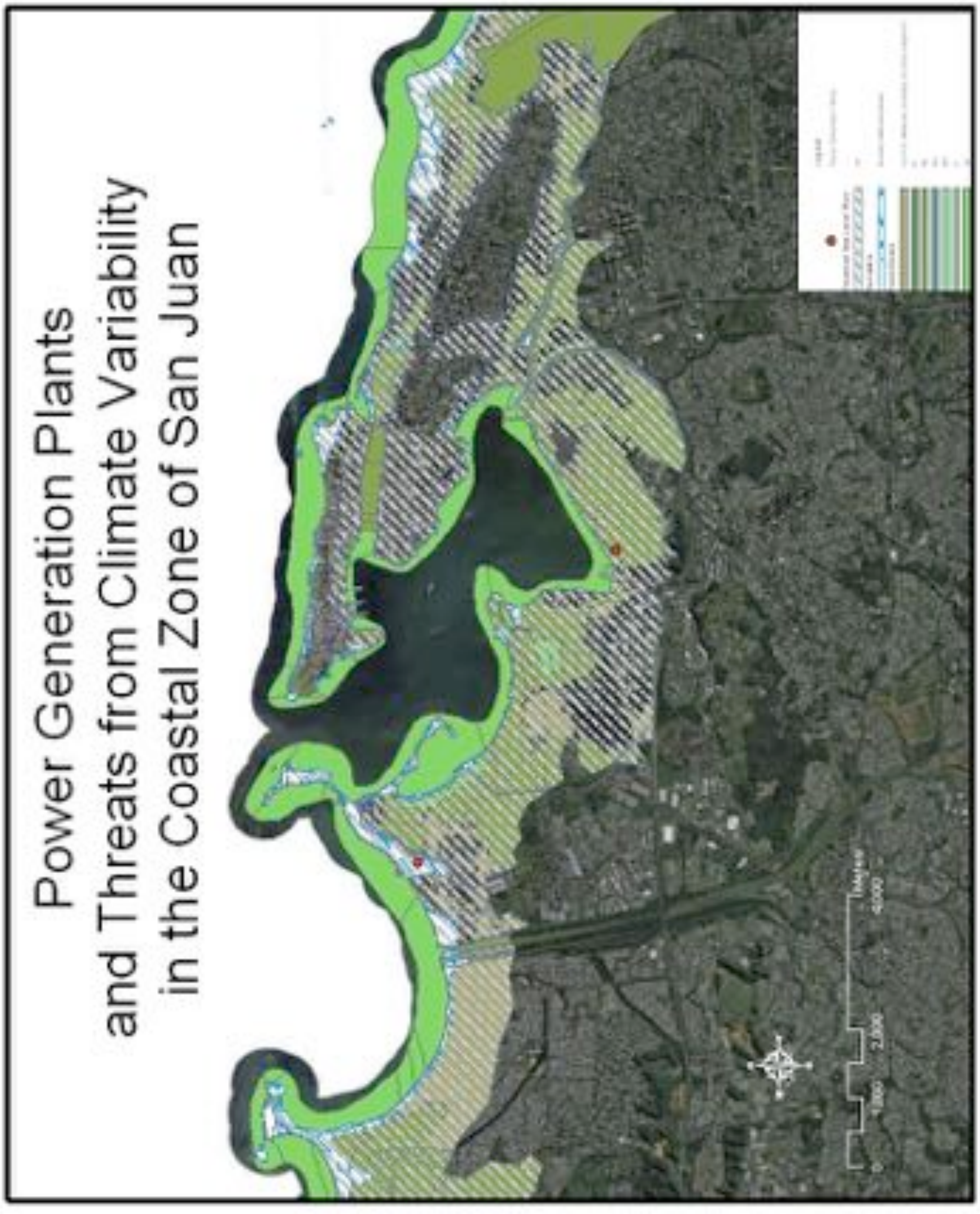

Figure 115: Power (Generation) Plants in San Juan

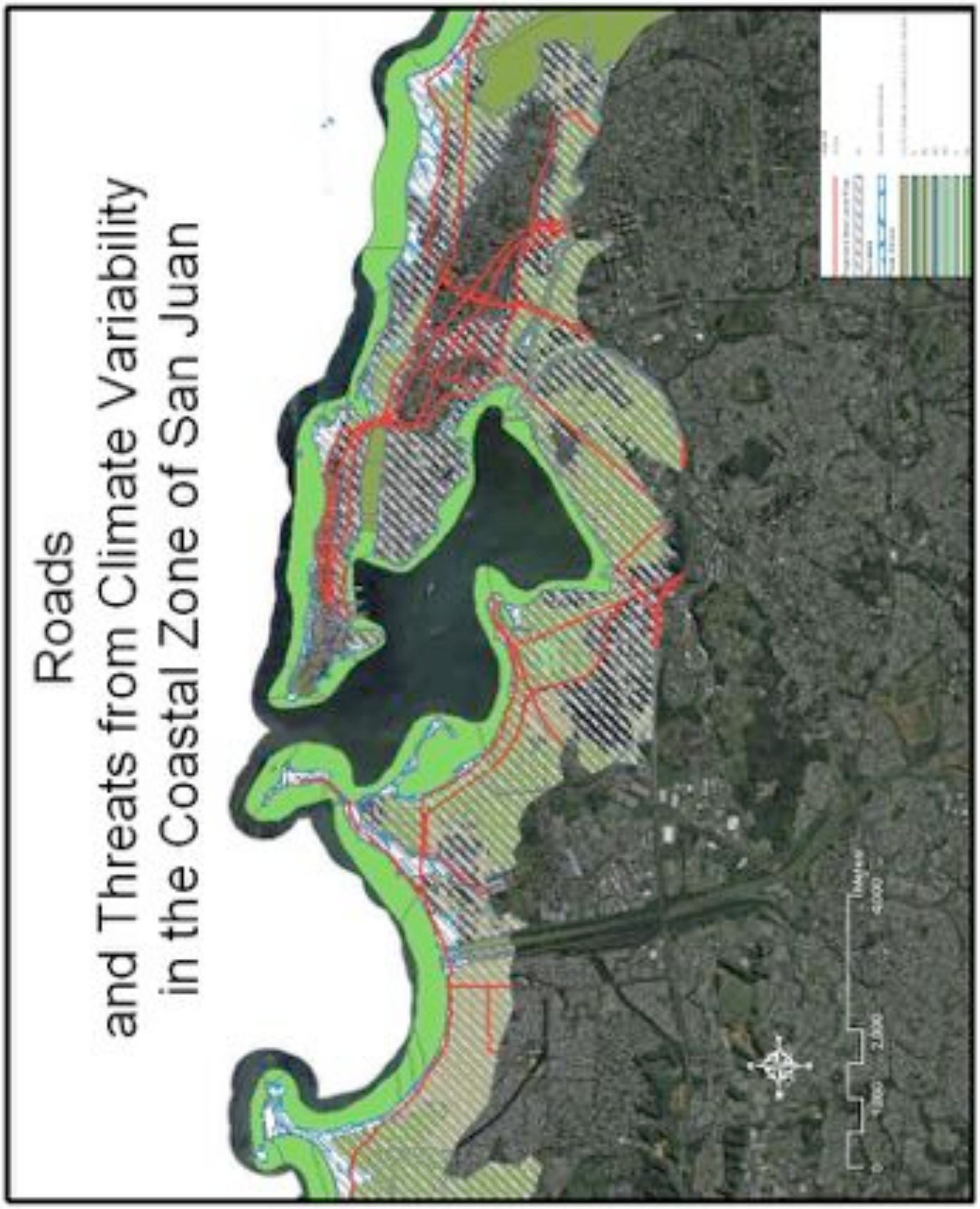

Figure 116: Roads in San Juan

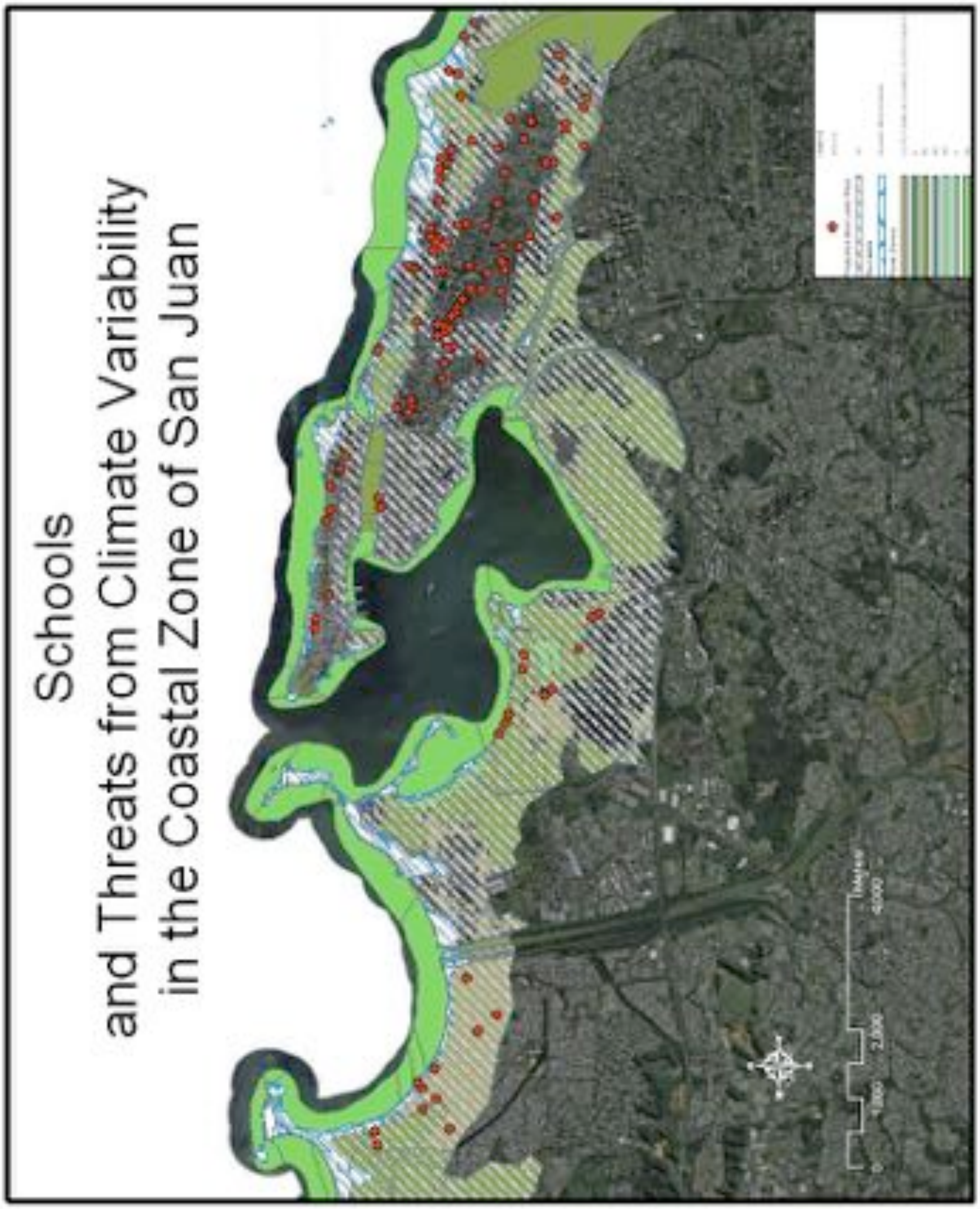

Figure 117: Schools in San Juan

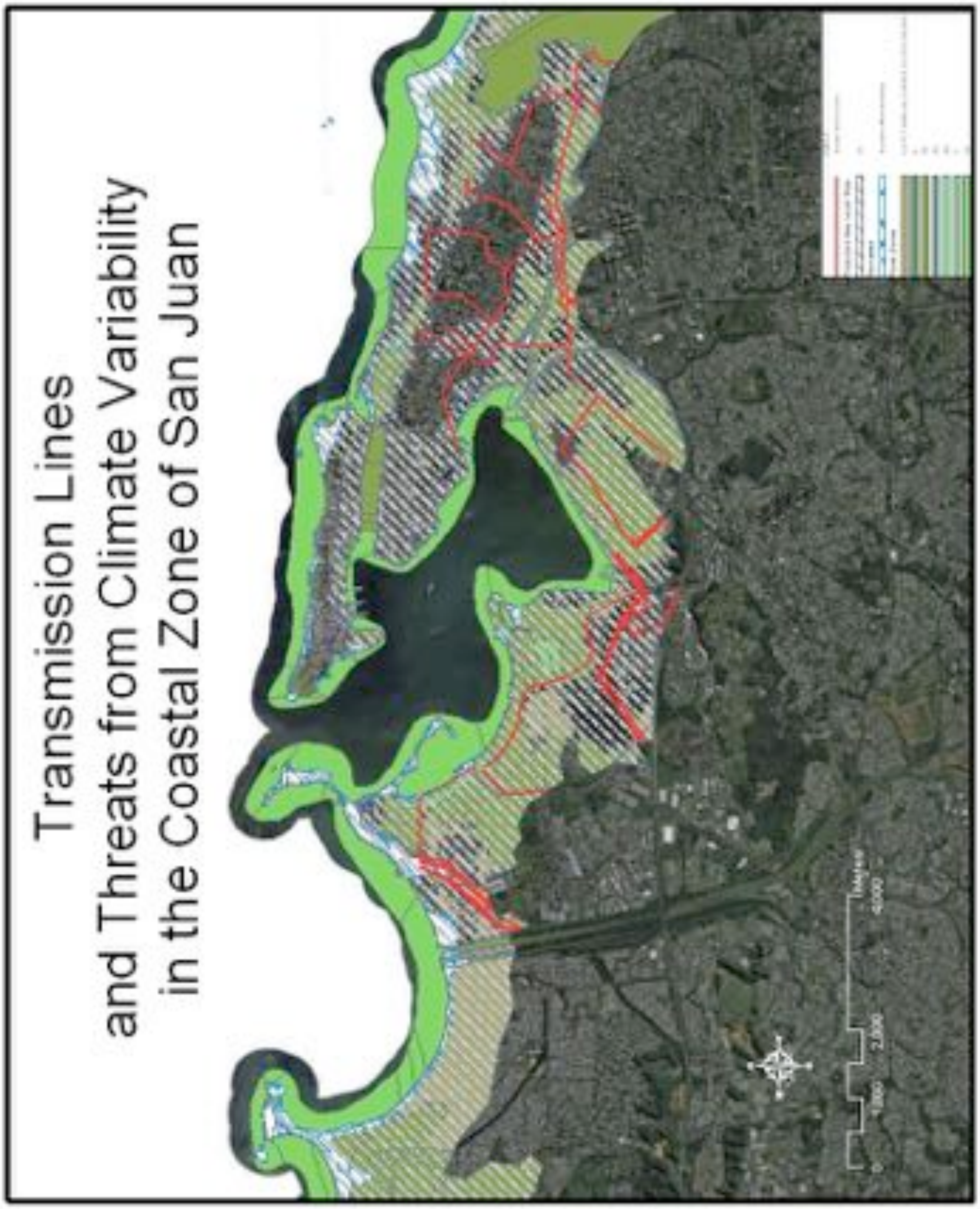

Figure 118: Transmission Lines in San Juan

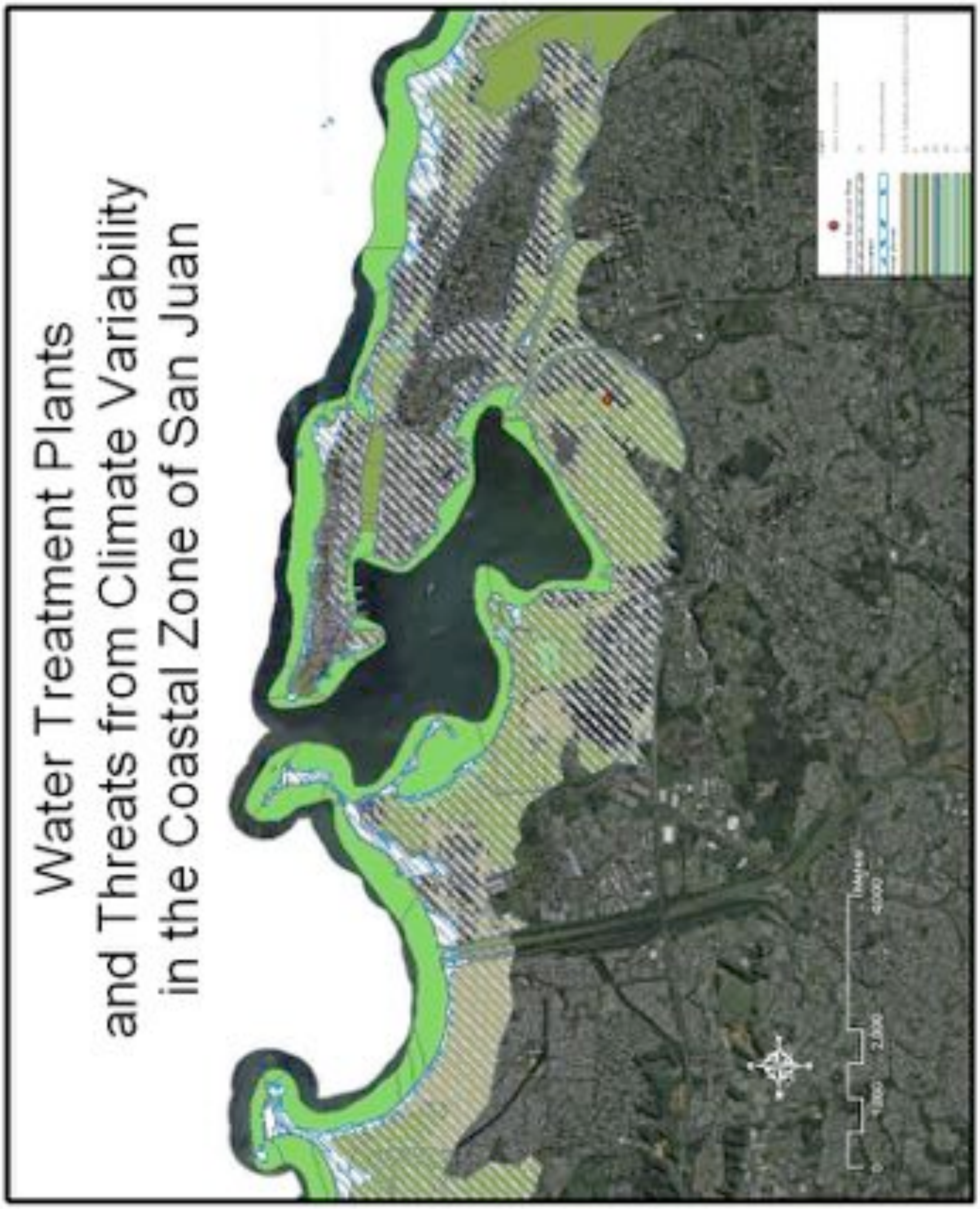

Figure 119: Water Treatment Plants in San Juan

Appendix E: Risk Assessment Table

Table 2: Full Risk Assessment Table

Infrastructure/ Asset	Detailed Description	Distance from coast (m)	Potential Climate Hazard	Potential Impact	Planned upgrades/ other actions
C.D.T. DR. ARNALDO J. GARC Hospital	Luis Llorens Torre Box 21405 Santurce Zip 00908	253.04	Tsunami/ 3m SLR/located in flood zone	Flooding (0.2 Pct Annual chance of flooding)	TBD
C.D.T. Playa de Ponce Hospital	Hostos # 216 Box 254Ponce 00734	348.21	Tsunami/ 3 m SLR/ located in flood zone	Flooding (AE with BFE 2.1 MSL)	TBD
Rehabilitation vocational Hospital	Carr # 2 Bo Sabalos Centro Medico Mayaguez 680	437.12	Tsunami/ 3m SLR/ located in flood zone	Flooding (AE with BFE 2.4 MSL)	TBD
F.S.E. (FONDO DEL SEGURO) Hostpital	C Cristy # 56 Box 1570 Mayaguez 00681	370.38	Tsunami/ 3m SLR/ located in flood zone	Flooding (AE with BFE 2.7 MSL)	TBD
Policlinica Bella Vista Hospital	C Mendez Vigo # 85 East Box 850 Mayaguez 00681	398.03	Tsunami/ 3m SLR/located in flood zone	Flooding (AE with BFE 2.7 MSL)	TBD
Luis Muñoz Marín International Airport	San Juan 18°26′22″N 066°00′07″W Elevation: 3 meters	25	3 meter sea-level rise	Flooding	$400 million expansion through 2011. [1]
Fernando Luis Ribas Dominicci Airport	San Juan 18°27′25″N 066°05′53″W Elevation: 3 meteres	10	3 meter sea-level rise	Flooding	TBD
Patillas Airport	Patillas 17°58′56″N 066°01′10″W Elevation: 3 meters	27	3 meter sea-level rise/ located in flood zone	Flooding (AE with BFE 2.7 MSL)	TBD

[1] http://www.worldtravelguide.net/puerto-rico/san-juan-luis-munoz-marin-international-airport

Infrastructure/ Asset	Detailed Description	Distance from coast (m)	Potential Climate Hazard	Potential Impact	Planned upgrades/ other actions
Costa Sur (Guayanilla) Power plant	Capacity of 990MW and constructed from 1962-1973	300	3 meter sea-level rise	flooding	TBD
Cambalache (Arecibo) Power plant	Capacity of 247MW and was constructed in 1997	560	none		TBD
San Juan (San Juan) Power plant	Capacity of 400MW and was constructed from 1965-1969		3 meter sea-level rise/ Located in flood zone	Flooding (AE with BFE 2.1 MSL)	TBD
Palo Seco (Cataño) Power plant	Capacity of 602MW and was constructed from 1960-1970		3 meter sea-level rise/ Tsunami	Flooding	TBD
Francisco M. Quinones (Ponce) school	Carr. 701 Bo. Playa	393.83	3 meter sea-level rise/ Located in flood zone/ Tsunami	Flooding (AE with BFE 2.4MSL)	TBD
Marcela Garcia Cora (Caguas) school	Ramal 707, Km. 2, Hm. 4 Bo. Puerto de Jobos		3 meter sea-level rise/ located in flood zone	Flooding (AE with BFE 3 MSL)	TBD
Eugenio Gonzalez Gonzalez (Mayaguez) school	Carr. 441, Km. 0, Hm. 9 Bo. Guaniquilla	144.10	3 meter sea-level rise/ Tsunami	Flooding	TBD
Rafael N. Coca (Humacao) school	Calle Fernandez Garcia 1 Luquillo Pueblo	117.68	3 meter sea-level rise/ located in flood zone/ Tsunami	Flooding (0.2 PCT ANNUAL)	TBD

Infrastructure/ Asset	Detailed Description	Distance from coast (m)	Potential Climate Hazard	Potential Impact	Planned upgrades/ other actions
ESCUELA DE COSTURA JULIE, INC. (San Juan) school	Calle Loiza Esq. Tapia 2031	970.61	3 meter sea-level rise/ located in flood zone/ Tsunami	Flooding (0.2 PCT ANNUAL)	TBD
Ramon B. Lopez (Bayamon) school	Calle Perucho Cepeda Catano Pueblo		3 meter sea-level rise/ located in flood zone	Flooding (02 PCT ANNUAL)	TBD
INSTITUTO COMERCIAL DE PUERTO RICO JUNIOR COLLEGE (Arecibo) school	Carr. 2 Km. 80.4	813.44	3 meter sea-level rise/ Tsunami	Flooding	TBD
San Juan Port Seaport	San Juan	40	3 meter sea-level rise/ located in flood zone	Flooding (AE with BFE 2.1MSL)	TBD
Port of the Americas (Rafael Cordero Santiago) seaport	Ponce 50ft deep Lat: 17.969099 Long: -66.617918 8 piers	160	none		TBD
Port of Mayagüez Seaport	Mayagüez 47-120 ft deep Lat: 18.218464 Long: -67.160194 4 Wharfs	40	3 meter sea-level rise/ located in flood zone/ Tsunami	Flooding (AE with BFE 3MSL)	TBD

Appendix F: Email Correspondences

Alberto Lazaro (PRASA)

Monday, April 18, 2011 4:47:13 PM AST

Subject: Invitation: Interview: PR Climate Change Assessment (Apr 29 09:30 AM AST in Conference Room 3 - Infrastructure)

Date: Tuesday, April 12, 2011 11:09:50 AM AST

From: Alberto.LAZARO@acueductospr.com (sent by <Iannette_.PIZARRO@acueductospr.com>)

To: prczn@WPI.EDU, sydneyh@WPI.EDU

Invitation: Interview: PR Climate Change Assessment

04/29/2011 -

Chair: **Alberto LAZARO CASTRO/Infra/Sede/AAA**

Sent By: **Alberto_LAZARO_CASTRO/Infra/Sede/AAA%AAA@acueductospr.local**

Location: Conference Room 3 - Infrastructure

Alberto_LAZARO_CASTRO/Infra/Sede/AAA%AAA@acueductospr.local Alberto LAZARO CASTRO has invited Alberto LAZARO CASTRO to a meeting. You have not yet responded.

Required: prczn@wpi.edu, sydneyh@WPI.EDU

FYI:

Subject: RE: Interview Request for PR Climate Change Assessment
Date: Friday, April 8, 2011 3:33:53 PM AST
From: Higginbottom, Sydney Lynn
To: Iannette_.PIZARRO@acueductospr.com
CC: prczn@wpi.edu

Hola,

We can be reached at 1401-439-4848. Muchas gracias.

Sincerely,
The Coastal Zone Management Team

____

From: Iannette_.PIZARRO@acueductospr.com [Iannette_.PIZARRO@acueductospr.com]
Sent: Thursday, April 07, 2011 4:47 PM
To: Higginbottom, Sydney Lynn
Cc: ediaz@drna.gobierno.pr
Subject: Fw: Interview Request for PR Climate Change Assessment

Greetings,

I would appreciate that you send me a phone number were I can call to arrange the meeting.

Thanks,

Ianette Pizarro Ayala
Directorado de Infraestructura
Autoridad de Acueductos y Alcantarillados
Tel. (787) 999-1717 Ext. 240
Fax (787) 999-1774

----- Forwarded by Iannette PIZARRO AYALA/Infra/Sede/AAA on 04/07/2011 04:41 PM -----
Alberto LAZARO CASTRO/Infra/Sede/AAA

04/07/2011 11:28 AM

To
"Higginbottom, Sydney Lynn" <sydneyh@WPI.EDU>, Iannette .PIZARRO@acueductospr.com
cc
ediaz@drna.gobierno.pr, "prczn@wpi.edu" <prczn@WPI.EDU>, kjacobs@drna.gobierno.pr
Subject
Re: Interview Request for PR Climate Change
AssessmentLink<notes://SSJDRS1006/0425740A0063A3A7/38D46BF5E8F08834852564B500129B2C/F91FD226C4
4E8942CCA576D77CA1A165>

Viewed by: Iannette PIZARRO AYALA/Infra/Sede/AAA at 04/07/2011 04:47:30 PM

Iannette, my assistant, will coordinate.

Alberto M. Lázaro
Director Ejecutivo de Infraestructura
Autoridad de Acueductos y Alcantarillados

Sent from my Blackberry. Please excuse any typos or myspells.

----- Original Message -----
From: "Higginbottom, Sydney Lynn" [sydneyh@WPI.EDU]
Sent: 04/07/2011 11:27 AM AST
To: Alberto LAZARO CASTRO
Cc: "ediaz@drna.gobierno.pr" <ediaz@drna.gobierno.pr>; "prczn@wpi.edu" <prczn@WPI.EDU>; "kjacobs@drna.gobierno.pr" <kjacobs@drna.gobierno.pr>
Subject: FW: Interview Request for PR Climate Change Assessment

Good Morning,

My name is Sydney Higginbottom and I am sending this email on behalf of the Coastal Zone Management team. We emailed you last week regarding a possible interview for our project with the Department of Natural and Environmental Resources, and unfortunately we have not heard back yet. In case you did not get a chance to read our previous email, I have attached it below along with an email from our sponsor. Please let us know if you are willing to be interviewed and your availability, we greatly appreciate it.

Thank you and have a nice day,

The WPI Coastal Zone Management Team

____

From: Ernesto L. Diaz [ediaz@drna.gobierno.pr]
Sent: Thursday, March 31, 2011 8:54 PM
To: Gonzalez, Gregory Michael; alberto.lazaro@acueductospr.com
Cc: Kasey Jacobs; prczn@wpi.edu
Subject: RE: Interview Request for PR Climate Change Assessment

Alberto,

Saludos. EL grupo de estudiantes del Worcester Polytechnic Institute estará trabajando con mi equipo de Zona Costanera hasta mayo 2011 en la actualización de nuestro inventario de infraestructura vulnerable a los cambios climáticos. Ellos quisieran entrevistar personas clave de agencias como Turismo, AEE, AAA, DTOP, Autoridad de Carreteras, Edificios Públicos, entre otros para identificar prioridades para la adaptación o protección de infraestructura de acuerdo a cada sector específico.

Su entrevista está diseñada para ser breve y es nuestro compromiso enviarte los resultados así como mantenerte informado sobre el proceso que adelantamos para la determinación de la vulnerabilidad de nuestras costas y el desarrollo de estrategias de adaptación a los cambios climáticos.

Espero que puedas sacar un tiempito para ellos.

Gracias,

Ernesto L. Díaz
Director
Programa de Manejo de la Zona Costanera
San Juan, Puerto Rico

-----Original Message-----
From: Gonzalez, Gregory Michael [mailto:gonzalez@WPI.EDU]
Sent: Thu 3/31/2011 2:40 PM
To: alberto.lazaro@acueductospr.com
Cc: Ernesto L. Diaz; Kasey Jacobs; prczn@wpi.edu
Subject: Interview Request for PR Climate Change Assessment

Sr. Alberto Lázaro

Buenos tardes,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

With that said, we are trying to collect information and conduct interviews to achieve more knowledge of these effects on specific infrastructures and assets within the coastal zone of Puerto Rico. The water supply infrastructure is of great interest to us and it would be extremely helpful and useful if we could conduct a brief interview either in person or over the phone, whichever is preferable to you. If we should contact someone specifically regarding our possible interview, please forward us the email address and we will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

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****

Subject: Re: Interview Request for PR Climate Change Assessment
Date: Thursday, April 7, 2011 11:28:22 AM AST
From: Alberto.LAZARO@acueductospr.com
To: Higginbottom, Sydney Lynn, Iannette_.PIZARRO@acueductospr.com
CC: ediaz@drna.gobierno.pr, prczn@wpi.edu, kjacobs@drna.gobierno.pr

Iannette, my assistant, will coordinate.
Alberto M. Lázaro
Director Ejecutivo de Infraestructura
Autoridad de Acueductos y Alcantarillados

Sent from my Blackberry. Please excuse any typos or myspells.

----- Original Message -----
From: "Higginbottom, Sydney Lynn" [sydneyh@WPI.EDU]
Sent: 04/07/2011 11:27 AM AST
To: Alberto LAZARO CASTRO
Cc: "ediaz@drna.gobierno.pr" <ediaz@drna.gobierno.pr>; "prczn@wpi.edu" <prczn@WPI.EDU>; "kjacobs@drna.gobierno.pr" <kjacobs@drna.gobierno.pr>
Subject: FW: Interview Request for PR Climate Change Assessment

Good Morning,

My name is Sydney Higginbottom and I am sending this email on behalf of the Coastal Zone Management team. We emailed you last week regarding a possible interview for our project with the Department of Natural and Environmental Resources, and unfortunately we have not heard back yet. In case you did not get a chance to read our previous email, I have attached it below along with an email from our sponsor. Please let us know if you are willing to be interviewed and your availability, we greatly appreciate it.

Thank you and have a nice day,

The WPI Coastal Zone Management Team

____

From: Ernesto L. Diaz [ediaz@drna.gobierno.pr]
Sent: Thursday, March 31, 2011 8:54 PM
To: Gonzalez, Gregory Michael; alberto.lazaro@acueductospr.com
Cc: Kasey Jacobs; prczn@wpi.edu
Subject: RE: Interview Request for PR Climate Change Assessment

Alberto,

Saludos. EL grupo de estudiantes del Worcester Polytechnic Institute estará trabajando con mi equipo de Zona Costanera hasta mayo 2011 en la actualización de nuestro inventario de infraestructura vulnerable a los cambios climáticos. Ellos quisieran entrevistar personas clave de agencias como Turismo, AEE, AAA, DTOP, Autoridad de Carreteras, Edificios Públicos, entre otros para identificar prioridades para la adaptación o protección de infraestructura de acuerdo a cada sector específico.

Su entrevista está diseñada para ser breve y es nuestro compromiso enviarte los resultados así como mantenerte informado sobre el proceso que adelantamos para la determinación de la vulnerabilidad de nuestras costas y el desarrollo de estrategias de adaptación a los cambios climáticos.

Espero que puedas sacar un tiempito para ellos.

Gracias,

Ernesto L. Díaz
Director
Programa de Manejo de la Zona Costanera
San Juan, Puerto Rico

-----Original Message-----
From: Gonzalez, Gregory Michael [mailto:gonzalez@WPI.EDU]
Sent: Thu 3/31/2011 2:40 PM
To: alberto.lazaro@acueductospr.com
Cc: Ernesto L. Diaz; Kasey Jacobs; prczn@wpi.edu
Subject: Interview Request for PR Climate Change Assessment

Sr. Alberto Lázaro

Buenos tardes,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

With that said, we are trying to collect information and conduct interviews to achieve more knowledge of these effects on specific infrastructures and assets within the coastal zone of Puerto Rico. The water supply infrastructure is of great interest to us and it would be extremely helpful and useful if we could conduct a brief interview either in person or over the phone, whichever is preferable to you. If we should contact someone specifically regarding our possible interview, please forward us the email address and we will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

Subject: Interview Request for PR Climate Change Assessment
Date: Thursday, March 31, 2011 2:40:04 PM AST
From: Gonzalez, Gregory Michael
To: alberto.lazaro@acueductospr.com
CC: ediaz@drna.gobierno.pr, Kasey Jacobs, prczn@wpi.edu

Sr. Alberto Lázaro

Buenos tardes,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

With that said, we are trying to collect information and conduct interviews to achieve more knowledge of these effects on specific infrastructures and assets within the coastal zone of Puerto Rico. The water supply infrastructure is of great interest to us and it would be extremely helpful and useful if we could conduct a brief interview either in person or over the phone, whichever is preferable to you. If we should contact someone specifically regarding our possible interview, please forward us the email address and we will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

Fransisco Mitchell (La Concha)

Subject: Correspondence with Mitchell
Date: Monday, April 18, 2011 10:44:33 AM AST
From: Gonzalez, Gregory Michael
To: prczn@WPI.EDU

Francisco Mitchell - La Concha
787-721-7500

Walked in on: April 8th, 3:15 PM, left a note for Mr. Mitchell
Voicemail received on: April 8th, 5:47 PM
Called on: April 8th, 6:41 PM
Called on: April 11th, 10:25 AM
Both calls just rang
Walked in on: April 11th, 2:00 PM
Told to return the next day at 2 and ask for Mr. Mitchell
Walked in on: April 12th, 2:00 PM
Mr. Mitchell not available.
Emailed on: April 12th, 3:51 PM
Called his cell on: April 14th, 3:25 PM
Left a message.

No response since his voicemail on April 8th.

Subject: La Concha Assessment
Date: Tuesday, April 12, 2011 3:51:01 PM AST
From: Gonzalez, Gregory Michael
To: fmitchell@laconcharesort.com
CC: prczn@WPI.EDU

Hi Mr. Mitchell
My name is Gregory Gonzalez, I left a message for you with the concierge at La Concha on Friday. I received your voicemail Friday afternoon and since then I've tried to contact you/meet with you several times with no luck. I understand you're a busy and important man so maybe our questions would be best answered over email at your convenience. First I will give you a background about who we are and what we are doing. We are a group of four students from Worcester Polytechnic Institute in Worcester Massachusetts, we are working with the Departamento de Recursos Naturales y Ambientales, specifically the Coastal Zone Management Program. Our project consists of identifying and assessing infrastructures on the coast of Puerto Rico that may be at risk to climate changes. The climate changes that concern us includes: sea level rise, coastal erosion, storm surges, earthquakes, and tsunamis.

With that being said I have prepared a few questions for you.

- Has La Concha suffered damages in the past from any of the hazards mentioned above?
  - If so what were they?
- Which of the mentioned climate hazards pose the biggest potential threat?
  - What would the potential impacts be of these threat(s)
- How long could La Concha last without any major upgrades or renovations?
- Are there any ongoing or planned upgrades or renovations?
- What is the estimated net worth of La Concha?

I appreciate any help that you may be able to provide. If you have any questions or need further documentation before answering these questions please let me know and I will be sure to get back to you.

Thanks again,

Hospital

Subject: Hospital correspondence
Date: Monday, April 18, 2011 1:53:49 PM AST
From: Gonzalez, Gregory Michael
To: prczn@WPI.EDU

Hospital Correspondence

* Emailed Jocelyn Padín on: March 24th, 2:16 PM
  * Was told to email Pedro Gonzalez
* Emailed Pedro Gonzalez on: March 25th, 10:14 AM
* Walked in to H&R on: April 12th, 2:45 PM
  * Was told to send an email with an official letter
* Official email was sent by Kasey on: April 13th, 12:49 PM

No word back.

Subject: Interview Request for Director of Hospital Security
Date: Wednesday, April 13, 2011 12:49:51 PM AST
From: Kasey Jacobs
To: jobs@presbypr.com
CC: prczn@WPI.EDU

GOVERNMENT OF PUERTO RICO

Department of Natural and Environmental Resources

April 13, 2011

Ashford Presbyterian Community Hospital
PO Box 9020032
San Juan, PR 00902-0032

Re: Interview Request

Dear Director of Hospital Security,

The Puerto Rico Coastal Zone Management Program is coordinating the development of a critical infrastructure vulnerability assessment for the coastal zone. We have contracted four Worchester Polytechnic Institute students to begin this work. Their names are Caitlin Chase, Gregory Gonzalez, Daphne Gorman and Sydney Higginbottom.

To conduct this work the students are mapping using GIS the Puerto Rico infrastructure assets that may be at risk from floods, storm surge, tsunami, and sea level rise. In addition to the mapping the students are conducting interviews with key facility and maintenance staff in San Juan to get an on-the-ground understanding of critical infrastructure operations.

Questions about this activity can be directed to myself or Ernesto L. Diaz, Director of the Puerto Rico Coastal Zone Management Program.

Sincerely,

Kasey R. Jacobs
Project Coordinator
Puerto Rico Coastal Zone Management Program
kjacobs@drna.gobierno.pr
787-999-2200 x 2720

Attachments: Word Version of Letter

Kasey R. Jacobs
NOAA Coastal Management Fellow
Puerto Rico Coastal Zone Management Program
Department of Natural and Environmental Resources
PO BOX 366147
San Juan PR 00936
Email: kjacobs@drna.gobierno.pr
Ph: (787) 999-2200 x2720
Fax: (787) 999-2267

PR-CC-Listserv: http://groups.google.com/group/pr-cc-listserv

Subject: Possible Interview
Date: Friday, March 25, 2011 10:14:49 AM AST
From: Gonzalez, Gregory Michael
To: pgonzalez@presbypr.com
CC: prczn@wpi.edu, Kasey Jacobs

Dear Mr. Gonzalez,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

With that said, we are trying to collect information and conduct interviews to achieve more knowledge of these effects on specific infrastructure within the coastal zone of Puerto Rico. It would be extremely helpful and useful if we could interview a building director or manager, and maintenance worker or custodian, to see how the hospital would be affected from the climate changes previously mentioned. If we should contact someone specifically regarding our possible interview, please forward us the email address and we will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

Subject: Re: Possible Interview
Date: Friday, March 25, 2011 10:11:07 AM AST
From: Gonzalez, Gregory Michael
To: jocelyn padin

Gracias por su ayuda.

On 3/25/11 9:16 AM, "jocelyn padin" <jpadin@presbypr.com> wrote:

> Gonzalez, please contact our Executive Director Pedro J. Gonzalez, email
> pgonzalez@presbypr.com, tel.(787) 722-2262
>
> Thanks you,
> Jocelyn
>
> -----Original Message-----
> From: Gonzalez, Gregory Michael [mailto:gonzalez@WPI.EDU]
> Sent: Thursday, March 24, 2011 2:16 PM
> To: jpadin@presbypr.com
> Cc: prczn@wpi.edu; Kasey Jacobs
> Subject: Possible Interview
>
> Dear Mrs. Padín,
>
> We are a group of four students from Worcester Polytechnic Institute in
> Worcester, Massachusetts and are currently in Puerto Rico working with the
> Department of Natural and Environmental Resources on assessing critical
> infrastructure within Puerto Rico's coastal zone. Our project is to
> determine whether some of Puerto Rico's infrastructure is vulnerable to
> the
> effects of climate variability such as rising sea-level, storm surges,
> high
> winds, earthquakes, and hurricanes; and if so, how.
>
> With that said, we are trying to collect information and conduct
> interviews
> to achieve more knowledge of these effects on specific infrastructure
> within
> the coastal zone of Puerto Rico. It would be extremely helpful and useful
> if we could interview a building director or manager, and maintenance
> worker
> or custodian, to see how the hospital would be affected from the climate
> changes previously mentioned. If we should contact someone specifically
> regarding our possible interview, please forward us the email address and
> we
> will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

Jamie Geliga (PRASA)

Subject: Correspondence with Geliga
Date: Monday, April 18, 2011 11:03:01 AM AST
From: Gonzalez, Gregory Michael
To: prczn@WPI.EDU

Jaime Geliga - Chief of Municipal Water Program Branch
787- 977-5870

* Emailed on: March 16th, 5:29
  * Sent from Kasey Jacobs.
* Follow up on: March 28th, 1:09 PM
* Response on: March 28th, 1:51 PM
* Emailed on: March 28th, 2:03 PM
  * Proposed meeting times.
* Received confirmation for a meeting on: March 30th, 8:31 AM
  * Meeting scheduled for March 31st, 2:00PM
* Received change of meeting time on: March 30th, 8:53 AM
  * Meeting changed to April 4th, afternoon
* Sent confirmation email on: March 30th, 10:46 AM
* Follow up confirmation email on: April 3rd: 10:47 PM
  * Regarding meeting on April 4th
* Called on: April 4th, 2:14 PM
  * Not in the office
* Emailed on: April 4th, 2:31PM
* Called on: April 5th, 2:30 PM
  * Not available, left a message with a number to reach us at.

Subject: Re: Interview Request for PR Climate Change Assessment
Date: Monday, April 4, 2011 2:31:24 PM AST
From: Gonzalez, Gregory Michael
To: Geliga.Jaime@epamail.epa.gov
CC: prczn@wpi.edu

Hello Mr. Geliga,
We tried calling you today however we were informed that you were not in the office today, but will be tomorrow. We will try to contact you again tomorrow. If there is a preferable time you would like us to call please let us know.

Sincerely,

The Coastal Zone Management Team

On 4/3/11 10:47 PM, "Higginbottom, Sydney Lynn" <sydneyh@WPI.EDU> wrote:

> Hi Mr. Geliga,
>
> We just wanted to confirm our interview for tomorrow afternoon. We are available for the phone interview any time during the afternoon so whenever is best for you, we would be happy to call. Would you mind sending us your phone number whenever you get a chance during the morning tomorrow along with what time you would like us to call? Thank you and we look forward to hearing from you.
>
> The Coastal Zone Management Team
>
> ________________________________
> From: Geliga.Jaime@epamail.epa.gov [Geliga.Jaime@epamail.epa.gov]
> Sent: Wednesday, March 30, 2011 8:53 AM
> To: Gonzalez, Gregory Michael
> Cc: Kasey Jacobs; prczn@wpi.edu; Rodriguez.Teresita@epamail.epa.gov
> Subject: Re: Interview Request for PR Climate Change Assessment
>
> My apologies but a meeting with our RA just came up for tomorrow afternoon. Can we meet next monday in the afternoon?
> Jaime A. Geliga, Chief
> Municipal Water Programs Branch
> Caribbean Environmental Protection Division
>
> Any time you have an opportunity to make a difference in this world and you don't do it, you are wasting your time on this earth. - Roberto Clemente

Subject: RE: Interview Request for PR Climate Change Assessment
Date: Sunday, April 3, 2011 10:47:55 PM AST
From: Higginbottom, Sydney Lynn
To: Geliga.Jaime@epamail.epa.gov
CC: prczn@wpi.edu

Hi Mr. Geliga,

We just wanted to confirm our interview for tomorrow afternoon. We are available for the phone interview any time during the afternoon so whenever is best for you, we would be happy to call. Would you mind sending us your phone number whenever you get a chance during the morning tomorrow along with what time you would like us to call? Thank you and we look forward to hearing from you.

The Coastal Zone Management Team

____

From: Geliga.Jaime@epamail.epa.gov [Geliga.Jaime@epamail.epa.gov]
Sent: Wednesday, March 30, 2011 8:53 AM
To: Gonzalez, Gregory Michael
Cc: Kasey Jacobs; prczn@wpi.edu; Rodriguez.Teresita@epamail.epa.gov
Subject: Re: Interview Request for PR Climate Change Assessment

My apologies but a meeting with our RA just came up for tomorrow afternoon. Can we meet next monday in the afternoon?
Jaime A. Geliga, Chief
Municipal Water Programs Branch
Caribbean Environmental Protection Division

Any time you have an opportunity to make a difference in this world and you don't do it, you are wasting your time on this earth. - Roberto Clemente

Subject: Re: Interview Request for PR Climate Change Assessment
Date: Wednesday, March 30, 2011 10:46:34 AM AST
From: Gonzalez, Gregory Michael
To: Geliga.Jaime@epamail.epa.gov
CC: Kasey Jacobs, prczn@wpi.edu, Rodriguez.Teresita@epamail.epa.gov

That's fine, Monday afternoon works however, we were planning on conducing the interview over the phone, it shouldn't take more than 20 minutes. If you have free time before Monday let us know and we can try to do it then.

Sincerely,
Coastal Zone Management Team

From: <Geliga.Jaime@epamail.epa.gov>
Date: Wed, 30 Mar 2011 08:53:47 -0400
To: Gregory Gonzalez <gonzalez@wpi.edu>
Cc: Kasey Jacobs <kjacobs@drna.gobierno.pr>, "prczn@wpi.edu" <prczn@WPI.EDU>, <Rodriguez.Teresita@epamail.epa.gov>
Subject: Re: Interview Request for PR Climate Change Assessment

My apologies but a meeting with our RA just came up for tomorrow afternoon. Can we meet next monday in the afternoon?
Jaime A. Geliga, Chief
Municipal Water Programs Branch
Caribbean Environmental Protection Division

Subject: Re: Interview Request for PR Climate Change Assessment
Date: Wednesday, March 30, 2011 8:53:47 AM AST
From: Geliga.Jaime@epamail.epa.gov
To: Gonzalez, Gregory Michael
CC: Kasey Jacobs, prczn@wpi.edu, Rodriguez.Teresita@epamail.epa.gov

My apologies but a meeting with our RA just came up for tomorrow afternoon. Can we meet next monday in the afternoon?
Jaime A. Geliga, Chief
Municipal Water Programs Branch
Caribbean Environmental Protection Division

Any time you have an opportunity to make a difference in this world and you don't do it, you are wasting your time on this earth. - Roberto Clemente

Subject: Re: Interview Request for PR Climate Change Assessment
Date: Wednesday, March 30, 2011 8:31:39 AM AST
From: Geliga.Jaime@epamail.epa.gov
To: Gonzalez, Gregory Michael
CC: Kasey Jacobs, prczn@wpi.edu, Rodriguez.Teresita@epamail.epa.gov

It is better for me on thursday 3/31 at 2:00 pm.
Jaime A. Geliga, Chief
Municipal Water Programs Branch
Caribbean Environmental Protection Division

Any time you have an opportunity to make a difference in this world and you don't do it, you are wasting your time on this earth. - Roberto Clemente

From: "Gonzalez, Gregory Michael" <gonzalez@WPI.EDU>
To: Kasey Jacobs <kjacobs@drna.gobierno.pr>, Jaime Geliga/R2/USEPA/US@EPA, "prczn@wpi.edu" <prczn@WPI.EDU>
Cc: Teresita Rodriguez/R2/USEPA/US@EPA
Date: 03/28/2011 02:03 PM
Subject: Re: Interview Request for PR Climate Change Assessment

---

We were thinking Wednesday (3/30) or Thursday (3/31) anytime between 9am-3pm. What time would work best for you?

Sincerely,
Coastal Management Team

From: Kasey Jacobs <kjacobs@drna.gobierno.pr<mailto:kjacobs@drna.gobierno.pr>>
Date: Mon, 28 Mar 2011 13:45:29 -0400
To: <Geliga.Jaime@epamail.epa.gov<mailto:Geliga.Jaime@epamail.epa.gov>>, "prczn@wpi.edu<mailto:prczn@wpi.edu>" <prczn@WPI.EDU<mailto:prczn@WPI.EDU>>
Cc: <Rodriguez.Teresita@epamail.epa.gov<mailto:Rodriguez.Teresita@epamail.epa.gov>>
Subject: RE: FW: Interview Request for PR Climate Change Assessment

Thank you. The WPI team will email you shortly with possible dates.

Sincerely,
Kasey

From: Geliga.Jaime@epamail.epa.gov<mailto:Geliga.Jaime@epamail.epa.gov> [mailto:Geliga.Jaime@epamail.epa.gov]
Sent: Monday, March 28, 2011 1:51 PM
To: Kasey Jacobs
Cc: Rodriguez.Teresita@epamail.epa.gov<mailto:Rodriguez.Teresita@epamail.epa.gov>
Subject: Re: FW: Interview Request for PR Climate Change Assessment

Please propose me a few dates and we can arrange the interview. Thanks

Jaime A.Geliga, Chief
Municipal Water Programs Branch
Caribbean Environmental Protection Division

Any time you have an opportunity to make a difference in this world and youdon't do it, you are wasting your time on this earth. - Roberto Clemente

From: "Kasey Jacobs" <kjacobs@drna.gobierno.pr<mailto:kjacobs@drna.gobierno.pr>>
To: Jaime Geliga/R2/USEPA/US@EPA
Cc: Teresita Rodriguez/R2/USEPA/US@EPA
Date: 03/28/2011 01:09 PM
Subject: FW: Interview Request for PR Climate Change Assessment

____

Buenas tardes Sr. Geliga,

I am just writing to follow up on the email below.

Thank you for your time,
Kasey

-----Original Message-----
From: Kasey Jacobs
Sent: Wednesday, March 16, 2011 5:30 PM
To: geliga.jaime@epa.gov<mailto:geliga.jaime@epa.gov>
Cc: rodriguez.teresita@epa.gov<mailto:rodriguez.teresita@epa.gov>; prczn@wpi.edu<mailto:prczn@wpi.edu>
Subject: Interview Request for PR Climate Change Assessment

Dear Jaime,

My name is Kasey Jacobs, coordinator of the Puerto Rico Coastal Adaptation Project at DNER. A couple of months ago I discussed our project with Ms. Teresita Rodriguez and she highly recommended we speak with you.

As a component of a Coastal Zone-wide Vulnerability Assessment we have contracted a team of students from Worcester Polytechnic Institute(WPI)to perform a critical infrastructure vulnerability assessment. This assessment will be identifying which types of infrastructure might be at-risk from climate impacts like sea level rise and storm surges. Wastewater treatment plants and sewage infrastructure are of course high priority.

Below is a letter from the WPI team requesting an interview with you at your earliest convenience. I have also cc'ed them to this interview request so you have their group email address.

Thank you for your time,
Kasey Jacobs

****

Dear Mr. Geliga,

We are a group of four students from Worcester Polytechnic Institute who are working on a coastal zone management project in Puerto Rico. We are working with Kasey Jacobs and the Department of Natural and Environmental Resources to identify which infrastructure within the coastal zone are vulnerable to certain climate changes or weather patterns such as rising sea-level and hurricanes, to name a few. Part of our project involves interviewing knowledgeable people in Puerto Rico about coastal infrastructure, and Kasey identified you as an important person we should interview. Some of the things we would like to discuss with you are sewage treatment plants and sewage systems, operations, upgrades and maintenance. We were wondering if we could schedule a time to meet next week and conduct a short interview. If it is okay with you we would like to tape the conversation instead of taking written notes. Please get back to us at your earliest convenience.

Sincerely,

The WPI Puerto Rico Coastal Zone Management Team

Subject: Interview Request for PR Climate Change Assessment
Date: Wednesday, March 16, 2011 5:29:41 PM AST
From: Kasey Jacobs
To: geliga.jaime@epa.gov
CC: rodriguez.teresita@epa.gov, prczn@WPI.EDU

Dear Jaime,

My name is Kasey Jacobs, coordinator of the Puerto Rico Coastal Adaptation Project at DNER. A couple of months ago I discussed our project with Ms. Teresita Rodriguez and she highly recommended we speak with you.

As a component of a Coastal Zone-wide Vulnerability Assessment we have contracted a team of students from Worcester Polytechnic Institute(WPI)to perform a critical infrastructure vulnerability assessment. This assessment will be identifying which types of infrastructure might be at-risk from climate impacts like sea level rise and storm surges. Wastewater treatment plants and sewage infrastructure are of course high priority.

Below is a letter from the WPI team requesting an interview with you at your earliest convenience. I have also cc'ed them to this interview request so you have their group email address.

Thank you for your time,
Kasey Jacobs

****

Dear Mr. Geliga,

We are a group of four students from Worcester Polytechnic Institute who are working on a coastal zone management project in Puerto Rico. We are working with Kasey Jacobs and the Department of Natural and Environmental Resources to identify which infrastructure within the coastal zone are vulnerable to certain climate changes or weather patterns such as rising sea-level and hurricanes, to name a few. Part of our project involves interviewing knowledgeable people in Puerto Rico about coastal infrastructure, and Kasey identified you as an important person we should interview. Some of the things we would like to discuss with you are sewage treatment plants and sewage systems, operations, upgrades and maintenance. We were wondering if we could schedule a time to meet next week and conduct a short interview. If it is okay with you we would like to tape the conversation instead of taking written notes. Please get back to us at your earliest convenience.

Sincerely,

The WPI Puerto Rico Coastal Zone Management Team

Juan Padilla

Subject: PREPA Correspondence
Date: Monday, April 18, 2011 11:46:42 AM AST
From: Gonzalez, Gregory Michael
To: prczn@WPI.EDU

Puerto Rico Electric
Juan Padilla/Martha Silva

* Emailed Martha Silva on: March 31st, 2:31 PM
* Follow up email on: April 7th, 11:29 AM
* Received an email on: April 7th, 1:03 PM
  * Referred us to Juan Padilla
* Emailed Juan Padilla on: April 8th, 4:13 PM
* Called Juan Padilla on April 11th, 3:36 PM
  * 787-521-4636
  * Left a message for Padilla, we were told he might call us back.

Subject: FW: FW: Interview Request for PR Climate Change Assessment
Date: Monday, April 18, 2011 10:05:48 AM AST
From: Higginbottom, Sydney Lynn
To: Gonzalez, Gregory Michael

From: Higginbottom, Sydney Lynn
Sent: Friday, April 08, 2011 3:49 PM
To: MARTA SILVA HERNANDEZ
Subject: RE: FW: Interview Request for PR Climate Change Assessment

Hello,

Thank you for your reply. We will send a request letter to Mr. Padilla.

Sincerely,
The Coastal Zone Management Team

From: MARTA SILVA HERNANDEZ [M-SILVA@PREPA.COM]
Sent: Thursday, April 07, 2011 1:03 PM
To: Higginbottom, Sydney Lynn
Cc: ediaz@drna.gobierno.pr; INDIRA MOHIP; RUPERTO BERRIOS
Subject: Re: FW: Interview Request for PR Climate Change Assessment

Hello,

Sorry for the delay in my reply, I was out of the office.

After consulting my supervisor, he told me that the students should send a request letter to the Press Office. The contact person is Juan D. Padilla (email: jpadilla12566@prepa.com, Fax: 787-521-4927, Phone: 787-521-4636, 787-521-3361, 787-521-3421).

Postal Address:

Attention: Juan D. Padilla
Puerto Rico Electric Power Authority (PREPA)
Press Office
PO Box 364267
San Juan, PR 00936-4267

Press Office personnel will determine who is the proper person from PREPA for the interview.

If you have any questions, please feel free to contact me.

Marta I. Silva Hernández
Oficial de Protección Ambiental
División de Protección Ambiental
y Confiabilidad de Calidad
Autoridad de Energía Eléctrica
PO Box 364267

San Juan, PR 00936-4267

Tel: 787.521.4965
Fax: 787.521.4999
email: m-silva@prepa.com

P ***"Before you print this E-mail, ask if it's really necessary. Our environment concerns us all."***

>>> "Higginbottom, Sydney Lynn" <sydneyh@WPI.EDU> 4/7/2011 11:29 AM >>>
Good Morning,

My name is Sydney Higginbottom and I am sending this email on behalf of the Coastal Zone Management team. We emailed you last week regarding a possible interview for our project with the Department of Natural and Environmental Resources, and unfortunately we have not heard back yet. In case you did not get a chance to read our previous email, I have attached it below along with an email from our sponsor. Please let us know if you are willing to be interviewed and your availability, we greatly appreciate it.

Thank you and have a nice day,

The WPI Coastal Zone Management Team

____
From: Ernesto L. Diaz [ediaz@drna.gobierno.pr]
Sent: Thursday, March 31, 2011 8:57 PM
To: Gonzalez, Gregory Michael; m-silva@prepa.com
Cc: Kasey Jacobs; prczn@wpi.edu
Subject: RE: Interview Request for PR Climate Change Assessment

Martha,

Saludos. EL grupo de estudiantes del Worcester Polytechnic Institute estará trabajando con mi equipo de Zona Costanera hasta mayo 2011 en la actualización de nuestro inventario de infraestructura vulnerable a los cambios climáticos. Ellos quisieran entrevistar personas clave de agencias como Turismo, AEE, AAA, DTOP, Autoridad de Carreteras, Edificios Públicos, entre otros para identificar prioridades para la adaptación o protección de infraestructura de acuerdo a cada sector específico.

Su entrevista está diseñada para ser breve y es nuestro compromiso enviarte los resultados así como mantenerte informado sobre el proceso que adelantamos para la determinación de la vulnerabilidad de nuestras costas y el desarrollo de estrategias de adaptación a los cambios climáticos.

Espero que puedas sacar un tiempito para ellos y/o ayudarlos a conseguir una entrevista con alguna persona de desarrollo, planificaicón o infraestructura que nos pueda ayudar.

Gracias,

Ernesto L. Díaz

Director
Programa de Manejo de la Zona Costanera
San Juan, Puerto Rico

-----Original Message-----
From: Gonzalez, Gregory Michael [mailto:gonzalez@WPI.EDU]
Sent: Thu 3/31/2011 2:31 PM
To: m-silva@prepa.com
Cc: Ernesto L. Diaz; Kasey Jacobs; prczn@wpi.edu
Subject: Interview Request for PR Climate Change Assessment

Sra. Martha Silva,

Buenos tardes,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

With that said, we are trying to collect information and conduct interviews to achieve more knowledge of these effects on specific infrastructures and assets within the coastal zone of Puerto Rico. The power supply infrastructure is of great interest to us and it would be extremely helpful and useful if we could conduct a brief interview either in person or over the phone, whichever is preferable to you. If we should contact someone specifically regarding our possible interview, please forward us the email address and we will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

Subject: possible interview
Date: Friday, April 8, 2011 4:13:58 PM AST
From: Higginbottom, Sydney Lynn
To: jpadilla12566@prepa.com
CC: prczn@wpi.edu, ediaz@drna.gobierno.pr

Buenos tardes,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

With that said, we are trying to collect information and conduct interviews to achieve more knowledge of these effects on specific infrastructures and assets within the coastal zone of Puerto Rico. The power supply infrastructure is of great interest to us and it would be extremely helpful and useful if we could conduct a brief interview either in person or over the phone, whichever is preferable to you. If we should contact someone specifically regarding our possible interview, please forward us the email address and we will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,
Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom
The WPI Coastal Zone Management Team

Subject: Fwd: Re: FW: Interview Request for PR Climate Change Assessment
Date: Thursday, April 7, 2011 1:04:48 PM AST
From: MARTA SILVA HERNANDEZ
To: gonzalez@WPI.EDU

>>> MARTA SILVA HERNANDEZ 4/7/2011 1:03 PM >>>
Hello,

Sorry for the delay in my reply, I was out of the office.

After consulting my supervisor, he told me that the students should send a request letter to the Press Office. The contact person is Juan D. Padilla (email: jpadilla12566@prepa.com, Fax: 787-521-4927, Phone: 787-521-4636, 787-521-3361, 787-521-3421).

Postal Address:

Attention: Juan D. Padilla
Puerto Rico Electric Power Authority (PREPA)
Press Office
PO Box 364267
San Juan, PR 00936-4267

Press Office personnel will determine who is the proper person from PREPA for the interview.

If you have any questions, please feel free to contact me.

Marta I. Silva Hernández
Oficial de Protección Ambiental
División de Protección Ambiental
y Confiabilidad de Calidad
Autoridad de Energía Eléctrica
PO Box 364267
San Juan, PR 00936-4267

Tel: 787.521.4965
Fax: 787.521.4999
email: m-silva@prepa.com

>>> "Higginbottom, Sydney Lynn" <sydneyh@WPI.EDU> 4/7/2011 11:29 AM >>>
Good Morning,

My name is Sydney Higginbottom and I am sending this email on behalf of the Coastal Zone Management team. We emailed you last week regarding a possible interview for our project with the Department of Natural and Environmental Resources, and unfortunately we have not heard back yet. In case you did not get a chance to read our previous email, I have attached it below along with an email from our sponsor. Please let us know if you are willing to be interviewed and your availability, we greatly appreciate it.

Thank you and have a nice day,

The WPI Coastal Zone Management Team

____

From: Ernesto L. Diaz [ediaz@drna.gobierno.pr]
Sent: Thursday, March 31, 2011 8:57 PM
To: Gonzalez, Gregory Michael; m-silva@prepa.com
Cc: Kasey Jacobs; prczn@wpi.edu
Subject: RE: Interview Request for PR Climate Change Assessment

Martha,

Saludos. EL grupo de estudiantes del Worcester Polytechnic Institute estará trabajando con mi equipo de Zona Costanera hasta mayo 2011 en la actualización de nuestro inventario de infraestructura vulnerable a los cambios climáticos. Ellos quisieran entrevistar personas clave de agencias como Turismo, AEE, AAA, DTOP, Autoridad de Carreteras, Edificios Públicos, entre otros para identificar prioridades para la adaptación o protección de infraestructura de acuerdo a cada sector específico.

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Espero que puedas sacar un tiempito para ellos y/o ayudarlos a conseguir una entrevista con alguna persona de desarrollo, planificaicón o infraestructura que nos pueda ayudar.

Gracias,

Ernesto L. Díaz
Director
Programa de Manejo de la Zona Costanera
San Juan, Puerto Rico

-----Original Message-----
From: Gonzalez, Gregory Michael [mailto:gonzalez@WPI.EDU]
Sent: Thu 3/31/2011 2:31 PM
To: m-silva@prepa.com
Cc: Ernesto L. Diaz; Kasey Jacobs; prczn@wpi.edu
Subject: Interview Request for PR Climate Change Assessment

Sra. Martha Silva,

Buenos tardes,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

With that said, we are trying to collect information and conduct interviews to achieve more knowledge of these effects on specific infrastructures and assets within the coastal zone of Puerto Rico. The power supply infrastructure is of great interest to us and it would be extremely helpful and useful if we could conduct a brief interview either in person or over the phone, whichever is preferable to you. If we should contact someone specifically regarding our possible interview, please forward us the email address and we will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

Verified by Puerto Rico Electric Power Authority McAfee Email and Web Security System (SCM1).

Subject: FW: Interview Request for PR Climate Change Assessment
Date: Thursday, April 7, 2011 11:29:50 AM AST
From: Higginbottom, Sydney Lynn
To: m-silva@prepa.com
CC: ediaz@drna.gobierno.pr, prczn@wpi.edu, kjacobs@drna.gobierno.pr

Good Morning,

My name is Sydney Higginbottom and I am sending this email on behalf of the Coastal Zone Management team. We emailed you last week regarding a possible interview for our project with the Department of Natural and Environmental Resources, and unfortunately we have not heard back yet. In case you did not get a chance to read our previous email, I have attached it below along with an email from our sponsor. Please let us know if you are willing to be interviewed and your availability, we greatly appreciate it.

Thank you and have a nice day,

The WPI Coastal Zone Management Team

____

From: Ernesto L. Diaz [ediaz@drna.gobierno.pr]
Sent: Thursday, March 31, 2011 8:57 PM
To: Gonzalez, Gregory Michael; m-silva@prepa.com
Cc: Kasey Jacobs; prczn@wpi.edu
Subject: RE: Interview Request for PR Climate Change Assessment

Martha,

Saludos. EL grupo de estudiantes del Worcester Polytechnic Institute estará trabajando con mi equipo de Zona Costanera hasta mayo 2011 en la actualización de nuestro inventario de infraestructura vulnerable a los cambios climáticos. Ellos quisieran entrevistar personas clave de agencias como Turismo, AEE, AAA, DTOP, Autoridad de Carreteras, Edificios Públicos, entre otros para identificar prioridades para la adaptación o protección de infraestructura de acuerdo a cada sector específico.

Su entrevista está diseñada para ser breve y es nuestro compromiso enviarte los resultados así como mantenerte informado sobre el proceso que adelantamos para la determinación de la vulnerabilidad de nuestras costas y el desarrollo de estrategias de adaptación a los cambios climáticos.

Espero que puedas sacar un tiempito para ellos y/o ayudarlos a conseguir una entrevista con alguna persona de desarrollo, planificaicón o infraestructura que nos pueda ayudar.

Gracias,

Ernesto L. Díaz
Director
Programa de Manejo de la Zona Costanera
San Juan, Puerto Rico

-----Original Message-----
From: Gonzalez, Gregory Michael [mailto:gonzalez@WPI.EDU]
Sent: Thu 3/31/2011 2:31 PM
To: m-silva@prepa.com

Cc: Ernesto L. Diaz; Kasey Jacobs; prczn@wpi.edu
Subject: Interview Request for PR Climate Change Assessment

Sra. Martha Silva,

Buenos tardes,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

With that said, we are trying to collect information and conduct interviews to achieve more knowledge of these effects on specific infrastructures and assets within the coastal zone of Puerto Rico. The power supply infrastructure is of great interest to us and it would be extremely helpful and useful if we could conduct a brief interview either in person or over the phone, whichever is preferable to you. If we should contact someone specifically regarding our possible interview, please forward us the email address and we will contact them directly.

Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

Subject: Interview Request for PR Climate Change Assessment
Date: Thursday, March 31, 2011 2:31:26 PM AST
From: Gonzalez, Gregory Michael
To: m-silva@prepa.com
CC: ediaz@drna.gobierno.pr, Kasey Jacobs, prczn@wpi.edu

Sra. Martha Silva,

Buenos tardes,

We are a group of four students from Worcester Polytechnic Institute in Worcester, Massachusetts and are currently in Puerto Rico working with the Department of Natural and Environmental Resources on assessing critical infrastructure within Puerto Rico's coastal zone. Our project is to determine whether some of Puerto Rico's infrastructure is vulnerable to the effects of climate variability such as rising sea-level, storm surges, high winds, earthquakes, and hurricanes; and if so, how.

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Thank you for your time and we look forward to hearing from you.

Sincerely,

Caitlin Chase, Gregory Gonzalez, Daphne Gorman, and Sydney Higginbottom

The WPI Coastal Zone Management Team

Lilliam Almeyda (Public Buildings)

Subject: Correspondence with Almeyda
Date: Monday, April 18, 2011 11:34:23 AM AST
From: Gonzalez, Gregory Michael
To: prczn@WPI.EDU

Lilliam Almeyda – Director, Public Building Authority
787-722-0101

* Called on: April 12th, 4:13 PM
* Follow up email on: April 12th, 4:40 PM
* Received confirmation email: April 13th, 4:42 PM
  * On vacation until April 25th

Subject: RE: Interview Request
Date: Wednesday, April 13, 2011 4:42:43 PM AST
From: Lilliam Almeyda
To: Gonzalez, Gregory Michael
CC: prczn@WPI.EDU

Good Afternoon:
I am going to be on vacation until April 25,after that you can call me at 787-721-3145

Lilliam Almeyda Ibáñez
Directora
Área de Desarrollo de Proyectos
Autoridad de Edificios Públicos
Tel. (787)721-3145

-----Original Message-----
From: Gonzalez, Gregory Michael [mailto:gonzalez@WPI.EDU]
Sent: Tuesday, April 12, 2011 4:41 PM
To: Lilliam Almeyda
Cc: prczn@WPI.EDU
Subject: Interview Request

Hola Lilliam,
My name is Gregory Gonzalez, I am part of a group of students working with the Departamento de Recursos Naturales y Ambientales, specifically the Coastal Zone Management Program. Our project consists of identifying and assessing infrastructures on the coast of Puerto Rico that may be at risk to climate changes. We would like to interview you, either by phone or in person whichever you prefer, to get a better understanding of how the public buildings of Puerto Rico prepare themselves for coastal hazards.

We look foreword to hearing from you,

-Greg and the Coastal Zone Management Team

Subject: Interview Request
Date: Tuesday, April 12, 2011 4:40:56 PM AST
From: Gonzalez, Gregory Michael
To: lilliam.almeyda@aep.gobierno.pr
CC: prczn@WPI.EDU

Hola Lilliam,
My name is Gregory Gonzalez, I am part of a group of students working with the Departamento de Recursos Naturales y Ambientales, specifically the Coastal Zone Management Program. Our project consists of identifying and assessing infrastructures on the coast of Puerto Rico that may be at risk to climate changes. We would like to interview you, either by phone or in person whichever you prefer, to get a better understanding of how the public buildings of Puerto Rico prepare themselves for coastal hazards.

We look foreword to hearing from you,

-Greg and the Coastal Zone Management Team

Appendix G: Spreadsheets with Recommended GIS Data Added

Airports (Complete Coastal Zone)

DESCRIP	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_METERS	VELOCITY_METERS_	FID_Tsunami	TSUNAMI_STATUS	3M_SEA_LEVEL_RISE
PATILLAS	yes	1979	AE		T	2.7	-9999	-9999	640	Safe Zone	affected
CULEBRA	yes	1	X		F	-9999	-9999	-9999	250	Safe Zone	affected
LUIS MUNOZ MARIN INTL	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected
FERNANDO LUIS RIBAS DOMINICCI	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected
ANTONIO RIVERA RODRIQUEZ	yes	279	X		F	-9999	-9999	-9999	472	Safe Zone	unaffected

Aqueducts (Partial)

FID_Aqueduct	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_METE	VELOCITY_ME	FID_Tsunami	TSUNAMI_STATUS	3M_SEA_LE	Affected_Shape_Length
78	yes	894	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	4	Flood Zone	affected	100.67566
79	yes	894	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	4	Flood Zone	affected	194.937394
199	yes	1367	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	200	Flood Zone	affected	61.458832
201	yes	1367	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	200	Flood Zone	affected	176.843854
203	yes	1367	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	200	Flood Zone	affected	60.884623
204	yes	1367	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	200	Flood Zone	affected	87.187397
205	yes	1367	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	200	Flood Zone	affected	70.466477
230	yes	1367	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	200	Flood Zone	affected	5.060618
230	yes	1370	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	200	Flood Zone	affected	61.333696
787	yes	1105	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	89	Safe Zone	affected	45.441435
788	yes	1105	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	89	Safe Zone	affected	10.732459
1903	yes	1042	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	21	Flood Zone	affected	63.515997
1905	yes	1042	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	31	Safe Zone	affected	0.42769
1922	yes	1101	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	31	Safe Zone	affected	14.910735
1923	yes	1101	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	21	Flood Zone	affected	13.932901
1923	yes	1101	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	31	Safe Zone	affected	16.025804
1924	yes	1101	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	31	Safe Zone	affected	10.093649
2478	yes	1042	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	21	Flood Zone	affected	14.738574
2501	yes	1075	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	25	Flood Zone	affected	45.83477
2556	yes	961	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	15	Flood Zone	affected	61.634277
2557	yes	961	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	15	Flood Zone	affected	116.866432
2558	yes	966	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	15	Flood Zone	affected	150.172648
2560	yes	966	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	15	Flood Zone	affected	63.827773
2562	yes	1177	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	33	Safe Zone	affected	62.691817
2564	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	104	Flood Zone	affected	34.797261
2565	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	33	Safe Zone	affected	111.196769
2565	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	104	Flood Zone	affected	16.578613
2568	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	33	Safe Zone	affected	18.628533
2895	yes	1006	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	-9999	-9999	15	Flood Zone	affected	397.373205
2898	yes	1006	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	-9999	-9999	15	Flood Zone	affected	30.777076
2900	yes	1006	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	-9999	-9999	15	Flood Zone	affected	198.788072
3049	yes	957	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	15	Flood Zone	affected	58.543785
3051	yes	957	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	15	Flood Zone	affected	158.760857
3459	yes	1001	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	34	Flood Zone	affected	10.854781
3471	yes	1084	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	34	Flood Zone	affected	91.303778
3932	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	43.638657
3934	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	26.855631
3935	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	21.992529
3938	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	12.656141
3941	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	31.96604
3951	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	21.101582
3954	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	45.230746
3957	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	33.80522
3959	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	68.866189
3960	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	25.620948
3965	yes	1205	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	44	Safe Zone	affected	27.056781
4690	yes	1105	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	89	Safe Zone	affected	2.774189
4691	yes	1105	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	89	Safe Zone	affected	57.877758
4692	yes	1105	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	89	Safe Zone	affected	64.685241
4693	yes	1105	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	89	Safe Zone	affected	21.649767
4694	yes	1105	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	89	Safe Zone	affected	16.92007
4695	yes	1105	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	89	Safe Zone	affected	39.461217

FID_Aqueduct	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_METE	VELOCITY_ME	FID_Tsunami	TSUNAMI_STATUS	3M_SEA_LE	Affected_Shape_Length
4999	yes	4114	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	482.850075
4999	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	99.834811
5001	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	86.203713
5008	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	47.179411
5012	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	79.30545
5013	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	12.034627
5013	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	23.894328
5015	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	8.523183
5015	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	68.320385
5016	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	48.488979
5017	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	18.186504
5019	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	58.502804
5021	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	19.445489
5023	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	111.588326
5023	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	89.535133
5023	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	77.226124
5530	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	59.387887
5531	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	-9999	-9999	123	Safe Zone	affected	39.163435
5532	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	-9999	-9999	123	Safe Zone	affected	312.912652
5534	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	-9999	-9999	123	Safe Zone	affected	1068.094939
5536	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	117.284053
5536	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	230.891879
5536	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	149	Safe Zone	affected	7.031867
5536	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	149	Safe Zone	affected	9.070665
5541	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	-9999	-9999	123	Safe Zone	affected	1564.188748
5688	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	-9999	-9999	123	Safe Zone	affected	589.644087
5888	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	485.382048
5889	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	32.875948
5890	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	8.684161
5891	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	220.689155
5895	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	83.908648
6036	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	277.96383
6036	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	159	Flood Zone	affected	57.126996
6037	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	49.39789
6038	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	48.468748
6039	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	48.519536
6039	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	159	Flood Zone	affected	6.000377
6040	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	291.335993
6044	yes	325	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	36.127362
6074	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	50.755263
6097	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	111.211488
6098	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	147	Flood Zone	affected	539.731494
6098	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	155	Safe Zone	affected	446.180025
6128	yes	4200	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	88.350841
6129	yes	4200	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	103.160869
6219	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	185.034192
6220	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	134.30109
6222	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	127.85221
6257	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	58.710359
6260	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	80.357684
6283	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	135.767107
6285	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	250.934563

FID_Aqueduct	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_METE	VELOCITY_ME	FID_Tsunami	TSUNAMI_STATUS	3M_SEA_LE	Affected_Shape_Length
6291	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	147	Flood Zone	affected	154.326646
6291	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	155	Safe Zone	affected	215.867747
6291	yes	4311	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	155	Safe Zone	affected	37.381173
6292	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	405.439295
6292	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	159	Flood Zone	affected	107.161314
6292	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	173	Flood Zone	affected	18.994026
6292	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	147	Flood Zone	affected	68.294414
6292	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	155	Safe Zone	affected	265.007815
6316	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	147	Flood Zone	affected	193.099804
6316	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	155	Safe Zone	affected	261.205759
6316	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	147	Flood Zone	affected	46.650474
6316	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	155	Safe Zone	affected	32.418601
6321	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	10.095331
6322	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	16.223872
6323	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	443.690558
6335	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	130.592553
6336	yes	4162	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	35.159291
6360	yes	319	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	14.915744
6361	yes	319	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	20.408415
6363	yes	4162	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	12.749126
6364	yes	4162	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	24.89745
6380	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	85.062029
6380	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	159	Flood Zone	affected	146.882521
6385	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	90.046286
6387	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	476.283024
6387	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	173	Flood Zone	affected	84.241585
6391	yes	315	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	32.735382
6394	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	154.962564
6405	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	147	Flood Zone	affected	133.966344
6405	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	155	Safe Zone	affected	481.601657
6405	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	155	Safe Zone	affected	152.167936
6407	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	147	Flood Zone	affected	445.789515
6423	yes	4318	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	139	Flood Zone	affected	9.228779
6423	yes	4318	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	156	Safe Zone	affected	63.315305
6424	yes	4320	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	139	Flood Zone	affected	46.216355
6425	yes	4311	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	155	Safe Zone	affected	554.437031
6426	yes	4322	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	156	Safe Zone	affected	87.864721
6427	yes	4318	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	156	Safe Zone	affected	90.075346
6430	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	62.979047
6430	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	193	Safe Zone	affected	31.391165
6431	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	118.995285
6431	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	193	Safe Zone	affected	46.448373
6432	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	83.507953
6433	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	143.805571
6434	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	134.321204
6435	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	30.681454
6436	yes	4738	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	0.003289
6436	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	407.54339
6436	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	193	Safe Zone	affected	51.411438
6437	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	329.061065
6439	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	114.67271
6440	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	193	Safe Zone	affected	118.012433

Bridges (Partial)

FID_Bridges	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_ME	VELOCITY_ME	FID_Tsunami	TSUNAMI_ST	3M_SEA_LEVEL_RIS	Height
968	yes	602	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	468	Safe Zone	affected	
71	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	
54	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	
74	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	
75	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	
76	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	
79	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	
491	yes	645	A		T	0	-9999	-9999	464	Safe Zone	affected	
490	yes	645	A		T	0	-9999	-9999	464	Safe Zone	affected	
1572	yes	1921	A		T	0	-9999	-9999	510	Safe Zone	affected	
846	yes	3717	A		T	0	-9999	-9999	391	Safe Zone	affected	
823	yes	1846	A		T	-9999	-9999	-9999	200	Flood Zone	affected	
757	yes	1169	A		T	-9999	-9999	-9999	21	Flood Zone	affected	
500	yes	749	AE		T	2.4	-9999	-9999	780	Flood Zone	affected	
1590	yes	2031	AE		T	2.4	-9999	-9999	672	Safe Zone	affected	
896	yes	667	AE	FLOODWAY	T	-9999	-9999	-9999	737	Safe Zone	affected	
501	yes	706	AE		T	2.1	-9999	-9999	464	Safe Zone	affected	
1611	yes	1968	AE		T	2.7	-9999	-9999	640	Safe Zone	affected	
898	yes	667	AE	FLOODWAY	T	-9999	-9999	-9999	737	Safe Zone	affected	
480	yes	647	AE		T	-9999	-9999	-9999	464	Safe Zone	affected	
481	yes	647	AE		T	-9999	-9999	-9999	464	Safe Zone	affected	
2056	yes	1946	AE		T	3	-9999	-9999	769	Flood Zone	affected	
965	yes	605	AE		T	3	-9999	-9999	468	Safe Zone	affected	
881	yes	614	AE	FLOODWAY	T	-9999	-9999	-9999	554	Safe Zone	affected	
2159	yes	612	AE		T	-9999	-9999	-9999	554	Safe Zone	affected	
966	yes	605	AE		T	3	-9999	-9999	468	Safe Zone	affected	
1093	yes	4500	AE		T	-9999	-9999	-9999	580	Safe Zone	affected	
1092	yes	3705	AE	FLOODWAY	T	-9999	-9999	-9999	580	Safe Zone	affected	
1460	yes	3776	AE		T	1.5	-9999	-9999	489	Flood Zone	affected	
2149	yes	3748	AE		T	4	-9999	-9999	489	Flood Zone	affected	
2148	yes	3747	AE		T	2.7	-9999	-9999	489	Flood Zone	affected	
1130	yes	3485	AE		T	2.7	-9999	-9999	437	Safe Zone	affected	
2147	yes	3745	AE		T	3.4	-9999	-9999	489	Flood Zone	affected	
841	yes	3312	AE		T	2.7	-9999	-9999	393	Flood Zone	affected	
842	yes	3312	AE		T	2.7	-9999	-9999	393	Flood Zone	affected	
1331	yes	3312	AE		T	2.7	-9999	-9999	393	Flood Zone	affected	
1164	yes	2966	AE	FLOODWAY	T	-9999	-9999	-9999	387	Flood Zone	affected	
992	yes	432	AE		T	2.7	-9999	-9999	220	Safe Zone	affected	
989	yes	504	AE		T	1.5	-9999	-9999	220	Safe Zone	affected	
988	yes	504	AE		T	1.5	-9999	-9999	213	Flood Zone	affected	
990	yes	446	AE		T	1.8	-9999	-9999	213	Flood Zone	affected	
797	yes	1461	AE	FLOODWAY	T	-9999	-9999	-9999	200	Flood Zone	affected	
1022	yes	365	AE		T	2.1	-9999	-9999	199	Safe Zone	affected	
796	yes	1476	AE	FLOODWAY	T	2.4	-9999	-9999	200	Flood Zone	affected	
794	yes	1476	AE	FLOODWAY	T	2.4	-9999	-9999	200	Flood Zone	affected	
795	yes	1476	AE	FLOODWAY	T	2.4	-9999	-9999	200	Flood Zone	affected	
32	yes	4168	AE		T	-9999	-9999	-9999	136	Safe Zone	affected	

FID_Bridges	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_ME	VELOCITY_ME	FID_Tsunami	TSUNAMI_ST	3M_SEA_LEVEL_RIS	Height
151	yes	4155	AE		T	2.1	0	0	136	Safe Zone	affected	
166	yes	4639	AE		T	1.5	-9999	-9999	155	Safe Zone	affected	
640	yes	4306	AE		T	1.2	0	0	155	Safe Zone	affected	
637	yes	4306	AE		T	1.2	0	0	155	Safe Zone	affected	
639	yes	4306	AE		T	1.2	0	0	155	Safe Zone	affected	
150	yes	4155	AE		T	2.1	0	0	136	Safe Zone	affected	
1020	yes	4751	AE	FLOODWAY	T	1.2	0	0	156	Safe Zone	affected	
195	yes	4152	AE		T	2.7	0	0	134	Safe Zone	affected	
44	yes	4153	AE		T	-9999	-9999	-9999	136	Safe Zone	affected	
49	yes	4154	AE		T	-9999	-9999	-9999	136	Safe Zone	affected	
153	yes	4143	AE		T	1.8	0	0	136	Safe Zone	affected	
193	yes	1291	AE		T	3	-9999	-9999	134	Safe Zone	affected	
77	yes	4105	AE		T	1.5	-9999	-9999	136	Safe Zone	affected	
83	yes	4105	AE		T	1.5	-9999	-9999	136	Safe Zone	affected	
78	yes	4105	AE		T	1.5	-9999	-9999	136	Safe Zone	affected	
84	yes	4105	AE		T	1.5	-9999	-9999	136	Safe Zone	affected	
239	yes	1214	AE		T	-9999	-9999	-9999	123	Safe Zone	affected	
751	yes	1221	AE		T	-9999	-9999	-9999	33	Safe Zone	affected	
739	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	33	Safe Zone	affected	
740	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	33	Safe Zone	affected	
1180	yes	1109	AE	FLOODWAY	T	-9999	-9999	-9999	89	Safe Zone	affected	
737	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	33	Safe Zone	affected	
741	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	109	Flood Zone	affected	
748	yes	1019	AE		T	-9999	-9999	-9999	57	Safe Zone	affected	
747	yes	1043	AE	FLOODWAY	T	-9999	-9999	-9999	57	Safe Zone	affected	
745	yes	1043	AE	FLOODWAY	T	-9999	-9999	-9999	57	Safe Zone	affected	
2098	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	21	Flood Zone	affected	
746	yes	986	AE	FLOODWAY	T	-9999	-9999	-9999	34	Flood Zone	affected	
1534	yes	643	AO		T	-9999	0.7	-9999	464	Safe Zone	affected	
1333	yes	3321	AO		T	-9999	0.9	-9999	393	Flood Zone	affected	
2150	yes	3313	AO		T	-9999	0.9	-9999	391	Safe Zone	affected	
2128	yes	3766	VE		T	4	-9999	-9999	489	Flood Zone	affected	
2086	yes	82	VE		T	4.9	-9999	-9999	472	Safe Zone	affected	
1129	yes	2606	VE		T	4.6	-9999	-9999	461	Flood Zone	affected	
979	yes	2740	VE		T	4.3	-9999	-9999	230	Safe Zone	affected	
152	yes	4144	VE		T	2.4	0	0	136	Safe Zone	affected	
194	yes	4112	VE		T	3.4	-9999	-9999	134	Safe Zone	affected	
67	yes	4125	VE		T	3	0	0	138	Flood Zone	affected	
238	yes	1186	VE		T	2.7	-9999	-9999	103	Flood Zone	affected	
237	yes	1186	VE		T	2.7	-9999	-9999	100	Flood Zone	affected	
736	yes	1180	VE		T	3	-9999	-9999	15	Flood Zone	affected	
1465	yes	3725	X		F	-9999	-9999	-9999	468	Safe Zone	affected	
967	yes	3725	X		F	-9999	-9999	-9999	468	Safe Zone	affected	
1630	yes	4925	X		F	-9999	-9999	-9999	740	Flood Zone	affected	
969	yes	3725	X		F	-9999	-9999	-9999	468	Safe Zone	affected	
1459	yes	2616	X		F	-9999	-9999	-9999	468	Safe Zone	affected	
1184	yes	4939	X		F	-9999	-9999	-9999	312	Flood Zone	affected	

FID_Bridges	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_ME	VELOCITY_ME	FID_Tsunami	TSUNAMI_ST	3M_SEA_LEVEL_RIS	Height
2198	yes	4939	X		F	-9999	-9999	-9999	229	Safe Zone	affected	
2196	yes	4939	X		F	-9999	-9999	-9999	229	Safe Zone	affected	
986	yes	2634	X		F	-9999	-9999	-9999	220	Safe Zone	affected	
987	yes	481	X		F	-9999	-9999	-9999	220	Safe Zone	affected	
991	yes	483	X		F	-9999	-9999	-9999	220	Safe Zone	affected	
19	yes	4184	X		F	-9999	-9999	-9999	189	Safe Zone	affected	
165	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
168	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
167	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
154	yes	4184	X		F	-9999	-9999	-9999	189	Safe Zone	affected	
1918	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
164	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
160	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
163	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
162	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
159	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
130	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
70	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
158	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
72	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
73	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
641	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
132	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
131	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
642	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
2054	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected	
155	yes	4157	X		F	-9999	-9999	-9999	134	Safe Zone	affected	
40	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
48	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
53	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
41	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
42	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
57	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
56	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
55	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
60	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
80	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
47	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
88	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
86	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
192	yes	4825	X		F	-9999	-9999	-9999	149	Safe Zone	affected	
64	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
63	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected	
87	yes	4117	X		F	-9999	-9999	-9999	111	Safe Zone	affected	
68	yes	4117	X		F	-9999	-9999	-9999	111	Safe Zone	affected	
1172	yes	935	X		F	0	-9999	-9999	101	Flood Zone	affected	
764	yes	2627	X		F	-9999	-9999	-9999	26	Safe Zone	affected	

Hospitals

FID_Hospitals	NOMBRE	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_METE	VELOCITY_I	FID_Tsunami	TSUNAMI_ST	3M_SEA_LEVEL_RISI	capacity at	# of emplc	# of patien	stability of	building cc	date of last inspection
190	C.D.T. DR. ARNALDO J. GARC	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	159	Flood Zone	affected						
106	C.S.F.	yes	667	AE	FLOODWAY	T	-9999	-9999	-9999	737	Safe Zone	affected						
171	C.S.F.	yes	1898	AE		T	-9999	-9999	-9999	672	Safe Zone	affected						
154	C.D.T. PLAYA DE PONCE	yes	706	AE		T	2.1	-9999	-9999	780	Flood Zone	affected						
34	REHABILITACION VOCACIONAL	yes	3718	AE		T	2.4	-9999	-9999	393	Flood Zone	affected						
54		yes	3718	AE		T	2.4	-9999	-9999	393	Flood Zone	affected						
138	F.S.E. (FONDO DEL SEGURO)	yes	3320	AE		T	2.7	-9999	-9999	393	Flood Zone	affected						
233	POLICLINICA BELLA VISTA	yes	3320	AE		T	2.7	-9999	-9999	393	Flood Zone	affected						
180	CDT DR. JOSE LOPEZ PTO NUE	yes	4168	AE		T	-9999	-9999	-9999	136	Safe Zone	affected						
258		yes	1221	AE		T	-9999	-9999	-9999	104	Flood Zone	affected						
261		yes	3321	AO		T	-9999	0.9	-9999	393	Flood Zone	affected						
13	INST. CIRUGIA PLASTICA OES	yes	3321	AO		T	-9999	0.9	-9999	391	Safe Zone	affected						
137	C.D.T. DR.PEDRO J. MONZON	yes	3321	AO		T	-9999	0.9	-9999	391	Safe Zone	affected						
16	CDT OJOS INC	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected						
264		yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected						
18	SAN JUAN HEALTH CENTRE	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected						
251	SAN JUAN HEALTH CENTRE	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected						

Power Generation Plants

FID_GenerationPlants	AEE_NPROY	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_I	VELOCITY_N	FID_Tsunami	TSUNAMI_ST/	3M_SEA_LEVEL_RISE
13	COSTA SUR	yes	2567	X		F	-9999	-9999	-9999	554	Safe Zone	affected
5	TURBINAS_DE_GAS_MAYAGUEZ	yes	3311	AE		T	3	-9999	-9999	393	Flood Zone	affected
2	SAN JUAN STEAM PLANT	yes	4155	AE		T	2.1	0	0	136	Safe Zone	affected
1	PALO_SECO	yes	4825	X		F	-9999	-9999	-9999	106	Flood Zone	affected

Roads (Partial)

FID_Roads	CARRETERA	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_	VELOCITY_I	FID_Tsunami	TSUNAMI_ST	3M_SEA_LI	Affected_Shape_Lengt	elevation
487	PR-53	yes	4529	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	580	Safe Zone	affected	4.950308	
487	PR-53	yes	4538	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	580	Safe Zone	affected	55.974744	
600	PR-2	yes	1101	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	31	Safe Zone	affected	13.481884	
773	PR-36	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	28.753562	
868	PR-2	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	104	Flood Zone	affected	3.299823	
888	PR-2	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	104	Flood Zone	affected	56.741018	
1154	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	14.838674	
1157	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	32.792588	
1157	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	159	Flood Zone	affected	31.66055	
1164	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	159	Flood Zone	affected	44.922815	
1167	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	159	Flood Zone	affected	19.436399	
1169	PR-37	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	159	Flood Zone	affected	78.671126	
1171	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	159	Flood Zone	affected	41.357738	
1174	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	25.995194	
1174	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	159	Flood Zone	affected	17.195187	
1177	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	52.419362	
1179	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	36.365372	
1182	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	15.727132	
1192	PR-37	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	159	Flood Zone	affected	26.971555	
1197	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	317.051855	
1201	PR-37	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	6.384175	
1226	PR-26	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	76.143721	
1230	PR-26	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	239.6049	
1232	PR-26	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	67.016058	
1234	PR-26	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	30.021249	
1268	PR-37	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	173	Flood Zone	affected	3.211363	
1300	PR-26	yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	209.14471	
1343	PR-2	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	17.690986	
1352	PR-2	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	45.931368	
1355	PR-26	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	292.462921	
1359	PR-2	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	27.9677	
1360	PR-1	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	10.896377	
1361	PR-1	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	24.499565	
1366	PR-1	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	55.235036	
1370	PR-2	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	70.969897	
1385	PR-26	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	119.543719	
1385	PR-26	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	147.327982	
1387	PR-2	yes	4148	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	136	Safe Zone	affected	47.671939	
1420	PR-26	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	202.288927	
1455	PR-26	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	184.711539	
1463	PR-5	yes	4114	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	14.286011	
1464	PR-26	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	40.86116	
1472	PR-26	yes	297	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	78.258394	
1475	PR-5	yes	4114	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	266.884767	
1479	PR-5	yes	4114	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	74.328285	
1482	PR-5	yes	4114	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	46.558188	
1494	PR-5	yes	4114	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	43.972818	
1494	PR-5	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	81.898733	
1498	PR-5	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	50.809265	
1503	PR-5	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	0.737092	

FID_Roads	CARRETERA	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_	VELOCITY_I	FID_Tsunami	TSUNAMI_ST	3M_SEA_LI	Affected	Shape_Lengt	elevation
1588	PR-36	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	136	Safe Zone	affected		89.458087	
1599	PR-36	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	136	Safe Zone	affected		18.967625	
1607	PR-36	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	136	Safe Zone	affected		62.449052	
1621	PR-36	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	136	Safe Zone	affected		55.844206	
1628	PR-24	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		93.441665	
1643	PR-24	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		99.060807	
1656	PR-24	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		67.942579	
1703	PR-28	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		23.849368	
1725	PR-28	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		218.909512	
1729	PR-28	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		32.753688	
1732	PR-28	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		56.13709	
1973	PR-8	yes	361	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	136	Safe Zone	affected		62.990529	
2402	PR-3	yes	478	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		6.404611	
2402	PR-3	yes	551	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		0.820539	
2403	PR-3	yes	478	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		6.153689	
2410	PR-3	yes	551	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		91.723999	
2419	PR-3	yes	473	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		121.958755	
2419	PR-3	yes	551	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		70.281349	
2433	PR-3	yes	473	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		213.096827	
2453	PR-3	yes	473	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		13.378759	
2535	PR-3	yes	2663	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		22.492071	
2541	PR-3	yes	2672	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		88.48056	
2550	PR-3	yes	2695	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	220	Safe Zone	affected		21.210401	
2828	PR-3	yes	2953	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	371	Safe Zone	affected		5.770973	
2948	PR-64	yes	4870	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	393	Flood Zone	affected		195.453578	
2958	PR-64	yes	4870	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	393	Flood Zone	affected		279.961443	
2968	PR-64	yes	4870	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	393	Flood Zone	affected		268.306465	
2989	PR-64	yes	4870	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	393	Flood Zone	affected		127.345521	
3138	PR-3	yes	3503	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	437	Safe Zone	affected		38.242337	
3140	PR-3	yes	3503	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	437	Safe Zone	affected		223.224911	
4416	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	672	Safe Zone	affected		104.963659	
4417	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	672	Safe Zone	affected		147.671188	
4418	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	672	Safe Zone	affected		64.382624	
4422	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	646	Safe Zone	affected		131.351764	
4422	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	672	Safe Zone	affected		69.320308	
4425	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	646	Safe Zone	affected		177.732899	
4429	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	646	Safe Zone	affected		100.131712	
4432	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	646	Safe Zone	affected		102.91401	
4442	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	646	Safe Zone	affected		286.718596	
4453	PR-3	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	646	Safe Zone	affected		19.748034	
4498	PR-3	yes	2019	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	640	Safe Zone	affected		53.267026	
4684	PR-12	yes	744	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	464	Safe Zone	affected		98.010869	
4685	PR-12	yes	744	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	464	Safe Zone	affected		31.776287	
4852	PR-37	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	155	Safe Zone	affected		275.501272	
4854	PR-24	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		50.490617	
4884	PR-37	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	155	Safe Zone	affected		141.818658	
4885	PR-25	yes	319	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	136	Safe Zone	affected		29.046182	
4887	PR-24	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		110.119497	
4925	PR-24	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		84.534744	
5970	PR-165	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected		14.068894	

FID_Roads	CARRETERA	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_	VELOCITY_I	FID_Tsunami	TSUNAMI_ST	3M_SEA_LI	Affected_Shape_Lengt	elevation
6704	PR-102	yes	3329	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	393	Flood Zone	affected	79.243557	
6720	PR-102	yes	4827	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	393	Flood Zone	affected	273.642043	
6735	PR-102	yes	3740	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	489	Flood Zone	affected	7.831957	
6735	PR-102	yes	3744	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	489	Flood Zone	affected	29.536735	
6759	PR-102	yes	3740	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	489	Flood Zone	affected	122.73313	
6761	PR-102	yes	3733	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	468	Safe Zone	affected	39.823879	
6778	PR-119	yes	1042	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	21	Flood Zone	affected	4.697924	
6794	PR-119	yes	1075	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	25	Flood Zone	affected	75.323978	
6867	PR-165	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	0	-9999	-9999	103	Flood Zone	affected	64.215061	
6867	PR-165	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	0	-9999	-9999	123	Safe Zone	affected	115.97738	
6889	PR-165	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	181.428362	
6891	PR-165	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	13.948427	
6893	PR-165	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	20.455612	
6896	PR-165	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	10.178243	
6939	PR-187	yes	4311	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	0	0	0	155	Safe Zone	affected	116.141285	
7001	PR-187	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	153.703911	
7002	PR-187	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	40.088805	
7003	PR-187	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	109.825335	
7004	PR-187	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	87.962491	
7040	PR-165	yes	4114	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	134	Safe Zone	affected	1.906588	
7041	PR-187	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	147	Flood Zone	affected	52.434932	
7041	PR-187	yes	4266	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	155	Safe Zone	affected	12.723417	
7099	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	89.794742	
7106	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	113.768291	
7111	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	116.628341	
7112	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	56.821251	
7114	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	100.381136	
7117	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	108.237662	
7122	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	84.408617	
7133	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	168.902681	
7134	PR-188	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	0	0	0	193	Safe Zone	affected	173.285145	
7142	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	135.579989	
7167	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	35.226193	
7168	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	191.29945	
7172	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	131.187569	
7173	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	39.456935	
7175	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	104.359228	
7178	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	85.871839	
7181	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	41.41172	
7182	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	79.727638	
7185	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	199.771108	
7187	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	250.112707	
7188	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	11.022491	
7190	PR-187	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	0	0	0	193	Safe Zone	affected	72.14423	
7197	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	151.797312	
7221	PR-187	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	193	Safe Zone	affected	79.384256	
7247	PR-165	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	189	Safe Zone	affected	19.325809	
7615	PR-193	yes	473	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	213	Flood Zone	affected	71.864264	
7615	PR-193	yes	473	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	220	Safe Zone	affected	87.459276	
7615	PR-193	yes	478	0.2 PCT ANNUAL CHANCE FLOOD HAZAF		F	-9999	-9999	-9999	220	Safe Zone	affected	12.087989	

Seaports

FID_Ports	AP_NPROY	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_I	VELOCITY_N	FID_Tsunami	TSUNAMI_ST	3M_SEA_LEVEL_RISE
8	P09	yes	1502	AE		T	2.7	-9999	-9999	646	Safe Zone	affected
6	P06	yes	1459	X		F	-9999	-9999	-9999	737	Safe Zone	affected
4	P11	yes	585	AE	FLOODWAY	T	-9999	-9999	-9999	554	Safe Zone	affected
3	P07	yes	3311	AE		T	3	-9999	-9999	393	Flood Zone	affected
9		yes	4155	AE		T	2.1	0	0	136	Safe Zone	affected

Schools

FID_Schools	NOMBRE	COASTAL_ZO	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFI	DEPTH_	VELOCITY_	FID_Tsunam	TSUNAMI_ST	3M_SEA_LEVEL_RIS	# of emplo	# of studer	stability of building cc	last date of inspection
1663	Segundo Ruiz Belvis	yes	3329	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	393	Flood Zone	affected				
915	Rafael N. Coca	yes	507	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	213	Flood Zone	affected				
391	Mediania Alta Elem.	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	193	Safe Zone	affected				
351		yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected				
349	Luis Munoz Rivera I	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected				
346	Parcelas Suarez	yes	4778	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	193	Safe Zone	affected				
345	Luis Munoz Rivera II	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	189	Safe Zone	affected				
337		yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	0	0	193	Safe Zone	affected				
332	Belen Blanco de Zequeira	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	0	0	193	Safe Zone	affected				
330	Carlos Escobar Lopez	yes	4760	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	0	0	193	Safe Zone	affected				
307	Ramon B. Lopez	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	134	Safe Zone	affected				
300	Rafael Cordero	yes	4159	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	134	Safe Zone	affected				
246	Dr. Efrain Sanchez H	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	-9999	-9999	123	Safe Zone	affected				
233	Dr. Julio J. Henna	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	136	Safe Zone	affected				
225	PRIMER CENTRO EDUCATIVO DE LEVITTOWN	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	-9999	-9999	123	Safe Zone	affected				
215	PUERTO RICO CHRISTIAN DAY SCHOOL	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	-9999	-9999	123	Safe Zone	affected				
208		yes	290	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	173	Flood Zone	affected				
193	ACADEMIA SANTA TERESITA	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	136	Safe Zone	affected				
192	ESCUELA DE COSTURA JULIE, INC.	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	159	Flood Zone	affected				
186	ACADEMIA SAN MIGUEL	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	-9999	-9999	123	Safe Zone	affected				
172	Pedro Albizu Campos	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	-9999	-9999	123	Safe Zone	affected				
171	PRESIDENT WASHINGTON ACADEMY	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	-9999	-9999	123	Safe Zone	affected				
163	ACADEMIA DEL ESPIRITU SANTO	yes	1260	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	0	-9999	-9999	123	Safe Zone	affected				
72	ESCUELA DE OFICIOS DE TALABARTERIA ACEVEDO	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZAR		F	-9999	-9999	-9999	104	Flood Zone	affected				
2396	Las Mareas	yes	2113	AE		T	2.7	-9999	-9999	672	Safe Zone	affected				
2395	Marcela Garcia Cora	yes	2116	AE		T	3	-9999	-9999	646	Safe Zone	affected				
2391	Playita	yes	2134	AE		T	3	-9999	-9999	672	Safe Zone	affected				
2388	Francisco M. Quinones	yes	2031	AE		T	2.4	-9999	-9999	802	Flood Zone	affected				
2379	San Felipe	yes	2107	AE		T	2.4	-9999	-9999	672	Safe Zone	affected				
2371	Franklin D. Roosevelt	yes	666	AE		T	-9999	-9999	-9999	737	Safe Zone	affected				
2370	ACADEMIA DE CORTE Y COSTURA ADANS, INC.	yes	666	AE		T	-9999	-9999	-9999	737	Safe Zone	affected				
2368	Agripina Seda	yes	666	AE		T	-9999	-9999	-9999	737	Safe Zone	affected				
2367	ESCUELA BEATA IMELDA	yes	666	AE		T	-9999	-9999	-9999	737	Safe Zone	affected				
2366	Maria L. McDougall	yes	666	AE		T	-9999	-9999	-9999	737	Safe Zone	affected				
2365	James A. Garfield	yes	666	AE		T	-9999	-9999	-9999	737	Safe Zone	affected				
2349	Manzanilla	yes	1940	AE	FLOODWAY	T	-9999	-9999	-9999	769	Flood Zone	affected				
2348	S. U. Playitas Cortada	yes	1948	AE		T	-9999	-9999	-9999	783	Flood Zone	affected				
2337	COLEGIO NUESTRA SENORA DEL CARMEN	yes	706	AE		T	2.1	-9999	-9999	464	Safe Zone	affected				
2332	COLEGIO METODISTA JULIA TORRES	yes	706	AE		T	2.1	-9999	-9999	780	Flood Zone	affected				
2327	TRINITY COLLEGE OF PUERTO RICO	yes	706	AE		T	2.1	-9999	-9999	464	Safe Zone	affected				
2311	Lucy Grillasca	yes	4102	AE		T	2.2	-9999	-9999	464	Safe Zone	affected				
2309		yes	706	AE		T	2.1	-9999	-9999	780	Flood Zone	affected				
2302	Eugenio Maria de Hostos	yes	4100	AE		T	2.1	-9999	-9999	464	Safe Zone	affected				
2296	Juan Serapio Mangual	yes	1931	AE		T	2.7	-9999	-9999	510	Safe Zone	affected				
2294	Luis Munoz Marin	yes	1931	AE		T	2.7	-9999	-9999	510	Safe Zone	affected				
2256	Zoilo Ferrero	yes	628	AE		T	2.4	-9999	-9999	554	Safe Zone	affected				
1903	Luis Muniz Souffront	yes	3767	AE		T	2.7	-9999	-9999	489	Flood Zone	affected				
1772		yes	3370	AE		T	3.4	-9999	-9999	437	Safe Zone	affected				
1765	S. U. Francisco Isern Gimenez	yes	2582	AE		T	3.4	-9999	-9999	437	Safe Zone	affected				
1660	Maria D. Faria	yes	3311	AE		T	3	-9999	-9999	393	Flood Zone	affected				
1656	Ramon Valle Seda	yes	3320	AE		T	2.7	-9999	-9999	393	Flood Zone	affected				
1615	Mariano Riera Palmer	yes	3320	AE		T	2.7	-9999	-9999	393	Flood Zone	affected				
1600	Concordia	yes	3312	AE		T	2.7	-9999	-9999	393	Flood Zone	affected				
1454	S. U. Sabanetas Mani	yes	3211	AE		T	-9999	-9999	-9999	393	Flood Zone	affected				
933	Rosendo Matienzo Cintron	yes	512	AE		T	2.4	-9999	-9999	213	Flood Zone	affected				
882	Fortuna Playa	yes	418	AE		T	2.7	-9999	-9999	213	Flood Zone	affected				
477	JARDIN INFANTIL MILIKYS	yes	1461	AE	FLOODWAY	T	-9999	-9999	-9999	176	Flood Zone	affected				
464	COLEGIO SAN CARLOS BORROMEO	yes	1479	AE		T	4.3	-9999	-9999	176	Flood Zone	affected				
414	Parcelas Vieques	yes	342	AE	FLOODWAY	T	2.4	-9999	-9999	191	Flood Zone	affected				
404	CENTRO ESPERANZA, INC.	yes	323	AE		T	2.4	-9999	-9999	191	Flood Zone	affected				
396	Jesusa Vizcarrondo	yes	4746	AE		T	-9999	-9999	-9999	193	Safe Zone	affected				
353	Marina Ramon Aneses Morell	yes	1360	AE		T	4	-9999	-9999	176	Flood Zone	affected				
342	Buena Vista	yes	4106	AE		T	1.8	-9999	-9999	136	Safe Zone	affected				
334	Rosalina C. Martinez	yes	4152	AE		T	2.7	0	0	189	Safe Zone	affected				
327	Haydee Rexach	yes	4106	AE		T	1.8	-9999	-9999	136	Safe Zone	affected				
328	Albert Einstein	yes	4106	AE		T	1.8	-9999	-9999	136	Safe Zone	affected				
318	Santiago Iglesias Pantin	yes	4106	AE		T	1.8	-9999	-9999	136	Safe Zone	affected				
281	COLEGIO SAN VICENTE DE FERRER	yes	4151	AE		T	3	-9999	-9999	134	Safe Zone	affected				
280	Horace Mann	yes	4151	AE		T	3	-9999	-9999	134	Safe Zone	affected				
267	Rosendo Matienzo Cin	yes	4110	AE		T	2.7	-9999	-9999	134	Safe Zone	affected				

FID_Schools	NOMBRE	COASTAL_ZO	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFI	DEPTH_	VELOCITY_	FID_Tsunam	TSUNAMI_ST	3M_SEA_LEVEL_RIS	# of emplc	# of studer	stability of building cc	last date of inspection
262	Onofre Carballeira	yes	4110	AE		T	2.7	-9999	-9999	134	Safe Zone	affected				
254	Francisco Oller	yes	4110	AE		T	2.7	-9999	-9999	134	Safe Zone	affected				
221	Luis Llorens Torres	yes	4105	AE		T	1.5	-9999	-9999	136	Safe Zone	affected				
218	Maria M. de Perez Almiroty	yes	4105	AE		T	1.5	-9999	-9999	155	Safe Zone	affected				
196	Emiliano Figueroa Torres	yes	4293	AE		T	2.1	0	0	139	Flood Zone	affected				
169	Lucchetti	yes	4138	AE		T	2.1	0	0	136	Safe Zone	affected				
162	ACADEMIA JULIA DE BURGOS	yes	1214	AE		T	-9999	-9999	-9999	123	Safe Zone	affected				
129	LURGREA CENTRAL COLLEGE	yes	1214	AE		T	-9999	-9999	-9999	123	Safe Zone	affected				
128	Lorencita Ramirez de Arellano	yes	1214	AE		T	-9999	-9999	-9999	123	Safe Zone	affected				
100	Dra. Maria Cadilla M	yes	1221	AE		T	-9999	-9999	-9999	33	Safe Zone	affected				
89	ACADEMIA ARECIBENA DE BELLEZA	yes	1221	AE		T	-9999	-9999	-9999	104	Flood Zone	affected				
87	CENTRO DE ASESORAMIENTO Y CAPACITACION V	yes	1221	AE		T	-9999	-9999	-9999	33	Safe Zone	affected				
78	INSTITUTO PREVOCACIONAL E INDUSTRIAL DE PI	yes	1221	AE		T	-9999	-9999	-9999	33	Safe Zone	affected				
1655	Franklin D. Roosevelt	yes	3321	AO		T	-9999	0.9	-9999	393	Flood Zone	affected				
1613	Pedro Perea Fajardo	yes	3313	AO		T	-9999	0.9	-9999	391	Safe Zone	affected				
237	COLEGIO NUESTRA SENORA DE LA PIEDAD	yes	291	AO		T	-9999	0.6	-9999	155	Safe Zone	affected				
224	COLEGIO PIAGET	yes	291	AO		T	-9999	0.6	-9999	155	Safe Zone	affected				
376	Dr. Agustin Stahl	yes	4816	VE		T	4	-9999	-9999	176	Flood Zone	affected				
2390	Aurea E. Quiles Claudio	yes	1459	X		F	-9999	-9999	-9999	737	Safe Zone	affected				
2363	Manuel Mendia Moret	yes	1871	X		F	-9999	-9999	-9999	640	Safe Zone	affected				
2350	Villa del Carmen	yes	642	X		F	0	-9999	-9999	464	Safe Zone	affected				
2322	COLEGIO BAUTISTA ROBERTO NAVARRO PLAYA [	yes	642	X		F	0	-9999	-9999	464	Safe Zone	affected				
2319	Santiago Gonzalez	yes	642	X		F	0	-9999	-9999	464	Safe Zone	affected				
2315	Segundo Ruiz Belvis	yes	642	X		F	0	-9999	-9999	464	Safe Zone	affected				
2310	Dr. Alfredo Aguayo	yes	642	X		F	0	-9999	-9999	464	Safe Zone	affected				
2144	S. U. Carmen Vignals Rosario	yes	3725	X		F	-9999	-9999	-9999	468	Safe Zone	affected				
1299	S. U. Playa	yes	4939	X		F	-9999	-9999	-9999	369	Flood Zone	affected				
919	KELLYS MINI SCHOOL	yes	481	X		F	-9999	-9999	-9999	220	Safe Zone	affected				
909	Pablo Suarez Ortiz	yes	511	X		F	-9999	-9999	-9999	220	Safe Zone	affected				
785	Eugenio Gonzalez Gonzalez	yes	2202	X		F	-9999	-9999	-9999	200	Flood Zone	affected				
782	Sup. Dr. Carlos Gonzalez	yes	2202	X		F	-9999	-9999	-9999	200	Flood Zone	affected				
375	COLEGIO JESUS DE NAZARETH	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected				
361	Julia de Burgos	yes	4276	X		F	-9999	-9999	-9999	155	Safe Zone	affected				
347	Sofa Rexach	yes	327	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
343	COLEGIO SAN JUAN BOSCO	yes	327	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
329	Manuel Elzaburu Vizcarrondo	yes	326	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
321	Fray Bartolome de las Casas	yes	313	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
283	CENTRO DE DESARROLLO TECNICO EDUCATIVO,	yes	4315	X		F	0	0	0	155	Safe Zone	affected				
276	ESCUELA SANTO DOMINGO SAVIO	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
261	CENTRO MET	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
235	Dr. Francisco Hernandez y Gaetan	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
210	Luis Rodriguez Cabrero	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
209	INSTITUTO TECNICO DE RELOJERIA DE PUERTO R	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
204	Ramon Power y Giralt	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
203		yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
202	Segundo Ruiz Belvis	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
200	Republica del Peru	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
191	COLEGIO LOIZA	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
190		yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
188		yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
185	Julian Blanco (Ballet)	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
182	ACADEMIA SAN JORGE	yes	555	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
179	ACADEMIA DEL PARQUE, INC.	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
166	ROBINSON SCHOOL	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
157	SAINT JOHNS SCHOOL	yes	4131	X		F	-9999	-9999	-9999	151	Flood Zone	affected				
137		yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
136	HELICOPTERS D/B/A CARIBE AVIATION	yes	4131	X		F	-9999	-9999	-9999	136	Safe Zone	affected				
120	INSTITUTO FONTECHA	yes	4117	X		F	-9999	-9999	-9999	111	Safe Zone	affected				
121	INSTITUTO FONTECHA	yes	4117	X		F	-9999	-9999	-9999	111	Safe Zone	affected				
106	Jose Julian Acosta (Teatro)	yes	4117	X		F	-9999	-9999	-9999	111	Safe Zone	affected				
107	Jose Julian Acosta (Teatro)	yes	4117	X		F	-9999	-9999	-9999	111	Safe Zone	affected				
67	INSTITUTO DE COSMETOLOGIA Y ESTETICA LA RE	yes	2627	X		F	-9999	-9999	-9999	33	Safe Zone	affected				
55	ACADEMIA ZIG ZAG	yes	2627	X		F	-9999	-9999	-9999	104	Flood Zone	affected				
39	INSTITUTO COMERCIAL DE PUERTO RICO JUNIOR	yes	2627	X		F	-9999	-9999	-9999	74	Flood Zone	affected				

Transmission Lines (Partial)

FID_TransmissionLines	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_I	VELOCITY_	FID_Tsunami	TSUNAMI_ST	3M_SEA_LEVE	Affected_Shape_Length
23	yes	1101	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	21	Flood Zone	affected	24.113352
23	yes	1136	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	21	Flood Zone	affected	6.837682
25	yes	1101	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	31	Safe Zone	affected	1.165481
33	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	104	Flood Zone	affected	94.201767
36	yes	1219	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	33	Safe Zone	affected	14.930619
96	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	126.720442
96	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	106.027805
96	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	13.727283
98	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	98.897011
98	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	172.437019
98	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	13.745826
100	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	435.386427
100	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	197	Safe Zone	affected	5.63765
100	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	13.097129
154	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	97.691779
154	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	239.041112
154	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	157	Safe Zone	affected	619.687551
154	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	44.832463
154	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	21.503691
154	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	157	Safe Zone	affected	1.367724
155	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	92.940768
156	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	172.566253
156	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	262.398659
156	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	157	Safe Zone	affected	585.442716
156	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	84.388127
156	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	21.015934
156	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	157	Safe Zone	affected	1.98511
157	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	84.822621
158	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	358.739359
158	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	370.213296
158	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	157	Safe Zone	affected	19.599117
158	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	274.937973
158	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	77.634569
158	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	157	Safe Zone	affected	165.236901
160	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	352.307606
160	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	365.701165
160	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	346.364527
160	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	0.725996
160	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	57.201101
162	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	87.331363
162	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	325.003386
162	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	157	Safe Zone	affected	367.46229
162	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	24.17333
162	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	24.648116
162	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	157	Safe Zone	affected	0.664821
163	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	21.677598
164	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	123.465464
168	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	116.917769
168	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	257.316784
168	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	106	Flood Zone	affected	47.928101
168	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	134	Safe Zone	affected	1.892486

FID_TransmissionLines	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_I	VELOCITY_I	FID_Tsunami	TSUNAMI_ST/	3M_SEA_LEVE	Affected_Shape_Length
168	yes	4824	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	165	Safe Zone	affected	50.259426
233	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	19.90827
235	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	21.364399
235	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	15.053541
238	yes	4174	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	45.027208
240	yes	4198	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	189	Safe Zone	affected	648.925898
314	yes	4188	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	173.013827
316	yes	4191	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	12.175252
317	yes	4186	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	61.744454
320	yes	4186	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	30.273492
321	yes	4186	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	41.060373
328	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	282.781457
329	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	63.385956
331	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	52.257193
332	yes	318	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	22.269764
332	yes	319	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	35.235078
333	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	39.708686
334	yes	4186	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	34.147744
335	yes	312	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	190.416703
335	yes	361	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	372.326143
335	yes	369	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	87.033185
336	yes	287	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	136	Safe Zone	affected	64.530595
381	yes	4340	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	0	0	0	155	Safe Zone	affected	35.116054
389	yes	473	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	220	Safe Zone	affected	138.711854
389	yes	551	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	213	Flood Zone	affected	83.333215
389	yes	551	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	220	Safe Zone	affected	174.88394
390	yes	473	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	220	Safe Zone	affected	92.40115
577	yes	2695	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	220	Safe Zone	affected	14.532561
578	yes	2672	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	220	Safe Zone	affected	45.836874
578	yes	2695	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	220	Safe Zone	affected	50.65447
583	yes	2953	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	230	Safe Zone	affected	17.653309
583	yes	2953	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	371	Safe Zone	affected	97.306699
780	yes	3462	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	437	Safe Zone	affected	7.424283
780	yes	3503	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	437	Safe Zone	affected	226.363135
792	yes	2379	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	371	Safe Zone	affected	15.427878
792	yes	2411	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	371	Safe Zone	affected	60.951594
844	yes	617	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	554	Safe Zone	affected	140.319601
1016	yes	4475	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	580	Safe Zone	affected	28.80227
1170	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	646	Safe Zone	affected	424.178269
1170	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	672	Safe Zone	affected	973.05523
1171	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	646	Safe Zone	affected	324.263894
1171	yes	2094	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	672	Safe Zone	affected	905.722992
1190	yes	1880	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	715	Safe Zone	affected	240.239793
8	yes	1846	A		T	-9999	-9999	-9999	200	Flood Zone	affected	77.846607
8	yes	1846	A		T	-9999	-9999	-9999	208	Safe Zone	affected	100.410845
395	yes	3085	A		T	-9999	-9999	-9999	208	Safe Zone	affected	19.990702
395	yes	3085	A		T	-9999	-9999	-9999	229	Safe Zone	affected	69.23744
577	yes	2705	A		T	0	-9999	-9999	220	Safe Zone	affected	384.138367
609	yes	3318	A		T	0	-9999	-9999	391	Safe Zone	affected	6.644546
609	yes	3318	A		T	0	-9999	-9999	391	Safe Zone	affected	9.175728
609	yes	3717	A		T	0	-9999	-9999	391	Safe Zone	affected	110.38839

FID_TransmissionLines	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_I	VELOCITY_N	FID_Tsunami	TSUNAMI_STA	3M_SEA_LEVE	Affected_Shape_Length
609	yes	3717	A		T	0	-9999	-9999	393	Flood Zone	affected	192.631154
1045	yes	645	A		T	0	-9999	-9999	464	Safe Zone	affected	134.532684
1077	yes	1934	A		T	0	-9999	-9999	510	Safe Zone	affected	216.503921
1078	yes	1934	A		T	0	-9999	-9999	510	Safe Zone	affected	367.352849
1079	yes	1934	A		T	0	-9999	-9999	510	Safe Zone	affected	209.948844
1080	yes	1934	A		T	0	-9999	-9999	510	Safe Zone	affected	327.697913
1081	yes	1934	A		T	0	-9999	-9999	510	Safe Zone	affected	22.789404
1082	yes	1934	A		T	0	-9999	-9999	510	Safe Zone	affected	299.844533
1083	yes	1921	A		T	0	-9999	-9999	510	Safe Zone	affected	688.13063
1083	yes	1934	A		T	0	-9999	-9999	510	Safe Zone	affected	559.563591
1088	yes	1921	A		T	0	-9999	-9999	510	Safe Zone	affected	637.395599
1088	yes	1934	A		T	0	-9999	-9999	510	Safe Zone	affected	598.791431
1180	yes	1884	A		T	-9999	-9999	-9999	640	Safe Zone	affected	1062.590666
1182	yes	1884	A		T	-9999	-9999	-9999	640	Safe Zone	affected	580.495555
1182	yes	1884	A		T	-9999	-9999	-9999	733	Safe Zone	affected	179.482231
1183	yes	1884	A		T	-9999	-9999	-9999	640	Safe Zone	affected	26.148118
1184	yes	1884	A		T	-9999	-9999	-9999	640	Safe Zone	affected	170.151686
1185	yes	1884	A		T	-9999	-9999	-9999	640	Safe Zone	affected	910.997723
1186	yes	1884	A		T	-9999	-9999	-9999	640	Safe Zone	affected	248.966148
1187	yes	1884	A		T	-9999	-9999	-9999	640	Safe Zone	affected	430.18598
1188	yes	1884	A		T	-9999	-9999	-9999	640	Safe Zone	affected	577.369408
1188	yes	1884	A		T	-9999	-9999	-9999	733	Safe Zone	affected	94.058739
8	yes	1441	AE		T	-9999	-9999	-9999	200	Flood Zone	affected	452.167391
8	yes	1845	AE	FLOODWAY	T	-9999	-9999	-9999	200	Flood Zone	affected	1056.186022
8	yes	1847	AE		T	-9999	-9999	-9999	200	Flood Zone	affected	541.208993
23	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	21	Flood Zone	affected	110.746829
23	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	21	Flood Zone	affected	161.106509
24	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	21	Flood Zone	affected	194.927152
24	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	43	Safe Zone	affected	5.692803
24	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	76	Flood Zone	affected	74.800395
24	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	43	Safe Zone	affected	12.943627
24	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	76	Flood Zone	affected	5.480248
25	yes	1017	AE	FLOODWAY	T	-9999	-9999	-9999	31	Safe Zone	affected	123.833195
33	yes	1221	AE		T	-9999	-9999	-9999	104	Flood Zone	affected	133.817971
36	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	15	Flood Zone	affected	336.876256
36	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	33	Safe Zone	affected	328.906637
36	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	109	Flood Zone	affected	129.717429
36	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	15	Flood Zone	affected	4.841912
36	yes	1175	AE	FLOODWAY	T	-9999	-9999	-9999	109	Flood Zone	affected	55.896907
36	yes	1221	AE		T	-9999	-9999	-9999	33	Safe Zone	affected	60.379511
36	yes	1221	AE		T	-9999	-9999	-9999	109	Flood Zone	affected	28.665104
36	yes	1221	AE		T	-9999	-9999	-9999	109	Flood Zone	affected	11.650679
79	yes	4099	AE		T	-9999	-9999	-9999	59	Safe Zone	affected	22.451954
95	yes	1291	AE		T	3	-9999	-9999	134	Safe Zone	affected	152.964162
95	yes	4110	AE		T	2.7	-9999	-9999	134	Safe Zone	affected	1087.125275
95	yes	4147	AE		T	2.7	-9999	-9999	134	Safe Zone	affected	50.513773
167	yes	1225	AE		T	2.7	-9999	-9999	106	Flood Zone	affected	49.32789
167	yes	1225	AE		T	2.7	-9999	-9999	149	Safe Zone	affected	64.360299
168	yes	1225	AE		T	2.7	-9999	-9999	106	Flood Zone	affected	34.029198
169	yes	1225	AE		T	2.7	-9999	-9999	106	Flood Zone	affected	24.817955
170	yes	1225	AE		T	2.7	-9999	-9999	106	Flood Zone	affected	11.999827

Water Treatment Plants

FID_WaterTreatmentPlants	FNAME	COASTAL_ZONE	FID_FEMA	FLD_ZONE	FLOODWAY	SFHA_TF	STATIC_BFE	DEPTH_I	VELOCITY_I	FID_Tsunami	TSUNAMI_STA	3M_SEA_LEVEL_RISE
16	Arecibo Regional WWTP	yes	1154	0.2 PCT ANNUAL CHANCE FLOOD HAZARD		F	-9999	-9999	-9999	15	Flood Zone	affected
37	Santa Isabel Regional WWTP	yes	1948	AE		T	-9999	-9999	-9999	731	Safe Zone	affected
30	Guanica WWTP	yes	666	AE		T	-9999	-9999	-9999	737	Safe Zone	affected
51	Luquillo (Brisas del Mar)	yes	2662	AE	FLOODWAY	T	-9999	-9999	-9999	220	Safe Zone	affected
52	Coco Beach	yes	404	AE		T	2.1	-9999	-9999	199	Safe Zone	affected
63	Puerto Nuevo	yes	4168	AE		T	-9999	-9999	-9999	136	Safe Zone	affected
21	La Parguera WWTP	yes	2624	VE		T	3	-9999	-9999	806	Flood Zone	affected
19	Boqueron (Villa Taina)	yes	603	VE		T	4.9	-9999	-9999	739	Flood Zone	affected
36	Ponce RWWTP	yes	722	X		F	0	-9999	-9999	780	Flood Zone	affected
6	Carolina Regional WWTP	yes	4752	X		F	0	0	0	156	Safe Zone	affected