Assessing the Implications of Sea Level Rise to the Natural and Built Environment
Cape May County, New Jersey

Critical Facilities and Infrastructure

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I. Abstract

This is a segment of the larger project of the Advanced Environmental Geomatics class at Rutgers University, which studied sea level rise implication on the natural and built environment of Cape May County, New Jersey. This paper outlines the procedures and analysis of the affected critical facilities portion of the class project, which purpose is to distinguish critical facilities that are at risk of inundation due to future sea level rise and storm surges. This section of the project is the first step helping to mitigate future land use planning for coastal counties such as Cape May County, and how these communities might begin to plan for future global climate change.

I. Introduction

Cape May County, serves as a major tourism and ecological hotspot for the state of New Jersey. Every year throughout all four seasons visitors from all over New Jersey and Mid-Atlantic region travel to this southern most peninsula for the sandy beaches, small quaint towns, and diverse coastal ecology that lie within its boarders. Yet in years to come, life as we know it in this coastal county is threatened by being permanently inundated due to future global climate change. Larger, more frequent storms along with rise in mean sea level could have devastating effects on human infrastructure and safety.

II. Background

Critical facilities play a key role to the communities they serve, in everyday life to hazardous disasters. According the book Primer on Natural Hazard Management in Integrated Regional Development Planning which discusses proper planning and mitigation for natural disasters, “The term ‘critical facilities’ is used to include all man-made structures or other improvements which because of their function, size, service area, or uniqueness have the potential to cause serious bodily harm, extensive property damage, or disruption of vital socioeconomic activities if they are destroyed, damaged, or if their services are repeatedly interrupted”(1). In Cape May County there are three hundred and six facilities that are considered critical and crucial for serving the public. These facilities include hospitals, fire stations, law enforcement, emergency management, doctor’s offices, government buildings, schools, power plants, and airports. Many of these facilities such as law enforcement and emergency management would not be available to the public if they were flooded.

Due to Cape May County’s geography as a peninsula and coastal region, many of these facilities are at risk for permanent flooding. In the report “Future Sea Level Rise and the New Jersey Coast” by Mathew J.P. Cooper, Cooper states, “Sea level rise is predicted to have pronounced impacts on New Jersey’s socioeconomic systems”(2). These changes could greatly affect critical infrastructure put in place. Cooper goes on to say, “The population of New Jersey’s coastal counties is estimated to climb over six million by 2020” (2). With an increase in year round population, critical facilities would be increasingly more important in the case of an emergency such as storm surges or hurricanes.

III. Objectives

In undertaking this study I focused on three primary objectives. First, was to compile what the critical facilities were in the county, where they were located, and what purpose did they serve to the community. My next objective was to map what facilities were most at risk for future inundation for each sea level rise scenario. My final objective was to determine the percentages lost for each type of critical facility based on the sea level rise. My overall analysis includes basic statistical methods in order to determine what facilities were most affected for particular sea level rise scenarios.

IV. Methods

In order to determine accurate sea level rise scenarios for my analysis on critical facilities, new Light Detection and Ranging (LIDAR) data was acquired for Cape May County. LIDAR, which is a remote sensing tool, uses laser pulses to model terrain in Digital Elevation Models (DEMS). This new data allowed the class and me to attain the very accuracies of two meters horizontal and thirteen centimeter vertical for the project. Along with the LIDAR data, sea rise scenarios where needed in order to model the actual future sea level rise on our Cape May LIDAR. North American Vertical Datum (NGVD) 1988, 0.0 (.284) elevation and Spring High Water (SHW) level (2.4 feet = 0.73m) were used as two individual baseline datums. Along with the baseline datums the scenarios took into account high and low sea level rise and 30 and 100 year storm surges.

My own analysis was preformed on critical facilities and infrastructure. A geodatabase was obtained from Cape May County's Planning Department server containing a shapefile of mapped critical infrastructure for the county. The shapefile contained point data of 43 schools, 15 Rescue Squads, 16 Police Stations, 1 Hospital, 2 Government Buildings, 35 Fire Stations, 11 Emergency Management facilities, and 185 Medical Practitioners which displayed with symbology representing each facility. In order to make the list more extensive I searched for other critical facilities on the internet such as airports, power plants, and county sewer infrastructure and point digitized them into the Cape May shapefile.

The next step was to determine what sea level rise scenarios would show the most realistic impact on the each of the critical facilities along the coastal and upland region of Cape May. I decided that utilizing the spring high water levels of 2.4 feet = 0.73m as baseline datum with a storm surge would yield the most threat to critical facilities because the tide range would be at a higher level and a storm surge would flood much greater land area of Cape May compared to NGVD 1988 0.0 (.284ft) elevation of the baseline datum. The three scenarios I selected were low end SLR = 1.3 meters rise, 30 yr Storm Surge + Low End SLR = 3.7 meters, and 100 Yr Storm Surge + High end SLR = 4.8 meters. For each sea level scenario I mapped my critical facility point data to show which facilities were affected by the rising oceans and storm surge.

Finally, the last step was to determine the percentages for total and individual loss for each scenario. This was done by doing a manual point count for each type of facility that was lost to flooding. I then divided the lost facilities by the total amount, 306 to determine the percentages flooded at each level.

V. Results

After mapping the scenarios and calculating the percentages for each of my three sea level rises, I was not surprised to see the positive correlation of intensity and height of sea level rise to amount of critical facilities lost to flooding. What surprised me the most was the amount of facilities lost based upon the spring high water datum. For the low end SLR = 1.3 meters rise (graph 1, map1), there was 21% total loss of facilities, with the most affected facility to be medical practitioners. This result is probably due to the relatively large amount of medical practitioners along the coast that were affected at this lower level. The next scenario, 30 yr Storm Surge + Low End SLR = 3.7 meters (graph 2, map 2) showed a significantly greater amount of flood damage to facilities due to the added storm surge, with the back bays and coasts flooded, only the center uplands region of Cape May is still above water. At this level 55% of all facilities are lost to flooding, along with most individual facilities above 20% flooded. The final and most devastating scenario 100 Yr Storm Surge + High end SLR = 4.8 meters (graph 3, map3) caused the most damage with 62.4% of all Cape May's facilities lost to flooding. Because the 100 year storm surge is more infrequent, it is more powerful, and in the last map only a thin strip of Cape May remains. At this level every facility with the exception of airports has a minimal loss of 40% or greater.

Overall, the results give good insight about what facilities could be lost to potential scenarios. One improvement that could have enhanced the analysis would have been to preform a query on facilities that were isolated by water. This information could be vital in determining if people could be stranded at a critical facility during a possible storm surge.

VI. Summary and Conclusions

The critical facilities and infrastructure in Cape May County is an important, vital resource to the communities they serve. The danger of future sea level rise and storm surges threatens these important facilities. It must be realized for future planning and mitigation practices that these facilities are at risk to being lost due to flood and in turn pose a risk to people who rely on their services every day.

Citations

(1)Primer on Natural Hazard Management in Integrated Regional Development Planning. Washington D.C.,1991. Http://www.oas.org/dsd/publications/Unit/oea66e/begin.htm#Contents. Department of Regional Development and Environment Executive Secretariat for Economic and Social Affairs Organization of American States. 06 May 2009.

(2) Cooper, Mathew J.P., Michael D. Beevers, and Michael Oppenheimer. "FUTURE SEA LEVEL RISE AND THE NEW JERSEY COAST: Assessing Potential Impacts and Opportunities." (2005). Princetion:Woodrow Wilson School of Public and International Affairs 06May2009<http://www.princeton.edu/~cmi/news/Future%20of%20Sea%20Level%20Rise%20and%20the%20New%20Jersey%20Coast.pdf>.

APPENDIX A: Graphs for Each Sea Level Rise Scenario

Total Loss: 21%

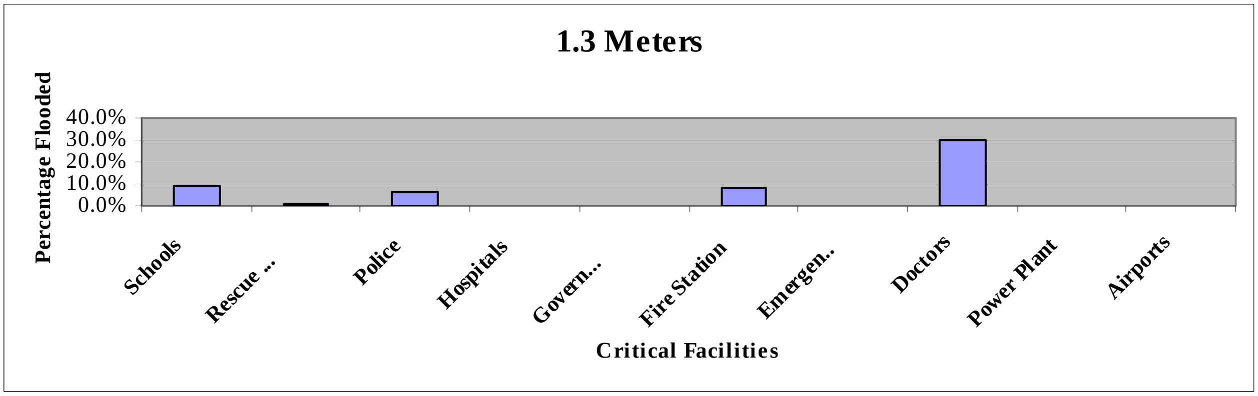


Table 1.

Total Loss: 55%

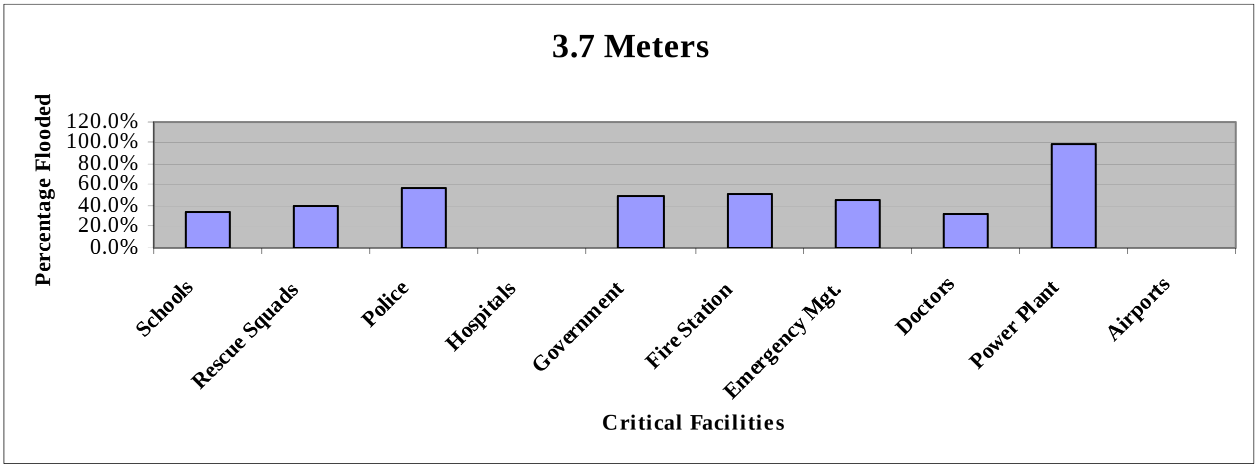


Table 2.

Total Loss: 62.4%

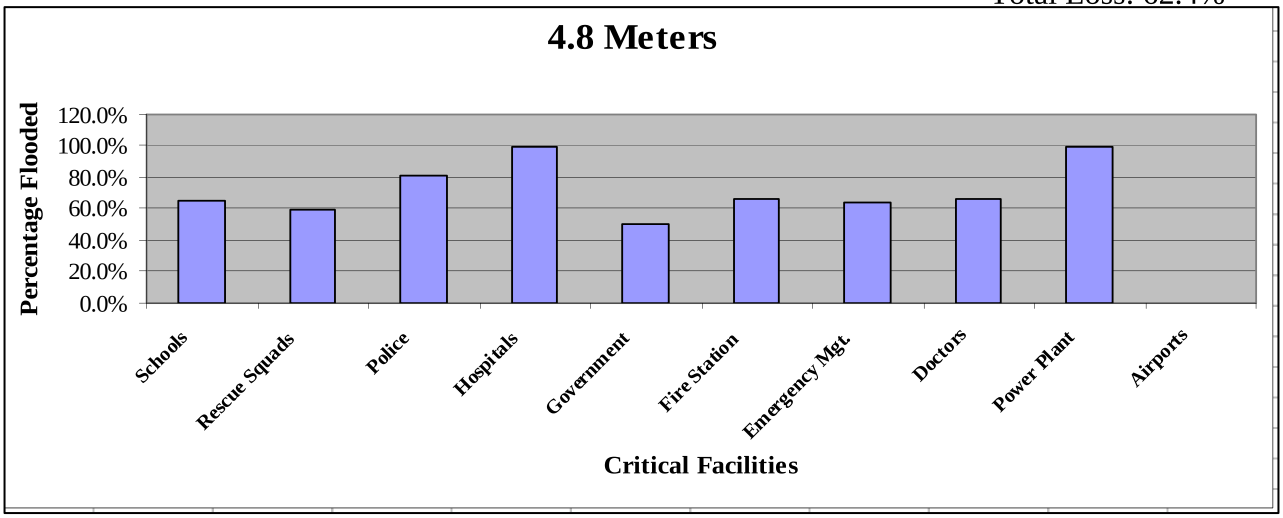
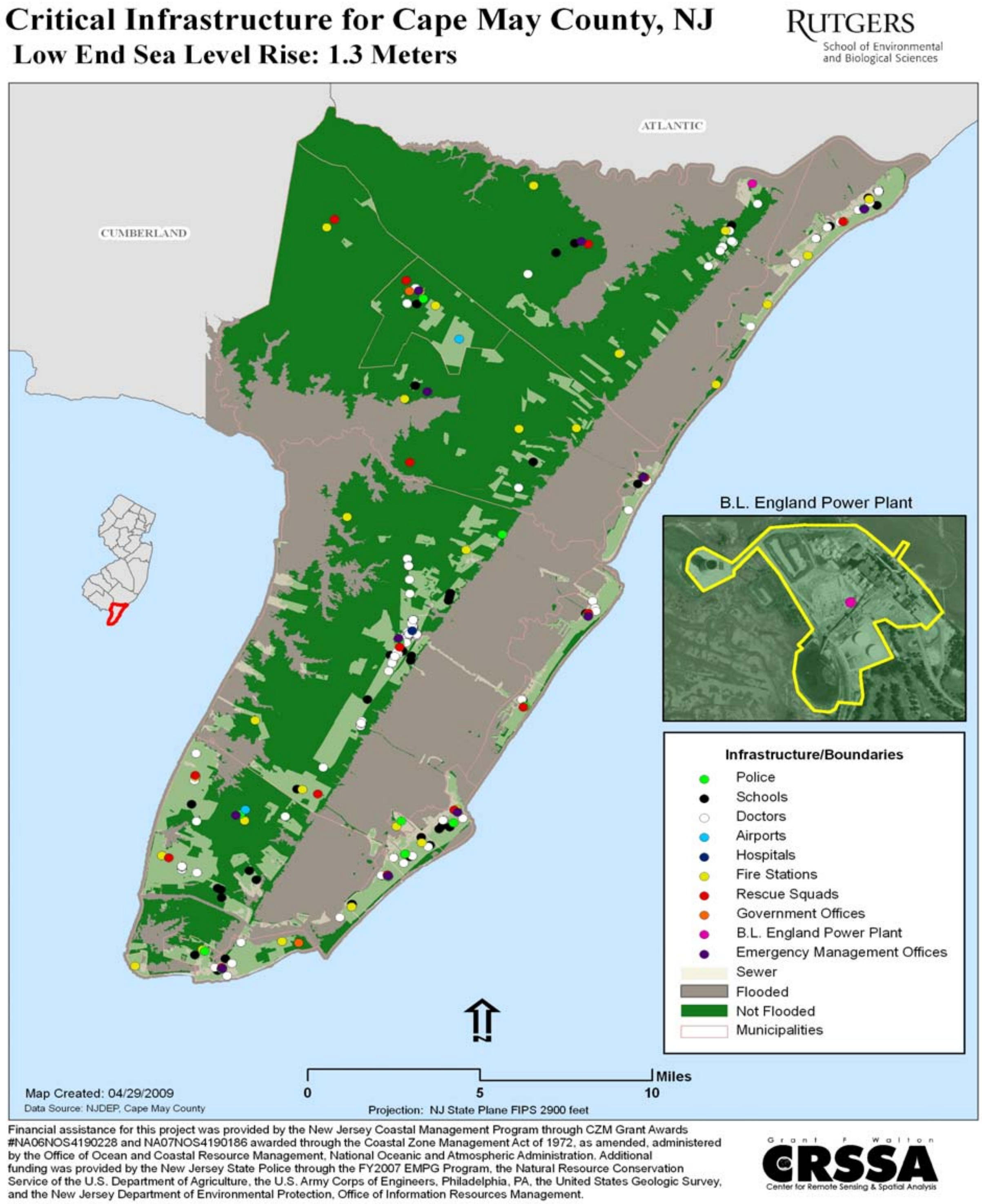


Table 3

APPENDIX B: Maps for Each Sea Level Rise Scenario



Map 1.

Critical Infrastructure for Cape May County, NJ
30 Year Storm Surge and Low End Sea Level Rise: 3.7 Meters

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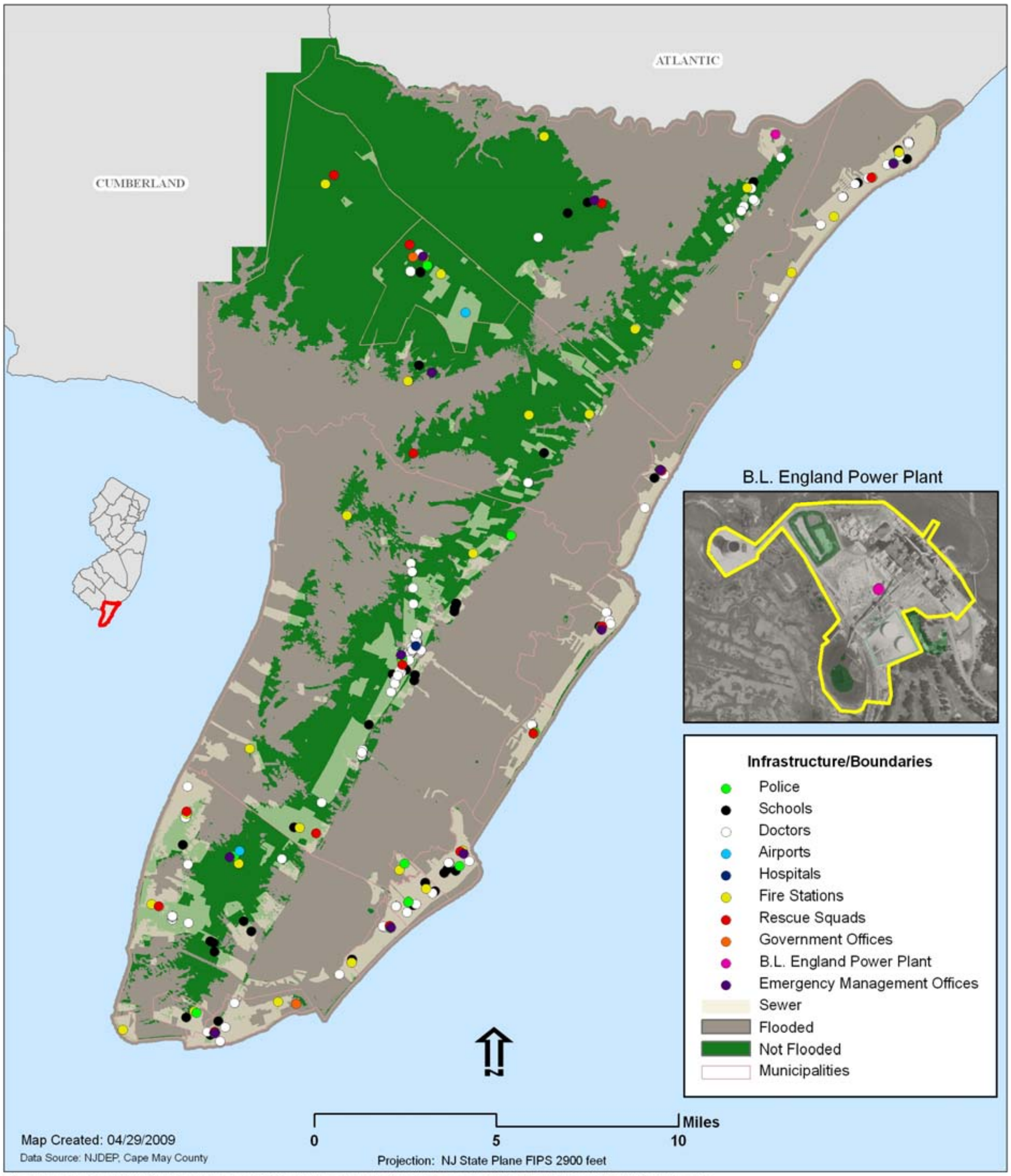

Financial assistance for this project was provided by the New Jersey Coastal Management Program through CZM Grant Awards #NA06NOS4190228 and NA07NOS4190186 awarded through the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration. Additional funding was provided by the New Jersey State Police through the FY2007 EMPG Program, the Natural Resource Conservation Service of the U.S. Department of Agriculture, the U.S. Army Corps of Engineers, Philadelphia, PA, the United States Geologic Survey, and the New Jersey Department of Environmental Protection, Office of Information Resources Management.

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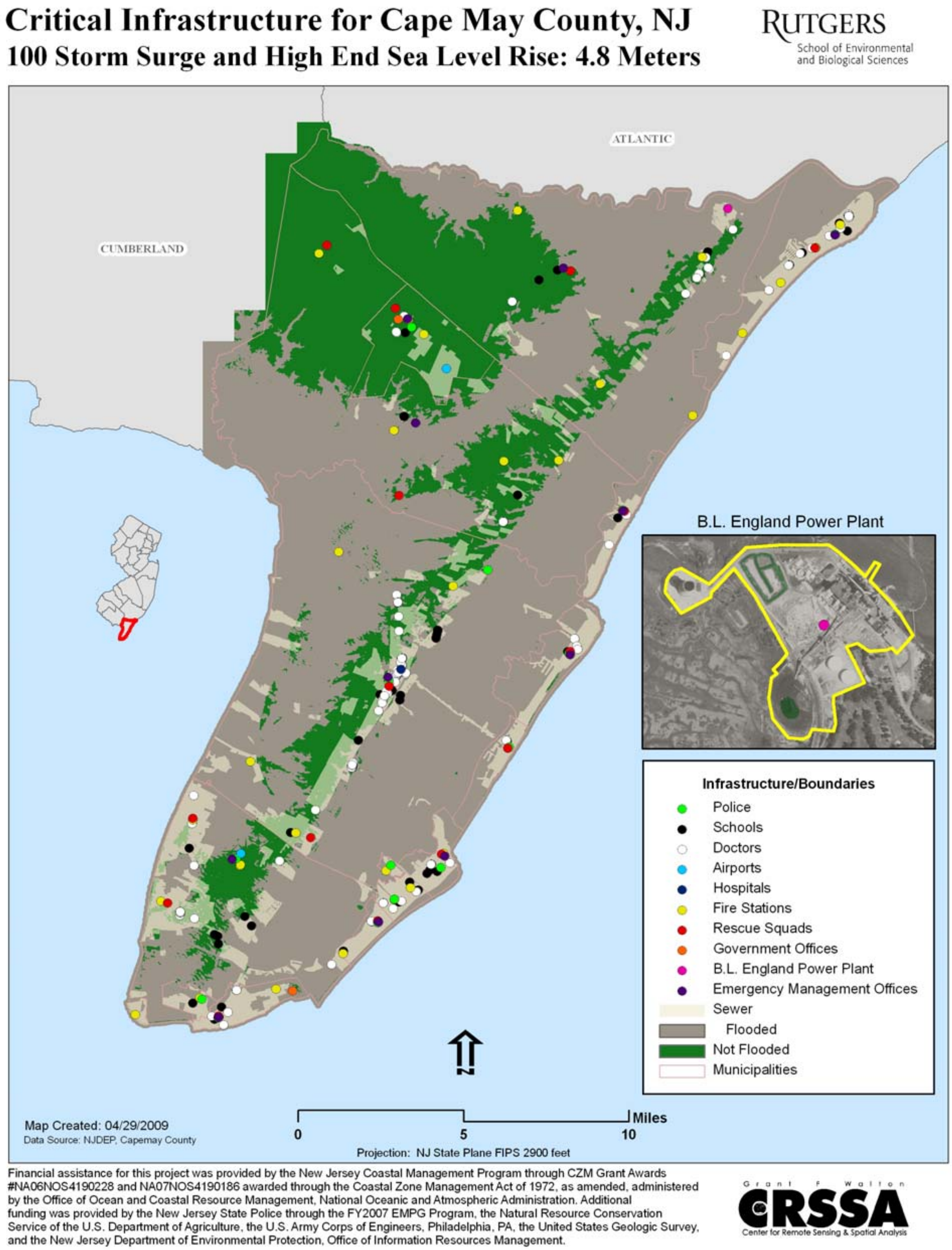
Map 2.


Critical Infrastructure for Cape May County, NJ
100 Storm Surge and High End Sea Level Rise: 4.8 Meters
RUTGERS
School of Environmental and Biological Sciences
ATLANTIC
CUMBERLAND
B.L. England Power Plant
Infrastructure/Boundaries
Police
Schools
Doctors
Airports
Hospitals
Fire Stations
Rescue Squads
Government Offices
B.L. England Power Plant
Emergency Management Offices
Sewer
Flooded
Not Flooded
Municipalities
Map Created: 04/29/2009
Data Source: NJDEP, Capemay County
0
5
10
Miles
Projection: NJ State Plane FIPS 2900 feet
Financial assistance for this project was provided by the New Jersey Coastal Management Program through CZM Grant Awards #NA06NOS4190228 and NA07NOS4190186 awarded through the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration. Additional funding was provided by the New Jersey State Police through the FY2007 EMPG Program, the Natural Resource Conservation Service of the U.S. Department of Agriculture, the U.S. Army Corps of Engineers, Philadelphia, PA, the United States Geologic Survey, and the New Jersey Department of Environmental Protection, Office of Information Resources Management.
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Map 3.