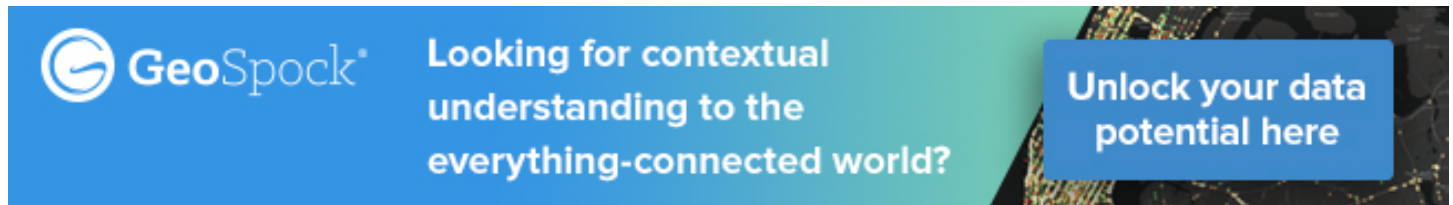


GIS enables Puerto Rico Power Mission, post Hurricane Maria

By **Joanne Castagna** - 10/12/2018



Gregory Aponte, a civil engineer with the New York District, U.S. Army Corps of Engineers, surprised his parents by showing up unannounced at their home in Puerto Rico. He had to because he had no way of contacting them. They lost power from Hurricane Maria. "After the storm made landfall, I didn't hear from them for three days. I started getting a little uneasy," said Aponte.

Aponte went there to ensure his parents were alright. He was also there to make life better for millions of citizens of the American commonwealth dealing with the aftermath of the strongest hurricane to hit the island in almost a century. He was one of approximately 2,000 Army Corps and contractor personnel that deployed to Puerto Rico for the Army Corps' Task Force Power Restoration Mission.

The mission was to make repairs to the damaged power system in order for it to generate electrical power temporarily. Aponte's role was to use **Geographic Information System** (GIS) and map out the island's electrical power grid in order to make repairs.

The Army Corps was called upon for its GIS expertise many times before, including FEMA's wildfire mission in California and for Hurricane Sandy. Last September, Hurricane Maria made landfall. The Category 4 hurricane was on the heels of Hurricane Irma that made landfall just 12 days prior. In just hours, 155 mph winds and torrential rain caused wide spread destruction, resulting in \$90 Billion in damages.

What was also devastated was the island's aging and fragile, 80-year-old power system. The vicious winds toppled transmission towers, snapped concrete utility poles, entangled lines, and battered power plants – creating the largest power outage in American history.

The lack of power for weeks in some places impacted every aspect of the economy and livelihood. There were closed factories, hospitals, banks, food stores, as well as water treatment plants that resulted in poor quality water.

"My parents didn't have power and water for three months," said Aponte. After the hurricane's onset, The Federal **Emergency Management** Agency began a Puerto Rico Recovery Mission that included repairing the power system.

The Army Corps was called upon for assistance and worked under the direction of FEMA, as well as in partnership with the Government of Puerto Rico, Puerto Rico Electric Power Authority – the island’s state run power company – and The U.S. Department of Energy.

To restore power, the Army Corps provided temporary emergency power and spot generation for critical facilities, such as hospitals and water treatment plants; ensured adequate generation at power plants; reinstalled and repaired transmission lines; and restored and repaired distribution lines.

The Army Corps installed more generators for this mission than after Hurricanes Sandy, Rita and Katrina combined. To perform this work in an efficient manner, GIS was used.

According to Aponte, the beginning of the mission was chaotic because different organizations had their own information that had different levels of accuracy.

Aponte, who served as a GIS Specialist Team Leader created a system that synchronized and updated information in one place.

His team created the Task Force Power Restoration Web Viewer, an internal interactive database of information, created using the Environmental Systems Research Institute’s (Esri) ArcGIS Online platform. An ArcGIS is a platform for organizations to create, manage, share, and analyze spatial data.

The Viewer kept involved participants updated on the mission progress and helped leaders make critical decisions. The system is an electronic map of the entire island of Puerto Rico, including a few smaller islands that are part of the region, totaling 5,320 square miles. Inside the map of the island,

the power system and various components that intersect the region, are displayed in different colors. Components include transmission and sub transmission lines, temporary power **locations**, transmission centers, micro grids and substations.

As repairs were being made to these components, the Viewer kept track of the percentage of the work getting completed. In addition, the system monitored: the location and status of the temporary power mission, power generation unit leases and micro grids; the power of critical infrastructures, including hospitals and fire stations; where contractors were located and the work they were performing; the locations of building materials; the location of work site access cuts; and the percentage of the region getting power or “energized.” Regions that were energized were light up with green on the system.

The Viewer also has a sub viewer within in called the Environmental Compliance Viewer. This system kept track of environmental impacts that needed mitigating.

“The Viewer is a front page to the mission when it came to the operation,” said Aponte. He added, “It was also helpful when it came to people rotating in and out of the mission. It helped everyone quickly get on the same page.”

To begin building the Viewer, several layers of pre-existing data was collected from the Government of Puerto Rico and FEMA and used to create a foundation. This data included demographic information, geographic data, such as terrain, wetland, fish and wildlife areas of concern, Pre and post storm imagery, the location of critical public facilities, and municipal and political boundaries. The team was also furnished with data on the power system including the location of transmission centers, substations, micro grids, and transmission lines and the number of homes that received power from them.

Aponte said, “Knowing where the transmission lines were located and the number of homes they served, was important because it told us how many people were getting energized when we repaired a power line.”

Aponte said that these transmission lines zig zag all over the island, in and around mountains, streams and other topographic features. In order to make the lines easy for the team to identify on the Viewer, they displayed them as straight lines on the schematic.

With a foundation in place, Aponte and his team started populating the system daily with information they received from field offices located throughout the island.

“At our headquarters’ office we had a big screen displaying the Viewer and we updated it with information from our field officers,” said Aponte. The field offices had an Army Corps GIS specialist that provided Aponte information from contractors and various agencies, pertaining to their specific regions.

From disaster management to municipal governance, the gamut of GIS applications

This information included the number of utility poles, the location of access roads, damage reports and assessments, power system repairs, contractor locations and work they were performing, location of building supplies, environmental impacts and regions getting energized.

“Contractors at the field locations used aerial drones to survey areas and locate transmission lines among fallen trees. They used GPS to validate these lines,” said Aponte.

The team also used the Viewer to perform spatial analysis for Army Corps and FEMA leadership. They created products – such as map books, info graphs and models – to keep them updated on the mission and to help them make important decisions that saved the mission time and resources.

These decisions included: deciding whether to deviate a power line that is being repaired that is obstructed by fallen trees or a landslide; deciding which access cut paths are the safest and most efficient to travel on to reach transmissions lines that need repairing; among many other decisions.

Aponte is particularly proud of a time they used the Viewer information to make the best use of mission resources.

Aponte said, “We were approaching the end of the mission and were assessing our time and funds and we saw there was remaining money.

“We asked ourselves several questions – What can we do that would do the most good? Make the best use of our remaining resources? Contractor’s time? Make the most impact? Energize the most residents?

“We wanted to see where there was the most need of power restoration and the most number of people. We used the Viewer to look at different areas of the island and compared the terrain, soil, difficulty of assessing location, and the location of the power lines. From this we created a target matrix that showed easy access, hard access, most clients, and less clients. This was presented to the command leaders to make decisions. The Viewer’s geospatial data enabled the team to focus their work and resources for the remainder of the mission.”

The power mission was completed and as of August 2018, 99-percent of the island’s power has been restored. Even though the mission is completed, the Viewer is still of great value. “Right now, FEMA is using the Web Viewer data to look at ways to modernize the island’s crippling power system,” said Aponte.

It’s been a year since Maria struck the island and we are in a new hurricane season. Can Puerto Rico handle it? “If another hurricane were to hit, the Army Corps’ work has made the system stronger than it was before Maria,” said Aponte.

Deploying to Puerto Rico was bitter sweet experience for Aponte. He has deployed it there a few times, first to help with housing and most recently to help the power mission. Each time he has seen Puerto Ricans go through hard times in understanding the system and each time he has been glad to explain to them in Spanish the work the Army Corps is performing and how it will help them.

Looking back, he feels he was meant to be there. He said, "This mission was why I studied engineering and joined the Army Corps. I heard that the Army Corps was the pillar of the engineering world and can organize itself to deploy people to places that need its engineering expertise. I was excited for the opportunity to do this. I began helping on various missions and when Maria hit in Puerto Rico, where I was born and raised, it was a no brainer for me. There was no way that I wasn't going to take part in this."

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