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Abstract

ABSTRACT- In September 20, 2017 Puerto Rico was struck by a category 4 hurricane, that left billions of dollars in damages, and thousand of people death. But the most casualties from this catastrophe were from the elderly community. For this project involves on identifying the retired homes and elderly building that are located on flood zone. To illustrates the evacuation routes in any emergency situation involving Huracan and tsunami.

Key words- Aguada, Elderly Buildings, Flood Zone, and Retired Homes.

Introduction

“The older adults in Puerto Rico was particularly affected by the widespread effects of Hurricane Maria. A study prepared by the Milken Institute of Public Health, attached to George Washington University, in collaboration with the Graduate School of Public Health of the University of Puerto Rico estimates excess mortality at 2,975 between the months of September 2017 to February of 2018 associated with the passage of Hurricane María.” [2].

“The recommended special flood hazard areas (starting with 1%) are identified as flood zones and are divided into:

- A: Areas susceptible to flooding from the one percent (1%) flood event. The mandatory requirements for the acquisition of flood insurance apply to this zone.
- AE: Areas susceptible to flooding from the one percent (1%) flood event determined by detailed methods. The mandatory requirements for the acquisition of flood insurance apply to this zone.
- AO: Areas susceptible to flooding from the shallow one percent flood event where the average depth is between one (1) and three (3) feet.
- A Coastal: has a wave effect with a height of 1.5 to 3 feet.
- VE: is of high coastal risk due to storm surge.” [3]

Law #3 from September 27, 1961 [4] established: “the towns and cities of Puerto Rico, with areas susceptible to flooding due to rain, rising tides, surges, overflowing of rivers or streams, or other forces of nature that affect the lives and properties of the present and future inhabitants of said areas, as well as the health, safety, order, convenience, prosperity, economic stability and well-being of the community at large.

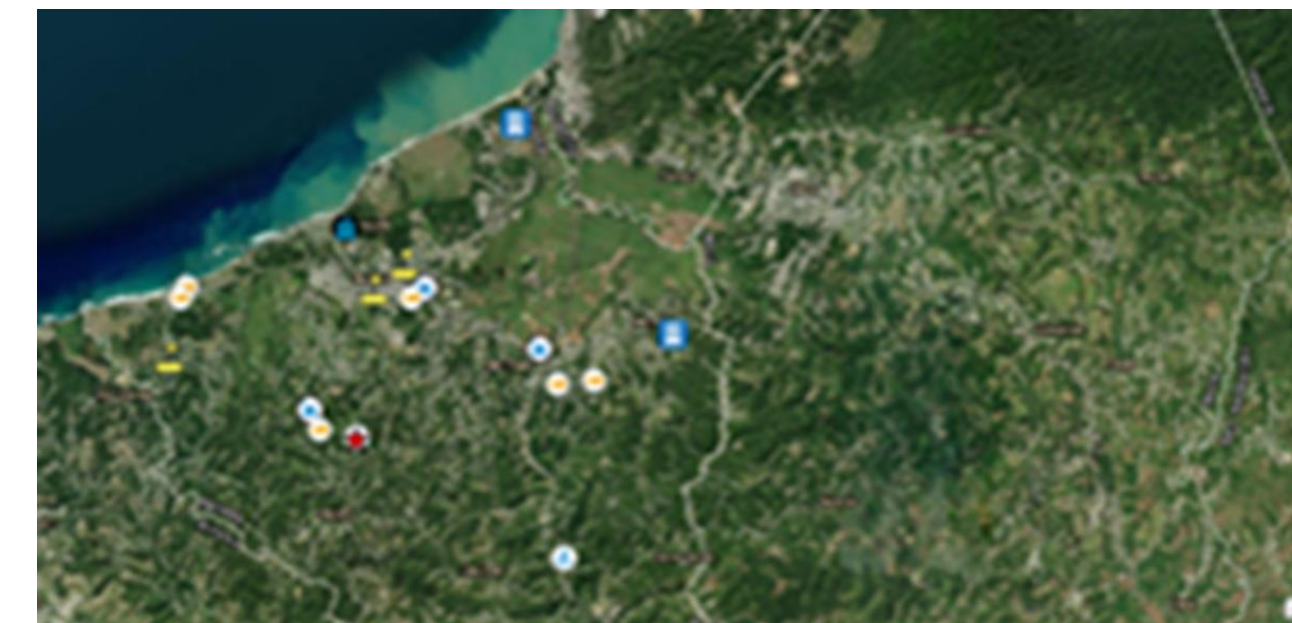
Problem

During the aftermath of Hurricane Maria many Retired Homes and Elderly Building where very affected do to the continues rained. Most of them took month to repaired the facilities and other were completely lost.

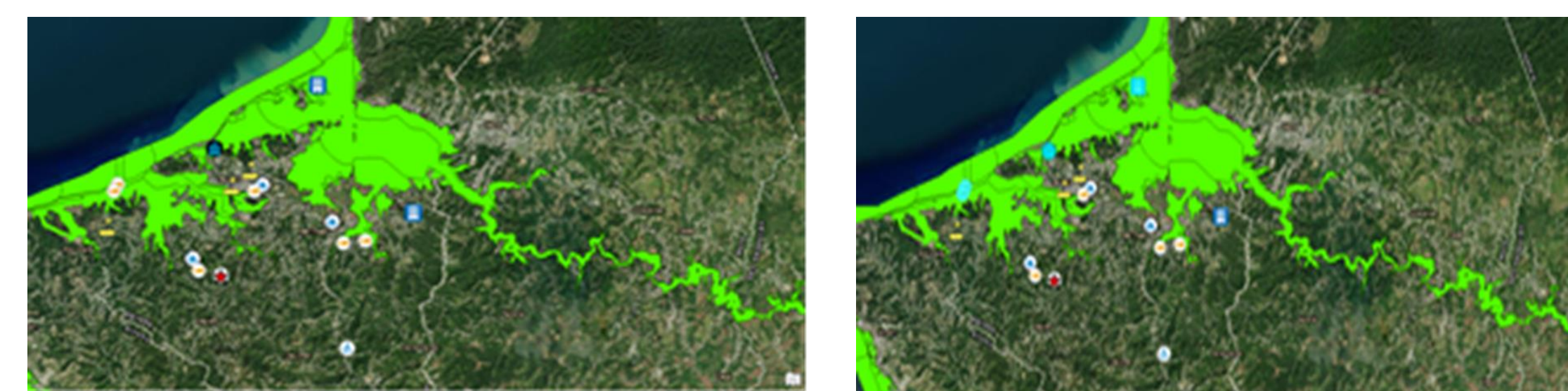
There is still not a clear list of what facilities are in flood zone or what alternative route they must take during an emergency evacuation. Which bring the opportunity to developed a GIS that can help the public to analyze where can be safe for their elderlies family member.

Methodology

Using the program ArcGIS Pro will be building the map that locates the Retired Home and Elderly Building, that are inside of flood zone. To star locating the Homes and Building we create a “Feature Class” to do this locate “view” tab and activate the “Catalog Pane” then create a database where the layers are going to be save. Right click on the database press “New” and then press “Feature Class”, insert the name of preference for this project we used (Retired_Home) and the “Feature Class Type” must be Points. Repeat the process for the Elderly Building, shelters and Assembly Point. After creating the four-point layers press the “edit” tab on the feature section used the “Create” tool. Which open the Create Feature Panel, it shows all the Feature layer created previously. From their tab on the Retired Home layer and begin to locate the structures. Repeat same steps for the other three layers.



Now to establish the flood zone area, visiting the web page “Junta de Planificacion (JP)” on the download tab press the shapefile (.SHP) [6] and download it to the computer desktop. In ArcGIS Pro catalog pane go to the folder of the project, right click and press “Add Folder Connection”. Drag the shapefile folder to the project. Next step is to choose the layer “FloodZone_1PCT” and added to the map, make sure the layer is place below the point layers so does not obstruct the location points. To identify which structure are inside of the flood zone used the “Select by location” tool. Tab on the analysis and press “tool”, on the search bar write select by location. In the “input feature” field place the Retired home and Elderly Building layers for the “relationship” field place (Within), on the “selecting features” field place (FloodZone_1PCT) layer and for the “Selection Type” just leave it on (new selection). Finally press the run tap and begin to process input data.



With the identified structures, we must now locate the shortest route that reach to the assembly point. To do this repeat the previous step from “Create Feature Class” only this time the “Feature Class Type” must be line, the chosen name was “Evacuation_Route”. Again, go to the “edit” tab and choose the created Layer, and located the shortest route to the assembly points.

OBJECTID	Shape_Length	Shape
1	1718.354442	Polyline
2	3908.700235	Polyline
3	1692.051717	Polyline
4	5177.565553	Polyline
5	5513.499041	Polyline

Results and Discussion

After completing the GIS, it was discovered that two (2) Retired Homes:

- “Hogar de Anciano Maria Isabel”
 - “Hogar de Anciano Miry”
- and two (2) Elderly Building:
- “Aguada Elderly”
 - “CAMPEA: Centro De Actividades Multiples Para Personas De Edad Avanzada”

were located inside of the flood zone which means are the most vulnerable to a Huracan or Tsunami, due to the low elevation they have with respect to the mean sea level. Also discovered that “CAMPEA” has the longest distance to nearest assembly point, with a distance of 5,177.565 meters or 5.177 kilometers



Conclusions

With the elderly population rising every day, the government or private business must take action to fix this situation before another similar event like hurricane Maria or more recent event with hurricane Fiona from the September 18, 2022. My recommendation is to establish a near by Assembly Point at list five (5) meters above the Flood zone or to relocate the structure on a more safety place. For future development for this type of business is important to consult with a Professional Surveyor (PS) to verify and conform if the property is inside of a flood zone.

Future Work

Future projects involving flood zones, can be to find federal fund and proposal to mitigate for properties that are identified in this areas. This should be the beginning to counter attack any effect created during a crisis. Other alternative can be break waves, lines for dredging, bridges, or concrete barrier can be a solution for this conflicts.

Acknowledgements

Most of the investigation was done by me. Occurs during the search of the retired homes and building, the owners where kind enough to provided me with the basic information and type of services they provide. The Flood Zones map where found on the “Junta de Planificación” (JP) web page, which is free for the public. Prof. Victor Romero supervised the project, gave guided and opinion in the development of the investigation.

References

- [1] El nuevo día y Primera hora. María, un nombre que no vamos a olvidar. Nov 27, 2017. <https://huracanmaria.elnuevodía.com/2017/>
- [2] Lombardi González. Giselle M. Los adultos mayores ante el paso de los huracanes Irma y María: leyes aplicables, observaciones y propuestas para un Puerto Rico resiliente. <https://derecho.uprrp.edu/inrev/2021/05/04/los-adultos-mayores-ante-el-paso-de-los-huracanes-irma-y-maria-leyes-aplicables-observaciones-y-propuestas-para-un-puerto-rico-resiliente/>
- [3] maps.jp.pr.gov. ¿Cómo buscar en los Mapas de Niveles de Inundación Base Recomendados? <https://maps.jp.pr.gov/index.php/como-buscar-en-los-mapas-de-niveles-de-inundacion/#:~:text=Las%20C3%A1reas%20especiales%20de%20peligro,de%20recurrir%20en%20cualquier%20a%20C3%B1o.>
- [4] bvirtualogp.pr.gov. May 6, 2021. “Ley para el Control de Edificaciones en Zonas Susceptibles a Inundaciones”. <https://bvirtualogp.pr.gov/ogp/Bvirtual/leyesreferencia/PDF/Recur%20Naturales/3-1961.pdf>
- [5] Aguada, Puerto Rico – La Villa de Sotomayor. BoricuasOnline.com. <https://boricuaonline.com/aguada-pr/>
- [6] maps.jp.pr.gov. HECRAS Models for the PR Advisory. Maps <https://maps.jp.pr.gov/index.php/download/>