# Designing a Resilience Hub for Vulnerable Populations in Las Carolinas, Puerto Rico

*An Interactive Qualifying Project Report Submitted to the Faculty of WORCESTER POLYTECHNIC INSTITUTE in partial fulfillment of the requirements for the Degree of Bachelor of Science by*


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# Abstract

Government agencies have been slow to respond and support Puerto Rican communities' post-disaster. The Centro de Apoyo Mutuo (CAM) in rural Las Carolinas is a mutual aid center based in a repurposed school that aims to increase community resilience and disaster preparedness for their community. Our project supported CAM Las Carolinas' resilience efforts by developing a disaster preparedness mobilization system that documented household-level assets and risks to improve post-disaster response effectiveness. The system was informed by interviews with 42 las Carolinas residents, 4 community leaders, and 6 other mutual aid centers. We created a database and mapping system to locate at-risk community members and provided the CAM with recommendations to build long-term resilience.

# Executive Summary

**Figure A: Damages to a road in Las Carolinas after Hurricane Maria**

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## Background

Climate change projections for Puerto Rico suggest an increase in the magnitude and frequency of intense cyclonic storms and extreme heat episodes (Intergovernmental Panel On Climate Change, 2023). In 2017, Hurricane Maria became an icon of climate change as the deadly Category 5 hurricane caused 90 billion USD worth of damage, destroyed over 300,000 homes, left residents without electricity for months, and led to the loss of thousands of lives (Housing Recovery Support Function, 2018, Irvin-Barnwell et al., 2020). Government response after Hurricane Maria was inadequate; it took over six weeks for rural regions in Puerto Rico to receive support from municipal, territorial, and federal governments. Subsequently, communities throughout Puerto Rico lost faith in government support post-disaster leading to the emergence of “Centros de Apoyo Mutuo” (CAMs), or mutual aid centers as alternative social organizing movements throughout the archipelago (Murray, 2018). CAMs are a social grassroots movement that help Puerto Ricans transition from the cycle of dependency

and paternalism caused by a century of corrupt policy and the colonial relation with the US. This social movement promotes autonomy and *autogestión*, which is the concept of self-management. These concepts were a response to understanding the roots of the disaster recovery and response issues (Vélez-Vélez & Villarrubia-Mendoza, 2020, 2021). In the rural community of Las Carolinas, several women established a CAM in 2017, operating out of a repurposed abandoned school.

This CAM is run by women volunteers who have provided a variety of services for the community over the past six years, including hot lunch deliveries on a lunch route consisting of vulnerable residents and homeless populations, medical brigades, a thrift shop, and a public space for socialization and other events. They aim to develop into a resilience hub to help the community respond better to future disasters.


**Figure B: CAM Las Carolinas on a map of Puerto Rico**

## Project Goal & Objectives

This project designed a Disaster Rapid Response Mapping System that increases disaster preparedness capabilities for the CAM Las Carolinas to support their community. The following objectives provided structure and direction to our project goal:

1. Document post-disaster risks and assets of vulnerable populations within the Las Carolinas community.
2. Create a mapping system of the community's risks and assets that informs disaster response protocol.
3. Propose a plan for the CAM resilience hub for preparation, resiliency, and post-disaster recovery with resources that respond to physical and social needs.

## Methods

We employed a multi-method approach to achieve our objectives. We conducted 4 interviews with Las Carolinas leaders to understand the community's response during previous disasters. We conducted 42 disaster preparedness surveys to understand household preparedness, assets, and risks. This information was then used to develop a mapping system for the CAM Las Carolinas to support rapid response post-disaster. We created the Disaster Rapid Response Mapping System (DRRMS) on Google My Maps to display our surveyed households' locations, assets, and risks. We interviewed 6 mutual aid centers within and outside Puerto Rico and reviewed the literature on resilience hubs to offer short-term and long-term recommendations to design a resilience hub in the CAM Las Carolinas space.

## Findings

Community members shared how the Las Carolinas community was underprepared and received inadequate government support after Hurricane Maria. From interviews, we learned that the community was left without power for six

months and without water for two months. Many residents did not board up their windows, store supplies, or take basic precautions as they had not experienced the need to, having only encountered Category 2 and 3 hurricanes in the past. Due to the hilly terrain of the community, many homes were flooded and faced structural damage (Delia De Leon, personal correspondence, 2024). When aid arrived, it was difficult to channel resources to those who needed them due to the lack of registered addresses and the complicated layout of the community.

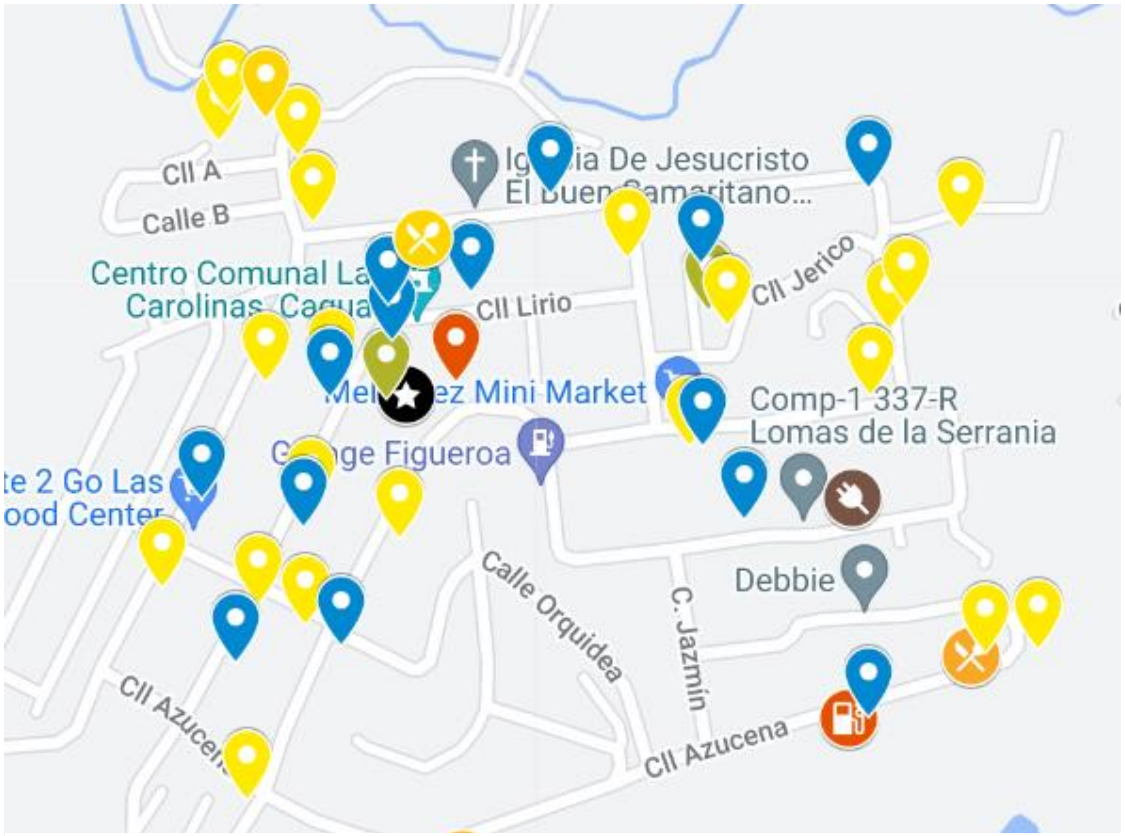


**Figure C: The DRRMS pilot in Las Carolinas showing surveys collected at the event in blue, and surveys collected house to house in yellow. Other nodes with items show household assets.**

Our quantitative data collection reveals that the Las Carolinas community is underprepared for disaster and has inadequate emergency evacuation strategies. Their disaster preparedness was measured by the number of emergency items they owned as recommended by government agencies responsible for disaster response and the Caguas municipality. We also found that residents have a strong support network but have various vulnerabilities. Our data shows that most of the lunch route elderly community has at least one medical impairment, and this impacts their ability and motivation to prepare for disaster. Many residents also received aid from outside of the community during Maria, which could influence their level of disaster preparedness. Surveying residents exhibited higher confidence that their neighbors would help them during an emergency than faith in their own personal preparedness, arguably making them more disaster-prepared than the survey data shows. We also found that many lunch route residents have assets in their homes

that they would be willing to share with the community. Leveraging the exchange of assets between community members could help build resilience.

## Recommendations

Based on our findings, we created three key recommendations to support resilience in Las Carolinas:

1) Expanding household data in the Disaster Rapid Response Mapping System (DRRMS)

Currently, there are 42 households on the map which can be scaled up to include the rest of the lunch route and community through surveys or other methods. Gathering more results on the assets and risks of the community will increase disaster preparedness. It will improve the accuracy of the quantity and types of items they could store and ensures that each households needs are understood and can be met post-disaster.

**Figure D: Using the DRRMS to identify at-risk households**

2) Holding disaster preparedness awareness activities

CAM volunteers can encourage the community to prepare for a disaster by holding educational events. This could include Community Emergency Response Trainings (CERT) (Baja, 2021).

The CAM volunteers could familiarize themselves with the DRRMS which contains household level information on residents' assets and risks. Assets are skills or shareable resources, and risks are medical conditions or lack of resources. The CAM can use the DRRMS before a disaster to check in on high-risk households' preparation measures, and to create a response plan before the disaster happens. Post-disaster, the system can be used to execute a response plan, distribute supplies, and direct external aid to at-risk households. By having this data in the form of a map, it creates a visual that is easily usable in a disaster response situation to increase quality and timeliness in an emergency.

**Figure E: Room in the CAM that uses solar energy for the proposed resilience hub**

3) Building a resilience hub

The CAM is dedicating a room in the school to serve as a resilience hub. This hub can be used to store emergency supplies, to act as a meeting place post-disaster, and to support long-term community resilience. Based on our survey data that assessed household preparedness,

we recommend the CAM stock up on the following supplies that households do not have in addition to food and water (FEMA, 2021). From the survey results, the most lacked items were a seven-day supply of daily medications, battery powered radios, first aid kits, extra batteries, whistles, plastic sheeting, tape, and blankets. Estimates of the quantity of each item were calculated from an estimated population base of 90 households that the CAM currently serves and a minimum of 3-days without outside aid (US Department of Commerce, n.d.). We recommend that as the CAM community grows, the quantity and type of supplies stored be reassessed. There are social and health risks that the CAM can support that are associated with a mostly elderly population. Socialization services could include game nights, crafting or cooking classes, or cultural events held at the CAM (Enterprise Community Partners et al., n.d.). Many of the households expressed difficulty in getting to doctor's appointments, so holding a regular medical clinic would be beneficial. Having access to holistic health services like acupuncture or yoga could act as both social engagement and help with chronic pain, stress, anxiety, and other conditions. These services could help strengthen the social cohesion of Las Carolinas.


**Figure F: Artwork in Las Carolinas reading 'One entrance, one exit, one family'**

# Acknowledgements

First and foremost, we would like to express our sincere gratitude to our sponsors Maria Arroyo and Dimarie Fontanez for the invaluable support and guidance that they have given us throughout the project. They were hospitable and caring, and welcomed us to the Las Carolinas community.

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Our team would like to express gratitude to all of the Centro de Apoyo Mutuo volunteers. They have all contributed to our project by allowing us to observe their day-to-day activities, showing us how to prepare lunch route meals, and for making the CAM a warm environment.

Thank you to Delia De Leon, the President of the Resident's Association, for allowing us to use the Centro Comunal Las Carolinas to hold a community gathering. She helped us set up and clean up our event and for that we are very grateful. She also provided helpful insight into the community to better our understanding during an interview.

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# Introduction

*"If Puerto Ricans were to wait for the state—federal or local—to address the absolute devastation and lack of resources, many would die waiting. During that time, multiple organizations—mostly based on grassroots groups that existed prior to the hurricane—quickly organized to channel aid" (Rodríguez Soto, 2020).*

On September 20th, 2017, Hurricane María devastated Puerto Rico by crushing homes, separating families, and ending lives. In February 2018, researchers concluded that 2,975 Puerto Ricans died from the hurricane and its aftermath (Feldscher, 2018). Inadequate response from local and federal government led to communities relying on one another for support, spurring the emergence of "Centros de Apoyo Mutuo" (CAMs), or mutual aid centers across the archipelago. Both the Federal Emergency Management Agency (FEMA) and municipal governments have been criticized for their untimely response to Hurricane María, taking over six weeks to provide aid to the rural parts of Puerto Rico. The aid Puerto Rico received for Hurricane María was much less than provided for other hurricanes in the continental United States (Murray, 2018). Due to these experiences and widespread mistrust in the government, many communities have taken disaster preparation into their own hands.

CAMs are community-run and focused on supporting immediate community needs, and some have transformed into centers of resilience. While the services and support they provided immediately after natural disasters were invaluable, they have become more permanent features in communities because of the pressing need for post-disaster organization and planning, funds, and other long-standing needs of their communities. In addition to providing aid to their respective communities, CAMs are a social grassroots movement that help Puerto Ricans transition from the cycle of dependency and paternalism caused by a century of corrupt policy and the colonial relation with the US. This social movement promotes autonomy and *autogestión,* which is the concept of self-management as a response to understanding the roots of the disaster recovery and response issues (Vélez-Vélez & Villarrubia-Mendoza, 2020, 2021).

The purpose of our project is to improve the disaster preparedness capabilities of the CAM Las Carolinas in Caguas, Puerto Rico by initiating tools, training, and planning that will help them better understand the community's vulnerabilities and assets. We implemented a survey of household risks and assets to create an emergency response plan *before* a disaster happens. Our first objective was to document post-disaster risks and assets of vulnerable populations within the Las Carolinas community. Afterwards we created a mapping system of the community's risks and assets that informs disaster response protocol. Lastly, we proposed a plan for the CAM resilience hub for preparation, resiliency, and post-disaster recovery with resources that respond to local physical and social needs.

In the following background section, we discuss how inadequate government response to Hurricane María, a decades long fiscal crisis, and government mismanagement led to the emergence of CAMs. We then describe our multi-method approach to help the CAM Las Carolinas understand their community's disaster preparedness, risks, and assets to develop a resilience hub that can address them.

## Building Resilience

Puerto Rico's status as an unincorporated territory of the United States, and history of colonization has long affected the conditions of the archipelago. Being subject to different laws and rights than the continental states allow for the resources and people to be taken advantage of. The economy shifted from an agricultural to industrial model after the territory was occupied by the United States, creating a dependency that caused increased risk of public debt as the US foreclosed alternative economic models for Puerto Rico. These conditions, in addition to local governmental mismanagement, have caused significant problems for Puerto Rico, and has only exacerbated the effects of the increasing natural disasters (Rosas et al., 2021). In 2016, the US Congress passed the Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA) to manage its $70 billion debt crisis (*Puerto Rico's Debt Restructuring Process*, n.d.) The effects of PROMESA, austerity, poor management by the government, and economic stagnation caused political and economic issues (Vélez-Vélez & Villarrubia-Mendoza, 2018).

In the wake of the 2017 hurricanes, Puerto Ricans have expressed frustration with the lack of effective response and mismanaged disaster relief from the government and instead have learned to depend on one another in times of need (Leiserowitz et al., 2023, Rafael et al., 2021). Aid from the government is unreliable and NGOs (Non-Governmental Organizations) and charities often have the resources needed but are unable to distribute them appropriately among those in need. The gaps created leave some people receiving little to no aid or assistance from the government, NGOs, or charities. Additionally, disasters create needs that existing networks and support systems are not prepared to deal with (Samaritan's Purse - Canada, n.d.). This creates an unmet needs group – a group whose needs are not being completely addressed by any aid organization and tend to rely on their communities for support.

### Consequences of Hurricane María

The devastating aftermath of Hurricane María exposed the vulnerabilities of Puerto Rico, leaving residents to grapple with widespread damage, a humanitarian crisis, and a prolonged struggle for recovery and reconstruction. The Category 4 hurricane made landfall in Puerto Rico on September 20, 2017, starting at the southeast shore of the archipelago and moving northwest (Pasch et al., 2023). Strong winds and heavy rainfall destroyed over 300,000 homes and left residents without electricity for months (Housing Recovery Support Function, 2018). An estimated 90 billion USD worth of damage and a 62% increase in mortality rate from Hurricane María quantify its devastation (Irvin-Barnwell et al., 2020). Contrary to many reports, the actual number of excess deaths could be far closer to 70 times the published estimate, due in part to survivorship bias (Irvin-Barnwell et al., 2020). Despite this, out-migration accounts for most of

the population lost in Puerto Rico after Hurricane María (West, 2023). Figure 1 shows a large population decline of 4.05% in 2018 compared to 2017.

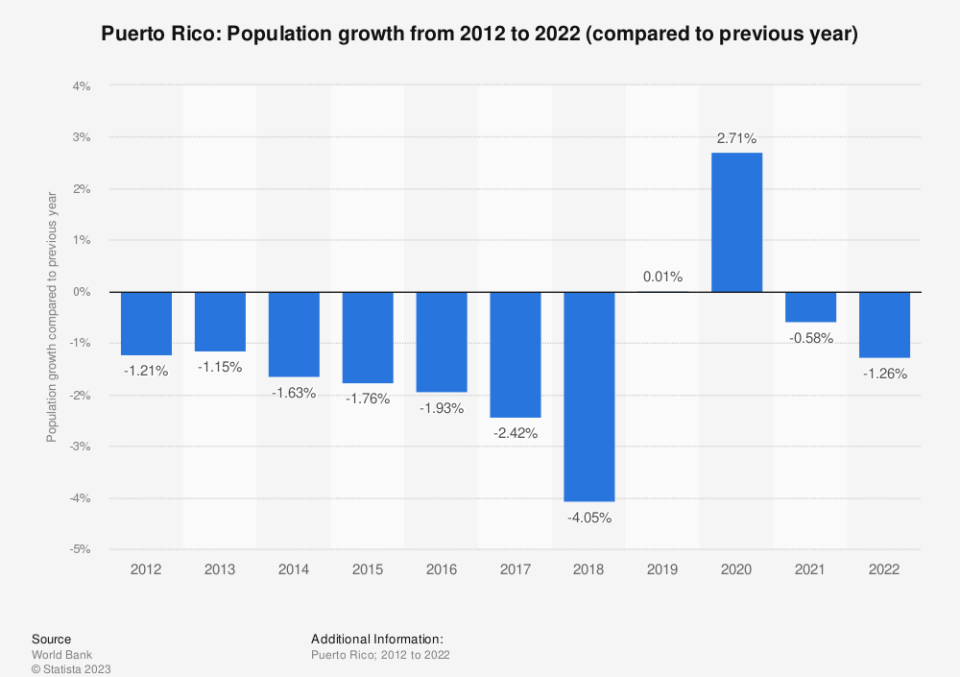



**Figure 1:** Population growth compared to the previous years from 2012 to 2022 in Puerto Rico (World Bank, October 2023).

Due to the widespread closure of public schools in rural areas, a high percentage of these out-migration families included those with children (West, 2023). Figure 2 shows the steady decline of children and adults in the Puerto Rican population and the rise of elderly populations aged 65 and above between 2010 to 2022. According to some studies, familial separation has a detrimental impact on the mental health of left-behind family members, who are primarily elderly residents (Matos-Moreno et al., 2022). Their increasing age correlates with a decreased ability to adapt to major life changes, such as loss of property and social connections due to disasters (Hutton et al., 2008). María's devastation has left a significant impact in Puerto Rico,

shaping both their response to natural disasters and the community's general distrust in the government's ability to help.

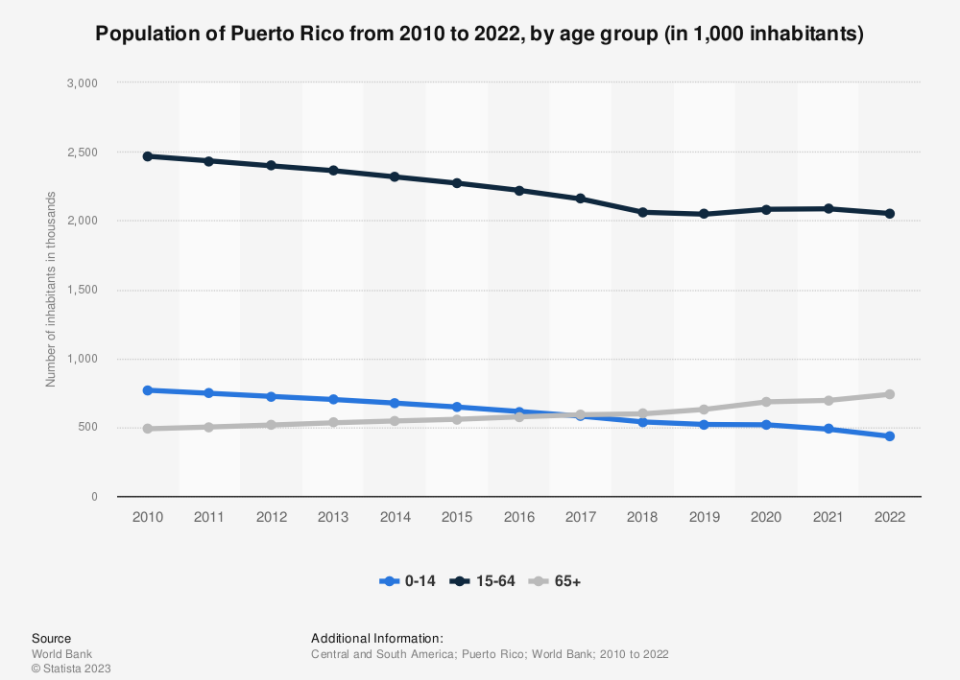
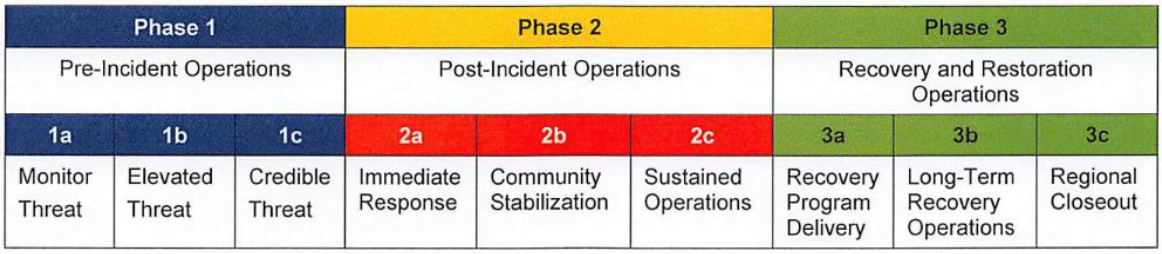



**Figure 2:** Puerto Rico's population from 2010 to 2022 by age group in 1,000 inhabitants (World Bank, July 2023)

In 2020, the Puerto Rico Emergency Management Bureau's (PREMB) Puerto Rico All-Hazards Plan (PRAHP) was created to address poor government response after Hurricane María. The plan outlines Puerto Rico's strategy to improve preparedness and response efforts post-disaster depending on the incident severity level of the disaster. To organize tasks and action over time, PREMB created three operational phases, and Figure 3 shows the three tasks associated with each phase. Phase I covers all pre-incident operations to identify potential threats and act before their impacts occur. Phase II covers all post-incident operations as soon as Puerto Rico is impacted by an emergency, so PREMB can promptly save lives and support communities after a disaster. Phase III covers all long-term recovery and restoration operations following

stabilization (Puerto Rico Department of Public Safety & Puerto Rico Emergency Management Bureau, 2020).



| Phase 1 | | | Phase 2 | | | Phase 3 | | |
|---|---|---|---|---|---|---|---|---|
| Pre-Incident Operations | | | Post-Incident Operations | | | Recovery and Restoration Operations | | |
| 1a | 1b | 1c | 2a | 2b | 2c | 3a | 3b | 3c |
| Monitor Threat | Elevated Threat | Credible Threat | Immediate Response | Community Stabilization | Sustained Operations | Recovery Program Delivery | Long-Term Recovery Operations | Regional Closeout |

**Figure 3:** All-Hazard's Plan Response & Recovery Operation Phases (Puerto Rico Department of Public Safety, & Puerto Rico Emergency Management Bureau, 2020)

## Community Resilience: Social Infrastructures and Assessment

Increasing climate disasters have brought resilience hubs to a notable place in literature. Largely, the literature presents methods on how to understand and meet these needs using models such as Community Assessments for Public Health Emergency Response (CASPER), Asset Based Community Mapping (ABCD), and Communities Advancing Resilience Toolkit (CART), as well as instructions for how to build preparedness kits and make evacuation plans (Kim et al., 2023, Schnall et al., 2018, The Samaritan's Purse - Canada, 2023). Similarly, case studies highlight how different lived experiences bring forward common patterns in relation to how resilience hubs are formed and the kinds of services they offer (Faber et al., 2021, International Federation of Red Cross and Red Crescent Societies, 2014, Tran, 2022). This literature shows that resilience hubs typically emerge as a response to a disaster as they work to understand the current needs and help to funnel aid to those who need it most: through immersion in the community, formal or informal data collection, or utilizing existing networks.

Community resilience is the ability of communities to withstand, recover, and learn from climate impacts to strengthen future response and recovery efforts (Lou, n.d.). This is similar to adaptive capacity which measures how much a society must adapt to minimize loss and maximize gain and is seen in the Vulnerability-Resilience Indicator Prototype (Figure 4) (Brenkert & Malone, 2005). The VRIP model is broken into three target areas measuring: the

extent a community is subject to changes in temperature, precipitation, and extreme weather, how much systems can be affected by climate change, and adaptive capacity.

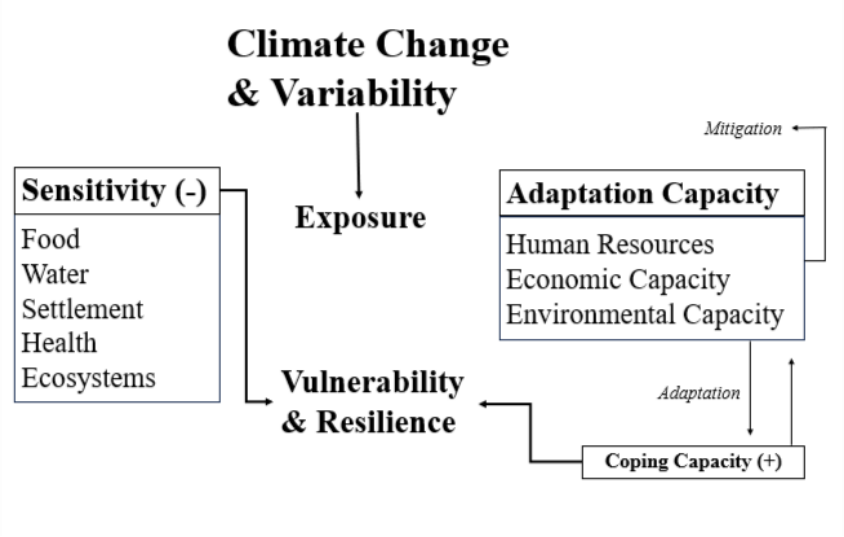



**Figure 4:** Vulnerability Resilience Indicator Prototype (VRIP) (Brenkert & Malone, 2005)

Another key concept is social cohesion, which is a community's overall sense of belonging and voluntary social participation (Lou, n.d.). Social cohesion is represented in the Nine Core Model (Figure 5). This model quantifies factors of local knowledge, community networks and relationships, communication, health, governance and leadership, resources, economic investment, preparedness, and mental outlook, to evaluate community resilience (Patel, 2017). Community networks and relationships evaluate a community's connectedness and cohesion. Bonding activities can help bring communities closer, improving trust in a time of crisis (Henry, 2018). Health issues can be best prepared for by noting all the risks in a community. At-risk populations are the sick, elderly, young children, those with mental health issues, and dependency on medicines (*At-Risk Individuals*, n.d.). Physical assets are identified as first aid supplies, food, and water, as well as the less tangible assets such as skills, certifications, and experience (Samaritan's Purse - Canada, n.d.). Approaching resilience by assessing all that the community has to offer and support one another helps to foster independence, interdependence, and growth. Surveying is a common method to understand what needs are unaddressed in a community. This type of activity is called a risk or needs assessment and is a form of data collection that surveys stakeholders to understand gaps in services. These concepts

come together to form a community that is both supportive in infrastructure and social climate, leading to a high level of resilience.

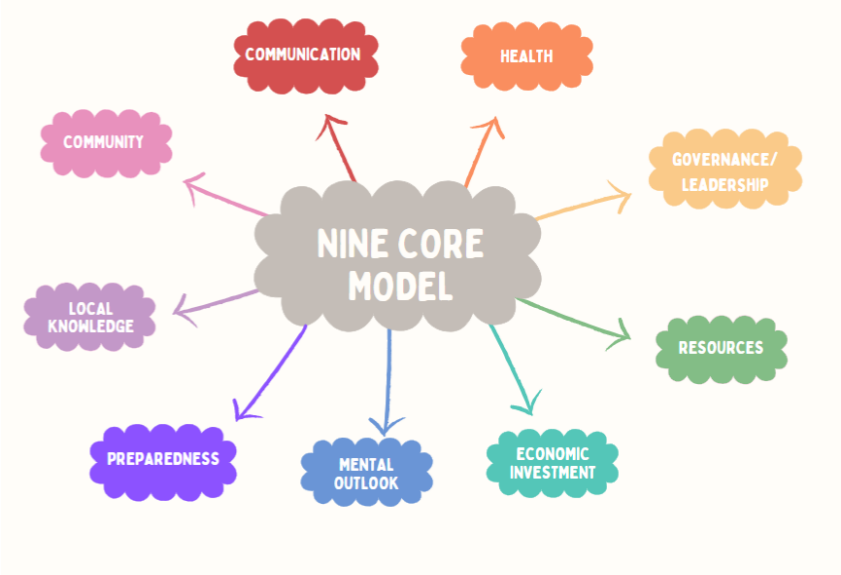



**Figure 5:** The Nine Core Model

## Emergency Preparedness Hubs

Emergency preparedness hubs are physical spaces within a community that provide support and resources to maintain safety and quality of life responsible for fostering resilience before and after a natural disaster happens (Ciriaco & Wong, 2022, Choi, 2020). They are places to ask for and offer help, share information, start organizing recovery efforts, and increase social morale (*Community Emergency Hubs,* 2023). Emergency preparedness is one aspect of community resilience. It involves preparation for a natural disaster, response during the disaster, and the recovery afterwards (*What Is Emergency Preparedness?*, n.d.). This includes two of the Nine Core Factors: resources and preparedness, which can involve better preparation of food, water, and resource storage. Additionally, the hub can serve as a meeting and recovery location for a community post-disaster to distribute goods, information, and power (Mazereeuw & Yarina, 2017). There are many ways for an emergency preparedness hub to take shape depending on space and resources.

## Understanding the Community

Assessing what resources a community has in abundance and what it lacks is an effective way to determine what an emergency preparedness hub can include. A survey is a common way to assess the quantities and types of preparedness supplies a hub may need that involves direct contact and data collection with individuals. It is important that those who are collecting data on the community's needs build trust beforehand as it can include sensitive information (Whittaker et al., 2015). Categories of information collected typically include a section on contact information, such as name, phone number, and address. The other categories relate to the specific needs and special considerations of the people represented in the survey. If taking an asset-based approach, there may follow a series of questions about the resources and skills the household has that they could share. Resource sharing is focused on an individual level. Each person in a

community has resources or skills they can share to help one another. Maintaining this knowledge and relationships helps with preparedness and recovery efforts (Pines et al., 2014). Varying by case, but also important are questions relating to the specific disaster – such as damages or needs caused by it (Qin, 2020). This information covers the scope of understanding that an outside aid organization would need to deliver the appropriate resources and help to the right people. The specific questions are always dependent on place and case, however under these main headings the people and their needs can be properly understood and addressed. An alternative form of understanding a community's risks and assets is through using local knowledge. For example, the city of Tallahassee published a Neighborhood Plan for Readiness and Emergency Preparedness (PREP) program for building community resilience. This involves designating a leader of every street or block who communicates the needs and assets of the street to the other block leaders as a form of emergency preparedness (Faber et al., 2021). This leader keeps track of the people on the street with specific conditions to expedite the process of distributing aid from external organizations (*Module One – Form A Neighborhood PREP Response Team*, n.d.).

### Preparedness Measures

A community can create a physical emergency preparedness hub if they see a need for greater disaster preparation. Some physical hubs have a guide for information, skills, and resources that exist and contain supplies relevant to emergencies that may be encountered, such as water, food, a generator, and a radio. There are specific points of management within a hub that streamline the distribution of information and supplies. The set-up of a communities' emergency preparedness hub varies on a need, space, and resource basis. The Red Road Resiliency Hub located in Puna, Hawaii has worked to create a plan to respond to natural disasters that includes distributing supplies. They offer food, water, ice, and emergency supplies and are hoping to offer cots, headlamps, road lighting, independent water and energy sources, and blankets to combat the risks faced in this environment such as limited road access and tropical disasters (*Hawaii's Volcano Circus Red Road Resiliency Hub*, 2023).

In a case study of The Taller Communidad La Goyco community center, the risks and assets were evaluated. The three courses of action that were implemented are creating an emergency protocol, development of an emergency preparedness toolkit, and modifying a Critical Information System (C.I.S) mapping stratagem (Fallon et al., 2023). The C.I.S mapping style involves constant data collection from its community, often monthly, to keep updated knowledge on risks that community members may have. The emergency preparation toolkit from the case study involves the application of the C.I.S mapping strategy along with the Emergency Support Function (E.S.F) chart. The goal of the E.S.F chart in Figure 6 is to evaluate the capabilities of a resiliency hub during a crisis, following the seven most important core capabilities of Puerto Rico's All-Hazard plan (Fallon et al., 2023). The All-Hazard plan (Figure 3) is a strategy crafted by both the governor of Puerto Rico and their Emergency Management Bureau Commissioner. The third action in this study was the emergency protocol. This was intended to focus on immediate preparation before a disaster strikes, giving structure to the otherwise impromptu rapid response (Fallon et al., 2023). Ultimately, these findings from this

case study provide insight into effective strategies for an emergency preparedness hub in Puerto Rico.

| Emergency Preparation Checklist: Descriptions | |
|---|---|
| **1. Developed Action Plan** | A plan in place that can adapt to the different incidents or emergencies that arises. |
| **2. Situational Awareness Assessment** | Gather awareness of where to locate resources or help in the region before, during, and after an incident occurs. |
| **3. Joint information system and center** | A program / or committee that can provide consistent public messaging to the region before, during, and after incidents occur. |
| **4. Basic Communication** | The ability to effectively communicate within the organization and with Municipal response agencies. |
| **5. Coordination between stakeholders and commonwealth** | Establish operational coordination within local, commonwealth, and possibly federal stakeholders and coordinate operational capabilities. |
| **6. Adequate Response Capabilities** | Deploy adequate response capabilities in impacted jurisdictions to mitigate damages until responders arrive. |
| **7. Critical Transportation Services** | Determine the most appropriate transportation services to facilitate response and act if possible. |

**Figure 6:** The E.S.F checklist with descriptions (Fallon et al., 2023)

### Post-Disaster Response Protocol

After a natural disaster, an emergency preparedness hub can be involved in post disaster recovery efforts. They can distribute resources and offer access to assets such as backup generators, solar panels, bathrooms, refrigerators, or stored water. Local leaders of mutual aid centers can help local and federal government organizations by informing them of vulnerable persons that exist within the community. Aid organizations can utilize the hub space to store supplies and convene to discuss strategic planning. It is recommended that the hub reaches out to local first responders and establishes communications outside the community via radio or television to continue to receive updates (Enterprise Community Partners et al., n.d.).

## Centro de Apoyo Mutuo, Las Carolinas

The Centro de Apoyo Mutuo (CAM) Las Carolinas is a resilience center located in the rural area of Las Carolinas in the central municipality of Caguas, Puerto Rico, shown on the map in Figure 7. The community center opened on November 17, 2017, shortly after Hurricane María hit the archipelago. The resilience hub is in a public elementary school, abandoned after a five-year battle with Puerto Rico's Department of Education in May 2017 as part of austerity school closures. As a result, many families with children left the community, leaving most of the Las Carolinas community of elderly residents with minimal family support.

The CAM Las Carolinas has provided a variety of services for the community in the past six years, including hot lunch deliveries to vulnerable residents and homeless populations, medical brigades, a thrift shop, and a public space for socialization and other events. The hot lunch deliveries occur twice a week along two different routes to reach about ninety homes. The hub has a following on social media, specifically Facebook, to promote their work. This CAM receives grants through organizations like the Maria Fund, a social justice intermediary

supporting community organizations. The CAM also receives donations and supplies from various private sources, including supermarkets, companies, and individual donors (Arroyo et al., personal correspondence, 2023).


**Figure 7:** Map of Puerto Rico municipalities, showing the location of CAM Las Carolinas (Mendez, 2023).

# Methodology

The purpose of this project was to design a resilience hub that increases disaster preparedness capabilities for the CAM Las Carolinas to support their community. The following objectives provided structure and direction to our project goal:

> **Objective 1:** Document post-disaster risks and assets of vulnerable populations within the Las Carolinas community.
>
> **Objective 2:** Create a mapping system of the community's risks and assets that informs disaster response protocol.
>
> **Objective 3:** Propose a plan for the CAM resilience hub for preparation, resiliency, and post-disaster recovery with resources that respond to physical and social needs.

In what follows, we discuss our multi-method approach to achieve each objective along with limitations that may have affected our results.

## Community Data Collection

We assessed the community needs and assets with a three-pronged approach. This included integrating ourselves into the community, interviews with community leaders, and surveys with community members. We began by introducing ourselves to the CAM volunteers and to the community. We integrated ourselves within the community by volunteering at the CAM to help organizers create, prepare, and deliver lunches, which developed a connection with the community to build trust and rapport. We became familiar with the recipients of the lunch route, and they were able to ask questions about our project. All interviews and surveys were conducted with a community member providing English-Spanish translation.

We then conducted four interviews with community members who hold leadership positions. The semi-structured interviews allowed us to ask more open-ended questions about their lived experiences post-disaster and their role in the community. They also provided insight into the community's resources at the time of Hurricane Maria and the resources they have today. The themes identified in the interviews informed the recommendations for emergency preparedness for the CAM space and for the community. We conducted interviews at the CAM, and each took 20-25 minutes The interview questions can be viewed in Appendix A and have the following topic structure: introduction (demographic and contact information), services or concerns relating to the CAM, and disaster preparedness (specifically lived experiences).

Our last step was to conduct surveys with residents on the lunch route to collect quantitative data on disaster preparedness, needs, and assets (see Appendix B). Our group conducted 29 surveys by going door to door throughout the community coupled with 13 surveys completed by community members during a gathering at a local community center. We identified the houses to survey through positional data taken from the lunch routes. After responses were interpreted, we entered them into a Google Form, which were then imported to a Google Sheet. The community event was hosted to gather more survey responses, and attendance was encouraged with incentives including food, clothes, and shoes. Voluntary participants pinned their locations on a paper map of Las Carolinas and filled out a paper survey. Our team manually added this new data to the digital database. To protect the privacy of the residents' personal information, we ensured that the account that stores the data is only accessible to the

sponsors. Furthermore, we inquired about medical conditions on a household level rather than an individual level so that the home could receive help but not make known the identity of the at-risk individual.

## Creating a Mapping System for the Community

We used Google My Maps to develop a mapping system called the Disaster Rapid Response Mapping System (DRRMS) that contained all the important information from the survey data. The DRRMS has several benefits for the CAM to use to help their community. It allows for the easy recognition of community members who need special care by the CAM leaders. This lets the CAM coordinate an effort to help these specific individuals through either their own capabilities and resources or by giving this information to third party aid organizations so that they may provide accurate assistance. The map can be read quickly during a disaster to analyze risks and assets with ease, which lets the CAM make important decisions quickly. Digital maps are also immune to physical damage that may come in a disaster.

To create the DRRMS, we first started by geolocating all the homes along the CAM's route. Gathering the locations of the homes was a two-step process because some residences in Las Carolinas do not have registered addresses, making it difficult to map their location. First, we attended the two main routes; for each route, we gathered data on the home's coordinates using the iPhone compass feature. The coordinates provided a foundation for locating the home. Then, we took photos of the homes and added two screenshots of its location on Google Maps, one zoomed in showing the exact home, and one zoomed out showing its place in the community (Figure 8). This additional step confirmed our positional data.

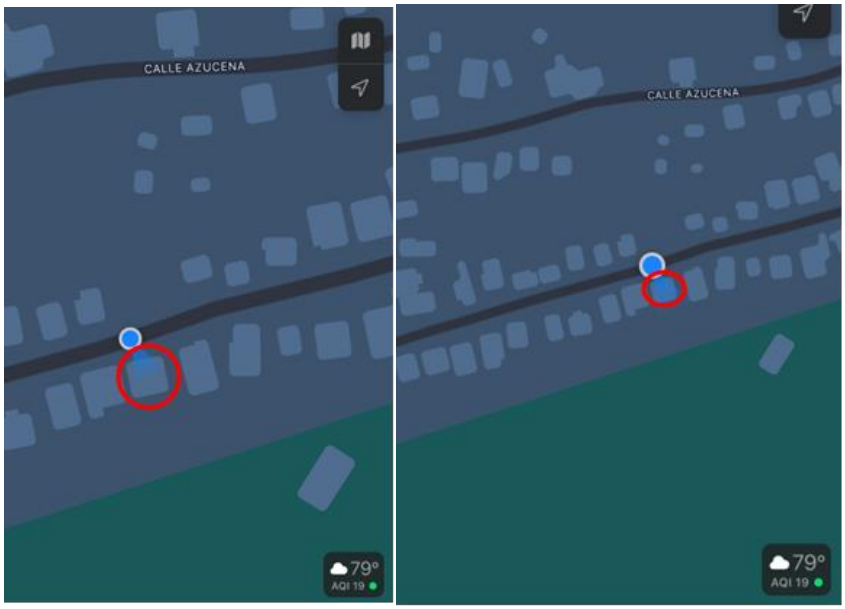



**Figure 8:** Location of a home (circled in red) in Las Carolinas gathered through the Apple Maps app, with one screenshot zoomed out to locate its position in the My Map software more easily.

With the confirmed positional data, the homes on the lunch route were plotted directly onto a Google My Maps (Figure 9). Survey data entered into the Google Form was then processed into both an automatic Google Sheets and Google My Maps.

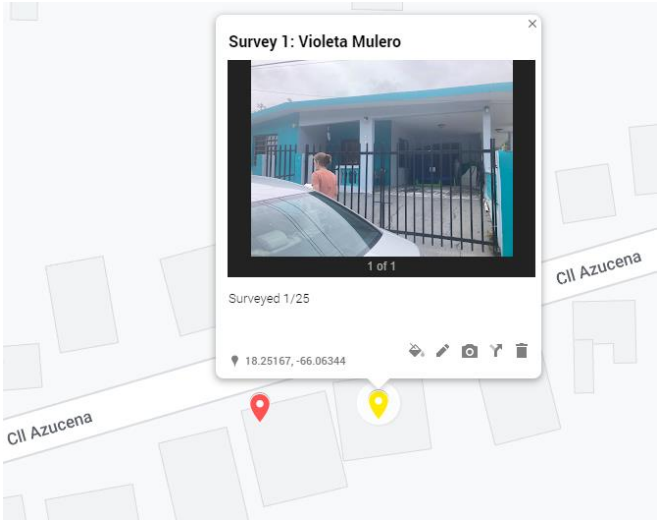



**Figure 9:** A survey node (yellow) plotted using the Maps app screenshots and refined from the initial compass coordinate gathered (red node) in Las Carolinas.

To then further visualize the overall risk each home faced, we assigned a color depending for each node depending on how many risks they put on their survey. This gradient went from bright yellow (no risks) to dark red (5+ risks). The node marker was also changed if the household had a specific asset or skill, such as an electrical plug symbol if they had a generator to share.

Some areas in Puerto Rico have weak cellular network connections, but in case of any future failures, we printed a paper copy of the database and the map for the CAM to store in case of emergencies. Additionally, we taught the CAM sponsors how to use the DRRMS so that they can continue this mapping system in the future (Appendix C).

## Redesigning the CAM Space

Redesigning the CAM space as a resilience hub comprised a two-pronged approach: interviewing other mutual aid centers to find their strengths and challenges and analyzing the survey and interview data. We then discussed with the CAM leaders physical and social assets they could implement given their funds and the volunteers' time.

We interviewed three mutual aid centers located outside of Puerto Rico to discuss best practices about building mutual aid centers and the day-to-day responsibilities of running one. Then we interviewed three mutual aid centers in Puerto Rico to understand their experience in dealing with hurricanes, extreme heat, and flooding, they also understand the difficulties of working with local and federal government. In our interviews, we inquired about programming that builds social cohesion, healing workshops, and emergency items that they offer. Then asked if they prioritize stocking emergency items or building community trust and strengthening relationships.

After the semi-structured interviews and surveys were completed, the data was analyzed to determine the most pressing needs and interests of the community after a natural disaster. If less than 75% of those surveyed identified that they do not have a specific item on the emergency “backpack” list, which contains supplies that are recommended to have on hand in case of an emergency, we determined that it is a priority item for the CAM to stock. There could be a 3-day supply on under-prepared items to support the community before outside aid arrives. We consulted online preparation guides to find out how much water is needed to support the community and how many hours flashlights and batteries will be needed for. Touring the CAM space and interviewing the volunteers helped conceptualize what assets they already had. The CAM stocks food and water to make the lunches for the route and has a water tank, solar panels, and the building is concrete. They also have many vacant spaces, one of which used to be a senior center arts and games room that closed during the COVID-19 pandemic.

## Limitations

The biggest limitation of our project was the language barrier. As none of the team members can speak Spanish fluently, we used the abilities of bilingual CAM volunteers to act as interpreters when collecting survey data from residents that only speak Spanish. One potential issue we encountered with interpreters was that information may have gotten lost in translation, risking inaccurate data. Furthermore, interpreters sometimes answered questions on behalf of interviewees based on assumption, which also might have affected accuracy. The language barrier also caused miscommunication, leading us to unintentionally survey several non-lunch route households instead of only lunch route households, which was our intended population. This reduced the sample size of the population we are studying, and therefore, may have reduced the precision of our results. Additionally, while we tried our best to integrate ourselves within the Las Carolinas community as much as possible, we only had limited time to do so. It is possible that interviewees and survey respondents withheld information from us due to a lack of trust, therefore influencing our results.

# Findings

In the following section, we analyze our interview and survey results to identify common themes and make conclusions about the disaster preparedness of the Las Carolinas community.

## Reality & Response to Disasters in Las Carolinas

After Hurricane María, Las Carolinas had to overcome many challenges before they could begin their recovery efforts. The president of the Resident's Association, Delia De Leon, shared that the community was left without power for six months and without water for two months. Many of the banana and plantain trees had fallen on nearby homes, leaving residents without shelter. Hurricane María was the strongest storm in Puerto Rico in three generations, therefore, the community was not equipped for a hurricane of this magnitude. Many of the residents did not board up their windows, store supplies, or take basic precautions as they had not experienced the need to in the past. This made recovery harder because many homes experienced damage from broken windows or from the strong winds and falling objects. Charity and nonprofit organizations were unable to donate to residents that did not have the title to their home. The community found it difficult to communicate with people outside of Las Carolinas; Rosario González, founding member of the CAM, waited nearly three days before she was able to contact her daughter living outside of the community. The largest struggle for the community was the slow response from the municipal and federal government; it took them six weeks to start providing aid. The community needed to learn to rely on each other and pool together their resources.

Evacuating the community was a challenge for many people; Delia De Leon, the President of the Resident's Association, mentioned that many of the residents have limited mobility or are bedridden and were unable to leave. Most residents do not have working cars or licenses, causing them to rely on public transportation, which is sparce in Las Carolinas. The community is separated by bridges which are prone to flooding, thereby trapping those residents in their sector (Figure 10). The community itself only has one bridge to and from the center of Caguas, which flooded during Hurricane María, preventing outside aid from getting to Las Carolinas. First aid organizations were unable to reach Las Carolinas by air as the community does not have a landing spot or space large enough to accommodate a helicopter.

**Figure 10:** Photo of the Los Ramos Sector bridge experiencing flooding and trapping residents of Las Carolinas inside their sector after a major hurricane (Las Carolinas Community Residents Association, 2023).

Interviews expressed how the challenges of Hurricane Maria brought the community together and increased social cohesion. In September the hurricane devastated Las Carolinas, but two months later, residents including Rosario González and Dimarie Fontanez, founding members of the CAM, entered the abandoned elementary school to use the kitchen to cook hot meals for sick and elderly community members. The hurricane also showed the community their own strengths- mechanics, cooks, engineers, electricians, and handymen came to help their neighbors in their time of need and to connect services to the CAM facility. Homes with solar panels or backup generators shared their energy and friends exchanged water and non-perishable foods.

Hurricane María was a learning experience for Las Carolinas. The community learned to store more hurricane disaster supplies. Many interviewees stated that they were not prepared because they had not stocked supplies or protected their homes. In the surveys, many responded that they now have a supply of food, water, and medicine in case of disaster. Furthermore, much of the community was without a generator, solar panels, or a rainwater collection system. Community members invested in alternate sources for power and water and are now more equipped to support themselves post disaster. The CAM represents autogestion by distributing 200 hot meals a week, proving that the Las Carolinas community can support themselves without government aid by focusing on their own strengths. The community learned to keep an emergency response plan after Hurricane María. Delia De Leon shared that their contingency plan contains a phone number they can call after a disaster that will help connect them to various aid organizations, such as the Red Cross and National Guard. The Caguas municipality also keeps an emergency response plan, which details a list of agencies they can call to help Las Carolinas. Furthermore, it details places that the community can use as shelters during a storm and outlines emergency response supplies, they should keep on hand. Lastly, the community learned that there are certain benefits to having an official title for their home, and there are social workers at the CAM in the main city of Caguas equipped to help residents acquire titles so that they can be eligible for donations and aid.

## Assets & Risks

To understand disaster preparedness at a household-level in Las Carolinas, our team collected household information from 42 families, with 15 collected from lunch route households and 27 collected from non-lunch route households. The lunch route consists of about 90 households and the entire community contains over 2,500 households. The data we collected supports trends that can be extrapolated to the entire community or expanded upon.

The first 29 surveys were collected verbally by going door-to-door, while the last 13 were individually completed on paper at our hosted community event. Our survey questions were categorized into three sections: household disaster preparation, assets, and risks. Based on our collected data, we can make the following claims:

1. **Based on FEMA, the Puerto Rico State Agency for Emergency and Disaster Management (PREMA), and the Caguas municipality's preparedness recommendations, the Las Carolinas lunch route community households are underprepared for post-disaster recovery and have inadequate emergency evacuation strategies.**

We defined disaster preparedness as a household owning certain "emergency backpack" items that FEMA, PREMA, and the Caguas municipality recommend having during an emergency. Table 1 shows how many residents on the lunch route and general population own emergency items. From the data, lunch route households are underprepared for certain situations during a disaster, increasing their risk of disaster vulnerability. It can be observed that community members are more likely to have a stock of daily necessities, such as food and water, than less frequently used safety items, such as sleeping bags and flashlights. It is important to note that some households reported keeping a stock of adult diapers based on their needs. While many residents have experienced natural disasters living in Las Carolinas, there are several factors that influence a household's level of preparedness, such as financial status, disaster preparation knowledge, and past disaster experience (Kim et. al, 2022).

| **Emergency items recommended by FEMA, PREMA, and Caguas municipality** | **Number of lunch route participants that responded "yes" at time of survey (n = 15)** | **Number of all participants that responded "yes" at time of survey (n = 42)** |
|---|---|---|
| Adequate drinking water (besides tap) for the next three days (1 gallon/person/day) | 12 (80%) | 34 (83%) |
| Adequate non-perishable food (e.g., protein bars, nuts) for the next 3 days | 13 (87%) | 33 (81%) |
| Seven-day supply of daily medications * | 11 (73%) | 30 (73%) |
| Battery-powered or hand-crank radio | 11 (73%) | 29 (71%) |
| Cell phone with chargers and a back-up battery | 13 (87%) | 36 (88%) |
| Matches | 13 (87%) | 38 (93%) |
| Flashlight | 11 (73%) | 36 (88%) |
| Multi-tool with can-opener | 12 (80%) | 34 (83%) |
| First-aid kit | 8 (53%) | 21 (51%) |
| Extra batteries | 10 (67%) | 29 (71%) |
| Whistle | 6 (40%) | 19 (46%) |
| Dust mask | 12 (80%) | 31 (76%) |
| Plastic sheeting and duct tape | 9 (60%) | 20 (49%) |
| Trash bags, bathroom tissue, and other hygiene supplies | 13 (87%) | 35 (85%) |
| Baby formula, diapers and wipes * | 0 (0%) | 2 (5%) |
| Pet food and other necessary pet supplies * | 8 (53%) | 23 (56%) |

| | | |
|---|---|---|
| Birth certificates, passports and other critical documents in a waterproof container | 9 (60%) | 29 (71%) |
| Sleeping bag or blanket and pillow | 6 (40%) | 18 (44%) |
| Disposable plates, cutlery and paper towels | 13 (87%) | 33 (81%) |

* Indicates that data is not used in our analyses

**Table 1:** Number of households containing "emergency backpack" items recommended by FEMA, PREMA, and the Caguas municipality

We also inquired about whether residents have emergency evacuation plans. Table 2 shows how many lunch route residents and general residents have specific emergency plans. When asking if they have multiple routes to leave the community, we learned that there is only one exit in Las Carolinas, making the default answer "no." Since that question is no longer related to individual household preparedness, it is not included in our analysis. Data shows that lunch route residents do not have adequate emergency evacuation plans in place. In a 2015 study taken place in Philadelphia, it was reported that bedridden adults with medical impairments, such as limited mobility and chronic illness, are unable or hesitant to evacuate during a disaster (Dostal, 2015). From our observations while conducting surveys and interviews, it appears that this framework applies to the Las Carolinas community too. This may explain why elderly residents on the lunch route do not prioritize creating evacuation plans.

| **Emergency evacuation plans in households** | **Number of lunch route participants that responded "yes" (n=15)** | **Number of all participants that responded "yes" (n=42)** |
|---|---|---|
| Emergency communication plan, such as a list of numbers and designated out of town contact | 9 (60%) | 25 (60%) |
| Designated meeting place/shelter in your neighborhood | 4 (27%) | 14 (33%) |
| Designated meeting place/shelter outside your neighborhood if you cannot return home | 6 (40%) | 16 (38%) |
| Multiple routes away from your home in case evacuation is necessary * | 1 (7%) | 8 (19%) |

* Indicates that data is not used in our analyses

**Table 2**: Number of households that have emergency evacuation plans in place.

2. **Lunch route residents are confident that they would receive support from within and outside of their community.**

When inquiring about lunch route residents' confidence in receiving support from their neighbors and community during a time of need on a scale from one to five (low confidence to high confidence), we found that 67% of lunch route respondents indicated a very high level of confidence (five) and 13% indicated a moderately high level of confidence (four). However, when having them rank their individual preparedness on a scale from one to five (low confidence to high confidence), we found that 40% of lunch route respondents indicated a very high level of confidence (five) and 33% indicated a moderately high level of confidence (four). Figure 11 demonstrates the stronger confidence that households have in receiving support from their community compared to their own preparedness.

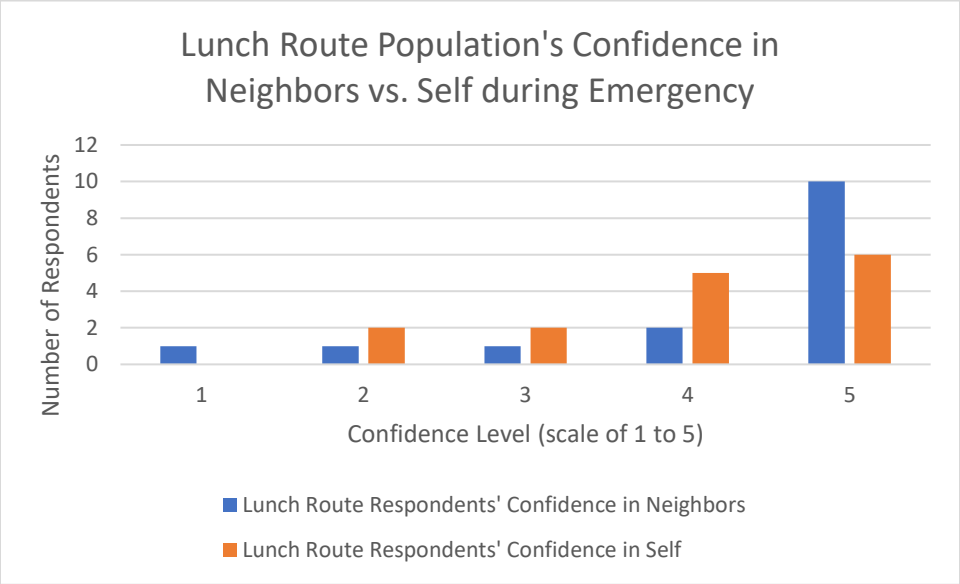



**Figure 11**: Confidence in neighbors of the lunch route population.

The interviews and surveys we conducted in Las Carolinas present a reoccurring theme: a strong sense of community trust. This data indicates that while most residents believe their disaster preparedness could be improved, most are confident that their neighbors would help them in a time of need. From our data and observations, it could be drawn that this mentality has made them less inclined to be individually prepared. However, this could be a long-term issue if all the neighbors share the same strategy, as they could all be lacking in resources and would be unable to adequately support each other. Due to the scattered locations of our surveyed households, we are unable to determine which specific neighborhoods are at higher risk. If this study was expanded to the entire community, it would be possible. It is interesting to note that all our surveyed lunch route residents lived in Las Carolinas during Hurricane María, so it is possible that their confidence comes from their ability to survive María when they are usually impacted with less devastating disasters. If community support and trust has helped residents recover from disaster before, it could be argued that they are more disaster-prepared than the data shows. Additionally, some verbally credited their high confidence to their structurally sound homes; one resident mentioned their home is made of concrete. When inquiring which community organizations would provide support to residents, several named the CAM Las Carolinas, Residents Association, and churches within Las Carolinas.

The community received disaster recovery support from external organizations and the municipality after María. When conducting interviews with leaders in the community, they had indicated that a variety of non-profit organizations helped the community recover from Hurricane María, including Red Cross and Habitat for Humanity. Part of Mrs. De Leon's responsibilities are to direct community needs to the municipality, who handles the logistics and creates plans. It could be inferred that residents feel less inclined to prepare for disaster since there are resources outside of the community that have helped in the past, though we noted an uneasy relationship between the Las Carolinas community and these outside organizations. From CAM volunteers, we heard that some residents were denied home assistance post-María due to ownership issues and some were left with incomplete work. Community leaders have also spoken of a strained relationship with the municipality.

3. **The elderly population on the lunch route presents specific challenges around disaster preparedness and recovery efforts.**

Our data shows that 95% of the lunch route population consists of elderly residents. To determine the risks for residents on the lunch route, we collected data on special considerations. The three most common lunch route household needs are daily medications (87% of lunch route population, 86% of general population), mobility devices (33% of lunch route population, 36% of general population), and home health care (33% of lunch route population, 29% of general population). We also found that there are households with residents suffering from Alzheimer's disease, cancer, asthma, diabetes, memory loss, and more. Certain household risks would make evacuating Las Carolinas challenging, such as dependence on mobility devices. Most of the lunch route consists of households with at least one special consideration, making them more vulnerable to disaster impacts and more likely to struggle to adapt to post-disaster changes (Hutton et al., 2008). Additionally, a 2017 San Francisco study reports that adults with medical impairments, such as home care and mobility issues, demonstrated low self-efficacy related to disaster preparedness due to their conditions (Gershon et. al, 2017). It is possible that the lunch route residents are unable to prioritize disaster preparedness over their own health needs.

When inquiring about other risks, we found that most surveyed households have at least one medical impairment. Table 3 details our survey results. The data trends of general survey respondents vary from those on the lunch route. Since the lunch route supports the most vulnerable populations in the community, we expected to see higher percentages of medical impairments in those households. However, data shows that a larger percentage of the general population consists of family members with these risks. One potential reason for this is that the general population sample size is small and not necessarily representative of the community. Another potential reason is that certain lunch route residents may have additional vulnerabilities, such as living alone, that makes them require support from the CAM. Meanwhile, it is possible some non-lunch route vulnerable residents are cared for by other family members and therefore do not require the CAM's services. It can also be theorized that mental health conditions, which may stem from loneliness or past disasters, contributes to their vulnerability, and therefore reduces the likelihood of them engaging in household disaster preparedness measures and creating emergency communication plans; a past study of the Los Angeles County population has proven this correlation before (Eisenman et. al, 2009).

| Household risks | Number of lunch route participants that responded "yes" (n=15) | Number of all participants that responded "yes" (n=42) |
|---|---|---|
| Impaired hearing | 5 (33%) | 10 (31%) |
| Impaired vision | 9 (60%) | 23 (72%) |
| Developmental/cognitive disability | 3 (20%) | 8 (25%) |
| Limited mobility | 5 (33%) | 18 (56%) |
| Chronic illness | 4 (27%) | 17 (53%) |

**Table 3:** Common risks associated with surveyed households

4. **Lunch route residents would be willing to engage in asset trading to increase community resiliency.**

The exchange of resources and services, or asset trading, is a strategic process that can occur within communities, as well as organizations for long-term mutual benefit. The CAM Las Carolinas has engaged in asset trading with other organizations to strengthen partnerships, implement financial strategy, and optimize resources. Leveraging the exchange of assets between different organizations can help build allies for vulnerable times, such as post-disaster. In a study that explores how various degrees of vulnerability and resiliency affect adaption to extreme temperatures, it was found that highly vulnerable populations with low resilience were most likely to struggle to adapt due to the limited assets available to them (Nunes, 2021). Our observations show similar trends within the Las Carolinas community, reducing their tendency to prepare for an emergency. Asset trading can build community resilience and decrease vulnerability.

When inquiring about household assets in Las Carolinas, we found that 7% of lunch route households and 13% of general households contain family members that have received training in first aid, CPR, or CERT in the past five years. When our team inquired about household members with skills useful in disaster recovery, we received a variety of responses, such as electrician, nurse, and mechanic. When asking surveyed households about any resources they have that can be used to support the community in disaster recovery, the most common responses were a generator (67% of lunch route population, 68% of general population), extra water (67% of lunch route population, 61% of general population), extra food (60% of lunch route population, 58% of general population), and tools (53% of lunch route population, 50% of general population). It is interesting to note that lunch route residents are more likely to have extra stock of food and water compared to the general population. This might correspond to a larger difficulty or insufficient economic means to obtain such supplies. Some residents mentioned that they were able to cook post-María because they have propane, which is an important asset for disaster recovery.

## Recommendations

By reviewing the literature on resilience hubs, we offered short-term and long-term recommendations to design a resilience hub in the CAM Las Carolinas space.

## The Disaster Rapid Response Mapping System

If our methodology process cannot be followed for surveying Las Carolinas, alternative methods can be considered to expand the DRRMS. Methods of surveying are often the most subject to change, as there can be different strategies depending on the community. Instead of door-to-door surveying, a community event is an opportunity to distribute paper surveys. The individuals surveyed use numbered pins to locate where they live on a physical map. The number on each pin correlates to the survey and database information. The paper map positions can then be converted to digital positions on Google My Maps, and vice versa, generating a useful physical copy of the map. A benefit to using a paper survey is residents can locate their own homes. If conducting surveys while on a lunch route, physical paper surveys could be distributed and then collected a couple days later when returning. While this could be less effective as residents may not fill out the surveys, it has merits as a very low-effort method to generate additional data. QR codes could also be distributed, displayed in public gathering spots on promotional posters, or posted online, allowing for residents to scan and fill out the digital form. The form could also be sent out online, allowing residents to fill it out if advertised through local community groups such as a Facebook page for a local church. These recommendations for future streamlining were not initially followed for our survey of the Las Carolinas community due to the rural nature of the region and lack of reliable access to specific technology. It was unreliable to assume that the entire elderly population knew how to operate and fill out a digital Google Form, let alone hinge on them using QR codes. This may change and should be considered in the future. The region also has issues with proper addresses, so caution should be taken if the survey is filled out in either of these manners as other positional data cannot be gathered. These future streamlining processes are far more effective if proper addresses are guaranteed, as then the address field on a Google Form can be utilized to its fullest accuracy. This process results in significantly more insight into the general preparedness of the community, assets the community has, risks the community likely faces, and provides a deliverable map that can be given to aid volunteers.

In the long term, the DRRMS can be expanded upon and should be kept up to date. Conducting more surveys, adapting surveys to general feedback or noticeable trends, or even checking in once a year on already surveyed homes to see if conditions have changed is important. Provided that the data collected is up to date, access to the DRRMS can be given to first responders, mutual aid organizations, or other post-disaster aid groups so that they may provide aid as efficiently as possible. Respecting the privacy of the surveyed households is crucial, so limited-time access to this sensitive data should only be provided to trusted organizations or individuals. Understanding which homes are facing specific issues allows for these organizations to act far faster. Instead of an organization blindly operating in an area, the DRRMS highlights which homes have significant risks and what those risks are, along with assets they may have to share with others in need. Ultimately, the DRRMS provides the basis for a far more efficient disaster response, making a more prepared and resilient community in general.

To capitalize on the DRRMS's capabilities, the CAM should consider the following options:

1. **Contact and share the DRRMS with external aid.** When a disaster happens, external aid organizations are crucial to the recovery response, and by providing these

organizations with the DRRMS they can gain a better understanding of which individuals have specific risks, and they have the resources to aid them.

2. **Share the DRRMS with first responders.** Trusted first responders that the CAM knows should have limited time access to the DRRMS so that they can utilize their resources to help.
3. **Home check-ins.** A CAM volunteer could be tasked with driving to check in on individuals who are listed with many risks on the DRRMS. Checking in involves asking if the household has any immediate medical needs or emergencies. This could be done immediately after a disaster but should also be done periodically. Additionally, access to the DRRMS could be given to medical brigades so that they may perform check-ins.
4. **Coordinating efforts from the CAM space.** If the extra room is decidedly not used for other purposes such as social programs and is currently empty, this additional space could be used to store physical assets that community members may volunteer. Checking in on individuals who have physical assets that they'd be willing to provide to others and then bringing these assets to the CAM for distribution could allow for a stronger disaster response. The DRRMS can be used to locate those who have useful physical assets (for distribution or collection) and decide who should receive them.

### Building a Resilience Hub

If the municipality of Caguas acquires the school title and grants use to the CAM long-term, there is potential to expand their services beyond the lunch route. The following are recommendations on how the CAM can develop into a resilience hub that can operate in three typical conditions: everyday, short-term response, and recovery (Baja, 2021). These recommendations are based on information collected from the Las Carolinas community at the time of the survey and from the experiences and successes of other resilience hubs.

To develop an emergency response hub the CAM Las Carolinas could set aside a room to store supplies. There are vital services like food, water, power, and shelter that would be beneficial for the CAM to have. The CAM already has a decent food storage that supplies the lunch routes; however, separate emergency food items could be kept in case of an emergency. While most of the residents surveyed stated that they had water supplies for 10 days, water is something that should be had in excess as it is used for drinking, cooking, and sanitary facilities. The CAM currently has a water tank that holds 600 gallons and could support drinking water for 200 people for 3 days (D. Arroyo, personal correspondence, 2024, Las Carolinas Community Residents Association, 2023). Repairs should be made to the sanitary facilities in the school building to be in operable condition. For power, the CAM has solar energy that powers one classroom, and so this space can serve as a charging station for community members in a disaster, or even during regular power outages. Reliable power is important for cold storage medicines or electric powered medical devices. For shelter, some of the extra space and classrooms could be used as the building is constructed from concrete. It is less susceptible to damages from a storm as it is in an area not exposed to high winds or flooding. Additionally, there could be multiple first aid kits including over-the-counter medications and sets of rescue equipment available for use. Other general items in storage should include spare clothing, blankets, toiletries, and kitchen supplies such as trash bags, plates, cups, and napkins.

Using a cut-off of 25% of responses indicating that they do not have the supplies, the community lacks these emergency items on a household level: seven-day supply of daily

medications, battery powered radios, first aid kits, extra batteries, whistles, plastic sheeting, tape, and blankets. These items could be stocked in excess by the CAM in anticipation of being used in an emergency. Common daily medications and vitamins could be stocked by the CAM, however residents may be encouraged to stock their own. A few reliable battery-powered radios can be at the CAM and information can be distributed through word of mouth. The following recommendations (seen in Table 4) are calculated assuming the CAM is preparing to support their lunch route community of about 90 households, and it should be noted that these are estimations calculated from a variety of resources and assumptions based on the survey data we collected.

| **Item** | **Recommended** | **Amount for the CAM** |
|---|---|---|
| First Aid Kit | 1 per 4 person family (Red Cross, n.d.) | 45 small kits or equivalent |
| Batteries | For LED AA or AAA flashlight (*Emergency Preparedness*, 2023, "LED FlashLight Batteries- How Long They Last," 2019)<br>** Varies by quantity and type per device* | 2 sets of batteries for each flashlight stored<br>**Assuming use of 4 hours/day for 3 days (US Department of Commerce, n.d.)* |
| Whistles | 1 per household, distributed before a disaster for use in locating individuals (FEMA, 2021) | 54 whistles |
| Plastic Sheeting & Tape** | 37 square feet per person (International Federation of the Red Cross & Oxfam International, 2007) | 2,664 square feet |
| Blankets | 2 per household | 108 blankets |

****** Plastic sheeting and tape are used to shelter in place or to make temporary repairs. This is difficult to estimate as damage is not known until after a disaster, but it is better to have extra supplies.

**Table 4:** Quantity and type of items recommended for the CAM to store.

Overall, these are rough estimations as to what emergency supplies the CAM could store that the community lacks. If more surveying is done, these estimations should be updated to conserve funds, space, and efficiency.

Fostering social cohesion increases the solidarity of a community and encourages behaviors such as asset and resource sharing – important to building long-term resilience (*Social Cohesion - Healthy People 2030 | Health.Gov*, n.d.). The CAM Las Carolinas can encourage this through holding a variety of programs that can include wellness, cultural arts, and economic and educational development (Enterprise Community Partners et al., n.d.). Other established CAMs have emphasized the responsibility of mutual aid centers to foster a culture of zero dependency, which is accomplished through programming that empowers and dignifies the individual (Villarrubia-Mendoza & Vélez-Vélez, 2020). CAM Caguas has done this through programming

such as Super Solidario – a community grocery store initiative and Solidarity Action – a block party that brings together local organizations, small businesses, and the community (Robles, personal correspondence, 2024). In addition to this they offer acupuncture services for those experiencing stress and anxiety (Centro Apoyo Mutuo- Caguas Pueblo, n.d.). Omar Reyes-Patxot from Centro de Apoyo Mutuo Bucarabones Unido (CAMBU) described how their services transitioned from immediate needs after Hurricane Maria to community education services. He described how the strength of the community has increased after adding programming that interests and appeals to individuals of every age (O. Reyes-Patxot, personal communication, 2024). Specifically, for the CAM Las Carolinas Community, programs could include visual arts, senior services, technology, and courses on managing finances. Also, offering access to holistic health services like acupuncture and mental health, medical clinics and resources would help the community (M. Robles, personal communication, 2024, B. Davis, personal communication, 2024, Kwon et al., 2020). Lastly, to increase disaster preparedness, holding Community Emergency Response Team (CERT) trainings and other educational and preparation sessions will help with a successful response in an emergency (Baja, 2021). Long-term resilience is achieved when individuals take control over the process of facing and working through the challenges in the community together (Villarrubia-Mendoza & Vélez-Vélez, 2020).

## Greater Insights

While there are many recommendations as to actions the CAM Las Carolinas could take to improve community resilience, there are some necessary steps that are beyond the scope of their work. It is important to keep in mind that while CAMs and other grassroots organizations have done tremendous work supporting and uplifting their communities, these undertakings should not be falling solely on them. While they deserve all the praise and attention given to their efforts, there is need to circle back to the 'why'. Why do they have to support their communities from within? It is due to failings on behalf of the government at both municipal and federal levels. If there was less corruption and privatization then communities would have timely resources and working infrastructure both after a disaster and everyday (Sosa Pascual & Mazzei, 2022). Local grassroots efforts do not have the capacity to transform the healthcare system, repair the transportation infrastructure, or the failing power grid (Coto, 2023, Rios et al., 2018). These issues are the responsibility of the government to address and cannot be ignored.

For a broader sense of the Las Carolinas community at large, the CAM volunteers can increase the surveys in the DRRMS by utilizing other strong networks in the community. The Las Carolinas population has several churches with dedicated members and having church leaders of the churches continue to share the survey can be a method for reaching a broader population in the community. Another low effort option for expansion is conducting a postal survey (National Geographic Society, 2023). The last option for expansion is conducting surveys over the phone. From the surveys we learned most members of the community have a phone and tend to share information through word of mouth (Bureau, n.d.). Phone calls also eliminate the need for driving which can take time and uses money on gas. For expansion, it would be helpful for the CAM to utilize their support network, having the municipality or other volunteers conduct some of the surveys eliminates the time burden on the CAM workers. It is important to note that surveys should be conducted at minimum 5 to 10 years to analyze trends and to present relevant information (Barrett et al., 2019 & National Geographic Society, 2023).

We believe there is value in other communities adopting our survey and mapping method. Having more communities understand their risks and assets before a natural disaster could help save lives. Furthermore, the DRRMS methodology can be easily adapted to showcase different questions for other researcher's surveys. This system can be applied to other case studies for its efficiency and scalability.

For other researchers embarking on a similar project, we would like to emphasize the importance of immersion within the community. From interviews with other mutual aid centers and similar organizations both within and outside Puerto Rico, the advice received was to build trust with the community we are working with. They shared that they learned more about the lived experiences and needs of a community over a meal than through a survey or interview. A researcher may approach data collection with thorough survey questions, but there will always be something left unaddressed or unaware. We actively practiced immersion and trust building in the community by helping with the lunch preparation and distribution, and found that as our time there increased, so did the information that was shared. Additionally, our understanding of the community – its ways and its people, was something that could only be learned by observation. We recommend, for both the personal experience and the accuracy of the research, that intentional effort is made to practice immersion and to build trust with the community that the researcher is working with.

Our concept of what resilience is has changed after the project's completion. As shown in our data, most of the residents do not have the emergency preparedness material items as recommended by government agencies (*How to Build a Kit for Emergencies | FEMA.Gov*, 2020, Las Carolinas Community Residents Association, 2023). However, most of them stated they felt prepared for a disaster, citing their friends, family, and neighbors as reliable resources in a time of need. This begs the question of what resilience and preparedness means for rural, underserved communities. In our survey, and other risk assessments, there is not a space that addresses the social and self-reliance of a community as a form of emergency preparedness (Las Carolinas Community Residents Association, 2023, Schnall et al., 2018, Waters, 2020). Through our conversations and time spent with the community there was an obvious strong sense of trust and reliance on one another. This has led to a reframing of the emergency preparedness measures that we recommend. Rather than taking the emergency backpack approach and educating each household on the items they should have, our recommendations shifted more to continuing to foster strong relationships and to build an asset trading and sharing network. Without outside aid, it is unlikely each household would be able to gather and store the recommended supplies, but no external dependency is required to build networks and relationships. For communities like Las Carolinas, reframing what emergency preparedness is to include community development could help to foster independence and change what customary disaster response methods are to be more attainable and successful.

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# Appendix A: Community Interview Questions

These interview questions serve as a framework to guide the interviewer as we followed a semi-structured interview format. As this is more conversational, the following questions guide the topics of conversation, but other questions may be asked as they come up.

**Introduction**

Hello, my name is_____. We are conducting research as part of an undergraduate research team from Worcester Polytechnic Institute in Massachusetts. We are working with CAM Las Carolinas and Charito and Dimarie to better understand the post-disaster needs of the community that the CAM serves. Our sponsors, (Charito and Dimarie) informed us that you may have some information that could be valuable to our understanding. Would you be willing to have us interview you? Your participation is completely voluntary, and you are free to abstain from answering any of the questions or to stop the interview at any time. Additionally, any personal information that you share will be kept confidential and only accessed among this group. Also, would you be okay with us recording the audio of this interview? If you are interested, a copy of our results will be available online at the conclusion of the study. Your participation and insight would be greatly appreciated.

**Questions:**

1. What is your name? Would you like to share a bit about yourself?
2. Do you have any contact information – phone #, email, permanent address?
3. How long have you lived in Las Carolinas, Caguas?
4. Do you like living here? Is it a good community?

*Now we will talk about the CAM.*

1. What services do you receive from the CAM?
2. Are there any services you wished were available?
3. Have you attended any medical brigades or clinics held by the CAM?
4. How do you stay informed about the CAM, or receive updates from them?

*Transition to disaster preparedness.*

1. Recently, with Hurricanes Fiona and María, what were you missing or in need of after the disaster?
2. Can you describe any irreparable damage that was done to you, your home, or your property?
3. What needs did you have immediately following Hurricane Maria? Do you feel like those needs were met?
4. Risks:
    a. How many live in your household?
        i. Any under 18?
        ii. Any over 70? Caretaker?
    b. Any special needs (physical or mental) or medical needs that the CAM could help you with post-disaster?

    c. What kinds of information do you need to access in an emergency? (family relations outside of the area, hospitals, repair work, etc.)
5. Assets:
    a. Does anyone in the household have any skills that would be useful in recovery? (nurse, doctor, electrician, food preparation, land maintenance, etc.)
6. Is there anything else that you would like to share with us?

# Appendix B: Community Survey Questions

The following survey questions regard topics that we think will be relevant and important for the CAM to know. These are subject to modification and change as we learn more about the lived experience of the CAM Caguas community through the interviews we conduct and the interactions that we have. When printed, the questions will be presented in both English and Spanish.

**Introduction**

Hello, we are a group of undergraduate students from Worcester Polytechnic Institute in Massachusetts conducting research with CAM Caguas. We are collecting information to better understand the post-disaster needs of the community the CAM serves. Would you be willing to complete a short survey? Your participation is completely voluntary, and you are free to abstain from answering any of the questions. Additionally, any personal information that you share will be kept confidential and only accessed among this group. If you are interested, a copy of our results will be available online at the conclusion of the study. Your participation and insight would be greatly appreciated.

**Questions:**

1. What is your name?
2. Do you have any contact information – phone #, email, permanent address?
3. How long have you lived in Las Carolinas, Caguas?
5. What services do you receive from the CAM?
6. Are there any services you wished were available?
7. Have you attended any medical brigades or clinics held by the CAM?
   YES NO
8. How do you stay informed about the CAM, or receive updates from them?
   a. Phone/email
   b. Facebook
   c. In person communication
7. Recently, with Hurricanes Fiona and María, what were you missing or in need of after the disaster?
   a. Medical supplies & services
   b. Food & clean water
   c. Electricity
   d. Transportation
   e. Home/property repairs
   f. Socialization
   g. Other
8. Risks:
   d. How many live in your household?
      i. Any under 18?
         YES NO
      ii. Any over 70?
         YES NO

iii. Caretaker?

YES NO

e. Any special needs (physical or mental) or medical needs that the CAM could help you with post-disaster?

9. Assets:
    a. Does anyone in the household have any skills that would be useful in recovery? (nurse, doctor, electrician, food preparation, land maintenance, etc.)
10. Is there anything else that you would like to share?

## Appendix C: Mapping and Data Collection with Google Guide

# Mapping and Data Collection with Google

***A rudimentary guide on mapping software and our methodology for the Centro de Apoyo Mutuo, Las Carolinas***


*Written by*

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*Edited by*

Aashi Goel

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## Introduction

This manual will cover an in-depth explanation into how to use Google software and map the locations of households in the community. It is intended to be used by the Centro de Apoyo Mutuo (CAM) Las Carolinas as a guide for continuing the process of mapping their community to evaluate assets and at-risk individuals. While our time here was limited to roughly seven weeks, we have fine-tuned a process that can be used in conjunction with Google My Maps, Google Drive, Google Forms, and Google Sheets to organize and plot out households in the Las Carolinas community. This manual will assume no knowledge of these Google systems to ensure as little confusion as possible.

As you are reading, if you find that you cannot follow this process, then please see the "Alternative Processes" section, located on page 54.

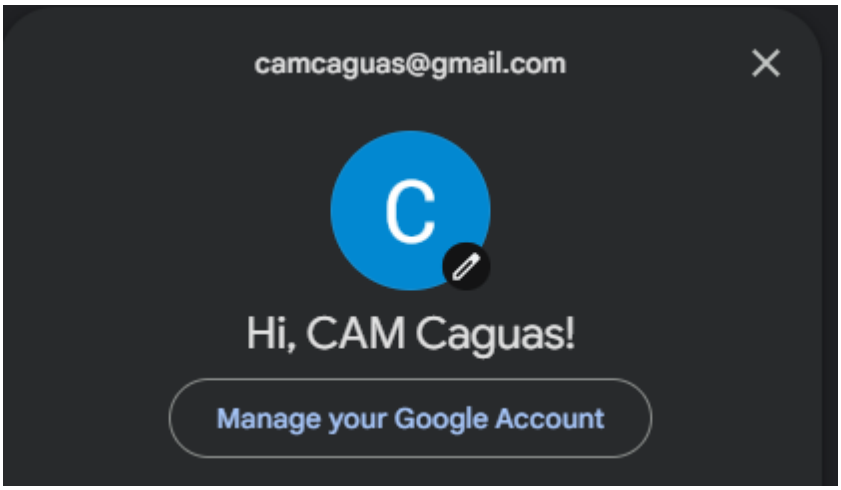

*Examples of mapping apps, from Apple Maps (left) to Google Maps (right)*

## Setting Up

There are a few prerequisites that should be met to start this process:

- A connection to the internet through cellular data, or preferably Wi-Fi.
- A mapping app on a mobile device, such as Google Maps or Apple Maps

## Google Account

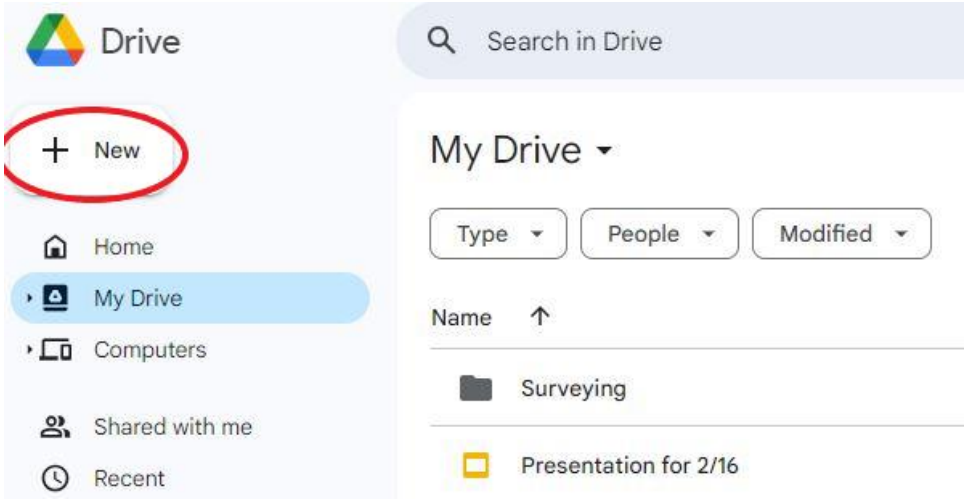



*The CAM's Google Account*

The Google account for the CAM is camcaguas@gmail.com. Logging into this email will allow you to sign into the other Google services that will be necessary later. The login credentials have

been shared with you privately. Due to the sensitive nature of the data collected, these credentials should be kept as private as possible, and the password should be changed every few months. It is important that those who are surveyed maintain their right to their privacy.

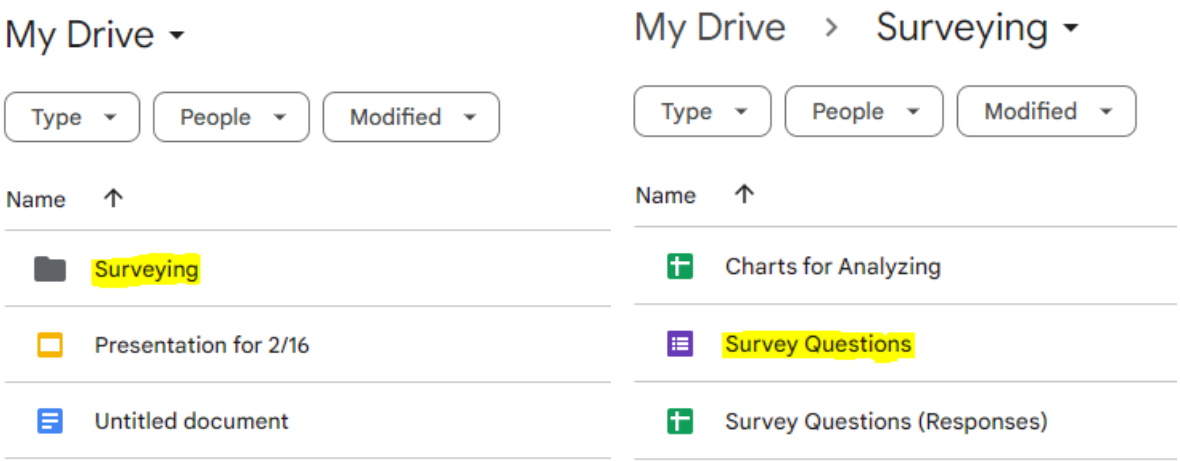
## Google Drive




*Circled in red is the option for making new files within Google Drive. This can be used for making new Google Form surveys, new folders, new text documents, or new Google Sheet files.*

Google Drive is the primary hub for all your information and resources related to the data collection and mapping process. All documents are stored here. The drive is connected to your Google account.

## Google Forms

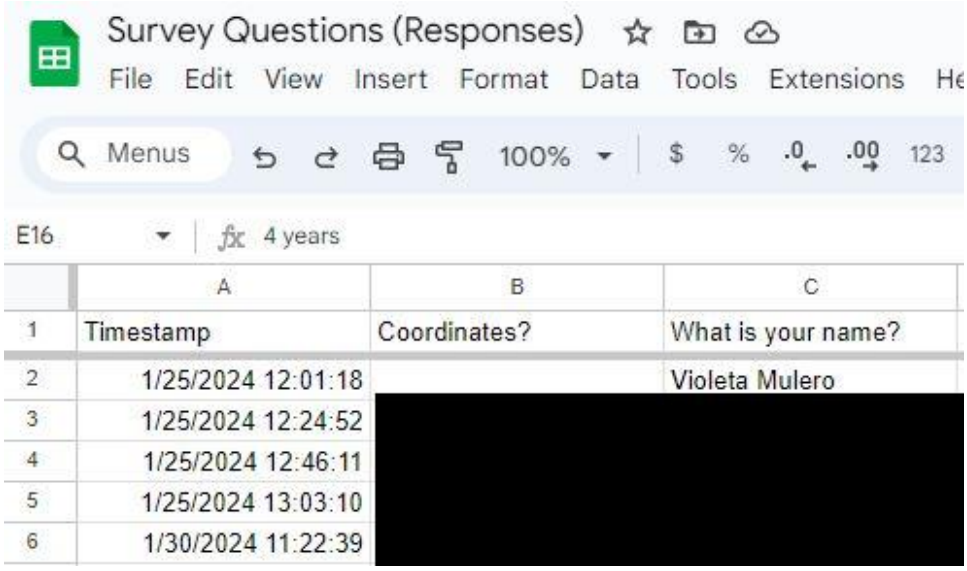



*An interior view of the files in the CAM Google Drive, with the Surveying folder highlighted in the first image, and the Survey Form highlighted in the second.*

Google Forms is effectively a form of digital survey. They are where the responses to the survey questions are entered into Google.

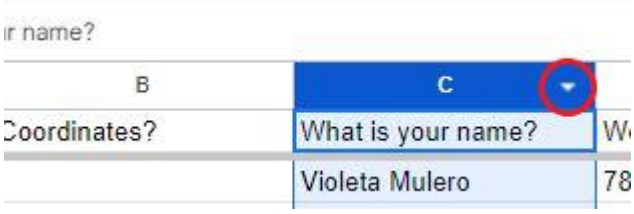
In your Google Drive, you will find the Google Form that we used to conduct our surveys under the "Surveying" folder. The file "Survey Questions" is the full survey that we used. The responses to these questions are automatically placed within a Google Sheets file, seen in the folder as "Survey Questions (Responses)".

## Google Sheets



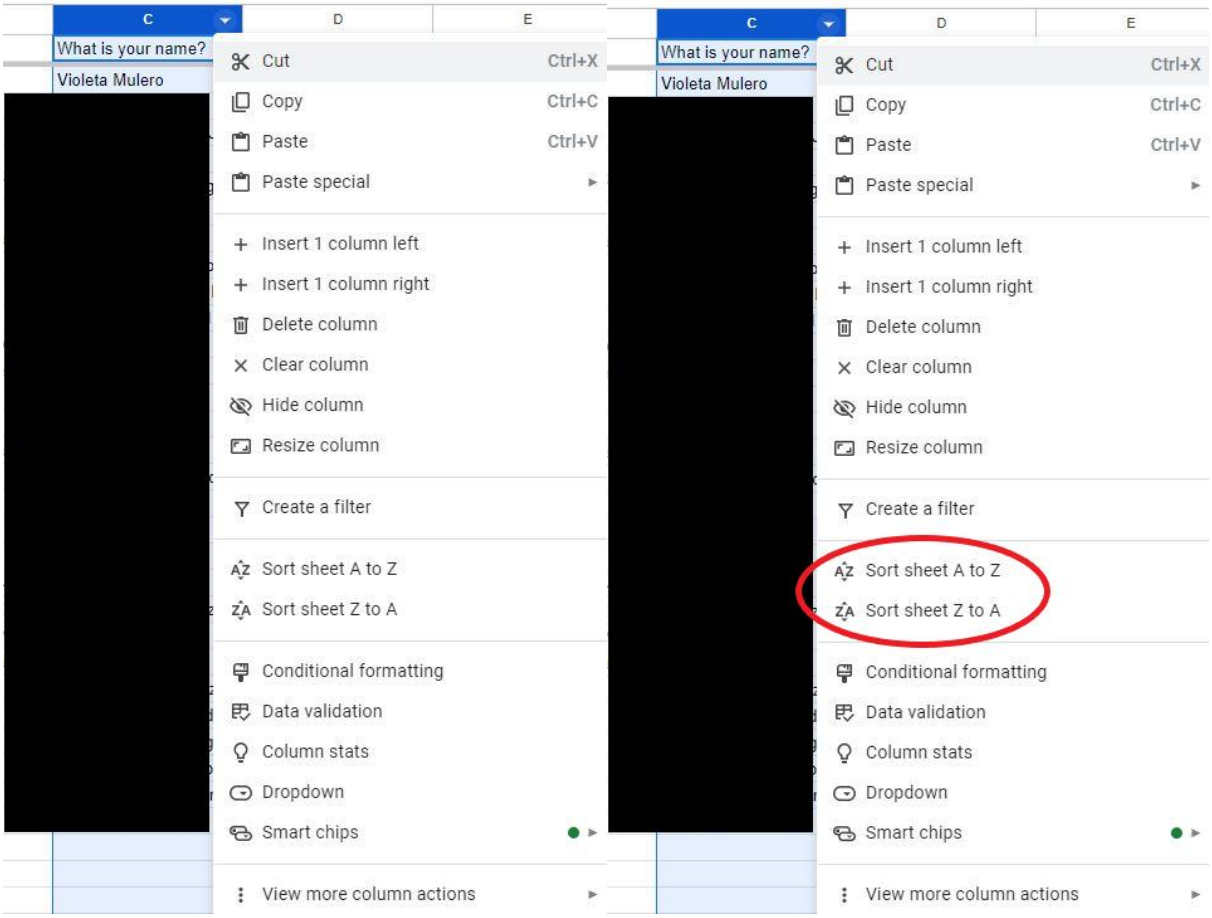

*An example of data in the Survey Questions Responses sheet.*

Google Sheets is a spreadsheets program that allows data to be organized and displayed easily. Once you have collected data and entered it into Sheets, you have myriad options to display it.




*The drop-down arrow, circled in red.*

By clicking on a column letter and hovering your cursor to the right side of it, you may notice a small arrow. Clicking on this gives a large menu with many options for the column.

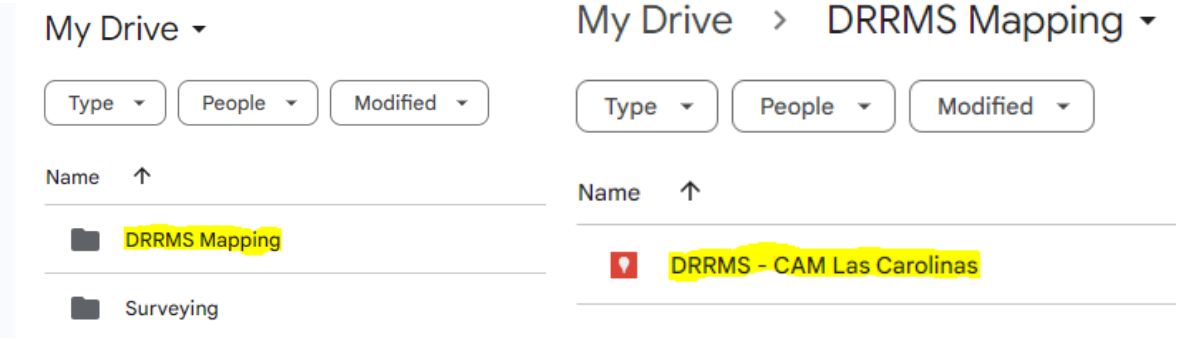



*The many options from the drop-down menu. Note in the second image the "Sort sheet" options circled in red.*

An example of one of the options in this menu is the option to sort the sheet from A to Z or vice versa. Depending on the data you'd like to see, you can sort it accordingly.

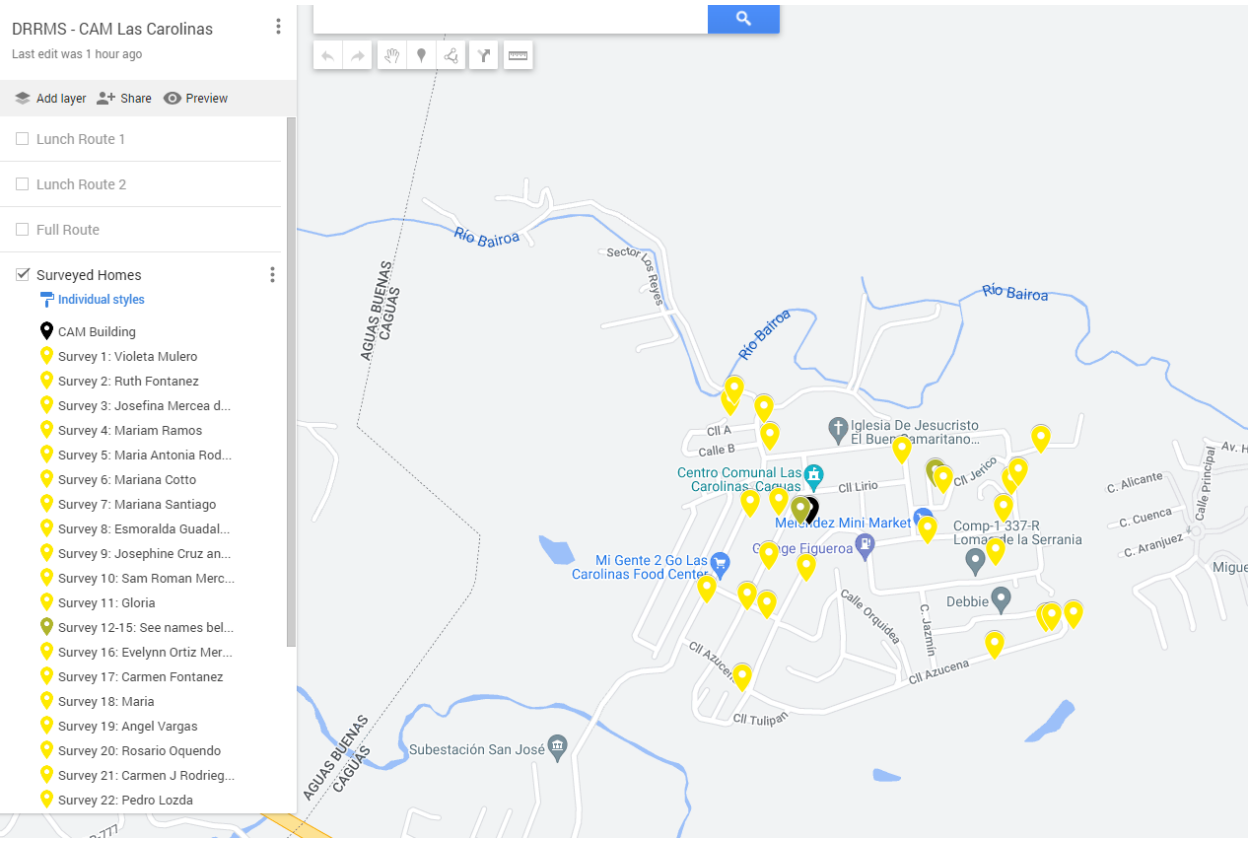
## Google My Maps

Google My Maps is an application that allows for the creation of your own maps with marked location nodes. This ties together the data collected in Google Forms and Google Sheets and presents it in a visual format.




*The mapping system folder highlighted, with the map inside also highlighted.*

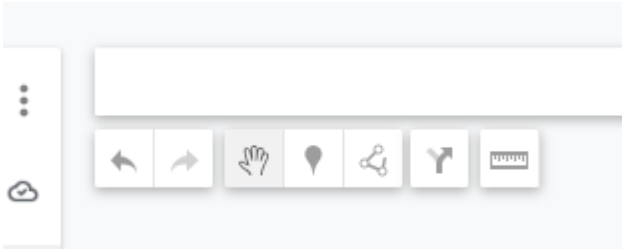
Within your Google Drive, you will see a folder named "DRRMS Mapping" which contains a file that is your Google My Maps. The name we coined for this mapping system, DRRMS, stands for Disaster Rapid Response Mapping System.




*The map from a zoomed out exterior view.*

The taskbar beneath the search bar allows for several options with the map, from leftmost to rightmost:

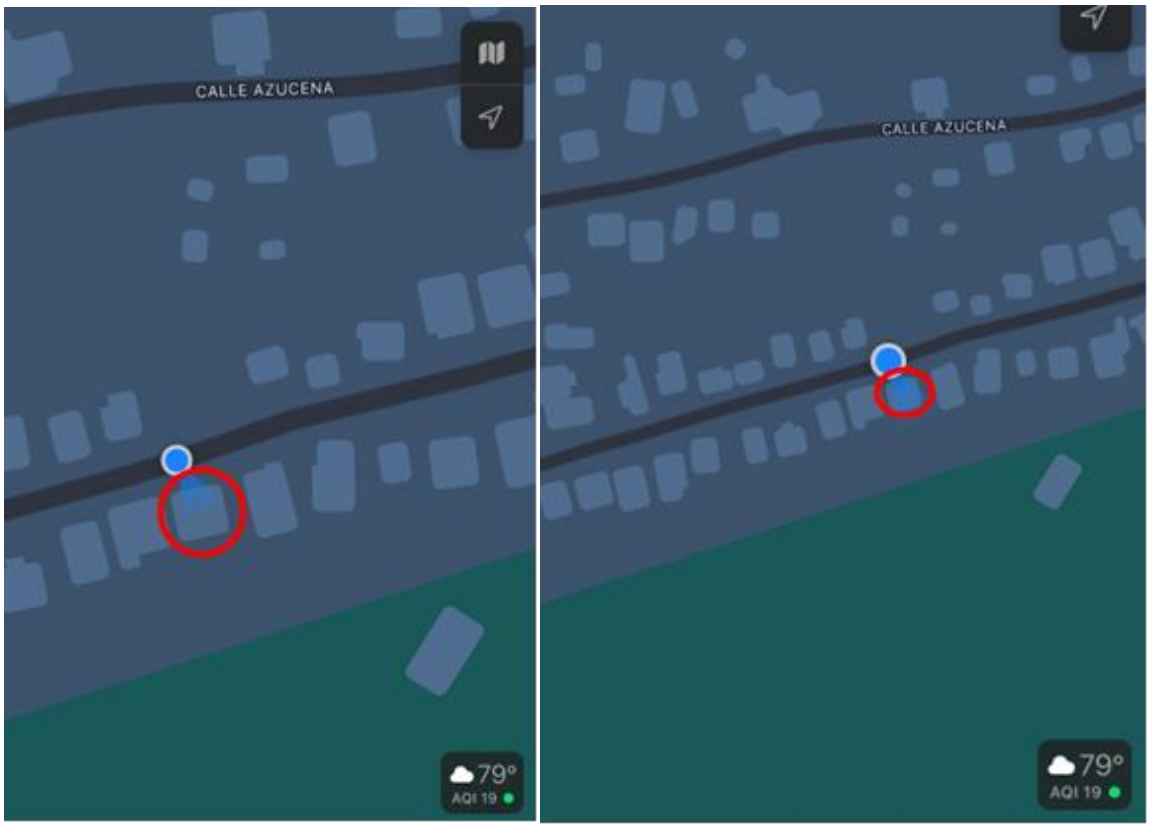
- Left arrow: undo
- Right arrow: redo
- Hand: Select nodes or drag map view
- Line: Draw a line across the map
- Long arrow to the right: Generate directions from one point to another
- Ruler: Measure distance between two places



*The taskbar beneath the search bar.*

## Gathering Positional Data

Positional data is crucial for placing the surveyed households in the context of the mapping system. As many homes in Las Carolinas may not have registered addresses, gathering the positional data when visiting a home to conduct a survey is crucial. The most reliable strategy we found is to use mapping software by tracking your location~~,~~ and then noting that location in relation to the community.




*Example of tracking a home location on a mapping software*

When at the household you will survey, the following steps are recommended:

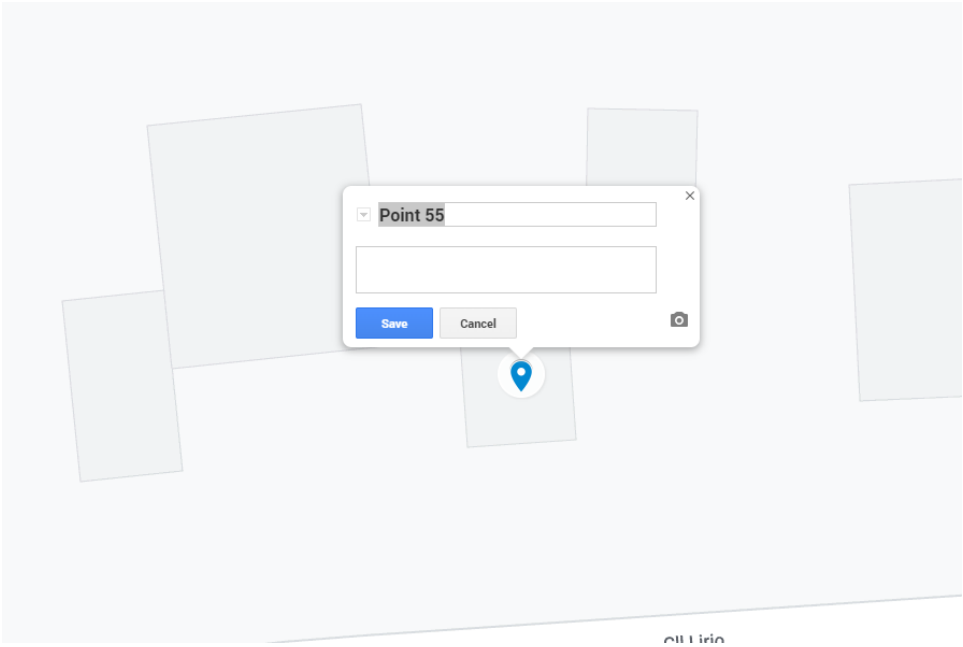
1. Open a map/GPS software, such as Apple Maps or Google Maps if it is not open already.
2. Allow a minimum of 20 seconds for the chosen app to calibrate its location.
3. Take a screenshot of the location while zoomed in, facing the direction of the home.
4. Take a second screenshot of the location while zoomed out further to better understand the location of the home in the community.
5. Write down the name of the homeowner being surveyed along with the current time.
6. **(OPTIONAL)** Take a picture of the front of the home being surveyed to later add to the My Maps.

The purpose of noting the time and date is to correlate the name to the screenshot location. After surveying several homes, the times at which the screenshots have been taken can be viewed and the Google My Maps nodes can be created.

To create a new node, first open the DRRMS My Map file in the Google Drive (refer to the Google My Maps section). For easier editing, this file should be opened on a laptop or personal computer.

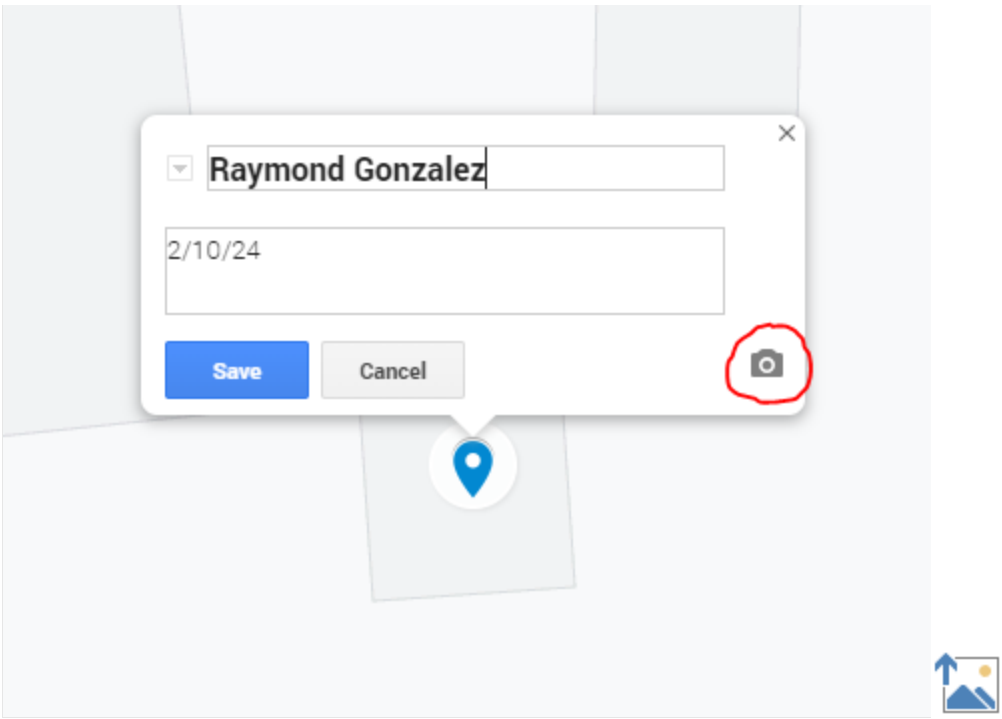
*The new node button, circled in red.*

Click on the icon circled in red to create a new node. Clicking on the location on the map where you want to add the node will place a default node down.



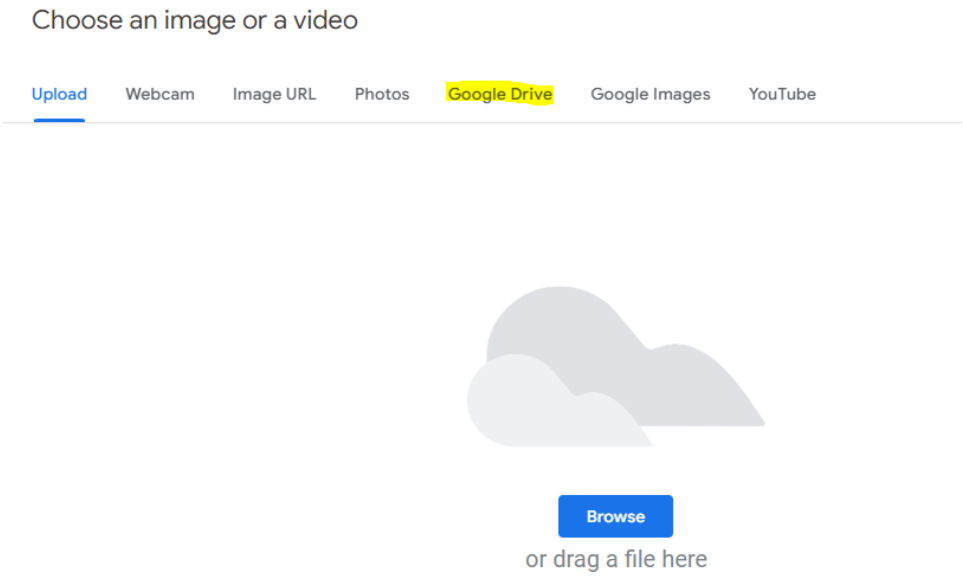

*The creation of a new node, unedited.*

The node will automatically gain a name “Point (newest node number)”. This can be renamed by typing in the name of the individual living in the household. Beneath the name is a description, where it’s recommended to fill out the date the survey was taken.




*A new node being created, with the add image button circled in red.*

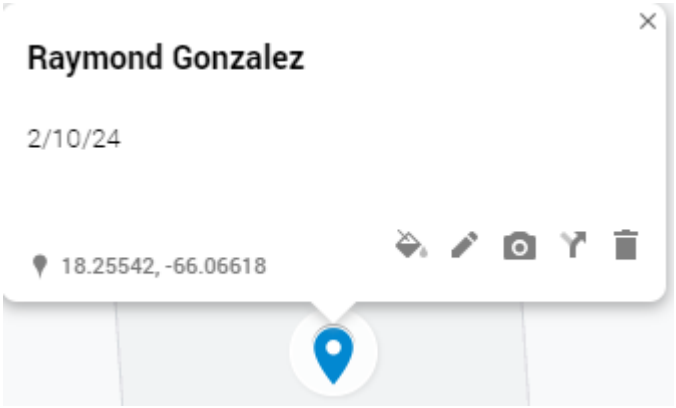
Pressing “Save” will officially create the new node. If you would like to add a picture of the home for better recognition later, the camera icon can be clicked. This will bring up a menu where an image can either be uploaded from your device or uploaded from the Google Drive.



*The menu present from pressing the image button. An image file can either be uploaded by dragging and dropping it into the area, pressing "browse" to find the file, or by uploading it from the Google Drive (highlighted in yellow).*

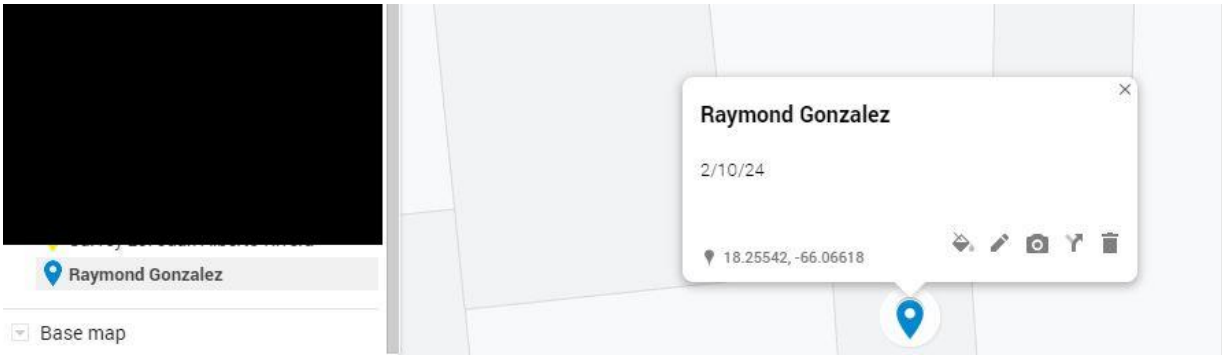
After the node has been created (with or without an image), you will notice there are several icons when selecting it. The icons each have a specific function, noted from left to right:

- The paint bucket icon allows you to change the color of the node and icon style, great for color coordination.
- The pencil allows you to edit the node's name and description.
- The camera allows you to add an image to the node.
- The arrow allows you to make directions to getting to the node. This is unreliable and should be ignored.
- The trashcan allows you to delete the node. This is useful if it was placed in an incorrect position.




*A view of a selected node. Note the five icons in the bottom right corner.*

Now that your node is made, it will appear amongst the others on the left side of the screen.



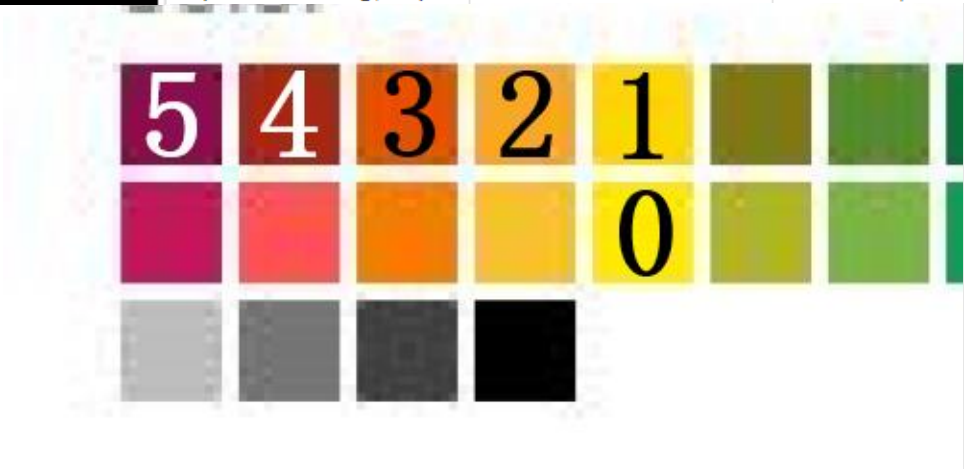

*Note the name of the surveyed individual appearing on the left side.*

This left side will hold all your noted positions. They should all be located under the "Surveyed Households" tab. If not, click and drag them under that tab's position. When placing nodes, to

coordinate better with the physical map copy, you should format the title as “Survey (number of survey)”. On the physical map within the CAM, a number can be coordinated to a pushpin, which can then be checked through the database or My Map for further details.

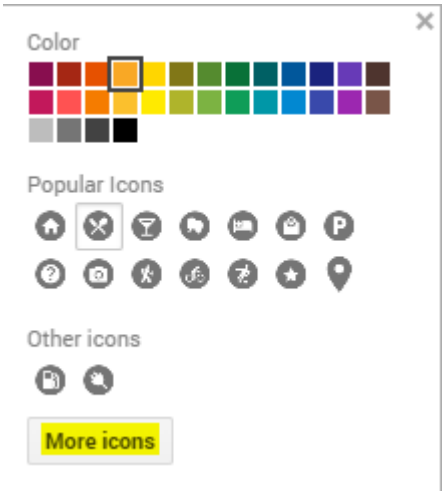
With our basic node created, we want to add more details to its description and make it easier to view the assets and risks with a brief view. Open your Google Sheets database and locate the person’s survey information. There are 4 very important data fields to add to the description of our nodes:

| **COLUMN D** | **COLUMN S** | **COLUMN AB** | **COLUMN AC** |
|---|---|---|---|
| **Phone/Contact Info** | **Health Risks** | **Skills** | **Shareable Assets** |
| D | S | AB | AC |
| Would you like to share y | Does anyone in your hou | Does anyone in your hou | Do you have any resourc |
| [redacted] | Impaired vision, Develop | License for explosions?? | Solar power, No batteries |
| | Impaired vision, Limited M | Yes, good at cooking | Solar power, Vehicle, Exc |
| | | Contractor can help in dis | Generator |
| | Developmental/cognitive | Carpenter (build screens, | Generator, Tools, Chains |
| [redacted] | | No | Generator, Tools, Excess |
| No | | Husband is mechanic | Solar power, Vehicle, Exc |
| | Impaired hearing | Food preparation, mainte | Generator, Vehicle, Exce |
| [redacted] | Impaired hearing, Impaire | Daughter was a nurse so | Generator, Solar power, T |
| | Impaired hearing, Impaire | No | Generator, Chainsaws, V |
| N/A | Impaired hearing, Impaire | No | Generator, Excess food s |
| [redacted] | Developmental/cognitive | Sister is nurse (she lives | Generator, Tools, Vehicle |
| | Impaired hearing, Impaire | No | Generator, Excess food s |

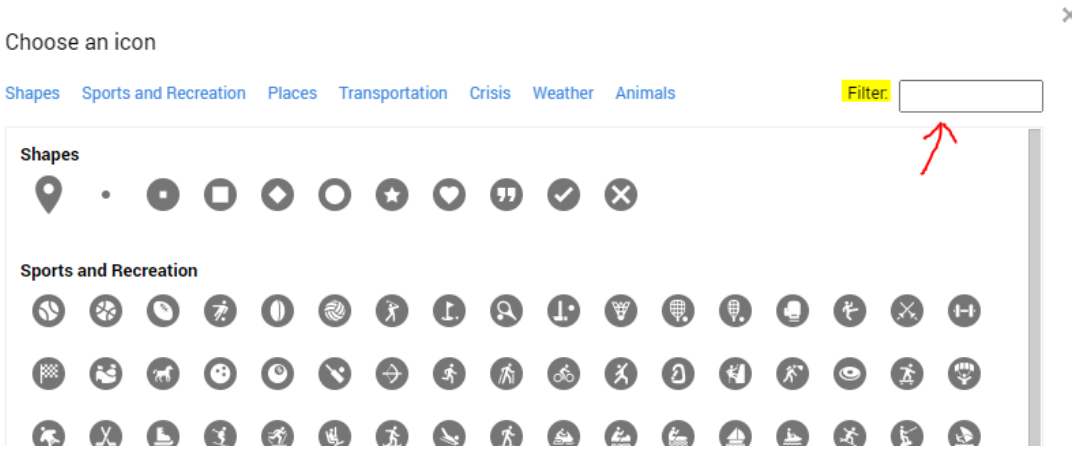



*The colors for the household’s risk level. Count the number of risks the home faces in Column S and pick the corresponding color for your node.*

Once that is done, an icon can be chosen to best represent what asset(s) the home may have. If they have no shareable assets or skills, the map marker can remain unchanged. Select the “more icons” tab under the color changing menu. Then, you may enter in a keyword to the filter to find a fitting icon. For example, you could search “Electricity” to find a plug icon to represent a household having a shareable generator.




*The more icons tab highlighted under the color picker.*



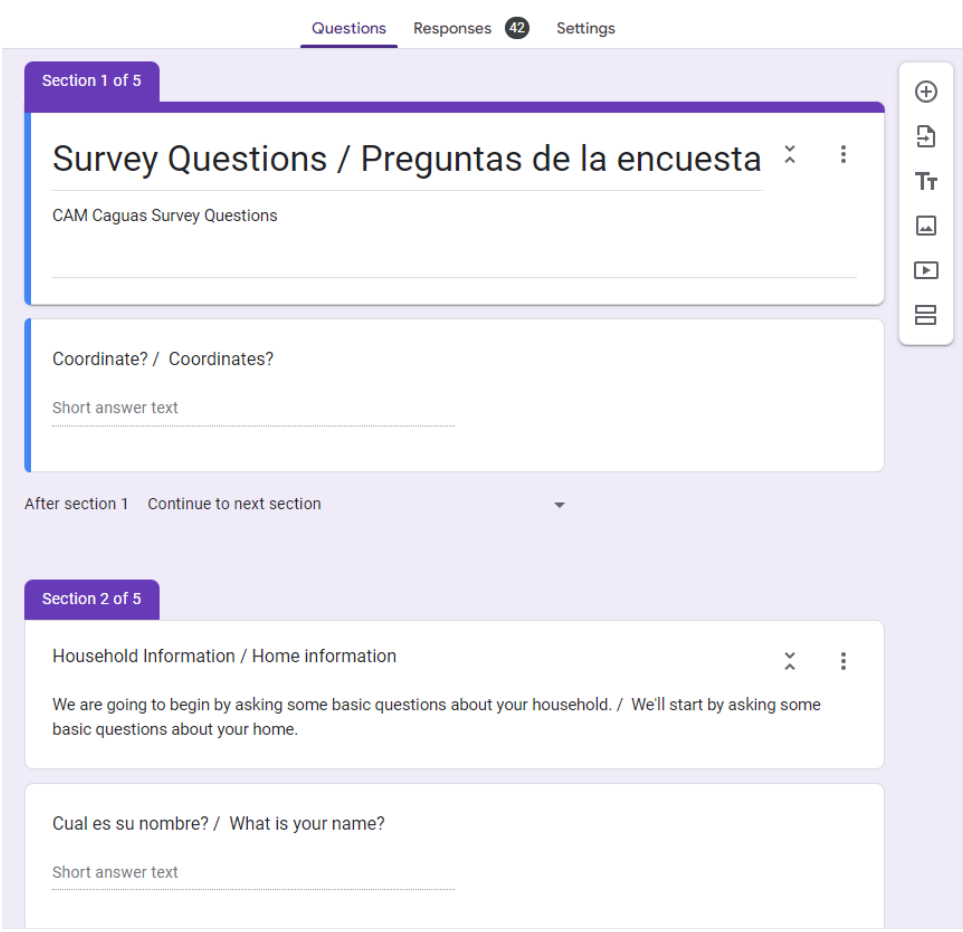

*The filter for filtering an icon to represent an asset.*

The end result of this will be an icon that can be easily viewed for a brief assessment on what risks they face, what they can offer for the community, and how to contact them.


*A completed node, some details redacted for privacy. Note the orange color as there are 2 risks, and the utensils icon best representing the cooking skills and shareable food.*

## Questionnaire

The questionnaire is the list of questions you will be asking. It is your survey. In the Google Drive, you will find the survey questions as a Google Forms file under the Surveying folder (see Google Forms on page 39 for clarification).

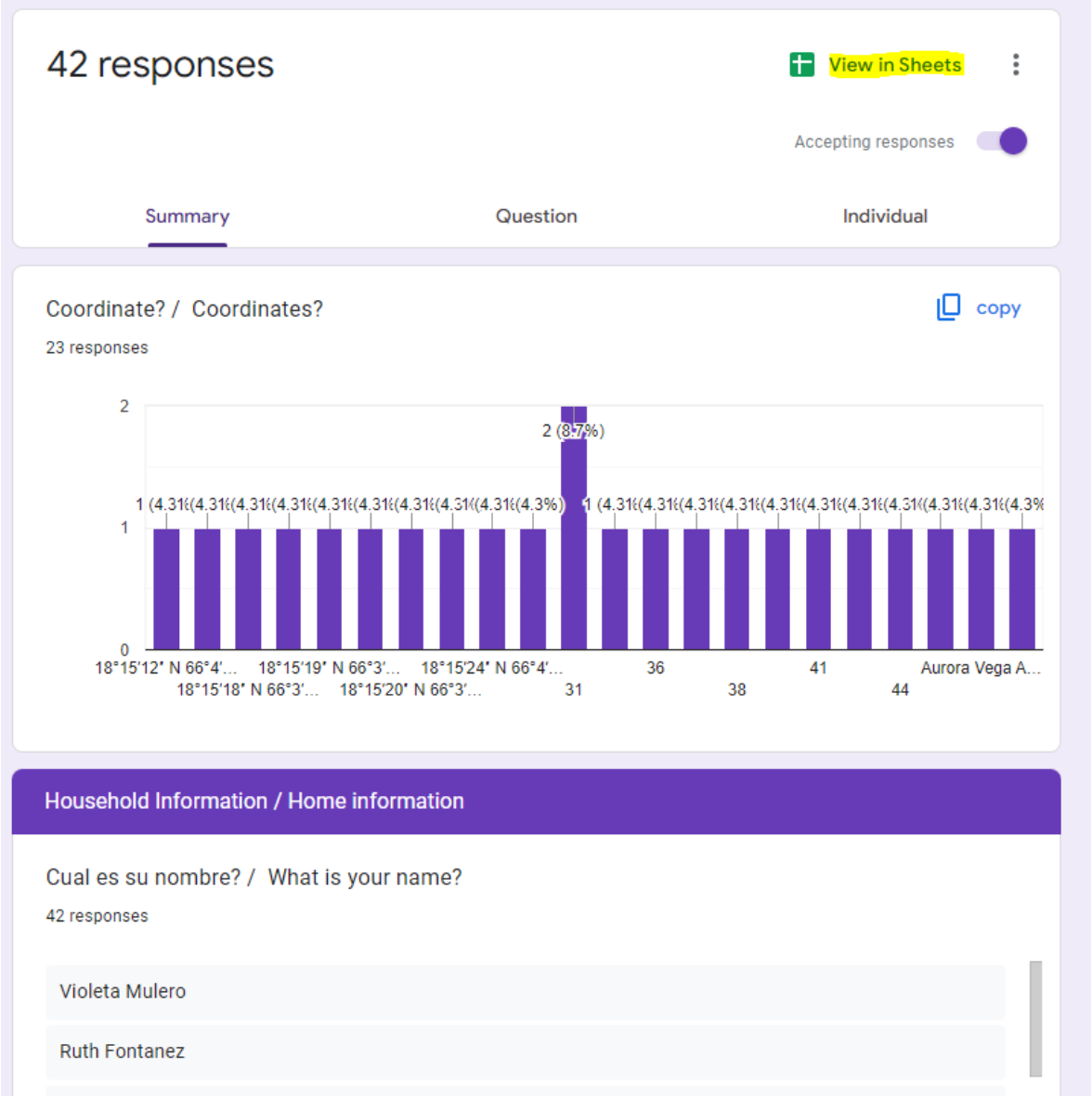



*The survey questions in Google Forms. Note the three tabs on the top: Questions, Responses, and Settings.*

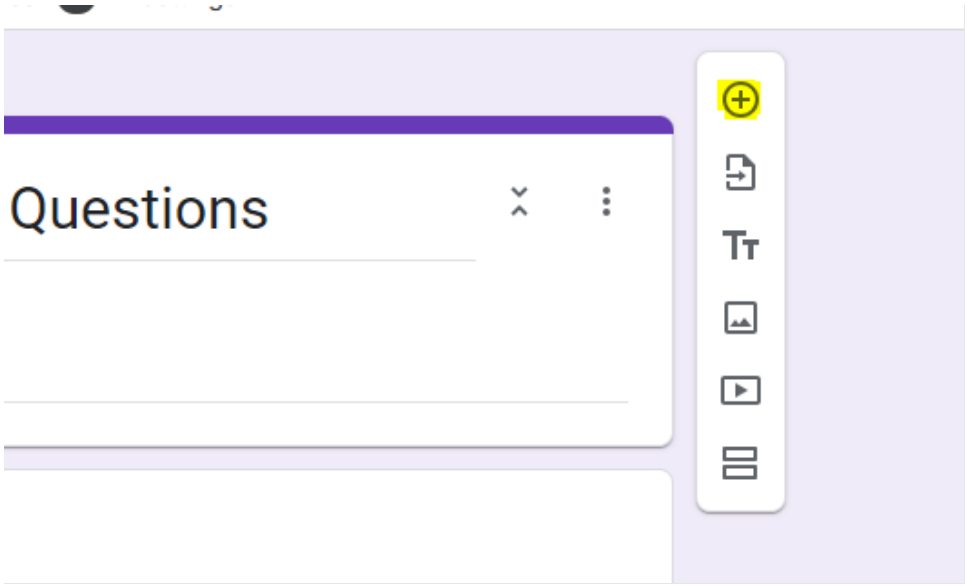
In the Google Form, there are three main tabs:

- Questions, which will let you view all the questions in the survey and edit them as needed.
- Responses, which show all responses submitted in the survey.
- Settings, which can be disregarded.

Under the responses tab, in addition to all of the statistics on data collected and individual responses there is a “View in Sheets” tab. This allows for updating the Google Sheets database. Clicking on it will open a new instance of the data collected.




*The responses tab. Note the "View in Sheets" link highlighted.*




*The new question icon highlighted while in the Google Forms survey.*

Remember when editing the survey, new questions can be added! By pressing on the plus icon, a new question can be inputted wherever necessary. For the time being, the included questions should be sufficient, but this capability allows you to change what data you collect in the future! You are now ready to conduct the surveys.

## Conducting Surveys

*A survey is being conducted with a physical paper copy.*

To conduct the surveys, it's best to plan which homes you would like to attend, then drive along the route and visit them. We found it most efficient to have two people for surveying – one to fill out the Google Form survey with each question answered and one to ask the questions and facilitate. It's best to bring the following:

- Your mobile phone, so that you can fill out the questions on the Google Form as they are asked, take photos if needed, and gather positional data.
- Water and some snacks, especially when it's very hot out!
- A printed copy of the survey isn't necessary, but very helpful.

## Alternative Processes

The methods previously stated aren't always necessary to follow verbatim. Adapting strategies depending on your capabilities and needs is important. There are a few alternative methods to consider for your data collection.

### Conducting Surveys – Writing Responses

When conducting surveys, if your mobile phone has low battery or you'd rather not use it to fill out the Google Form immediately, you can simply write down the answers to each question. Bring along a pen and paper and write down the responses, just make sure that you still gather the positional data using mapping software. The questions can then be entered into Google Forms later.

*A useful incentive for social events – food!*

### Paper Surveys and Social Events

Another alternative method to surveying the community is to release paper surveys. This requires printing out many copies of the survey, however, it's relatively low effort. When operating the lunch route, the surveys can be handed out. Coming to pick them up two days later (handing them out on Tuesday and then collecting them on Thursday) or waiting until the next

week to collect them can yield easy results. A major consideration of this method is how many homes will respond or remember to fill out the survey, many may not. Additionally, you will need to gather the positional data for each location, which can be done when the completed surveys are returned to you.

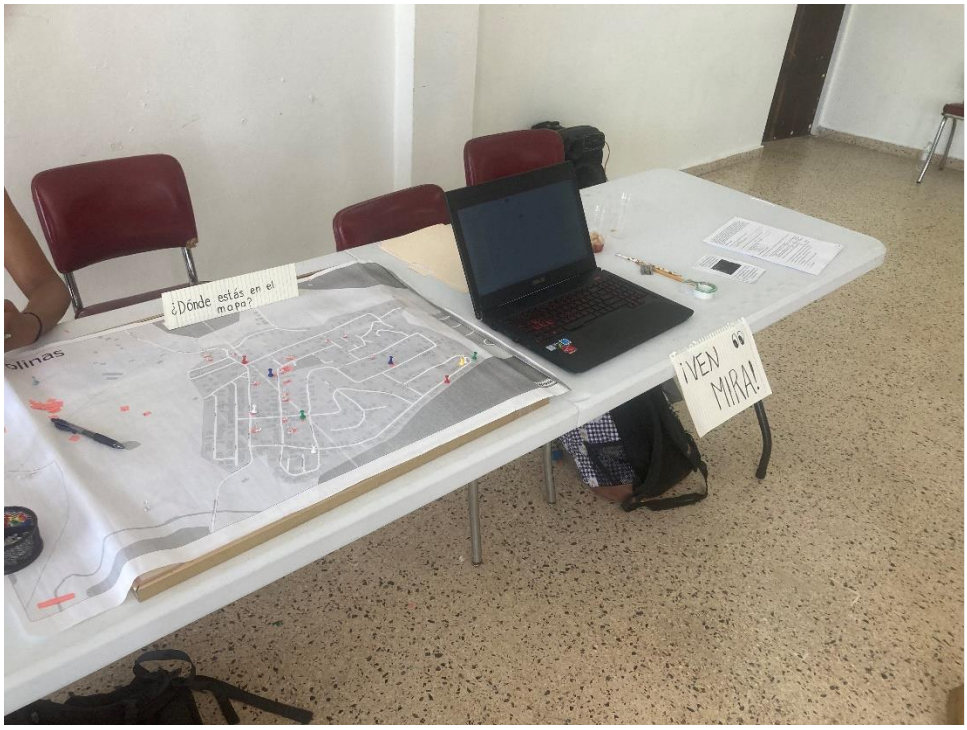
*An example of a social event being held for surveying.*

Paper surveys can also be distributed at events. Holding an event, perhaps a social one that we've noted in our recommendations, is a great opportunity for surveying the community. Incentives such as food or free clothing will yield even more attendees than at a normal social event but are not necessary. One of the churches may be a great ally to partner with for help with these events.


*An example of numbered pins for surveying at an event.*

At these events, passing out paper surveys is far more efficient than individually surveying each attendant, but gathering positional data is trickier. Bringing along the physical

map with pins from the CAM is a great method. Number each one of the paper surveys with an identification number, starting with a number higher than the highest one existing on the map. From here, each time a paper survey is completed and handed in, write down the number from the survey on one of the pins. If the number can't be written directly on the pin, then writing it on a small piece of paper and pinning that on works as well. Have the individual who completed the survey point out where they live on the map. This method works best when there is a table set aside for collecting the paper surveys and mapping the home locations.




*A station for plotting map locations and gathering surveys at an event.*

## Conclusion

To conclude, the process of surveying the community can be tedious, but using the DRRMS (Disaster Rapid Response Mapping System) that we've created through Google services will consolidate your data into one centralized hub. We highly recommend that this surveying process be maintained and adapted as the CAM grows into a stronger resiliency hub. Updating the survey every 2-5 years, or as major events occur, is critical to keeping relevant data that can be shared with mutual aid organizations in times of crisis. We wish you the best of luck with your future surveys!