Hurricane Harvey in Houston

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Abstract

- As the threats of severe weather and the effects of climate change become more prevalent, a collaborative approach is put toward protection of people, property, and land. Using the devastation of Hurricane Harvey as an example, we will analyze the emergency response, recovery, preparedness, and mitigation of the city of Houston. Our analysis concludes that there is a need for greater emphasis on Emergency planning and risk mapping. We used the Geographic Information System (GIS) mapping system to help *analyze*, *measure* and *quantify* portions of the physical risk and mitigation solutions. For this study, the focus is on analysis of Risk mapping and the Emergency response in the aftermath of the Hurricane.

Hurricane Harvey

Step 1 - Response
What was the emergency response

Step 2 - Recovery
What changed for Houston in the aftermath of the hurricane

Step 3 - Plan
How did they update their Emergency plan/ response

Step 4 - Mitigate
How to implement Harvey's data for making better decision in the future

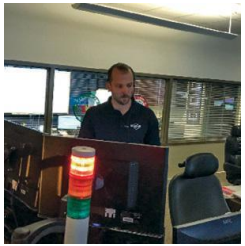
Background- Hurricane Harvey Flooding

- **Category 4 hurricane**
- **Made landfall on Aug. 25, 2017**
- **Stalled over Texas for 5 Days**
- **103 Direct and Indirect deaths**
- **Estimated $150-200 billion in damage**
- **Second-most costly hurricane to hit the U.S. mainland since 1900**

Response

- **Historic Response included**:
  - Neighbors
  - Strangers
  - Nonprofit organizations
  - Governments at all levels
- The Federal Emergency Management Agency (**FEMA**) pre-positioned supplies and personnel in the state before the storm made landfall
- **Major disaster declaration issued immediately**:
  - Allowed dozens of federal agencies to assign personnel to support the State of Texas
  - Over 31,000 Personnel deployed from:
    - FEMA
    - National Guard
    - Other Federal agencies

Response



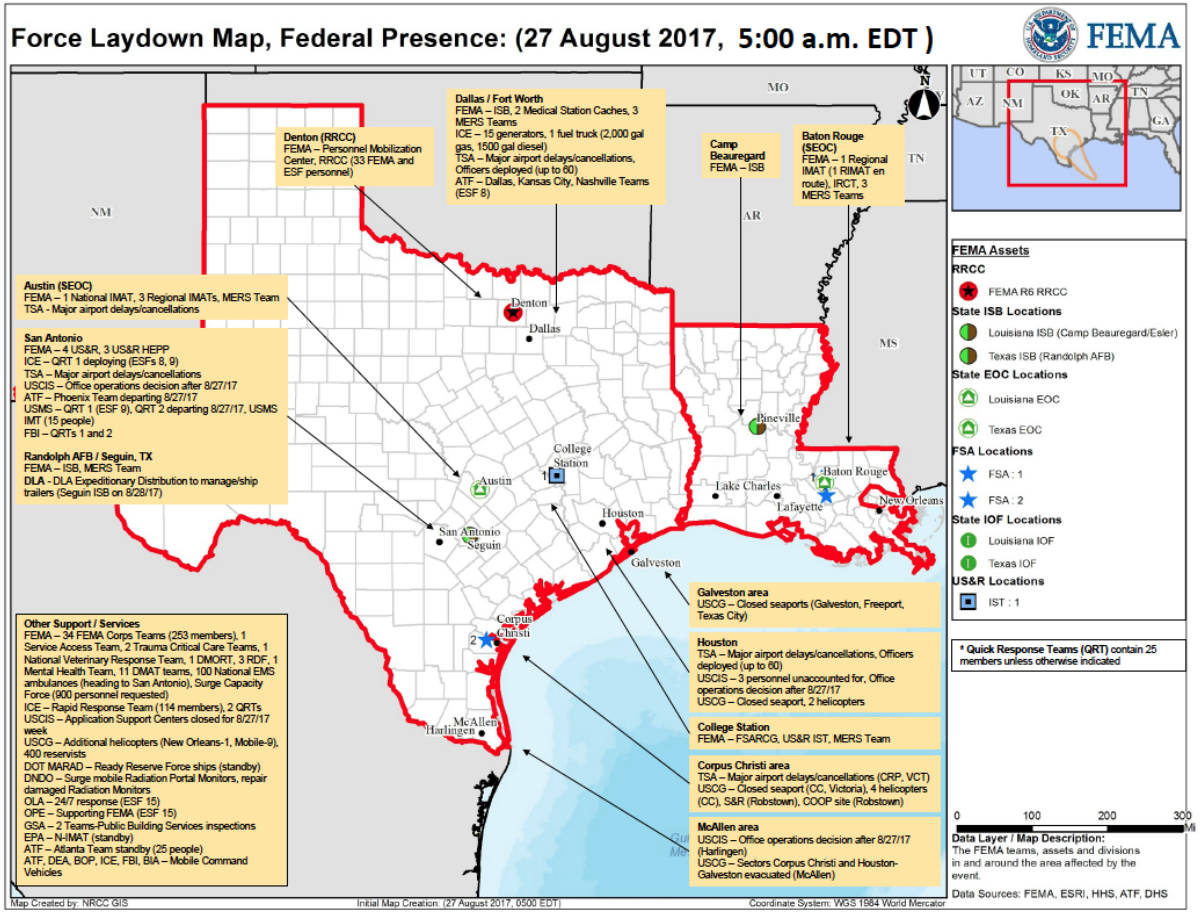
- FEMA
  - Coast Guard
    - Civil Air Patrol
      - National Weather Service
      - Department of Transportation
        - American Red Cross
        - Texas Workforce Commission
        - General Services Administration
    - Department of Energy
  - U.S. Army Corps of Engineers
    - Department of Housing & Urban Development
      - Environmental Protection Agency
      - Department of Health & Human Services
        - Centers for Medicare and Medicaid
      - 300 Volunteers Organizations
    - Department of Defense

Response

- **Mobilized Assets**:
  - 83 Aircraft
  - 75 Boats
  - 29 Cutters
  - 28 Urban Search and Rescue Teams
- **Emergency Efforts:**
  - 122,331 People Rescued
  - 5234 Pets Rescued
  - 1.5 Billion in Emergency Aid
  - **Supplies Distributed:**
    - 3 Million Meals
    - 3 Million Bottles of Water
    - 9,900 Blankets
    - 480 cots
    - 10,300 Hygine Kits
    - 210,00 Lbs of Hay for Livestock
    - 25 Tons of Pet Food

Response

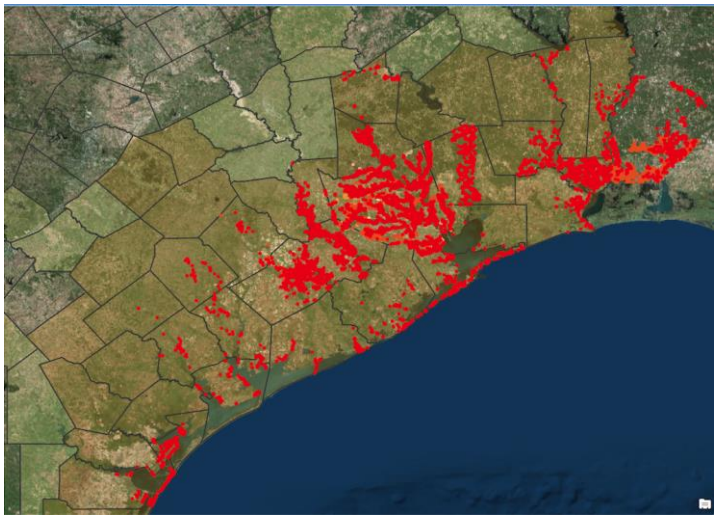
- 5,359 Medical Patients Cared
- 24 Hospitals Evacuated
- 23 Ports Closed
- 780,000 Texans Evacuated
- 42,000 Texans Housed in 692 Shelters



Recovery

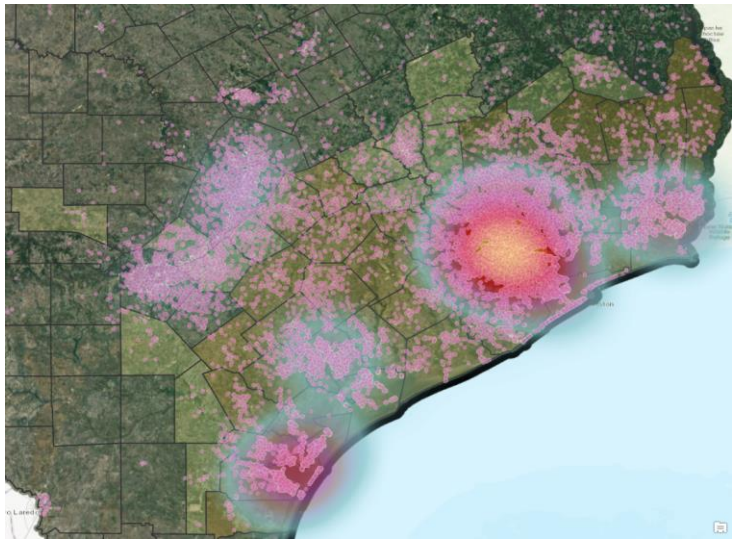
- 87,000 Flood Insurance Claims
- 608,000 Flood Insurance Advances
- 367 Million Low Interest SBA Loans
- 792,000 households applied for assistance
- More than $1.5 billion in federal funds was paid to Texans impacted by the disaster
- 270,916 Texas households were provided $571.8 million from FEMA for temporary housing
- Three years later and 20% of those that applied for temporary housing are still in it

Recovery



1 FEMA Damage Assessment

The damage assessment is used to inform policy and keep other organizations abreast.



2 Property Claims

National Insurance activates and transfer risk from the major of the population.

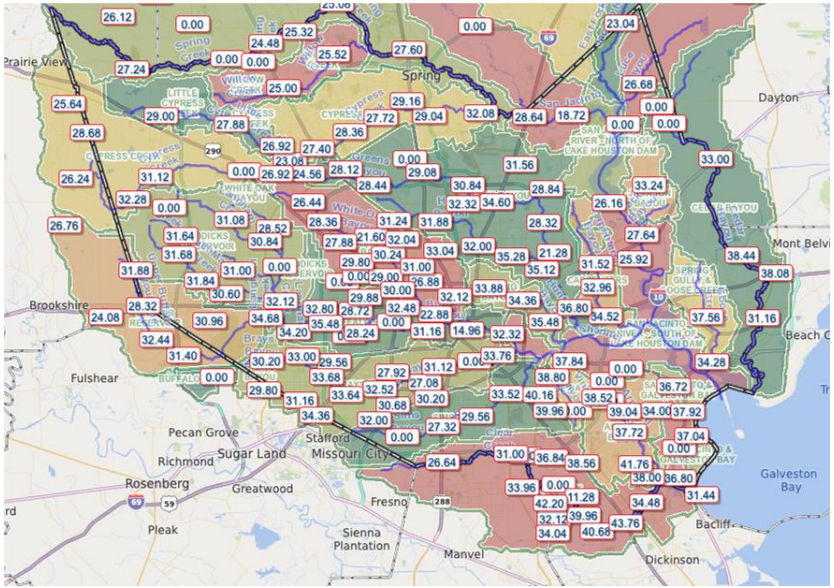
What changed in Houston after Hurricane Harvey

- Revisions to Harris County's Floodplain Regulations
- Updates to Chapter 19 of the City of Houston Code of Ordinances
- The City of Houston Adopts Recommendations from the Redevelopment and Drainage Task Force
- Houston Public Works Made Significant Changes to its Detention Requirements
- Hurricane Harvey Flood Mitigation and Restoration Projects
- FEMA Changed Flood Hazard Area based on Harvey's Flooding

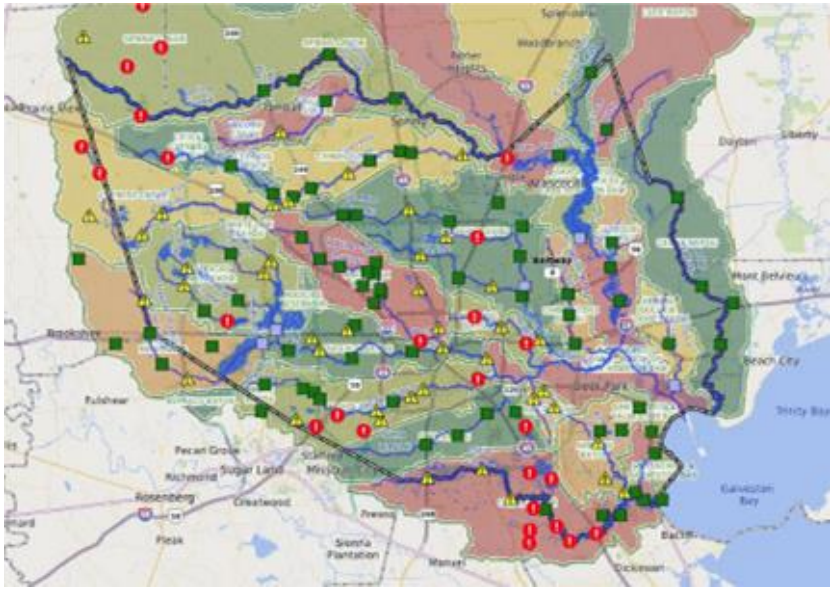
Plan & Prepare: Hazard & Vulnerabilities

- Harris County Flood Warning System shows the current and historical rainfall, inundation, and channel status:https://www.harriscountyfws.org

Accumulated Rainfall during Harvey

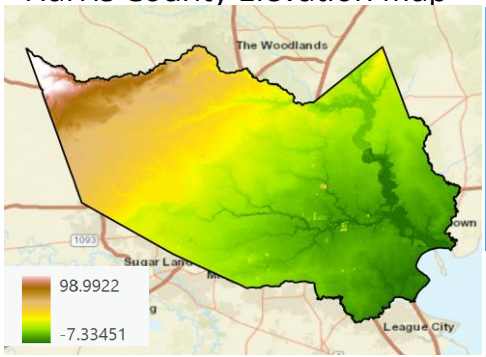


Floods and channel status during Harvey

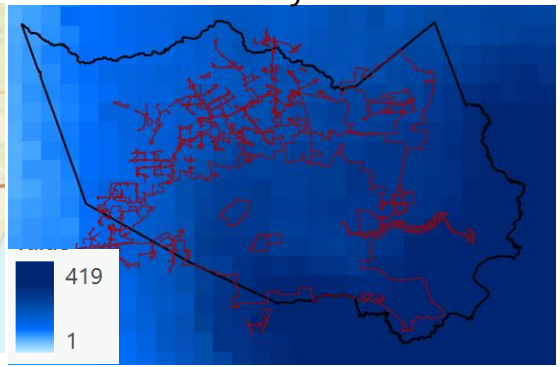


Mitigate:Risk Mapping

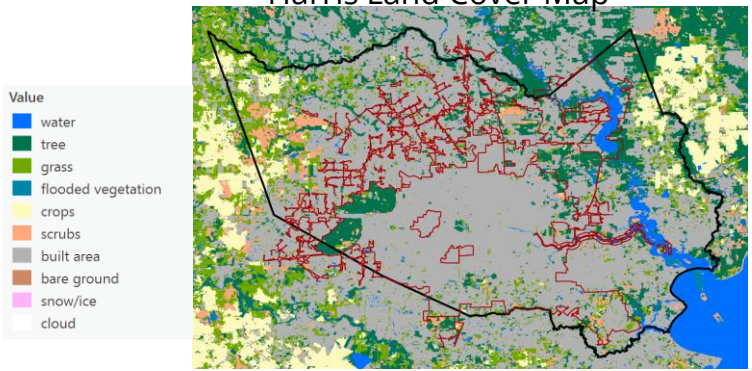
Harris County Elevation Map



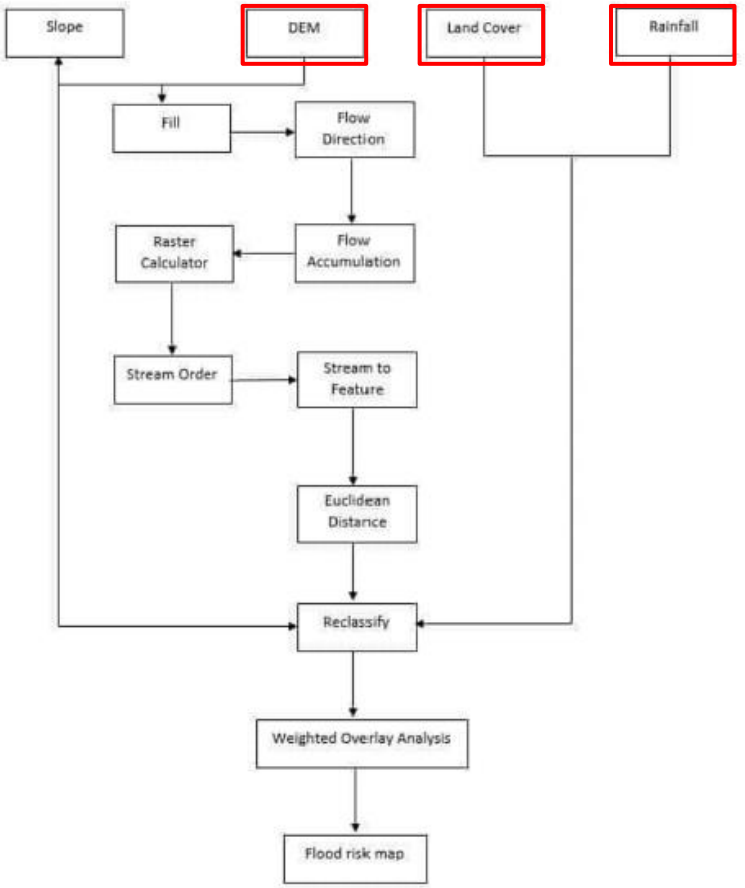
Hurricane Harvey Rainfall



Harris Land Cover Map

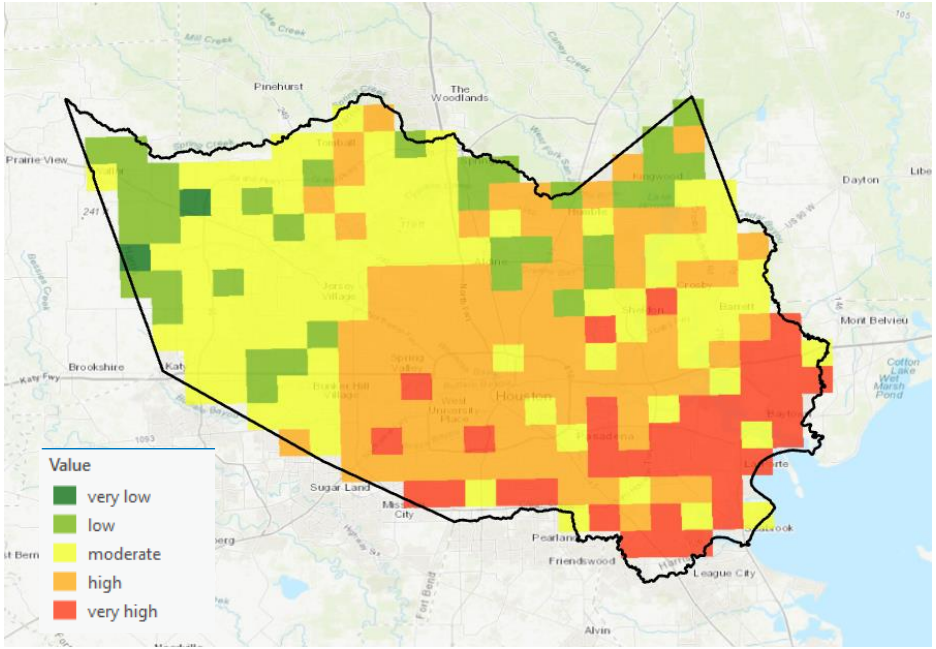


Flow chart picture for risk mapping



Mitigate: Risk Mapping

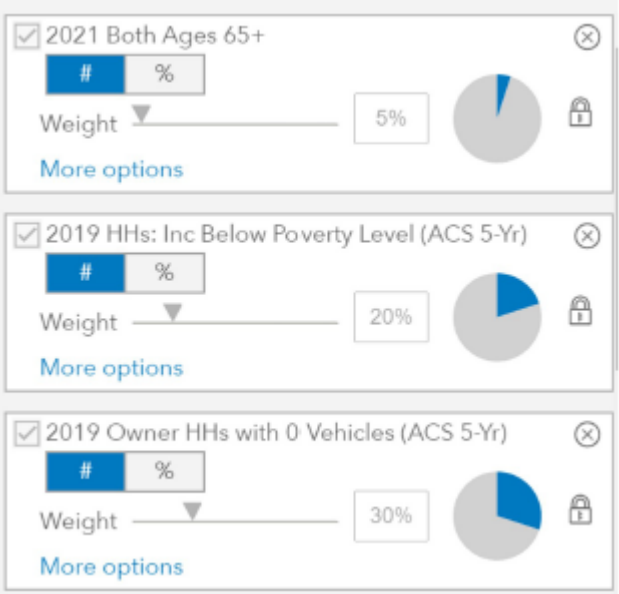
Harris County Flood Risk Map

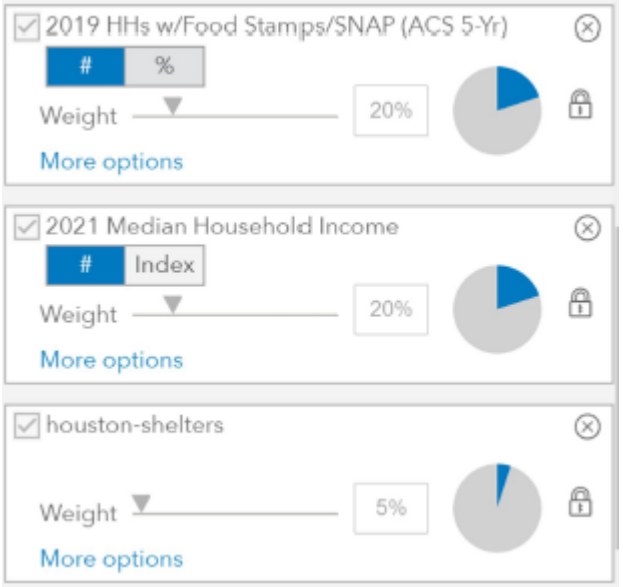


- Identify high risk area with the rainfall data as input
- Very high risk areas align with the evacuation zone
- High risk areas are mostly the heavy flood zone

Mitigate: Identify Vulnerabilities

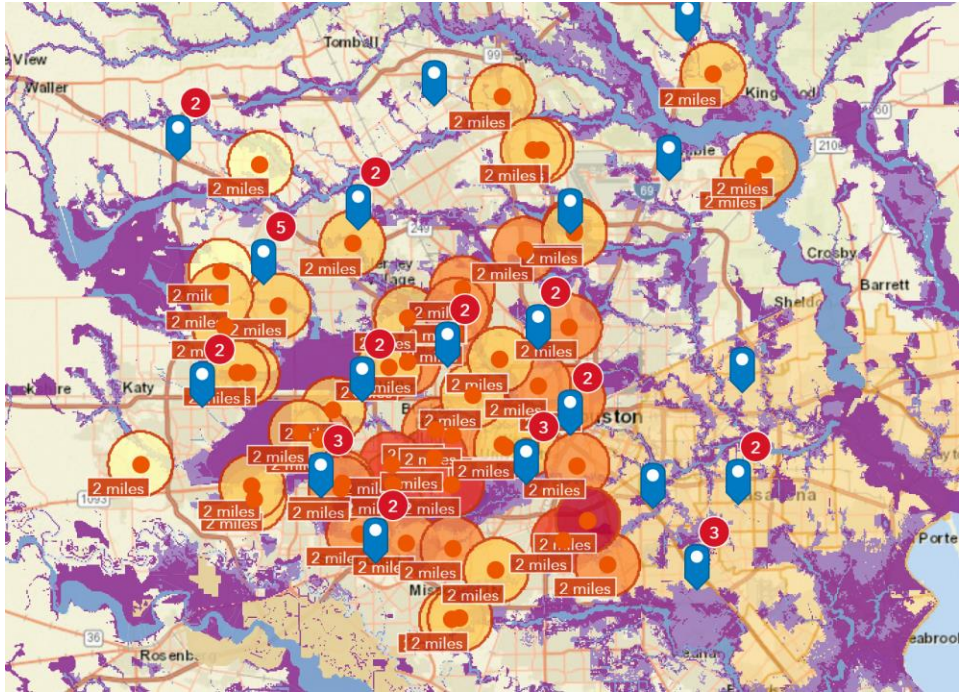
1. List of proxies for potential high risk groups
2. Assigning Weights for additional shelter mapping (e.g., high weight for households without cars)





Mitigate: Shelter Mapping

Possible Additional Shelter locations



- Utilize the high vulnerability data and the existing shelter location to identify potential additional shelters
- Higher weight goes to household without vehicles

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