

Guidance on Flood Mapping to Inform Community-Driven Buyout Projects

Michelle Hummel, Ph.D., University of Texas at Arlington

1. Background

Communities facing severe and/or chronic flood risks are potential candidates for residential buyouts, which aim to relocate residents out of high-risk areas. The decision to relocate is not an easy one. Residents must decide whether to stay in their homes and risk future flooding or abandon their homes and move away from their existing social and community networks to reduce future flood exposure. It is thus important that residents and community groups have access to quantitative data about past flood events to make informed decisions about buyouts. This guidance document presents a method for mapping historical flood impacts to identify candidate neighborhoods for targeted and effective residential home buyouts. It is intended to be used by community groups and their partners to inform local decision-making regarding flood mitigation.

This document is organized as follows. Section 2 describes the data sets and sources that are used in the mapping effort. Section 3 outlines the methods for aggregating and mapping the data. Section 4 discusses the potential uses and limitations of the approach. Section 5 contains links to the data sources.

2. Data Requirements

The following data sources can be used to map historical flood damages and associated factors in the community of interest: (a) severe repetitive loss properties (SRLP), (b) National Flood Insurance Program (NFIP) claims, (c) individual assistance (IA) grants, (d) socioeconomic data, and (e) digital elevation data. Each of these data sets is described in more detail below. Appendix A displays the data fields for the SRLP, NFIP, and IA data sets in tabular form.

a. Severe Repetitive Loss Properties

According to the National Flood Insurance Reform Act of 2004, a SRLP is “a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.” SRLP data is available by contacting the Natural Resources Defense Council, which obtained the data from the Federal Emergency Management Agency (FEMA) as part of a public records request. The data covers the entire U.S. and is provided at the zip code level. The data set excludes properties without flood insurance policies and properties that have incurred flood-related damage on fewer occasions or at lower cost than the given thresholds.

b. National Flood Insurance Program Claims

The NFIP was created following passage of the National Flood Insurance Act of 1968. As part of the NFIP, the federal government establishes flood insurance rates, engages in risk studies for communities, and sets floodplain management criteria. Local communities must then adopt floodplain management standards within their boundaries to qualify for the NFIP. Flood insurance is sold to homeowners by FEMA directly or through private insurance companies. Following a flood event, homeowners must file claims with the NFIP or their insurance provider.

Redacted data for over two million NFIP claims dating back to 1978 is available through the OpenFEMA platform [1]. This data set covers the entire U.S. and is provided at the Census tract level. The claims data does not capture the cost of flood damages for properties without NFIP flood insurance policies.

c. Individual Assistance

FEMA provides IA, in the form of disaster assistance grants, to individuals and families whose homes, vehicles, personal property, businesses, or inventory have sustained damage due to a disaster. The IA data set is available on the OpenFEMA platform [2] and includes claims made for large disasters since 2017. The IA data is provided at the Census block level, which allows for a more localized picture of claim distribution in areas that have recently experienced a disaster.

d. Socioeconomic Data

Socioeconomic data can be used to identify potential environmental justice issues within a community. In addition, some federal disaster funding sources are targeted at low- or moderate-income residents, so quantifying the income status of homeowners in neighborhoods that are candidates for buyouts could enable the community to leverage these funding opportunities. Socioeconomic data, including population characteristics and income, is provided by the U.S. Census Bureau and can be aggregated at the same level as each of the flood loss data sets (i.e., zip code [3], Census tract [4], and Census block [5]). The data covers the entire U.S.

e. Digital Elevation Data

Elevation data can be used to identify low-lying areas that may be more prone to flooding. Digital elevation data at approximately 10-meter resolution is available from the U.S. Geological Survey's National Map [6]. The data set covers the entire U.S.

3. Aggregation and Mapping Methods

To generate maps, the flood damage data sets are first processed in Python (freeware). The results can then be mapped using a geographic information system (GIS) software. The specific details of each of these steps are described below.

a. Data Aggregation

The SRLP, NFIP, and IA data are all provided as individual entries for each property, with associated geographic identifiers (i.e., zip code, Census tract, and Census block). For mapping purposes, this data needs to be aggregated and summarized by geographic unit. This can be accomplished using the Python script located here: <https://thrivingearthexchange.org/wp-content/uploads/2019/03/floodDamageAggregation.pdf>. Detailed comments are provided in the script to facilitate its use. In brief, after the flood data sets are loaded into the program, the sum or average of each variable is calculated for each geographic unit. The outputs of the script are saved as text files for use within the GIS platform.

b. Mapping

Mapping of flood damage data can be accomplished using one of several GIS platforms, such as ArcGIS (proprietary) or QGIS (freeware). Outputs from the Python script (in text format) can be loaded directly into the GIS platform, along with the Census data (in shapefile format). The flood damage data can then be joined with the geographic units from the Census data for mapping. Socioeconomic and elevation

data can also be incorporated. Someone with experience using GIS software should be consulted to develop the desired maps.

Some example maps for Port Arthur, Texas, created using the IA data at the Census block level, are shown in Figure 1. These maps summarize (a) the total number of claims per Census block, (b) the average gross income of residents, (c) the average reported water level of flooding (in feet), and (d) the percent of applicants with flood insurance. The IA data provide the highest-resolution information and capture local variability better than the SRLP data at the zip code level and NFIP data at the Census tract level.

4. Uses and Limitations

The flood damage, socioeconomic, and elevation maps developed using the guidance in this report provide an initial picture of the distribution of historical flood impacts and can be used to identify neighborhoods that might be targeted for residential home buyouts. These could include neighborhoods with a high magnitude or frequency of past flood losses, areas with higher social vulnerability due to factors such as income, race/ethnicity, age, or gender, and areas at relatively low elevation that may be more prone to flooding. Once target areas are identified, additional local-level information should be collected, including information about substantially damaged properties, elevation certificates, and local post-flood damage assessments.

Outputs from this mapping approach should not be used to coerce residents into moving but rather to provide residents with the information needed to make informed decisions about whether to participate in buyout and relocation programs. Sustained engagement with community leaders and residents is essential to understand residents' attitudes toward buyouts and gauge interest in neighborhood-scale relocation programs.

After a community has decided to pursue a buyout program, it is necessary to identify appropriate sources of funding. Some potential sources include the FEMA Hazard Mitigation Grant Program or the U.S. Housing and Urban Development Community Development Block Grant Program for Disaster Recovery. As mentioned previously, these programs often set aside funds for low- and moderate-income households, which can be leveraged when appropriate.

5. Data Sources

[1] Federal Emergency Management Agency. (2019). FIMA NFIP Redacted Claims Data Set. Available: <https://www.fema.gov/media-library/assets/documents/180374>. Accessed 14 June 2019.

[2] Federal Emergency Management Agency. (2018). OpenFEMA Dataset: Individual Assistance Housing Registrants Large Disasters - V1. Available: <https://www.fema.gov/openfema-dataset-individual-assistance-housing-registrants-large-disasters-v1>. Accessed 5 July 2019.

[3] U.S. Census Bureau. (2017). TIGER/Line with Selected Demographic and Economic Data: Zip Code Tabulation Area. Available: <https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-data.html>. Accessed 17 October 2019.

[4] U.S. Census Bureau. (2017). TIGER/Line with Selected Demographic and Economic Data: Census Tract State Files. Available: <https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-data.html>. Accessed 17 October 2019.

[5] U.S. Census Bureau. (2018). Census Block Tabulation Areas. Available: <https://www2.census.gov/geo/tiger/TIGER2018/TABBLOCK/>. Accessed 17 October 2019.

[6] U.S. Geological Survey. (2019). The National Map Viewer. Available: <https://viewer.nationalmap.gov/advanced-viewer/>. Accessed 10 July 2019.

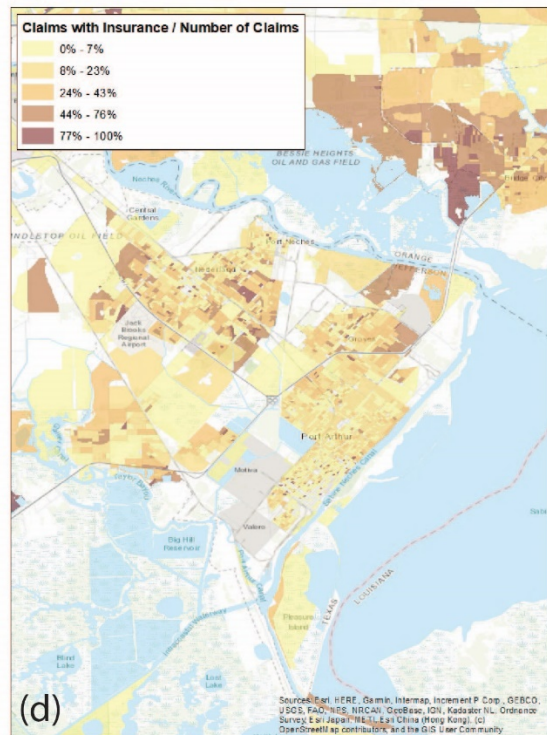
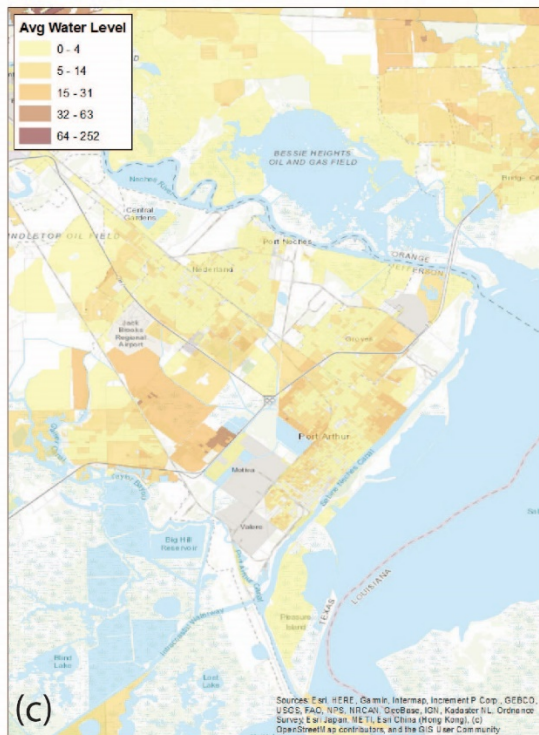
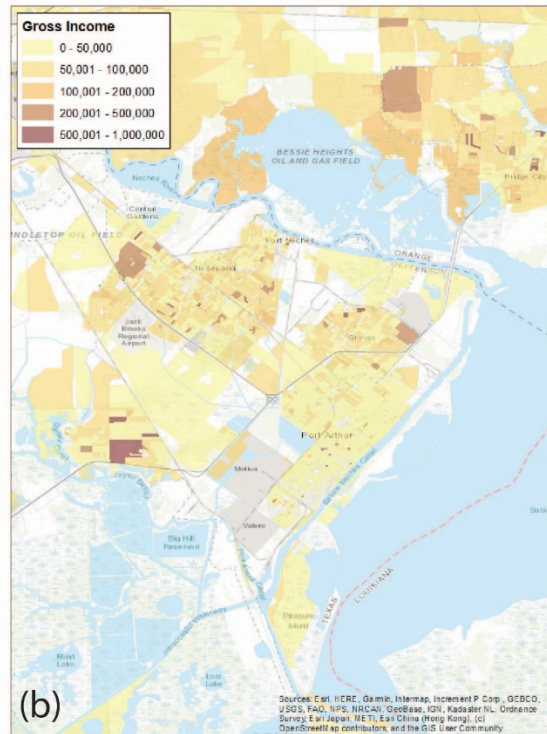
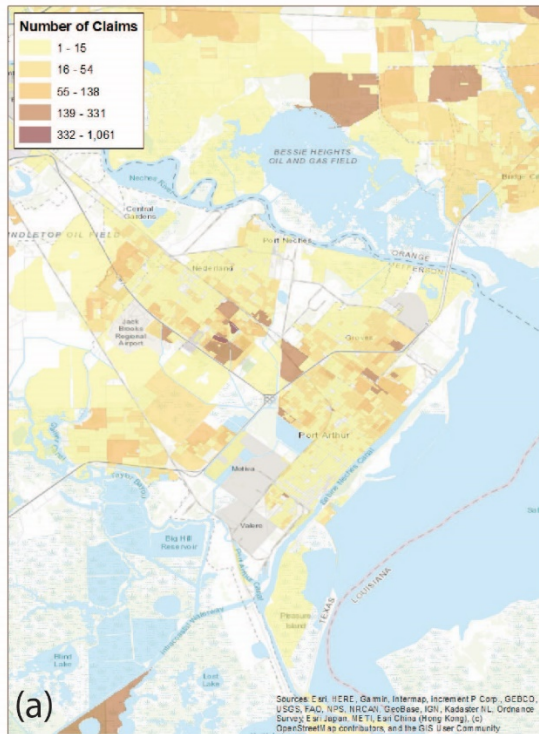


Figure 1. Maps of individual assistance data for Port Arthur, Texas.

Appendix A: Flood Damage Data Fields

a. Severe Repetitive Loss Properties

Name	Description
State Name	State Name
Community Name	Community Name
Comm Nbr	Community Identification Number
Insured?	YES/NO - Currently Insured
Mitigated?	Typically Yes if mitigation measures, unlocatable, or Historic Building
NOTSPECSW	Updated as - Unable to locate
NOBLDGSW	No building on property
FLOODPRSW	Flood Protection Provided
GT100SW	Updated as - All losses greater than 100 year
UNABLIDSW	Updated as - Unable to identify cause of flooding
BOX_1_SW	Code Section 1.) of Mitigation Action Codes
BOX_2_SW	Code Section 2.) of Mitigation Action Codes
BOX_3_SW	Code Section 3.) of Mitigation Action Codes
BOX_4_SW	Code Section 3.) of Mitigation Action Codes
HISTBLDGSW	Updated as - Historic Building
Dt of Loss	Date of Loss
Occupancy	Occupancy Type
Zone	Flood Zone
Post FIRM	YES/NO - Is this a Post FIRM structure?
Building Payment	Building Payment
Contents Payment	Contents Payment
Building Value	RCV that is determined and reported by the claims adjuster at the time of adjustment
Tot Building Payment	Total of Building Claim Payments
Tot Contents Payment	Total of Contents Claim Payments
Losses	Total Number of Losses

Total Paid	Total of ALL Payments
Average Pay	Average of ALL Payments
Data Type	Indicates the type of properties included on report (Mitigated/non-mitigated)
As of Date	As of Date for data on report
County Name	County Name
SRL Indicator	See SRL Indicator Descriptions Tab

b. National Flood Insurance Program Claims

Name	Description
agriculturestructureindicator	Indicator of whether a building is an agricultural structure
asofdate	The effective date of the data
basefloodelevation	Base Flood Elevation (BFE) for which there is a 1% chance per year of flooding
basementenclosurecrawlspacetype	Basement code
reportedcity	City of the insured property
condominiumindicator	Indicator of what type of condominium property is being insured
policycount	Insured units in an active status
countycode	FIPS code for the primary County
crsdiscount	Community Rating System (CRS) Classification Credit Percentage
dateofloss	Date on which water first entered the insured building;
elevatedbuildingindicator	Indicator of whether or not a building meets the NFIP definition of an elevated building
elevationcertificateindicator	Indicates if a policy has been rated with elevation certificate
elevationdifference	Difference between elevation of lowest floor and base flood elevation (BFE)
censustract	US Census Bureau defined census Tracts
floodzone	Flood zone derived from the Flood Insurance Rate Map (FIRM)
houseworship	Indicator of whether a building is a house of worship
latitude	Approximate latitude of the insured building
locationofcontents	Code that indicates where within the structure the contents are located
longitude	Approximate longitude of the insured building
lowestadjacentgrade	Lowest natural grade adjacent to the insured structure prior to excavating or filling

lowestfloorelevation	Building's lowest floor elevation
numberoffloorsintheinsuredbuilding	Code that indicates the number of floors in the insured building
nonprofitindicator	Indicator of whether a building is a nonprofit
obstructiontype	Type of obstruction in the enclosure
occupancytype	Code indicating the use and occupancy type of the insured structure
originalconstructiondate	The original date of the construction of the building
originalnbdate	The original date of the flood policy
amountpaidonbuildingclaim	Dollar amount paid on the building claim
amountpaidoncontentsclaim	Dollar amount paid on the contents claim
amountpaidonincreasedcostofcomplianceclaim	Dollar amount paid on the Increased Cost of Compliance (ICC) claim
postfirmconstructionindicator	Indicator of whether construction was started before or after publication of the FIRM
ratemethod	Indicates policy rating method
smallbusinessindicatorbuilding	Indicator of whether the insured represents a small business
state	The two-character alpha abbreviation of the state
totalbuildinginsurancecoverage	Total Insurance Amount in dollars on the building
totalcontentsinsurancecoverage	Total Insurance Amount in dollars on the contents
yearoffloss	Year of Loss = Year in which the flood loss occurred
reportedzip	5 digit Postal Zip Code of the insured property
primaryresidence	Indicator of whether a building is a primary residence

c. Individual Assistance

Name	Description
id	System generated unique identifier
disasterNumber	Unique FEMA numerical identifier for each disaster declaration
damagedCity	Damaged Dwelling City
damagedStateAbbreviation	Damaged Dwelling State Abbreviation
damagedZipCode	Damaged Dwelling Zip Code
householdComposition	Number of individuals living in household at time of damage
grossIncome	Self-reported Gross Income

specialNeeds	Applicant requires special accommodations to use FEMA assistance
ownRent	Applicant is Owner or Renter of Dwelling
residenceType	Damaged Dwelling Residence Type
homeOwnersInsurance	Does the applicant have Home Owner's Insurance?
floodInsurance	Does the applicant have flood insurance?
inspected	Has the applicant been inspected by FEMA?
rpfvl	Real property damage amount observed by FEMA
habitabilityRepairsRequired	Are repairs required to make the dwelling habitable?
destroyed	Is structure permanently uninhabitable?
waterLevel	Total depth of water in damaged dwelling
floodDamage	Was damage caused by flooding?
foundationDamage	Has the damaged dwelling's foundation been damaged?
foundationDamageAmount	Foundation damage amount observed by FEMA
roofDamage	Has the damage dwelling's roof been damaged?
roofDamageAmount	Roof damage amount observed by FEMA
tsaEligible	Is applicant eligible for Temporary Sheltering Assistance?
tsaCheckedIn	Has applicant checked in to FEMA provided Temporary Sheltering Assistance facility?
rentalAssistanceEligible	Is applicant eligible for FEMA rental assistance?
rentalAssistanceAmount	Amount of Rental Assistance in dollars
repairAssistanceEligible	Is applicant eligible for FEMA assistance to repair the damaged dwelling?
repairAmount	Amount of Repair Assistance in dollars
replacementAssistanceEligible	Is applicant eligible for FEMA assistance to replace the damaged dwelling?
replacementAmount	Amount of Replacement Assistance in dollars
sbaEligible	Is applicant eligible for a Small Business Association loan?
renterDamageLevel	Level of Damage: Moderate, Major, Destroyed
rentalAssistanceEndDate	Final Month applicant received Rental Assistance
rentalResourceCity	Rental Resource City
rentalResourceStateAbbreviation	Rental Resource State Abbreviation

rentalResourceZipCode	Rental Resource Zip Code
primaryResidence	Is the applicant's damaged dwelling his/her primary residence?
personalPropertyEligible	Is the applicant eligible for FEMA's Other Needs Assistance to cover damaged personal property?
ppfvl	FEMA Verified Loss captured during inspection of personal property
censusBlockId	Address-based 15-character code
censusYear	Census period used to obtain Census Block ID