

## Independent Problem Part 1

### Flood Hazard Vulnerability in Vermont's Mobile Homes

#### Honor Code

This Independent Problem (IP) is *independent*. Do not discuss the questions with other students or lab monitors. Do not share the questions with other students after you have completed the course. The only reason to contact an instructor is to ask for clarification or to request assistance with technical errors that seem beyond your control. Feel free to use your notes, videos, and software documentation. Avoid consulting external sources online, you have everything you need to solve the problem from course materials.

#### Due:

- By Wednesday (2/1) at 10:30 AM, please upload to the Canvas quiz a single .pdf document. Follow the following guidelines:
  - The .pdf document is named with “YourLastName\_YourFirstName\_GISIP\_Part1.pdf”
  - The .pdf document contains your complete workflow. Legibility is extremely important (see evaluation). If your handwriting is not legible, create the workflow digitally.
  - The .pdf should also contain your results in the form of completed Table 1.
  - Export an .xlsx (Excel) spreadsheet of your final results, open it in Excel or Google Sheets, **and revise the column headings so that it's very clear which columns are which!**
  - Please include the honor code at the bottom of the document (a typed signature is acceptable).
  - Bring a printout of your .pdf to Wednesday's class so that you can annotate your solution.

#### Background

Accurate assessment of risk is an essential for effective response to any natural disaster. The methodologies used to assess risk can end up underestimating vulnerabilities. Tropical Storm Irene offers an example of inadequate assessment of risk, which then leads to inadequate planning for and response to a disaster. The storm inundated Vermont with unprecedented rainfall on August 28 and 29 of 2011. The storm destroyed 480 bridges and 960 culverts (where streams cross under a road), causing \$350 million in road damage and cutting off road access to 13 mountain communities. Even Vermont's emergency management offices were flooded! Some of the most affected people were living in mobile homes, whether on individual parcels of land or in mobile home parks. At least 130 mobile homes were destroyed and an additional 300 severely damaged (Figure 1). Our problem will evaluate assessments of flooding risks with a focus on mobile homes in Vermont.

There are two different ways of assessing flooding risk in Vermont: one is by the federal agency, FEMA (The Federal Emergency Management Association), and one by a state agency, Vermont Rivers Program.

The federal agency, FEMA, estimates flood risk in terms of inundation from rising water levels in stable river channels. Based on existing channels, FEMA hydrologists estimate the region of land that would be potentially flooded by a 1% (100-year) flood. The residents with mortgages in that region are required to purchase flood insurance.

The state of Vermont's River Corridors Program estimates flooding risk differently, using river corridors. After Irene, the state of Vermont recognized that the most damaging flooding in Vermont is not due to inundation but rather due to fluvial erosion: the erosion of riverbanks as the river channel widens or migrates to form new channels (Figure 1 and Figure 2). By this estimation, regions where rivers may erode and migrate to in the future are *also* at risk of flooding.



**Figure 1:** A mobile home damaged by stream channel erosion during tropical storm Irene. Mobile homes were disproportionately affected by the tropical storm, partially due to inadequate assessment of flooding risk.



**Figure 2:** Sample river corridor in Vermont. The river is digitized as a line (blue) and its corridor is represented as a light yellow/green region around it. The river can flow anywhere in the corridor region, and it has started forming alternative channels at the bottom-left of the figure.

## The Problem

Your analysis should allow you to contrast two different data sources' estimates of the number of mobile homes facing flooding risk. One source is the American Community Survey, and the other source is e911 building point locations. Contrast these two data sources using FEMA flood zones as the source of information on flooding risk.

Your analysis should also allow you to contrast two different methods for defining flood risk: the federal FEMA flood zones and the Vermont River Corridors (inclusive of rivers and small streams). To contrast these two definitions of flood risk, use the same source of data on the location of mobile homes: e911 point data.

You will analyze exposure to flooding risk to Vermont's mobile homes by creating a workflow and implementing it to generate a table shown in Table 1. Conduct your analysis in three steps as follows:

### Step 1: Analyzing Exposure to Flood Risk Using American Community Survey Data and FEMA Zones

First, you will estimate the mobile homes at risk in each county based on FEMA flood zones and the American Community Survey (ACS) data. Step 1 will add two columns to Table 1: Total Mobile Homes (ACS), and Mobile Homes at Risk based on the ACS and FEMA flood zones (See Table 1). For this step, you may assume that mobile homes are evenly distributed within block groups.

### Step 2: Analyzing Exposure to Flood Risk Using e911 Data and FEMA Zones

Second, you will refine the FEMA estimate of mobile homes at risk of flooding. You will refine the estimate by using exact point locations from e911 data, rather than assuming an even distribution of mobile homes. For this step, use a GIS methodology outlined by Baker, Hamshaw and Hamshaw (2014) in the Mobile Home Park Flood Hazard Identification section, and Figure 5 of the paper. Their method includes creating a 60-foot buffer around point locations of mobile homes, since a typical mobile home is 120 feet long. They consider a mobile home to be at risk of flooding if any part of the buffer is in the 100-year FEMA flood zone. Step 2 will add one column to Table 1: Mobile Homes at Risk (e911 and FEMA).

### Step 3: Analyzing Exposure to Flood Risk Using e911 Data and River Corridors

Finally, you will estimate mobile homes at risk of flooding using the Vermont River Corridors. Vermont river corridors encompass both major river corridors (Figure 2) and a 50-foot buffer around small streams. Estimate the number of mobile homes at risk of flooding according to Vermont River Corridors using the Baker, Hamshaw and Hamshaw (2014) methodology described above. Step 3 will add one column to Table 1: Mobile Homes at Risk (e911 and River Corridors).

### Deliverable: Comparative Environmental Risk and Vulnerability Analysis

Please communicate your results for the three parts with one table, as illustrated below:

For your final values in Table 1, please round the values to integers. There should be no “xx.000” decimal places following your values.

**Table 1:** Expected results table for Independent Problem 2 Part 1

County	Total Mobile Homes (ACS)	Mobile Homes at Risk (ACS and FEMA)	Mobile Homes at Risk (e911 and FEMA)	Mobile Homes at Risk (e911 and River Corridors)
Bennington				
Rutland				
Windham				
Windsor				

## References

- Baker, D., S. D. Hamshaw, and K. A. Hamshaw. 2014. Rapid flood exposure assessment of Vermont mobile home parks following Tropical Storm Irene. *Natural Hazards Review* 15 (1):27–37 (On Canvas).
- Flood Ready Vermont. River Corridors. Vermont.gov. Available online at: [https://floodready.vermont.gov/flood\\_protection/river\\_corridors\\_floodplains/river\\_corridors](https://floodready.vermont.gov/flood_protection/river_corridors_floodplains/river_corridors)

## Given Data

- [https://drive.google.com/uc?id=19Dg1tSukD9SFrzQt\\_nHIKvgme50hVOe&export=download](https://drive.google.com/uc?id=19Dg1tSukD9SFrzQt_nHIKvgme50hVOe&export=download)
- e911pts.shp, point, epsg: 32145, locations of residences and buildings in Vermont for use with emergency response
  - SITETYPE: Type of location, of which one category is 'MOBILE HOME'
  - Source: Vermont Open GeoData Portal, <https://geodata.vermont.gov/>
- FEMA\_100yr.shp, polygon, epsg:32145, flood zones determined by FEMA
  - FLD\_Zone contains FEMA Flood Zone codes. All codes beginning with 'A' are included in the 1% flood risk zone (100-year flood risk).
  - Source: Vermont Open GeoData Portal, <https://geodata.vermont.gov/>
- river\_corridors.shp, polygon, epsg: 32145, river corridor zones defined by Flood Ready Vermont. Includes streams (with a 50 foot buffer) and rivers with watersheds more than 2km.
  - Source: Vermont Open GeoData Portal, <https://geodata.vermont.gov/>
- block\_groups.shp, polygon, epsg: 32145, block groups in southern Vermont, with data on housing
  - mobileHU: estimated total of mobile home housing units
  - totalHU: estimated total of all housing units
  - county: name of county in which the block\_group is located
  - source: U.S. Census American Community Survey 2014-2018

## Notes and advice

- Please work in your documents folder, a local drive, every time you plan to leave your computer, you must upload your work to the W:/ Drive to avoid any chance of losing data. If you are still confused, we are happy to provide support moving between documents and W:/ Drive.
- Please use the `area($geometry)` for area calculation whenever you need to calculate areas
- If you get stuck and did not finish the IP, take a moment to write out steps you wished to take, and what columns they would generate on your workflow. *Communicate your intentions. If your workflow is on the right path, you will earn some points.*

### Evaluation Criteria for Independent Problem Part 1

	D/F	C/C-	C+	B-	B	B+	A-	A
Steps 1, 2, & 3	Incomplete OR no documentation	Achieved initial results and documented goals clearly. You got stuck somewhere but demonstrated good progress towards a solution.  OR  Poorly documented workflow that can't produce shown results!!!***	Your workflow and results are legible, but contain multiple important conceptual problems.  OR  Your results are not correct and it's difficult to understand why based on your documentation	Incorrect answer from one conceptual/major error or a combination of minor errors	Incorrect answer. from a minor error (e.g., parameter error or a step out of order)	Correct answers but workflow is missing some important information	Correct and fully documented analysis	Correct, fully documented, and efficient analysis
Workflow	No workflow	very messy handwriting, OR crisscrossing steps, scribbled out or crossed out			Workflow legible, but could be improved (e.g., poor scan quality, pages mis-rotated, or spans multiple pages)			Tidy, fits in one page, <b>numbered steps</b> , correctly oriented, and easy to follow

\*\*\*If you submit a workflow that does not line-up with your results, you may be asked to clarify the inconsistency\*\*\*

### Overall weighting of Independent Problem components

	Step 1	Step 2	Step 3	WORKFLOW	CORRECTIONS	VISUAL ESSAY
Weight	25%	15%	15%	5%	10%	30%