Comparative Analysis of Flood Hazard Vulnerability in Southern Vermont's Mobile Homes

Emily Zhou

Content

Part I Vulnerability of Counties in Southern Vermont to Flood Events

County	Total Mobile Homes		Risky Mobile Homes		
	ACS	e911	ACS and FEMA	e911 and FEMA	e911 and River Corridor
Bennington	1277	1296	65	189	130
Rutland	1992	2110	188	164	204
Windham	1833	1823	126	298	298
Windsor	2427	2290	134	198	353

Table one provides an overview of the data sources used in this analysis. Mobile home data is collected from American Community Survey and e911 point data. These two types of data differs in the number of mobile homes and their accuracy to identify those that are risky. The flood zone used in this analysis is determined by Federal Emergency Management Association and Vermont River Corridors program. These two approaches also differ greatly in their focus of identifying areas prone to flood risk. As such, the result for total number of risky mobile homes is different across all three combinations of analyses.

## Percentage of Mobile Homes Vulunerable to Flooding in Each County
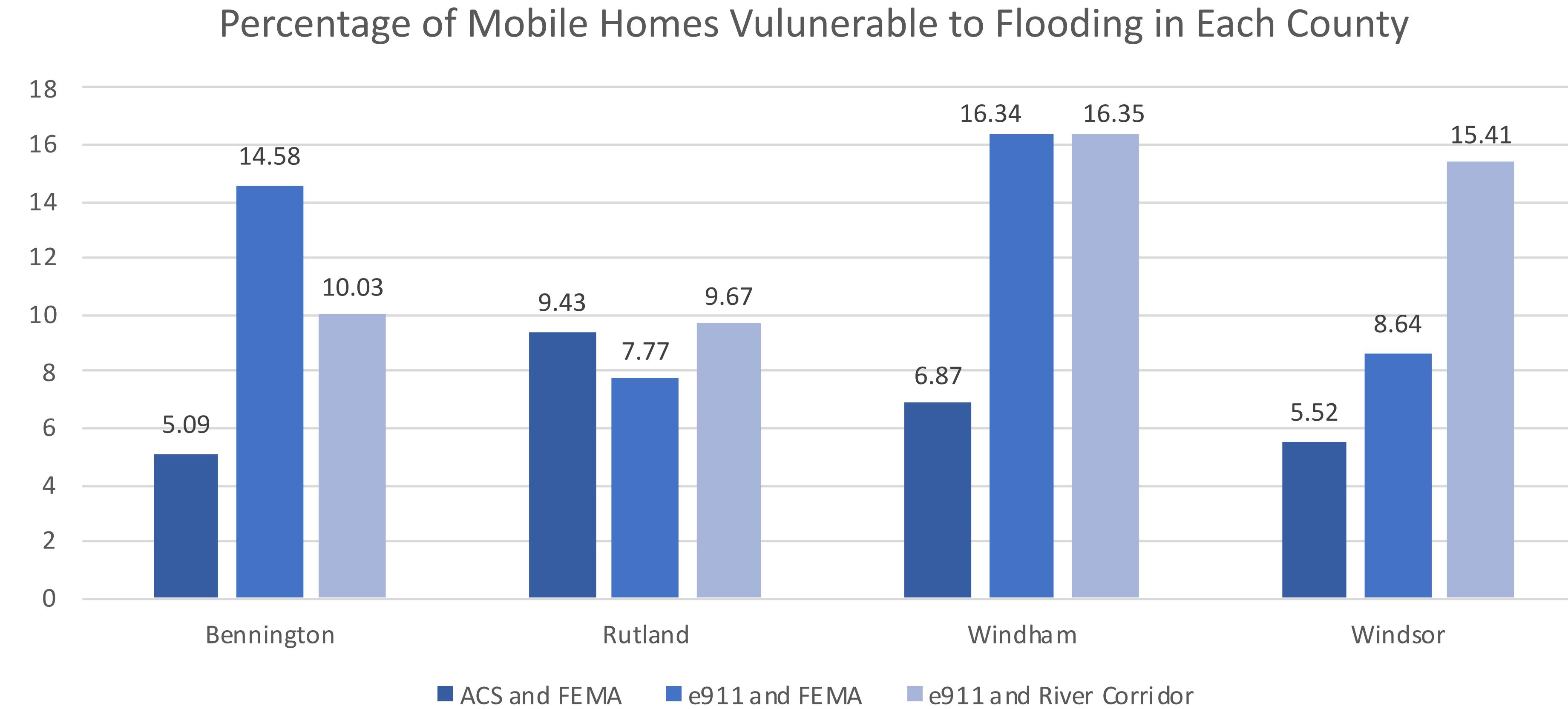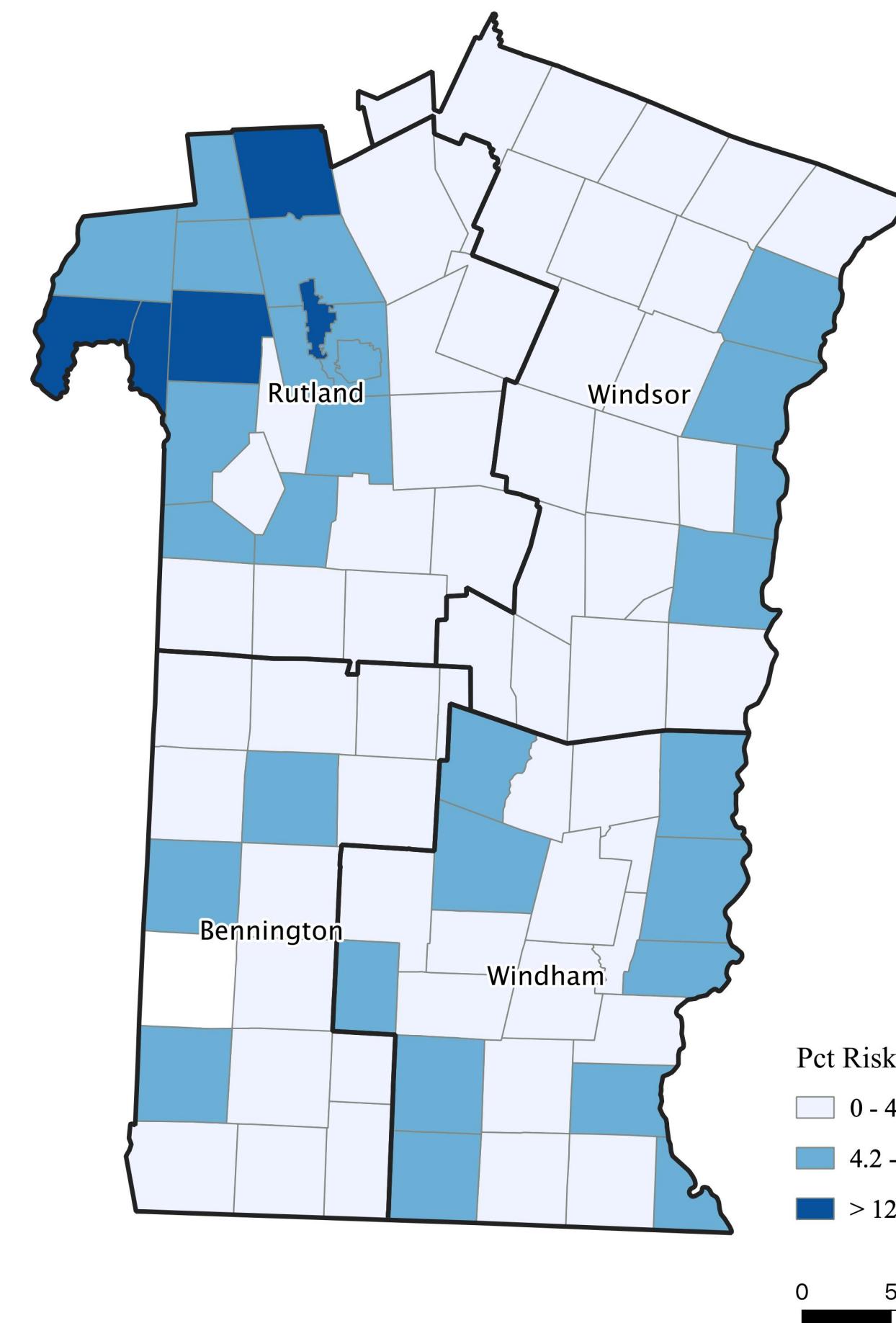
Figure one shows that mobiles homes in Windham and Windsor counties are more vulnerable. The results also imply how flood risks could be exaggerated or undermined with different methods. For example, analysis using ACS and FEMA data only identified 5% of mobile homes in Bennington to be risky, but e911 and FEMA data combined identified 15% of risky mobile homes. Similarly, whereas analysis using e911 and FEMA data identified 5.5% of risky mobile homes in Windsor county, River Corridor identified as much as 15.5%. Therefore, whether ACS is less accurate in counting mobile homes or River Corridor is more accurate in drawing flood zones requires more examination.

Mobile Homes at Risk (ACS and FEMA)

Pct Risky Households
- 0 - 4.2
- 4.2 - 12
- > 12

0 5 10 km

Mobile Homes at Risk (e911 and FEMA)

Pct Risky Households
- 0 - 4.2
- 4.2 - 12
- >12

0 5 10 km
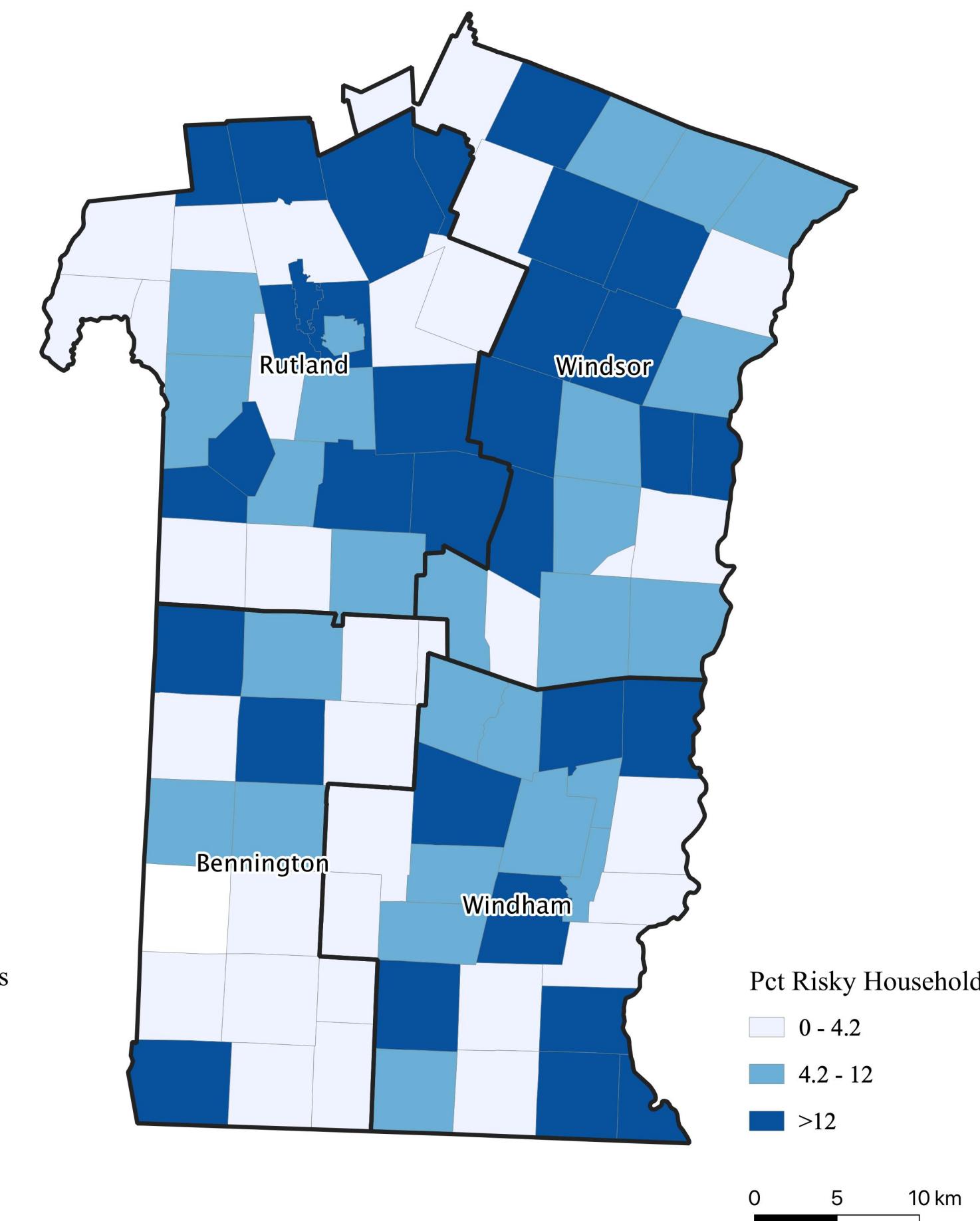
Figure two compares the percentage of mobile homes identified as risky in each town using ACS and e911 mobile home data and FEMA 100-year flood zone. The darker colored towns demonstrate a greater vulnerability of mobile homes to flood damage, which is greater in Windsor and Windham counties. Each method has identified certain towns to be riskier than the other method. Yet, method using e911 point data identifies substantially more towns to have higher percentage of risky mobile homes than ACS overall, which indicates that ACS has underestimated the flood risks.

Contrasting Mobile Home Representation Using ACS and e911 in Windham County
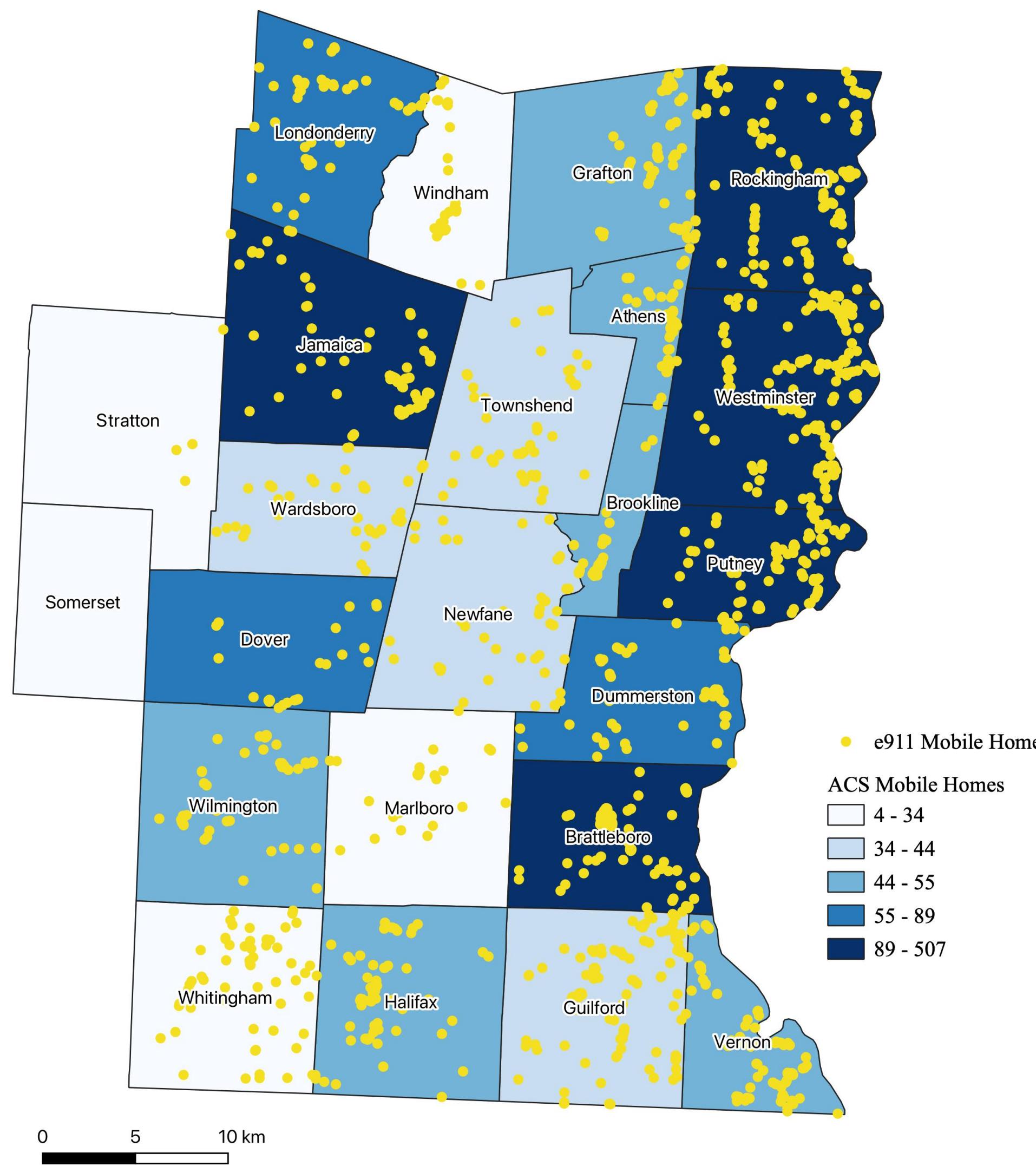

Figure three zooms into Windham county to contrast how ACS and e911 data have differed from each other in representing mobile homes. It can be seen that mobile homes are randomly distributed in each town while the analysis using ACS data assumed that mobile homes are evenly distributed across space, which generates inaccuracies. For instance, while ACS identifies the number of mobile homes in Whitingham town to be less than 34, e911 identifies far more than that. This suggests a limitation of using re-aggregated data: findings obtained from one set of areal units are not necessarily valid for areal units with different shapes. As such, e911 data is more accurate as it specifically pinpoints the location of the mobile home rather than averaging the data to fit into different statistical areas.

Figure four compares the flood zones outlined by FEMA and River Corridor Program at different elevations. Both analyses identified areas prone to flooding that are omitted by the other. It shows that FEMA identifies substantially more flood zones in low-lying areas while River Corridor identifies more flood zones in mountainous areas. In particular, River Corridor seems to be better at outlining smaller streams. Though FEMA has undermined smaller streams, it is more accurate in identifying flood zones in mountain valleys.

**Contrasting Mobile Homes at Risk, Classified by FEMA and Corridor Flood Zone**

Legend:
- Corridor Flood Zone
- FEMA Flood Zone

Mobile Homes
- River Corridor and FEMA
- FEMA Only
- River Corridor Only
- Non-Risky Homes
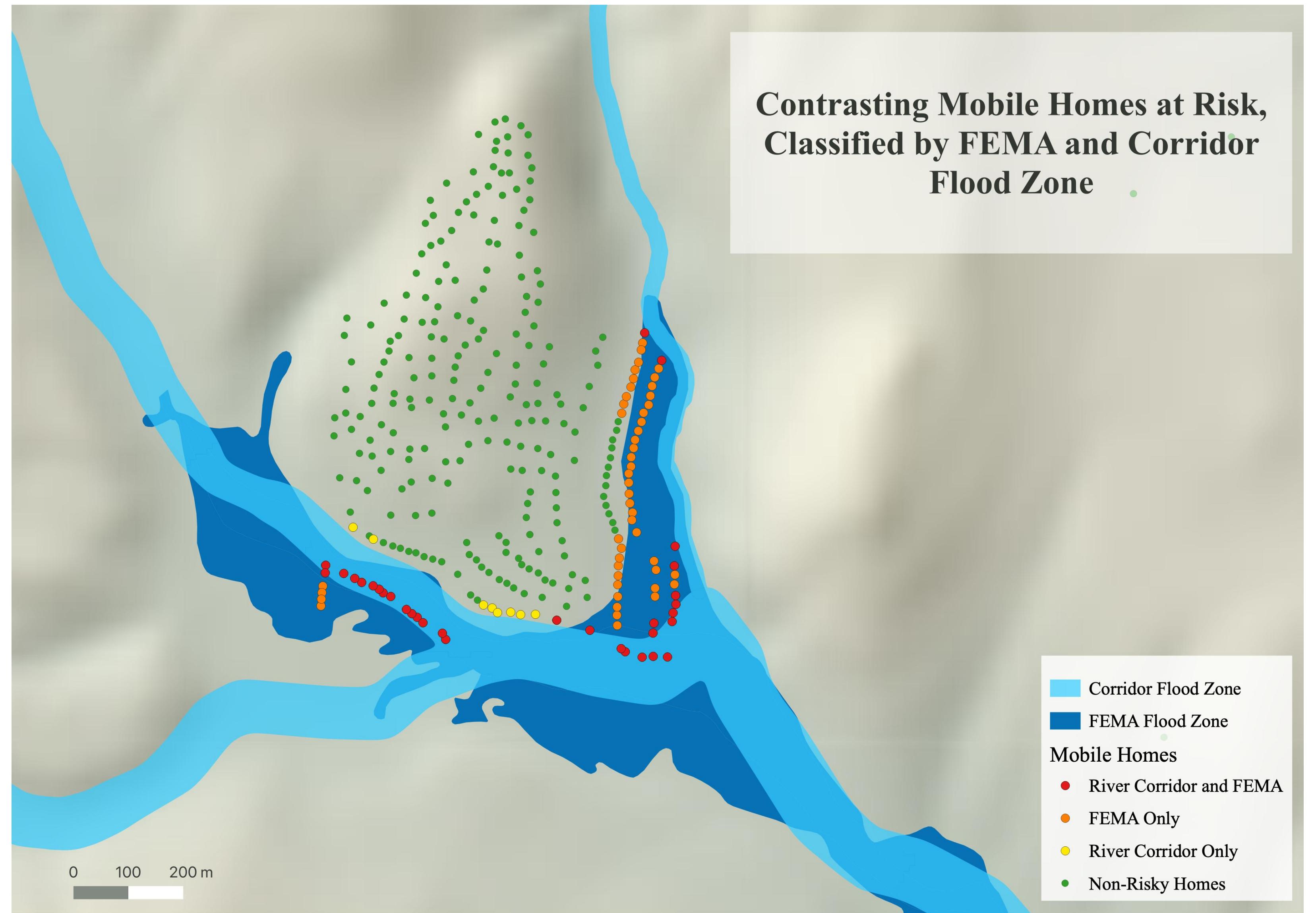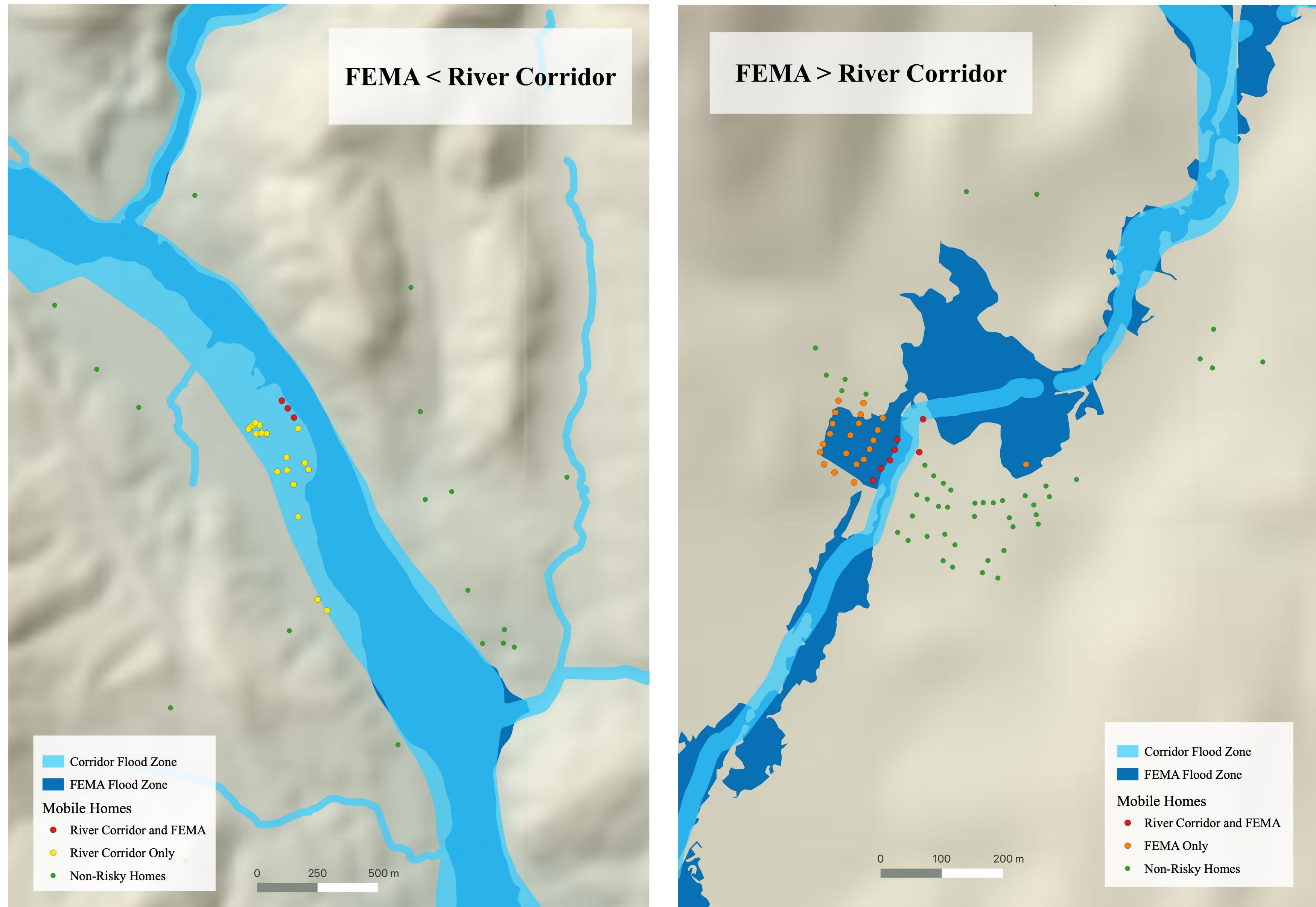
Figure five shows how the use of different methods could lead to different identification of risky mobile homes. In this particular map, FEMA identifies more risky mobile homes than River Corridor, but there are also a certain number of mobile homes omitted by FEMA but identified by River Corridor. This suggests that neither method is effective enough to be used alone in disaster management. In addition, this map reveals a limitation of current approach to risk identification. Since mobile houses are in close proximity to each other, if one mobile home were prone to flood risk, it is unlikely that other mobile houses nearby, though identified by neither FEMA nor River Corridor, would completely be unaffected by flood water.

Figure six projects southern Vermont on larger scale. It shows that there are places where FEMA identifies more mobile homes as well as places where River Corridors identifies more. As such, the best way to locate flood zones is to combine the FEMA and River Corridor methods and develop a more holistic analysis to evaluate the vulnerability of mobile houses.

FEMA < River Corridor

FEMA > River Corridor

Corridor Flood Zone
FEMA Flood Zone
Mobile Homes
● River Corridor and FEMA
● River Corridor Only
● Non-Risky Homes

Corridor Flood Zone
FEMA Flood Zone
Mobile Homes
● River Corridor and FEMA
● FEMA Only
● Non-Risky Homes
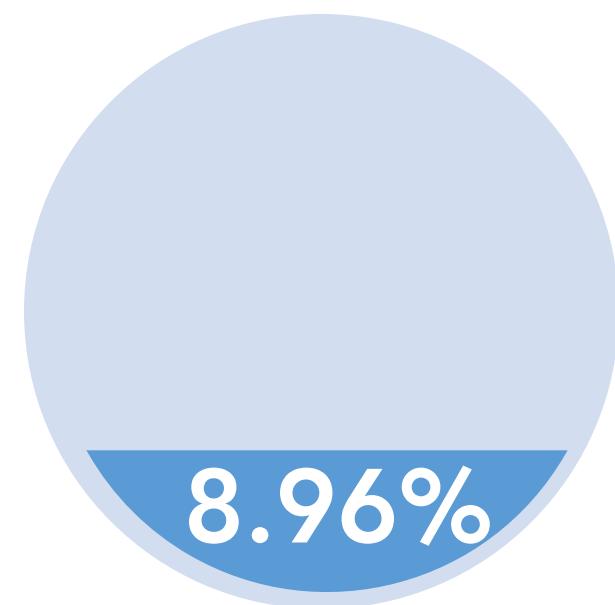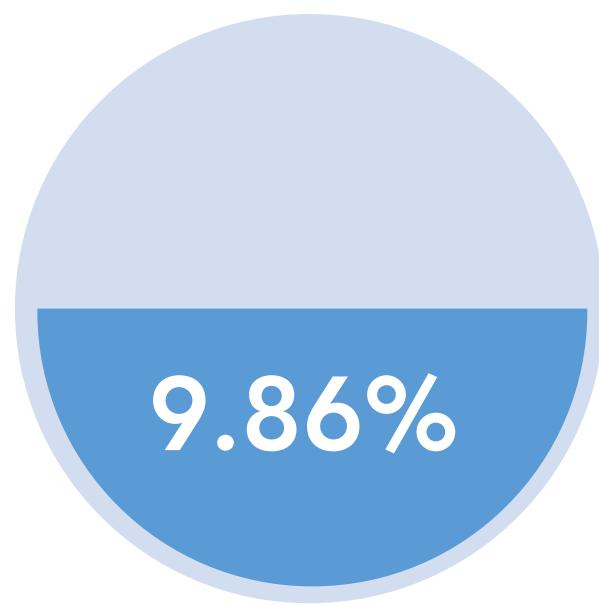
Figure seven: It is important to note that flood risks are not static but changes over time based on changing topography. Another limitation of both methods is that mobile houses located in close proximity to a wide meander should also be considered as risky, although they might not fall exactly into the flood zone. This is because river flows while carving away a curve in the riverbank. Over time, this curve become more pronounced due to continuous erosion and hydraulic actions. During flood season, when the amount of rainwater exceeds the threshold of riverbank, the wide meander is likely to be cut off, affecting mobile non-risky mobile houses along the riverbank, as exemplified by these two maps.
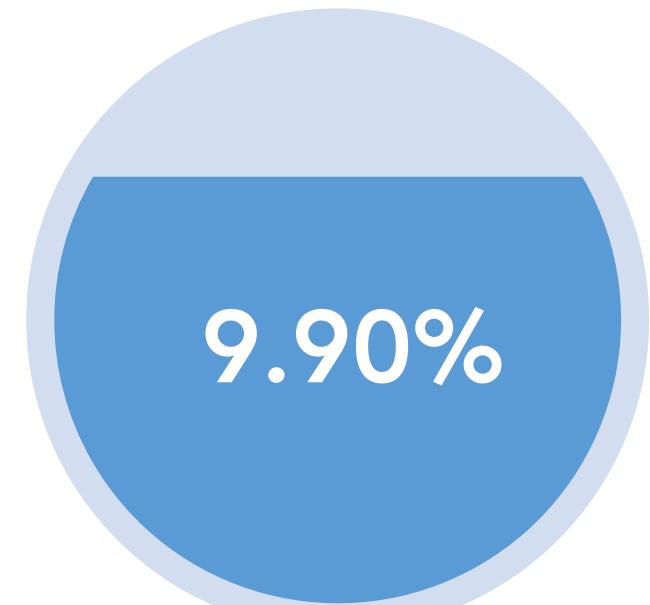
8.96%

Rutland

9.86%

Windsor

9.90%

Bennington

13.19%
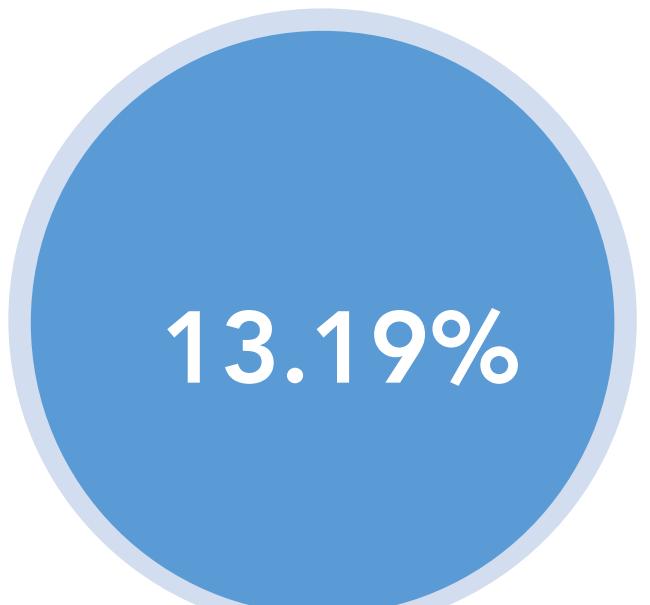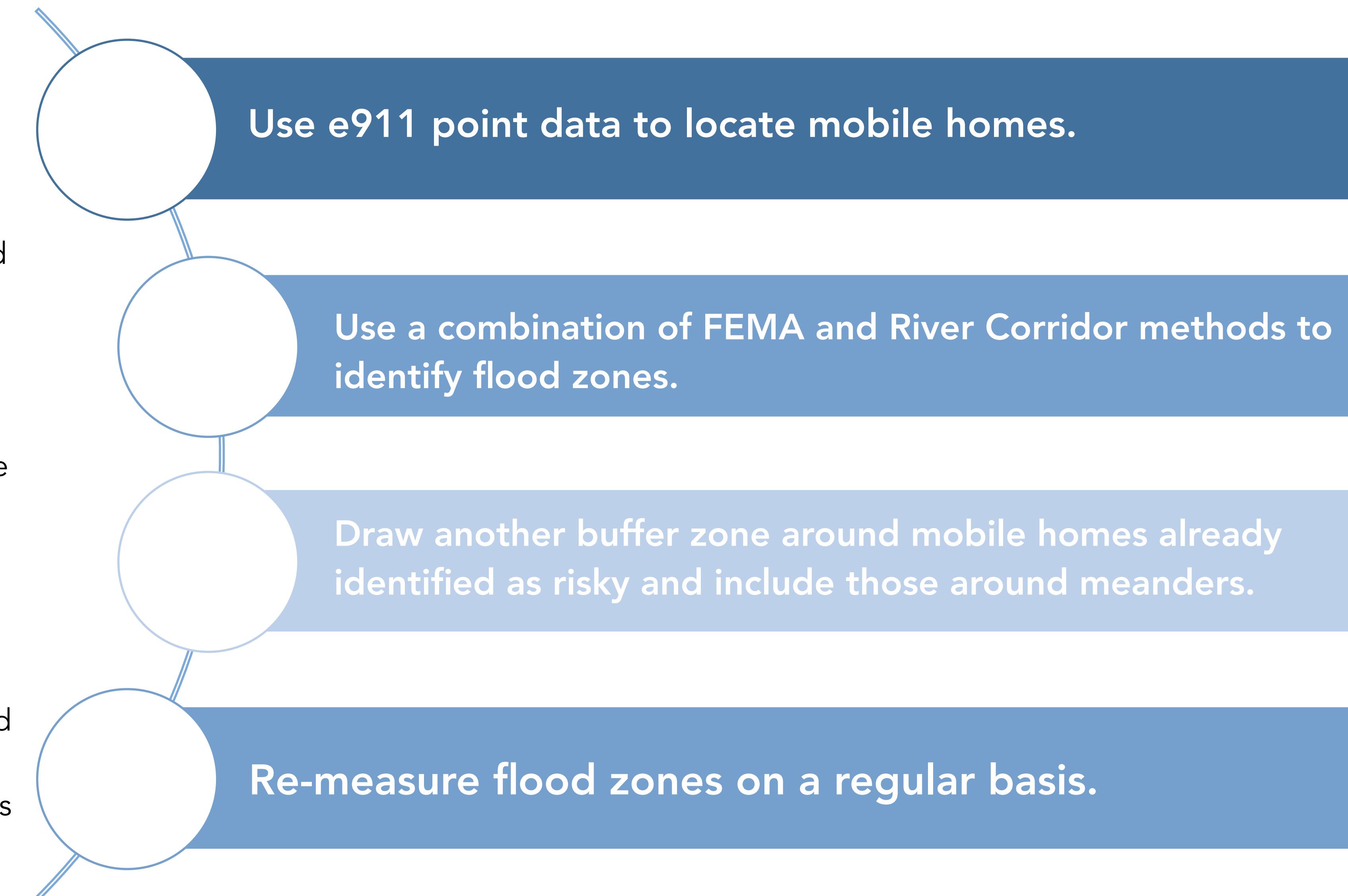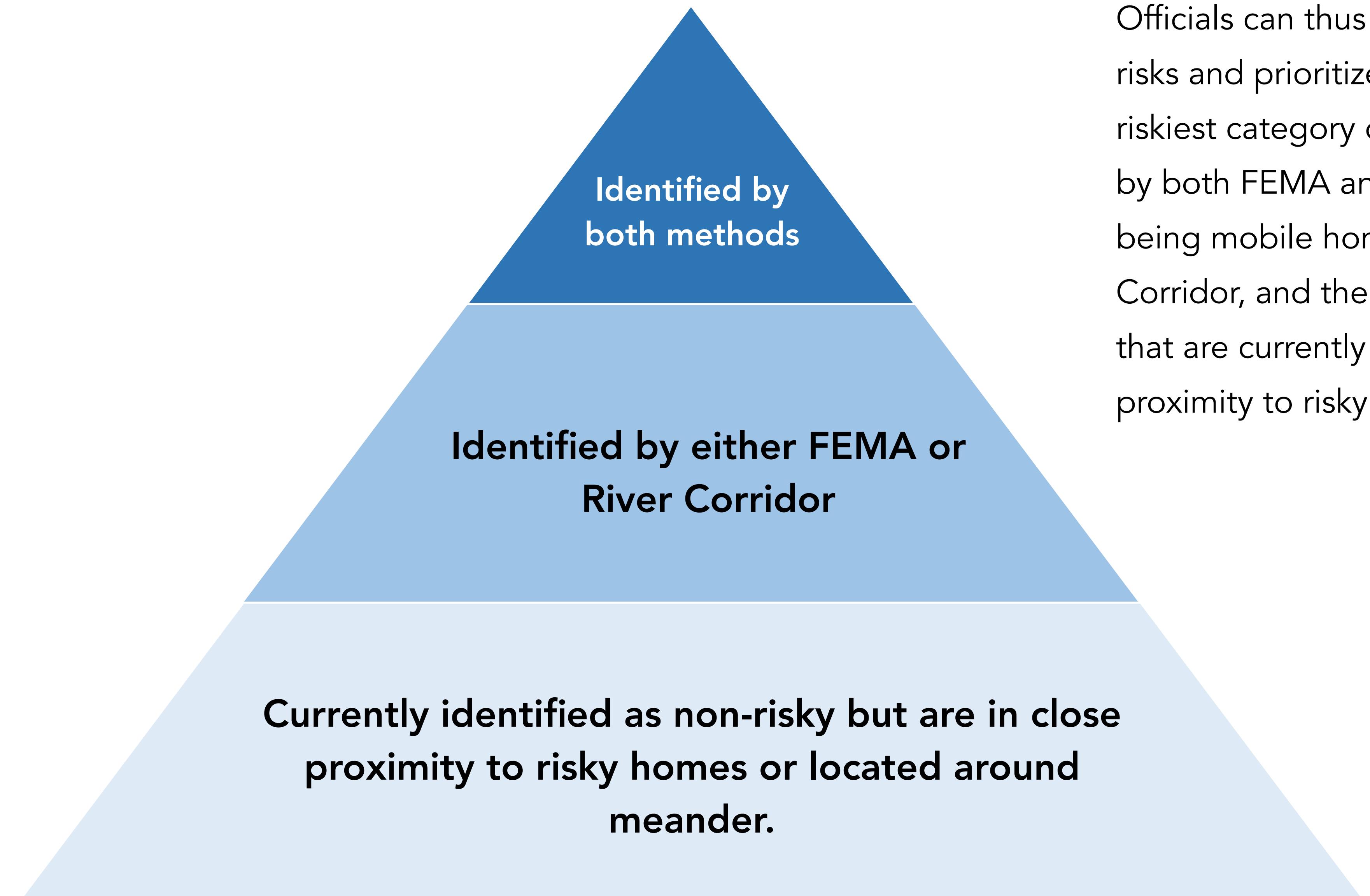
Windham

Vulnerability is higher in Windham and Windsor counties in Southern Vermont and lower in Bennington and Rutland counties. For Windham county in particular, as much as 13% of mobile homes are considered risky on average. This county should therefore be prioritized in reducing vulnerability and increasing preparedness to flood events.

To accurately identify mobile homes prone to flood risks, local officials should use e911 point data to locate mobile homes and a combination of FEMA and River Corridor methods to identify flood zones. This is because using re-aggregated ACS data would systematically underestimate flood risk and using FEMA or River Corridor method alone would either omit small streams at higher elevation or underestimate the flood zones in low-lying river valleys. On top of that, because mobile homes locate in proximity to each other, it is essential to draw another buffer zone around risky mobile homes and identify those mobile homes in their vicinity that are also likely to be affected. Further, it is also important for local officials to re-measure flood zones on a regular basis because of changing topography and be aware of the potential risks of mobile homes located around wide meanders.

Use e911 point data to locate mobile homes.

Use a combination of FEMA and River Corridor methods to identify flood zones.

Draw another buffer zone around mobile homes already identified as risky and include those around meanders.

Re-measure flood zones on a regular basis.

Identified by
both methods

Identified by either FEMA or
River Corridor

Currently identified as non-risky but are in close
proximity to risky homes or located around
meander.

Officials can thus develop a hierarchy to better classify risks and prioritize disaster reliefs: the first and the riskiest category of mobile homes being those identified by both FEMA and River Corridor, the second category being mobile homes identified by either FEMA or River Corridor, and the third category being mobile homes that are currently identified as non-risky but are in close proximity to risky homes or located around meanders.

Data Sources

E911 Data: Vermont Open GeoData Portal, https://geodata.vermont.gov/

Census Data: U.S. Census American Community Survey 2014-2018

FEMA Flood Zone: Vermont Open GeoData Portal, https://geodata.vermont.gov/

Vermont River Corridors: Vermont Open GeoData Portal, https://geodata.vermont.gov/

Small Streams: Vermont Open GeoData Portal, https://geodata.vermont.gov/

Towns Data: U.S. Census American Community Survey 2014-2018