



Example of DFIRM map

### Introduction and Problem Explanation

In a broad sense, our macro-problem is the decoupling of the societal and economic systems which create the human built environment from the natural environment/ecosystem. We will examine the repercussions of this decoupling from the lens of the National Flood Insurance Program (NFIP) in Vermont and the growing pressures on the human-built environment due to climate change. The NFIP represents an attempt by the federal government to correct what it sees to be a major market failure to provide flood insurance. In a sense, the government seeking to provide insurance decouples the human-built environment from the ecosystem by ignoring the inherent risk of living in a floodplain. This creates an implicit subsidy for people to build structures in a place which is riskier than other areas by providing a safety net for homeowners to fall back on when their structures are damaged.

In response to massive flood damages caused by Hurricane Betsy in 1965, which illuminated the issue of the lack of private flood insurance being provided to residents of floodplains, the federal government created a program which sought to correct this supposed market failure - the National Flood Insurance Program (Michel-Kerjan 2010). The NFIP can regulate Vermont's floodplains through land use controls, building requirements, and elevation requirements that communities which are located in Special Flood Hazard Areas (SFHA) have to adopt and enforce for their residents to be eligible for government-provided flood insurance (King 2013). The NFIP assesses the risk of flooding in a community and then creates a flood map for the community which designates various flood risk zones (Michel-Kerjan 2010). Areas that are located in a 100-year floodplain (areas with an annual 1 percent chance of flooding) are designated as SFHAs. These risks are then communicated to property owners and the private insurance agents which distribute NFIP policies through the flood maps.

Climate change will degrade the human-built environment in Vermont and around the United States like never before. Climate modeling projects increasing flood events around the United States due to increased precipitation and recent trends in Vermont reflect these projections through recorded streamflow increase, earlier winter thaw date projections, and a higher percentage of precipitation falling as rain rather than snow (Betts 2011). Due to the fact that nearly 90% of Vermont's 251 municipalities currently participate in the NFIP and approximately 17% have adopted regulations that protect river corridors or floodplains, the NFIP could be used as a tool to increase the resiliency of communities in the face of increased flood risks due to climate change (Institute for Sustainable Communities 2013). Because communities are the ones that participate in the NFIP, there is a greater chance that more resilient floodplain regulations can be adopted without the often cumbersome process of obtaining legislation from the state legislature. In fact, many communities have not only adopted NFIP regulations but have gone a step further by creating new fluvial erosion hazard zones (Waitsfield Town Plan 2012). Just by getting communities to think about flood risk can often change their willingness to accept greater regulations.

Although there are many reasons to be hopeful for the NFIP being used as a tool for increasing the resiliency of Vermont's municipalities, there are myriad issues with the operation of the NFIP in Vermont and nationally. Although much could be said about the lack of financial solvency of the program, the most pressing issue with regards to Vermont is that in order to make the program financially solvent, insurance premium rates will likely have to be raised in the future. This may lead to even greater lack of participation in the program. Congress already tried to raise premium rates through the Biggert-Waters Act of 2012, but much of the rate increases were delayed or cut out of the bill in the face of public backlash (Flood Insurance Reform Act of 2012).

Individual participation in the program in Vermont is also astoundingly low. The Vermont Division of Emergency Management and Homeland Security reports that only 2% to 3% of property owners in the state have flood insurance (Edwards 2013). FEMA reports that, as of April 30<sup>th</sup> 2013, there were 4,504 flood policies in Vermont, 2,808 of which belonged to policyholders located in high-risk areas (Edwards 2013). After a flood in August 1998 that caused considerable damage in northern Vermont, FEMA found that 84% of the homeowners in flood-prone areas did not have insurance despite 45% of the owners falling under the relevant criteria for mandatory flood insurance (Michel-Kerjan, Lemoyne de Forges, Kunreuther 2012). People may also opt not to buy flood insurance because they expect FEMA to provide disaster assistance if flooding occurs. Given recent history, this is a reasonable expectation. The lack of participation limits the effectiveness of the NFIP as a policy tool to increase resilience.

There are also many issues with the current NFIP flood maps. The most pressing one being that the current flood maps for Vermont were created in the 1980's and do not reflect the current flood risks faced by many communities. The Biggert-Waters Act appropriated funding for the remapping of many areas of the country, including Vermont, and so this should be resolved relatively soon. This will likely cause even more Vermonters to be subject to mandatory flood insurance and eligible for flood insurance (Lindholm & Van Wing 2013). Another large issue with the current flood maps is that the NFIP focused mostly on inundation risk. This does not capture all of the flood risk from living in a floodplain in Vermont because rivers in Vermont can shift their course by large distances in short periods of time (called fluvial erosion) during high precipitation events, as happened recently during Hurricane Irene. The increased risk of fluvial erosion in Vermont is caused by the previous channeling of rivers, which forces the water running through the river into high velocity sections and increases the pressure on riverbanks. Equity issues with the NFIP in Vermont are varied. Often times the people living in floodplains, especially in Vermont, are of lower economic status, such as people who own mobile homes. This creates an unjust situation when the people who were initially subsidized to live in a floodplain through the NFIP have to pay increasing premiums. In contrast to this, many homes in floodplains are secondary homes of out-of-staters. These people are most likely more than wealthy enough to pay increased premiums. These insights suggest that an income-sensitive premium rate increase would be least painful to those that are less economically well-off.

# Climate Change Adaptation in Vermont: The National Flood Insurance Program and FEH Zones

### Summary

This poster represents the culmination of two years of research, thinking, and insights gained by UVM undergraduates Danny Baker and Justin Barton on the problems and potential solutions with climate change adaptation in Vermont concerning flooding. To the right is an editorial which we published using simple language to describe the problems and some potential solutions to increased flood risk in Vermont.

Problems:

- Flooding is expected to increase in frequency and intensity due to climate change in Vermont. This puts strain on the built infrastructure, ecologic systems, etc., in Vermont.
- The NFIP has the authority to regulate floodplains in Vermont and could be used as a tool for increasing the flood resiliency of Vermont's communities but there are many existing problems with its current implementation and set up including: outdated flood maps which do not reflect current or future flood risk; lack of participation in the program due to high premium rates and lax compliance with the flood insurance requirement for properties with federally-backed mortgages; the program is not financially solvent and is in debt to the U.S. Treasury (this problem is expected to get worse with increasing flood damage claims due to climate change and growing population).
- Vermont faces a somewhat unique problem in that many of its rivers are prone to fluvial erosion (where a river changes course) during periods of intense rainfall – a risk which is expected to increase as time goes on.

Potential solutions:

- Reforming the NFIP with the implementation of Community-based Flood Insurance (CBFI) policies where municipalities must purchase long term, actuarially sound contracts (5, 10, 20 years) reflecting the risk of all properties across a community's SFHA (FEMA NFIP Reform 2011). The municipality or county government would be required to purchase a broad insurance policy for all structures identified in the FIRM, including private homes and businesses, infrastructure, and government buildings. Rather than the current system of annual, individual homeowner policies, varying payments would be collected through property and/or building taxes enforced at the local level.
- The fluvial erosion problem is already being addressed to some extent by the state of Vermont through the Agency of Natural Resource's support for the development of fluvial erosion hazard zones. NFIP hazard regulations have not provided sufficient protection against flooding in Vermont because the regulations only take into account inundation flooding (rivers rising above their banks, similar to a bathtub overflowing). FEH zones fixes the problem by taking into account fluvial erosion and prevents damage due to fluvial erosion by restricting new development in these zones, while only allowing for conditional use review (Vermont River Management Program 2008). We propose that the state should pass a law requiring all towns in Vermont to develop fluvial erosion hazard zones in conjunction with their regional planning commissions.

### Appendix

Rawle O. King. (2013) The National Flood Insurance Program: Status and Remaining Issues for Congress. Congressional Research Service. Retrieved from <http://www.fas.org/sgp/crs/misc/R42850.pdf>

Erwann O. Michel-Kerjan (2010) Catastrophe Economics: The National Flood Insurance Program. The Journal of Economic Perspectives, Vol. 24, No. 4, pp. 165-186 Retrieved from American Economic Association Article <http://www.jstor.org/stable/20799178>

Institute for Sustainable Communities (2013). Taking Stock of Vermont's Resilience: Preparing for Natural Disasters and the Effects of Climate Change in the Green Mountain State. Report for Resilient Vermont Project. <http://resilientvt.files.wordpress.com/2013/02/taking-stock-of-vermonts-resilience.pdf>

Waitsfield. Town Plan (2012). Joshua Schwartz.

Warren. Town Plan (2010). Joshua Schwartz.

Fayston. Town Plan (2008). Joshua Schwartz.

Charles M Nyce, "Into harm's way: The relationship between homeowners' insurance premiums, property values, and natural hazards" (January 1, 1999). Dissertations available from ProQuest. Paper AA19953577. <http://repository.upenn.edu/dissertations/AA19953577>

J. Lindholm and S. Van Wing (2013, November 4th). Flood Insurance Rising. Vermont Public Radio. Retrieved from digital.vpr.net

(2014). Flood Insurance Reform Act of 2012. Federal Emergency Management Agency, Retrieved from [www.fema.gov](http://www.fema.gov)

(2013). Vermonter Flood Insurance Forum. Retrieved from [www.facebook.com](http://www.facebook.com)

Simpson, A. (2014, March 4). House passes flood insurance bill; key senators sign on. Insurance Journal. Retrieved from <http://www.insurancejournal.com/news/national/2014/03/04/322194.htm>

Mark J. Browne, Robert E. Hoyt. (2000) The Demand for Flood Insurance: Empirical Evidence. Journal of Risk and Uncertainty, Vol 20, Issues 3, pp 291-306 <http://sfx.uvm.edu/UVM/?sid=google&auinit=MJ&aulast=Browne&atitle=The+demand+for+flood+insurance+empirical+evidence&doi=10.1023/A:1007823631497&title=Journal+of+Risk+and+Uncertainty&volume=20&issue=3&date=2000&spage=291&issn=0895-5646>

James M. Holway, & Raymond J. Burby (1990). The Effects of Floodplain Development Controls on Residential Land Values. University of Wisconsin Press Land Economics, Vol. 66, No. 3, pp 259-271. Retrieved from <http://www.jstor.org/stable/pdfplus/3146728.pdf?acceptTC=true>

Bruce Edwards (2013) Flood Insurance Rates Will Soar For Many. The Barre Montpelier Times Argus. Retrieved from <http://www.timesargus.com/article/20130701/THISJUSTIN/71102987>

Erwann Michel-Kerjan, Sabine Lemoyne de Forges, & Howard Kunreuther. (2012). Policy tenure under the u.s. national flood insurance program. *Risk Analysis*, Vol. 32, pp 644-658. Retrieved from [http://opim.wharton.upenn.edu/risk/library/2012RA\\_PolicyTenureNFIP\\_EMK.pdf](http://opim.wharton.upenn.edu/risk/library/2012RA_PolicyTenureNFIP_EMK.pdf)

Roger A. Pielke, JR. (1999) Nine Fallacies of Floods. *Climatic Change*, Vol 42, pp 413-438. Retrieved from [http://sciencepolicy.colorado.edu/admin/publication\\_files/resource-78-1999-15.pdf](http://sciencepolicy.colorado.edu/admin/publication_files/resource-78-1999-15.pdf)



Editorial published in Rutland Herald

Most Vermonters do not need to be reminded of the horrible destruction that followed in the wake of Tropical Storm Irene. The storm caused untold damage to roadways, property and, most importantly, people. It left many Vermonters wondering what could be done to keep a tragedy of Irene's magnitude from happening again. The good news is that a number of efforts are already underway to increase the resiliency of Vermont's communities when it comes to flooding. Flooding in Vermont is different than in many other places around the country. In many places, the biggest worry is inundation flooding, where the river rises over its banks — similar to a bathtub overflowing with water. This happens in Vermont, but another type of flooding affects many communities here: fluvial erosion. This occurs when a river changes its course during a storm or high-precipitation event. Fluvial erosion caused much of the damage to roads and many houses during Tropical Storm Irene. Because the Federal Emergency Management Agency does not consider this type of flooding when it maps flood risk, development was allowed in areas with a high risk of fluvial erosion flooding but a low risk of inundation flooding. To address this problem, Waterbury and other towns in central Vermont are adopting new zoning regulations called fluvial erosion hazard zones. The zones restrict future development and will help to ensure that more buildings aren't built in areas where fluvial erosion might be a problem. We propose that the state should require towns with a history of fluvial erosion flooding to develop this type of zoning, and to provide resources to those towns. Critics will say that restricting development in these areas puts a damper on the economic development of a town. But these people need to face the reality that putting buildings in areas where they are likely to get damaged or destroyed is, plain and simple, not smart. Although fluvial erosion hazard zones are moving in the right direction by restricting further development in floodplains, these zones fail to address buildings that are already at a high risk for flooding. A small number of properties in floodplains have been repeatedly flooded. Rebuilding these homes and buildings (with money provided by FEMA), is not an efficient use of taxpayer money. Instead, we believe that a FEMA program called the Hazard Mitigation Grant Program, in which Waterbury is currently participating, offers hope for homeowners whose properties were seriously damaged during flooding and who want to sell their properties to the government for pre-flood market value. FEMA demolishes these buildings and mandates that the property be allowed to return to the floodplain. The state should provide funds for towns that want to join this program. This will help taxpayer money be used more effectively by reducing the money used to rebuild after a flood. It will also lower overall inundation flood risk for other properties by reducing the number of buildings in the floodplain. Together, these two policies of developing fluvial erosion hazard zones and promoting greater participation in the Hazard Mitigation Grant Program provide realistic ways for Vermont's communities to increase their resilience to flooding and prepare for the next Irene. Flooding is likely to happen in the future, but the time to act is now.



Flooding Damage During Hurricane Irene  
Image Source: VT Agency of Natural Resources



Irene damage & aftermath. Photo: Jeff Knight @jkw

### Biggert Waters Flood Insurance Reform Act of 2012

The NFIP does not operate under traditional insurance industry practices of fiscal solvency that require the insurer to have a mandatory amount of reserves as a condition of their authorization to sell insurance in a given state. Instead, it's budget is connected to FEMA's and in turn the federal government. Due to the program's mounting debt and rather challenging future regarding projected climate change impacts, the Obama administration passed the Biggert Waters Flood Insurance Reform Act of 2012 on July 6, 2012<sup>9</sup>. Among various provisions, Biggert Waters aims to address the program's debt issues by phasing in a series of premium rate increases over the next few years, 25% a year or so<sup>8</sup>. The phase ins do not extend to certain situations such as second homes or if remapping takes place, in which case the program is accelerated and bills have to be paid up front. Biggert Waters will eliminate subsidies which kept premiums artificially low but affordable<sup>9</sup>. It is expected that aggressive remapping will subject more Vermonters to mandatory flood insurance<sup>8</sup>. In Vermont NFIP premiums, although they are determined on an individual basis, were \$100 to \$300 in low risk areas and about \$600 or \$700, even \$1000 depending on location, in high risk areas<sup>8</sup>. For Vermont Biggert Waters, attempting to reflect actual risk in its rates, means rates are climbing to the \$5000 to \$15000 range<sup>8</sup>.

Biggert Waters has been met with substantial opposition from concerned homeowners across the country and the Congressmen and Senators that represent them and as a result has been delayed from its October 1<sup>st</sup>, 2013 start date. Vermonters (and concerned homeowners around the country) fearfully point to the devastating economic affects caused by the phase in of substantially higher actual risk rates as well as the potential for these increases to be pass phase ins and immediately take place upon sale of a home, a lapse in a policy, new construction, or a new flood<sup>10</sup>. Homeowner and constituent concerns in Vermont focus primarily on the law's potentially devastating affects on property values of flood plain properties and the financial hardship and mortgage defaults the resident homeowners would face<sup>10</sup>. In response to these concerns, the Senate passed the Homeowner Flood Insurance Affordability Act in January and the House subsequently passed an updated version called the Grimm-Waters bill which is expected to be accepted in the Senate. The bills aim to address the concerns of homeowners by preventing FEMA from raising the average rates above 15% for a class of properties and from raising rates on individual policies as a whole above 18% per year<sup>11</sup>. The bills also remove the immediate rate increase triggers (by-passing phase ins) due to the sale of a home, a lapse in a policy, new construction, or a new flood map<sup>11</sup>. Additionally, the bills reinstate grandfathering (which the previous Biggert-Waters Act removed), refunds homeowners who overpaid, and requires FEMA to minimize the number of policies with annual premiums that exceed one percent of the total coverage provided by the policy<sup>1</sup>. We believe that this is an important illustration of the difficulty of passing flood insurance reform legislation

Authors: Daniel Baker and Justin Barton  
Funding provided by NSF Grant EPS-1101317