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Changing Flood Risk in the Lamprey River Watershed: Raymond

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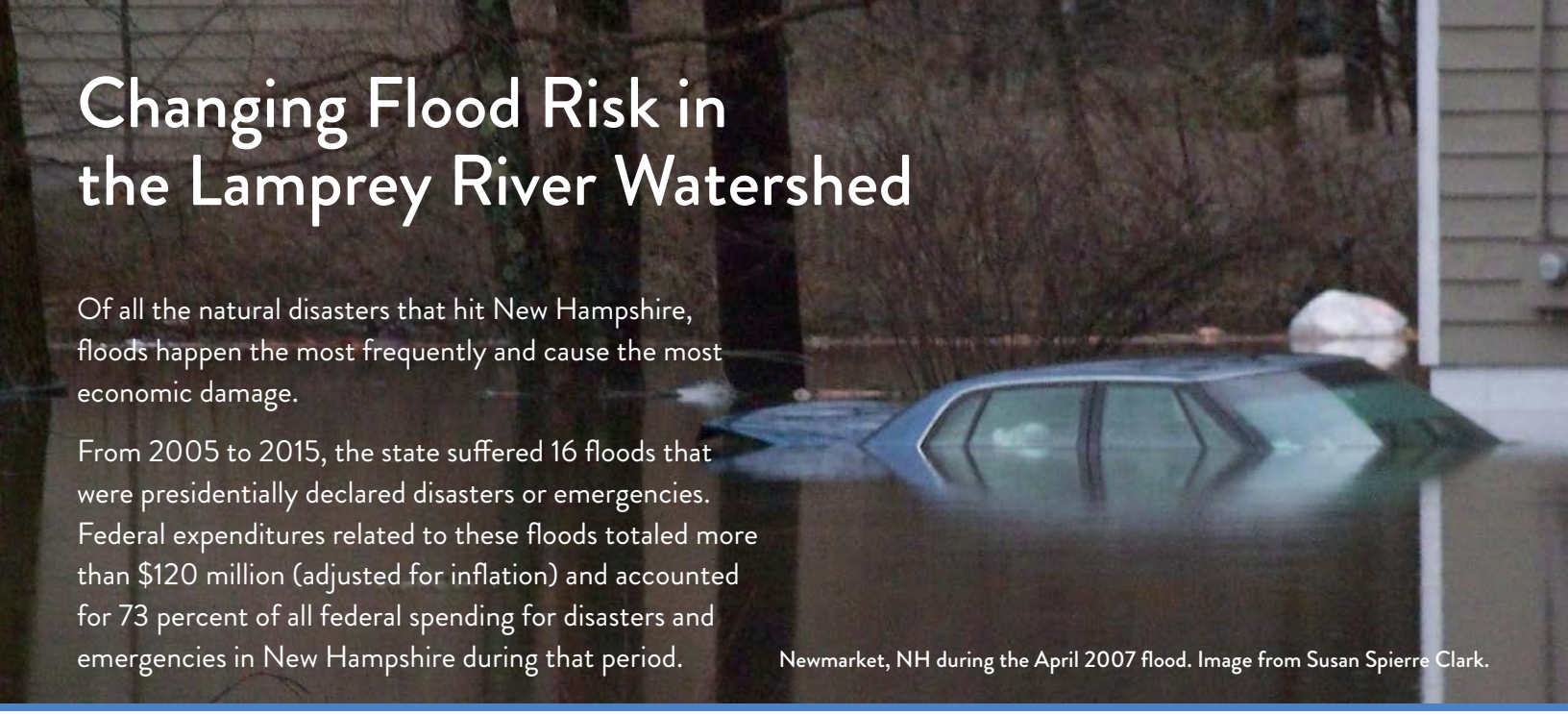
Of all the natural disasters that hit New Hampshire, floods happen the most frequently and cause the most economic damage.

From 2005 to 2015, the state suffered 16 floods that were presidentially declared disasters or emergencies. Federal expenditures related to these floods totaled more than $120 million (adjusted for inflation) and accounted for 73 percent of all federal spending for disasters and emergencies in New Hampshire during that period.



Newmarket, NH during the April 2007 flood. Image from Susan Spierre Clark.

1 Have destructive floods in Lamprey River communities increased over the past two or three decades?

Yes. The five largest floods recorded along the Lamprey River have all occurred since 1987, three of the five since 2006. (*Figure 1*).

2 Will destructive floods along the Lamprey River increase in the future?

Floods along the Lamprey will **very likely** be bigger and more common for two reasons. One: Extreme precipitation events resulting from global climate change are projected to become more frequent. Two: Continued development will increase the area of paved and hardened surfaces that prevent rain and snowmelt from soaking into the ground and force it to run off into rivers and streams instead. The peak discharge at Packers Falls during a 1 percent annual chance flood could increase over 60 percent by 2050 if current trends in land development and emissions of heat-trapping greenhouse gases continue. The area covered by flood waters could expand by 10 percent to 17 percent (*Figure 2*). And the 10 miles of road covered by more than 6 inches of water in 2005's 1 percent annual chance flood could increase to 15 miles in 2050.

3 How will economic damage from floods change in the future?

Damage is **likely to increase** as floods become bigger and more frequent.[1] The maps in Figures 3 and 4 show the estimated replacement value of buildings and their contents damaged by the 1 percent annual chance flood in Raymond during 2005 and 2050. (These estimates come from the Federal Emergency Management Agency [FEMA] Hazus model, which estimates flood damage based on base-flood elevation and building type.) Damages associated with a 1 percent annual chance flood in five Lamprey River communities are expected to increase by 33 percent, from $164 million in 2005 to $219 million in 2050. Approximately 40 percent of the damage occurs in Raymond.

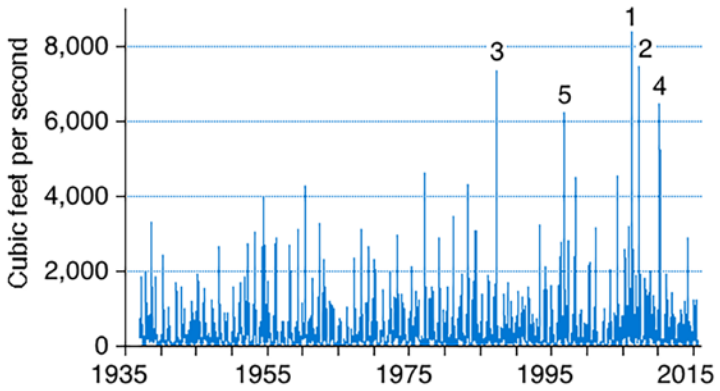


Figure 1. *Daily peak discharge measured on the Lamprey River at Packers Falls. The five largest flood events were: 1) May 2006, 2) April 2007, 3) April 1987, 4) March 2010, 5) October 1996.*

Town	Flooded Area (sq. mi.)		Percent Increase
	2005	2050	
Raymond	1.5	1.7	10%
Epping	1.5	1.7	14%
Lee	1.2	1.5	17%
Newmarket	1.1	1.2	13%
Durham	0.9	1.0	11%
TOTAL	**6.2**	**7.0**	**13%**

Figure 2. *Comparison of current and potential future 1 % annual chance floodplain.*

[1] Economic impacts data from: Geosyntec Consultants (2016) Analysis of flood damage cost avoidance in the Lamprey River watershed of New Hampshire. Available at http://100yearfloods.org.

Raymond NH during the April 2007 flood. Image from Jennifer Gilbert.

Why are these estimated damages so much larger than the federal payouts associated with presidentially declared disasters or emergencies? There are several reasons:

- Insured losses — private or National Flood Insurance Program (NFIP) — are NOT reported as part of federal disaster related expenditures.
- Without NFIP, the maximum disaster-related FEMA payout for an individual household is $34,000 (for 2017). Rarely does any household get the maximum amount.
- FEMA reimbursements are much less than the total property damage and much less than the unreimbursed losses. Disaster assistance is not meant to make property owners "whole."
- Business losses are not covered by federal disaster programs.

4 How can municipalities along the Lamprey River be more resilient when it comes to floods?

Many community leaders who work on flooding issues in the Lamprey River watershed accurately recognize that flood risk has increased over the recent past and are concerned about future flooding in their communities. They expect municipal officials, regional planners, state agencies, engineers, and developers to use up-to-date floodplain maps and analyses to better understand flood risk and impacts.[1] Municipal officials do have the legal authority to act and are best prepared when they use sound planning techniques and state their rationale for managing development in flood-prone areas.[2]

Here's what community leaders within the Lamprey River watershed said:

"In our town, even post severe flooding episodes, it was difficult to communicate the necessity to take long-term preventative action. As soon as the disaster is over, people forget and do not want to make the investment to, for example, conserve floodplain land."

"There should be a significant effort put forth to prevent new construction within the newly defined floodplains."

"[Economic information should be used] to justify more generous setbacks and stricter zoning laws. The regulations are set by people who need to understand the cost that inaction will incur."

[1] Results from an October 2016 online survey completed by 35 community leaders who work on flooding issues in the Lamprey River watershed.

[2] Vermont Law School. New Floodplain Maps for a Coastal New Hampshire Watershed and Questions of Legal Authority, Measures and Consequences. (2012). Available through http://100yearfloods.org.

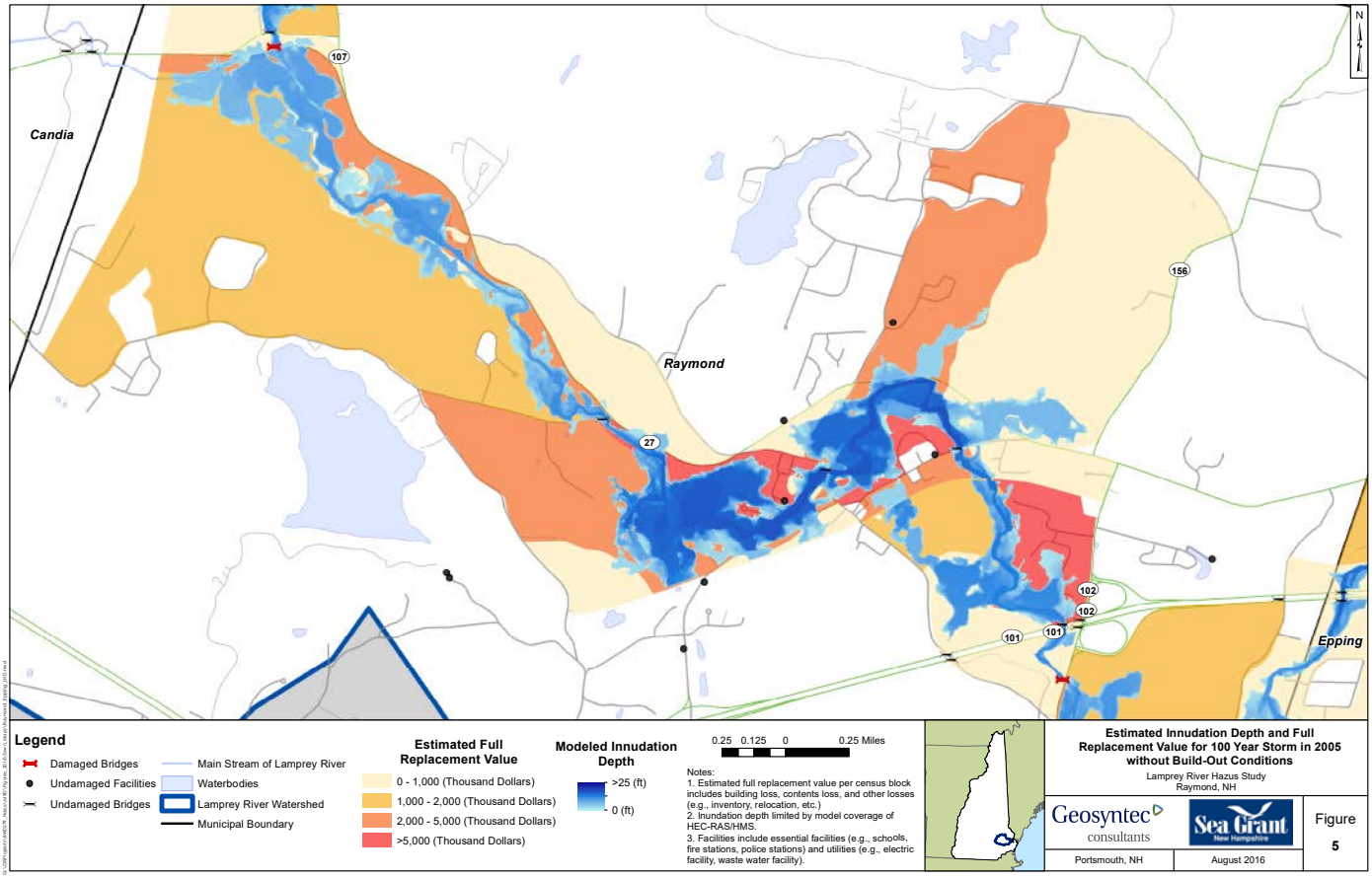


Figure 3. *Estimated damage associated with the 1 percent annual chance flood in Raymond in 2005. The orange to red colors represent estimates of full replacement value in thousands of dollars. Figure from Geosyntec Consultants 2016 Report. Available at* http://100yearfloods.org

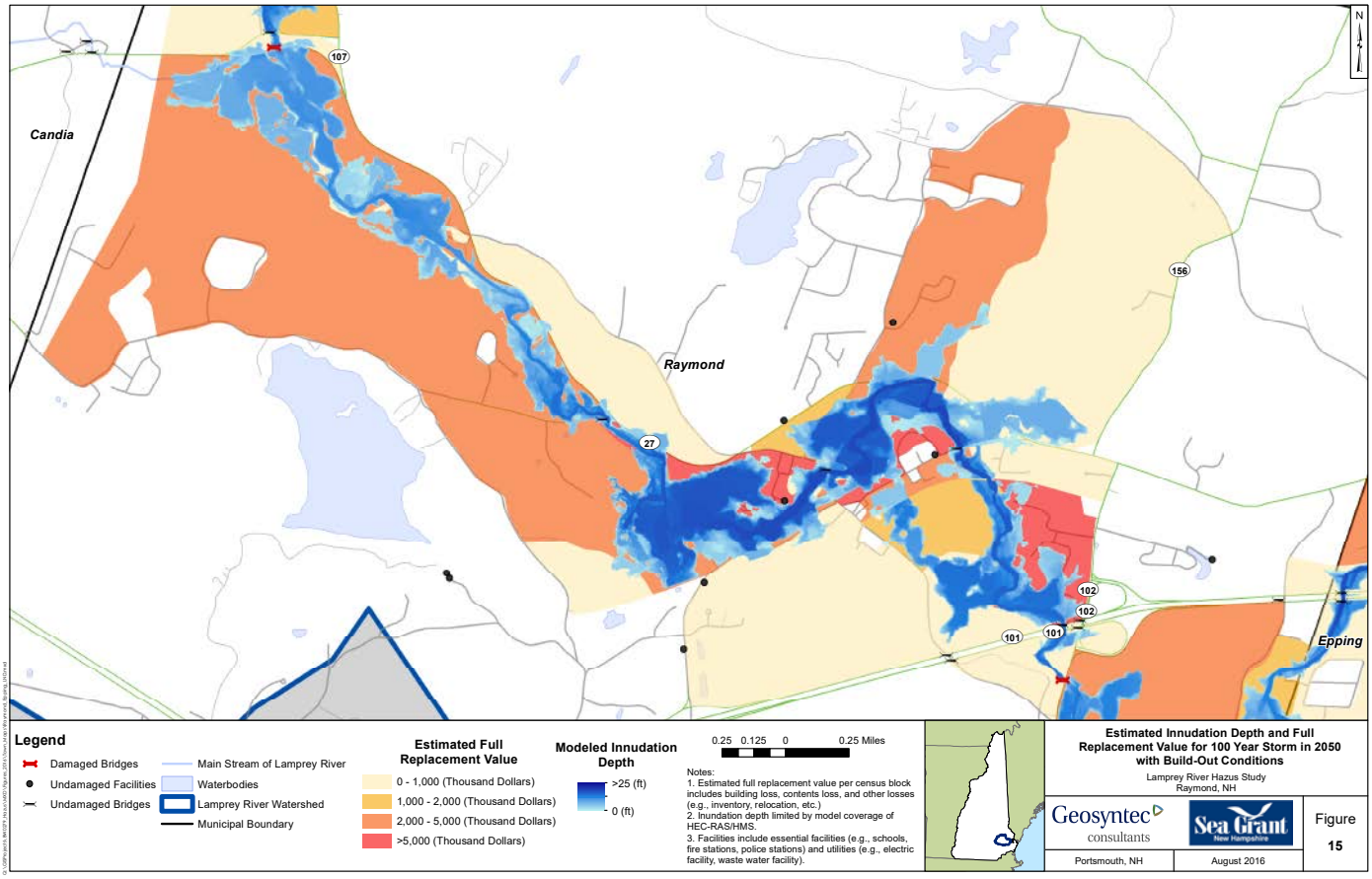


Figure 4. *Estimated damage associated with the 1 percent annual chance flood in Raymond in 2050. The orange to red colors represent estimates of full replacement value in thousands of dollars. Figure from Geosyntec Consultants 2016 Report. Available at* http://100yearfloods.org

Each town along the river faces different flood risks and has different priorities.

The following steps outline an approach that municipal leaders can take based on their risks, priorities, time-frames, and budgets in order to protect human health, property, and local economies.

1 Recognize that the risk of floods may be changing for your community

- Review historical records and explore local knowledge
- Review FEMA flood insurance rate maps (FIRM) http://msc.fema.gov/portal
- Review UNH Lamprey flood risk maps and Hazus results http://100yearfloods.org

2 Assemble the human, technical, and financial resources needed to act

- Gain knowledge and information; participate in trainings; host public outreach events
- Identify community champions and partners
- Explore what other NH communities are doing to reduce flood risk www.nh.gov/osi/planning/programs/fmp/documents/communities-enforcing-nfip.pdf
- Locate relevant grants, bond measures, and municipal budget options

3 Plan

- Acknowledge a changing climate, its effects, and uncertainty in Town Master Plans
- Include current and projected flooding impacts in Hazard Mitigation Plans
- Use conservation plans to identify critical areas that provide important benefits to society, such as flood storage
- Use municipal asset management and capital improvement plans to prepare financially

The 1% annual chance flood[3]

The "100-year flood" is confusing because it leads people to believe that it only happens once every 100 years. The term "100-year flood" is sometimes used to simplify the definition of a flood that statistically has a 1% chance (or 1-in-100 chance) of occurring in any given year. The technical term used by hydrologists for this extreme hydrologic event is the 1% annual chance flood and is based on the probability that the given event will be equaled or exceeded in any given year.

The 1% annual chance flood is calculated for a single year. However, one might be interested to know the probability of the 1% annual chance flood over a longer time period – say the 30-year lifetime of a standard mortgage on an individual property. The probability of 1% annual chance flood occurring over a 30-year period is 26%![4]

4 Implement

- Use non-regulatory tools such as floodplain property buyouts and easements to establish no-build areas
- Develop and use regulatory tools such as zoning, freeboard requirements, and development setbacks; redirect development to lower risk areas; create floodplain overlay districts; and proactively manage stormwater
- Allow "No Adverse Impact" principles to guide regulations www.floods.org/index.asp?menuID=460
- Design infrastructure projects such as replacing or upgrading culverts and elevating, fortifying, or moving critical, at-risk facilities to accommodate current and future flood risk
- Support natural resource conservation projects such as maintaining and restoring vegetative buffers conserving land, and living shorelines

Is your community looking for help with any of the steps outlined above?

If so, contact the **NH Coastal Adaptation Workgroup** (www.nhcaw.org), your local planner, Rockingham Planning Commission (www.rpc-nh.org), Strafford Regional Planning Commission (www.strafford.org), or **NH's Office of Strategic Initiatives – Floodplain Program** (www.floods.org/index.asp?menuID=460).

Looking for more details? Recommendations for assessing and reducing flood hazards in coastal areas are available for both New Hampshire and Maine. Many of the recommendations are also relevant for freshwater river watershed communities.

- **New Hampshire Coastal Risk and Hazard Commission Report and Recommendations** (www.nhcrhc.org)
- **Maine Flood Resilience Checklist:** A self-assessment tool for Maine's coastal communities to evaluate vulnerability to flood hazards and increase resilience (http://digitalmaine.com/mgs_publications/521)

[3] From: i) USGS, Floods: Recurrence Intervals and 100-year floods. https://water.usgs.gov/edu/100yearflood.html; ii) USGS, Questions and answers about floods. https://water.usgs.gov/edu/qafloods.html

[4] Statistical analysis to calculate these values is provided at Geology Labs-On-line Project: www.sciencecourseware.com/VirtualRiver/FloodingDemo/Files/page13.html

This summary written by Cameron Wake (UNH Sustainability Institute and Institute for the Study of Earth, Oceans, and Space) and Julia Peterson (NH Sea Grant and UNH Cooperative Extension), February 2018.

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