

## Background

Flood risk has been misunderstood by the general public and even community leaders since at least the time of Noah. A sound approach considers the seriousness of a flood in terms of how often it can be expected to recur—on *average*—over a very long time assuming conditions don't change. The greater the average recurrence interval (or return period), the rarer the flood, and the higher it is. Return periods are easily converted to annual probabilities: for example, the 100-yr and 500-yr return periods are equivalent to 1/100 and 1/500 (1 and 0.2 percent) chances for occurring each year.

Good statistical estimates for floods, as with other risks, can be very useful in individual and collective decisions. However, current flood risk information—primarily the local National Flood Insurance Program (NFIP) flood hazard maps—has five notable limitations:

1. It is woefully inadequate. These maps overemphasize a single level—the 100-yr flood—leading to a pervasive false binary: below that level there is risk and above that level there is no risk.
2. It is not routinely updated and doesn't depict the likely impacts of climate change on flood hazards.
3. It doesn't address large uncertainties. Flood hazard studies often only have decades of local data from which to derive estimates and thus can't begin to give precise flood hazards estimates at specific locations—somewhat like national health statistics applied to an individual. The uncertainty in estimates for the 100-yr flood for many rivers and coastal water bodies is plus/minus several feet—substantially multiplying the floodplain area. For a so-called 100-yr flood, the true return period is better represented as a range: such as between 50 and 200 years.
4. It doesn't convey to the public the tangible chance of flooding over more meaningful durations, such as over the course of a 30-yr mortgage or a lifetime.
5. It doesn't communicate anything about location-specific consequences associated with the estimated inundation. ***Real Flood Risk*** information should combine a full range of flood chances with the impacts of those floods—providing, for example, the probabilities for a range of property damage costs.

The absence of a clear, full spectrum of pertinent flood risk information impairs many crucial decisions, such as:

- The value of a particular home or building;
- Whether to rebuild a flood damaged home or business;
- The true cost of flood insurance and whether to purchase it;
- Whether government should subsidize flood insurance for some citizens and how much; and
- What flood reduction projects, community resiliency programs, land-use regulations, and building codes to support.



***The Flood Risk Game***

To better illustrate ***Real Flood Risk*** and how we should approach it, let’s imagine that when we buy a house we must play the following *Flood Risk Game*. At the closing, after we’ve signed all the regular papers, we are told that we also have to spin a roulette wheel twice before getting the keys. If any of the seven results shown in the table below happen, then we must make a corresponding Payout. The Flood Risk Game is played “blind”—we won’t know the results of our spins at the time of the closing. The results of our spins will also randomly determine the year of any Payout if we should lose.

The table shows the statistical probability for each of the seven results. These are similar to the chances for a range of seven flood hazards occurring during our 30-yr mortgage. From 1 to 7 the chances for each result get smaller as the associated flood hazard gets more extreme.

The game Payouts corresponding to each result are specific to the property we are buying and depend on the local depth of flooding for each of the seven flood hazards. The Payouts are the total cost that would be experienced with each associated flood. These include complete restoration of damages to the property, its contents, and exterior items, plus compensation for any personal costs associated with that flood (lost income, temporary housing, possible automobile losses, care of pets and disabled relatives, etc.). The seven Payouts will be higher for floodplain properties, especially those which are less elevated—perhaps as high as 0, 60, 80, 90, 100, 120, and 150 percent (or even higher). In this case a \$300,000 home would have a Payout 2 for a 100-yr flood of \$180,000. On the other hand, properties located far above local floodplains can have zero Payouts across the board.

*Importantly, in the Flood Risk Game we can try to find out our seven Payouts in advance, but we will not be able to determine the results of our spins, and if we must make a Payout, which one, and when.*

***Playing “The Flood Risk Game” Skillfully***

***Real Flood Risk*** works much like the Flood Risk Game—everyone who buys a house must play and everyone has zero control over the *game of chance*. The only part of the Flood Risk Game, and ***Real***

<b>Seven Results for Roulette Wheel Spins</b> (Each Has a Corresponding Payout)	<b>Chance of Result</b>	<b>Similar to Flood Return Period</b> (Chance of Flood in 30 Years*)
1. First spin is an even number	18/38, 47.3%	50-Yr (45.5%)
2. First spin is an even number between 2 & 20	10/38, 26.3%	100-Yr (26.0%)
3. First spin is a 2, 4, 6 or 8	4/38, 10.5%	250-Yr (11.3%)
4. First spin is a 2 or 4	2/38, 5.3%	500-Yr (5.8%)
5. First spin is a 2	1/38, 2.6%	1,000-Yr (3.0%)
6. First spin is a 2 and second spin is any number between 1 and 9	1/38 x 9/38, 0.62%	5,000-Yr (0.6%)
7. First spin is a 2 and second spin is a 1, 2, 3 or 4	1/38 x 4/38, 0.27%	10,000-Yr (0.3)

\* Some other games of chance with similar probabilities over a 30-yr duration are: for the 50-yr flood—flip a coin (50%); for a 100-yr flood—draw a heart from a deck of cards (25%); for a 250-yr flood —roll a 5 with a pair of dice (11.1%); for a 500-yr flood —roll an 11 with a pair of dice (5.6%); and for a 1,000-yr flood—roll “snake eyes” with a pair of dice (2.8%). *Note that over a period of 60 years, the chances nearly double for the more extreme flood hazards—with close to a 6 percent chance for a 1,000-yr flood!*

***Flood Risk***, that we can control—the only part that is a *game of skill*—is whether to buy a particular house with its particular Payout levels. (In reality the game duration is for as long we live in the house, and is renewed each time we move. Furthermore, we don't individually spin the roulette wheel; instead the wheel is spun for large floodplain areas.)

There are three aspects to the game of skill. First, common sense tells us that we should consider the potential for flood costs before we buy a house and factor them into the house price. But in doing so we should never depend on just a single hazard such as the 100-yr flood—flood costs for a house could jump drastically between Payouts 2 and 3! Instead we should determine the *full spectrum of flood hazards* and Payouts, and then estimate a reasonable *flood risk markdown* to a property's value relative to a similar property with no flood exposure.

Second, if the Payouts aren't negligible we should evaluate the affordability of flood insurance to cover our Payout risk. A significant Payout 5 should give us pause even with its low probability of 3 percent, as that is greater than the chance of a house fire over a 30-yr mortgage. If we still want the house we should plan on buying and maintaining flood insurance—just like fire insurance.

Third, we should be extra prudent and recognize the significant uncertainties in the seven flood hazard estimates, and that climate, economic conditions, and information can change—potentially raising Payouts and the cost of flood insurance and reducing property values.

### ***The “Real Flood Risk App”***

Let's further imagine that to help us play the Flood Risk Game there is an “App” we can use that has the following information:

1. An up-to-date high resolution map that shows—for any property—the best estimates of flood depth associated with each of the seven flood hazards. The map has options to adjust the estimated flood depths for climate change and uncertainty.
2. The estimated Payouts for each of the seven floods (again for any property), and their impact on the property's value, i.e. the effective *flood risk markdown*. The App has options to adjust the Payouts and the flood risk markdown for climate change, economic assumptions, and uncertainty.
3. The estimated annual cost of flood insurance based on the flood risk and an open, efficient flood insurance market. The App then compares this estimated cost to the actual coverages and premiums for the NFIP and other available policies; and has options to adjust the future cost of flood insurance for various assumptions, including changes to NFIP subsidies.
4. The estimated impact at any property for proposed flood mitigation projects and community resiliency programs, including increases/decreases in flood hazards, associated Payouts, flood risk markdown, flood insurance premiums, and taxes. And similar information for proposals that could exacerbate flooding in some areas (like roads and development).

In this age of Supercomputers, Big Data, the Cloud, and 12 megapixel cell phone cameras, setting up *The Real Flood Risk App* should be easy and economical. Unfortunately, providing it is well beyond the current scope of the NFIP. If Congress' reauthorization of the NFIP in 2017 does not address the need for such a tool, then other entities—public or private—should consider stepping in. Millions of current and potential homeowners don't want to take foolish chances on a big flood loss . . .

**. . . AFTER ALL, REAL FLOOD RISK IS NOT A GAME!**