EBC Ocean & Coastal Resources Webinar: Flood Insurance and Its Role in Resilience
Welcome

Payson Whitney

Chair, EBC Ocean & Coastal Resources Committee
Vice President, ESS Group, Inc.
Program Introduction – What You Will Learn

Nathan Dill

Program Chair & Moderator

Project Manager / Engineer

Ransom Consulting, LLC
Modernizing Flood Risk Management

Post-NFIP/Climate-Change

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Environmental Business Council of New England

Portions of this presentation have been shared with:
American Society of Civil Engineers (Baton Rouge)
Louisiana Engineering Society
Louisiana Urban Stormwater Coalition
Center for Planning Excellence
Amite River Basin Commission
Together Baton Rouge
Louisiana Floodplain Management Association
Sierra Club of Baton Rouge
Tulane Engineering Forum
Houston Geological Society
St. Bernard Economic Development Foundation
Louisiana Geological Survey/Baton Rouge Geological Society
LSU College of the Coast and Environment Seminar Series
LSU Marine Extension Program

2016 - 2020
Bob Jacobsen PE

MA Political Science, 1981
MS Civil Engineering, 1996; PhD Coursework
Professional Environmental Engineer, 1997

- Environmental Policy
  - LDNR/LDEQ
- Environmental/Coastal/Flood Hydrology
  - Central LA Rivers
  - Mississippi River-near Darrow LA
  - Amite River Basin
  - Coastal Storm Surge Modeling/
    Hazard/Risk Analysis & Reduction
  - High Resolution/”Supercomputing”

- Clients:
  - Amite River Basin Commission
  - Louisiana Coastal Protection & Restoration Authority
  - SE Louisiana Flood Protection Authority—East
  - US Army Corps of Engineers
  - Federal Emergency Management Agency

- 2013-14 President of ASCE Louisiana Section

1970s Hurricane Tracking Map
(made when I was about 14)
The Wise and Foolish Builders

A **WISE** man built his house on the rock—the rain came down, the streams rose, and the winds blew and beat against that house; yet it did not fall, because it had its foundation on the rock.

A **FOOLISH** man built his house on sand—the rain came down, the streams rose, and the winds blew and beat against that house; and it fell with a great crash.

*Who told this proverb . . . about 2,000 years ago?*

Jesus of Nazareth  
*from the Sermon on the Mount*  
Matthew: Chapter 7
21st Century Wise Builders Adopt:

*Full-Spectrum Flood Hazard*

and

*Flood Risk Pricing*
Presentation:

I. Background—Flood Hazard & Risk
II. Mr. Emoji
III. Technology—State of the Art
IV. Policy Trends/Challenges
Part I.

Background—

Flood Hazard & Risk
Flash Flooding

- Localized, intense rainfall inundates topographic **bowls**.
- Rainfall not conveyed away fast enough by runoff & urban drainage networks.
- **Neighborhood/Local drainage issue.**
River *Headwater* Flooding

- Flood wave moves down river
- Peak/timing/duration dictated by
  1. Rainfall location/duration/intensity.
  2. Drastic change in floodplain width/slope from upper to middle to lower ARB.
  3. Wave slows with widening/flattening of floodplains to south.
- **Local/Regional flood management issue.**
River Backwater Flooding

- Local stream level impacted by conditions downstream—blockage, high water, etc.
- Also severe slope reductions from upper to lower basin.
- Actual flow can—but does not have to—reverse.
- Regional flood management issue.
Coastal Flooding

- Added impact of strong, long-duration onshore wind.
- Prolonged 30 mph SE wind can raise coastal lakes by several feet.
- Long recognized in southern ARB.
- Hurricane surge.
- Regional flood management issue.
Flood Hazard is **Location-Specific**

*Can change drastically over short distances*

**Flood Elevation**
in Survey Datum (ft NAVD88)
—due to obstructions

**Flood Depth**
above Ground (ft)
—due to topography
Two *Foolish* Flood Hazard Frameworks

1. **Personal history:**
   “There’s never been that much water here before!”
   - Too brief to properly gauge magnitude of *rare* events
   - Need perspective of *millennia*

2. **Single hazard threshold:**
   **Below/Above → Risk/No-Risk → “False Binary”**
   - Inside/Outside one line on a map
   - Not granular—doesn’t convey shades of hazard/risk
   - Ignores huge uncertainty
   - **No such thing as “The Flood Zone”**
   - **Encourages excessive risk at the margin!**

   Plus need to consider long-term trends & cycles
   Rainfall/Hurricane Climate    Sea Level    Rivers/Floodplains/Coasts    Land Use/Cover
Could Use Flood Hazard Ratings/Scores

- Categories of hazard—like Saffir-Simpson Scale for hurricane wind
- **Better than a False Binary**
- **But not fully “quantitative”**—can’t do crucial math
  - Straightforward aggregation over an area
  - Good Benefit-Cost & Adverse Impact
  - Optimizing economic decisions
  - How much better/worse is Alternative A vs B
- Factors for categories can be too limited—like applying SSS to hurricane surge

**Is There a Better Way to Characterize Flood Hazard?**
Return Period is Quantitative Flood Hazard

Return Period is average recurrence interval

For an extreme flood elevation—over millennia

Example:
Flood elevation reached 10 times in 5,000 years:
\[ \text{Return Period} = \frac{5,000}{10} = 500 \text{ years} \]

Return Period is an AVERAGE
NOT exactly 500 years between these floods!
Annual Exceedance Probability

AEP is the odds/chance of a flood elevation in any calendar year, *each & every individual year*.

\[
\text{AEP} = \frac{1}{\text{Return Period}}
\]

Example: 500-yr RP
\[
\text{AEP} = \frac{1}{500} = 0.002 = 0.2\%
\]
Full-Spectrum Flood Hazard CURVE

Logarithmic horizontal scale shows orders of magnitude

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<th>RP yrs</th>
<th>AEP</th>
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Most Hazard Curves Have Large Uncertainty
Exact Line is a “Scientific Guesstimate”

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Statistical techniques can be used to make estimates with shorter gauge record.

Without a gauge, have to create a synthetic record of storms—this is the case nearly everywhere.

Ideally want Gauge Record = 10 X RP
Full Spectrum Flood Hazard is NOT NEW

USACE Flood Control Projects (1966)
This gauge has about 60 years of data. But notice huge uncertainty in 100-yr flood elevation.
Tide gauges have some of lowest uncertainties for any flood hazard estimate—
But the 100-yr flood could really have a 50-yr RP!
Full Spectrum with Uncertainty

NOAA Rainfall

Duration:
- 5-min
- 10-min
- 15-min
- 30-min
- 60-min
- 2-hr
- 3-hr
- 6-hr
- 12-hr
- 24-hr
- 2-day
- 3-day
- 4-day
- 7-day
- 10-day
- 20-day
- 30-day
- 45-day
- 60-day

24-hr PF estimates with 90% confidence intervals
Latitude: 30.5372°, Longitude: -91.1469°

Confidence Interval

Precipitation depth (in)

Average recurrence interval (years)
Full Spectrum with Uncertainty

NOAA Rainfall

Even with > century of regional data, best science/statistics:
100-yr rainfall could really have a 50-yr RP
Critical to Appreciate:
Most Flood Hazard Exposure is NOT for Just 1 Year!

- **Mortgage** 30 Years
- **Community Planning** 50 Years
- **Lifetime** 80 Years

*These are repeat exposures/chances!*

Compared to an annual chance, long-term exposures have much higher probability!
Over a 30-Year Period the Chance of a

2% AEP or 50-yr Flood becomes 45.5%:
≈ flip a coin (50%)

1% AEP or 100-yr Flood becomes 26.0%:
≈ draw a heart from a deck of cards (25%)

0.4% AEP or 250-yr Flood becomes 11.3%:
≈ roll a 5 with a pair of dice (11.1%)

0.2% AEP or 500-yr Flood becomes 5.8%—or 1 in 17:
≈ roll an 11 with a pair of dice (5.6%)

0.1% AEP or 1,000-yr Flood becomes 3.0%:
≈ roll snake eyes with a pair of dice (2.8%)

The chance of a 1,000-yr flood over a lifetime is 8%
Greater than the chance of a house fire!
Probability Also Increases with Multiple Independent Exposures

Examples of Independent Exposure:
- Exposure to more than one type of flood: *Flash, River, Backwater, Coastal*
- Exposure to flooding from two (or more) independent directions
- Areas that are far enough apart

Suppose you oversee regional planning for a large basin. Say it has five independent flood exposures. The chance of a 1,000-yr flood occurring somewhere in your basin over a 50-yr period is 22%.
Location-Specific Flood Risk Based On:

1. **The Location-Specific Full-Spectrum Flood Hazard**
   - Factoring in any Flood Control Failure Probability

2. **Consequences of Flooding at Each Hazard Level**
   - Safety Risk—Goal is *Protection*: Evacuation/Prevent Fatalities
   - Economic Risk—Goal is Community *Resiliency*: Reduce
     - **Damage**—Buildings, Contents, Autos, Facilities, Infrastructure
     - **Expenses**—Temporary Relocation, Clean-up, Lost Income/Business Activity/Taxes
   - Social/Cultural/Psychological Impacts
   - Broader Ecosystem Impacts

3. **Integrated Over Meaningful Exposure Durations**

Flood Risk Can Be Aggregated Over Area
Pricing (Economic) Flood Risk

**5 Steps:** sound, robust, quantitative location flood risk

- **Step 1** Prepare a *Full Spectrum Flood Hazard Curve* with uncertainty
- **Step 2** Use estimates of total cost at each depth to produce a *Full Spectrum Flood Economic Risk Curve* with uncertainty
- **Step 3** Integrate the *Full Spectrum Flood Economic Risk Curve*, incorporating some uncertainties, to get *Expected Annual Cost*
- **Step 4** Estimate future changes in *Expected Annual Cost*
- **Step 5** Convert to *Present Value*

- *Present Value* easily aggregated for neighborhoods, watersheds, & regions
Pricing (Economic) Flood Risk

- Aggregation can “average out” many uncertainties—random errors such as ground elevation & depth-damage; this reduces the uncertainty in Pricing Flood Risk over an area.

- Pricing Risk has a very long, well-established history of use in risk management for fire, wind, drought, hard freeze, & other hazards!

- *Expected Annual Cost* is basis for *Actuarial Cost* used in the insurance business; further aggregation over many independent regions reduces uncertainty even more.
Pricing Risk is “Best Practice”

- **Individual & Business**
  - *Due Diligence* for transaction decisions: *Buy? Build? Insure?*
  - Mitigating risk to reduce insurance cost
- **Commercial & Investment Banks**
  - Insurance requirements for loans
- **Insurance Industry**
  - Policy coverages/terms/cost
- **Government**
  - Regulating private insurance market
  - Regulating bank loan flood risk
  - Writing building regulations/codes
  - Controlling adverse impact
  - Investing in public mitigation

*Wind & Fire Risks!*
Historically, Flood Risk Not Effectively Priced

1. Up until recently, many private & public decisions driven exclusively by framework of National Flood Insurance Program (NFIP)

2. NFIP has antiquated approach rooted in how set up 50 years ago: Heavy emphasizes ONE zone/level—the 100-yr Flood Basic framework is a False Binary Flood Insurance Rate Maps (FIRMs) do not provide Full-Spectrum Flood Hazard

4. Most FIRMs based studies of synthetic floods decades old—obsolete
   - Storms—range of scenarios
   - Hydrology—local rainfall runoff, where to & what rate
   - Hydraulics—waterway flow routing & inundation in floodplain
   - Changing Conditions—climate, sea level, subsidence, rivers, land-use
Historically, Flood Risk Not Effectively Priced

5. FIRMs do **NOT** show uncertainty
   *Best location-specific 100-yr flood level*
   *“Scientific Guesstimate”*

   **FIRM Uncertainty**
   In depth above normal stream level

   **Rainfall Hazard Uncertainty**
   and
   **Tide Gauge Flood Hazard Uncertainty**

   **Often**

6. Moreover, FIRMs often subject to excessive one-sided pressure to reduce 100-yr flood zones—
   **NO FACTOR OF SAFETY**

   East Baton Rouge Parish 100-yr Flood Zone
An antiquated NFIP has encouraged decades of bad decisions!

- Over-simplified *due diligence* & insurance requirements
- Overpriced modest risk & subsidized high risk
- Poor flood insurance participation
- Risky floodplain development
- Antiquated building codes
- Major road/bridge impacts >100-yr
- Uneconomical flood mitigation
- Excessive disaster response/recovery
- Massive uninsured losses
- NFIP debt
- Getting worse with climate change
Better if all flood economic risk is properly priced & insured

- Insurance is just “pooled savings” by a large, diverse group of individuals/entities for a major economic risk likely to occur at random to just some.

- **Personal/Business Insurance = Financial Resiliency**

- **Broad Participation = Community Resiliency**
  Homeowners, renters, businesses, organizations, public facilities

- **Mitigate risk when it makes economic sense**

- Need proper pricing of flood economic risk AND an effective, competitive, fair insurance market.
Part II.

Mr. Emoji
FIRM Flood Hazard is Too Simplistic

According to the local FIRM 100-year Flood Zone
Mr. Emoji’s flood elevation is . . .

Flood Elevation (ft)

<table>
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<th>60</th>
<th>55</th>
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Return Period (Years)

44 ft
False Binary

Return Period (Years)

Flood Elevation (ft)

No Risk

Risk

44 ft
False Binary Leads To

FOOLISH DECISIONS

Let’s Build Our House Just Above the 100-yr Flood!

Return Period (Years)

Flood Elevation (ft)

No Risk

Risk

44 ft
False Binary Leads To

FOOLISH DECISIONS

Let’s Approve More Development Based on the 100-yr Flood!

Return Period (Years)

Flood Elevation (ft)

44 ft
False Binary Leads To FOOLISH DECISIONS

Let's Ignore Road/Bridge Impacts >>100-yr Flood

Return Period (Years)
False Binary Leads To

FOOLISH DECISIONS

Let’s Build Levees & Control Drainage for the 100-yr Flood!
False Binary Leads To

FOOLISH DECISIONS

Let’s Not Buy Flood Insurance!
But FIRMs Are Often Outdated

Flood Elevation (ft)

Return Period (Years)

44 ft
And There are More Flood Hazard Levels
Full-Spectrum Flood Hazard

Real Quantitative Flood Hazard

Graph showing flood elevation (ft) against return period (years).
With Estimated Uncertainty

150-yr flood hazard:
>50 ft elevation
>5 ft deep
Almost 1:20 chance over 30 years! Nearly 50:50 chance over lifetime!
That 150-yr flood costs $200K!

Full Spectrum Flood Economic Risk
Easily Integrate Curve to a Single Number:

Average Annual Cost: $2,000
Also Integrate Many Curve Uncertainties

*Expected* Annual Cost: $2,100
30 Years: Cumulative Expected Annual Cost

$63,000
30 Years: Adjust for Future Hazard Increase

$73,000
30 Years: Plus Inflation

$122,400
Present Value—Impact on Property Value

$54,500
Present Value—Impact on Property Value

$54,500

Foolish Builder/Buyer Beware!
Part III.

Technology—
State-of-the-Art
Dramatic Advances in State-of-the-Art

- Big data/cloud/GIS
- Cheap computer capacity for simulations with $10^{14}$ floating point operations
- Parallelized 2D flood modeling
- Flood hazard analysis
- Flood risk analysis
- “What If” analysis
SOA Big Data/Cloud/GIS

- Accurate high resolution (1-meter) topo- & bathy DEM
- Key topo breaklines—embankments & floodwalls
- Land cover & vegetation
- Private/public asset inventories—e.g., tax assessor databases
- Software to process huge data sets for model setup, simulation conditions, economic impacts
  - Spatial resampling
  - Merging data sets
  - Data clean-up and quality control
  - e.g., merging LIDAR/ground/bathy surveys and rectifying different survey datums
- Data acquisition/prep crucial to good Full Spectrum Flood Hazard Analysis & Pricing Flood Risk
  - Acquiring data can be most time-consuming & expensive step.
  - Increasingly, data are already available
- Data upgrade big focus of improving analysis
SOA 2D Flood Modeling

- Since 2005, accelerating demand for better forecasts, hindcasts, synthetic storms—for all 4 types of flooding
- **Major flood codes undergo significant upgrades every 3-4 years to encompass more flood physics**
- Today, heading toward two major goals:
  1. **Handling all 4 types of flooding in single model**
     - 2D grid/mesh hydrology—“Rain-on-Grid”
     - Supercritical & subcritical & transitions—Full Dynamic Wave Routing
  2. **Simulating whole basins/regions with high (sub-acre) resolution where needed**
     - Early 2000s $10^4$ of computation cells, by 2010 $10^6$, now $10^7$, **soon $10^8$ cells**
     - Accurately analyze/locate impact of terrain/hydraulic features on inundation levels & patterns—*headloss in tenths of ft over tens of feet*
     - Automatically produce/map results accurate to individual properties
     - This eliminates additional step of translating coarse results to detail maps (and having to modify results for specific features)
Numerical Methods

**Finite Difference**
- HEC-RAS
- TUFLOW
- FLO2D
- WRF-Hydro
- DELFT3D
- MIKE 21

**Finite Element**
- ADCIRC
- RMA2
- TELEMAC-2D
- ADaptive Hydrology/Hydraulics (ADH)

**Finite Volume**
- HEC-RAS
- TUFLOW FV
- TELEMAC-3D
- SRH-2D
- D-Flow Flexible Mesh
- RiverFlow2D
- MIKE 21 FLOW MODEL FM
SOA Flood Hazard Analysis

- Cheap/fast parallel computing technology allows for 100s of scenario simulations
  - Similar to bigger ensembles in forecasting
- **Trend toward >1000 “naturalistic” events for better synthetic records**
  - Rainfall events—all seasons
  - Hurricane wind-fields: intensity at various radii and quadrants, IKE, forward speed/stalling, empirical tracks
- More scenarios reduces need for JPM-OS & response functions
- Codes (Matlab, R, Python, etc.) to crunch location-specific *Full-Spectrum Flood Hazard Curve*
- **Alternate synthetic records & Full-Spectrum Flood Hazard Curves for:**
  - SLR
  - Increase in rainfall frequency (Houston)
  - Land-loss & landscape trends

*Complete redo of coastal flood studies for all states along Gulf-Atlantic 2005-to-present have stimulated tremendous advances.*
SOA Flood Risk Analysis

- Concept of Pricing Flood Risk not new—textbooks/manuals date back decades
- SOA now making it happen
- Detailed depth-damage algorithms
- Codes (Matlab, R, Python, etc.) use
  - Structure inventories
  - Location-specific *Full Spectrum Hazard*
  - Depth-damage algorithms
  and then
  - Compile granular, structure-by-structure *Flood Risk Present Value*
  - Crunch aggregate *Flood Risk Present Value*
  - Monte Carlo analysis for uncertainty
SOA Revolutionizing “What If” Analysis

- Price Flood Risk for “What-If” using
  - Alternative synthetic records & Full Spectrum Flood Hazard Curves
  - Modified structure inventory/depth-damage
- Price the impact from development, roads, bridges, etc.
- Price risk mitigation for individual, business, or community
  - Reduction in Flood Risk Present Value: cost of insurance & other financial impacts
  - Uncertainty/reliability over multi-decades with Monte Carlo analysis.
  - Location-specific uncertainty very high
  - Uncertainty for insurance much lower
  - How much over-design Factor for Uncertainty is appropriate?
  - Can enhancing natural ecosystem features reduce flood insurance cost?

FLOOD RISK TO OUR COMMUNITIES
PREDICTED FUTURE RISK FROM A 100-YEAR FLOOD EVENT WITH NO ADDITIONAL ACTION

Flood depths increase in the future as we lose our natural defenses. While many of our major urban centers such as metro New Orleans, the North Shore, and Lake Charles are projected to undergo significant increases in flood depths, it will be the low-lying areas of the coast which see the most pronounced changes. For example, in 50 years, Houma could see 5 to 9 feet of flooding, Lafitte could see 10 to 15 feet of flooding, and Cameron could see over 15 feet of flooding from a 100-year flood event. Expected annual damage from storm surge based flooding events could be over seven times greater in the future if nothing else is done.

EXPECTED ANNUAL DAMAGE FROM FLOODING OVER THE NEXT 50 YEARS

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2017 Master Plan
Private Sector is Now Pushing **SOA**  

**Pricing Flood Risk** is becoming a “Best Practice” for

- Businesses trying to optimize decisions.
- **Private Flood Insurance** companies refining policies.
- Specialty flood hazard consultants.
SOA + Climate Change: Financial World that no longer ignores flood risk

Flood Risk Due Diligence

Flood insurance for ALL commercial loans

One day: flood insurance for ALL mortgage loans

Local Bonds won’t be available if community has significant uninsured risk

Flood riders on private insurance will be affordable for modest exposure
Future Synergistic Advances in SOA

- More Accurate Flood Risk Pricing
  - Less Under & Over Pricing

- Better “What If” Analysis
  - SLR, Rainfall, Landscape, Mitigation

- Increased Use of Pricing Flood Risk

- Optimal Due Diligence & Risk Management

- Better Flood Modeling
SOA—Coming in the Near Future

Cell Phone App

Pricing Flood Risk for Any Home!

Property-Specific Full-Spectrum Flood Hazard Expected Annual Cost & Present Value with default values adjustable for

- Property elevation
- Key features
- Depth-damages
- Indirect losses (car, relocation, wages, etc.)
- Future changes: climate, sea level, subsidence, rivers, floodplains, landscape, etc.
With Better & Better Flood Risk Pricing

- **Reduce Distortion: Under AND Over**
- **Real idea of what flood risk is affordable**
- Inflection @ ~300-yr RP
  (10% chance for 30-yr mortgage)
  - **Inches** of flooding—affordable insurance
  - **Feet** of flooding—unaffordable insurance
- **Will Clarify Community Resiliency Issues!**
  - New Orleans Polders—more likely flood risk will be unaffordable for drainage than surge
Part IV.

Policy Trends/Challenges
Educate Public/Officials/Media

- **Abandon False Binary**
- **Correct decades of bad public policy**
  - Some communities lobbying to leave NFIP
  - Many in Congress want to eliminate NFIP
  - Big changes coming for flood risk policy framework—regardless of NFIP Reauthorization!
Five *Wiseful* Policies for Flood Economic Risk

1. **Adopt** the framework of *Full-Spectrum Hazard* and *Pricing Flood Risk*
2. **Incorporate** consensus change forecasts for climate, sea level, subsidence, rivers, etc.
3. **Broaden** participation in flood insurance
   *Essential to Community Resiliency*
4. **Promote only sensible** Mitigation Projects/Programs
5. **Address** equity issues—subsidize flood insurance & mitigation where appropriate
   *BUT don’t over tax flood insurance for those at modest risk—discourages them from buying it!*
Five Wise Policies for Flood Economic Risk

1. **Adopt** the framework of Full-Spectrum Hazard and Pricing Flood Risk

2. **Incorporate** consensus change forecasts for climate, seas rise, subsidence, etc.

3. **Broaden participation** in flood insurance—Essential to Community Resiliency

4. **Promote** only sensible Mitigation Projects/Programs

5. **Address** equity issues—subsidize flood insurance & mitigation where appropriate

**Don't waste $ on mitigating flood risk that is actually cheaper to insure!**

Mitigation is mostly

“Flood Insurance Cost Reduction”

Just like mitigation of fire risk

with water systems, hydrants, and fire stations

Local taxpayers should fund flood mitigation measures

if they save enough on

Expected Annual Cost—

actuarial cost for insurance
Local/Regional Government Priorities

1. **Consolidate** basin-level flood risk management responsibility & authority in *Basin Agencies*

2. **Lead** the community to accept *ownership* of local flood risk—accountability for broad insurance participation and cost-effective mitigation

3. **Make** *Full Spectrum Flood Hazard and Pricing Flood Risk* available for every property ASAP

4. **Use** *Pricing Flood Risk* plus equity factors to drive *wise* building codes, land-use planning, and sensible mitigation—incorporating consensus change forecasts
State Government Priorities

1. **Expand/Regulate** effective/fair private flood insurance market; *promote accurate Actuarial Cost*

2. **Leverage** resources/efforts across many agencies for improving
   - GIS information—LIDAR-topo, bathy, breaklines, land-cover, & structure/facility/infrastructure inventories
   - SOA H&H model demonstrations—calibration/validation
   - Depth-damage algorithms

3. **Fully Empower Basin Agencies** —“stand up/behind” them to
   - **Prioritize** flood risk while other agencies prioritize transportation & ecosystem issues
   - **Regulate** big development & drainage measures for regional impacts
   - **Evaluate/Fund/Direct/Maintain** sensible regional flood mitigation

4. **Lead** on remedying equity issues—especially for historically disadvantaged neighborhoods
Floodplain Restoration vs Flood Risk Mitigation

- Ecosystem Restoration is a valid public objective—but may not cost-effective for flood risk reduction
- Flood economic risk mitigation must lower priced flood risk—the cost of flood insurance
- **Flood risk beneficiaries of projects should help fund them only to the extent their flood insurance costs are reduced**
- Uncertainty in ecosystem restoration project performance for flood risk reduction is huge
- **Projects should be optimized for their objective**
- If they have a goal of enhancing habitat—that needs to be the focus
Federal Government Priorities

1. **Privatize** flood insurance for most coverage needs

2. **Update** banking regulations for appropriate insurance for all loan exposure to flood risk

3. **Streamline** FEMA, Corps, HUD, etc. to serve in a support role to Basin Agencies for fast-tracking sensible mitigation based on Pricing Flood Risk

4. **Expand** NOAA, USGS, etc. research efforts to advance SOA:
   - **Data**: LIDAR topo, bathy, land-cover, gauges, flood data
   - **Modeling**: synthetic record of naturalistic storms, H&H, supercomputing
   - **Change Forecasts**: rainfall/hurricane climate, sea level, subsidence, river erosion/sedimentation
Thank You!

Questions?

Discussion . . .

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Flood Insurance as a Tool for Community Resilience

Joe Rossi

Executive Director
Massachusetts Coastal Coalition
Flood Insurance as a Tool of Community Resiliency
Joe Rossi, ANFI, CFM

- Flood Specialist- RogersGray Insurance
- Chair- Mass. Coastal Coalition
- Chair- Marshfield CRS Committee
- Co-Chair- National Flood Association Legislative Committee
- Board Member- Flood Insurance Producers National Committee
- Certified Floodplain Manager
- Associate in National Flood Insurance
- Degree in Architecture from Wentworth Institute of Technology
Questions we need to answer

• How do we make recovery better, faster, stronger?
• How does flood insurance make us resilient?
• How do they come together to better our community?

April: National Financial Capability Month

“Check your insurance coverage. Having insurance for your apartment, home or business property is the best way to be sure you will have the necessary financial resources to help you repair, rebuild or replace whatever is damaged.”

• https://www.ready.gov/financial-preparedness
• #FinancialFuture2019
Closing the Insurance Gap
Resiliency requires all levels of government and the private sector

Help your customers understand the risk they face for all disasters, and take action to protect the life they’ve built through insurance.

Share the importance of flood insurance through your networks and marketing channels.

Provide clients with options to mitigate their home to bring down the cost of hazard-specific insurance.

Together, we can double the amount of flood coverage nation-wide by 2022.

FEMA

Challenges, innovations, and “setting the course”
Figure 2. Conceptual Representation of Resilience for a Particular Disaster Event

“The red dotted curve conceptualizes what could be achieved by widespread take-up of flood insurance, which increases the resilience of individuals and communities by both speeding recovery and lessening the magnitude of the shock”
Recovery

1. A return to a normal state of health, mind, or strength.
2. The action or process of regaining possession or control of something stolen or lost.
- Building is valued at $100,000

- Insurance is taken out for 80% of replacement cost

- Building receives $80,000 of damage in a flood

- Can we rebuild this building for $80,000?
• Building will cost $80,000 to repair
• Demolition will cost $20,000
• Building has to be elevated (covered under ICC)- estimated at $30,000

• Building coverage will cover +$80,000 of building damage
• Building coverage will cover -$20,000 of demolition
• =+$60,000 left for reconstruction and elevation
• +$30,000 in ICC to raise the building
• Total payout: $110,000
• Total cost covered to rebuild and elevate (minus demo): $90,000

Can you finance $20,000?
Lender Requirements

• The lesser of:
  • Full amount available in the program
  • Loan amount (MA Mandatory form)
  • 100% replacement cost

ACKNOWLEDGEMENT:

I understand that my lender cannot require me to purchase flood insurance above the amount of my principal mortgage balance, or purchase coverage for the contents of my property, or require a deductible of less than $5,000. I understand that if I choose to purchase flood insurance that is the limit of my principal mortgage balance, that I understand the lender or insurance producer, will be responsible for any loss over that amount. I also understand that having a high deductible or failing to purchase coverage for the contents of my property could expose me to a significant loss should a flood event occur. My insurance producer has explained my flood insurance options and I understand that I am free to purchase flood insurance in an amount above the principal mortgage balance, with a lower deductible, and contents coverage.
University Case Study

• Large commercial risk placement
• 62 buildings across two different property locations
• 6 buildings within the SFHA- rest are shaded and unshaded “X” zone
• Due to those 6 buildings, all structures have $500,000 deductible for flood
University Case Study

- Client wanted to buy down deductible through a private “deductible buydown” program for 36 of the buildings
- Cost across all buildings: $100,000
- We looked at NFIP and Private for a solution

Solution?
- Bought “up” deductible for $46,000
- Included content coverage for $100,000 per building
- Secured private flood for the SFHA locations

Result?
- Deductible of $1,250 per building ($5,000 in SFHA)
- Coverage up to $5,000,000 per occurrence
- More insured property!
• Flood is NOT covered under most homeowners policies
• If a house burns down (or damaged other than a flood) and is in a high risk flood zone, it will still be required to come into compliance with the flood maps
• VERY important to have more ordinance and law coverage in these areas
• Most homeowners carriers require copy of flood coverage
Resiliency

1. The capacity to recover quickly from difficulties; toughness.

2. The ability of a substance or object to spring back into shape; elasticity.
National Flood Insurance Program

• Communities must participate in order to receive Federal Flood Insurance
• Participation is voluntary: 22,000 participate out of 26,000 communities
Flood Mapping
- Identification of risk
- Establishes high and low risk flood zones
- Sets rates
- Flood zones set the standards for mitigation

Flood Insurance
- Rates inform risk
- Financially resilient
- Increase in mitigation activity
- Grants!

Floodplain Management
- Avoided losses ($2B a year)
- Both structural and non-structural
- More mitigation = lower rates
Flood City

- Flood City has a total of 10,000 buildings
- Flood City has a total of 1764 flood policies
- The total insurance in force is $446,060,800
- Flood City has a population of about 20,000 citizens
Disaster Assistance? (IA)  
Average payout in Harvey: $6,000

HMGP?  
Limited funding after a storm

SBA?  
Up to $200,000 for primary home owners

Traditional Lending?  
Traditional LTV requirements apply. 203K more flexible but still has lending restrictions

Flood Insurance  
$446,060, 800 in force of insurance-guarantee to be available
Federally Supported, State Managed, and Locally Executed
Readiness for Target States Moving Forward

Disasters costing $41 M or less constitute 80% of declared disasters

39,266 declared disasters - 54% did not include IA
Resiliency - Affordability

Flood Insurance Affordability

• 26% of policyholders inside the SFHA are low income.
• 21% of policyholders outside the SFHA are low income.
• 51% of non-policyholders in the SFHA are low income.
• 41% of non-policyholders outside the SFHA are low income.

Annual Increases

• Pre-FIRM second homes, Pre-FIRM businesses and Pre-FIRM SRLs increase at 25% a year
• All Pre-FIRM structures have a mandatory annual increase of at least 5%
• All rate increases occur on April 1st
• Rate increases do not include fees and surcharges
Lowest floor at BFE

Utilities

Properly vented enclosure

Premium: ~$2,000

Resiliency - Affordability
Lowest floor +3 over BFE

Utilities

Properly vented enclosure

Premium: ~$400

Resiliency - Affordability
Marshfield, MA

Bump Out: “When floodproofing an existing home on a preexisting nonconforming residential lot, one single-story thirty-two-square-foot utility addition (bump out) located on the first floor may project into the side or rear setback.”

Hull, MA

Freeboard Incentive: In September 2009, the Hull Board of Selectman unanimously voted to enact the state's first freeboard incentive program... to offer a credit up to $500 for permit fees to builders and homeowners who elevate new and renovated structures at least two feet above the highest federal or state requirement.
Flood City

- Why worry about 1 or 2 policies being sold?
- Single family building fully insured at $250,000
- Every 4 policies sold = $1,000,000 in more coverage for the community
Implementation
Public Outreach

• Pre and Post Disaster Outreach
• 5 held statewide post disaster, 1 held pre disaster
• Hundreds reached, many policies reviewed, advise provided and followed up
SERVICES

KNOW FLOOD SUITE OF SERVICES

The Massachusetts Coastal Coalition’s Know Flood suite of services brings flood risk information to your fingertips. These services are designed to meet the needs of realtors, lenders, policy holders and residential and commercial applications where flood information can affect everyday life.

Note: By clicking on one of our services below, you will be taken away from the MCC website and to a MCC/MassiveCert website.

"KNOW FLOOD INSURANCE" INFORMATION

Flood Insurance Service Center

Have a question about flood insurance? You’ve come to the right place. The MCC knows the value of understanding flood insurance. Over the years, we have fielded thousands of inquiries on questions about flood insurance and realize there is no single place for stakeholders to get simple, easy answers for flood insurance questions.

That’s why the MCC is proud to present our flood insurance service center, run by MCC flood expert Art McKinney. Art will do his best to answer broad and specific flood insurance questions, or help point you in the right direction.

Simply fill out the form below, attach any helpful documents and we will get back to you during our posted hours of operation.

HOURS OF OPERATION: Tuesdays 6pm-8pm, Thursdays 7pm-9pm
Public Outreach

• Implementation in the community of Marshfield (Full CRS implementation)
• 2019 CRS Symposium on the North Shore
• CRS user groups
• Focus on public outreach (PPI), hazard mitigation plan (CRS credits), and Flood Insurance Study (FIS)
H.E.L.P.

• A full life cycle hazard mitigation service
• Philanthropic funds pay for all pre-award grant costs, with a current focus on the federal Flood Mitigation Assistance (FMA) and Hazard Mitigation Grant Program (HMGP).
• Completing the grant application on behalf of the local government
• Support individual homeowner’s navigation the implementation process
• All pre award community meetings and pre application screening is included.
Legislation: Special Commission

• Would have established commission to investigate and scope a state grant or low interest low program for structural evaluation or acquisitions of properties prone to flooding

• Language struck and changed by Governor; Legislator took no action

• Would greatly help our layered defense

• Federal legislation (state revolving loan fund) would hopefully tie into program
Contact

Joe Rossi, ANFI, CFM

Email
– jrossi@knowflood.org

Web
– www.knowflood.org

Social
– Facebook: Massachusetts Coastal Coalition
– LinkedIn: Massachusetts Coastal Coalition
– Instagram: Massachusettscoastalcoalition
– Twitter: @Knowflood

Become a member today!
The Importance of Flood Insurance in Recovery

Joy Duperault

Director, Flood Hazard Management Program
NFIP Coordinator & Department Hazard Mitigation Officer
Massachusetts Department of Conservation & Recreation
The Importance of Flood Insurance in Recovery

FLOOD HAZARD MANAGEMENT PROGRAM
MA DEPT. OF CONSERVATION & RECREATION
70% of damages from Harvey were not insured.

Total residential flood damage in Houston from Hurricane Harvey was more than $2.3 billion.

(CoreLogic, 2019 Insurance Coverage Adequacy Report March 2019)
Over 93% of all flood claims for the March 2010 heavy rain event in the Metro Boston area were not located in FEMA’s SFHA.
Flooding and storm damages are on the rise

In a paper published earlier this year (2018), National Center for Atmospheric Research scientists modeled sea level rise for 20 cities worldwide. They found that cities like Boston and New York might experience twice the global mean increase, while San Francisco and Buenos Aires will likely be 15 to 25 percent below the mean.

A report earlier this year from the National Oceanic and Atmospheric Administration (NOAA) said that “by 2100, high tide flooding will occur every other day (182 days/year) or more often” under an “intermediate low” scenario along the Atlantic coast and the western Gulf of Mexico. Scientists have been steadily increasing their estimates of how much sea level overall will rise this century from melting glaciers and polar ice sheets. The current best estimates are in the range of 3 to 6 feet.

*This 2016 study demonstrates quantitatively that the frequency of Hurricane Sandy-like extreme flood events has increased significantly over the past two centuries and is very likely to increase more sharply over the 21st century, due to the compound effects of sea level rise and storm climatology change.*
Post-Disaster Recovery

- Returning to the site (residence or business)
- Assessing the damage, considering available resources
- Working with insurance adjuster, FEMA representatives
- Army Corps “Blue Tarp” program (if wind damage)
- Removing debris, cleaning up
- Contacting a contractor, working with local building department
- Working with lender or SBA if necessary
- Working with VOAD organizations, if applicable
- Beginning the rebuild, purchasing new contents
NFIP Flood Insurance

- 1 in 4 flood insurance claims come from outside FEMA’s Special Flood Hazard Area. (FEMA)

- **Most homeowners insurance does not cover flooding.**

- One inch of water in an average sized home can cause more than $25,000 in damage. (FEMA)

- With federal flood insurance, you’ll be reimbursed up to:
  - $250,000 for your residential property
  - $100,000 for your personal belongings
  - $500,000 for your non-residential property
  - $500,000 for your non-residential property contents
Reality Check

The average NFIP flood insurance claim pay-out after Hurricane Harvey* was $116,800.

The average federal assistance check for uninsured properties that could not meet SBA loan requirements is $8,000.

If a flood is not declared a federal disaster, there will be no pay-outs for uninsured properties, and possibly no option to secure an SBA loan.

*Insurance Information Institute, 2018 report
**FEMA
341 out of 351 MA communities are in the National Flood Insurance Program

As of 5-11-20, there were 58,712 active policies, with an average annual premium of $1,262. This insurance covers more than $15.6 billion in property value.

The coastal counties have 48,067 policies (82% of state total)

Property covered by flood insurance in these coastal counties = $13 billion (83% of state total)

1,140 covered properties on MA coasts are in the very high risk flood zone (V zone)
Repetitive loss properties

On 2-28-19 there were 3,451 structures designated as “repetitive loss structures” in MA

- Repetitive loss is defined as any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978

284 of these are “severe repetitive loss structures.”

- Severe repetitive loss properties are defined as those properties for which the program has either made at least four payments for buildings and/or contents of more than $5,000 or at least two building-only payments that exceeded the value of the property.
## Repetitive Loss Structures in MA

### Top 10 MA communities with RL structures (as of 2-28-19)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Community</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Scituate</td>
<td>554</td>
</tr>
<tr>
<td>2.</td>
<td>Revere</td>
<td>296</td>
</tr>
<tr>
<td>3.</td>
<td>Hull</td>
<td>253</td>
</tr>
<tr>
<td>4.</td>
<td>Marshfield</td>
<td>206</td>
</tr>
<tr>
<td>5.</td>
<td>Quincy</td>
<td>202</td>
</tr>
<tr>
<td>6.</td>
<td>Winthrop</td>
<td>148</td>
</tr>
<tr>
<td>7.</td>
<td>Nantucket</td>
<td>75</td>
</tr>
<tr>
<td>8.</td>
<td>Duxbury</td>
<td>64</td>
</tr>
<tr>
<td>9.</td>
<td>Billerica</td>
<td>51</td>
</tr>
<tr>
<td>10.</td>
<td>Tied: Nahant, Peabody &amp; Swampscott</td>
<td>47 each</td>
</tr>
</tbody>
</table>

Since 1978, the NFIP has paid out over $416 million for 34,014 in claims in MA.
Massachusetts Sea Level Rise and Coastal Flooding Viewer

Interactive maps of coastal flooding areas and community facilities and infrastructure based on sea level rise scenarios, Federal Emergency Management Agency coastal flood zones, and hurricane surge models.

For planning purposes only. Sea level rise data courtesy of NOAA, January 2013. Please see the technical report (PDF, 2.22 MB) for data sources and processing steps.

Potential Extent of Mean Higher High Water (MHHW) with Sea Level Rise

- MHHW
- MHHW + 1 ft Sea Level Rise
- MHHW + 2 ft Sea Level Rise
- MHHW + 3 ft Sea Level Rise
- MHHW + 4 ft Sea Level Rise
- MHHW + 5 ft Sea Level Rise
- MHHW + 6 ft Sea Level Rise

Public Facilities and Infrastructure

- Airport
- Community Health Center
- Electrical Generation Facility
- Fire Station
- Harbormaster

Massachusetts Climate Change Clearinghouse at http://resilientma.org
Flood Insurance Inadequacies in Coastal MA

There is almost $550 billion dollars’ worth of property in CZM’s 78 MA coastal communities.* NFIP flood insurance for these communities covers just over $11 billion.**

That’s a difference of almost $538 billion.

*MA Dept of Revenue, Division of Local Services, Data Analytics & Resources Bureau, Assessed Property Values, 5-15-2020
What are the real numbers?

FEMA policies only cover a maximum $500K for residential, or $1M for commercial properties.

The inadequacy might actually be higher because:

- Assessed values do not reflect replacement values

The inadequacy might actually be lower because:

- These numbers do not include private flood coverage
- Not all structures will be flooded
- Not all damage will be from flood
If your property is in a flood risk area...

Buy
Flood
Insurance!
Flood Mitigation Makes a Difference

### Benefit-Cost Ratio by Hazard Mitigation Type

<table>
<thead>
<tr>
<th>Hazard Mitigation Type</th>
<th>Overall Hazard Benefit-Cost Ratio</th>
<th>Exceed common code requirements</th>
<th>Meet common code requirements</th>
<th>Utilities and transportation</th>
<th>Federally funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverine Flood</td>
<td>5:1</td>
<td>6:1</td>
<td>Not applicable</td>
<td>7:1</td>
<td>8:1</td>
</tr>
<tr>
<td>Hurricane Surge</td>
<td>7:1</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Too few grants</td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>5:1</td>
<td>10:1</td>
<td>7:1</td>
<td>5:1</td>
<td></td>
</tr>
<tr>
<td>Earthquake</td>
<td>4:1</td>
<td>12:1</td>
<td>3:1</td>
<td>3:1</td>
<td></td>
</tr>
<tr>
<td>Wildland-Urban Interface Fire</td>
<td>4:1</td>
<td>12:1</td>
<td>3:1</td>
<td>3:1</td>
<td></td>
</tr>
</tbody>
</table>

*BCR numbers in this study have been rounded.*

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National Institute of Building Sciences, “Natural Hazard Mitigation Saves 2017 Interim Report”

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### Flood Insurance Premium Comparison

<table>
<thead>
<tr>
<th>Zone</th>
<th>Freeboard</th>
<th>Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE</td>
<td>At BFE (no freeboard)</td>
<td>$2,147</td>
</tr>
<tr>
<td>AE</td>
<td>BFE + 1 foot</td>
<td>$1,106</td>
</tr>
<tr>
<td>AE</td>
<td>BFE + 2 feet</td>
<td>$734</td>
</tr>
<tr>
<td>AE</td>
<td>BFE + 3 feet</td>
<td>$614</td>
</tr>
</tbody>
</table>

Premiums are for a single-family house, one floor, slab on grade, stem wall foundation, or crawlspace with proper flood openings, $200,000 in building coverage, $80,000 in contents coverage, $1,000 deductible, no CRS discount, April 2017 Flood Insurance Manual.
Resources

**Learn about your risk:**
FEMA’s Flood Map Service Center- [https://msc.fema.gov/portal/home](https://msc.fema.gov/portal/home)

**Learn about NFIP insurance:**
FEMA’s Flood Smart website- [https://www.floodsmart.gov/](https://www.floodsmart.gov/)

**Speak with an expert:**
FEMA Region I flood insurance expert- Tom Young
[thomas.young@associates.fema.dhs.gov](mailto:thomas.young@associates.fema.dhs.gov) or 603-625-5125
Joy Duperault, CFM  
State NFIP Coordinator & Deputy Hazard Mitigation Officer  
Flood Hazard Management Program, DCR  
(617) 626-1406 or joy.duperault@mass.gov
Panel Discussion

Moderator: Nathan Dill

Project Manager / Engineer
Ransom Consulting, LLC