

# The Dollars and \$ense of Flood Resiliency

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**CDM  
Smith.**

**WATER** + ENVIRONMENT + TRANSPORTATION + ENERGY + FACILITIES



# Why are we concerned about freeboard?

- States have been removing freeboard requirements from their codes
- Builders\Developers spread the message that freeboard costs too much
- Consider how many events we experience where floods exceed the BFE
- Maintaining building values is good for both owners and the stability of lending institutions
- The future will not be kind to those constructed to the minimum – we must consider the building lifespan
- We should be looking at mitigation beyond FEMA grants

# In many cases the future is deeper

What impacts future conditions?

- Age of the maps
- Increased Development and Land Use
- Sea Level Rise (SLR is a stillwater elev. and waves will increase that value)



# Residential Freeboard

- NFIP Minimum is BFE
- ASCE 24 Requires:
  - BFE +1 or DFE (A Zones)
  - BFE+1 or DFE to Bottom of LSHSM (V Zone & CAZ)
- 2008 Study Indicates
  - Even up to 3 or 4 feet it's cost effective in both the V Zone and Coastal A Zone
  - It's cost effective in the A Zone up to 2 feet, but likely higher since the BFEs were assumed to be static

# Cost of Coastal Freeboard

Flood Zone	Freeboard (ft)	Cost of Freeboard (% increase)
V Zone	BFE +1	0.4-1.8
	BFE +2	0.8-3.6
	BFE +3	1.3-5.4
	BFE +4	1.7-7.2
Coastal A Zone	BFE +1	0.5-3.9
	BFE +2	0.7-4.8
	BFE +3	1.1-6.1
	BFE +4	1.4-8.1
A Zone	BFE +1	0.2-2.3
	BFE +2	0.3-4.5
	BFE +3	0.7-6.8
	BFE +4	0.9-9.1

Source: 2008 Supplement to the 2006 Evaluation of the NFIP Program's Building Standards

# What's the period of Return On Investment?

- The 2008 Study indicates that the ROI is usually less than 5 years for V Zones and 8 years for A Zones.
- Since much of the data uses percentages the data is likely still relevant.
- 8 years is a hard sell to homeowners that on average spend only 7 years in a home.
  - Likely quicker now due to premium increases



# What do homeowners REALLY care about?

- Homeowners rarely buy a house outright and most finance
- Let's consider a Monthly Cash Flow Analysis
  - Address the increase cost of freeboard
  - 30 year fixed rate mortgage (5% rate)
  - 20% down payment
  - Approximate Inflation 3%
  - Flood Insurance escrowed

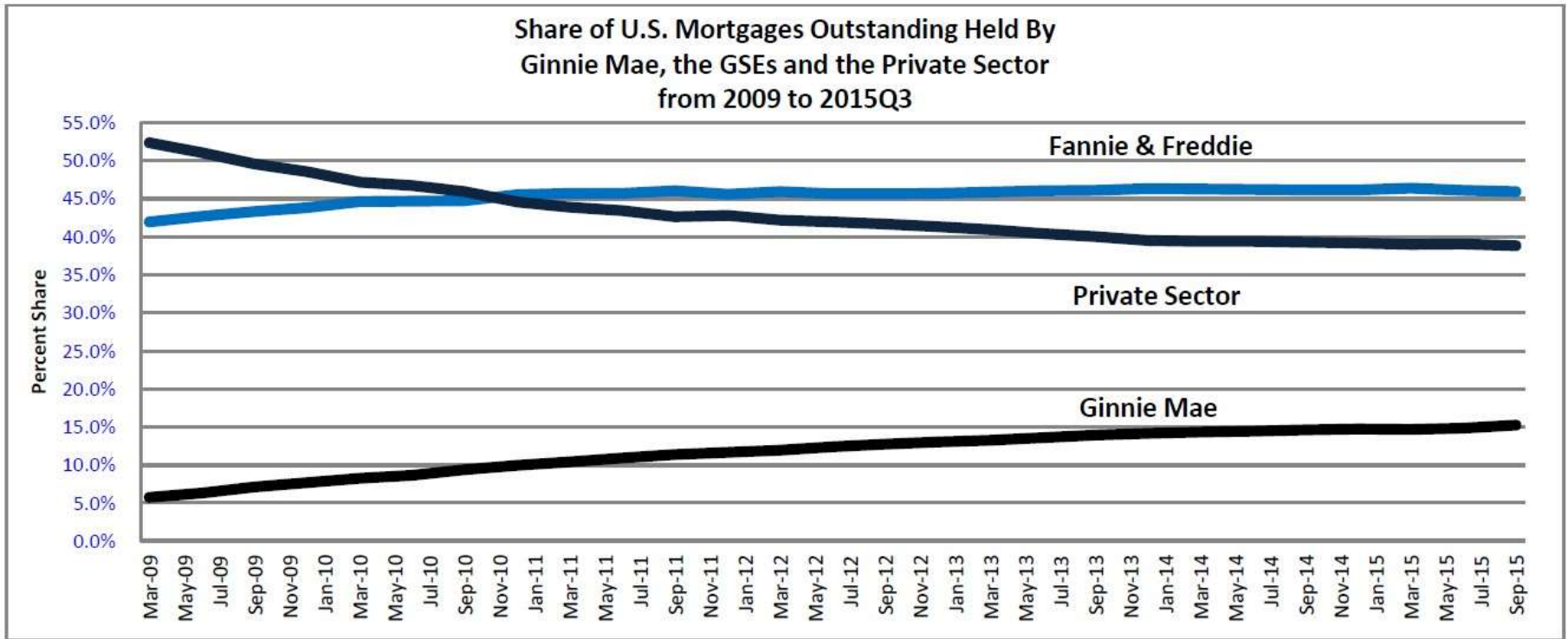


# Monthly Savings of Freeboard

- In many instances even 2 feet of freeboard takes less than 2 years to provide a return on the investment based on 20% down payment and monthly cash flow
- Due to the reduction in premium, savings were typically over \$50 per month despite the increased cost of the mortgage
- This could be a selling point if homeowners are made aware of the benefits before they signed a contract



# Why freeboard is good for the housing market

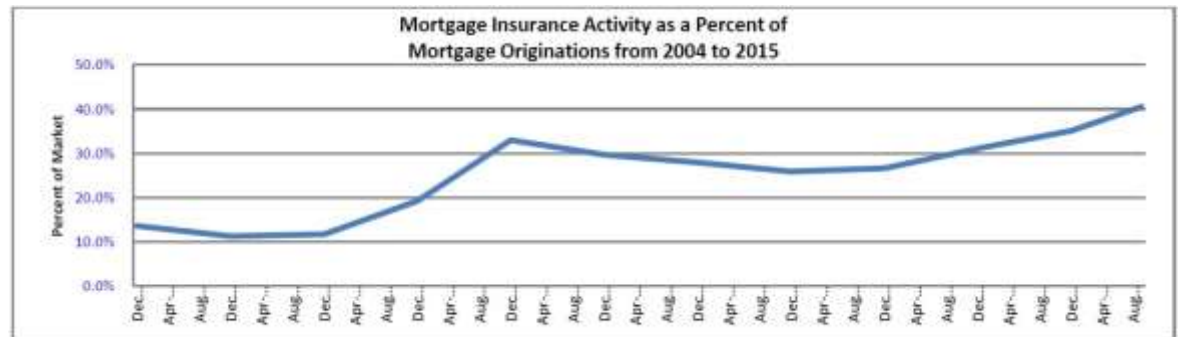


Source: Federal Reserve; Inside Mortgage Finance

Over 60% of loans are owned by enterprises associated with the Federal government.

# Government Ownership/ Government Risk

- In 2011 the government bought closer to 85% of loans
- Mortgage Insurance is at an all time high (owners are putting less money down)
  - This could take 7-11 years to reach sufficient equity to remove insurance
- As insurance rates increase homes have been shown to lose value.
- Banks service many loans rather than owning them, so less incentive to monitor flood insurance (so loans are un- or underinsured)



Source: Inside Mortgage Finance

# What does freeboard have to do with this?

- The low amount of equity in homes and low home values associated with homes subject to frequent flooding suggests a significant risk to Fannie, Freddy, and Ginnie Mae.
- Homeowners with homes worth less than what they paid are more likely to walk away.

**Recommendation:** The incorporation of freeboard requirements for new construction into FDIC regulations would likely:

- Reduce the number of loans defaulted upon due to flood damages or high flood insurance premiums and
- Better maintain home values.

# What do we know about the cost of freeboard for nonresidential?

## Increased Cost to Elevate as a Percent of New Construction

Building Type	BFE +1	BFE +2	BFE +3	BFE +4
Elementary School	0.6%	1.1%	1.5%	2.0%
Hospital 2-3 Stories	0.3%	0.4%	0.6%	0.8%
Police Station	1.1%	1.6%	2.1%	2.6%
Office Building 1-Story	1.1%	1.6%	2.2%	2.7%
Office Building 3-Story	0.9%	1.3%	1.7%	2.2%
Retail Store 1-Story	1.4%	2.1%	2.8%	3.5%

# What do we know about the cost of freeboard for nonresidential?

## Increased Cost to Dry Floodproof as a Percent of New Construction

Building Type	BFE +1	BFE +2	BFE +3	BFE +4
Elementary School	1.3%	2.6%	3.9%	4.0%
Hospital 2-3 Stories	0.5%	0.9%	1.3%	1.6%
Police Station	1.6%	2.9%	4.3%	5.0%
Office Building 1-Story	1.7%	3.3%	4.8%	5.5%
Office Building 3-Story	1.3%	2.4%	3.5%	4.1%
Retail Store 1-Story	1.9%	3.4%	4.9%	6.4%

# What do we know about the cost of freeboard for nonresidential?

## Cost to Dry Floodproof as a Percent of BRV as a Retrofit

Building Type	BFE +1	BFE +2	BFE +3	BFE +4
Elementary School	1.4%	2.8%	4.2%	4.4%
Hospital 2-3 Stories	0.5%	0.9%	1.3%	1.8%
Police Station	1.7%	3.1%	4.6%	5.4%
Office Building 1-Story	1.8%	3.5%	5.2%	6.0%
Office Building 3-Story	1.4%	2.6%	3.8%	4.4%
Retail Store 1-Story	2.1%	3.7%	5.4%	7.0%

# Is the Mitigation Cost Effective?

Using 7% Discount Rate and Static Flood Conditions

Building Type	Elevate	DF New	DF Retrofit
Elementary School*	Even up to 4'	Varies	Depends on need
Hospital 2-3 Stories	Even up to 4'	Even up to 4'	Even up to 4'
Police Station	Even up to 4'	Even up to 4'	Even up to 4'
Office Building 1-Story	Depends on use	Depends on use	Depends on use
Office Building 3-Story	Up to 3'	Depends on use	Depends on use

\* Usually cost effective when considering the value of loss of use

**Note:** For above design events the elevated building may see minor damages, but dry floodproofing overtops

# The Commercial Side



## A Work in Progress!

We can't always rely on FEMA grants and this decision should make business sense

Source: FEMA  
Photo Library



# Is Mitigation Cost Effective for a Business?

- Utilize a more realistic approach with modifying the Discount Rate to something like 3.5%..or even less...*gasp!*
- It likely depends on the type of business
- A breakeven approach can tell an owner of much freeboard makes good business sense

**Almost 40 percent of small businesses never reopen their doors following a disaster. - FEMA**

# Commercial Business Case

## Round 1

Preliminary Runs Using 3.5% Discount Rate

Building Type	Elevate	DF New	DF Retrofit
Office Building 1-Story	Depends on use	Depends on use	Depends on use
Office Building 3-Story	Typically Up to 3'	Depends on use	Depends on use
Retail Store 1-Story	Depends on use	Depends on use	Depends on use

\* Usually cost effective when considering the value of loss of use

This seems to provide too many unknowns...there must be a better way

We need to determine which uses and conditions may justify various amounts of freeboard

# How can we help business owners determine their risk?

- Compare the value of Freeboard vs. Potential Losses (building damage, contents damage, and various metrics of business interruption)
- Provide some breakeven values so that if an owner's business interruption exceeds this value that they can demonstrate freeboard is worth the investment

# Adam's Approach

- Determine flood data (can also address SLR)
- Determine mitigation measure (elevation or floodproofing)
- Run example BCAs to determine the “Business Interruption Factor” per foot of mitigation
  - Modified by flood data, freeboard, and mitigation option
- Determine building and contents damages per foot of freeboard and mitigation

# Adam's Approach (cont'd)

$$\text{Breakeven BI Value} = \frac{\left(1 - \left(\frac{PV\ B\&C\ Ben.}{Mit.Cost}\right)\right) * Mit.Cost}{PV\ Factor} * BI\ Factor$$

- Use and Occupancy will influence results
- May provide lenders or investors a better idea of their risk it isn't just about loss of rent for one tenant, but loss of desirable space
- We can provide in \$ per square foot if owners are still in the planning phase
- Results can be compared to business revenues to evaluate how much freeboard should be considered

# The increases from SLR Scenarios

- Approach must consider that SLR isn't instantaneous or at a constant rate
- It should only address the rise over the lifespan of the evaluation

Sea Level Rise Scenario	Increase in Cost Effectiveness
20" Rise by 2100	<b>20%</b>
39" Rise by 2100	<b>40%</b>
59" Rise by 2100	<b>60%-80%</b>

# Other thoughts

- Consider the type of business Apple at \$4,551/sf per year or Department Store \$160-\$200 (2015 Report)
- Business Interruption insurance would require owners to understand it would require several riders and still may not address all their risk
  - It may be cheaper to finance freeboard instead of paying high business interruption insurance premiums
- Initial evaluations indicate that many businesses will find there isn't much increase in revenues necessary to go to 4 feet of freeboard instead 2 feet or 3 feet

# Some thoughts on freeboard

- Go as high as practical
- Base Flood Elevations are rounded to the nearest foot, so it could be almost 6 inches too low.
- Recurring above design events in your flood data suggests considering more freeboard
- Freeboard is particularly important with dry floodproofing
  - Once flood protection is overtopped it is almost impossible to pump out

**This should not replace freeboard in codes, but makes a better case to build higher than required.**



## Some final thoughts on risk

**Consider going above the minimum!**

Following a disaster no one ever says that they wish they had done less.



Questions?/Discussion

# What happens if we overtop?

- Office Building (16,000 sf)
- 3 feet of floodproofing
- Doors: 2 double glass doors and one single glass door
- Windows: 12 windows about 3 feet wide each
- Assuming an offset gap between the shields and windows about 6 inches
- **1 inch** overtopping
- Overflow Rate: +4 cfs about **1,834 GPM** and 110,000+ GPH
- Duration to fill the space is: **196 minutes**