HURRICANE-RESISTANT BUILDING CONSTRUTION

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UNC-Wilmington Center for Marine Science
NCSU Dept. of Civil Engineering

Sea Grant
North Carolina

BEGINNING TRUTHS For Hurricane-Resistant Buildings

1. Nothing is Hurricane Proof
2. Hurricane resistant not an alternative to evacuation in high risk zones
3. Usually not expensive or difficult
4. This Year's Predictions? WHO CARES?

It only takes one hurricane to ruin your day

Hurricane Proof?
Almost Nothing

PRIMARY HAZARDS

FLOOD

- STILL WATER or STORM SURGE
- WAVES or CURRENT VELOCITY
- EROSION

WIND

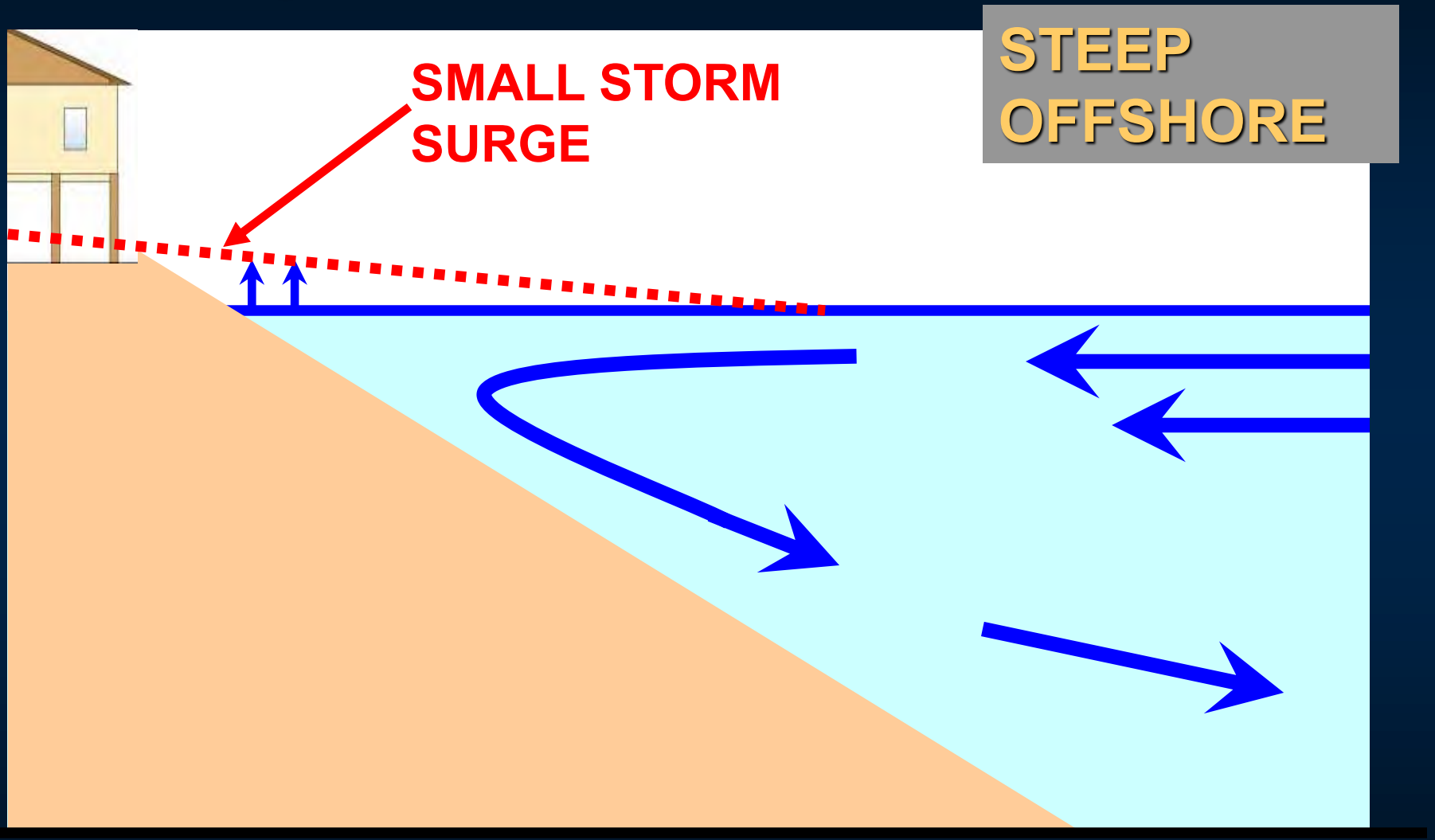
- WIND SPEED/FORCE
- WIND-BLOWN WATER
- WIND-BLOWN DEBRIS

FLOOD LEVEL COMPLEX TO PREDICT
EASY TO DESIGN

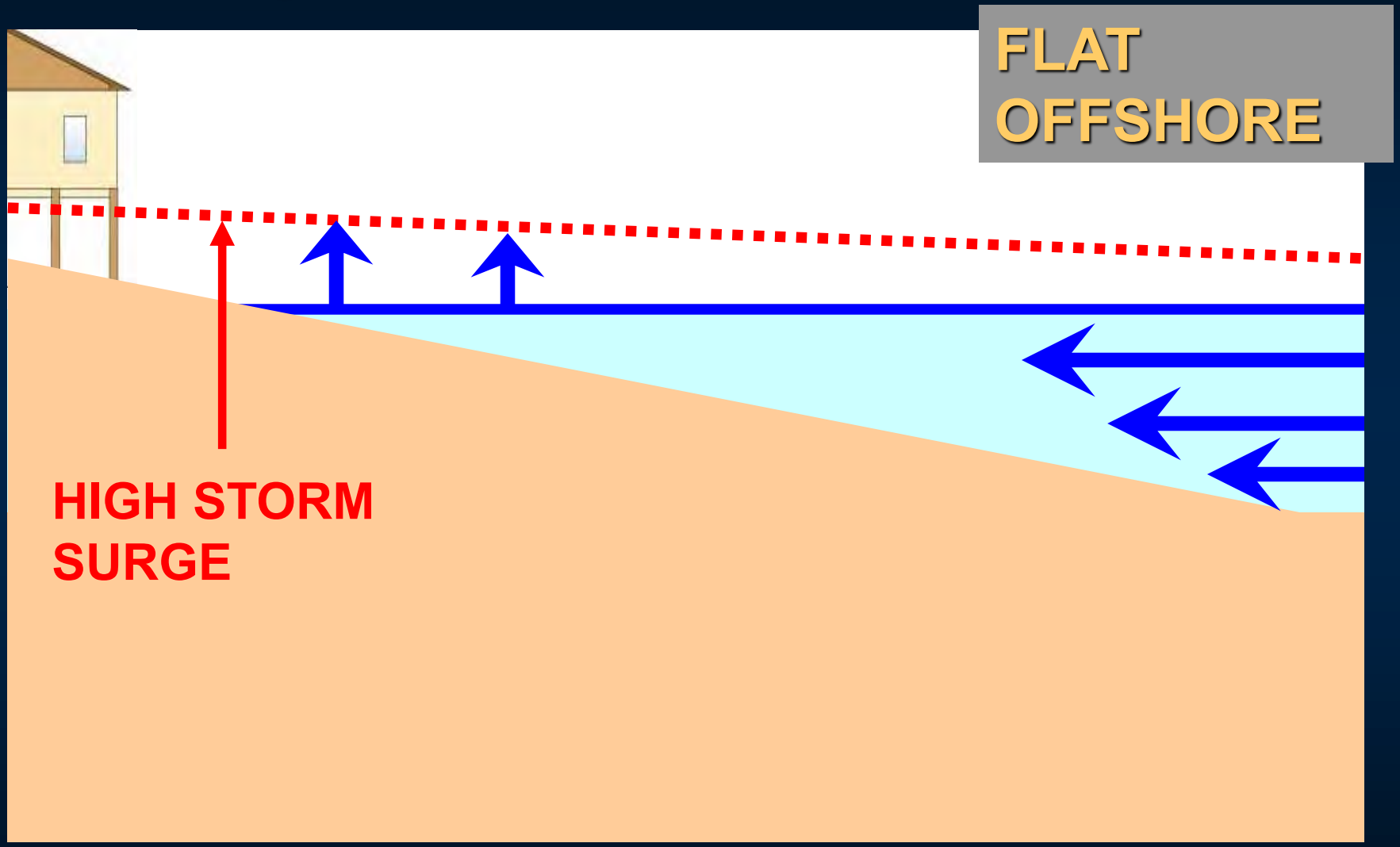
FLOOD DESIGN RULE # 1

DON'T GET WET

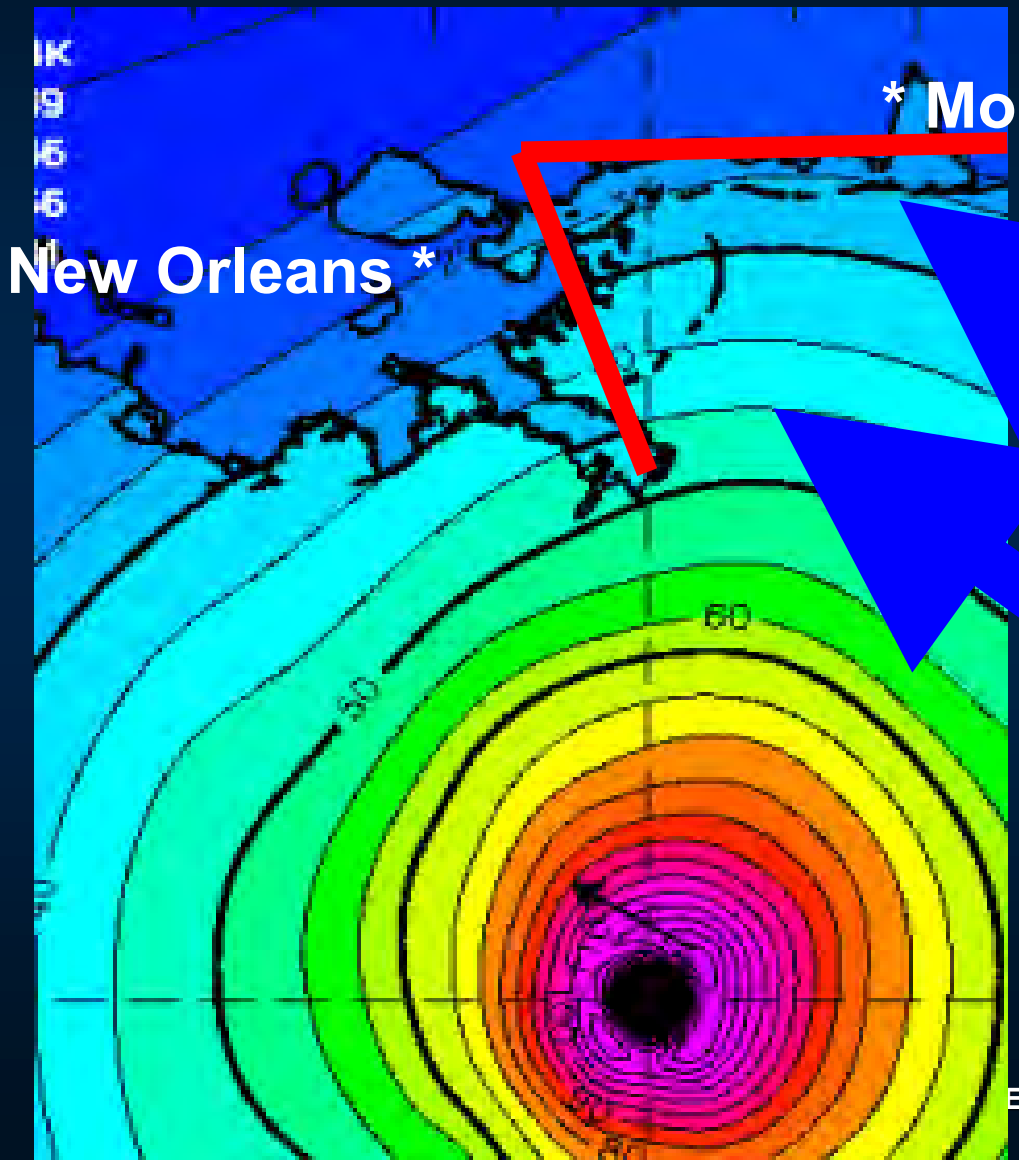
Storm Surge



Storm Surge



Storm Surge - Katrina



FEMA

SOURCES OF FLOOD ELEVATION INFO

- FLOOD INSURANCE RATE MAPS (FIRMS)

  CAUTION: BEST AVAILABLE DATA
- CORPS OF ENGINEERS - SLOSH MODEL
- HISTORICAL FLOOD LEVELS

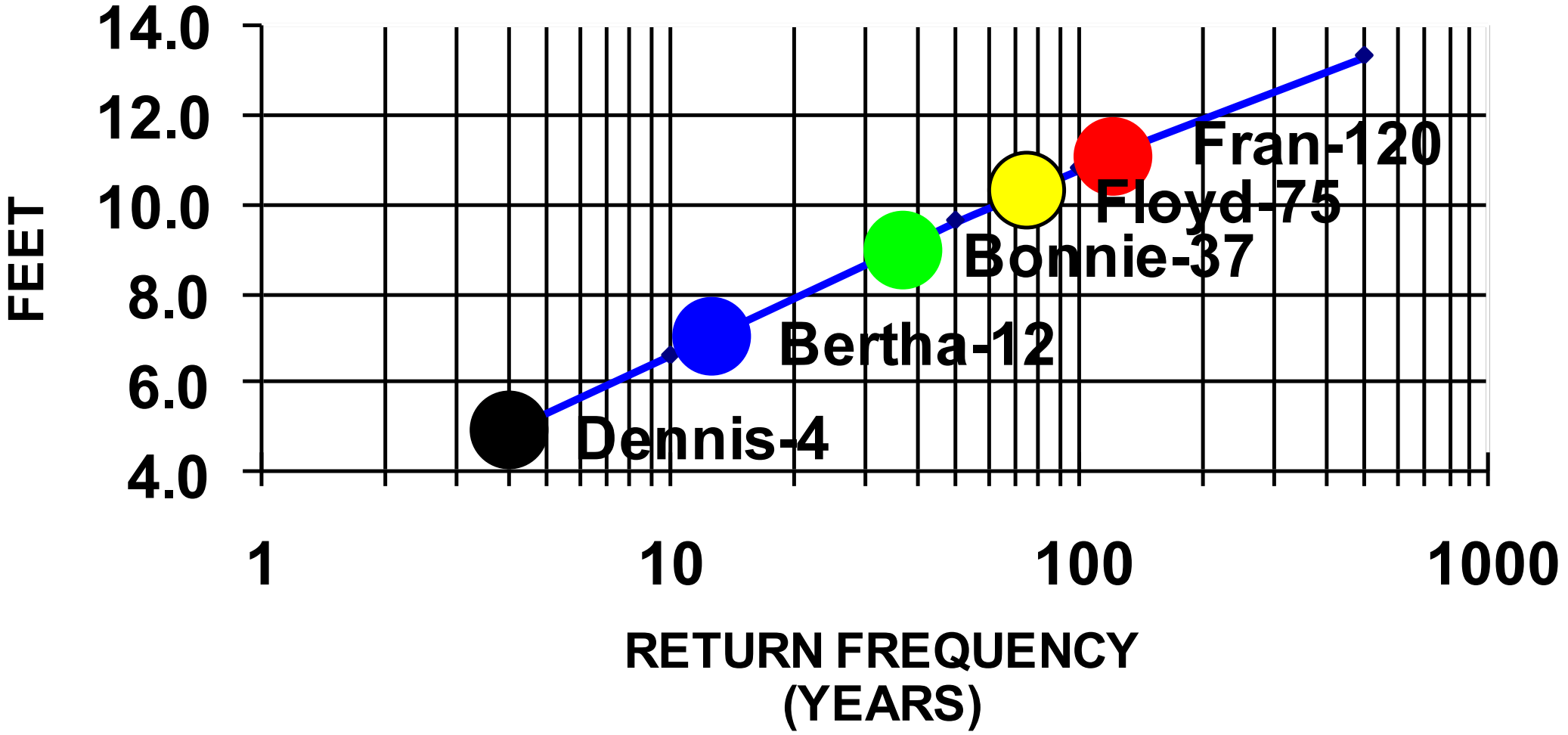
  U.S. GEOLOGICAL SURVEY

  STORM SURGE GAGES

  https://stn.wim.usgs.gov/FEV/

STORM SURGE ELEVATIONS
Behind Masonboro Island

HISTORY



ACCUMULATED RISK

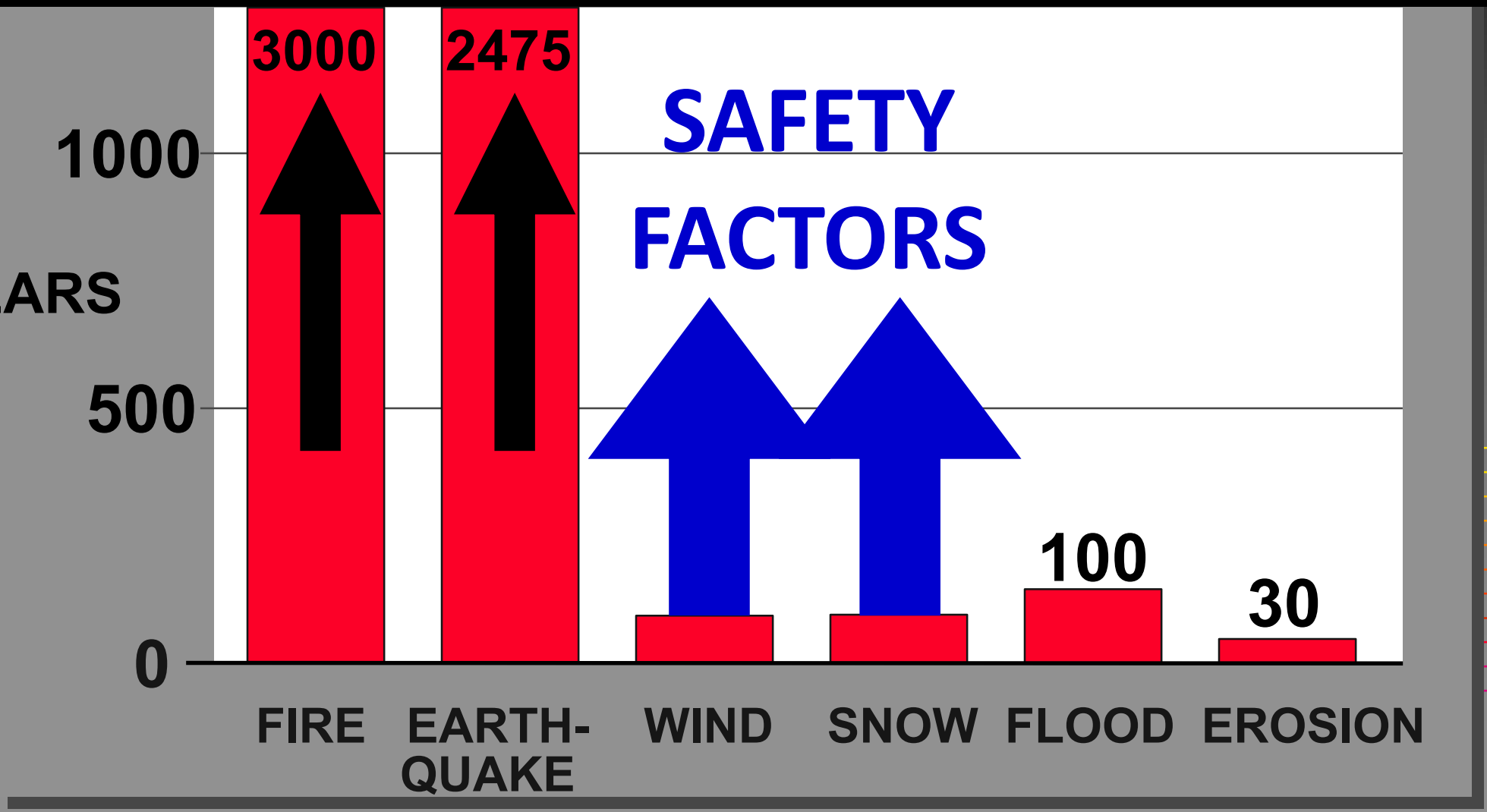
100-Year Flood = 1% Risk Each Year

70-Year Average Building Lifetime

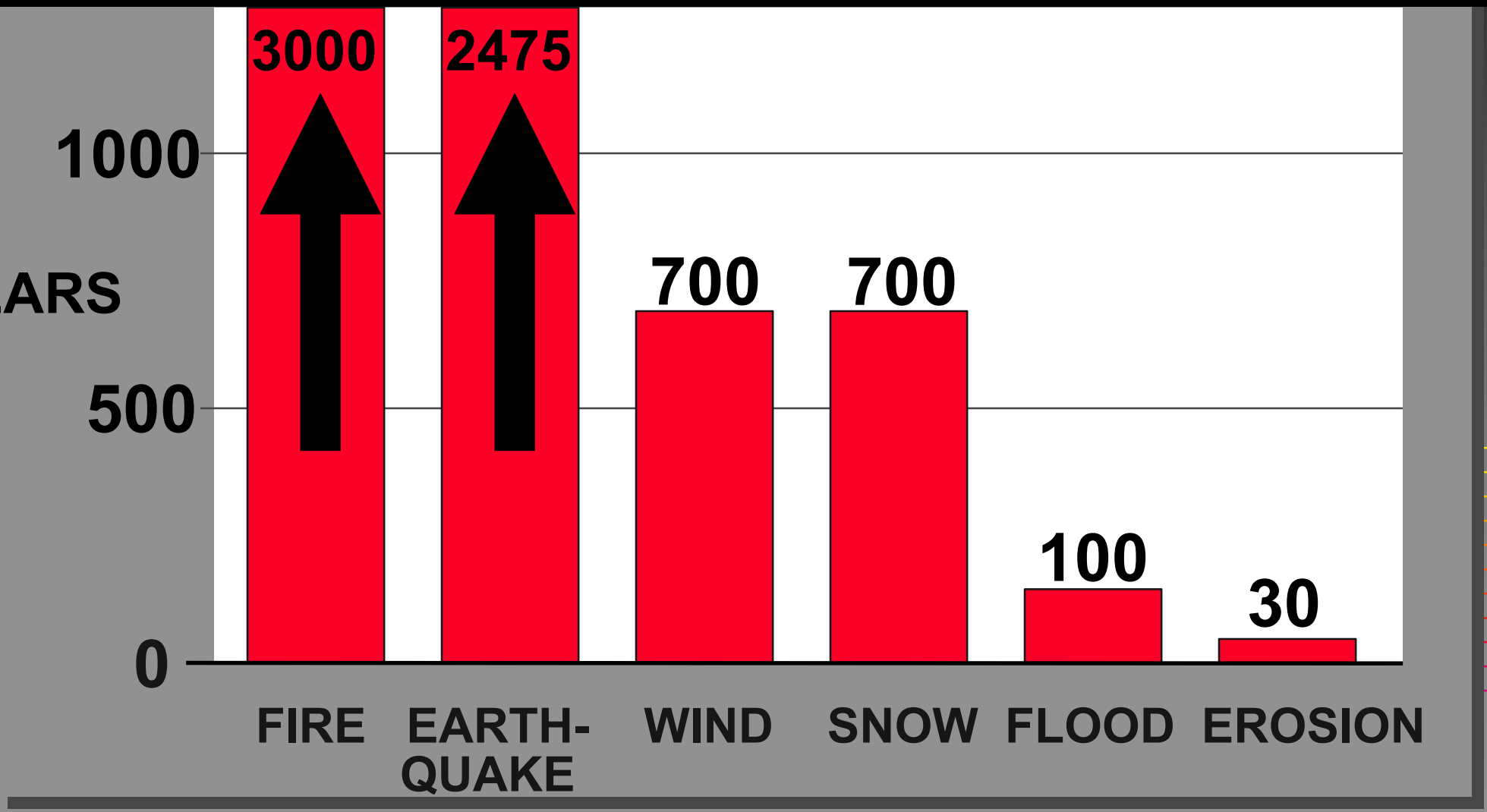
= 51% RISK OF EXCEEDANCE

HEADS or TAILS!

CONSTRUTION STANDARDS: RETURN PERIODS



CONSTRUTION STANDARDS: RETURN PERIODS



FLOOD PREDICTION MAY BE TOO LOW
INSULATION AND UTILITIES IN FLOOR

NO SAFETY FACTOR

FLOOD DESIGN RULE # 2

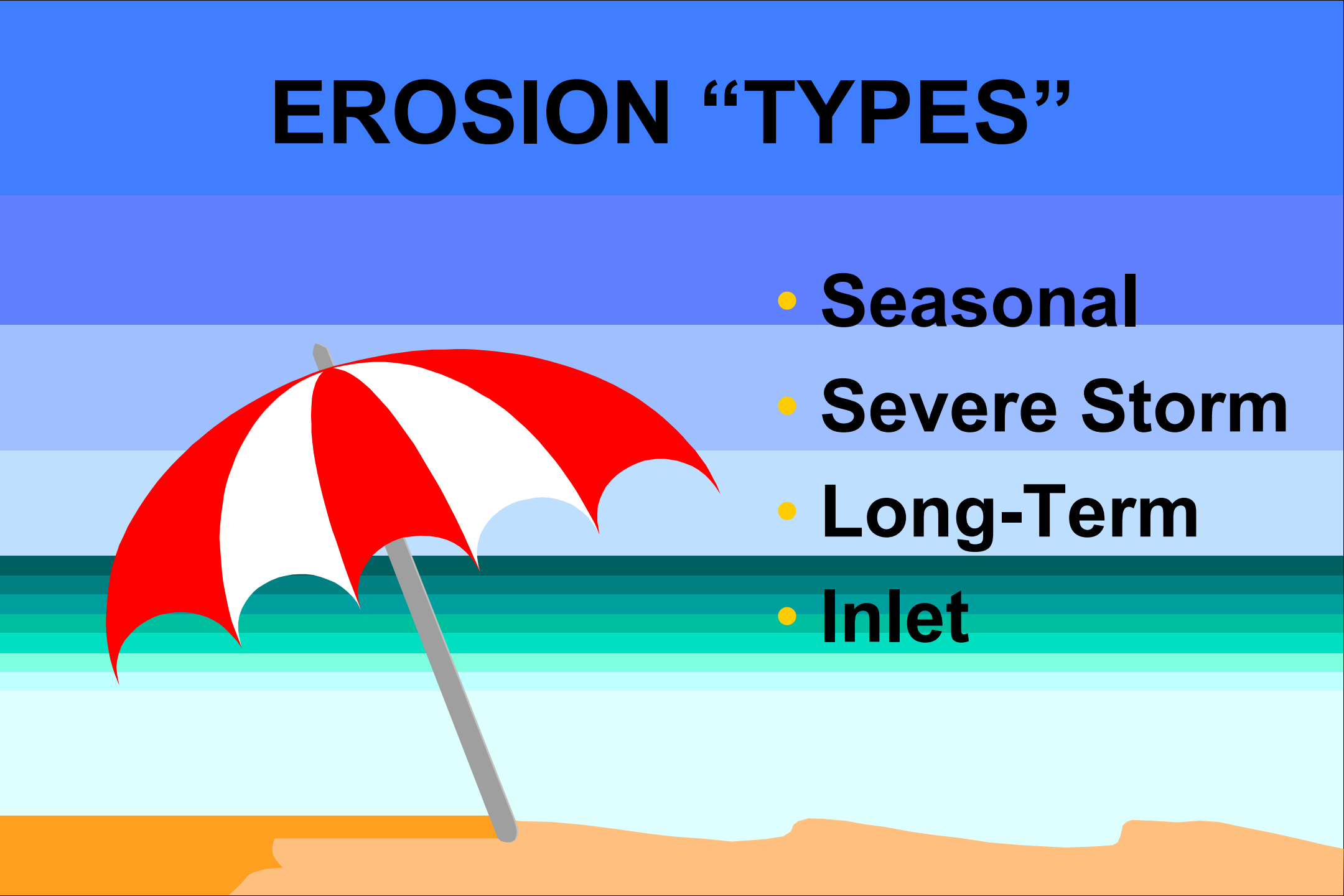
DON'T EVEN GET CLOSE TO WET

COASTAL HAZARDS

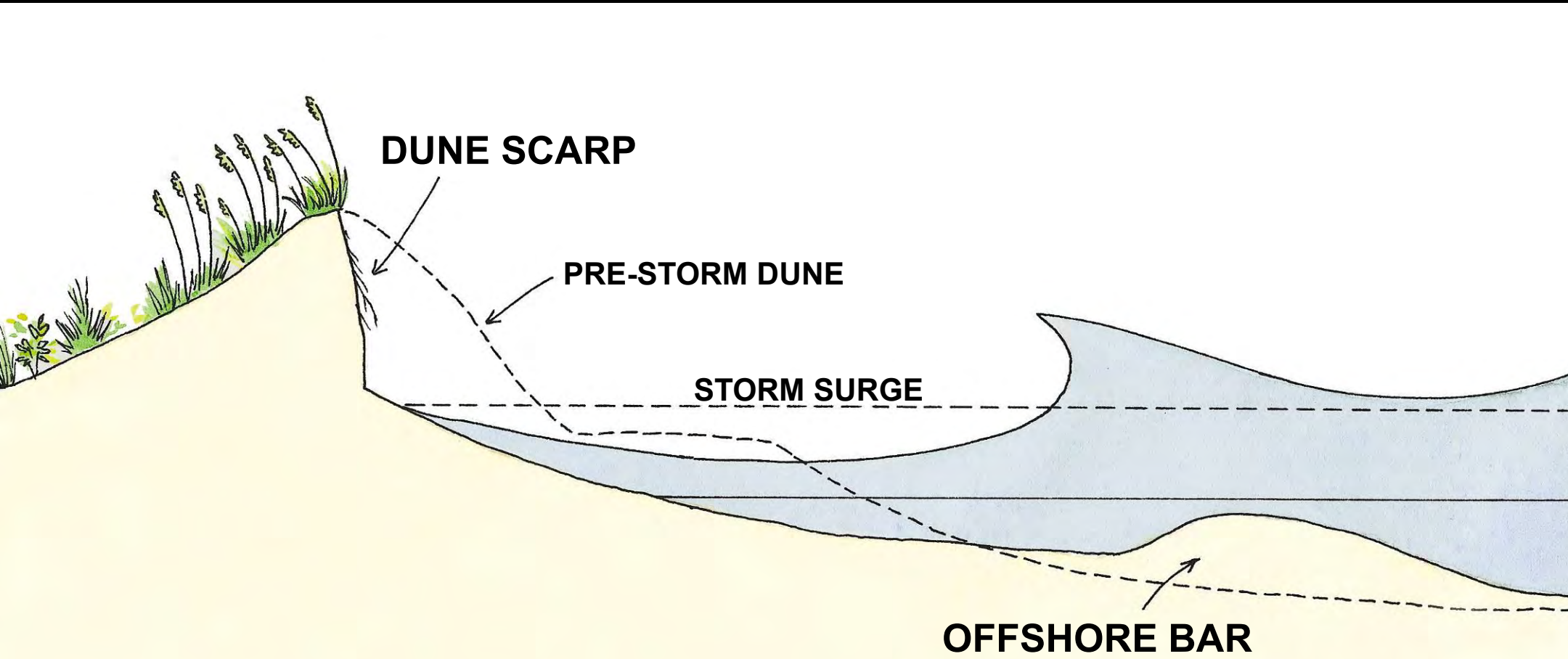
THE WORST:

- **FLOODING or STORM SURGE**
- **EROSION**
- **WAVES**
- **WIND EXPOSURE**

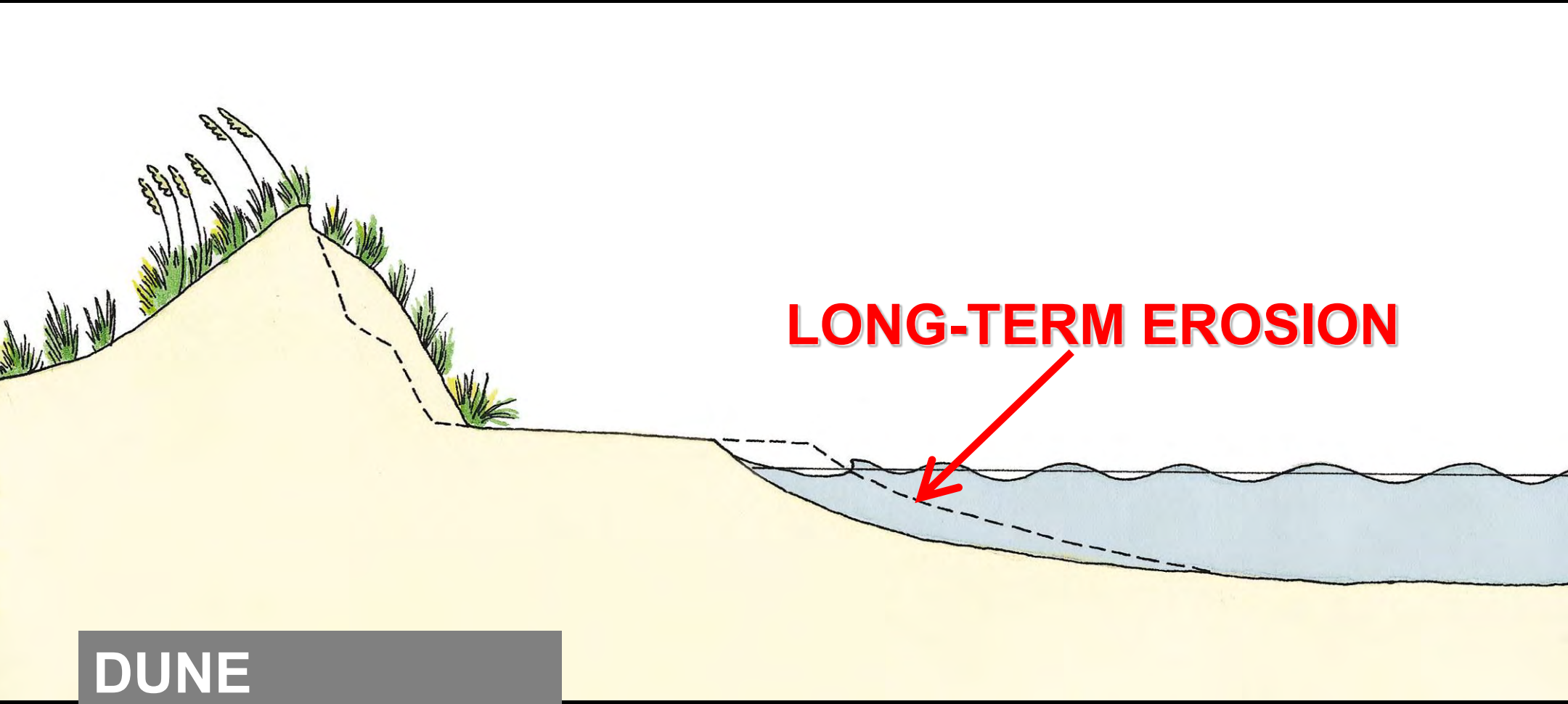
EROSION “TYPES”



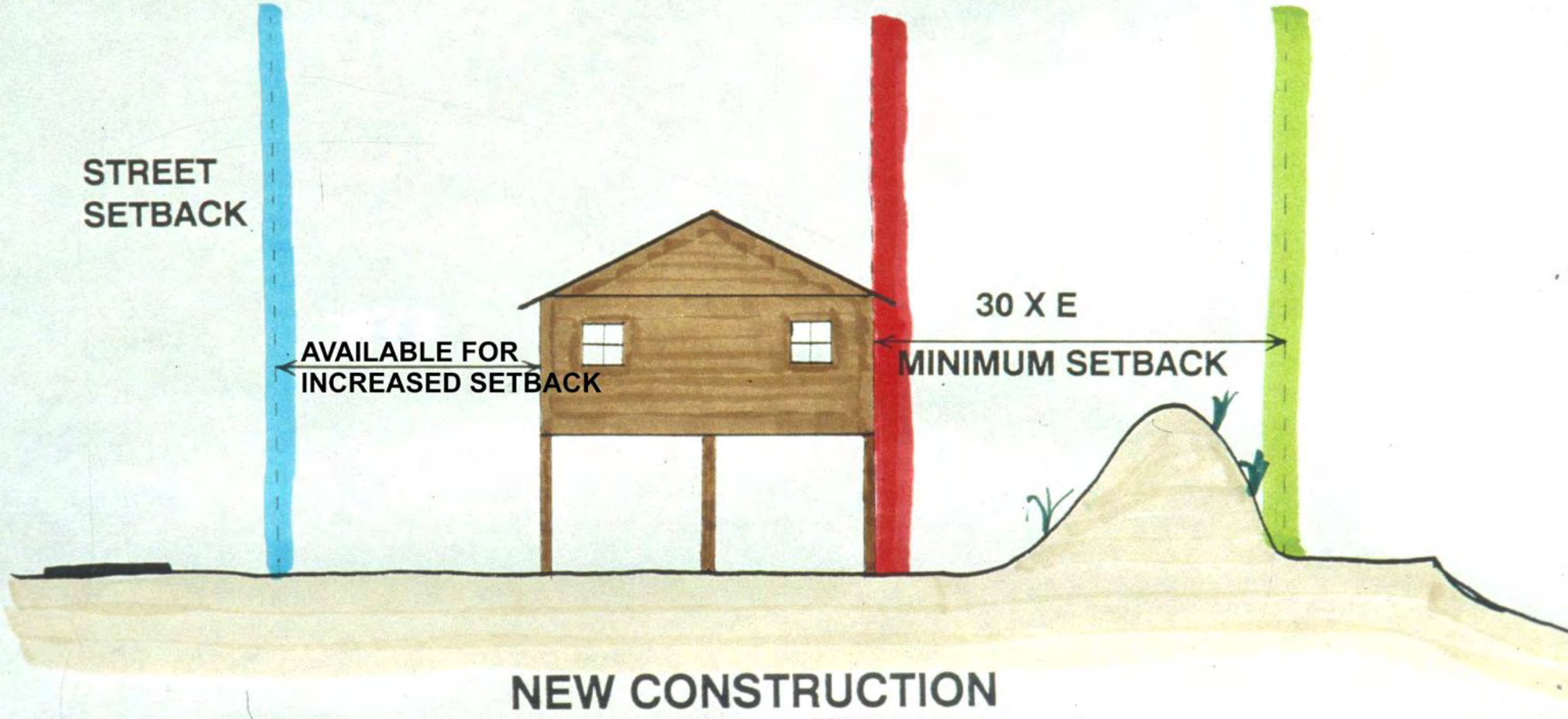
- Seasonal
- Severe Storm
- Long-Term
- Inlet

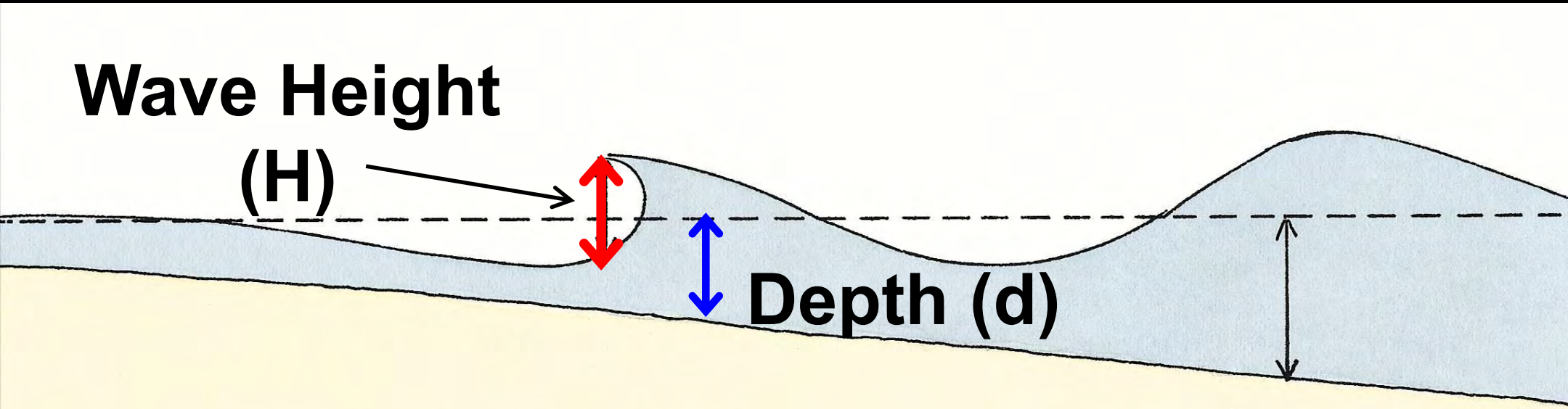


STORM-INDUCED



DUNE RECOVERY


STREET
SETBACK
AVAILABLE FOR
INCREASED SETBACK
30 X E
MINIMUM SETBACK
NEW CONSTRUCTION



Wave breaks: Wave Height = Depth

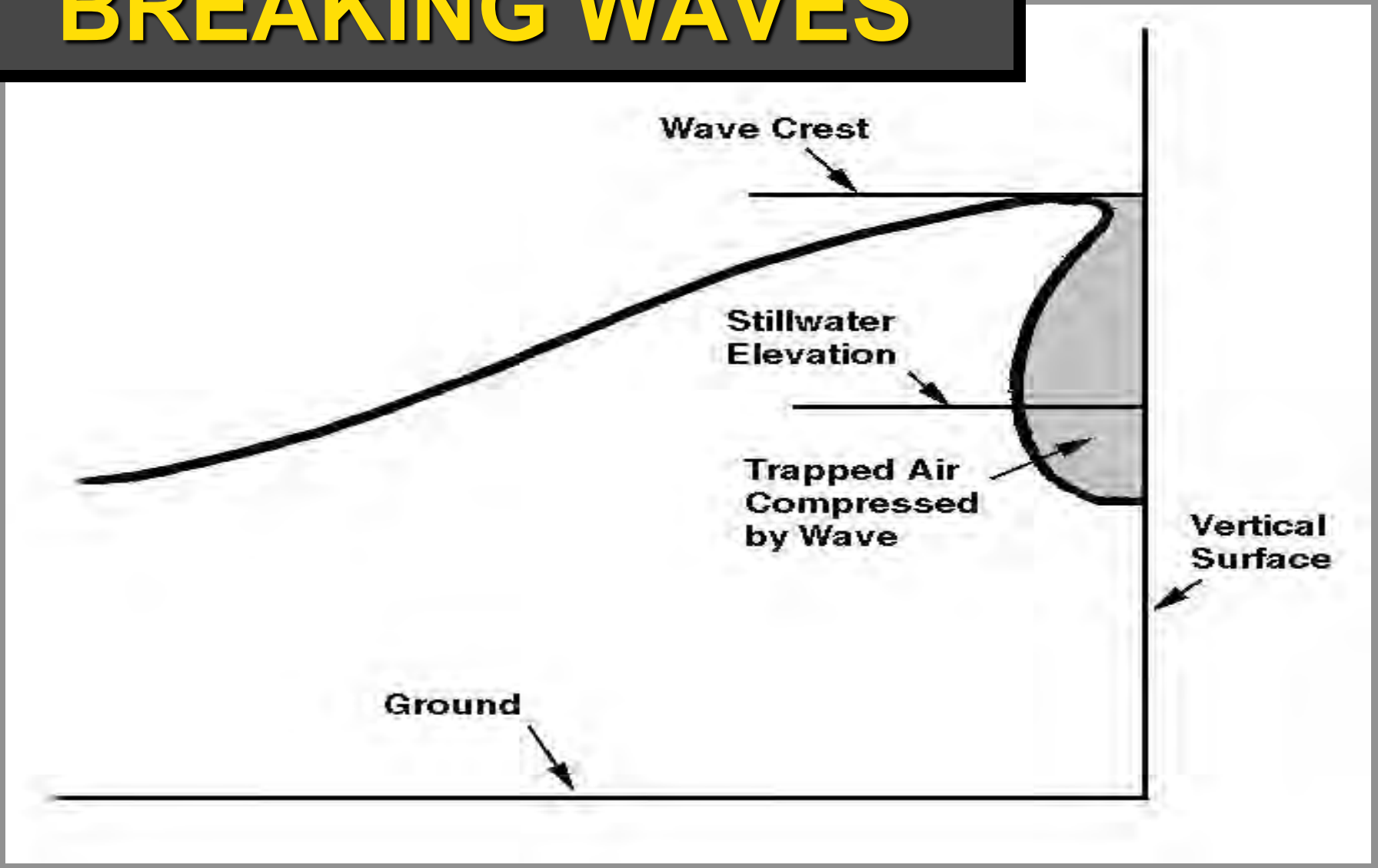
H = 78% d

SHALLOW WATER DEPTH LIMITS
WAVES TO LESS THAN 6 FEET
UNDER MOST BUILDINGS

FLOOD RULE # 3 (Coastal)

DON'T EVER GET HIT BY A WAVE

BREAKING WAVES



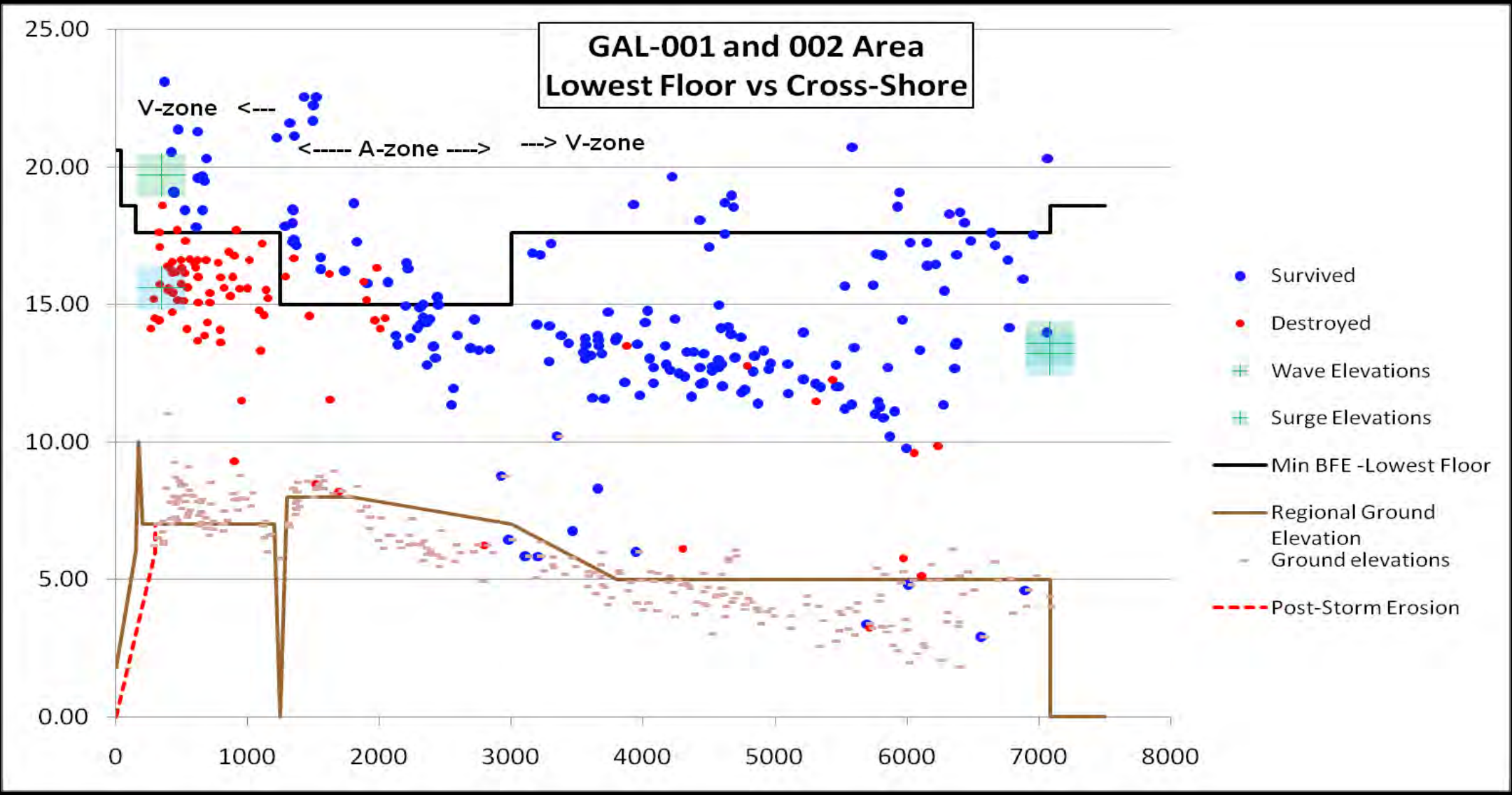
LIMWA
Limit of Moderate Wave Action

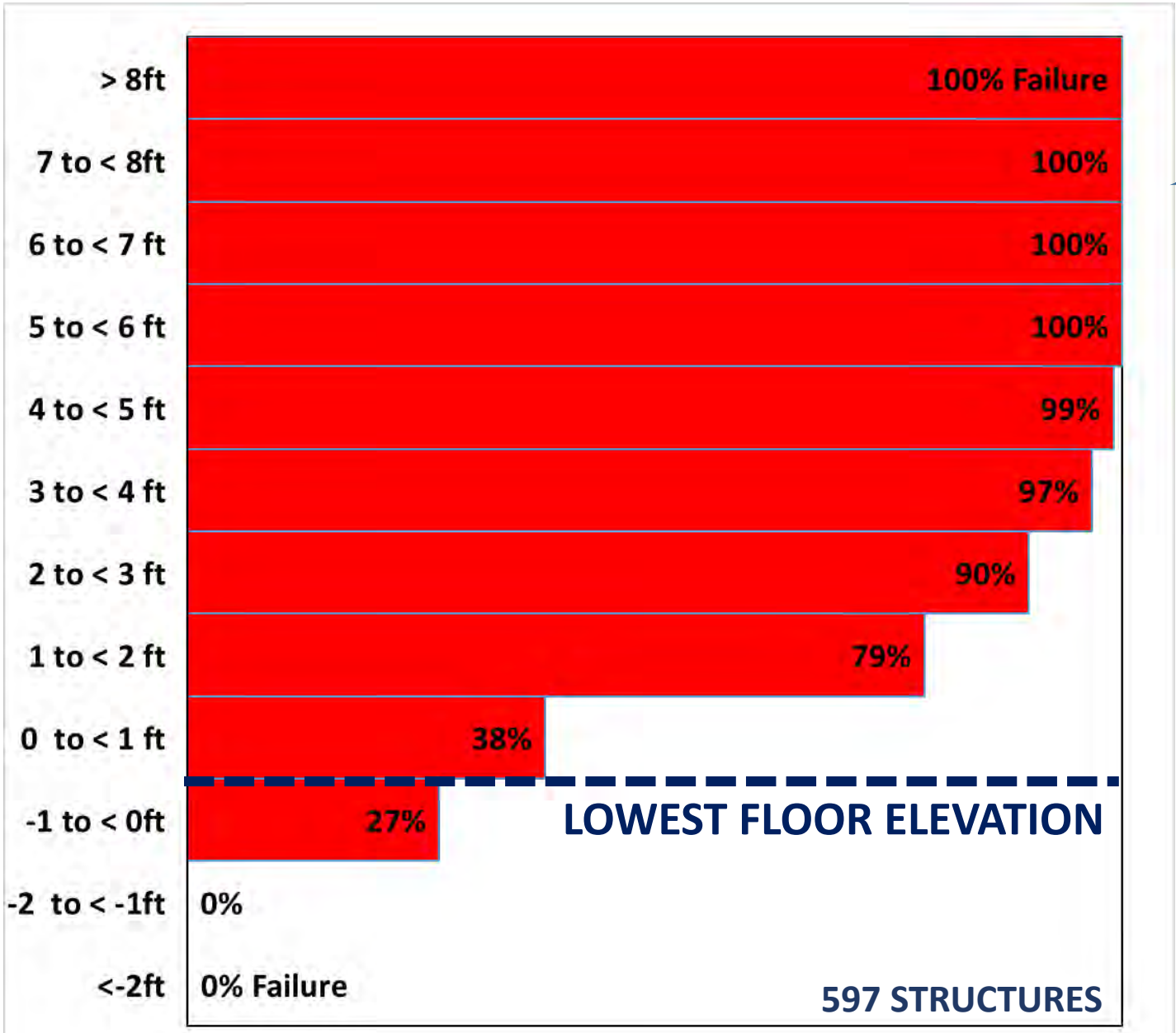
EQUIVALENT FORCES:

~160 mph WIND = ? - foot WAVE

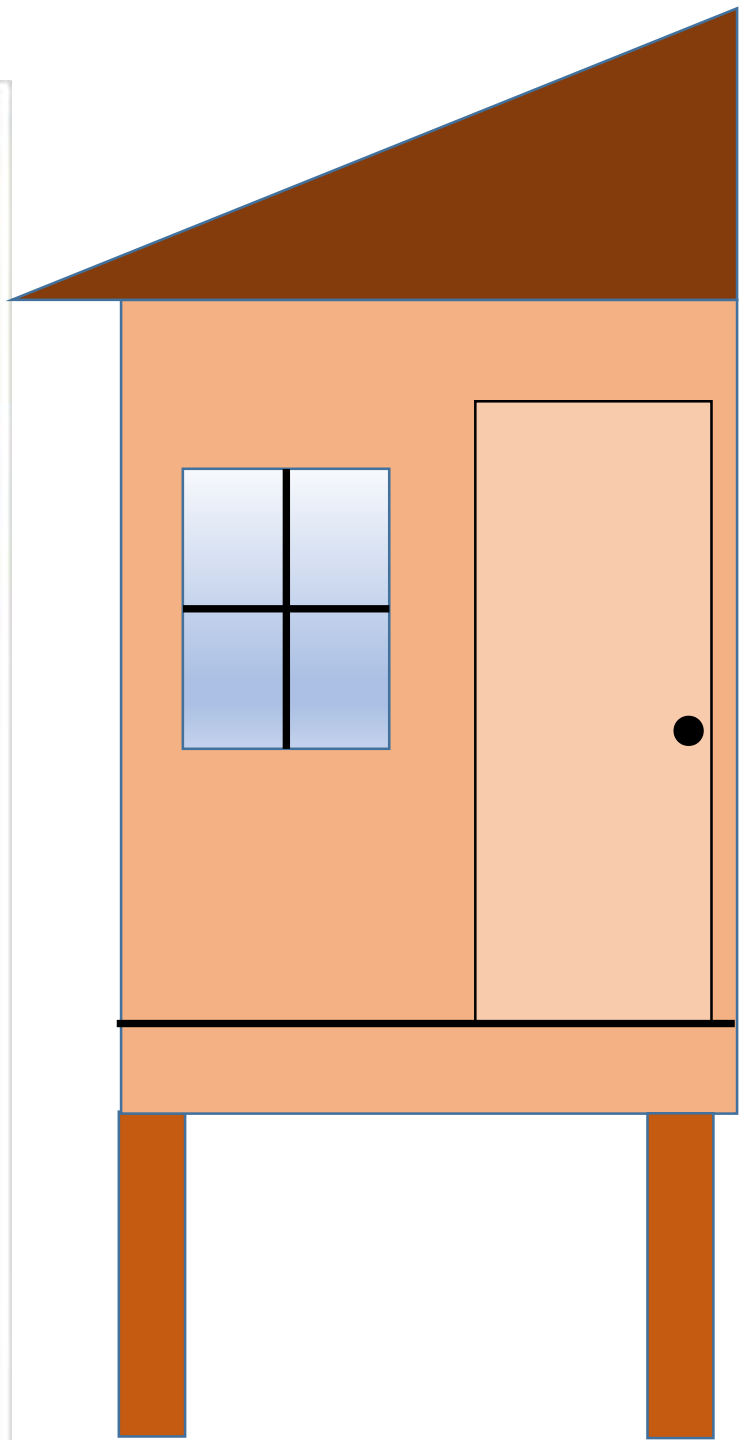
~1.5 - foot WAVE

6th Row


GAL-001 and 002 Area
Lowest Floor vs Cross-Shore
V-zone <---
<----- A-zone ----->
---> V-zone
25.00
20.00
15.00
10.00
5.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
Survived
Destroyed
Wave Elevations
Surge Elevations
Min BFE -Lowest Floor
Regional Ground Elevation
Ground elevations
Post-Storm Erosion



Failure Rate Relative to Peak Wave Elevation above Lowest Floor Elevation (LFE): ≤ 500' from Shoreline for ADCIRC



FLOOD INSURANCE FREEBOARD INCENTIVES

$$$

NFIP elevation discounts*

V-zone: $250K building/$100K contents

- +4 feet 66% (SAVING $5,580/year)
- +3 feet 62% DISCOUNT
- **+2 feet 47% DISCOUNT**
- **+1 foot 24% DISCOUNT**
- **Minimum $8,434 Annual Premium**

*Rates change annually. Ask your insurance agent

FLOOD INSURANCE RATES

WARNING! $$,$$$

2012-2014 NFIP legislation

- Pre-FIRM subsidies repealed
- Actuarial rates required
- Premium increases up to 25% year
- Some increases delayed
- May need elevation certificate to stop increases

PRACTICE:

“Ask your insurance agent.”

WIND

- STRUCTURAL INTEGRITY
- BUILDING ENVELOPE

STRUCTURAL INTEGRITY RULES

1. CONNECTIONS
2. CONNECTIONS
3. CONNECTIONS

STRUCTURAL DAMAGE OBSERVATIONS

UPLIFT DAMAGE MORE COMMON THAN LATERAL FAILURES

ROOF DECK: INSPECT & RENAIL WHEN REROOFING

79

BUILDING ENVELOPE

EXTERIOR WATER BARRIER

- ROOFING
- SIDING
- WINDOWS AND DOORS

OPENING PROTECTION

- WINDOW MATERIALS
- STORM SHUTTERS

DAMAGE RATIO

$ WATER DAMAGE vs STRUCTURAL DAMAGE

HOUSES = 3:1

HIGH RISE = 7:1

ROOF COVERING STANDARDS

65 MPH

PREVIOUS STANDARD

HIGH WIND PRODUCTS AVAILABLE

WIND INSURANCE MITIGATION INCENTIVES

$$$

PRACTICE:

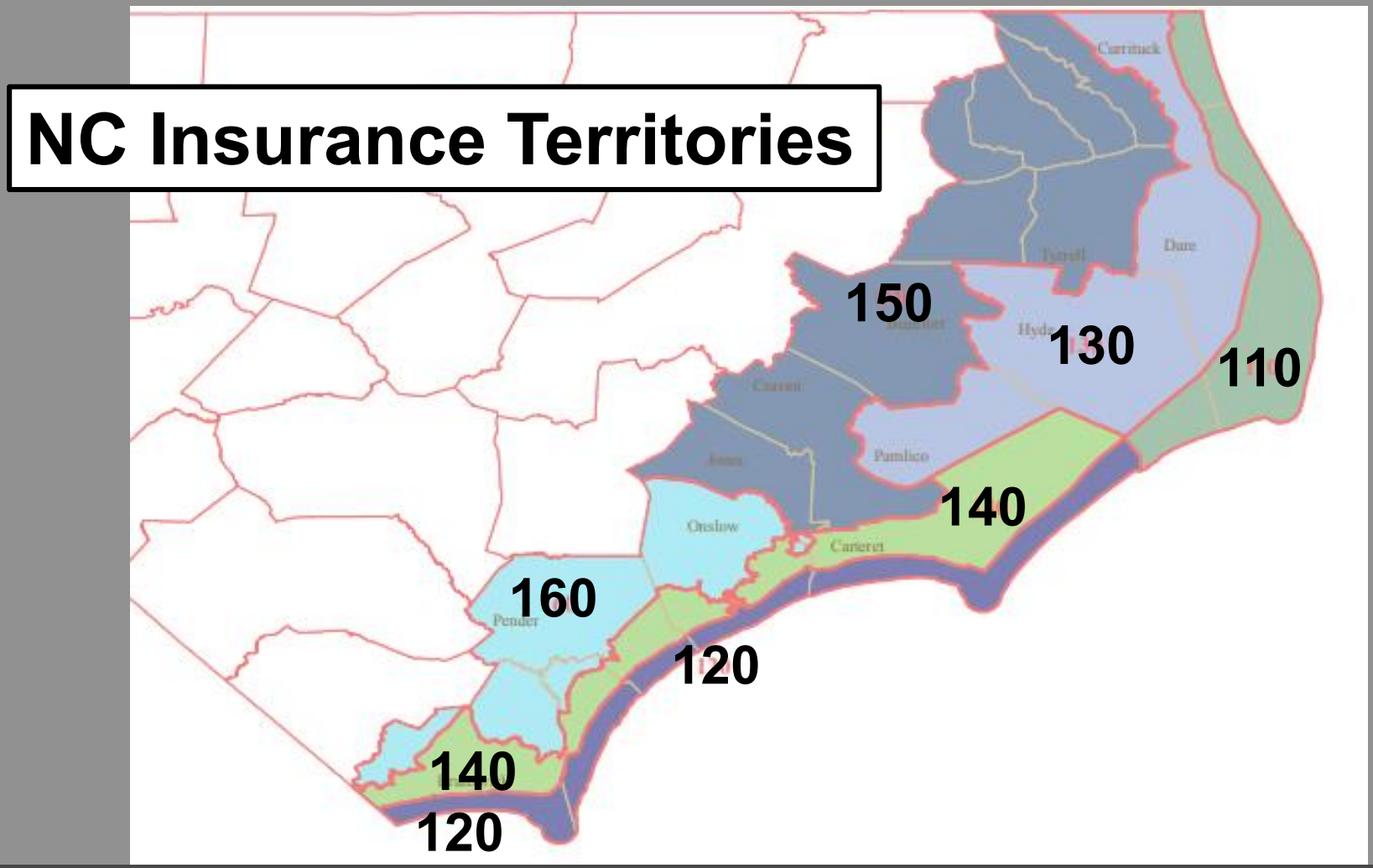
“Ask your insurance agent.”

WIND INSURANCE MITIGATION INCENTIVES

$$$

- PREMIUM DISCOUNTS
  (All companies)
- ROOFING UPGRADE INCENTIVES
  (NCJUA/NCIUA policies only)

WHO WILL QUALIFY?



OPTIONS TO QUALIFY for PREMIUM DISCOUNTS

1. NC Dept. of INSURANCE
2. Institute for Business and Home Safety (IBHS)

FORTIFIED HOMES PROGRAM

NC Dept of Insurance Credits

- Full HIP ROOF
- OPENING PROTECTION

Windows, Doors & other glass (Certified shutters or impact glass)

- or BOTH

NC DOI: HOW I QUALIFY?

Provide your agent:

- **ROOF PHOTOS**
- **WINDOWS:**

CONTRACTOR INSTALLATION CERTIFICATION & PRODUCT TEST DOCUMENTION (no plywood)

NC DOI: HOW MUCH CAN I SAVE?

HOMEOWNERS WIND & HAIL POLICY FRAME CONSTRUCTION

Territory	HIP ROOF	(WINDOW) OPENING PROTECTION	HIP ROOF & OPENING PROTECTION
SOUTHERN BEACHES #120	6.2%	6.3%	12.5%
Carteret to Brunswick #140	6.0%	6.1%	12.1%
West of Above #160	5.6%	5.8%	11.4%

Oct. 2018

FORTIFIED: HOW DOES IT WORK?

BUILDING "EVALUATION" REQUIRED

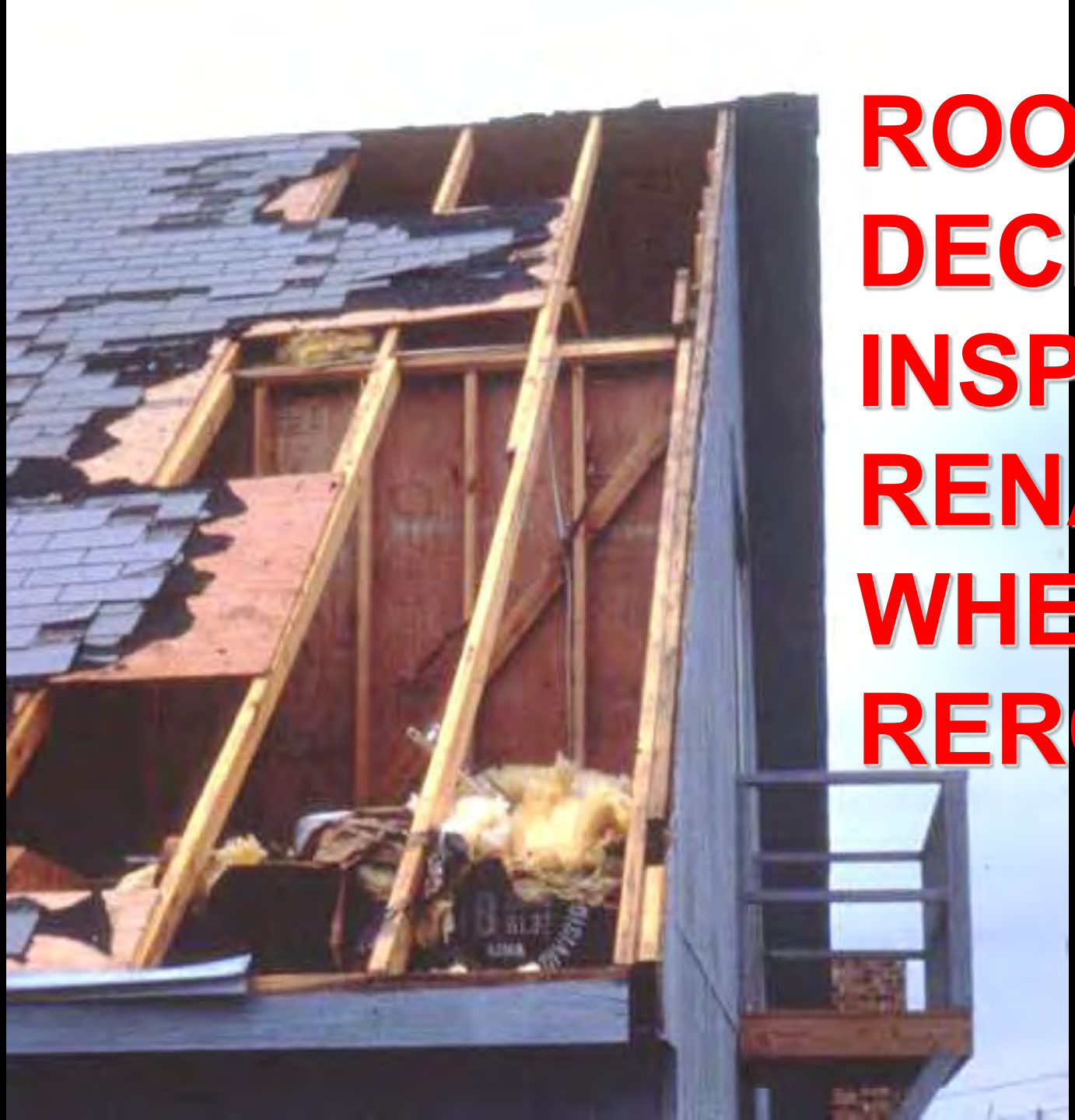
FORTIFIED: Existing Retrofit or New Construction

FORTIFIED ROOF "Bronze"	FORTIFIED SILVER	FORTIFIED GOLD	SAFER LIVING
MINIMAL DAMAGE IN CAT 1	MINIMAL DAMAGE IN CAT 2	MINIMAL DAMAGE IN CAT 3	BUILDING CODE PLUS

fortifiedhome.org

Re-Roofing or New Construction

- EXTRA ROOF DECK NAILING
- SECONDARY WATER PROTECTION
- HIGH WIND ROOF COVERING
- ROOF VENT ATTACHMENTS AND SEALING GABLE VENTS
- REINFORCE GABLE ENDS



ROOF DECK: INSPECT & RENAIL WHEN REROOFING

FORTIFIED ROOF™

NEW or RE-ROOFING

SECONDARY WATER PROTECTION

FORTIFIED GOLD™

- ALL OF BRONZE & SILVER
- DETAILED LOAD PATH ANALYSIS
- MAY REQUIRED SOME DISASSEMBLY TO INSPECT
- WIND RATED WINDOWS AND DOORS

IBHS: HOW MUCH CAN I SAVE?

Re-roofing or New Construction
Wind & Hail Coverage
Frame Construction

Territory	FORTIFIED: ROOF "BRONZE"	SILVER	GOLD	Code PLUS
NORTHERN BEACHES #110	7.6%	14.7%	18.1%	20.3%
SOUTHERN BEACHES #120	7.8%	15.9%	19.5%	21.9%
Currituck to Pamlico #130	6.8%	11.6%	14.8%	17.4%
Mainland Carteret to Brunswick #140	7.5%	15.0%	18.7%	20.2%
West of above #160	7.0%	14.1%	16.9%	19.0%

Oct. 2018

HOW MUCH WILL A FORTIFIED EVALUATION COST ME?

IT DEPENDS: $200-$600

- CURRENT CONDITION REPORT
- ~ 2 PROGRESS INSPECTIONS
- FINAL INSPECTIONS
- CONSTRUCTION IMPROVEMENTS MUCH LOWER FOR NEW HOUSES

WIND INSURANCE INCENTIVES

$$$

BEACH & FAIR PLANS (NCJUA & NCIUA)

- Beach Territories

If roof covering **+50% damaged**:

Construction Cost - Fortified Bronze

$5,000

- Coastal County Territories

If **reroofing**:

Up to **$600** Bronze Evaluation

WIND INSURANCE INCENTIVES

$$$

BEACH & FAIR PLANS (NCJUA & NCIUA)

Beach Territories

NCIUA Reroofing Grants

(limited number in 2020)

$6000 grants

OOPS! Didn't read your notice?

Sorry, Expired Sept. 10th…….

INSURANCE INCENTIVES

$$$

QUESTIONS?

“Ask your insurance agent.”

Other QUESTIONS?

rogerssp@uncw.edu

https://ncseagrant.ncsu.edu/wp-content/uploads/2018/09/WindInsuranceIncentivesMemo_Sept2018.pdf