Coastal Flood Hazard Mitigation in the Great Lakes

Basic Training for Great Lakes Stakeholders

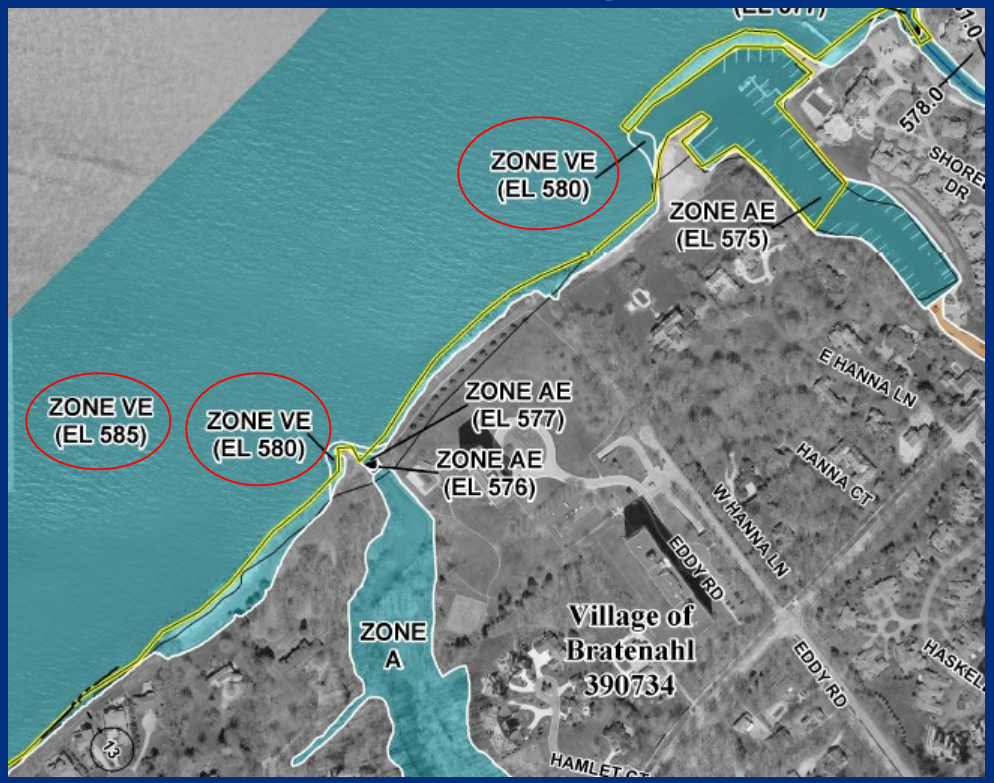
Summer 2019

FEMA

So you're getting new maps…

…and they have new zones (VE zones) on them.

Now what?



Cuyahoga County, OH, effective 8/15/19

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You need to know about:

- What makes coastal flooding different from riverine flooding;
- Finding relevant data for floodplain management in coastal areas;
- Floodplain management standards for coastal high-hazard areas (NFIP minimum and “higher” standards);
- Reducing potential flood damage in a coastal area without unduly restricting property rights;
- Coastal high hazard areas and NFIP insurance.

NFIP participating communities:

- Will need to adopt floodplain management regulations that meet NFIP standards for coastal high-hazard areas set forth in Section 60.3(e) of Title 44, *Code of Federal Regulations*.
  - Not just updating the effective date of FIRM and FIS!

- Will have a period of 6 months to do so after the date of the Letter of Final Determination setting the effective date of an FIS and FIRMs containing coastal high-hazard areas.

State coordination

- We want to ease that transition, and to familiarize you with coastal floodplain management in advance.

- FEMA and the States cooperate to assist local communities with the fulfillment of the responsibilities they undertake by choosing to participate in the NFIP.

State regulations and model ordinances

In Lake County the Lake County WDO contains floodplain management regulations that meet NFIP minimum standards up through Section 60.3(d), as well as applicable state regulations.

- FEMA and Illinois DNR will work with Lake County SMC and stakeholder communities to add 60.3(e) standards to the Lake County WDO for those communities' use.

In Cook County, the MWRD Watershed Management Ordinance <u>does not</u> meet NFIP minimum standards, and each community must maintain its own compliant ordinance.

- FEMA and Illinois DNR can work with stakeholder communities individually or provide a revised version of the former NEIPC model floodplain management ordinance, to include 60.3(e) standards.

Responsibilities:

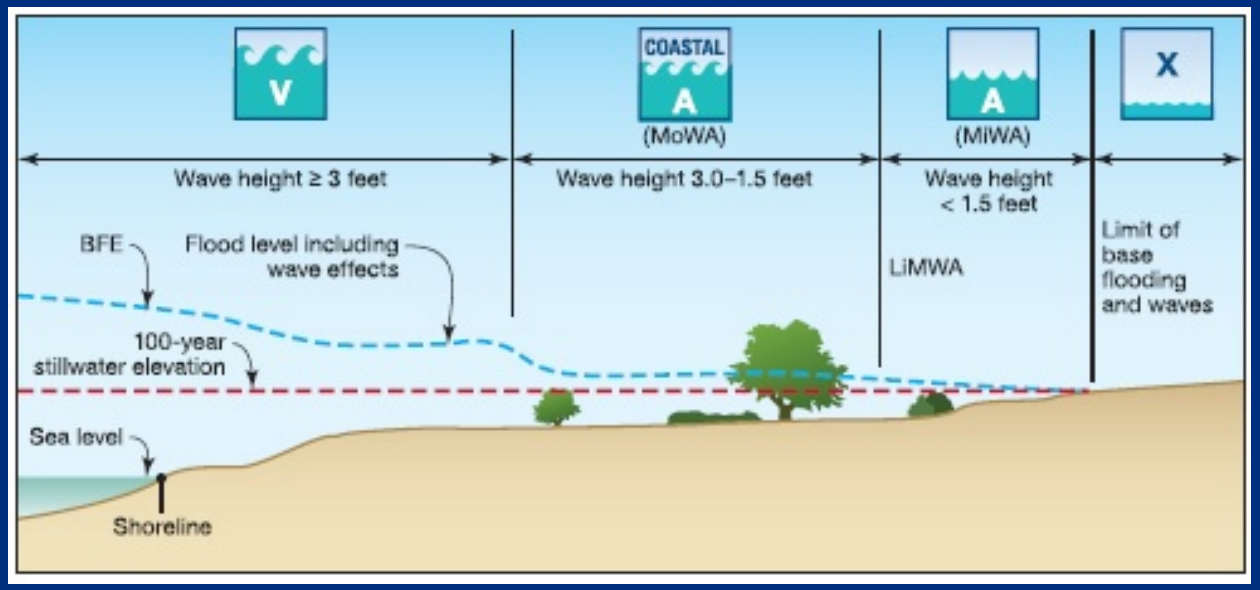
"After December 31, 1971, no new flood insurance coverage shall be provided under this chapter in any area (or subdivision thereof) unless an appropriate public body shall have adopted adequate land use and control measures (with effective enforcement provisions) which the Administrator finds are consistent with the comprehensive criteria for land management and use under section 4102 of this title."

Section 1315 of the National Flood Insurance Act of 1968, as amended (42 U.S.C. §4022(a)(1) (2017)).

Your community's responsibilities

"A community eligible for the sale of flood insurance shall be subject to suspension from the Program for failing to submit copies of adequate flood plain management regulations meeting the minimum requirements of paragraphs (b), (c), (d), (e) or (f) of §60.3 […] within six months from the date the Federal Insurance Administrator provides the data upon which the flood plain management regulations for the applicable paragraph shall be based."

44 C.F.R. §59.24(a)



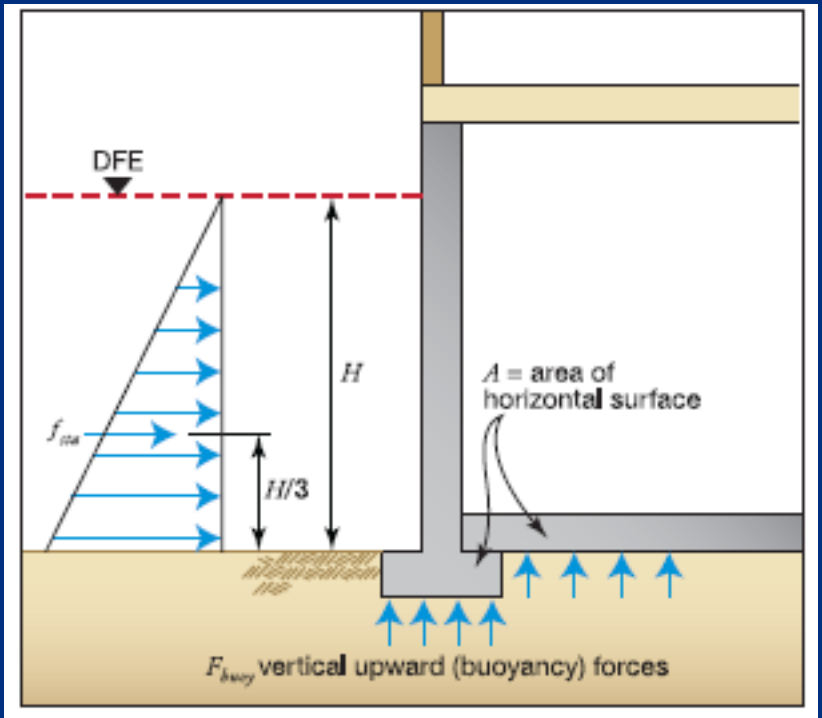
Basics of coastal flooding

I. COASTAL FLOODING

How is coastal flooding different from riverine and lacustrine flooding?

- A river floods when the discharge exceeds the capacity of the channel and it overflows its banks into areas that are “normally” dry.
- A pond or small lake floods when the water level rises above the ordinary high water mark and overflows onto normally dry land areas.
- In both cases, the usual primary hazards to property (i.e. buildings and their contents) are the hydrostatic and buoyant forces from the rising water, and the fact that stuff gets wet.

Horizontal and vertical (buoyant) hydrostatic forces



When the water rises THIS high…

- The stuff that isn't that high gets wet.
- Water spreads out over the floodplain and generally covers the area that is <u>not</u> that high.
- After a while the water flows away downstream, soaks into the ground, or evaporates, and the flood height decreases.

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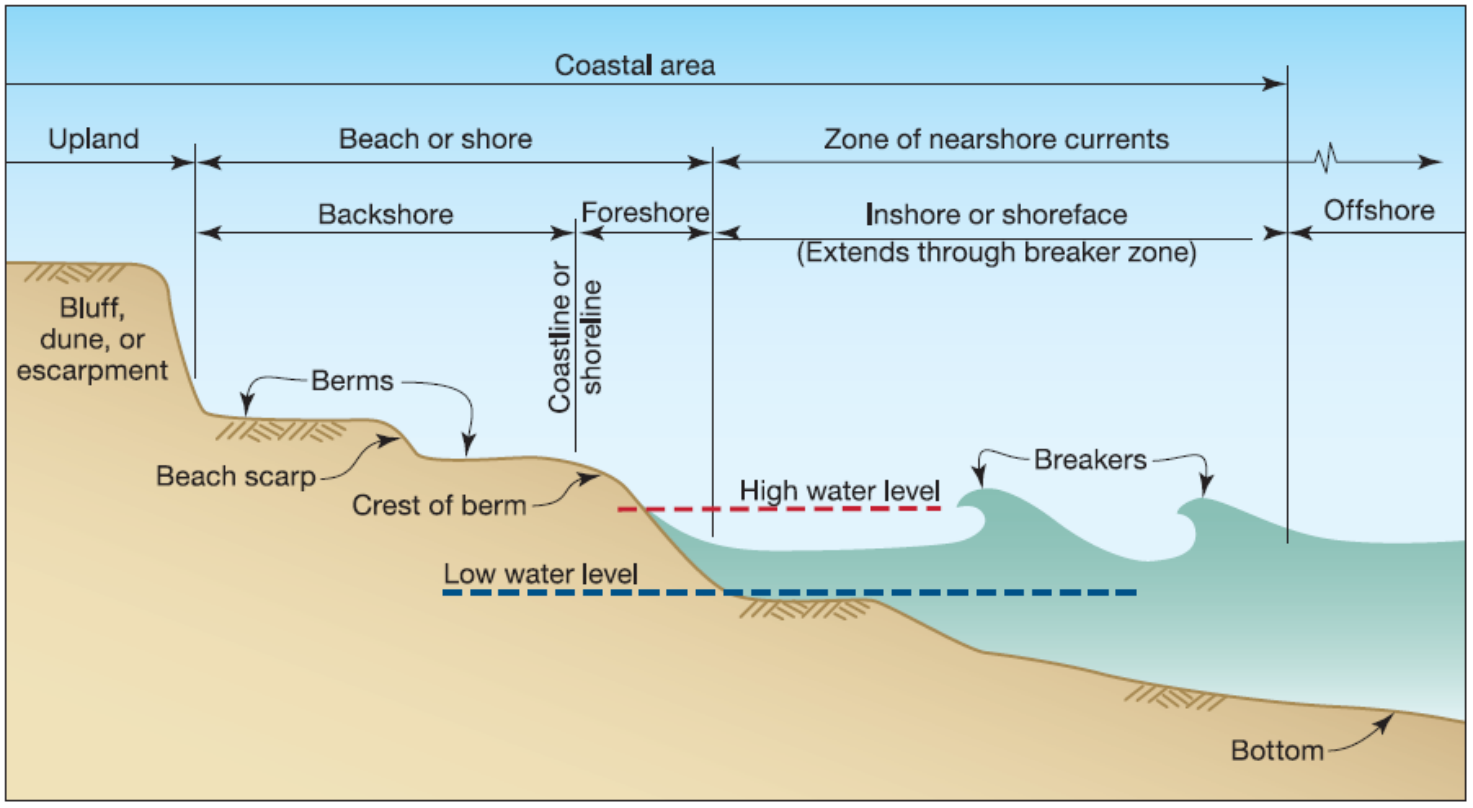
Coastal flooding:

- Tides (or fluctuating water levels)
- Currents
- Waves
- Wind



Coasts flood when storm surge (rising water) combines with wave effects (runup, overtopping, and/or overland wave propagation) to inundate normally dry land areas.

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Coastal flooding in the Great Lakes

- Tidal variation in Great Lakes is negligible
- Water levels do vary over long periods (years and decades) and seasonally (month to month)
- Storm events, varying atmospheric pressure, and wind-driven wave setup can produce storm surge over short periods (hours)
- Presence of ice cover may reduce the effects of storm events on water levels
- Great Lakes studies account for all of these probabilities

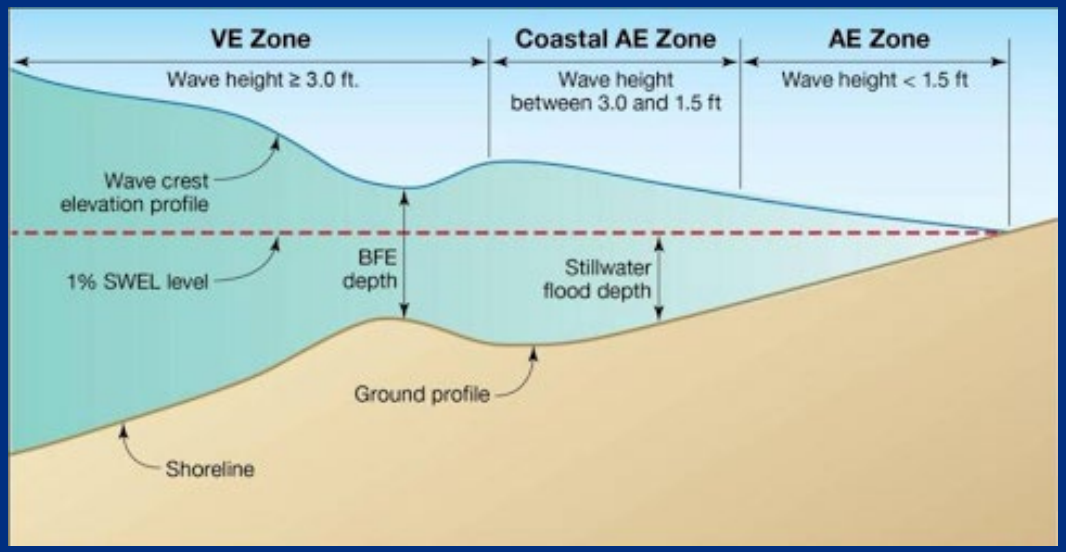
Wave height coastal flood zones:

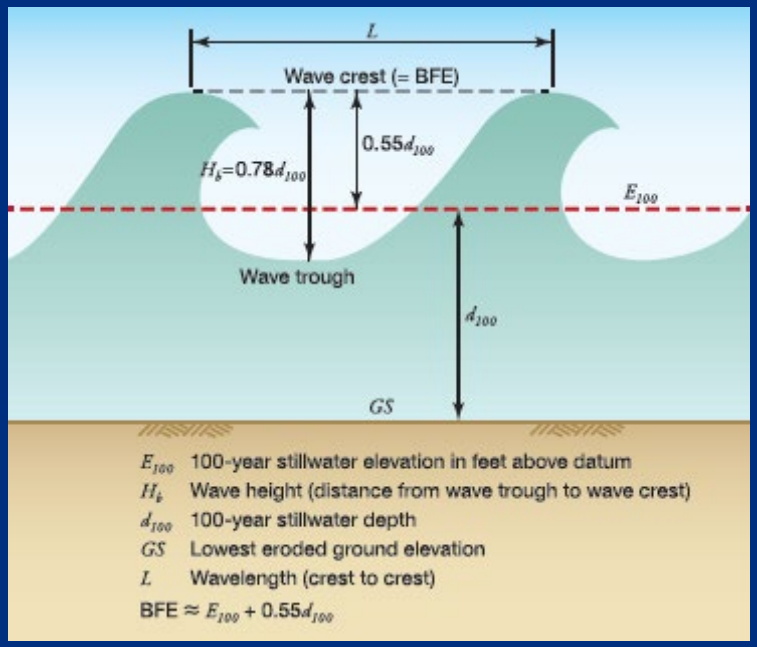
Rising water + waves

- In addition to rising water (surge plus wave setup), coastal flood hazards include some component of onshore wave effects.
- Generally, where the coastal topography is inundated by the rising water, the onshore wave component will include wave heights and may include overland wave propagation.
- Generally, where the slope is steeper or where there is a bluff face close to the shoreline, the onshore wave component will include wave runup where runup height is 3 feet or more.
- If runup exceeds the barrier crest height by 3 feet or more, landward of the barrier is an overtopping splash zone.

Wave heights and overland wave propagation:

- Analysis uses Wave Height Analysis for Flood Insurance Studies ("WHAFIS")





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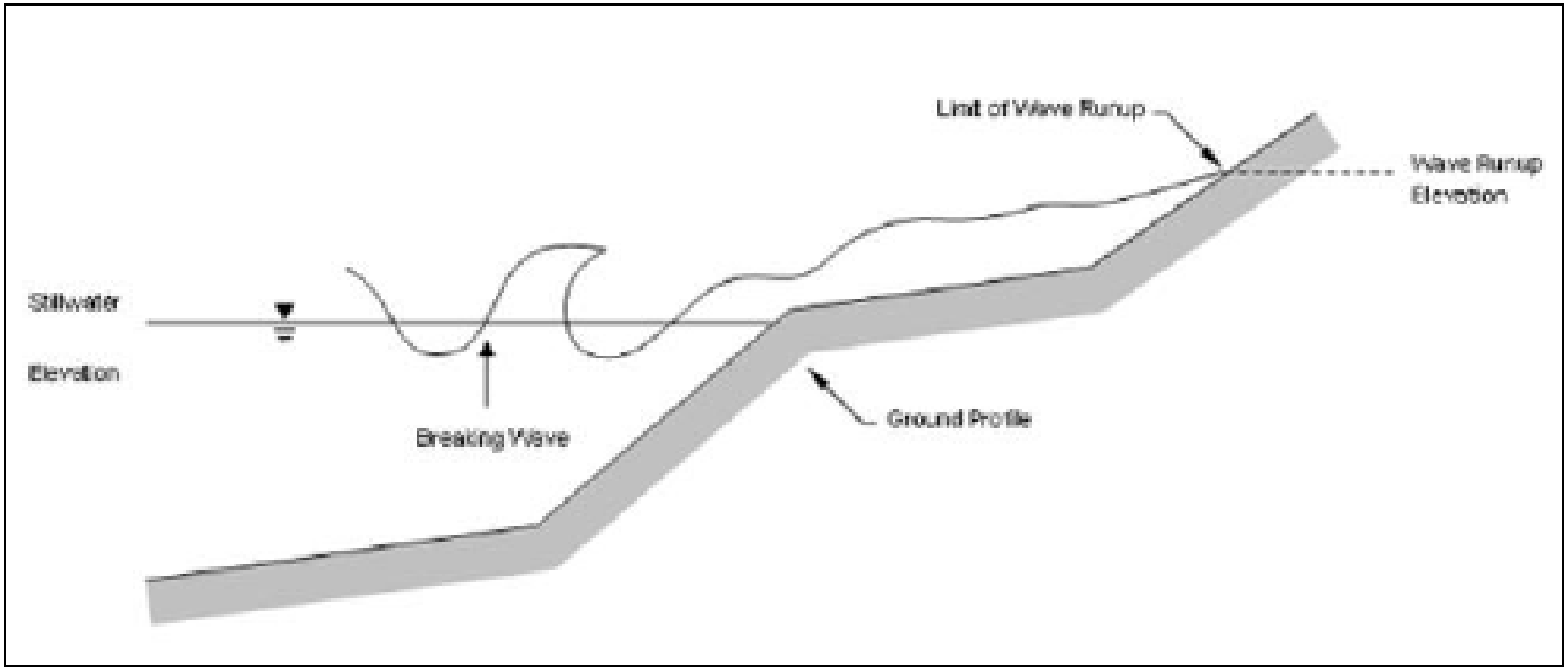
Wave runup:


Limit of Wave Runup
Wave Runup
Elevation
Stillwater
Elevation
Breaking Wave
Ground Profile

Wave runup scenarios:

Figure 5-1. Non-erodible High Coastal Bluff with VE Zone Controlled by Wave Runup (No Overtopping)

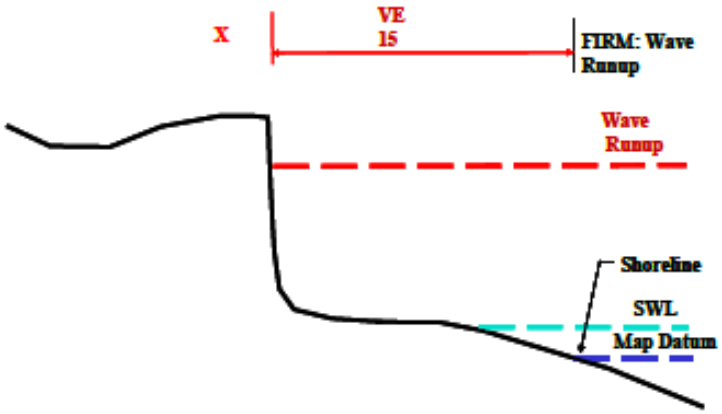


Figure 5-9. Sandy Beach Backed by Shore Protection Structure with VE Zone Controlled by the Splash Zone and High-velocity Flow from Wave Overtopping

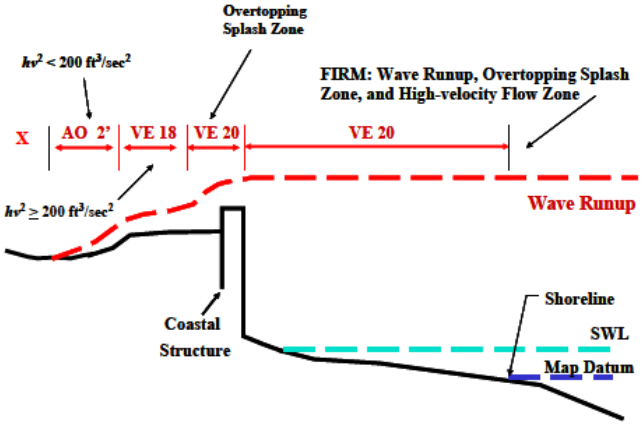


Figure 5-11. Cobble, Gravel, Shingle or Mixed Grain Sized Beach with VE Zone Controlled By Wave Runup, Overtopping and High Velocity Flow

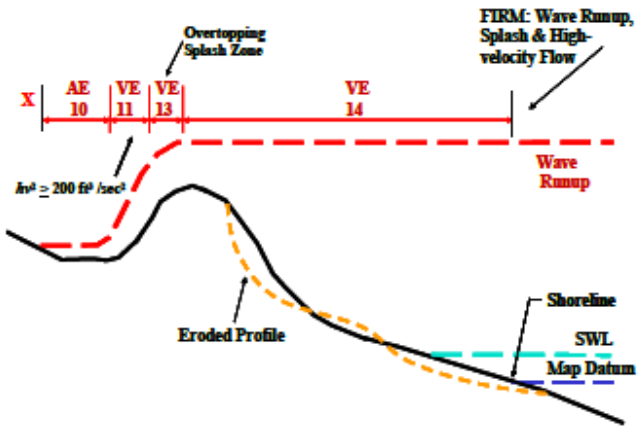
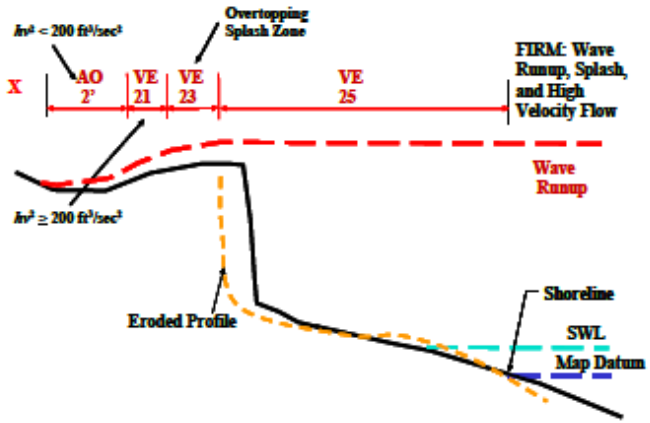


Figure 5-3. Erodible Low Coastal Bluff with VE Zone Controlled by Wave Runup, Overtopping Splash, and High-velocity Flow



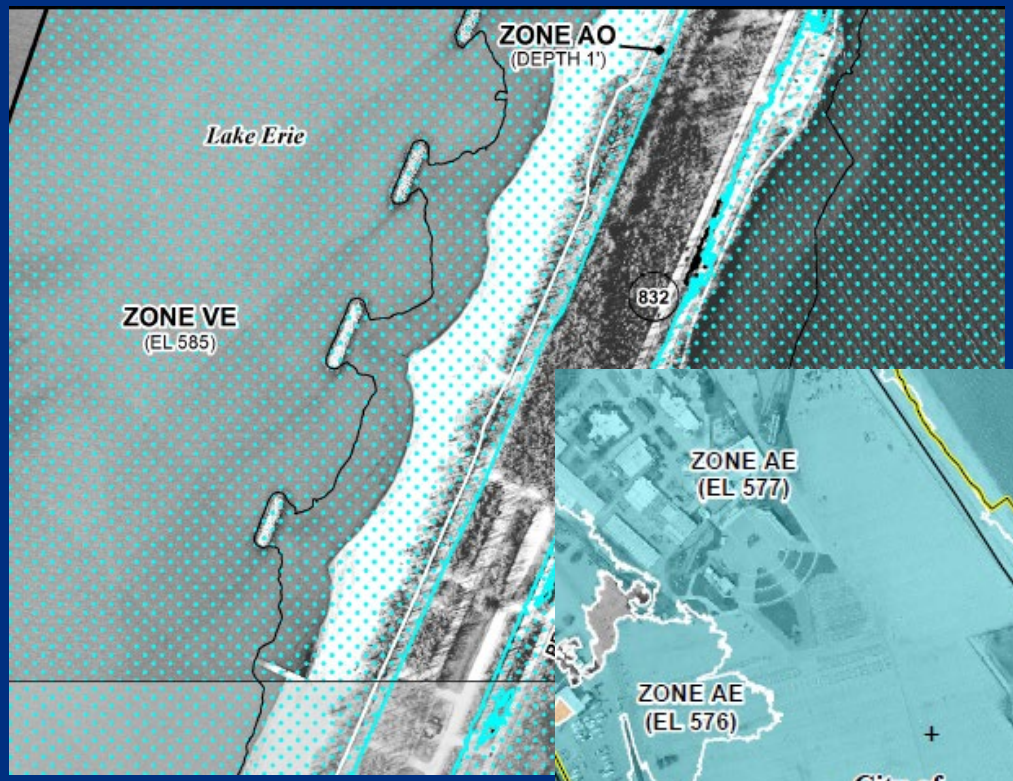
Wave runup/overtopping:

- Click on link for video of wave runup and overtopping example (Aberystwyth, Wales UK, 2014)
- Second link is Minnesota's Lake Superior coast in October 2018

https://www.youtube.com/watch?v=v0OKbJaLsk4

https://www.youtube.com/watch?v=cjQiPWDuS20

What does this look like on a map?



Presque Isle,
Erie County, PA

Cedar Point
Erie County, OH
(Prelim FIRM)

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Things to remember about coastal maps:

- A 1%-annual-chance flood event at one location does not necessarily result in a 1%-annual-chance flood event at another location.
  - Even if the two locations are “near” one another!
- One storm event probably will not (and perhaps could not) result in a flood that inundates all the areas shown in the SFHA on the map.
- SFHAs do not necessarily represent areas that would be continuously inundated by water for a period of time. Think of moving water and waves that could damage buildings.
- FIS and FIRMs do NOT account for future projections of long-term erosion!

Additional forces acting on buildings in coastal areas

- *Hydrodynamic* forces
  - Velocity flow
  - Breaking waves
  - Wave uplift
- High winds
  - Lateral
  - Uplift
- Debris
  - Windborne
  - Waterborne
- Erosion and scour

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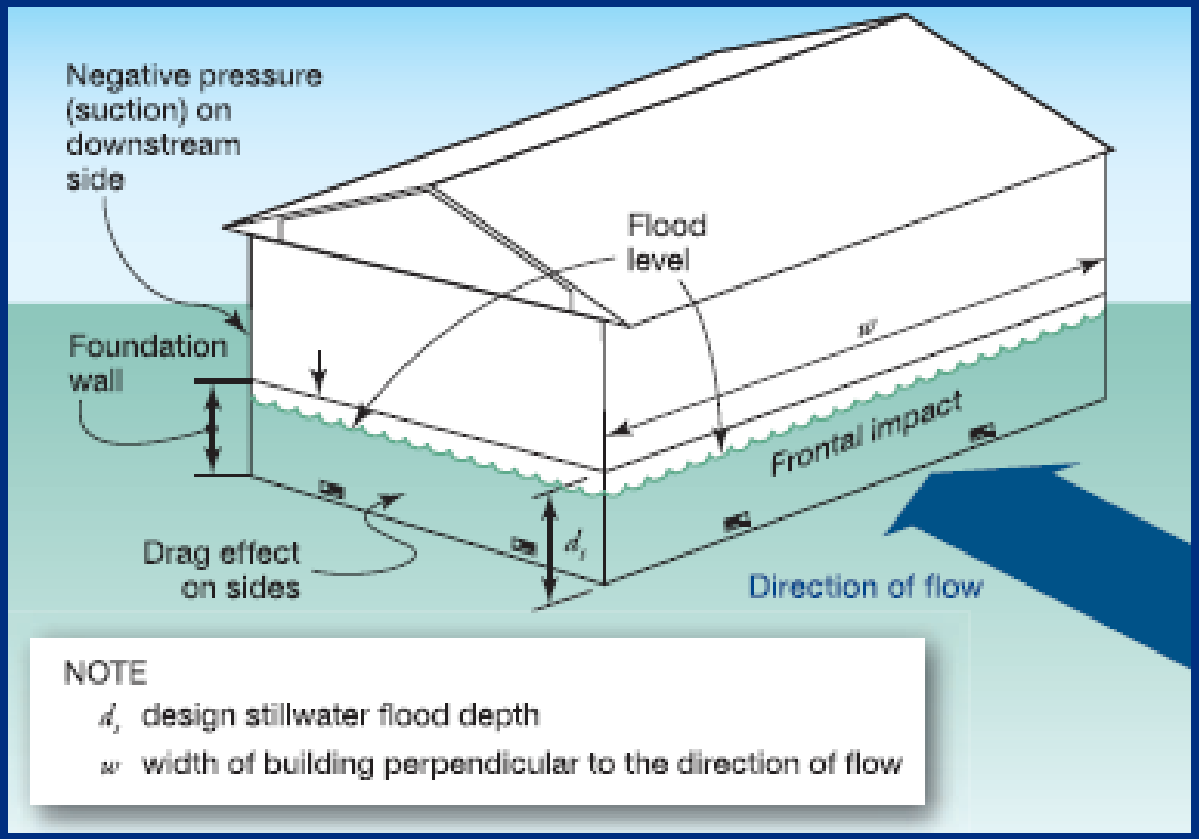
Hydrodynamic forces



Not in the SFHA = No flood risk

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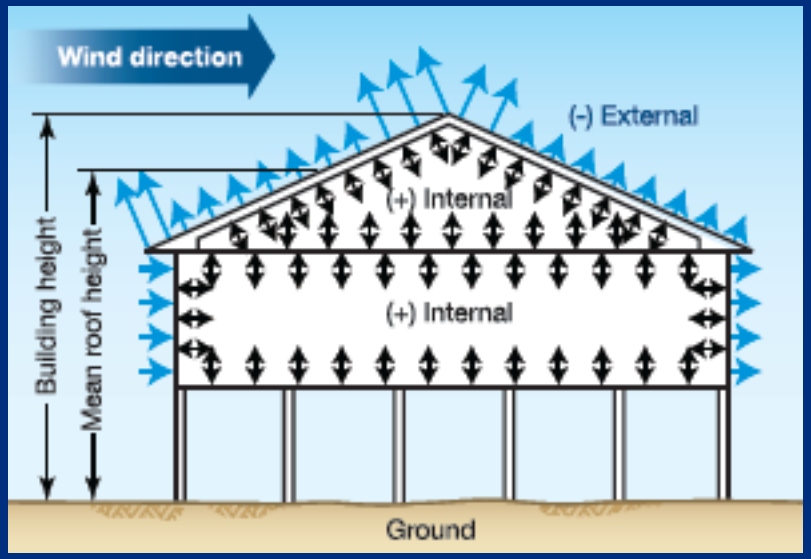
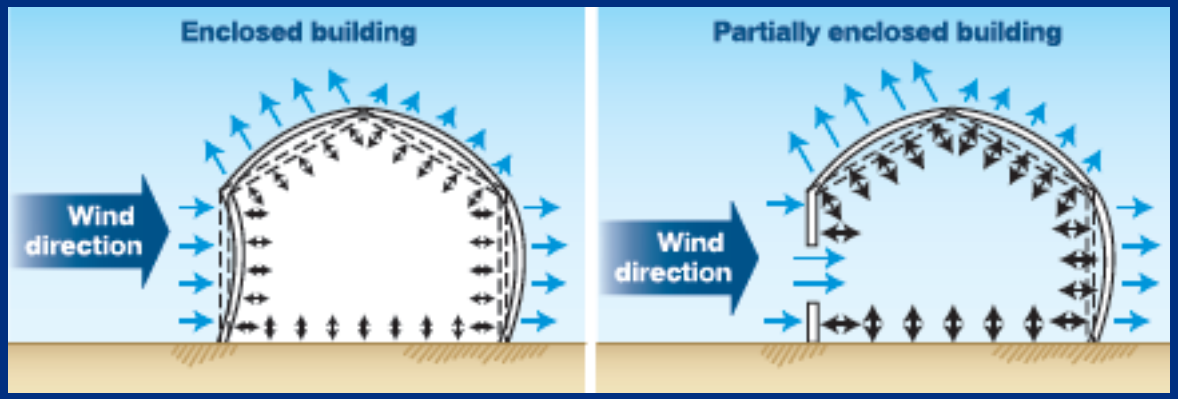
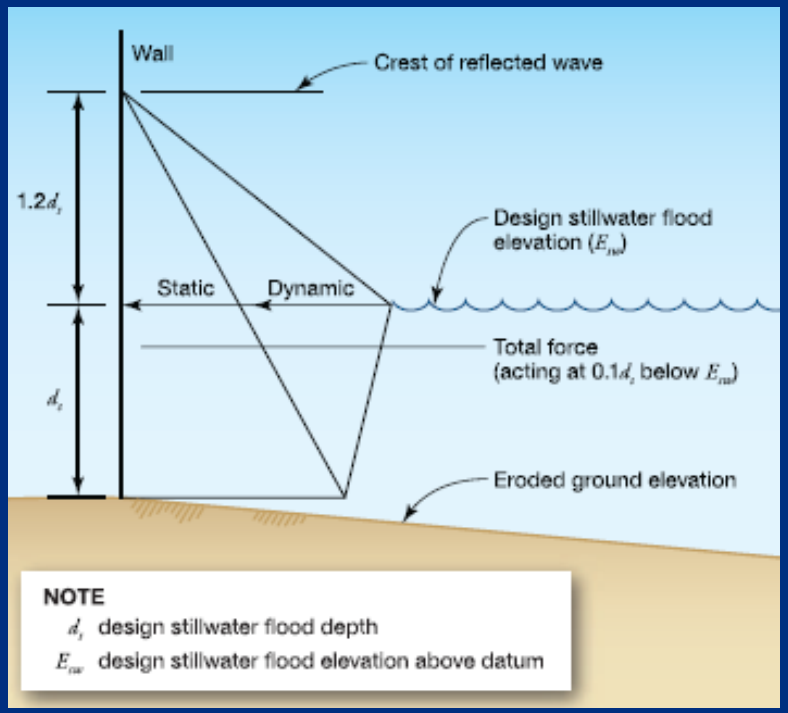
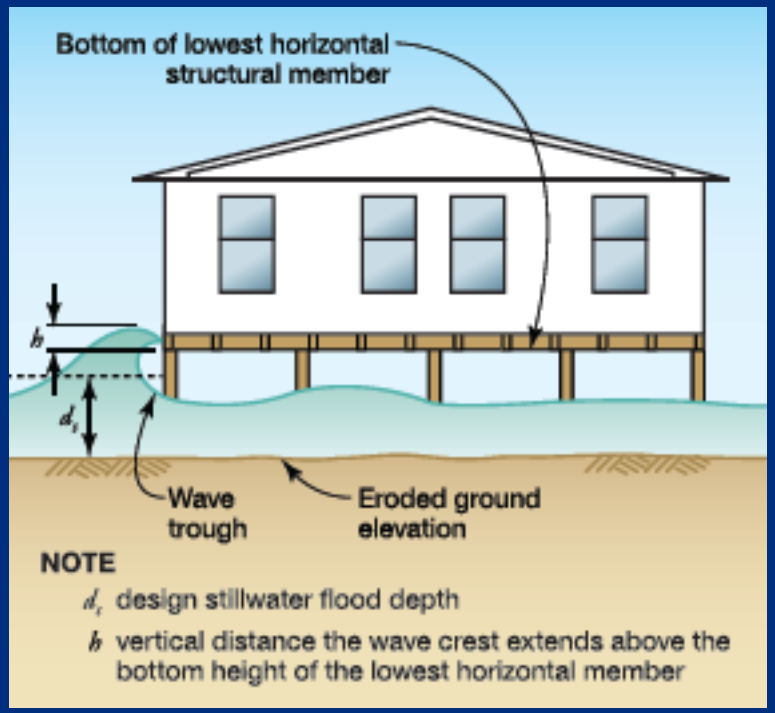
Winds


Wind direction
(-) External
(+) Internal
(+) Internal
Building height
Mean roof height
Ground


Enclosed building
Wind direction
Partially enclosed building
Wind direction

Waves


Wall
Crest of reflected wave
1.2d_s
Design stillwater flood elevation (E_{sw})
Static
Dynamic
Total force (acting at 0.1d_s below E_{sw})
d_s
Eroded ground elevation
NOTE
d_s design stillwater flood depth
E_{sw} design stillwater flood elevation above datum


Bottom of lowest horizontal structural member
h
d_s
Wave trough
Eroded ground elevation
NOTE
d_s design stillwater flood depth
h vertical distance the wave crest extends above the bottom height of the lowest horizontal member

Waves and debris impacts

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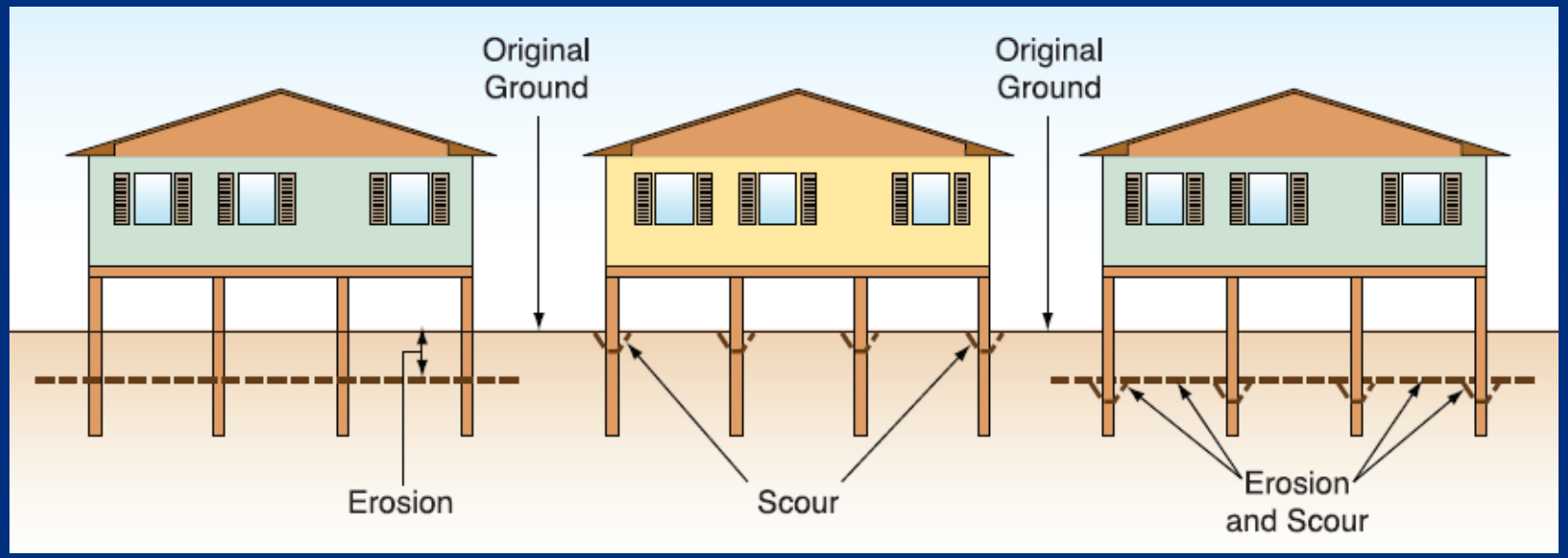
Erosion and Scour

- Erosion means lowering of the ground surface across a wide area
- Scour means localized loss of soil, often around a building foundation element

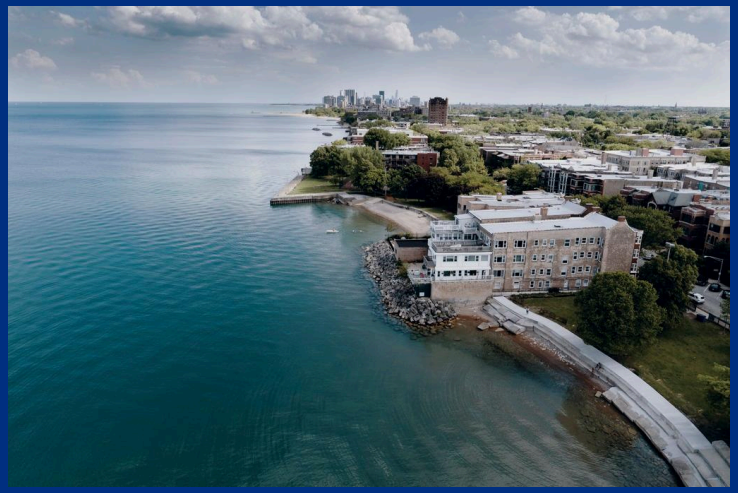


Erosion, scour, and foundation failure

Additional, different damaging forces

- Several additional forces can act on buildings in a coastal flood hazard area, including hydrodynamic forces, waves, and winds.
- Other sources of damage include debris impacts, generalized erosion and localized scour.
- The potential for combinations of these factors acting on buildings simultaneously calls for additional, different regulations to protect buildings.
- Don’t plan for the best case of the worst case: plan for the worst case of the worst case.

No flood risk in any of these places…



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Coastal flooding could only cause problems someplace else…

Patrick G. and Shirley W. Ryan Center for the Musical Arts, Northwestern University

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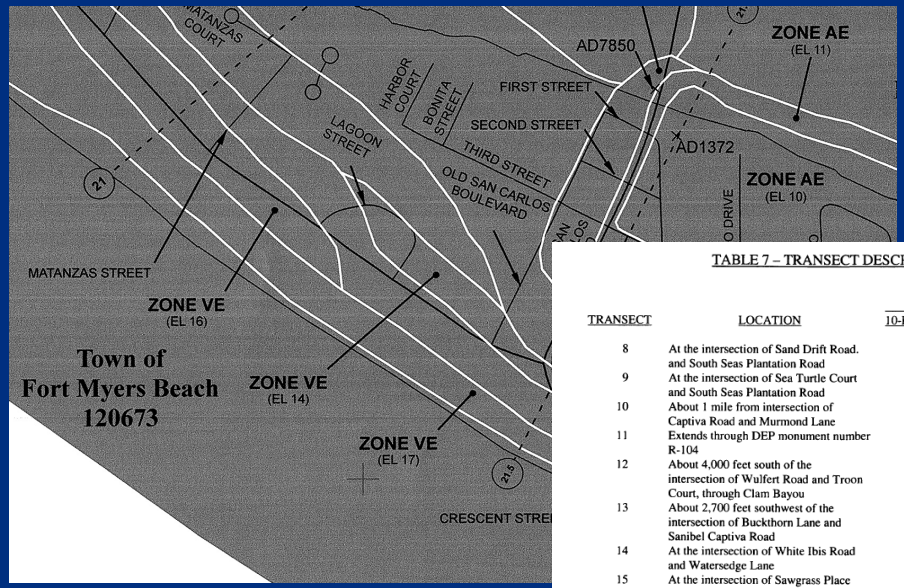


TABLE 5 - SUMMARY OF COASTAL STILLWATER ELEVATIONS – continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD*) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SAN CARLOS BAY				
Between Punta Rassa and Bunch Beach	5.2	10.0	11.5	14.0
Between Bunch Beach and Bodwitch Point	5.4	9.8	11.3	14.1
GULF OF MEXICO				
ge Avenue on	4.9	9.7	11.3	14.3
Island and Big	4.9	9.6	11.2	14.3
Pass	4.1	9.8	11.7	14.8
y Pass	5.2	8.8	11.5	14.3
nty boundary	4.8	8.9	11.3	13.2
section of Bonita rd along the	4.8	8.9	11.3	13.2
ntersection of Boulevard along the	4.8	8.9	11.3	13.2
ntersection of Boulevard along the	4.8	8.9	9.9	N/A

TABLE 7 – TRANSECT DESCRIPTIONS - continued

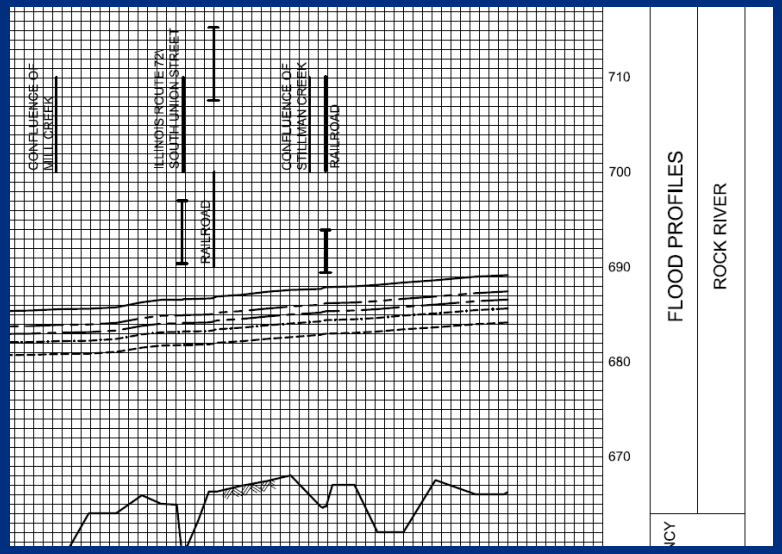
TRANSECT	LOCATION	STILLWATER ELEVATION IN FEET (NAVD 88) 10-PERCENT	1-PERCENT	WAVE CREST[1]
8	At the intersection of Sand Drift Road. and South Seas Plantation Road	4.52	10.52[2]	16.17
9	At the intersection of Sea Turtle Court and South Seas Plantation Road	4.52	10.52[2]	16.17
10	About 1 mile from intersection of Captiva Road and Murmond Lane	4.52	10.52[2]	16.17
11	Extends through DEP monument number R-104	4.52	10.52[2]	16.17
12	About 4,000 feet south of the intersection of Wulfert Road and Troon Court, through Clam Bayou	4.12	10.62[3]	16.32
13	About 2,700 feet southwest of the intersection of Buckthorn Lane and Sanibel Captiva Road	4.12	9.82[3]	15.10
14	At the intersection of White Ibis Road and Watersedge Lane	4.12	9.82[3]	15.10
15	At the intersection of Sawgrass Place and West Gulf Drive	4.12	11.22[3]	17.24
16	About 300 feet east from the intersection of Daniels Drive and West Gulf Drive	4.12	11.22[3]	17.24
17	About 150 feet east from the intersection of Olde Middle Gulf Drive and Middle Gulf Drive	4.52	12.72[2]	19.53
18	At the intersection of Sand Dollar Drive and Lindgren Boulevard	4.72	12.82[2]	19.68
19	About 70 feet east from the intersection of Spoon Bill Court and East Gulf Drive	4.92	13.22[2]	20.29
20	About 300 feet west of the end of Sanibel Island	4.92	13.22[2]	20.29
21	At the intersection of Matanzas Street and Matanzas Court	4.92	12.82[3]	19.68
21.5	100 ft east of the intersection of Estero Boulevard and Fishermans Wharf Drive	4.92	12.82[3]	19.68

NFIP Coastal FIRM and FIS Data

II. FLOODPLAIN MANAGEMENT USING COASTAL DATA

FEMA

Riverine BFE: Cross Sections and Profiles



FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Rock River (continued)								
113.14	113.14	1,330	16,477	3.6	679.4	679.4	679.4	0.0
114.17	114.17	1,027	14,595	4.1	680.3	680.3	680.3	0.0
115.75	115.75	1,170	13,736	4.4	681.0	681.0	681.0	0.0
116.94	116.94	903	14,961	4.0	681.7	681.7	681.8	0.1
118.34	118.34	1,127	14,560	4.1	682.6	682.6	682.6	0.0
119.17	119.17	681	12,023	5.0	683.1	683.1	683.2	0.1
120.87	120.87	1,141	12,768	4.7	684.1	684.1	684.1	0.0
121.34	121.34	1,177	19,189	3.1	684.8	684.8	684.9	0.1
121.73	121.73	962	13,850	4.3	684.9	684.9	685.0	0.1
122.19	122.19	1,110	13,441	4.5	685.3	685.3	685.4	0.1
123.62	123.62	1,075	11,645	5.2	686.4	686.4	686.4	0.0
124.23	124.23	730	11,275	5.3	686.9	686.9	686.9	0.0
124.96	124.96	575	10,393	5.8	687.4	687.4	687.5	0.1
125.94	125.94	555	9,444	6.4	688.2	688.2	688.2	0.0
126.50	126.50	866	14,045	4.3	688.9	688.9	689.0	0.1
127.22	127.22	814	11,513	5.2	689.9	689.9	689.9	0.0
127.81	127.81	680	10,505	5.7	690.4	690.4	690.5	0.1
128.87	128.87	945	13,010	4.6	691.7	691.7	691.7	0.0

[1] Miles above confluence with Mississippi River

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

OGLE COUNTY, IL
AND INCORPORATED AREAS

FLOODWAY DATA

ROCK RIVER

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Coastal BFE: Where's the Base Flood Elevation?

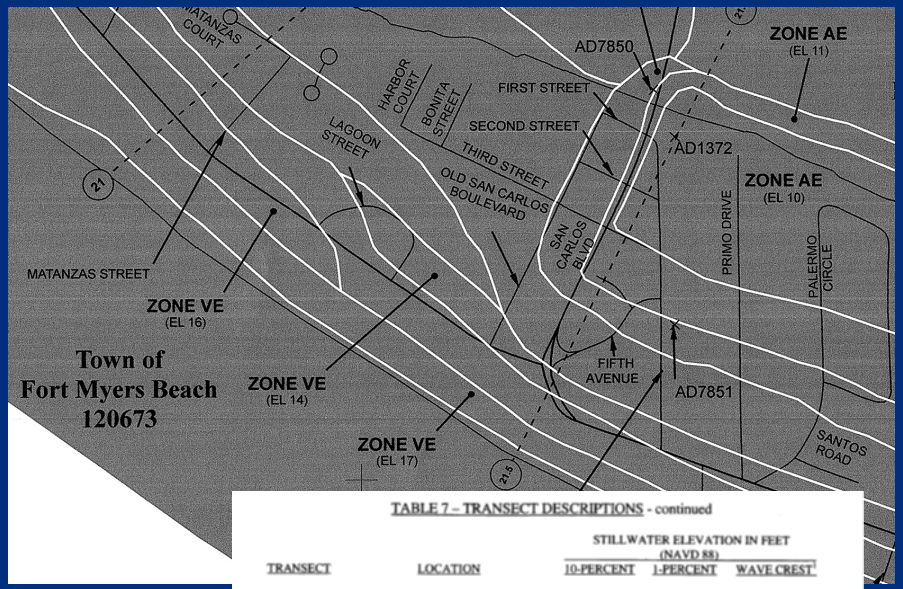

TABLE 5 - SUMMARY OF COASTAL STILLWATER ELEVATIONS – continued

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Between Bunch Beach and Bodwitch Point	5.4	9.8	11.3	14.1
GULF OF MEXICO				
Between Bodwitch Point and Cottage Avenue on Estero Island	4.9	9.7	11.3	14.3
Between Cottage Avenue on Estero Island and Big Carlos Pass	4.9	9.6	11.2	14.3
Between Big Carlos Pass and New Pass	4.1	9.8	11.7	14.8
Between New Pass and Big Hickory Pass	5.2	8.8	11.5	14.3
Between Big Hickory Pass and county boundary	4.8	8.9	11.3	13.2
About 1 mile northwest of the intersection of Bonita Beach Road and Hickory Boulevard along the shoreline	4.8	8.9	11.3	13.2
About 2,400 feet northwest of the intersection of Bonita Beach Road and Hickory Boulevard along the shoreline	4.8	8.9	11.3	13.2
About 1,950 feet southeast of the intersection of Bonita Beach Road and Hickory Boulevard along the shoreline	4.8	8.9	9.9	N/A

TABLE 7 – TRANSECT DESCRIPTIONS - continued

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18	At the intersection of Sand Dollar Drive and Lindgren Boulevard	4.72	12.82[2]	19.68
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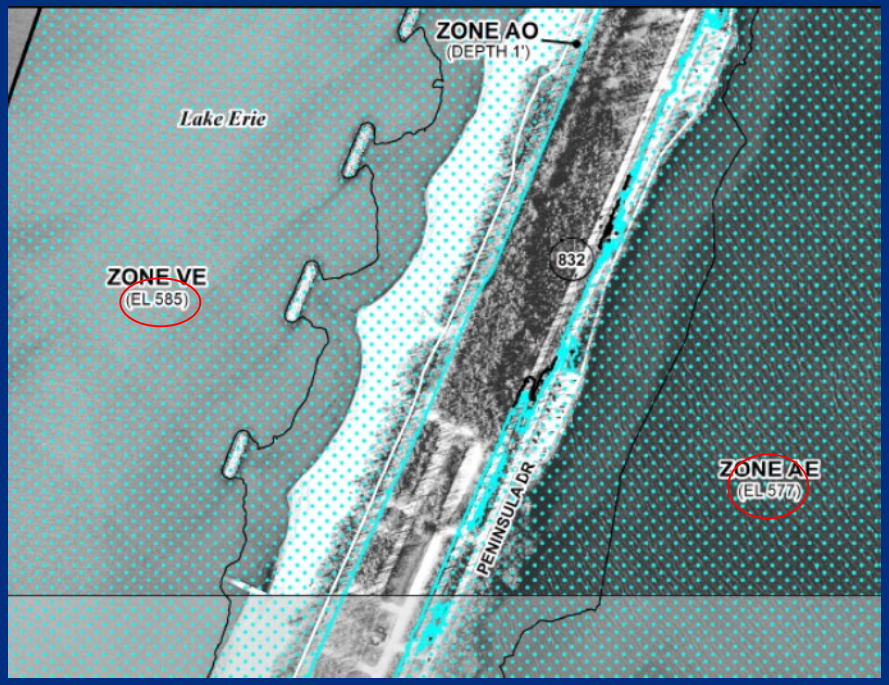
21.5	100 ft east of the intersection of Estero Boulevard and Fishermans Wharf Drive	4.92	12.82[3]	19.68

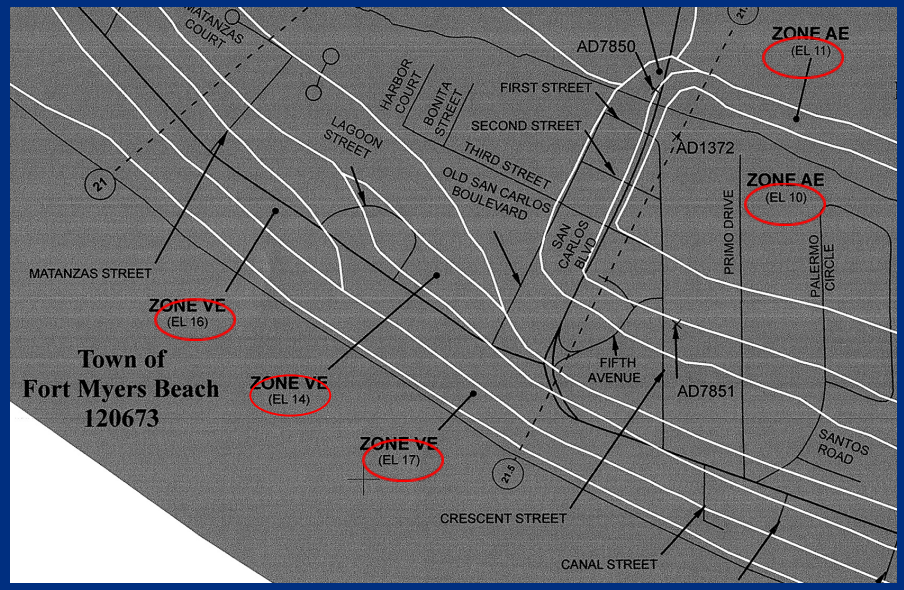
TABLE 8 - TRANSECT DATA - continued

FLOODING SOURCE	TRANSECT	STILLWATER ELEVATION (feet NAVD*) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	BASE FLOOD ELEVATION (feet NAVD*)
Gulf of Mexico	17	4.5	N/A	12.8[2]	N/A	VE	14-20
						AE	11-14
Pine Island Sound		3.1	N/A	6.5	N/A	VE	9-11
						AE	7-9
Matlacha Pass		3.5	N/A	7.3	9.3	VE	9-11
						AE	7-9
Gulf of Mexico	18	4.7	N/A	13.2[2]	N/A	VE	15-20
						AE	12-15
Pine Island Sound		3.1	N/A	6.5	N/A	VE	10-11
						AE	8-10
Matlacha Pass		3.5	N/A	7.3	9.3	VE	9-11
						AE	7-9
Gulf of Mexico	19	4.9	N/A	13.2[2]	N/A	VE	15-20
						AE	12-15
Matlacha Pass		3.5	N/A	7.3	9.3	VE	9-11
						AE	7-9
Gulf of Mexico	20	4.9	N/A	13.2[2]	N/A	VE	15-20
						AE	12-15
Matlacha Pass		3.5	N/A	7.3	9.3	VE	9-11
						AE	7-9
Gulf of Mexico	21	4.9	9.7	12.8[2]	14.3	VE	14-20
						AE	13-14
Estero Bay		2.5	N/A	9.4	13.2	VE	10-13
						AE	9-10
Gulf of Mexico	21.5	4.9	9.7	12.8[2]	14.3	VE	13-20
						AE	10-13
Estero Bay		2.5	N/A	9.4	13.2	AE	10-11

FEMA

The BFE is the number ON THE MAP for the area bounded by the gutter lines





FEMA

What if the site crosses over the gutter lines?

And therefore has multiple BFEs?

Or multiple flood zones (VE, AE, AO…)?

- Always use the more hazardous zone for the area encompassed by the development.
- Always use the highest BFE for the area encompassed by the development.
- If the development is a building, the whole building needs to meet the requirements for the most hazardous zone and highest BFE that applies to any part of the building.

The BFE labeled on the map may be rounded to the nearest whole number

- Whole-number BFEs on coastal FIRMs are rounded, just like the wavy-line BFEs in riverine areas. (100.4 becomes 100, 100.5 becomes 101)

- Check the FIS table to ensure that the 1% annual chance stillwater elevation for the lake is not higher than the whole-number BFE on the map. Use the higher of the two elevations.
  - In the Great Lakes this would be unusual but possible

Where's the floodway? How do I show there's no rise?

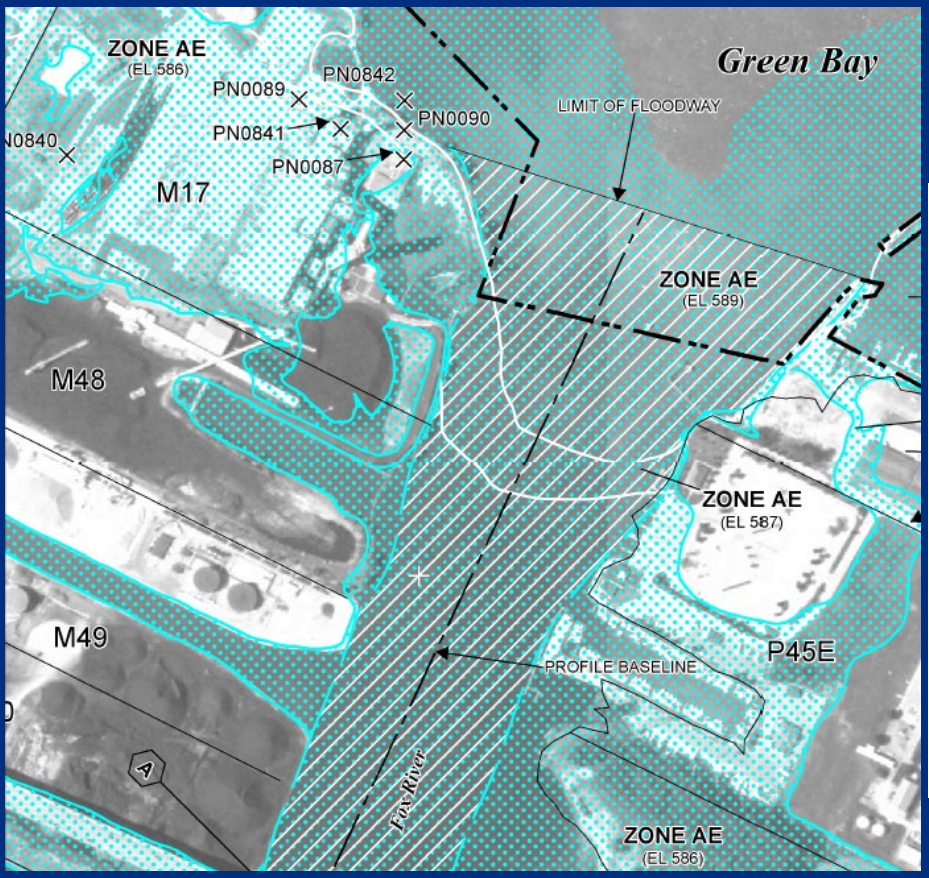
- In locations where the 1%-annual-chance flood is solely the result of coastal flooding effects, there is no floodway.

- The floodway concept applies to areas where there is flow in a channel.

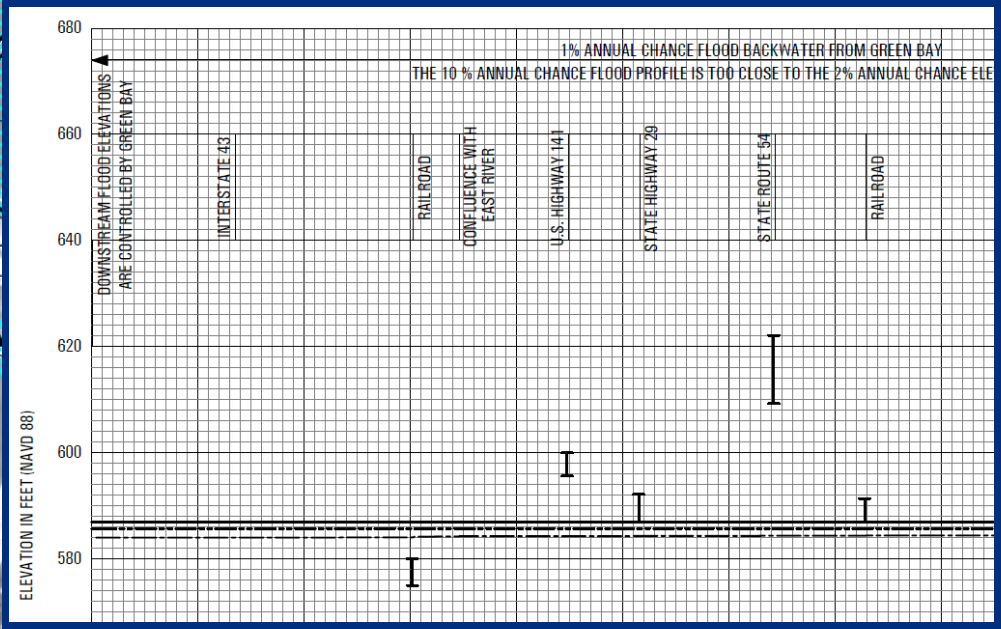
Floodway meets coastal flooding:

- At river mouths, the terminus of the floodway is labeled.
- The floodway near a river mouth may extend for administrative purposes into areas where the 1% flood is a coastal (or lacustrine) event.
- The “no rise” requirement is in relation to the river’s “without floodway” profile, not the regulatory BFE!
- When in doubt, read the FIS text, look at the Floodway Data Table, and the profiles!

Floodway and river mouth:



Green Bay, Brown County, WI



Fox River Profile, Brown County, WI

FEMA

Regulatory BFE is higher than "with floodway" profile

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fox River								
A	3,076	604	15,597	2.2	585.7	584.1[2]	584.1[2]	0.0
B	6,119	515	14,870	2.3	585.7	584.2[2]	584.2[2]	0.0
C	9,196	699	17,355	1.8	585.7	584.7[2]	584.7[2]	0.0
D	10,658	614	16,216	1.9	585.7	584.7[2]	584.7[2]	0.0
E	13,207	540	15,369	2.0	585.7	584.8[2]	584.8[2]	0.0
F	14,982	615	17,770	1.7	585.7	584.9[2]	584.9[2]	0.0
G	18,584	1,067	29,370	1.1	585.7	585.0[2]	585.0[2]	0.0
H	22,084	1,413	22,815	1.5	585.7	585.0[2]	585.0[2]	0.0
I	26,962	2,483	30,720	1.0	585.7	585.1[2]	585.1[2]	0.0
J	40,215	1,042	9,264	3.2	585.7	585.3[2]	585.3[2]	0.0
K	40,497	983	21,852	1.4	589.3	589.3	589.3	0.0
L	53,939	1,032	11,248	2.7	589.9	589.9	589.9	0.0
M	66,171	1,820	14,712	2.0	590.7	590.6	590.7	0.0
N	71,996	537	6,388	4.7	591.5	591.5	591.5	0.0
O	72,693	565	8,266	3.6	598.5	598.5	598.5	0.0
P	78,931	530	7,363	4.0	599.2	599.2	599.2	0.0
Q	86,403	478	6,833	4.1	600.4	600.4	600.4	0.0
R	94,903	454	5,682	5.0	601.4	601.4	601.5	0.1
S	103,310	535	7,444	3.8	602.7	602.5	602.7	0.2

[1]Feet above mouth
[2] Elevations computed without consideration of backwater effects from Green Bay

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, WI
AND INCORPORATED AREAS

FLOODWAY DATA

FOX RIVER

FEMA

Designing and building a compliant building in a coastal high-hazard area

- Coastal high-hazard means Zone VE

- Not a simple matter of “raising it up high enough.”
- A qualified design professional will need to be involved.
- Relies on data from the FIRM and FIS, and on that design professional’s calculations and judgments.

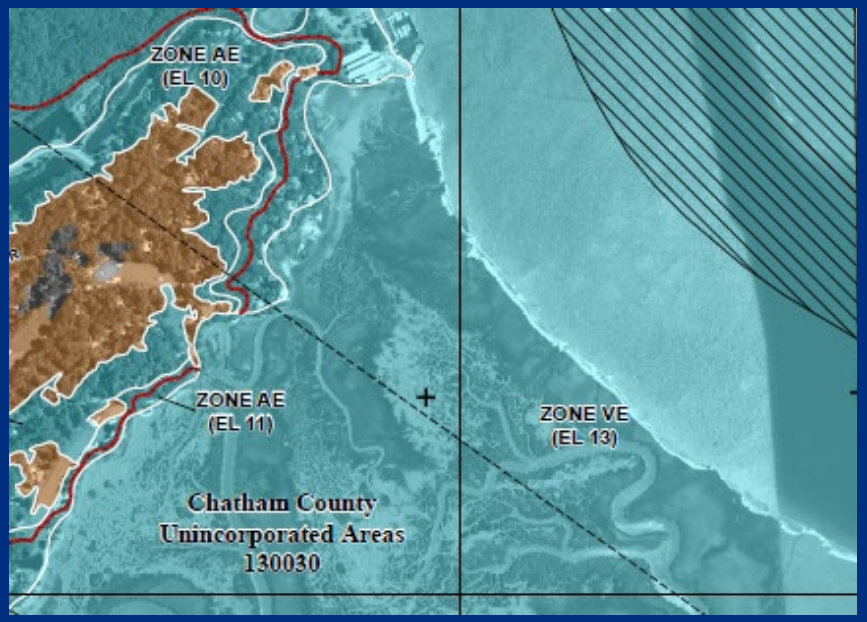
- Much guidance on this topic is in FEMA’s Coastal Construction Manual (FEMA 55), and companion publications.

LiMWA/MoWA areas

- Sometimes (somewhat misleadingly) called “coastal A zones”
- There are AE and AO zones in coastal areas in which the 1%-annual-chance flood is a result of coastal flooding effects.
- In <u>some</u> coastal AE zones, wave heights may be more than 1.5 feet, but less than the 3 feet that would make them VE zones.
- The boundary showing where the wave heights drop to less than 1.5 feet is called a Limit of Moderate Wave Action (LiMWA). This indicates the area between the LiMWA and VE zone gutter line is a MoWA area (waves between 1.5 and 3 feet).

LiMWA/MoWA

- LiMWA <u>does not appear</u> in areas where VE zone is a result of wave runup/overtopping.
- Possibility of LiMWA will be uncommon in Great Lakes.
- VE zone standards are <u>recommended</u> by FEMA in MoWA areas.



Chatham County, GA (preliminary map)
LiMWA is the RED line within Zone AE

FEMA

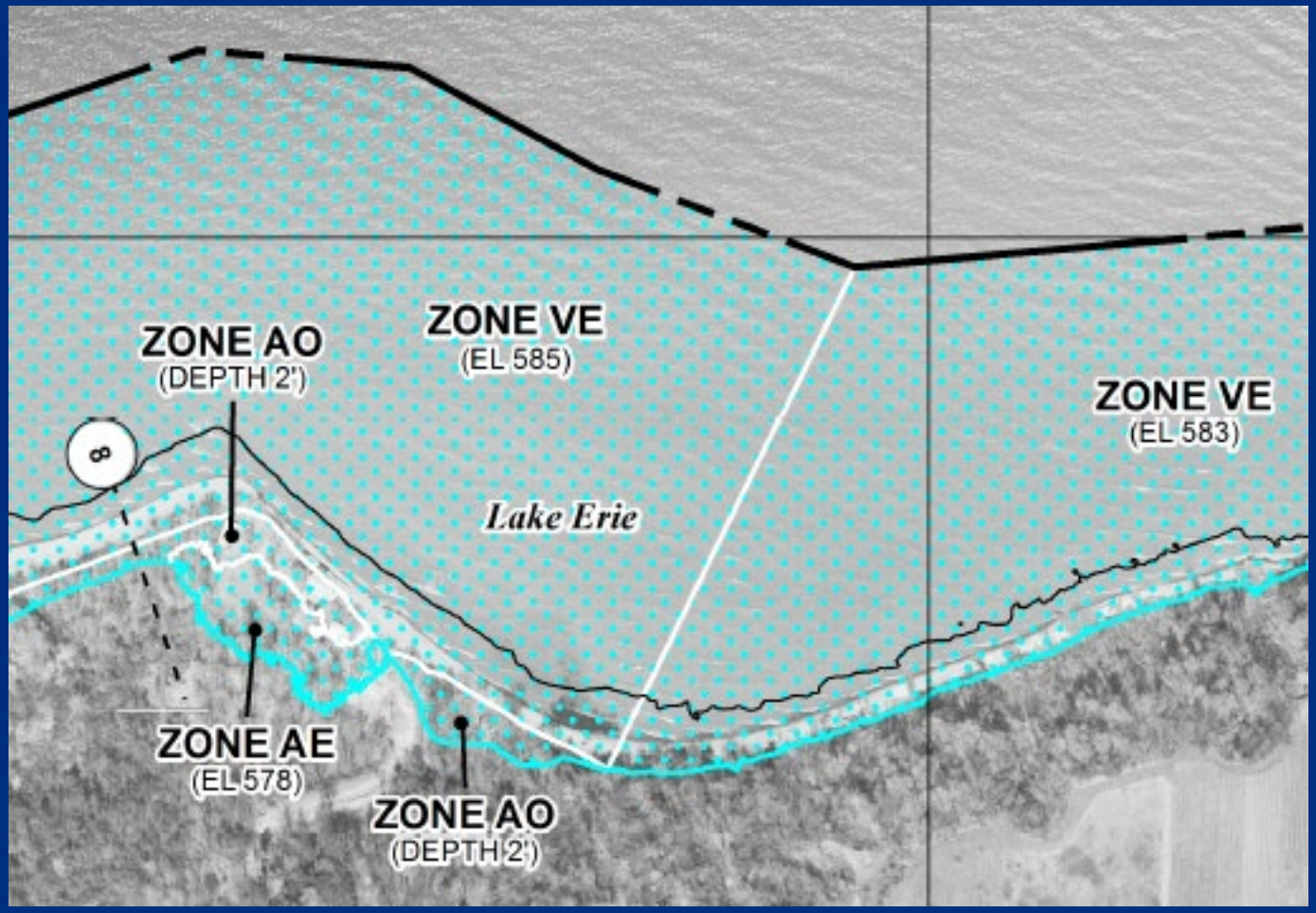
LiMWA/MoWA footnotes

- 60.3(e) standards are recommended, not required, by FEMA in MoWA.
- Higher standards (60.3(e) and better) are required by I-Codes and by referenced consensus engineering standard ASCE/SEI 24-14, when MoWA is shown.
- There is no difference between a MoWA and any other AE zone for NFIP Flood Insurance purposes.
- CRS communities with Coastal Flood Hazards must have any LiMWA supported by new or revised Flood Hazard Study shown on effective FIRMs as a prerequisite for CRS CLASS 9.

AO zones? What's an AO zone?!

- Zone AO: an "area of special flood hazard having shallow water depths and/or unpredictable flow paths between 1 and 3 feet."
- Used to represent sheet flow: the depth number is a height above the highest adjacent natural ground elevation, NOT A BFE.
- Zone AO often appears to the landward of a VE zone gutter where waves overtop a bluff or coastal structure: the overtopping splash zone.
- Special building regulations in zone AO are distinct from zone AE and AH (and often forgotten).

Zone AO with depth number



FEMA

AO zone regulations (review)

- Elevate lowest floor, including basement, of new construction and substantial improvements to or above the depth number specified on the FIRM (or 2 feet if not specified), measured from the highest adjacent natural grade.
- Community needs to keep a record of the natural grade prior to construction in order to document that construction in Zone AO was compliant.
- Compliance is all or nothing for NFIP flood insurance purposes in Zone AO (we'll return to this later).

FEMA

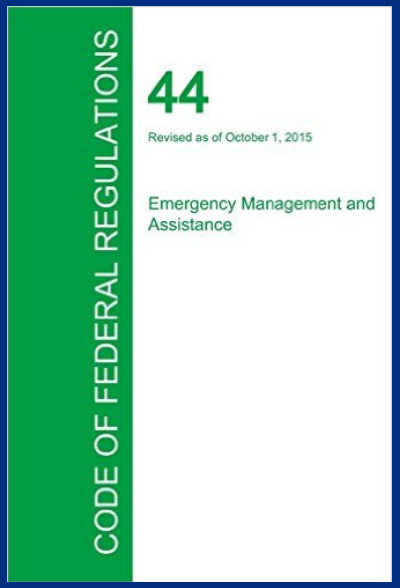
FEMA

FEMA

What's the lesson here?

- There is a residual risk of shallow flooding in areas landward of the zone VE or zone AE limit, especially if they are below BFE.
- There is a residual risk of wave effects including hydrodynamic forces and erosion and scour in these areas also.

- What kinds of foundations do people like to use here in the Midwest?
- What kinds of foundations perform poorly when they experience hydrodynamic forces, erosion, and scour?
- <u>Did your community commit to ensure that development is "reasonably safe from flooding" when it joined the NFIP?</u>



Minimum NFIP Provisions, Building Codes, and Consensus Engineering Standards

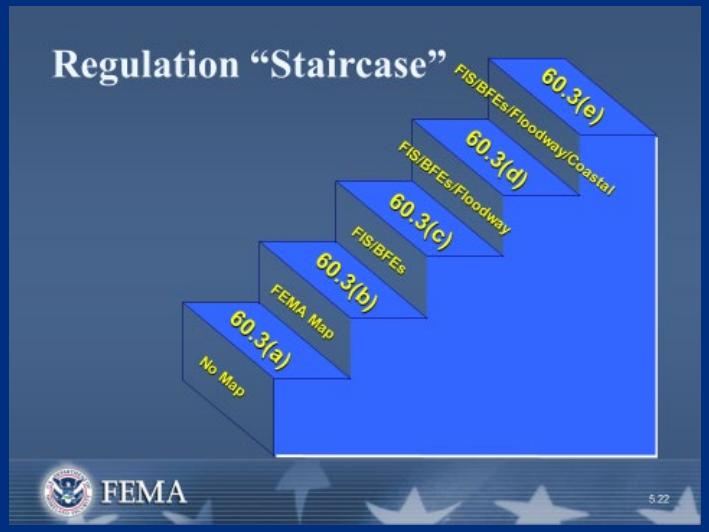
III. FLOODPLAIN MANAGEMENT STANDARDS IN COASTAL ZONES

FEMA

NFIP Floodplain Management Standards for Coastal High Hazard Areas

- 44 CFR §60.3(e):

"When the Federal Insurance Administrator […] has identified on the community's FIRM coastal high hazard areas by designating Zones V1-30, VE, and/or V, the community shall: […]"

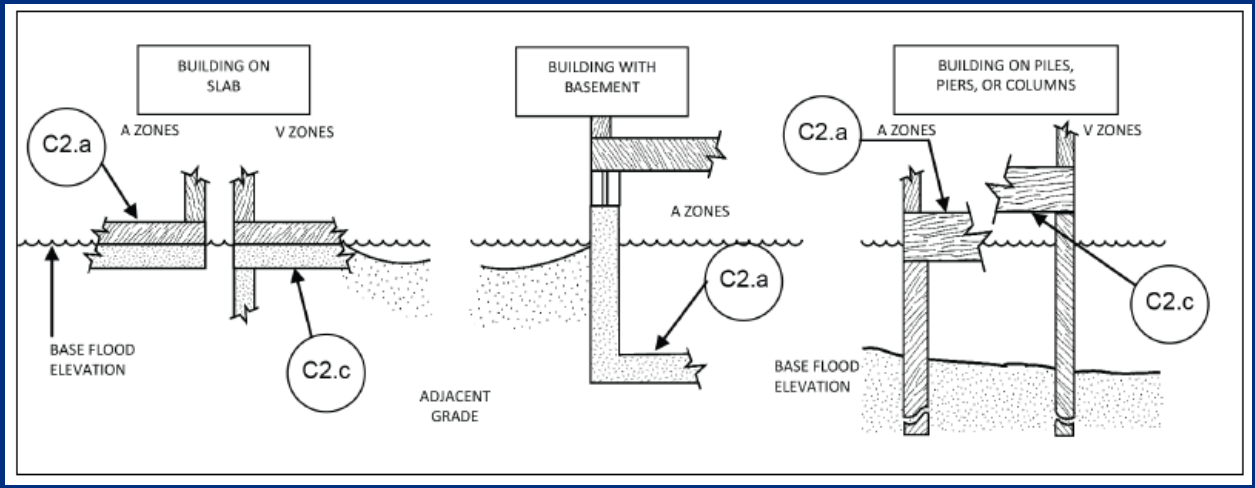


Remember the staircase from E273?

60.3(e)(2)

Within Zones V1-30, VE, and V on the FIRM:

"Obtain the elevation [in relation to the FIRM datum] of the bottom of the lowest structural member of the lowest floor (excluding pilings and columns) of all new and substantially improved structures, and whether or not such structures contain a basement, and maintain a record of all such information[…]"



Line C2.c on the Elevation Certificate

IBC 110.3.3; 110.3.10.1; 104.7; 1612.5(2.1); R104.7; R109.1.3; R109.1.6.1; R322.1.10

Where's the bottom of the lowest horizontal structural member?

FEMA

60.3(e)(3)

- "Provide that all new construction within Zone[…] VE […] on the community's FIRM is located landward of the reach of mean high tide"
- In the Great Lakes, the line of mean high tide is analogous in many ways to the Ordinary High Water Mark.
- The purpose is to prevent new buildings from being built in extraordinarily exposed positions directly over water in locations where damaging wave impacts are anticipated.

1612.4 (through reference to ASCE 24-14, 4.3(1)); G401.2; R322.3.1(1)

Built circa 1942

J.N. “Ding” Darling Fish House, later owned by abstract expressionist artist Robert Rauschenberg

(not landward of mean high tide, also not “new construction”)

FEMA

60.3(e)(4)(i)

- "Provide that all new construction and substantial improvements in Zone[…] VE […] on the community's FIRM are elevated on pilings and columns so that (i) the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to or above the base flood level[…]"

60.3(e)(4)(ii)

- "[…] and (ii) the pile or column foundation and structure attached thereto is anchored to resist flotation, collapse and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Water loading values shall be those associated with the base flood. Wind loading values shall be those required by applicable State or local building standards." (emphasis added)

104.2.1; 1612.1; 1612.4 (through reference to ASCE 24); R322.3; R322.3.2; R322.3.3

60.3(e)(4)

"A registered professional engineer shall develop or review the structural design, specifications and plans for the construction, and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of paragraphs (e)(4)(i) and (ii) of this section."

"accepted standards of practice":

ASCE/SEI 7-16 Minimum Design Loads for Buildings and Other Structures

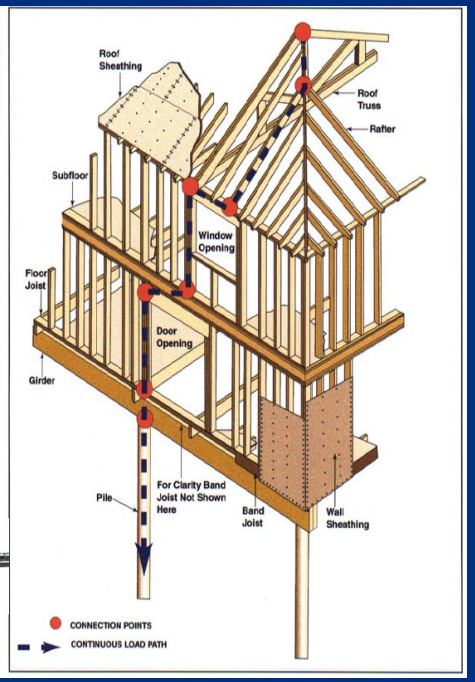
ASCE/SEI 24-14 Flood Resistant Design and Construction

1612.5(2.2); R322.3.3; R322.3.6

“Continuous load path” (Sec. 60.3(e)(4)(ii))

Load Paths

- Load path must be continuous
- Each link must be strong
- Load path always ends in supporting soil
- A building has hundreds of load paths

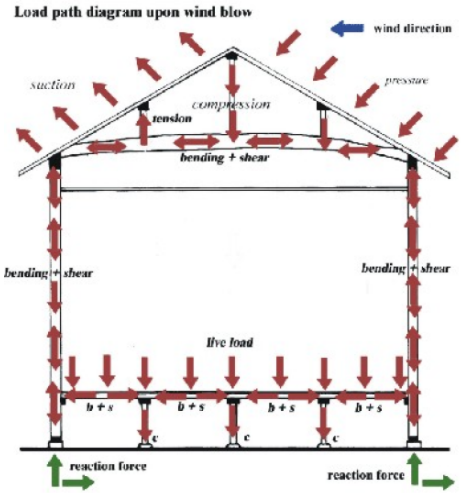


FEMA

Anticipated loads can and must be transferred through the building in a continuous path to the supporting soils.

Any weakness in that continuous path is a potential point of failure.

A structure is as strong as its weakest connection.



FEMA

Continuous load path:

"Superstorm" Sandy November 2012

60.3(e)(5)

"Provide that all new construction and substantial improvements within Zone[…] VE […] on the community's FIRM have the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls, open wood lattice-work, or insect screening intended to collapse under wind and water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or supporting foundation system."

Wood lattice-work:

FEMA

“Breakaway” walls (60.3(e)(5))

- “[…]a design safe loading resistance of <u>not less than 10 and no more than 20 pounds per square foot</u>.”

“Use of breakaway walls which exceed a design safe loading resistance of 20 pounds per square foot (either by design or when so required by local or State codes) may be permitted only if a registered professional engineer or architect certifies that the designs proposed meet the following conditions:

(i) Breakaway wall collapse shall result from a water load less than that which would occur during the base flood; and

(ii) The elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement or other structural damage due to the effects of wind and water loads acting simultaneously on all building components (structural and non-structural).”

1403.6; 1612.4 (through reference to ASCE 24; 1612.5(2.3); 1804.4(3); G501.5; R322.3.2; R322.3.4; R322.3.5

Breakaway wall enclosures

"Such enclosed space shall be useable solely for parking of vehicles, building access, or storage."

Separate rooms?

"Roughed in" plumbing and electrical?

Windows and French double-doors in "breakaway" walls?

What's that blue glow coming from the windows after dark?

Community must be diligent in ongoing enforcement.

FEMA

60.3(e)(6)

"Prohibit the use of fill for structural support of buildings within Zones V1-30, VE, and V on the community's FIRM." (emphasis added)

FEMA

1612.4(through reference to ASCE 24; G401.2; R322.3.2(3)

Fill is not a substitute for sufficient pile embedment

Elevating the low floor is not the only concern in a coastal high hazard area

FEMA

No fill?

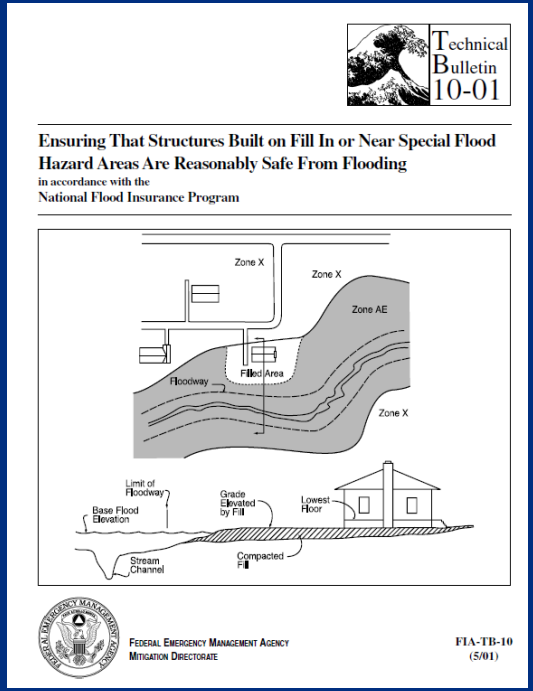
How am I going to get my LOMR-F so I can get out of paying for flood insurance?!

NO LOMR-F in Zone VE. End of discussion.

NO BASEMENT in Zone VE. End of discussion.

What about Zone AE, right on the other side of the gutter line?

Technical Bulletin 10-01 and coastal areas



Technical Bulletin 10-01

Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding
in accordance with the
National Flood Insurance Program

Federal Emergency Management Agency
Mitigation Directorate

FIA-TB-10
(5/01)

ASCE/SEI 7 requires all flood loads, including wave loads, to be included in design, even in A zones.

Fill and below-BFE basement floor do not meet the assumptions for the “simplified” approach in TB 10-01.

TB 10 says “this bulletin strongly recommends that structural fill not be used to elevate buildings constructed in A zones in coastal areas.”

FEMA

Basement? Crawlspace?

FEMA

60.3(e)(7)

"Prohibit man-made alteration of sand dunes and mangrove stands within Zone[…] VE […] on the community's FIRM which would increase potential flood damage."

Mangroves (*Avicennia nitida*, *Rhizophora mangle, Languncularia racemosa*, and *Conocarpus erecta*) do not grow naturally in the Great Lakes.

Sand dunes are present in some parts of the Great Lakes, however, and if altering them would increase the potential for flood damage, man-made alterations must be prohibited.

1612.4(through reference to ASCE 24); G103.7; R322.3.1(2)

Sand dunes may or may not be vegetated

ASCE/SEI 24-14 "Flood Resistant Design and Construction"

- Sec. 60.3(e): "accepted standards of practice"
- ASCE 24 is a consensus standard developed by engineering professionals
- Relied upon by International Code Council for International Building Code and International Residential Code

Chapter 6 of ASCE 7 (referenced in ASCE 24) contains direction on calculation and application of flood loads for structural design purposes.

Things to remember about floodplain management regulations in Zone VE:

- Elevate lowest horizontal supporting member to or above BFE on piling or column foundation, with space below open to present no obstruction, or enclosed only with breakaway walls/latticework
- NO FILL FOR STRUCTURAL SUPPORT
- NO DRY-FLOODPROOFING (see above)
- NO LOMR-F (see above)
- ENGINEERING is not optional
- NO, NO, NO, NO, NO BASEMENTS. <u>NO BASEMENTS!</u>

Miscellaneous FAQs

- ASCE/SEI 24-14, I-Codes, and FEMA 55 (along with other FEMA guidance documents) contain more specific guidance and standards for:
  - Swimming pools in VE zones and coastal AE zones
  - Decks and screen porches
  - Parking garages
  - Underground and above-ground tanks
  - Exterior utilities
  - Nonstructural concrete parking pads and driveways
  - Accessory detached garages, carports, and storage sheds
  - Elevator shafts extending below elevated buildings
- No exceptions for non-elevated restrooms in zone VE.

Residual risk ≠ No risk

- Site is shown outside SFHA.
- Pre- and post-construction grade is below BFE.
  - Is there truly *no* risk of flooding during the base flood?
- How clearly is the site outside the SFHA? Is there no chance that a Flood Hazard Determination Vendor is going to call the building "in" the SFHA?
- <u>If you apply for a LOMA or LOMR-F and the lowest adjacent grade is below BFE, the result is a non-removal.</u>

FEMA

LOMR-F non-removal

- A building with a basement below BFE needs to be "reasonably safe from flooding" to qualify for LOMR-F even if lowest adjacent grade is at or above BFE.
- If lowest adjacent grade is below BFE and the building was called "in" the SFHA, it will be identified as a potential violation of local floodplain regulations.
- Whether it is or is not actually a violation of local regulations, the lender will require the insurance, and will require the insurance to be based on the zone the Vendor called the building "in" (AE, AO, VE, etc).
- Basement below BFE = Rates you don't want to have to pay

Amend-In and Deny

"non-removal"

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP AMENDMENT
DETERMINATION DOCUMENT (NON-REMOVAL)

ND MAP PANEL INFORMATION	LEGAL PROPERTY DESCRIPTION
CITY OF SANDUSKY, ERIE COUNTY, OHIO	Units 385 through 388, Building 2 (North Building), Harbour Island Boathouse Condominium No. 1, as described in the Declaration of Condominium Ownership recorded as Document No. 0345596, in Volume 513, Pages 892 through 933, in the Office of the Recorder, Erie County, Ohio
MUNITY NO.: 390156	
BER: 39043C0083D	
: 8/28/2008	
LAKE ERIE	APPROXIMATE LATITUDE & LONGITUDE OF PROPERTY: 41.443, -82.673 SOURCE OF LAT & LONG: GOOGLE EARTH PRO DATUM: NAD 83

DETERMINATION

	SECTION	SUBDIVISION	STREET	OUTCOME WHAT IS NOT REMOVED FROM THE SFHA	FLOOD ZONE	1% ANNUAL CHANCE FLOOD ELEVATION (NAVD 88)	LOWEST ADJACENT GRADE ELEVATION (NAVD 88)	LOWEST LOT ELEVATION (NAVD 88)
--	--	Harbour Island Boathouse Condominium	Portside Drive (Units 385-388)	Structure (Building 2)	AE	577.2 feet	565.3 feet	--

Special Flood Hazard Area (SFHA) - The SFHA is an area that would be inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood).

ADDITIONAL CONSIDERATIONS (Please refer to the appropriate section on Attachment 1 for the additional considerations listed below.)

GREAT LAKES
SUPERSEDES PREVIOUS DETERMINATION

"supersedes previous determination"

FEMA

c. 1994

c. 2010

c. 2013

What makes a successful development project?

What does it take for a building in a coastal area to be a success after a disaster?

FEMA

After the event:

- Building's foundation should be intact.
- Building envelope (floor, walls, openings, roof) should remain sound and minimize penetration by wind, rain, and debris.
- Utility connections should be intact or be easily restored.
- Floodwater should not have entered the building.
- The building should be accessible and useable after an event it was designed to withstand.

How long are you hoping the building/development will last? 30 years? 50 years? "Forever"? What may happen during that time?

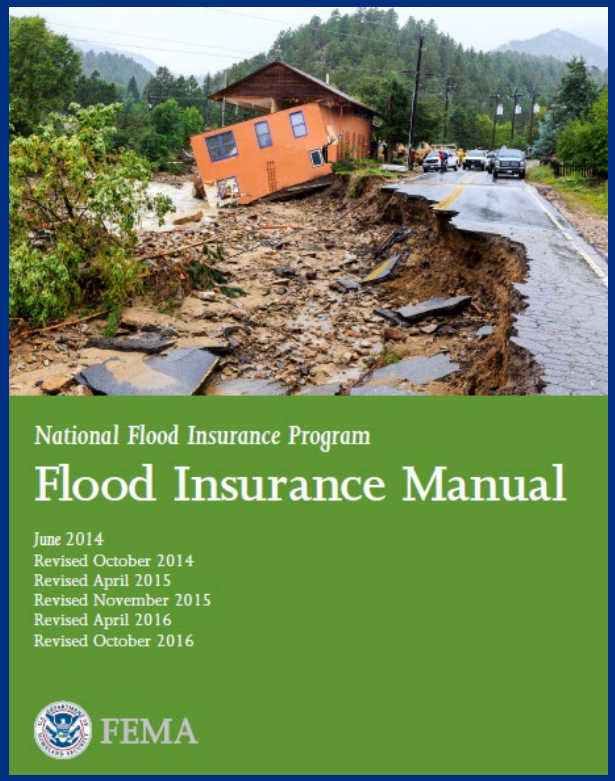
Coastal areas challenge conventional assumptions:

- There is not necessarily a viable engineering solution to every site-related factor.
- Wise subdivision practices, and wise siting decisions, can minimize the cost of building design and construction to resist anticipated coastal hazards.
- Following *only* the NFIP-minimum floodplain management regulations could allow design practices that could result in reduced coverage or very costly flood insurance premiums.
- Plan for the future events, not the past events:

http://www.geol.ucsb.edu/faculty/sylvester/UCSB_Beaches/IVCLIFFS/pillarhus.html

This site is shown in unshaded zone X (not zone VE) on the Kenosha County workmap released in 2017

FEMA



Consequences for new construction and for existing buildings

IV. OVERVIEW OF NFIP INSURANCE IN COASTAL ZONES

Based on current insurance methodology as of 2019

FEMA

Flood insurance basic concepts review

- Pre-FIRM (subsidized) rates
  - Based on building type, occupancy
  - Subsidies are being phased out, with some categories increasing more quickly than others under HFIAA of 2014
- Post-FIRM (actuarial) rates
  - Based on elevation difference between BFE and lowest floor
- Grandfathering is alive and well
  - Continuous coverage
  - Built-in-compliance
- HFIAA and the “newly mapped” rating procedure

“newly mapped”

- Remember that “newly mapped” means buildings in zones B, C, X, D, AR, or A99 on a FIRM that are later shown in the SFHA on a FIRM with effective date on or after April 1, 2015.
  - (spoiler alert: today is after April 1, 2015)
- Exceptions from “newly mapped” eligibility:
  - Community’s FIRST FIRM
  - Multi-unit buildings eligible to be insured under the RCBAP
  - Policy is first purchased, or lapses and is reinstated, more than 12 months after the effective date of the FIRM that “newly mapped” the building in the SFHA.
- “Newly mapped” rates start very low, then gradually increase on an annual basis

Grandfathering

- Continuous coverage
  - Buy coverage while the building is shown in zone X, don't let it lapse, and you get the "newly mapped" rating and also keep eligibility to grandfather to standard zone X rates (not PRP).
  - Buy coverage while the building is shown in zone AE, don't let it lapse, and you keep zone AE rates even if the building is later shown in zone VE.
- Built in compliance
  - Site was shown in zone X on the FIRM at the start of construction: post-FIRM standard zone X rates (not PRP) remain available until building is substantially improved, even if mapped into zone AE or VE.
  - Site was located in zone AE on the FIRM: IF built in compliance with BFE required at the start of construction, post-FIRM zone AE rates available until building is substantially improved, even if mapped into zone VE.

Pre-FIRM subsidized rates in Zone VE

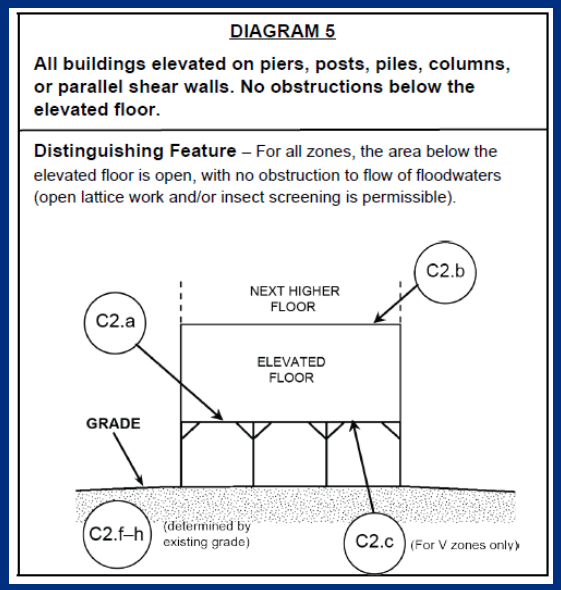
- Will apply to buildings that were built before the date of the community's first FIRM that:
  - Are already shown in the SFHA (zone A, AE, A1-30, AH, or AO) on the prior FIRM, and
  - do not have continuous coverage beginning prior to the effective date of the new map showing the building in Zone VE.

- In Zone VE, Pre-FIRM subsidized rates are somewhat higher, across the board, for all categories and occupancies, for each of the schedules of subsidy phase-out.

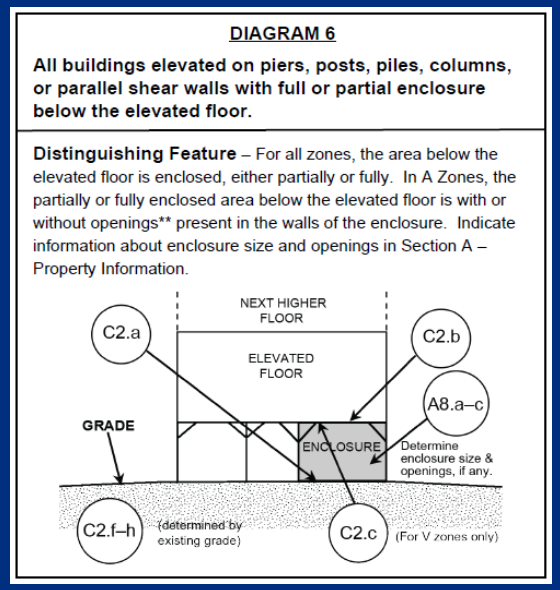
Post-FIRM (actuarial) rates in Zone VE

- Will apply to buildings that are new construction in (or partly in) areas shown in Zone VE, with start of construction after the effective date of new maps.
- Actuarial rates in VE zone are higher across the board for all categories of buildings and occupancies, with some additional complications:
  - Completely free of obstruction, or latticework/insect screening only, below lowest horizontal member = least costly
  - Enclosure (with breakaway walls) <300 square feet = more costly
  - Enclosure (with breakaway walls) ≥300 square feet = submit for rating
  - Any enclosure with walls that are not breakaway = submit for rating
- V-zone risk factor rating form (optional)

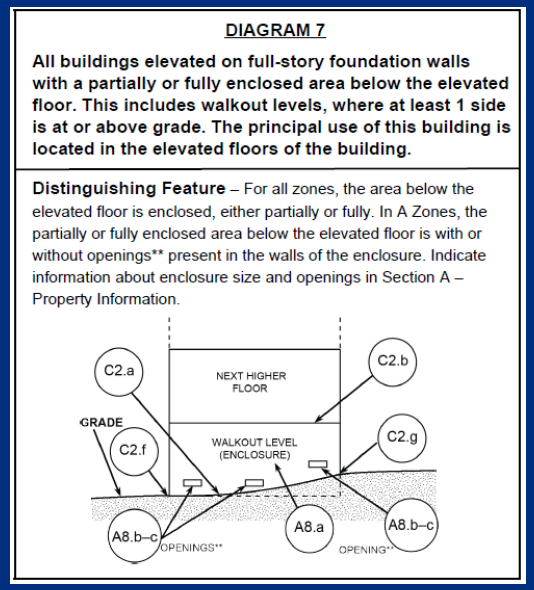
Post-FIRM Zone VE



Not bad.



Not good.



Terrible.

Enclosure ≥ 300 ft^2
=*Very* not good.

Post-FIRM rates in Zone VE (continued)

- Post-FIRM rates in Zone VE also vary in relation to the ratio between the amount of building coverage purchased through the NFIP and the building's replacement cost.
  - 0.75 or higher ratio (better)
  - 0.50 to 0.74 ratio (worse)
  - Under 0.50 ratio (much worse)
- Closer to insuring the full replacement cost (higher ratio) means relatively lower rates

Things to remember about Post-FIRM VE Zone insurance

- Avoid new construction in Zone VE.
  - Look at the map. How difficult is that, really?
- Don’t expect, or predict, “affordable” flood insurance to be available for the obstinately persistent who insist on new construction in Zone VE, however designed and constructed.
- Hold design professionals and construction contractors to the highest standard in Zone VE.
- Clients had better be willing to pay a high price for good design and construction, because they will be paying a high price for flood insurance, under the best circumstances.

Zone AO pre- and post-FIRM

- Pre-FIRM Zone AO rates use the same rate tables as Pre-FIRM Zone AE rates
  - Applies to pre-FIRM buildings that are NOT “newly mapped” into SFHA (were in a zone other than B, C, X, D, AR, or A99 on prior map)
- Post-FIRM Zone AO rates use a different table, with only two (2) categories for residential and nonresidential occupancies: “with certification of compliance” and “without certification of compliance”
  - “With certification” = inexpensive
  - “Without certification” = more expensive, but sometimes less costly than pre-FIRM rates. ***The insured can choose to use post-FIRM rates if the cost is advantageous!***

Things to remember about Zone AO rates

- For existing buildings NOT newly mapped (were in the SFHA before), suggest comparing the cost of post-FIRM AO rates with the pre-FIRM rates.
- For new buildings, compliance makes all the difference between a very cheap rate and a not-so-good rate.

- Zone AO building: lowest floor, including basement, must be elevated above the highest adjacent natural grade by depth number (in feet). <u>HIGHEST ADJACENT NATURAL GRADE!</u>
- <u>COMMUNITY MUST DOCUMENT NATURAL GRADES!</u>

Summary:

- Development in VE zones is hazardous.
- In the Great Lakes development in VE zones is usually avoidable. Staying out of the SFHA, or *at least* getting to Zone AO or AE, is possible on almost every site.
- When pursued, more stringent development regulations apply to buildings and other forms of development in Zone VE.
- Flood insurance rates for new construction in VE zones will be high even for properly constructed buildings. They can be reduced somewhat by design and construction that exceeds NFIP minimum floodplain management standards.

A few words about "risk rating redesign"

Risk Rating 2.0 will fundamentally change the way FEMA rates a property's flood risk and prices insurance.

Rating 2.0 will help agents more easily price and sell policies.

Rating 2.0 will help customers better understand their flood risk and provide them with more accurate rates based on their unique risk. Basis for policy premium and coverage will include:

- Predominant flood scenario,
- Distance from flooding source
- Replacement value

Customers will no longer face dramatic rate increases during map changes or at the edge of flood zones.

Rating 2.0 will comply with existing statutory caps on premium increases. This will help transition policyholders who may face otherwise substantial rate increases.

Frank Shockey

Senior NFIP Specialist
FEMA Region 5
536 S Clark St. 6th floor
Chicago IL 60605
frank.shockey@fema.dhs.gov

James Sink

Regional Flood Insurance Liaison
FEMA Region 5
james.sink@fema.dhs.gov

QUESTIONS?

FEMA

FEMA

Vertical Datum and Height

- Except in AO and some unnumbered A zones, NFIP floodplain management and insurance are concerned with elevation in terms of height above a vertical datum.
- The datum used to regulate floodplain development, and to report as-built conditions, should be the same as the datum used on the FIRM and in the FIS.
- "We've always used IGLD 85 on the lakes! Why do we have to change to NAVD 88?"
- The short answer is "because we are concerned with building construction and land development."
  - The long answer would take an entire presentation to explain fully.