

## VULNERABILITY FLOOD STANDARDS

### VF-1 Derivation of Personal Residential Structure Flood Vulnerability Functions

- A. Development of the personal residential structure flood vulnerability functions shall be based on a combination of the following: (1) rational structural analysis, (2) post-event site investigations, (3) technical literature, (4) expert opinion, (5) laboratory or field testing, and (6) insurance claims data. Personal residential structure flood vulnerability functions shall be supported by historical and other relevant data.*
- B. The derivation of personal residential structure flood vulnerability functions and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.*
- C. Residential building stock classification shall be representative of Florida construction for personal residential structures.*
- D. The following flood characteristics shall be used in the derivation of personal residential structure flood vulnerability functions: depth above ground and wave action in coastal areas.*
- E. The following primary building characteristics shall be used or accounted for in the derivation of personal residential structure vulnerability functions: lowest floor elevation relative to ground, foundation type, construction materials, and year of construction.*
- F. Flood vulnerability functions shall be separately derived for personal residential building structures, manufactured homes, and appurtenant structures.*
- ~~*G. The relationship between the modeled personal residential structure flood vulnerability functions and historical personal residential structure losses shall be justified.*~~

Purpose: Personal residential structure flood vulnerability functions are to account for both flood and building characteristics. This standard requires the development of personal residential flood vulnerability functions to be supported by historical or other relevant data.

The data and methods used to develop personal residential flood vulnerability functions, and their associated uncertainties, affect the modeled flood loss costs and flood probable maximum loss levels. Their development and documentation are essential parts of the flood model.

The adoption and enforcement of building codes and floodplain management regulations affect the flood vulnerability functions.

This standard allows insurance claims data used in personal residential flood vulnerability function development to include appropriate insurer or modeling organization adjustments that do not diminish the usefulness of the data.

Relevant Forms: GF-4, Vulnerability Flood Standards Structural/Hydraulic/Coastal Engineer Expert Certification  
VF-1, Hypothetical Coastal Flood Event with Damaging Waves  
VF-2, Hypothetical Inland Flood Event  
AF-1, Zero Deductible Personal Residential Flood Loss Costs  
AF-5, Logical Relationship to Flood Risk (Trade Secret item)

### Disclosures

1. Provide a flowchart documenting the process by which the personal residential structure flood vulnerability functions are derived and implemented.
2. Describe the assumptions, data (including insurance claims data), methods, and processes used for the development of the personal residential structure flood vulnerability functions.
3. As applicable, describe the nature and extent of actual insurance claims data used to develop the personal residential structure flood vulnerability functions. Describe in detail what is included, such as, number of policies, number of insurers, date of loss, and number of units of dollar exposure, separated into personal residential and manufactured homes.
4. Summarize post-event site investigations, including the source, and provide a brief description of the resulting use of these data in the development or validation of personal residential structure flood vulnerability functions.
5. Describe how the personal residential structure flood vulnerability functions incorporate depth of flooding (above ground and above lowest floor) and wave action (in coastal areas).
6. State if the following flood characteristics are considered in the development of the personal residential structure flood vulnerability functions, and if so, how; if not, explain why: flood duration, flood velocity, flood-induced erosion, flood-borne debris, salinity (saltwater versus freshwater flooding), contaminated floodwaters, and likelihood of mold following flooding.
7. Describe how the personal residential structure flood vulnerability functions incorporate the following primary building characteristics: lowest floor elevation relative to ground, foundation type, primary construction materials, and year of construction.

8. State if the following building characteristics are considered in the development of the personal residential structure flood vulnerability functions, and if so, how; if not, explain why: number of stories, use of each story (e.g., habitable space, parking, storage, other), presence of basement, replacement value of building, structure value by story, square footage of living area, and other construction characteristics, as applicable.
9. Describe the process by which local construction practices, building code, and floodplain management regulation adoption and enforcement are considered in the development of personal residential structure flood vulnerability functions.
10. Provide the total number of personal residential structure flood vulnerability functions available for use in the flood model. Describe which structure flood vulnerability functions are used for personal residential structures, manufactured homes, condo unit owners and apartment renters.
11. Describe the relationship between personal residential structure and appurtenant structure flood vulnerability functions and their consistency with insurance claims data as applicable.
12. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop personal residential structure flood vulnerability functions for unknown personal residential construction types or for when some building characteristics are unknown.
13. Describe similarities and differences in how the personal residential structure vulnerability functions are developed and applied for coastal and inland flooding.
14. Describe how personal residential structure vulnerability functions are selected when input data are missing, incomplete, or conflicting.
15. Provide a completed Form VF-1, Hypothetical Coastal Flood Event with Damaging Waves. Provide a link to the location of the form [insert hyperlink here].
16. Provide a completed Form VF-2, Hypothetical Inland Flood Event. Provide a link to the location of the form [insert hyperlink here].

### **Audit**

1. All personal residential structure flood vulnerability functions will be reviewed.
2. Validation of the personal residential structure flood vulnerability functions and associated uncertainties will be reviewed.
3. Historical data in the original form will be reviewed with explanations for any changes made and descriptions of how missing or incorrect data were handled. For historical data used to develop personal residential structure flood vulnerability functions, the goodness-of-fit of the data will be reviewed. Complete reports detailing

- flooding conditions and damage suffered for any laboratory or field testing data used will be reviewed. A variety of different personal residential structure construction classes will be selected from the complete rational structural analyses and calculations to be reviewed. Laboratory or field tests and original post-event site investigation reports will be reviewed. Other technical literature and expert opinion summaries will be reviewed.
4. All papers, reports, and studies used in the continual development of the personal residential structure flood vulnerability functions must be available for review in hard copy or electronic form.
  5. Multiple samples of personal residential structure flood vulnerability functions for personal residential structures, manufactured homes, and appurtenant structures will be reviewed. The magnitude of logical changes among these items for given flood events and validation materials will be reviewed.
  6. Justification for the personal residential structures construction classes and characteristics used will be reviewed.
  7. Documentation and justification for all modifications to the personal residential structure flood vulnerability functions due to building codes, floodplain management regulations, and their enforcement will be reviewed. If year of construction and/or geographical location of personal residential structure is used as a surrogate for building code, floodplain management regulation, and their enforcement, complete supporting information for the number of year of construction groups used as well as the year(s) and/or geographical region(s) of construction that separates particular group(s) will be reviewed.
  8. The effects on personal residential structure flood vulnerability from local and regional construction characteristics, building codes, and floodplain management regulations will be reviewed.
  9. How the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify personal residential structure flood vulnerability functions will be reviewed. Examples include the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.
  10. The percentage of damage at or above which the flood model assumes a total structure loss will be reviewed.
  11. Documentation and justification for the method of derivation and data on which the personal residential structure flood vulnerability functions are based will be reviewed.
  12. Form VF-1, Hypothetical Coastal Flood Event with Damaging Waves, will be reviewed.
  13. Form VF-2, Hypothetical Inland Flood Event, will be reviewed.

## **VF-2 Derivation of Personal Residential Contents Flood Vulnerability Functions**

- A. Development of the personal residential contents flood vulnerability functions shall be based on some combination of the following: (1) post-event site investigations, (2) technical literature, (3) expert opinion, (4) laboratory or field testing, and (5) insurance claims data. Contents flood vulnerability functions shall be supported by historical and other relevant data.***
- B. The derivation of personal residential contents vulnerability functions and their associated uncertainties shall consider the extent of personal residential structure damage.***
- C. Contents flood vulnerability functions shall be derived separately for personal residential building structures and manufactured homes.***

**Purpose:** Personal residential contents flood vulnerability functions are to account for flood, contents, and building characteristics. This standard requires the development of personal residential contents flood vulnerability functions to be supported by historical or other relevant data.

The development of personal residential contents flood vulnerability functions is to be documented with respect to the methods and sources, including any use of insurance claims data, post-event site investigations, expert opinion, technical literature, testing data, and other relevant data.

This standard allows insurance claims data used in contents flood vulnerability function development to include appropriate insurer or modeling organization adjustments that do not diminish the usefulness of the data.

A reasonable representation of contents flood vulnerability is necessary in order to address policies that cover contents losses.

**Relevant Forms:** GF-4, Vulnerability Flood Standards Structural/Hydraulic/Coastal  
Engineer Expert Certification  
AF-5, Logical Relationship to Flood Risk (Trade Secret item)

### **Disclosures**

1. Provide a flowchart documenting the process by which the personal residential contents flood vulnerability functions are derived and implemented.
2. Describe the relationship between personal residential contents and personal residential structure flood vulnerability functions.

3. As applicable, describe the nature and extent of actual insurance claims data used to develop the personal residential contents flood vulnerability functions. Describe in detail what is included, such as, number of policies, number of insurers, date of loss, and number of units of dollar exposure, separated into personal residential structure and manufactured homes.
4. Describe any assumptions, data (including insurance claims data), methods, and processes used to develop and validate the personal residential contents flood vulnerability functions.
5. Provide the total number of personal residential contents flood vulnerability functions available for use in the flood model. Describe whether different contents flood vulnerability functions are used for personal residential structures, manufactured homes, unit location for condo owners and apartment renters, and various building classes.
6. Describe any relationships between flood characteristics and personal residential contents flood vulnerability functions.
7. State the minimum threshold, if any, at which personal residential contents flood damage is calculated (e.g., personal residential contents damage is estimated for personal residential structure damage greater than  $x\%$ , or flood depth greater than  $y$  inches). Provide documentation of assumptions and available validation data to verify the approach used.
8. Describe similarities and differences in how personal residential contents flood vulnerability functions are developed and applied for coastal and inland flooding.
9. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop personal residential contents flood vulnerability functions for unknown personal residential construction types and for when some primary building characteristics are unknown.

### **Audit**

1. All personal residential contents flood vulnerability functions will be reviewed.
2. Validation of the personal residential contents flood vulnerability functions and associated uncertainties will be reviewed.
3. Documentation and justification of the following aspects or assumptions related to personal residential contents flood vulnerability functions will be reviewed:
  - a. The method of derivation and data;
  - b. Variability of personal residential contents flood damage by personal residential structure classification and characteristics;
  - c. Variability of personal residential contents flood damage by flood characteristics;
  - d. Personal residential contents flood damage for various occupancies.

4. Historical data in the original form will be reviewed with explanations for any changes made and descriptions of how missing or incorrect data were handled. For historical data used to develop personal residential contents flood vulnerability functions, the goodness-of-fit of the data will be reviewed. Complete reports detailing flood conditions and damage suffered for any test data used will be reviewed. Original post-event site investigation reports will be reviewed. Other technical literature and expert opinion summaries will be reviewed.
5. All papers, reports, and studies used in the continual development of the personal residential contents flood vulnerability functions must be available for review in hard copy or electronic form.

### **VF-3 Derivation of Personal Residential Time Element Flood Vulnerability Functions**

- A. Development of the personal residential time element flood vulnerability functions shall be based on some combination of the following: (1) post-event site investigations, (2) technical literature, (3) expert opinion, (4) laboratory or field testing, and (5) insurance claims data. Time element vulnerability functions shall be supported by historical and other relevant data.***
- B. The derivation of personal residential time element flood vulnerability functions and their associated uncertainties shall consider the extent of personal residential structure and/or contents damage and the estimated time required to repair or replace the structure.***
- C. Personal residential time element flood vulnerability functions shall be derived separately for personal residential building structures and manufactured homes.***

Purpose: Personal residential time element flood vulnerability functions are to account for flood, contents and building characteristics, as well as external factors that affect the ability to repair or replace a structure. This standard requires the development of personal residential time element flood vulnerability functions to be supported by historical or other relevant data.

The development of personal residential time element flood vulnerability functions is to be documented with respect to the methods and sources, including any use of insurance claims data, post-event site investigations, expert opinion, technical literature, testing data, and other relevant data.

This standard allows insurance claims data used in personal residential time element flood vulnerability function development to include appropriate insurer or modeling organization adjustments that do not diminish the usefulness of the data.

A reasonable representation of personal residential time element flood vulnerability is necessary in order to address policies that cover personal residential time element losses.

Policies can provide varying types of personal residential time element coverage and insurance policies may pay for personal residential time element claims irrespective of flood damage to the insured property.

Relevant Form: GF-4, Vulnerability Flood Standards Structural/Hydraulic/Coastal  
Engineer Expert Certification  
AF-5, Logical Relationship to Risk (Trade Secret item)

## Disclosures

1. Provide a flowchart documenting the process by which the personal residential time element flood vulnerability functions are derived and implemented.
2. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate personal residential time element flood vulnerability functions.
3. As applicable, describe the nature and extent of actual insurance claims data used to develop the personal residential time element flood vulnerability functions. Describe in detail what is included, such as number of policies, number of insurers, date of loss, and number of units of dollar exposure, separated into personal residential structure and manufactured homes.
4. Provide the total number of personal residential time element flood vulnerability functions available for use in the flood model. Describe whether different time element flood vulnerability functions are used for personal residential structures, manufactured homes, unit location for condo owners and apartment renters, and various building classes.
5. State the minimum threshold, if any, at which personal residential time element flood vulnerability is calculated (e.g., personal residential time element flood vulnerability is estimated for personal residential structure damage greater than  $x\%$ , ~~post-event re-entry is delayed more than  $y$  days~~). Provide documentation of assumptions and available validation data to verify the approach used.

### Explanation of Problem:

Governmental mandate on re-entry after an event was removed from hurricane, should it be removed from flood?

Modelers do not have data available to validate.

Commissioner Lee will check forms that have been approved by OIR.

Note from Commissioner Lee: Latest flood coverage approved, on the time element government mandate issue, if Civil authority prohibits use, there is coverage for up to two weeks.

6. Describe similarities and differences in how personal residential time element flood vulnerability functions are developed and applied for coastal and inland flooding.
7. Describe whether and how personal residential structure classification and characteristics, and flood characteristics, are incorporated into the personal residential time element flood vulnerability functions.
8. Describe whether and how personal residential time element flood vulnerability functions take into consideration the damage to local and regional infrastructure, or personal residential time element vulnerability resulting from a governmental mandate associated with flood events (e.g., evacuation ~~and re-entry mandates~~).

9. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop personal residential time element flood vulnerability functions for unknown personal residential construction types and for when some primary building characteristics are unknown.

### **Audit**

1. All personal residential time element flood vulnerability functions will be reviewed.
2. Validation of the personal residential time element flood vulnerability functions and associated uncertainties will be reviewed.
3. Documentation and justification of the following aspects or assumptions related to personal residential time element flood vulnerability functions will be reviewed:
  - a. The method of derivation and underlying data;
  - b. Variability of personal residential time element flood vulnerability by personal residential structure classification and characteristics;
  - c. Variability of personal residential time element flood vulnerability by flood characteristics;
  - d. Personal residential time element flood vulnerability for various occupancies;
  - e. The methods used to estimate the time required to repair or replace the property due to flooding.
4. Historical data in the original form will be reviewed with explanations for any changes made and descriptions of how missing or incorrect data were handled. For historical data used to develop personal residential time element flood vulnerability functions, the goodness-of-fit of the data will be reviewed. Complete reports detailing flooding conditions and damage suffered for any test data used will be reviewed. Original post-event site investigation reports will be reviewed. Other technical literature and expert opinion summaries will be reviewed.
5. The methodology and validation for determining the extent of infrastructure flood damage and governmental mandate and their effect on personal residential time element vulnerability will be reviewed.

## VF-4 Flood Mitigation Measures

- A. Modeling of flood mitigation measures to improve flood resistance of personal residential structures, the corresponding effects on flood vulnerability, and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include design, construction, and retrofit techniques that enhance the flood resistance or flood protection of personal residential structures. The modeling organization shall justify all flood mitigation measures considered by the flood model.**
- B. Application of flood mitigation measures that enhance the performance of personal residential structures and their contents shall be justified as to the impact on reducing flood damage whether done individually or in combination.**

**Purpose:** This standard requires that flood mitigation measures intended to eliminate or reduce flood damage are accounted for in the flood model as they impact personal residential exposures.

Flood mitigation measures are those measures undertaken at an individual building level, usually within the building footprint, and may include, but not be limited to such things as:

- Strengthening foundation
- Strengthening foundation to building connection
- Wet and/or dry floodproofing
- Use of flood damage resistant materials
- Permanent elevation or protection of equipment and utilities
- Temporary elevation or relocation of building contents
- Temporary flood protection measures
- Pumps.

It is necessary to account for the total impact that the use of multiple flood mitigation measures will have on flood damage. When multiple measures are used, the combined effect on flood damage must be estimated, and this may not be the sum of the effects of the individual measures.

This standard requires sensitivity of flood damage to effectiveness of building mitigation measures to be considered and flood loss uncertainties to be estimated.

**Relevant Forms:** GF-4, Vulnerability Flood Standards Structural/Hydraulic/Coastal Engineer Expert Certification  
 VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage  
 VF-4, Coastal Flood Mitigation Measures, Mean Coastal Flood Damage Ratios and Coastal Flood Loss Costs (Trade Secret item)

- VF-5, Inland Flood Mitigation Measures, Inland Mean Flood Damage Ratios and Inland Flood Loss Costs (Trade Secret item)
- AF-5, Logical Relationship to Flood Risk (Trade Secret item)

## Disclosures

1. Provide a completed Form VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage. Provide a link to the location of the form [insert hyperlink here].
2. Provide a description of all flood mitigation measures used by the flood model, whether or not they are listed in Form VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage.
3. Describe how personal residential time element losses are affected by performance of flood mitigation measures. Identify any assumptions.
4. Describe how personal residential structure and contents damage and their associated uncertainties are affected by flood mitigation measures. Identify any assumptions.
5. Describe how the effects of multiple flood mitigation measures are combined in the flood model and the process used to ensure that multiple flood mitigation measures are correctly combined.
6. Describe how flood mitigation measures affect the uncertainty of the vulnerability. Identify any assumptions.

## Audit

1. Flood mitigation measures used by the flood model will be reviewed for theoretical soundness and reasonability.
2. Form VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage, Form VF-4, Coastal Flood Mitigation Measures, Mean Coastal Flood Damage Ratios and Coastal Flood Loss Costs (Trade Secret item), and Form VF-5, Inland Flood Mitigation Measures, Mean Inland Flood Damage Ratios and Inland Flood Loss Costs (Trade Secret item), will be reviewed.
3. Implementation of flood mitigation measures will be reviewed as well as the effect of individual flood mitigation measures on flood damage. Any variation in the change over the range of flood depths above ground for individual flood mitigation measures will be reviewed. Historical data, technical literature, or expert opinion used to support the assumptions and implementation of flood mitigation measures will be reviewed. How flood mitigation measures affect the uncertainty of the vulnerability will be reviewed.
4. Implementation of multiple flood mitigation measures will be reviewed. The combined effects of these flood mitigation measures on flood damage will be

reviewed. Any variation in the change over the range of flood depths above ground for multiple flood mitigation measures will be reviewed.

**Form VF-1: Hypothetical Coastal Flood Event with Damaging Waves**

Purpose: This form provides an illustration of the aggregate damage/exposure ratios by flood depth and by construction type for a specific set of reference structures subject to coastal flooding with damaging waves.

A. Sample personal residential exposure data for 8 reference structures as defined below and 51 flood depths (0-25 feet at half foot increments) are provided in the file named “VFEventFormsInput15.xlsx.”

Model the sample personal residential exposure data provided in the file versus the flood depths and provide the damage ratios summarized by flood depth and construction type.

For completing Part A, Estimated Damage for each individual flood depth is the sum of ground up loss to all structures in the flood depth range, excluding demand surge. For completing Part B, Estimated Damage is the sum of the ground up loss to all structures of a specific construction type (wood frame, masonry, or manufactured home) in all of the flood depth ranges, excluding demand surge.

Personal residential contents, appurtenant structures, or time element coverages are not included.

**Reference Structures**

Wood Frame	Masonry	Manufactured Home
#1 One story Crawlspace foundation Top of foundation wall 3 feet above grade	#4 One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls	#7 Manufactured post 1994 Dry stack concrete foundation Pier height 3 feet above grade Tie downs Single unit
#2 Two story Slab foundation Top of slab 1 foot above grade 5/8” diameter anchors at 48” centers for wall/slab connections	#5 Two story Slab foundation Top of slab 1 foot above grade Reinforced masonry exterior walls	#8 Manufactured post 1994 Reinforced masonry pier foundation Pier height 6 feet above grade Tie downs Single unit
#3 Two story Unbraced timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	#6 Two story Concrete pile foundation Concrete slab Top of pile 8 feet above grade Reinforced masonry exterior walls	

B. Confirm that the structures used in completing the form are identical to those in the above table for the reference structures.

C. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a description of how they are included.

D. Provide a plot of the Form VF-1, Part A data.

E. Include Form VF-1, Hypothetical Coastal Flood Event with Damaging Waves, in a submission appendix.

**Form VF-1: Hypothetical Coastal Flood Event with Damaging Waves**

**Part A**

<u>Flood depth (feet) above ground level</u>	<u>Estimated Damage/ Subject Exposure</u>	<u>Flood depth (feet) above ground level</u>	<u>Estimated Damage/ Subject Exposure</u>
0		13	
0.5		13.5	
1		14	
1.5		14.5	
2		15	
2.5		15.5	
3		16	
3.5		16.5	
4		17	
4.5		17.5	
5		18	
5.5		18.5	
6		19	
6.5		19.5	
7		20	
7.5		20.5	
8		21	
8.5		21.5	
9		22	
9.5		22.5	
10		23	
10.5		23.5	
11		24	
11.5		24.5	
12		25	
12.5			

**Part B**

<u>Construction Type</u>	<u>Estimated Damage/ Subject Exposure</u>
Wood Frame	
Masonry	
Manufactured Home	

**Form VF-2: Hypothetical Inland Flood Event**

Purpose: This form provides an illustration of the aggregate damage/exposure ratios by flood depth and by construction type for a specific set of reference structures subject to inland (inundation) flooding.

A. Sample personal residential exposure data for 8 reference structures as defined below and 51 flood depths (0-25 feet at half foot increments) are provided in the file named “VFEventFormsInput15.xlsx.”

Model the sample personal residential exposure data provided in the file versus the flood depths and provide the damage ratios summarized by flood depth and construction type.

For completing Part A, Estimated Damage for each individual flood depth is the sum of ground up loss to all structures in the flood depth range, excluding demand surge. For completing Part B, Estimated Damage is the sum of the ground up loss to all structures of a specific construction type (wood frame, masonry, or manufactured home) in all of the flood depth ranges, excluding demand surge.

Personal residential contents, appurtenant structures, or time element coverages are not included.

**Reference Structures**

Wood Frame	Masonry	Manufactured Home
#1 One story Crawlspace foundation Top of foundation wall 3 feet above grade	#4 One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls	#7 Manufactured post 1994 Dry stack concrete foundation Pier height 3 feet above grade Tie downs Single unit
#2 Two story Slab foundation Top of slab 1 foot above grade 5/8” diameter anchors at 48” centers for wall/slab connections	#5 Two story Slab foundation Top of slab 1 foot above grade Reinforced masonry exterior walls	#8 Manufactured post 1994 Reinforced masonry pier foundation Pier height 6 feet above grade Tie downs Single unit
#3 Two story Unbraced timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	#6 Two story Concrete pile foundation Concrete slab Top of pile 8 feet above grade Reinforced masonry exterior walls	

B. Confirm that the structures used in completing the form are identical to those in the above table for the reference structures.

- C. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a description of how they are included.
- D. Provide a plot of the Form VF-2, Part A data.
- E. Included Form VF-2, Hypothetical Inland Flood Event, in a submission appendix.

**Form VF-2: Hypothetical Inland Flood Event**

**Part A**

<u>Flood depth (feet) above ground level</u>	<u>Estimated Damage/ Subject Exposure</u>	<u>Flood depth (feet) above ground level</u>	<u>Estimated Damage/ Subject Exposure</u>
0		13	
0.5		13.5	
1		14	
1.5		14.5	
2		15	
2.5		15.5	
3		16	
3.5		16.5	
4		17	
4.5		17.5	
5		18	
5.5		18.5	
6		19	
6.5		19.5	
7		20	
7.5		20.5	
8		21	
8.5		21.5	
9		22	
9.5		22.5	
10		23	
10.5		23.5	
11		24	
11.5		24.5	
12		25	
12.5			

**Part B**

<u>Construction Type</u>	<u>Estimated Damage/ Subject Exposure</u>
Wood Frame	
Masonry	
Manufactured Home	

**Form VF-3: Flood Mitigation Measures  
Range of Changes in Flood Damage**

Purpose: This form illustrates the changes in flood damage rates for two specific reference structures subject to individual flood mitigation measures and to combinations of flood mitigation measures.

- A. Provide the change in the personal residential reference building damage rate (not loss cost) for each individual flood mitigation measure listed in Form V-3, Flood Mitigation Measures, Range of Changes in Flood Damage, as well as for the combination of the flood mitigation measures.
- B. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.
- C. Provide this form in Excel format without truncation. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage, in a submission appendix.

**Reference Structures**

Wood Frame	Masonry
Two story Unbraced timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls

Place the reference structures at the following locations, with latitude and longitude referenced to the World Geodetic System of 1984 (WGS84) datum, and provide the aggregated results:

Gulf of Mexico

Latitude: 27.9957517

Longitude: -82.8277373

St. Johns River

Latitude: ~~29.4777005~~29.376888

Longitude: ~~-81.6739088~~-81.619022

D. Provide the elevation used from the model elevation database for both reference points.

**Form VF-3: Flood Mitigation Measures  
Range of Changes in Flood Damage**

INDIVIDUAL MITIGATION MEASURES		PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATE - MITIGATED DAMAGE RATE) / REFERENCE DAMAGE RATE) * 100											
		WOOD FRAME STRUCTURE					MASONRY STRUCTURE						
		FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND						
		7	9	11	13	15	1	23	35	47	59		
	REFERENCE STRUCTURE	—	—	—	—	—	—	—	—	—	—	—	—
FIRST FLOOR HEIGHT AND FLOODPROOFED UTILITY EQUIPMENT	Elevate Floor 1 Foot						—	—	—	—	—	—	—
	Elevate Floor 2 Feet						—	—	—	—	—	—	—
	Elevate Floor 3 Feet						—	—	—	—	—	—	—
FLOODPROOFED UTILITY EQUIPMENT	Elevate or Protect 1 Foot												
	Elevate or Protect 2 Feet												
	Elevate or Protect 3 Feet												
STRENGTHEN FOUNDATION	Bracing of Timber Pile Foundation						—	—	—	—	—	—	—
FLOODPROOFING	Wet 1 Foot												
	Wet 2 Feet												
	Wet 3 Feet												
	Dry 1 Foot	—	—	—	—	—							
	Dry 2 Feet	—	—	—	—	—							
	Dry 3 Feet	—	—	—	—	—							
MITIGATION MEASURES IN COMBINATION		PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATE - MITIGATED DAMAGE RATE) / REFERENCE DAMAGE RATE) * 100											
		WOOD FRAME STRUCTURE					MASONRY STRUCTURE						
		FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND						
		7	9	11	13	15	1	23	35	47	59		
STRUCTURE	Mitigated Structure Utility Equipment Elevated 2 Feet Above Floor and Wet Floodproofing 2 Feet												

**Form VF-4: Coastal Flood Mitigation Measures,  
Mean Coastal Flood Damage Ratios and  
Coastal Flood Loss Costs (Trade Secret Item)**

Purpose: This form illustrates the coastal flood damage ratios and coastal flood loss costs for two specific reference structures subject to individual flood mitigation measures and to combinations of flood mitigation measures.

- A. Provide the mean damage ratio (prior to any insurance considerations) to the reference structure for each individual flood mitigation measure listed in Form VF-4, Coastal Flood Mitigation Measures, Mean Coastal Flood Damage Ratios and Coastal Flood Loss Costs (Trade Secret item), as well as the percent damage for the combination of the flood mitigation measures.
- B. Provide the loss costs rounded to three decimal places, for the reference structures and for each individual flood mitigation measure listed in Form VF-4, Coastal Flood Mitigation Measures, Mean Coastal Flood Damage Ratios and Coastal Flood Loss Costs (Trade Secret item), as well as the loss costs for the combination of the flood mitigation measures.
- C. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.
- D. Provide a graphical representation of the personal residential vulnerability functions for the reference and fully mitigated structures.

**Reference Structures**

Wood Frame	Masonry
Two story Unbraced timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls

Reference and mitigated structures are fully insured personal residential building structures with a zero deductible structure only policy.

Place the reference structures at the following location, with latitude and longitude referenced to the World Geodetic System of 1984 (WGS84) datum:

Gulf of Mexico  
Latitude: 27.9957517  
Longitude: -82.8277373

E. Provide the elevation used from the model elevation database for the reference point.

**Form VF-4: Coastal Flood Mitigation Measures,  
Mean Coastal Flood Damage Ratios and  
Coastal Flood Loss Costs (Trade Secret Item)**

INDIVIDUAL MITIGATION MEASURES		MEAN DAMAGE RATIO											LOSS COSTS	
		WOOD FRAME STRUCTURE					MASONRY STRUCTURE					WOOD FRAME STRUCTURE	MASONRY STRUCTURE	
		FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND					WOOD FRAME STRUCTURE	MASONRY STRUCTURE	
		7	9	11	13	15	1	23	35	47	59	ACROSS ALL FLOOD DEPTHS		
	REFERENCE STRUCTURE	—	—	—	—	—	—	—	—	—	—	—	—	—
FIRST FLOOR HEIGHTENED FLOODPROOFED UTILITY EQUIPMENT	Elevate Floor 1 Foot						—	—	—	—	—			
	Elevate Floor 2 Feet						—	—	—	—	—			
	Elevate Floor 3 Feet						—	—	—	—	—			
FLOODPROOFED UTILITY EQUIPMENT	Elevate or Protect 1 Foot													
	Elevate or Protect 2 Feet													
	Elevate or Protect 3 Feet													
STRENGTHEN FOUNDATION	Bracing of Timber Pile Foundation						—	—	—	—	—			
FLOODPROOFING	Wet 1 Foot													
	Wet 2 Feet													
	Wet 3 Feet													
	Dry 1 Foot	—	—	—	—	—						—		
	Dry 2 Feet	—	—	—	—	—						—		
	Dry 3 Feet	—	—	—	—	—						—		
MITIGATION MEASURES IN COMBINATION		MEAN DAMAGE RATIO											LOSS COSTS	
		WOOD FRAME STRUCTURE					MASONRY STRUCTURE					WOOD FRAME STRUCTURE	MASONRY STRUCTURE	
		FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND					WOOD FRAME STRUCTURE	MASONRY STRUCTURE	
		7	9	11	13	15	1	23	35	47	59	ACROSS ALL FLOOD DEPTHS		
STRUCTURE	Mitigated Structure Utility Equipment Elevated 2 Feet Above Floor and Wet Floodproofing 2 Feet													

**Form VF-5: Inland Flood Mitigation Measures,  
Mean Inland Flood Damage Ratios and  
Inland Flood Loss Costs (Trade Secret Item)**

Purpose: This form illustrates the inland flood damage ratios and inland flood loss costs for two specific reference structures subject to individual flood mitigation measures and to combinations of flood mitigation measures.

- A. Provide the mean damage ratio (prior to any insurance considerations) to the reference structure for each individual flood mitigation measure listed in Form VF-5, Inland Flood Mitigation Measures, Mean Inland Flood Damage Ratios and Inland Flood Loss Costs (Trade Secret item), as well as the percent damage for the combination of the flood mitigation measures.
- B. Provide the loss costs rounded to three decimal places, for the reference structures and for each individual flood mitigation measure listed in Form VF-5, Inland Flood Mitigation Measures, Mean Inland Flood Damage Ratios and Inland Flood Loss Costs (Trade Secret item), as well as the loss costs for the combination of the flood mitigation measures.
- C. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.
- D. Provide a graphical representation of the personal residential vulnerability functions for the reference and fully mitigated structures.

**Reference Structures**

Wood Frame	Masonry
Two story Unbraced timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls

Reference and mitigated structures are fully insured personal residential building structures with a zero deductible structure only policy.

Place the reference structures at the following location, with latitude and longitude referenced to the World Geodetic System of 1984 (WGS84) datum:

St. Johns River  
 Latitude: ~~29.4777005~~29.376888  
 Longitude: ~~-81.6739088~~-81.619022

F. Provide the elevation used from the model elevation database for the reference point.

**Form VF-5: Inland Flood Mitigation Measures,  
Mean Inland Flood Damage Ratios and  
Inland Flood Loss Costs (Trade Secret Item)**

INDIVIDUAL MITIGATION MEASURES		MEAN DAMAGE RATIO											LOSS COSTS	
		WOOD FRAME STRUCTURE					MASONRY STRUCTURE					WOOD FRAME STRUCTURE	MASONRY STRUCTURE	
		FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND					WOOD FRAME STRUCTURE	MASONRY STRUCTURE	
		7	9	11	13	15	1	23	35	47	59	ACROSS ALL FLOOD DEPTHS		
	REFERENCE STRUCTURE	—	—	—	—	—	—	—	—	—	—	—	—	—
FIRST FLOOR HEIGHT AND FLOODPROOFED UTILITY EQUIPMENT	Elevate Floor 1 Foot						—	—	—	—	—			
	Elevate Floor 2 Feet						—	—	—	—	—			
	Elevate Floor 3 Feet						—	—	—	—	—			
FLOODPROOFED UTILITY EQUIPMENT	Elevate or Protect 1 Foot													
	Elevate or Protect 2 Feet													
	Elevate or Protect 3 Feet													
STRENGTHEN FOUNDATION	Bracing of Timber Pile Foundation						—	—	—	—	—			
FLOODPROOFING	Wet 1 Foot													
	Wet 2 Feet													
	Wet 3 Feet													
	Dry 1 Foot	—	—	—	—	—						—		
	Dry 2 Feet	—	—	—	—	—						—		
	Dry 3 Feet	—	—	—	—	—						—		
MITIGATION MEASURES IN COMBINATION		MEAN DAMAGE RATIO											LOSS COSTS	
		WOOD FRAME STRUCTURE					MASONRY STRUCTURE					WOOD FRAME STRUCTURE	MASONRY STRUCTURE	
		FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND					WOOD FRAME STRUCTURE	MASONRY STRUCTURE	
		7	9	11	13	15	1	23	35	47	59	ACROSS ALL FLOOD DEPTHS		
STRUCTURE	Mitigated Structure Utility Equipment Elevated 2 Feet Above Floor and Wet Floodproofing 2 Feet													