2017 FLOOD STANDARDS, DISCLOSURES, AND FORMS

GENERAL FLOOD STANDARDS

GF-1 Scope of the Flood Model and Its Implementation

A. The flood model shall project loss costs and probable maximum loss levels for primary damage to insured personal residential property from flood events.

B. The modeling organization shall maintain a documented process to assure continual agreement and correct correspondence of databases, data files, and computer source code to slides, technical papers, and modeling organization documents.

C. All software and data (1) located within the flood model, (2) used to validate the flood model, (3) used to project modeled flood loss costs and flood probable maximum loss levels, and (4) used to create forms required by the Commission in the Flood Standards Report of Activities shall fall within the scope of the Computer/Information Flood Standards and shall be located in centralized, model-level file areas.

D. Differences between historical and modeled flood losses shall be reasonable, given available flood loss data.

Purpose: This standard yields a high level view of the scope of the flood model to be reviewed, namely projecting flood loss costs and flood probable maximum loss levels for primary damage to insured personal residential property from flood events. The definition of flood as used in this standard is based on Section 627.715(1)(b), Florida Statutes. The scope of the flood model applies to all types of flooding determined to be scientifically feasible at a location (that is, where frequencies and severities of such events are available and can be projected) and is not limited to any specific subsets or types of flood peril. Use of the flood loss data will be reviewed.

Relevant Form: GF-1, General Flood Standards Expert Certification

Disclosures

1. Specify the flood model version identification. If the flood model submitted for review is implemented on more than one platform, specify each flood model platform. Specify which platform is the primary platform and verify how any other platforms produce the same flood model output results or are otherwise functionally equivalent as provided for in the "Process for Determining the Acceptability of a Computer Simulation Flood Loss Model" in VI. Review by the Commission, I. Review and Acceptance Criteria for Functionally Equivalent Model Platforms.

2. Provide a comprehensive summary of the flood model. This summary should include a technical description of the flood model, including each major component of the flood model used to project loss costs and probable maximum loss levels for insured primary damage to personal residential property from flood events causing damage in Florida. Describe the theoretical basis of the flood model and include a description of the methodology, particularly the meteorology components, the hydrology and hydraulic components, the vulnerability components, and the insured flood loss components used in the flood model. The description should be complete and is not to reference unpublished work.

3. Provide a flowchart that illustrates interactions among major flood model components.

4. Provide a comprehensive list of complete references pertinent to the submission by flood standard grouping using professional citation standards.

5. Provide a list and description of any potential interim updates to underlying data relied upon by the flood model. State whether the time interval for the update has a possibility of occurring during the period of time the flood model could be found acceptable by the Commission under the review cycle in this *Flood Standards Report of Activities*.

6. Identify and describe the modeling-organization-specified, predetermined, and comprehensive exposure dataset used for projecting personal residential flood loss costs and flood probable maximum loss levels.

Audit

1. All primary technical papers that describe the underlying flood model theory and implementation (where applicable) should be available for review in hard copy or electronic form. Modeling-organization-specific publications cited must be available for review in hard copy or electronic form.

2. Compliance with the process prescribed in Standard GF-1.B in all stages of the flood modeling process will be reviewed.

3. Items specified in Standard GF-1.C will be reviewed as part of the Computer/Information Flood Standards.

4. Maps, databases, and data files relevant to the modeling organization's submission will be reviewed.

5. Justification for the differences in modeled versus historical flood losses will be reviewed, recognizing that flood loss data may be limited to internal or proprietary datasets.

6. The following information related to changes in the flood model, since the initial submission for each subsequent revision of the submission, will be reviewed.

A. Flood model changes:

1. A summary description of changes that affect, or are believed to affect, the personal residential flood loss costs or flood probable maximum loss levels,

2. A list of all other changes, and

3. The rationale for each change.

B. Percentage difference in average annual zero deductible statewide flood loss costs based on a modeling-organization-specified, predetermined, and comprehensive exposure dataset for:

1. All changes combined, and

2. Each individual flood model component and subcomponent change.

C. Color-coded maps by rating area or zone reflecting the percentage difference in average annual zero deductible statewide flood loss costs based on the modeling-organization-specified, predetermined, and comprehensive exposure dataset for each flood model component change:

1. Between the initial submission and the revised submission, and

2. Between any intermediate revisions and the revised submission.

7. The modeling-organization-specified, predetermined, and comprehensive exposure dataset used for projecting personal residential flood loss costs and flood probable maximum loss levels will be reviewed.

GF-2 Qualifications of Modeling Organization Personnel and Consultants Engaged in Development of the Flood Model

A. Flood model construction, testing, and evaluation shall be performed by modeling organization personnel or consultants who possess the necessary skills, formal education, and experience to develop the relevant components for flood loss projection methodologies.

B. The flood model and flood model submission documentation shall be reviewed by modeling organization personnel or consultants in the following professional disciplines with requisite experience: hydrology and hydraulics (advanced degree or licensed Professional Engineer(s) with experience in coastal and inland flooding), meteorology (advanced degree), statistics (advanced degree), structural engineering (licensed Professional Engineer(s) with experience in coastal and inland flooding), actuarial science (Associate or Fellow of Casualty Actuarial Society or Society of Actuaries), and computer/information science (advanced degree or equivalent experience and certifications). These individuals shall certify Expert Certification Forms GF-1 through GF-7 as applicable.

Purpose: Professional disciplines with requisite experience necessary to develop the flood model are to be represented among modeling organization staff and consultants. Academic or professional designations are required but not necessarily sufficient for the personnel involved in flood model development, implementation, and preparation of material for review by the Commission.

Relevant Forms: GF-1, General Flood Standards Expert Certification
GF-2, Meteorological Flood Standards Expert Certification
GF-3, Hydrological and Hydraulic Flood Standards Expert Certification
GF-4, Statistical Flood Standards Expert Certification
GF-5, Vulnerability Flood Standards Expert Certification
GF-6, Actuarial Flood Standards Expert Certification
GF-7, Computer/Information Flood Standards Expert Certification

Disclosures

1. Organization Background

A. Describe the ownership structure of the modeling organization engaged in the development of the flood model. Describe affiliations with other companies and the nature of the relationship, if any. Indicate if the organization has changed its name and explain the circumstances.

B. If the flood model is developed by an entity other than the modeling organization, describe its organizational structure and indicate how proprietary rights and control over

the flood model and its components are exercised. If more than one entity is involved in the development of the flood model, describe all involved.

C. If the flood model is developed by an entity other than the modeling organization, describe the funding source for the development of the flood model.

D. Describe any services other than flood modeling provided by the modeling organization.

E. Indicate if the modeling organization has ever been involved directly in litigation or challenged by a governmental authority where the credibility of one of its U.S. flood model versions for projection of flood loss costs or flood probable maximum loss levels was disputed. Describe the nature of each case and its conclusion.

2. Professional Credentials

A. Provide in a tabular format (a) the highest degree obtained (discipline and university), (b) employment or consultant status and tenure in years, and (c) relevant experience and responsibilities of individuals currently involved in the acceptability process or in any of the following aspects of the flood model:
    1. Meteorology
    2. Hydrology and Hydraulics
    3. Statistics
    4. Vulnerability
    5. Actuarial Science
    6. Computer/Information Science

B. Provide visual business workflow documentation connecting all personnel related to flood model design, testing, execution, maintenance, and decision-making.

3. Independent Peer Review

A. Provide reviewer names and dates of external independent peer reviews that have been performed on the following components as currently functioning in the flood model:
    1. Meteorology
    2. Hydrology and Hydraulics
    3. Statistics
    4. Vulnerability
    5. Actuarial Science
    6. Computer/Information Science

B. Provide documentation of independent peer reviews directly relevant to the modeling organization’s responses to the flood standards, disclosures, or forms. Identify any unresolved or outstanding issues as a result of these reviews.

C. Describe the nature of any on-going or functional relationship the organization has with any of the persons performing the independent peer reviews.

4. Provide a list of rating agencies and insurance regulators that have reviewed the flood model. Include the dates and purpose of the reviews.

5. Provide a completed Form GF-1, General Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

6. Provide a completed Form GF-2, Meteorological Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

7. Provide a completed Form GF-3, Hydrological and Hydraulic Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

8. Provide a completed Form GF-4, Statistical Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

9. Provide a completed Form GF-5, Vulnerability Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

10. Provide a completed Form GF-6, Actuarial Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

11. Provide a completed Form GF-7, Computer/Information Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

Audit

1. The professional vitae of personnel and consultants engaged in the development of the flood model and responsible for the current flood model and the submission will be reviewed. Background information on the professional credentials and the requisite experience of individuals providing testimonial letters in the submission will be reviewed.

2. Forms GF-1, General Flood Standards Expert Certification, GF-2, Meteorological Flood Standards Expert Certification, GF-3, Hydrological and Hydraulic Flood Standards Expert Certification, GF-4, Statistical Flood Standards Expert Certification, GF-5, Vulnerability Flood Standards Expert Certification, GF-6, Actuarial Flood Standards Expert Certification, GF-7, Computer/Information Flood Standards Expert Certification, and all independent peer reviews of the flood model under consideration will be reviewed. Signatories on the individual forms will be required to provide a description of their review process.

3. Incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession will be discussed.

4. For each individual listed under Disclosure 2.A, specific information as to any consulting activities and any relationship with an insurer, reinsurer, trade association, governmental entity, consumer group, or other advocacy group within the previous four years will be reviewed.

GF-3 Insured Exposure Location

A. ZIP Codes used in the model shall not differ from the United States Postal Service publication date by more than 48 months at the date of submission of the model. ZIP Code information shall originate from the United States Postal Service.

B. Horizontal location information used by the modeling organization shall be verified by the modeling organization for accuracy and timeliness and linked to the structure where available. The publication date of the horizontal location data shall be no more than 48 months prior to the date of submission of the model. The horizontal location information data source shall be documented and updated.

C. If any hazard or any flood model vulnerability components are dependent on databases pertaining to location, the modeling organization shall maintain a logical process for ensuring these components are consistent with the horizontal location database updates.

D. Geocoding methodology shall be justified.

E. Use and conversion of horizontal and vertical projections and datum references shall be consistent and justified.

Purpose: Flood model outputs, including flood loss costs and flood probable maximum loss levels, are sensitive to insured exposure locations and topography. Accurate insured exposure locations are necessary for projecting flood loss costs and flood probable maximum loss levels. Appropriate methods must be used when converting location information to latitude-longitude, when associating the elevation, and when aggregating results to the ZIP Code level.

Relevant Form: GF-1, General Flood Standards Expert Certification

Disclosures

1. List the current location databases used by the flood model and the flood model components to which they relate. Provide the effective dates corresponding to the location databases.

2. Describe in detail how invalid ZIP Codes, parcels, addresses, and other location information are handled.

3. Describe any methods used for subdividing or disaggregating the location input data and the treatment of any variations for populated versus unpopulated areas.

4. Describe the data, methods, and process used in the flood model to convert between street addresses and geocode locations (latitude-longitude).

5. Describe the use of geographic information systems (GIS) in the process of converting among street addresses and geocode locations, and the generation of insured exposure locations.

6. List and provide a brief description of each database used in the flood model for determining geocode locations.

7. Describe the process for updating flood model geocode locations as location databases are updated.

8. Describe in detail the methods by which ground elevation data at the insured exposure location (e.g., building) is associated with the location databases and how this associated data is used in the flood model.

9. For each parameter used in the flood model, provide the horizontal and vertical projections and datum references, if applicable. If any horizontal or vertical datum conversions are required, provide conversion factors and describe the conversion methodology used.

Audit

1. Geographic displays of the spatial distribution of insured exposures will be reviewed. The treatment of any variations for populated versus unpopulated areas will be reviewed.

2. Third party vendor information, if applicable, and a complete description of the process used to create, validate, and justify geographic grids will be reviewed.

3. The treatment of exposures over water or other uninhabitable terrain will be reviewed.

4. The process for geocoding complete and incomplete street addresses will be reviewed.

5. Flood model geocode location databases will be reviewed.

GF-4 Independence of Flood Model Components

The meteorology, hydrology and hydraulics, vulnerability, and actuarial components of the flood model shall each be theoretically sound without compensation for potential bias from other components.

Purpose: The primary components of the flood model ought to be individually sound and operate independently. For example, the flood model should not allow adjustments to one component to compensate for deficiencies in other components (compensation which could inflate or reduce damage). A flood model would not meet this standard if an artificial calibration adjustment has been made to improve the match of historical and flood model results for a specific flood event. In addition to each component of the flood model meeting its respective flood standards, the interrelationship of the flood model components as a whole must be reasonable, logical, and justified.

Relevant Form: GF-1, General Flood Standards Expert Certification

Audit

1. The flood model components will be reviewed for adequately portraying flood phenomena and effects (damage, flood loss costs, and flood probable maximum loss levels). Attention will be paid to an assessment of (1) the theoretical soundness of each component, (2) the basis of the integration of each component into the flood model, and (3) consistency between the results of one component and another.

GF-5 Editorial Compliance

The flood model submission and any revisions provided to the Commission throughout the review process shall be reviewed and edited by a person or persons with experience in reviewing technical documents who shall certify on Form GF-8, Editorial Review Expert Certification, that the flood model submission has been personally reviewed and is editorially correct.

Purpose: A quality control process with regard to creating, maintaining, and reviewing all documentation associated with the flood model must be maintained.

Person(s) with experience in reviewing technical documents for grammatical correctness, typographical accuracy, and accurate citations, charts, or graphs must have reviewed the flood model submission and certify that the flood model submission is in compliance with the acceptability process.

Relevant Forms: GF-1, General Flood Standards Expert Certification
GF-2, Meteorological Flood Standards Expert Certification
GF-3, Hydrological and Hydraulic Flood Standards Expert Certification
GF-4, Statistical Flood Standards Expert Certification
GF-5, Vulnerability Flood Standards Expert Certification
GF-6, Actuarial Flood Standards Expert Certification
GF-7, Computer/Information Flood Standards Expert Certification
GF-8, Editorial Review Expert Certification

Disclosures

1. Describe the process used for document control of the flood model submission. Describe the process used to ensure that the paper and electronic versions of specific files are identical in content.

2. Describe the process used by the signatories on the Expert Certification Forms GF-1 through GF-7 to ensure that the information contained under each set of flood standards is accurate and complete.

3. Provide a completed Form GF-8, Editorial Review Expert Certification. Provide a link to the location of the form [insert hyperlink here].

Audit

1. An assessment that the person(s) who has reviewed the flood model submission has experience in reviewing technical documentation and that such person(s) is familiar with the flood model submission requirements as set forth in the Commission's *Flood Standards Report of Activities as of November 1, 2017* will be made.

2. Attestation that the flood model submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and no inclusion of extraneous data or materials will be assessed.

3. Confirmation that the flood model submission has been reviewed by the signatories on the Expert Certification Forms GF-1 through GF-7 for accuracy and completeness will be assessed.

4. The modification history for flood model submission documentation will be reviewed.

5. A flowchart defining the process for form creation will be reviewed.

6. Form GF-8, Editorial Review Expert Certification, will be reviewed.

Form GF-1: General Flood Standards Expert Certification

Purpose: This form identifies the signatory or signatories who have reviewed the current flood model submission (submission) for compliance with the General Flood Standards (GF-1 – GF-5) in accordance with the stated provisions.

I hereby certify that I have reviewed the current submission of _____
(Name of Flood Model)
Version _____ for compliance with the 2017 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1) The flood model meets the General Flood Standards (GF-1 – GF-5);
2) The disclosures and forms related to the General Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3) My review was completed in accordance with the professional standards and code of ethical conduct for my profession;
4) My review involved ensuring the consistency of the content in all sections of the submission; and
5) In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Name	Professional Credentials (Area of Expertise)
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form is required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form GF-1, General Flood Standards Expert Certification, in a submission appendix.

Form GF-2: Meteorological Flood Standards Expert Certification

Purpose: This form identifies the signatory or signatories who have reviewed the current flood model submission (submission) for compliance with the Meteorological Flood Standards (MF-1 – MF-5) in accordance with the stated provisions.

I hereby certify that I have reviewed the current submission of _____
(Name of Flood Model)
Version _____ for compliance with the 2017 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1) The flood model meets the Meteorological Flood Standards (MF-1 – MF-5);
2) The disclosures and forms related to the Meteorological Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3) My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4) In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Name	Professional Credentials (Area of Expertise)
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form is required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form GF-2, Meteorological Flood Standards Expert Certification, in a submission appendix.

Form GF-3: Hydrological and Hydraulic Flood Standards Expert Certification

Purpose: This form identifies the signatory or signatories who have reviewed the current flood model submission (submission) for compliance with the Hydrological and Hydraulic Flood Standards (HHF-1 – HHF-4) in accordance with the stated provisions.

I hereby certify that I have reviewed the current submission of _____
(Name of Flood Model)
Version _____ for compliance with the 2017 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1) The flood model meets the Hydrological and Hydraulic Flood Standards (HHF-1 – HHF-4);
2) The disclosures and forms related to the Hydrological and Hydraulic Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3) My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4) In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Name	Professional Credentials (Area of Expertise)
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form is required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form GF-3, Hydrological and Hydraulic Flood Standards Expert Certification, in a submission appendix.

Form GF-4: Statistical Flood Standards Expert Certification

Purpose: This form identifies the signatory or signatories who have reviewed the current flood model submission (submission) for compliance with the Statistical Flood Standards (SF-1 – SF-5) in accordance with the stated provisions.

I hereby certify that I have reviewed the current submission of _____
(Name of Flood Model)
Version _____ for compliance with the 2017 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1) The flood model meets the Statistical Flood Standards (SF-1 – SF-5);
2) The disclosures and forms related to the Statistical Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3) My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4) In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Name	Professional Credentials (Area of Expertise)
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form is required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form GF-4, Statistical Flood Standards Expert Certification, in a submission appendix.

Form GF-5: Vulnerability Flood Standards Expert Certification

Purpose: This form identifies the signatory or signatories who have reviewed the current flood model submission (submission) for compliance with the Vulnerability Flood Standards (VF-1 – VF-4) in accordance with the stated provisions.

I hereby certify that I have reviewed the current submission of _____
(Name of Flood Model)
Version _____ for compliance with the 2017 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1) The flood model meets the Vulnerability Flood Standards (VF-1 – VF-4);
2) The disclosures and forms related to the Vulnerability Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3) My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4) In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Name	Professional Credentials (Area of Expertise)
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form is required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form GF-5, Vulnerability Flood Standards Expert Certification, in a submission appendix.

Form GF-6: Actuarial Flood Standards Expert Certification

Purpose: This form identifies the signatory or signatories who have reviewed the current flood model submission (submission) for compliance with the Actuarial Flood Standards (AF-1 – AF-6) in accordance with the stated provisions.

I hereby certify that I have reviewed the current submission of _____
(Name of Flood Model)
Version _____ for compliance with the 2017 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1) The flood model meets the Actuarial Flood Standards (AF-1 – AF-6);
2) The disclosures and forms related to the Actuarial Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3) My review was completed in accordance with the Actuarial Standards of Practice and Code of Conduct; and
4) In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Name	Professional Credentials (Area of Expertise)
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form is required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form GF-6, Actuarial Flood Standards Expert Certification, in a submission appendix.

Form GF-7: Computer/Information Flood Standards Expert Certification

Purpose: This form identifies the signatory or signatories who have reviewed the current flood model submission (submission) for compliance with the Computer/Information Flood Standards (CIF-1 – CIF-7) in accordance with the stated provisions.

I hereby certify that I have reviewed the current submission of _____
(Name of Flood Model)
Version _____ for compliance with the 2017 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1) The flood model meets the Computer/Information Flood Standards (CIF-1 – CIF-7);
2) The disclosures and forms related to the Computer/Information Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3) My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4) In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Name	Professional Credentials (Area of Expertise)
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form is required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form GF-7, Computer/Information Flood Standards Expert Certification, in a submission appendix.

Form GF-8: Editorial Review Expert Certification

Purpose: This form identifies the signatory or signatories who have reviewed the current flood model submission (submission) for compliance with the Commission's Notification Requirements and General Flood Standard GF-5, Editorial Compliance, in accordance with the stated provisions.

I hereby certify that I have reviewed the current submission of _____
(Name of Flood Model)
Version _____ for compliance with the "Process for Determining the Acceptability of a Computer Simulation Flood Loss Model" adopted by the Florida Commission on Hurricane Loss Projection Methodology in its *Flood Standards Report of Activities as of November 1, 2017*, and hereby certify that:

1) The submission is in compliance with the Commission's Notification Requirements and General Flood Standard GF-5, Editorial Compliance;
2) The disclosures and forms related to each flood standards section are editorially accurate and contain complete information and any changes that have been made to the submission during the review process have been reviewed for completeness, grammatical correctness, and typographical errors;
3) There are no incomplete responses, inaccurate citations, charts or graphs, or extraneous text or references;
4) The current version of the submission has been reviewed for grammatical correctness, typographical errors, completeness, the exclusion of extraneous data/information and is otherwise acceptable for publication; and
5) In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Name	Professional Credentials (Area of Expertise)
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form is required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form GF-8, Editorial Review Expert Certification, in a submission appendix.

METEOROLOGICAL FLOOD STANDARDS

MF-1 Flood Event Data Sources

A. The modeling of floods in Florida shall involve meteorological, hydrological, hydraulic, and other relevant data sources required to model coastal and inland flooding.

B. The flood model shall incorporate relevant data sources in order to account for meteorological, hydrological, and hydraulic events and circumstances occurring either inside or outside of Florida that result in, or contribute to, flooding in Florida.

C. Coastal and inland flood model calibration and validation shall be justified based upon historical data consistent with peer reviewed or publicly developed data sources.

D. Any trends, weighting, or partitioning shall be justified and consistent with current scientific and technical literature.

Purpose: Storm surge is the dominant source of coastal flooding, and precipitation is the dominant source of inland flooding. The modeling of coastal flooding requires explicit consideration of wind and other meteorological elements that drive storm surge. The phenomena to be represented encompass surge, waves, and related processes. The modeling of inland flooding may either explicitly represent precipitation, or the role of precipitation may be represented implicitly in the analysis. Inland flooding includes riverine, lacustrine, and surface water flooding.

It is important that utilized data sources associated with each type of flooding be documented and the stochastic flood event data sources be scientifically defensible. If other flood sub-perils are included, they are to be identified.

This standard is applicable to both coastal and inland flooding.

Relevant Forms:
- GF-2, Meteorological Flood Standards Expert Certification
- GF-3, Hydrological and Hydraulic Flood Standards Expert Certification
- HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability
- HHF-3, Coastal Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)
- HHF-4, Inland Flood Characteristics by Annual Exceedance Probability
- HHF-5, Inland Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)
- AF-2, Total Flood Statewide Loss Costs

Disclosures

1. Specify relevant data sources, their release dates, and the time periods used to develop and implement flood frequencies for coastal and inland flooding into the flood model.

2. Where the flood model incorporates modification, partitioning, or adjustment of the historical data leading to differences between modeled climatological and historical data, justify each modification and describe how it is incorporated.

3. Describe any assumptions or calculations used in the flood model relating to future conditions (e.g., sea level rise, changes in precipitation patterns, changes in storm frequency or severity).

4. If precipitation is explicitly modeled for either inland or coastal flooding, then describe the underlying data and how they are used as inputs to the flood model.

5. Provide citations to all data sources used to develop and support bottom friction for storm surge modeling, including publicly developed or peer reviewed information.

6. State whether the model includes flooding other than coastal and inland flooding. State whether the other flooding types are independent of the minimum required sub-perils of coastal and inland flooding.

Audit

1. The modeling organization’s data sources will be reviewed.

2. Justification for any modification, partitioning, or adjustment to historical data and the impact on flood model parameters and characteristics will be reviewed.

3. The method and process used for calibration and validation of the flood model, including adjustments to input parameters, will be reviewed.

MF-2 Flood Parameters (Inputs)

A. The flood model shall be developed with consideration given to flood parameters that are scientifically appropriate for modeling coastal and inland flooding. The modeling organization shall justify the use of all flood parameters based on information documented in current scientific and technical literature.

B. Any differences in the treatment of flood parameters between historical and stochastic events shall be justified.

C. The grid cell sizes(s) used in the flood model shall be justified.

Purpose: Flood parameters are inputs to the flood model and are needed by the flood model to define or determine the nature, severity, and physical characteristics associated with coastal and inland flooding.

Relevant Forms: GF-2, Meteorological Flood Standards Expert Certification
GF-3, Hydrological and Hydraulic Flood Standards Expert Certification
SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland)

Disclosures

1. For coastal and inland flood model components, identify and justify the various flood parameters used in the flood model.

2. For coastal and inland flood model components, describe the dependencies among flood model parameters and specify any assumed mathematical dependencies among these parameters.

3. For coastal and inland flood model components, describe the dependencies that exist among the flood model components.

4. Identify whether physical flood parameters are modeled as random variables, functions, or fixed values for the stochastic flood event generation. Provide rationale for the choice of parameter representations.

5. Describe if and how any physical flood parameters are treated differently in the historical and stochastic flood event sets and provide rationale.

6. If there is explicit modeling of precipitation-driven flooding, then describe how rainfall extent, duration, and rate are modeled. If the effects of precipitation are implicitly incorporated into the flood model, then describe the method and implementation.

7. For coastal flood analyses, describe how the coastline is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

8. For coastal flooding, describe how astronomical tides are incorporated and combined with storm surge to obtain storm tide.

9. Describe if and how any flood parameters change or evolve during an individual flood life cycle (e.g., astronomical tide, representation of Manning's roughness varying with flood depth).

10. For coastal modeling, describe any wave assumptions, calculations or proxies and their impact on flood elevations.

11. Provide the source, resolution, datum, and accuracy of the topography and bathymetry throughout the flood model domain.

12. Describe the grid geometry used in the coastal flood model.

Audit

1. All flood parameters used in the flood model will be reviewed.

2. For explicit representation of precipitation, data sources, calibration, and evaluation will be reviewed.

3. For implicit representation of precipitation, justification, data sources, method, and implementation will be reviewed.

4. Graphical depictions of flood parameters as used in the flood model will be reviewed. Descriptions and justification of the following will be reviewed:
    a. The dataset basis for any fitted distributions, the methods used, and any smoothing techniques employed,
    b. The modeled dependencies among correlated parameters in the flood model and how they are represented, and
    c. The dependencies between the coastal and inland flooding analyses.

5. Scientific literature cited in Standard GF-1, Scope of the Flood Model and Its Implementation, may be reviewed to determine applicability.

6. The initial and boundary conditions for coastal flood events will be reviewed.

MF-3 Wind and Pressure Fields for Storm Surge

A. Modeling of wind and pressure fields shall be employed to drive storm surge models due to tropical cyclones.

B. The wind and pressure fields shall be based on current scientific and technical literature or developed using scientifically defensible methods.

C. The modeling of wind and pressure fields that drive coastal flood models shall be conducted over a sufficiently large domain that storm surge height is converged.

D. The features of modeled wind and pressure fields shall be consistent with those of historical storms affecting Florida.

Purpose: Wind is the dominant feature of tropical cyclones that drives storm surge and storm surge is frequently the dominant component of the associated flooding. The representation of the windfield and related pressure field is, therefore, crucial to storm surge modeling, as is the propagation of these fields along storm tracks, which determines their duration over ocean waters relevant for surges affecting Florida.

Relevant Forms: GF-2, Meteorological Flood Standards Expert Certification
AF-2, Total Flood Statewide Loss Costs

Disclosures

1. Describe the modeling of the wind and pressure fields for tropical cyclones. State and justify the choice of the parametric forms and the parameter values.

2. Provide the historical data used to estimate parameters and to develop stochastic storm sets.

3. Provide a rotational (y-axis) versus radial (x-axis) plot of the average or default wind and pressure fields for tropical cyclones. Provide such plots for non-tropical cyclones, if non-tropical cyclones are modeled explicitly.

4. If windfields are modeled above the surface and translated to the surface to drive storm surge, then describe this translation; e.g., via planetary boundary layer models or empirical surface wind reduction factors and inflow angles. Discuss the associated uncertainties.

5. Describe how storm translation is accounted for when computing surface windfields.

6. Describe how storm surge due to non-tropical cyclones is accounted for in the model. If it is not accounted for, explain why.

7. Describe and justify the averaging time of the windspeeds used to drive the storm surge model.

8. Describe the process for verifying storm surge height convergence as a function of domain size.

Audit

1. All external data sources that affect the modeled wind and pressure fields associated with storm surge will be identified and their appropriateness reviewed.

2. Calibration and evaluation of wind and pressure fields will be reviewed. Scientific comparisons of simulated wind and pressure fields to historical storms will be reviewed.

3. The sensitivity of flood extent and depth results to changes in the representation of wind and pressure fields will be reviewed.

4. The over-land evolution of simulated wind and pressure fields and its impact on the simulated flooding will be reviewed.

5. The derivation of surface water wind stress from surface windspeed will be reviewed. If a sea-surface drag coefficient is employed, how it is related to the surface windspeed will be reviewed. A comparison of the sea-surface drag coefficient to coefficients from current scientific and technical literature will be reviewed.

6. The uncertainties in the factors used to convert from a reference windfield to a geographic distribution of surface winds and the impact of the resulting winds upon the storm surge will be reviewed and compared with current scientific and technical literature.

MF-4 Flood Characteristics (Outputs)

A. Flood extent and elevation or depth generated by the flood model shall be consistent with observed historical floods affecting Florida.

B. Methods for deriving flood extent and elevation or depth shall be scientifically defensible and technically sound.

C. Methods for modeling or approximating wave conditions in coastal flooding shall be defensible and technically sound.

D. Modeled flood characteristics shall be sufficient for the calculation of flood damage.

Purpose: Flood characteristics are outputs of the coastal and inland flood models, such as flood extent and elevation or depth. In addition to providing input to other flood model components, flood characteristics are used for flood model evaluation and calibration by comparison to observations. Flood characteristics should be determined using scientifically sound information and methods, and they must be representative of historical floods in Florida. Differences between flood model characteristics and relevant historical Florida flood data must be documented and justified.

Relevant Forms:
- GF-2, Meteorological Flood Standards Expert Certification
- GF-3, Hydrological and Hydraulic Flood Standards Expert Certification
- HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps
- HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability
- HHF-3, Coastal Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)

Disclosures

1. Demonstrate that the coastal flood model component incorporates flood parameters necessary for simulating storm-surge-related flood damage in Florida. Provide justification for validation using any historical events not specified in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps.

2. For coastal flooding, describe how the presence, size, and transformation of waves are modeled or approximated.

3. For coastal modeling, describe if and how the flood model accounts for flood velocity, flood duration, flood-induced erosion, floodborne debris, salinity, and contaminated floodwaters.

4. Describe if and how the coincidence and interaction of inland and coastal flooding is modeled.

5. Provide a flowchart illustrating how the characteristics of each flood model component are utilized in other components of the flood model.

6. Describe and justify the appropriateness of the databases and methods used for the calibration and validation of flood extent and elevation or depth.

7. Describe any variations in the treatment of the flood model flood extent and elevation or depth for stochastic versus historical floods and justify this variation.

8. Provide a completed Form HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability. Provide a link to the location of the form [insert hyperlink here].

9. Describe the effects of storm size, bathymetry, and windspeed on storm surge height for the coastal flood model.

10. Describe the effects of windspeed, depth, fetch, and wind duration on locally generated wave heights or wave proxies for the coastal flood model.

Audit

1. The method and supporting material for determining flood extent and elevation or depth for coastal flooding will be reviewed.

2. Any modeling-organization-specific research performed to calculate the flood extent and elevation or depth and wave conditions will be reviewed, along with the associated databases.

3. Historical data used as the basis for the flood model's flood extent and elevation or depth will be reviewed. Historical data used as the basis for the flood model's flood velocity, as available, will be reviewed.

4. The comparison of the calculated characteristics with historical flood events will be reviewed. The selected locations and corresponding storm events will be reviewed to verify sufficient representation of the varied geographic areas. If a single storm is used for both coastal and inland flooding validation, then its appropriateness will be reviewed.

5. Consistency of the flood model's stochastic flood extent and elevation or depth with reference to the historical flood databases will be reviewed. Consistency of the flood model's stochastic flood velocity, as available, with reference to the historical flood databases will be reviewed.

6. Form HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, and Form HHF-3, Coastal Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item), will be reviewed.

7. Modeled frequencies will be compared with the observed spatial distribution of flood frequencies across Florida using methods documented in current scientific and technical literature. The comparison of modeled to historical statewide and regional coastal flood frequencies as provided in Form HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, and Form HHF-3, Coastal Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item), will be reviewed.

8. Temporal evolution of coastal flood characteristics will be reviewed. (Trade Secret Item to be provided during the closed meeting portion of the Commission meeting to review the flood model for acceptability.)

9. Comparisons of the flood flow calculated in the flood model with records from United States Geological Survey (USGS) or Florida Water Management District (FWMD) gauging stations will be reviewed.

10. Calculation of relevant characteristics in the flood model, such as flood extent, elevation or depth, and waves, will be reviewed. The methods by which each flood model component utilizes the characteristics of other flood model components will be reviewed.

11. The modeled coincidence and interaction of inland and coastal flooding will be reviewed. If it is not modeled, justification will be reviewed.

MF-5 Flood Probability Distributions

A. Flood probability, its geographic variation, and the associated flood extent and elevation or depth shall be scientifically defensible and shall be consistent with flooding observed for Florida.

B. Flood probability distributions for storm tide affected areas shall include tropical, and if modeled, non-tropical events.

C. Probability distributions for coastal wave conditions, if modeled, shall arise from the same events as the storm tide modeling.

D. Any additional probability distributions of flood parameters and modeled characteristics shall be consistent with historical floods for Florida resulting from coastal and inland flooding.

Purpose: The probabilities of flood occurrence, flood extent and elevation or depth, vary geographically across Florida. Meteorological phenomena affecting coastal flood probabilities are tropical cyclone and non-tropical cyclone surge, waves driven by the cyclones, and tides; the phenomena affecting inland flood probabilities are precipitation in Florida and precipitation in adjacent states (e.g., the Chattahoochee River watershed in North Georgia contributing to Apalachicola River flooding). The determination of flood probability distributions may employ explicit modeling of all these phenomena. Alternatively, the effects of non-tropical surge, waves, tides, and precipitation may be treated implicitly, if the approach is scientifically justifiable. Regardless of the modeling approach, the probability distributions of flood parameters and characteristics should be consistent with documentation in official meteorological, hydrological, and hydraulic databases and with historical floods affecting Florida.

Relevant Forms:
GF-2, Meteorological Flood Standards Expert Certification
GF-3, Hydrological and Hydraulic Flood Standards Expert Certification
HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability
HHF-3, Coastal Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)
SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland)

Disclosures

1. Describe how non-tropical and tropical event coastal storm tide flood probability distributions are combined, if applicable. Provide an example demonstrating the process.

2. Provide the rationale for each of the probability distributions used for relevant flood parameters and characteristics.

3. Demonstrate that simulated flood elevation or depth frequencies are consistent with historical frequencies.

Audit

1. The consistency in accounting for similar flood parameters and characteristics across Florida and segments in adjacent states will be reviewed.

2. The method and supporting material for generating stochastic coastal and inland flood events will be reviewed.

3. Any modeling-organization-specific research performed to develop the functions used for simulating flood model characteristics and to develop flood databases will be reviewed.

4. Form SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland), will be reviewed.

5. Comparisons of modeled flood probabilities and characteristics for coastal and inland flooding against the available historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against this historical record. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete historical record.

HYDROLOGICAL AND HYDRAULIC FLOOD STANDARDS

HHF-1 Flood Parameters (Inputs)

A. Treatment of land use and land cover (LULC) effects shall be consistent with current scientific and technical literature. Any LULC database used shall be consistent with the National Land Cover Database (NLCD) 2006 or later. Use of alternate datasets shall be justified.

B. Treatment of soil effects on inland flooding shall be consistent with current scientific and technical literature.

Purpose: Inland flooding includes riverine, lacustrine, and surface water flooding.

Flood parameters are inputs to the flood model and are needed by the flood model to determine the nature, severity, and physical characteristics associated with inland flooding. The appropriate use and consideration of flood parameters in the calculation of inland flood directly impacts the predicted flood damage. The effects of LULC and soil type are necessary considerations in the calculation of rainfall runoff and the evaluation of other hydrologic parameters, such as infiltration, which influence inland flooding.

Relevant Forms: GF-3, Hydrological and Hydraulic Flood Standards Expert Certification
SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland)

Disclosures

1. For inland flood analyses associated with riverine and lacustrine flooding, describe how the rivers, lakes, and associated floodplains are segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

2. For inland flood analyses associated with surface water flooding, describe how the affected area is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

3. Describe any assumptions or calculations used in the inland flood model relating to initial and boundary conditions (e.g., groundwater levels, lake levels, river discharges, tides, soil moisture).

4. Provide the grid resolution or other area partitioning used to model the inland flood extent and depth and how the hydrological and hydraulic characteristics are determined on these scales.

5. Describe any assumptions or calculations used in the inland flood model relating to flood-induced erosion or topographic changes.

6. Provide citations to all data sources used to develop and support the land-use evaluation methodology, including publicly developed or peer reviewed information.

7. Provide the collection and publication dates of the LULC and soil data used in the flood model, and justify the data's applicability and timeliness for Florida.

8. Describe the methodology used to convert LULC information into a spatial distribution of hydrological parameters, including roughness coefficients, throughout the flood model domain.

9. Describe the methods used to account for soil infiltration and percolation rates and soil moisture conditions in the inland flood model, if applicable. Provide citations to all data sources used to develop and support the soil infiltration and percolation rates and soil moisture conditions methodology, including publicly developed or peer reviewed information.

Audit

1. The initial and boundary conditions for flood events will be reviewed.

2. Any modeling-organization-specific methodology used to incorporate LULC information into the flood model will be reviewed.

3. Any modeling-organization-specific research performed to develop the soil infiltration and percolation rates or soil moisture conditions used in the flood model will be reviewed, if applicable.

HHF-2 Flood Characteristics (Outputs)

A. Flood extent and elevation or depth generated by the flood model shall be consistent with observed historical floods affecting Florida.

B. Methods for deriving flood extent and depth shall be scientifically defensible and technically sound.

C. Modeled flood characteristics shall be sufficient for the calculation of flood damage.

Purpose: The extent and depth of inland flooding predicted by the flood model are fundamental factors in assessing flood damage to buildings. Variations in the extent or depth can significantly change the estimated damage. Flood characteristics other than extent and depth can also be used to determine flood damage. While the data for historical flood events may be limited, the comparison of predicted characteristics to available historical information should be made and can help inform the methods and approaches to calculating flood damage.

Relevant Forms:
- GF-2, Meteorological Flood Standards Expert Certification
- GF-3, Hydrological and Hydraulic Flood Standards Expert Certification
- HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps
- HHF-4, Inland Flood Characteristics by Annual Exceedance Probability
- HHF-5, Inland Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)

Disclosures

1. Provide comparisons of the modeled and historical flood extents and elevations or depths for the storm events listed in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps. For any storms where sufficient data are not available, the modeling organization may substitute an alternate historical storm of their choosing. Describe how each substituted storm provides similar coastal and inland flooding characteristics to the storm being replaced.

2. Demonstrate that the inland flood model component incorporates flood parameters necessary for simulating inland flood damage and accommodates the varied geographic, geologic, hydrologic, hydraulic, and LULC conditions in Florida. Provide justification for validation using any historical events not specified in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps.

3. For each of the storm events in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps, resulting in inland flooding, provide a comparison of the modeled flood flow to recorded flow data from selected United States Geological Survey (USGS) or Florida Water Management District (FWMD) gauging stations. Provide the rationale for gauging station selections.

4. Identify all hydrological and hydraulic variables that affect the flood extent, elevation, depth, and other flood characteristics.

5. For inland flood modeling, describe if and how the flood model accounts for flood velocity, flood duration, flood-induced erosion, floodborne debris, and contaminated floodwaters.

6. Describe the effect of any assumptions or calculations relating to initial and boundary conditions on the flood characteristics.

7. Describe and justify the appropriateness of the databases and methods used for the calibration and validation of flood extent and elevation or depth.

8. Describe any variations in the treatment of the flood model flood extent and elevation or depth for stochastic versus historical floods and justify this variation.

9. Provide a completed Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps. Provide a link to the location of the form [insert hyperlink here].

10. Provide a completed Form HHF-4, Inland Flood Characteristics by Annual Exceedance Probability. Provide a link to the location of the form [insert hyperlink here].

Audit

1. The method and supporting material for determining flood extent and elevation or depth for inland flooding will be reviewed.

2. Any modeling-organization-specific research performed to calculate the inland flood extent and elevation or depth will be reviewed along with the associated databases.

3. Any modeling-organization-specific research performed to derive the hydrological characteristics associated with the topography, LULC distributions and soil conditions, for the flood extent and elevation or depth will be reviewed.

4. Historical data used as the basis for the flood model's flood extent and elevation or depth will be reviewed. Historical data used as the basis for the flood model's flood flow and velocity, if applicable, will be reviewed.

5. The comparison of the calculated characteristics with historical inland flood events will be reviewed. The selected locations and corresponding storm events will be reviewed to verify sufficient representation of the varied geographic areas.

6. Consistency of the flood model's stochastic flood extent and elevation or depth with reference to the historical flood databases will be reviewed. Consistency of the flood model's stochastic flood flow and velocity, if applicable, with reference to the historical flood databases will be reviewed.

7. Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps, will be reviewed.

8. For the historical flood events given in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps, the flood characteristics, including temporal and spatial variations contributing to modeled flood damage, will be reviewed.

9. Modeled frequencies will be compared with the observed spatial distribution of flood frequencies across Florida using methods documented in current scientific and technical literature. The comparison of modeled to historical statewide and regional inland flood frequencies as provided in Form HHF-4, Inland Flood Characteristics by Annual Exceedance Probability, and Form HHF-5, Inland Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item), will be reviewed.

10. Temporal evolution of inland flood characteristics will be reviewed, if applicable. (Trade Secret Item to be provided during the closed meeting portion of the Commission meeting to review the flood model for acceptability.)

11. Calculation of relevant characteristics in the inland flood model, such as flood extent and elevation or depth, will be reviewed. The methods by which each flood model component utilizes the characteristics of other flood model components will be reviewed.

HHF-3 Modeling of Major Flood Control Measures

A. The flood model's treatment of major flood control measures and their performance shall be consistent with available information and current state-of-the-science.

B. The modeling organization shall have a documented procedure for reviewing and updating information about major flood control measures and if justified, shall update the model flood control databases.

C. Treatment of the potential failure of major flood control measures shall be based upon current scientific and technical literature, empirical studies, or engineering analyses.

Purpose: Major flood control measures are those measures undertaken outside the building footprint and on a larger scale, to reduce the presence, depth or energy of flow or waves that affect personal residential structures. The presence of major flood control measures can reduce the flood damage to buildings. The failure of major flood control measures during a flooding event can cause damage to buildings equal to or in excess of the damage that would occur if the measures were not present. The evaluation of impacts of major flood control measures may include, but not be limited to, considering dams, levees, and floodwalls, and the associated location, dimensions, strength, and performance thereof.

Relevant Forms: GF-3, Hydrological and Hydraulic Flood Standards Expert Certification

Disclosures

1. List the major flood control measures incorporated in the flood model and the sources of all data employed.

2. Describe the methodology to account for major flood control measures in the flood model and indicate if these measures can be set (either to on or off) in the flood model.

3. Describe if and how major flood control measures that require human intervention are incorporated into the flood model.

4. Describe and justify the methodology used to account for the potential failure or alteration of major flood control measures in the flood model and if the level of failure can be adjusted in the flood model.

5. Provide an example of the flood extent and elevation or depth showing the potential impact of a major flood control measure failure.

Audit

1. Treatment of major flood control measures incorporated in the flood model will be reviewed.

2. The documented procedure addressing the updating of major flood control measures as necessary will be reviewed.

3. The methodology and justification used to account for the potential failure or alteration of major flood control measures in the flood model will be reviewed.

4. Examples of flood extent and depth showing the potential impact of major flood control measures failures will be reviewed.

5. If the flood model incorporates major flood control measures that require human intervention, then the methodology used in the flood model will be reviewed.

HHF-4 Logical Relationships Among Flood Parameters and Characteristics

A. At a specific location, water surface elevation shall increase with increasing terrain roughness at that location, all other factors held constant.

B. Rate of discharge shall increase with increase in steepness in the topography, all other factors held constant.

C. Inland flood extent and depth associated with riverine and lacustrine flooding shall increase with increasing discharge, all other factors held constant.

D. The coincidence of storm tide and inland flooding shall not decrease the flood extent and depth, all other factors held constant.

Purpose: The parameters used in the inland flood model and the resulting characteristics calculated by the flood model, such as flood extent, elevation, and depth, are related through logical relationships. Consideration and evaluation of these logical relationships can help inform the methods and approaches to calculate flood damage and identify errors in the calculations.

Relevant Form: GF-3, Hydrological and Hydraulic Flood Standards Expert Certification

Disclosures

1. Provide a sample graph of water surface elevation and discharge versus time associated with inland flooding for modeling-organization-defined locations within each region in Florida identified in *Figure 1*. Discuss how the flood characteristics exhibit logical relationships.

2. Describe the analysis performed in order to demonstrate the logical relationships in this standard.

Audit

1. The analysis performed to demonstrate the logical relationships will be reviewed.

2. Methods (including any software) used in verifying the logical relationships will be reviewed.

Form HHF-1: Historical Event Flood Extent and Elevation or Depth Validation Maps

Purpose: While the data for historical flood events may be limited, the comparison of predicted characteristics to available historical information should be made and can help inform the methods and approaches to calculating flood damage. This form illustrates the flood model's ability to simulate historical flood events.

A. Provide color-coded contour or high-resolution maps with appropriate base map data illustrating modeled flood extents and elevations or depths for the following historical Florida flood events:

Hurricane Andrew (1992)
Hurricane Ivan (2004)
Hurricane Jeanne (2004)
Hurricane Wilma (2005)
Tropical Storm Fay (2008)
Unnamed Storm in East Florida (May 2009)
Unnamed Storm in Panhandle (July 2013)
Storm chosen by modeling organization

For any storms where sufficient data are not available, the modeling organization may substitute an alternate historical storm of their choosing.

B. Plot the locations and values associated with validation points (e.g., maximum flood elevations or depths from observations such as gauge data, high watermarks) on each contour or high-resolution map for the historical events.

Provide sources of the validation data.

Indicate the resolution of the flood model elevation or depth grid used on each contour or high-resolution map.

Demonstrate the consistency of the modeled flood extent and elevation or depth with observed flood extent and elevation or depth for each historical event.

C. Explain any differences between the modeled flood extent and elevation or depth and the historical floods observations. Include an explanation if the differences are impacted by major flood control measures.

D. 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.

E. Include Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps, in a submission appendix.

Form HHF-2: Coastal Flood Characteristics by Annual Exceedance Probability

Purpose: The graphical and visual depiction of flood characteristics predicted by the flood model can better inform the evaluation of the flood model results. This form illustrates the simulations of key coastal flood characteristics at a range of locations for an annual exceedance probability.

A. Define one study area subject to coastal flooding within each of the five Florida geographic regions identified in *Figure 1*. The extent of each study area shall be determined by the modeling organization and shall be large enough to encompass at least one county. The modeling organization shall create the underlying grid for this form.

B. Provide, for each study area, color-coded contour or high-resolution maps showing the modeled flood extent and elevation or depth corresponding to 0.01 annual exceedance probability. Flood extent and elevation or depth shall incorporate waves or wave proxies, if modeled. For locations subject to both coastal and inland flooding, this information should reflect only coastal flooding.

C. Include Form HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, in a submission appendix.

Form HHF-3: Coastal Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)

Purpose: The graphical and visual depiction of flood characteristics predicted by the flood model can better inform the evaluation of the flood model results. This form illustrates the simulations of key coastal flood characteristics at a range of locations and annual exceedance probabilities.

Provide, for each study area defined in Form HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, the following information. For locations subject to both coastal and inland flooding, this information should reflect only coastal flooding.

1) Study area color-coded contour or high-resolution maps showing modeled flood extent and elevation or depth corresponding to the 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities. Flood extent and elevation or depth shall incorporate waves or wave proxies, if modeled.

2) Graphs and tables showing model results at 10 or more locations within the study area and representative of the range of flood conditions in the study area. The following flood characteristics shall be included for the 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities:

    a) Stillwater flood elevations,

    b) Coastal wave heights or wave proxies,

    c) If the vulnerability model requires explicit representation of flood-induced erosion effects, the erosion depth (original ground elevation minus eroded ground elevation),

    d) If the vulnerability model requires explicit representation of flow velocity effects, the flow velocities, and

    e) If the vulnerability model requires explicit representation of flood inundation duration effects, the duration of flood inundation.

Form HHF-4: Inland Flood Characteristics by Annual Exceedance Probability

Purpose: The graphical and visual depiction of flood characteristics predicted by the flood model can better inform the evaluation of the flood model results. This form illustrates the simulations of key inland flood characteristics at a range of locations for an annual exceedance probability.

A. Define one study area subject to inland flooding within each of the five Florida geographic regions identified in *Figure 1*. The extent of each study area shall be determined by the modeling organization and shall be large enough to encompass at least one county. The modeling organization shall create the underlying grid for this form.

B. Provide, for each study area, color-coded contour or high-resolution maps showing modeled flood extent and elevation or depth corresponding to the 0.01 annual exceedance probability. Flood extent and elevation or depth shall incorporate the effects of flood-induced erosion, if modeled. For locations subject to both inland and coastal flooding, this information should reflect only inland flooding.

C. Include Form HHF-4, Inland Flood Characteristics by Annual Exceedance Probability, in a submission appendix.

Form HHF-5: Inland Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)

Purpose: The graphical and visual depiction of flood characteristics predicted by the flood model can better inform the evaluation of the flood model results. This form illustrates the simulations of key inland flood characteristics at a range of locations and annual exceedance probabilities.

Provide, for each study area defined in Form HHF-4, Inland Flood Characteristics by Annual Exceedance Probability, the following information. For locations subject to both coastal and inland flooding, this information should reflect only inland flooding.

1) Study area color-coded contour or high-resolution maps showing modeled flood extent and elevation or depth corresponding to the 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities. Flood extent and elevation or depth shall incorporate the effects of flood-induced erosion, if modeled.

2) Graphs and tables, based on the underlying gridded data, showing model results at 10 or more locations within the study area and representative of the range of flood conditions in the study area. The following flood characteristics shall be included for the 0.1 0.02, 0.01, and 0.002 annual exceedance probabilities:

    a) Modeled flood elevations,

    b) Flood depths,

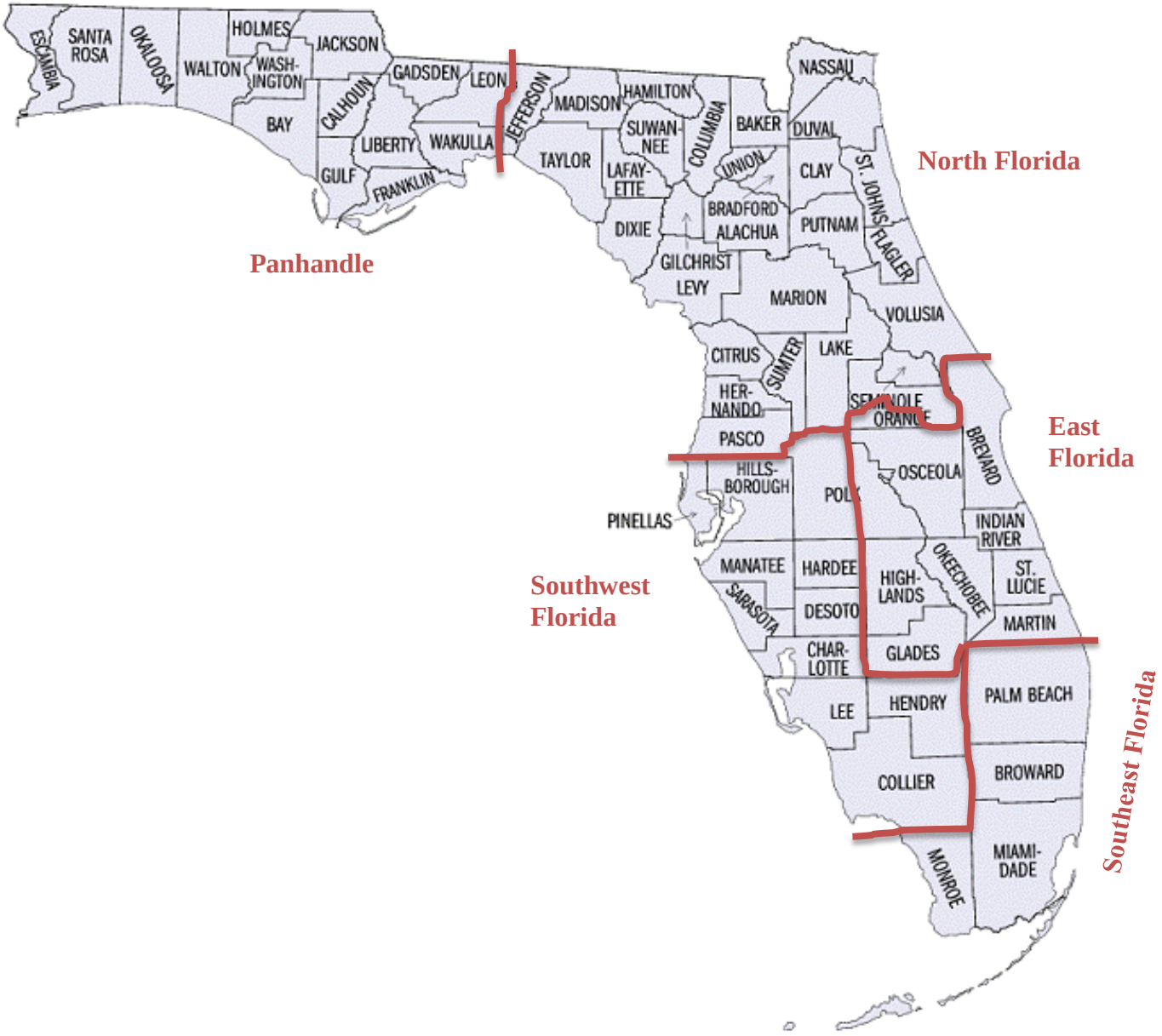
    c) If the vulnerability model requires explicit representation of flood-induced erosion effects, the erosion depth (original ground elevation minus eroded ground elevation),

    d) If the vulnerability model requires explicit representation of flow velocity effects, the flow and flow velocities, and

    e) If the vulnerability model requires explicit representation of flood inundation duration effects, the duration of flood inundation.

Figure 1

State of Florida
By Region



STATISTICAL FLOOD STANDARDS

SF-1 Modeled Results and Goodness-of-Fit

A. The use of historical data in developing the flood model shall be supported by rigorous methods published in current scientific and technical literature.

B. Modeled results and historical observations shall reflect statistical agreement using current scientific and statistical methods for the academic disciplines appropriate for the various flood model components or characteristics.

Purpose: Many aspects of flood model development and implementation involve fitting a probability distribution to historical data for use in generating stochastic floods. Such fitted models must be checked to ensure that the distributions are reasonable. The chi-square goodness-of-fit test may not be sufficiently rigorous for demonstrating the reasonableness of models of historical data.

Relevant Forms:
- GF-4, Statistical Flood Standards Expert Certification
- HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps
- SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland)
- SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined)

Disclosures

1. Provide a completed Form SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland). Identify the form of the probability distributions used for each function or variable, if applicable. Identify statistical techniques used for estimation and the specific goodness-of-fit evaluations applied along with appropriate metrics. Describe whether the fitted distributions provide a reasonable agreement with available historical data. Provide a link to the location of the form [insert hyperlink here].

2. Provide the dates of loss of the insurance claims data used for validation and verification of the flood model.

3. Provide an assessment of uncertainty in flood probable maximum loss levels and in flood loss costs for output ranges using confidence intervals or other scientific characterizations of uncertainty.

4. Justify any differences between the historical and modeled results using current scientific and statistical methods in the appropriate disciplines.

5. Provide graphical comparisons of modeled and historical data and goodness-of-fit evaluations. Examples to include are flood frequencies, flow, elevations or depths, and available damage.

6. Provide a completed Form SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined). Provide a link to the location of the form [insert hyperlink here].

Audit

1. Forms SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland), and SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined), will be reviewed. Justification for the distributions selected, including for example, citations to published literature or analyses of specific historical data, will be reviewed.

2. The modeling organization's characterization of uncertainty for damage estimates, annual flood loss, flood probable maximum loss levels, and flood loss costs will be reviewed.

SF-2 Sensitivity Analysis for Flood Model Output

The modeling organization shall have assessed the sensitivity of temporal and spatial outputs with respect to the simultaneous variation of input variables using current scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action.

Purpose: Sensitivity analysis involves the quantification of the magnitude and direction of the output (e.g., flood extent and elevation or depth, flood loss cost) as a function of the input variables in the flood model and provides critical insight into the behavior of the flood model.

Relevant Form: GF-4, Statistical Flood Standards Expert Certification

Disclosures

1. Identify the most sensitive aspects of the flood model and the basis for making this determination.

2. Identify other input variables that impact the magnitude of the output when the input variables are varied simultaneously. Describe the degree to which these sensitivities affect output results and illustrate with an example.

3. Describe how other aspects of the flood model may have a significant impact on the sensitivities in output results and the basis for making this determination.

4. Describe and justify action or inaction as a result of the sensitivity analyses performed.

Audit

1. The modeling organization's sensitivity analysis for the flood model will be reviewed in detail. Statistical techniques used to perform sensitivity analysis will be reviewed. The results of the sensitivity analysis displayed in graphical format (e.g., color-coded contour or high-resolution plots with temporal animation) will be reviewed.

SF-3 Uncertainty Analysis for Flood Model Output

The modeling organization shall have performed an uncertainty analysis on the temporal and spatial outputs of the flood model using current scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action. The analysis shall identify and quantify the extent that input variables impact the uncertainty in flood model output as the input variables are simultaneously varied.

Purpose: Uncertainty analysis involves the quantification of the variability of the output (e.g., flood extent and elevation or depth, flood loss cost) as a function of the input variables in the flood model and provides critical insight into the behavior of the flood model.

Relevant Form: GF-4, Statistical Flood Standards Expert Certification

Disclosures

1. Identify the major contributors to the uncertainty in flood model outputs and the basis for making this determination. Provide a full discussion of the degree to which these uncertainties affect output results and illustrate with an example.

2. Describe how other aspects of the flood model may have a significant impact on the uncertainties in output results and the basis for making this determination.

3. Describe and justify action or inaction as a result of the uncertainty analyses performed.

Audit

1. The modeling organization's uncertainty analysis for the flood model will be reviewed in detail. Statistical techniques used to perform uncertainty analysis will be reviewed. The results of the uncertainty analysis displayed in graphical format (e.g., color-coded contour or high-resolution plots with temporal animation) will be reviewed.

SF-4 Flood Model Loss Cost Convergence by Geographic Zone

At a modeling-organization-determined level of aggregation utilizing a minimum of 30 geographic zones encompassing the entire state, the contribution to the error in flood loss cost estimates attributable to the sampling process shall be negligible for the modeled coastal and inland flooding combined.

Purpose: The intent of this standard is to ensure that sufficient runs of the simulation have been made or a suitable sampling design invoked so that the contribution to the error of the flood loss cost estimates due to its probabilistic nature is negligible considering the computational effort involved. To be negligible, the standard error of flood loss cost estimator within each identified geographic zone should be less than 5% of the flood loss cost estimate unless otherwise justified.

Relevant Form: GF-4, Statistical Flood Standards Expert Certification

Disclosures

1. Describe the sampling plan used to obtain the average annual flood loss costs and output ranges. For a direct Monte Carlo simulation, indicate steps taken to determine sample size. For an importance sampling design or other sampling scheme, describe the underpinnings of the design and how it achieves the required performance.

2. Describe the nature and results of the convergence tests performed to validate the expected flood loss projections generated. If a set of simulated flood events or simulation trials was used to determine these flood loss projections, specify the convergence tests that were used and the results. Specify the number of flood events or trials that were used.

Audit

1. An exhibit of the standard error by each geographic zone will be reviewed.

SF-5 Replication of Known Flood Losses

The flood model shall estimate incurred flood losses in an unbiased manner on a sufficient body of past flood events, including the most current data available to the modeling organization. This standard applies to personal residential exposures. The replications shall be produced on an objective body of flood loss data by county or an appropriate level of geographic detail.

Purpose: This standard applies to the combined effects of flood hazard, vulnerability functions, and loss estimation. Given a past flood event and a book of insured properties at the time of the flood event, the flood model is required to be able to provide expected flood losses.

Relevant Form: GF-4, Statistical Flood Standards Expert Certification

Disclosure

1. Describe the nature and results of the analyses performed to validate the flood loss projections generated for personal residential losses. Include analyses for the events listed in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps.

Audit

1. The following information for each flood event will be reviewed:
    a. The validity of the flood model assessed by comparing projected flood losses produced by the flood model to available flood losses incurred by insurers at both the state and county level,
    b. The version of the flood model used to calculate modeled flood losses for each flood event provided,
    c. A general description of the data and its sources,
    d. A disclosure of any material mismatch of exposure and flood loss data problems, or other material consideration,
    e. The date of the exposures used for modeling and the date of the flood event,
    f. An explanation of differences in the actual and modeled flood parameters,
    g. A listing of the differences between the modeled and observed flood conditions used in validating a particular flood event,
    h. The type of coverage applied in each flood event to address:
        (1) Personal residential structures
        (2) Manufactured homes
        (3) Condominiums
        (4) Contents
        (5) Time element,
    i. The treatment of demand surge or loss adjustment expenses in the actual flood losses or the modeled flood losses, and
    j. The treatment of wind losses in the actual flood losses or the modeled flood losses.

2. The following documentation will be reviewed:
    a. Publicly available documentation and data referenced in the flood model submission in hard copy or electronic form,
    b. Modeling-organization-specific documentation and data used in validation of flood losses,
    c. An analysis that identifies and explains anomalies observed in the validation data, and
    d. User input data for each insurer and flood event detailing specific assumptions made with regard to exposed personal residential property.

3. The confidence intervals used to gauge the comparison between historical and modeled flood losses will be reviewed.

4. The results for more than one flood event will be reviewed to the extent data are available.

Form SF-1: Distributions of Stochastic Flood Parameters (Coastal, Inland)

Purpose: This form identifies the probability distributions used in the coastal and inland flooding model and provides their justification.

A. Provide the probability distribution functional form used for each stochastic flood parameter in the flood model (one each for coastal and inland flooding). Provide a summary of the justification for each functional form selected for each general classification. Specify the relevant classification (coastal or inland) for each distribution.

B. Include Form SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland), in a submission appendix.

Stochastic Flood Parameter: Function or Variable	Classification: Coastal or Inland	Functional Form of Distribution	Data Source	Year Range Used	Justification for Functional Form

Form SF-2: Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined)

Purpose: This form provides the modeling organization's flood loss exceedance estimates for coastal and inland losses combined.

A. Provide estimates of the aggregate personal residential insured flood losses for various probability levels using a modeling-organization-specified, predetermined, and comprehensive exposure dataset justified by the modeling organization. Provide the total average annual flood loss for the loss exceedance distribution. If the modeling methodology does not allow the flood model to produce a viable answer for certain return periods, state so and why.

B. Include Form SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined), in a submission appendix.

Part A

Return Period (Years)	Annual Probability of Exceedance	Estimated Flood Loss Modeling Organization Exposure Dataset
Top Event	N/A	_____
10,000	0.0001	_____
5,000	0.0002	_____
2,000	0.0005	_____
1,000	0.0010	_____
500	0.0020	_____
250	0.0040	_____
100	0.0100	_____
50	0.0200	_____
20	0.0500	_____
10	0.1000	_____
5	0.2000	_____

Part B

Mean (Total Average Annual Flood Loss)	_____
Median	_____
Standard Deviation	_____
Interquartile Range	_____
Sample Size	_____

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 two or more 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 in coastal areas, damaging wave action.

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 and manufactured homes.

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

In coastal areas, the effects of damaging wave action must be incorporated into personal residential structure flood vulnerability functions by explicit wave modeling or by wave proxies.

The data and methods used to develop personal residential structure 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.

Relevant Forms: GF-5, Vulnerability Flood Standards Expert Certification
VF-1, Coastal Flood with Damaging Wave Action
VF-2, Inland Flood by Flood Depth
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, 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, dates of loss, and number of units of dollar exposure, separated into personal residential building structures and manufactured homes.

4. Summarize post-event site investigations, including the sources, 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 damaging wave action (in coastal areas). For coastal areas, define the thresholds indicating the presence of damaging wave action for personal residential building structures and manufactured homes. Describe the area over which vulnerability functions for damaging wave action or wave proxies are applied.

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 velocity, flood duration, flood-induced erosion, flood-borne debris, salinity (saltwater versus freshwater flooding), and contaminated floodwaters.

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 building structures, manufactured homes, condo unit owners and apartment renters.

11. Describe the assumptions, 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.

12. Describe similarities and differences in how the personal residential structure flood vulnerability functions are developed and applied for coastal and inland flooding.

13. Describe how personal residential structure flood vulnerability functions are selected when input data are missing, incomplete, or conflicting.

14. Provide a completed Form VF-1, Coastal Flood with Damaging Wave Action. Provide a link to the location of the form [insert hyperlink here].

15. Provide a completed Form VF-2, Inland Flood by Flood Depth. 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. Vulnerability functions for waves or wave proxies will be reviewed. Modeling organization thresholds for damaging wave action will be reviewed. The area over which vulnerability functions for damaging waves or wave proxies are applied will be reviewed.

3. Validation of the personal residential structure flood vulnerability functions and associated uncertainties will be reviewed.

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 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. Insurance claims data will be reviewed.

5. 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.

6. Multiple samples of personal residential structure flood vulnerability functions for personal residential structures and manufactured homes will be reviewed. The magnitude of logical changes among these items for given flood events and validation materials will be reviewed.

7. Justification for the personal residential structure construction classes and characteristics used will be reviewed.

8. 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 the 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.

9. The effects on personal residential structure flood vulnerability from local and regional construction characteristics, building codes, and floodplain management regulations will be reviewed.

10. 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.

11. The percentage of damage at or above which the flood model assumes a total structure loss will be reviewed.

12. Documentation and justification for the method of derivation and data on which the personal residential structure flood vulnerability functions are based will be reviewed.

13. If modeled, the treatment of water intrusion in personal residential structure flood vulnerability functions will be reviewed.

14. Form VF-1, Coastal Flood with Damaging Wave Action, will be reviewed.

15. Form VF-2, Inland Flood by Flood Depth, 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 relationship between personal residential structure and contents flood vulnerability functions shall be reasonable.

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

In coastal areas, the effects of damaging wave action must be incorporated into personal residential contents flood vulnerability functions by explicit wave modeling or by wave proxies.

The development of personal residential contents flood vulnerability functions is to be documented with respect to the methods and sources.

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

Relevant Forms: GF-5, Vulnerability Flood Standards 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. Describe any assumptions, data, methods, and processes used to develop and validate the personal residential contents flood vulnerability functions.

4. 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, dates of loss, and number of units of dollar exposure, separated into personal residential building structures and manufactured homes.

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 building 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* percent 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, 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; and
    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. Insurance claims data 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 one or more of the following: (1) post-event site investigations, (2) technical literature, (3) expert opinion, (4) laboratory or field testing, and (5) insurance claims data.

B. The relationship among personal residential structure, contents, and time element flood vulnerability functions shall be reasonable.

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. The development of personal residential time element flood vulnerability functions is to be supported by historical or other relevant data.

In coastal areas, the treatment of damaging wave action in personal residential time element flood vulnerability functions may be important.

The development of personal residential time element flood vulnerability functions is to be documented with respect to the methods and sources.

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 Forms: GF-5, Vulnerability Flood Standards 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, methods, and processes used to develop and validate personal residential time element flood vulnerability functions.

3. Describe the relationships among personal residential structure, contents, and time element vulnerability functions.

4. 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, dates of loss, and number of units of dollar exposure, separated into personal residential building structures and manufactured homes.

5. 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 building structures, manufactured homes, unit location for condo owners and apartment renters, and various building classes.

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, 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; and
    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. To the extent historical data are 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. Insurance claims data will be reviewed.

5. If included, 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: Flood mitigation measures are those measures undertaken at an individual building level, usually within the building footprint, and may include the following:

- Elevating the structure
- Adding flood openings to enclosure walls
- Wet and/or dry floodproofing
- Permanent elevation or protection of equipment and utilities
- Flood barriers
- Pumps.

Multiple flood mitigation measures will be considered and their combined effect on flood damage must be estimated.

Relevant Forms: GF-5, Vulnerability Flood Standards 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 Damage/$1,000 (Trade Secret Item)
VF-5, Inland Flood Mitigation Measures, Inland Mean Flood Damage Ratios and Inland Flood Damage/$1,000 (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 Damage/$1,000 (Trade Secret Item), and Form VF-5, Inland Flood Mitigation Measures, Mean Inland Flood Damage Ratios and Inland Flood Damage/$1,000 (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, expert opinion, or insurance claims data 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: Coastal Flood with Damaging Wave Action

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 wave action.

A. Sample personal residential exposure data for 8 reference structures as defined below and 26 flood depths (0-25 feet at 1-foot increments) are provided in the file named "*VFEventFormsInput17.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. Estimated Damage for each individual flood depth is the sum of ground up loss to all reference structures in the flood depth range, 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 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 estimated damage/subject exposure data (*y*-axis) versus flood depth (*x*-axis).

E. Include Form VF-1, Coastal Flood with Damaging Wave Action, in a submission appendix.

Form VF-1: Coastal Flood with Damaging Wave Action

Flood depth (feet) above ground level	Estimated Damage/ Subject Exposure
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
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25	

Form VF-2: Inland Flood by Flood Depth

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 26 flood depths (0-25 feet at 1-foot increments) are provided in the file named "*VFEventFormsInput17.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. Estimated Damage for each individual flood depth is the sum of ground up loss to all reference structures in the flood depth range, 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 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 estimated damage/subject exposure data (*y*-axis) versus flood depth (*x*-axis).

E. Include Form VF-2, Inland Flood by Flood Depth, in a submission appendix.

Form VF-2: Inland Flood by Flood Depth

Flood depth (feet) above ground level	Estimated Damage/ Subject Exposure
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

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

Purpose: This form illustrates the changes in flood damage ratios for three 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 ratio (not loss cost) for each individual flood mitigation measure listed in Form VF-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 flood 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
One story Crawlspace foundation Top of foundation wall 3 feet above grade	One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls
Two story Timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	

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	St. Johns River
Latitude: 27.9957517	Latitude: 29.3768881
Longitude: -82.8277373	Longitude: -81.6190223

D. Provide the ground elevation used from the flood 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 RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100									
		TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE				
		FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND				
		7	9	11	13	15	1	3	5	7	9
	REFERENCE STRUCTURE	—	—	—	—	—	—	—	—	—	—
ELEVATE STRUCTURE	Elevate Floor 1 Foot						—	—	—	—	—
	Elevate Floor 2 Feet						—	—	—	—	—
	Elevate Floor 3 Feet						—	—	—	—	—
UTILITY EQUIPMENT	Elevate or Protect 1 Foot										
	Elevate or Protect 2 Feet										
	Elevate or Protect 3 Feet										
FLOODPROOFING	Wet 1 Foot										
	Wet 2 Feet										
	Wet 3 Feet										
	Dry 1 Foot	—	—	—	—	—					
	Dry 2 Feet	—	—	—	—	—					
	Dry 3 Feet	—	—	—	—	—					
FLOOD OPENINGS		ONE-STORY WOOD FRAME STRUCTURE									
		FLOOD DEPTH (FT) ABOVE GROUND									
		1	3	5	7	9					
	Flood Openings in Foundation Walls						—	—	—	—	—

MITIGATION MEASURES IN COMBINATION	PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100									
	TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE				
	FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND				
	7	9	11	13	15	1	3	5	7	9
Elevate Utility Equipment 2 Feet Above Floor and Wet Floodproof Structure to 2 Feet										

Form VF-4: Coastal Flood Mitigation Measures, Mean Coastal Flood Damage Ratios and Coastal Flood Damage/$1,000 (Trade Secret Item)

Purpose: This form illustrates the coastal flood damage ratios and coastal flood damage/$1,000 for three 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 Damage/$1,000 (Trade Secret Item), as well as the percent damage for the combination of the flood mitigation measures.

B. Provide the damage/$1,000 rounded to three decimal places in the printed form, 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 Damage/$1,000 (Trade Secret Item), as well as the damage/$1,000 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 structure vulnerability functions for the reference and fully mitigated structures.

Reference Structures

Wood Frame	Masonry
One story Crawlspace foundation Top of foundation wall 3 feet above grade	One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls
Two story Timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	

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 ground elevation used from the flood model elevation database for the reference point.

Form VF-4: Coastal Flood Mitigation Measures, Mean Coastal Flood Damage Ratios and Coastal Flood Damage/$1,000 (Trade Secret Item)

INDIVIDUAL MITIGATION MEASURES		MEAN DAMAGE RATIO										DAMAGE PER $1,000									
		TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE					TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE				
		FLOOD DEPTH (FT) ABOVE GROUND																			
		7	9	11	13	15	1	3	5	7	9	7	9	11	13	15	1	3	5	7	9
	REFERENCE STRUCTURE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ELEVATE STRUCTURE	Elevate Floor 1 Foot						—	—	—	—	—						—	—	—	—	—
	Elevate Floor 2 Feet						—	—	—	—	—						—	—	—	—	—
	Elevate Floor 3 Feet						—	—	—	—	—						—	—	—	—	—
UTILITY EQUIPMENT	Elevate or Protect 1 Foot																				
	Elevate or Protect 2 Feet																				
	Elevate or Protect 3 Feet																				
FLOODPROOFING	Wet 1 Foot																				
	Wet 2 Feet																				
	Wet 3 Feet																				
	Dry 1 Foot	—	—	—	—	—						—	—	—	—	—					
	Dry 2 Feet	—	—	—	—	—						—	—	—	—	—					
	Dry 3 Feet	—	—	—	—	—						—	—	—	—	—					
FLOOD OPENINGS		ONE-STORY WOOD FRAME STRUCTURE										ONE-STORY WOOD FRAME STRUCTURE									
		FLOOD DEPTH (FT) ABOVE GROUND																			
		1	3	5	7	9						1	3	5	7	9					
	Flood Openings in Foundation Walls						—	—	—	—	—						—	—	—	—	—

MITIGATION MEASURES IN COMBINATION	MEAN DAMAGE RATIO										DAMAGE PER $1,000									
	TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE					TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE				
	FLOOD DEPTH (FT) ABOVE GROUND																			
	7	9	11	13	15	1	3	5	7	9	7	9	11	13	15	1	3	5	7	9
Elevate Utility Equipment 2 Feet Above Floor and Wet Floodproof Structure to 2 Feet																				

Form VF-5: Inland Flood Mitigation Measures, Mean Inland Flood Damage Ratios and Inland Flood Damage/$1,000 (Trade Secret Item)

Purpose: This form illustrates the inland flood damage ratios and inland flood damage/$1,000 for three 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 Damage/$1,000 (Trade Secret Item), as well as the percent damage for the combination of the flood mitigation measures.

B. Provide the damage/$1,000 rounded to three decimal places in the printed form, 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 Damage/$1,000 (Trade Secret Item), as well as the damage/$1,000 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 structure vulnerability functions for the reference and fully mitigated structures.

Reference Structures

Wood Frame	Masonry
One story Crawlspace foundation Top of foundation wall 3 feet above grade	One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls
Two story Timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	

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: 29.3768881
Longitude: -81.6190223

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

Form VF-5: Inland Flood Mitigation Measures, Mean Inland Flood Damage Ratios and Inland Flood Damage/$1,000 (Trade Secret Item)

INDIVIDUAL MITIGATION MEASURES		MEAN DAMAGE RATIO										DAMAGE PER $1,000									
		TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE					TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE				
		FLOOD DEPTH (FT) ABOVE GROUND																			
		7	9	11	13	15	1	3	5	7	9	7	9	11	13	15	1	3	5	7	9
	REFERENCE STRUCTURE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ELEVATE STRUCTURE	Elevate Floor 1 Foot						—	—	—	—	—						—	—	—	—	—
	Elevate Floor 2 Feet						—	—	—	—	—						—	—	—	—	—
	Elevate Floor 3 Feet						—	—	—	—	—						—	—	—	—	—
UTILITY EQUIPMENT	Elevate or Protect 1 Foot																				
	Elevate or Protect 2 Feet																				
	Elevate or Protect 3 Feet																				
FLOODPROOFING	Wet 1 Foot																				
	Wet 2 Feet																				
	Wet 3 Feet																				
	Dry 1 Foot	—	—	—	—	—						—	—	—	—	—					
	Dry 2 Feet	—	—	—	—	—						—	—	—	—	—					
	Dry 3 Feet	—	—	—	—	—						—	—	—	—	—					
FLOOD OPENINGS		ONE-STORY WOOD FRAME STRUCTURE										ONE-STORY WOOD FRAME STRUCTURE									
		FLOOD DEPTH (FT) ABOVE GROUND																			
		1	3	5	7	9						1	3	5	7	9					
	Flood Openings in Foundation Walls						—	—	—	—	—						—	—	—	—	—

MITIGATION MEASURES IN COMBINATION	MEAN DAMAGE RATIO										DAMAGE PER $1,000									
	TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE					TWO-STORY WOOD FRAME STRUCTURE					MASONRY STRUCTURE				
	FLOOD DEPTH (FT) ABOVE GROUND																			
	7	9	11	13	15	1	3	5	7	9	7	9	11	13	15	1	3	5	7	9
Elevate Utility Equipment 2 Feet Above Floor and Wet Floodproof Structure to 2 Feet																				

ACTUARIAL FLOOD STANDARDS

AF-1 Flood Modeling Input Data and Output Reports

A. Adjustments, edits, inclusions, or deletions to insurance company or other input data used by the modeling organization shall be based upon generally accepted actuarial, underwriting, and statistical procedures.

B. All modifications, adjustments, assumptions, inputs and input file identification, and defaults necessary to use the flood model shall be actuarially sound and shall be included with the flood model output report. Treatment of missing values for user inputs required to run the flood model shall be actuarially sound and described with the flood model output report.

Purpose: Flood modeled loss costs and probable maximum loss levels rely on certain input data assumptions. Implicit assumptions may or may not be appropriate for a given entity using the flood model, depending on the circumstances.

Different modeling approaches may require different input data.

Relevant Form: GF-6, Actuarial Flood Standards Expert Certification

Disclosures

1. Identify insurance-to-value assumptions and describe the methods and assumptions used to determine the property value and associated flood losses. Provide a sample calculation for determining the property value.

2. Identify depreciation assumptions and describe the methods and assumptions used to reduce insured flood losses on account of depreciation. Provide a sample calculation for determining the amount of depreciation and the actual cash value (ACV) flood losses.

3. Describe the different flood policies, contracts, and endorsements as specified in s. 627.715, F.S., that are modeled.

4. Provide a copy of the input form(s) used by the flood model with the flood model options available for selection by the user for the Florida flood model under review. Describe the process followed by the user to generate the flood model output produced from the input form. Include the flood model name and version identification on the input form. All items included in the input form submitted to the Commission should be clearly labeled and defined.

5. Disclose, in a flood model output report, the specific inputs required to use the flood model and the options of the flood model selected for use in a personal residential property flood insurance rate filing. Include the flood model name and version identification on the flood model output report. All items included in the flood model output report submitted to the Commission should be clearly labeled and defined.

6. Explain the differences in data input and model output required for coastal and inland flood modeling.

7. Describe actions performed to ensure the validity of insurer or other input data used for flood model inputs or validation/verification.

8. Disclose if changing the order of the flood model input exposure data produces different flood model output or results.

9. Disclose if removing or adding policies from the flood model input file affects the output for the remaining policies.

Audit

1. Quality assurance procedures, including methods to assure accuracy of flood insurance or other input data, will be reviewed. Compliance with this standard will be readily demonstrated through documented rules and procedures.

2. All flood model inputs and assumptions will be reviewed to determine that the flood model output report appropriately discloses all modifications, adjustments, assumptions, and defaults used to produce the flood loss costs and flood probable maximum loss levels.

3. Explanation of the differences in data input and model output for coastal and inland flood modeling will be reviewed.

AF-2 Flood Events Resulting in Modeled Flood Losses

A. Flood modeled loss costs and probable maximum loss levels shall reflect insured flood related damages from both coastal and inland flood events impacting Florida.

B. The modeling organization shall have a documented procedure for addressing double counting or under counting of flood losses from any source.

Purpose: Flood loss costs and flood probable maximum loss levels should reflect the flood losses insurers pay as a result of a flood event (coastal and inland flooding). Note: the flood event may originate outside of Florida and may involve multiple circumstances or a confluence of events (e.g., meteorological events and hydrological and hydraulic events) that contribute to flooding in Florida. Coastal flooding includes storm tide, and inland flooding includes riverine, lacustrine, and surface water flooding.

Flood loss costs and flood probable maximum loss levels should only include insured flood related losses and time element flood losses in Florida resulting from an event modeled as a flood event (as described above) consistent with s. 627.715, F.S., and consistent with the different flood policies, contracts, and endorsements. The event should include all such insured flood related damage due to a flood event causing loss in Florida and should not be over-estimated or under-estimated.

Relevant Forms: GF-6, Actuarial Flood Standards Expert Certification
AF-2, Total Flood Statewide Loss Costs

Disclosures

1. Describe how damage from model-generated floods (originating either inside or outside of Florida) is excluded or included in the calculation of flood loss costs and flood probable maximum loss levels for Florida.

2. Describe how wind losses associated with coastal and inland flooding are treated in the calculation of flood loss costs and flood probable maximum loss levels for Florida.

3. Describe how the flood model considers the correlation and potential overlap of losses associated with coastal and inland flooding.

4. Other than coastal and inland flooding, state whether any other types of flooding events are modeled. If so, describe how damage resulting from these flood type events is treated in the calculation of flood loss costs and flood probable maximum loss levels for Florida.

5. Describe which non-flood water losses are considered flood losses from water intrusion. Describe how water intrusion losses are considered in the calculation of flood loss costs and flood probable maximum loss levels for Florida.

Audit

1. The flood model will be reviewed to evaluate whether the determination of losses in the flood model is consistent with this standard.

2. The flood model will be reviewed to determine that meteorological or hydrological and hydraulic events originating either inside or outside of Florida are modeled for flood losses occurring in Florida and that such effects are considered in a manner which is consistent with this standard.

3. The flood model will be reviewed to determine whether the model takes into account any damage resulting directly and solely from wind. Losses associated with flooding will be reviewed to determine the treatment of wind losses.

4. The flood model will be reviewed to determine how losses from water intrusion are identified and calculated.

5. The documented procedure addressing the double counting or under counting of flood losses will be reviewed.

6. The effect on flood loss costs and flood probable maximum loss levels arising from flood events that are neither inland nor coastal flooding will be reviewed.

AF-3 Flood Coverages

A. The methods used in the calculation of personal residential structure flood loss costs shall be actuarially sound.

B. The methods used in the calculation of personal residential appurtenant structure flood loss costs shall be actuarially sound.

C. The methods used in the calculation of personal residential contents flood loss costs shall be actuarially sound.

D. The methods used in the calculation of personal residential time element flood loss costs shall be actuarially sound.

Purpose: A reasonable representation of personal residential structure, appurtenant structure, contents, and time element flood losses is necessary in order to address how the different flood policies, contracts, and endorsements handle flood losses.

Relevant Form: GF-6, Actuarial Flood Standards Expert Certification

Disclosures

1. Describe the methods used in the flood model to calculate flood loss costs for residential structure coverage associated with personal residential properties.

2. Describe the methods used in the flood model to calculate flood loss costs for appurtenant structure coverage associated with personal residential properties.

3. Describe the methods used in the flood model to calculate flood loss costs for contents coverage associated with personal residential properties.

4. Describe the methods used in the flood model to calculate flood loss costs for time element coverage associated with personal residential properties.

Audit

1. The methods used to produce personal residential structure, appurtenant structure, contents, and time element flood loss costs will be reviewed.

AF-4 Modeled Flood Loss Cost and Flood Probable Maximum Loss Level Considerations

A. Flood loss cost projections and flood probable maximum loss levels shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

B. Flood loss cost projections and flood probable maximum loss levels shall not make a prospective provision for economic inflation.

C. Flood loss cost projections and flood probable maximum loss levels shall not include any explicit provision for wind losses.

D. Damage caused from inland and coastal flooding shall be included in the flood model's calculation of flood loss costs and flood probable maximum loss levels.

E. Flood loss cost projections and flood probable maximum loss levels shall be capable of being calculated from exposures at a geocode (latitude-longitude) level of resolution including the consideration of flood extent and elevation or depth.

F. Demand surge shall be included in the flood model's calculation of flood loss costs and flood probable maximum loss levels using relevant data and actuarially sound methods and assumptions.

Purpose: The flood loss costs and flood probable maximum loss levels from the flood model should reflect flood losses paid by the insurance company as insurance claims resulting from flood damage from an event as defined in Standard AF-2, Flood Events Resulting in Modeled Flood Losses.

Flood probable maximum loss levels can be either on an annual aggregate, an annual occurrence, or an event basis. All bases can be useful for understanding the flood loss distribution produced by the flood model.

Flood loss costs represent the expected annual loss per $1,000 exposure. Other "expense and profit loads" such as those listed in the standard may be included in rate filings but are outside the scope of the Commission.

Flood loss severity may be influenced by supply and demand factors applicable to material and labor costs. This is generally known as demand surge which occurs at the time of a large catastrophic event and is recognized as an important element for flood modeling.

Flood insurance may also be influenced (although perhaps differently from demand surge) by general price inflation. This is a type of economic inflation that is associated with past insured flood loss experience that has been used to

develop and validate flood loss projection models. The standard does not allow for prospective recognition of future economic inflation or price inflation.

Relevant Forms: GF-6, Actuarial Flood Standards Expert Certification
AF-6, Flood Probable Maximum Loss for Florida

Disclosures

1. Describe the method(s) used to estimate annual flood loss costs and flood probable maximum loss levels. Identify any source documents used and any relevant research results.

2. Identify the highest level of resolution for which flood loss costs and flood probable maximum loss levels can be provided. Identify all possible resolutions available for the reported flood output ranges.

3. Describe how the flood model incorporates demand surge in the calculation of flood loss costs and flood probable maximum loss levels. Indicate if there are any differences in the manner that demand surge is incorporated for coastal and inland flooding.

4. Provide citations to published papers, if any, or modeling-organization studies that were used to develop how the flood model estimates demand surge.

5. Describe how economic inflation has been applied to past insurance experience to develop and validate flood loss costs and flood probable maximum loss levels.

Audit

1. How the flood model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, economic inflation, and any criteria other than direct property flood insurance claim payments will be reviewed.

2. The method of determining flood probable maximum loss levels will be reviewed.

3. The uncertainty in the estimated annual flood loss costs and flood probable maximum loss levels will be reviewed.

4. The data and methods used to incorporate individual aspects of demand surge on personal residential coverages for coastal and inland flooding, inclusive of the effects from building material costs, labor costs, contents costs, and repair time will be reviewed.

5. How the flood model accounts for economic inflation associated with past insurance experience will be reviewed.

6. The treatment of wind losses in the determination of flood losses will be reviewed.

7. How the flood model determines flood loss costs and flood probable maximum loss levels associated with coastal flooding will be reviewed.

8. How the flood model determines flood loss costs and flood probable maximum loss levels associated with inland flooding will be reviewed.

9. The methods used to ensure there is no systematic over-estimation or under-estimation of flood loss costs and flood probable maximum loss levels from coastal and inland flooding will be reviewed.

10. All referenced literature will be reviewed, in hard copy or electronic form, to determine applicability.

AF-5 Flood Policy Conditions

A. The methods used in the development of mathematical distributions to reflect the effects of deductibles, policy limits, and flood policy exclusions shall be actuarially sound.

B. The relationship among the modeled deductible flood loss costs shall be reasonable.

C. Deductible loss costs shall be calculated in accordance with s. 627.715, F.S.

Purpose: For a given flood event and personal residential policy type, flood losses may fall below the deductible or above the policy limit; and therefore, the distribution of flood losses is important.

Section 627.715, F.S., presents a number of options regarding deductibles and loss settlement options. Flood policy exclusions are also an important consideration.

Relevant Form: GF-6, Actuarial Flood Standards Expert Certification

Disclosures

1. Describe the methods used in the flood model to treat deductibles, policy limits, policy exclusions, loss settlement provisions, and insurance-to-value criteria when projecting flood loss costs and flood probable maximum loss levels. In particular, specify the loss settlement options available for manufactured homes.

2. Provide an example of how insurer flood loss (flood loss net of deductibles) is calculated. Discuss data or documentation used to validate the method used by the flood model.

Example:

(A)		(B)	(C)	(D)=(A)*(C)	(E)=(D)-(B)
Structure Value	Policy Limit	Deductible	Damage Ratio	Zero Deductible Flood Loss	Flood Loss Net of Deductible
100,000	90,000	1,500	2%	2,000	500

3. Describe how the flood model treats annual deductibles.

Audit

1. The process used to determine the accuracy of the insurance-to-value criteria in data used to develop and validate the flood model results will be reviewed.

2. To the extent that historical data are used to develop mathematical depictions of deductibles, policy limits, policy exclusions, and loss settlement provisions for flood coverage, the goodness-of-fit of the data to fitted models will be reviewed.

3. To the extent that historical data are used to validate the flood model results, the treatment of the effects of deductibles, policy limits, policy exclusions, coinsurance, and loss settlement provisions for flood coverage in the data will be reviewed.

4. Treatment of annual deductibles will be reviewed.

AF-6 Flood Loss Outputs and Logical Relationships to Risk

A. The methods, data, and assumptions used in the estimation of flood probable maximum loss levels shall be actuarially sound.

B. Flood loss costs shall not exhibit an illogical relation to risk, nor shall flood loss costs exhibit a significant change when the underlying risk does not change significantly.

C. Flood loss costs cannot increase as the structure flood damage resistance increases, all other factors held constant.

D. Flood loss costs cannot increase as flood hazard mitigation measures incorporated in the structure increase, all other factors held constant.

E. Flood loss costs shall be consistent with the effects of major flood control measures, all other factors held constant.

F. Flood loss costs cannot increase as the flood resistant design provisions increase, all other factors held constant.

G. Flood loss costs cannot increase as building code enforcement increases, all other factors held constant.

H. Flood loss costs shall decrease as deductibles increase, all other factors held constant.

I. The relationship of flood loss costs for individual coverages, (e.g., personal residential structure, appurtenant structure, contents, and time element) shall be consistent with the coverages provided.

J. Flood output ranges shall be logical for the type of risk being modeled and apparent deviations shall be justified.

K. All other factors held constant, flood output ranges produced by the flood model shall in general reflect lower flood loss costs for personal residential structures that have a higher elevation versus those that have a lower elevation.

L. For flood loss cost and flood probable maximum loss level estimates derived from and validated with historical insured flood losses or other input data and information, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, and (3) contractual provisions shall be appropriate based on the type of risk being modeled.

Purpose: This standard is to ensure that flood probable maximum loss levels are based on an actuarially sound methodology. The actuarial soundness resulting from compliance with the standard is particularly important to capital markets, insurers, reinsurers and rating agencies that frequently use flood probable maximum loss levels.

Modeled flood loss costs should vary according to risk. If the risk of loss due to floods is higher for one area or personal residential structure type, then the flood loss costs should also be higher. Likewise, if there is no difference in risk, there should be no difference in flood loss costs. Flood loss costs not having these properties do not have a logical relationship to risk.

Relevant Forms: GF-6, Actuarial Flood Standards Expert Certification
AF-1, Zero Deductible Personal Residential Standard Flood Loss Costs
AF-2, Total Flood Statewide Loss Costs
AF-3, Personal Residential Standard Flood Loss Costs by ZIP Code
AF-4, Flood Output Ranges
AF-5, Logical Relationship to Flood Risk (Trade Secret Item)
AF-6, Flood Probable Maximum Loss for Florida
SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined)

Disclosures

1. Provide a completed Form AF-1, Zero Deductible Personal Residential Standard Flood Loss Costs. Provide a link to the location of the form [insert hyperlink here].

2. Provide a completed Form AF-2, Total Flood Statewide Loss Costs. Provide a link to the location of the form [insert hyperlink here].

3. Provide a completed Form AF-3, Personal Residential Standard Flood Loss Costs by ZIP Code. Provide a link to the location of the form [insert hyperlink here].

4. Provide a completed Form AF-4, Flood Output Ranges, using the modeling-organization-specified, predetermined, and comprehensive exposure dataset. Provide a link to the location of the form [insert hyperlink here].

5. Provide a completed Form AF-6, Flood Probable Maximum Loss for Florida. Provide a link to the location of the form [insert hyperlink here].

6. Describe how the flood model produces flood probable maximum loss levels.

7. Provide citations to published papers, if any, or modeling-organization studies that were used to estimate flood probable maximum loss levels.

8. Explain any difference between the values provided on Form AF-6, Flood Probable Maximum Loss for Florida, and those provided on Form SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined).

9. Provide an explanation for all anomalies in the flood loss costs that are not consistent with the requirements of this standard.

Audit

1. The data and methods used for flood probable maximum loss levels for Form AF-6, Flood Probable Maximum Loss for Florida, will be reviewed. The Top Event and Conditional Tail Expectations will be reviewed.

2. All referenced literature will be reviewed, in hard copy or electronic form, to determine applicability.

3. Graphical representations of flood loss costs by rating areas and geographic zones (consistent with the modeling-organization grid resolution) will be reviewed.

4. Color-coded maps depicting the effects of topography and major flood control measures on flood loss costs by rating areas and geographic zones (consistent with the modeling-organization grid resolution) will be reviewed.

5. The procedures used by the modeling organization to verify the individual flood loss cost relationships will be reviewed. Methods (including any software) used in verifying Standard AF-6 will be reviewed. Forms AF-1, Zero Deductible Personal Residential Standard Flood Loss Costs, AF-2, Total Flood Statewide Loss Costs, AF-3, Personal Residential Standard Flood Loss Costs by ZIP Code, and AF-5, Logical Relationship to Flood Risk (Trade Secret Item), will be reviewed to assess flood coverage relationships.

6. The flood loss cost relationships among deductible, construction type, policy form, coverage, year of construction, foundation type, condo unit floor, number of stories, and lowest floor elevation will be reviewed. For coastal flooding, the flood loss cost relationship with distance to the closest coast will be reviewed.

7. The total personal residential insured flood losses provided in Form AF-2, Total Flood Statewide Loss Costs, and Form AF-3, Personal Residential Standard Flood Loss Costs by ZIP Code, will be reviewed.

8. Form AF-4, Flood Output Ranges, will be reviewed, including geographical representations of the data where applicable.

9. Form AF-4, Flood Output Ranges, will be reviewed to ensure appropriate relativities among deductibles, coverages, and construction types.

10. Apparent anomalies in the flood output ranges and their justification will be reviewed.

11. Form AF-6, Flood Probable Maximum Loss for Florida, will be reviewed.

Form AF-1: Zero Deductible Personal Residential Standard Flood Loss Costs

Purpose: This form and the associated maps illustrate the range and variation of zero deductible standard flood loss costs across Florida for personal residential building property and for personal property separately for frame owners, masonry owners, and manufactured homes. Each modeling organization can define its own rating areas or geographic zones.

A. Provide three maps, color-coded by rating areas or geographic zones (with a minimum of six value ranges), displaying zero deductible personal residential standard flood loss costs per $1,000 of exposure for wood frame, masonry, and manufactured homes.

   Note: Standard Flood in Florida is equivalent to the National Flood Insurance Program (NFIP). Rating areas or geographic zones shall be defined by the modeling organization.

B. Create exposure sets for these exhibits by modeling all of the buildings from Notional Set 3 described in the file *"NotionalInput17_Flood.xlsx"* geocoded to each rating area or geographic zone in the state, as provided in the flood model. Define the flood model's flood rating areas or geographic zones. Provide the predominant County name and the Federal Information Processing Standards (FIPS) Code associated with each rating area or geographic zone. Refer to the Notional Standard Flood Policy Specifications below for additional modeling information. Explain any assumptions, deviations, and differences from the prescribed exposure information.

C. Provide, in the format given in the file named *"2017FormAF1.xlsx"* in both Excel and PDF format, the underlying standard flood loss cost data, rounded to three decimal places in the PDF file, used for A above. The file name shall include the abbreviated name of the modeling organization, the flood standards year, and the form name.

Notional Standard Policy Specifications

Policy Type	Assumptions
Owners	**Coverage A = Building Property** • Replacement cost equal to Coverage A limit • Excludes all appurtenant structures **Coverage B = Personal Property** • Actual cash value equal to Coverage B limit **Time Element Coverage** • To be defined by the modeling organization ✧ Flood loss costs per $1,000 shall be related to the Coverage A limit for Coverage A, to the Coverage B limit for Coverage B, and to the Time Element limit for Time Element Coverage
Manufactured Homes	**Coverage A = Building Property** • Replacement cost equal to Coverage A limit **Coverage B = Personal Property** • Actual cash value equal to Coverage B limit **Time Element Coverage** • To be defined by the modeling organization ✧ Flood loss costs per $1,000 shall be related to the Coverage A limit for Coverage A, to the Coverage B limit for Coverage B, and to the Time Element limit for Time Element Coverage

Form AF-2: Total Flood Statewide Loss Costs

Purpose: This form illustrates the modeling organization's ability to estimate flood loss costs for a modeling-organization-specified, predetermined and comprehensive exposure dataset.

A. Provide the total personal residential insured flood loss and the percentage contribution of the total personal residential insured flood loss assuming zero deductible policies for individual historical flooding events using a modeling-organization-specified, predetermined and comprehensive exposure dataset. The list of flooding events in this form shall include meteorological, hydrological, and hydraulic events and circumstances occurring inside or outside of Florida that resulted in or contributed to flooding in Florida included in the modeling organization flood-event dataset (e.g., Florida and by-passing hurricanes, tropical cyclones below hurricane strength that caused flood losses in Florida, rainfall events that caused flood losses in Florida).

   The table below contains the minimum number of tropical cyclones from HURDAT2 and rainfall events to be included in the modeling organization flood-event dataset. Each tropical cyclone and rainfall event has been assigned an ID number. Additional tropical cyclones and rainfall events included in the modeling organization flood-event dataset shall be added to the table below in order of year and assigned an intermediate ID number as the tropical cyclone and rainfall event falls within the bounding ID numbers.

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. The file name shall include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form AF-2, Total Flood Statewide Loss Costs, in a submission appendix.

ID	Landfall/ Closest Approach Date	Year	Name	Personal Residential Insured Losses ($)	Percentage Contribution
005	10/25/1921	1921	TampaBay06-1921		
010	09/18/1926	1926	GreatMiami07-1926		
015	09/17/1928	1928	LakeOkeechobee04-1928		
020	09/03/1935	1935	LaborDay03-1935		
025	08/31/1950	1950	Baker-1950		
030	09/05/1950	1950	Easy-1950		
035	10/18/1950	1950	King-1950		
040	09/26/1953	1953	Florence-1953		
045	10/09/1953	1953	Hazel-1953		
050	09/25/1956	1956	Flossy-1956		
055	09/10/1960	1960	Donna-1960		
060	08/27/1964	1964	Cleo-1964		
065	09/10/1964	1964	Dora-1964		

ID	Landfall/ Closest Approach Date	Year	Name	Personal Residential Insured Losses ($)	Percentage Contribution
070	10/14/1964	1964	Isbell-1964		
075	09/08/1965	1965	Betsy-1965		
080	06/09/1966	1966	Alma-1966		
085	10/04/1966	1966	Inez-1966		
090	10/19/1968	1968	Gladys-1968		
095	06/19/1972	1972	Agnes-1972		
100	09/23/1975	1975	Eloise-1975		
105	09/04/1979	1979	David-1979		
110	09/13/1979	1979	Frederic-1979		
115	09/02/1985	1985	Elena-1985		
120	11/21/1985	1985	Kate-1985		
125	10/12/1987	1987	Floyd-1987		
130	08/24/1992	1992	Andrew-1992		
135	08/03/1995	1995	Erin-1995		
140	10/04/1995	1995	Opal-1995		
145	07/19/1997	1997	Danny-1997		
150	09/03/1998	1998	Earl-1998		
155	09/25/1998	1998	Georges-1998		
160	10/15/1999	1999	Irene-1999		
165	08/13/2004	2004	Charley-2004		
170	09/05/2004	2004	Frances-2004		
175	09/16/2004	2004	Ivan-2004		
180	09/26/2004	2004	Jeanne-2004		
185	0710/2005	2005	Dennis-2005		
190	08/25/2005	2005	Katrina-2005		
195	10/24/2005	2005	Wilma-2005		
200	08/18/2008	2008	Tropical Storm Fay		
205		May 2009	Unnamed Storm in East Florida		
210		July 2013	Unnamed Storm in Panhandle		
TBD			Storm(s) chosen by modeling organization		
			Total		

Form AF-3: Personal Residential Standard Flood Loss Costs by ZIP Code

Purpose: This form illustrates the modeling organization's ability to estimate zero deductible standard flood loss costs for a specified set of historical flood events.

A. Provide the percentage of personal residential zero deductible standard flood losses, rounded to four decimal places in the printed form, and the monetary contribution from the events listed below using the modeling-organization-specified, predetermined, and comprehensive exposure dataset. Include all ZIP Codes where losses are material. Disclose the materiality threshold.

B. Provide maps color-coded by ZIP Code depicting the percentage total personal residential standard flood losses from each flood event and for the cumulative flood losses using the following interval coding:

Red	Over 5%
Light Red	2% to 5%
Pink	1% to 2%
Light Pink	0.5% to 1%
Light Blue	0.2% to 0.5%
Medium Blue	0.1% to 0.2%
Blue	Below 0.1%

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.

Form AF-3 Events:

- Hurricane Andrew (1992)
- Hurricane Ivan (2004)
- Hurricane Jeanne (2004)
- Hurricane Wilma (2005)
- Tropical Storm Fay (2008)
- Unnamed Storm in East Florida (May 2009)
- Unnamed Storm in Panhandle (July 2013)
- Storm chosen by modeling organization

D. Provide, in the format given in the file named *"2017FormAF3.xlsx"* in Excel format, the total flood loss costs by ZIP Code. The file name shall include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form AF-3, Personal Residential Standard Flood Loss Costs by ZIP Code, in a submission appendix.

Form AF-4: Flood Output Ranges

Purpose: This form provides an illustration of the projected personal residential modeled flood loss costs by county and provides a means to review for appropriate differentials among deductibles, coverage, and construction types.

A. Provide personal residential flood output ranges in the format shown in the file named *"2017FormAF4.xlsx"* by using an automated program or script. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form AF-4, Flood Output Ranges, in a submission appendix.

B. Provide flood loss costs by county, rounded to three decimal places in the printed form. Within each county, flood loss costs shall be shown separately per $1,000 of exposure for frame owners, masonry owners, frame renters, masonry renters, frame condo unit owners, masonry condo unit owners, and manufactured homes. For each of these categories using rating areas or geographic zones, the flood output range shall show the highest flood loss cost, the lowest flood loss cost, and the weighted average flood loss cost. The aggregate personal residential exposure data for this form shall be developed from the modeling-organization-specified, predetermined, and comprehensive exposure dataset except for insured values and deductibles information. Insured values shall be based on the standard flood output range specifications given below. When calculating the weighted average flood loss costs, weight the flood loss costs by the total insured value calculated above. Include the statewide range of flood loss costs (i.e., low, high, and weighted average).

C. If a modeling organization has flood loss costs for a rating area or geographic zone for which there is no exposure, give the flood loss costs zero weight (i.e., assume the exposure in that rating area or geographic zone is zero). Provide a list in the flood model submission document of those rating areas or geographic zones where this occurs.

D. If a modeling organization does not have flood loss costs for a rating area or geographic zone for which there is some exposure, do not assume such flood loss costs are zero, but use only the exposures for which there are flood loss costs in calculating the weighted average flood loss costs. Provide a list in the flood model submission document of the rating areas or geographic zones where this occurs.

E. NA shall be used in cells to signify no exposure.

F. All anomalies in flood loss costs that are not consistent with the requirements of Standard AF-6, Flood Loss Outputs and Logical Relationships to Risk, and have been explained in Disclosure AF-6.9 shall be shaded.

Standard Flood Output Range Specifications

Policy Type **Assumptions**

Owners

Coverage A = Building Property
- Coverage A limit = $100,000
- Replacement cost equal to Coverage A limit
- Deductible = $1,500

Coverage B = Personal Property
- Coverage B limit = $40,000
- Actual cash value equal to Coverage B limit
- Deductible = $1,000

Time Element Coverage
- To be defined by the modeling organization

✧ Flood loss costs per $1,000 shall be specified for each coverage limit

Renters

Coverage B = Personal Property
- Coverage B limit = $25,000
- No coverage for tenant improvements
- Deductible = $1,000
- Actual cash value equal to Coverage B limit

Time Element Coverage
- To be defined by the modeling organization

✧ Flood loss costs per $1,000 shall be related to the Coverage B limit

Condo Unit Owners

Coverage A = Building Property
- Coverage A limit = 10% of Coverage B limit
- Replacement cost equal to Coverage A limit

Coverage B = Personal Property
- Coverage B limit = $50,000
- Actual cash value equal to Coverage B limit
- Deductible = $500

Time Element Coverage
- To be defined by the modeling organization

✧ Flood loss costs per $1,000 shall be related to the Coverage B limit

Policy Type	Assumptions
Manufactured Homes	**Coverage A = Building Property** • Coverage A limit = $50,000 • Replacement cost equal to Coverage A limit • Deductible = $500 **Coverage B = Personal Property** • Coverage B limit = $25,000 • Actual cash value equal to Coverage B limit **Time Element Coverage** • To be defined by the modeling organization

✧ Flood loss costs per $1,000 shall be related to the coverage limit

Form AF-5: Logical Relationship to Flood Risk (Trade Secret Item)

Purpose: This form provides an illustration of the flood loss cost relationships among deductible, construction type, policy form, coverage, year of construction, foundation type, condo unit floor, number of stories, lowest floor elevation and for coastal flooding, the flood loss cost relationship with distance to the closest coast.

A. Provide the logical relationship to flood risk exhibits in the format shown in the file named *"2017FormAF5.xlsx."*

B. Create exposure sets for each exhibit by modeling all of the flood coverages from the appropriate Notional Set listed below at each of the locations in "Location Grid A" as described in the file "*NotionalInput17_Flood.xlsx."* Refer to the Notional Standard Flood Policy Specifications below for additional modeling information. Explain any assumptions, deviations, and differences from the prescribed exposure information.

Exhibit	Notional Set
Deductible Sensitivity	Set 1
Construction Sensitivity	Set 2
Policy Form Sensitivity	Set 3
Coverage Sensitivity	Set 4
Year Built Sensitivity	Set 5
Foundation Type Sensitivity	Set 6
Condo Unit Floor Sensitivity	Set 7
Number of Stories Sensitivity	Set 8
Lowest Floor Elevation of Residential Structure Sensitivity	Set 9

Flood models shall treat points in "Location Grid A" as coordinates that would result from a geocoding process. Flood models shall treat points by simulating flood loss at exact location or by using the nearest modeled parcel/street/cell in the flood model. Explain any assumptions, deviations, and differences from the prescribed exposure information.

Report results for each of the points in "Location Grid A" individually, unless specified. Flood loss cost per $1,000 of exposure shall be rounded to three decimal places in the printed form.

Note: All flood deductibles are $0 except for the Deductible Sensitivity. Coverage Sensitivity includes time element.

C. All anomalies in flood loss costs that are not consistent with the requirements of Standard AF-6, Flood Loss Outputs and Logical Relationships to Risk, and have been explained in Disclosure AF-6.9 shall be shaded.

D. Create an exposure set and report flood loss cost results for slab foundation owners frame buildings (Notional Set 6) for each of the points in "Location Grid B" as described in the file "*NotionalInput17_Flood.xlsx."* Provide a color-coded contour or high-resolution map of the flood loss costs for coastal flooding. Provide a scatter plot of the flood loss costs (*y*-axis) against distance to closest coast (*x*-axis).

Notional Standard Flood Policy Specifications

Policy Type **Assumptions**

Owners

Coverage A = Building Property
- Coverage A limit = $100,000
- Replacement cost equal to Coverage A limit

Coverage B = Personal Property
- Coverage B limit = $40,000
- Actual cash value equal to Coverage B limit

Time Element Coverage
- To be defined by the modeling organization

✧ Flood loss costs per $1,000 shall be specified for each coverage limit

Renters

Coverage B = Personal Property
- Coverage B limit = $25,000
- No coverage for tenant improvements
- Actual cash value equal to Coverage B limit

Time Element Coverage
- To be defined by the modeling organization

✧ Flood loss costs per $1,000 shall be related to the Coverage B limit

Condo Unit Owners

Coverage A = Building Property
- Coverage A limit = 10% of Coverage B limit
- Replacement cost equal to Coverage A limit

Coverage B = Personal Property
- Coverage B limit = $50,000
- Actual cash value equal to Coverage B limit

Time Element Coverage
- To be defined by the modeling organization

✧ Flood loss costs per $1,000 shall be related to the Coverage B limit

Policy Type	Assumptions
Manufactured Homes	**Coverage A = Building Property** • Coverage A limit = $50,000 • Replacement cost equal to Coverage A limit **Coverage B = Personal Property** • Coverage B limit = $25,000 • Actual cash value equal to Coverage B limit **Time Element Coverage** • To be defined by the modeling organization

✧ Flood loss costs per $1,000 shall be related to the coverage limit

Form AF-6: Flood Probable Maximum Loss for Florida

Purpose: This form provides an illustration of the distribution of flood losses and illustrates that appropriate calculations were used to produce both expected annual flood losses and flood probable maximum loss levels.

A. Provide the estimated flood loss and uncertainty interval for each of the Personal Residential Annual Exceedance Probabilities given in Part A, Annual Aggregate and Part B, Annual Occurrence. Describe how the uncertainty intervals are derived. Also, provide in Parts A and B, the Conditional Tail Expectation, the expected value of flood losses greater than the Estimated Flood Loss Level. If the modeling methodology does not allow the flood model to produce a viable answer for certain exceedance probabilities, state so and why.

B. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form AF-6, Flood Probable Maximum Loss for Florida, in a submission appendix.

Part A – Personal Residential Flood Probable Maximum Loss for Florida (Annual Aggregate)

Annual Exceedance Probability	Estimated Flood Loss Level	Uncertainty Interval	Conditional Tail Expectation
Top Event			---
0.001			
0.002			
0.004			
0.01			
0.02			
0.05			
0.10			
0.20			

Part B – Personal Residential Flood Probable Maximum Loss for Florida (Annual Occurrence)

Annual Exceedance Probability	Estimated Flood Loss Level	Uncertainty Interval	Conditional Tail Expectation
Top Event			---
0.001			
0.002			
0.004			
0.01			
0.02			
0.05			
0.10			
0.20			

COMPUTER/INFORMATION FLOOD STANDARDS

CIF-1 Flood Model Documentation

A. Flood model functionality and technical descriptions shall be documented formally in an archival format separate from the use of letters, slides, and unformatted text files.

B. The modeling organization shall maintain a primary document repository, containing or referencing a complete set of documentation specifying the flood model structure, detailed software description, and functionality. Documentation shall be indicative of current model development and software engineering practices.

C. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the flood model shall be consistently documented and dated.

D. The modeling organization shall maintain a table of all substantive changes in the flood model since this year's initial submission.

E. The modeling organization shall maintain a list of all externally acquired flood model-specific assets (e.g., software, data). The list shall include 1) asset name, 2) asset version number, 3) date asset acquired, 4) source from which asset was acquired, and 5) length of time asset has been in use by the modeling organization.

F. Documentation shall be created separately from the source code.

Purpose: To capture all aspects of *documenting* the flood model. Documentation enables the modeling organization personnel to create a shared, formal organizational structure of all information specifically related to the flood model. This structure may include many forms of media such as printed documentation, diagrams, and time-based media such as animations.

Relevant Form: GF-7, Computer/Information Flood Standards Expert Certification

Audit

1. The primary document repository, in either electronic or physical form, and its maintenance process will be reviewed. The repository should contain or reference full documentation of the software.

2. All documentation should be easily accessible from a central location in order to be reviewed.

3. Complete user documentation, including all recent updates, will be reviewed.

4. Modeling organization personnel, or their designated proxies, responsible for each aspect of the software (i.e., user interface, quality assurance, engineering, actuarial, verification) should be present when the Computer/Information Flood Standards are being reviewed. Internal users of the software will be interviewed.

5. The list of all externally acquired flood model-specific assets (e.g., software, data) will be reviewed.

6. Verification that documentation is created separately from, and is maintained consistently with, the source code and data will be reviewed.

7. The tables specified in CIF-1.D that contain the items listed in Standard GF-1, Scope of the Flood Model and Its Implementation, Audit 6 will be reviewed. The tables should contain the item number in the first column. The remaining five columns should contain specific document or file references for affected components or data relating to the following Computer/Information Flood Standards: CIF-2, Flood Model Requirements, CIF-3, Flood Model Architecture and Component Design, CIF-4, Flood Model Implementation, CIF-5, Flood Model Verification, and CIF-6, Flood Model Maintenance and Revision.

8. Tracing of the flood model changes specified in Standard GF-1, Scope of the Flood Model and Its Implementation, Audit 6 through all Computer/Information Flood Standards will be reviewed.

CIF-2 Flood Model Requirements

The modeling organization shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component. Requirements shall be updated whenever changes are made to the flood model.

Purpose: To define an initial stage of flood model development. Software development for flood modeling begins with a thorough *specification of requirements* for each component, database, or data file accessed by a component. These requirements are frequently documented informally in natural language, with the addition of illustrations that aid both users and software engineers in specifying components, databases, or data files accessed by a component for the software product and process. Requirements drive the subsequent design (CIF-3, Flood Model Architecture and Component Design), implementation (CIF-4, Flood Model Implementation), and verification (CIF-5, Flood Model Verification) of the flood model.

A typical division of requirements into categories would include:

1. ***Interface:*** For example, use the web browser Internet Explorer, with ActiveX technology, to show county and ZIP Code maps of Florida. Allow text search commands for browsing and locating counties.

2. ***Human Factors:*** For example, ZIP Code boundaries, and contents, can be scaled to the extent that the average user can visually identify residential home exposures marked with small circles.

3. ***Functionality:*** For example, make the software design at the topmost level a data flowchart containing the following components: FLOODS, TERRAIN, FLOOD ELEVATION OR DEPTH, WAVE CONDITIONS, FLOOD EXTENT, DAMAGE, and FLOOD LOSS COSTS. Write the low-level code in Java.

4. ***Documentation:*** For example, use Acrobat PDF for the layout language, and add PDF hyperlinks in documents to connect the sub-documents.

5. ***Data:*** For example, store the vulnerability data in an Excel spreadsheet using a different sheet for each construction type.

6. ***Human Resources:*** For example, task individuals for the six-month coding of the flood extent and elevation or depth simulation. Ask others to design the user-interface by working with the Quality Assurance team.

7. ***System Models:*** For example, models with representations of software, data, and associated human collaboration, will use Business Process Model and Notation (BPMN), Unified Modeling Language (UML), or Systems Modeling Language (SysML).

8. ***Security:*** For example, store tapes off-site, with incremental daily backups. Password-protect all source files.

9. ***Quality Assurance:*** For example, filter insurance claims data against norms and extremes created for the last project.

Relevant Form: GF-7, Computer/Information Flood Standards Expert Certification

Disclosure

1. Provide a description of the documentation for interface, human factors, functionality, documentation, data, human and material resources, security, and quality assurance.

Audit

1. Maintenance and documentation of a complete set of requirements for each software component, database, and data file accessed by a component will be reviewed.

2. The response to Disclosure 1 will be reviewed.

CIF-3 Flood Model Architecture and Component Design

A. The modeling organization shall maintain and document (1) detailed control and data flowcharts and interface specifications for each software component, (2) schema definitions for each database and data file, (3) flowcharts illustrating flood model-related flow of information and its processing by modeling organization personnel or consultants, and (4) system model representations associated with (1)-(3). Documentation shall be to the level of components that make significant contributions to the flood model output.

B. All flowcharts (e.g., software, data, and system models) shall be based on (1) a referenced industry standard (e.g., Unified Modeling Language (UML), Business Process Model and Notation (BPMN), Systems Modeling Language (SysML)), or (2) a comparable internally-developed standard which is separately documented.

Purpose: To *design* the flood model once requirements (CIF-2, Flood Model Requirements) have been specified. The software system (comprised of code and data) and the business process (composed of people and information flows) are designed as a collection of interconnected components. These components are frequently specified in hierarchical flowcharts and diagrams. Example components might include: FLOODS, TERRAIN, FLOOD ELEVATION OR DEPTH, WAVE CONDITIONS, FLOOD EXTENT, DAMAGE, and FLOOD LOSS COSTS, and the major sub-components of each. The purpose of each example component is, as follows:

1. FLOODS accepts historical flood event data sources and generates historical and stochastic flood events;

2. TERRAIN accepts topographic, bathymetric, and land use/land cover data and produces ground surface characteristics used by FLOOD ELEVATION OR DEPTH, WAVE CONDITIONS, and FLOOD EXTENT;

3. FLOOD ELEVATION OR DEPTH accepts the output from FLOODS and TERRAIN and produces a stillwater flood surface and site-specific flood elevations or depths throughout the area inundated by a flood event;

4. WAVE CONDITIONS accepts the output from FLOODS, FLOOD ELEVATION OR DEPTH, and TERRAIN and produces wave characteristics and wave elevations throughout the area inundated by a coastal flood event;

5. FLOOD EXTENT accepts the output from FLOOD ELEVATION OR DEPTH, TERRAIN, and WAVE CONDITIONS and generates the horizontal limits of flooding for a flood event;

6. DAMAGE accepts the output from FLOOD ELEVATION OR DEPTH and WAVE CONDITIONS and generates flood damage to personal residential property;

7. FLOOD LOSS COSTS accepts the output from DAMAGE and generates flood loss costs.

Relevant Form: GF-7, Computer/Information Flood Standards Expert Certification

Audit

1. The following will be reviewed:
    a. Detailed control and data flowcharts, completely and sufficiently labeled for each component,
    b. Interface specifications for all components in the flood model,
    c. Documentation for schemas for all data files, along with field type definitions,
    d. Each network flowchart including components, sub-component flowcharts, arcs, and labels, and
    e. Flowcharts illustrating flood model-related information flow among modeling organization personnel or consultants (e.g., BPMN, UML, SysML, or equivalent technique including a modeling organization internal standard).

2. A flood model component custodian, or designated proxy, should be available for the review of each component.

3. The flowchart reference guide or industry standard reference will be reviewed.

CIF-4 Flood Model Implementation

A. The modeling organization shall maintain a complete procedure of coding guidelines consistent with current software engineering practices.

B. The modeling organization shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.

C. All components shall be traceable, through explicit component identification in the flood model representations (e.g., flowcharts) down to the code level.

D. The modeling organization shall maintain a table of all software components affecting flood loss costs and flood probable maximum loss levels, with the following table columns: (1) component name, (2) number of lines of code, minus blank and comment lines, and (3) number of explanatory comment lines.

E. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.

F. The modeling organization shall maintain the following documentation for all components or data modified by items identified in Standard GF-1, Scope of the Flood Model and Its Implementation, Audit 6:

1. A list of all equations and formulas used in documentation of the flood model with definitions of all terms and variables.

2. A cross-referenced list of implementation source code terms and variable names corresponding to items within F.1 above.

Purpose: To *implement* the flood model based on requirements (CIF-2, Flood Model Requirements) and design (CIF-3, Flood Model Architecture and Component Design). The flood model implementation is created using computer software (i.e., code) and data. Elements formed in the design stage should be fully traceable to components of the implementation. The design stage serves as an abstract, and often visual, representation of the underlying implementation comprised of code and data.

Relevant Form: GF-7, Computer/Information Flood Standards Expert Certification

Disclosure

1. Specify the hardware, operating system, other software, and all computer languages required to use the flood model.

Audit

1. The interfaces and the coupling assumptions will be reviewed.

2. The documented coding guidelines, including procedures for ensuring readable identifiers for variables, constants, and components, and confirmation that these guidelines are uniformly implemented will be reviewed.

3. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.

4. The traceability among components at all levels of representation will be reviewed.

5. The following information will be reviewed for each component, either in a header comment block, source control database, or the documentation:
    a. Component name,
    b. Date created,
    c. Dates modified, modification rationale, and by whom,
    d. Purpose or function of the component, and
    e. Input and output parameter definitions.

6. The table of all software components as specified in CIF-4.D will be reviewed.

7. Flood model components and the method of mapping to elements in the computer program will be reviewed.

8. Comments within components will be reviewed for sufficiency, consistency, and explanatory quality.

9. The response to Disclosure 1 will be reviewed.

CIF-5 Flood Model Verification

A. General

For each component, the modeling organization shall maintain procedures for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. Verification procedures shall include tests performed by modeling organization personnel other than the original component developers.

B. Component Testing

1. The modeling organization shall use testing software to assist in documenting and analyzing all components.

2. Unit tests shall be performed and documented for each component.

3. Regression tests shall be performed and documented on incremental builds.

4. Aggregation tests shall be performed and documented to ensure the correctness of all flood model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.

C. Data Testing

1. The modeling organization shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.

2. The modeling organization shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.

Purpose: To ensure a correct mapping from executing the implementation (CIF-4, Flood Model Implementation) to previously specified requirements (CIF-2, Flood Model Requirements) and design (CIF-3, Flood Model Architecture and Component Design). *Verification* requires tests to be run by varying component inputs to ensure correct output.

Relevant Form: GF-7, Computer/Information Flood Standards Expert Certification

Disclosures

1. State whether any two executions of the flood model with no changes in input data, parameters, code, and seeds of random number generators produce the same flood loss costs and flood probable maximum loss levels.

2. Provide an overview of the component testing procedures.

3. Provide a description of verification approaches used for externally acquired data, software, and models.

Audit

1. The components will be reviewed for containment of sufficient logical assertions, exception-handling mechanisms, and flag-triggered output statements to test the correct values for key variables that might be subject to modification.

2. The testing software used by the modeling organization will be reviewed.

3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed including compliance with independence of the verification procedures.

4. Fully time-stamped, documented cross-checking procedures and results for verifying equations, including tester identification, will be reviewed. Examples include mathematical calculations versus source code implementation, or the use of multiple implementations using different languages.

5. Flowcharts defining the processes used for manual and automatic verification will be reviewed.

6. Verification approaches used for externally acquired data, software, and models will be reviewed.

7. The responses to Disclosures 1, 2, and 3 will be reviewed.

CIF-6 Flood Model Maintenance and Revision

A. The modeling organization shall maintain a clearly written policy for flood model review, maintenance, and revision, including verification and validation of revised components, databases, and data files.

B. A revision to any portion of the flood model that results in a change in any Florida personal residential flood loss cost or flood probable maximum loss level shall result in a new flood model version identification.

C. The modeling organization shall use tracking software to identify and describe all errors, as well as modifications to code, data, and documentation.

D. The modeling organization shall maintain a list of all flood model versions since the initial submission for this year. Each flood model description shall have an unique version identification and a list of additions, deletions, and changes that define that version.

Purpose: To create a formal procedure for identifying, organizing, and *maintaining flood model versions*. Flood model software, data, and documentation are stored in an online system that tracks all editing changes by author and change date.

Relevant Form: GF-7, Computer/Information Flood Standards Expert Certification

Disclosures

1. Identify procedures used to review and maintain code, data, and documentation.

2. Describe the rules underlying the flood model and code revision identification systems.

Audit

1. All policies and procedures used to review and maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, the installation date under configuration control, the current version identification, and the date of the most recent change(s) will be reviewed.

2. The policy for flood model revision and management will be reviewed.

3. Portions of the code will be reviewed.

4. The tracking software will be reviewed and checked for the ability to track date and time.

5. The list of all flood model revisions as specified in CIF-6.D will be reviewed.

6. The responses to Disclosures 1 and 2 will be reviewed.

CIF-7 Flood Model Security

The modeling organization shall have implemented and fully documented security procedures for: (1) secure access to individual computers where the software components or data can be created or modified, (2) secure operation of the flood model by clients, if relevant, to ensure that the correct software operation cannot be compromised, (3) anti-virus software installation for all machines where all components and data are being accessed, and (4) secure access to documentation, software, and data in the event of a catastrophe.

Purpose: To ensure that the model is *secured* against unauthorized access. Security procedures are necessary to maintain an adequate, secure, and correct base for code, data, and documentation. The modeling organization is expected to have a secure location supporting all code, data, and documentation development and maintenance. Necessary measures include, but are not limited to, (1) virus protection, (2) limited access protocols for software, hardware, and networks, and (3) backup and redundancy procedures.

Relevant Form: GF-7, Computer/Information Flood Standards Expert Certification

Disclosure

1. Describe methods used to ensure the security and integrity of the code, data, and documentation.

Audit

1. The written policy for all security procedures and methods used to ensure the security of code, data, and documentation will be reviewed.

2. Documented security procedures for access, client flood model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.

3. The response to Disclosure 1 will be reviewed.