METEOROLOGICAL/HYDROLOGICAL FLOOD STANDARDS

MHF-1 Flood Event Data Sources

A. The modeling of floods in Florida shall involve meteorological, hydrological, and other relevant data sources.

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

C. Annual frequencies used in both flood model calibration and flood model validation shall be based upon peer reviewed data sources, publically developed data sources, or both types representing an unadjusted long-term record. [cite data sources and dates including the most current hydrological data sources]

D. Calibration and validation shall encompass all relevant flood event data sources required to model flood, which shall include, but not be limited to, coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding, as well as any partitions or subsets.

E. Any trends, weighting, or partitioning shall be justified and consistent with currently accepted scientific literature and statistical techniques.

Purpose: The Flood Event Data Sources cover the period [add dates]. The primary use of the Flood Event Data Sources is to both calibrate and validate modeled versus historical flood events impacting Florida. Failure to update modeled flood statistics based on changes in the Flood Event Data Sources through their latest publication dates will not be acceptable.

As a minimum, modeling organizations shall model coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding and data sources associated with each type of flooding will be utilized. However, if the modeling organization models other types of flooding and adequate data is available to project loss costs and probable maximum loss levels, relevant data sources shall be incorporated based on their latest publication dates.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification
MHF-1, Annual Flood Occurrence Rates by County

AF-2, Flood Event Data Sources Statewide Losses
SF-1, Probability and Frequency of Florida Flood Events per Year
SF-5, Average Annual Zero Deductible Statewide Flood Loss Costs – Historical versus Modeled

Disclosures

1. Identify the Flood Event Data Sources, the release dates, and the time periods used to develop and implement flood frequencies for coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding into the flood model.

2. If the modeling organization has made any modifications to the Flood Event Data Sources related to flood frequencies and characteristics for any aspect of coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding, provide justification for each such modification.

3. State whether the modeling organization models other types of flooding (which can be characterized as other than coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding) and whether adequate data sources are available in order to project flood loss costs and flood probable maximum loss levels in a scientifically feasible manner. Identify all other types of flooding modeled and the data sources utilized for each. Provide justification for any modifications to such data sources.

4. Where the flood model incorporates short-term or long-term modification of the historical data leading to differences between modeled climatology and that in the Flood Event Data Sources, describe how this is incorporated.

5. Provide a completed Form MHF-1, Annual Flood Occurrence Rates by County which includes data for the most recent 5, 25, 50, and 100 years. Provide a link to the location of the form [insert hyperlink here].

Audit

1. The modeling organization's Flood Event Data Sources will be reviewed.

2. Reasoning and justification underlying any short-term and long-term variations in coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding frequencies incorporated in the flood model will be reviewed.

3. Modeled probabilities will be compared with the observed spatial distribution of flood frequencies across Florida using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical statewide and regional coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding flood frequencies as provided in Form MHF-1 (Annual Flood Occurrence Rates by County) will be reviewed.

4. Form MHF-1 (Annual Flood Occurrence Rates by County) will be reviewed for consistency with Form SF-1 (Probability and Frequency of Florida Flood Events per Year).

5. Comparisons of modeled flood probabilities and characteristics for coastal flooding associated with storm surge, flood plain flooding, and non-flood plain 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.

6. Comparisons of coastal flood extremes will be reviewed and compared with the historically-determined Maximum Envelope of Winds (MEOW) database at a county level or finer.
   [Are there similar ways to look at flood plain and non-flood plain? – See FEMA National Flood Hazard Layer (NFHL) Inventory Table]

MHF-2 Flood Parameters and Characteristics

A. The flood model shall be developed with consideration given to flood parameters and characteristics that are scientifically appropriate for various types of flooding being modeled (i.e., coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding). The modeling organization shall justify the use of all flood parameters and characteristics based on information currently available in scientific literature.

B. If any of the following flood parameters or characteristics are not incorporated with the type of flood being modeled, justification shall be provided:

1. *Tidal levels,*
2. *Windfields producing storm surge (e.g., spatial and time variant distributions of wind and pressure, minimum central pressure, spatial extent of storm-related winds, landfall frequency, tracks, and conversion factors),*
3. *Forward speed of tropical systems or tropical disturbances contributing to flood,*
4. *Bathymetry,*
5. *Coastal geography,*
6. *Exposure location,*
7. *Wave field properties (e.g., height, periodicity, speed, and force),*
8. *Land contours, topography, vegetation, and other natural barriers,*
9. *Commercial and consumer usages of water,*
10. *Soil type and soil saturation in the flood profile area,*
11. *Unusual and rapid accumulation or runoff of surface waters from any source,*
12. *Historical rainfall amounts and duration,*
13. *Surface water evaporation,*
14. *Flow and shape of rivers, creeks, and streams,*
15. *Duration of flood waters in an area and the time it takes for flood waters to recede,*
16. *Catchments including lakes, ponds, streams, creeks, and man-made drainage areas,*
17. *Flood control or mitigation including levees, dams, drainage ponds, diversion canals, river defenses, coastal defenses, self-closing flood barriers, and other man-made and natural measures deemed relevant by the modeling organization,*
18. *The interaction of coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding which exacerbates water flow retrograding,*
19. *Non-flood plain characteristics associated with urban development and infrastructure, residential and rural development, and*

MHF-2 Flood Parameters and Characteristics (continued)

20. Other hydrological factors dealing with the speed, forces, energy, weight, hydraulic roughness, and direction and movement of water or debris.

C. Flood models shall consider water height and the duration of the flood event (time needed for flood waters to recede) and water flows including wave action, rate of water flow along banks and structures, and the weight, pressure, the energy generated by moving water and its volume, and impacts of debris transported by the flow.

Purpose: This standard requires that the modeling organization use only scientifically sound information for determining coastal flooding associated with storm surge, flood plain flooding and non-flood plain flooding parameters and characteristics. The stochastic flood event data sources shall include only floods that have realistic flood characteristics. Any differences in the treatment of flood parameters between historical and stochastic floods shall be justified.

A flood parameter is an input to the flood model. Flood parameters are needed by the model to define or determine the windfield and rain associated with a flood event as well as define the nature of the flood plain and non-flood plain areas (e.g., catchments, topography, urban development, soil type and saturation, etc.).

Flood characteristics are outputs of the flood model. Examples of flood characteristics are modeled flood profile (depth, expanse, speed and force associated with movement, and its duration) associated with flood plain flooding and non-flood plain flooding at various locations, and coastal flooding associated with storm surge including weight and energy of the flood event at coast locations.

Characteristics associated with static water volume and dynamic flows of waters resulting from flooding shall be scientifically determined and recognized in the flood model.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification
SF-3, Distributions of Stochastic Flood Parameters (Coastal, Flood Plain, Non-Flood Plain)

Disclosures

1. Identify and justify the various flood parameters and characteristics which are used in each of the flood model components: coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding.

2. Identify and justify the various flood parameters or characteristics listed in this standard which have not been used in each of the flood model components: coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding.

3. Describe the dependencies among variables and specify any assumed mathematical dependencies among these variables for each of the following components of the flood model:
    a. Coastal flooding associated with storm surge,
    b. Flood plain flooding, and
    c. Non-flood plain flooding.

4. Describe the dependencies which exist among the following components of the flood model:
    a. Coastal flooding associated with storm surge,
    b. Flood plain flooding, and
    c. Non-flood plain flooding.

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

6. Describe how any flood parameters are treated differently in the historical and stochastic flood event sets (e.g., a fixed value in one event set and not the other).

7. For coastal flooding associated with storm surge, state whether the flood model simulates surface winds directly. If the storm surge component relies on conversion of winds between some other reference level or layer and the surface, describe the process used including the treatment of the inherent uncertainties in the conversion factor.

8. For coastal flooding associated with storm surge, describe how the flood height and the force of the water, including the action of waves are calculated in the flood model.

9. For flood plain flooding, describe how the flood height and the force of the water are calculated in the flood model.

10. For non-flood plain flooding, describe how the flood height and the force of the water are calculated in the flood model.

11. For coastal flooding associated with storm surge, describe the historical data used as the basis for the model's flood profile. Discuss the appropriateness of the model

stochastic flood profiles with reference to the historical coastal flood database associated with storm surge.

12. If the historical flood data are partitioned or modified, describe how the various flood parameters and characteristics are affected.

13. For coastal flooding associated with storm surge, describe how the coastline is segmented (or partitioned) in determining the parameters for coastal flood frequency used in the flood model. Provide the frequency distribution of the flood profile associated with each segment.

14. For flood plain flooding, describe how the flood plain is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model. Provide the frequency distribution of the flood profile associated with each segment.

15. For non-flood plain flooding, describe how the non-flood plain area is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model. Provide the frequency distribution of the flood profile associated with each segment.

16. Describe any evolution of the functional representation of flood parameters during an individual flood life cycle.

17. Describe the assumptions used and the calculations which account for evaporation, absorption, the amount of saturation, and the amount of commercial and consumer use of water in the flood profile area.

18. Provide the source and resolution of the bathymetry and coastal topography used in the storm surge calculation at the risk location level.

19. Describe how storm surge is initialized in an individual storm surge calculation. In particular, describe how storm surge development is related to the storm track out to sea.

20. Provide a comparison of the storm surge calculated in the model with historical storm surge for five locations, each location from a different coastal county.

21. Provide a comparison of the storm surge calculated in the model worst case for the same five locations and compare with the NOAA *Maximum of MEOW* for each location.

Audit

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

2. Prepare graphical depictions of flood parameters as used in the flood model. Describe and justify:
    a. The data set basis for any fitted distributions,
    b. The modeled dependencies among correlated parameters in the flood model and how they are represented,
    c. The fitting methods used and any smoothing techniques employed.

3. For coastal flooding associated with storm surge, the treatment of the inherent uncertainty in the factor 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 currently accepted scientific literature. Treatment of conversion factor uncertainty at a fixed time and location will be reviewed.

4. Scientific literature cited in Standard GF-1 (Scope of the Computer Flood Model and Its Implementation) may be reviewed to determine applicability.

5. All external data sources that affect the model generated windfields associated with coastal flooding due to storm surge will be identified, and their appropriateness will be reviewed.

Note the following from the 2013 Future Inquiries and how they are proposed to be addressed for the development of the flood standards.

1. Provide a flow chart of the storm surge calculation. [Consider: See GF-1, Disclosure 3]

2. Describe the underlying formulation of the storm surge calculation (e.g., dynamical or statistical, underlying equations or functional/distributional form), including whether it includes wave action. [Consider: MHF-2, Disclosure 8]

3. Provide the source and resolution of the bathymetry and coastal topography used in the storm surge calculation at the risk location level. [Consider: MHF-2, Disclosure 18]

4. Identify all hurricane or storm parameters and characteristics used in the storm surge calculation. [Included: See MHF-2, Disclosure 1]

5. Identify all inputs used in the storm surge calculation that have not already been described. [Consider: See MHF-2, Disclosure 1]

6. Describe how storm surge is initialized in an individual storm surge calculation. In particular, describe how storm surge development is related to the storm track out to sea. [Included: See MHF-2, Disclosure 19]

7. Provide a comparison of the storm surge calculated in the model with historical storm surge for five locations, each location from a different coastal county. [Included: See MHF-2, Disclosure 20]

8. Provide a comparison of the storm surge calculated in the model worst case for the same five locations and compare with the NOAA *Maximum of MEOW* for each location. [Included: See MHF-2, Disclosure 21]

9. Describe the capability of the flood model to determine losses due to storm surge explicitly. [Included: See AF-2, Disclosure 4]

10. Describe how the residential structure vulnerability functions for storm surge are developed. [Included: See VF-1, Disclosure 15]

MHF-3 Flood Probabilities

A. Modeled probability distributions of flood parameters and characteristics shall be consistent with historical floods for Florida resulting from coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding.

B. Modeled flood frequency distributions shall reflect the Flood Event Data Sources used for a specific set of return periods (and corresponding probabilities) and shall be consistent with flooding observed for Florida over the time frames relevant to each data source and shall be consistent with those observed for each coastal and inland segment (or partition) of Florida and in which the flood event could occur in other parts of the United States where flooding damage impacts Florida.

C. Flood models shall use wave energy, storm surge height, flood penetration, and the duration and other characteristics of standing water prior to receding to assess severity of damage for coastal flooding associated with wind related flood events.

Purpose: This standard requires that the modeled probability distributions of flood parameters and characteristics be consistent with those documented in official meteorological and hydrological databases. Consistent means that spatial distributions of modeled flood probabilities accurately depict coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding in Florida. This standard addresses consideration of flooding events in neighboring states (e.g., Georgia) which could impact Florida (e.g., Chattahoochee River floods from massive rains in North Georgia).

This standard also notes the necessity to recognize the impacts from flooding driven by wind related events.

The probability of occurrence of floods and flood profiles shall reasonably reflect the historical record with respect to severity and geographical locations.

Relevant Forms:
GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification
MHF-1, Annual Flood Occurrence Rates by County
AF-2, Flood Event Data Sources Statewide Losses
SF-1, Probability and Frequency of Florida Flood Events per Year
SF-3, Distributions of Stochastic Flood Parameters (Coastal, Flood Plain, Non-Flood Plain)

Disclosures

1. List assumptions used in creating the database(s) containing flood parameters and characteristics.

2. Provide a brief rationale for the probability distributions used for all flood parameters and characteristics.

Audit

1. Demonstrate that similar model flood parameters and characteristics are accounted for in the same manner across Florida and are appropriate for adjacent segments in Alabama and Georgia.

2. Describe and support the method of generating stochastic flood events.

3. Describe and support the method of determining flood profiles for coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding.

4. Provide any modeling organization specific research performed to develop the functions used for simulating flood model variables or to develop flood databases.

5. Form SF-3 (Distributions of Stochastic Flood Parameters – Coastal, Flood Plain, Non-Flood Plain) will be reviewed for the probability distributions and data sources.

MHF-4 Flood Profile Structure

A. Flood profiles generated by the flood model shall be consistent with observed historical floods affecting Florida adjusted for flood mitigation and prevention measures.

B. Consideration of topography, land use and land cover, soil type, and other hydrological characteristics associated with the flood profile area shall be consistent with the current state-of-the-science.

C. The land use and land cover database shall be consistent with National Land Cover Database (NLCD) 2006 or later. Use of alternate data sets shall be justified.

D. The flood model shall account for rising waters and the forces associated with water flow and weight.

E. The flood model shall account for the duration of flood waters and the time for flood waters to recede.

Purpose: This standard requires that the flood model be implemented consistently with a contemporary land use and land cover distribution (including soil type) as well as flood mitigation and prevention measures. The resulting surface flood profile shall be representative of historical floods in Florida.

Note: The NLCD products are created by the Multi-Resolution Land Characteristics (MRLC) Consortium, a partnership of Federal agencies led by the U.S. Geological Survey (USGS) and are updated every five years.

Comparison of the flood profiles produced by the stochastic flood events and historical flood profiles shall be documented, and variations between them shall be justified.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification
MHF-2, Maps of Flood Profiles by Return Period
AF-2, Flood Event Data Sources Statewide Losses

Disclosures

1. Provide visual descriptions (total of eleven) illustrating the flood profile of:
    a. A coastal flooding area associated with storm surge for Florida's Panhandle, East Coast, Gulf Coast, South Florida, and Monroe County including the Keys,

b. A flood plain area for the regions of North Florida, Central Florida, and South Florida, and
c. A non-flood plain area for the regions of North Florida, Central Florida, and South Florida.

The visual description should illustrate each area subject to flooding prior to the flooding and various stages of flooding from initiation to maximum flooding to the flood waters receding indicating the time intervals and key statistics during the flooding process. Such statistics should include the area of flooding, volume of water, depth of water, and speed and forces of the water flow.

2. For coastal flooding associated with storm surge, describe how the wave action and their forces are calculated and used in the flood model.

3. Identify all hydrological variables that affect the flood profile.

4. Provide the collection and publication dates of the land use and land cover data and soil type data used in the flood model and justify their timeliness for Florida.

5. Describe the methodology used to convert land use and land cover information into a spatial distribution of roughness coefficients in Florida as related to the flood profile.

6. Demonstrate the consistency of the spatial distribution of model-generated flood profiles with observed flood profiles for floods affecting Florida. Describe and justify the appropriateness of the databases used in the flood profile validations.

7. Describe how the model's flood profile is consistent with the inherent differences in flood profiles for such diverse floods as Hurricane Dennis (2005) for coastal, South Florida flooding (2000), and Tropical Storm Debby (2012) for North Florida.

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

9. Provide the level of resolution of the grid or areas modeled for the flood profile and how the hydrological characteristics associated with the grid or areas are determined.

10. Provide a completed Form MHF-2, Maps of Flood Profiles by Return Period. Explain any differences between modeled flood profiles and historical flood profiles. Provide a link to the location of the form [insert hyperlink here].

Audit

1. Provide any modeling organization-specific research performed to develop the flood profile functions used in the flood model. Identify the databases used.

2. Provide any modeling organization-specific research performed to derive the topography, land use and land cover and soil type distributions, including any associated hydrological characteristics for the flood profile area.

3. Provide the current flood parameters used in calculating the flood loss costs for three historical flood events which include coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding, and justify the choices used. Provide the resulting spatial distribution of the surface hydrology. These will be reviewed with Form AF-2 (Flood Event Data Sources Statewide Losses). [consider for deletion if this form is not going to specify a list]

4. Present time-based contour animations (capable of being paused) to demonstrate scientifically reasonable temporal evolution of flood profile characteristics. (Trade Secret item to be provided during the closed meeting portion of the Commission meeting to review the flood model for acceptability.)

5. Form MHF-2 (Maps of Flood Profiles by Return Period) will be reviewed.

MHF-5 Modeling of Natural and Man-Made Flood Mitigation and Prevention Measures

A. The flood model shall account for levees, dams, drainage ponds, diversion canals, river defenses, coastal defenses, self-closing flood barriers, and other man-made and natural mitigation/prevention measures.

B. The flood model shall account for the soil infiltration rates associated with various soil types and conditions and shall be based on information documented in currently accepted scientific literature.

C. The flood model shall account for the varying nature of soil saturation including water table levels in the modeled flood zone and shall be based on information documented in currently accepted scientific literature.

D. The modeling organization shall have a documented procedure for addressing the periodic review of current flood mitigation and prevention measures and shall update the flood model mitigation and prevention databases as necessary in their appropriate databases used in the flood model.

Purpose: This standard ensures that flood mitigation and prevention measures are accounted for and updated on a periodic basis.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification

Disclosures

1. Describe the methodology used to account for natural and man-made flood mitigation and prevention measures in the flood model and indicate if these measures can be set (either to on and off) in the flood model.

2. List all the natural and man-made flood mitigation and prevention measures used in the flood model and the sources of all data employed.

3. Illustrate the flood profile distributions showing the impact of flood mitigation and prevention measures versus no flood mitigation and prevention measures.

4. Describe the method or methods used to account for soil infiltration rates in the flood model. Provide citations to published papers, if any, used to develop and support the soil infiltration rate methodology.

5. Describe the method or methods used to account for soil saturation in the flood model. Provide citations to published papers, if any, used to develop and support the soil saturation methodology.

6. Describe the process for conducting the periodic review of natural and man-made flood mitigation and prevention measures. Describe how a determination is made to update databases or the time period planned for regular updating of databases.

Audit

1. Natural and man-made flood mitigation and prevention measures incorporated in the flood model will be reviewed.

2. Provide any modeling organization specific research performed to develop the soil infiltration rates used in the flood model. Identify the databases used. This material will be reviewed in the context of the cited scientific literature.

3. Provide any modeling organization specific research performed to develop soil saturation in the flood model. Identify the databases used. This material will be reviewed in the context of the cited scientific literature.

4. The documented procedure addressing the periodic review and updating of current flood mitigation and prevention measures will be reviewed.

MHF-6 Modeling for the Failure of Flood Mitigation or Prevention Measures

The flood model shall appropriately model the potential failure of natural and man-made flood mitigation or prevention measures and shall be based upon currently accepted scientific literature, empirical studies, or engineering analyses.

Purpose: The flood model should appropriately adjust the probability distribution of flooding if flood mitigation or prevention measures fail or are intentionally altered. Failure of mitigation and prevention measures shall be modeled and probabilities accounted for by modeling such scenarios.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification

Disclosures

1. Describe and justify the methodology used to account for the potential failure or alteration of natural and man-made flood mitigation and prevention measures in the flood model and if the level of failure can be adjusted in the flood model.

2. Provide the probability distribution for flooding scenarios incorporating the failure of flood mitigation and prevention measures.

3. State whether the flood model incorporates natural discharge of flood waters or intentional discharge of flood waters by governmental or other human actions for flood mitigation purposes. If so, describe how this is handled in the flood model.

4. Describe the flood loss distributions assuming no failure of natural and man-made flood mitigation and prevention measures compared to the flood loss distribution accounting for failure.

Audit

1. The methodology and justification used to account for the potential failure or alteration of natural and man-made flood mitigation and prevention measures in the flood model will be reviewed.

2. The probability distribution for flooding scenarios incorporating the failure of flood mitigation and prevention measures will be reviewed.

3. If the flood model incorporates discharge of flood waters by governmental or other human actions, the methodology used in the model will be reviewed.

4. The flood loss distributions assuming no failure of natural and man-made flood mitigation and prevention measures compared to the flood loss distribution accounting for failure will be reviewed.

MHF-7 Logical Relationships of Flood Characteristics

A. The larger the area of the over water windfield, the greater the flood profile area all other factors held constant.

B. The rate of water flow shall decrease with increasing surface roughness, all other factors held constant.

C. The rate of water infiltration shall decrease with increasing surface roughness, all other factors held constant.

D. Increases in the rate of water absorption shall reduce the flood profile area, all other factors held constant.

E. The coastal flooding associated with storm surge shall increase with a shallow and gently sloping shoreline, all other factors held constant.

F. Increases in the soil saturation level shall increase the flood profile area, all other factors held constant.

G. The interaction of coastal flooding associated with storm surge and inland flooding shall increase the flood profile area, all other factors held constant.

H. Aboveground water flows associated and combined with underground water flows in an area shall increase the flood profile area, all other factors held constant.

I. The rate of water flow shall increase the steeper the topography and greater the surface slope, all other factors held constant.

J. The height of storm surge shall increase with increasing windspeeds, all other factors held constant.

Purpose: The flood model shall produce logical consistencies associated among the flood parameters and the flood characteristics used in the flood model.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification

Disclosure

1. Provide a sample hydrograph (rate of flow versus time) associated with flooding for an area in each region of the Florida Panhandle, Gulf Coast, North Florida, Central Florida, and South Florida. Discuss how the flood characteristics result in logical relationships.

Audit

1. The modeling organization's sensitivity analyses will provide the information used in auditing this standard.

2. Verify that the flood model produces logical relationships among flood characteristics, as listed in this standard.

Form MHF-1: Annual Flood Occurrence Rates by County

[Review and revise form as appropriate for flood – seeking public input]
[Create form table template]

A. Provide annual historical and modeled flood occurrence rates for the most current 5, 25, 50, and 100 years of data for each County in the entire state of Florida. Annual flood occurrence rates shall be rounded to four decimal places.

B. Describe variations in the flood model frequencies from the historical frequencies.

C. Provide vertical bar graphs depicting distributions of flood frequencies by Florida County.

D. Provide a color coded map by County with a legend displaying the flood frequency ranges. Increasing flood frequency shall correspond to greater color intensity.

E. If the data are partitioned or modified, provide the historical annual flood occurrence rates for the applicable partition (and its complement) or modification as well as the modeled annual flood occurrence rates in additional copies of Form MHF-1 (Annual Flood Occurrence Rates by County).

F. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Form MHF-1 (Annual Flood Occurrence Rates by County) shall also be included in a submission appendix.

Form MHF-2: Maps of Flood Profiles by Return Period

[Review and revise form as appropriate for flood – seeking public input]

Historical Florida Floods

A. Identify historical Florida floods with return periods of 10, 25, 50, 75, 100, 250, 500, and greater than 500 years for each of the following: coastal flooding associated with storm surge, flood plain flooding, and non-flood plain flooding.

B. Provide color contour maps for the flood event associated with each 10, 25, 50, 75, 100, 250, 500, and greater than 500 year return periods for:
   1. Coastal flooding associated with storm surge,
   2. Flood plain flooding, and
   3. Non-flood plain flooding.

   Plot the locations and numerical measures of the maximum flood level by the level of storm surge for coastal areas or the level above river flood stage for flood plain areas or the level above the sea level elevation for non-flood plain areas on each contour map.

Modeled Florida Floods

C. For coastal flooding associated with storm surge, provide static color maps of the maximum area flood profiles that match the above five locations of the historical 10, 25, 50, 75, 100, 250, 500, and greater than 500 year return periods. Plot the locations and numerical measures of the maximum flood level by the level of storm surge on each contour map. Contour colors will be the same as those used for the maps provided in response to B.1 above.

D. For flood plain flooding, provide static color maps of the maximum area flood profiles that match the above five locations of the historical 10, 25, 50, 75, 100, 250, 500, and greater than 500 year return periods. Plot the locations and numerical measures of the maximum flood level by the level above river flood stage on each contour map. Contour colors will be the same as those used for the maps provided in response to B.2 above.

E. For non-flood plain flooding, provide static color maps of the maximum area flood profiles that match the above five locations of historical 10, 25, 50, 75, 100, 250, 500, and greater than 500 year return periods. Plot the locations and numerical measures of the maximum flood level by the level above the sea level elevation on each contour map. Contour colors will be the same as those used for the maps provided in response to B.3 above.

F. Explain any differences between the modeled flood profiles and the historical floods identified in item A. above. Include an explanation if the differences are impacted by flood mitigation and prevention measures.

All maps shall be color coded or shaded at elevation contours to describe the topography associated with the flood profile area.