Guidance for Flood Risk Analysis and Mapping

Coastal-Specific Non-Regulatory Datasets

November 2022

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Requirements for the Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) Program are specified separately by statute, regulation, or FEMA policy (primarily the Standards for Flood Risk Analysis and Mapping). This document provides guidance to support the requirements and recommends approaches for effective and efficient implementation. Alternate approaches that comply with all requirements are acceptable.

For more information, please visit the FEMA Guidelines and Standards for Flood Risk Analysis and Mapping webpage (https://www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping). Copies of the Standards for Flood Risk Analysis and Mapping policy, related guidance, technical references, and other information about the guidelines and standards development process are all available here. You can also search directly by document title at https://www.fema.gov/resource-document-library.

Table of Revisions

Affected Section or Subsection	Date	Description
Throughout document	November 2022	Updated language to accommodate Risk Rating 2.0

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1. Definitions

Coastal non-regulatory products have been developed to effectively communicate risk to a broad audience. These products comprise the following datasets: Increased Flooding Scenarios, Dune Size and Location, and Simplified Coastal Zones. There are other datasets not discussed here that may be better suited for helping to communicate coastal risks along particular sections of a coastline. Therefore, this is not intended be an all-inclusive list of the only coastal datasets that could or should be produced as a non-regulatory product. References directing individuals towards other existing information which communicates coastal risks should be provided in the Flood Risk Report (FRR), rather than duplicating that data within the Flood Risk Database (FRD). These additional resources may include the United States Geological Survey's (USGS's) Coastal and Marine Geology Program National Assessment of Shoreline Change web mapping applications, or the National Oceanic and Atmospheric Administration's (NOAA's) Coastal Services Center (CSC) resources, such as Digital Coast, Spatial Trends in Coastal Socioeconomics, and their Sea Level Rise Viewer. Additional resources that provide guidance for other flood risk datasets that can be produced in coastal areas are also available, such as for Coastal Flood Depth & Analysis Grids, Coastal Flood Risk Assessment data, the Changes Since Last FIRM dataset, and the Areas of Mitigation Interest dataset.

As with many enhanced risk datasets, decisions to deviate from the products described herein should include considerations for available data and project funding, the desire for and commitment to appropriate use of the data by project stakeholders, and community capacity for utilizing this data. If products are developed or datasets are enhanced in ways that are not described herein, the Mapping Partner should provide adequate documentation so that any such supplemental datasets could be beneficial to future Flood Risk Projects. Furthermore, the names of the datasets herein are suggestions; the datasets may be named differently to accommodate community needs and outreach efforts.

Regions and Mapping Partners should use discretion when considering whether to produce these coastal datasets and where to apply them as part of a Flood Risk Project. Key decision factors are the accessibility of coastal analysis modeling information and identifying sections of the coast for which the creation of these datasets could be expected to increase the community's risk awareness and/or lead them to mitigation actions. However, the availability of coastal modeling information is not the only criteria to use when identifying the coastal non-regulatory datasets to be funded; another key factor is an awareness of local coastal processes and topographic characteristics. For example, the Dune Size and Location dataset would not be applicable for sections of the coastline where dunes are not present. It is, therefore, important that the applicability or benefit to the end user of the data be taken into account when selecting the coastal non-regulatory datasets to be included in the project.

Additionally, if any of the coastal non-regulatory data could introduce confusion or unnecessary complication for affected communities, or if any of the coastal non-regulatory data otherwise might not specifically help the community better understand risk and take appropriate mitigation action, it

may be best to avoid the use of particular datasets. In other words, although it may be possible to create a particular coastal non-regulatory dataset, the creation, use, and/or distribution of such datasets should be carried out with discretion in terms of usability and efficacy. Details on the appropriate application of each coastal non-regulatory dataset are included in each dataset's discussion below.

2. FRD-Related Guidance

The Coastal-Specific Non-Regulatory dataset is made up of the following tables in the FRD:

- S_Cst_Inc_Inundation_Ar: "Increased Flooding Scenarios"
- S_PFD_Ersn_Ar: "Dune Size and Location"
- S_Cst_Wave_Haz_Ar: "Simplified Coastal Zones"

Guidance specific to each of these tables is below.

Note: Product names have changed in this document. The associated database schema/feature class names will be changed to match at a later date.

2.1. Increased Flooding Scenarios

2.1.1. DEFINITION AND PURPOSE

This dataset estimates hypothetical increases above the base flood elevation levels associated with a particular annual-chance event. These polygon features are produced by adding the hypothetical increased inundation value to the inland extent (or "envelope") of the selected annual-chance event Coastal Depth Grid. Polygon features are non-overlapping, discrete features. This dataset would typically be produced using the 1% annual-chance flood event Coastal Depth Grid. Typical increases include 1, 2, and 3 feet, but other increases are allowed, including fractional values (e.g., 1.5 or 2.75 feet) if specifically requested by the community, Cooperating Technical Partner (CTP), or Region. Communities may request a fractional value to enforce a specific freeboard, to investigate sea level rise scenarios, or for local planning, floodplain management, or mitigation purposes.

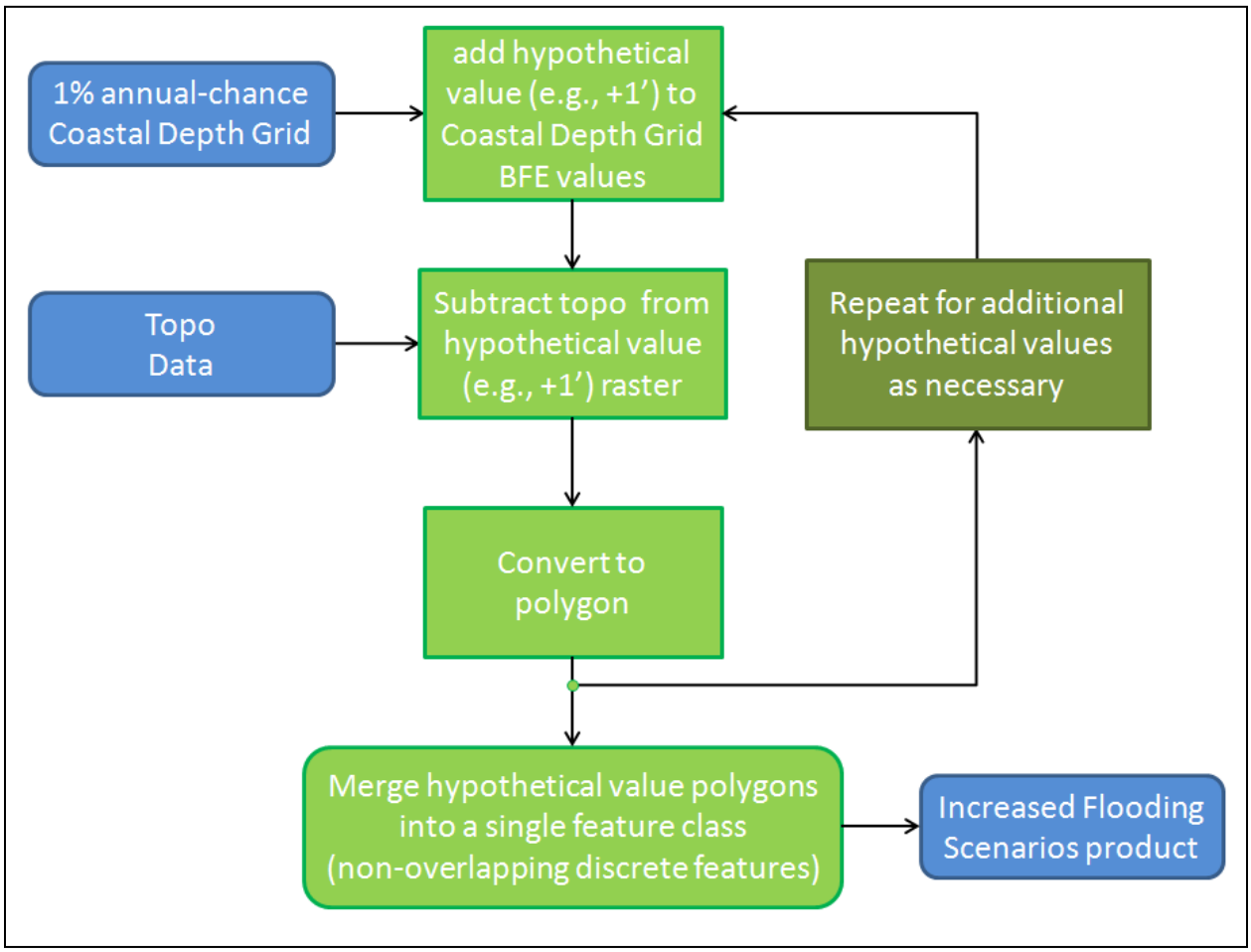
2.1.2. GUIDANCE FOR CREATION

The spatial analysis required to produce these polygons typically involves acquiring the base topographic dataset, along with the Coastal Depth Grid for the 1% annual-chance flood conditions (see Figure 1).

The required hypothetical increases would each be added to the 1% annual-chance Coastal Depth Grid, with the resulting increased inundation envelope being extracted from the base topographic dataset. This extraction produces a raster dataset that represents the potential horizontal increase in inundation resulting from the hypothetically vertically increased flood elevation. That is, as the

flood elevation increases, the horizontal extent of the inundation will increase according to the characteristics of the underlying topography. The raster dataset resulting from the above analysis can then be converted into a single dataset of discrete, non-overlapping polygons. The flowchart below visualizes a possible spatial analysis workflow for the Increased Flooding Scenarios dataset creation.

Figure 1: Example of Flowchart for Creating the Increased Flooding Scenarios Dataset



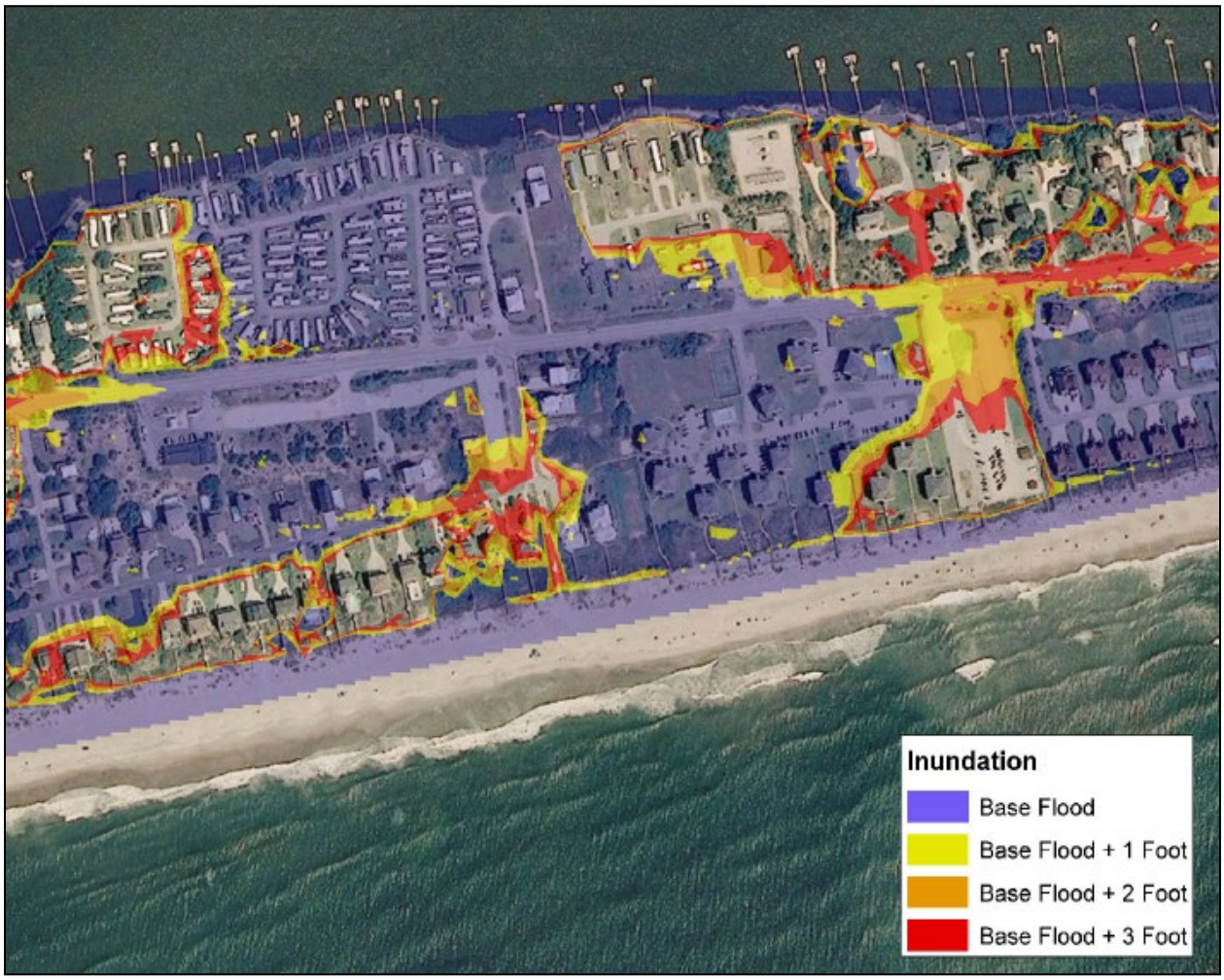
There may be instances where certain sections of dunes are higher than the total water level, and engineering judgment has been applied to the coastal boundary output. In these areas, the input Coastal Depth Grid will reflect a "NO DATA" value or a depth of zero. Therefore, it may not be appropriate to develop this dataset in areas where the mapped boundary does not directly reflect the underlying terrain, such as where a primary frontal dune (PFD) has been delineated.

Figure 2 highlights the Increased Flooding Scenarios dataset, symbolized to show the areas of added increases of 1 (yellow), 2 (orange), and 3 (red) feet, superimposed on the extents of the 1% annual-chance flood event boundaries (purple). No cartographic specifications have been developed for this dataset at this time; however, for purposes of community outreach, an intuitive color gradient should be chosen to communicate the nature of the information that this dataset represents.

2.1.3. GUIDANCE FOR USE

This dataset may also be named "Additional Hazard Areas," "Flood Risk Potential," or "Additional Coastal Risk," if one of these alternate names better supports outreach and communication with the community.

Figure 2: Example of the Increased Flooding Scenarios Dataset



This dataset could be used by communities as a planning tool to estimate the location of increased inundation based on the chosen value(s). While the regulatory 1% annual-chance flood event is represented by the mapped boundaries of the 100-year floodplain, areas outside this mapped Special Flood Hazard Area (SFHA) may remain at-risk for flooding, and floods larger than the 1% annual-chance event may impact areas outside of the SFHA. Therefore, this product should be used to communicate this risk to people just outside of the SFHA.

Flood hazards change over time, and with sea-level rise, flood hazards tend to increase over time. This product can be used to convey this risk, and can be used to help communities make intelligent development decisions near SHFAs, helping to mitigate risks for that development as the hazard

increases over time. Additionally, because the increased inundation extent (or freeboard) increases horizontally on the ground as the estimated hypothetical base flood is increased, this dataset may provide a simple planning tool for communities to determine the spatial extents of, and therefore compliance with, freeboard.

Each raster result from the Increased Flooding Scenarios processing (see the 2nd step in the "possible workflow" above) can be used as inputs to perform a Hazus loss analysis. This Hazus loss analysis can be performed on each hypothetical increased value (each raster) produced, which will provide loss dollar values (in thousands) for that specific hypothetical increase. Typically, the general building stock is used in the loss analysis. The loss values can then be used to evaluate the highest potential risk areas within each Increased Flooding Scenario using each particular hypothetical value. Other Hazus analyses can include essential facilities, demographics, agriculture, and vehicles. Essential facilities are also commonly a strong focus in Hazus for mitigation actions. Any Hazus results utilizing the Increased Flooding Scenario dataset should be summarized and included in the FRR.

Generally, the non-regulatory datasets are provided to coastal communities with the intention of providing enhanced flood hazard and/or flood risk information. However, this dataset should be presented to (and used by) communities with discretion; because this dataset represents the envelope of hypothetical increased elevation or inundation based upon the "linear supposition" method (a simple "linear" increase to the Base Flood Elevation), this dataset is subject to limitations. It may not necessarily account for non-linear factors such as geomorphology, or for wave effects that might otherwise be associated with, for example, a dedicated sea level rise analysis.

For coastal locations where increased flooding scenario areas are calculated, a table should be added to the FRR that summarizes the total area within each area. Additionally, if building footprint information is available and was used to count the number of structures located within each scenario, this count should be included within the table. If a building count was not performed, that column can be removed from the FRR table.

2.2. Dune Size and Location

2.2.1. DEFINITION AND PURPOSE

This dataset depicts reaches of shoreline along which dune size is relatively larger or smaller, based on the spatial extent of the FEMA regulatory PFD, and delineated between the dune toe and heel, as defined in 44.CFR.59.1. The creation of this dataset is generally only applicable in coastal areas where dunes are present.

2.2.2. GUIDANCE FOR CREATION

The Dune Size and Location features are polygons. To represent dune location, Dune Size and Location features should directly reflect the delineations already established during coastal analysis for the creation of the Flood Insurance Rate Map (FIRM) Database features in S_PFD_Ln. The overall

dune features should represent the location and horizontal extent of the PFD. To represent dune size, the dune location features are subdivided into "Large Dune" or "Small Dune" reaches. These reaches of dune size may not necessarily be ascertained transect-to-transect, but may be established on a larger scale. For details concerning the identification of the dune peak, toe, and/or heel, and for details concerning the delineation of the Primary Frontal Dune, refer to the coastal guidance.

Although the Dune Size and Location features should directly reflect the location and horizontal extent of the PFD, some exceptions may be necessary where the dune toe is preceded by a wide, flat area, or where the beach area is particularly narrow. In these cases, it may be more appropriate to use the shoreline as the seaward limit for this polygon feature. Otherwise, a particularly wide or particularly narrow strip of dune area may look unusual when superimposed over the orthophoto base map. Similar to the application of the "Apparent Limit" feature on the FIRM, this approach may aid in data presentation/cartographic purposes. Coordination with the community may be necessary to establish the most effective cartographic display that is of maximum use to the community. In any case, it is recommended that the PFD area itself be represented by diagonal hatching.

Figure 3 illustrates the location and horizontal extent of the PFD delineation, with the shoreline symbolized according to dune size reach.

Figure 3: Example of the Dune Size and Location Dataset

2.2.3. GUIDANCE FOR USE

This dataset is meant to supplement the regulatory FIRM Database feature class S_PFD, to assist communities in understanding the extent, impact, and mapping of PFD areas. It is intended to serve as a high-level indicator of reaches where dunes are relatively small and may provide less protection during storms. This dataset may help communities understand where dune overtopping may occur, or where beach nourishment may be necessary. Based on the results of this dataset, the community may be able to implement dune protection activities such as dune grass planting, walkovers, signage, and other activities that protect and enhance dunes. This product is not intended to indicate in a direct way where erosion categorically will or will not occur. This dataset can, however help communities understand the mapping principles behind PFD delineation, and can help communities understand that while a wave model can indicate that wave effects for a particular area are less than three feet, if the area is classified as a PFD, it must still be shown as a VE Zone on the FIRM. Refer to the Guidelines for Coastal Flood Hazard Analysis and Mapping for full details on mapping applications of the PFD.

This dataset should be applied with discretion, because of the dynamic nature of dunes. The delineation of this dataset is accurate only to the date of the base topographic and/or survey data used to produce the dune profile, which might not properly represent the present-day dune conditions. Because Light Detection and Ranging (LiDAR) data is typically used to produce the dune profiles, the delineation for this dataset would be based on the profile of the dune at the time the LiDAR was taken, which most likely will vary from the time of feature delineation. The dune representation after a storm event or due to seasonal changes may be different than the dune representation during the specific LiDAR, survey, and/or dune profile snapshot in time.

For coastal locations where dune sizes and locations are mapped, a table should be added to the FRR that summarizes the total area of each dune region.

2.3. Simplified Coastal Zones

2.3.1. DEFINITION AND PURPOSE

This dataset represents the wave hazards determined from overland wave propagation analysis and/or from wave runup analysis. The creation of this dataset is applicable in all areas where waves contribute to the overall flood hazard.

2.3.2. GUIDANCE FOR CREATION

The Simplified Coastal Zone polygon features are composed of the FIRM Database S_Fld_Haz_Ar coastal polygon features (see Figure 4). This dataset is created using the generalized VE and Coastal A Zones from S_Fld_Haz_Ar, in conjunction with the S_LiMWA feature class, if the Limit of Moderate Wave Action (LiMWA) features are applicable to the study area.

Based on the FLD_ZONE attribute in S_Fld_Haz_Ar, coastal polygons would be generalized ("dissolved") into up to three separate wave hazard severity types based on the flood zone's wave

height: High Wave Action (V Zone), Moderate Wave Action (Coastal A Zone), or Low Wave Action (A Zone). This dissolve process is wave-hazard-dependent, not Base Flood Elevation (BFE)-dependent; thus, all differing coastal BFE values within one wave hazard severity type would also be dissolved together. The table below provides a breakdown of the simplified classification of the S_Fld_Haz_Ar coastal flood zones.

2.3.3. GUIDANCE FOR USE

This dataset may also be named "Simplified Wave Hazard Areas" or "Simplified Coastal Risk," if one of these alternate names better supports outreach and communication with the community.

Figure 4: Example of the Simplified Coastal Zones Dataset

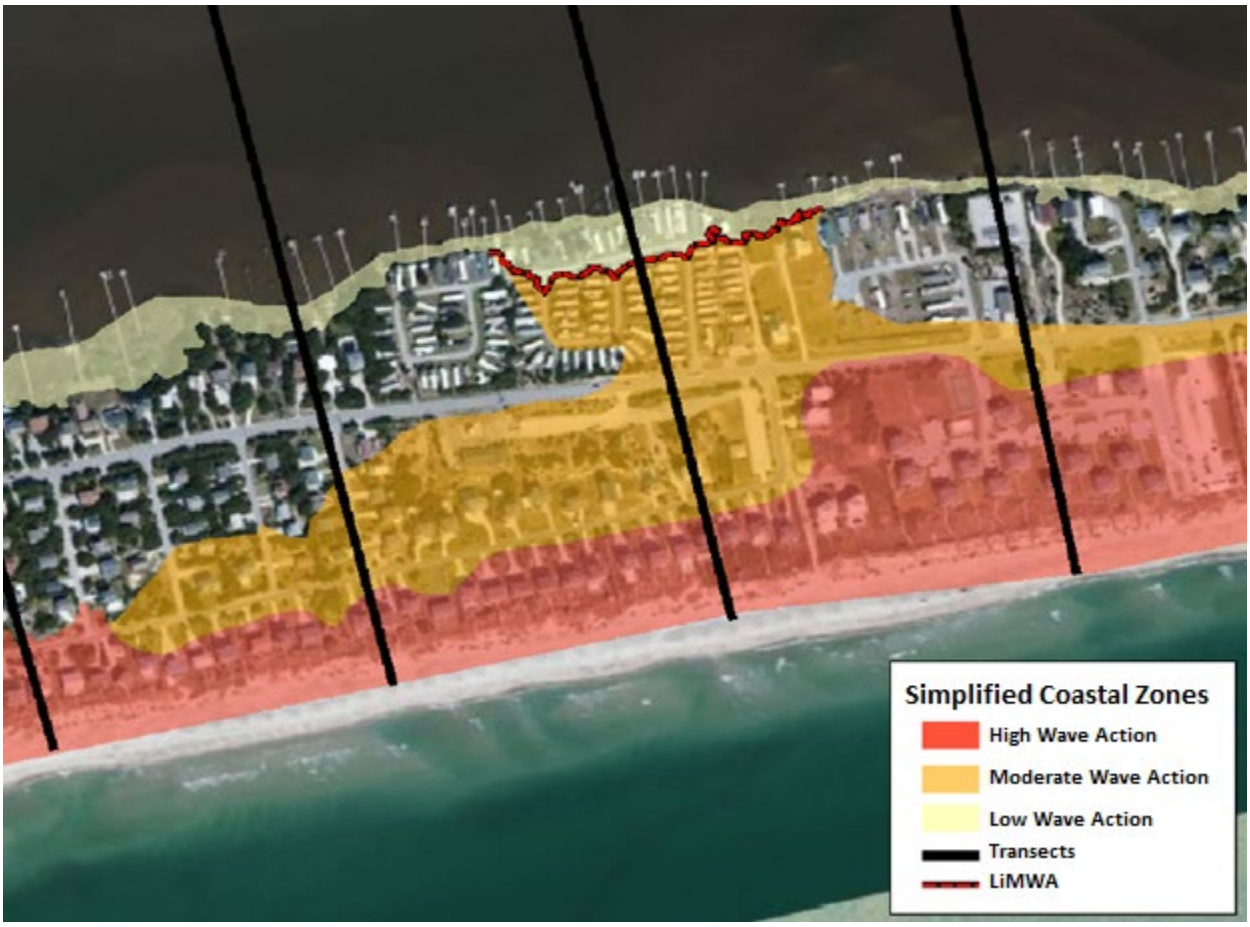


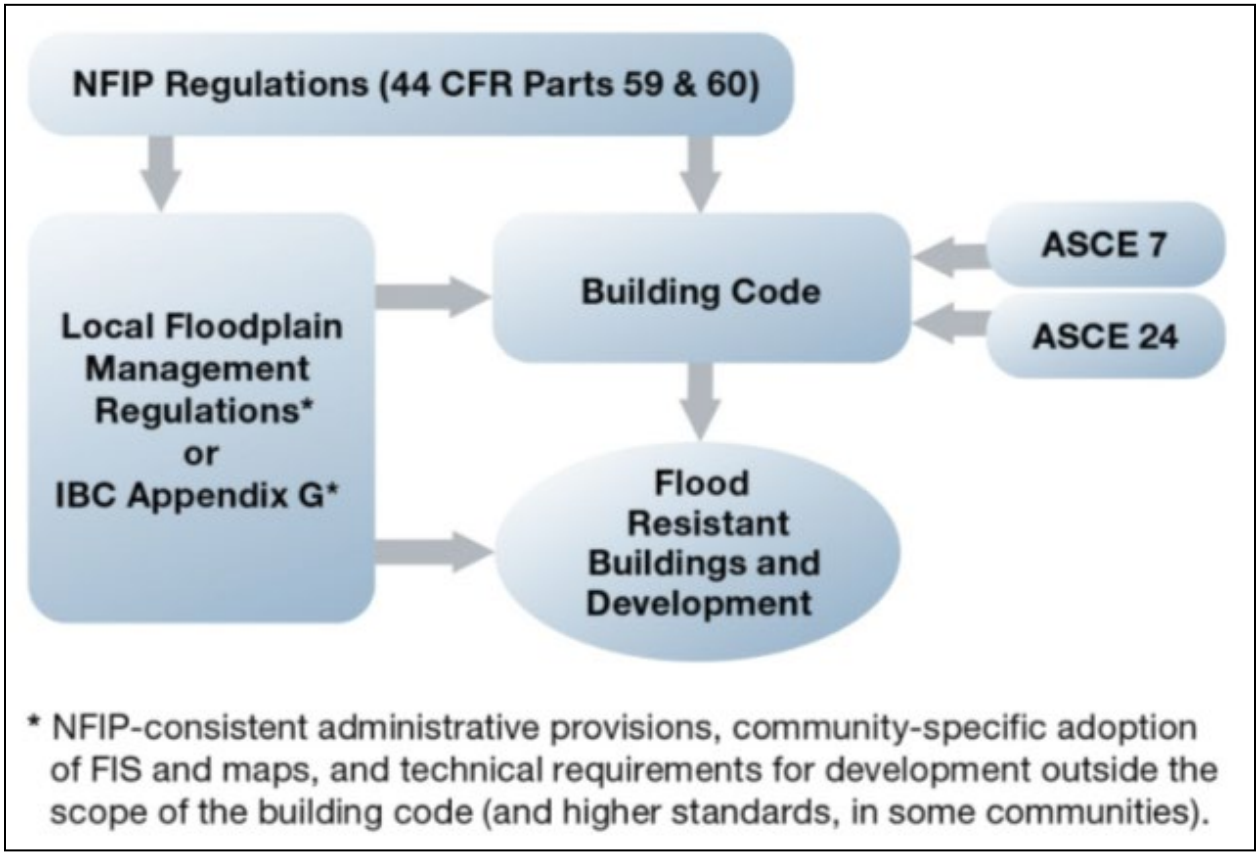
Table 1: Simplified Coastal Zone Classification

Merged FLD_ZONE Type	Simplified Coastal Zone classification
VE Zone (wave height 3.0 ft +)	High Wave Action (V Zone)
Coastal A Zone, wave height 1.5 ft – 3.0 ft	Moderate Wave Action (Coastal A Zone)
Coastal A Zone, wave height of 0.0 ft – 1.5 ft	Low Wave Action (A Zone)

For coastal locations where wave hazard severity areas were mapped, a table should be added to the FRR that summarizes the total area within each hazard severity level (High, Moderate, and Minimal). Additionally, if building footprint information is available and was used to count the number of structures located within each hazard polygon, this count should be included within the table. If a building count was not performed, that column can be removed from the FRR table.

FEMA does not impose floodplain management requirements based on the LiMWA; however, higher flood risk exists within Coastal A Zone Moderate Wave Hazard areas. Communities are encouraged to adopt building construction standards for building in Coastal A Zone Moderate Wave Hazard areas similar to those for Zone VE. Communities may require design elevation to be above the minimum requirement, and in doing so add a factor of safety. For more information implementing higher construction standards per the LiMWA, communities may reference the FEMA Fact Sheet, "Using the Limit of Moderate Wave Action to Implement Higher Construction Standards." Community Rating System (CRS) credits may be available for participating communities that adopt Zone VE building standards in Coastal A Zone Moderate Wave Hazard areas. Some Coastal A Zone practices may be required by State- or locally-adopted building codes, including the International Building Code, through its reference to ASCE 24-98 (see Figure 5).

Figure 5: Coordinating Local Flood Regulations and Building Codes



Because this dataset can provide a tangible link for communities between their coastal hazard areas, the National Flood Insurance Program (NFIP), and building codes, several links are provided below that may be relevant to the local community-level application of the Simplified Coastal Zones dataset. This type of information may also be valuable to include within Section 4 of the Flood Risk Report.

The FEMA Publication CRS Credit for Coastal A Zone Regulations may be found at http://training.fema.gov/EMIWeb/CRS/430 CAZ CRS Credit for Coastal A Zones.pdf.

The FEMA Publication CRS Credit for Management of Coastal Erosion Hazards may be found at http://training.fema.gov/EMIWeb/CRS/2006 Coastal Erosion Supplement.pdf.

FEMA recommends that communities review and consider adopting the widely used and nationally recognized codes (the International Building Code (IBC), International Residential Code (IRC), and International Existing Building Code (IEBC)) collectively referred to as I-Codes. The Report to Congress entitled Including Building Codes in the National Flood Insurance Program "…presents findings of the impact, effectiveness, and feasibility of including widely used and nationally recognized building codes as part of the NFIP floodplain management criteria." The report is intended to "…help floodplain managers and building officials understand impacts of the new statutory potential future affiliation between building codes and the NFIP."

Continuing, "…Because the I-Codes contain provisions that are consistent with NFIP requirements for buildings and structures, in large part by references to ASCE 24-05 and ASCE 7-10, Minimum Design Loads for Buildings and Other Structures, States and communities have two primary tools for regulating development in flood hazard areas to participate in the NFIP: building codes that govern the design and construction of buildings and structures and floodplain management regulations that satisfy all other NFIP requirements for participation, including an administrative framework and specifications for regulation of all development other than buildings. Communities that enforce both building codes and floodplain management regulations should ensure that the codes and regulations are coordinated and designed to work together."

The following resources, while not a comprehensive list, may also assist when addressing building codes and standards with communities:

- *ASCE 24-05 Flood Resistant Design and Construction*:
  - https://www.fema.gov/sites/default/files/2020-07/asce24_highlights_dec2010.pdf
- *Evaluation of the NFIP Building Standards*:
  - https://www.fema.gov/sites/default/files/2020-07/fema_nfip_eval_building_standards.pdf
- *FEMA P-55, Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas (4th ed.):*

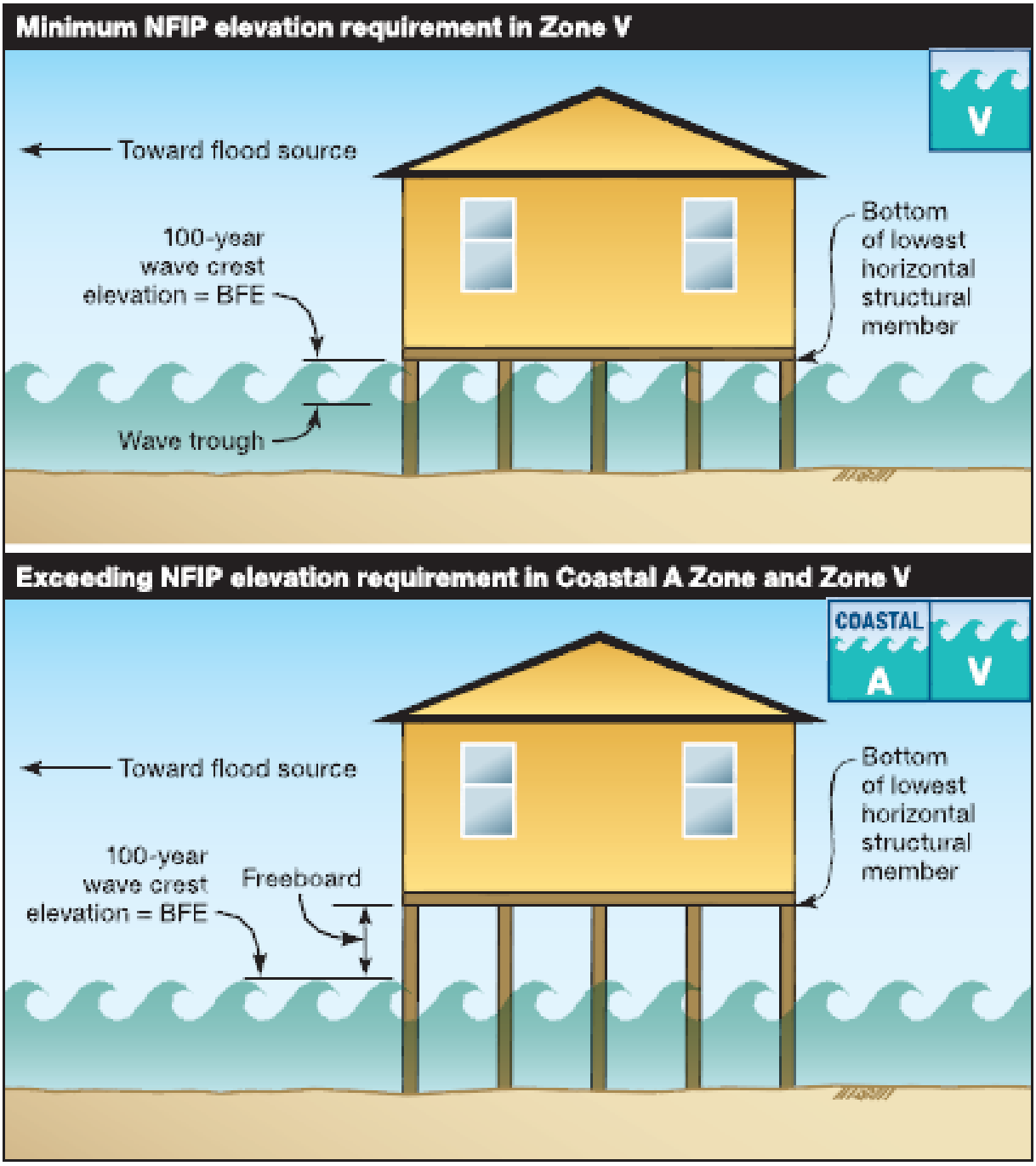
  - https://www.fema.gov/sites/default/files/2020-08/fema55_voli_combined.pdf

- *FEMA Building Sciences webpage:*

  - https://www.fema.gov/emergency-managers/risk-management/building-science

Mapping Partners should seek out and identify additional resources from Federal, State, and local sources that would be applicable and helpful to the specific community being analyzed. Communities are encouraged to do the same.

Figure 6: Coordinating Local Flood Regulations and Building Codes



3. Coastal Non-Regulatory Information on the Flood Risk Map

Coastal non-regulatory information should be shown on the Flood Risk Map (FRM) as appropriate. The FRM may cover the geographic footprint of the coastal Flood Risk Project or focus on specific

areas of particular interest to the community. Multiple FRMs may be created that focus on smaller subsections of the coastline if doing so would improve the usability of the product with the community. The FRM Guidance provides additional information related to how this information may be depicted.

4. Coastal Non-Regulatory information in the Flood Risk Report

Coastal non-regulatory information should be included in the FRR. The FRR Guidance provides additional information related to how this information is reported. Although a template exists for the FRR that can be used, the content of the FRR is flexible and can be customized to meet the needs of the stakeholders within the Flood Risk Project area.

The type of additional coastal-specific information that should be taken into consideration to be added into the FRR, if available, includes the following:

- Photographs that call attention to specific risks or areas at risk (local photos, field reconnaissance photos, historic flood photos, etc.)
- Graphic visualizations that show the potential impacts of flooding on certain areas within the project footprint (such as through the use of NOAA's CanVis software, which helps graphically visualize the impacts of various flood levels on existing infrastructure or other coastal features)
- Links to other data and resources that provide information on long-term erosion, sea level rise, tsunami hazards, or other coastal-specific hazards (such as wind, historic hurricane paths, etc.)

5. Dataset Spatial Extents

The coastal-specific non-regulatory datasets should only be produced within the extents defined by the project footprint (S_FRD_Proj_Ar in the FRD). Within this Flood Risk Project area, they may be produced for the entire coastline or only for a portion of the coastline, depending on applicability and data availability. The data delivered should not extend beyond S_FRD_Proj_Ar.

6. Data Delivery Timeline

The Flood Risk Database Guidance provides recommendations as to when the coastal non-regulatory datasets should generally be provided to communities during the life of a Flood Risk Project, and the conditions under which they should be updated after their initial delivery.