



A Guide for Higher Standards in Floodplain Management

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Introduction

The purpose of the Guide for Higher Regulatory Standards in Floodplain Management is to provide options for communities that want to implement floodplain regulations which reduce flood damage and the overall impacts of floods. These impacts include human risk, environmental damage, property damage, flood insurance claims, displacement of residents, and burden on community infrastructure and services.

The Guide is not a substitute for a set of community floodplain regulations, rather it is a guide to enhancing existing regulations with higher standards that will greatly reduce risk, and provide protections to functional floodplains.



Photo Credit: Delaware DNREC

The higher standards options in this guide are described in detail because they are recommended for safer development and use the natural protection provided by the natural functions and resources of the floodplain. Please note that the model language presented in this document was developed to promote effective floodplain management, and mesh with the FEMA minimum flood damage reduction standards described in 44CFR§60.3. Each community can tailor the model language to meet its own specific needs.

A note about enforcement:

Higher regulatory standards are only as good as the enforcement process that supports them. Many of the higher regulatory standards suggested in this guide necessitate increased documentation requirements and enforcement efforts compared to the minimum NFIP standards

ASFPM strongly believes the minimum NFIP floodplain regulations do not provide adequate long-term flood risk reduction for communities and that the benefits of flood risk reduction achieved by higher regulatory standards far outweighs the burden of administering them.

ASFPM RECOMMENDED HIGHER REGULATORY STANDARDS

I. FREEBOARD REQUIREMENTS in Zone A, A1-30 and AE:

OBJECTIVE:

To at least minimally protect structures against damage from floods in floodplain areas with 1% annual (base) flood elevations and in areas where no 1%-annual-chance flood elevations are available.

RATIONALE:

Freeboard is the single most effective means for reducing flood risk to a structure in the floodplain. Freeboard is standard for placing the first floor of a structure above the elevation of the calculated 1% flood level in order to allow for nature's uncertainty and future changes in the watershed that will increase flood levels. Freeboard is relatively inexpensive to build into development, and typically pays for itself in reduced insurance premiums and prevented flood damage within the first 10 years of a structure's lifetime. Significant Community Rating System (CRS) credit is available for this activity, which leads to lower flood insurance premiums for all policy holders in the community.

MODEL LANGUAGE:

Add the following sentence (bolded) to specific requirements for Residential Structures and Non-Residential structures:

Option 1:

New Construction and substantial improvement of any residential structure, including manufactured homes, shall have the lowest floor, including basement, elevated (1, 2, or 3) feet above the base flood elevation. The base flood elevation is the level of the 1% flood. Where base flood elevation data is not available, a floodplain study must be performed by a Professional Engineer (PE) establishing the base flood elevation (BFE) and the floodplain and floodway boundaries prior to issuing a development permit.

Option 2:

New Construction and substantial improvement of any residential structure, including manufactured homes, shall have the lowest floor, including basement, elevated (1, 2, or 3) feet above the base flood elevation. The base flood elevation is the level of the 1% flood. Where base flood elevation data is not available, the structure shall have the lowest floor, including basement, elevated at least two feet above the highest adjacent natural grade or above the crown of the nearest street, whichever is higher.

FREEBOARD REQUIREMENTS IN ZONE X:

Zone X (shaded):

In areas mapped as Zone X (shaded) on the community Flood Insurance Rate Map (FIRM), defined as Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

Zone X (unshaded)

In areas mapped as Zone X (unshaded) on the community Flood Insurance Rate Map (FIRM), defined as areas determined to be outside the 0.2% annual chance floodplain.

MODEL LANGUAGE:

Add the following sentence (bolded) to specific requirements for Residential Structures and Non-Residential structures:

In areas mapped as Zone X (shaded and unshaded) on the community Flood Insurance Rate Map (FIRM), the structure shall have the lowest floor, including basement, elevated at least two feet above the highest adjacent natural grade or above the crown of the nearest street, whichever is higher.

II. ACCESS (INGRESS-EGRESS)

OBJECTIVE:

To promote development design which will reduce flood damage and facilitate emergency vehicular access and/or pedestrian access and evacuation during flood events.

RATIONALE:

Buildings in high risk floodplains can be elevated to reduce flood damage by elevating the building to higher standards, such as to or above the 1% flood level. However, residual risk remains on the property. Ensuring that building sites are relatively accessible during floods decreases the likelihood of stranded residents, reduces the need for water rescues which places emergency personnel at risk, and increases public safety.

MODEL LANGUAGE:

(1) Add to specific requirements for Residential Structures:

New development proposals will be designed, to the maximum extent practicable, so residential building sites, walkways, driveways, and roadways are located on land with a natural grade with elevation not less than the base flood elevation and with evacuation routes leading directly out of the floodplain area (dryland access).

(2) Add to specific requirements for Nonresidential Structures:

New development proposals will be designed, to the maximum extent practicable, so non-residential building sites, walkways, driveways, and roadways are located on land with a natural grade with elevation not less than the base flood elevation and with evacuation routes leading directly out of the floodplain area.

III. COMPENSATORY STORAGE

OBJECTIVE:

To compensate for the loss of floodplain storage caused by filling in the floodplain, which can result in raising flood elevations, especially with the impact of cumulative fills.

RATIONALE:

Floodplains provide the critical and beneficial functions of flood storage, natural habitat, and water quality. The placement of fill impairs these functions and should be avoided. Where some placement of fill is unavoidable, requiring compensatory storage can mitigate some of the negative impacts of floodplain fill.

MODEL LANGUAGE:

There are a number of versions of compensatory storage language. The following sample language is provided as developed from a review of existing regulations:

(1) Add to language for the Assurance of Flood Carrying Capacity:

Compensatory Storage Required for Fill

Fill within the special flood hazard area shall result in no net loss of natural floodplain storage. The volume of the loss of floodwater storage due to filling in the special flood hazard area shall be offset by providing an equal volume of flood storage by excavation or other compensatory measures at or adjacent to the development site.

(2) If your regulations explain the minimum application items necessary to seek a permit, add to the language for the Application Requirements section:

Volumetric calculations demonstrating compensatory storage.

The City of Dallas, Texas adopted detailed floodplain development regulations related to loss of valley storage as follows:

Section 51A-5.105 Filling in the Floodplain

Subsection (e)(4)(g)(4) Filling to remove a FP designation

The FP area may be altered only to the extent permitted by equal conveyance reduction on both sides of the natural channel. The following valley storage requirements apply to all FP areas except those governed by a city council-adopted management plan that contains valley storage regulations, in which event the valley storage regulations contained in the plan apply:

(A) Except as otherwise provided in Subparagraph (B):

(i) no loss of valley storage is permitted along a stream with a drainage area of three square miles or more;

(ii) valley storage losses along streams with a drainage area between 130 acres and three square miles may not exceed 15 percent, as calculated on a site by site basis; and

(iii) valley storage losses along streams with a drainage area of less than 130 acres is not limited.

(B) Hydrologic computations may be performed to evaluate basin-wide valley storage loss impacts on the design flood discharge. If the computations demonstrate that valley storage losses do not result in increases in the design flood discharge at any point downstream of the project, valley storage losses are permitted even though they exceed the limits provided in Subparagraph (A).

IV. CRITICAL DEVELOPMENT PROTECTION

OBJECTIVE:

To protect critical facilities and development against damage, and to minimize the potential loss of life from flooding.

RATIONALE:

Facilities which provide critical services, or services that are depended on during storms, should be protected to an even higher standard than other development. Failure to provide flood protection to these types of critical facilities creates severe and unacceptable public safety risk.

MODEL LANGUAGE:

The standard used in Executive Order 11988 is the 500-year flood event, or the historically highest flood (if records are available), whichever is greater. Two alternatives are presented below, the first being less restrictive, the second being more restrictive:

(1) Add to Definitions:

Critical Development

Critical development is that which is critical to the community's public health and safety, are essential to the orderly functioning of a community, store or produce highly volatile, toxic or water-reactive materials, or house occupants that may be insufficiently mobile to avoid loss of life or injury. Examples of critical development include jails, hospitals, schools, daycare facilities, public electric utilities, fire stations, emergency operation centers, police facilities, nursing homes, wastewater treatment facilities, water plants, gas/oil/propane storage facilities, hazardous waste handling and storage facilities and other public equipment storage facilities.

(2) Add to Use Regulations (Prohibited Uses):

[Option I]

Critical facilities and developments in all special flood hazard areas. Where critical developments are located adjacent to special flood hazard areas, the flood protection elevation shall be two feet above the 0.2% flood elevation and that elevation shall be used as the basis for the ACCESS (INGRESS-EGRESS) provisions in section II.

[Option II]

Critical facilities and developments in all special flood hazard areas, and in all 0.2% annual (500-year) floodplains.

V. CUMULATIVE SUBSTANTIAL DAMAGE / SUBSTANTIAL IMPROVEMENT

OBJECTIVE:

To track cumulative improvements or damages to structures in special flood hazard areas to ensure that flood protection measures are incorporated.

RATIONALE:

The vast majority of flood damages to structures amount to less than 50% of the value of the structure. Without cumulative substantial damage/improvement provisions, the cycle of flood-repair-flood is typically never broken by mitigating risk. The NFIP Increased Cost of Compliance provisions (provides added funds to substantially damaged flood insurance claims for mitigating the structure) are most effective in communities with cumulative provisions.

MODEL LANGUAGE:

(1) Add the following sentence at the end of the “substantial damage” definition:

Substantial Damage

Substantial damage also means flood related damage sustained by a structure on two (2) separate occasions during a 10-year period for which the cost of repairs at the time of each such flood event, on the average, equals or exceeds 25 percent of the market value of the structure before the damage occurred.

(2) Add the following sentence (bolded) to the “substantial improvement” definition:

Substantial Improvement

Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. When the combined total of all improvements or repairs made after the adoption of this regulation equals or exceeds 50 percent of a structure's market value, that structure is considered to be substantially improved.

VI. FILL STANDARDS

OBJECTIVE 1:

To provide guidelines for the placement of fill in special flood hazard areas.

RATIONALE:

Nearly all floodplain filling activities create negative consequences to adjacent areas. Improperly designed and constructed fill can also jeopardize structures elevated on fill.

MODEL LANGUAGE:

There are many variations and combinations of standards that can be used for fill. The model language below incorporates standards for quality, stability, and compaction.

Add to Use and Development Standards for Flood Hazard Reduction:

Fill

The following standards apply to all fill activities in special flood hazard areas:

- A. Fill sites, upon which structures will be constructed or placed, must be compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test method or an acceptable equivalent method,*
- B. Fill slopes shall not be steeper than one foot vertical to two feet horizontal,*
- C. Adequate protection against erosion and scour is provided for fill slopes. When expected velocities during the occurrence of the base flood are greater than five feet per second armoring with stone or rock protection shall be provided. When expected velocities during the base flood are five feet per second or less protection shall be provided by covering them with vegetative cover.*
- D. Fill shall be composed of clean granular or earthen material.*

OBJECTIVE 2:

To ensure structures built in areas removed from the floodplain via Letters of Map Revision Based on Fill (LOMR-F) are built “reasonably safe from flooding.”

MODEL LANGUAGE:

Add the following provisions to the residential and non-residential development requirements for new construction or substantial improvement:

In any area that has been removed from the floodplain via a Letter of Map Revision Based on Fill, any existing or new structure, addition, or substantial improvement must meet the required elevation freeboard requirements.

VII. FLOODWAY RISE

OBJECTIVE:

To delineate a larger area within the 1%-annual-chance floodplain for flood flow conveyance and to restrict future encroachments that could increase flood levels.

RATIONALE:

Communities with flood studies based on FEMA's standard floodway encroachment typically see more frequent and more severe flood events because those standards allow the carrying capacity to be reduced by pinching in the floodway until flood levels raise one foot, thus encroaching the allowable development area into the natural floodway. Base flood elevations and flood insurance premiums do not account for these increases, leaving communities unprotected during the base flood event, and property owners uninsured or under-insured.

MODEL LANGUAGE:

Add the following provisions to the floodway requirements:

The allowable floodway rise is that level in the community flood study. For new studies, floodway encroachment analyses shall be performed using a ___ foot surcharge to be determined by the community where practicable. (The ASFPM recommends an allowable floodway rise of no more than 0.5 foot and as little as 0.1 feet where vulnerable or critical development exists and strongly recommended in watershed's that are not fully developed.)

VIII. FOUNDATION DESIGN

OBJECTIVE:

To ensure proper design and construction of building foundations to protect building structural integrity against the effects of buoyancy, uplift, debris impacts, and other flood forces.

RATIONALE:

ASCE-24 provides a standard of practice for flood resistant design and construction in flood-prone areas.

MODEL LANGUAGE:

Add the following sentence (bolded) to the Residential Construction section:

New construction and substantial improvement of any residential structure, including manufactured homes, shall have the lowest floor, including basement, elevated to or above the base flood elevation plus two feet of freeboard. Support structures and other foundation members shall be certified by a registered professional engineer or architect as designed in accordance with ASCE 24, Flood Resistant Design and Construction, or shall be constructed with designs meeting this standard.

IX. FUTURE CONDITIONS HYDROLOGIC MAPPING

OBJECTIVE:

To protect property against impacts of increased flood heights due to anticipated future development anywhere in the watershed, especially in rapidly developing areas.

RATIONALE:

In many cases, flood studies reflect current conditions at best, and more likely past conditions since the studies often rely on old data. As watersheds are developed, future flood heights are likely to increase. The flood risk

criteria used to site and design a project should rely on conditions the location is likely to experience during the project's lifetime, not past or current conditions.

MODEL LANGUAGE:

Communities that are experiencing rapid urban and suburban growth and development should require that all new construction and substantial improvement have the lowest floor elevated to or above the future conditions 1%-annual-chance (base) flood level, ideally with the freeboard and other higher standards recommended in this document. We recommend the following three regulations:

(1) Add the following definition:

Future Conditions Flood Hazard Area – Also known as area of future conditions flood hazard, the land area that would be inundated by the one-percent-annual-chance flood based on future conditions hydrology.

(2) Add the following sentence to the “special flood hazard area” definition:

Any area outside the one-percent-annual-chance flood hazard area identified by FEMA and designated as Future Conditions Flood Hazard Area on FEMA’s Flood Insurance Rate Map shall also be considered special flood hazard areas.

(3) ***Require that all map revisions and watershed studies include analyses based on future conditions associated with anticipated watershed growth and land-use and land-cover changes. These future condition analyses shall be included on community floodplain maps and will serve as the basis for this regulation.***

X. MATERIALS STORAGE

OBJECTIVE:

To protect the community against flood damage from materials that may block flood flows or which become buoyant, flammable, explosive, or cause other environmental health issues in floods.

RATIONALE:

Storage of materials is often difficult to regulate since many areas do not require building permits for storage. Stored materials can become waterborne debris during floods, endangering adjacent properties, and creating potential debris blockages where bridges or culverts exist.

MODEL LANGUAGE:

(1) Add the following to the Prohibited Uses section:

A. Storage or processing of materials that are hazardous, flammable, or explosive in the identified special flood hazard area.

B. Storage of material or equipment that, in time of flooding, could become buoyant and pose an obstruction to flow in identified floodway areas.

(2) Add the following to the Storage of Materials section:

Storage of material or equipment not otherwise prohibited shall be firmly anchored to prevent flotation.

XI. SETBACKS

OBJECTIVE:

To provide a limited use/development set aside area along a stream for flood damage prevention, resource protection, floodwater storage, water quality, pollutant/sediment removal, and natural stream function.

RATIONALE:

Most floodplain regulations protect lands adjacent to streams with property protection and flooding conditions in mind. Floodplains provide a wide range of natural and beneficial functions, and many of these resource protection functions can only be achieved with setbacks that preserve a riparian corridor adjacent to streams. Significant CRS credit is available for this activity, if it results in floodplain open space.

MODEL LANGUAGE:

(1) Setbacks in riverine floodplains

Proposed development adjacent to riverine floodplains shall be setback (50', 100', 200'...) from the floodway boundary or from the centerline of the stream if the floodway has not been delineated.

(2) Setbacks in coastal floodplains

Proposed development adjacent to coastal floodplains, mapped as Coastal High Hazard Areas –Zones V, VI-30 and VE, shall be set back (100', 200', 300') from the mean low tide boundary.

(3) Proposed development in areas designated as coastal A Zones (areas between the 3' breaking wave and the 1.5', 1.0' breaking wave), shall have the same development requirements as development in Coastal High Hazard Area, Zones V, VI-30 and VE.

(4) Setbacks in erosion areas

Development in areas with annual erosion (advance) rates of (5, 10...) feet or more per year, based on a study by a Federal, State or local agency and adopted by the community, shall be set back (100', 200', ...) from the mean low tide boundary in coastal areas and setback (100', 200'...) from the floodway boundary or stream centerline if the floodway has not been defined.

[In areas with severe erosion rates the community may elect to require more stringent requirements]

Specific model language has not been developed due to the technical and planning information needed to establish a setback for a given watercourse. The Center for Watershed Protection (www.cwp.org) has developed some excellent materials about setbacks and has sample ordinances that can be downloaded from the internet.

XII. STORMWATER MANAGEMENT

OBJECTIVE:

To prevent increased flood flows and limit increased runoff from a proposed development to pre-development conditions, and to maintain floodplains and stream channels by reducing erosion and sedimentation from construction activities in flood hazard areas.

RATIONALE:

One of the most effective ways to prevent flooding problems from getting worse over time is to limit the changes in watershed hydrology that increase flood flows. Probably the single most effective way to accomplish this is through storm water regulations which limit increases in runoff that result from new development. Significant CRS credit is available for this activity.

MODEL LANGUAGE:

Communities should adopt comprehensive stormwater management regulations which address water quality issues associated with development, and address increased runoff quantity by adopting regulations which ensure, at a minimum:

All subdivision and other development proposals which involve disturbing more than 10000 square feet of land shall include a stormwater management plan which is designed to limit peak runoff from the site to predevelopment levels for the 1, 10, and 100 year rainfall event. These plans shall be designed to limit adverse impacts to downstream channels and floodplains. Single residential lots involving less than (1/4, 1/2, 1) acre of land disturbance are not subject to this regulation.

For an example of comprehensive stormwater management regulations, the State of Delaware's regulations are here:

<http://regulations.delaware.gov/AdminCode/title7/5000/5101.shtml>

XIII. SUBDIVISION STANDARDS

OBJECTIVE:

To ensure subdivisions, including infrastructure and lots are created and designed to minimize risk of damage to property and potential loss of life from flooding, and to minimize the disturbance of floodplain riparian zones.

RATIONALE:

Avoidance of floodplains is far preferable to setting standards and allowing building in the floodplain. The cost of typical flood insurance policy is approaching \$1000 dollars, and this doesn't account for public expenses associated with building in the floodplain.

MODEL LANGUAGE:

The following higher standards language should be adopted into the community's subdivision regulations (if applicable) and/or flood damage reduction regulations:

(1) Modify the section on subdivisions and large scale development to incorporate the bolded text:

In all areas of special flood hazard where base flood elevation data are not available, the applicant shall provide a hydrologic and hydraulic engineering analysis that generates base flood elevations and floodway boundaries for all subdivision proposals, and other proposed developments at least 5 acres or 5 lots in size (optional language: greater than 1, 2, 5 acres) . These studies may be submitted to FEMA as a request for map revision if appropriate.

(2) Add the following to the section for Subdivisions and Large Scale Development:

- A. All preliminary plans for platted subdivisions shall identify the flood hazard area and the elevation of the base flood.*
 - B. All final subdivision plats will provide the boundary of the special flood hazard area, the floodway boundary, and base flood elevations.*
 - C. In platted subdivisions, all proposed lots or parcels that will be future building sites shall have a minimum buildable area outside the natural (non-filled) 1% chance annual floodplain. The buildable area shall be large enough to accommodate any primary structure and associated structures such as sheds, barns, swimming pools, detached garages, on-site sewage disposal systems, and water supply wells, if applicable.*
 - D. Approval shall not be given for streets within a subdivision, which would be subject to flooding in the base flood. All street surfaces must be located at or above the base flood elevation*
-

XIV. USE RESTRICTIONS

OBJECTIVE:

To restrict or prohibit uses of the floodplain which are dangerous to health, safety or property in times of flood, or which cause excessive increases in flood stages or velocities.

RATIONALE:

Avoidance of floodplains is far preferable to setting standards and allowing building in the floodplain. For many types of critical facilities, the tolerance for even minimal flood risk is extremely low, and complete avoidance of the floodplain should be the standard.

MODEL LANGUAGE:

Add the following to the Prohibited Uses section:

- A. New construction of any residential or nonresidential structures in floodway areas.*
- B. Storage or processing of hazardous, flammable, or explosive materials in special flood hazard areas. [Caution: while this policy defines the floodplain, floodway and BFE's future conflicts may occur when the watershed is remapped or modified by a LOMC]*
- C. Critical development in special flood hazard areas. (Note: Must also adopt the critical development definition – see critical development higher standard).*
- D. The use of nonconforming structures shall not be changed from a non-residential structure to a residential structure or a mixed-use structure, or increase the residential use area of a mixed-use structure.*
- E. The use of any structure shall not be changed to a critical facility, where such a change in use will render the new critical facility in violation of Section IV - Critical Development Protection.*

XV. REGULATING AREAS NOT MAPPED ON FIRM

OBJECTIVE:

To provide a means for a community to regulate development in areas at risk to flooding that have not been mapped on FEMA's FIRMs.

RATIONALE:

At best, most flood insurance studies do not map floodplains in watersheds with drainage areas, of less than one square mile, floodplain widths less than 200', and in areas with poor drainage not associated with flooding sources. In many undeveloped areas, some larger watersheds may not have been mapped. Estimates are that nationally, over 1/3 of flood damage occurs outside of mapped floodplains.

MODEL LANGUAGE:

(1) Add the following sentence to the "special flood hazard area" definition:

Any area outside the FEMA studied areas lying along streams as shown on the United States Department of the Interior Geological Survey (hereafter referred to as "USGS") quadrants of which [community name] is contained and/or areas with flood prone soils which are contiguous to blue line streams as shown on the [community name] Flood Prone Soils Map shall also be considered special flood hazard areas.

[Note – in determining the extent of land "contiguous" to streams, (blue line streams on some USGS maps) communities may elect to establish a buffer defined by width, land elevation, historical flooding, or other data].

(2) In areas upstream of the Limit of Detail Study, as delineated on the community FIRM, where *base flood elevation data is not available, a floodplain study must be performed by a Professional Engineer (PE) establishing the base flood elevation (BFE) and the floodplain and floodway boundaries prior to issuing a development permit.*

(3) Add the following references to the flood hazard data adopted in Basis for Establishing the Areas of Special Flood Hazard:

- A. USGS quadrants in which [community name] is contained;*
- B. [community name] Flood Prone Soils Map.*

XVI. ELEVATION OF ALL ADDITIONS

OBJECTIVE:

To protect new horizontal additions (increase in building footprint) from flood damage.

RATIONALE:

Building an addition below flood level is essentially expanding a non-conforming use – a practice that has been prohibited in many contexts.

MODEL LANGUAGE:

Add the following provisions to the residential and non-residential development requirements:

All new horizontal additions must have the lowest floor and all HVAC elevated to the regulatory base flood elevation.

XVII. COASTAL SITING

OBJECTIVE:

To provide greater protection to coastal resources and structures that would be at risk of experiencing damage from wave action (V Zones).

RATIONALE:

Coastal flood risk increases dramatically with proximity to oceans and bays. While the NFIP has no siting requirements for V-Zones, locating new construction landward of frontal sand dunes and erosion prone lands provides tremendous protection. Note: several states have higher regulatory standards requiring new development to be landward of mean high or mean low tide.

MODEL LANGUAGE:

Add the following provisions to the general requirements for development in V Zones:

All new structures shall be located on the lot so as to minimize exposure to coastal hazards and shoreline erosion, and to accommodate primary frontal sand dunes. Structures should be located outside of the V-Zone, to the greatest extent possible. Building setback requirements should consider predicted future erosion rates, or historical erosion rates.

XVIII. DUNE PROTECTION

OBJECTIVE:

To provide greater protection to sand dunes and their flood mitigation qualities.

RATIONALE:

Sand dunes act as flood protection barriers along shorelines, and absorb wave energy before it causes damage to buildings. Land altering activities can destabilize sand dunes, and reduce the ability of the dune to absorb wave energy.

MODEL LANGUAGE:

Add the following provisions to the general requirements for development in V Zones:

Retaining walls, landscaping, dune crossovers and other non-essential accessory structures shall be designed and located to minimize impacts to sand dunes. Primary frontal dunes shall not be altered unless a qualified engineer demonstrates and certifies that flood risk will not be increased to the subject, or other, properties. Activities which reduce the volume of sand on the dunes or beach can generally be presumed to increase flood risk to landward locations. Adding sand volume to the dune or beach can generally be presumed to not increase flood risk.



Photo Credit: Delaware DNREC

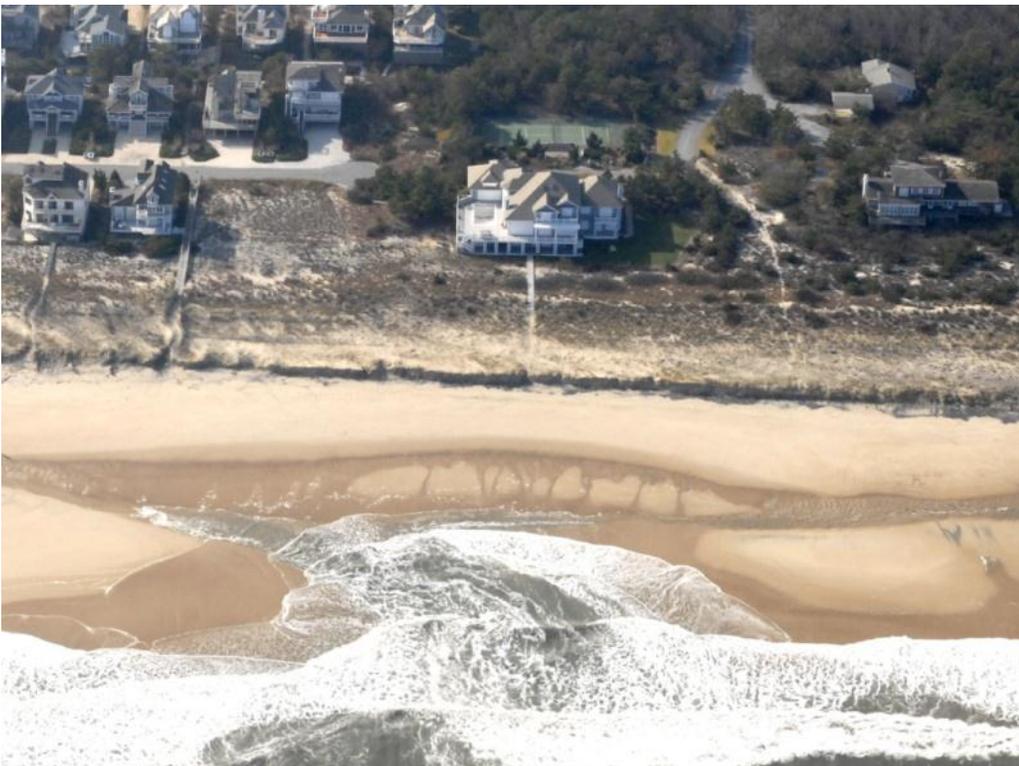


Photo Credit: Delaware DNREC

The community in the bottom photograph required coastal construction behind primary frontal sand dunes. The top photo shows adjacent community with no dune setback requirements.

XIX. COASTAL CONSTRUCTION

OBJECTIVE:

To provide a greater factor of protection to structures built in V Zones.

RATIONALE:

Because of the extreme potential for damage from wave energy and high velocity flows and debris associated with coastal flooding, higher construction standards are essential. Breakaway enclosures are a compromise strategy which allow coastal property owners ground level improvements, but maintain structural integrity. Breakaway walls typically create debris problems and should be kept to a minimum. Enclosures, below BFE, should be limited to less than 300 square feet to permit the parking of two vehicles, limited storage and building access.

MODEL LANGUAGE:

Add the following provisions to the residential and non-residential development requirements for V Zone construction:

- A. New and substantially improved structures shall have the bottom of the lowest horizontal structural member elevated (1', 2', 3') above the base flood elevation.*
 - B. Enclosures below the lowest floor of elevated buildings shall be usable solely for parking, access, and limited storage. These enclosures shall be less than 300 square feet in area, and shall be designed and constructed with breakaway walls which minimize the amount and impact of debris and adverse effects on adjacent properties.*
 - C. Option to B – Enclosures below the lowest floor of elevated buildings is prohibited in V Zones.*
 - D. Breakaway walls for enclosures below the lowest floor shall be designed to meet building code wind requirements. Such enclosures may be used only for limited storage, parking and access and shall be designed to minimize adverse debris impacts to adjacent properties. Where enclosures are used as access ways to elevated buildings, a secure door located at the elevated floor level must separate the enclosed area from the elevated building.*
 - E. Detached accessory structures such as sheds or garages shall be prohibited in V-Zones.*
-

XX. COASTAL A-ZONE

OBJECTIVE:

To better protect structures in coastal areas where storm-induced velocity wave actions are unknown.

RATIONALE:

Flooding with wave heights of as little as 1.5 feet can transmit significant energy loads to buildings or other obstructions. A reasonable amount of protection can be provided to development in these A-Zone areas with the potential for 1.5 feet or greater by adopting V-Zone standards in these areas.

MODEL LANGUAGE:

Add the following provisions to the residential and non-residential development requirements for Coastal A Zone construction:

In areas which have been identified as subject to limited wave action (between 1.5 and 3 feet) and designated as a Coastal A-Zone, new and substantially improved structures shall comply with all of the V-Zone provisions of this ordinance. Elevation requirements should refer to the bottom of the lowest horizontal structural member of the lowest floor.

XXI. SINK Holes [The following standards and ordinance language is patterned after the Lexington, Kentucky Sinkhole Ordinance and can be modified as needed]

Background:

Sinkhole flooding can be divided into 3 categories:

- 1) sinkhole flooding that is predominantly from surface runoff;
- 2) Flooding predominantly from surcharging of the caves below, and
- 3) flooding that can be a mixture of the two.

The first category is the easiest to analyze though you may get one sinkhole overflowing into another, and that one into another, and so on, and so on. Bowling Green, Kentucky, for example, has a series of seven (7) sinkholes that share water during big flood events.

Category 3 is the hardest to analyze because often the caves below cannot be entered. They operate basically as storm sewers that cannot be inspected or maintained. Massive changes in underground drainage caused by debris/sediment plugging have been documented. Analysis of sinkhole systems (three categories) requires that you can identify the correct category for any given sinkhole. This can only be done by careful field investigation and/or eye witness accounts. Once you have the sinkhole classified as to flooding in category 3, then you must delineate the groundwater basin and somehow model the cave hydraulics.

Sinkhole-- Any closed depression formed by removal (typical underground) of water, surficial soil, rock, or other material. The existence of a sinkhole shall be indicated by the closed depression contour lines on the Unified Mapping Program topographic maps or other documents as approved by the Community Floodplain Manager. Its actual limits may, however, be determined by field measurements with concurrence of the Community Engineer. Sinkholes may be either circular in plan or irregular, depending upon structural control.

Plan Requirements - A sinkhole, the immediate sinkhole drainage area, a sinkhole cluster area, or portions of such items shall be shown on any development or preliminary subdivision plan for land where they exist. Sinkhole-related nonbuildable areas and restricted fill areas shall be shown on final subdivision plans and development plans.

Sinkhole-Related Nonbuildable Areas - Based upon the topography, geology, soils, and known history of the sinkhole (such as past filling) and the developer's engineer's stormwater analysis and the community Planning Commission shall establish sinkhole-related, nonbuildable areas. No buildings, parking areas, or other structures shall be permitted within the sinkhole related, nonbuildable area.

This nonbuilding area shall follow the limits of the sinkhole in most cases. However, the nonbuilding area may be expanded or contracted by action of the Community Planning Commission where warranted due to the nature of the specific sinkhole, the underlying geology, soils, drainage, and any related information such as depth to bedrock. In sinkhole cluster areas, the Community Engineer may require the developer to provide recommendations from a consulting engineer and a consulting hydrologist based upon substantial and state-of-the-art field studies and evaluation of the specific sinkhole system. Such studies shall be submitted to the Community Floodplain Manager, which shall review said studies and make recommendations to the Community Planning Commission.

Development in Sinkhole Drainage Areas - Development may occur in the immediate sinkhole drainage area if the developer provides alternative surface drainage away from the sinkhole, while keeping the water in the same surface drainage basin, and provided further that the water shall not go into another sinkhole drainage area off the petitioner's property, nor into another stream of known flooding problems. The immediate sinkhole drainage system area (or portion thereof) which cannot be provided with an alternative drainage system can be deleted from the development area and can be used to meet the normal open space requirements. The developer may request that the Community Planning Commission increase the density on the remainder of the developable area, with the total resulting density no greater than if the entire area were developed to the permitted density.

For portions of the immediate sinkhole drainage area where alternative surface drainage methods cannot be provided, as determined by the Community Engineer, the developer may choose one of the options described below.

Sinkhole Surface Drainage Analysis - The sinkhole can be used for surface runoff drainage of a proposed development of the conditions of either of the following alternatives are met:

A. Alternative 1: A sinkhole can be used for surface runoff of a proposed development with or without retention or detention facilities as recommended by a consulting Engineer and a consulting hydro geologist, provided that any increase in the quantity of surface runoff due to development of the entire sinkhole drainage area in question will not aggravate flooding on the proposed development, adjacent existing development, or connected/adjacent sinkhole sub- surface systems. Such engineering and geologist reports must be substantive and based on state-of-the-art field studies and evaluation of the specific sinkhole system. The Community Planning Commission shall not approve developments of this subsection unless the Community Engineer concurs with those findings and recommendations.

B. Alternative 2: A sinkhole can be used for surface drainage of a proposed development if all of the following conditions and provisions are met:

1. That the runoff from the development area is either completely retained in a retention basin or detained in a detention basin. The flow rate out of the above basin shall be regulated so that it is no greater than the flow rate into the sinkhole of the development area prior to development of each of the following storms: 10 year/1-hour, 25year/24-hour storm or a 100 year/1-hour storm. The outflow rate shall not aggravate flooding on downstream properties for any of these storms.

2. As previously noted, the developer may elect to divert enough of the sinkhole drainage area so that the development of the remaining area does not increase the total quantity of the runoff into the sinkhole where additional runoff is anticipated, a consulting engineer and hydro geologist shall evaluate and show the effect of any additional quantity of runoff to the sinkhole and sinkhole system. For approval, the study must show the development will not aggravate flooding on the proposed development, adjacent lands, or connected/adjacent

sinkhole systems. The Community Engineer shall review the study findings and make recommendations to the Community Planning Commission for alternative 2 to be accepted .

3. Where the sinkhole outlet is offsite, either the runoff leaving the subject property must be shown to be no greater in flow or in quantity than that which existed before development or written approvals must be submitted from owners of property where any increase in flow or quantity of water must go to reach the sinkhole outlet. Easement areas shall be approved by the Community Engineer based upon the calculations of the engineer of the developer on the proposed ponding elevation.

Filling in Sinkholes and Drainage Areas - Development may involve some filling of the sinkhole drainage area or sinkhole upon approval by the Community Engineer. However, no principal or accessory buildings with soil-bearing foundations shall be permitted to be constructed on fill within the limits of any sinkhole.

XXII. Playa Lakes

Background:

The Spanish word *playa* (pronounced [*ˈplaja*]) literally means "beach". Dry lakes are known by this name in some parts of Mexico and the western United States. This term is also used on the Llano Estacado and other parts of the Southern High Plains.

In South America, the usual term for a dry lake is **salar**, Spanish for "salt pan".

The surface of a dry lake is typically dry, hard and rough during the dry season, but wet and very soft in the rainy season. Dry lakes are generally small, round depressions in the surface of the landscape.

A playa lake is formed when rain fills a round depression in the landscape, creating a small lake. The water is generally freshwater. When all of the water evaporates, a playa is formed. The playa appears as a flat bed of clay, generally encrusted with precipitated salts. These evaporate minerals are a concentration of weathering products that have been left behind. Some examples of evaporite minerals are sodium carbonate, borax, and other salts. Playas are often found in bajadas, a depositional landform of desert environments.

Dry lakes can also form when the water table intersects the surface and water seeps into them.

Dry lakes are typically formed in semi-arid to arid regions of the world. The largest concentration of dry lakes in the world (nearly 22,000) is in the southern High Plains of Texas and eastern New Mexico.

Most dry lakes are small, however Salar de Uyuni in Bolivia, near Potosi, the largest salt flat in the world is of 4,085 square miles (10,582 square km).

Many dry lakes contain shallow water during the rainy season, especially during wet years. If the layer of water is thin and is moved around the dry lake by wind, an exceedingly hard and smooth surface may develop. Thicker layers of water may result in a "cracked-mud" surface and "teepee" structure desiccation features. Very little water can result in dune formation.

While the dry lake itself will be devoid of vegetation, they are commonly ringed by shadscale, saltbrush and other salt-tolerant plants that provide critical winter fodder for livestock and other herbivores.

Threats to dry lakes include pollution from concentrated animal feeding operations such as cattle feedlots and dairies, erosion, fertilizer, pesticide and sediment runoff from farms, and overgrazing.

The extremely flat, smooth and hard surfaces of dry lakes make them ideal for motor vehicles and bicycles. Furthermore, large-sized dry lakes are excellent spots for pursuing land speed records, as the smoothness of the surface allows low-clearance vehicles to travel very fast without any risk of disruption by surface irregularities, and the path traveled has no obstacles to avoid. The dry lakes at Bonneville Salt Flats in Utah and Black Rock Desert in Nevada have both been used for setting land speed records. Dry lake beds that do not fill with water at any time are sometimes used as locations for air bases, for similar reasons. Examples include Area 51 in Nevada, and Edwards Air Force Base (originally known as Muroc Dry Lake) in California.

Brines from the subsurface of dry lakes are often exploited for valuable minerals in solution.

Under United States law, a "playa lake" may be considered isolated wetlands, and may be eligible to enroll in the new wetlands component of the Conservation Reserve Program, enacted in the 2002 farm bill (P.L. 107-171, Sec. 2101).

Development Requirements:

[The following requirements were established by the City of Lubbock, Texas regarding development in Playa Lake areas and may be modified as needed by a community with Playa Lake flood hazards]:

In Playa Lake areas, there are 5 criteria that would be used to determine what a new structure's lowest floor should be, based upon Local Floodplain Administrator's requirements:

- (1) - The floor shall be a minimum of 12" above the highest adjacent top of curb (or street crown).
- (2) - If the structure is located within a playa lake, the lowest finish floor (LFE) shall be a minimum of 1' above the FEMA BFE **OR** a minimum of 2' above the lake overflow, **whichever is higher**. If the playa is a 'true non-overflow lake' (where it doesn't overflow even in the 500-year event) the LFE shall be a minimum of 1' above the 500-year event.
- (3) - If a Drainage Analysis has been prepared for a **new** development, the LFE is to be a minimum of 6" above the established BFE.
- (4) - If a new structure is to be built in the SFHA shown on the FIRM, then the LFE shall be built a minimum of 1' above FEMA's BFE.
- (5) - The lowest floor elevation may have to be raised to allow the site to drain properly, consistent with COL requirements.

Whichever of these 5 requirements yields the highest elevation will govern and shall be used to set the floor level for the proposed structure.

XXIII. Alluvial Fans

Alluvial Fans are usually mapped on Flood Insurance Rate Maps (FIRMs) as Zone AO (shallow overland flooding) by FEMA. Development in Alluvial Fan areas creates unique floodplain management issues for local communities, developers and homeowners. The ASFPM Arid Regions Committee prepared an excellent companion White Paper entitled *Riverine Erosion Hazards & Floodplain Management*. The Arid Regions Committee has been requested to provide guidance and higher standards recommendations to CBOR regarding development in Alluvial Fan areas to help guide communities in their quest to mitigate flood risks.

XXIV. LEGAL RIGHT OF ENTRY TO ENFORCE FLOODPLAIN ORDINANCE

OBJECTIVE:

The community floodplain administrator must have legal authority to enter private property to enforce the community floodplain ordinance and the minimum requirements of the NFIP. While this may not be considered a higher standard this authority is paramount for a community to have a sound floodplain management program.

RATIONALE:

44 CFR

- Part 60.2 (h) - The community shall adopt and enforce floodplain management regulations...
- Part 60.3 (a) (1) - Require permits for all proposed construction and other developments in the community...
- Part 73 - a property that has been declared to be in violation of State or local laws, regulations or ordinances using Section 1316 of the National Flood Insurance Act of 1968

The *Texas Guide to Local Floodplain Management*, RG-12 (Rev. 8/06), Chapter 4 (page 33) - Duties of a Floodplain Administrator include:

- enforcing ordinances, which includes follow-up inspections on all permits granted;
- addressing violations by working with the community's attorney and informing citizens of the penalties of noncompliance with NFIP requirements;

Texas Guide to Local Floodplain Management, Chapter 4 (page 42), Importance of Enforcing Permit System:

- Your community is violating its agreement with the NFIP by failing to maintain a permit system, by granting variances regularly, and by being lax about enforcement responsibilities

FEMA 480, *A Study Guide and Desk Reference for Local Officials*, Unit 7 Section D, page 7-39:

Later Inspections:

- "Your office should periodically check to ensure that the property continues to remain in compliance over time. Later inspections are particularly important when a structure contains an enclosure below the lowest floor. Such areas can be easily modified and made into habitable spaces in violation of regulations".
- Note: "In some states, communities do not have the statutory authority to go onto private property to look for violations."

FEMA 480, Unit 7 Section E, page 7-40:

Enforcement

- "In order to ensure that development is meeting these requirements, you must monitor the floodplain, and where necessary, conduct an inspection of a property. Some permit officials have statutory limits on where they can go to inspect a potential violation. Be sure to review your authority to access onto private property with your attorney."

Texas Water Code 13.315 [example of a State Code]

"... All political subdivisions are hereby authorized to take all necessary and reasonable actions to comply with the requirements and criteria of the National Flood Insurance Program, including but not limited to:..." those political subdivisions are acting as functionaries of state, and federal government in the enforcement of those actions necessary to comply with the "Flood Control Insurance Act". The authority to inspect on private property is passed on from the federal, and state government, to county government by the Texas Constitution's

description of the rights and duties of county government as it acts as an extension of the State therefore the authority does not have to be specifically created in additional statute.

MODEL LANGUAGE:

Add the following provisions to the Community flood damage prevention ordinance or court order:

"The community floodplain administrator, or his designee, has the right to enter any structure to perform any duties or responsibilities imposed by this Chapter (Ordinance or Court Order)".

XXV. ENFORCEMENT – FINES AND PENALTIES

Several Flood Damage Prevention Ordinances, adopted by participating NFIP communities, contain the following language:

PENALTIES FOR NON COMPLIANCE

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. Violation of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be fined not more than \$1,000 or imprisoned for not more than 30 days, or both, for each violation, and in addition shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent (name of community) from taking such other lawful action as is necessary to prevent or remedy any violation.

The following City of Houston Flood Damage Prevention Ordinance contains language where a person violating the ordinance can be guilty of a misdemeanor punishable by a fine of not less than \$250.00 nor more than \$2,000.00. Each day that any violation continues shall constitute a separate violation. This is considered a "higher standard" action making violation of the flood damage prevention ordinance a serious offense.

City of Houston Section 19-91 Actions authorized to enforce chapter.

- (a) The city, acting through the city attorney or any attorney representing the city, is hereby authorized to file an action in a court of competent jurisdiction to:
 - (1) Enjoin any person from violating the terms, conditions and restrictions of any permit issued under this chapter;
 - (2) Enjoin the violation of the provisions of this chapter;
 - (3) Recover civil penalties for violations of the terms, conditions and restrictions of any permit issued under this article;
 - (4) Recover civil penalties for violations for conditions of this article; or
 - (5) Recover damages from the owner of a site in an amount adequate for the city to undertake any construction or other activity necessary to bring about compliance with this chapter.

This authority is in addition to all provisions of this code and the Construction Code relative to the definition of offenses and the provision of penalties for violations of such ordinances.

- (b) The city, acting through the city attorney or any other attorney representing the city, is hereby authorized to enter into agreements in lieu of litigation to achieve compliance with the terms, conditions and restrictions of any permit issued under this article or the provisions of this article.
- (c) The city engineer is authorized to:
 - (1) Whenever any work authorized by a development permit is being performed contrary to the provisions of this chapter, or other pertinent laws or ordinances implement through the enforcement of this article, order the work (other than work to cure a violation) stopped by notice in writing served on any persons performing the work or causing the work to be performed. Any such persons shall forthwith stop the work until authorized by the city engineer to proceed with the work.
 - (2) At the time a stop order is issued, the person performing the work and the permit holder shall be given notice of a right to a hearing on the matter pursuant to Section 116.2 of the Building Code for permits authorized by that Code. Upon request, such a hearing shall be held within three business days unless the permit holder or person who was performing the work requests an extension of time. Any stop order that has been issued shall remain in effect pending any hearing that has been requested unless the stop order is withdrawn by the city engineer.

Section 19-92 Criminal sanctions

Any person violating any provision of this chapter within the corporate limits of the city shall be guilty of a misdemeanor punishable by a fine of not less than \$250.00 nor more than \$2,000.00. Each day that any violation continues shall constitute a separate offense.

[Reference City of Houston Ord. No. 85-1705, 1, 9/25/1985; Ord. No. 92-1449, 34, 11/4/1992; Ord. No. 02-399, 48, 5/15/2002; Ord. No. 03-1190, 16, 12/3/2003; Ord. No. 06-894, 30 &31, 8/30/2006]

MODEL LANGUAGE:

It is recommended that a community consider amending their flood damage prevention ordinance to include authority to enforce and criminal sanctions similar to the City of Houston ordinance above.

NFIP communities are encouraged to modify this document as needed to meet their floodplain management requirements necessary to minimize flood hazards.