A Guide for Higher Standards in Floodplain Management

Prepared by:

ASFPM Floodplain Regulations Committee

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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.

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 than1 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 safely.

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.

(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.

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.

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:

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, ½, 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

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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:

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:

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.

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 modifies 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.

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 building s 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 ['plaʝa]) 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 Bolivis, 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.

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

(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.