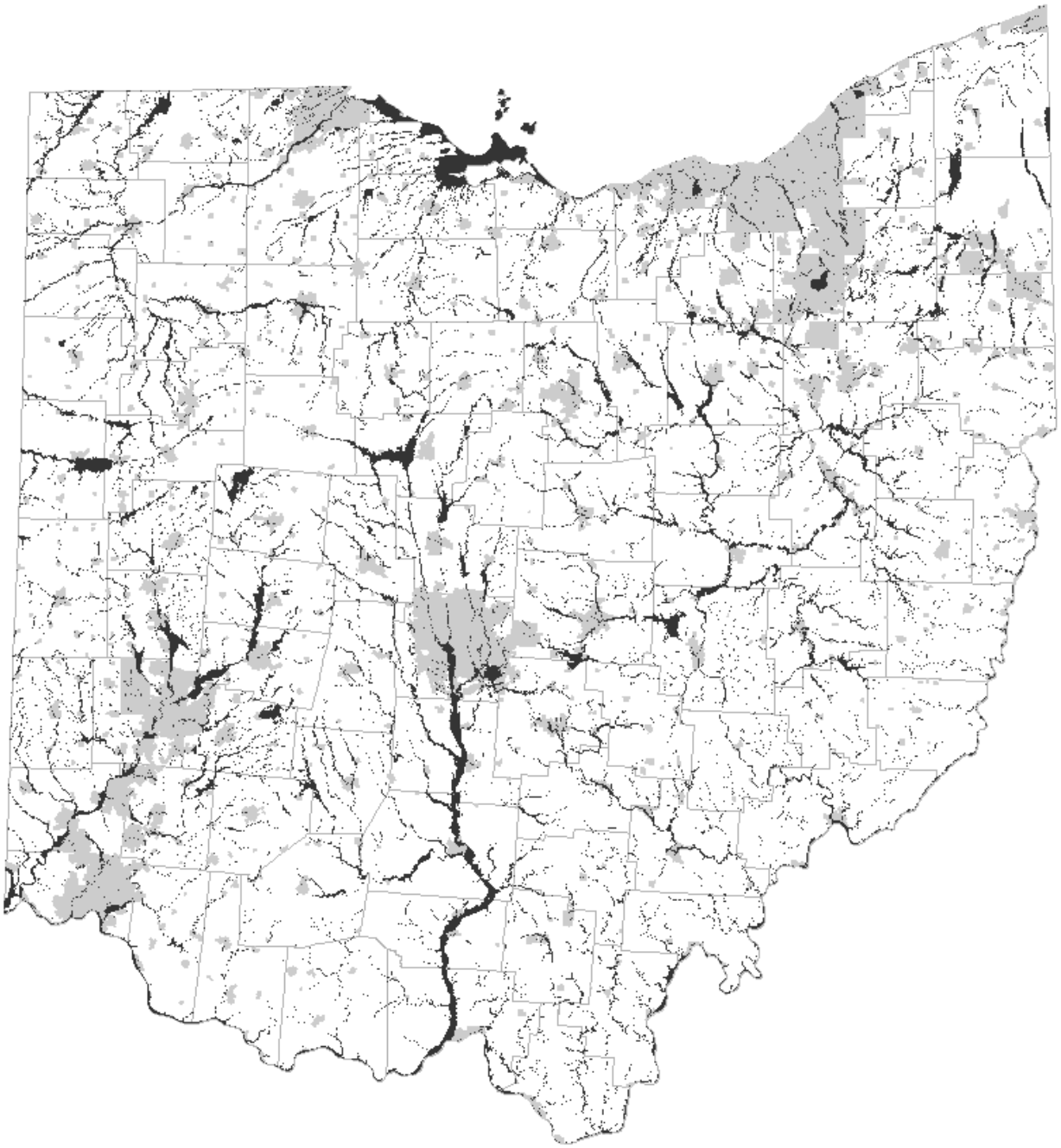
OHIO FLOODPLAIN
REGULATION CRITERIA



MISSION of the Division of Water:

To ensure the wise management of Ohio's water resources

VISION of the Division of Water:

To be a leader in water resources management,
by providing the highest quality customer service

MISSION of the Floodplain Management Program:

To provide leadership to local governments, state agencies, and interested parties toward cooperative management of Ohio's floodplains to support reduction of flood damage and the recognition of the floodplain's natural function and benefit

Cover: Reduced scale GIS coverage of identified floodplain areas in Ohio produced by the Division of Water, Floodplain Management Program

Recommended
OHIO FLOODPLAIN REGULATION CRITERIA
For Floodplain Management

Fifth Edition
Revised August 2006

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PREFACE

The term "floodplain management" encompasses a wide range of public policy and action for ensuring wise use of floodplain areas. It includes collection and dissemination of floodplain information, acquisition of floodplain lands through the purchase of easements, flood control structures such as dams and levees, and "nonstructural" measures such as the enactment of land use regulations that are designed to encourage wise floodplain development and require at minimum the protection of buildings and other development from flood damage. The goal of floodplain management is to strike a balance between the natural, beneficial functions and values of the floodplain, and the potential costs and benefits to society arising from its use and development.

The purpose of this publication is to acquaint local officials, professionals, and the general public with floodplain management and regulation in Ohio. Ohio Floodplain Regulation Criteria was first published by the Division of Water in 1976 and, at that time, contained progressive recommendations for standards that went beyond minimum standards of the National Flood Insurance Program. Through the 1990's, it became evident that those recommendations were important in reducing the risk of loss of life and property damage due to flooding. Today, many of those recommendations have become mainstream as communities in Ohio and nationwide are taking steps to have truly effective floodplain management programs.

Ohio Floodplain Regulation Criteria is meant to serve as a guide to understanding the various criteria that must be addressed in order to manage the natural resources of the floodplain, to adequately protect floodplain development from future flood damages, and to reduce adverse impacts of floodplain development. **Although prepared and reviewed by professionals, this document should not be used as a substitute for professional services in specific situations. If legal advice or other expert assistance is required, the services of a specialist should be sought.**

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CHAPTER 1

INTRODUCTION

Floods and Floodplains In Ohio

Floodplains are low, flat areas bordering watercourses that serve as storage and flow areas for excess water. In the case of riverine flooding, "normal" daily flows remain in the stream channel. However, when rapid snowmelt, severe thunderstorms or prolonged rainfall occurs, the flow of water exceeds the channel and extends across the floodplain. This "runoff" is carried south into the Ohio River and north into Lake Erie. Flooding is therefore a natural component of the hydrologic cycle in which water constantly moves across the land and between the earth and atmosphere.

Flooding in Ohio can occur in different ways. In many areas of the state, runoff causes floodwaters to rise gradually and remain out of bank for several days or longer. On the Ohio River, a flood event may last for more than a week. In other areas of the state, especially small watersheds and areas of steep topography, "flash flooding" results from the rapid runoff of water causing a watercourse to flood and recede in a very short period of time. Flash floods are especially dangerous as there may be little or no warning time for evacuation. Coastal flooding from Lake Erie is a special phenomenon. Gales from the northeast push lake water into the western basin. Several hours of strong northeast winds may increase lake levels by several feet in the western basin of Lake Erie causing flooding of the flat shoreline. The floodplain can be thought of as nature's "safety valve" in the hydrologic cycle. Streams and their floodplains are part of watersheds, the natural drainage systems of rivers and their tributaries.

In their natural state, floodplains have enormous but often unrecognized value. These complex, dynamic systems contribute to the physical and biological support of water resources, living resources, and cultural resources. Floodplains are important to Ohio's water resources because they provide natural flood and erosion control, help maintain high water quality, and contribute to sustaining groundwater supplies. Floodplains have living resource value as they are among the most productive of all ecosystems, supporting a wide variety of flora and habitat for fish and wildlife. The cultural resources of floodplains include the maintenance of a harvest of agricultural products, places for recreation, outdoor education, and often sites of historic and archeological interest. Although these values are recognized, it has been difficult and sometimes impossible to assign economic values to the functions served and benefits provided by floodplains[1].

Ohio's river systems and coastal areas, including the corresponding floodplain areas, have played a major role in this state's economic progress and growth. Throughout Ohio's history, floodplains have attracted development. Fertile soil, flat terrain, and an abundance of water have encouraged agriculture, commerce, and industry along Lake Erie, the Ohio River, and major tributaries throughout the state.

[1] Adapted from *Floodplain Management in the United States: An Assessment Report (1992)*. Please see the bibliography for additional information.

Negative aspects of development in floodplain areas have been the exposure of new properties to flood damage and risk to human life. In fact, Ohio has a tragic flood history. In March 1913, known as Ohio's largest flood disaster, approximately 100 cities and communities were devastated by floodwaters. The results were catastrophic: 467 people died, thousands were left homeless, and damages totaled $143 million, which today would equal at least several billion dollars in property losses. Other major flood events occurred in the state in 1936, 1937, 1959, 1963, 1964, 1969, 1980, 1981, 1982, 1987, 1989, 1990, 1992, 1995, 1996, 1997, and 1998. These disasters include major Ohio River and other large river basin floods; flash floods such as the 1990 Shadyside flood (which killed 26 people), and Lake Erie coastal flooding. Flooding is Ohio's primary natural hazard.

An Assessment of Traditional Floodplain Management Approaches

The era of the structural approach to floodplain management began in 1917, when the Corps of Engineers was given the responsibility to build flood prevention works. This era focused on construction projects that controlled one of nature's primary forces. Such measures focus on keeping floodwater away from buildings and people and include dams, dikes, levees, river channelization, drainage works, and manipulation of coastlines. Billions of dollars have been invested by the federal government and billions more invested by state and local governments. These traditional projects have saved lives and prevented hundreds of millions of dollars in property losses. Yet, in spite of this effort, flood losses in the U.S. and Ohio continue to rise.

Due to increasing flood prevention and disaster costs, national policy slowly began to reform. In 1956, a flood insurance statute was passed but it was not until 1968, with the enactment of the National Flood Insurance Program (NFIP), that a nationwide attempt was made to use flood insurance and flood damage reduction regulations as floodplain management tools. As of June 2006, there were 4.6 million flood insurance policies nationwide, and more than 37,000 flood insurance policies in Ohio. The NFIP has been an effective floodplain management tool. Since 1969, insured flood losses have totaled nearly 12 billion dollars, and it is estimated that the NFIP now results in nearly $800 million annually in avoided flood losses due to floodplain management regulations. However, it is estimated that nationally only about 30 percent of structures in flood hazard areas have flood insurance, and flood losses continue to rise.

Nationally, flood losses are averaging over $6 billion per year. Several reasons are offered to explain this trend. First, the population and development of the floodplain has increased, notably in coastal areas but in many riverine communities as well, especially in rapidly urbanizing areas. With increased development pressure there is increased stormwater runoff from impervious areas, and less floodplain land to function as floodwater storage areas in large floods, increasing flood stages and velocities. Second, some argue that the availability of federally backed flood insurance as well as state and federal disaster mechanisms actually support new investment in floodplain areas. Third, there appears to be a societal perception that flooding problems have been "solved" by construction of dams, levees, and other structural projects, *i.e.*, the risk is disregarded or considered acceptable in property investment decisions. Finally, the use of new techniques for measuring and predicting flood events is resulting in flood maps and studies reflecting higher flood stages. From the above discussion it is apparent that other means of reducing flood damage must be used if past trends are to be reversed.

Non-traditional Approaches, Emerging Trends

Unlike conventional structural flood protection measures, the "nonstructural" approach to floodplain management focuses on reducing flood risk by keeping individuals and structures away from floodwaters. One of the most common approaches involves the enactment of floodplain regulations by a community, usually as a result of the community's participation in the NFIP. Since 1968, when the National Flood Insurance Program was enacted by Congress, nearly 700 Ohio communities have adopted floodplain regulations.

Communities participating in the National Flood Insurance Program (NFIP) must adopt certain land use regulations for identified floodplain areas. In exchange for adopting these regulations, the federal government makes flood insurance available throughout the community. These regulations, also known as the "NFIP minimum standards" can be found in the Code of Federal Regulations, Chapter 44 Parts 59-75. These regulations establish flood protection standards for buildings and other types of development in identified floodplain areas.

Zoning and land acquisition for open space floodplain uses, relocation of flood prone buildings, implementation of flood warning systems and disaster mitigation plans are other examples of non-structural management techniques. By comparison, flood insurance, disaster relief, and public education and information activities are examples of nonstructural floodplain management strategies that reduce the impact of flooding on individuals and the community.

A strategy gaining in popularity is to align conventional non-structural measures with an emphasis on the natural, beneficial functions and values of undeveloped floodplains, and the protection of these resources to ensure sustainable, disaster resistant communities. Programs to purchase environmentally sensitive properties, development rights, or dedication of environmentally sensitive land when it is being subdivided are a few ways Ohio communities are preserving the natural functions of floodplain areas.[2] In rural areas, fertile floodplains are important agriculturally. Farmland preservation tools, when applied in floodplain areas, can achieve goals of preserving farmland and reducing flood damages by limiting development.

Another emerging concept in floodplain management is ***No Adverse Impact***. Developed by the Association of State Floodplain Managers, a non-profit organization dedicated to reducing flood loss and promoting sound floodplain management, no adverse impact, or NAI, is the concept that the action of one property owner or community does not adversely affect the flood risks for other properties or communities as measured by increased flood stages, increased flood velocity, increased flows, or the increased potential for erosion and sedimentation, unless the impact is mitigated as provided for in a community or watershed based plan.[3]

A Call to Action for Ohio Communities

Communities have a variety of options regarding the type of floodplain management programs that will most appropriately meet their needs. However, prior to deciding the type of local

[2] To learn more about these types of programs, see the book titled *Common Groundwork* in the bibliography.
[3] Excerpted from *No Adverse Impact: A New Direction in Floodplain Management Policy (2001).* Please see the bibliography for additional information.

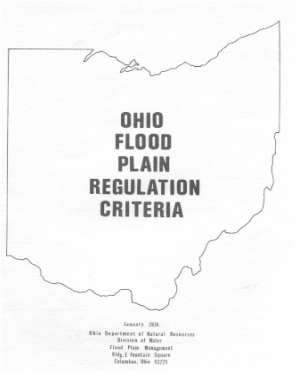
program that is to be established (including whether higher regulatory standards are needed), the community, through its local officials, must first agree on the goals they want to accomplish. The objectives of any local floodplain management program may include reducing the threat to life and property from flood hazards, achieving beneficial use of floodplain areas, and preserving and/or enhancing natural floodplain functions. This means that the goal of cutting flood losses must be considered in the context of competing community goals such as economic development, public safety, water quality improvement, farmland preservation, fish and wildlife protection, recreation, tax considerations, *etc*. Therefore, some specific questions must be answered. What is the most desirable use of floodplains given the needs of the entire community? What are local and regional development goals? How will the community benefit? What are the benefits of various possible floodplain uses compared to the risks and potential costs of each use?

In measuring possible costs of floodplain development, community officials must look beyond just dollar losses to the owners of new developments. They must also examine the costs of municipal services as well as potential liability due to increased damage to individuals, both upstream and downstream, that will be affected if a new floodplain development increases the elevation and velocity of floodwaters. Finally, there are increased costs to the public due to flood-fighting, rescue, and relief operations.

Once these questions have been answered, a community can then examine the variety of options available to implement these decisions. Community officials may decide that reserving the floodplain for open space uses may be the most effective and feasible approach. In other instances, this type of program may not be possible or appear desirable to a local government. Officials may decide that the benefits of certain types of floodplain development may outweigh the risks inherent in locating in a floodplain area. Whatever the goals at the outset, an active floodplain management program will continually evolve as the community grows and its development-based needs and goals change accordingly.

Ohio Floodplain Regulation Criteria: A Historical Perspective

Ohio was an early leader in promoting effective floodplain management and flood protection standards. In the early 1970's, the Ohio Department of Natural Resources produced *Model Flood Plain Regulations*, which gave Ohio communities model floodplain regulations to adopt. Since the 1970's, ODNR has continued to produce model regulations. *Ohio Floodplain Regulation Criteria* had its genesis from a report entitled *The Development of Floodplain Management in Ohio*, from Batelle Columbus Laboratories in 1971. From 1971 to 1976, the Ohio Department of Natural Resources produced several floodplain management guides and in 1976, the first edition of *Ohio Floodplain Regulation Criteria* was published. That edition contained a number of recommended standards to promote effective floodplain management. Many of those standards remain in this edition.



The Ohio Revised Code (ORC), Section 1521 directs the ODNR, Division of Water to produce model regulations and provide technical assistance to Ohio Communities. The provisions and recommendations of the *Ohio Floodplain Regulation Criteria* have been established under the

general authority of Section 1521.13 of the ORC, and state agency authority for floodplain management is also explained in Sections 1521.03, 1521.14, and 1521.18. *Ohio Floodplain Regulation Criteria* has been prepared to provide uniformity in the engineering analysis of proposed floodplain development and to ensure that Ohio communities have access to floodplain management regulations that are consistent with local, regional, and state goals and that meet or exceed the minimum requirements of the NFIP. The Floodplain Management Program within ODNR, Division of Water, is ready and willing to assist communities in developing a floodplain management program or in adopting or revising floodplain regulations.

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CHAPTER 2

ADOPTING AND AMENDING LOCAL FLOODPLAIN MANAGEMENT REGULATIONS

In Ohio, the majority of communities adopt flood damage reduction regulations in a special purpose format, with only three percent of the regulations adopted through zoning. However, many communities that have zoning regulations have references to the community's flood damage reduction regulations.

Flood damage reduction regulations must be properly adopted and amended so they can be administered without fear of being stricken down by a court of law due to adoption procedures not being followed. In fact, several Ohio communities have experienced this problem. This chapter will provide an overview of authority to adopt flood damage reduction regulations and the steps that are required to adopt and amend local flood damage reduction regulations. **It is strongly recommended that a community's legal counsel review any proposed regulations and the community's adoption procedure.**

Authority for Ohio Communities to Regulate Floodplains

The police power is the power of government to regulate to promote public health, safety, morals, and welfare. The police power authority of Ohio counties and townships originates through direct statutory delegation by the Ohio General Assembly instead of through the state constitution, as is the case for municipalities (cities and villages). Ohio communities have the authority to adopt flood damage reduction regulations through the police power.

Counties

Specifically, the statutory delegation, also called enabling authority, for counties to participate in the NFIP and adopt flood damage reduction regulations is found in Sections 307.37 and 307.85 of the ORC. Section 307.37 states:

> *A county building code may include regulations for participation in the national flood insurance program established in the "Flood Disaster Protection Act of 1973," ...and regulations adopted for the purposes of section 1506.04 or 1506.07 of the Revised Code governing the prohibition, location, erection, construction, redevelopment, or floodproofing of new buildings or structures, substantial improvements to existing buildings or structures, and other development in unincorporated territory within flood hazard areas...*

Section 307.85 states:

> *The board of county commissioners of any county may participate in, give financial assistance to, and cooperate with other agencies or organizations, either private or governmental, in establishing and operating any federal program enacted by the Congress of the United States, or with any such agency or organization that is receiving federal funds pursuant to a federal program, and for such purpose may adopt any procedures and take any action not prohibited by the constitution of Ohio nor in conflict with the laws of this state...*

The Ohio Attorney General has opined (OAG 91-028) that ORC 307.37 and 307.85 provide counties, as participants in the NFIP, sufficient authority to adopt floodplain management regulations. The authority granted to Boards of County Commissioners to adopt regulations necessary for participation in the NFIP are broader in two aspects than the earlier authority granted to County Commissioners to adopt building regulations. First, flood regulations are not limited to one, two, or three family dwellings, as are traditional county building codes but extend to "residential, commercial or industrial buildings or structures." Second, these regulations apply to buildings and structures used for agricultural purposes. While such buildings or structures are exempt from county zoning (ORC 303.21) and state building regulations (ORC 3781.06, 3786.061), they may be subject to county floodplain regulations (OAG 91-028 SYLLABUS ONE).

Municipalities

Municipal corporations are not limited to authority granted by statute. Instead, they have constitutional authority to "exercise all powers of local self-government and to adopt and enforce within their limits such local police, sanitary, and other similar regulations, as are not in conflict with general laws" (Ohio Constitution, art. XVIII, section 3). These municipalities are called non-charter or statutory municipalities. Alternatively, a municipal corporation may adopt a charter and use that device to exercise its powers of local self-government.[4]

The model regulations provided in this handbook include references to the authority to adopt flood damage reduction regulations in Section 1.1 for both counties and municipalities.

Under Ohio law, townships do not have enough home rule authority delegated to them to qualify for participation in the NFIP independently; rather, townships are included under the county's NFIP participation. However, several townships in Ohio with zoning regulations have adopted a zoning overlay district or similar language for floodplain areas. Often these district regulations are more restrictive than the county's flood damage reduction regulations.

Adoption Procedures for Non-Charter (Statutory) Cities and Villages

ORC 731.17 to 731.26 details the process for adopting and amending ordinances. Additionally, ORC 1521.18 has requirements specific to flood damage reduction regulations. In summary, these sections require:

- It is recommended that the draft ordinance or any amendment to an existing floodplain management ordinance prepared by the community be forwarded to the ODNR, Division of Water for review and comment.
- The ordinance shall be read on three different days by the legislative authority of the municipality.
- The ordinance shall be passed by a vote of at least a majority of all members of the legislative authority.
- The ordinance shall be authenticated by the signature of the presiding officer and clerk of the legislative authority.
- The ordinance or a succinct summary of the ordinance shall be published once a week for two consecutive weeks in a newspaper published and of general circulation in the city or

[4] 12/20/1994 letter from Ohio Attorney General's office to ODNR.

village (the number of newspapers and alternatives to publication are discussed in ORC 731.21). If a summary of the ordinance is published, the publication shall contain notice that the complete text of the ordinance may be obtained or viewed at any location designated by the legislative authority.

- The clerk of the legislative authority of a municipal corporation shall enter and officially sign a certificate stating in which newspaper and on what dates such publication was made, on the record of ordinances.
- The ordinance shall not take effect prior to ten days after the first publication of the ordinance (or summary of the ordinance) and not prior to 30 days after passage unless all emergency adoption criteria have been met.
- The ordinance, including any amendments to the ordinance, shall be submitted to the Chief of the Division of Water for a determination that it is in compliance with applicable federal standards adopted under the National Flood Insurance Act.

BE AWARE OF THE PROCEDURES NECESSARY FOR EMERGENCY PASSAGE OF AN ORDINANCE! Often, cities and villages consider emergency passage of flood damage reduction ordinances because they are facing a deadline (*i.e.*, a new flood map has been produced and the community is required to update its ordinance by a specific date). Emergency passage of an ordinance so it will be effective immediately, and suspending the requirement to have the ordinance read on three different dates, are two separate procedures. Although there are times where it may be necessary to pass an ordinance as an emergency, the Division of Water generally discourages such actions because of the added risk of the ordinance being held invalid in court due to a community not following the necessary procedures for adoption.

If a community has a need for suspending the three readings or emergency passage the following steps should be followed:

- In accordance with ORC 731.17, a motion to suspend the three readings on three separate days must be approved with an affirmative vote of at least three fourths of all the members of the legislative authority.
- If it is desired that the ordinance go into effect immediately for the preservation of the public peace, health, or safety, ORC 731.30 requires that the ordinance include a section stating the reasons for emergency adoption.
- The ordinance is approved by the legislative authority. It must be approved by at least two-thirds vote of all the members of the legislative authority for emergency adoption, and approved by a majority of all members of the legislative authority if it is not being adopted as an emergency.
- The ordinance must be authenticated and published in accordance with ORC 731.20 to 731.26 (see section above).

If a statutory plan municipality decides to enact floodplain regulations as part of its zoning ordinance, the following procedure must be followed:

- If the municipality has a Planning Commission, the proposed amendment must be submitted to the Planning Commission for its review. It is allowed a reasonable time, not less than thirty days to consider the amendment and report back to Council. (ORC 713.10)

- The municipal Council shall hold a public hearing on the proposed amendment and shall give notice by publication of the time and date of the hearing in a newspaper of general circulation in the municipality. The text as well as any report from the Planning Commission must be on file at the office of the clerk of the municipality for public examination during the thirty-day period. If the regulations affect ten or fewer parcels of land as shown on the tax duplicate, written notice of the hearing shall be mailed by the Clerk of the legislative authority by first class mail at least twenty days before the date of the public hearing to the owners of the property within, contiguous to and directly across the street from such parcel or parcels to the addresses on the County Auditor's current tax list or the Treasurer's mailing list or such other list as may be specified by the legislative authority.
- After the public hearing, Council may adopt the amendment by a majority vote provided that if the amendment differs or departs from the report from the Planning Commission, it may be adopted only be a vote of at least three-fourths of the membership of the legislative authority. (ORC 713.12)
- The amendment must be published as any other ordinance and submitted to the Chief of ODNR, Division of Water for approval under ORC 1521.18.

Adoption Procedures for Counties

ORC 307.37 identifies an adoption and amendment procedure for flood damage reduction regulations. Additionally, ORC 1521.18 has requirements specific to flood damage reduction regulations. In summary, these sections require:

- It is recommended that the draft resolution or any amendment to an existing floodplain management resolution prepared by the community be forwarded to ODNR, Division of Water for review or comment.
- A public hearing must be held on the resolution or amendment at not fewer than two regular sessions of the Board of County Commissioners.
- Notice of the public hearings must be given by publication in a newspaper of general circulation including the time, date, and place once a week for two consecutive weeks preceding the hearings. Copies of the proposed resolution or amendment must be made available to the public at the Commissioners' office.
- The resolution or amendment takes effect on the thirty-first day after its adoption. The resolution or amendment must be submitted to the Chief, ODNR, Division of Water for approval under ORC 1521.18.

Counties that have enacted floodplain regulations through their zoning codes (which is rare for an entire county) must follow the adoption or amendment procedures found in ORC 303 (counties) or ORC 519 (townships).

Adoption Procedures for Charter Cities and Villages

Charter cities or villages may have their own procedures for adopting floodplain ordinances, regardless if they are special purpose or zoning; however, the draft ordinance or amendment, must be forwarded to the ODNR, Division of Water for review and comment in accordance with ORC 1521.18. As long as the community follows the procedure spelled out in its charter, the adoption process is valid. If no process for the adoption of ordinances is detailed in the charter, the process in ORC 731.17-731.26 must be followed.

Summary of Ohio Adoption Criteria

Non-Charter Municipality

Statutory Authorization: ARTICLE XVIII, Section 3, of the Ohio Constitution grants municipalities the legal authority to adopt land use and control measures for promoting the health, safety, and general welfare of its citizens.

Regular Adoption:

A. 3 public hearings
B. ordinance approved by majority vote
C. published after vote (2 successive weeks)
D. goes into effect after 30 days from adoption

Emergency Adoption:

A. 1 public hearing
B. motion to suspend three readings approved by 3/4 vote
C. ordinance approved by 2/3 vote
D. published after vote (2 successive weeks)
E. must specifically state that it will go into effect immediately and why

County

Statutory Authorization: Sections 307.37 and 307.85 of the Ohio Revised Code grant counties the authority to adopt regulations for areas of special flood hazard that are necessary for participation in the National Flood Insurance Program.

Regular Adoption:

A. 2 public hearings
B. published prior to hearings (2 successive weeks)
C. published once after vote
C. resolution approved by majority vote

No Emergency Adoption for Counties!

Charter Municipalities

Statutory Authorization: ARTICLE XVIII, Section 3, of the Ohio Constitution grants municipalities the legal authority to adopt land use and control measures for promoting the health, safety, and general welfare of its citizens. Section 701.05 of the Ohio Revised Code allows for charter municipalities to provide methods differing from general law to publish and pass legislation.

Follow the community's charter process for adoption of ordinances.

ORC 1521.18(B) mandates obtaining odnr approval of all Flood Damage Reduction regulations!

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CHAPTER 3

BEYOND THE NFIP: HIGHER STANDARDS

How Can Development Cause Flood Levels to Increase?

Development in a watershed or its floodplains can cause increases in flood levels (surcharging) in two ways: hydraulic surcharge and hydrologic surcharge. Hydraulic surcharge is the rise associated with the physical constriction of flow. As fill is placed in the floodplain, there is less cross-sectional area. This causes the flow velocity and flood levels to increase. Hydrologic surcharge is the increase in flood elevations due to increased flows resulting from development in the watershed. Flow increases with development due to the following hydrologic factors:

- As development occurs, more land is made impervious and less open area is available to absorb rainfall. The volume of runoff from a site increases.
- Water runs across paved surfaces, curbs, and storm drains much faster than across vegetated or natural terrain surfaces. The water gets to the creek faster, and the peak of runoff increases.
- When a flood wave passes downstream through a channel, storage in the floodplains along the stream reduces the peak flow. This process is known as attenuation. Loss of floodplain storage reduces attenuation and increases peak flows.

Considerations for Adopting Higher Standards

Many Ohio communities have already taken steps to reduce flood risks and enhance the natural benefits of floodplains by adopting flood maps and/or floodplain management standards that are more conservative than the minimum Federal standards. This handbook includes suggested language for many of the higher standards presented. Many of these standards are applicable to all Ohio communities, others may not be appropriate. Below is a discussion of some of the factors that may influence a community's choice of standards that encourage safer development.

Regional Differences

Ohio has significant differences in geography, topography, climate and flood hazards from Lake Erie to the Ohio River. Some generalizations can be made about which higher standards are appropriate for a particular region of the state. Higher standards that may be influenced by regional differences include:

- Freeboard – Coastal communities such as those along Lake Erie, and communities in very flat areas of western and northwestern Ohio may consider a lower freeboard requirement. Most streams and rivers in this region of the state have wide floodplains to accommodate floodwaters. Some increases in the flows above the 1% chance annual event do not cause significant increases in the flood elevations of these rivers. In other areas of the state, where the terrain is rolling to steeply sloping, a higher freeboard requirement may be a consideration.
- Future conditions mapping – Large rivers should not be mapped for future conditions because the impact of land use changes is attenuated in large watersheds. The peak of severe flooding on large rivers occurs days after the rain. By then, flooding on smaller

streams, which could be impacted by development, has already receded.

- Use restrictions (for public safety protection) – Whether use restrictions apply to floodways or special flood hazard areas altogether, this safety standard is most appropriate where flash flooding is more likely to occur. Although flash floods can occur anywhere, the most susceptible areas include eastern, southeastern, southern, and southwestern Ohio.

Flood History

A community's flood history is an important determinant in the desire to adopt higher standards and what standards to adopt. For example, areas that have been affected by a significant historical flood may not be shown as floodprone on a FEMA flood map. Communities can map these inundation areas, adopt them as special flood hazard areas, and regulate them. Flood elevations from these events can be important to a community's regulatory program, as they will establish a protection level, especially in areas that are identified as special flood hazard areas without base flood elevations.

Development Patterns

Projected development patterns can impact the choice of higher standards a community considers. An actively growing community with a lot of developable land may want to adopt a freeboard, compensatory standards, stormwater management standards, fill regulations, *etc*. On the other hand, a community with a fully developed floodplain may have higher standards for accessory structures, or establish setbacks, especially for the storage of materials (to minimize debris). In rural areas, more developable land exists; therefore, development can cause a greater impact to flood risks than in a more developed, urbanized area. Floodplains in rural areas may need to be set aside through zoning, purchase of easements, and other tools before development pressure occurs.

Financial Considerations

Communities should compare the benefits of higher standards to the possibility of increased construction costs that may result. However, when looking at financial considerations, all costs and benefits should be determined. For example, what would the increased cost be for a new wastewater treatment facility that was elevated to the .2% annual flood level? Would this cost offset the benefits of less flood damage during a flood event larger than the 1% annual chance flood? Would the cost of access routes passable during the 1% annual chance flood be offset by the benefits of a family being able to escape a flood or the elimination of the need for rescue crews and the expenditure of taxpayer dollars?

Recommended Higher Standards

The higher standards are listed alphabetically by keywords. The keywords are listed below:

A Zone Freeboard
Access (ingress-egress)
Compensatory Storage
Critical Development
Cumulative Substantial Damage/Substantial Improvement
Fill

Floodway Rise
Foundation Design
Freeboard
Future Conditions Mapping
Materials Storage
Setbacks (Buffers)
Stormwater Management
Subdivision Regulations
Use Restrictions

Each higher standard in this chapter elaborates on five items related specifically to the standard, to explain the standard and assist in its implementation. These items include the following:

Objective
Discussion
Model Language
Special Considerations
Ohio Communities Having Adopted Standard

The higher standards options in this section of the handbook are described in detail because they are recommended for safer development and natural benefit protection. Most of the recommended higher standards have been adopted in some form by Ohio communities. Please note that the model language presented in this document was developed to promote effective floodplain management, and mesh with the model flood damage reduction regulations. Each community can tailor the model language to meet its own specific needs. A compendium report in Appendix C summarizes the higher standards adopted by Ohio communities by keyword.

STANDARD / KEYWORD: A ZONE FREEBOARD

OBJECTIVE: To at least minimally protect structures against damage from floods in areas where no 100-year flood elevations are available.

DISCUSSION: A "freeboard" is a safety factor usually expressed in feet above a flood level for the purpose of floodplain management. Generally, freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for the base flood and conditions such as wave action, obstructed bridge openings, debris and ice jams and the effects of urbanization in a watershed. However, where no detailed 100-year flood elevation data are available in NFIP approximate A Zones or in AO Zones (shallow flooding), elevation of a structure's lowest floor at least two feet above the highest adjacent natural grade touching the structure will ensure some positive drainage away from the structure.

Another advantage of an A Zone freeboard is the reduction in the cost of flood insurance. The insurance rates for new structures in SFHAs are directly related to their lowest floor elevation compared to the base flood elevation. In approximate A Zones, rating is based on a comparison of the lowest floor elevation to either a "base" (100-year) flood elevation that is calculated or estimated using standard engineering practices, or alternatively, based on the elevation of at least two feet above grade. For example, based on NFIP rating information (as of May 1, 2006) the annual flood insurance rate for $50,000.00 coverage for a single family home with no basement built, without an estimated base flood elevation, at highest adjacent existing grade would be $470.00, while if the structure is built with the lowest floor one foot above highest adjacent natural grade, the rate would be only $341.00.

Disadvantages of freeboard include potentially increased construction costs for structures, and more fill being placed in the SFHA if the method for elevating the structure is a fill pad. The effect of additional fill is the loss of floodplain storage for floodwaters. Also, because the construction is only tied to the highest adjacent natural grade, some site planning, and additional surveying should be involved in order to attempt to identify the higher ground on the site. And, because there is no actual estimated base flood elevation, the structure could still be affected by actual flooding.

MODEL LANGUAGE:

(1) Add the following sentence (bolded) to Section 4.4(D), Residential Structures:

> *New Construction and substantial improvement of any residential structure, including manufactured homes, shall have the lowest floor, including basement, elevated to or above the flood protection elevation.* ***Where flood protection elevation data are not available the structure shall have the lowest floor, including basement, elevated at least two feet above the highest adjacent natural grade.***

(2) Add to Section 4.5, Nonresidential Structures:

C. Where flood protection elevation data are not available, the structure shall have the lowest floor, including basement, elevated at least two feet above the highest adjacent natural grade.

SPECIAL CONSIDERATIONS: Fill should extend at least 15-20 feet laterally from the structure to establish a stable building pad. Other methods of elevating a structure could include extended foundations (with proper flood vent openings to relieve hydrostatic pressure on the foundation), piers, piles or columns.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Well over 150 Ohio communities have adopted an A Zone freeboard.

STANDARD / KEYWORD: ACCESS (INGRESS-EGRESS)

OBJECTIVE: To provide vehicular and/or pedestrian access into and out of the floodplain during flood conditions.

DISCUSSION: The provision of access routes is a safety factor for floodplain development, in order to ensure that occupants of the floodplain may be able to safely evacuate or enter into flood hazard areas during flood conditions. In times of flooding, roads, streets, and bridges in low-lying areas may be covered by floodwaters, isolating building occupants. Ingress (access into an area) and egress (access out of an area) is vital to police and fire/rescue personnel and equipment, and to the community generally, for the safe and orderly evacuation of flooded areas. Access criteria are often linked to "freeboard," or elevation of a building, street, bridge, *etc*. usually expressed in feet above a flood level for the purpose of floodplain management. Generally, access is desired at least at the 100-year flood level.

From a planning standpoint, in some areas low topography at bridges and approaches and along stretches of roads may not allow for a safe access route. Disadvantages of designed and constructed access include potentially increased construction costs for structures, and more fill being placed in the SFHA if the method for providing the access is fill. The impact of additional fill is the loss of floodplain storage for floodwaters and possible changes in stormwater runoff. Careful site design is needed, including identifying areas of higher ground within or adjacent to the floodplain for access routes. However, the intent of providing safe access to properties in flood prone areas may outweigh design considerations.

MODEL LANGUAGE:

(1) Add to Section 4.4, Residential Structures:

H. Each new residential site shall have direct access to a walkway, driveway, or roadway whose surface elevation is not less than the flood protection elevation and such escape route shall lead directly out of the floodplain area.

(2) Add to Section 4.5, Nonresidential Structures:

C. Each new nonresidential site shall have direct access to a walkway, driveway, or roadway whose surface elevation is not less than the flood protection elevation and such escape route shall lead directly out of the floodplain area. (Note: use this format if the community does not have AO Zones; if the community uses the AO Zone option, then renumber the above as Section D)

SPECIAL CONSIDERATIONS: If access language is adopted for subdivisions and large-scale development, it is recommended that this language also be adopted into the community's subdivision regulations. For manufactured homes and parks, or recreational vehicle campgrounds, access should be sufficient for a hauler to remove the units, ideally prior to the flood event.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Several Ohio communities have adopted access criteria, including Sylvania (applied to manufactured home sites), and Columbus (streets must be above the base flood elevation).

STANDARD / KEYWORD: COMPENSATORY STORAGE

OBJECTIVE: To compensate for the loss of floodplain storage caused by filling in the floodplain.

DISCUSSION: Sometimes referred to as "cut and fill," this type of provision requires the compensation for filling or other construction in the floodplain by removal of an equal amount of material from the floodplain near the proposed development. This helps to maintain the general cross-sectional area and floodplain storage volume at that location and ensure that floodwaters will not be displaced onto someone else's property as the result of a floodplain fill.

In some situations due to factors such as property ownership, density of land use activity in the floodplain, or topographical constraints, sufficient land may not be available for excavation and removal of material to offset the placement of fill or building construction. The adoption of a freeboard for filling may mean a greater amount of excavation is needed to compensate for the increased fill volume. For large development sites where parking space constitutes a significant portion of the development, alternatives to filling the parking area should be evaluated to allow for floodwater storage, especially near or within regulatory floodways. Also, recommended "best management practices" for reducing soil erosion should be utilized especially when excavating and filling in areas close to streambanks or on steeper slopes.

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 Section 4.9, Assurance of Flood Carrying Capacity:

D. Compensatory Storage Required for Fill

Fill within the area of special flood hazard 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) Add to Section 3.4(E), Application Required:

7. Volumetric calculations demonstrating compensatory storage has been provided as required by Section 4.9(D).

SPECIAL CONSIDERATIONS: Although the model language is limited to fill, some communities have adopted more restrictive compensatory storage standards that include all development, and the term "fill" could be substituted for "development."

Ideally, fill volumes should be balanced by excavating material on the same site as the development and on-site material, if suitable for backfilling, should be used to minimize site disturbance. In some situations off site locations on the same waterway may be acquired by

developers to obtain the necessary area for excavation to offset the filling and provide an effective compensatory storage volume.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Several Ohio communities have adopted compensatory storage criteria, including Paulding County (special regulation for Flat Rock Creek) and Toledo (water dependent uses constructed on fill such as marinas, docks, wharves, *etc.* must provide volume for displaced floodwater storage). The City of Columbus Hellbranch Run Watercourse Protection Overlay zoning includes criteria for no net loss of floodplain area storage.

STANDARD / KEYWORD: CRITICAL DEVELOPMENT PROTECTION

OBJECTIVE: To protect critical development against damage and minimize the potential loss of life from flooding.

DISCUSSION: Critical facility protection was first introduced as a concept in the federal Water Resource Council's Floodplain Management Guidelines published in 1978, which explained how to implement Executive Order 11988 – Floodplain Management. Certain facilities, are considered to be "critical" developments because they are 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 these facilities include, jails, hospitals, fire stations, nursing homes, wastewater treatment facilities, water plants, and gas/oil/propane storage facilities.

These developments, due to their impact on human safety, health and welfare, must have a higher degree of protection than the base flood provides. The emphasis of this standard is on the increased hazard to life and health as opposed to property damage.

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 Section 4, Use and Development Standards for Flood Hazard Reduction:

Section 4.10: 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, fire stations, nursing homes, wastewater treatment facilities, water plants, and gas/oil/propane storage facilities.

Critical Developments shall be elevated to the 500-year flood elevation or be elevated to the highest known historical flood elevation (where records are available), whichever is greater. If no data exists establishing the 500-year flood elevation or the highest known historical flood elevation, the applicant shall provide a hydrologic and hydraulic engineering analysis that generates 500-year flood elevation data.

(2) Add to Section 3.4(E), Application Required:

7. *Generation of the 500-year flood elevation for critical development as required by Section 4.10.*

-OR-

(1) Add to Section 2.0, 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, fire stations, nursing homes, wastewater treatment facilities, water plants, and gas/oil/ propane storage facilities.

(2) Add to Section 4.1(B), Use Regulations (Prohibited Uses):

3. Critical developments in all special flood hazard areas.

SPECIAL CONSIDERATIONS: None.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Village of Corning.

STANDARD / KEYWORD: 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.

DISCUSSION: The primary advantage to adding the cumulative provision for substantial damage is to increase the availability of Increased Cost of Compliance (ICC) flood insurance coverage. ICC will pay up to twenty thousand dollars beyond the flood insurance claim payment for compliance with local flood damage reduction regulations. Structures that have been declared substantially damaged and are required to meet flood damage reduction regulations because of cumulative losses can only obtain ICC coverage if the community has adopted the cumulative provisions identified in the model language below. The cumulative provisions for substantial improvement assures that a structure will not have a 49 percent improvement one year, a 35 percent improvement three years later, a 40 percent improvement two years later, just to avoid the substantial improvement requirements.

Unless records are kept very well and up to date, there can be difficulty in implementing cumulative provisions for substantial improvement and substantial damage.

MODEL LANGUAGE:

(1) Add to Section 2.0, Definitions, 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 to Section 2.0, Definitions, 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 previous improvements or repairs made during the life of the structure equals or exceeds 50 percent of a structure's market value, that structure is considered a substantial improvement.***

SPECIAL CONSIDERATIONS: Either or both cumulative provisions can be adopted.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Clermont County.

STANDARD / KEYWORD: FILL

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

DISCUSSION: Minimum NFIP regulations are silent on fill. Increasingly, Ohio communities are discovering that fill in floodplain areas causes several problems including adverse impacts on adjacent property owners, water quality impacts (increased turbidity and siltation), and loss of flood storage capacity. Fill standards generally address one or more of the following:

> Quantity – Limits on the amount of fill in terms of cubic yards or feet in height. In Louisiana, a state judge upheld two city ordinances that restricted the amount of fill to an average of twelve inches for the footprint of a residential structure and twenty-four inches for the footprint of non-residential structures. Quantity restrictions help preserve the flood storage capacity of the floodplain but may result in higher construction costs if a structure must be built on piers, posts, or columns.
> Quality – Limits on the types of materials that are suitable as floodplain fill. Unfortunately, many fill sites have a combination of materials that degrade water quality and may cause uneven or extreme settling. Examples of unsuitable materials include woody debris, asphalt, and garbage.
> Location – Limits on where within the floodplain fill material can be placed. For example, in the City of Dublin, fill is prohibited in the floodway. Location requirements may also be expressed in terms of distance from a structure's foundation to the floodplain. For instance, some standards require that a fill pad used for a structure must be at or above the base flood elevation for a distance of 15 or more feet beyond the foundation of the structure.
> Stability – Requires that fill areas be properly stabilized. Stabilization measures may include suitable side slopes and proper erosion protection (vegetation or armoring) of the side slopes.
> Compaction – Requires that fill, especially fill used for elevating structures, be properly compacted to reduce the risk of settling and erosion.

FEMA's Technical Bulletin 10-01, *Ensuring that Structures Built on Fill in or near Special Flood Hazard Areas are Reasonably Safe from Flooding,* contains fill quality and compaction standards.

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.

(1) Add to Section 4, Use and Development Standards for Flood Hazard Reduction:

> *Section 4.10: 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 of 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.*

SPECIAL CONSIDERATIONS: This standard could cause difficulty with freeboard standards, especially if the fill standard is very restrictive (in terms of quantity or height), since fill pads are a common method of elevating a structure. In this case, methods for elevating a structure could be limited to extended foundations, piers, piles or columns.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: At least ten Ohio communities have fill standards including the City of Tiffin, City of Dublin, Preble County, City of Gallipolis, and the City of Newark.

STANDARD /KEYWORD: FLOODWAY RISE

OBJECTIVE: To delineate a larger area within the 100-year floodplain for flood flow conveyance and to restrict future encroachments that could increase flood levels.

DISCUSSION: For regulatory purposes, the floodplain is divided into two components: the *floodway* and the *flood fringe*. The floodway is the portion of the floodplain that generally must be preserved for the movement of floodwater. It conveys the deeper, higher velocity flood flow. The flood fringe is the portion of the floodplain outside the limits of the floodway. Flood fringe areas are "storage" areas characterized by generally shallow, slower moving floodwaters. The boundaries of the floodway are determined by simulating encroachments, or loss of conveyance, on each side of the floodplain. That is, portions of the floodplain are assumed in the model to be "filled in" or otherwise obstructed on each side resulting in equal reductions in conveyance of floodwaters. This procedure, known as "equal degree of encroachment," assures that property owners on each side of the watercourse will have the same development rights. Several computer models are used in floodway determination. Cross-sections of the floodplain are selected, and the computer model simulates the effect of filling in or "encroachment," effectively reducing the width of the flood flow path. The discharge that formerly flowed through the filled overbank areas is now contained in the narrower flow path (floodway); consequently, the water surface elevation increases. In most cases, because of differences in topography and vegetation, the floodway boundaries will not be equidistant from the respective sides of the stream channel.

Under NFIP minimum standards, the allowable degree of encroachment is "limited" by a maximum increase in water surface elevation of one foot at any point along the watercourse. This concept was developed on the concept that increases of less than one foot would not result in dangerous increases in flood flow velocity. However, since the studies developed using this concept did not account for watershed hydrology changes such as increased runoff, use of the one foot rise floodway may allow for too much development in the flood fringe, reducing floodwater storage capacity and accelerating flood flow velocity, leading to actual flood increases of well over one foot, as well as increased erosion and other detrimental impacts.

Many Ohio communities were studied under the NFIP using the maximum allowable rise of one foot. However, a number of Ohio communities either were studied or chose a NFIP study based on a one-half foot (0.5) rise in flood elevation. Generally, the smaller the allowable rise, the greater the portion of the total 100-year floodplain that is reserved as floodway. In some states, laws set the maximum rise based on an even more restrictive standard. For example, the state of Illinois allows only a one-tenth foot (0.1 foot) rise standard; in Wisconsin state legislation sets the rise at one-hundredth of one foot (0.01 foot), meaning nearly the entire floodplain is designated as floodway in some cases. Once a regulatory floodway is defined and adopted in land use regulation by a community, further development or "encroachment" into the floodway is prohibited, unless the developer can prove "no rise" in 100-year flood elevation, using a similar methodology and computer model used in the effective study.

From a planning standpoint, in communities without established flood study data for the NFIP and floodplain management, flood study evaluation should consider developing a floodway for

regulation based on a higher standard than NFIP minimum criteria. However, adoption of a different floodway rise than that defined in an existing NFIP study would create a conflict, as then the study on which the floodway and 100-year elevations and mapping are based would not match the technical basis for the regulation. Also, communities seeking to develop and adopt a more restrictive floodway should also examine existing and proposed floodplain land uses to determine the extent of potential impacts on property owners. For example, structures not in the floodway based on a one foot rise standard could well be within a more restrictive floodway. Also, the development of floodway mapping is expensive, requiring the services of a licensed Professional Engineer skilled in the science of floodplain hydrology and hydraulics.

MODEL LANGUAGE: The 2006 Minimum Standards Model includes language requiring adoption of a floodway allowable rise where such floodway data are provided under the NFIP, or where studies are developed from other sources. The allowable rise is that level in the community flood study. If a smaller floodway rise is desired, the definition should be changed accordingly.

SPECIAL CONSIDERATIONS: There are several agencies and programs available for communities to study and map floodways using a more restrictive allowable rise. Under the NFIP's Cooperating Technical Communities Program, local partnerships are established with FEMA, agencies such as the U.S. Geologic Survey, Corps of Engineers, regional watershed management agencies, and other entities to combine resources and provide NFIP restudies and new flood maps using the latest engineering and mapping techniques. The U.S. Geologic Survey, Corps of Engineers, and Natural Resources Conservation Service also have flood study programs. These federal agency programs could be also utilized to conduct flood studies based on a more restrictive floodway, then adopted for planning and management, and incorporated into NFIP restudies.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: At least 67 Ohio communities have adopted a more restrictive floodway allowable rise, including Allen County, City of Clyde, City of Fairfield, Franklin County, City of Kent, City of Painesville, and the City of Worthington. Many of these communities have incorporated the regulatory floodway into parks and greenway-bikeway systems. The City of Sharonville in Hamilton County is working with the Corps of Engineers to develop a floodway for Mill Creek based on a one-tenth (0.1) foot allowable rise, for future adoption in order to more effectively manage the waterway.

STANDARD / KEYWORD: 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.

DISCUSSION: Proper foundation design and construction is critical for building "survivability" in the event of a flood. Despite local and NFIP requirements to elevate residential structures and elevate or "dry floodproof" nonresidential structures to at least the BFE or flood protection elevation, many such buildings are damaged in floods due to failure of one or more foundation elements. For example, during severe flooding in South Texas in the summer of 2002, some elevated residential structures were completely washed away even while remaining intact, because their foundations and/or connections to building supports were inadequately designed and/or constructed to meet flood forces. Generally in flood hazard areas foundation design should be "overbuilt" and exceed the performance criteria for foundations in non-flood prone areas.

The discussion on foundation design must be preceded by a brief review of how flood forces damage buildings. Floods damage buildings in several ways beyond the simple intrusion of floodwaters into a structure. These include several types of flood forces: *Hydrostatic* forces act as static loads, or the weight of the floodwater against a building at any point. Hydrostatic loads increase as increased flood depth translates into higher static pressures against the foundation and building walls exposed to flooding. These forces combine to act by exerting vertical pressures downward on any structural elements such as roofs and overhead members under floodwater; vertically upward (uplift) from the underside of horizontal members such as floor slabs and footings (also known as buoyancy); and laterally, in a horizontal direction on walls, piers, and other vertical surfaces. Hydrostatic flood forces include lateral water pressures, saturated soil loads, the combination of the two, equivalent hydrostatic pressures due to the added effects of velocity, and vertical or buoyancy pressures. Manufactured homes are particularly vulnerable to such forces with foundations often consisting only of dry stacked concrete blocks with inadequate anchoring systems designed more for wind than flood loads.

At moderate to high flood flow velocities around a structure, floodwaters create *hydrodynamic* forces, or additional loads consisting of frontal impact by the mass of moving floodwater against the projected height and width of the flow obstruction presented by the structure itself, the effects of drag around and along the sides of the structure, and eddies or negative pressures on the downstream side of the structure. Such forces act in conjunction with hydrostatic forces to add to effective pressures on building foundation elements. The third type of flood force is the effect of *debris impacts* on structures, which is a function of the mass or weight of the object and the speed or velocity of flow. Depending on flow velocities, impact forces can range from minimal, accounting for smaller objects with relatively low mass and low velocity, to extreme, in situations where flow velocities are very high, for example, over 10 feet per second, and objects are massive, such as large logs, ice floes, or accumulated flood debris. Other flood factors that must be considered in building design include stream bank erosion, interior drainage, and non-flood forces such as wind loads.

To counteract the potential for damage by flood forces, architects, engineers, and other building design professionals should incorporate building site considerations and design aspects such as soil type, stability, and slope (influences type of foundation), depth of flooding at the 100-year frequency above grade (to help determine whether elevation on fill or other design is appropriate), use of the building, *etc.*

The advantage of better foundation design is essentially a hardened building envelope that can survive floodwater pressures and debris impacts on exterior walls and foundation members. This in turn reduces the potential for structural failure, which by itself can lead to failure of load bearing supports, floor and wall to foundation connections, and ultimately floodwater intrusion into the structure. In many cases foundation damage renders a structure uninhabitable or subject to extensive repairs. Stronger foundations mean less flood damage, fewer repair costs, building sustainability, and protection of the investment. And, under the NFIP's Community Rating System that provides flood insurance discounts to participating communities that go beyond NFIP minimums, rating credits are available for foundation design criteria. The main disadvantage is that the limitation of the specific design chosen may not be as aesthetically desirable by the developer, and in some cases foundation design challenges and intended building purpose and function may be unsuitable for location in a flood hazard area.

MODEL LANGUAGE: The 2006 Minimum Standards Model contains requirements at Section 4.5 B (3) for nonresidential floodproofing certification, *i.e*., that the design and methods of construction ensure it is dry floodproofed, or watertight, to the flood protection elevation, and for construction using enclosures below the lowest floor, at Section 4.4 (E). (Note: NFIP minimum standards require floodproofing certification to the base flood, or 100-year flood elevation).

The recommended higher standard to incorporate similar design certification for residential construction is as follows:

(1) Add to Section 4.4(D), Residential Construction, the following bolded language:

> *New construction and substantial improvement of any residential structure, including manufactured homes, shall have the lowest floor, including basement, elevated to or above the flood protection elevation.* **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.**

SPECIAL CONSIDERATIONS: There are several helpful technical publications on foundation design available from FEMA, including FEMA 102, *Floodproofing Nonresidential Structures*, FEMA 85, *Manufactured Home Installation in Flood Hazard Areas*, FEMA 312, *A Homeowner's Guide to Retrofitting*, and the FEMA Technical Bulletin Series. To order FEMA publications call 800/480-2520.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Several Ohio communities have adopted foundation design criteria, including Clermont County (both residential and nonresidential designs must be certified by registered Professional Engineer or Architect), Creston (manufactured home foundation support/reinforcement criteria), and New Richmond (enclosures below the lowest floor and support design certifications).

STANDARD / KEYWORD: FREEBOARD

OBJECTIVE: To protect structures against damage from floods heights greater than the base flood (100-year frequency flood).

DISCUSSION: A "freeboard" is a safety factor usually expressed in feet above a flood level for the purpose of floodplain management. Freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for the base flood and conditions such as wave action, obstructed bridge openings, debris and ice jams and the effects of urbanization in a watershed.

Seldom does nature pay attention to the term "100-year flood." Although the nationwide regulatory standard set by the National Flood Insurance Program is the base, 1% chance annual, (or 100-year) flood, greater floods can and will occur. In fact, communities can even experience two or more 1% chance annual floods in the same year. Also, structures that are built in compliance with local floodplain regulations can expect to have up to one foot of water in them if the flood fringe was totally developed! In communities experiencing rapid growth and urbanization this problem can be worse. Studies done in Charlotte, North Carolina indicated an average 2.7-foot increase in base flood elevations from their flood maps created in the 1970's to today due to urbanization.

Another advantage of a freeboard is the reduction in the cost of flood insurance. The insurance rates for new structures in SFHA's are directly related to their lowest floor elevation compared to the base flood elevation. For example, the annual flood insurance rate for $50,000.00 coverage for a single family home with no basement built at base flood elevation would be $370.00. The rate for the same structure, with 1 foot of freeboard, would be $215.00 and the rate with 2 feet of freeboard would be $110.00.[5]

Disadvantages of freeboard include potentially increased construction costs for structures, and more fill being placed in the SFHA if the method for elevating the structure is a fill pad. The impact of additional fill is the loss of floodplain storage for floodwaters.

MODEL LANGUAGE: The 2006 Minimum Standards Model has a definition of flood protection elevation. This definition has a place for the insertion of a freeboard:

(1) Add the recommended freeboard (bolded) to Section 2.0, Definitions:

> *Flood Protection Elevation*
> *The Flood Protection Elevation, or FPE is the base flood elevation plus **two** feet of freeboard.*

SPECIAL CONSIDERATIONS: Could cause difficulty with higher standards for fill, especially if the fill standard is very restrictive (in terms of quantity or height) and fill pads are

[5] This rate does not include certain policy fees and is based on a simplified analysis of flood insurance rates as of May 1, 2002. Many variables affect flood insurance rates and these numbers are for comparative purposes only.

the most common method of elevating a structure. In this case, methods for elevating a structure could be limited to extended foundations, piers, piles or columns.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: At least 26 Ohio communities have adopted a freeboard including Union County, the Village of Ansonia, the City of Sandusky, Licking County, Ross County and the City of Columbus.

STANDARD / KEYWORD: FUTURE CONDITIONS HYDROLOGIC MAPPING[6]

OBJECTIVE: To protect property against impacts of increased flood heights due to anticipated future development in rapidly developing areas.

DISUCUSSION: "Future conditions hydrology" means the flood discharges associated with projected land-use conditions are based on a community's zoning map and/or comprehensive land-use plans, and the 1% chance annual floodplain is based on future hydrology conditions shown on a community's FIRM. Future development in the drainage area for a stream will increase the amount of impervious area and reduce the timing of runoff, causing the peak flow in a stream to increase during heavy rains. When this happens, structures built to current standards (i.e., to the base flood elevation on the community's FIRM) may be damaged by a storm that has a higher frequency of occurring.

Until recently, NFIP regulations did not allow for mapping of floodplains on a FIRM based on future conditions; however, FEMA has issued new guidelines and regulation changes to allow new or updated FIRMs to show both the existing conditions 1% annual chance floodplain (designated as Zone A Special Flood Hazard Areas) and the future conditions 1% annual chance floodplain. If a community or state chooses to develop and submit the required information, FEMA will show the future conditions 1% chance annual floodplain as a shaded Zone X and designate it Zone X (future base flood). Only the existing conditions 1% chance annual floodplain will be shown on the FIRM. The future conditions 1% annual chance flood elevations will be included in the flood profiles and data tables in the Flood Insurance Study report. The base flood elevations will be used for mandatory flood insurance purchase requirements of the NFIP. Communities would be able to regulate development in the future conditions floodplain with proper regulatory changes.

Adoption of this standard may prevent loss of life and property because elevated construction is safer during a flood event (adopting a freeboard also does this). The lowest floor elevation has a direct impact on the flood insurance rates for a structure and any structure built using future conditions standards will be rated based on its lowest floor above the existing conditions base flood elevation. Also, the "effective life" of a FIRM is extended if future conditions are mapped.

Disadvantages include the additional cost for elevating structures to the future conditions levels. Also, future conditions mapping would be an additional cost above the amount to produce a detailed study floodplain.

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 flood level.

(1) Under Section 2, add the following definitions:

[6] Information about this standard has been adapted from *Safer Development in Floodprone Areas*. Please see the bibliography for additional information.

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) Modify Section 1.5 to add the following (bolded) phrase:

These regulations shall apply to all areas of special flood hazard ***and areas of future conditions flood hazard*** *within the jurisdiction of the [COMMUNITY NAME] as identified in Section 1.6, including any additional areas of special flood hazard annexed by [COMMUNITY NAME].*

(3) Modify Section 1.9 to add the following (bolded) phrase:

. . . These regulations do not imply that land outside the areas of special flood hazard ***or areas of future conditions flood hazard*** *or uses permitted within such areas will be free from flooding or flood damage . . .*

(4) Modify Section 3.2(A) to add the following (bolded) phrase:

Evaluate applications for permits to develop in special flood hazard areas ***and future conditions flood hazard areas****.*

(5) Modify Section 3.3 to add the following (bolded) phrase:

It shall be unlawful for any person to begin construction or other development activity including but not limited to filling; grading; construction; alteration, remodeling, or expanding any structure; or alteration of any watercourse wholly within, partially within or in contact with any identified special flood hazard area ***or future conditions flood hazard area****, as established in Section 1.6 . . .*

(6) Modify Section 3.4 to add the following (bolded) phrases:

An application for a floodplain development permit shall be required for all development activities located wholly within, partially within, or in contact with an identified special flood hazard area ***or future conditions flood hazard area****. Such application shall be made by the owner of the property or his/her authorized agent, herein referred to as the applicant, prior to the actual commencement of such construction on a form furnished for that purpose. Where it is unclear whether a development site is in a special flood hazard area or* ***future conditions flood hazard area****, the Floodplain Administrator may. . .*

(7) Modify Section 3.11(D) and (E) to add the following (bolded) phrases:

D. The Floodplain Administrator shall make interpretations, where needed, as to the exact location of the flood boundaries and areas of special flood hazard ***and areas of future conditions flood hazard****...*

E. Where a map boundary showing an area of special flood hazard ***or area of future conditions flood hazard*** *and field elevations disagree...*

(8) Modify Section 4.0 to add the following (bolded) phrase:

The following use and development standards apply to development wholly within, partially within, or in contact with any special flood hazard area ***or future conditions flood hazard area*** *as established in Section 1.6 or 3.11(A):*

SPECIAL CONSIDERATIONS: One of the most important considerations in choosing to map and regulate based on future conditions is the size of the watershed in which the development is occurring. In general, the larger the drainage area, the smaller the impact future development will have on the peak flows and flood levels in a stream. There are two reasons for this.

First, the percentage of the total basin that will become impervious is less for larger basins. For example, a large commercial or industrial development with 5 acres of impervious surfaces could increase the flows in the stormwater drainage paths by a factor of 5 or more. This impact, however, will decrease as the total area of the basin increases. The second reason is the difference in timing between runoff from developed and undeveloped areas. Development speeds runoff. If the receiving stream has a large undeveloped watershed upstream of the urban area, the development could actually reduce the peak flow in the stream at the community by accelerating runoff ahead of the flood peak flow.

The predicted future condition flow and flood elevation depends on the method of analysis and assumptions made by the hydrologists and engineers preparing the flood study. The difference in the results could be dramatic. For example, one assumption that must be made in the analysis is the percentage of the floodplain storage that will be filled in by development. The most conservative approach would be to assume all areas not within a floodway would be ultimately filled. Technically, there is no prohibition on fill in floodplains outside the floodway, so this is theoretically possible. However, developers typically use enough fill to raise only the building footprint to the required level; lawn and parking areas often remain below the BFE.

There are other higher standards that could be adopted to reduce the impacts of future development. These include limiting the volume of fill within the flood fringe, requiring compensatory storage for fill, minimum setbacks or buffer zones for development, or low density zoning within the floodplain. Adopting these higher standards would be less costly than determining future flood elevations. Finally, adopting future hydrologic conditions floodplains and enforcing floodplain regulations without adopting these other higher standards may prevent future structures from flooding, but it would not prevent future increases in the flood elevations from impacting existing structures.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Currently, no Ohio communities have adopted future hydrologic floodplain mapping. Nationally, the City of Charlotte and Mecklenburg County, North Carolina have created and adopted such mapping.

STANDARD / KEYWORD: 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.

DISCUSSION: There are several ways in which materials storage affects flood damages. Many types of materials used in construction activities, for example, can easily float off site during a flood, becoming flood borne debris. Such debris collects against bridges, fences, and in channels and culverts, causing blockages that may increase flood stages upstream and in higher velocity flood zones, can cause impact damage to buildings and other structures and choke off a stream's carrying capacity, increasing flood stages. Examples would include lumber yards, building supply centers, and manufacturing facilities. Pallets, lumber, scrap metals, and other large floatable objects should be securely anchored outside of any identified floodways. To reduce the debris hazard created by materials storage in the floodplain is to move them out of floodway areas and anchor them if located in flood fringe areas.

Chemicals such as fuels, paints, oils, fertilizers, and other toxic substances in floodwaters become absorbed into walls and other surfaces, leading to residual deposits, biological and chemical contamination, and odors that can render a structure unsafe and uninhabitable, with extensive cleanup and environmental health costs. Included in this category are gas or liquid storage tanks both above and below ground, chemicals used at manufacturing facilities, and those stored in residential and commercial buildings. Hazardous chemical materials are best kept out of any known flood risk areas but at minimum should be stored in floodproofed containers above the flood protection elevation outside of any floodway areas.

Storage tanks in flood prone areas should be anchored to meet buoyancy factors and elevated or floodproofed to at least the flood protection elevation.

Disadvantages of anchoring materials may include service delays and other on site logistical problems associated with movement and retrieval of pallets, board lumber and other items. Disadvantages of locating chemicals outside of any flood risk areas include inaccessibility and handling problems.

MODEL LANGUAGE:

(1) Add to Section 4.1 B Prohibited Uses:

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

4. *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: Section 4.10 Storage of Materials:

Storage of material or equipment not otherwise prohibited in Section 4.1(B) shall be firmly anchored to prevent flotation.

SPECIAL CONSIDERATIONS: The potential for aggravated flood damages and higher post flood cleanup costs and public environmental health issues often outweighs the location advantages of locating and storing hazardous and other materials in flood hazard areas. For existing developments, sites should be found above the flood protection elevation, or materials should be stored in a properly elevated or dry floodproofed structure.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Several Ohio communities have adopted language limiting or prohibiting materials storage, including the Village of Corning, City of Columbus, City of Eaton, Montgomery County, Village of Obetz, Preble County, and the City of Toledo.

STANDARD / KEYWORD: 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.

DISCUSSION: The provision of setbacks allows for the preservation of a greater portion of the floodplain as open space. By setting areas aside as "no build/no fill" or "open space use" zones along streams, communities can reduce flood impacts. Setbacks:

- Allow the use of the floodplain as a natural retention area slows flood peaks downstream.
- Can be used in conjunction with or in lieu of NFIP floodway delineation to keep proposed development out of that portion of the floodplain subject to deeper, higher velocity flow that in larger floods is often accompanied by debris or ice jams.
- Retard direct soil erosion into the stream by minimizing disturbance along valley slopes adjoining the stream and floodplain.
- Assure natural stream functions and allows for stream dynamics such as channel migration (meanders) over time.
- Help to maintain and enhance water quality by allowing the stream to flood, spilling its load of suspended sediments and dispersing pollutants that degrade water quality, thus lessening the need for more expensive or additional water and wastewater treatment systems.
- Allow communities participating in the NFIP's Community Rating System to receive credits to reduce flood insurance premiums borne by policyholders.
- In a planning and zoning context are a compatible term with building lot and road setbacks that can be adjusted to accommodate the riparian area.

A number of methodologies have been developed to establish setbacks based on slope, stream order, vegetation, soil type, adjacent land use, and effective nutrient/pollutant removal. Setbacks can be established generally based on the functional relationship of the stream channel to its floodplain. They can also be established based on drainage area of the stream or river. The Ohio Department of Natural Resources' Scenic River Program recommends that forest "buffers", measured from the top of the riverbank outward for 120 feet, be the minimum necessary to maintain healthy riparian corridor conditions. Forested setback areas provide shade to stabilize water temperature, leaf litter to provide food for aquatic organisms, root masses from trees to stabilize the streambank and reduce erosion, and a zone for filtering chemicals and reducing soil sediments. The Ohio EPA has found that a minimum riparian setback of 75 feet is needed to provide healthy aquatic diversity.

Three important factors for communities to consider when adopting setbacks are: Setbacks should be based on some empirical data (i.e., minimum size needed to remove sediment); setbacks should be linked to goals or objectives in the community's adopted planning document(s) such as a comprehensive plan, natural hazards mitigation plan, *etc.*; setbacks must have clearly defined allowable and unallowable uses. Community leaders must reconcile what

uses are to be allowed or denied in the setback zone. Compatible uses for setback areas include bike trails, footpaths, utility crossings, campgrounds, athletic fields, playgrounds and decks.

When adopting setbacks, consideration must be given to the development that already exists that will be "grandfathered." Also, for streams that have been historically modified, constricted by development, controlled by dams, or otherwise functionally degraded, there may be a need to examine the feasibility of restoring natural stream channel and floodplain function as well as establishing a riparian setback zone.

MODEL LANGUAGE: Specific model language has not been developed due to the technical and planning information needed to establish a setback for a given watercourse. The Chagrin River Watershed Partners is a regional watershed organization in northeast Ohio that has developed a model "stand alone" ordinance for establishing riparian setbacks. 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.

SPECIAL CONSIDERATIONS: Following the recommendations of Ohio's Scenic Rivers Program managed by the ODNR Division of Natural Areas and Preserves, some local jurisdictions (primarily counties and townships) protect waterways designated as state scenic rivers for public health, safety, and welfare and natural benefits by establishing a setback of 120 feet extending out from the low water channel on both sides of the stream. There are many organizations and universities that have conducted research on buffer criteria and applicability to stream and floodplain size and function; much of this information is available on the internet.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Several Ohio communities have adopted setbacks for floodplain management. The Village of Ansonia adopted a 50 foot setback for streams having a low flow channel width less than 10 feet. The City of Delaware and the Village of Powell adopted the ODNR recommended 120-foot setback for scenic river protection on the Olentangy River, while Franklin County adopted special legislation establishing a similar setback on Big Darby Creek. Both streams have National as well as State Scenic River designation. The City of Columbus recently adopted the Hellbranch Run Watercourse Protection Overlay District establishing a "stream corridor protection zone," that includes standards for stormwater management and flood protection through limited use criteria. Several communities in northeast Ohio including Kirtland, Chagrin Falls, Aurora and Hunting Valley have adopted riparian setbacks. Summit County has adopted "countywide" setbacks ranging from 50 to 300 foot widths as part of a stream and stormwater management plan identifying critical watersheds for protection.

STANDARD / KEYWORD: 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.

DISCUSSION: Stormwater management is the process of controlling and processing runoff so it does not harm the environment or human health. Under natural conditions soil and vegetation absorb rain and make it part of the living ecosystem. What rainwater does become runoff travels slowly, allowing time for suspended particles to settle out and percolation of the water into the soil. Water percolating deep into soil increases groundwater supplies and runoff is naturally filtered of impurities.

Land development alters the natural hydrological cycle by removing vegetative cover, changing the soil structure, modifying natural drainage patterns, and adding impervious surfaces such as roads and parking lots. This altering of drainage patterns results in higher peak flows as rainwater reaches streams quicker and in larger volumes, causing more frequent and severe flooding. In addition, stream channels are often eroded by these peak flows, which result in degraded fish habitat. Stormwater also washes off pollutants from roads in parking lots and carries these contaminants to streams. By storing stormwater runoff and releasing it over time, peak flows are reduced, and sediments and pollutants in the water are given time to settle out or absorb into the ground before they wind up in a stream or river.[7]

Traditionally, most communities have managed for stormwater quantity rather than quality. The goal has been to convey water from sites as rapidly as possible through the use of gutters, downspouts, catch basins, *etc.* Some communities require developers to install detention ponds to collect and temporarily store a portion of excess runoff then gradually release it after the peak runoff has occurred. Also popular are runoff control measures such as illicit connection control, reduced use of fertilizers and pesticides, setback or buffer zones, and limitations on impervious services (often through zoning). Finally, cleansing measures are used to promote filtration and settling of pollutants. Filtering devices include sediment basins, vegetated filter strips, and silt fences.[8]

The following stormwater management concepts are presented as considerations and are adapted and summarized from the *Stormwater Management Manual for Western Washington*, August 2000 draft:

- **Stormwater Site Plans**-prior to permit approval; all projects should prepare a stormwater site plan for local review.

- **Stormwater Pollution Prevention During Construction**:
    - Mark Clearing Limits-both on the site plan and in the field.

[7] Adapted from "Floodplain Management: Higher Regulatory Standards, FEMA Region 10, 1st Edition, July 2001.
[8] Adapted from "Stormwater and Your Community" Fact sheet AEX-442, Ohio State University Extension, July 2000.

- Establish Construction Access-to limit off-site water and sediment movement, construction vehicle access should be limited to one route if possible. In addition, access points should be stabilized with crushed rock to minimize the tracking of sediment onto public roads.
- Sediment Controls-an analysis of downstream flow rates should be conducted if changes to flow rates could impair stream conveyance, cause erosion or negatively impact aquatic habitat. The native topsoil and natural vegetation should be retained to the maximum extent possible, and stormwater runoff from disturbed areas should pass through a sediment pond. Any stormwater detention facilities should be constructed prior to grading.
- Stabilize Soils and Slope Protection-during construction, all exposed soils should be protected from the erosive forces of rain, flowing water, and wind by constructing silt fences around the site and by applying mulch, grass seed, plastic covering, or gravel directly to exposed soil. The velocity of runoff from slopes can be reduced through terracing and diversions, reducing slope steepness, and roughening the slope surface. Other requirements like check dams placed at regular intervals along a ditch can also reduce the amount of sediment that leaves the construction site.
- Protect Inlets and Outlets-storm drain inlets made operable during construction shall be protected so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment. All temporary on-site conveyance channels should be constructed to prevent erosion from velocity flows caused by rainstorms.
- Source Control of Pollution-all known and reasonable operational and structural source control Best Management Practices (BMPs) should be applied to all projects to prevent stormwater from coming into contact with pollutants.
- Preserve Natural Drainage Systems and Outfalls-creating new drainage patterns results in more site disturbance and creates more potential for erosion and sedimentation during and after construction. Therefore, natural drainage patterns should be maintained to the fullest extent possible because of the multiple benefits these systems provide. Erosion control at the downstream end of the discharge point should be incorporated as well.
- On-Site Stormwater Management-retaining stormwater on-site helps to re-create a more natural hydrologic discharge cycle by simulating the effects that natural ground cover would have by slowing the release of rainfall into nearby streams and rivers. On-site stormwater management techniques infiltrate, disperse, and retain stormwater runoff at the project site thereby reducing the amount of disruption to the natural hydrologic cycle of the watershed.
- Runoff Treatment-many communities have set standards for the percent of pollutants (*e.g.*, suspended solids, phosphorous, oil, *etc.*) that must be removed to meet stormwater runoff treatment requirements. The purpose of runoff treatment is to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms to improve the water quality of the receiving stream. There are a number of BMPs designed to treat stormwater runoff.

- Flow Control-maintaining or reducing existing erosion rates within streams is vital to protect fish habitat. Therefore, it is prudent to limit the peak rate of runoff from individual development sites to some allowable discharge threshold (e.g., 50% of the pre-developed condition 2 year, 24-hour design storm).
- Wetlands Protection-wetlands can be severely degraded by stormwater discharges from urban development due both to pollutants and to the disruption of natural flow rates into the wetland. If unchecked, sediments washed off construction sites can fill in wetlands. Since wetlands provide multiple benefits including flood storage, groundwater recharge, and water purification, it is important that discharges to wetlands be controlled to protect the hydrologic and hydrophytic (wetland plant) characteristics necessary to support the wetland.

MODEL LANGUAGE: Specific model language has not been developed due to the diverse options available to communities in the management of stormwater. However, the best management practices in the ODNR, Division of Soil and Water Conservation's publication *Rainwater and Land Development* provide recommended state of Ohio standards for stormwater management, land development, and urban stream protection. For more information, please visit the Division of Soil and Water Conservation website at http://www.dnr.state.oh.us/soilandwater.

Technical assistance in stormwater management is available from three agencies: the ODNR Division of Soil and Water Conservation, the Ohio Environmental Protection Agency (OEPA) Division of Surface Water, and the federal Natural Resources Conservation Service.

- ODNR Division of Soil and Water Conservation: (614) 265-6610
- OEPA Division of Surface Water: (614) 644-2001
- Natural Resources Conservation Service: (614) 255-2500

SPECIAL CONSIDERATIONS: The development and adoption of stormwater management and erosion and sedimentation control regulations is compatible with many of the recommended higher floodplain management standards contained in this Chapter, including Compensatory Storage, Fill, Future Conditions Mapping, Setbacks, and Subdivision Regulations. Adoption and use of the best management practices in *Rainwater and Land Development* will meet some of the requirements (construction site stormwater runoff and post-construction site storm water management in new developments and redevelopments) for municipal separate storm sewer systems (MS4s) that will be required to obtain National Pollutant Discharge Elimination System (NPDES) Permits under Ohio Small MS4 Storm Water Management Program.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Licking County is considering adopting the recommended State of Ohio criteria of the current edition of *Rainwater and Land Development* into its subdivision regulations. Clermont County, which has adopted comprehensive *Water Management and Sediment Control Regulations*, requires the study and mapping of 100-year "existing inundation areas" for all streams regardless of size and whether they are mapped as Special Flood Hazard Area for the National Flood Insurance Program. Union County requires easements for conveying the 100-year storm in storm sewers and flood routing in subdivisions even if no flood hazards have been mapped.

STANDARD / KEYWORD: 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.

DISUCUSSION: Subdivision regulations are land use controls that govern the division of land into lots or building sites. Villages, cities and counties can adopt subdivision regulations in Ohio. Communities that do not have subdivision regulations but participate in the NFIP, have some development standards applicable to subdivisions within their flood damage reduction regulations. This is due to the minimum federal requirements of the NFIP.

Subdivision design has a tremendous bearing on whether a community develops in a flood resistant, sustainable manner or whether an increasing amount of developed property and infrastructure is being placed in harms way. In some areas of Ohio, there is tremendous pressure to create subdivisions in flood hazard areas because the land is usually cheaper, and it is usually flat or gently sloping. However, these lower up-front costs should be balanced with the costs associated with flood damage to buildings, roads, and other infrastructure; costs associated with flood clean-up and costs associated with rescue, not to mention the potential loss of life.

One approach to reduce flood risk and protect the natural benefits of the floodplain that is gaining is c*onservation subdivision design (CSD),* also called open space subdivision design or cluster development. CSD is an approach to subdivision design that minimizes environmental impacts. With CSD, developers are allowed to build homes on smaller lots if they leave a portion of the land undisturbed as protected open space. Compared to traditional subdivision design, CSD offers the full development potential of a parcel while minimizing environmental impacts and protecting desirable open spaces. The developed portion of the parcel is concentrated on those areas most suitable for development, such as upland areas or areas with well-drained soils. The undeveloped portion of a conservation subdivision can include such ecologically or culturally rich areas as wetlands, forestland, agricultural land/buildings, historical or archeological resources, riparian zones (vegetated waterway buffers), wildlife habitat, and scenic viewsheds. To use CSD, communities need to modify their comprehensive plans, zoning ordinances, and subdivision regulations to allow conservation subdivisions and to incorporate the flexibility into key development codes - such as lot sizes, building setbacks, and road frontages and standards[9].

Although CSD is a very effective approach for minimizing the impacts of subdivisions in floodplain areas, other techniques work well. These techniques include designing subdivisions where each lot must have buildable areas outside the floodplain area, designing each lot to have an emergency access route that is above the base flood elevation, preventing an increase in downstream flooding by minimizing the amount of impervious surface (pavement, roofing, *etc.*) allowed on a lot, and a variety of stormwater management measures.

[9] Information on conservation subdivision design was excerpted from the Reason Public Policy Institute article *Conservation Subdivision Design, A Market-Friendly Approach to Local Environmental Protection*. Please see the bibliography for additional information.

MODEL LANGUAGE: The following higher standards language should be adopted into the community's subdivision regulations and/or flood damage reduction regulations:

(1) Modify Section 4.3(D), Subdivision and large scale development to incorporate the bolded text:

D. 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 for **all major (platted) subdivision proposals, and other proposed developments at least 5 acres in size:**

(2) Add to Section 4.3, Subdivisions and Large Scale Development:

F. All preliminary plans for platted subdivisions shall identify the flood hazard area and the elevation of the base flood.

G. All final subdivision plats will provide the boundary of the special flood hazard area, the floodway boundary, and base flood elevations.

H. 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.

I. Approval shall not be given for streets within a subdivision, which would be subject to flooding. All street surfaces must be located at or above the base flood elevation

SPECIAL CONSIDERATIONS: There are other approaches to create flood resistant subdivisions in flood hazard areas. For additional information on these approaches one recommended resource is *Subdivision Design in Flood Hazard Areas.* Detailed information about this source can be found in the appendix.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: Communities that have adopted one or more of the standards recommended above include Licking County, Henry County, Greene County, Village of Creston, and the City of Tiffin.

STANDARD / KEYWORD: 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.

DISUCUSSION: Managing the use of flood hazard areas involves identifying uses compatible with the natural functions and values of the floodplain, and limiting or restricting non-compatible uses. Although use restrictions commonly are adopted under local zoning regulations, they can also be applied through special purpose regulations such as those adopted for the NFIP. Use restrictions may be the most effective tool available to regulate floodplain areas, with the possible exception of outright purchase of floodplain lands or easements. When properly used and enforced, such criteria can bring about utilization of the floodplain in a manner compatible with both the community's needs and the floodplain's natural functions.

The establishment of floodway and flood fringe areas under NFIP regulatory criteria, or by equivalent "two-district" zoning within the regulatory floodplain, provides the community with an effective land use tool. Generally, in floodways only open space uses that have low flood damage potential and which will not obstruct flood flows or increase velocities or stages should be permitted. Such uses may include agricultural uses, recreational areas such as parks, residential lawn areas, and water oriented public utilities, bridges, and other infrastructure, provided they are constructed in a manner that will not increase the base flood elevation. Uses that may increase flood levels or that pose threats to public health and safety should be prohibited in the floodway, including structures, critical facilities, and hazardous materials storage and processing. Such restrictions may also be applied to the flood fringe, especially for critical facilities and hazardous materials, for which any risk of flooding would be too great for the community.

Unlimited use of the flood fringe for development reduces the storage capacity of the regulatory floodplain to some degree, depending on the extent of the encroachment involved. Placing limitations on the uses, density and types of development in the floodway and flood fringe help to preserve flood storage capacity and flow conveyance. For example, principal structures may be prohibited from the flood fringe, with only accessory structures permitted; or only structures with engineered pier, post or pile foundations would be allowed in the flood fringe to allow for floodwater flow beneath the structure to compensate for lost storage capacity.

Among the disadvantages of use restrictions include limitations for potential development, especially for communities with few annexation opportunities. Communities also need to be aware of the ramifications of adopting very stringent use restrictions that may present regulatory takings challenges. Existing uses are generally "grandfathered," and provisions should be considered that would allow for improvements meeting at least minimum flood damage prevention criteria.

Most importantly, use restrictions should reflect goals stated in a community's planning document(s).

MODEL LANGUAGE: The 2006 Minimum Standards Model contains use restrictions at Section 4.1 B referencing state laws applicable to private water systems and infectious waste facilities. The following optional language is provided for additional use restrictions:

Add to Section 4.1 B Prohibited Uses:

3. *New construction of any residential or nonresidential structures in floodway areas.*

4. *Storage or processing of hazardous, flammable, or explosive materials in special flood hazard areas.*

5. *Critical development in special flood hazard areas.* (Note: Must also adopt the critical development definition – see critical development higher standard).

SPECIAL CONSIDERATIONS: The adoption of use restriction criteria should be carefully considered beforehand. The community's comprehensive land use plan should be reviewed to determine factors affecting use criteria including existing and proposed land use, availability of alternative locations for development outside flood prone areas, goals and objectives to be addressed by the use criteria, *etc.* There should also be a link between the purpose/intent sections of the regulations and the use restriction.

OHIO COMMUNITIES HAVING ADOPTED STANDARD: At least 38 Ohio communities have adopted some type of floodplain use restrictions, including the City of Clyde (only open space uses permitted), City of Euclid (development prohibited except accessory structures), City of Lebanon (no manufactured homes allowed), Madison County (no new principal residential or nonresidential structures), Seneca County (no new residential structures in the special flood hazard area). Sylvania (no encroachment on stream bed), and the City of Worthington (only park, agricultural, or accessory uses allowed).

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CHAPTER 4

FEDERAL AND STATE REGULATIONS

Although the primary focus of this document is local floodplain management regulations, there are several federal and state entities, which regulate floodplain development in Ohio. The permits required by these agencies are in addition to the issuance of a floodplain development permit by local jurisdictions. A brief description of the pertinent state and federal regulations, as well as the responsible entities, follows. For detailed information on any particular one, contact the agency or authority that has specific responsibility for the program or provisions in question.

This chapter should be used as a tool for obtaining information and the applicable permits for project within a stream or floodplain environment. The size of the stream and the project design will affect permit requirements. This chapter may not contain all of the permits necessary for a particular project, but should indicate most of the necessary permits.

STATE

Conservancy Districts

A conservancy district is a legal subdivision of the state, organized to conserve, control or manage water. Conservancy districts are usually organized to carry out a comprehensive water management program for an entire watershed without regard to municipal and county jurisdictions. The extent of regulatory authority exercised by conservancy districts varies from district to district. For specific information, contact the district in question.

Ohio Department of Health

The Department of Health is responsible for various public health related planning and regulatory functions. They have exclusive authority over manufactured home parks, including those located in the 100-year floodplain (this is one type of development exempt from local floodplain development permits), and review/approve plans for recreational vehicle parks and campgrounds. The Division of Water assists the Department of Health in reviewing the location of new manufactured home parks and expansions to existing parks to ensure that such sites are not subject to recurring flooding. For more information, please review the Department of Health website at http://www.odh.state.oh.us.

Ohio Department of Natural Resources

A permit must be obtained from the Division of Mineral Resources Management for in-stream mining activities (including sand and gravel dredging). The Division of Wildlife must be consulted prior to in-stream blasting or dewatering projects that may cause a loss of aquatic life. The Division of Water must be consulted for water withdrawals, or projects with the capacity to withdraw more than 100,000 gallons per day and for dam, dike and levee construction or repair. Also, state agencies and political subdivisions, prior to expenditure of funds for construction of buildings, structures, roads, bridges or other facilities subject to flooding or flood damage must consult with the Division of Water. Finally, the ODNR Director's approval authority may be

needed before a project can commence in or near a State Scenic River. For more information, please visit the Department of Natural Resources website at http://www.dnr.state.oh.us/.

Ohio Environmental Protection Agency (OEPA)

The OEPA has broad regulatory authority in the areas of air quality, water quality, and waste disposal. Projects involving streams and rivers may require a *401 Water Quality Certification,* a *National Pollutant Discharge Elimination System (NPDES) Permit,* and/or a surface water *Permit To Install (PTI)*. The OEPA has fact sheets available which explain the certification and permit processes which can be viewed on their website at www.epa.state.oh.us. Additionally, the Division of Water assists the OEPA in reviewing the flood protection aspects of wastewater treatment plants.

FEDERAL

According to federal law, anyone who wishes to dredge of place fill in the waters of the United States must obtain a *Section 10 Permit* (Rivers and Harbors Act) and/or a *Section 404 Permit* (Clean Water Act) from the U.S. Army Corps of Engineers (COE). Please note that the COE cannot permit an activity until the *Section 401 Water Quality Certification* is approved by the OEPA. Four COE Districts possess jurisdiction in Ohio: Buffalo (Lake Erie basin), Pittsburgh (Mahoning River basin), Huntington (Muskingum, Hocking and Scioto River basins) and Louisville (Little and Great Miami River basins). For additional information visit the COE website at http://www.usace.army.mil/.

APPENDIX A

ANNOTATED BIBLIOGRAPHY

The following are materials used in this handbook as references and/or sources of further information related to floodplain management regulations. Most of the documents and information are available on the internet as well and website addresses are included if known.

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APPENDIX B

MODEL FLOOD DAMAGE REDUCTION REGULATIONS

NOTICE

July 2020

The Ohio Floodplain Regulation Criteria document is currently under revision. The Floodplain Management Program has removed the Model Regulations and Compendium of Communities Having Adopted Higher Standards from this INTERIM document. The Standard and Coastal versions of ODNR's Model Flood Damage Reduction Regulations are current as of 2019 and may be downloaded from the ODNR website or requested from the Floodplain Management Program. You may still utilize this INTERIM document for guidance in adopting community floodplain management regulations and incorporating higher standards.