RECOMMENDATIONS OF THE

DRBC FLOOD ADVISORY COMMITTEE (FAC)

FOR MORE EFFECTIVE FLOODPLAIN REGULATIONS

IN THE DELAWARE RIVER BASIN

October 2009

While we have made great progress in providing flood control works, many of our river valleys are still subject to destructive floods, and the degree of protection varies widely. Moreover, it will probably not be possible, because of physical and economic limitations, to provide full flood protection. This leads to the inescapable conclusion that greater attention must be given by states, municipalities and industry, and by the federal agencies concerned with development, to some form of regulation of floodplain use…We should be as much concerned with the avoidance of creating a future flood hazard, as with means of correcting the damage after it occurs.

-Brigadier General John L. Person, Assistant Chief of Engineers for Civil Works, in testimony before the House Committee on Public Works, May 1959.

DRBC Flood Advisory Committee

Delaware Department of Natural Resources and Environmental Control (DNREC)	**New Jersey Department of Environmental Protection (NJDEP)**
New York State Department of Environmental Conservation (NYSDEC)	**Pennsylvania Department of Environmental Protection (PADEP)**
New York City Department of Environmental Protection (NYCDEP)	**Federal Emergency Management Agency (FEMA) RII and RIII**
Delaware Emergency Management Agency (DEMA)	**New Jersey Office of Emergency Management (NJOEM)**
New York State Office of Emergency Management (NY SEMO)	**Pennsylvania Emergency Management Agency (PEMA)**
US Army Corps of Engineers, Philadelphia District	**US Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS)**
U.S. Geological Survey (USGS)	**National Weather Service (NWS)**
National Park Service	**Delaware River Joint Toll Bridge Commission**
Electric Generation Industry (Hydropower and Off-Stream Storage)	**County Water Resources Agencies**
County and Local Emergency Management Representatives	

We dedicate this report to our late colleague, Mr. Joseph Zagone, P.E., PLS, CFM who was employed by the Federal Emergency Management Agency and served most recently on the Floodplain Regulations Evaluation Subcommittee (FRES). Joe was among a handful of early Certified Floodplain Managers. Joe was stalwart member of the DRBC FAC and a champion of stronger floodplain management through his work on the FRES.

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INTRODUCTION:

Background: Between September 2004 and June 2006, three major floods caused devastation along the main stem Delaware River, repeatedly damaging property and disrupting tens of thousands of lives.

Reducing flood loss is a responsibility shared by many. Recognizing this, the governors of the four basin states – Delaware, New Jersey, New York and Pennsylvania – directed the executive director of the Delaware River Basin Commission, Carol Collier, to convene an interstate task force to develop a set of recommended measures for mitigating and alleviating flooding impacts along the Delaware and its tributaries.

In July 2007, the Delaware River Basin Interstate Flood Mitigation Task Force issued a report identifying six priority management areas and a total of 45 consensus recommendations for a more proactive, sustainable, and systematic approach to flood damage reduction in the basin. One of the six priority management areas identified by the Task Force was floodplain regulations.

In November 2008, at the request of New Jersey and Pennsylvania commissioners, the Flood Advisory Committee of the DRBC formed the Floodplain Regulations Evaluation Subcommittee to address Recommendation FR-1 of the Interstate Task Mitigation Task Force Report.

Excerpt from Recommendation FR-1:
"There is no consistent set of floodplain regulations basinwide to uniformly manage development within the floodplain areas of the basin. Currently, floodplain regulations vary widely from State to State and often from community to community. As a result, development may be occurring in the floodplain of one State or community that may be adversely affecting other States and communities.

Development in the floodplain individually and cumulatively results in adverse impacts somewhere in the watershed. These adverse impacts can include increased flood stages, increased velocities, erosion and sedimentation, water quality degradation and habitat loss. In addition to these negative effects, development in the floodplain disturbs naturally vegetated riparian corridors and often threatens the safety of both residents and emergency personnel in the event of a flood." (Task Force Report July, 2007)

The Flood Advisory Committee (FAC) of the DRBC provides a forum for coordination of flood warning and flood loss reduction activities and the efficient use of technical and financial resources for the benefit of the Delaware River Basin community.

FAC Charge to the Floodplain Regulations Evaluation Subcommittee: To review and evaluate the similarities and differences in floodplain regulations throughout the Delaware River Basin, and to develop and present recommendations on the potential for more effective floodplain management throughout the Basin to the FAC.

Subcommittee Organization: The Floodplain Regulation Evaluation Subcommittee (FRES) was composed of twenty (20) representatives who represent the interests of the basin states, federal government, environment, citizens, builders, agriculture, commerce, floodplain mapping and local officials. Representatives were appointed by their representative interest group when possible. The list of subcommittee representatives is included in Appendix II of this report.

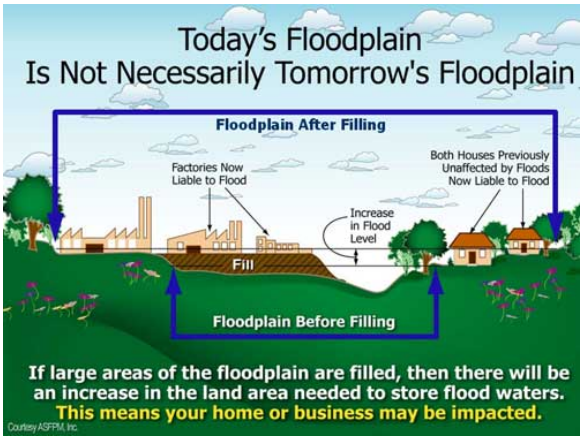
Review Materials: The following list of regulations and guidance was reviewed by the subcommittee to inform their deliberations:

- National Flood Insurance Program (NFIP) minimum requirements (44 CFR 60.3)
- Delaware River Basin Commission Floodplain Regulations
- New Jersey - NJDEP Flood Hazard Area Control Act Rules (N.J.A.C. 7:13)
- Pennsylvania – Pennsylvania Flood Plain Management Act (Act 166-1978)
- Guidance from PADCED on how municipalities can meet the minimum National Flood Insurance Program (NFIP) requirements
- New York - Floodplain Management Criteria for State Projects (6NYCRR Part 502)
- NYS Residential Building Code (Chapter III, Section R323)
- Guidance by NYSDEC; Optional Additional Language to Model Local Law for Flood Damage Prevention

- New Castle County, DE (Unified Development Code Section 40.10.310 – Floodplains and Floodways)
- National Flood Programs and Policies in Review, Association of State Floodplain Managers, 2007
- Effective State Floodplain Management Programs, Association of State Floodplain Managers, 2003

Timeline: The Floodplain Regulation Evaluation Subcommittee (FRES) of the FAC met eight (8) times over the course of seven months. The first meeting convened on November 12, 2008. Meeting agendas noting speakers when applicable are included as Appendix II to this report.

In May 2008, the subcommittee presented its report and recommendations to the FAC. Following deliberation and some modification, the FAC now presents its recommendations for more effective floodplain regulations to the Commission.



SUMMARY:

The FAC herein presents twelve (12) recommendations for more effective floodplain regulations to the Commission. These recommendations can be considered each individually or in their entirety for a comprehensive approach.

A summary table of FAC recommendations and regulations currently in place is included as an Appendix to this report. Currently, floodplain regulations vary widely from State to State and often from community to community.

The National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), requires that communities adopt and enforce floodplain management ordinances in order for flood insurance to be available to homeowners in that community. These floodplain management ordinances are known as the "minimum" requirements that each community must have in place.

Communities are allowed and even encouraged by FEMA to adopt floodplain regulations that are "more than the minimum". Some progressive communities in the basin have adopted more stringent regulations, but the majority have only adopted NFIP minimum regulations.

As there are 868 communities in the basin, this report does not catalog the floodplain regulations adopted by each community. Instead, National Flood Insurance Program (NFIP) minimum regulations, DRBC Floodplain Regulations and basin state regulations are compared in Appendix I.

In most cases, the FAC is proposing that in order to be more effective, floodplain regulations need to be applied on a broader, watershed basis and not adhere to state jurisdictional boundaries. Flood damage potential is a function of human development in floodplains. Development in flood-prone areas needs to be discouraged and new and substantially improved structures must be constructed in ways that minimize or prevent future flood damage.

The regulations currently in place for addressing development in the floodplain have not successfully reduced flood damages, in fact they have allowed new development, redevelopment, and expansion of existing development to continue and the result has been a continued increase in flood damages.

A brief summary of the twelve (12) FAC recommendations for more effective floodplain regulations is presented here:

A. Regulatory Floodplain Definition:

1. The regulatory floodplain for waterways in the Delaware River Basin should be greater than the 1% annual chance (previously known as the 100-year) floodplain.

2. Unmapped waterways of the Basin need a mechanism for identifying the regulatory floodplain.

B. Floodway Definition:
The floodway in the Delaware River Basin should be defined by a 0.2 foot rise standard for main stem Delaware River and all other streams and rivers within the basin. The floodway is currently defined as a less restrictive 1.0 foot rise.

C. Development/Fill in the Flood Fringe:
Protect the flood fringe in a naturally vegetated state and limit development including, but not limited to, structures, infrastructure, impervious surfaces, fill, grading and removal of vegetation.

D. Development/Fill in the Floodway:
New development in floodways should be prohibited.

E. Stream/Riparian Corridors and Vegetation Disturbance:
Incorporate the buffer concept as part of a comprehensive floodplain management program to protect communities from flood damage.

F. Adopted Building Code:
Continue the adoption of International Codes issued by the International Code Council.

G. Standards for the Lowest Habitable Floor of Structures (Freeboard):
All new substantially improved residential, institutional and commercial structures within the Delaware River Basin should be constructed two (2) feet above 1% annual chance base flood elevation.

H. Enclosed Areas below Flood Elevation:
1: Deed restriction should be required for enclosures.
2. Structural requirement: If the enclosure below the flood elevation is greater than 6 feet in height measured from floor to floor, at least 25 percent of the surface area of the outer wall of enclosures should be left permanently open.

I. Substantial Damage/Improvement to Structures:
1. Cumulative Substantial Damage Declaration
2. Tracking of Cumulative Substantial Damage/Improvements

J. Dams and Flood Damage Risk:
1. Increase monitoring of dams. Dams with a clear and present danger of failure should be removed.
2. States should increase funding and assistance to small dam owners for evaluation and removal.
3. Hydraulic studies in the vicinity of high and medium hazard dams should be revisited to evaluate the change in flood hazard areas.
4. Completion of emergency action plans for high hazard and significant hazard dams must be prioritized. These plans contain inundation maps that identify flood hazard areas in cases of a dam failure.
5. Before a dam is removed, hydraulics must be revisited to evaluate the adequacy of downstream drainage structures, and the accuracy of upstream floodplain maps.
6. Require the evaluation of downstream flooding impacts as part of the permit application process for dam decommissioning or dam repair which increases spillway capacity.

K. Bridge/Culvert Construction or Reconstruction and Flood Damage Risk:
1. Design new bridges and culverts to ensure that flooding to existing buildings or facilities is not exacerbated upstream or downstream. Design should be based on the results of updated flood models using recent climate data that incorporates changing precipitation trends.
2. Maps should be updated for new crossings.

L. Stormwater Regulations - New and Redevelopment:
The goal of stormwater design within the Delaware River Basin should mimic pre-development hydrology at a minimum.

CONSIDERATIONS:

In developing recommendations on the potential for more effective floodplain management throughout the Basin, the following considerations were recognized and discussed:

- Diversity of Stream Character across the Basin
  - Main stem vs. tributary
  - Urban vs. Rural
  - Tidal vs. Non-tidal
  - Agricultural Lands

- Floodplain Restoration
- Floodplain Mapping
- Implementation
- Socio/economic Impacts
- Permitting/Enforcement
- Education

Diversity of Stream Character across the Basin: The committee recognizes that the character of stream reaches in the Delaware River Basin vary tremendously. The main stem Delaware River stretches roughly 360 miles from it's headwaters in New York State to its mouth at the Delaware Bay, and its tributaries extend many hundreds of miles more. Over its course the river and its tributaries run through a variety of landscapes, all which affect the risk to life and property from flood events differently.

Many geomorphic, geologic, climatological, and anthropogenic factors influence the flood risk on a particular stream reach, including location in the watershed (mainstem vs. tributary), land use and population distribution (urban vs. rural), and the effect of tidal action (tidal vs. non-tidal). This committee found that comprehensive floodplain regulations beyond minimum NFIP standards need to be implemented across the entire Delaware River Basin, which responsibly reflect the conditions and needs of the various watershed regions within the basin.

Given the diversity across the Basin in watershed and stream corridor character, and development patterns, it is essential that management prescriptions be suited to the stream reach where they are applied. Good stream management on a lightly populated headwater reach is going to look very different from good stream management on a lower estuarine reach adjacent to a major metropolitan area. While adopting consistent goals throughout the Basin is critical, the methods for attaining those goals are going to vary on particular stream reaches. Stream regulators and managers must be wary of over-generalizing the Basin when prescribing management solutions. To proceed otherwise risks harming communities, either by not requiring enough safety precautions, or by over-regulation.

A major consideration resulting from the difference in flood risk across the Basin is how to allocate resources to the areas where they are most needed.

Main stem vs. tributary: The character of flood risk varies considerably between the main stem Delaware River and its tributaries, and changes continuously as one moves downriver. As an example of two extremes, many headwater tributaries in the upper watershed are characterized by flash flooding in narrow canyons. These flash floods develop very quickly (minutes to a few hours) in response to excessive local runoff, are brief in duration, and transport a relatively small amount of water compared to floods on the lower main stem. Floods on the lower main stem generally come on more gradually, cover a large extent, convey a large amount of water, and persist for longer periods of time. Each kind of flood requires different methods of preparation and response in order to avoid loss of life and property. When developing a management prescription for a particular stream reach, its location in the watershed should be considered.

Urban vs. rural: Anthropogenic factors, development patterns in particular, are a key determinant of the risk a flood poses to life and property. In the event of a flood, more people and property will be in harm's way in densely populated areas. Current and future population distribution in flood hazard areas should be taken into account when creating management prescriptions for particular stream reaches.

Tidal/Non-tidal: Storm surge can affect all of the tidal portions of the Delaware River and tributaries and can extend well beyond the normal head of tide in severe surge events. The head of tide for the main stem of the Delaware River is at Trenton, New Jersey.

Storm surge associated with major hurricanes can far exceed the 100-year flood elevations. For example, at Wilmington, Delaware the 100 year flood level is +10 NAVD 88 yet the storm surge elevation associated with a Category 3 hurricane is over 16 feet NAVD 88. Although the return frequency of a major hurricane may be rare, and may not be appropriate for normal floodplain construction standards, for certain critical facilities and emergency operations functions, it may be appropriate to use hurricane surge levels, in location and design considerations.

Hurricane evacuation scenario planning often relies on surge modeling and mapping. Where surge

areas have been mapped using outdated topography, they are likely not very accurately delineated.

- Surge inundation areas should be delineated using best available topography.

Existing DRBC floodplain regulations are applicable only to non-tidal areas of the Delaware River Basin. NFIP regulations allow fill in tidal areas because it is assumed that encroachment in tidal areas will not cause increase in the 100-year flood stage. It is known, though, that filling may cause increases in regional flooding and exacerbate drainage problems during rainfall events in which flood stages do not approach 100-year levels.

- Consideration of restriction of fill, such as through DRBC's floodplain regulations, should be given to tidal areas.

Agricultural Lands:

Agricultural use has historically occurred in the floodplains because of their fertile soils and generally flat topography. The effect of agriculture in the floodplain should be taken into account when creating management prescriptions for particular stream reaches. It is not the goal of these recommendations to create regulations on agriculture that may impede their ability to remain competitive against other regional farm operations. Instead, agriculture in the floodplain should be encouraged to be compatible with responsible floodplain management including, but not limited to, existing programs that provide incentives to farmers to provide buffers along watercourses.

Floodplain Restoration: As articulated by the Congressional Task Force on Natural and Beneficial Functions of the Floodplain, June 2002, floodplains "reduce flooding and limit flood-related damages through their floodwater conveyance and storage functions."

As a result, protecting and restoring floodplain functions "will reduce flood losses" in addition to providing groundwater recharge, filtering sediment and contaminants, transporting nutrients, supporting habitats for a variety of sensitive living resources, and enhancing community quality of life.

The regulations currently in place for addressing development in the floodplain have not successfully reduced flood damages, in fact they have allowed new development, redevelopment, and expansion of existing development to continue and the result has been a continued increase in flood damages.

Communities subject to increasing flood damages include both historic communities (those over 100 years old) as well as recent development (those built within the past 5 years). Historic communities play an important role in the history of our region and nation. New development has contributed to increasing flood damages by both placing new homes in harms way as well as increasing flood flows and peaks for pre-existing communities. If we are to reduce flood damages in the future it will be important to undertake a floodplain protection and restoration strategy.

Floodplains vegetated with trees and shrubs can be four times as effective at retarding flood flows as grassy areas. Naturally vegetated floodplains are generally layered with leaf and organic matter that result in organic soils with high porosity and a greater capacity for holding water. More than just being an area that can help address flooding issues in a community, the floodplain, in this natural state, is a riparian ecosystem that needs the overbank flows that the natural watershed's hydrology provides in order to remain healthy and in balance.

The protection and restoration of forested floodplains reduces the harm and threat of flooding to homes, businesses and communities (1) by ensuring they are not located in these most hazardous of areas that are known to flood and (2) by reducing the peak and breadth of flooding thereby protecting homes that historically have not been located in the path of floods. Protection and restoration of the floodplain also removes the need for emergency services, the costs of rebuilding, and all of the other financial, physical and psychological costs associated with flood damaged communities located in the floodplain.

A floodplain protection and restoration program focused on reducing present and future flood damages does not mandate the removal of every structure – for example there are numerous community reasons for maintaining and protecting historic structures and vistas despite their location in the floodplain as these structures and areas have other cultural, historic and social values to the community. A floodplain protection and restoration strategy can and should leave room for honoring these and other values of the community.

- The Basin States and the DRBC should provide funding and programs for acquisition, protection and restoration of developed and undeveloped property in the flood plain on both tributary streams and the main stem Delaware River. DRBC's authority to engage in acquisition and restoration of floodplain lands is provided under Article 6, section 6.3 of the Delaware River Basin Compact.

- States should craft and carry forward a program to identify and purchase for fair value structures located in the floodplain that property owners are interested and willing to sell – this program would be focused on identifying and pursuing structures/properties that the home owner/property owner has, by their own volition, initiation, choice and action, put on the market for sale. This program should include a mechanism whereby homeowners could reach out to state, federal and/or regional agencies to first offer them the home for sale at fair market value plus an additional financial incentive- thereby providing the homeowner an economic incentive to offer the home first to government programs focused on purchase and removal of structures at risk of flooding prior to the homes entering the public market for sale.

- DRBC should develop a prioritization of areas, communities and structures for acquisition and floodplain restoration and reforestation activities. This prioritization should include identification of historic communities and structures that should be targeted for alternative flood damage solutions including floodproofing and elevation.

- The Basin states must get out ahead of efforts of the federal government regarding the potential impacts of climate change on flood risk and incorporate this information in all of its flood mitigation strategies. Regional predictions for sea level rise, temperature and precipitation trends are available. There is now a solid, scientific basis for these predictions and further refinements in predictions for the Delaware Basin can be expected on a periodic basis.

- The Basin states must get out ahead of efforts of FEMA regarding repetitive loss properties and put together a repetitive loss reduction strategy. This strategy should include well-rounded programs that encourage the offer and acceptance of buyouts for repetitive loss properties including creating and funding programs that provide funds needed to give fair market value for purchased properties as well as creation of programs to assist flood victims in their relocation programs to assist in securing new, affordable mortgage rates, and affordable housing within their community if they so chose. A basin-wide committee that works with FEMA, state emergency management agencies and other state and regional agencies to identify priorities, possible funding and programs should be formed.

- States should also create and implement programs to remove highly vulnerable public works structures from the floodplain with a special emphasis on waste water treatment plants which are routinely overwhelmed by floodwaters and discharge untreated or partially treated sewage into receiving streams and rivers. As part of this program, all public works without an NHR listing that have experienced repetitive loss should be phased out by requiring removal from the flood hazard area upon substantial change. For instance, a wastewater treatment plant should be required to move out of the flood hazard area if the footprint of the physical plant is expanded.

Floodplain Mapping: FEMA develops and produces flood hazard data and maps in order to administer the National Flood Insurance Program (NFIP). The Delaware River Basin is comprised of two FEMA Regions, FEMA Region II and FEMA Region III. This requires the states and FEMA Regions to coordinate and confer on methodology and mapping specifics so that a seamless map can be created across state boundaries.

Having accurate maps of flood hazard areas is critical to the ability to properly identify and manage flood hazard areas. There are many areas, particularly in the upper portions or other undeveloped areas of the Basin, where flood hazard maps do not exist or if they do exist are inaccurate. New regulations based on inaccurate maps will be ineffective. Furthermore, any regulation based on a flood hazard map is only applicable on streams where flood hazard areas are defined. While the expense inherent in creating detailed flood hazard maps is great, it is an inescapable fact that this information is necessary to plan for flood damage prevention and the enforcement of regulations regarding development in stream corridors. Also critical is the ability of the appropriate people to access and use those maps.

- Fund further detailed studies and flood hazard mapping throughout the basin: Available resources should be directed at creating new, more accurate flood hazard maps in the areas that are lacking this information. This is essential to proper planning for flood damage prevention and the enforcement of any new regulation.

- Fund training in the use of flood hazard maps for individuals tasked with enforcing existing and any potential new regulations: Individuals who will be encountering potentially non-compliant projects the most should be familiar with flood hazard maps for their community and their use. This includes but is not limited to code enforcement officers, planning board members, and realtors.

- Make maps accessible and easy to use: Maps should be widely accessible and easy to use, so that any person concerned with the flood risk to a particular property can access and understand that information. Making maps available in an interactive form on the internet would be a good way to provide access to many people at low cost.

- FEMA must develop a means to incorporate into its flood mapping program the projected impacts of sea level rise and precipitation due to climate change in assessing flood hazard areas. Periodically updated projections of what flood hazard maps for T+10, T+25, T+50, and T+100 years from now (T= year of update) would be very helpful to planners, especially in low lying coastal areas.

Implementation: The committee did not recommend means of implementation for the recommendations contained within this report. The committee realized that there may be many different means of implementing any one recommendation. When possible, proposed regulations should be implemented within existing regulatory frameworks either at the local, county, state or regional level recognizing that adequate implementation of any one recommendation is strongly dependant on education, permitting and enforcement.

Socio/economic Impacts: The committee did not analyze social, economic or environmental impacts of the recommendations contained in this report. This issue of considering impacts was raised as an important factor that should be considered as recommendations were formulated. This type of analysis is often required as any rule making process and should be performed by the entity proposing any higher regulatory standard.

The higher standards for floodplain development recommended by the committee are primarily intended to specifically reduce flood damage to new and existing property and generally to reduce the impacts of flood events on both the built and natural environment.

Permitting/Enforcement: Permitting and enforcement of floodplain regulations often occurs at the local level by local officials. Floodplain managers come from a variety of curricula and backgrounds. In small communities, floodplain managers are sometimes part-time employees. The role of these floodplain managers is expanding due to increases in disaster losses and the emphasis being placed upon mitigation to alleviate the cycle of damage-rebuild-damage. Many of these localities do not have the necessary resources to provide consistent and comprehensive administration and enforcement of floodplain regulations. An integral part of improving the floodplain management in the Basin is the allocation of more resources to this function.

A review of the enforcement methods throughout the Basin found that there was consistency in the structure of the regulations as many were based on State models that were subsequently adopted by the local communities. However: effective administration of existing regulations and the potential adoption of new standards will not be successful unless the overall administration and enforcement of floodplain regulation improves. The following components need to be included in any proposed floodplain regulation:

1. Due process for applicants
3. The ability to issue stop work orders with the owner having the option to fully mitigate or remove a structure
4. A variance procedure and no certificate of occupancy issued without completion of an as-built elevation certificate
5. Monitoring and investigative staff
6. The ability to levy fines
7. Training for inspection/enforcement personnel

Education: There is a need for a coordinated education, outreach and training program in the basin

for floodplain managers, local planning and zoning boards, professionals and the public. Communities need to be armed with the proper knowledge to properly evaluate whether development is reasonably safe from flooding or will exacerbate local flooding conditions, will result in increased flood damages and flood response costs, and result in other issues of community concern.

The Certified Floodplain Managers (CFM) certification should be promoted for all local floodplain managers and professionals. This national certification was established by the Association of State Floodplain Managers (ASFPM) to improve the knowledge and abilities of floodplain managers in the United States. CFMs are professionals that:

- understand the rules and regulations of floodplain management;
- understand natural and beneficial functions of the floodplain;
- understand the various causes of flooding (e.g. how several moderate rain events in quick succession can increase flood risk);
- understand how NWS products and services can be utilized to assess the near term flood risk;
- understand the possible impacts on flood risk of sea level rise and increased heavy rainfall and warmer temperatures associated with climate change;
- understand risk analysis and map interpretation;
- understand the impacts of building in the floodplain;
- stay current with floodplain management trends and activities by taking continuing education classes;
- provide guidance on local conditions and development;
- provide guidance to officials and citizens on floodplain management and describe the risks involved in building in the floodplain as well as the beneficial uses of the floodplain; and
- have attained a level of knowledge of floodplain management that allows them to perform a variety of flood preventive activities in the community.

The local State chapters of ASFPM, the New Jersey Association of Floodplain Managers (NJAFM) and the New York State Floodplain and Stormwater Managers Association (NYSFSMA) currently provide CFM training and exam opportunities.

RECOMMENDATIONS

A. Regulatory Floodplain Definition

Background: A naturally functioning floodplain is a hydrologically important and dynamic component of a watershed. In addition to being environmentally sensitive and ecologically diverse, floodplains provide flood storage and conveyance, protection of water quality and recharge of groundwater.

A regulatory floodplain may, or may not, encompass the natural floodplain, the area needed for a watercourse to maintain its natural biologic, geomorphic and hydrologic functions. Instead, regulatory floodplains are adopted standards designed to guide floodplain development and lessen the effects of floods on the built environment.

In order for property owners to be able to purchase flood insurance through the National Flood Insurance Program (NFIP), their municipality is required to enforce certain minimum regulations on development in the floodplain. FEMA defines its regulatory floodplain, the Special Flood Hazard Area (SFHA), as any area inundated by the base flood. The base flood is the national standard used by the NFIP and Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development.

The base flood is defined as having a one-percent chance of being equaled or exceeded in any single year. It is also informally referred to as the 100-year flood, which incorrectly leads to the assumption that a base flood is expected to occur once in 100 years. Instead, the base flood has a one-percent (1 out of a 100) chance of being equaled or exceeded in any single year. Therefore, a base flood could occur two times in the same year, two years in a row, or four times over the course of 100 years. The terms “base flood,” “100-year flood,” and “one-percent annual chance flood” are often used interchangeably with the 1% annual chance of flood deemed the most accurate description.

Flood Probabilities	
Return Period	Chances
500-year	1 in 500 (0.2%)
100-year	1 in 100 (1%)
50-year	1 in 50 (2%)
25-year	1 in 25 (4%)
10-year	1 in 10 (10%)

It is important to acknowledge that floods do not stop at regulatory floodplains, nor does the regulatory floodplain define the limit of potential flood damage or losses. Nationally, FEMA reports that 25 percent of total flood insurance claims are made by property owners located outside of the 1% annual chance floodplain. In the Delaware River Basin, 35 percent of repetitive loss property owners are located outside of the 1% annual chance floodplain.

In addition, an uncontrolled release of water during either a non-storm or storm event, like the catastrophic dam failure or the breach of a levee, could result in significant flooding impacts beyond the 1% annual chance floodplain.

States and local municipalities are encouraged by FEMA to adopt “more than the minimum” requirements. In fact, the Community Rating System (CRS), a FEMA program, rewards such communities by issuing credit points based on the adoption of standards higher than the NFIP's minimum requirements. Policyholders in these communities receive discounts on their flood insurance premiums because their communities are implementing floodplain management programs that go beyond the minimum requirements of the NFIP.

Future development and the impacts of climate change are not taken into account during the development of FEMA flood hazard area mapping. As future development or other land use changes within a watershed area occur, runoff may increase flows to flood-prone areas downstream.

In NJ, for State land use regulatory permits, the NJ Flood Hazard Area Design Flood (NJFHADF) is equal to the 1% annual chance flood plus an additional 25% in flow, not to exceed the 0.2% annual chance flood. The NJFHADF boundary is to regulate disturbance to the land and vegetation within a flood hazard area. This regulation is set forth by the State of New Jersey Flood Hazard Area Control Act Rules N.J.A.C. 7:13 and is administered by the New Jersey Department of Environmental Protection. This NJFHADF is more restrictive than the national standard of the 1% annual chance floodplain and was adopted by NJ as a means to consider the effects of future development. It is important to notice that at points along the Delaware River, the NJFHADF ranges from about 3 to 8 feet above the 1% annual chance base flood elevation.

DE, PA and NY currently use the 1% annual chance peak flow to define the regulatory floodplain without any considerations for future build out.

As mentioned in the Preamble under the heading "Floodplain Mapping", substantial portions of the Basin have inaccurate maps, or in some cases no maps at all. In these areas map-based regulations are currently not an option. Members of the sub-committee expressed the importance of evaluating the flood risk in these areas based on population density, development trends, projected climate change impacts, and history of flood damage.

Recommendations: The regulatory floodplain for waterways in the Delaware River Basin should be greater than the 1% annual chance floodplain.

Projected impacts due to climate change should be incorporated into flood plain maps and future regulatory decisions. This is especially important in coastal areas where significant changes in sea level are projected. While doing this will be a significant challenge, it is important given recent projections. It is recommended that projected flood maps be created for times T+10, T+25, T+50, T+100 years based on the best available predictions for sea level rise, temperature, and precipitation in the basin. (T= year of update)

1) The Flood Advisory Committee proposes one of the following two comparable approaches:

Option 1

The regulatory floodplain for the Delaware River Basin should be defined by the 1% annual chance flood plus an additional 25% in flow, not to exceed the 0.2% annual chance flood along the main stem of the Delaware River and all other streams and rivers within the basin. Flood hazard area maps should include this residual risk factor of 25%; 1) to consider current and future planned development, 2) to recognize variability in hydrologic modeling, 3) to consider temporary blockages to culverts and other hydraulic impediments, and 4) to more accurately define flood risk.

Option 2

The regulatory floodplain for the Delaware River Basin should be defined by the 0.2% annual chance floodplain (also known as the 500-year floodplain) along the main stem of the Delaware River and all other streams and rivers within the basin. Any change in the regulatory floodplain for the Delaware River Basin would require a remapping effort. As the 0.2% annual chance floodplain is already mapped in a large part of the basin, implementation of this regulatory floodplain definition may be able to occur more quickly. If and when projected flood plain maps for T+10, T+25, T+50, T+100 years become available, consideration should be given to defining the flood plain using one of these maps.

2) Unmapped waterways of the Basin need a mechanism for identifying the regulatory floodplain. Whether this mapping is prepared by 1) DRBC, 2) the developer, or 3) States and Communities, all maps prepared along previously unmapped waterways should be prepared using consistent methodology.

In order to prioritize mapping preparation, unmapped or inadequately mapped areas should be evaluated based on population density, development trends, projected climate change impacts, and history of flood damage. Areas at high risk of flood damage based on this evaluation can be prioritized for future mapping and possibly more stringent regulations.

B. Floodway definition

Background: Existing flood hazard area maps greatly underestimate the limit of floodways along the main stem Delaware River and other waterways within the Delaware River Basin. The flood hazard area, or floodplain, is the area along a waterway that is expected to be or has been inundated by floodwaters. The floodway, which is the inner portion of the flood hazard area nearest the stream or river, is the most dangerous area that carries deeper flows and higher velocities during a flood. New construction of structures is generally prohibited in floodways because it is unsafe and obstructs the passage of floodwaters, although removal of vegetation and construction of parking or other nonstructural activities while having an impact are often allowed. The flood fringe, or areas immediately adjacent to floodways where development is commonly allowed are often subject to flood depths and velocities similar to those of the floodway.

A regulatory floodway is defined as the channel of a river or other watercourse and portions of the floodplain adjoining the channel that must be reserved in order to carry and discharge the base (or 1% annual chance) flood without cumulatively increasing the

water surface elevation more than a designated height. The Floodway drawn on floodplain maps is based on a technique of compressing the wetted cross section in the hydraulic model, until a desired surcharge is achieved. This surcharge is the floodway standard, of which the minimum FEMA floodway standard allows for a 1.0-ft rise. The current New Jersey State floodway standard, allows for a more conservative 0.2-ft. rise in flood depths. This more stringent, lower rise determination results in a larger regulatory floodway allowing the same base floodwaters to be carried downstream over a larger area. Even though NJ has adopted this more stringent standard on its in-state waterways, the less stringent FEMA standard was used to delimit the floodway for the main stem of the Delaware River to avoid inconsistencies between different floodway criteria on the New Jersey and Pennsylvania sides of the river. Both Pennsylvania and New York allow a 1.0-ft rise floodway standard throughout the Delaware River Basin. Communities must regulate development in these floodways to ensure that there is no increase in the base flood elevation at any location.

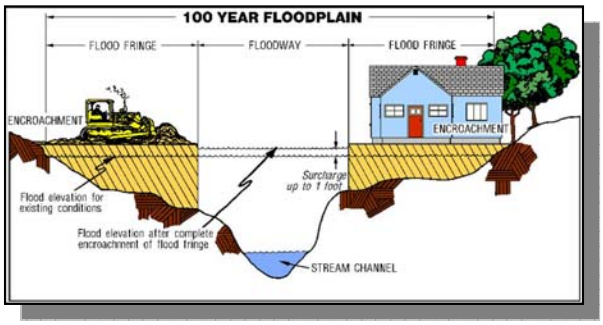
Due to the inherent challenges of hydrologic and hydraulic modeling, limitations of topographic accuracy, and general cartographic limitations, the exact placement of a floodway is open for discussion, debate and change. An experienced land development engineer, working for a developer with enough resources, will likely be able to relocate the floodway boundary using the FEMA Letter of Map Revision (LOMR) process. Therefore, while the floodway concept is a strong floodplain management tool, it is only as strong as the mapping it is based on. Any regulation tied to the floodway could be avoided entirely if the floodway is amended via the LOMR process. Savvy developers will review the modeling and determine if it is cheaper to comply with stricter regulation, or simply attempt to adjust the floodway limits and thereby remove themselves from regulatory authority. In these cases, a 0.2-ft rise floodway standard would make it more difficult to play these types of games.

Currently designated 1-ft rise floodways are extremely narrow and new construction is sometimes improperly permitted in close proximity to streams and rivers simply because they are not currently demarcated as floodways. Greater portions of the floodplain would lie within mapped floodways if the 0.2-ft floodway standard were to be used. Adequately defining the floodway and regulating development in these floodways is one way to ensure future flood loss reduction.

Recommendation: The floodway in the Delaware River Basin should be defined by a 0.2-foot rise standard for the main stem Delaware River and all other streams and rivers within the basin. Such a change would help to deter risky, new development in close proximity to streams and rivers.

C. Development/ Fill in the Flood Fringe

Background: The Flood Hazard Area, as defined by FEMA, is composed of a floodway and a flood fringe. The flood fringe is the portion of the floodplain that lies outside the floodway.



Floodwaters generally move more slowly in the flood fringe as compared with the floodway, and the flood fringe serves to temporarily store large volumes of floodwater during a flood. The space that floodwaters occupy on a given site during a flood is referred to as the "flood storage volume" of that site.

When structures or fills are placed in a flood fringe, it occupies a space that would otherwise be filled with floodwaters during a flood, thus reducing the flood storage volume on the site. If a significant volume of floodwater is prevented from occupying a given area, excess floodwater will instead occupy neighboring and downstream properties, thus worsening flood conditions on those sites.

Unless properly managed, development within floodplains can exacerbate the intensity and frequency of flooding by increasing stormwater runoff, reducing flood storage, and obstructing the flow of floodwaters. Structures constructed in the flood fringe are subject to flood damage and threaten the health, safety and welfare of both the people who occupy them and emergency responders who respond in times of flood emergency.

Historically, the earliest settlements along the eastern seaboard were established along navigable waters. As a result, many of the Delaware River basin's older communities lie partially or completely within floodplains. As development has continued within the basin over the years, increased impervious cover in the form of roads, buildings and parking lots combined with the destruction of forest and wetlands for development and agriculture has increased peak rates and the volume of runoff flowing to the streams and rivers within the basin.

Development within the floodplain obstructs flood flows and compromises the flood storage and peak attenuation contributions of a natural floodplain. In addition, it knowingly places structures, infrastructure and people in the very locations that are known and expected to be subject to flooding and flood damages. As a result, flooding that naturally occurs along waterways has become progressively more threatening and damaging to people, buildings and infrastructure as a combination of increased runoff, decreased vegetation and storage absorption capacity and additional development in floodplains occurs. It is expected that these negative trends will continue so long as buildings and structures continue to be placed in the floodplains of the streams and rivers of the Delaware River basin.

<u>Recommendation:</u> Protect the flood fringe in a naturally vegetated state and limit development including, but not limited to, structures, infrastructure, impervious surfaces, fill, grading and removal of vegetation.

The goal of managing development in the floodplain shall be to prohibit, except in extraordinary cases, new development in the flood fringe and to reduce risk to people and structures currently located in the floodplain. Development, for purposes of this document, is defined to include structures, infrastructure, impervious surfaces, fill, grading, storage of materials and equipment, and removal of vegetation.

Furthermore, the overall goal shall be to preserve existing floodplains and enhance the ability and function of floodplains by removing unnatural obstructions and reconnecting streams to their floodplains.

All communities in the basin should be encouraged to develop comprehensive plans that establish no build and no disturbance zones within environmentally sensitive and high storm hazard areas such as riverine floodplains and coastal storm surge areas.

Development shall be based on avoiding construction in the flood fringe and maintaining the floodplains in a natural state. Strong standards shall be established for siting, construction and protection of all structures in the flood fringe.

As governments face the costs of maintaining an aging infrastructure, it is wise to focus on flood solutions that do not depend on active maintenance. Non-structural solutions to flooding problems should be considered before structural solutions. Non-structural solutions include, but are not limited to, physical relocation or elevation of structures in the floodplain and floodplain or stream restoration projects. Some structural solutions include dams, levees and backflow prevention devices. Structural solutions should be reserved only to address existing development.

The Flood Advisory Committee recommends establishing regulations and policies throughout the basin that:

- Promote standards that protect floodplains from alteration and promote enhancement.
- Permit only passive uses in the flood fringe. Passive uses are defined as uses that do not require grading or placement of habitable structures. Examples include agriculture, pasture, orchards and natural areas.
- In the flood fringe, prohibit creation of new lots without sufficient buildable area outside of the flood hazard area.
- Limit new structures within the flood fringe to the maximum extent possible.
- Prohibit the placement of fill as a means to make a previously undevelopable parcel buildable.
- Require any development in the flood fringe to be designed so that it does not unnecessarily displace existing flood storage or increase flood heights. Where flood storage displacement does occur, an equal volume of flood storage shall be created offsite, but within the same watershed and as near to the fill as possible.

- Require critical facilities including, but not limited to, hospitals, fire and police stations, transportation facilities to be kept outside of the 0.2% (500 year floodplain) to protect life, health and the local economy.
- Provide incentives to existing property owners in the flood fringe to: 1) relocate homes and businesses outside the flood hazard area where possible; 2) make improvements to structures below substantial improvement levels to reduce flood damage potential and increase flood storage (reference K. Substantial Damage/Improvement to Structures); and 3) make improvements to properties in the flood fringe to increase flood storage.
- Design new bridges and crossings to ensure that flooding to existing buildings or facilities is not exacerbated upstream or downstream.
- Design new agricultural structures in a manner that results in minimal damage to the structure and its contents, and will create no additional threats to public safety or environmental degradation.
- Establish urban floodplain reclamation programs. These should establish incentives for projects that include floodplain reclamation, such as a "density bonus" for building outside of the floodplain.
- Coordinate with existing programs that preserve agricultural lands, forests, wildlife habitat and others, which help guide encroaching development areas outside of floodplains.

D. Development/ Fill in the Floodway

Background: The floodway is the portion of the floodplain that is required to carry the design flood with a pre-defined rise. The depth and velocity of flow in the floodway is much greater than flow within the flood fringe. Therefore, development in floodways is subject to greater flood damage potential from the depth and velocity of flow. It is recommended that policies prohibit new development in the floodway and encourage relocation of people who have chosen to live in floodways.

People living within floodways are subject to devastating flood events that impact public heath, safety and welfare, and often result in loss of life and severe damage to property. Emergency response systems are often overextended during floods as they attempt to rescue people from dangerous flood prone areas.

Since the floodway is the portion of the floodplain that is reasonably required to carry floodwaters, the dynamics of flooding are much different in the floodway than within the flood fringe. Whereas the flood fringe temporarily stores floodwaters, the floodway quickly conveys floodwaters.

Placing structures or fill within a floodway can also cause serious obstructions to flow, which increases the depth of flooding and exacerbates erosion, therefore adversely impacting people situated outside the floodway as well as within the floodway. Furthermore, placing fill in one portion of a floodway can not easily be offset by an equal cut in another portion of the floodway because floodwater conveyance within floodways can be quite complicated and is often sensitive to a number of factors, such as the size, shape, skew, cross-sectional area and friction of the channel and adjacent floodway, as well as the presence of manmade structures and natural topographic features.

Structures situated in floodways are often subject to greater depth and velocity of flooding than those in the flood fringe, placing the people who use and rely on these structures at great risk during a flood.

Recommendation: New development in floodways should be prohibited. Development, for purposes of this document, is defined to include structures, infrastructure, impervious surfaces, fill, grading, storage of materials and equipment, and removal of vegetation.

The Flood Advisory Committee recommends establishing regulations and policies throughout the basin that:

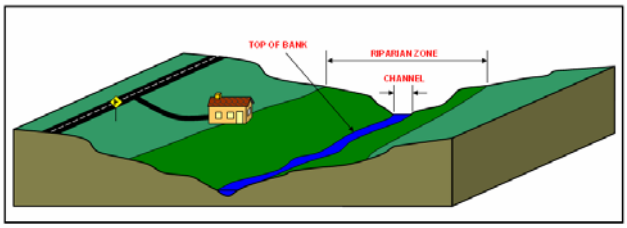
- Prohibit the placement of fill or new structures within floodways.
- Eliminate/redesign existing obstructions to flow where possible.
- Provide existing floodway property owners with opportunity to make improvements below substantial improvement levels to

properties and structures to reduce flood damage potential.

- Provide incentives to relocate homes and businesses outside the floodway, where possible.
- Design and construct all bridges and crossings to ensure that flooding to existing buildings or facilities is not exacerbated upstream or downstream.

E. Stream/riparian Corridors and Vegetation Disturbance

Background: A stream corridor is composed of several essential elements including the stream channel itself, associated wetlands, floodplain and vegetation. Literature indicates that stream buffers, particularly those dominated by woody vegetation, are instrumental in providing numerous ecological and socioeconomic benefits. Simply put, riparian corridors protect and restore the functionality and integrity of streams. A natural riparian corridor decreases flood damages, decreases erosion, and improves water quality.



While the focus of riparian buffer research has often been on the water quality and habitat benefits of buffers, there is support for the ability of buffers to attenuate flooding. Research has demonstrated that because of the hydrologic and hydraulic impacts of vegetated buffers, buffered streams experience a less dramatic spike in stream flow from storm events, and do a better job of storing floodwaters and releasing them gradually, thus reducing flood crest height downstream.

While there is no question that riparian buffers can help to prevent flood damage, there was debate over the most effective way to define and regulate them in the Basin. Literature does indicate that the desirable width and character of a riparian buffer varies according to the purpose of the buffer (flood damage prevention, water quality, bank stability, aquatic habitat, terrestrial habitat, etc.), and the characteristics of the stream and the riparian area (stream width, stream discharge, drainage area, topography, soil type, land use, population density, existing and traditional riparian vegetation, etc.). Several formulas exist to determine buffer design based on desired function and site characteristics.

While designing buffers based on site and watershed characteristics is ideal, it requires scientific analysis that can be time consuming and expensive. Regulations based on science can also be more complex and thus more difficult to enforce. For these reasons, many regulators advocate a fixed-width buffer mandate.

Recommendations: Incorporate the buffer concept as part of a comprehensive floodplain management program to protect communities from flood damage.

The Flood Advisory Committee proposes one of the following two comparable approaches:

Option 1

1) Adopt a minimum 100' vegetated buffer along all waterways of the basin; and

2) Communities who have crafted an approved fixed or variable-width riparian buffer program can implement that program in lieu of the 100' minimum buffer mandate.

Option 2

1) DRBC should establish and require a riparian variable-design buffer program. The program should include a minimum buffer recommendation based on an evaluation of buffer widths as they relate to flood damage prevention. This model program should be informed by an evaluation of existing programs in the basin and elsewhere.

2) If a community already has a buffer program in place judged by DRBC or the relevant state agency to be effective, that program should be considered adequate for compliance.

3) The resulting buffer program should include an element that requires restoration/creation of vegetated buffers in new development and redevelopment circumstances.

F. Adopted Building Code

Background: The International Building Code (IBC) is a model building code developed by the

International Code Council. It has been adopted throughout most of the United States.

Pennsylvania, New York, New Jersey and New Castle County, DE have adopted the 2006 International Code issued by the International Code Council. Section 1612.4 of the International Building Code states the design and construction of buildings and structures located in flood hazard areas shall be in accordance with American Society of Civil Engineers known as the ASCE 24 – 05 Flood Resistant Design and Construction. Highlights of the ASCE 24 are as follows:

Freeboard:

- Dwellings: 1-foot freeboard.
- Essential/Emergency Facilities: 2-3 feet freeboard
- Agricultural/Temporary Facilities: Lowest Floors at Base Flood Elevation (BFE)

Fill: Required to be stable under conditions of flooding, including rapid rise and rapid drawdown, prolonged inundation, and erosion and scour; structural fill compaction is specified or an engineering report is required; side slopes are required to be no steeper than 1:1.5.

Soil considerations: Soil characteristics and underlying strata, including soil consolidation, expansion or movement, erosion and scour, liquefaction, and subsidence must be considered.

Flood-Damage Resistant Materials: Flood-damage resistant materials shall be used below the lowest floor elevations, including freeboard. Requires structural steel exposed to salt water, salt spray, or other corrosive agents to be hot-dipped galvanized after fabrication; other metal components shall be stainless steel or hot-dipped galvanized.

Utilities and Service Equipment: Utilities and attendant equipment that is elevated shall not be located below the lowest floor elevations, including freeboard.

Siting Considerations: Structures shall not be built in:

- Areas subject to flash flooding (floodwaters rise to 3 feet or more above banks in less than 2 hours).
- Erosion-prone areas (determined by analyses) unless protected.
- High velocity flow areas (faster than 10 ft/sec) unless protected.

Buildings in proximity to flood protective works (dams, levees, floodwalls, diversions, channels) shall not have adverse effects on, or conflict with, maintenance and repairs of those protective works.

Recommendation: Continue the adoption of International Codes issued by the International Code Council concerning standards in the floodplain, except in cases where the recommendations proposed in this report are more restrictive.

G. Standards for the Lowest Floor of Structures (Freeboard)

Background: "Freeboard" is a factor of safety usually expressed in feet above a flood level for purposes of floodplain management. Freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of a watershed.

Benefits of freeboard include avoided damages and insurance savings. Freeboard often results in significantly lower flood insurance rates due to the lower flood risk. The flood damage reduction benefits of freeboard —and the savings on NFIP flood insurance policies—were documented in the NFIP Evaluation Report, Evaluation of the National Flood Insurance Program's Building Standards (October 2006).

Example A Zone building, slab or crawlspace foundation (no basement). $200,000 building coverage, $75,000 contents coverage.

Floor Elevation above BFE	Reduction in Annual Flood Premium*
1 foot	39%
2 feet	48%
3 feet	48%
4 feet	48%

* Compared to flood premium with lowest floor at BFE

Freeboard is not required by FEMA's NFIP standards, which require that the lowest floor (including basements) of structures within the 1% annual chance floodplain be constructed at or above the FEMA base flood elevation (BFE). The BFE is the computed elevation to which floodwater is

anticipated to rise during the base flood. BFEs are shown on Flood Insurance Rate Maps (FIRMs) and on flood profiles.

Recently FEMA proposed to have a freeboard requirement added directly to the 2009 International Residential Code (IRC). Despite strong support, the vote required the addition of freeboard for V Zones and Coastal A Zones only. The requirement will not extend to all Special Flood Hazard Areas, including riverine floodplains.

Many states already require freeboard. In the basin, these states include New York and New Jersey. In NY, the lowest floor of all one or two family buildings must be constructed two (2) feet above the FEMA base flood elevation. In NJ, the lowest floor of all residential and commercial structures must be set at least one (1) foot above the NJ Flood Hazard Area Design Flood (NJFHADF), or, in cases where a NJ flood hazard design flood elevation does not exist, two (2) feet above the FEMA base flood elevation.

Pennsylvania and Delaware currently adhere to the NFIP minimum which permits the lowest floor of all residential and commercial structures to be at or above the BFE.

It is important to notice that at points along the Delaware River, the NJFHADF ranges from about 3 to 8 feet above the FEMA base flood elevation. Therefore, at a specific locations, current regulations in NJ will require new construction to be built approximately 6' above the FEMA base flood elevation (1' above the NJFHADF), whereas at the same location across the river in PA, the lowest floor of new construction is permitted to be built at the FEMA base flood elevation.

Recommendation: All new or substantially improved residential, institutional and commercial structures within the Delaware River Basin should be constructed with two (2) feet of freeboard above the 1% annual chance base flood elevation. This recommendation should apply to all structures within the 1% annual chance floodplain and those outside of it that are less than two feet higher than the base flood elevation.

Currently, floodproofing of non-residential structures, instead of elevation, is an approved means to prevent or reduce flood damage. In the event of a basinwide freeboard requirement, a provision for floodproofing of non-habitable and/or commercial structures may be requested.

H. Enclosed Areas below Flood Elevation

Background: History tells us that what was, at the time of construction, compliant space below the lowest floor, over time transitions to living space. Vigilance on the part of local officials is needed to prevent this from occurring.

NFIP standards require that the lowest floor (including basements) of structures within the 1% annual chance floodplain be constructed at or above the FEMA base flood elevation (BFE). Fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Specific opening requirements can be found at 44 CFR 60.3 (c)(5).

Recommendations:

1) At time of construction, a deed restriction should be required for enclosures. This deed restriction would need to be filed with the recorder of deed. It is recommended that a copy of the deed restriction be filed with floodplain administrator to aid in proper floodplain management and enforcement at the community level.

2) Structural requirement: If the enclosure below the flood elevation is greater than 6 feet in height measured from floor to floor, at least 25 percent of the surface area of the outer wall of enclosures should be left permanently open. Such a requirement would prevent conversion of enclosures built below the flood hazard design elevation from being converted into living space.

I. Substantial Damage/Improvement to Structures

Background: "Substantial damage" has occurred when the cost of restoring a structure to its pre-damage condition equals or exceeds 50 percent of the structure's pre-damage market value. A cumulative substantial loss determination would be two (2) flood losses over a ten year period with an average damage of 25% of the structure's market value at the time of each damage event. Once a structure is considered substantially damaged, the structure is required to

come into NFIP compliance which often means elevation of the structure is mandatory.

Increased Cost of Compliance or ICC coverage will pay up to thirty 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 in their ordinance. ICC coverage is part of the standard flood insurance policy.

To qualify for Increased Cost of Compliance, a building must be:

- Covered by a National Flood Insurance Program standard policy,
- Located in a Special Flood Hazard Area, also known as a regulatory floodplain,
- Below the base flood level, and
- Either "substantially damaged" or a "repetitive loss property."

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. The extra money can be used by property owners to make their homes or businesses safe from future floods.

Unless records are kept very well and up to date, there can be difficulty in implementing cumulative provisions for substantial improvement and substantial damage. This issue needs to be well covered by educational training programs.

"Substantial improvement" means any reconstruction, rehabilitation, addition or other improvement to a structure, the total cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement.

Recommendation(s):

1) Cumulative Substantial Damage Declaration: A cumulative loss determination should be applied in the basin following the ICC definition of cumulative loss, two flood losses over a ten year period with an average damage of 25% of the structure's market value at the time of each damage event.

As ICC coverage does not fully cover the costs of mitigation, it is recommended that once a property is determined to be substantially damaged or a repetitive loss property, the structure should go on a high priority list for acquisition and/or have greater access to funds for elevation.

2) Tracking of Cumulative Substantial Damage/ Improvements: Tracking of cumulative substantial improvements and/or damages for structures in special flood hazard areas is necessary to ensure that flood protection measures are incorporated.

J. Dams and Flood Damage Risk

Background: When considering dam construction, dam removal, spillway modification and potential dam failure, the most significant issue related to flood damage prevention is the change in floodwater distribution that will result. FEMA generally doesn't include small impoundments as being influential to the 100 year floodplain. More common flood events (1yr, 10yr, 25yr, 50yr), however, can be greatly affected by smaller impoundments. The creation/removal/failure of a dam has the potential to dramatically change the magnitude of these flood events, and their failure during larger flood events can result in increased damage and loss of life immediately downstream.

There are a large number of dams in the Delaware River basin. Many of these dams are very old, and present a wide range of structural integrity. Failure of these dams can create a flood hazard that is not predicted by existing maps, especially in areas directly downstream. Failure of dams of this nature has resulted in fatalities in Delaware County, NY. Better monitoring of dams and their effects on flood damage is necessary to fully safeguard life and property in the basin.

Recommendations:

1) Monitoring of all dams, and small, possibly-overlooked dams in particular, **should be increased**. Dams that present a clear and present danger of failure should be removed or their hazard sufficiently mitigated.

2) States should seek to increase funding and technical assistance to small dam owners for evaluation and removal, where necessary.

3) Completion of emergency action plans for high hazard and significant hazard dams must be prioritized. These plans contain inundation maps that identify flood hazard areas in cases of a dam failure. These maps are essential for emergency planning. A mechanism should be developed to communicate the location of dam failure hazard zones to the public. The emergency action plans should be regularly exercised and include notification of the National Weather Service in their communication plan.

4) Hydraulic studies in the vicinity of high hazard and significant hazard dams should be revisited to evaluate the change in flood hazard areas above and below the dam in the event of failure. Consideration should be given to the possibility of the failure of multiple small dams in a major flood event. Such studies should also occur prior to any non-emergency dam breach.

5) Before a dam is removed, hydraulics must be revisited to evaluate the adequacy of downstream drainage structures, and the accuracy of upstream floodplain maps.

6) The evaluation of downstream flooding impacts should be completed as part of the permit application process for either a dam decommissioning or dam repair which increases spillway capacity. This evaluation should detail the effects of a breach or change in spillway configuration on the downstream channel demonstrating that the project will not adversely affect flooding conditions downstream during the 10-, 50-, and 100-year storm events.

K. Bridge/Culvert Construction or Reconstruction and Flood Damage Risk

Background: The Delaware River watershed is very large. Over its course the river runs through a variety of landscapes, all which affect the risk to life and property from flood events differently. Particularly important to bridge and culvert design is the geomorphology of the stream channel, valley, and adjacent uplands, and population distribution and density where the structure occurs. While all of the states in the basin should be aware of the policies and standards of the others, and all should work together where appropriate to mitigate flooding, it is important for each state in the watershed to develop standards and details that are appropriate for their topography, population densities and development. One standard design procedure for the entire basin is inappropriate.

The central concerns of designing highway drainage structures are the duration of their useful life, the costs they will incur over the course of that lifespan, and risk assessment. While it is possible to design and build structures that would withstand extremely large events, it is likely that the benefit will not be worth the cost given that the structure will reach the end of its useful life long before the design event affects it.

Recommendation(s):

1) Design new bridges and culverts to ensure that flooding to existing buildings or facilities is not exacerbated upstream or downstream. Design should be based on the results of updated flood models using recent climate data that incorporates changing precipitation/temperature trends and, where appropriate, the latest regional projections for sea level rise. It is likely that old models for determining the probability of occurrence of a particular event are no longer appropriate, given the impacts of climate change in the Basin. These models should be re-evaluated using USGS stream gage data.

The USGS streamgage network is critical to providing real-time information used for making flood forecasts, determining adequate heights for construction of bridges and levees, and to emergency management agencies for deciding whether or not to evacuate cities and towns that are in danger of flooding. It is highly important that the streamgage network continue to be maintained and supported via funding of its local cooperators.

2) Maps should be updated for new crossings; the applicant should submit Letter of Map Revision (LOMR) as part of the application process should there be any change in the base flood elevation or extent.

L. Stormwater Regulations –New and Redevelopment

Background: Managing the impacts of stormwater runoff and the flooding that often results is becoming as challenging as ever. Impacts caused by urbanization and impervious land cover include increased runoff volumes, diminished stream base flow, increased frequency of bank full flooding,

stream bank erosion, loss of riparian forest cover, floodplain disconnection, decline in aquatic and plant diversity and changes in sediment yield and transport. Facing many of same the challenges experienced by stormwater managers nationwide, such as impaired watercourses listed on the EPA 303d stream inventory, antiquated drainage infrastructure and an increase in flooding frequency and severity, stormwater managers and regulators have been forced to move away from traditional stormwater management methods which have been proven to be ineffective.

To that end, ordinances have been promulgated that focus on a runoff volume based method of stormwater management; rather than traditional store and release stormwater designs. These new designs emphasize the importance of maintaining a healthy hydrologic balance between recharging groundwater supplies, the use of infiltration to maintain stream health and filtering stormwater runoff using natural, non-structural practices by the implementation of Green Technology Best Management Practices (GTBMPs). Stormwater managers in the Mid-Atlantic region recognize that approximately 90% of the annual rainfall comes from rain events of 2 inches or less.

The challenges to successfully managing stormwater runoff are not limited to the physical boundaries of hydrology and hydraulics. Runoff is a natural occurring process respective of land uses and the associated land covers. A successful stormwater program must address the range of land uses from residential to commercial and Greenfield development to Brownfield development and redevelopment.

<u>Recommendation:</u> The goal of stormwater design within the Delaware River Basin should mimic pre-development hydrology at a minimum by the following:

- Require post development infiltration to achieve 100% of the pre-development infiltration condition when feasible.
- Mandate no net increase in the volume rate of runoff post development as compared to pre-development.
- Mandate use of stormwater best management practices to address runoff volume management, pre-development infiltration goals, re-use and reduction of stormwater. Include peak rate control for the 2, 10 and 100 year design storm if not already addressed by the series of strategies already used to address volume, infiltration and quality issues.
- Establish corridors for the conveyance event (typically the 10 year frequency storm event) and verify that no hazards or life-safety issues exist for storm events up to the 100 year flood event through the creation of easements or right of ways.
- Require minimum vegetated buffers on riparian buffers to all watercourses in the basin.
- Provide 100% water quality treatment for the 2.0” rainfall event in 24-hours.