

The Floodplain Management Plan

of the COMMONWEALTH OF VIRGINIA



Prepared for:
**Virginia Department of
Conservation & Recreation**



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*The Floodplain Management Plan
for the Commonwealth of Virginia*

Executive Summary

EXECUTIVE SUMMARY

Virginia has experienced several recent severe flooding events that have increased the awareness of many local officials and citizens in the Commonwealth. Recent federal disasters in Virginia resulting from Hurricane Fran (1996), Hurricane Floyd (1999), flash flooding in Southwest Virginia (2001, 2002, 2003), Hurricane Isabel (2003) and Tropical Storm Gaston (2004) demonstrate the vulnerability of Virginians to the damages caused by flood events. The economic impact of these events is in the 100's of millions of dollars. In addition, is the incalculable loss of human life. Proper floodplain management can reduce these impacts.

The purpose of floodplain management in Virginia is to reduce the loss of life and property caused by floods, and to restore the natural resources and functions of floodplains. While many people have an understanding of the damages that flood hazards can cause, there is still misunderstandings of how extensive flooding can occur in some areas and what can cause flooding.

This Plan provides guidance information to address those misunderstandings and put forth a comprehensive catalogue of flood hazards and characteristics, floodplain development regulations, proper strategies for floodplain development, and flood-proofing alternatives that are appropriate in Virginia.

The Floodplain Management Plan provides a comprehensive guidance document to federal, state, and local officials in addressing floodplain

management issues common to Virginia and to assess the floodplain management needs of the communities in the Commonwealth while establishing strategies, measures, and priorities for meeting those needs.

The Plan presents the Commonwealth's strategy for floodplain management in order to allocate federal, state, and local resources more effectively to address identification, planning, and mitigation of flood hazards as well as to promote sound floodplain management in the Commonwealth. In addition, the Plan provides tools for flood hazard risk identification to enhance the knowledge and skills of local and state officials responsible for floodplain management within the Commonwealth. The Plan also promotes the advancement of responsible development in and beneficial uses of floodplains.

The Plan establishes a short-term horizon that identifies more immediate problems, needs, solutions and priorities for implementation that will focus on reducing or preventing the creation of new flood hazards. Along with this short-term perspective is the promotion of ideas and programs that will ultimately lead to elimination or reduction of existing flood hazards.

In recognition of the leadership role of local floodplain managers, the strategies of the Plan are designed to support local efforts. By developing appropriate and useful tools, providing technical assistance for resource management and conducting education and outreach activities, the Virginia Department of Conservation and Recreation can

support and promote more effective flood management efforts.

Finally, the Plan is a primary tool for floodplain management activities within the Commonwealth. The Plan identifies a state strategy for floodplain management to allow for better use of state, local, federal, and private resources in the promotion of floodplain management issues.

*The Floodplain Management Plan
for the Commonwealth of Virginia*

Chapter 1

Purpose and Intent of the Plan

CHAPTER 1

PURPOSE AND INTENT OF THE PLAN

INTRODUCTION

Virginia has experienced several severe flooding events that have increased the awareness of many local officials and citizens in the Commonwealth. Recent federal disasters in Virginia resulting from Hurricane Fran (1996), Hurricane Floyd (1999), flash flooding in Southwest Virginia (2001, 2002, 2003), Hurricane Isabel (2003) and Tropical Storm Gaston (2004) demonstrate the vulnerability of Virginians to the damages caused by flood events. The economic impact of these events is in the 100's of millions of dollars. In addition, is the incalculable loss of human life. Proper floodplain management can reduce these impacts.

The purpose of floodplain management in Virginia is to reduce the loss of life and property caused by floods, and to restore the natural resources and functions of floodplains. While many people have an understanding of the damages that flood hazards can cause, there are still misunderstandings of how extensive flooding can occur in some areas and what can cause flooding. This Plan provides guidance information to address those misunderstandings and put forth a comprehensive catalogue of flood hazards and characteristics, floodplain development regulations, proper strategies for floodplain development, and flood-proofing alternatives that are appropriate in Virginia.

Federal Authority

The federal regulations indicate that the State Coordinating Agency has responsibility for coordinating National Flood Insurance Program (NFIP) aspects of floodplain management in the Commonwealth. The Department of Conservation and Recreation (DCR) has been designated the State Coordinating Agency in Virginia (see below). The Plan is one strategy to meet the assigned responsibilities and duties for DCR by providing NFIP information to local governments and the general public, assisting communities in disseminating NFIP information, recommending floodplain management activities based on local needs, assuring coordination and consistency with other state and federal agencies, and assisting in the identification and implementation of flood hazard mitigation recommendations (see 44 CFR 60.25 below).

Code of Federal Regulations Title 44

§ 60.25 Designation, duties, and responsibilities of State Coordinating Agencies.

(a) States are encouraged to demonstrate a commitment to the minimum flood plain management criteria set forth in § 60.3, 60.4, and 60.5 as evidenced by the designation of an agency of state government to be responsible for coordinating the Program aspects of flood plain management in the State.

(b) State participation in furthering the objectives of this part shall include maintaining capability to perform the

appropriate duties and responsibilities as follows:

- (1) Enact, whenever necessary, legislation enabling counties and municipalities to regulate development within flood-prone areas;
- (2) Encourage and assist communities in qualifying for participation in the Program;
- (3) Guide and assist county and municipal public bodies and agencies in developing, implementing, and maintaining local flood plain management regulations;
- (4) Provide local governments and the general public with Program information on the coordination of local activities with federal and state requirements for managing flood-prone areas;
- (5) Assist communities in disseminating information on minimum elevation requirements for development within flood-prone areas;
- (6) Assist in the delineation of riverine and coastal flood-prone areas, whenever possible, and provide all relevant technical information to the Administrator;
- (7) Recommend priorities for federal flood plain management activities in relation to the needs of county and municipal localities within the State;
- (8) Provide notification to the Administrator in the event of apparent irreconcilable differences between a community's local flood plain management program and the minimum requirements of the Program;
- (9) Establish minimum state flood plain management regulatory standards consistent with those established in this part and in conformance with other federal and state environmental and water pollution standards for the prevention of pollution during periods of flooding;
- (10) Assure coordination and consistency of

flood plain management activities with other state, area-wide, and local planning and enforcement agencies;

- (11) Assist in the identification and implementation of flood hazard mitigation recommendations which are consistent with the minimum flood plain management criteria for the Program;
 - (12) Participate in flood plain management training opportunities and other flood hazard preparedness programs whenever practicable.
- (c) Other duties and responsibilities, which may be deemed appropriate by the State and which are to be officially designated as being conducted in the capacity of the State Coordinating Agency for the Program, may be carried out with prior notification of the Administrator.
- (d) For states which have demonstrated a commitment to and experience in application of the minimum flood plain management criteria set forth in §§ 60.3, 60.4, and 60.5 as evidenced by the establishment and implementation of programs which substantially encompass the activities described in paragraphs (a), (b), and (c) of this section, the Administrator shall take the foregoing into account when:
- (1) Considering state recommendations prior to implementing Program activities affecting state communities;
 - (2) Considering state approval or certifications of local flood plain management regulations as meeting the requirements of this part.

State Authority

The Plan was originally developed following a Joint Subcommittee Study and Report (*House Document No. 64, 1989*) that assigned coordinating responsibility for all floodplain management activities statutorily within the DCR. As a result of the study, legislation was enacted to amend §10.1-

600 to 10.1-603 of the *Code of Virginia* to codify the report recommendations. Plan elements were specified within the legislation, but it should be noted that development and use of the Plan has far greater benefits than satisfaction of a statutory requirement. The Plan provides a comprehensive framework that details roles and responsibilities of federal, state and local governments (communities) to implement the Commonwealth’s flood hazard identification and floodplain development policies. This framework assists DCR with ensuring that the effects of flooding are minimized through proper prevention and mitigation, and promoting maximum protection of all Virginia citizens and their property.

The *Code of Virginia* (§10.1-602) sets forth the requirements of the Plan (see below).

Code of Virginia

Title 10.1 – Conservation; Chapter 6 - Flood Protection and Dam Safety

§ 10.1-602. Powers and duties of Department.

Develop a flood protection plan for the Commonwealth. This plan shall include:

- An inventory of flood-prone areas;
- An inventory of flood protection studies;
- A record of flood damages;
- Strategies to prevent or mitigate flood damage; and
- The collection and distribution of information relating to flooding and flood plain management.

Serve as the coordinator of all flood protection programs and activities in the Commonwealth, including the coordination of

federal flood protection programs administered by the United States Army Corps of Engineers, the United States Department of Agriculture, the Federal Emergency Management Agency, the United States Geological Survey, the Tennessee Valley Authority, other federal agencies and local governments.

Make available flood and flood damage reduction data to localities for planning purposes, in order to assure necessary local participation in the planning process and in the selection of desirable alternatives which will fulfill the intent of this article. This shall include the development of a data base to include (i) all flood protection projects implemented by federal agencies and (ii) the estimated value of property damaged by major floods.

Assist localities in their management of flood plain activities in cooperation with the Department of Housing and Community Development.

Carry out the provisions of this article in a manner which will ensure that the management of flood plains will preserve the capacity of the flood plain to carry and discharge a hundred year flood.

Make, in cooperation with localities, periodic inspections to determine the effectiveness of local flood plain management programs, including an evaluation of the enforcement of and compliance with local flood plain management ordinances, rules and regulations.

Coordinate with the United States Federal Emergency Management Agency to ensure current knowledge of the identification of flood-prone communities and of the status of applications made by localities to participate in the National Flood Insurance Program.

Establish guidelines which will meet minimum requirements of the National Flood Insurance Program in furtherance of the policy of the Commonwealth to assure that all citizens living in flood-prone areas may have the opportunity to indemnify themselves from flood losses through the purchase of flood

insurance under the regular flood insurance program of the National Flood Insurance Act of 1968 as amended.

Subject to the provisions of the Appropriations Act, provide financial and technical assistance to localities in an amount not to exceed fifty percent of the nonfederal costs of flood protection projects.

PURPOSE

The Floodplain Management Plan provides a comprehensive guidance document to federal, state, and local officials in addressing floodplain management issues common to Virginia and to assess the floodplain management needs of the communities in the Commonwealth while establishing strategies, measures, and priorities for meeting those needs.

The Plan presents the Commonwealth’s strategy for floodplain management in order to allocate federal, state, and local resources more effectively to address identification, planning, and mitigation of flood hazards as well as to promote sound floodplain management in the Commonwealth. In addition, the Plan provides tools for flood hazard risk identification to enhance the knowledge and skills of local and state officials responsible for floodplain management within the Commonwealth and to promote the advancement of responsible development in and beneficial uses of floodplains.

The Plan establishes a short-term (5 years) horizon that identifies more immediate problems, needs, solutions and priorities for implementation that will focus on reducing or preventing the creation of new flood hazards. Along with this short-term perspective is the promotion of ideas and programs that will ultimately lead to elimination or

reduction of existing flood hazards. Inherent throughout the Plan is a guiding philosophy that government must develop flood loss reduction strategies that provide better management of the natural floodplain environment, and balance the competing needs of man, flora, fauna and water resources.

In recognition of the leadership role of local floodplain managers, the strategies of the Plan are designed to support local efforts. By developing appropriate and useful tools, providing technical assistance for resource management and conducting education and outreach activities, DCR can support and promote more effective flood management efforts. The Plan promotes multi-objective planning and management, to balance the need for reducing economic losses resulting from continued or future occupancy and use of the Commonwealth's floodplains, with the need to protect and, in some instances, restore the floodplain environment.

Finally, the Plan is a primary tool for floodplain management activities within the Commonwealth. The Plan identifies a state strategy for floodplain management to allow for better use of state, local, federal, and private resources in the promotion of floodplain management issues.

Since the Plan will be used by a wide variety of stakeholders in a variety of ways, the Plan has some very technical sections and others much less technical in nature. Portions of the Plan are targeted toward the practicing professional and are very technical in nature. Other sections are written in a more general nature targeting citizens and local government officials that may not have a technical background.

BENEFITS OF THE PLAN**BENEFITS OF THE PLAN****The Plan as a Resource for Information, Guidance, and Assistance**

The Plan serves as a "guide" for managing the Commonwealth's floodplains (which also include wetlands, coastal areas, and other critical and sensitive areas). It's intended to be used to identify floodplain management needs and issues and provide direction as to how the Commonwealth's Floodplain Management Program can coordinate with local, state, and federal agencies to resolve these issues. There is discussion of how this plan integrates with other related state plans, manuals, guides, and permitting requirements that affect environmental issues including:

- DCR's Virginia Stormwater Management Handbook;
- DCR's Virginia Erosion and Sediment Control Handbook;
- DCR's CBLAD Better Site Design Manual;
- DCR's Riparian Buffer Modification & Mitigation Manual;
- DCR's Stream Restoration & Stabilization Best Management Practices Guide;
- VDOT's Drainage Manual; and
- The Virginia Marine Resource Commission's Joint Permit Application.

Through the provision of a variety of information regarding the Commonwealth's floodplains (e.g., uses, resources, management tools, a description of present and desired roles, responsibilities and activities; and the establishment of goals, objectives and priorities), the Plan can serve as a resource for information, guidance and

assistance for state and federal agencies, local officials and other decision-makers.

The Plan as a Data Source

The Plan includes the most recent data (available at the time of writing) for flood insurance policies and claims, repetitive losses, and mapping needs. It provides for, in part, the analytical basis for planning and action, both short-term and long-term. Provisions will be required to keep the data current and for including new data as it becomes available. The number of policies, mapping updates, and information on repetitive losses should form the basis of local floodplain managements.

The Plan as a Vision for the Future

The Plan provides a "vision" for the future, spelling out both long-term and short-term goals, strategies and implementation procedures. It provides strategies and performance measurement goals, i.e., what the Commonwealth wants to accomplish and by what dates.

The Plan as a Performance Measurement Baseline

The 1991 Plan established a "baseline" for measuring future change. Changes that can be measured include occupancy and use in floodplains, resource protection or loss, damages experienced and prevented, effectiveness of various floodplain management strategies and tools, commitment to and effectiveness of local programs, effectiveness of various state and federal roles in floodplain management, and cooperative local-state-federal partnership efforts.

FUTURE EFFORTS

The Plan can be thought of as a snapshot and projection of a program based on existing and anticipated conditions. There will be ongoing efforts to implement the strategies identified within this Plan. There will be a need to formally revisit the Plan periodically, possibly every 5-6 years, and to evaluate the need for sectional updates and course adjustments based on new data and experience gained.

SUMMARY OF CHAPTER ONE

Virginia has experienced several recent severe flooding events that have increased the awareness of many local officials and citizens in the Commonwealth. Proper floodplain management can reduce these impacts. The purpose of floodplain management in Virginia is to reduce the loss of life and property caused by floods, and to restore the natural resources and functions of floodplains.

This Plan puts forth a comprehensive catalogue of flood hazards and characteristics, floodplain development regulations, proper strategies for floodplain development, and flood-proofing alternatives that are appropriate in Virginia. The Floodplain Management Plan provides a comprehensive guidance document to federal, state, and local officials in addressing floodplain management issues common to Virginia.

*The Floodplain Management Plan
for the Commonwealth of Virginia*

Chapter 2

Federal and State Regulations

CHAPTER 2

FEDERAL AND STATE REGULATIONS

INTRODUCTION

The framework for floodplain management in Virginia is established by federal and state regulations, which dictate the different roles that federal, state, and local officials have. Federal legislation impacting floodplain management has been quite diverse. This chapter explores what is considered the most meaningful federal and state legislation and regulations impacting floodplain management and how different agencies and officials enforce and promote floodplain management in the Commonwealth. This will be accomplished by providing an overview of regulations and brief summaries of the role of different federal and state programs in fulfilling these regulations. The order of federal and state programs listed was based on their impact on floodplain management in Virginia.

FEDERAL FLOODPLAIN REGULATIONS

Department of Homeland Security (DHS), Federal Emergency Management Agency (FEMA)

Since 1968, the Federal Emergency Management Agency (FEMA), now part of the Department of Homeland Security (DHS), has played the lead federal role in flood related programs. This role has included floodplain mapping, insurance, mitigation, and establishing state and local regulations.

Regulations

a. National Flood Insurance Act of 1968 (P.L. 90-448)

http://www.fema.gov/fhm/dl_acts.shtm and http://www.fema.gov/pdf/fhm/frm_acts.pdf

The National Flood Insurance Program (NFIP) is a federal program enabling property owners and renters to purchase flood insurance. The NFIP is based upon an agreement between local communities and the federal government, which states that if a community will implement measures to reduce future flood risks to new construction in Special Flood Hazard Areas, the federal government will make flood insurance available within the community as financial protection against flood losses which do occur. Floodplain maps and studies are prepared for individual communities through the NFIP. The Act and amendments also allow FEMA to purchase storm damaged property including structures and lands that meet certain requirements relating to frequency and extent of flood damages. Ownership of the property is then transferred to the locality to be maintained as undeveloped open space or other compatible use. The Act also established a Unified National Program for Floodplain Management, focusing on the use of mapping, insurance, and regulations to implement this program. The 2004 amendment added a pilot program for mitigation of severe repetitive loss properties.

FEDERAL FLOODPLAIN REGULATIONS

b. Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1994

<http://www.fema.gov/library/stafact.shtm>

The 1994 Act established the Flood Mitigation Assistance (FMA) Program, with the goal of reducing or eliminating claims under the NFIP. FMA is funded annually. Funds are provided to each state used primarily for planning. The 1994 Act also established the Hazard Mitigation Grant Program (HMGP) (Section 404) which provides funds to state and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and enable implementation of mitigation measures during the immediate recovery from a disaster. The amount of funding available depends on the severity of the federal disaster in a given state.

This Act also authorizes the President to establish a program of disaster preparedness and response that utilizes services of all appropriate agencies. This program can address hazard mitigation, repair, restoration and replacement of damaged facilities; debris removal; temporary housing assistance; unemployment assistance; individual and family grant programs; food coupons and distribution; relocation assistance; legal services; community disaster loans; emergency communications; emergency public transportation; fire suppression grants and others.

The 2000 amendment, also called the Disaster Mitigation Act of 2000 (DMA2K) established mandatory state and local Hazard Mitigation Plans (Section 322) to maintain eligibility for emergency and other FEMA disaster funding. DMA2K also established the Pre-Disaster

Mitigation Program (information available at <http://www.fema.gov/fima/pdm.shtm>) as a nationally competitive grant program.

c. Executive Order: Floodplain Management Executive Order 11988 (1977)

<http://www.fema.gov/library/eo11988.shtm>

E.O. 11988 directs federal agencies to assert leadership in reducing flood losses and losses to environmental values served by floodplains; to avoid actions located in or adversely affecting floodplains unless there is no practicable alternative; and to take action to mitigate losses if avoidance is not practicable. It establishes a process for flood hazard evaluation based upon the 100-year base flood standard of the NFIP and directs federal agencies to issue implementing procedures. E.O. 11988 also provides oversight mechanisms: a) certification by federal agencies to the Office of Management and Budget (OMB) that proposed actions are in accord with the Executive Order when authorizations and appropriations are requested; b) periodic evaluation of agencies and procedures and their effectiveness by the OMB; and c) public notice of proposed actions.

Role

FEMA is responsible for the administration of the NFIP, a federal program enabling property owners to purchase flood insurance. FEMA published an informative booklet on the NFIP entitled *Questions and Answers about the National Flood Insurance Program*. This insurance is designed to provide a program alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by

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floods. The NFIP is based upon the establishment of an agreement between local communities and the federal government, that if a community will enforce certain zoning and building construction practice standards in the 100-year floodplain, the federal government will make affordable flood insurance available within the community; thereby providing some financial protection against flood losses when they occur. FEMA establishes minimum floodplain construction standards which are intended to reduce the possibility of flood damage. These standards include such design requirements as having the lowest floor of a structure built above the 100-year flood elevation. Floodproofing and ensuring that any alterations such as filling and grading in certain floodplain areas are properly conducted. There are forms to be completed when constructing or altering a structure in the floodplain and there are specific tools for local officials to document construction activity in a floodplain.

The important concept and underlying principle of the NFIP is that it is a voluntary program whereby local communities may elect to join and participate. However, if a community with identified flood hazard areas chooses not to participate, it will not be eligible for certain financial assistance in the event of a presidentially declared disaster. In order to participate, communities must adopt local ordinances which establish acceptable uses in a floodplain

FEMA publishes Flood Insurance Studies that include 100-year flood elevations, stream profiles, discharge amounts and other hydrologic and hydraulic information, Flood Insurance Rate Maps that indicate the 100-year floodplain and Flood Boundary Floodway Maps that outline the extent of the Regulatory

Floodway. Many of the detailed Flood Insurance Studies also have included estimates of flooding for a 10, 25 and 500 year flood events. These publications are used to identify floodplain areas and for planning and zoning purposes. Procedures are in place to have the FEMA maps amended or corrected if it is believed that the maps or studies are in error.

Inaccuracies may be due to information overlooked during the preparation stage or because development has altered the runoff characteristics of the floodplain. These map change procedures include the following:

- Flood Insurance Study Restudy
- Limited Map Maintenance Revision
- Conditional Map Revision
- Map Revision
- Map Amendment
- Floodway Revision

FEMA publishes a Community Status Book which lists the dates of the current effective maps for a specific community.

FEMA provides a 75% federal / 25% state annual matching cost share grant entitled the "Community Assistance Program" (CAP) to the Commonwealth to assist the Commonwealth in coordinating the participation of Virginia localities in the NFIP. The general purposes of the CAP are to assist and assess communities which participate in the NFIP. Activities performed by state agency staff includes conducting community visits, inspecting floodplain areas, organizing and presenting workshops, and reviewing floodplain district zoning ordinances. Assistance is provided to local officials regarding the latest requirements of the NFIP. Assessments

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covering community NFIP regulation compliance are conducted via meetings and inspections of floodplain areas by state agency staff for the FEMA Regional Office. In those cases where communities are not enforcing the minimum requirements of the NFIP, as required, the state staff will work with the localities to establish compliance prior to FEMA Regional office staff bringing the local program into compliance or suspending the local program from the NFIP. The CAP has a unique advantage of being a program which puts a floodplain manager, typically the building or zoning official in the community, to work directly with state officials.

The NFIP has entered a significant phase of its activities with the implementation of the "Community Rating System" (CRS). Under the CRS, the cost of flood insurance to the property owner is lower if the community undertakes specific activities to reduce the potential of flood losses. This is a program that rewards those communities that are doing more than meeting the minimum NFIP standards, and it will encourage communities to initiate additional flood protection activities. It is important to note that community participation and application for CRS credit program is voluntary. Any community in good standing as a participant in the NFIP may apply for a community-wide flood insurance premium credit. There are 20 floodplain management activities that are eligible for credit. Such activities include: maintaining a flood protection library; regulating stormwater management activities; coordinating a flood warning system; and acquiring floodplain lands for open space protection. Other benefits include: increased public safety; avoidance of economic disruption and losses; reduced risks upon local public safety officials and

utility personnel; and reduced human suffering. FEMA and the Federal Insurance Administration provide many helpful publications about the NFIP available at <http://www.fema.gov>.

FEMA is also responsible for the coordination of federal Disaster Relief Programs whenever the President of the United States declares an "emergency" or a "major disaster". FEMA provides grants to individuals, state and local units of government and qualified non-profit agencies for the restoration, repair or replacement of eligible buildings, bridges, roads and other eligible items. Grants to government units are on a cost share basis. The development of a Hazard Mitigation Plan, by the Virginia Department of Emergency Management (VDEM), helps to identify measures to reduce or eliminate future damages. This is a key component of the recovery process and one which serves to strengthen further ongoing floodplain management programs of state and local governments. For flooding disasters, FEMA chairs a federal Interagency Hazard Mitigation Team which examines the incident and issues recommendations to reduce future exposure to flood hazards.

U.S. Army Corps of Engineers (USACE)

Prior to the establishment of FEMA, the U.S. Army Corps of Engineers (USACE) played the lead role in floodplain management in the U.S., primarily through the use of structural flood control programs and projects, such as dams, levees, and wetlands. In addition to playing a key role in major disaster emergency response, funding and technical assistance on floodplain management and mapping projects, and wetlands and navigable waters management. Regulations tend to fall

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under the categories of flood control, hurricane and storm damage reduction, and streambank protection.

Regulations

a. Floodplain Management Services Flood Control Act of 1960, Section 206, Public Law 86-645, as amended

<http://web1.whs.osd.mil/peidhome/guide/cfda/p12104.htm>

The FPMS Program was developed by the USACE specifically to help others mitigate flood damages. It provides the full range of technical services and planning guidance that is needed to support flood damage reduction. This can vary from developing site specific data (i.e., depth of flooding at a residence) to helping a community select the most effective measures to be in a comprehensive floodplain management plan. Assistance is provided to states, local governments, and Indian Tribes upon request and is free-of-charge. Site specific information usually is furnished in about one day or less and larger, community-wide studies in less than one year.

b. Flood Control and Coastal Emergency Act of 1955, Public Law 84-99, as amended

<http://www.spd.usace.army.mil/cheatsheet.htm>

The U.S. Congress has granted the USACE specific authority under Public Law 84-99 to respond to disasters caused by hurricanes, floods and droughts. This law authorizes the USACE to provide disaster preparedness services and advanced planning measures designed to reduce the amount of damage caused by an impending disaster. Activities include:

c. Planning Assistance to States Water Resource Development Act of 1990, Section 22 Public Law 93-251, as amended

<http://www.mvr.usace.army.mil/pdw/pdf/cap/cap205.htm>

The PAS Program assists states, Indian Tribes, local governments, and other non-federal entities in the preparation of comprehensive plans for the development, utilization, and conservation of water and related resources. Although its authority is much broader, its flood damage reduction assistance is similar to that provided by FPMS Program. Assistance is usually provided in the form of specific studies that are detailed in brief cost-sharing agreements with non-federal sponsors providing 50% of the costs. The USACE provides the other 50% and based on WRDA of 1996, the funding threshold is limited to not more than \$500,000 in a single state, locality, or Indian Tribe in any one year. The studies usually take about one year to complete.

d. Small Flood Control Projects Flood Control, Public Law 80-858, Section 295, as amended

<http://web1.whs.osd.mil/peidhome/guide/cfda/p12106.htm>

This section authorizes the USACE to construct small flood control structures without specific authorization by Congress, when the Chief of Engineers determines that the work is advisable. In addition, the project must constitute a complete solution to the flood problem involved, and not require subsequent improvements to ensure effective operation.

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e. Flood Control Projects Flood Control Act of 1954, Public Law 83-780, Section 208, as amended

This section authorizes the USACE to conduct snagging and clearing activities within streams to remove debris for purposes of flood control. Additionally the straightening of stream channels can be performed.

f. National Dam Safety Act Public Law 92-367

This Act amended the National Dam Safety Act, Public Law 92-367, and authorized a national program of inspection of dams for the purpose of protecting human life and property. It calls for an inventory of all dams in the U.S. and recommends a comprehensive national program of dam inspection and regulation.

g. Small Beach Erosion Control Projects River and Harbor Act of 1962, Public Law 87-874, Section 103, as amended

<http://www.nab.usace.army.mil/whatwedo/civwks/CAP/103.pdf>

This section authorizes the USACE to construct small beach restoration and protection projects not specifically authorized by Congress.

h. Shore Protection (Including Beach Erosion Control), General, Public Law 79-727, 1946 Act (as amended) and Public Law 99-662, Sections 103 (c)(5) and (d), 1986 WRDA

These laws establish federal policy to assist in the construction, but not the maintenance, of works for the improvement and protection of the shores of the U.S. against erosion by waves and currents, and stipulates that

USACE projects be formulated primarily for hurricane and storm damage reduction.

i. Shore Protection Periodic Nourishment, Public Law 84-826 of 1956

This Act states that Federal Assistance in periodic beach nourishment is provided on the same basis as new construction when it would be the most suitable and economical remedial measure.

j. Emergency Stream Bank Protection Projects Flood Control Act of 1946, Public Law 79-526, Section 14, as amended

<http://www.mvr.usace.army.mil/pdw/pdf/cap/cap14.htm>

This section authorizes the USACE to expend funds for the construction, repair, restoration and modification of emergency streambank and shoreline protection works designed to protect highways; bridge approaches and public works; as well as churches, hospitals, schools, and other non-profit services endangered by bank erosion.

k. Technical and Engineering Assistance of Streambank Erosion. Water Resources Development Act of 1974, Section 55

This section authorizes the USACE to provide technical and engineering assistance to non-federal public interests for development of methods to prevent damage from shore and stream bank erosion.

The following table shows the major watersheds that fall within their boundaries.

**TABLE 2.1
MAJOR WATERSHEDS**

DISTRICT	RIVER BASIN(S)
Baltimore	Potomac River Basin
Norfolk	Atlantic Coast Chesapeake Bay Chowan River Basin James River Basin Rappahannock River Basin York River Basin
Huntington	Big Sandy River Basin Kanawha-New River Basin
Wilmington	Roanoke River Basin
Nashville	Tennessee River Basin

Role

Planning activities done by the USACE for the management and development of water and related land resources are undertaken through various congressional authorizations. The majority of studies, however, fall under one of two following programs.

1. General Investigations
 - Congress authorized
 - Used when a major federal investment is required
 - Examples: studies for major dams, floodwalls
2. Continuing Authorities
 - District offices authorized
 - Smaller, less expensive
 - Examples: Small Flood Control Projects (Section 205); Small Beach Erosion Control Projects (Section 103)

The USACE is generally well known for its major civil works projects for water resources, which are usually the result of general investigations. These

include dams, seawalls, levees, breakwaters, floodwalls, hurricane barriers and channel enlargements. The traditional and most common way for the USACE to help a community solve a water resource problem, such as flooding is to conduct a study and, if shown by the study to be feasible, construct a project. The approach uses a six-step process, and requires that Congress provide the USACE with authority to both study and construct a project. The process is:

1. Request for federal action - The community asks its Congressional delegation for help, and Congress authorizes the USACE to study the identified problem.
2. Study problem and report preparation - The local USACE district studies the community's identified water resource problem, and reports its findings in a feasibility report - a project may be recommended for construction if it is feasible and meets certain requirements
3. Report review and approval - The feasibility report is reviewed at the

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Washington level by the USACE, the Assistant Secretary of the Army (Civil Works), and the OMB. When approved, the report is sent to Congress.

4. Report review and approval - Congressional authorization - Congress authorizes the USACE to construct a project.
5. Project implementation - The USACE designs the project, and a project cooperation agreement is signed by the local project sponsor and the Assistant Secretary. The project is built, and turned over to the sponsor for ongoing use, including operation and maintenance.

This step-by-step description is provided to indicate the detailed levels of review, comment and analysis the major civil works projects receive. The high cost of these projects necessitates this level of analysis. This detailed process of comment and review forces the consideration of other possible solutions to a given flooding problem. For instance, a combination of nonstructural solutions which may include acquisitions, relocations, flood proofing, and local protection measures may be considered.

The purpose of the USACE flood control works is to regulate flood flows and thus prevent flood damage. In addition, the Flood Control Act of 1944 provided that "flood control" shall include major drainage of land. These objectives are accomplished with reservoirs, local protection works, or combinations of the two. Reservoirs constructed for flood control storage often include additional storage capacity for multiple-purpose uses, such as the storage of water for municipal and industrial use, navigation, irrigation, development of hydroelectric power, conservation of fish and wildlife, and recreation. Local protection works

are turned over to non-federal authorities for maintenance, as are small reservoirs with a local impact.

In addition to the service provided by the USACE through individually appropriated projects (studies and construction projects), the USACE also provides services through its Continuing Authorities Programs. Congress has provided the USACE with six standing authorities to study and build water resource projects for specific purposes and with specified limits on how much federal money can be spent for a project. The process and rules, such as cost sharing, that apply to individual authorized studies and projects also apply to this program, except that individual Congressional authorizations are not needed. This saves development and approval time, and permits quicker response to small, local problems. The issues that can be addressed by the Continuing Authorities Programs are:

- Flood Control - Authorized by Section 205 of the 1948 Flood Control Act, as amended; the federal share may not exceed \$5 million for each project.
- Navigation - Authorized by Section 107 of the 1960 River and Harbor Act, as amended; the federal share may not exceed \$4 million for each project.
- Shore Protection - Authorized by Section 103 of the 1962 River and Harbor Act, as amended; the federal share may not exceed \$2 million for each project.
- Emergency streambank and shoreline protection for public facilities - Authorized by Section 14 of the 1946 Flood Control Act, as amended; the federal share

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- cannot exceed \$500,000 for each project.
- Snagging and clearing for flood control - Authorized by Section 208 of the 1954 Flood Control Act, as amended; the federal share may not exceed \$500,000 for each project.
- Shore damage attributable to federal navigation works - Authorized by Section 111 of the 1968 River and Harbor Act, as amended; the federal share may not exceed \$2 million for each project.

Floodplain Management Services (Section 206, Flood Control Act of 1960) allows USACE staff to respond to requests for assistance from state and local officials, citizens, and the private sector in order to promote prudent floodplain development. The program can respond on short notice to day-to-day problems. Most of the assistance provided through this program is information on a site's flood hazard and guidance on how to best prevent or reduce flood damages or other negative impacts on the natural and beneficial values of floodplains, including wetlands. The USACE provides (upon request) flood hazard information, technical assistance and planning guidance. These data and assistance are designed to aid in planning for floods and providing for the regulation of flood plain areas, thus avoiding unwise development in flood-prone areas. For example, if community officials know what areas flood in their community and how often floods occur, they then can take necessary action to prevent or minimize damages to existing and new buildings and facilities by adopting and enforcing zoning ordinances, building codes, and subdivision regulations. The data on flooding and assistance in preparing the

various regulations are the type of help available through the Floodplain Management Services Program.

Through the Planning Assistance to States Program (Section 22, Water Resources Development Act of 1974) the USACE is authorized to cooperate with any state in preparing comprehensive plans for the development, utilization and conservation of water and related resources. This program is significant to states because it allows a broad range of eligible activities to be completed by the USACE. The program uses USACE staff and expertise to encourage and promote broad, statewide comprehensive water resources planning, to avoid duplication of federal/state efforts and to achieve federal and state goals. The planning assistance provided by the USACE under this program encompasses the full array of planning methodologies embodied in the development of comprehensive multi-objective water resource projects and related areas for which the USACE has planning expertise. The program provides assistance that supports and supplements state efforts and, in many cases, becomes an integral part of the state's overall plan. Assistance is provided on a 50/50 cost share as an incentive for the states, localities, and Indian Tribes to use the program and take action to resolve identified water resource problems such as flood control, water supply, coastal issues, etc. Section 22 can be used effectively to tie together several water resource concerns including floodplain management.

The Technical and Engineering Assistance for Streambank Erosion Program (Section 55, Water Resources Development Act of 1974) allows the USACE to provide technical and engineering assistance to non-federal

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public interests for development of methods to prevent damage from shore and stream bank erosion.

The Small Flood Control Projects Program provides the USACE with the authority to respond quickly to water resource problems. Congress has authorized the USACE to construct small projects within certain funding limits. This saves much time in development and approval of projects. Funding limits for these small projects range from \$500,000 to \$5.0 million.

Small Flood Control Projects (Section 205, Flood Control Act of 1948, as amended) may be constructed when the Chief of Engineers determines that the work is advisable. In addition, the project must constitute a complete solution to the flood problem involved, and not require subsequent improvements to ensure effective operation. The federal share may not exceed \$5 million.

The USACE also provides shore and hurricane protection. While each situation the USACE studies requires different considerations, engineers look at each one with structural and nonstructural solutions in mind. Engineering feasibility and economic efficiency are considered along with environmental and social impacts. Recommendations for federal participation is based on shore ownership, use and type and incidence of benefits. If there is public use or benefit, federal participation is not recommended. Hurricane protection can be prevented or reduced by protective structures, including dams and barriers in estuaries, with openings for navigation. Other measures include raising dunes and constructing dikes, walls, and breakwaters. There are also cases where increasing the height of natural beaches affords effective protection.

The USACE also administers the Emergency Flood Control Activities Disaster Assistance Program. Through this program the Chief of Engineers is authorized to expend funds for flood emergency preparation, flood fighting and rescue operations, or for the repair and restoration of any flood control work threatened or destroyed by flood, regardless of origin or ownership of the project.

The USACE is responsible for administering the Wetlands and Waterways Regulations that regulate certain types of activities in waters of the United States including wetlands and the oceans. The decision whether or not to authorize a proposal, and if so, the conditions under which it will be allowed to occur, are determined by the outcome of a general balancing process. All factors which may be relevant to the proposal must be considered; among these are conservation, economics, aesthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production, and, in general, the needs and welfare of the people.

"Waters of the United States" are administratively defined as follows and are specified by Congress to be given the broadest constitutional interpretation:

1. "Navigable waters of the United States" are those "waters of the United States" that are subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies

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laterally over the entire surface of the water body, and is not extinguished by later actions or events which impede or destroy navigable capacity. The term includes coastal and inland waters, lakes, rivers, and streams that are navigable and the oceans.

2. "Wetlands," including those adjacent to "waters of the United States," are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The term "adjacent wetlands" includes those areas that are separated from other "waters of the United States" by man-made dikes or barriers, natural river berms, beach dunes and the like.
3. Tributaries to "navigable waters of the United States" including adjacent wetlands.
4. Interstate waters and their tributaries including adjacent wetlands.
5. All other waters of the United States not identified above, such as isolated wetlands and lakes, intermittent streams, and other waters that are not part of a tributary system to interstate waters or to "navigable waters of the United States."

Section 404 of the Clean Water Act requires authorization from the USACE for the discharge of dredged or fill material into all "waters of the United States," including wetlands (both adjacent and isolated) at specified disposal sites. Discharge of fill material generally includes without limitation the

following activities: placement of fill that is necessary to the construction of any structure or impoundment requiring rock, sand, dirt, or other material for its construction; site-development fills for recreation, industrial, commercial, residential, and other uses; causeways or road fills; dams and dikes; artificial islands; property protection and/or reclamation devices such as riprap, groins, seawalls, breakwaters, and revetments; beach nourishment; levees; fill for intake and outfall pipes usually associated with power plants and subaqueous utility lines; fill associated with the creation of ponds and any other work involving the discharge of fill material.

Section 9 of the River and Harbors Act of 1899 requires authorization from the USACE to construct any dam or dike in a "navigable water of the United States."

Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the USACE for the construction of any structure in or over any "navigable water of the United States," the excavation from or deposition of material in such waters, or any obstruction or alteration in a "navigable water of the United States." Structures or work outside the limits defined for "navigable waters of the United States" will require a Section 10 permit if the structure or work affects the course, location, or condition of the water body in such a manner as to impact on the navigable capacity of the water body. The law applies to any dredging or disposal of dredged material, excavation, filling, rechannelization, or any other modification of a "navigable water of the United States" and applies to all structures from the smallest recreational dock, floating or fixed, to the largest commercial undertaking, and includes without limitation any wharf,

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dolphin weir, boom, breakwater, jetty, groin, bank protection (e.g., riprap, revetment or bulkhead), permanent mooring structures such as pilings, aerial or subaqueous power transmission lines, etc.

**U.S. Department of Commerce (DOC),
National Oceanic and Atmospheric
Administration (NOAA)**

Regulations

**a. Coastal Zone Management Act
Public Law 92-583**

<http://laws.fws.gov/lawsdigest/coaszon.html>

This Act declares a national interest in the effective management, beneficial use, protection and development of the coastal zone. It indicates that the primary responsibility for planning and regulation of land and water uses rests with the state and local governments. The Act states that Congress finds that the key to more effective protection and use of the land and water resources of the coastal zone is to encourage the states to exercise their full authority over lands and waters in the coastal zone. The Secretary of Commerce is authorized to award federal grants to assist the states in developing and administering land and water use management programs for the coastal zone, giving full consideration to ecological, cultural, historic and aesthetic values as well as the need for economic development.

**b. Coastal Barriers Resources Act
(NOAA) Public Law 97-348**

<http://laws.fws.gov/lawsdigest/coasbar.html>

This Act establishes the Coastal Barriers Resource System, consisting of 182 units of undeveloped barrier islands on the Atlantic and Gulf coasts, and

prohibits federal expenditures for construction, purchase, or stabilization projects within those units. It recognizes that coastal barriers serve as natural storm protective buffers and are generally unsuitable for development because they are vulnerable to hurricane and other storm damage, and because natural shoreline recession and the movement of unstable sediments undermine manmade structures. The intent is to protect fish, wildlife and migratory habitats; to prevent loss of human life; and to preclude federal expenditures that induce development on coastal barrier islands and adjacent near shore areas. Except for specified maintenance projects, e.g., publicly owned road repair and jetty maintenance, no new federal expenditures or financial assistance, including flood insurance, is allowed for areas within the system.

Role

NOAA and its agencies such as the Office of Ocean and Coastal Resource Management and the National Weather Service (NWS) have the lead role in coastal zone management and weather forecasting.

OCRM administers the National Coastal Zone Management (CZM) Program. CZM is a voluntary program established by the Coastal Zone Management Act of 1972. Congress declared four basic national coastal zone management (CZM) policies: 1) to preserve, protect, develop, and where possible, to restore or enhance the resources of the U.S. coastal zone; 2) to encourage and assist the states to develop and implement CZM programs meeting specified national standards; 3) to provide for increased specificity in protecting significant natural resources, reasonable coastal dependent economic growth, improved protection of life and property

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in hazardous areas and improved predictability in government decision making; and 4) to encourage the participation and cooperation of public, state and local governments, interstate and other regional agencies, and federal agencies in achieving the purposes of the Act.

In its efforts to promote "improved protection of life and property in hazardous areas" the OCRM provides funds to states to implement state CZM programs. These programs can undertake a variety of activities to reduce hazards to people and property. These include: development of hazard zone setback lines from zones of immediate danger or anticipated erosion zones; special scrutiny of infrastructure growth that would promote development of ocean-hazard areas through construction of roads, bridges, water and sewer lines; assistance with determining a state policy on the use of structural and nonstructural solutions to coastal erosion; sand dune restoration, preservation and management programs; assistance with community ordinance and building standards which provide a greater level of protection than the NFIP minimums; assistance with sea level rise hazard assessment; public information and education outreach programs; evacuation planning; and assistance to acquire and relocate structures out of flood hazard zones. NOAA's CZM program is flexible enough for states to undertake hazard reduction activities which are uniquely suited to the needs of a particular state. Virginia's CZM program was approved by OCRM since 1986 and is administered by the Department of Environmental Quality (DEQ).

The NWS is concerned with atmospheric events, and the monitoring and/or prediction of routine and destructive weather events. The NWS describes

and predicts those processes of the hydrologic cycle which impact the functioning of the nation's economy and communities. The information produced by the Weather Service takes the form of several different "products." One of the principal functions of the Weather Service Forecast Office (WSFO), Weather Service Office (WSO) and Hydrologic Service Area (HSA) is issuance of these products in the form of river forecasts and flood warnings to the general public, specialized users, and disseminating media such as, newspapers and radio and TV stations.

The NWS operates three specific programs related to water management. These include the River Forecast Centers and River Districts activities, the Flood and Flash Flood Warning program and the Hydrologic Services activities. River and rainfall records kept by the weather service are indispensable to riverside industries and their engineers as they design flood protection systems. The flood and flash flood warnings issued by the NWS are a reliable tool to assist emergency operation managers in implementing flood fighting strategies. The river forecast centers produce forecasts which are essential for navigation activities, transportation commerce, crop management, reservoir operation, fish and wildlife management, and industrial practices along rivers.

The operations of the WSFO and the WSO include the flood/flash flood watch/warning program. Generally, flood/flash flood watches are issued by WSFOs and focus on large areas such as portions of states. Flood/flash flood warnings are issued by both WSFOs and WSOs and are primarily county-based. The river forecast centers (RFC) focus on longer-term flood events. Accordingly, RFCs prepare forecasts for rivers and river systems detailing river

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stages at specific gauging points. These specific stage forecasts are folded into flood warnings which are normally issued by WSFOs and WSOs for specific rivers or river systems.

The flood/ flash-flood watch and warning program produce the following products:

Flood Potential Outlook (FPO) - A FPO may be issued by the WSFO if forecast meteorological conditions indicate that a significantly heavy precipitation episode may occur that would either cause flooding or aggravate existing flooding.

Flood/Flash Flood Watch (Advisory) (FFA) - This product is used to inform the public and cooperating agencies that current and developing hydrometeorological conditions are such that there is a threat of flooding, but the occurrence is neither certain nor imminent. Persons in the watch area are thereby advised to check flood action plans, keep informed, and be ready to take necessary actions if a warning is issued or flooding is observed.

Flood/Flash Flood Warning (FFW) - A FFW is a public warning issued by WSFOs and WSOs. It is as specific as possible, focusing on specific communities, streams or areas where flooding is imminent or in progress. Persons in the warning area are advised to take necessary precautions immediately.

Urban and Small Stream Flood Advisory (FSS) - In general, urban flooding refers to flooding of streets, low-lying areas, such as railroad underpasses and urban storm drains. Small stream flooding refers to natural streams, generally in rural areas. However, in most cities there are still quite a few natural stream channels.

Flood/Flash Flood Statement (FFS) - The office issuing a flood/flash flood watch or warning is responsible for issuing follow-up statements keeping the public fully informed of current information.

Ice Jam Flooding, Dambreak Flooding, Levee Failure - These are forms of flooding which are usually associated with already existing flooding conditions and would be announced along with the FFA, FFW and FFS.

The NWS recognizes the importance of local flood warning and response systems to improve flood warning service to communities, and provides technical assistance to communities with flood problems. Technical support involves recommending alternative flood warning systems appropriate to the economic capabilities of the community; helping communities in the design, installation, and implementation of warning and response systems and the training of personnel; and providing operational support to responsible community officials. In the case of automated systems, the NWS provides site selection of the hydrologic observation network, radio path analysis, generic standards for automated local flood warning systems, consulting service on the calibration of hydrologic models, and, when the system is operational, additional weather information. The NOAA weather radio broadcasts 24 hours per day with local and regional weather forecasts. These forecasts can be monitored on radios with the capabilities to monitor between 162.40 to 162.55 MHz. Also available are weather radio monitors that can be tuned to the local weather radio frequency. Some of these monitors can be placed in a standby "mode" and will be activated by an emergency tone broadcast by the NWS alerting the user to the broadcast of an emergency message.

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Integrated Flood Observing and Warning System (IFLOWS) is an automated rain and river gages early warning system installed in seven Appalachia states. This system covers the western region of Virginia. IFLOWS is monitored locally with information relayed to the state emergency operation center, and to the NWS office responsible for flood forecasting. State and local emergency personnel and NWS forecasters use the information in monitoring developing flooding situations and implementing emergency response plans.

**U.S. Department of the Interior (DOI),
U.S. Geological Survey (USGS)**

Regulations

a. Water Resources Development Act of 1990 P.L. 101-640.

<http://www.usgs.gov/laws/index.html>

This Act is only one recent example of how the USGS is involved with water resources and floodplain management. Most notable for floodplain management, this Act provides for additional implementation of a long-term resource monitoring program to help continue the USGS water monitoring program. The URL shown above provides a link to all of the different regulations that define responsibilities of the USGS.

Role

Like NOAA, the USGS plays a major role in gathering the data used to help predict flood events. Where the NWS provides weather prediction, the USGS gathers the stream and river gage data used for flood modeling and flood predictions. As the principal federal water resources fact-finding agency, the USGS Water Resources Division provides information and technical

assistance to officials at all levels of government who are responsible for planning, design, and management decisions related to the hydrologic environment. To accomplish its mission, the Water Resources Division, in conjunction with state and local governments and other federal agencies, conducts surveys, investigations, and research on the occurrence, quality, distribution, utilization, movement, and availability of the Nation's surface and ground water resources. An essential part of this activity is the systematic, nationwide program of data collection, analysis, and dissemination. Water quality, especially the quality of ground water, continues to receive major emphasis by numerous federal agencies. Most of the major water agencies report programs deal with nonpoint source pollution, hazardous waste management, salinity and irrigated agriculture, erosion and sedimentation, and myriad issues relating to protecting the nation's water quality and providing the information required for effective decision making.

USGS does, however, provide several areas of data and technical expertise in matters pertaining to floodplains. A partial list of related informational resources includes the following:

- Hydrologic information from more than 500 specific stream locations statewide
- Stages, times of duration, and peak flows for sites, some as far back as 1895
- Daily discharges and annual peaks throughout Virginia
- Hydrologic atlases illustrating areas flooded by major floods

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The U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)**Regulations**

- a. **Emergency Watershed Protection (EWP) Program, authorized by Section 216 of The Flood Control Act of 1950, Public Law 81-516, 33 U.S.C. 701b-1; Section 403 of the Agricultural Credit Act of 1978, Public Law 95-334, as amended**

<http://www.nrcs.usda.gov/programs/ewp/>

The Emergency Watershed Protection (EWP) Program, through local sponsors, provides emergency measures for run-off retardation and erosion control to areas where a sudden impairment of a watershed threatens life or property. Upon request from a local unit of government, NRCS will respond within 15 days of a flood, by utilizing local resources and contractors to carry out the needed work. The program was used extensively during hurricane Camille in 1969. The 1985 flood of the James and Potomac-Shenandoah River basins resulted in \$1.5 million of emergency measures by NRCS.

- b. **Watershed Protection and Flood Prevention Act of 1954. Public Law 83-566**

http://www.nrcs.usda.gov/programs/watershed/WS_main/law.html

This Act authorized the Small Watershed Program. Through this program a local sponsoring organization develops a watershed plan with technical assistance from the Soil Conservation Service and other agencies. Plans are for watershed protection, flood prevention, drainage, irrigation, rural water supply, fish and wildlife habitat, municipal and industrial

water supply, water quality management and recreation. Once a plan is approved and authorized for operation, the sponsors are eligible for financial and technical assistance from the NRCS for installation of the works of improvement.

- c. **River Basin Program Public Law 83-566, Section 6**

http://www.nrcs.usda.gov/programs/watershed/WS_main/law.html

The River Basin Program authorized the investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs. The program has been used to identify upstream areas that could benefit from a flood prevention and watershed protection project, and to assist with the inventory and evaluation of resources to address future watershed conservation program needs.

Role

In the 1980's and early 1990's, the NRCS (formerly known as the Soil Conservation Service) had a much more prominent role in floodplain management in Virginia by providing annual funding for watershed and floodplain studies. As federal budget cuts have changed the focus of NRCS, the most recognized role for the NRCS is through their Emergency Watershed Protection Programs, which provides funds for post-disaster cleanup.

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**U.S. Department of the Interior (DOI),
National Fish and Wildlife Service
(FWS):**

Regulations

- a. Endangered Species Act of 1973
(P.L.93-205) (87 Stat. 884 as
amended: 16 U.S.C. 1531 et seq.)**

The purpose of this act is to provide a means, whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to implement a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth. This includes land acquisition as set forth by the authority granted the U.S. Fish and Wildlife Service.

Role

The main role of the FWS for floodplain management concerns the agency's wetland initiative. The most important tool they have helped developed is the National Wetlands Inventory, which provides wetlands mapping for the entire US, and in many places is more comprehensive than FEMA floodplain mapping, which tends to have less detailed mapping in lower population areas.

**U.S. Environmental Protection Agency
(EPA)**

Regulations

- a. National Environmental Policy
Act of 1969 Public Law 91-190**

http://ceq.eh.doe.gov/nepa/reg/nepa/nepa_eqia.htm

This law declares it a national policy to encourage productive and enjoyable

harmony between humans and their environment, and for other purposes. Specifically it declared a "continuing policy of the federal government . . . to use all practicable means and measures . . . to foster and promote the general welfare, to create conditions under which humans and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans." Section 102 authorized that to the fullest extent possible, the policies, regulations and public laws of the United States shall be interpreted and administered in accordance with the policies of the act.

- b. The Clean Water Act of 1977
Public Law 95-217**

<http://www.epa.gov/region5/water/cwa.htm>

This Act assigns the Environmental Protection Agency (EPA) the primary responsibility of overseeing the nation's water clean up activities. Under Section 404 of the Act however, the USACE is assigned the responsibility of permits to discharge dredged or fill material into waters of the United States.

Role

Most of the EPA's role in water resources deal with water quality, not water quantity. However, in post-flood disasters, often water quality and drinking water issues arise that require EPA involvement and technical assistance. The EPA has also undertaken significant efforts to monitor wetlands activity nationwide. This has bearing upon floodplain management concerns because of the overlapping nature of wetlands and floodplains. This work has produced information about the current status of wetlands in the state. Although EPA is the administering agency for the Clean Water Act, the USACE actually issues

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permits. The National Environmental Policy Act (NEPA) requires that impacts from projects involving federal action be made public.

U.S. Department of Housing and Urban Development (HUD)

Regulations

a. Small Business Administration (SBA) Section 20

<http://www.sba.gov/>

Through the authority granted by the SBA up to 25 percent of additional loan funds may be obtained for improvements to protect damaged property from possible future disasters of the same type. The measures may include building retaining walls and seawalls, grading and contouring of land, relocating utilities, and modifying structures.

Role

The SBA plays a key role in post-disaster assistance by providing low-interest loans to homeowners following a flood event. Especially for individuals without flood insurance, the SBA loans are an important part of the flood recovery cycle.

Tennessee Valley Authority (TVA)

Regulations

a. Tennessee Valley Authority Act of 1933

<http://www.tva.gov/> and http://www.tva.gov/abouttva/pdf/TVA_Act.pdf

TVA was established as a unique problem-solving approach to fulfilling its mission-integrated resource management. Each issue TVA faced—

whether it was power production, navigation, flood control, malaria prevention, reforestation, or erosion control—was studied in its broadest context. TVA weighed each issue in relation to the others.

Role

The TVA has a broad duty of planning for the proper use, conservation and development of the natural resources of the Tennessee River drainage basin and its adjoining territory for the general, social, and economic welfare of the Nation. In Virginia, the Tennessee River basin drains all or a portion of 10 counties (Bland, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise and Wythe); primarily by the Clinch and Holston Rivers and their tributaries. The land area in Virginia within the Tennessee basin comprises 3,250 square miles, or 8 percent of the Commonwealth's land area. A responsibility of TVA is the control of floodwaters along the Tennessee River and its tributaries.

TVA initially responded to this charge by the construction of a system of multipurpose flood damage detention reservoirs. Despite the construction of flood control structures there were still areas subject to flooding where structural flood control solutions were not feasible. In 1953 TVA's approach was broadened to permit the use of flood damage reduction measures which encourage locality-based planning and the wise use of floodplain lands. Since 1953 and until the mid-1990's TVA had worked with Virginia communities in the Tennessee Basin in an effort to reduce the flood damage potential and to improve the quality of life. In the course of this effort, TVA has used many approaches, ranging from the publication of local flood reports that detail the nature and extent of the

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problem, to providing assistance on locally administered relocation projects in towns where housing has been badly damaged by unusually large floods, to flood damage abatement as part of broader community redevelopment projects. Most current TVA floodplain management efforts are directed to helping local governments and land use planners avoid the floodplain or make new development less susceptible to flood hazard so that future floods are less destructive. Projects in Virginia have included:

- Floodplain Management Technical Services Assistance Programs
- Community Redevelopment Projects
- Acquisition and Relocation Projects
- Flood Control Facilities
- Local Flood Warning Systems
- Greenway Corridor Recreation Planning

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Note that details of different the acts list for Virginia are available at the *Code of Virginia* Website.

<http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+TOC>

Virginia Department of Conservation and Recreation (DCR)

Virginia flood protection and hazard mitigation laws have followed from federal legislation and disasters that have occurred in Virginia. Starting with Hurricane Camille in 1969 through the mid 1980's, several disastrous floods and coastal storms experienced by the Commonwealth resulted in legislation. In 1987, the Department of

Conservation and Recreation (DCR) worked with the General Assembly to place programs related to flood protection into one agency in an effort to improve Virginia's flood protection efforts. This brought about the General Assembly enacting the Virginia Flood Damage Reduction Act in 1989, which made DCR responsible for coordination of all floodplain management programs in the Commonwealth. This was further clarified by the Governor's Memorandum 2-97 "Floodplain Management for State Agencies" (dated July 1, 1997), where the powers and duties of DCR are established. This detailed that the manager of the Floodplain Program is designated as the State Coordinator for the NFIP. The most recent change in DCR for floodplain management was in 2003 when the Floodplain Management Program was merged with DCR's Dam Safety Program to form the Division of Dam Safety & Floodplain Management.

Regulations

- a. **Title 10.1, Chapter 6 Flood Protection and Dam Safety: Article 1. Flood Damage Reduction Act - Section 10.1-600. to 10.1-603.**

This article establishes working definitions for many floodplain management terms, requires the DCR to develop a flood protection plan for the Commonwealth, establishes the Department as the State Coordinator of the NFIP, and generally requires the Department to establish a floodplain management program that as a minimum meets the requirements of the NFIP. The article further directs that all state agencies must comply with floodplain regulations established pursuant to the article.

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b. Title 10.1, Article 1.1. Stormwater Management – Section 10.1 – 603.1 to 10.1 – 603.15

The Stormwater Management Law (10.1 – 603.1 to 10.1 – 603.15) has been replaced by the Stormwater Management Program which will go into effect on January 1st, 2005. The preliminary changes that were made on April, 8th 2004 are available for review at the following address.

<http://leg1.state.va.us/cgi-bin/legp504.exe?041+ful+CHAP0372+pdf>

The purpose of the Stormwater Management Program is to protect Virginia's resources from being damaged by excessive stormwater runoff, and to protect them from nonpoint source pollution. The DCR offers an extensive explanation of the program in the Virginia Stormwater Management Handbook, available for download in a two volume, PDF format.

http://www.dcr.state.va.us/sw/docs/swm/Volume_I.pdf

http://www.dcr.state.va.us/sw/docs/swm/Volume_II.pdf

c. Title 10.1, Article 1.2. Flood Prevention and Protection Assistance Fund - Sections 10.1-603.16. to 10.1-603.23.

This article authorizes the creation of a fund, to be administered by the Director of the DCR, to make grants or loans to any city, county, town, water authority, service authority or taxing district for the purpose of assisting local sponsors in providing required matching funds for flood prevention or protection, or for flood prevention or protection studies. The distribution of the fund is limited to not exceed 50% of the local share of the project. Information on this fund and attendant regulations can be found

in Appendix C and obtained from the Floodplain Program Section.

d. Title 10.1, Article 2. Dam Safety Act - Sections 10.1-604. to 10.1-613

This article requires the Virginia Soil and Water Conservation Board to promulgate regulations and administer the Dam Safety Program in the Commonwealth. The act enables the permitting of new facilities, and the issuance of operational certificates to ensure that impounding structures are constructed, operated and maintained in a safe and proper manner. Dams that are greater than 25 feet high and with 50 acre-feet of storage or more, with few exceptions, are regulated structures. The article also provides a mechanism through administrative or legal procedures to eliminate any threat to life or property posed by an unsafe dam presenting imminent danger to the public. This program is administered by DCR. The Division of Dam Safety Regulations for the Dam Safety Program can be obtained from the Division of Dam Safety.

e. Title 10.1, Article 3. Watershed Improvement Districts - Sections 10.1-614. to 10.1-635

Article 3 authorizes the creation of Watershed Improvement Districts (WID). The purpose of the WID is to take actions that check erosion, provide drainage, collect sediment, or stabilize the runoff of surface water. The Soil and Water Conservation District in which the WID is established will be the governing body, and this governing body may appoint trustees to administer the WID. The article further allows the WID to levy taxes, condemn land and employ agents or staff to meet the needs of the WID. The creation of a WID and its taxing authority are vested

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in the voters residing in the proposed WID and requires that two thirds of the votes cast representing at least two-thirds of the WID land area vote in favor of the proposition.

**f. Title 10.1, Article 4.
Conservation, Small Watersheds
Flood Control and Area
Development Fund - Sections
10.1-636. to 10.1-649**

This article establishes a revolving fund to develop water supplies in conjunction with flood control dams. While much of the language is pointed towards water supply there are flood control considerations. These include additional storage in the reservoir which might be available during times of flooding. This fund may also be utilized to pay for part of the land acquisition costs associated with the construction of the facility.

**g. Title 10.1, Article 5. Stream
Restoration Assistance Program
- Sections 10.1-650. to 10.1-657**

This article establishes a program to restore, stabilize and protect the natural streams in the Commonwealth, and is administered by the Virginia Soil and Water Conservation Board. Its purpose is to assist communities and private property owners with repairs to storm damaged rivers and streams. Assistance can be in the form of technical assistance and/or financial assistance.

**h. Title 10.1, Article 6.
Comprehensive Flood Control
Program - Sections 10.1-658. to
10.1-659**

This act recognizes the General Assembly's support and encouragement of those measures which prevent, mitigate and alleviate the effects of stormwater surges and flooding, and

declares that the expenditure of public funds in the development of flood control projects is necessary for local and state government. The article also prescribes that the DCR is to coordinate the programs outlined in the previous six articles, as well as, programs administered by other state, federal and local agencies in furthering the goals to minimize; loss of life and property and negative environmental impacts.

**i. Title 10.1, Erosion and Sediment
Control Law – Sections 10.1-560
to 10.1-571**

This law requires that the Virginia Soil and Water Conservation Board promulgate regulations to provide statewide minimum standards and requirements to localities and state agencies. This law was created to implement controls limiting the erosion of land and sedimentation received by streams in the Commonwealth due to land disturbance activities. Certain land disturbance activities such as agriculture are exempt. The law in general applies to the development of subdivisions, commercial, and industrial properties, although other uses can be regulated. The law directs the preparation of an erosion and sedimentation control plan subject to review and approval by the locality. Commonwealth projects not exempted are reviewed and approved by the DCR. Enforcement of the law is provided at the local level for private, commercial or industrial land disturbing activities. DCR provides oversight of local enforcement.

**j. Title 10.1, Shore Erosion Control
– Sections 10.700. to 10.1-704**

This act directs the DCR to coordinate shore erosion control programs of all state agencies to implement practical solutions to shoreline erosion problems,

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secure the assistance of the federal government and any of its agencies to protect waterfront property from destructive shore erosion, and explore all facets of the problems and alternative solutions to determine if other practical and economical methods and practices to control shore erosion may be devised.

k. Title 10.1, Shore Erosion Control and Public Beach Act - Sections 10.1-700. to 10.1-704

This act requires the DCR to coordinate a shore erosion control program; secure assistance from the federal government and its agencies to protect waterfront property from erosion; establish a Shoreline Erosion Advisory Service; cooperate with the Virginia Institute of Marine Science; and to promote the use of dredged material for beach nourishment. The Shoreline Advisory Service is implemented under the Department’s Division of Soil and Water Conservation.

l. Title 10.1, Public Beach Conservation and Development Act - Sections 10.1-705. to 10.1-711

This act requires that the DCR shall promote an understanding of the value of public beaches and the causes and effects of erosion and make available information concerning erosion of public beaches. It establishes a fund to provide grants to local governments for partial costs of erosion abatement measures.

m. Title 10.1, Chesapeake Bay Preservation Act - Sections 10.1-2100. to 10.1-2116

This act requires counties, cities and towns of Tidewater Virginia that directly or indirectly drain into the Chesapeake

Bay to incorporate general water quality protection measures into their comprehensive plans, zoning ordinances and subdivision ordinances. The Division of Chesapeake Bay Local Assistance (CBLAD) within DCR is tasked with participation in the multi-jurisdictional Chesapeake Bay Program, Virginia Coastal Program and implementation of the Commonwealth of Virginia's Chesapeake Bay Preservation Act and the associated Regulations. This includes promulgating and keeping current regulations that establish criteria for local Bay Act programs, providing technical and financial assistance to Tidewater local governments, providing technical assistance and advice to regional and state agencies on land use and water quality protection, and ensuring that local government comprehensive plans, zoning ordinances, and subdivision ordinances are in compliance with the regulations.

Role

The Division of Dam Safety and Floodplain Management has the direct responsibility for coordinating all federal, state, and local floodplain management programs and activities in the Commonwealth to minimize loss of life, property damage, and negative impacts on the environment related to flooding or dam safety issues.

The primary focus of the Floodplain Program Section is to address the floodplain management needs of the Commonwealth. These floodplain management needs include the following: identify those areas of the Commonwealth which have the greatest proportion of damages and losses; identify specific projects which might be undertaken to reduce flood risks; improve existing state regulations by including provisions which will afford a

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greater level of safety to people and property; and establish a technical assistance program which will provide support and guidance to local officials for addressing specific floodplain management problems in their communities.

The State Coordinator role for the NFIP in Virginia has been assigned to the Floodplain Program Section. A primary responsibility in this role is to work with communities that participate in the NFIP to ensure they are enforcing program requirements. The Division also provides assistance to communities interested in the NFIP Community Rating System. This program allows individual flood insurance policy holders in communities that enforce more protective floodplain management requirements than the minimum required by the FEMA to receive a reduction in the cost of their flood insurance premiums. This is an important financial incentive to encourage communities to consider seriously taking extra steps to improve floodplain management practices.

The Division of Dam Safety has approximately 1,600 dams on its inventory of which approximately 500 are subject to regulation. There are approximately 1,600 dams in the Commonwealth. The Commonwealth is divided into four regions with approximately 120 regulated dams per region. Regulated dams are those which are 25 feet or more in height and 50 acre-feet or more in maximum capacity. There are some exceptions to the height and volume criteria: dams licensed by the State Corporation Commission (SCC), dams owned or licensed by the United States government and dams licensed under mining regulations. Also exempt are those dams primarily used for agricultural purposes and are less than

100 acre-feet in maximum capacity. Existing regulated dams are required to have an Operation and Maintenance Certificate. For new construction a Construction Permit is required. All dam related applications are reviewed by the Division staff and the Certificate or Permit is issued by the Virginia Soil and Water Conservation Board. An emergency action plan is required for every certificate and permit. A significant number of large dams in the Commonwealth are regulated by federal agencies, such as the USACE, Federal Energy Regulatory Commission (FERC), and the TVA.

Department of Emergency Management

Regulations

- a. Commonwealth of Virginia
Emergency Services and
Disaster Law of 2000 – Sections
44.146.13 - 44.146.29**

<http://www.vdem.state.va.us/>

This law authorizes provide the VDEM with the authority of take steps to prevent or reduce the harmful consequences of disasters.

Role

The VDEM is a state agency that works closely with local government emergency managers, other state agencies, voluntary organizations and federal agencies such as the FEMA to ensure a comprehensive, efficient and effective response to emergencies and disasters throughout Virginia. Reporting directly to the Secretary of Public Safety and the Governor of Virginia, VDEM works under the broad authority of the Commonwealth of Virginia Emergency Services and Disaster Law of 2000, as amended. VDEM has the authority to:

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- Declare State of Emergency
- Control and Regulate Resources
- Direct Mandatory Evacuation
- Commit State Resources
- Expend "Sum Sufficient" Monies
- Suspend Normal Procurement Procedures*
- Request Federal Assistance
- All Actions Necessary for Protection of the Public
- Pre-Delegation of Authority

Department of Housing and Community Development (DHCD)

Regulations

- a. **Virginia Uniform Statewide Building Code – Sections 36.97 - 36.119.1**

<http://www.dhcd.virginia.gov/Forms/DBFR/1USBC.pdf>

The Virginia Uniform Statewide Building Code is derived from the model codes of the International Code Council, and prescribes building regulations to meet general safety conditions such as electrical, plumbing, structural and other standards for construction. The code is authorized to consider issues that protect the health, safety and welfare of the residents of the Commonwealth, while developing standards that allow for the construction of buildings at the least possible cost consistent with recognized standards of health, safety, energy conservation, water conservation, and barrier-free provisions for the physically handicapped and aged.

Role

The Department of Housing and Community Development (DHCD) administers the Virginia Uniform Statewide Building Code which is compiled from the national model code. This national code is developed from the model codes of the International Code Council, referred to as the "I-Codes." The Virginia Uniform Statewide Building Code (USBC) is administered by local building officials who ensure that the design and construction standards required by the code are met. The USBC includes the floodplain construction standards required to be enforced by communities participating in the NFIP. These requirements are included in the BOCA Code. The sections of the Virginia Code which contain the floodplain requirements are distributed within the Code. There is no single section which contains all the floodplain requirements. Each locality has an appointed Local Building Code Board of Appeals.

Another activity of the DHCD is the administration of Community Development Block Grants to local governments. If the grant funds are to be used for activities in the floodplain then the chief elected official must certify that the community participates in the NFIP, that alternatives to building in the floodplain have been considered and that procedural requirements for advertising and conducting public hearings have been met.

The Planning Assistance program also facilitates coordination and grants for the activities of the Planning District Commissions (PDC's). The program reviews annual work plans, organizes workshops and assists with the dissemination of grant money. Most of the workshops present topics of interest primarily to the RPD directors, such as budget prospects and administrative

items. There is always, an increasing need to provide training for staff members on the technical aspects of some of the planning responsibilities localities face, such as implementing the Chesapeake Bay Preservation Act requirements. These technical training

needs may result in more workshops for the planning staff.

Other State Agencies

The following table provides a list of other state agencies with minor roles in floodplain management in Virginia:

**TABLE 2.2
STATE AGENCIES ROLES IN FLOODPLAIN MANAGEMENT
IN VIRGINIA**

DEPARTMENT	ROLE	WEBSITE
Department of Transportation (VDOT)	Involved in the design, construction and maintenance of highway facilities, VDOT Drainage Manual contains Floodplain and Stormwater Design Standards for Roads	www.virginiadot.org
Department of Environmental Quality (DEQ)	Oversees and reviews water quality and supply issues and enforcement of Clean Water Act	www.deq.virginia.gov
Department of Forestry (DOF)	Enforcement responsibilities for the debris in stream law	www.dof.virginia.gov
Virginia Marine Resources Commission (VMRC)	Administering regulations controlling the use and development of state-owned subaqueous lands, tidal wetlands and coastal primary sand dunes	www.mrc.state.va.us
Department of Game and Inland Fisheries (DGIF)	Responsible for property, facilities, structures and equipment located in floodplain areas, and enforcement of game and boating laws	www.dgif.virginia.gov
Department of Mines, Minerals and Energy (DMME)	Enforce standards which minimizes the environmental impacts of mining and mineral exploration activities	www.dmme.virginia.gov
Library of Virginia	Retains in their collection outdated Flood Insurance Studies and Flood Insurance Rate Maps for localities which have been restudied	www.lva.lib.va.us
Department of Health	Enforcement of Sewage Handling and Disposal and Drinking Water Regulations	www.vdh.state.va.us

SUMMARY OF CHAPTER 2

The framework for floodplain management in Virginia is established by federal and state regulations, which dictate the different roles that federal, state, and local officials have. The most relevant federal and state legislation and regulations impacting floodplain management have been presented. Likewise, the roles of different agencies and officials in enforcing and promoting floodplain management in the Commonwealth has been discussed.

*The Floodplain Management Plan
for the Commonwealth of Virginia*

Chapter 3

Understanding & Reducing Flood Losses

CHAPTER 3

UNDERSTANDING & REDUCING FLOOD LOSSES

INTRODUCTION

An objective of the National Flood Insurance Program (NFIP) is to protect those who suffer losses due to flooding and subsequently reduce flood losses. A significant strategy within a floodplain management program would be to achieve loss reduction through the preservation, conservation or reestablishment of natural floodplain corridors. The two objectives go hand in hand, and actions to achieve either objective are frequently beneficial to both. A large number of strategies and measures are available for meeting these objectives. They differ markedly in concept, applicability, cost, speed of implementation and effectiveness. Public and private decisions affecting floodplains must give explicit consideration to the hazards of life and property.

Because the land and water resources of the floodplain and the flood-related problems are highly varied, different strategies must be used to achieve desired objectives in different settings. Within these strategies are a large variety of options or "tools" for enabling desired uses or changes in the use of the floodplain. Each situation is different, but the basic objectives of floodplain management are to reduce or eliminate flood damages and loss of life.

Flood hazards are often broken into two categories, coastal and riverine. While much of the material in this chapter

pertains to both categories, certain issues may specifically be associated with one, more than the other.

COASTAL HAZARDS

Coastal areas are particularly vulnerable to natural hazards that pose a risk to human life and safety as well as development. Typically, over the years, coastal area land use has been predominantly the conversion along rivers, creeks and bays from woodland to agricultural uses with residential development ever increasing (Hardaway et al., 1992). Coastal areas within Virginia are no exception to this land use conversion process. The outlying rural counties of Tidewater Virginia are only in the early stages of development, whereas, the more urban cities and counties that are often referred to as the Hampton Roads Area are the most heavily populated and developed areas within Virginia.

The increase growth of population and development along the coastal areas is world-wide. About 50% of the world's population now lives along the coastal fringe and that trend is expected to increase to 75% in the next century. Within the United States nine of the 10 largest metropolitan areas, inhabited by more than 1/4 of the United States population are on oceans or the Great Lakes (U.S. Bureau of the Census, 1991). In 1980, coastal Virginia was made up of about 23% of the Commonwealth's population with the

COASTAL HAZARDS

heaviest concentration in the Hampton Roads (USACE, 1992).

In simple terms, coastal hazards are those hazards that are unique to coastal zones. For the Commonwealth these hazards include the effects of hurricanes (tropical storms), northeasters (extratropical storms) and the associated winds and waves as well as the long- and short-term tidal flooding or super elevation of water levels associated with these storms. Wind, waves, and increased water surface elevations have an impact on coastal zones. These forces are responsible for

the most damage within coastal communities. Hurricanes have a major impact on coastal zone areas of the Atlantic coast.

Table 3.1 lists coastal environments and their associated physical processes and hazards. These environments are effected not only by the ongoing active physical processes of erosion but also by the intensity and frequency major storm events. The processes impacting coastal environments are not considered critical or hazardous until development, land improvements, and/or lives are threatened.

**TABLE 3.1
COASTAL ENVIRONMENTS AND THEIR ASSOCIATED HAZARDS**

ENVIRONMENT	PHYSICAL PROCESSES AND HAZARDS	FREQUENCY
Lagoon	Tides, waves	Daily, seasonally, extreme events
Subtidal (nearshore)	Waves	Daily (seasonal), moderate plus extreme events
Tidal flats	Tidal	Daily (seasonal), extreme events
Salt marsh	Biological, tidal over wash	Slow trends, daily, extreme events
Frontal dunes	Eolian, wave erosion	Daily, extreme events
Beaches	Wave scour, offshore and alongshore sediment transport	Daily, extreme events
Interior dunes	Eolian	Extreme events
Urban or built up land	Storm surge	Episodic
Inlets	Migration, channel changes	Seasonal, extreme events

(after Anderson et al., 1975) Coastal Virginia

The coastal area of Virginia that is considered at risk from coastal flooding is made up of 10 counties and 8 cities that cover the entire Virginia Atlantic coast and most of the shoreline along the major tributaries to the Chesapeake Bay. This area includes the counties of Accomack, Gloucester, Lancaster, Mathews, Middlesex, Northampton, Northumberland, Richmond,

Westmoreland, and York as well as the cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, and Virginia Beach. These at-risk regions consist of approximately 9% of the total area of the Commonwealth, cover an area of 3,726 square miles (VA Hurricane Evacuation Study, 1992) and include approximately 3,100 miles of tidal

MODIFY SUSCEPTIBILITY TO FLOODING AND FLOOD-RELATED DAMAGES

shoreline, including offshore islands as well as the Chesapeake Bay and Atlantic coasts.

Four major river systems, the James, York, Rappahannock, and Potomac, significantly influence the topography of mainland Virginia. These rivers form peninsulas that are part of the character of the area. The region of Virginia commonly referred to as "The Peninsula" is between the James and York Rivers and contains the cities of Newport News, Hampton, Poquoson, and York County. "The Middle Peninsula" exists between the York and Rappahannock Rivers and consists of Gloucester, Mathews, and Middlesex Counties. The northern portion of coastal Virginia, or "The Northern Neck," has higher elevations with a maximum of about 160 feet above sea level. In the southern portion, particularly Hampton Roads, the elevations decrease to a maximum of less than 100 feet with most elevations below 50 feet (VA Hurricane Evacuation Study, 1992).

MODIFY SUSCEPTIBILITY TO FLOODING AND FLOOD-RELATED DAMAGES

The strategy to modify a locality's susceptibility to flood damage and disruptions consists of actions to avoid dangerous, uneconomic, undesirable, or unwise use of the floodplain.

There are three steps for the planning associated with the reduction of flood damages. First is a comprehensive understanding of the past, current and future flooding problems. Second is the establishment of land use policy that will result in some combination of open space and/or developed lands within the floodplain. Third is the implementation of a program using tools that meet the

land use goals and will help to reduce or eliminate the susceptibility to flood damages.

Under this strategy specific tools for floodplain management include floodplain regulations, development and redevelopment policies, floodproofing, hazard mitigation planning, disaster preparedness and response plans, and flood forecasting and warning systems.

Floodplain Regulations

Authorities for local floodplain regulations are found in part within the enabling statutes for zoning and within the Flood Damage Reduction Act, discussed elsewhere in the Plan. Floodplain regulations can provide a standard to assist in protecting new construction from flooding and assures the flood carrying capacity of the floodplain is maintained at a pre-determined level. Generally floodplain regulations neither restrict nor require land uses within the floodplain; rather they establish performance standards to which new uses must adhere. An exception to this general rule could result when certain specific uses are restricted from the floodplain due to public health and safety issues.

Floodplain regulations, which are part of broader land use regulations, can be applied effectively only by state and community action; they are increasingly required under ongoing federal programs as a prerequisite to other assistance. Administration of floodplain regulations adds only a small incremental cost when performed in combination with other ordinances, and may save significantly on flood related damages if implemented responsibly.

Floodplain regulations are largely a local government responsibility. The regulation may be used to (1) control future development in floodplains, and

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(2) correct inappropriate development already in the floodplain, particularly where older structures are being rehabilitated. Floodplain regulations, providing they are applied uniformly throughout the jurisdiction, can effectively prevent inappropriate development practices. Their implementation at an early stage of community growth can stop or slow down the creation of new problems while planning is under way for other corrective measures.

Floodplain regulations also serve several related purposes including:

- Preventing new development in floodprone areas that could result in loss of life and excessive damage to property, or reducing the potential for such losses and damages.
- Protecting unwary buyers from purchasing land or homes in floodprone areas.
- Preventing encroachments that decrease the flood carrying capacity of floodplains, increase flood heights, or otherwise aggravate flood problems.
- Reducing public costs for emergency operations, relief, evacuation and restoration.
- Reducing need for future expenditures for construction, operation and maintenance of reservoirs, levees and other flood control measures.
- Preserving natural floodplain values.

The regulatory aspects of floodplain management programs are sensitive to political pressures for change in favor of individuals, but they can be effective

when equitably reinforced at all government levels.

Local Regulations for Flood Hazard Areas

The principal local control of flood hazard areas is through zoning, subdivision regulations, building and housing codes, and sanitary codes with specific flood hazard provisions.

a. Zoning

Zoning divides a government unit into specified areas for the purpose of regulating (a) the use of structures and land, (b) the size of structures, and (c) the size of lots and density of use. Zoning may be used to set special standards for land uses in flood hazard areas including specification of minimum floor elevations.

Administration of riverine floodplain zoning ordinances is simplified by the designation of floodway and/or floodplain encroachment limits. The two-district floodplain concept is made up of two distinct zones: the floodway, being that portion of the floodplain that includes the channel of the flooding source and enough of the overbank area to convey flood discharges at some predetermined elevation relative to the Base Flood Elevation; and the floodway fringe, which is the remaining area of the floodplain outside of the floodway. Regulated floodplains do not need a floodway delineation, since standard model ordinance language specifies a minimum one foot (or less where mandated by local ordinance) allowable rise in the floodplain associated with impacts (i.e. fill associated with development). Where a Floodway exists, however, the burden of determining impacts associated with a specific project's fill become unnecessary, as the whole reach has been evaluated, on both sides of the

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flooding source, to determine the maximum encroachment associated with the allowable rise in the Base Flood Elevation.

It is important to recognize that the encroachment will not be a linear distance from the floodplain boundary, since the permissible encroachment is associated with a reduction in conveyance, not land area. In other words, a certain amount of discharge rate is iteratively reduced from the left and right overbank until the allowable rise is reached. In no case can the floodway boundary be inside the channel bank or outside the limits of the floodplain, with the exception of the special circumstance where the floodplain is wholly contained within the channel.

Although the floodway as such does not apply to coastal areas, there is a parallel for high hazard coastal and lake shore areas where the major forces of tides and waves come into play and where the erosional changes are at a maximum during flooding. The coastal area maps prepared by the NFIP identify such areas as "coastal high hazard areas."

b. Subdivision Regulations

Subdivision Regulations guide the process of land division to assure that lots are suitable for intended use without putting a disproportionate burden on the community. They also control improvements such as roads, sewers, water, and recreation areas. Subdivision regulations often require (a) installing adequate drainage facilities, (b) showing the location of flood hazard areas on the plat, (c) avoiding encroachment into floodplain areas, (d) determining the most appropriate means of elevating a building above the regulatory flood height in accordance

with sound engineering practice, and (e) placing streets and public utilities relative to the selected flood protection elevation.

c. Building Codes

The Virginia Uniform Statewide Building Code (USBC) prescribes mandatory building regulations for the construction of buildings and structures and the equipment in them and local option building regulations for the maintenance of buildings and structures and the equipment in them. All localities in the Commonwealth must enforce the USBC for the construction, renovation, alteration, demolition or repair of buildings and structures. The localities may adopt enforcement of the maintenance provisions of the USBC for the continued maintenance of existing buildings and structures and the equipment therein.

The purpose of the USBC is to ensure safety to life and property from all hazards incident to structure design, construction, occupancy, repair, maintenance, renovation, removal or demolition, including buildings and structures in flood hazard areas. The USBC adopts by reference model codes published by the International Code Council. The International Residential Code (IRC) contains the design and construction requirements for one and two family dwellings and townhouses. The requirements for flood-resistant construction are found in Chapter 3 of the IRC and include structural and elevation requirements, foundation design, protection of mechanical and electrical systems, enclosed areas below the design flood elevation, and other provisions for protecting buildings and structures in areas prone to flooding. The International Building Code (IBC) and its companion codes for equipment (International Mechanical Code,

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International Plumbing Code, and National Electrical Code) include the requirements for the design, construction, repair, renovation and protection of equipment for all other regulated buildings and structures in flood hazard areas.

The USBC can reduce flood damages to buildings and structures by setting specifications to (a) require suitable anchorage to prevent flotation of buildings during floods, (b) establish minimum protection elevations for the first floor of structures, (c) require electrical outlets and mechanical equipment to be above established flood levels or to be flood proofed appropriately, (d) restrict the use of certain materials subject to severe water damage and deterioration, and (e) require a structural design adequate to safely withstand the effects of water pressure and flood velocities. The USBC also contains provisions for substantial damages and substantial improvements when existing buildings and structures are subjected to flooding.

d. Sanitary and Well Codes

Sanitary and Well Codes establish minimum standards for waste water disposal and water supply. Sanitary codes commonly prohibit onsite waste disposal facilities such as septic tank systems in areas of high groundwater and flood hazards. Sometimes elevation or floodproofing requirements are established for public sewer systems. Well codes often establish special floodproofing requirements for facilities located in flood hazard areas in order to reduce their potential for contamination during flooding. Current standards addressing the location of these facilities are available through the Virginia Department of Health (VDH).

e. Other Tools

Other tools are available to reduce flood losses and promote sound management of floodprone lands. Many of these are related to hazard disclosure. Special statutes or local ordinances might require that sellers or real estate brokers disclose flood hazards on marketed lands. For example, the Department of Housing and Urban Development (HUD) program for Interstate Land Sales Registration now requires that natural hazards be included in the statement filed with the HUD and that such information is made available to the purchaser or potential purchasers. Currently, floodplain disclosure is left up to the individual realtor when making a sale within the Commonwealth. With flood insurance requirements, in theory, most buyers would be made aware of the requirement for flood insurance and the identification of a property as floodprone prior to the closing on a property, especially when a federally backed loan is being obtained. Within the Commonwealth the availability of a sanitary sewer backup rider must be disclosed. For many residents that are not directly inundated from flood water, but have experienced flooding from sewer backup, this rider represents the only form of insurance protection that might be available.

Development and Redevelopment Policies

Other public actions not necessarily employing policing power can modify susceptibility to flood damage and guide development in a manner that takes into account the flood hazard and the natural characteristics of the floodplain. Such actions may be applied through the design and location of utilities and services, through policies on open space acquisition and easement, and through redevelopment or permanent evacuation. These policies are normally

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required in any community, but in this context they should reflect the flood hazard. Examples of development and redevelopment policies follow.

Design and Location of Services and Utilities

Design and Location of Services and Utilities reduce flood loss potentials by guiding private and public developments, such as public services and utilities, to low risk areas or areas not subject to flooding. Local governments can exercise discretion in extending roads or sewer and water mains or their access in flood hazard areas. Locating libraries, schools, post offices, and other public and government facilities away from the flood hazard area not only lessens the possibility of flood damages to such buildings but prevents them from otherwise encouraging private development in areas prone to flooding.

Land Rights, Acquisition, and Open Space Use

Land Rights, Acquisition, and Open Space Use lessen the potential for flood losses and consequences. Land is purchased directly, or control is purchased through easements or development rights, for the purpose of precluding future uses incompatible with floodplain management programs and for the purpose of providing open space. Communities also occasionally acquire land for parks or other recreational, cultural or scientific uses that would not be seriously affected by floods. A policy of acquiring floodplain lands for such purposes will gradually protect larger floodplain areas from intensive development. In some cases, land can be acquired by allowing a developer to cluster to a higher density development away from the floodplain in exchange for dedicating the flood-prone portions of a property for public use as a

greenway or open space. In the short run, while acquisition may be a costly substitute for regulation, it may be the best tool in certain circumstances, and may be the only acceptable approach if the proposed use has a specific non-flood-related purpose, such as public use areas. Easements are being used in some situations to continue agricultural use of the land.

Redevelopment

Redevelopment may offer a tool for improving floodplain areas blighted for reasons that may or may not include repeated exposure to flooding. Usually the motives for redevelopment are broader than just flood damage reduction. However, the principles of floodplain management can be accomplished in the process. Disaster assistance, urban redevelopment, economic development, and other community development activities should be coordinated in such situations. The opportunities for and justification of redevelopment should not be overlooked. Redevelopment programs can be undertaken to correct existing problems. These can include relocating existing buildings to safe sites or demolishing undesirably located structures and providing replacements in a flood-free site. Areas vacated in either way are usually converted to a suitable open space use. Remaining structures may be modified to make them more resistant to flood damage. Redevelopment may help to achieve at least some of the floodplain management objectives by improving both economic efficiency and the natural environment.

Permanent Evacuation

Permanent evacuation, like redevelopment is presently less common than other tools except perhaps for small, isolated sectors of

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nonconforming uses. As in many of the post-disaster hazard mitigation projects. To the extent permitted by statute, localities should provide encouragement for relocation of structures and facilities from floodways and perilous floodprone areas, leaving such areas for open space uses or other flood compatible uses. It is important that existing opportunities are not overlooked. In some instances, permanent evacuation of floodplain areas may be the only economically feasible alternative.

Taxing Policies

Taxing Policies can also be used to discourage floodplain development or to encourage the protection of property from flood damage. Taxing undeveloped floodplain land at low rates and developed floodplain lands at higher rates discourages floodplain development. This usually results in a net savings for the community. Private efforts to reduce damages to existing properties can be encouraged by giving tax credits or deductions for investments in floodproofing, relocation and other damage averting actions.

Planning and Preparation for Flood Events

Good planning and preparation efforts can often reduce the impact of a flood on a locality and save lives. Making use of the time before the next flood for planning, mitigation, and the installation of warning systems can be a cost-effective way in which to deal with the next flood.

Disaster Preparation

No plan is complete without a response plan that specifies the appropriate and effective action to take during flood events. Periodic drills will help refine the response plan and familiarize officials with the plan. Preparedness

plans and programs provide for pre-disaster mitigation, warning and emergency operations. Training, public information, and readiness evaluations are all tools available for disaster preparedness. Other concerns include research, review and coordination of federal, state, and local disaster preparedness plans and programs, and post disaster evaluation. Success of this planning is closely associated with the degree to which individuals and governments protect themselves by taking appropriate hazard mitigation measures and obtaining flood insurance coverage to supplement or replace government assistance. While it is most desirable to develop preparedness and recovery programs prior to flood disasters the opportunity should be seized when such disasters occur to design recovery and redevelopment activities that will reduce or eliminate future flood hazards. This is where the Hazard Mitigation program plays an important role in disaster recovery.

Disaster Assistance

The impact of floods on individuals and communities can be reduced by relief and recovery measures. These include tax adjustments for the individual, provisions for speedy cleanup and resumption of commerce in the community, and effective use of various types of federal disaster aid.

An individual's flood losses may be partly offset if local government allows them as a credit or deduction against local taxes, in effect transferring a portion of the losses to the public. This type of relief is most applicable in developed areas where past losses have eroded the property owners' capability to cope with the cost of repairs and rehabilitation. However, it does not provide any protection against future flood damages. In fact, the knowledge

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that flood losses will be partly compensated through tax adjustments may encourage continued floodplain occupancy and possibly even greater floodplain development. This type of recovery effort does not help in the long run for the property owner of community, better efforts can be made in the mandatory purchase of flood insurance, increased efforts in the NFIP Community Rating System and coordinated efforts in the Hazard Mitigation Program.

Losses caused by disruptions and interruptions to businesses, industry, utilities and transportation facilities can be reduced if these activities are quickly returned to normal operation after a flood. This requires advance planning for debris clearance, pumping of basements, and restoration of utilities and other community services. This planning can be included in flood preparedness plans.

Many federal and state programs are available to help communities and individuals recover after flood disasters. Specific funding is available for mitigation planning. This planning activity encourages localities to foresee the kind of problems they may encounter during flooding conditions and make preparations to protect themselves. Evacuation planning, formalizing administrative chains of command with assigned duties, inventorying and assigning equipment, identifying highly vulnerable sites are all activities which mitigation planning can address and for which funding is available. State and federal aid is usually available only after a flood has been declared a disaster by the Governor or the President. Since disaster declarations are made on the basis of information about the type and extent of damages, communities should have plans ready for collecting the

needed information when floods occur. Up-to-date information on the requirements and benefits of available assistance programs should be maintained by community officials for use by local authorities and the public.

Simply returning a community to its pre-flood condition reestablishes the original risk of flooding. In many cases, opportunities arise after floods to eliminate unsuitable developments that have been damaged or rebuild essential structures to minimize future flood losses. These opportunities should be exploited to their fullest potential to better enable the community to withstand future disasters.

Floodproofing

Floodproofing refers to the use of techniques to either prevent entry of flood waters into buildings (dry floodproofing) or to minimize the damages from water that is deliberately allowed to enter a building (wet floodproofing). Floodproofing may be applied both to construction of new buildings and to existing structures (retrofitting) located within flood hazard areas.

Some of the floodproofing techniques that may be employed include: use of permanent or temporary seals, closures or barriers to prevent floodwater from entering a building; use of water-resistant materials; and temporary relocation of contents of buildings to avoid contact with floodwater. These techniques may be used individually or in various combinations.

Floodproofing may also be defined in terms of the level of human intervention required:

- **Permanent Measures:** Those that become an integral part of the structure and are rarely

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noticeable. They also generally do not require any type of human intervention to be effective.

- **Contingent or Standby Measures:** Those that are used only during floods, but which are constructed or made ready prior to any flood threat. These measures require some human action to be effective.
- **Emergency Measures:** Those carried out during a flood according to a predetermined plan. These may require major efforts during the flood which often are difficult to implement.

While floodproofing offers many advantages and if properly used can significantly reduce flood losses, there are many limitations and issues that should be considered. These include:

- Floodproofing may generate a false sense of security and encourage inappropriate occupancy of buildings during floods.
- If flood levels exceed the design standard for floodproofing measures, resulting losses may be high.
- If applied to structurally unsound buildings, flood proofing efforts can result in more damage than would occur without floodproofing (e.g. buoyancy uplift on structures with basements).
- Floodproofing is only partially effective unless it is also applied to means of access -- especially for commercial buildings.
- Floodproofing some properties may aggravate the hazard for others.

Floodproofing techniques are primarily for use in flood fringe areas where floodwaters are expected to be shallow and slow moving. Most floodproofing measures cannot withstand deep flooding. People should always be evacuated from floodproofed structures to avoid being trapped in case the floodproofing fails or access routes are closed.

The application of economic criteria is more likely to justify floodproofing for commercial structures than for residential structures. Usually it is applied to individual structures, but it is only partially effective unless it is also applied to means of access. Access to buildings should be passable at least in floods up to the magnitude used in setting floodproofing elevations. For example, to meet National Flood Insurance Program criteria, floodproofing of structures must protect against the flood with a 1 percent chance of being exceeded during any given year plus a minimum freeboard of one foot.

Flood Forecasting and Warning Systems

The National Weather Service (NWS) has established flood forecasting systems for the major river systems in Virginia. These systems provide information on the time of occurrence and magnitude of flooding to be expected. On major rivers where the flood crest moves slowly, warnings may provide several days notice. For smaller tributaries, warning times decrease to a matter of a few hours and probably not more than a day at a maximum. On short headwater streams with steep channel gradients, flash flood warnings may be possible only a few hours or even a few minutes in advance of the event. Community warning systems can be established for such conditions,

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but the short interval available for warning and response demands even tighter advance planning and preparedness than is required in areas with longer warning periods.

The NWS has developed a computerized warning system called IFLOWS (Integrated Flood Observing and Warning System) to alert downstream officials of an impending flash flood. The system consists of a central collection point managed by a minicomputer, located in the state Emergency Operations Center in Richmond, operated by the Virginia Department of Emergency Management (VDEM) services. It acquires, validates, and correlates rainfall, stream stage, and other meteorological data from automatic sensors, other National Weather Service systems, and the county centers. The collection point develops information relevant to potential flash flood threats and quickly disseminates the information and warning messages to the local jurisdictions.

The local centers receive the data directly to their computer stations. They can look at the rainfall data in time intervals of minutes, hours, days, or months. Warning messages trigger an alarm and provide a printout of the message. The local computers can also be used by the local coordinator to put volunteer rainfall and stream gauge observer reports into the system.

The NWS also prepares coastal flood forecasts and warnings primarily relating to tropical storms, hurricanes, and deep low pressure systems off the coast. The principle tool used for hurricane forecasts is the NWS SLOSH (Sea, Lake and Overland Surges from Hurricanes) computer model. SLOSH is used to generate a series of simulations of possible hurricane movement within a specific area or basin. Simulation runs

represent various combinations of hurricane intensity, track, size, and forward speed. The National Hurricane Center in Coral Gables, Florida issues all forecasts and storm warnings for hurricanes, including storm surge forecasts generated by the SLOSH model. The effectiveness of flood warnings depends upon the effectiveness of their dissemination to the public, the time available, and the actions taken in response. At minimum, local officials, police, fire and rescue squads, and radio and television stations are notified. Warnings must be effectively presented. The new NWS (NEXRAD) DOPLER radar system recently installed and operational throughout the states enhances the NWS ability to forecast and track tornados and hurricanes along the coast.

The VDEM also operates the VAWAS (Virginia Warning System) which is primarily a civil defense attack warning voice network. Located in selected regional sites, this provides an avenue for immediate voice notification of weather warnings. The VCIN (Virginia Criminal Information Network) provides immediate computer linkage with all jurisdictions. Weather watches and warnings are regularly transmitted by the Virginia Emergency Operations Center to all jurisdictions via this system.

Coastal Storm Awareness

A detailed knowledge of coastal environments and natural processes can provide a rational basis for regional mitigation of potential disaster. Mitigation includes any activities that prevent emergencies, reduce the chance of an emergency happening, or lessen the damaging effects of unavoidable emergencies and can take place before or after an emergency. Mitigation of

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coastal hazards is accomplished through development of emergency management plans which are supported by the incorporation of historical flood data and scientific information. Mitigation planning helps managers save lives as well as reduce costs of hurricane evacuation.

Property damage mitigation can be broken down into two broad categories: 1) Engineering and 2) Land use planning. Engineering applications alter the coast or strengthen buildings. Land use planning and zoning are coastal management efforts that help reduce the number of buildings and people at risk.

During recovery from a disaster, a locality can enact policies to mitigate future disasters after a storm. Policies are generally not challenged since everyone is making an effort to "return to normal" as quickly as possible. This attitude can hinder long-term mitigation efforts by returning to possibly inappropriate practices. Even after Hurricane Hugo, many beachfront properties were rebuilt after they had been completely destroyed. Management of a region can significantly reduce coastal storm damage and associated costs.

Identification of Coastal Hazards

Storms

Storm-related hazards have increased with the large-scale development along the shoreline. People who live along the coast can experience two different types of storms - tropical storms (hurricanes) and extratropical storms (northeasters). Severe storms have recently devastated parts of the Atlantic coast while providing us with an opportunity for research.

a. Predicting Tropical Depressions, Storms & Hurricanes

Modern technology can track a hurricane, as well as, predict its intensity. If a storm has a "closed" circulation and has wind speeds between 23 and 39 mph, it is called a tropical depression. When wind speeds are 40-74 mph, the storm is called a tropical storm and is named. Should the storm develop winds over 74 mph it constitutes a hurricane. Since 1950, tropical storms and resulting hurricanes have been named. Meteorologists can track hurricanes and use models to predict its path, but generally a wide range of likely landfall areas is given since assurance as to the location of landfall can not be given. When a hurricane is forecast to move inland on a path nearly perpendicular to the coast, the area placed under warning is about 300 miles in length (Finkl, 1994). From 1976 to 1985, the average error in the official 24-hour hurricane track forecast was 140 miles left or right of the forecast track while the average error in the 12-hour official forecast was 69 miles (VA Hurricane Evacuation Study, 1992). It is usually not known where landfall will be until it may be too late to initiate very specific evacuation plans.

Descriptions

Hurricanes are large-scale low pressure systems that develop in the warm waters of the tropics or subtropics north of the equator. It contains a series of spiral bands of high winds and thunderstorms rotating counterclockwise around a clear area of low pressure called the eye. The eyewall, the area of the storm adjacent to the eye, is the most intense part of the storm. As a hurricane makes landfall, the right front quadrant of the storm is the most dangerous since the

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counterclockwise circulation around the eye along with the forward momentum of the storm increases onshore wind speeds. These systems have a definite organized circulation with winds greater than 74 mph and a central pressure of less than 980 millibars (based on the Saffir/Simpson Hurricane Scale). The Saffir/Simpson Hurricane Scale (shown below) is a system that was set up to categorize the intensity of a hurricane. The scale describes storms in terms of central pressure, wind speed, and storm surge. Although the class of a hurricane cannot generally be linked directly to a damage estimate, there is a relative relationship. Some types of damage related to the five hurricane categories are (from NOAA table, 1990 version):

- **Category 1.** No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery and trees. Also, some coastal road flooding and minor pier damage.
- **Category 2.** Some roofing material, door, and window damage to buildings. Considerable damage to vegetation, mobile homes and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of center. Small craft in unprotected anchorages break moorings.
- **Category 3.** Some structural damage to small residences and utility buildings with a minor amount of curtain wall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain continuously lower than 5 feet above sea level may be flooded inland as far as 6 miles.
- **Category 4.** More extensive curtain wall failures with erosion of beach areas. Major damage to lower floors of structures near the shore. Terrain continuously below 10 feet above sea level may be flooded requiring massive evacuation of residential areas inland as far as 6 miles.
- **Category 5.** Complete roof failure on many residences and industrial buildings. Some complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Major damage to lower floors of all structures located less than 15 feet above sea level and within 500 yards of the shoreline. Massive evacuation of low areas on low ground within 5-10 miles of the shoreline may be required.

**TABLE 3.2
SAFFIR/SIMPSON SCALE FOR HURRICANE CLASSIFICATION**

Scale Number category	Central Pressure millibars	Winds mph	Winds m/sec	Surge feet	Surge meters	Damage
1	<980	74-95	32-42	4-5	1.32	Minimal
2	965-979	96-110	42-49	6-8	2.13	Moderate
3	945-964	111-130	50-57	9-12	3.20	Extensive
4	920-944	131-155	58-68	13-18	4.57	Extreme
5	>920	>155	>69	>18	>5.49	Catastrophic

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The size of waves generated by hurricanes depends on three factors: wind speed, duration, and fetch. As these factors increase so does the wave height. The waves generated by a hurricane can still affect the shoreline even if the hurricane itself does not make landfall.

As a hurricane strikes the shoreline and begins to move over land, changes occur to the system. The spiral bands of high winds and thunderstorms begin to weaken and become more disorganized. As they do, the water stored in the storm begins to drop out over inland areas causing severe flooding. The rotary movement of the winds can generate tornadoes.

Frequency

The frequency of hurricanes during a season will vary from year to year. The total number of tropical storms and how many of them become hurricanes can be listed to determine the severity and ranking of a season. This has been done since the late 1800's, and by this method, 1995 was the second worst season in that time period.

Recent studies on hurricane frequency show a correlation between Atlantic hurricane frequency and patterns of rainfall in West Africa such that more hurricanes tended to be formed when Africa had wetter years. In 24 hurricane seasons between 1900 and 1992, 32 major (category 3, 4, or 5) hurricanes made landfall along the United States East Coast and Peninsula Florida (Gray, 1992). In most of these 24 seasons, the Western region of West Africa had above normal rainfall. In fact, landfall is much less frequent in seasons when West Africa is dry. During wet periods in West Africa (1943-1969) many hurricanes impacted the Atlantic Coast; however, during the

dry period (1970-1987) only one major hurricane (Gloria in 1985) affected the North Atlantic Coast of the United States. Additional evidence suggests that the warm phase of El Nino tends to suppress hurricanes while a cold phase encourages hurricanes. Also, studies show that a decade-long cycle of increased hurricane frequency may have begun in the late 1980's.

b. Extra-tropical Storms

An extratropical storm is a low pressure, high intensity storm which develops near the Atlantic coast. These storms form rapidly and are generally known as northeasters. Most extratropical storms occur in the winter months between December and April. Although these storms are not as powerful as a hurricane, wind speeds generally range from 20 to 50 mph, the waves they generate can have greater wave heights because of a northeasters longer duration and larger fetch distance. Northeasters routinely span several days (Dolan et al., 1988) and can produce wave heights comparable to hurricanes. In March 1989, one of the three worst storms between 1949 and 1989 hit the mid-Atlantic coast and caused serious beach erosion and millions of dollars in damage from Ocean City, Maryland to Cape Hatteras, North Carolina (Dolan et al., 1990).

A northeaster can be classified according to the Dolan-Davis classification of northeast storms (Table 3.3). Dolan and Davis (1992) grouped 1,347 northeast storms that occurred between 1943 and 1984 into five categories analogous to the Saffir-Simpson scale for hurricanes. Since these storms generally only impact the shoreline, wave height and duration are more important factors than wind speed and pressure. The wave height is shown as an average height for a class of storm,

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but the actual range of mean wave heights is given by the standard deviation plus or minus the mean wave height. The average wave height for an extreme northeaster is 6.8 m but the mean wave during a real storm could range from 5.5 to 8.1 meters. The mean duration of each class of storm is also given; however, the mean duration also has a range given by the standard deviation.

Halsey (1986) proposed ranking extratropical storms into five categories based on damage potential. This system included 5 categories and takes into consideration the occurrence of the storm with respect to the tidal cycle and how many tidal cycles are affected by the storm (duration). This classification system adequately describes the damage potential of a storm but is not a way to compare northeaster storm intensities to hurricane intensities. The Northeast Storm Scale is as follows:

- Class 1 (up to 1 tide): Beach erosion and dunes sustain some scarping.
- Class 2 (up to 2 tides): Besides heavy beach erosion, dunes moderately to significantly scarped; overwash in weak areas, especially down street ends; sections of unprotected boardwalks popped or lifted off; flooding begins.
- Class 3 (2 to 3 tides): Serious beach erosion: dunes not only scarped, but some areas flattened by overwash; flooding serious; widespread boardwalk damage.
- Class 4 (3 to 4 tides): Erosion reaching to marsh “basement” in some areas; most manmade dunes flattened; significant overwash; fans coalescing; deeper flooding widespread; breaching in natural dunes increasing.
- Class 5 (4 to 5 tides): Surge platforms and incipient inlets present; washover sands completely clog low-lying islands and roads, natural dunes heavily eroded.

**TABLE 3.3
DOLAN-DAVIS CLASSIFICATION FOR NORTHEAST STORMS**

Storm Class	FREQUENCY		WAVE HEIGHT (m)		DURATION (hr)	
	Number of Storms	% of Total	Mean	Standard Deviation	Mean	Standard Deviation
Weak	786	50.3	2.0	0.3	8	4.4
Moderate	393	25.1	2.5	0.5	19	7.0
Significant	338	21.6	3.2	0.7	35	17
Severe	39	2.5	5.0	0.9	62	25
Extreme	8	0.5	6.8	1.3	97	44

Frequency

In Hayden’s study (1981) on the long-term trends of cyclone frequencies, he

found that through the late 1920's fewer coastal storms occurred. However, between then and the early 1960's, the number of northeasters

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increased followed by a decrease in storms through the early 1970's. Dolan and Davis (1994) found the same trends in their data set but they also identified an increasing frequency of events in the 1970's and a decreasing number of events through the 1980's.

Dolan and Davis (1994) calculated the return intervals for the different classes of storms. Class II northeasters occur on an average of about once per month; Class III storms return about once every 10 months; Class IV northeasters average once every 11.3 years; Class V storms have a return interval of over 100 years. However, since eight Class V storms were identified in the last fifty years, the extremes of the analysis may not be appropriate.

Created another topic for effects of storms and demoted each item.

Effects of Storms

Damage from hurricanes occurs from storm surge, wind, and waves as well as heavy rains and tornados. If a locality is prone to storm damage, managers should consider the financial impact of not only the large storms that occur infrequently but also the cumulative reoccurrence of smaller extratropical storms that frequently impact the shoreline. Managers should consider the cost of repairing and rebuilding infrastructure like roads and bridges as well as amenities such as boardwalks and piers after more frequent extratropical storms. Several of these individual events may often result in cost equal or greater to a large catastrophe.

Storm Surge

Often, high winds during a storm push water up into streams and estuaries that are already flooded with rain from the hurricane or northeaster. The wind

can actually keep the tide from receding so that the next high tide accumulates water even higher. This increase in water level is known as the storm surge. Storm surge is the difference between the observed and typical tidal water elevations during a coastal storm. Storm surges can exceed 13 or 16 feet during a hurricane, but northeasters have weaker wind fields and therefore generally have surges less than 7 feet. However, northeasters usually have longer durations and can span several tidal cycles creating a significantly elevated water level during that time. During a hurricane, the greatest change in water level is to the right of where the storm makes landfall (Reid, 1990).

This chapter deals with the potential impact of Atlantic storms but the far reaching devastation potential of hurricanes can not be underestimated. The remains of Hurricane Camille which struck the Gulf Coast over 500 miles away from Virginia contributed to a historical flooding event in central Virginia. Of the 256 deaths noted in the Gulf States and Virginia at least half were in Virginia almost a 150 miles from the Atlantic Coastline.

Increased water elevation can cause an unanchored house to float off its foundation. Even if the structure is left intact, flooding can damage the house and its contents with debris, mud and sand that can accompany the salt water intrusion into the structure. Low-lying coastal areas that exhibit little significant topographic relief have always had a tendency to experience flooding as well as drainage deficiencies. Large-scale development of the coastal plain has led to changes in the natural drainage and flooding patterns through storm-water drainage systems as well as hardening of the ground. These man-made changes can increase the

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damaging effect of storm surge as well as ebb surge.

After the passage of the hurricane, the storm surge is released as an ebb surge. Ebb surges are channeled through low areas and cause additional damage since the channeling increases velocity, scouring and sediment transport (Bush and Pilkey, 1994). Streets perpendicular to the shore and beach access roads concentrate storm surge ebb, and there is a close correlation between the type of development and damage from storm surge ebb. Gayes (1991) found that gaps in condominiums and hotels along Myrtle Beach, South Carolina following Hurricane Hugo concentrated storm surge ebb flow, increasing sediment transport offshore.

Wind Damage

Winds can cause structural damage by their force, pressure effects, and the debris they carry. Winds exert pressure on structures causing uplift and shifting the structure in the wind direction. Since both tropical and extratropical storms are cyclonic in nature, a whole suite of wind directions can impact the structure causing twisting. Damage due to wind tends to increase with wind speed, altitude and structure exposure, as well as, poor construction. A 100 mph wind exerts a pressure or force of about 40 pounds per square foot on a flat surface such as a sign (Ward et al., 1989). The taller the building, the more pressure is exerted since wind velocity increases with height above ground. The lower floors of high-rise building along the shoreline may sustain damage due to storm surge, but low pressure created by wind blowing across buildings can lift off parts of the upper floors exposing the interiors to additional wind and water damage. Structures that are sheltered either by

vegetation or another structure are not as likely to sustain wind damage.

The severity of a storm depends not only on the wind speed of the storm but also the forward velocity of the entire system. The speed of a storm has two contrasting impacts. The forward speed adds to the winds of the storm creating a more destructive force. This is why the maximum winds are on the right side of the eye of the hurricane. However, the speed at which the storm moves limits the amount of time the storm can impact an area through the generation of waves or wind storm surges. When a storm system passes through quickly, there is little time for waves to build up or for winds to push water further inland creating higher water on successive high tides (Ward et al., 1989).

Wind damage can continue well inland. Over-blown trees can cause massive utility and transportation disruption, and uprooted trees can destroy underground pipes and utility conduits.

Wave Damage

Severe erosion by waves occurs during the passage of a storm when high winds blow across an increased fetch and generate increased wave conditions. The amount of wave damage at any specific location depends on the storm type and direction as well as its intensity and duration. In addition, the shoreline's fetch exposure, orientation, type, and nearshore bathymetry affect the wave climate impacting that specific location.

Storm waves can cause severe damage to upland structures by forcing water onshore to flood buildings. They also can destroy boats and piers, and send floating debris against the structures. While seawalls are an effective way of protecting upland structures, they

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themselves are in danger from storm waves since reflection of the waves will lead to scour in front of the wall thereby reducing the beach width and elevation. If waves scour enough sand away from shoreline structures, such that the toe is exposed, these structures can collapse. Also destruction of the natural features by waves, such as dunes, leads to storm-wave damage of the upland areas and overwash penetration.

Shoreline Erosion

Erosion is both a natural and human-induced process. Human-induced erosion occurs when man hardens the shoreline without accounting for downdrift impacts. In nature, the shoreline recedes in response to processes which effect the dynamic equilibrium of the coast. These processes include: sand supply; wind, wave, tide, and current energy; beach shape; and relative sea-level (Platt et al., 1991). Tidal currents may be more important on Chesapeake Bay sites than ocean sites especially near tidal channels, headlands or constrictions in the Bay (Nordstrom, 1989; Downing, 1983). Boat and ship wakes can also be an important process acting on shorelines since the height of wakes is great relative to the normal incident waves in the smaller bays and narrow creeks where the boats pass within 100 meters of shore (Nordstrom, 1989; Byrne et al., 1981). The types of physical forces causing erosion are the same everywhere, but the rate, type, and location of coastal erosion are largely a function of local conditions (Ives and Furuseth, 1988).

There are over 5,000 miles of tidal shoreline in the Commonwealth of Virginia. Some of the most dramatic shore erosion occurs along the Chesapeake Bay main stem where fetch exposures and impinging wave heights are highest. In the Bay, the irregular

orientation of the shoreline as well as natural and man-made features create reaches along the shore that are effectively isolated from each other such that there is no exchange of sediment (Nordstrom, 1989). This compartmentalization can result in varying rates of change along adjacent shorelines (Philips, 1985). On the ocean side, shore processes affect the entire coast such that change along the shoreline may occur more rapidly than in the Bay, but sediment is replenished between storms by the low, "fair-weather", persistent swells that impact the shoreline.

Since the upland areas surrounding the Bay vary in height and composition, they may come under attack by waves and storm surge when shore zone features such as beaches, fringing marsh, and beach/dune systems are absent or not wide enough to protect them. The shore zone features themselves are either eroding, stable or accreting. These features may protect upland properties during annual events, but during more severe storms, the upland may be left open to wave attack as the features are removed by the storm event (Hardaway, 1996).

Statistics on Shoreline Erosion

Land loss to shoreline erosion since 1850 amounts to over 40,000 acres. Byrne and Anderson (1978) summarized the changes to the shoreline in Tidewater Virginia, excluding the ocean shoreline, by calculating the shoreline change in acre per 100 years for both marsh and beach shoreline. The marshes had a net loss of 7,361 acres per 100 years while the beaches had a net loss of 13,718; the total change was a net loss of 21,079 acres per 100 years over the study area. If the average loss of shoreline is evenly distributed over

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the total site area, the average loss would be 9 acres/mile/century. Conservative estimates of total volume of material lost by erosion and introduced into the waters of the Chesapeake Bay system was 270,126,000 cubic yards/100 years; this figure is equivalent to a volume one mile square and 165 feet high. It has long been understood that shorelines do not erode at uniform rates over long-time periods. However, it is easiest to describe the movement of the shoreline in this manner.

Fenster and Dolan (1994) analyzed long-term shoreline behavior to model historical data. Their analysis found that about one-fourth of the shoreline along the East Coast of the United States is migrating linearly (i.e. there have been no significant changes in rates of shoreline movement over the period of record), but two-thirds of the shoreline has had at least one significant reversal of long-term trends over the past 60 years. The shorelines that changed from accretion to erosion accounted for 62% of the data. Conversely, 38% changed from erosion to accretion. Since the timing of the trend of reversal was similar all along the East Coast (1967 was the average year), a large-scale process was probably responsible for the reversal (Fenster and Dolan, 1994). A link was made between the reversal and the increase in storm frequency which peaked in the 1960's when more and larger-magnitude storms occurred (Dolan and Davis, 1992).

Types of Shoreline Erosion

A profile cross-section of the shoreline shows several morphologic zones that are subject to erosion -- beaches, dunes, uplands and nearshore. Under normal weather conditions, the shore profile will not change very much;

however, various zones are part of a highly dynamic system that is trying to achieve equilibrium with the wave climate. Profile equilibrium is the ultimate shape of the profile if average conditions persist for a relatively long time period. Sediment movement in and out of the system is by both cross-shore and longshore transport.

A general trend for beaches, especially along the ocean and southern Chesapeake Bay shoreline is accretion in the summer under gentle wave conditions and erosion in the winter due to storm events. While this is not true in all cases, storms generally erode beaches since their profile is not in equilibrium with the storm waves. Because of the storm, wave heights and the water level increase is such that the beach profile is too steep for the storm conditions, thus, generating huge cross-shore transport and causing more damage since waves are breaking over a smaller area. Depending on the storm conditions, sand from the beach and also possibly the dune and upland zones are eroded and deposited in the nearshore so that the profile is flattened and the storm waves will expend their energy over a broader and more level surface (Ward et al., 1989). The sand is placed in offshore bars or further seaward. If the sand is stored in offshore bars, much of it may come back to the beach, moved shoreward by fair-weather waves. On the beach, the wind slowly rebuilds the dunes. However, this process can take years to complete.

Dunes are the result of wind blow across the beach. If the wind speed is great enough to get the sand grains moving, they will be deposited in the dune area. As the dune system matures, vegetation will grow and interior dunes will be created. Dunes are the storage system for sand that is

necessary to replenish the beach naturally as erosion occurs. During storms, the stored sand is used to flatten the beach profile. The rate of dune erosion during a storm depends on the severity of the storm. Wave runup across the beach and into the base of the dune causes dune face scarping. The longer the storm persists the less beach and consequently the less dune structure will be available to offer landward protection.

Moderate wind speeds can transport unconsolidated sand along almost any sandy shoreline. Eolian (wind-blown) transport is greatest during low and rising tide when the beach area is the widest and when drying of surface sediment occurs. As wind velocity and duration increases, so does the capability of the wind to transport material. Dune migration occurs when onshore winds blow sediment landward. Problems arise when the material is transported onto streets and lawns. Wind-blown sand can be a problem for coastal cities and towns. Not only is sand lost from the coastal system, but it can pose a hazard to residents and property especially in areas where the sea breezes are particularly strong.

During the passage of a storm, elevated water levels allow for direct wave and water current action on the dunes. Sand is generally eroded from dunes and deposited in the nearshore region as the beach profile adjusts to the conditions imposed by the storm. However, raised water levels and increased breaker heights may cause overwash to occur which will transport large quantities of sand landward of the dune.

The upland or fastland areas adjacent to the Chesapeake Bay vary in height and composition. They are threatened by erosion when shore zone features, such as beaches, fringing marsh, and dune

systems, are not present or not wide enough to protect the upland from wave attack. The shore zone features themselves are either eroding, stable or accreting. Any fastland elevation greater than 10 feet mean low water (MLW) is considered a high bank while a fastland elevation of less than 10 feet MLW is a low bank. The erosion of banks along the Chesapeake provide the necessary sediment to the beaches in the area by making sand available to the littoral transport system. The higher the bank, the more sediment available to the system (Dalrymple et al., 1986).

Erosion varies along these different shoreline situations. Under storm conditions, waves and storm surge may occur landward of the top of the bank and threaten property improvements directly since low upland banks are susceptible to frequent flooding. Property improvements on high upland banks are not susceptible to direct wave or storm surge attack; however, improvements near the edge of the bank may be threatened by erosion and slumping due to wave undercutting at the base.

FLOOD CONTROL

The traditional strategy of flood control relies upon the construction of: dams and reservoirs, dikes, levees, floodwalls, channel alterations, high flow diversions, onsite detention, and land treatment measures. These structures permit changes in the volume of runoff; in the peak stage of the flood; in the time of rise and duration; in the velocity and depth of floodwater; and consequently, in the amount of debris, sediment, and pollutants that floods carry. While the effectiveness of these tools in protecting property and saving lives has been well demonstrated, sole

reliance upon a flood modification strategy is neither possible nor desirable.

Structural flood control methods are generally applied for two reasons, the first is for floodplain "reclamation," the other is to protect existing developed areas that are floodprone. While either application may be appropriate, the initial high cost of these structures and the continued maintenance cost is rapidly reducing the number of locations where structural controls are economically justified. Flood control structures are generally best suited to areas that have other dire consequences associated with flooding. These include: sewage treatment plants, hazardous waste sites, or sites which may have equally detrimental materials. Additionally, flood modification (structural) measures acting alone leave a residual flood loss potential within the remaining floodplain and add the risk of rare but potentially devastating damages from structural failure or from uncontrolled flows of major storms. Unless accompanied by appropriate nonstructural measures, the structural measures could lead to a false sense of security and encourage inappropriate development of the floodplain. For this reason, some form of land use regulation and other appropriate nonstructural measures should accompany the implementation of structural measures.

Dams and Reservoirs

Storage of floodwater in reservoirs can be a highly effective flood modification device and may modify floods in a number of ways, including reduction in flood flow rates, extent of area flooded, and timing of peak floods. Dams and reservoirs have been constructed solely for flood control purposes, but usually flood control is only one of several

objectives served by dams and reservoirs.

In areas that are already well-developed with structures and uses subject to damage from flooding, temporary storage of floodwater in a reservoir may be the only feasible means of reducing potential flood damages, short of permanent evacuation of the floodplain. Even though the potential for flood damage may be greatly reduced, the damage potential remains if a flood greater than the design capacity occurs or if the dam should fail. When a dam fails, the unanticipated flooding and high velocity of the water can lead to severe damage. Once signs of dam failure become visible, breaching often occurs within hours. There is limited time for evacuation.

Dikes, Levees, and Floodwalls

Dikes, levees, and floodwalls protect a portion of the floodplain from flooding to a design level. Dikes, levees, and floodwalls should be engineered (including planning and construction) to avoid problems with overtopping, erosion of the levee material, seepage through or under the levee, subsidence and cracking. Design should also anticipate storm drainage accumulation behind the levee. FEMA has specific design standards that must be met in the design of new dikes, levees, and floodwalls. If the FEMA standards are not met, they will not allow the removal of flood hazard designations for the protected areas. Dikes, levees, and floodwalls have the advantage of flexibility, since they can be designed to protect relatively small areas, but they may create a false sense of security, since the level of protection is limited. They may actually increase flood elevations on adjacent, upstream and downstream properties by obstructing

or accelerating flood flow and/or increasing flood peaks.

Levees and floodwalls provide only partial protection from flood problems for several reasons:

- Many levees (emergency, agricultural) are designed to provide protection only from smaller floods (e.g., 5-15-year flood frequencies) or were built immediately before or during a specific flood event.
- Only a portion of all earthen levees built with crown elevations at the design flood elevation can provide the expected flood protection because of changing hydrologic conditions and the possibility of structural failure before overtopping.
- Areas behind levees and floodwalls are often subject to severe interior drainage problems. The exclusion of floodwater also serves to retain stormwater runoff. Surfacing groundwater may be another problem.

Areas behind levees and floodwalls may be at risk of greater than normal flood damage for several reasons. Floodplain residents believe that they are protected from floods and do not feel it necessary to take proper precautions. Development may also continue or accelerate based on expected flood protection. A dike/levee/floodwall failure, like a dam break, unleashes flood waters with a high velocity. After a breach, the downstream portion of a dike/levee/floodwall may also act like a dam, prolonging the flooding behind it.

Channel Alterations

Channel alterations, if properly engineered and operated, reduce

flooding by increasing the flow carrying capacity of a stream's channel. The various types of alterations include: straightening, deepening or widening the channel; removing debris; paving the channel; raising or enlarging bridges and culverts that restrict flow; and removing dams that interfere with flow. Underground conduits can also be installed to carry part or all of a small stream's flow.

The above-mentioned channel alterations contribute toward reducing the height of a flood. It is sometimes possible, by extensively reconstructing a stream channel, to contain major floods within its banks. Such alterations can sometimes increase flooding downstream by accelerating the flow of flood waters. Also, there is no guarantee that new channel modifications will be adequate under future development conditions.

Channel alterations are like levees and floodwalls in that they can be used to protect a specific site or region. However, they differ in that they are not subject to sudden or disastrous failure. Channel alterations for flood control can sometimes be used for other purposes such as navigation and recreation. For example, features such as boat launching facilities can be included in projects to deepen a channel.

The environmental impact of altering a stream channel depends on the specific techniques used. Some, such as reconstructing bridges and culverts, usually have only a temporary effect during construction. However, widening, deepening or paving of channels may destroy fish and wildlife habitat and other natural values for several years, decades or perhaps, even permanently.

ONSITE DETENTION MEASURES**High Flow Diversions**

Diversions intercept flood flows upstream of a damage-prone or constricted area and route flows around the area through an artificial conveyance mechanism. Diversions may either completely re-route a stream or only collect and transport flows that exceed the normal capacity of the channel or that would cause damage.

Diversions are particularly well suited for protecting developed areas because they do not require land acquisition or construction within the protected area. However, opportunities for diversions are often limited by the nature of local land formations and soil conditions. The receiving channel should have enough capacity to carry the flow disposed of through the diversion without causing flooding. In some circumstances, such diversions may sharply alter downstream flow patterns and discharges, thereby producing unwanted environmental effects. Where communities are not adequately protected from flooding by diversion, additional measures may be required.

Land Treatment Measures

Land Treatment measures can not be used to modify flooding to an appreciable amount. Land treatment measures can do a lot to maintain the current status, but would not appear to be a practical tool to alleviate an existing flooding problem.

Land treatment as a reaction would generally not keep pace with the impacts it's intended to address, but in a proactive context, should do a great deal to mitigate future flood damages.

Land treatment measures are used to reduce runoff of water to streams or other areas and are generally most

effective in controlling low volume, frequent flooding. Land treatment may include maintenance of trees, shrubbery and vegetative cover; terracing; slope stabilization; grass waterways; contour plowing; and strip farming. These measures reduce water flow by improving infiltration of rainfall into the soil, slowing and reducing runoff rates, and reducing the sedimentation that can clog stream channels or storage reservoirs. While the effect of any individual measure is small, extensive land treatment programs can effectively impact flooding when implemented over the whole watershed. Land treatment measures are less effective in downstream areas subject to larger floods.

Land treatment measures are commonly used in agricultural areas. In areas with steep slopes and unstable soils, maintaining a good growth of grass and other vegetation may be the most practical way of reducing runoff and erosion. Several land treatment measures involve little or no additional cost to the farmer, and some, such as no till or minimum tillage practices, may actually reduce costs. Land treatment measures may be undertaken as either a public or private effort. Practices requiring significant expenditures by the land owner are frequently encouraged by providing technical and financial assistance from public sources.

ONSITE DETENTION MEASURES

Flooding can be increased significantly by the runoff from lands which have been stripped of vegetation or covered with buildings, pavements and other impervious materials. The main objective of onsite detention is to prevent excessive runoff from such areas. A secondary benefit is that

onsite detention traps pollutants and therefore may improve water quality.

The principal onsite detention measures are those implemented to mitigate the adverse flooding impacts of land clearing or from the creation of impervious areas. Use of the measures may be voluntary or required by regulatory or permit programs. Required primarily through Virginia's Erosion and Sediment Control Law, land disturbing activities must evaluate the capacity of the receiving channel. If found to be inadequate, some combination of channel improvements and detention or retention must be provided.

Detention facilities are sized to temporarily hold excess runoff and designed to discharge flows in a non-damaging release. Detention ponds tend to reduce the peak rate of discharge during the flood event by temporarily storing a portion of the design flood volume. Basins that are designed for retention prevent some or all of the runoff producing event to reach the receiving waters through normal conveyances. Retention may include infiltration facilities that help reduce the volume of runoff as well the peak discharge rate.

The large use of detention basins may pose problems that are not yet fully evident. It has been shown that providing for numerous small detention basins on a watershed without considering the interaction of design outflow hydrographs can lead to aggravating rather than reducing flooding. And finally in certain areas, detention and retention policies have provided a false sense of flood reduction, without considering the overall impact of urbanization on stream response.

SHORELINE PROTECTION

Virginia has more than 5,000 miles of tidal shoreline. These shores include practically all known landforms and consist of materials of varying vulnerability to coastal processes. Damages from shore erosion include the loss of beaches for recreation; loss of waterfront land; damage to highways, residences, commercial development, access points and other waterfront structures; and loss of wetlands and other environments important to marine and coastal life forms.

Traditionally, historical hydrological data have been used in judging and evaluating the need for shoreline protection measures. However, it is beginning to appear that current and projected future changes in climate are leading to environmental changes--particularly rising sea levels--with at least three key water resources implications. First, shoreline protection problems associated with sea level rise are likely to become more significant from an infrastructure policy viewpoint. Second, existing hydrological data and analytical techniques may not be relevant to assessing future project needs. Third, climate changes or sea level rise may affect water resources beyond shoreline areas in inland regions in ways that are not well understood today.

Nonstructural Measures

When the natural protection system fails during large storms, the first solutions frequently chosen are quasi-natural methods such as beach nourishment or artificial sand-dune building. Such solutions retain the beach as an effective wave energy dissipater and the dune as a flexible last line of defense. However, these methods may provide only a temporary solution to chronic

long-term erosion caused by the diminishing supply of sediment in the littoral system and by the slow rise of sea level.

When conditions are suitable for artificial nourishment, long reaches of shore may be protected by this method provided that a source of sand is readily available.

Structural Measures

In general, measures designed to stabilize the shore fall into two classes: (1) structures to prevent waves from reaching a harbor area (e.g., breakwaters, seawalls, bulkheads, revetments), and (2) structures, such as groins and jetties, used to retard the alongshore transport of littoral drift. These may be used in conjunction with seawalls or beach fills or both.

Separate protection for short reaches of eroding shores, (e.g., individual shorefront lots) within a larger zone of eroding shore, is a difficult and costly approach. Such protection often fails at the flanks of these reaches as the adjacent unprotected shores continue to recede. Partial or inadequate protective measures may even accelerate erosion of adjacent shores. Coordinated action under a comprehensive plan that considers erosion processes over the full length of the regional shore compartment is much more effective and economical.

Onshore structures, termed bulkheads, seawalls, and revetments, provide protection, based on their use and design, for the upper beach which fronts backshore development or erodible bluffs. Shorefront owners have resorted to this shore armoring by wave-resistant walls of various types when justified by the economic or aesthetic value of what is protected.

Breakwaters have both beneficial and detrimental effects on the shore. All breakwaters reduce or eliminate wave action in their lee (shadow). However, whether they are offshore, detached, or shore-connected structures, the reduction or elimination of wave action also reduces the longshore transport in the shadow.

Groins are barrier-type structures that extend from the backshore into the littoral zone. Groins are generally constructed in series, referred to as a groin field or system, along the entire length of beach to be protected. The basic purposes of a groin are to modify the longshore movement of sand and to either accumulate sand on the shore or retard sand losses. Trapping of sand by a groin is done at the expense of the adjacent downdrift shore unless the groin or groin system is artificially filled to its entrapment capacity with sand from other sources. To reduce the potential for damage to property downdrift of a groin, some limitation must be imposed on the amount of sand permitted to be impounded on the updrift side. Since more and more shores are being protected and less and less sand is available as natural supply, it is now desirable, and frequently necessary, to place sand artificially to fill the area between the groins, thereby ensuring an uninterrupted passage of the sand to the downdrift beaches.

Jetties are structures used at inlets to stabilize the position of the navigation channel, to shield vessels from wave forces, and to control the movement of sand along the adjacent beaches so as to minimize the movement of sand into the channel. Like the groin, the jetty's major adverse impact is the erosion of the downdrift beach.

MODIFY THE IMPACT OF FLOODING ON INDIVIDUALS AND THE COMMUNITY

MODIFY THE IMPACT OF FLOODING ON INDIVIDUALS AND THE COMMUNITY

Another strategy for mitigating flood losses consists of actions designed to assist individuals and communities in their preparatory, survival, and recovery responses to floods. Tools include information dissemination and education, arrangements for spreading the costs of the loss over time, and purposeful transfer of some of the individual's loss to the community.

Information and Education

Flood hazard information is a prerequisite for sound floodplain management. The development of technical information and public education, especially by or for the officials and planners who will have the major task of interpreting and applying it, is essential in an effective floodplain management program. This information includes: hydrology of small large floods on the areas subject to inundation; the floodplain's resource attributes; the role of the floodplain within its region; and the potential impact of land use decisions on expected flooding. From this information, alternative floodplain management approaches can be formulated.

The NWS whose mission is to provide flood forecasts to the nation can assist any community in the technical aspects of flood forecast procedures.

Renters are traditionally poorly informed of flood risks. They may rent a trailer space in a floodplain, or live in an apartment within a flood hazard area. Unfortunately, because of their lack of understanding and preparation for the risk, they often are at the highest risk in a flood emergency.

Preparing for Storm Events

The threat of a hurricane making landfall in a coastal community will usually create upheaval and confusion among its citizens. Everyone must be ready well ahead of time for the extreme storm event. This includes individuals, businesses and government. While the hurricanes that have recently made landfall in the United States and other nations have caused massive destruction and tragedy, these events have also taught emergency management officials and planners what worked and what did not work when implementing their emergency responses plans and the importance of refining these plans with each disaster.

Individuals & Families

It is necessary for individuals and families to prepare well ahead of time. When a hurricane or major storm event threatens the shoreline services that are normally available may become sporadic; the roads become jammed with traffic, and the grocery and hardware stores sell out of supplies quickly.

Family disaster planning is recommended for any and all emergencies that may occur within a household and certainly it is absolutely essential when a large-scale natural disaster strikes a community. In order to develop a plan, individuals should find out what types of disasters are likely within the area. For those families living within a coastal community the family can plan for coastal storm events. They should learn what types of warning systems are used in the community as well as the emergency response plans for the home, workplace and schools.

Among other things, the plan should include:

MODIFY THE IMPACT OF FLOODING ON INDIVIDUALS AND THE COMMUNITY

- Meeting places
- A disaster kit
- Roles all members of the family should have (e.g. turning off utilities, operating fire extinguishers, location of home hazards)
- A communication system
- What to do with pets
- Preserving important documents

The plan should be understood and practiced, and the supplies and information that support the plan should be updated as necessary. With the capability of tracking coastal storms there is typically a sufficient amount of time to respond to the potential threat, however, there may not be time to develop an emergency response plan from scratch.

Businesses

After Hurricane Andrew, many companies couldn't locate their employees nor were they able to respond to employee needs prior to the event. Even the businesses that had emergency management plans had trouble enacting those plans. With businesses that have important records that need to be preserved an emergency plan needs to be in place. This will significantly help with the recovery of the business after the storm. In the wake of Hurricane Andrew, many companies were able to send computer data out of the path of the storm electronically, and thus they recovered fairly quickly.

Any business, no matter what size, needs to look at emergency preparedness from the position that if they were to lose all of their inventory and all of their records how would they

recover and how quickly could they be operating.

Companies need to take an active role in emergency management planning. Employees who are on the planning team need to be supported by allowing them to practice regularly as well as encouraging all employees to participate. Large corporations have an advantage since they may have offices across the country where data and records could be sent for storage. Emergency management agencies and officials, both local, state and federal can provide information and assistance in developing an emergency preparedness plan. Some companies are required to have an emergency action plan because of the nature of their work and/or the materials they handle.

Government

The combination of a growing coastal population, uncertainties in storm forecasts, and the time and expense of evacuating people from vulnerable areas poses a problem for emergency management agencies and officials. Preparation for hurricanes is expensive but the ramifications of not preparing are even more costly.

All levels of government need to have emergency action plans, and to practice these plans regularly so that all members of emergency response teams know their roles. In addition, all levels of government need to educate and encourage businesses and individuals to have emergency management plans. This will help reduce loss of life and property as well as reduce the amount of time needed for businesses and families to recover after a disaster. Educational programs should include specific information on what to do before, during, and after a storm. Residents must understand that after a

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large scale disaster, they may not have immediate access to rescue and recovery personnel and services and will need to survive on their own. Also, once evacuated from the area, they may not be allowed to return until recovery efforts have made the area safe.

The Virginia Hurricane Evacuation Study (1992) is a comprehensive detailed hurricane planning tool which can be used by federal, state and local governments to update and refine existing hurricane evacuation plans and to develop new plans. Key components of the study include a Hazard Analysis, Vulnerability Analysis, Behavior Analysis, Shelter Analysis and Transportation Analysis. When faced with an approaching hurricane, the study can be used to assist government officials in determining: (1) expected areas of storm surge inundation and the population at risk; (2) evacuation routes and shelter resources that will be required; and (3) when to issue an evacuation order.

Flood Insurance

Insurance is a mechanism for spreading the cost of losses both over time and over a relatively large number of similarly exposed risks. For the citizens this is the only commonly available mechanism to protect themselves from flood damages. Most if not all home insurance policies do not cover losses from flooding. Under the NFIP the federal government makes flood insurance available for existing property in the flood hazard area in return for enactment and enforcement of floodplain management regulations designed to reduce future flood losses and regulate new development in the designated flood hazard area. To be eligible for participation in the NFIP, communities must agree to adopt and

enforce floodplain management regulations consistent with program criteria.

By emphasizing the long-term advantages of wise floodplain use and by providing a mechanism for widespread risk sharing, the NFIP provides persuasive strength and beneficial emphasis to floodplain management. Specific information is provided to potential owners of floodprone properties about the economic costs of locational decisions, and thus serves to discourage unwise construction in hazardous floodplain areas. The program's floodplain management provisions help reduce flood losses and the dependency upon public support and should make continuation of its insurance features manageable through cooperating private insurers.

Within the Commonwealth as of September, 1996 there are 255 localities participate in the NFIP, eight localities have been suspended from the program, 24 localities not in the program with hazard areas identified, one locality withdrew, and 34 localities have not been mapped or enrolled as of September, 1996. At this time flood insurance is available to the majority of citizens of the Commonwealth, although efforts will be made to enroll new localities or rectify suspensions.

Tax Adjustments

Tax adjustments can play an important role both in influencing decisions about floodplain occupancy and in providing relief to individuals. Tax provisions can be used to encourage appropriate use and discourage inappropriate use. It is highly important that the tax structure recognize the regulatory aspects of the program so that the latter are reinforced; e.g., low density use

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achieved by regulations can be supported by low tax for such use. An excellent example of this type of program is the Land Use tax for agricultural activities. Financial relief can be found in provisions for claiming losses in federal and state income taxes and through special allowances on real estate taxes following a flood.

Flood Emergency Measures

Preparation for floods and flood fighting plans, including contingency and emergency floodproofing, can be completed in anticipation of flooding for areas where flood warning time permits. During and immediately after a flood, emergency activities may include actions to remove people and property from areas which may be flooded; sandbagging around individual structures and constructing dikes and other activities to direct floodwater away from vulnerable areas; search and rescue efforts during and immediately after flooding; and immediate post-flood measures to protect the health and safety of area residents. Flood fighting has been effective in helping communities to survive a flood. But opportunities for successful flood fighting are limited by flood characteristics, the physical nature of some flood problem areas, and the large manpower, fiscal, supply, and equipment requirements. One of the functions of overall floodplain management is to reduce the need for this type of emergency action.

Federal agencies

The USACE is one federal agency commonly involved in flood emergencies. The USACE can furnish assistance for: flood emergency preparation; flood fighting; the repair and restoration of any flood control works threatened or damaged by a

flood; provide emergency supplies of clean drinking water for communities with water supply contaminated by a flood; advance measures to protect against flooding; and hazard mitigation to limit damage potential caused by future flood events. During a flood emergency the maximum use of local and state resources must be made before assistance in the form of supplies and equipment can be provided by the USACE.

The U.S.D.A. Natural Resources Conservation Service (NRCS) may also become involved in flood emergency measures through its Emergency Watershed Protection Program with efforts to stabilize streambanks and prevent further erosion and flooding. The Emergency Watershed Protection Program is divided into two phases: Exigency Phase and Non-Exigency Phase. The Exigency Phase provides for temporary or permanent measures in areas where immediate action is needed to prevent further damage. The ability to respond quickly has placed the NRCS in a unique federal position to respond to flood disasters with minimal advance warning. Locality officials may wish to discuss NRCS procedure for this service with the District, Area or state NRCS office. The Non-Exigency Phase provides for stabilization efforts where there is no immediate threat of further damage if additional flooding were to occur.

FEMA's involvement during the emergency phase of flooding is to assemble disaster assistance, formulate post flood recovery strategies and administer federal assistance, and lead an inter-agency damage assessment team.

Local and State activities

Most flood emergency measures are carried out at the local level. Local civil

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defense, police, fire departments, public works agencies, public health personnel, and most other local government personnel may become involved in emergency measures depending upon the severity of the flooding. If the severity of a flooding condition exceeds a locality's capability to deal with the problems then the state would be called upon to assist.

The VDEM coordinates Commonwealth resources and activities during flood emergencies. State police, public works departments, and National Guard undertake major roles during flood emergencies. Other state agencies may also become involved depending upon the nature and severity of the flooding.

Private sector activities

The private sector is usually thoroughly involved with flood emergency measures. Activity may range from the individual who evacuates in anticipation of flooding and/or takes emergency measures such as relocating furniture or placing sandbags around a home, to the efforts of organized groups such as local chapters of the American Red Cross who may provide emergency food, shelter and other supplies. Private contractors and industry play a major role in work for communities and individuals to remove debris, repair homes, roads, bridges and other property damaged from floods. In the 1977 flood in the vicinity of Grundy the rapid opening of local roads was attributed by town officials and newspaper to the willingness of local coal companies to use manpower and equipment to clear the roads.

Emergency Evacuation

Northeasters are usually predicted only a day or two in advance and the intensity is difficult to forecast, making evacuation plans difficult to formalize.

Large scale evacuation does not generally occur before or during a northeaster; however, due to erosion of the shoreline and high tides, first row waterfront properties and their occupants may be in danger from erosion and entire waterfront communities from flooding.

The Disaster Relief Act of 1974 authorized the FEMA to establish disaster preparedness plans in cooperation with state and local governments. Over the past 20 years, hurricane preparedness has improved significantly especially with the advent of long range hurricane forecasting models available which generally allow sufficient time for warnings. When a hurricane threatens, residents that are in low-lying areas or mobile homes may be asked to evacuate their homes. If a direct landfall prediction is made, all coastal residents may need to be evacuated. Even with new technology, hurricane warning capabilities may be limited, and a mandatory evacuation order may be made within 12 hours or less of the predicted landfall of the hurricane. With well over one million permanent residents in the Hampton Roads Area, not to mention the seasonal tourist population, it may be impossible to completely evacuate the region since the low topography of the region as well as its access with vulnerable bridges and tunnels may make further evacuation impossible even before the hurricane strikes.

There are several types of traffic during a hurricane evacuation. There are people evacuating completely from the area, those heading to shelters or other destinations in non-flood prone areas, and those who intend to ride the storm out in their home but are driving around to obtain the necessary supplies. In any regard, a large number of vehicles

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have to move out of the area in a relatively short time.

When an order to evacuate is given, the amount of time actually taken by the residents and tourists to depart can be hours or even days. This has to be taken into account when the decision to evacuate an area is made. Clearance time must be weighted with respect to the arrival of tropical storm winds and road inundation; otherwise, evacuees can be left stranded on the road when the hurricane makes landfall. Clearance time is the time required to clear the roadways of all vehicles evacuation in response to a hurricane situation, including the time to gather possessions and secure homes as well as the time spent on the road. However, clearance time does not relate to the time any one vehicle is on the road. Given that the 24-hour hurricane track forecast could be off by about 140 miles either to the left or right of where the hurricane actually makes landfall, there may not be time to evacuate all citizens when the forecast becomes narrower as the hurricane approaches, particularly since the elevations of southern coastal Virginia are low and subject to inundation even before the hurricane arrives.

a. Emergency Shelters

When a hurricane is predicted to make landfall in a region, local authorities will open shelters for residents that may need to evacuate their homes. Buildings designated as shelters are generally on higher ground and built to withstand high winds. Overall, the shelter space for residents is considered adequate. When residents go to a shelter, they need to take enough food, water, and bedding for their entire family as shelters are usually set up at the last minute and have limited supplies. Also, any medications and

baby supplies that are necessary should be brought. In addition, it is a good idea to have games for the children, flashlights, and a change of clothes. Pets are rarely allowed in shelters so provisions must be made for them before you arrive. If you must leave a pet at home, notify people and attach a note to the door to let people know that a pet is inside.

b. Evacuation Routes

In order for the safe evacuation of coastal residents when a storm threatens, evacuees must reach safety before the onset of gale force winds (39 mph) and storm surge roadway inundation. Roadway inundation can occur early on in low-lying waterfront communities as high winds and large waves impact the coast prior to hurricane landfall. Local and state authorities have designated certain roads as evacuation routes. Residents should follow these routes and not try to take shortcuts since roads and bridges could be unsafe or trees and downed power lines could be across roads. A decision to evacuate should be made early by residents and local authorities since travel becomes dangerous as the hurricane comes closer to shore.

During a hurricane warning period, the U.S. Coast Guard has the authority to allow Civil Defense personnel to keep drawbridges locked down and open to vehicular traffic. Boaters need to be aware that bridges may be obstructed and will have to find an alternative safe harbor. While this is difficult for boat owners, it is imperative to keep the vehicular traffic flowing at full capacity or lives may be in danger if evacuees are caught on the road during the storm. For this same reason, mobile homes, campers, and boat trailers being towed along evacuation routes are hazardous. They need to be minimized

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or strictly prohibited in an emergency evacuation effort, since these vehicles are difficult to handle with high wind gusts and a disabled towing vehicle can block an entire escape route.

During A Hurricane

If an order by any form of government is given to evacuate in the event of a hurricane your residence or business it needs to be followed. Should you chose not to leave seek shelter. If staying at home, be sure to stay indoors at all times away from doors and windows. Do not go out when the eye of the hurricane passes over since the winds may resume suddenly, from the opposite direction and with greater force. Open a window or door on the side of the building opposite the storm winds to alleviate pressure differences inside and outside the house. If wind direction changes after the eye passes, you must change the window or door you have open. Have a radio tuned for continuing weather bulletins and official reports. You may not be in the direct path of the hurricane, but torrential rains and tornadoes may be in your area and reported on the radio. Follow official instructions only; ignore rumors. Be alert for rising water. Turn off major appliances at their source, gas and electric, and stay away from fallen power lines.

Post Flood Recovery

Like other aspects of floodplain management, post flood recovery requires a plan. Public facilities and services are restored and aid given to individuals. Aid from public and quasi-public agencies is often in the form of donations of food and clothing or grants and loans (which may be counter-productive if used to rehabilitate damaged structures or property located in high hazard areas). Relief may also

be in the form of tax adjustments. Although relief does not directly reduce flood losses, it does reduce the overall loss impact by shortening the period of disruption and by accelerating the return to normalcy. Due to recent legislative changes, property owners in a flooded community are required to purchase and maintain flood insurance as a condition for obtaining federal financial assistance.

Accordingly, a Federal Interagency Agreement provides that following a presidentially declared disaster, an Interagency Hazard Mitigation Team will assess the flooding situation and recommend ways in which federal program funds should be used to avoid action which will recreate previous high risk conditions and will take advantage of existing long-term area and basin plans for reducing flood losses.

In addition, it is essential that plans for post-flood recovery recognize opportunities to eliminate submarginal development and proceed with reconstruction in a way that will minimize future flood exposure. When there is a presidentially declared flood disaster, an Interagency Flood Hazard Mitigation Team is assigned to prepare a Post-Flood Hazard Mitigation Report. These reports identify opportunities for breaking the cycle of destruction, reconstruction of structures at risk, and destruction again. The plans include suggestions as to how these opportunities can be implemented. Flood disaster and emergency response planning should consider both economic and social disruption and inflated construction costs that may result from a disaster of significant size.

Following a declaration assistance is available to state and local governments and eligible private nonprofit organizations. Under a major disaster declaration assistance may be available

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for projects such as clearance of debris; emergency protective measures for the preservation of life and property; repair or replacement of roads or bridges; and repair or replacement of recreational facilities and parks. Hazard mitigation funding is also available to identify and implement measures to reduce the severity of future disasters. These might include preparing or updating the State Hazard Mitigation Plan and funding mitigation projects through the Hazard Mitigation Grant Program (HMGP), which can fund up to 75 percent of the cost of the project.

The VDEM has developed a Hazard Mitigation Management Plan (Annex 1-BB to Volume II, Commonwealth of Virginia Emergency Operations Plan) and a Flood Hazard Mitigation Plan (prepared in response to presidentially declared disasters) which if implemented in local jurisdictions would aid in reducing the damaging effects of floods throughout the Commonwealth. Additional local and regional planning efforts will assist in further preparing localities for flood preparedness and recovery.

After the Storm

Immediate recovery within a locality involves: debris removal, restoration of utilities, protection of exposed public and private property, recovery and reconstruction. Listed below are a few general guidelines; additional information on storm recovery is readily available from the FEMA, state agencies and from many internet sites.

a. Safety

After a major storm, many dangers exist in and around homes and businesses. Downed electrical wires could still be live; tree branches may fall; animals (particularly snakes and rodents) that may have been displaced

may move into your home; and even more serious, there may be structural damage such as; gas leaks; or household chemicals, like medicines, bleaches, kerosene or other flammable liquids, may have spilled. Use flashlights rather than lanterns or candles as they may start a blaze. Also, after a disaster, a pet's behavior may change. Pets may become more aggressive or defensive.

If a gas leak is detected, do not light matches or turn on electrical equipment and report gas service interruptions to the gas company. Extinguish all flames and shut off gas supply at the meter. When it comes to drinking water, the only "safe" water is that which was stored before it could come in contact with flood waters through a leak in the water distribution lines. If you need an additional water supply, boil the water for 30 minutes before use or treat water with water purification tablets or bleach.

b. Clean Up

Wash out mud, dirt and debris as soon as possible. To protect from further damage, open all doors and windows and patch all holes. Clean and disinfect everything that became wet since flood waters and mud may contain sewage and chemicals. Objects, such as pots and pans, that can be taken apart should be and washed separately. Throw out food, cosmetics and medicines that have come into contact with the flood waters. Books and papers can be dried, but mildew may grow before they are dry in humid conditions. If appliances have been submerged in flood water, they must be reconditioned by a qualified repairman. If the basement is flooded, pump it out gradually (about one third of the water per day) since the walls may collapse and the floor may buckle if it is pumped

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out while the surrounding ground is still saturated.

Assessing the Damage

Check foundations, footings, and walls for damage. Walls should be plumb. All appliances and electronic equipment should be checked out by a qualified repairman to determine if the items can be salvaged. Salt water from the storm surge and flooding as well as humidity in the days following the disaster can hamper restoration of personal property.

Insurance and Disaster Assistance

Most homeowners do not realize until after an emergency that their homeowner’s policies do not cover flood damage, and in order to receive federal disaster assistance, the area must be declared a disaster region by the President.

The NFIP defines flooding as ***a general and temporary condition during which the surface of normally dry land is partially or completely inundated.*** Two adjacent properties or two or more acres must be affected. Flooding can be caused by any one of the following:

- The overflow of inland or tidal waters,
- The unusual and rapid accumulation or runoff of surface waters from any source such as heavy rainfall,
- The incidence of mudslides or mudflows caused by flooding which are comparable to a river of liquid and flowing mud,
- The collapse or destabilization of land along the shore of a lake or other body of water resulting from erosion or the effect of waves or

water currents exceeding normal, cyclical levels.

Rain entering through wind-damaged windows, doors or a hole in a wall or roof which may result in standing water or puddles is not considered flood damage by insurance, but rather it is windstorm damage which may be covered by a homeowner’s policy. Flood damage generally results in a watermark showing how high the water has risen before it subsides.

A NFIP policy ensures almost every type of walled and roofed building that is mostly above ground and its contents, and all direct losses by flood are covered by the policy. Policy holders may be reimbursed for preventive measures taken to reduce flood damage to an insured building as well as the cost of removing insured contents from a building that has been declared by the community officials to be in imminent danger of flooding. Also, losses resulting from land collapse caused by water activity exceeding established levels are covered. Not insurable are livestock, motor vehicles, land growing crops, shrubbery, etc. Additionally, there are no federal or state regulations that prevent homeowners from rebuilding and insuring new structures against the next loss under NFIP (Platt et al., 1991).

While a homeowner’s policy does not cover flooding, it may cover other types of damage that results from a hurricane or other natural disaster. These include: your house and any attachments to the building such as a garage; any structures on the grounds that are not attached to the house such as a garage, tool shed, pools, decks, cabana or gazebo; the lawn, trees and shrubs on the property; personal possessions that members of the household own or use or that guests bring to your house; any items friends

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have loaned you and are being kept on your property; your living expenses if your house is unlivable due to damage; rental payments if your rental property is unlivable; and settlements, medical expenses, defense, and court costs involved in claims against you for bodily injury or damage to the property of other that occurred on your premises. However, policies vary, and it is a good idea to know what is covered by your policy. To protect against flooding, the NFIP requires that structures be built above the 100-year flood elevation, which is the estimated height of coastal storm surge that could occur in a 100-year period. Along open coasts, construction must occur landward of Mean High Water (MHW) and not destroy sand dunes (Platt et al., 1991).

Individuals, families, farmers and businesses are eligible for federal assistance if they live or own a business in an region declared a Major Disaster Area, incur sufficient property damage or loss, and, they do not have the insurance or resources to meet their needs. Aid can come from many sources: (1) disaster loans from the Small Business Administration (SBA) or the Farmers Home Administration (FmHA), or the minimal repair program (MRP) offered by HUD; (2) grants from FEMA or the state government; (3) temporary housing or housing assistance from FEMA's Disaster Housing Assistance Program (DHA); (4) benefits like pensions, death benefits, insurance settlements, and adjustments to home mortgages for veterans from the Department of Veterans' Affairs; (5) casualty losses are deductions allowed by the Internal Revenue Service (IRS) on federal income tax returns for the year of loss or through an immediate amendment to the previous year's return; and (5) unemployment benefits from the state unemployment office.

When disaster strikes, these steps can help the claim process move more smoothly (Torres, 1992).

1. Contact your insurance agent. Make sure you leave a number where you can be reached as well as your policy number and the property address.
2. Take pictures of the damage.
3. Protect property from further damage or theft. Save receipts for what you spend in your recovery efforts and submit them to the insurance company.
4. Dry out water-damaged furnishings and clothing as soon as possible to prevent fading and deterioration.
5. Keep accurate records:
 - A list of cleaning and repair bills, including materials and cost of rental equipment.
 - A list of additional living expenses if your home is so severely damaged that you must live elsewhere while repairs are made. Include motel and restaurant bills, home and car rental.
 - A list of actual losses including furniture, appliances, clothing, paintings, foods and equipment.
 - Try to document the value of each object lost. Bills of sale, canceled checks, charge account records, and insurance evaluations are good evidence.
6. Contact a reputable firm to repair damage and be wary of door-to-door salesman after a disaster.
7. Don't be in a hurry to settle a claim. It is advisable to wait until all damage is discovered.

SUMMARY OF CHAPTER 3

An objective of the National Flood Insurance Program (NFIP) is to protect those who suffer losses due to flooding and subsequently reduce flood losses. A large number of strategies and measures are available for meeting this objective. A significant strategy within this Plan is to achieve loss reduction through the preservation, conservation or reestablishment of natural floodplain corridors.

Because the land and water resources of the floodplain and the flood-related problems are highly varied, different strategies must be used to achieve desired objectives in different settings. Within these strategies are a large variety of options or "tools" for enabling desired uses or changes in the use of the floodplain. Each situation is different, but the basic objectives of floodplain management are to reduce or eliminate flood damages and loss of life.

*The Floodplain Management Plan
for the Commonwealth of Virginia*

Chapter 4

Maintaining Natural Floodplain Resources

CHAPTER 4

MAINTAINING NATURAL FLOODPLAIN RESOURCES

INTRODUCTION

As long as humans venture into the floodplain and flood prone areas they will continue to impact natural floodplain function and value and it is likely they will personally suffer from flood related damages. Therefore, it seems logical that humans should not occupy nor encroach on the floodplain. If a management philosophy of avoidance were pursued, many environmental concerns would be reduced, and flood losses would be minimized. However, present world realities and political pressures prevent floodplain managers from applying this simple, yet practical concept.

National floodplain management policy has not aggressively promoted implementation of open space, or land preservation strategies. The prevailing philosophy has been that it is better to have a program that is politically supported and that will reduce flood loss potential over time, rather than having little chance for the implementation of a program that eliminates the entire loss over time.

Natural beneficial values of floodplains are those features that serve the interests of the ecological floodplain community and benefit society's developed communities. Examples include water supply resources, water quality improvement, diverse scenic resources, flood water storage and conveyance, wildlife and fisheries

habitats and water-based recreational resources. Many wetland environments are also floodplains and the wetland management goals relating to flow attenuation for these areas benefit floodplain management. The goal of integrating natural and beneficial values with other floodplain management goals is to consider the relative merits of retaining a floodplain in its natural unaltered form.

Floodplains left in an undeveloped, unaltered state are areas where several unique natural and historic resource values converge. Some of these values are outlined in the list below:

1. Water supply
 - Allows recharge of aquifers
 - Detains peak volumes for local diversions
2. Water quality
 - Vegetated buffers filter out contaminants
 - Riparian vegetation processes sediments naturally
 - Nonpoint contaminants in receiving waters are processed and reduced naturally
3. Flood control
 - Peak flow storage and attenuation
 - Scour velocities in watercourse are reduced

DETERRENTS TO NATURAL AND BENEFICIAL VALUE PROTECTION

- May reduce need to modify upstream dams due to dam safety requirements
- 4. Fisheries habitat
 - Buffers provide more food sources
 - Water temperature can be cooler
 - Supports habitat diversity
 - Aerated water and oxygen tends to be greater
- 5. Wildlife habitat
 - Water for consumption is accessible
 - Diversity of vegetation provides cover
 - Stream provides stable source of food for prey/predator chain
 - Corridor provides pathways for movement
- 6. Recreation
 - Water based (boating, fishing, swimming)
 - Wildlife observation
 - Scenic
 - Corridor connections
 - Locations of historic structures and districts
- 7. Historic
 - Locations of historic settlement and archaeological sites

The preservation of these values can be very challenging. Obstacles may arise when attempting to protect these resources. These relate to evaluating public benefits versus private rights; legalities of zoning authority; accurately assessing a floodplain's attributes and popular perception of those attributes; the loss of local tax revenue if tax paying property is converted to public

open space; the high cost of purchasing land; and mustering the citizen support necessary to carry out a resource protection strategy.

The historic origins of many communities are based upon their relationship to rivers or the coast. Early settlements, commerce and industry were located in the floodplain to take advantage of water supply, hydropower and transportation. These historic resources are valuable sites through which many communities derived their historic identity. To completely relocate or raze these sites would devastate some communities. Therefore appropriate floodplain management of historic districts requires techniques and activities which may not otherwise be applicable for a community with less historic significance.

This chapter of the Virginia Floodplain Management Plan presents perspectives on values of floodplains and strategies available to manage these resources and the benefits they provide.

DETERRENTS TO NATURAL AND BENEFICIAL VALUE PROTECTION

If all of the base flood floodplain resources in Virginia consisted of undeveloped open space, then the flood damages suffered through the years would be much less significant, particularly to human development. Realistically though, the preservation of open space in floodplain areas, whether through acquisition, regulation, or through voluntary efforts is extremely resource intensive. It is usually accomplished on a site-by-site basis rather than through a massive statewide initiative. The reasons for this include:

DETERRENTS TO NATURAL AND BENEFICIAL VALUE PROTECTION

- Participation in the NFIP is an option for localities. Many localities pursue the program to remain eligible for federal assistance and disaster aid. The minimum national floodplain management standards were developed and serve as a compromise between unregulated uncontrolled development and no development within the floodplain and do not address the protection of natural and beneficial values.
- Floodplain managers administer regulations that are "performance based." These are regulations that require a specific standard that can be measured. For example development in the floodway is not allowed if it results in an unacceptable increase in the Base Flood Elevation. The regulation has not eliminated the potential for development or construction in the regulated floodplain, it has simply dictated a design requirement that must be complied with. Such performance-based standards have stood the test of the courts as being reasonable. This is partially due to an acceptance that design, engineering and construction techniques are available to protect against the forces of flooding and as long as a property owner can meet these standards the owner should be allowed to proceed with the development.
- The generation of performance-based standards requires the uniform application of the standards within the regulated area. There is a fear and the potential that a standard that is too strict will have severe impacts on existing uses. Many communities view themselves as not being able to endure the expense of appeals and special attention they would face if highly restrictive performance-based standards were adopted.
- Coordination of multi-objective management and planning for river and stream corridors has not been adequately supported to obtain the requisite political and public support and funding.
- Open space acquisition, standing alone, receives little funding.
- In certain areas of the Commonwealth, such as the Valley and Ridge Province of southwestern Virginia, the only economically viable area available for development may be within the floodplain.
- In today's society it is desirable to own a waterfront home or business to the point that individuals are willing to pay high costs despite the presence of flood hazards.
- Floodplain management efforts and responsibilities are often fragmented in their implementation or take a back seat to other community priorities. Localities often split responsibility for floodplain management between the planners, engineers, and building officials. Typically, in these situations, no single department assumes and controls the responsibility for setting program goals.

APPROACHES FOR THE MANAGEMENT OF NATURAL AND BENEFICIAL VALUES

RESOURCE IMPACTS RESULTING FROM LOSS OF NATURAL VALUES

Some examples of cumulative impacts resulting from floodplain alterations and uses include:

1. The filling of the floodplain areas results in the loss of overbank flood storage, which can cause the reduction in flood peak attenuation and may result in an increase in downstream flooding.
2. Within a stream reach, the filling of these floodplain areas results in an increased flood elevation for any given discharge. This could lead to damages to properties that would be less severely flooded if no filling of these fringe areas had occurred.
3. Channel modifications usually result in altered stream flow regimes, a redistribution of flow within the channel, and sediment transport changes. Streams will adjust to channel modifications by altering their sediment carrying capacities upstream and downstream of the modification in an attempt to re-establish system equilibrium. These alterations will generally result in erosion of streambanks causing undermining and collapse of land and producing obvious hazards to nearby structures. These alterations, however, may not manifest themselves for years after the initial channel modification.
4. The placement of new structures and materials in a floodplain or floodway such as mobile homes, vehicles, above ground storage tanks, storage of lumber, and hazardous materials even if they are properly elevated and tied

down, present potential debris problems. If structures and material becomes buoyant debris, it can cause significant damage upon impact to other property.

5. Dam safety requirements are in part based on the density and location of downstream development below the dam. Floodplain encroachment into a sparsely developed floodplain may result in a change in the hazard classification of the dam and further result in the need to enlarge or modify upstream dams to safely pass larger design floods.
6. Elimination of fisheries and wildlife habitats.
7. Increased sediment and nutrient loads.
8. Increased water temperature, and lower dissolved oxygen levels from removal of the riparian canopy.
9. Reduction in natural water treatment capabilities.
10. Modified and reduced recreational potential.

A practical approach to addressing floodplain management issues is to develop tools and strategies that allow for better management . A more balanced view of the objectives of floodplain management will achieve both flood loss reduction and maintain the natural floodplain functions.

APPROACHES FOR THE MANAGEMENT OF NATURAL AND BENEFICIAL VALUES

The management strategies for the protection of natural and beneficial values of floodplains can span a wide range of applications. On the most extreme end of effectiveness would be a

APPROACHES FOR THE MANAGEMENT OF NATURAL AND BENEFICIAL VALUES

management approach whereby absolutely no alterations of the floodplain environment would occur. The watercourse and its adjoining corridor would exist untouched. This would allow maximum flood storage capacity and would preclude development in the floodplain. On the other end of the spectrum would be a management approach which would allow any alteration within the floodplain. These two extremes are practiced within the Commonwealth. The first where a private preserve exists along a floodplain and the second in a community that does not participate in the National Flood Insurance Program (NFIP) and exercises no floodplain management at all. Most communities in the Commonwealth manage their floodplain areas at a point between these two extremes.

The Association of State Floodplain Managers (ASFPM) is a national organization whose mission is to mitigate the losses, costs and human suffering caused by flooding and to promote wise use of the natural and beneficial functions of floodplains. ASFPM has undertaken an initiative that is consistent with protecting the natural beneficial uses of floodplain areas that is referred to as "No Adverse Impact" or NAI. NAI accomplishes the mission of ASFPM by protecting floodplains as a resource, and thereby mitigating the losses, cost and human suffering associated with flooding.

"No Adverse Impact Floodplain Management" is a managing principle that is easy to communicate and from a policy perspective tough to challenge. In essence, NAI floodplain management is where the action of one property owner does not adversely impact the rights of other property owners, as measured by increased flood peaks, flood stage, flood velocity, and erosion and sedimentation.

NAI floodplains could become the default management criteria, unless a community has developed and adopted a comprehensive plan to manage development that identifies acceptable levels of impact, appropriate measures to mitigate those adverse impacts and a plan for implementation. (NAI White Paper, April 29, 2004)

The following approaches are discussed to establish a frame of reference for understanding the protection of natural and beneficial values and consequently provide mitigation for flood damages.

Preservation

A preservation approach for the protection of floodplains would entail a no alteration strategy whereby the natural features of a floodplain would be allowed to remain undisturbed. This would apply to areas that are presently undeveloped: wilderness areas, rural areas, even some urban river corridor greenways have floodplain reaches which are "managed" through a preservation strategy.

A tremendous portion of floodplains in the Commonwealth exists in a preserved status by default. These are typically rural areas for which there is no interest or need to develop. But these areas that are preserved through default are not the problem areas. The problem areas are those floodplains for which there is pressure to invest infrastructure and buildings. It is these areas where society could benefit by implementing an aggressive preservation management strategy. Such an aggressive preservation approach to protect natural and beneficial values of floodplains would have multiple benefits to the corridor. Such a strategy might include outright acquisition; conservation easements; voluntary preservation practices by

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landowners; land use assessment; stream corridor setback regulations; and no-build zoning bylaws.

As a management tool, preservation is often the least understood, and most controversial strategy. The establishment of performance-based regulations to uphold a preservation strategy requires a bold commitment by local officials. If a preservation strategy is deemed to be a strategy where no alterations to the floodplain are allowed, this will require not only local official perseverance but also support from the citizens of the community who will enjoy the benefits of open space river corridor management.

A preservation policy can only be realistic if there are resources and characteristics being preserved which are deemed to serve the general public welfare. Another key element is that the resources and characteristics being preserved usually are not renewable. For example the maintenance of a regulatory floodway is a preservation policy for a resource that is not readily reversible. The specific attribute preserved is the ability of the floodway to store and convey floodwaters for a given flood event without causing an increase in flood elevations. For highly critical areas absolute prohibition of land use changes within the floodway may be appropriate.

If the regulatory tools do not adequately provide a mechanism to protect the specific attributes of concern, then acquisition of a land right would be the ultimate preservation strategy. Acquisition of a land right can allow for a management philosophy that exceeds the limits of the regulatory control.

Conservation

The protection of natural and beneficial values through a conservation

management approach involves a combination of strategies where some preservation practices are applied and some low impact alterations of a floodplain are allowed. Implementing a conservation approach is a realistic and reasonable goal for most Virginia communities. It is a sensible point along the spectrum of extremes. A conservation strategy for a particular reach of a floodplain would include a preservation component where appropriate and would allow alterations to a natural floodplain where no practicable alternative was feasible.

A conservation strategy must contain a tangible effort to include a preservation component, thereby attempting to achieve some multiple objectives. If the extent of a community's floodplain management program consists only of the enforcement of the NFIP regulations and minimum standards, it would not qualify as a conservation strategy for the protection of natural and beneficial values of a floodplain. The NFIP regulations serve primarily the interest of reducing flood damages to the point that is nationally enforceable. They are not regulations which make a substantial contribution toward water quality improvement, water supply enhancement, wildlife and fisheries habitat protection, recreational resource access, or scenic resource protection. NFIP regulations do provide a degree of conservation by controlling filling or development of the floodway.

The conservation strategy can be the most intensive strategy to implement in terms of staff time and money. It requires the identification of those natural and beneficial values of a floodplain that are renewable and non-renewable and making decisions about what resources are expendable. In floodplain management structural changes to the floodplain are virtually

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non-renewable, changes in vegetation or temporary degradation of water quality are renewable.

The key to a conservation strategy is to determine for those natural resources that are renewable what the degrading impacts might be, and if the time frame for renewal is acceptable. For non-renewable impacts a tolerance level must be established that balances the resource need with the needs for a modified use of the floodplain.

Restoration

This strategy allows for the identification of critical lands and the expenditure of resources to recover lost benefits. Acquisition and relocation programs are an example of a restoration strategy. Once these lands are cleared of structures, other uses compatible with the floodplain and the environment could be developed or restored. Funding for implementation of this strategy is usually the major obstacle. One possible funding source is through the Hazard Mitigation Grant Program (HMGP). Under this program, eligible flood damaged property can be acquired, the structure removed and the land turned over to the locality to be used for open space or other compatible purposes. Although the program's primary purpose is to reduce future flood damages and expenditures for flood insurance claim payout, it provides a valuable service to communities by providing open space. The HMGP will be discussed in more detail elsewhere in this plan.

Mitigation

At times, driving social and economic pressures in support of development and construction in a floodplain are so strong that the projects will proceed despite the loss of known beneficial

natural values. From an ecological systems viewpoint, it might be possible to transfer, preserve, or recreate similar beneficial natural values within the system on adjoining land. An example would be a case where someone wanted to construct a commercial building in a floodplain which would increase the base flood elevation by some previously established amount. In this case the project proponent may agree to excavate in the fringe to provide an equal amount of compensatory flood storage volume. This would therefore mitigate the impact of lost flood storage, or otherwise negate their impacts to flooding potential within the confines of their property (upstream and downstream). The project proponent may be agreeable to enhancing the water quality function of the compensatory mitigation area, which would serve further the interests of recreation, water supply or fisheries habitat. An area of increasing interest to land managers is the replication of wetland functions. Increasingly, regulatory authorities require project proponents to mitigate for the lost functional values of the wetlands as a condition of receiving a permit to proceed.

There are two commonly implemented practices used as mitigation strategies to minimize flood damages. One strategy is the design and construction requirements for buildings constructed in floodplains. This can include the rehabilitation of existing structures as well. Dry floodproofing, wet floodproofing, elevating structures and retrofitting structures are common techniques employed. Typically, these practices do very little to protect the natural and beneficial values of floodplains.

The other common strategy is the construction of flood control structures,

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such as dams, levees and flood walls to hold back and/ or retard flood waters. The construction of these flood control structures may adversely impact the values of floodplains. In an attempt to minimize these impacts, additional land acquisition or resource enhancement might be achieved through project negotiations. Often the construction of these structures can easily incorporate an enhancement of recreational resources associated with them. These multi-purpose flood control projects receive greater public support from the citizens and the locality that will benefit from the project than single-purpose flood control projects.

Cooperation

This can be the most effective tool of all. If realistic environmental goals and objectives are presented to developers and project designers during initial plan review meetings. These goals and objectives can often be incorporated in the design process with minimal impacts and perhaps an enhancement to the proposed project. An early understanding of floodplain management goals and objectives will often expedite the review process. The developer is also concerned about the appearance of the finished product. The preservation of a wetland area, or wooded habitat can be highly beneficial in the marketing of the project to subsequent buyers.

The key to this strategy is to understand local needs and to lay out community concerns early in the process. The goals must be made obtainable without destroying the project potential and assure the long-term protection of the attributes which are to be achieved. This process involves cooperation and negotiation.

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Many of the tools discussed in this section contain elements of all five strategies previously mentioned. Several of these tools are also mentioned elsewhere in the Plan. The discussion here is more in terms of flood loss reduction strategies.

Single Project Focus

The values of a particular floodplain area can best be protected through dedicated individuals working through a cooperative approach on the specific project. As a tool, single project focus involves looking first at the resource and then considering all alternatives feasible to protect that site. Sites that become the focus of such great interest often mean something special to individuals or groups which organize themselves to protect these areas. These individuals might have enjoyed such sites through hunting, exploring, observing wildlife, swimming and other recreational uses. Public interest in continuing to pursue these recreational activities often leads to protection strategies which result in an increased public benefit. This pattern has been borne out time and again through successful river corridor planning efforts.

Experience has shown there are significant key ingredients to a successful single project focus.

- Cooperation is a must among local department heads and between local, state and federal facilitators.
- There must be a strong, committed citizen's advisory or similar group involved with the effort.

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- A floodplain area, stream reach or project site must be of sufficient significance to win support and carry the requisite commitment necessary for success.

When local groups have pulled together to protect special areas, they usually do not do so because of a desire to promote flood damage protection or reduction. However, when flood protection and reduction issues are combined with recreation, scenic values and water quality protection objectives these river corridor projects become very attractive from a public safety and public health standpoint.

The National Park Service's Rivers and Trails Program (NPS) is an example of mobilizing local support for river corridor protection efforts. Through the Rivers Conservation Assistance Program local communities that demonstrate a serious interest in conserving a river area may receive technical planning assistance from the National Park Service. A community would make a formal application and there is a competition among a national pool of applicants.

What makes the NPS program special is that it attempts to break through multi-jurisdictional barriers inherent between all government agencies that have natural resources management responsibilities and incorporates the interests that the private entities, which have devoted their efforts to the resource that they wish to protect. It attempts to assess resources from a broad perspective by integrating input from citizens and localities and encouraging the localities to conceive and develop plans that truly serve the interests of their residents and the resources at question.

Information and Education

There is often a gap between the public's understanding the value of protecting natural resources, and their willingness to take an active role in ensuring the continued availability of those resources. Public information and education can help bridge that gap. This can make or break an effective single project focus effort.

Public information and education efforts can remind residents of their appreciation for natural areas, help them to define and focus on what they enjoy, inform them of possible threats to the survival of certain resources as they understand them, and move them to recognize they can help make change. Again, it is unlikely that flood damage and flood reduction awareness is the subject that will drive the interest of residents about the protection of floodplain areas. More likely, it will be their recreational interests in the riverine or coastal environments which they enjoy.

Technical information and public education programs related to the management of floodplain natural values are important components of a floodplain management program. At the state and local levels this information can inspire community interest and its residents into taking an active role in protecting floodplain areas and promoting floodplain management practices.

River Corridor Master Plans

One tool that fosters a proactive stance in river management, and which improves the opportunity to plan for the protection of floodplain attributes is the master planning process. Master plan studies would contain technical components that establish the baseline conditions that exist and define the

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potential impacts that a land use change would have on these baseline conditions. This requires the cooperation of the local officials, planners, boards, individual citizens and citizen groups, since these parties will ultimately implement and live with the plan. Furthermore, this process requires the participation of numerous government agencies. The master planning process accomplishes two very important steps toward recognizing a particular river or coastal area. One is obviously the product of the process. This would be a final document, and in developing this document there are usually a series of public meetings to obtain the needed input, to present findings, and conclusions. The second, and less obvious benefit of the master planning process, is that it brings key people, groups and agencies together. They learn of each other's needs and the potential resources. They communicate and establish a foundation of rapport from which to proceed. In this respect the "process" of preparing the master plan is critical.

The objectives a master plan would include:

- Quantify the baseline condition of the system
- Ensure residents of the community are afforded opportunity to express their wishes in a management plan for the river corridor
- Establish performance guidelines that meet the locality's need for growth, yet allow for the conservation and preservation of floodplain values
- Identify critical land areas that should be considered for land and resource acquisition or for the restoration of degraded lands and

- Provide sufficient detail within areas designated for development so as to facilitate any permit process and to provide incentives to develop in designated areas, rather than in sensitive areas planned for protection.

The benefits to this type of approach would be the assurance that the needs for growth within the community will balance with the need to protect the natural and beneficial values. There is an overall savings of public and private resources, by developing and following a master plan rather than managing on a parcel by parcel basis.

The master planning process has been widely accused of being an exercise in wishful thinking on the part of well-intended individuals and public officials. If a particular plan identifies only high costs with unrealistic goals requiring a significant federally funding or conversely is unrealistically optimistic, then such an accusation may have merit. If, on the other hand, the planning process unveils small scale, realistic, with citizen-motivated initiatives, then there is a greater likelihood for success.

Acquisitions

The most effective tool for protecting the value of floodplain areas is through the outright purchase of the property and subsequent management of it as public open space. This is also the most expensive approach. There are many communities in which such an action would be economically crippling. Acquisition and relocation initiatives for such a community may not be in the best interest for its residents. However, the concept of full public ownership of floodplain areas must be considered as a possible solution to the repetitive

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cycle of flood damage and disaster response and recovery.

Property acquisition is typically evaluated as an alternative to solving flooding problems of a community during the post-flood mitigation assessment process. Construction of flood control structures is also an option to reduce future flood damages. Traditional project assessments may fail to consider the broader benefits of an acquisition from the standpoint of water quality, habitat protection, recreational purposes, and other natural values.

When investigating the merits of acquisition as a possible solution to a flooding problem the question of costs and future benefits is paramount. At a given site the high cost of acquiring some buildings and/or relocating them out of the floodplain may be more expensive than the construction of a major flood control structure. However, acquisition and relocation are permanent solutions. The cost for the construction of a flood control structure may initially be less expensive but, expenditures will have to be made to operate and maintain the structure. The acquisition approach is permanent, with minimal future costs to consider.

Such a cursory discussion does not pretend to consider all the many factors involved when comparing the relative costs and benefits of acquisition versus structural solutions. But it does point out the advantages to the protection of resource values and the long-term benefits of the acquisition approach.

For all agency people, please review the following paragraph for accuracy and comprehensiveness.

There are many federal acquisition programs. Under the Stafford Act, the Federal Emergency Management Agency (FEMA) through the HMGP it is possible

to buyout severely flood damaged property. The NPS has the Land and Water Conservation Fund which purchases property for recreational purposes. The U.S. Army Corps of Engineers (USACE) will purchase property for flood control purposes. The Tennessee Valley Authority (TVA) has in the past provided funding to assist communities in implementing local floodplain evacuation/relocation projects. The U.S. Fish and Wildlife Service (FWS) is capable of purchasing property to protect and manage waterfowl habitat. However, each of these agencies has very specific criteria which must be met for an acquisition to be consistent with their agency missions. If a particular site does not meet the requirements of any of the various programs, it will not be acquired.

Easements and Tax Adjustments

Most of the previously mentioned tools for the protection of values of floodplains have required some coordination with government agencies and citizen groups. These tools, except for information and education, have centered around a specific project, significant outputs of energy, communications and cooperation. But much can be accomplished through the efforts of individual citizens and landowners to protect floodplain areas since many floodplain lands are not in public ownership. There are many tools which may be exercised individually that contribute substantially to protecting the floodplain environment.

Easements for open space are a well-tested tool that can provide substantial benefits to a landowner, not only from the interest in protecting open space areas but also from a financial planning point of view. The easement provides a way for the private landowner to further

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public policies without giving up ownership of his land or opening it to the public.

Easements are considered a form of conservation of open space and natural areas that is consistent with planned community growth and development. A parcel of land protected by an open space easement will likely be considered a community asset that should be recognized in plans for future growth. Protected land aids localities in their efforts to provide a pleasant and liveable environment. In Virginia easements for conservation purposes were authorized for use by state and local agencies in legislation passed by the General Assembly. The Virginia Outdoors Foundation is the primary agency which administers the open space easement program. Both the Department of Conservation and Recreation (DCR) and the Department of Historic Resources (DHR) have open space, natural area or historic easement programs.

Through an easement private property title is retained by the owner with only those rights the owner specifically agrees to voluntarily forgo to the recipient of the easement. An easement is signed and recorded like other deeds and is a covenant, running with the title of the land, by which the landowner agrees to protect the existing character of his property. Since an easement runs with the title of the property, future owners are also bound by its terms. Easements can be given by the landowner for the purpose of preserving open space which may be wetlands, floodplains, scenic areas, forest or agricultural land. An easement is a flexible document and may be written to protect varied types of land, depending on the desire of the landowner. An easement does not open the donor's land to public access.

There are several financial benefits to the landowner when an easement is donated. A landowner's assessment for real estate tax purposes is based upon the land's fair market value. This is known as ad valorem taxation. A land's potential for commercial, industrial, or high density residential development is an important component of the land's assessed value. If an open space easement is placed on a property, its potential for development is reduced and Virginia law requires that this must be recognized in assessing the property for real estate tax purposes. Real estate taxes are often stabilized or significantly reduced by the open space easement, especially in urbanizing areas.

The Land Use Assessment Law allows for special assessment of real estate devoted to agricultural, horticultural, forestry or open space uses with the option of the locality to implement any, all, or none of these optional assessments by local ordinance. The open space option further describes the qualification of lands preserved or provided for floodplains and floodways. Such qualifying lands receive a special assessment, with lower than ad valorem rates, for each year they so qualify and participate in the program. A penalty for conversion of land use is also part of the program. Floodways are described in the *Code of Virginia* and Regulations as lands that are provided or preserved for:

- The passage or containment of waters, including the floodplains or valleys and side slopes of streams that are or may be subject to periodic or occasional overflow, such as floodplains identified by engineering surveys by the U.S. Corps of Engineers or others, or by soil surveys or topographic maps. Floodways also include

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adjacent lands that should be reserved as additional channels for future floods due to increased runoffs.

- Coastal lowlands, such as bays, estuaries or ocean shores, subject to inundation by storms or high tides.
- Tidal and Nontidal wetlands, such as swamps, bogs and marshes.

In addition, other lands described as conservation lands may also qualify as open space lands. These lands must either be:

- An agricultural, forestry or in an agricultural forest district;
- Under a perpetual conservation easement held by a public body; or
- Subject to written comment between the land owner and local governing body for a period of not less than four and more than ten years.

Properties must conform to the local land use plan and DCR Regulations.

The gift of a qualified open space easement in perpetuity to the Virginia Outdoors Foundation, DCR or DHR is a charitable deduction for federal and state income tax purposes. The value of the gift is measured by the decrease in the land's estimated fair market value based on an appraisal that determines the value of the land before and after the easement donation. The difference in the two appraisals is the value of the easement and that amount may be deducted from state and federal income taxes. Open space easements result in a reduction in federal estate taxes and Virginia inheritance taxes. When the land passes to heirs, it cannot be assessed on the basis of the land having

pre-easement development potential. Consequently, heirs may retain property that they otherwise may have been forced to sell to pay estate taxes.

Tax incentives have often been used to acquire areas for open space uses. The Internal Revenue Code provides that organizations which meet certain criteria may achieve tax exempt status. Most conservation-oriented organizations are tax exempt, and some of these organizations are actively involved in acquiring wetlands and floodplains. The code also provides that individuals and businesses may receive a deduction for the value of land donated to a government agency or qualified non-profit organization. Generally the property must be donated in perpetuity and used for some historical or conservation-related purpose. Conservation easements as well as donations may qualify under provision of the tax code.

Regulations

The sections and issues previously discussed; the single project focus, the use of information and education, the development of master plans, acquisition projects and easements and tax adjustments all involve private citizen participation to a substantial degree. There are other activities which fall traditionally within the operational domain of government. Regulations constituting administrative law are a prime example. Regulations can be an effective means of protecting the natural values of floodplains, and could be used at all levels of government. However, regulations are limited in their ability to achieve total preservation of natural values.

This is due largely to the potential for an unconstitutional "taking" of private property if potential for economic return

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is denied the owner. Regulations that restrict what a property owner may do with their land must be based upon sound evidence that the regulation will reasonably achieve the intended public objective while still permitting some economic use or return.

There are few communities bold enough to implement regulations that would prohibit all uses of floodplain areas - and thereby achieve a full preservation management approach of the floodplain. But certainly regulations which provide a substantial measure of flood protection can be implemented by local governments. These are conservation strategies rather than a full preservation strategy. Most localities base their regulations for floodplain management on the NFIP. The provisions required by the NFIP have been tested in court and have been found not to be a taking. This is because the National Flood Insurance Program requirements do not prohibit the use of property, they simply require that land use be conducted according to certain performance standards.

Current information on NAI legal proceedings can be obtained by contacting ASFPM. To date, however, the more stringent floodplain management criteria provided for in NAI recommendations has withstood legal challenge in various communities throughout the Nation.

Local Regulations

Regulatory tools may either directly or indirectly address the management of natural floodplain resources and include zoning and subdivision regulations, building codes, housing codes, sanitary and well codes, etc. Local zoning and subdivision regulations include provisions related to protection of natural floodplain values. For example: setbacks from floodplain areas and from

coastlines; limited density in coastal environments; restrictions or prohibitions on certain kinds of development in highly sensitive areas; and specification of land uses compatible with natural values protection and floodplain management purposes. In addition to floodplain regulations, which require permits for activities involving fill, grading or structures, some Virginia communities have adopted wetland regulations and sand dune protection regulations for areas of environmental sensitivity, including tidal and non-tidal islands, coastal beaches, natural drainage ways, and aquifer recharge areas. Resource-based floodplain regulations could also include a transfer mechanism under which development rights may be shifted from one sensitive area to another less sensitive area.

In Virginia the General Assembly has recognized the need for local planning and regulation by requiring every county, city and town to adopt a comprehensive plan for the physical development of its territory. Section 15.1-446.1 *Code of Virginia* states:

"... The comprehensive plan shall be made with the purpose of guiding and accomplishing a coordinated, well adjusted and harmonious development of the territory which will, in accordance with present and probable future needs and resources, best promote the health, safety, morals, order, convenience, prosperity and general welfare of the inhabitants."

By requiring local governments to adopt comprehensive plans, the legislature implied that local problems and concerns are best handled at the local level of government and that a comprehensive plan is the best means of establishing a mechanism to address

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local issues and to solving those problems. From the standpoint of protecting natural and beneficial values resources of floodplains, this places a large responsibility upon localities to analyze their communities.

The natural outcome of a comprehensive plan is the implementation of zoning ordinances which are tools to carry out the goals and objectives of the comprehensive plan. Section 15.1-490, *Code of Virginia* specifically sets out,

"...The requirements of airports, housing, schools, parks, playgrounds, recreation areas and other public services, the conservation of natural resources, the preservation of floodplains, the preservation of agricultural and forestal lands, the conservation of properties and their values and the encouragement of the most appropriate use of land throughout the county or municipality as matters to be considered in drafting zoning ordinances and delineating districts."

Section 15.1-489 *Code of Virginia* contains minimum language which should be included in the purpose of a zoning ordinance, however, note how many of the following provisions directly or indirectly relate to the protection of the natural and beneficial values of floodplains.

Zoning ordinances shall be for the general purpose of promoting health, safety or general welfare of the public. To these ends, such zoning ordinances shall be designed to give reasonable consideration to each of the following purpose, where applicable:

1. To provide for adequate light, air, convenience of access and safety from fire, flood and other dangers;

2. To reduce or prevent congestion in the public streets;
3. To facilitate the creation of a convenient, attractive and harmonious community;
4. To facilitate the provision of adequate police and fire protection, disaster evacuation, civil defense, transportation, water, sewerage, flood protection, schools, parks, forests, playgrounds, recreational facilities, airports and other public requirements;
5. To protect against destruction of or encroachment upon historic areas;
6. To protect against one or more of the following: overcrowding of land, undue density of population in relation to the community facilities existing or available, obstruction of light and air, danger and congestion in travel and transportation, or loss of life, health, or property from fire, flood, panic or other dangers;
7. To encourage economic development activities that provide desirable employment and enlarge the tax base; and
8. To provide for the preservation of agricultural and forestal lands.
9. To protect approach slopes and other safety areas of licensed airports. Such ordinance may also include reasonable provisions, not inconsistent with applicable state water quality standards, to protect surface water and ground water as defined in Sec. 62.1-44.85 (8). (Code 1950, Sec. 15-821; Code 1950, Sec. 15-968.3; 1962, c. 407; 1966, c.344; 1968, c. 407; 1975, c. 641; 1976, c. 642; 1980,

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c. 321; 1983, c. 439; 1988, c. 439; 1989, cc. 447, 449.)

Five of the above nine provisions relate to resource values or benefits and/or protection from flooding. This clearly represents an intent by the General Assembly to guide localities in implementation of local regulations that recognize floodplains and natural areas as resources that serve citizens and deserve special management practices.

State Law and Regulations

Many commonwealth laws and attendant regulations already contain provisions that preserve floodplain values. Further discussion of commonwealth law and attendant regulations is covered in Section V of the Plan.

Federal Regulations

Development and Redevelopment Policies

Federal, state, and local governments can influence the rate and location of development. Federal and state influence generally comes in the form of financial assistance for the construction of new or replacement infrastructure. Local influence extends beyond the financing and placement of infrastructure and includes zoning authority, emergency service, police and fire protection and other services.

In almost all cases, industrial, commercial and residential construction in the floodplain brings with it increased public costs. This can be related primarily to increased infrastructure installation and maintenance costs, the increased responsibility for emergency operations during times of flooding and the associated cost of flood recovery efforts. In those localities where floodplain development is not essential

to fulfill the needs of the locality, discouraging development in these sensitive areas is strongly recommended.

Providing that sensitive floodplain areas are identified through a public planning process, the locality could have the foundation to implement a strong floodplain development policy. The intent of the policy would be to define the type of development in floodplain areas that will be allowed and most importantly to ensure that the local benefit for the burden of such development will equal or exceed the costs of emergency response and recovery efforts. Indirectly, such standards may slow floodplain development and lead to the protection of critical resources. All of these policies should be carefully reviewed by a community's attorney and implemented in a manner to protect the locality.

Policies that may assist in this implementation include:

1. Mitigation of Impact - (zero rise floodway) would require that encroachment into the floodplain must provide for flood water conveyance that is hydraulically equivalent to the flood water conveyance displaced (i.e. net increase of base flood elevation equals 0.00'). For example, if a floodplain is filled, than a hydraulically equivalent area in the floodplain must be created and its perpetual maintenance assured. This policy needs to assure that with proposed development that such development does not cause any increase in flood water elevations.
2. Standards and Specifications for Utilities in the Floodplain -Utilities, particularly sewer trunks, have

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| <p>always gravitated toward floodplain areas due to those areas providing the most vertical relief within a sewershed. Local policies and regulations should not discourage this practice, as it is often the most economical way of serving a vital need of the community, and generally has little residual impact on the function of the floodplain. However, local regulations should take into consideration factors such as flood source inverts and base flood elevations to provide access to utilities and protect them from inflow and infiltration issues without impacting the floodplain conveyance and benefits. Well casings could be elevated above the 100-year flood water surface elevation and properly sealed at the ground elevation to prevent contamination caused by a flood event.</p> <p>3. <u>Water and Sewer Standards</u> - water and sewer lines should be designed and constructed to withstand a 100-year flood and erosion event. On-site sewage disposal systems should not be allowed within critical areas unless the design and installation was certified by a professional engineer as to be free of failure during a flood event.</p> <p>4. <u>All Weather Access</u> - each dwelling should have at least one method of ingress and egress that would not be flooded during a 100-year flood.</p> <p>5. <u>Flood Warning and Evacuation Systems</u> - Where relevant, as a condition of development, the developer could install a warning system. This could include the installation of a flood alert systems siren controlled by</p> | <p>emergency response authorities, the posting of flood evacuation routes within the development and the posting of historic high water marks within the development.</p> <p>6. <u>Fire Sprinkler Systems</u> - In many floods due to mixing of electricity, natural gas, or solvents in the water, fires can begin in structures and be totally isolated from the fire fighting equipment. Local standards in floodplains could require the installation of sprinkler systems in new construction, or in the reconstruction of significantly damaged structures.</p> <p>7. <u>Density Restrictions</u> - The master planned zoning for floodprone areas could be for very low density development or open space land.</p> <p>8. <u>Zoning Standards</u> - New construction needs to require set backs from the banks of the rivers or shorelines for a defined protection distance, unless an appropriate engineering study was prepared that documented the long term safety of the structure, or an appropriate structural control was implemented.</p> <p>9. <u>Plat Notes</u> - With the subdivision of land plat, notes would be required that provide recognition of the flood hazards as defined by the locality.</p> <p>10. <u>Construction Standards</u> - construction standards could be adopted that recognized the issues of flood depth, erosion, flotation, inundation, dynamic and static forces against the structure and foundation, and foundational subsoil. Appropriate safety factors could be recommended, such as, finished floor elevations 2 feet above the existing 100-year flood</p> |
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water surface elevation. All of these components would be certified by a professional engineer.

MANAGEMENT OF WETLAND RESOURCES

A large percentage of the Commonwealth's wetlands are located within its coastal and riverine floodplains. Floodplain management efforts and activities affect, directly or indirectly, many of these wetlands. Conversely, wetland management programs affect many floodplain areas. The management of wetlands, while understood to be important by many, is currently elusive in application. Research on wetlands and their functions continues and wetland and floodplain management programs will continue to undergo an evolutionary process together to merge the management of critical resources with the competing needs of man. The following description of wetland management programs is provided.

Tidal Wetlands

In 1983 representatives of the federal government and the governors of the states within the Chesapeake Bay watershed signed an agreement for management of the Bay to improve water quality and its other natural resources. The agreement established the Chesapeake Bay Executive Council, comprised of federal and state agency representatives, to administer the terms of the agreement. The Council adopted a Chesapeake Bay Wetlands Policy in December 1988. The Policy includes a commitment to adopt implementation plans by June 1990. The Council issued the Chesapeake Bay Wetlands Policy Implementation Plan in August, 1990. Efforts of numerous state agencies

within the Commonwealth are directed towards plan implementation.

Nontidal Wetlands

During the 1988 and 1989 sessions of the General Assembly, state interest in nontidal wetlands came under intense review. There was a general consensus that nontidal wetlands are an important resource of the Commonwealth. The Virginia Nontidal Wetlands Roundtable was created to carry out a study on wetlands management within the Commonwealth.

The Roundtable report was issued in 1990 as House Document 54. The report concluded that "while effective management of nontidal wetlands should be of immediate and continuing concern to the Commonwealth, creation of a new regulatory program for the resource may be premature at this time" the Commonwealth should take immediate steps to: enhance, coordinate and assess existing programs; institute continuing educational, research and incentive-based preservation programs; and develop a current inventory of the resource. Once these efforts have been undertaken, the Commonwealth will be better able to determine both the need and appropriate design for any new regulatory program."

SUMMARY OF CHAPTER 4

The primary message of this chapter is that the floodplain resources provide valuable natural benefit to communities. A proactive local ordinance and community support are necessary to realize these benefits, which include: flood reduction and control, recreational benefits, wildlife habitat and water quality through natural processes. The primary regulatory tools for floodplain

management are the NFIP and the adoption of a local floodplain ordinance. However, the local floodplain ordinances, in most cases, are a reflection of National Model Ordinances, without incorporation of local needs and issues. A more holistic view of water resources management would tie floodplain issues to other regulations that relate to water resources, thereby strengthening all of a communities approaches toward protection of the water resources.

ASFPM's NAI program seeks to encourage communities to elevate their management of floodplains and water resources above national minimums and provides specific guidance on obstacles and programs to do that. In Virginia, however, many of the ideal goals of NAI are currently being implemented. These include: watershed-wide stormwater management currently required by Virginia Erosion and Sediment Control and Stormwater Management Laws; Riparian Buffers, similar to those required by the Chesapeake Bay Preservation Act in the form of Resource Protection Areas (RPA) in tidewater communities. Recognizing the difficulty with implementing these regulations, it may be beneficial for communities to incorporate these and other design requirements into their floodplain management programs.

*The Floodplain Management Plan
for the Commonwealth of Virginia*

Chapter 5

An Inventory of the Commonwealth's Floodplain Areas

CHAPTER 5

AN INVENTORY OF THE COMMONWEALTH'S FLOODPLAIN AREAS

INTRODUCTION TO FLOOD INSURANCE RATE MAP (FIRM) INVENTORY

An important function in developing any long range plan is the recovery and interpretation of high-quality data. In floodplain management, good data regarding what is within the Commonwealth's floodplains can provide invaluable information on populations and properties at risk. It reflects the current status of hazard mapping and knowledge, points to the similarities and differences in flood hazards within the Commonwealth and, most important, if collected and maintained properly, will serve as a basis for the analysis of future trends. Much of the data that has been collected is suspect or conflicts with other published data. In the broadest sense nearly all land in the Commonwealth can be considered to be floodprone if runoff water occasionally interferes or damages the land and/or any structures or habitats associated with that land. Currently, a comprehensive survey of flood hazards has not been undertaken within the Commonwealth. As the floodplain management program matures, these types of data will be critical in determining study and project priorities. A significant strategy discussed within this plan will be methods to expand and improve this data base.

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Virginia has more than 50,000 miles of rivers and streams. All of these waterways have floodplains subject to inundation. Combining a 1987 estimate prepared by the Federal Emergency Management Agency (FEMA) with other estimates from rural areas, the Plan's authors suggest that a "reasonable approximation of the total area that is subject to flooding by the 100-year flood would be 10 percent of the Commonwealth or 3,970 square miles."

Virginia partners with the National Weather Service (NWS) and adjacent states to manage the Integrated Flood Observing and Warning System (IFLOWS), a wide area monitoring and communications network designed to improve local flash food warnings. Appendix A contains a map entitled Major Watersheds of Virginia. This map illustrates large portions of the Commonwealth that are drained through narrow river corridors often beside major cities. The watersheds in the northern and eastern parts of the Commonwealth (Potomac, Rappahannock, York, James) drain to the Chesapeake Bay and the Atlantic Ocean. The rivers in southeastern Virginia (Roanoke and Chowan, along with the Albemarle Basin) drain to Albemarle Sound in North Carolina. The southwestern rivers (New, Holston, Clinch, Powell, Big Sandy) eventually

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drain to the Mississippi River and the Gulf of Mexico.

Virginia's coastal communities, as well as the rest of the Commonwealth, are vulnerable to Hurricanes. Section C, Historic Flood Events includes past hurricanes and resultant flooding in the Commonwealth of Virginia. Floodplains are typically defined and identified in two basic ways: (1) as natural geologic features, carved by water flowing over land areas, or (2) from a regulatory or protective perspective where a specific land area is identified by map or other means as a floodplain.

The standard that is most commonly used for defining an acceptable level of risks within a regulatory floodplain is a flood magnitude which, on average, would occur once every 100 years. The land area inundated by the "100-year flood" usually defines the limits of the floodplain for floodplain management purposes. Additional land area outside of the 100-year floodplain will be inundated by waters from a larger, less frequent flood. In Chapter 6 of this plan the management strategies suggested are generally intended for the limits of the 100-year floodplain, and the use of the term floodplain can be thought of as synonymous with the term "100-year

floodplain." Nothing prevents users of the plan to apply these strategies to any given floodplain area.

The terms "100-year flood" and the "100-year floodplain" or "floodplain" as commonly used are misnomer. They imply a consistent or predictable frequency or occurrence, or they imply an absolute flood-prone/flood-free status for a property. This is not the case. A property that is out of "the floodplain" simply will not be inundated by a flood event of a given magnitude, but may be flooded by a larger flood event or magnitude. A "100-year flood" is a term used to describe a flood that has a 1% chance of being equaled or exceeded in any given year, or on the average will occur once in a 100-year period of time. A 100-year flood could occur this year, it could occur two years in a row, it could occur twice in a decade, or it might not occur for a period of time longer than 100-years. The second point to consider is that a 50-year flood is not, one-half the magnitude of a 100-year flood. In fact a 50-year flood peak may crest within several feet of the 100-year flood for many Virginia streams. The following table illustrates the percent chance of flooding given a specified flood size and period of time.

**TABLE 5.1
PROBABILITY OF FLOODING**

CHANCE OF FLOODING OVER A PERIOD OF TIME				
Time Period	Flood Size			
	10-year	25-year	50-year	100-year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

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Current Flood Insurance Rate Map (FIRM) Status

FEMA estimated flood-prone areas within those counties and communities where those areas have been mapped by the agency for the National Flood Insurance Program (NFIP). FEMA generally mapped only those areas with current or pending development. They do not identify other floodplains that may contain significant agriculture, forestry or open space areas. Data published by FEMA in 1987 show that there are over 2,600 square miles of floodplain areas in identified flood-prone counties and communities in Virginia.

The Virginia Department of Conservation and Recreation (DCR)

(along with FEMA Region III) are in the process of updating the FIRM maps for the Commonwealth of Virginia, with map adjustments and digital versions. Digital conversions of all of the FIRMs are anticipated being completed by 2009. The following table illustrates the communities that have their digital conversion complete or the restudy is currently underway. There are only two counties in Virginia that have Geographic Information Systems (GIS) digital coverage. Nine counties and cities have CADD digital coverage. The majority of the communities lacking GIS coverage also have maps that are 20 to 24 years old. Therefore, Virginia has some significant needs not only for updating flood maps but also for generating digital maps in communities.

**TABLE 5.2
COMMUNITIES CONSIDERED CURRENT AND NOT INCLUDED IN
THE PRIORITIZATION OF MAP MODERNIZATION 5-YEAR
BUSINESS PLAN**

COMMUNITY	CURRENT EFFECTIVE DATE OF FIRMS	STATUS
Accomack County	7/20/1998	Digital map conversion underway (2003)
Albemarle County	4/2/1990	Likely effective date for new maps – October 2004 (2001)
Bristol, City of	2/4/2004	(2001)
Buchanan County	8/19/1997	
Buena Vista, City of	4/6/2000	
Charlottesville, City of	6/15/1979	Likely effective date for new maps – Late 2004 (2001)
Chesapeake, City of	5/2/1999	
Chesterfield County	5/2/1994	Restudy underway (2003)
Danville, City of	8/9/2001	
Fairfax County	3/5/1990	Restudy underway (2003)
Fairfax, City of	2/19/2003	
Falls Church, City of	2/3/1983	Restudy underway
Franklin, City of	9/4/2002	(1999, 2002)
Hanover County	9/2/1981	Restudy underway (2002)
Harrisonburg, City of	11/3/1989	Restudy underway (2001, 2002)
Henrico County	2/4/1981	Restudy underway (2003)
Isle Of Wight County	9/4/2002	(1999, 2002)

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COMMUNITY	CURRENT EFFECTIVE DATE OF FIRMS	STATUS
Lexington, City of	4/6/2000	
Loudoun County	7/5/2001	
Northampton County	7/20/1998	Digital map conversion underway (2003)
Pittsylvania County	8/9/2001	
Prince William County	1/5/1995	Restudy underway
Rappahannock County	8/3/1998	
Roanoke County	10/18/1995	Restudy underway (2003)
Roanoke, City of	10/18/1995	Restudy underway (2003)
Rockbridge County	4/6/2000	
Salem, City of	10/18/1995	Restudy underway
Shenandoah County	7/16/2003	(2001)
Southampton County	9/4/2002	(1999, 2002)
Spotsylvania County	2/18/1998	
Stafford County	3/3/1992	(2002)
Suffolk, City of	9/4/2002	(1999, 2002)
Tazewell County	8/2/1994	Restudy underway (2002)
Virginia Beach, City of	12/5/1996	

Maps depicting flood-hazard areas are not only the foundation of the National Flood Insurance Program, but also the basis of sound floodplain management at the local and state levels. Adequate, accurate, and current maps are essential for the program to function. Without quality mapping, neither land-use regulations nor the insurance elements of the program can be effective.

By 2002 these flood hazard maps were averaging over 13 years old nationwide, making them nearly obsolete in some communities, and still many areas of the country were unmapped. In recognition of these needs, Congress directed FEMA in 1994 to establish the Technical Mapping Advisory Council who in turn made recommendations to FEMA through a series of annual reports and

then in a final report in November 2000. FEMA then prepared a plan to implement those recommendations along with the resources necessary to fund its Map Modernization Plan.

FEMA has established a broad goal of modernizing these flood hazard maps nationwide. Initially, in 2002, FEMA requested that the State NFIP Coordinators prepare a Map Modernization Implementation Plan for their states. This included prioritizing mapping projects for communities in their states based on mapping needs assessments that were performed and input into a national database named Mapping Needs Update Support System (MNUSS).

In order to achieve their goal, in 2003, FEMA was allocated funding by

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Congress to implement the Flood Map Modernization Plan that it had been developing since 1995. Each state with an interest and the capability to assist with implementing FEMA's Map Modernization Plan was offered funds to upgrade the plans that were developed in 2002 and develop Flood Map Modernization State Business Plans.

A need exists for a state or regional agency/organization to provide assistance in meeting the mapping requirements in order for local building code, engineering, and zoning officials to have adequate tools (i.e., accurate flood maps) to perform their floodplain management duties effectively. There are currently 270 communities in the Commonwealth that participate in the NFIP consisting of 96 counties, 41 cities and 133 incorporated towns. Based on information provided by FEMA in 2002, about 29 counties (including 49 towns) and 14 independent cities in Virginia have maps with an average age between 20 to 24 years. Of these, 17 are located in the James River Basin, which has an extensive history of flooding associated with significant damages and costs to repair or replace structures. There are about 27 counties and 6 cities in the Commonwealth that have maps with an average age between 15 and 19 years.

As of October 2003, 85 percent of Virginia's FIRM's were greater than 10 years old, with 42 percent of the total being greater than 20 years old. The resulting effect is that maps, particularly in urbanized and high growth communities, may not accurately reflect flood hazard conditions. This may create a false sense of security in those communities and allow communities to permit development (buildings and infrastructure) and individuals to be put at risk for flooding.

Inventory of Flood Prone Mileage

There is no "official" estimate of the total mileage of rivers and coastlines in Virginia that are subject to flooding, because of the different ways of determining and identifying floodplains. For this Plan, the approximate floodprone mileage by community (counties and cities) was gathered from the official FEMA FIRMs in 2004. Table 5.4 illustrates the results of the study. Stream mileage was broken down by zone type and the method used for data collection.

Table 5.3 outlines the procedure used for collecting the stream mileage. For Method 1, stream mileage estimates came from past data gathering efforts for FEMA and DCR prior to 2004. Method 2 had the Virginia Tech Center for Geospatial Information Technology (CGIT) use a Geographic Information Systems (GIS) procedure of georeferencing digital scans of paper FIRMs and collecting stream centerline information by zone type and stream name. Method 3 had CGIT estimate mileage using digital Q3 and DFIRM floodmaps. Finally, Method 4 had CGIT develop estimated floodplain mileage in communities (riverine only) using an area-weighted regression based on measured floodplain information from other Virginia communities. This estimate was only for the total riverine length (Subtotal Zones A & AE). Table 5.3 shows that floodplain distances were directly measured from FEMA maps for over 70% (95 communities) of the Commonwealth.

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**TABLE 5.3
METHODS USED FOR IDENTIFYING FLOODPRONE LENGTHS
IN VIRGINIA.**

METHOD	DESCRIPTION	TOTAL COMMUNITIES
1	Data Gathered by Consultants for DCR and FEMA Prior to 2004	36
2	Digitized from FIRMs in 2004	30
3	Digitized from DFIRMs and Q3 Data in 2004	29
4	Distances Estimated from Area-Weighted Calculations from Measured Lengths in Other Communities	39
	Total	134

**TABLE 5.4
FLOODPRONE LENGTHS IN VIRGINIA, BROKEN DOWN BY FLOOD
ZONE (IN MILES).**

COUNTY	METHOD	APPROX. ZONE A	ZONE AE	RIVERINE SUBTOTAL: ZONE A&AE	COASTAL SUBTOTAL: ZONE VE	GRAND TOTAL
Accomack County	3	0.31	113.95	114.26	96.68	210.94
Albemarle County	2	555.96		555.96		555.96
Alexandria City	1		16.42	16.42		16.42
Alleghany County	1	175.12	138.15	313.27		313.27
Amelia County	4			199.36		199.36
Amherst County	1	209.86	101.50	311.36		311.36
Appomattox County	2	150.98	35.08	186.06		186.06
Arlington County	1	0.20	23.78	23.98		23.98
Augusta County	1	7.89	321.31	329.20		329.20
Bath County	1	138.58		138.58		138.58
Bedford City	1		10.97	10.97		10.97
Bedford County	2	400.06		400.06		400.06
Bland County	2	125.90	20.81	146.71		146.71
Botetourt County	1		269.87	269.87		269.87
Bristol City	3	2.25	12.32	14.57		14.57
Brunswick County	3	349.61	31.37	380.97		380.97
Buchanan County	3	112.60	57.51	170.10		170.10
Buckingham County	4			324.45		324.45
Buena Vista City	1	3.94	6.75	10.69		10.69
Campbell County	1	101.77	216.04	317.81		317.81
Caroline County	4			299.90		299.90
Carroll County	4			265.27		265.27
Charles City County	2	14.59	128.65	143.24		143.24
Charlotte County	4			265.42		265.42
Charlottesville City	3	2.86	6.64	9.51		9.51
Chesapeake City	2	0.36	135.98	136.34		136.34
Chesterfield County	2	181.38	143.71	325.09		325.09
Clarke County	1	29.11	75.01	104.12		104.12
Colonial Heights City	2	0.59	17.55	18.14		18.14
Covington City	1	1.97	8.55	10.52		10.52

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COUNTY	METHOD	APPROX. ZONE A	ZONE AE	RIVERINE SUBTOTAL: ZONE A&AE	COASTAL SUBTOTAL: ZONE VE	GRAND TOTAL
Craig County	4			183.65		183.65
Culpeper County	3	240.75		240.75		240.75
Cumberland County	2	103.05	16.55	119.60		119.60
Danville City	2	24.69	17.95	42.64		42.64
Dickenson County	4			185.36		185.36
Dinwiddie County	4			282.22		282.22
Emporia City	4			7.77		7.77
Essex County	4			151.59		151.59
Fairfax City	1	0.55	9.07	9.61		9.61
Fairfax County	2	175.31	180.64	355.95		355.95
Falls Church City	1		1.63	1.63		1.63
Fauquier County	1	461.40	180.49	641.89		641.89
Floyd County	4			211.72		211.72
Fluvanna County	1	55.33	50.46	105.79		105.79
Franklin City	3		9.51	9.51		9.51
Franklin County	4			395.20		395.20
Frederick County	4			231.22		231.22
Fredericksburg City	1	1.03	10.00	11.03		11.03
Galax City	4			9.16		9.16
Giles County	1	52.39	88.97	141.36		141.36
Gloucester County	3	89.42	141.32	230.74	32.50	263.24
Goochland County	1	48.30	99.17	147.47		147.47
Grayson County	4			247.63		247.63
Greene County	3	35.11		35.11		35.11
Greensville County	4			165.21		165.21
Halifax County	3	477.47	42.95	520.42		520.42
Hampton City *	4		36.53	36.53	23.26	59.79
Hanover County	2	462.98		462.98		462.98
Harrisonburg City	3	0.31	17.57	17.88		17.88
Henrico County	1	200.00	100.00	300.00		300.00
Henry County	4			213.52		213.52
Highland County	4			231.02		231.02
Hopewell City	1	10.42	10.60	21.02		21.02
Isle of Wight County *	4			178.70	28.56	207.26
James City County	4			83.56		83.56
King and Queen	4			178.72		178.72
King George County	4			103.18		103.18
King William County *	4			158.94	12.09	171.03
Lancaster County	3	47.50	117.92	165.43	33.54	198.97
Lee County	1	263.40		263.40		263.40
Lexington City	3	3.08	1.13	4.21		4.21
Loudoun County	2	108.09	285.50	393.59		393.59
Louisa County	4	284.11		284.11		284.11
Lunenburg County	4			240.46		240.46
Lynchburg City	2	15.19	38.75	53.93		53.93
Madison County	3	77.72	16.74	94.47		94.47
Manassas City	3	1.30	13.60	14.90		14.90
Manassas Park City	3	1.56	2.80	4.37		4.37
Martinsville City	4	1.75	9.74	11.49		11.49
Mathews County	3	0.24	93.72	93.96	57.07	151.03
Mecklenburg County	4			377.75		377.75
Middlesex County	3	72.78	154.15	226.92	18.51	245.43

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COUNTY	METHOD	APPROX. ZONE A	ZONE AE	RIVERINE SUBTOTAL: ZONE A&AE	COASTAL SUBTOTAL: ZONE VE	GRAND TOTAL
Montgomery County	2	75.00	159.53	234.54		234.54
Nelson County	2	311.45		311.45		311.45
New Kent County	4			122.58		122.58
Newport News City	2	26.34	39.77	66.11	16.71	82.82
Norfolk City	2		74.35	74.35	22.87	97.22
Northampton County	3		112.29	112.29	65.32	177.61
Northumberland	3	71.29	207.55	278.84	61.62	340.46
Norton City	1		8.83	8.83		8.83
Nottoway County	4			175.84		175.84
Orange County	3	159.16		159.16		159.16
Page County	4			174.63		174.63
Patrick County	4			269.84		269.84
Petersburg City	1	9.18	24.55	33.73		33.73
Pittsylvania County	3	273.40	329.26	602.67		602.67
Poquoson City	3		9.56	9.56	16.19	25.75
Portsmouth City	3		44.29	44.29	8.15	52.44
Powhatan County	1	89.09	53.69	142.78		142.78
Prince Edward County	1	60.64	103.13	163.77		163.77
Prince George County	2	179.69		179.69		179.69
Prince William County	2	145.56	196.37	341.92		341.92
Pulaski County	4			183.04		183.04
Radford City	1		10.57	10.57		10.57
Rappahannock County	3	104.83		104.83		104.83
Richmond City	2	4.69	32.07	36.76		36.76
Richmond County	3	26.87	82.75	109.62		109.62
Roanoke City	2	0.08	45.31	45.39		45.39
Roanoke County	2	9.91	89.89	99.80		99.80
Rockbridge County	1	248.99	102.26	351.25		351.25
Rockingham County	1	19.33	319.47	338.80		338.80
Russell County	4			264.82		264.82
Salem City	3		26.70	26.70		26.70
Scott County	1	100.78	158.66	259.44		259.44
Shenandoah County **	4	203.48	81.45	284.93		284.93
Smyth County	1	36.26	144.12	180.38		180.38
Southampton County **	4	268.46	67.09	335.55		335.55
Spotsylvania County	2	265.76		265.76		265.76
Stafford County	2	267.08		267.08		267.08
Staunton City	1		13.04	13.04		13.04
Suffolk City	2	162.22	59.36	221.58	11.47	233.05
Surry County	4			156.86		156.86
Sussex County	4			274.43		274.43
Tazewell County	4			288.72		288.72
Virginia Beach City	2	7.25	208.33	215.58	37.72	253.30
Warren County	1	30.37	64.74	95.11		95.11
Washington County	1	117.97	66.57	184.54		184.54
Waynesboro City	3	0.38	12.49	12.87		12.87
Westmoreland County	3	99.26	156.93	256.19	45.97	302.16
Williamsburg City	2	0.28	3.75	4.03		4.03
Winchester City	2	10.72		10.72		10.72
Wise County	1	54.32	106.06	160.38		160.38
Wythe County	1	184.60	125.15	309.75		309.75
York County	2	18.72	119.27	138.00	20.50	158.50

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FLOODPLAIN DEVELOPMENT AND FLOOD INSURANCE

COUNTY	METHOD	APPROX. ZONE A	ZONE AE	RIVERINE SUBTOTAL: ZONE A&AE	COASTAL SUBTOTAL: ZONE VE	GRAND TOTAL
Totals				23,724.86	608.73	24,333.58
* Zone VE lengths measured from DFIRM and Q3 data for these communities.						
** Zone AE lengths from FIS flood profiles.						

Future Considerations

The floodplain management program for the Commonwealth should strive to develop a library, or map-based inventory of all the Commonwealth's riverine and coastal floodplains. The purpose of these maps would be to examine the level of floodplain recognition for given areas, and to identify the need for new mapping studies to meet a level of technical detail commensurate with each management objective. Since coastal areas subject to flooding have such a large number of structures in floodplains, there is a serious need for assessment of hazards in these areas.

FLOODPLAIN DEVELOPMENT AND FLOOD INSURANCE

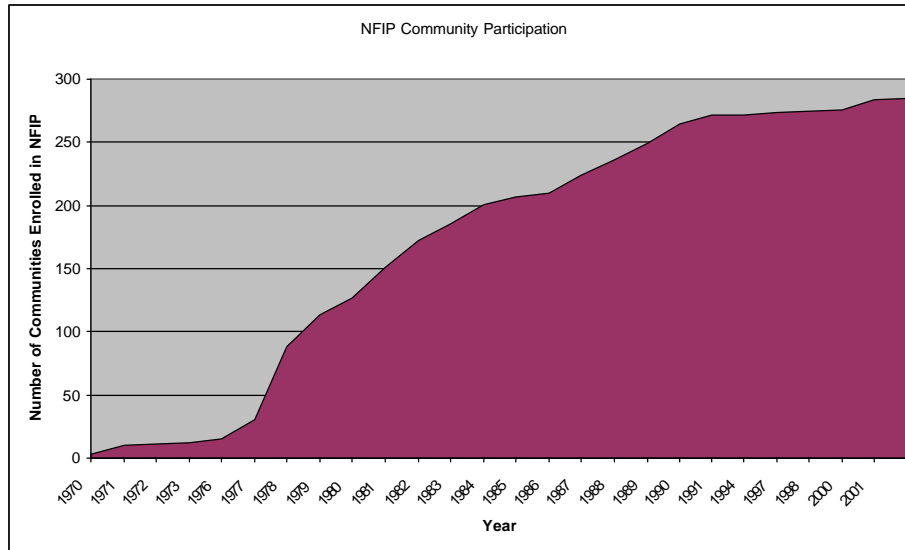
There are no known estimates of the percentage or amount of floodplain lands that have been developed within the Commonwealth. The central portions of many cities and towns consist of floodplain lands. National estimates place the amount of urban floodplain lands that have been developed at well over 50 percent. This estimate may hold true for Virginia. In fact, because of its population rank (12th among the states), its high density populations in coastal communities, the rapid growth in the northern part of the Commonwealth, the historical establishment of the large population centers on the waterfronts, and in the mountainous regions where floodplains often provide the only "flat"

ground for development, Virginia may considerably exceed this national average.

Virginia does have a significant level of participation in the NFIP by localities. Figure 5.1 and Table 5.5 indicate the years when most communities joined the NFIP. Table 5.5 illustrates that most communities joined the NFIP directly following the Flood Disaster Act that was passed in 1973. This act required that all buildings located in identified flood hazard areas have flood insurance coverage as a condition of federal aid or loans from federally-insured banks and savings and loans, and as a condition for receiving flood disaster assistance. Since joining the Program a small number of localities have dropped or been suspended. All NFIP participants have adopted local ordinances which regulate floodplain development.

The Community Information System (CIS) is the official record of the National Flood Insurance information. The CIS, as the database system is commonly called, provides information about floodplain management, mapping and insurance for the NFIP communities. The CIS includes demographic, engineering, insurance and community specific information for jurisdictions in the United States that are identified as flood prone.

**FIGURE 5.1
VIRGINIA LOCALITY ENROLLMENT IN THE
NATIONAL FLOOD INSURANCE PROGRAM**



**TABLE 5.5
VIRGINIA COMMUNITY PARTICIPATION IN THE NFIP
(YEAR OF ENROLLMENT).**

Based on CIS FIP Community Status Book (02/06/04)

YEAR OF ENTRY	PROBATION EFF.:02/07/03	ALL ZONE C	NON-PARTICIPATING COMMUNITY	PARTICIPATING COMMUNITY	GRAND TOTAL
1970				3	3
1971				6	6
1972				1	1
1973				1	1
1976		1	1	2	4
1977			5	10	15
1978	1	3	1	53	58
1979		1	1	23	25
1980				14	14
1981		2		22	24
1982			1	20	21
1983				13	13
1984				16	16
1985				5	5
1986				4	4

FLOODPLAIN DEVELOPMENT AND FLOOD INSURANCE

YEAR OF ENTRY	PROBATION EFF.:02/07/03	ALL ZONE C	NON-PARTICIPATING COMMUNITY	PARTICIPATING COMMUNITY	GRAND TOTAL
1987				14	14
1988				12	12
1989				13	13
1990			1	14	15
1991			1	6	7
1994				1	1
1997				2	2
1998				1	1
2000				1	1
2001			3	4	7
2002		1	1		2
Grand Total	1	8	15	261	285

National surveys of urban areas suggest that growth within the floodplain is occurring at roughly twice the rate of population growth as compared to the non-floodplain areas. It is believed that Virginia meets, if not exceeds, the national average. The Virginia coastlines have also been attracting people in ever increasing numbers for several decades. The value of property at risk to coastal storms has increased tremendously during this period of time. Much of the original development was primarily for second homes and seasonal tourism. Many seasonal homes have been converted to year-round use and the tourism season has been expanded in many areas to encompass the entire year, coupled with intense development or redevelopment of these areas. Roughly 15-20% of buildings are insured through the NFIP.

A 1987 national survey conducted by FEMA examined floodplain areas within the Commonwealth's flood-prone counties and communities to estimate the number of households and the total value of property subject to flood damage. As reported before, these areas were identified in studies conducted by FEMA for the NIFP. A

composite risk score provided by FEMA, based on the average of the current (1987) and projected floodplain development through 2002, ranks Virginia 10th in the nation in the total amount of property subject to flood risk.

As of June 1996 over 57,000 floodplain properties in Virginia had flood insurance coverage of about \$6,071,043,000. This implies that roughly 20 percent of the homes that are floodprone have flood insurance coverage. Therefore, approximately 300,000 or 80% homes that are potentially floodprone do not have any insurance coverage for flooding due to the fact that most home owner policies do not cover flood damages. Considering that a floodprone structure will have a 26% chance of being flooded by a 100-year flood event (the current regulatory design flood) over a 30-year mortgage, significant personal and investment funds are currently at risk within the Commonwealth.

As verification that these statistical assessments are adequate, consider that for the 57,000 policies in Virginia approximately 8,848 individual structures have been damaged at least

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one time since 1978, or roughly 15% of all policy holders have filed claims over a 19-year period. Statistically over a 19-year period a single structure would have an 11% chance of being flooded by a 100-year flood.

Projection of these statistics to the uninsured properties provides an estimate that over this same 19-year period a potential 30,000+ structures that carried no flood insurance were flooded within the Commonwealth. While this estimate is probably high due to randomness and non-uniformity in the population, the staggering amount of potential flood damages is quite real.

Aside from the FEMA study there are no other known studies that provide information on the extent of riverine and coastal floodplain development within the Commonwealth. One of the most useful tools to gather this data is the Biennial Report, a form to be completed by communities which participate in the NFIP and returned to FEMA for statistical purposes.

A specific category of floodplain development is those structures constructed within the regulatory floodway. The floodway is that portion of the floodplain reserved to convey flood flows and where hazardous water depths and velocities are likely to occur. Currently no data exists that specifically identify the number of structures within the floodway. The future management of floodway lands should result in few, if any, floodprone structures being constructed within these areas. Long term, due to flood and other property losses, the natural aging and decay of many properties, and stringent enforcement of floodplain management regulations, there should be a net reduction in floodway occupancy.

Future Considerations

The Commonwealth Floodplain Program database should be expanded by including an inventory of floodprone properties. This data base could then be used to determine the number and valuation of structures and damage potential in a given floodplain. These data would be useful in developing strategies to reduce property losses in critical areas. One point of review would be an analysis of structures in the floodway. This could be used to establish a program goal to significantly reduce floodway occupancy within a given period of time, e.g., attempt a 50% reduction in floodway structures within 20 years. Efforts to expand the flood insurance policy base will increase the level of protection citizens will have from flooding. The new mandatory purchase requirement will also enhance protection. Continued efforts to encourage the completion and submittal of Biennial Report forms by communities will provide accurate data.

Design Standards, Regulations and Zoning

Currently the only required floodplain management standard within the Commonwealth is the NFIP minimum standards, and those standards of the BOCA code. Several localities have adopted local standards that exceed the NFIP minimum standards but most have not. The refinement of a national standard for local application is usually the result of several factors. These could include, unique local conditions dictating a higher standard, high value properties at risk, belief that the existing standard does not provide the "advertised" level of protection, a history of frequent damages from a lesser standard, a situation where a slight improvement in the standard provides a significantly higher level of

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protection, and others. FEMA can require a higher level of design standards and reconstruction following a disaster event. This can require a disaster assistance applicant to implement floodproofing measures.

FEMA has established minimum floodplain requirements for communities participating in the NFIP. Communities must enforce more restrictive state requirements. However communities should seriously consider enacting regulations that exceed minimum state and federal criteria. The NFIP requirements can be found in Chapter 44 of the *Code of Federal Regulations* (44 CFR). Revisions to these requirements are first published in the Federal Register, a publication the Federal Government uses to disseminate rules, regulations and announcements.

The NFIP underwrites flood insurance coverage only in communities that adopt and enforce floodplain regulations that meet or exceed NFIP criteria. Buildings built in accordance with these regulations have a lower risk of flooding and can be insured at lower rates.

The community's floodplain regulations are designed to ensure that new buildings will be protected from the flood levels shown on the FIRM and that development will not make flood hazards worse. Over time, exposure to flood damage should be reduced, as the stock of floodplain's older pre-FIRM buildings are replaced. Eventually a community should have only post-FIRM buildings subject to little or no flood damage.

The Floodplain Management Program works with Virginia's counties, cities and towns to establish and enforce floodplain management zoning. The Program has model ordinances that set minimum standards for local

regulations, are used by localities in development of their floodplain ordinances. The local governments can set more restrictive standards to ensure higher levels of protection for citizens located in flood hazard areas. In addition, through the Virginia Uniform Statewide Building Code, the Commonwealth has set construction standards for structures built in FEMA's special flood hazard area (a.k.a., 100-year flood). The Virginia Building Code provides design standards for the construction of individual structures. The construction standards for new buildings in general meet, but do not exceed the requirements of the NFIP.

Future Considerations

In years past the construction of structures above the 100-year flood elevation has been considered by many to be an adequate protection measure. But more and more the concept of preventing flood waters from reaching structures through the design and construction of small, locally managed stormwater management facilities is becoming more common nationwide. These small systems are distinct from the major regional dam projects. An important area of statewide standards is the recent promulgation of the 4VAC 3-20-10 Virginia Stormwater Management Regulation by the DCR. This regulation is mandatory for localities that have a stormwater management program and is mandatory for all state agencies. The stormwater regulation deals with both stormwater quality and quantity issues. For flooding conditions the regulation specifies that for a 10-year storm no increased runoff can leave the sight and likewise local drainage channels must be sized so as to safely convey the 10-year flow. Construction and land use practices that develop under this regulation may only have a marginal impact on major floods but will be

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significant in resolving local nuisance flooding. These regulations are important for many reasons. The first is that many localities begin to consider local drainage issues when in many cases the local drainage has been somewhat neglected. The second is that new construction outside of the mapped floodplain could ultimately be afforded a level of protection previously only considered within the mapped floodplain.

Flood Insurance Claims

From 1968 until the adoption of the Flood Disaster Protection Act of 1973, the purchase of flood insurance was voluntary. Property owners could make their own decision whether to purchase flood insurance. Unfortunately, the response nationwide to purchasing flood insurance voluntarily was less than enthusiastic. Just over 95,000 policies were in force in 1972, and very few victims from Tropical Storm Agnes that hit that same year had flood insurance.

The 1973 Act mandated flood insurance coverage for many properties. For the

first time, regulated lending institutions could not make, increase, extend, or renew any loan secured by improved real estate located in a SFHA in a participating NFIP community unless the secured building and any personal property securing the loan were covered for the life of the loan by flood insurance. Congress established this requirement because, after major flood disasters, it became evident that relatively few individuals in eligible communities who sustained flood damage had purchased flood insurance.

Flood insurance claims are one measure of the historic losses from flooding although they only provide the claims paid for those who had flood insurance and suffered-covered losses. These losses are significant because in some cases they occurred despite a magnitude of preplanning and mitigation. With the writing of this plan the FEMA data provides the most significant detailed look at flood damages and damage potential. The following table indicates the NFIP Insurance Report for the Commonwealth of Virginia from CIS.

**TABLE 5.6
NFIP POLICY & CLAIMS REPORT**

NFIP INSURANCE REPORT	
Total Premium	\$36,574,875
V-Zone	651
A-Zone	51,294
Current Total	81,624
Coverage Total	\$13,007,187,200
Total Claims since 1978	27,278
Total Doll since 1978	\$366,681,192

Based on loss statistics from FEMA (09/30/2003) the total losses submitted, regardless of status were 21,196. Losses that have been paid (closed losses) were 11,438. Losses

that are still open and have not been paid in full 5,271 and losses that have been closed and no payment granted were 4,487. The total amount of losses paid on was \$152,355,205.91.

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Based on policy statistics from FEMA (09/30/2003) for Virginia indicate that there are 77,991 policies in force, with coverage for the policies at \$11,956,017,400. The total written premium for in-force policies was \$32,989,572.

A significant number of claims are the result of repetitively damaged structures. See the following table for those Top 15 Virginia communities with the greatest number of repetitive loss claims and claim amounts. Appendix D lists all repetitive loss communities in Virginia.

**TABLE 5.7
VIRGINIA TOP 15 REPETITIVE LOSS COMMUNITIES**

COMMUNITY NAME	TOTAL # CLAIMS	CLAIMS AMOUNT
VIRGINIA BEACH, CITY OF	106	\$1,083,761.77
NORFOLK, CITY OF	41	\$331,915.79
ROANOKE, CITY OF	30	\$377,271.02
WARREN COUNTY *	28	\$742,936.44
BUENA VISTA, CITY OF	27	\$297,052.15
DANVILLE, CITY OF	19	\$167,650.98
SHENANDOAH COUNTY *	19	\$977,333.51
BOTETOURT COUNTY *	18	\$170,209.28
WAYNESBORO, CITY OF	16	\$791,044.42
SALEM, CITY OF	15	\$149,963.68
CLARKE COUNTY *	13	\$345,226.31
HENRICO COUNTY *	13	\$143,208.61
PAGE COUNTY *	13	\$275,590.84
CHESAPEAKE, CITY OF	12	\$56,358.10
GLASGOW, TOWN OF	11	\$301,429.86

Future Considerations

Methods to reduce repetitive losses must be examined. Repetitive losses are not only a drain on the NFIP but they represent a significant loss to the citizens of the Commonwealth. Often when there is a loss or threat of loss businesses are closed, people miss work, emergency funds are expended to assist individuals, and more lives are jeopardized. In areas where repetitive losses are clustered flood control projects might be warranted, in areas where a single structure is repetitively damaged other non-structural projects could be warranted. In such cases the Hazard Mitigation Grant Program (HMGP) could be an effective tool to

help reduce the number of repetitive losses.

Future Potential and Projections of Flood Damages

There have been projections of future potential flood damages in some communities as a result of detailed studies conducted by various federal agencies to determine feasibility of possible flood damage reduction measures. However, these limited instances cannot be projected to the entire Commonwealth. The only projections of future flood damages are those contained in the discussion under section B of this chapter. These projections may be subject to

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considerable error in the same way that past projections or estimates of population and economic growth for Virginia have erred. Nevertheless, it can be reasonably and logically assumed that present rapid growth of certain areas of the Commonwealth will continue, although possibly at a reduced rate of growth. Rapid growth will likely result in increased occupancy and use of floodplain lands in these areas to satisfy habitation, business, commerce and infrastructure needs. This may result in development and use of present underdeveloped areas or more intense development of already developed areas.

Rapid growth and change in land use not only leads to increased floodplain occupancy, but also can change the flooding frequency and intensity at a given location. Flood waters will have less floodplain area to attenuate, passing the flooding problem downstream, possibly into areas not prepared for increased flood depths.

Today's minimum standards for development in the Commonwealth's floodplains are prescribed by the NFIP. These standards leave structures marginally protected from inundation by today's 100-year flood. By following the minimum floodplain management practices required by FEMA and the Commonwealth, in the future these same structures can be 1 foot or more below the future 100-year flood level. The future 100-year flood level will be influenced by changes in the watershed and the loss of conveyance capacity within the floodplain fringe areas. A few localities recognize this problem and require floors to be elevated above the present condition 100-year water surface elevation; however, most do not.

Future Considerations

Over the last two decades several government programs have evolved which reduce flood damages, particularly through the establishment of standards for new construction. Although improvements can be made in this area, it remains an area of accomplishments. The areas of the Commonwealth which have the most debilitating and chronic problems are older portions of communities. Modifications to existing federal, state and local programs must address these problem areas. Incentives must be developed which will attract the participation of property owners and community leaders to tackle these chronic problems, otherwise future damages can be assured of being greater than a current average loss year. The increased growth rate of coastal areas is a trend which introduces more occupants to flood prone hazard areas. There is also evidence of structures being vulnerable to damage through erosion and collapse along coastal areas as erosion zones encroach closer to shorefront properties.

Flood Control Projects

Extensive flood damage reduction has been accomplished through the construction of flood control structures such as those coordinated by the U.S. Army Corps of Engineers (USACE) and the NRCS. There are many other sites where past investigations determined that it would not be cost effective to carry on with construction of a project yet where significant flood hazards remain.

According to the NRCS, there is \$27,000,000 in flood control projects programmed for construction which will require approximately \$6,000,000 in

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non-federal matching funds to construct, assuming the federal government will provide its share.

The USACE has identified projects which have a positive benefit/cost determination for which nonfederal funding is needed. There are other projects which have been investigated and produced a negative benefit/cost ratio and were not further pursued. Cases arise where delays to proceeding with construction may not only be funding difficulties the delays may relate to property acquisition or a project may be stopped because of environmental

concerns. The following Table 5.8 is a summary report from the Norfolk district on flood damages prevented during water year 2003.

Table 5.8 provides a summary of the flood damages prevented by Norfolk District projects during WY 2003. The values were computed at the time of the flood event. This provides information on the historic flood damages prevented by Norfolk District projects.

**TABLE 5.8
FY 2003 DAMAGES PREVENTED BY CENAO PROJECTS**

(\$1000, SEPTEMBER 2003 PRICE LEVELS)		
Project/Basin	WY 2003 Events	Cumulative
Gathright Dam & Lake Moomaw (James River)	\$2,249	\$211,783
James R. Olin Flood Protection (James River)	\$ 3,873	since 1977 \$ 4,504
Scottsville Local Flood Protection (LFP) (James River)	\$ 104	since 1995 \$ 6,954
Richmond Water Purification Plant LFP (James River)	\$0	since 1989 \$0
Richmond LFP (James River)	\$1,952	since 1999 \$34,574
New Market Creek Section 205 LFP (James River)	\$ 0	since 1992 \$ 34,889
Norfolk Floodwall Hurricane Protection (Chesapeake Bay)	\$ 3,643	since 1972 \$ 11,374
Virginia Beach Streams Canal #2 LFP (Atlantic Coast of Virginia)	\$0	since 1968 \$ 14,051
Virginia Beach Hurricane Protection (Atlantic Coast of Virginia)	\$ 82,000	since 1990 \$ 82,000
Sandbridge Beach Hurricane Protection (Atlantic Coast of Virginia)	\$ 23,000	since 2002 \$ 23,000
TOTALS	\$116,821	\$423,129

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A record of these flood hazard areas and unsuccessful projects are important, not only for tracking potential structural solutions but as a record of areas with severe flooding problems. These areas might warrant further attention from the Commonwealth to determine if other management approaches may alleviate flooding hazards.

The Flood Mitigation Assistance (FMA) program provides funding to assist states and communities to accomplish flood mitigation planning and implement measures to reduce future flood damages to structures. This program is authorized under the 1994 Act. These funds can be used before disaster strikes.

The FMA program provides funding up to \$20 million a year with a 75/25 cost share. Examples of eligible activities for planning grants include conducting local planning meetings to obtain citizen input; contracting for engineering or planning technical assistance; surveying structures at risk of flooding; and assessing repetitive losses. Only projects for mitigation activities specified in an approved Flood Mitigation Plan are eligible for project grants. For example, a community may determine in its plan that acquisition of structures would be the preferred alternative for floodway areas, while elevation may be more appropriate solution in other areas of the floodplain.

The HMGP was created in 1988 by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (amendments include the Hazard Mitigation and Relocation Assistance Act of 1993 and the Disaster Mitigation Act of 2000). The HMGP assists states and communities in implementing long-term hazard mitigation measures for all hazard types following a major disaster

declaration. A key purpose of the HMGP is to ensure that the opportunity to take critical mitigation measures to protect life and property from future disasters is not lost during recovery and reconstruction process following a disaster.

The Disaster Mitigation Act (DMA) of 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988. The DMA authorizes the creation of a pre-disaster mitigation program to make grants to state, local and tribal governments. It also includes a provision that defines mitigation planning requirements for state, local and tribal governments. Section 322 establishes a new requirement for local and tribal mitigation plans; authorizes up to 7 percent of the HMGP funds available to a state to be used for development of state, local and tribal mitigation plans; and provides for states to receive an increased percentage of HMGP funds from 15 percent to 20 percent if, at the time of the disaster declaration, the Commonwealth has in effect a FEMA approved State Mitigation Plan that meets the criteria established in regulations.

Flood control projects will most likely be a focal point in the local all hazard mitigation plans. Mitigation projects will be completed in order to lessen the impacts from hazards. Since flooding is a devastating and annual occurrence, projects that lessen the impacts will most likely be considered and completed. FEMA's lists of repetitive loss structures (most on the list due to flooding) will be addressed and the appropriate mitigation measure taken.

Future Considerations

Due to reduced federal, state and local funds for flood control structures and

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the detrimental impact upon some types of construction activities, there is less support for new construction than in past years. Flood control structures can support environmental protection such as water quality protection. Examples include sites where a flood control structure would protect a sewage treatment facility or an industrial complex which may contain hazardous materials. In these cases flooding would intensify a water quality problem. In the presence of no adequate floodproofing solutions for these two examples, the construction of a flood control structure may be the best option. Historic districts are often located in floodplains and warrant special protection. To completely relocate these districts would compromise their value as historic resources. Protecting these districts as they are without alteration may be the most practical solution.

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Virginia's geographical location along the Atlantic Coast places it in the path of cyclonic storms that move northward from the Gulf of Mexico and moisture that moves inland from the Atlantic Ocean. These weather systems provide needed rainfall but also have resulted in severe localized or area wide flooding. Rarely is the Commonwealth spared an annual flood event in some region of the Commonwealth.

The systematic collection of stream flow records in Virginia (producing information on volumes of water flowing past a given point and the maximum water surface elevation for a peak flow rate) began in 1898 under a cooperative agreement between the U. S. Geological Survey and the Virginia Geological Survey. Since that time, floods have been well documented on the major

streams that drain the Commonwealth's land surface. Some documentation of floods prior to 1898 is available from various historical reports and accounts. These earlier floods impacted settlements of that time and were reported in newspapers and by other means. Since many intense localized or area wide floods did not have the effect or impact they would have today, or even at the turn of this century, they were unreported or under-reported. For these reasons, the record of major floods in Virginia during the time of the first European settlers early in the 17th Century through the end of the 19th Century is far from complete. Information on a few memorable floods during this period is available.

Historic Dates

The following list, based on available records from Virginia Department of Emergency Management (VDEM), DCR and the NWS, denotes the most significant floods in the Commonwealth:

In May 1771 a flood occurred along portions of the James and Roanoke Rivers. This flood produced what is believed to be the second largest discharge of water at many locations along these streams. When the rivers receded, 150 persons were said to have lost their lives. Animal carcasses, trees and other debris were found matted together in some places to heights of 12 to 20 feet. A record of this flood is carved in stone on the Randolph Monument in east Henrico County near the Malvern Hill Plantation.

In February 1862 floods on the Clinch and Holston Rivers affected military strategies during the Civil War.

The flood of September 30, 1870 was considered to be one of the greatest floods of the 19th Century in Virginia. Losses were reported to approximate

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\$25 million. Lynchburg and parts of the James River were particularly affected.

A flood which peaked on November 26, 1877 resulted in the highest stage on record for the James River at Lick Run.

Earlier this century floods occurred in March 1913 along the Shenandoah River and portions of the James River. This multi-state event produced the highest stage of record for the Cowpasture River near Clifton Forge.

The March 2-3, 1927 storm in the coastal areas of Virginia Beach is the earliest record of significant coastal flood damages. Most of the damage occurred on March 2 as a result of high tides in the Atlantic Ocean. The storm denuded beaches exposing underlying soils, and caused extensive damage to a local hotel and other recreational amenities.

The hurricane of August 1933 caused the highest stages of record in the vicinity of Norfolk and Virginia Beach. Maximum tidal stages of 8.6 feet were observed on the Atlantic Coast and Lynnhaven Bay, 8 feet for the Eastern Branch Elizabeth River, 5.3 feet in Broad Bay and Linkhorn Bay and 3.8 feet in the Back Bay and North Landing River areas. Extensive damage to waterfront property and low-lying buildings occurred during this storm.

In March 1936 torrential rains caused substantial damage to agricultural areas in a considerable portion of the Commonwealth. Properties in 16 counties and towns sustained enormous monetary losses. Particularly hard hit were Richmond, Buena Vista and Lynchburg.

A flood which peaked on April 26, 1937 caused localized flooding on the Rappahannock River. This flood caused

the second highest stage of record along the river near Fredericksburg.

The flood of August 14-16, 1940 was caused by a hurricane that moved inland at Beaufort, S.C., traveled northward along the Appalachian Mountains, then moved eastward through southern Virginia to the Atlantic Coast at Norfolk. About 20 deaths were reported and estimated property damage was about \$3 million. Five deaths in Virginia were attributed either directly or indirectly to the elements. Flooding was most severe in the New, Roanoke, and Chowan Rivers basins. The peak stage on the Nottoway River near Stony Creek was the peak of record. The flood was the worst on the Roanoke River since the first European settlers. Damage to highways, crops, and property was hundreds of thousands of dollars. Highway damage alone during August 1940 was estimated to be \$750,000. In southern Virginia, the tobacco crop was largely swept away by raging waters caused by prolonged rainfall over the area.

The flood of October 15-16, 1942 was unprecedented in terms of peak stage on many streams in northern Virginia. The Shenandoah, Rappahannock and James Rivers basins were the most affected. At many gauging stations in these areas, river stages were the highest ever recorded. The peak stage on the North Fork Shenandoah River at a house at Cootes Store was the highest since the house was built in 1836 and the peak of record occurred on the South Fork Shenandoah River at Front Royal. On the Rappahannock River at Kelly's Ford, the peak stage was 3.4 feet higher than the peak of the April 1937 flood and 5.9 feet higher than the Johnstown flood of 1889. Damages to the Rappahannock neared \$2.5 million and \$4.5 million on the Potomac River.

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Deaths and record losses were reported in many localities. Five persons were known to have died in floods in Virginia, West Virginia, Maryland, and the District of Columbia. In the Fredericksburg area, more than 1,500 people had to evacuate their homes and property losses were estimated to run into hundreds of thousands of dollars. Agricultural losses resulted from flooding of unharvested crops along the river bottoms. Livestock and poultry losses were also extensive.

August 18-20, 1955 "Diane" Heavy rains resulted in flash flooding along the piedmont and in the Shenandoah Valley. Hurricane Diane moved across central Virginia, Richmond and Washington, D.C. Rain from the two storms set records for the month of August over central and northern Virginia and caused flooding from Virginia through Pennsylvania

An unusual series of storms occurred over the Tennessee and Big Sandy River basins between January 20 and February 10, 1957, producing rainfall totals that in many places exceeded previous records for a similar period. The floods during this period were noteworthy because of the large volume of flood runoff produced by the continued heavy rains rather than for extreme flood heights. Floods on the Clinch River and its tributaries and in the Big Sandy River basin along the headwater streams of Levisa Fork, Russell Fork, and Pound River left about 2,000 families homeless in southwestern Virginia, and over 800 homes and many businesses were destroyed or heavily damaged. The U.S. Army Corps of Engineers estimated flood damages of around \$5 million. Particularly hard hit were Tazewell County, including the towns of Richlands and Raven; Russell County, including the towns of Cleveland and St. Paul;

areas along Russell Fork near Haysi; and the communities of Pound and Grundy. Record or near-record stages were also reached on the North Fork of the Holston River, but damages were small because most flood-prone areas were undeveloped.

The Ash Wednesday Storm on March 6-8, 1962 resulted from a northeaster along the Atlantic coast. A maximum flood height of 6.7 feet occurred March 7 and caused significant damage to Virginia Beach, Norfolk and vicinity. Total damages were estimated at \$8 million. Of special significance is the observation that the flood stage in 1962 was nearly 2 feet lower than the Hurricane of 1933, yet damages were more extensive due to increased development in the coastal and tidal areas.

Some of the streams in the Clinch River watersheds and in the adjoining Powell River watershed rose above flood stage three times during March 1963. Compared to the January - February 1957 floods in this area, damages were not significant.

In August 20, 1969 Hurricane Camille produced record rainfalls in the James River basin. The storm claimed 152 lives in Virginia. Rapidly rising streams and landslides disrupted communication lines and damaged roads, preventing many downstream residents from being alerted in time to take emergency measures. Twenty counties and two cities suffered flood damages of nearly \$110 million. Particularly hard hit were Rockbridge County, including Buena Vista, and Nelson County. This flood was probably the worst natural disaster in central Virginia's recorded history. The deluge was of catastrophic proportions. Rainfall of 12 - 14 inches was common in Nelson County with reliable reports of 27 - 28 inches in the central part of Nelson County (Camp

and Miller, 1970; Schwarz, 1970). Other sources have reported unconfirmed amounts of 46 inches (Simpson and Simpson, 1970, page 31). The unusually intense rainfall, as indicated by Figure II-1 produced not only floodwater inundation damage. The forceful erosion, scouring and down-cutting of streams and hillsides vividly reshaped the landscape. Camille caused the death of 152 people in Virginia. A majority of the deaths were not caused by drowning but as a result of broken bones and other blunt injuries. The intensity of this rainfall supported the basis of "probable maximum precipitation" theory which has been incorporated with dam safety regulations. This experience is a vivid reminder that true to life events can occur as anticipated through scientific theory and models. It also demonstrates that design standards that protect to the 1% storm are minimal.

The flood of June 21-24, 1972 was caused by intense prolonged rainfall from the remnants of Hurricane Agnes which moved northward along the East Coast. This flood was one of the most widespread and disastrous floods of record in Virginia. Peak stages of record occurred at many gauging stations. The Roanoke, James and Rappahannock Rivers basins were the most affected. The peak stage of the James River at Cartersville was the highest recorded since 1877. Record stages at other gauging stations include Goose Creek near Leesburg, where the stage was the highest recorded since 1889, and Slate River near Arvonnia, where the stage was the highest since record keeping at this site began in 1927. Peak discharge at these stations had recurrence intervals greater than a 100- year event.

Damage to property from the 1972 flood, both public and private, was widespread within the Commonwealth. Twenty-two counties and six cities sustained flood damages. Damages ranged from agricultural losses in rural areas to major damage in cities and towns. Many water treatment facilities which provided potable water or disposal of wastes water were flooded, creating severe health problems. A seriously impacted area was Richmond where water-supply, sewage-treatment and electric and gas plants were flooded. Four of the five bridges crossing the James River were closed as well as Richmond's downtown area which was closed for several days. Over \$37 million in flood damage was reported. The northern area of the Commonwealth had the greatest losses, and many cities and towns in other areas received substantial damage. Throughout the Commonwealth, about 1,400 homes as well as roads and bridges were destroyed or damaged. Thirteen deaths were reported and the estimate of property damage was \$325 million. Deaths and property damage was decreased somewhat by timely warning of the impending flood.

Intense rainfall caused record-breaking floods on April 2-7, 1977 in southwestern Virginia. The flooding was most severe in the Big Sandy and Tennessee River basins. Flooding of lesser magnitude occurred in the New River basin. Record peak stages were recorded at many gauging stations. For the Clinch River at Cleveland, the peak stage was 2.0 feet higher than the previously recorded maximum of 24.4 feet on January 30, 1957, and the highest recorded since the flood of 1862. The recurrence intervals of flood peaks at 18 gauging stations within the area were equal to or greater than a 100-year event. Damage to public and private property, roads and bridges was

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extensive. Damages estimated by the VDEM were about \$243 million. Twenty-two deaths were reported and estimated property damage in Kentucky, Tennessee, Virginia, and West Virginia totaled more than \$400 million.

"The Election Day Flood" November 1985 very intense rainfall resulted from a complex weather system when remnants of Hurricane Juan and moisture from the Gulf of Mexico generated record-breaking flooding in the headwaters of the Roanoke, James and Potomac Rivers basins. The flood of November 4-6, 1985 was the largest flood of record at many locations in these basins. Tidal flooding also occurred in the Potomac and Chesapeake Bay estuaries due in large measure to a northeast high pressure system which caused wind-driven waves to move up the estuaries. Total rainfall during the above dates was 12.2 inches at Montebello and 17.8 inches at Big Meadows. For the Roanoke River at Roanoke, the peak discharge was 25 percent greater than the previous maximum of June 21, 1972; record keeping began in 1899. Flood peaks at many gauging stations had recurrence intervals of a 100-year event or greater. In Roanoke the river rose seven feet between 11:00 A.M. and noon, and nearly 18 feet in six hours. Had this event taken place during the evening hours, casualties would have been much higher. Flood waters rose so quickly that there was little time for evacuation. The downstream commercial district was flooded up to eight feet. Businesses lost major inventories and many residents lost all their personal belongings. As a result of the flood, some businesses in the areas have closed permanently. Mobile homes located in parks along the river were transported downstream by the force of the floodwater. The Environmental

Protection Agency (EPA) and other agencies were called in to clean up between 1,200 and 1,500 55-gallon drums that were carried from manufacturing plants by the storm. Small flood control structures served quite well in retarding flow. However, several suffered major erosion damage. Response teams using boats and helicopters rescued people from rooftops. Despite these and other rescue efforts, 22 people lost their lives as a consequence of this flood event. In the Lynchburg area, the James River flood elevations exceeded the previous record stage by seven feet. Millions of dollars of tobacco stored in warehouses was lost. Potentially dangerous situations existed. These involved the potential for spontaneous combustion of wet tobacco, potential flooding of stored cyanide, and potential release of industrial chemicals upstream of the water supply intake. Several blocks of commercial and industrial buildings adjacent to the James River in Richmond were damaged. The city was successful in protecting its wastewater treatment and wastewater supply plants. Several smaller communities in the western part of the Commonwealth suffered severe damage. A common problem in these areas was rapid flooding from surrounding steep hills. Normally dry hollows carried large amounts of debris, taking out bridges and leaving channels filled with rocks. Statewide property damages were estimated at \$750 million.

An intense storm on June 27, 1995, dropped up to 30 inches of rain on the foothills of the Blue Ridge Mountains in the area of Madison County and surrounding jurisdictions. This storm triggered hundreds of debris flows and caused widespread flooding. Some rural communities were isolated when bridges, roads, and power lines failed. Devastation was so great that the

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President declared the area a federal disaster.

In the Winter of 1996 Virginia residents were hit with blizzard and flooding conditions. Also known as the "Great Furlough Storm" due to Congressional impasse over the federal budget, the blizzard paralyzed the Interstate 95 corridor, and reached westward into the Appalachians where snow depths of over 48 inches were recorded. Several local governments and schools were closed for more than a week. The blizzard was followed with another storm, which blanketed the entire Commonwealth with at least one foot of snow. To compound things, heavy snowfall piled on top of this storm's accumulations in the next week, which kept snow pack on the ground for an extended period of time. This snow was eventually thawed by higher temperatures and heavy rain that fell after this thaw resulted in severe flooding. Total damage between the blizzard and subsequent flooding was over \$30 million.

Hurricane Fran made landfall on the southern coast of North Carolina as a Category 2 hurricane on September 5, 1996. This hurricane is notable not only for the \$350 million in damages, but because of its widespread effects, including a record number of people without power and the closure of 78 primary and 853 secondary roads. Rainfall amounts between 8 and 20 inches fell over the mountains and Shenandoah Valley, leading to record-level flooding in many locations within this region. 100 people had to be rescued from the flood waters and hundreds of homes and buildings were damaged by the flood waters and high winds. More than fifty localities were declared for federal disaster assistance. The affected area extended the length of the Commonwealth from south to

north, sparing only the most eastern and western jurisdictions.

Hurricane Dennis loomed off of Cape Hatteras for several days and weakened to a tropical storm. It then moved west making landfall on the Outer Banks of North Carolina and spreading rains and wind across Virginia. Tropical cyclone conditions were felt over eastern Virginia from August 10-September 5, 1999. The peak of the storm came on the 4th and 5th. A sustained wind of 52 mph was recorded at Langley Air Force Base with a peak gust of 76 mph. A F2 tornado (winds 113 to 157) touched down in the city of Hampton causing significant damage to a three block area and injuring six people. Six apartment complexes, an assisted living complex, and a nursing home were damaged causing 460 people to be evacuated. Four of those buildings were condemned. An estimated 800 vehicles were damaged. Tidal departures with the storm were about 3 feet above normal resulting in moderate coastal flooding at high tide. About 2 to 5 inches of rain fell resulting in some street flooding in southeast Virginia. Across the southern and central Piedmont into the mountains of Virginia about 4 to 7 inches of rain fell with as much as 9.5 inches at Montebello in Nelson County and Mill Creek Dam in Augusta County and 8.5 inches at Monterey in Highland County.

Hurricane Floyd brought 10 to 20 inches of total rainfall over portions of southeast Virginia, during the period of September 15-16, 1999. Along the Coast, wind gusts up to 100 mph and storm surges approaching 7 feet. These three elements combine together to cause total storm damages of approximately \$255 million. This disaster will long be remembered in the City of Franklin and Southampton and Isle of Wight Counties, as well as the

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other 44 Virginia jurisdictions included in the major disaster declaration. More than 8,900 homes, businesses and public facilities were either destroyed, significantly damaged, or sustained moderate impacts. In addition to direct property damage, lost business revenues were estimated at \$13.1 million, with the City of Franklin losing nearly \$2 million in tax revenues. Direct crop losses were estimated at \$17 million. FEMA reports allocating \$8.9 million for assistance to families and individuals, and \$19.8 million for public assistance.

A total of six federal disasters, primarily flooding and severe storms, have been declared in Southwest Virginia from 2001-2004 (Disasters 1386, 1406, 1411, 1458, 1502, and 1525). The worse hit counties were Tazewell (all 6 disasters), Buchanan (5 disasters), and Russell (4 disasters). Dickenson, Lee, Smyth, and Wise Counties were also declared in half of these six disasters. Many of these disasters have storm tracks along the mountain valleys, producing excessive localized flooding. Catastrophic flooding has been experienced in rural settlements as well as in Bluefield, Hurley, Appalachia, Pennington Gap, Norton, Dante and Wise.

Hurricane Isabel entered Virginia September 18, 2003 after making landfall along the North Carolina Outer Banks. The Commonwealth sustained tropical storm winds for 29 hours with some maximum winds approaching 100 mph. The hurricane produced storm surge of 5 to 8 feet along the coast and in the Chesapeake Bay with rainfall totals between 2 to 11 inches along its track. Twenty-one inches of rainfall was measured near Waynesboro

Virginia. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, debris, transportation interruption, and damaged homes and businesses. At the height of the incident approximately 6,000 residents were housed in 134 shelters and curfews were imposed in many jurisdictions. Further damages occurred when a series of thunderstorms and tornados came through many of the designated areas in the southeast portion of Virginia on September 23. There were a total of 36 confirmed deaths. More than 93,000 registrations were made for assistance. Residential destruction included 1,186 homes reported destroyed and 9,110 with major damage, 107,908 minor damage, with losses estimated over \$590 million. Of the 1,470 businesses involved, 77 are reported destroyed, 333 suffered major damage and 1,060 businesses suffered minor or casual damage, with losses exceeding \$84 million. Public assistance exceeds \$250 million and continues to increase. More than two-thirds of the households and businesses within the Commonwealth were without power. Remote locations did not have power restored for three weeks.

Appendix A shows the location of the major hurricanes that have impacted Virginia in the last 150 years (note that the map excludes the most recent 2004 hurricanes). Most of these tracks have occurred east of the mountains, in central and eastern Virginia. Storms typically track to the northeast, with the notable exceptions of Camille (Track O), Hugo (Track R), Fran (Track T), and Isabel (Track W). Historic flood events confirm that many of the major floods in Virginia are related to hurricane occurrences.

**TABLE 5.9
PRESIDENTIAL DISASTER DECLARATIONS FOR FLOODING IN
VIRGINIA AUGUST 1969 – MAY 2004**

DATE	TYPE	JURISDICTIONS DECLARED	DAMAGES
August 1969	Hurricane Camille	27	\$100,000,000
June 1972	Hurricane Agnes	106	\$325,000,000
September 1972	Storm/Flood	3	\$833,000
October 1972	Flood	31	\$22,000,000
April 1977	Flash Flood	16	\$227,000,000
November 1977	Flood	8	\$24,800,000
July 1979	Flood	1	\$7,800,000
September 1979	Flood	1	\$17,000,000
May 1984	Flood	3	\$7,000,000
November 1985	Flood	52	\$750,000,000
October 1989	Flood	1	\$3,400,000
April 1992	Flood	24	
June 1995	Flood	24	
January 1996	Flood	27	\$30,000,000
September 1996	Hurricane Fran	88	\$350,000,000
August 1998	Hurricane Bonnie	5	
September 1999	Hurricane Dennis	1	
September 1999	Hurricane Floyd	48	\$255,000,000
July 2001	Flood	10	
March 2002	Flood	10	
April/May 2002	Flood	9	
February 2003	Winter Storms/Flood	39	
September 2003	Hurricane Isabel	100	\$590,000,000
November 2003	Flood	6	
May 2004	Flood	3	
		643	\$2,709,833,000

Reference:

Virginia Department of Emergency Management (VDEM). 2004. Presidential Disaster Declarations in Virginia since 1969. < <http://www.vdem.state.va.us/library/dishist.cfm> > (8/19/2004).

Future Considerations

Despite recurring flooding events the public awareness of flooding risks drops rapidly as time passes after the most recent flood. A common perception prevails that once an area has flooded it will not flood again for many years. However, as illustrated in the last three major events this is not always the case. An increased effort to educate the public is necessary to advance a more protective way of life in floodplains. There should be a common

understanding that floodplains pose risks and hazards and should be managed with caution.

Loss of Life

From 1955 through 2003, more than 200 deaths have been attributed to flooding or flash flooding. Of this total, 137 deaths were tied to three specific flooding events. In 1969 much of west central Virginia was inundated by extreme rainfalls as a result of Hurricane Camille. Estimates of 115 to

152 deaths were attributed to this single event. The second event occurred in 1985 in the vicinity of Roanoke, where 22 deaths occurred. The third event, in 2003, was from the impacts of Hurricane Isabel which resulted in the death of 36 Virginians.

Typically most reported deaths in flooding events are attributed to drowning. The unknown question is whether these statistics include deaths that are not a direct result of drowning. These include heart attack victims, accident victims due to poor traveling conditions such as a washed out road, individuals electrocuted while cleaning up flood damages or while reconnecting a utility, and other potential accident victims. The death toll from major and minor flooding could be higher if these deaths were related to the flood event.

Future Considerations

Damages to homes, loss of jobs, disruption to businesses and monetary damages rate second in importance compared to the tragedy of loss of life due to flooding. Unfortunately victims are often not floodplain residents. They may be driving through floodplains or assisting with rescue works. The flash-flood prone areas of the Commonwealth are the most susceptible to loss of life. Public information and the fostering of common knowledge about floodplain hazards must be implemented to enhance public safety. Early warning systems and emergency response plans are the most practical tools for hazard areas ensuring as high a degree of public safety in these areas as is possible.

Economic Losses from Floods

Historically floodwater invades the Commonwealth on a regular basis, often with devastating results. Rarely does

the Commonwealth go through an entire year without suffering damages and economic losses as a consequence of flooding. Flood related events such as hurricanes, which can result in intense amounts of rainfall and destructive wind-driven waves along coastal areas greatly compound the situation.

Although reasonably good information is available for the large floods which have caused serious loss of life or major damage to property, equivalent information is frequently not available for the numerous smaller flood events which occur on a regular basis throughout the Commonwealth. Many of these small events go unreported and/or no damage data are acquired. Therefore, the total flood damages may be consistently under-reported. There is no complete record of past flood damages in the Commonwealth.

Additionally data from numerous reports have not been assimilated into a single database making a basis for comparison difficult. Typically more data is available for Presidential Declarations.

Due to differences in determining and reporting flood losses (e.g., floods vs. storms, floods vs. drainage) and in adjusting past monetary losses to reflect changes in monetary values, as well as other problems in obtaining data (or the lack of data) from various sources, the interpretation of flood loss data is difficult and estimates may vary widely or be questionable. Traditionally the two most comprehensive sources of annual flood loss data are those prepared by the NWS, and by the American Red Cross.

Since 1902 the NWS has compiled annual estimates of damages caused by floods (excluding losses to agriculture) and of the number of lives lost to floods. Estimates are initially prepared by local offices which obtain information from a variety of sources, including

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government officials and news media. This information may be supplemented by that provided by other federal agencies.

For some of the years considerable differences exist between in estimated flood damages compiled by the NWS and those reported by other sources and mentioned in other sections of this plan.

The NWS data can be used to make comparisons of flood damages between selected years and for longer periods. They seem to show a trend of increasing flood losses resulting from increased occupancy and use of the Commonwealth's floodplains and an increase in the amount and value of property subject to flooding.

The VDEM is an important source of damage information. The following table provides damage data for Presidential Declarations due to flooding.

The American Red Cross also provides data on lives lost and dwellings damaged or destroyed due to disasters. Information for storms, floods and hurricanes is not readily available for Virginia, although national totals are available in the Red Cross Annual Summaries of Disaster Services Activities. The difficulty with this data however, is that much of the data is "lumped" into accumulated statistics and the breakdown of these data by specific flood event and location is not possible.

**TABLE 5.10
REPETITIVE LOSS FROM CIS**

	AE, A1-30, AO, AH, A	VE, V1-30, V	B, C, X	TOTAL
RL Buildings (Total)	1,595	35	334	2,022
RL Buildings (Insured)	1,016	25	194	1,243
RL Losses (Total)	4,041	87	851	5,113
RL Losses (Insured)	2,536	63	491	3,109
RL Payments (Total)	\$93,864,082.92	\$1,833,082.19	\$15,215,559.70	\$112,221,663.63
Building	\$70,193,482.94	\$1,551,344.61	\$10,983,409.31	\$83,732,041.79
Contents	\$23,670,599.98	\$281,737.58	\$4,232,150.39	\$28,489,621.84
RL Payments (Insured)	\$57,391,265.91	\$1,464,545.78	\$8,757,442.00	\$67,794,599.04
Building	\$47,174,003.45	\$1,254,196.34	\$6,771,091.91	\$55,306,946.46
Contents	\$10,217,262.46	\$210,349.44	\$1,986,350.09	\$12,487,652.58

Post - FIRM SFHA RL Buildings: 120
 Insured Buildings with 4 or More Losses: 118
 Insured Buildings with 2-3 Losses > Building Value: 37
 Total Target RL Buildings: 155

Future Considerations

It appears that organizations and government agencies determine damages using varying techniques, according to what serves their priority need. An effort is needed to maintain a log or account of all these estimates to, as best as possible, determine total flood damages in future years. It is difficult to estimate the many small losses which may not individually be placed on the damage assessment reports but that amount to significant numbers when totaled. In future years close accountability must be maintained on the expenditure of public monies in floodplain areas. Federal Executive Order 11988 which oversees such expenditures must be complied with. Through review of floodplain development permits state expenditures can be reviewed. The encouragement of floodproofing, retrofitting and, where practicable, relocation can be undertaken for private expenditures in floodplains for those existing damaged sites.

HAZARD MAPPING

Nearly every flood-prone locality has at least one portion of its flood-prone area mapped. In some localities nearly all floodplains have been mapped, in others only a limited number. This effort, put forth by the FEMA, the NRCS, USACE, the Tennessee Valley Authority (TVA), the U.S. Geological Survey, the Department of Environment Quality (DEQ) and others, has led to a significant management tool. For the purposes of the NFIP, these maps are a good tool for providing flood insurance rate quotes and for providing data for the implementation of floodplain regulations. These studies also provide substantial technical support and can

provide a partial basis for advanced planning and the study of the effectiveness of alternative floodplain management measures. For communities which are undergoing a rapid rate of growth maps that are five years old may no longer accurately depict flooding conditions. In most cases the actual data gathered to prepare the maps may have been obtained two years prior to the publication date therefore making the maps less current than their publication date implies.

Because of the scope of this effort some of the work was done by approximate mapping methods. In some localities over 50% of the mapped floodplains are done to an approximate standard. Approximate mapping can provide a reasonable depiction of a floodplain, but often will not provide sufficient detail to allow for sound floodplain management decisions.

Rapid growth in many Virginia areas has led to floodplain mapping restudied; however, shrinking federal budgets are not able to keep up with the restudy needs. Presently no large scale program is known that will result in updating the floodplain map base. However, there are several programs available which can assist localities in developing new studies and/or remapping projects. These programs are administered through the DCR and such federal agencies as the USACE.

The Bureau of Urban Programs has an inventory of approximately 250 studies which may be borrowed on a checkout basis. The U.S. Geological Survey maintains a data base of annual peak flow data. The TVA also generated records of observed flood profiles; although TVA no longer is active in Virginia's floodplain management, much of their information is in the Bureau of Urban Programs library. Both of these

NATURAL AND BENEFICIAL RESOURCES

two sources of flood data are available from the Bureau of Urban Programs.

The Commonwealth of Virginia's All Hazard Mitigation Plan is being developed concurrently to this plan and includes information on the hazards affecting Virginia. Some of the hazards that have been considered in the development of the plan include: Winter Storm, Dam Failure, Drought, Earthquake, Flooding, High Wind, Hurricane, Land Subsidence, Landslide, Tornado and Wildfire.

Future Considerations

Mapping and remapping programs will be critical to the long-term success of floodplain management. As maps become outdated due to expansions in the community or to changes in the hydrologic and hydraulic condition confidence in the maps will decrease. Additionally, many areas which previously were slightly populated now are experiencing significant growth and mapping lags behind this expansion. Efforts to increase funding for federally produced maps, and the establishment of a flood mapping program within the Commonwealth, should be considered before the map base becomes obsolete.

NATURAL AND BENEFICIAL RESOURCES

An inventory of the Commonwealth's floodprone areas must recognize those floodplains which are managed in a manner which permits no development and therefore no potential for flood losses. These are areas which are preserved or conserved for recreational resources, scenic resources, wildlife habitat, flora preserves, water supply sites and open space. A full discussion of the role natural resource protection plays in floodplain management is presented in Chapter IV of this plan.

An undetermined number of localities have taken the initiative to preserve riverine corridors which pass through their communities. These sites include parks, golf courses, arboretums and other uses. Even today, in an era of minimal funding for nonessential expenses there are localities committed to acquiring additional urban, water-based open space and coastal beach areas. Acquisition of these floodplain sites translates into new resources to serve the public and one less flood prone location.

Through the Commonwealth's Scenic Rivers Program 346 miles of Virginia's rivers have received designation. The following table lists the State's Scenic Rivers and length of designation.

**TABLE 5.11
VIRGINIA'S SCENIC RIVERS**

COMPONENTS OF THE VIRIGINIA SCENIC RIVERS SYSTEM		
River	Location	Length (miles)
Rivanna	Albemarle County	37
Goose Creek	Loudoun/Fauquier Counties	27
Catoctin Creek	Loudoun County	16
Appomattox	Dinwiddie County	5
Staunton	Charlotte County	11
St. Mary's	Augusta County	6

COMPONENTS OF THE VIRGINIA SCENIC RIVERS SYSTEM		
River	Location	Length (miles)
Nottoway	Sussex/Southampton Counties	33
Shenandoah	Warren/Clarke Counties	14
Historic Falls of James	Richmond City	8
James River	Botetourt County	14
Rappahannock	Rappahannock County	86
Moormans	Charlottesville City	13
N. Landing Rivers & Tributaries	Virginia Beach City	26
Lower James Historic	James City	25
Rockfish	Nelson County	9
Chickahominy	Hanover County	10
Guest	Scott County	6
Total Miles		346

Virginia has 14 barrier islands off the coast of Accomack and Northampton Counties. Three are federally protected, nine are protected through the Virginia Coast Reserve Program, and two are unprotected. One of the two is Cedar Island, which contains existing structures. However, due to the federal Coastal Barrier Resources Act and the rapid rate of erosion, new development has ceased. In total the Virginia Coast Reserve Program contains some 40,000 acres of sandy beaches, salt marsh and adjacent upland. The preserve is owned by the Nature Conservancy.

The total length of shoreline in the Chesapeake Bay is estimated at 2,951 miles. Of this, 2,365 miles have been measured for erosion characteristics through the Virginia Institute of Marine Science. In 100 years it has been estimated that 21,079 acres of marsh and beach shoreline have been lost. In that same period of time 270,126,000 cubic yards of shoreline has been lost.

This rate of erosion is presenting a noteworthy risk to structures located near the edge of shorelines. The Chesapeake Bay Program (CBP) works with regional staff to restore the Chesapeake Bay. The CBP partners

include the states of Maryland, Pennsylvania and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; and the EPA, representing the federal government. The main areas for projects and activities include: The Chesapeake Bay Model; Oyster Restoration; Habitat Restoration; Beneficial Use of Dredged Material; Abandoned Mine Lands Restoration; Sediment Reduction; Shoreline Erosion Protection; Watershed Planning; Contaminated Site Clean-Up; Regulatory oversight of watersheds and wetlands; and Assisting military installations with environmental planning, compliance, and restoration. For additional information refer to Chapter 6, On Coastal Hazards.

Virginia's Natural Heritage Program, which developed from a cooperative effort of the Commonwealth and The Nature Conservancy (a private non-profit organization dedicated to the preservation of natural diversity) provides for the identification of the Commonwealth's most significant natural areas through an intensive inventory and provides for protection of these areas using a variety of conservation tools. The inventory

developed as part of the program, is organized in computer-based files, and is supported by location maps and manual files for easy access. This data source can serve as a valuable planning tool and should be considered in the development of site specific plans. Because the data base does not distinguish between floodplain lands versus other land types, no definitive estimate exists as to the number of sites that occur in floodplains. However, it stands to reason that many of the natural areas containing sensitive flora and fauna are water dependent, so that many of these sites by default may be in the river, tidal or coastal floodplains of the Commonwealth.

The U.S. Fish and Wildlife Service (FWS) in cooperation with various state agencies have carried out various inventories and investigations of the Commonwealth's wetlands starting in the late 1970's. A statewide mapping effort was completed in early 1990. The ultimate goal is to have up-to-date and digitized maps of the entire Commonwealth. According to the USFWS, in the 1780's Virginia had 1,850,000 acres of tidal and nontidal wetlands. In the mid-1980's wetlands covered 1,075,000 acres or roughly 4% of the Commonwealth.

According to the U.S. Fish and Wildlife study of wetland losses, Virginia has lost 42 percent of its original wetlands in the past 200 years. Between 1956 and 1977, 63,000 acres of Virginia's coastal wetlands and inland vegetated wetlands were lost, for a 6 percent loss. Annual losses of these wetlands averaged 3,000 acres. Inland vegetated wetland loss was greatest in the lower coastal plain region where about 14 percent of these wetlands were destroyed. Losses in this region accounted for 80 percent of the Commonwealth's inland vegetated wetlands losses.

On the Eastern Shore of Virginia both Accomack and Northampton Counties have coastal barriers protected under the Coastal Barrier Resources Act. This act prohibits the advancement of federal assistance including Flood Insurance that is used in any fashion to promote the development of these critical areas.

Future Considerations

Trying to implement a statewide practice of retaining or converting floodplains as open space would be impossible. But the point should be made that this is the most effective approach to reducing flood damages. Where there is local interest in pursuing this objective there should be assistance available not only from the Commonwealth but also from federal agencies. Special efforts should be made following major floods to uncover opportunities to relocate damaged structures out of floodplains and have the vacated lots dedicated as open space. Retaining wetlands as open space serves an important function of storing flood waters in those cases where the wetlands are hydraulically connected to the flooding watercourse. The relationship between flood storage and wetlands protection should be pursued.

SUMMARY OF CHAPTER 5

Currently, a comprehensive survey of flood hazards has not been undertaken within the Commonwealth. As the floodplain management program matures, these types of data will be critical in determining study and project priorities. A significant strategy discussed within this Plan will be methods to expand and improve this data base.

Virginia has more than > 50,000 miles of rivers and streams. All of these waterways have floodplains subject to inundation. This Chapter has summarized the information that is available regarding floodprone areas within the Commonwealth, the reliability of the information, and what additional information would be beneficial to assist future floodplain management efforts.

*The Floodplain Management Plan
for the Commonwealth of Virginia*

Chapter 6

A Strategy for Floodplain Management

CHAPTER 6

A STRATEGY FOR FLOODPLAIN MANAGEMENT

INTRODUCTION

Floodplain management in Virginia is a partnership between federal, state and local government entities. All three levels of government are integral components to having an effective system statewide. The responsibilities of all three are inter-dependant and interwoven. Basically, the federal government provides the regulations, funding for states to provide community assistance, and funding for mapping and mitigation efforts; the state provides resources to assist communities with implementing the federal regulations, training, identifying flood hazards, and correcting non-compliant (NFIP) development; the localities provide local enforcement of the federal regulations related to development in the floodplain and identify mapping needs.

This chapter will explain the various roles in more detail that each level of government has and how these roles work together to form an effective strategy for floodplain management in the Commonwealth. In addition, the chapter provides an overview of the short-term and long-term program strategies that are being implemented by Virginia's Floodplain Management Program (Program). To begin the discussion, an explanation of the Program's five functional elements are provided in order to put the remainder of the chapter in context.

THE VIRGINIA FLOODPLAIN MANAGEMENT PROGRAM

The Program's main goal is to protect people and their property from unwise floodplain development, as well as to protect society from the costs which are associated with developed floodplains. The Floodplain Management Program's objectives are to prevent loss of life, reduce property damage, and conserve the natural and beneficial values of the Commonwealth's riverine and coastal floodplains. These objectives are accomplished through the Program's five functional elements which are the National Flood Insurance Program (NFIP) compliance and assistance, community education, flood hazard mitigation assistance, coordination of flood hazard identification and risk assessment, and management of the Flood Prevention and Protection Assistance Fund.

NFIP Compliance and Assistance

The Floodplain Management Program works with Virginia's counties, cities and towns to establish and enforce floodplain management, primarily in planning and development. The Program has model ordinances that set minimum standards for use by localities in developing their floodplain ordinances. The local governments can set more restrictive standards to ensure higher levels of protection for citizens located in flood hazard areas. In

THE VIRGINIA FLOODPLAIN MANAGEMENT PROGRAM

addition, through the Virginia Uniform Statewide Building Code, the Commonwealth has set construction standards for structures built in the Federal Emergency Management Agency's (FEMA) special flood hazard areas.

Typically, the Department of Conservation and Recreation (DCR) staff annually visit or contact 60 to 80 of the 270 NFIP communities in Virginia to assure proper floodplain management ordinance enforcement, continued understanding of floodplain management issues, and awareness/training of new or updated FEMA programs. Through Community Assistance Visits (CAVs) or Community Assistance Contacts (CACs), DCR staff and local program administrators review a community's floodplain management ordinance, zoning and comprehensive planning process, building code enforcement system and emergency preparedness system for localized flooding. Through these contacts DCR staff serves as a liaison between Virginia communities and FEMA to help local officials continue proper implementation of floodplain ordinances.

DCR staff also provides technical assistance through review of floodplain ordinances, local flood studies and other technical engineering documents involving potential development in the regulated floodplain. Training in workshops or one-on-one formats is available to community staffs on a variety of topics including the NFIP, hazard mitigation, Community Rating System and floodplain management related building code enforcement. Staff works with communities seeking assistance in re-mapping their floodplains, in developing hazard mitigation strategies, and reducing risks to structures in the flood hazard areas

through several state and federal grant programs.

Community Education and Training

DCR provides community education and training through a variety of mechanisms and responds to individuals requesting assistance and understanding of floodplain regulations and flood insurance. Flood insurance is the primary way for property and homeowners to minimize the economic impacts of flooding and DCR continues to educate Virginia's insurance industry on its responsibilities to provide insurance policies. Education and training are also provided to citizens, engineers, consultants, surveyors, developers, realtors and insurance agents with questions on flood insurance rate maps, flood-proofing techniques, construction methods, and ordinance or building code interpretation.

Flood Hazard Mitigation Assistance and Risk Reduction

Flooding is the greatest threat of all natural hazards in Virginia, accounting for more than 90% of Virginia's declared disasters. Damage from flooding since the 1950's indicates that Virginia experiences more than \$400 million in damages each decade and during the past decade more than \$100 million annually. Flood hazard mitigation is a primary goal of the program. During the past decade there have been 11 presidentially declared disasters that have resulted from flooding. These include (1) severe weather in the Central Shenandoah Valley during the Summer of 1995, (2) Hurricane Fran in the Central Shenandoah Valley and northern Blue Ridge Mountains during the Fall of 1996; (3) Snow melt throughout the Commonwealth during the Winter of 1996; (4) Hurricane Floyd

THE VIRGINIA FLOODPLAIN MANAGEMENT PROGRAM

in eastern Southside and Tidewater Virginia during the Fall of 1999; (5), (6), (7) severe weather in Southwest Virginia during the Summer of 2001, Spring of 2002, Spring of 2003; (8) Hurricane Isabel across two-thirds of the Commonwealth (east of Roanoke) during the Fall of 2003; (9) severe weather in the Roanoke Valley during the Spring of 2004; (10) Tropical Depression Gaston in the Richmond Metro Area during late Summer of 2004; and (11) Tropical Storm Jeanne in Southwest Virginia and Roanoke Valley during the Fall of 2004. The Program's staff has provided technical and administrative assistance to the Virginia Department of Emergency Management (VDEM) and FEMA. Also, DCR staff coordinates with the VDEM to administer the FEMA Flood Mitigation Assistance Program, which provides an annual source of flood mitigation funding, and provide technical support during Hazard Mitigation Grant Program (HMGP) project selections and administration.

In addition to emergency responses, DCR seeks to increase involvement by state agencies in hazard mitigation responsibilities and awareness. For example, DCR serves on the Virginia Interagency Hazard Mitigation Committee. Also, staff works with the Virginia Department of Transportation (VDOT) to assure that VDOT policies and procedures relative to rivers, stream crossings and floodplains reduce flooding potential. Finally, through participation in the Virginia Interagency Environmental Review process, federal and state-sponsored construction projects are reviewed to assure consistency with federal, state and local floodplain management ordinances and policies.

Flood Hazard Identification and Risk Assessment

DCR coordinates with FEMA in prioritizing flood hazard mapping studies and participating in the scoping of flood insurance studies around the Commonwealth. DCR also assists communities in assessing their mapping needs and in the adoption of revised maps. This includes updating the Mapping Needs Update Support System (MNUSS) as mapping information becomes available from local officials or through independent analysis of flood hazard areas by DCR and their contracted engineering services. In addition, DCR coordinates with other federal and state agencies regarding floodplain studies or projects that they are performing at the request of a locality or resulting from a watershed study.

DCR routinely assists communities and state agencies with assessing the need for and clarification of the processes involved in applications for letters of map revision (LOMR) and conditional letters of map revision (CLOMR) when floodplain development in their communities warrants them.

DCR is a partner with FEMA in flood mapping through the Cooperating Technical Partners (CTP) program which recognizes state, regional and local governments that have expressed a desire to perform certain functions in the flood hazard identification process and have provided evidence of sufficient technical capability and willingness to dedicate the resources necessary to perform those functions. DCR promotes participation of NFIP communities in FEMA's CTP program that has also expressed that desire and willingness to share resources.

In 2004 DCR developed and initiated implementation of a multi-year Map

CURRENT STATUS OF VIRGINIA'S FLOODPLAIN MANAGEMENT PROGRAM (2004)

Modernization Business Plan. The Business Plan describes how DCR will implement activities that support mapping initiatives within the Commonwealth including flood mapping needs assessment and evaluation, mapping prioritization, coordination and management of mapping data and projects, and community outreach for mapping efforts. The Commonwealth will partner with FEMA in the implementation of the Map Modernization Business Plan. The Business Plan has six primary objectives:

1. Cooperating Technical Partner Participation.
2. Approaching Mapping Projects with a "Clustering" Strategy.
3. Development of Mutually Beneficial Partnerships with State, Regional, and Local Government and Private Entities.
4. Development of a Web-Based System for Public Access to FIRMs and Mapping Information.
5. Providing Technical Mapping and Flood Study Support to Local Officials for LOMCs and Approximate A-Zones.
6. Meeting FEMA's Performance Measures

State Sponsored Flood Risk Reduction Initiatives

The Virginia Flood Prevention and Protection Assistance Fund was established in May 1990 to provide localities a 50 percent match for flood prevention or protection projects, either as a grant or a loan. Such projects can include floodplain studies and mapping, structural protection and buy-outs, relocation, and flood proofing and/or elevation of structures repeatedly damaged by flooding. The fund can be

used for any project regardless of sponsor - local, state or federal. The fund is generated by the collection of one percent of the gross premium income from insurance companies for all flood insurance policies sold in the Commonwealth annually.

The development of the Floodplain Management Plan for the Commonwealth of Virginia is an important tool that can be used toward meeting the objectives of those Program elements. By statute, the Plan is to provide:

An inventory of flood-prone areas;

1. An inventory of flood protection studies;
2. A record of flood damages;
3. Strategies to prevent or mitigate flood damage; and
4. The collection and distribution of information relating to flooding and flood plain management.

CURRENT STATUS OF VIRGINIA'S FLOODPLAIN MANAGEMENT PROGRAM (2004)

Organizational Structure of Program

The Virginia Floodplain Management Program is held within the Division of Dam Safety and Floodplain Management (DDSFM) which is in DCR. As stated previously in Chapter 1 of this Plan, DCR has been designated by state statute to be the placeholder for the NFIP Coordinator's office. The current Program staff includes the Floodplain Management Program Manager who serves as the Virginia NFIP Coordinator, the Floodplain Management Program Engineer, and the Floodplain Management Program Planner.

CURRENT STATUS OF VIRGINIA’S FLOODPLAIN MANAGEMENT PROGRAM (2004)

Program’s NFIP Compliance and Assistance Activities

Currently, FEMA’s Community Assistance Program – State Support Services Element (CAP-SSSE) Grant provides funding to the Virginia Department of Conservation and Recreation’s (DCR’s) Floodplain Management Program. The Floodplain Management Program staff work with local, state, and federal offices/agencies to assist participating Virginia communities in maintaining compliance with the NFIP and to ensure that communities are achieving the flood loss reduction objectives of the NFIP. The following activities are part of the annual CAP-SSSE Agreement between DCR and FEMA to support those goals:

- Develop/update State Five-Year Floodplain Management Plan;
- Conduct periodic compliance and technical assistance visits to assess communities’ needs, to ensure continued compliance with the NFIP, and to correct program deficiencies and remedy violations;
- Provide assistance to localities with updating floodplain management ordinances as needed and during flood map updates;
- Update state model ordinances to include all minimum provisions of the NFIP regulations and additional flood loss reduction objectives;
- Conduct workshops and other training to support the implementation and enforcement of community floodplain management regulations and to promote hazard identification and

local and state planning initiatives/strategies;

- Coordinate with FEMA in prioritizing flood hazard mapping studies and participating in the scoping of flood insurance studies;
- Coordinate with other state agencies and programs that impact floodplain management or review and approve permitted activities that occur in floodplains;
- Provide technical and planning support to NFIP communities in coordination with VDEM and FEMA during post-disaster response and recovery periods as requested; and
- Conduct other activities relative to the Commonwealth’s support of sound floodplain management and compliant NFIP development in Virginia that will enhance technical and planning assistance to NFIP communities including introduction of legislation, promoting and managing the Virginia Flood Prevention and Protection Assistance Fund, and supporting professional organizations involved in floodplain management.

Programs Flood Hazard Identification and Mapping Activities

In the past, the Virginia Floodplain Management Program has been involved in the flood hazard mapping process in Virginia at a somewhat minimal level due to limitations in staffing levels. DCR routinely assists communities and state agencies with assessing the need for and clarification of the processes involved in applications for letters of map revision and conditional letters of map revision when floodplain development in their

CURRENT STATUS OF VIRGINIA'S FLOODPLAIN MANAGEMENT PROGRAM (2004)

communities warrants them. DCR's involvement has contributed to appropriating federal mapping efforts and funding more effectively across the Commonwealth through its involvement in the process.

During the past 10 to 12 years, DCR has assisted FEMA in coordinating and participating in flood study scoping and coordination meetings with various NFIP communities in the Commonwealth. In 1998-1999 DCR assisted FEMA with summarizing the results of a community mapping needs assessment survey that was conducted for NFIP communities in May 1997 by FEMA. That survey was part of the requirements in Section 575 of the National Flood Insurance Reform Act of 1994 to address creating a national database of flood hazard mapping needs. DCR has provided recommendations to FEMA, based on CAVs and other local resources, on mapping priorities within the Commonwealth when federal funds have been available to conduct limited map maintenance studies, flood hazard verification studies (disaster related), and traditional flood hazard mapping restudies.

In 2002, DCR prepared a Map Modernization Prioritization (or Implementation) Plan. That plan's goals were to reduce the average age of the Commonwealth's maps from over 12 years to 6 years or less, produce digital flood hazard maps with up-to-date flood hazard data for 15% of highest priority areas, and develop flood hazard maps for half of the unmapped, flood-prone communities in the Commonwealth. The basis for the prioritization process was on limited data gathered during the development of the plan, the responses to FEMA's mapping needs assessment survey, and information gathered during community visits.

Since 2000, DCR has been providing data input to the FEMA Mapping Needs Update Support System (MNUSS). In 2003, DCR contracted with Virginia Tech's Center for Geospatial Information and Technology (VT-CGIT) to input mapping needs data into MNUSS that was gathered from communities in the Commonwealth.

In 2004, DCR prepared a comprehensive plan to assist in the development of a comprehensive national strategy for modernizing FEMA's inventory of Flood Insurance Rate Maps (FIRMs). The plan, entitled the Virginia Statewide Flood Map Modernization Business Plan, summarizes DCR's role in the Map Modernization mapping activities and how these activities will be performed and managed. The Plan identifies mapping priorities within the Commonwealth, describes how these priorities were established, and explains the planned implementation process to address the priorities.

Overview of FEMA's Map Modernization Program

Floods are the nation's most common and costly natural disaster. To reduce the ever-growing expense to the federal government related to flooding, Congress established the National Flood Insurance Program (NFIP) in 1968. The NFIP guarantees that flood insurance will be available in communities that agree to adopt land-use regulations so that new development is reasonably protected from flood damages.

Maps depicting flood-hazard areas are not only the foundation of the National Flood Insurance Program, but also the basis of sound floodplain management at the local and state levels. Adequate, accurate, and current maps are essential for the program to function. Without quality mapping, neither land-use regulations nor the insurance elements of the program can be effective.

OVERVIEW OF THE IMPLEMENTATION OF FLOODPLAIN MANAGEMENT PROGRAMS WITHIN THE COMMONWEALTH OF VIRGINIA

By 2002 these flood hazard maps were averaging over 13 years old nationwide, making them nearly obsolete in some communities, and still many areas of the country were unmapped. In recognition of these needs, Congress directed FEMA in 1994 to establish the Technical Mapping Advisory Council who in turn made recommendations to FEMA through a series of annual reports and then in a final report in November 2000. FEMA then prepared a plan to implement those recommendations along with the resources necessary to fund its Map Modernization Plan.

FEMA has established a broad goal of modernizing these flood hazard maps nationwide. Initially, in FY2002, FEMA requested that the State NFIP Coordinators prepare a Map Modernization Implementation Plan for their states. This included prioritizing mapping projects for communities in their states based on mapping needs assessments that were performed and input into a national database named Mapping Needs Update Support System (MNUSS).

In order to achieve their goal, in FY2003, FEMA was allocated funding by Congress to implement the Flood Map Modernization Plan that it had been developing since 1995. Each state with an interest and the capability to assist with implementing FEMA's Map Modernization Plan was offered funds to upgrade the plans that were developed in FY2002 and develop Flood Map Modernization State Business Plans. Overview of FEMA's Map Modernization Program (cont'd)

FEMA's Multi-Hazard Flood Map Modernization effort includes an integrated partnership composed of multiple state, local, and/or tribal agencies/organizations that contribute to or guide the development of projects. The ultimate goal is devolving floodplain mapping to state/local entities with interest and capability. The goal of the Map Modernization Program is to upgrade the flood map inventory by:

- ❖ developing up-to-date flood hazard data for all flood-prone areas nationwide to support sound floodplain management and prudent flood insurance decisions;
- ❖ providing the maps and data in digital format to improve the efficiency and precision with which mapping program

customers can use this information;

- ❖ fully integrating FEMA's community and state partners into the mapping process to build on local knowledge and efforts;
- ❖ improving processes to make it faster to create and update the maps;
- ❖ improving customer services to speed processing of flood map orders and raise public awareness of flood hazards.

All endeavors connected with FEMA's Multi-Hazard Flood Map Modernization, including the efforts of states and localities, must contribute to achieving the following objectives:

1. Establish and maintain a premier data collection and delivery system.
2. Achieve effective program management.
3. Build and maintain mutually beneficial partnerships.
4. Expand and better inform the user community.

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Federal Government

The programs of the federal government remain the most recognized driving force behind floodplain management in Virginia to date. The federal programs have provided Virginia with flood insurance, flood control devices, flood loss reduction tools, flood data, and programs that protect or manage vital natural resources within the floodplain. In recent years FEMA has been devolving its roles in NFIP compliance enforcement, flood hazard identification and risk assessment, technical assistance, and mitigation planning to the states nationwide. The anticipated trend for the future role of the federal government can be characterized as a continuation of many historical programs, but with a significant

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increase in the devolving of the program responsibilities to the states.

State Government

State NFIP Programs are essential to the workings of the NFIP. In most states the responsibilities of the various aspects of the NFIP are shared among a few agencies. The states:

- Serve as key governmental units in the Program;
- Coordinate vast majority of NFIP activities;
- Provide technical and planning assistance for development, compliance enforcement, and mitigation to the localities.
- Designate specific state and local agencies to be responsible for floodplain management;
- Act as liaison between FEMA and municipal authorities on flood issues;
- Identify prospective mitigation projects, develop mitigation plans, and implement flood hazard mitigation grant programs;
- Enact most of the laws that implement national flood policy and authorize local initiative and follow-through; and
- License and regulate insurance professionals and companies that service the Program.

In Virginia, the agency that is tasked with the first five of these responsibilities is the DCR. Mitigation activities are handled primarily by the VDEM. The Department of Housing and Community Development oversees the development and implementation of the Uniform Statewide Building Code which is the cornerstone for NFIP regulations

in the Commonwealth. The licensing of insurance professionals is the duty of the State Corporation Commission (SCC).

Additionally, in a broad sense, a state is a NFIP community in that it cannot buy or renew flood insurance policies under the NFIP unless it has adopted and enforced floodplain management regulations the meet or exceed the NFIP criteria. To purchase flood insurance coverage for state-owned properties located in a flood-prone area, a state must comply with the NFIP’s floodplain management standards. A state can comply with the floodplain standards of the local communities in which the properties are located, or it can establish and comply with its own state floodplain management regulations. In Virginia, Executive Memorandum 2-97 provides those standards for state facilities. The Memorandum establishes the following:

- DCR as the coordinating agency for the NFIP,
- All state agencies are to comply with locally adopted floodplain management ordinances,
- New state-owned structures shall not be constructed in the 100-year floodplain unless a variance is granted by the Director, Division of Engineering and Buildings (as Building Official for state-owned buildings) and will only be considered under the following conditions:
 - The Building Official for state-owned buildings will provide written rulings on variance requests after consultation with the State Coordinator for the National Flood Insurance Program,

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- DCR is to Chair the Virginia Interagency Task Force on Floodplain Management which is to develop interagency recommendations and products to promote the mitigation of public and private flood damages in the Commonwealth,
- DCR shall serve as the technical advisor to state agencies participating in flood protection projects on the viability of proposed alternatives, and
- Annually, the Department of General Services (DGS) shall coordinate with DCR to determine if the Commonwealth's insurance program provides adequate protection against flood hazards.

There are strong incentives to comply with the NFIP's requirements because if a state fails to treat state-owned properties in accordance with the NFIP it is subject to suspension from the NFIP.

Local Government

The localities of the Commonwealth are very diverse in their approach and understanding of floodplain management programs. Typically the communities that have an extensive knowledge of floodplain management have a "strong" local program. While there is not a current comprehensive listing of each locality's program, it has been noted in the most qualitative observation that being flood prone does not necessarily foster an environment for the establishment of a strong local floodplain management program. There have been several reasons observed that may account for that perception including:

- Based on past experience and observations of other communities

receiving disaster assistance, there is a belief that the state or federal government will provide all necessary aide to remediate all losses;

- There has not been a severe event in 20 to 50 years in their community, no matter what the flood hazard shown on the maps is, and therefore the risk of flooding must not be significant;
- There may be differing perceptions as to the appropriate role of and response from various levels of government in resolving the flood damages;

Unfortunately all of these perceptions are misguided and can result in a community being devastated during the next flood disaster.

As state and federal budgetary resources are not always available in significant amounts, many localities may not receive assistance for their flooding problems for a considerable period of time. Fortunately, there are many communities throughout the Commonwealth that have taken individual steps to protect their residents from flood damages. These communities are to be commended for their accomplishments. Especially noteworthy are those localities that recognize the need to improve upon the minimum floodplain management standards required by FEMA. But the number of localities that do exceed these minimum standards appear to be too few to have a sizable impact on statewide flood damages. As the importance of floodplain management is brought to the attention of local officials, as local officials become familiar with the new cost sharing requirements of many federal flood control projects, and with the incentives provided in the FEMA Community Rating

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System, many localities may rethink their floodplain management policy.

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Floods impact the citizens of the Commonwealth from the Atlantic Ocean and Chesapeake Bay to the Blue Ridge Mountains and Shenandoah and Roanoke Valleys. Flooding not only impacts those citizens that reside in the flood hazard areas but also the communities wherein the flooding occurs as well as the adjacent communities. Businesses can be disrupted, either directly from business facilities being inundated with floodwaters or indirectly by customers being unable to participate in the marketplace due to economic impact or being busy with flooding clean-up. Public services can either be suspended or overwhelmed with emergency response efforts.

The Commonwealth must have an effective program to interact with and assist localities, utilizing federal initiatives and funding, in minimizing their flood risks, reducing their losses from floods, protecting public safety and health, and improving the quality of life for residents. As stated previously, there are five functional elements in the Floodplain Management Program. They are:

- **NFIP Compliance and Assistance**
- **Community Education and Training**
- **Flood Hazard Mitigation Assistance and Risk Reduction**
- **Flood Hazard Identification and Risk Assessment**

■ **State Sponsored Flood Risk Reduction Initiatives**

Those elements encapsulate the Floodplain Management Program’s objective to “prevent loss of life, reduce property damage, and conserve the natural and beneficial values of the Commonwealth’s river and coastal floodplains” which fulfills the duties of DCR that are stated in *The Code of Virginia*, Title 10.1, Chapter 602 (see Chapter 1). However, in order for Virginia’s Floodplain Management Program to be truly effective in achieving its objective, it must have a vision that goes beyond statutory requirements and must be guided by underlying principles that can be consistently implemented and applied across the Commonwealth. While there are varying types of flood hazards based on geographic locations or degrees of urbanization and varying political cultures encountered across Virginia, there are underlying floodplain management principles that should be adhered to by DCR while implementing its objectives. A recent ASFPM draft document (dated October 2003) entitled “Effective State Floodplain Management Programs” discusses 10 Guiding Principles that when implemented properly will result in an effective State Program. A summary from the ASFPM document’s Guiding Principles are provided below.

Principle #1: State Floodplain Management Programs Need Strong, Clear Authority.

Effective state programs are stable and long-lasting—they are established with clear legal authority, work cooperatively with local governments and other state and federal agencies, and are supported by adequate resources. Although they are institutionalized via state law, good state-level floodplain management programs are administered to allow

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evolution and improvement in response to changes such as major floods, new research and management techniques, and new federal programs and initiatives.

Whatever form the state/local relationship takes, an effective state floodplain management program provides for strong elements at both state and local levels. Effective state floodplain management programs extend into many facets of state government, and certainly extend far beyond simply performing the duties and responsibilities outlined in the NFIP regulations for “state coordinating agencies.” An effective program with strong leadership identifies all floodplain-related state and local activities and coordinates with all state agencies and the state legislature to effect programmatic changes.

As stated above in Section B, floodplain management responsibilities extend across several Virginia agencies to ensure consistent application of NFIP compliance and assistance across the communities in the Commonwealth. Additional coordination between DCR’s Floodplain Management Program and other agencies as well as other programs within DCR would serve to advance the objectives of the Program.

Principle #2: State Floodplain Management Programs should be Comprehensive and Integrated With Other State Functions.

Effective state floodplain management programs set a performance standard by ensuring that flood hazards are identified, avoided, minimized, and mitigated as part of state construction projects or projects undertaken with state funding. In addition, state floodplain management programs should be comprehensive and be integrated with elements from many

state agencies and programs. Because the actions and policies of many state agencies can influence both new development and mitigation of existing flood risks, effective state floodplain management programs are not confined to a single office or agency.

Principle #3: Flood Hazards within the State Must be Identified and the Flood Risks Assessed.

Flood hazard areas need to be identified and delineated in order to

- Avoid future flood damage and disaster costs,
- Apply regulatory criteria,
- Inform property owners and the public, and
- Craft mitigation measures for existing at-risk development.

Flood hazard areas change over time, through deliberate modification or as a result of changes in the watershed or the body of water itself. An effective state floodplain management program ensures that the flood risks are known and that changing conditions are accounted for.

Principle #4: Natural Floodplain Functions and Resources throughout the State need to be respected.

Effective state programs take a holistic approach to floodplain management—one that moves beyond simply protecting people and property to cooperating with nature and recognizing the value of allowing floodplains to function as floodplains, and enjoying the benefits that accrue when they do. Effective state floodplain management programs coordinate and integrate their goals and activities with the many other state (and federal, and local, and

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private) programs, agencies, and departments whose activities affect floodplain functions, such as:

- Control of sediment and erosion;
- Protection of water quality, wetlands, aquifer recharge, and open space;
- Management of coastal areas, shorelines, overall growth, and stormwater;
- Preservation of wild and scenic rivers, rare and endangered species, cultural resources, and agricultural lands; and
- Public recreation.

Principle #5: Development within the State must be guided Away From Flood-prone Areas; Its Adverse Impacts must be minimized.

Adverse floodplain impacts can be avoided or minimized if communities within the state have the authority, tools, and political will to guide development to less hazard-prone areas, or to examine the full extent of impacts—both on-site and off-site—when floodplain development is proposed. By guiding development away from flood-prone areas, the state protects its citizens.

- First, it protects landowners by requiring that their development activities meet certain standards to avoid flood damage to their property.
- Second, it protects the entire community by requiring that those activities do not adversely affect others.

Effective state programs apply land use management techniques directly through state regulation, or authorize

and foster application of those techniques at the local level, including planning, zoning, risk assessment, growth management, impact analyses, subdivision regulations, and permitting programs. Besides requiring that floodplain development be built so that it withstands flood damage, effective programs acknowledge that watersheds and floodplains are complex natural systems, and that their interrelationship with human-caused actions and the impacts of each development on other property owners must be taken into consideration.

Principle #6: Flood Mitigation and Recovery Strategies should be in Place throughout the State.

Effective state floodplain management programs use post-flood mitigation and recovery strategies to break the cycle of flood damage, recovery, then repeated flood damage. Immediately after a flood, citizens and governments are most aware of the risks and far-reaching consequences of major losses, and additional funds may be leveraged for flood-reduction projects because governments feel compelled to assist right after a disaster. Rather than rely on federal post-disaster mitigation resources, effective state programs have clear authority and adequate resources to work on their own and cooperatively with local governments on planning and projects that will reduce the costs of flooding over the long term. The majority of floods in any state do not become federally declared disasters, but ones the state and local governments must deal with. In effective state programs, interagency coordination for the purpose of mitigation is not dependent upon, or limited to, declaration of a federal disaster. Effective state programs:

- Authorize or encourage temporary post-disaster moratoria on

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reconstruction and repair to create the time needed to assess damage,

- Set priorities for mitigation,
- Consider alternative ways to recover while reducing future risk, and
- Have the ability to provide needed help to localities, through pre-disaster training, mobilization of damage assessment teams, direct support, or agreements with other governments and organizations for staff and expertise.

Effective state mitigation programs should be in place and active regardless of the presence or absence of flood conditions, because better, more financially sound decisions can be made in the absence of the post flood rush to correct the problem.

Principle #7: The State’s People need to be informed About Flood Hazards and Mitigation Options.

An effective state provides the appropriate authority and encourages use of informational tools for flood hazards. Better informed citizens, property owners, private sector entities, public officials, and government agencies are more likely to make sound decisions about whether and how to develop and redevelop property, and how to make sound land and home purchases.

Although many tools to inform the public are best applied at the local level, states have a number of roles, especially to actively support local public information efforts, whether they are training workshops, printed materials, newsletters, media coverage, or websites. Some tools for informing the public are most effective if required by state statute or regulation, such as

disclosure during property transactions, recording flood history on property deeds, and continuing education for professionals.

Principle #8: Training and Technical Assistance in Floodplain Management Need to be Available to State’s Communities.

Effective state programs assess community needs and provide ongoing training opportunities and access to technical assistance. In most communities, floodplain management is just one of many responsibilities that must be handled by small staffs, but the administration of the floodplain provisions can be quite complex, and the consequences of inadequate attention to the flood hazards can be disastrous and expensive. Effective states:

- Produce a reference manual to inform local officials about floodplain management;
- Monitor how communities are administering their regulations, including enforcement actions for any violations;
- Support community efforts to participate in the Community Rating System;
- Hold workshops and training on a variety of issues;
- Encourage local staff to become Certified Floodplain Managers;
- Support state-level professional associations;
- Produce newsletters and web pages; and
- Are accessible to local staffs.

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Principle #9: The Levels of Funding and Staffing for Floodplain Management Should Meet the Demand Within the State.

Effective state floodplain management programs know that it is not enough to rely on federal funding to meet state needs or to effectively reduce state, regional, and local flood costs and damage. Behind an effective state floodplain management program are state executive and legislative branches that have committed adequate staff resources and funding to the necessary program elements and agencies. Effective states have assessed the needed level of funding and staffing, based on factors appropriate to their states, such as frequency and severity of flooding, extent and capability of local administration, and the anticipated functions of staff members. With this information, a budget is arrived at that includes salaries, operations, mapping, mitigation grants, and other activities. Creative ways of obtaining funds and generating revenue are not overlooked.

Principle #10: Evaluation of the Effectiveness State's Floodplain Management Programs is Essential and Successes should be documented.

Achieving and maintaining an effective state floodplain management program is an ongoing effort. When program effectiveness is measured through regular evaluations, it is easier to identify opportunities to make adjustments or to add new program elements. An effective state program finds ways to tally and keep records on different aspects of the status of floodplain management within its jurisdiction, such as inventorying flood-prone property, taking advantage of the post-disaster period to document damage avoided and the success of

mitigation projects, taking an accounting of acreage of floodplain lands preserved in a natural state or otherwise protected, monitoring community program administration, and tracking the progress of mitigation projects. Such data are essential to evaluating how effective programs are, and how to adjust the program to be even more effective.

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Since 1991 when the Floodplain Management Plan was developed and printed, there have been significant strides in the advancement of floodplain management objectives within the Commonwealth. There have also been some areas that the Floodplain Management Program could improve upon. As stated above in Guiding Principle number ten, it is important to evaluate the effectiveness of the Floodplain Management Program by documenting its accomplishments, evaluating what could be done better, and based on that evaluation, establish new priorities that will make the Program more effective in the future. With that consideration, the following section discusses the status of the Goals and Priorities that were established in the 1991 and versions of the Plan are briefly discussed below. In parts 1 and 2 below, the Goals and Priorities are stated in italics and then a discussion of their status follows.

Status of the Goals from the 1991 Edition of the Floodplain Management Plan.

It was stated in the 1991 Plan that the overall strategy for floodplain

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<p>management in the Commonwealth should achieve several goals, some of which are short term (2-5 years) and others more long-term. There were eight overall goals that comprised the 1991 strategy. Those goals were as follows:</p> <p>a. Develop an enhanced state role and responsibility for floodplain management as part of a true federal-state-local partnership.</p> <p>DCR continues to provide leadership in coordination of floodplain management and NFIP activities in the Commonwealth. As FEMA has devolved its NFIP responsibilities down to the states, the Virginia Floodplain Management Program has increased its role in the following activities:</p> <ul style="list-style-type: none"> ■ Increased the number of CAVs and CACs performed; ■ Increased the number of ordinances reviewed; ■ Increased its role in coordination of flood studies; ■ Increased its level of training statewide; ■ Provides input into FEMA's web based databases (Community Information System and Mapping Needs Update Support System) for Virginia communities; ■ Has assisted communities with enrollment in the Community Rating System; and ■ Has developed an inventory of the status of flood studies and mapping needs for the Commonwealth. <p>b. Lead the formulation, coordination and prioritizing of floodplain management issues; and maximize the allocation of all</p>	<p>local, state, federal, and private resources for the resolution of floodplain management concerns.</p> <p>DCR has leveraged the resources of state associations to assist in meeting training needs statewide and used statewide conferences and association newsletters to provide programmatic updates to the citizenry of the Commonwealth.</p> <p>c. Ensure state compliance, continued participation, and coordination of the National Flood Insurance Program.</p> <p>At DCR's request, an Executive Memorandum was issued in 1997 to address the compliance with NFIP regulations of all new construction and improvements to state facilities that are constructed in a FEMA designated floodplain.</p> <p>d. Provide technical and planning assistance to localities through training, education, problem resolution, planning studies, and engineering studies.</p> <p>DCR regularly provides technical and planning assistance to localities on floodplain management issues. DCR's Floodplain Management Program has become recognized statewide as a resource for assistance through training opportunities it's staff have participated in. These have included local workshops, presentations at professional association meetings, and presentations at national conferences.</p>
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<p>e. Serve as a resource center for the collection of floodplain data, the distribution of data to interested parties and, as a user of the data, formulate future priorities and monitor the effectiveness of continuing efforts. Study and evaluate special or evolving floodplain management issues and incorporate into the database and future program efforts.</p> <p>DCR has developed an internal database to track the dates that CAVs and CACs are performed in all 270 NFIP communities in Virginia. In addition, DCR tracks significant floodplain management activities such as flood studies and non-compliant issues that are occurring in those communities. DCR also utilizes the various reporting tools that are available in FEMA's Community Information System (CIS) and BureauNet to assess community trends through flood insurance and repetitive loss statistics.</p> <p>f. Encourage and assist in multi-objective planning and management of floodplains and where appropriate pursue programs that promote open space and the protection of natural and beneficial values that occur in the floodplain.</p> <p>DCR staff address these issues routinely during CAVs and occasionally with presentations at conferences.</p> <p>g. Encourage and assist in the development of flood control projects, mitigation plans, relocation projects, flood proofing technique and other assistance for populations that suffer repeated flood damages.</p>	<p>Although there are currently no significant flood control projects being developed in Virginia, the Virginia Department of Emergency Management's (VDEM) Recovery and Mitigation Division oversee the mitigation programs in the Commonwealth. DCR provides technical and planning support when requested.</p> <p>h. Develop standards, guidelines, and regulations designed to meet the particular needs of the Commonwealth, and promote the wise use of floodplain lands and the reduction of flood damage potentials.</p> <p>DCR continues to provide assistance to NFIP communities for the enforcement of their floodplain management ordinances. DCR provides model floodplain management ordinances to communities to assist them in development/ revisions of their ordinances. DCR will be updating its model ordinances in 2005 to reflect revisions to the Virginia Uniform Statewide Building Code which now reflects the 2000 version of the International Code Series and is planned to be updated to the 2003 version in 2006.</p> <p><u>Status of the Priorities from the 1991 Version of the Floodplain Management Plan.</u></p> <p>The following priorities were established in the original Virginia Floodplain Management Plan in 1991. The original presentation of these priorities had them divided into Categories A, B, and C with the Category A priorities being of the highest importance. For this section, comments are only provided for the Category A and Category B priorities since it was apparently assumed that Category C priorities were not achievable realistically without a</p>
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significant increase in staffing and funding levels for the Floodplain Management Program. The only priority of the seven listed in Category C that had much if any activity was the State Flood Hazard Mapping Program. Comments are provided for it.

Category A

a. Enhancement of the Commonwealth's floodplain management standards, guidelines, and regulations.

DCR will be updating its model floodplain management ordinances in 2005 that are provided to communities. Along with those revisions, DCR will include optional higher standards that are based on publications such as ASFPM's No Adverse Impact Toolkit and other State's model ordinances. In addition, DCR continues to review FEMA's guidance documents and other State's regulations for possible enhancements to the floodplain management provisions of the Code of Virginia and will coordinate with the DCR Director's office on introducing legislation to make the appropriate revisions.

b. Coordination of all NFIP activities.

As stated in the 1997 Executive Memorandum 2-97 and in the Code of Virginia (§ 10.1-602), DCR is designated as "*the coordinator of all flood protection programs and activities in the Commonwealth*".

c. Increase participation of NFIP communities in FEMA's Community Rating System (CRS).

DCR continues to assist communities with information about the program,

preparing applications, and training. DCR currently has a goal of enrolling one new community into CRS every two years.

d. Development of Flood Hazard Mitigation Plans and implementation of those plans.

This role is provided by VDEM.

e. Survey for localities' most critical floodplain management issues.

FEMA and the States have recognized the repetitive loss properties as the most critical issue nationwide. The Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 establishes a strategy to address repetitive losses and creates a pilot program for mitigation of severe repetitive loss properties. DCR will coordinate with FEMA on implementation of the legislation.

Category B

a. Evaluation and update of the Floodplain Management Plan.

A draft revision of the 1991 version of the Plan was developed in 1996 but was not finalized or published. The Plan has been revised in 2004/2005.

b. Maintain and upgrade database for tracking floodplain management activities in the Commonwealth.

DCR has created its own internal tracking database for floodplain management activities in the Commonwealth but also utilizes and updates FEMA's Community Information System, BureauNet, and Mapping Needs Update Support System extensively.

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<p>c. Development of a broad-based educational program for full cross section of stakeholders including floodplain management, flood hazard identification, understanding mitigation options, and flood insurance.</p> <p>DCR staff has provided at least five or more presentations at professional association events, statewide conferences, and local workshops in Virginia over the past six years and will continue.</p> <p>d. Identification and coordination of flood protection, structural projects (including administration of the Flood Prevention and Protection Assistance Fund).</p> <p>DCR has not promoted the use of the Fund for structural projects, however, VDEM has utilized it in the past for matching funds for HMGP projects.</p> <p>e. Integration of the Coastal Flood Hazard Status Report into the Floodplain Management Plan.</p> <p>The Coastal Flood Hazard Report was incorporated into the Plan during the development of the 1996 revisions.</p> <p>f. Utilization of FEMA's Hazard Mitigation Grant Program to elevate, relocate, or acquire structures damaged from flooding.</p> <p>VDEM manages and coordinates all activities associated with HMGP.</p> <p>g. Establishment of standards for structures planned for construction in flood hazard areas without base flood elevations (as shown on FEMA</p>	<p>maps) or in areas outside but adjacent to the flood hazard area.</p> <p>DCR has not pursued this priority.</p> <p>h. Conduct a survey to assess the flood control works across the Commonwealth for the proper design criteria, construction, maintenance schedule, and location.</p> <p>DCR has not pursued this priority.</p> <p>Category C</p> <p>a. Development of a state flood hazard mapping program.</p> <p>As described later in this chapter under Program Strategy #2, DCR is undertaking several new mapping responsibilities to assist FEMA and localities with flood map revisions.</p> <p>b. Development of Floodplain Corridor Master Plans that include multi-objective planning within the floodplain environment.</p> <p>DCR has not pursued this priority.</p> <p>c. Development of watershed-based hydrologic and hydraulic monitoring plans to assist in land use development decision-making.</p> <p>DCR has not pursued this priority for floodplain management purposes but the Soil and Water Conservation Division has several water quality monitoring plans that it has developed for the Commonwealth.</p>
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d. Contribute to the flood map revision process (LOMAs and LOMRs) by providing reviews and recommendations prior to FEMA processing.

This is one of the activities proposed under Program Strategy #2 to be implemented as part of the Map Modernization Business Plan.

e. Development of a flood-proofing assistance program to promote mitigation techniques to local officials and citizens.

DCR has not pursued this priority.

f. Development of a management strategy to examine the interaction of wetlands and floodplains and provide guidelines that address the benefits maintaining wetlands or mitigating their losses.

DCR has not pursued this priority.

g. Develop a study that examines why people build in floodplains in order to more effectively address educational programs informing the public of the hazards and risks of floodplains and how to reduce flood damages.

DCR has not pursued this priority.

PROGRAM NEEDS ANALYSIS

As stated earlier in this chapter, the Floodplain Management Program's main goal is to protect people and their property from unwise floodplain development, as well as to protect society from the costs which are associated with developed floodplains. The Program's objectives are to prevent

loss of life, reduce property damage, and conserve the natural and beneficial values of the Commonwealth's river and coastal floodplains. In order to accomplish the goal and objectives of the Program more effectively, there are several needs that must be addressed. These needs include:

- Better coordination and interaction with other state agencies and federal agencies to assess common interests and objectives and opportunities to develop partnerships or working relationships.
- Develop partnerships to access resources.
- Better contact list and maintenance in order to permit more responsive dissemination of NFIP and flood mapping (including LOMAs and LOMRs) information to local officials as well as requests for information from communities.
- Enhanced state statutes and regulations to administer better oversight to communities.
- Increase the number of mapping projects managed.
- Other MMMS activities stated in the Map Modernization Business Plan.

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DCR's Floodplain Management Program will continue to perform the activities described above and as part of a strategy to improve floodplain management in Virginia, proposes to

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enhance and establish performance measures for some of those efforts and to provide additional activities. DCR will be dependant upon our partners in FEMA Region 3 to continue providing input and support in order to implement the priorities and associated activities discussed below. The activities described below indicate what is needed to accomplish the priorities that are listed. The following Program Strategies that are necessary to enhance the effectiveness of floodplain management in the Commonwealth.

Strategy #1: Enhance the Floodplain Management Program’s Effectiveness in Coordinating NFIP Activities and Achieving the Program’s Goal and Objectives.

The following activities will aid in accomplishing the desired results for this strategy.

- a. Improve the Effectiveness of Community Assistance Visits (CAVs), Contacts (CACs), and Planning/Technical Assistance Visits (PTAVS) With NFIP Communities Within the Commonwealth.**

There are currently 270 NFIP communities in Virginia. DCR will target it’s CAVs with NFIP communities that have ten or more flood insurance policies (includes about 200 communities) and other communities determined to have “special needs” on at least a five-year rotational basis. DCR will perform CACs with communities having less than ten flood insurance policies on at least a five-year rotational basis. Typically, DCR will perform 30-40 CAVs, 30-40 CACs, and 15-25 PTAVs annually with the number

of each varying depending on FEMA requirements within CAP-SSSE.

CACs and PTAVs will be used to follow-up on communities that have demonstrated floodplain management program deficiencies during previous CAVs. CACs will be used to assist DCR in planning future CAVs where potential non-compliant development or other programmatic issues have been identified. Provide the appropriate follow-up by performing technical assistance visits to correct program deficiencies and remedy violations to the maximum extent possible within a six-month period. Coordinate with FEMA Region 3 staff to clarify appropriate follow-up activities and refer community compliance problems to the Region that are unable to be resolved at the state level.

Data from the CAAV and CAC reports into FEMA’s Community Information System (CIS) database within a 90-day period after completion of the CAVs and CACs. Submit CAV and CAC reports to FEMA within a 120-day period after their completion.

DCR will develop and maintain a Top 50 At-Risk for Flood Damages Communities list based on number of flood insurance claims, cost of claims, number of repetitive losses (with consideration for both insured and non-insured properties). Priorities for CAAVs and PTAVs will be based on the Top 50 At-Risk for Flood Damages Communities.

- b. Maintain/Improve the Percentage of Communities Adopting New/Revised FIRMs and Floodplain Management Ordinances and Increase the Percentage of Communities that Adopt Prior to FEMA Issuing the 30-Day Notification Letter.**

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As the Map Modernization Program advances, many more communities will require their maps to be updated as their flood hazard maps are revised. That will create a greater need for updating communities' floodplain management ordinances (FPMO). The goal will be to get a copy of the Virginia Floodplain Management Model Ordinance to the community within 90-day comment period following the Final Meeting where the Preliminary FIRMs are presented to the community. During this period DCR will initiate coordination with the community, the applicable Regional PDC, and FEMA for adoption of the new or revised FIRM(s) and an updated FPMO. The process for adoption of the map(s) and ordinance will be explained clearly to the appropriate local officials. Some of this coordination will take place during the map coordination meetings that occur during the mapping update process. The objective of this activity is to keep the community from being entered in the Federal Register.

c. Implement Utilization of the Virginia Flood Prevention and Protection Assistance Fund for Flood Hazard Identification and Reduction Projects.

The VFPPAF was established to provide localities a 50 percent match for flood prevention or protection projects, either as a grant or a loan. Such projects can include floodplain studies and mapping, structural protection and buy-outs, relocation, and flood proofing and/or elevation of structures repeatedly damaged by flooding. The fund can be used for any project regardless of sponsor - local, state or federal. The fund is generated by the collection of one percent of the gross premium income from insurance companies for all flood insurance policies sold in the Commonwealth annually.

The Fund has been un-used for six years except to provide matching funds toward HMGP projects. DCR will develop a list of priority projects and a process for distributing the funding for appropriate projects. Grant funding will be assigned to selected, high priority projects. DCR will coordinate projects with applicable local, state, or federal officials.

Strategy #2: Expand the Role of the Program in Floodplain Mapping Activities

The vision for the Commonwealth of Virginia's participation in the Map Modernization Program is to provide its NFIP communities with a more comprehensive and timely means for updating their flood hazard maps. This will enable them to more effectively manage and enforce compliant development in the FEMA designated, special flood hazard areas. In order to fulfill this vision and within the limits of the federal funding levels, DCR will increase the role that it performs in:

- Managing and coordinating flood mapping activities;
- Forging partnerships with various local, regional, state, and federal stakeholders to access available and developing resources;
- Prioritizing flood mapping and study updates;
- Collecting, compiling, assessing and inventorying data for flood hazard identification and flood mapping needs including input of applicable data into MNUSS; and
- Conducting outreach programs associated with Map Modernization.

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In addition, new roles that DCR will assume in order to accomplish its vision are:

- Develop an inventory of base maps within the Commonwealth that meet or exceed FEMA specifications;
- Coordinate with statewide partners to provide base maps for use in producing FIRMs;
- Coordinate with statewide partners, where possible, to provide for long-term, periodic maintenance of FIRMs (this will be limited in extent to participation of various partners);
- Coordinate with capable community and regional partners in adopting specific technical standards or processes that are appropriate for local conditions for development of new FIRMs;
- Developing and maintaining a digital Information Technology System to archive, organize, distribute, and otherwise manage effective FIRMs and preliminary FIRMs along with their underlying databases and models.

While the Virginia DCR Floodplain Management Program will take a lead role in managing and coordinating the mapping revisions for the Commonwealth, partnerships with other organizations and agencies that reside or operate in Virginia is necessary. The DCR staff will collaborate with its partners on at least an annual basis through the establishment of a stakeholder’s group to further develop and refine the resources that will be used to annually update the information and strategies provided in the Virginia Map Modernization Business Plan.

There are six primary objectives discussed in the Map Modernization Business Plan which will be adopted as the activities for this priority. The objectives are as follows:

a. Cooperating Technical Partner Participation

DCR will continue its agreement (initially established in 2002 for Mapping Prioritization Plan) as a Cooperating Technical Partner (CTP) with FEMA to perform mapping activities. Depending on the availability of federal funding, DCR would like manage two CTP projects during FY2005 and will progressively add more projects to its management role each year (i.e., FY2006 – 3 new CTP projects, FY2007 – 4 new CTP projects, etc.). This process is explained in more detail in the Map Modernization Business Plan.

In addition, DCR (again, depending on federal funding levels) would provide support and guidance to other regional or local government bodies that are interested in CTP. DCR would seek to include these types of organizations into its CTP agreement with FEMA and encourage them to provide whatever resources they can to benefit the mapping project that includes their community. Some of these partners may determine that they are capable of doing more than they are initially aware of once they get involved in the process. DCR will try to coach or mentor local or regional government entities that reveal potential to provide their own capabilities in collecting, managing and distributing flood hazard data.

b. Approaching Mapping Projects with a “Clustering” Strategy

DCR believes that the best approach to the mapping projects planned as part of the implementation phase of this Plan is

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to group the communities into “clusters” of communities that, in addition to having a common geographic proximity, are within the same planning districts, are within the same watershed, have similar socio-economic communities, and/or can share hydrologic and hydraulic data from water-bodies along their mutual corporate boundaries. It will also ensure that flood boundaries and flood elevations are consistent across corporate boundaries because of using engineering models continuously across those boundaries instead of piece-meal as is the case now in many Virginia communities that were individually and independently mapped by different study contractors.

This strategy will give communities within the cluster the opportunity to share resources that the other communities may not have and as a result be able to contribute to getting those other communities remapped. The types of resources that could be shared include:

- Engineering staff that can perform or provide QA/QC review hydrologic and hydraulic analyses;
- GIS capabilities,
- Topographic data for river/stream corridors along mutual boundaries;
- Surveying teams; and
- Hydrologic or hydraulic data from storm-water studies, stream restoration plans, or Letters of Map Revisions for mutual water-bodies.

In addition, using the clustering strategy will enable the DCR and FEMA staffs to more effectively manage the mapping projects because the time for meetings and administrative activities can be consolidated. This will provide a

synergism to the process that will aid in the completion of the projects by combining resources going into the projects and reducing the effort necessary to manage them. The details on how these clusters were developed are explained in the Map Modernization Business Plan.

c. Development of Mutually Beneficial Partnerships with State, Regional, and Local Government and Private Entities

As discussed in the Map Modernization Business Plan, there are several opportunities for developing mutually beneficial partnerships with other government and private-sector entities that may be willing to share resources in order to assist DCR and FEMA in developing maps or mapping data that they can, in turn, use for their own purposes. Because of the current economic limitations being experienced within state agencies in Virginia, DCR recognizes the tremendous benefit of this strategy to assist it in realizing its vision for Map Modernization in Virginia. This economic condition may also provide more of an incentive for other agencies to partner their resources and efforts because of their recognition of the need to utilize the resources of others to accomplish their own objectives.

d. Development of a Web-Based System for Public Access to FIRMs and Mapping Information

Providing a digital, web-based platform that has the technological capacity to be populated with geo-spatial data and other forms of flood hazard data as well as be distribution system to Map Modernization stakeholders in Virginia is a critical aspect of the implementation of this Plan. DCR will work with Virginia

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Tech’s Center for Geospatial Information Technology (GIT) and the Virginia Information Technology Agency (VITA) along with information technology contractors to develop a system that is reliable, flexible, adaptable to new technologies, provides suitable security, and is accessible to various stakeholders groups. Part of the system will also be accessible to the general public.

There will be a web page associated with the web-based flood hazard map delivery system that provides educational information and materials on Map Modernization efforts in Virginia and other aspects of the flood study/mapping process to anyone interested.

e. Providing Technical Mapping and Flood Study Support to Local Officials for LOMCs and Approximate A-Zones

DCR plans to develop the capability, at some level yet to be determined, to assist FEMA Regional staff in reviewing and processing LOMCs that originate in Virginia. DCR will investigate the steps necessary in the LOMC process to determine what level it will be able to assist FEMA based on the staffing resources available at DCR.

During the process of assisting local floodplain managers with interpretations of how specific situations are relevant to enforcement of the local floodplain ordinance, DCR regularly come across the situations where development is planned in un-numbered or approximate A-Zones. While there are “approximate” methods to assist officials in these situations, development of approximate BFEs is the most beneficial method. DCR plans to provide this service to assist local officials in their floodplain ordinance enforcement efforts.

f. Meeting FEMA’s “Sub-Program” Performance Measures”

FEMA has a requirement to meet certain national milestones. These include:

- Developing digital GIS flood hazard maps for specified population levels for each of the 5 years that this Plan is to be implemented;
- Adopting digital GIS flood hazard maps for specified population levels for each of the Plan’s 5 years;
- Leveraging non-federal resources toward development of digital GIS flood hazard maps; and
- Utilizing CTP to achieve the other three goals.

The Commonwealth’s Floodplain Management Program plans to increase its role in Map Modernization but the level to which it will be able to increase that role is very dependant on the level of funding that FEMA is able to provide to the Commonwealth. DCR will utilize its internal staff wherever possible to manage the mapping activities associated with the Map Modernization program but in order to fully implement its vision, additional staff and contracted services will be required.

DCR also plans to manage some of the proposed mapping projects through its CTP Agreement with FEMA. DCR will use study contractors that have exhibited expertise in both GIS capabilities and flood mapping studies to perform new flood studies, restudies, and digital conversions. DCR will continue to work with local officials to assess each community’s capability to participate as a CTP and assist in the mapping process.

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In order to facilitate the vision described the following additional staff will be required:

- **Mapping Engineer** – Since this position does not currently exist at DCR, the Mapping Engineer will not be involved with implementation of the 5-year Plan during the majority of the first year. The Mapping Engineer will share management responsibilities for CTP and the overall Map Modernization Program with the Program Manager and Program Engineer. Throughout execution of this 5-year Plan, these management responsibilities along with coordination for development of a digital IT system and eventually hydraulic and hydrologic reviews will be the focus of this position.
- **Program Specialist** – The Program Specialist will provide assistance to the other positions in their roles and will coordinate correspondence with FEMA, other agencies, localities and contractors. The Program Specialist will be responsible for managing and archiving all Map Modernization Program files.

Strategy #3: Broaden and Deepen Floodplain Management Education and Training.

The following activities will aid in accomplishing the desired results for this strategy.

- a. **Revise and Update Virginia’s Floodplain Management Plan and Accompanying Guides for Citizens and Local Officials.**

DCR is in the process of having its Floodplain Management Plan which was

created to meet the requirements of DCR in the Virginia Code to develop a flood protection plan for the Commonwealth. It includes an inventory of flood-prone areas, an inventory of flood protection studies, a record of flood damages, strategies to prevent or mitigate flood damage, and the collection and distribution of information relating to flooding and floodplain management. It provides updated information and data regarding flood hazards and flood loss reduction programs that are functioning in the Commonwealth and through FEMA. Also, it was originally developed and published in 1991 and the revisions that were made to the document in 1996 were never published for public distribution.

As part of the continual updating of the Plan every five years, in 2005 DCR will begin development of a more comprehensive inventory of structures that are at-risk for flooding within localities and state properties and identify flood insurance status for those structures utilizing regional and local resources and staff for data when possible.

Additionally, there are two guides that were developed which are complimentary to the Plan. They provide practical “how-to” guidance for implementation of the Plan. The Guides target local officials that are responsible for enforcement of local floodplain ordinances and citizens that either own property in flood hazard areas or are planning to develop in flood hazard areas.

- b. **Increase the Number of Attendees at Floodplain Management Training Workshops and Expand the Audience to Include Non-Traditional Attendees.**

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Currently DCR’s Floodplain Management Program coordinates with the Virginia Floodplain Management Association (VFMA is a chapter of the Association of State Floodplain Managers) to conduct workshops around the Commonwealth. Typically there are three to four workshops that are sponsored by VFMA and DCR. In addition, VFMA co-sponsors the Virginia Water Conference along with the Virginia Lakes and Watershed Association where VFMA coordinate two to three of the technical sessions held during the conference. VFMA and DCR also provide training for preparation for ASFPM’s Certified Floodplain Manager exam. In addition, DCR staff is invited regularly to regional and state-wide association meetings, seminars, and conferences to discuss the NFIP, flood hazards and flooding events, and floodplain management strategies.

DCR will strategically target specific audiences to provide more in-depth information on aspects of floodplain management that are specific to their area of practice. DCR will strategically target locations and times that will draw the largest audiences and get Regional PDCs involved in the training and coordination of the workshops. Develop partnerships with various associations (building code zoning/planning officials, surveyors, engineers, builders/ developers, etc.) to leverage opportunities to provide presentations at their conferences or regional meetings.

c. Increase the Number of Certified Floodplain Managers that are Local Officials in the Commonwealth.

DCR will continue to coordinate with the VFMA for providing CFM training and continuing education credits in the Commonwealth. DCR will target local

officials during CAVs and CACs for becoming CFMs and work with FEMA, ASFPM, and statewide associations on incentives for local officials to become CFMs.

Strategy #4: Expand the Enrollment of Virginia Communities in the NFIP and the Number NFIP Communities in the Community Rating System.

The following activities will aid in accomplishing the desired results for this strategy.

a. Increase the Number of Flood-Prone Communities in Virginia That Are Enrolled in the NFIP.

There are currently 270 communities enrolled in the NFIP. There are an additional 15 communities that have special flood hazard areas (SFHAs) identified by FEMA but are not located in the NFIP. There are approximately 45 other incorporated communities (towns) that either don’t have SFHAs (classified as communities with No Special Flood Hazard Areas) and were not mapped by FEMA or were not incorporated at the time the current effective county maps where-in they reside were mapped. There are areas within these communities that flood infrequently from stormwater related problems. Over the past seven years DCR and FEMA have assisted four such communities with enrolling in the NFIP. DCR and FEMA are currently coordinating with five other communities that have expressed some level of interest in joining the NFIP. DCR will continue to promote the NFIP to these communities and assist them if they determine to apply to enroll in the NFIP. DCR will also target non-participating flood-prone communities for enrollment in the NFIP and develop an outreach strategy to enroll flood-

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prone communities that don't have SFHAs or have not been mapped by FEMA.

b. Increase the Number of Community Rating System (CRS) Communities in Virginia and Improve CRS Classification of Existing Communities.

There are currently 16 NFIP communities that participate in the CRS Program in Virginia. There are several of the NFIP communities (not currently in CRS) that are cities or urbanized counties that have sufficient staffing and capabilities to administer the CRS Program within their own community. Most of them are likely performing many of the credible activities that could be included under the four CRS categories of Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness.

DCR will target its "marketing" efforts on communities with a large number (greater than 200) of flood insurance policies and/or have the staffing capacity and capability to perform administrative tasks associated with CRS. CAVs will be used to inform communities about the CRS Program. DCR will conduct CRS workshops for communities that express an interest in CRS and inform them about the CRS course offered at FEMA's Emergency Management Institute. In addition, DCR will provide assistance to prospective CRS communities with completing the CRS application and to current CRS communities with evaluating programs or operations that can be used to enhance their current CRS ranking.

Strategy #5: Expand Upon Existing Partnerships of Floodplain Management Stakeholders and Develop Additional Partnerships.

While performing various NFIP and floodplain management roles within the Commonwealth, DCR has established relationships with a diverse group of organizations and government agencies. Through these relationships, DCR has identified resources for environmental and community planning, building science, hazard identification, GIS mapping, surveying, and more. These resources can provide varying levels of support for flood hazard mapping activities. These resources were identified in:

- State agencies and regional planning districts;
- State universities;
- Cooperating Technical Partners;
- Hydrologic and hydraulic analysis performed for other plans and permits;
- Federal agencies; and
- Local anecdotal or historical flood information.

Several state agencies in Virginia are involved in either managing, studying or influencing the lands and waters associated with floodplains. As part of their roles in managing, evaluating or utilizing the flood hazard areas, some of these agencies and their potential resources that can be developed for use in either floodplain management or flood hazard mapping include:

- Virginia Department of Conservation and Recreation – There are several programs within DCR that work specifically in

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water resource management or design/manage facilities that utilize water resources. These include Dam Safety, Stormwater Management, Erosion and Sediment Control, Planning and Recreational Resources Design and Construction, and State Parks. These programs have resources for mapping and hazard identification that can be useful to floodplain management and flood hazard mapping.

- Virginia Geographic Information Network – VGIN has overseen development of the Virginia Base Mapping Program which is a digital ortho-imagery base. It will act as a reference network and base for additional spatial data development by local communities for use in Geographic Information Systems (GIS) development.
- Department of Transportation – VDOT regularly designs and constructs structures (i.e., bridges and culverts) that are placed over and through floodplains. Part of the design process is to evaluate how those structures will impact the floodplains through hydrologic and hydraulic studies. VDOT has expressed an interest with partnering in updating the state's flood maps in order to enhance their capabilities in design decisions.
- Virginia Tech Center for Geospatial Information Technology – VT-CGIT has expertise in gathering, analyzing, compiling, and processing geospatial data from watersheds and communities in Virginia that is related to the identification and mapping of flood hazards. VT-

CGIT has an extensive database available for structures that are at-risk for flood hazards because of on-going work with VDEM.

- Virginia Department of Emergency Management – VDEM has an extensive network of resources through its relationships with local emergency management coordinators and risk managers statewide. It should also have an interest in utilizing more the updated or new maps that will be generated to provide them with more accurate flood risk data.
- Various Colleges and Universities in the Commonwealth – Several colleges and universities appear to have resources that could be useful to assist in flood hazard identification, floodplain management planning, and flood hazard mapping.
- Planning District Commissions – Several of the PDC's in Virginia have worked with communities within their jurisdiction to develop hazard mitigation plans or storm-water management plans in which they've collected, analyzed, and compiled for reports that could be useful for providing assistance to communities in floodplain management training and assistance as well as flood hazard identification and mapping.
- Department of General Services – VDGS is responsible for the operation, maintenance, management, and construction of the majority of state-owned facilities statewide. Many of the state facilities have structures that are located in flood hazard areas. Because of the limitations of space where some of these

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<p>facilities are located and the desire of the state to minimize its risk to flooding, among other risks, VDGS has a vested interest in the accuracy of the flood maps in those communities.</p> <ul style="list-style-type: none"> ■ <u>Department of Game and Inland Fisheries</u> – VDGFIF manages and maintains hundreds of dams around the Commonwealth and regularly conducts hydrologic evaluations of those impoundments and their watersheds. ■ <u>Department of Environmental Quality</u> – Until July 2004 DEQ provided oversight of all the NPDES programs throughout the Commonwealth and as a result has compiled a sizeable database of information on many of the state’s watersheds. The responsibilities for non-point 	<p>NPDES are being turned over to DCR. DEQ also oversees the Coastal Zone Program and has developed many databases while preparing guidance documents for coastal zone management.</p> <ul style="list-style-type: none"> ■ <u>Marine Resources Commission</u> – VMRC oversees the management and use of the coastal and tidal areas of the Commonwealth and have acquired a sizeable database of those water resource areas. <p>Currently there are six Virginia communities that have participated in FEMA’s Cooperating Technical Partners (CTP) Program. Other communities are considering becoming CTPs. The current CTPs are providing various levels of resources and efforts to the flood hazard mapping process for their communities. These are included in the table below.</p>
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**TABLE 6.1
FEMA’S EXISTING COOPERATING TECHNIAL PARTNER (CTP)
PROGRAM COMMUNITIES IN VIRGINIA**

COMMUNITY	TYPE OF MAPPING PROJECT	TYPE OF SERVICES/ RESOURCES PROVIDED
Shenandoah County	Limited study area	Contract management of engineering services
City of Harrisonburg	City-wide restudy	Contract management of engineering services
City of Roanoke	Limited study area	Partial funding of flood studies
Roanoke County	Limited study area	Partial funding of flood studies
Fairfax County	County-wide restudy	Funding for flood studies and GIS services
Henrico County	County-wide restudy	Funding and management of flood studies & GIS services

Several Virginia communities have had hydrologic and hydraulic analyses performed on a number of stream or river segments for storm-water management designs, NPDES permitting, and LOMRs. The calculations for these plans and permits

can either be utilized as they currently exist or with minor modifications be incorporated into flood studies that meet FEMA criteria.

There are federal agencies that have significant resources that could be

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utilized in floodplain management and flood hazard mapping. These include:

- United States Geological Survey – stream gage databases, regional hydrologic regression equations, legacy flood studies;
- United States Army Corps of Engineers – old flood hazard identification studies, storm surge model data for coastal areas, flood hazard mitigation studies and plans, state and local planning;
- National Oceanic and Atmospheric Administration – rainfall and flooding records, coastal erosion studies and data, coastal flooding studies;
- Natural Resource Conservation Service – Emergency Watershed Protection studies and planning, stream restoration design and projects,
- Bureau of Mines and Reclamation – watershed hydrologic data.
- Tennessee Valley Authority – legacy flood studies, flood hazard mitigation studies.

In order to better organize the resources and organizations that are stakeholders in floodplain management and flood hazard mapping, DCR will establish two stake-holder’s groups to further develop and refine the resources that will be used to annually update the information and strategies needed to develop a more effective, statewide floodplain management program. The stake-holder’s group for floodplain management compliance and assistance will be tentatively named the Virginia Map Modernization Task Force (VMMTF), should consist of representatives from the following agencies and organizations:

- Virginia Tech Center for Geospatial Information Technology,
- Virginia Geographical Information Network,
- Selected Virginia Planning District Commissions,
- Virginia Department of Transportation,
- Virginia Department of Game and Inland Fisheries,
- Virginia Department of Environmental Quality,
- Virginia Floodplain Management Association,
- Virginia Marine Resources Commission,
- US Geological Survey,
- USDA Natural Resource Conservation Service,
- FEMA Region 3, and
- US Army Corps of Engineers.

Strategy #6: Develop Regulations at the State and Local Level to Encourage Development Away From Flood Hazard Areas and to Provide a Better System of Checks and Balances for Local Floodplain Management Programs.

The following activities will aid in accomplishing the desired results for this strategy.

- a. **Coordinate With Local Officials Administering the Floodplain Management Ordinances to Encourage Adoption of State Recommended Higher Standards as Additional Flood Damage Preventive Measures.**

GAP ASSESSMENT BETWEEN PROGRAM STRATEGIES AND RESOURCES

DCR Floodplain Management Program staff will be revising the State Model Floodplain Management Ordinances (levels “a” through “e” correlating to 44CFR 60.3). The revised model ordinances will include recommended higher standards for communities to adopt during the mapping update process. DCR will utilize training and outreach opportunities to inform local officials of the benefits of using higher standards.

b. Develop Higher Standards of Flood Hazard Protection in State Statutes and Regulations that Enable DCR to Provide Better Oversight of Local Programs.

Too many times, DCR’s Floodplain Management Program staff is notified of either non-compliant development that has occurred in the floodplain by a local citizen or the local official informs the staff of variances that have been granted by the Board of Zoning Appeals or the Board of Building Code Appeals. Currently the NFIP communities are required to provide certain documents to FEMA as part of their NFIP agreement with FEMA but are not required to submit these to the NFIP State Coordinator. Apparently FEMA is not able to sufficiently review and respond to all community submittals resulting in some non-compliant development occurring. In order to avoid a continuation of this process, the state laws should require the following documents to be submitted to the NFIP State Coordinator:

- Requests and approvals for floodplain management ordinance variances and building code variances for flood resistant construction;

- Applications for Letters of Map Revisions that involve floodway encroachments; and
- NFIP Biennial Reports (these provide updates to FEMA on the number of permits issued for development in floodplains).

GAP ASSESSMENT BETWEEN PROGRAM STRATEGIES AND RESOURCES

The current funding level (2005) for the Program’s CAP-SSSE Grant Agreement and Map Modernization Management Support Grant Agreement with FEMA are sufficient to fulfill the requirements of the strategies listed in Section G above. However, at this time additional staff will be required and can be funded with the two grants. It is anticipated that the total workload for the CAP-SSSE positions will increase some in future years. Also, the allocation of time for various activities will be altered to reflect changing conditions, primarily related to the Map Modernization Program and the need for ordinance assistance for an increasing number of communities.

Additionally, a web site will need to be developed outside of the current DCR web site due to the lack of server capacity available from current state resources to handle the data storage capabilities needed for the Map Modernization work.

The DCR Floodplain Management Program, however, would like to expand some of the training and public outreach opportunities so that flood risks and mitigation activities become more publicized throughout the Commonwealth. This can be accomplished through a number of activities, including the following:

- Additional training for Elevation Certificates, Substantial Damage Estimator, LOMR applications and procedures, and development in un-numbered A-Zones;
- More public outreach, such as newsletters and Virginia “fact sheets”;
- Attendance at additional state and regional conferences; and
- More resources for general technical assistance.

Based on the current workload, it is not anticipated that any of these can occur without additional funding or assistance from FEMA’s National Service Provider since the current CAP-SSSE program staff are already fully utilized.

THE VISION FOR FLOODPLAIN MANAGEMENT IN YEAR 2010 AND BEYOND

DCR’s Floodplain Management Program and floodplain management in Virginia have come a long way in its evolution since 1991. The focus on what the priorities are from 1991 and 2004 has shifted dramatically. There is still a long way to go toward making the Program as effective as it can be. There should be an assessment of floodplain management policies at the regional and local levels. The diversity of land forms, populations, business needs, available natural and capital resources, and the severity of potential dangers require further refinement of floodplain management at the local level.

The minimum NFIP standards reflected in the Commonwealth’s current flood hazard protection regulations are not sufficient to provide adequate flood protection in certain geographical settings of the Commonwealth. This

has become apparent after experiencing the impacts of several major flood events throughout the Commonwealth in the past ten years. There needs to be stronger agency and Executive support of higher standards for flood hazard protection in state statutes and regulations. There are numerous examples of these higher standards in other state laws including Michigan, Illinois, North Carolina, Ohio, Missouri, New Jersey, etc.

In order for floodplain management priorities to be advanced, there must be more “buy-in” at the local program level. A catalyst to this development of local programs in part will come from the Community Rating System. In recognition of this natural progression the state program should find ways to foster and support local initiative for floodplain management.

SUMMARY OF CHAPTER 6

The Program's main goal is to protect people and their property from unwise floodplain development, as well as to protect society from the costs which are associated with developed floodplains. The Floodplain Management Program’s objectives are to prevent loss of life, reduce property damage, and conserve the natural and beneficial values of the Commonwealth's riverine and coastal floodplains. These objectives are accomplished through the Program’s five functional elements which are the National Flood Insurance Program (NFIP) compliance and assistance, community education, flood hazard mitigation assistance, coordination of flood hazard identification and risk assessment, and management of the Flood Prevention and Protection Assistance Fund.