CHAPTER IV

RESOURCE PROTECTION AND HAZARD MITIGATION

Overview

In the last decade, Congress, the states, and local governments have adopted a variety of independent resource protection and management programs that apply in part to floodplains.[1] These programs often contain hazard mitigation standards for new uses or indirectly reduce flood losses by restricting the types, locations, and densities of uses and by protecting flood conveyance and storage. They also protect natural vegetation and control erosion.

Conversely, many floodplain management programs have been adopted or amended to include resource protection and management standards to meet multipurpose community goals such as protection of prime agricultural areas and wetlands. Such provisions have been adopted to promote the wise use of floodplains, as determined at state and local levels. This concern with floodplain resource values is reflected in the NFIP standards and in the Floodplain Management and Wetlands Protection Executive Orders.

Independent resource protection and management programs that apply wholly or in part to floodplain areas include wetland, prime agricultural land, and mineral resource protection programs; coastal zone and shoreland management programs; and "critical area" programs. Many programs have been adopted at the state level as state or cooperative state/local planning and management efforts.

Two types of state and local resource management and floodplain management standards have been applied to protect and conserve natural values. The first--tight control or prohibition of structural development in selected areas--has been applied to highly hazardous or sensitive floodways, wetlands, and habitats for rare and endangered species.

TABLE 5

RESOURCE PROTECTION BENEFITS

Regulations, acquisition and other techniques to maintain all or portions of floodplain areas in an open condition can serve the following objectives:

Protect Water Resource Values

Natural Moderation of Floods (Avoid Costs of Flood Control Works)

- reduce flood velocities
- reduce flood peaks
- reduce wind and wave impacts

Water Quality Maintenance (Avoid Costs of Waste Water Treatment)

- remove nitrogen, phosphorous, toxics, litter from runoff before reaching rivers, lakes and streams
- remove pathogens from runoff
- moderate temperature of water
- reduce downstream siltation

Groundwater Recharge (Reduce Costs of Water Supply)

- increase groundwater infiltration for human use and low flow during dry periods
- prevent land subsidence

Maintain Living Resource Values

Protect Flora

- maintain the high biological productivity of floodplain and wetland flora important to animals and people
- maintain the productivity of natural forests and the supply of timber products
- maintain natural crops such as salt marsh hay, blueberries, cranberries

Protect Fauna

- create and enhance wildlife habitats for breeding and feeding of water fowl
- provide migratory flyways for water fowl
- protect habitat of rare and endangered species
- maintain breeding and feeding grounds of fish, shellfish

Maintain Cultural Resource Values

Protect Open Space

- absorb noise
- clean air
- moderate temperatures
- reduce erosion
- preserve historical and archaeological sites

TABLE 5 (continued)

Protect Natural Beauty

- provide variety in the urban pattern
- provide natural greenbelt and forested areas of natural beauty

Protect Scientific Study and Outdoor Education Areas

- serve as an ecological "experiment station"
- facilitate study of the unique wildlife occurring at the interface of land and water
- serve as a classroom for how human and natural systems are linked

Protect Recreation Areas

- provide opportunities for water sports (swimming, boating)
- provide areas for hunting, fishing, and wildlife preservation
- provide wilderness experience areas (in some cases)
- provide areas for hiking, camping, picnicking, bird watching

Maintain Cultivated Resource Values

Protect Agricultural Lands

- renew soil through sediment deposition (periodic flooding) and replenish nutrients in soil for higher productivity
- reduce the need for commercial fertilizer additives
- in some cases, provide uniquely suitable soil for specialty crops

Protect Aquaculture

- provide areas for cultivation of fish, shellfish

Protect Silviculture

- create and preserve valued species that have adapted to naturally moist conditions, especially bottomland hardwoods
- enhance productivity of forest resources and provide opportunity for sound commercial management

This type of regulation is best in small areas where upland sites are available for development.

The second--general performance standards--requires that activities incorporate environmental mitigation measures to reduce project impacts. Mitigation measures of the sort listed in Table 6 are required for permitted uses. Mitigation standards are contained in zoning and subdivision control ordinances and "special permit," upgrading, floodplain, wetland, and regional impact regulations.[2] Environmental impact statements are often required for major projects.

Both resource protection and floodplain management with resource protection provisions protect the nine principal natural resource functions discussed below.

Natural Resource Values

Flooding contributes to the maintenance of special natural resources. Flowing waters shape lands, thereby creating optimum flood conveyance configurations. Flood waters deposit rich soils particularly suited for agriculture. Storm waves create beaches and bars attractive for swimming and other recreation. Fast-moving flood flows deposit sand and gravel needed for roads and industry. Rains and periodic flooding recharge groundwater supplies. High groundwater levels and periodic flooding give rise to "wetland" vegetation and wildlife that contribute to food production, fish spawning, pollution control, bird watching, hunting, fishing, and aesthetic values.

Most floodplain natural values such as forestry, wildlife, and pollution control are adjusted to and may depend upon periodic flooding. In contrast, unprotected development at the same sites is subject to flood damage. Protection of development through floodproofing, dikes, levees, channelization, and similar measures is, in the long run, prone

TABLE 6

TYPICAL MITIGATION APPROACHES

1. Minimize impact on natural values by limiting floodplain occupancy to compatible uses.

2. Avoid locating fill and structures within critical wetlands, dunes, beaches, and scientific areas.

3. Reduce impacts on sensitive areas by elevating structures on pilings or other open works.

4. Avoid sensitive areas by routing access roads, sewers, and water supply systems around them.

5. Avoid vegetation removal on dunes, in wetlands, and along stream banks by means of building setbacks and limitations on cutting and grading.

6. Replant wetland and other vegetation where destruction of vegetation cannot be avoided.

7. Protect erosion-prone areas through rip-rap or other measures.

8. Avoid removal of sand, gravel, and other materials from beaches and dunes.

9. Avoid use of off-road vehicles where they may destroy dune and wetland vegetation.

10. Protect fish populations by constructing fish pools in channelization projects and installing fish ladders at dams.

11. Compensate for destroyed areas by constructing new wetlands and other wildlife areas by diking, land acquisition, or other means.

12. Manage game to enhance and reestablish species.

13. Reconstruct disturbed or destroyed natural dunes by planting vegetation, beach nourishment, and other techniques.

14. Control runoff from construction sites by using plastic sheets and similar measures.

15. Reduce sedimentation by constructing detention ponds.

16. Provide sufficient flows for downstream fish and wildlife and periodically flush wetlands by managing dam operations.

17. Limit development densities (e.g., require large lot sizes).

18. Protect sensitive and hazardous areas by clustering development on upland sites.

19. Permit adequate groundwater infiltration by limiting the allowable amount of impermeable surfaces.

20. Avoid disposal of wastes, litter, and debris in wetlands and floodplains.

21. Protect natural vegetation and water quality and reduce erosion by fencing wetlands and floodplains.

to failure because it opposes the natural processes of flow, erosion, scour, sedimentation, and stream and beach migration.

Not all floodplains are characterized by the same natural values, nor have natural resource protection and floodplain management in the 1970s given equal weight to all values.

Flood Conveyance

Flood conveyance is a valuable function of river channels and adjacent overbank areas. These areas are shaped by the erosion and deposition accompanying large floods. Fill, structures, and other development in such natural floodways cumulatively increase flood heights and velocities, causing not only increased flood damages on adjacent and upstream lands but also downstream erosion. Plant and animal life in these areas has adapted to and may depend upon periodic flooding.

Protection of flood conveyance was a common objective of shoreland, wild and scenic river, wetland regulatory, and floodplain management programs in the 1970s. Many of these programs were designed to protect the entire natural or "no rise" floodway. The programs assume no permitted increases in flood heights and are more inclusive than the NFIP regulatory floodway.

Flood Storage

Except in areas characterized by steep terrain and bluffs, most riverine floodplains provide temporary flood storage, thereby lowering downstream flood peaks. One acre of floodplain can hold more than 330,000 gallons of water if flooded to a depth of one foot.

Flood (also termed valley) storage is particularly important in urbanizing areas where even small floods resulting from a five- or a 10-year storm can cause severe flood damage. The flood storage effectiveness of a particular floodplain area depends on its size and hydrologic

A wetland reestablished on dredge spoil as a mitigation measure.

Photo by John Clark.

character, flooding characteristics, the distribution of streams or rivers in the watershed, vegetation and ground cover, and the location of development.

Protection of flood storage was an objective of most inland state and local wetland programs and some shoreland zoning and wild and scenic river programs. Some localities also adopted floodplain or stormwater management regulations to protect storage. NFIP standards do not directly address storage, although floodway restrictions provide some protection. For this reason many wetland and comprehensive flood hazard management policymakers consider the NFIP standards to be inadequate. In order to compensate for this problem, some state and local floodplain regulations use a natural floodway or allow less than the one-foot rise permitted by the NFIP standards.

The federal government has protected some natural storage areas. For example, the Corps of Engineers, after studying the Charles River near Boston in 1965, reversed an earlier recommendation for a flood control structure and instead recommended protection of 17 parcels, constituting 8,500 acres, which function as natural storage areas. The Corps has now acquired much of this land. State and local regulations will protect other storage areas along the Charles.

Wave Reduction

Beaches, bars, dunes, and wetlands act as natural barriers that dissipate coastal waves and protect backlying areas from flooding and erosion. Along the coast, waves may cause severe damage for a distance of 300 to 1,000 feet inland, depending on topography, vegetation, and manmade or natural barriers. Coastal islands are vulnerable to extensive impacts from storm waves.

Natural barriers form several lines of defense against waves and erosion. Offshore and nearshore bars are the first line of defense. They absorb much of a wave's energy, causing it to "break" and weaken even though it may travel some distance inland. Dredging beaches or bars to replenish dunes may increase wave damage by increasing wave heights. Most coastal states now control dredging, sand removal or other alteration of beaches through floodplain, wetland, and beach protection; shore erosion control; or coastal zone management. Generally, floodplain regulations also prohibit structures below the mean high water line. Federal 404 or Section 10 permits are required for most dredging activities.

Dunes lying behind the beach are the second line of defense against storm waves, although a severe storm may destroy the dunes.[3] In addition to acting as buffers to waves and erosion, they also partially protect against hurricane winds, which may exceed 150 miles per hour. Dune areas are also important for recreation and contain unique plant and animal species. Florida has adopted a beach setback line, designed in part to protect dune areas.[4] North Carolina has adopted dune protection regulations as part of its coastal zone management program.[5] Many local communities have adopted dune protection ordinances, particularly in Massachusetts, New York, North Carolina, and Rhode Island. NFIP standards require protection for dunes where it is shown that any proposed alteration could cause flood damage.

Vegetated coastal wetlands are a third line of defense in estuaries and behind barrier islands.[6] Growth of wetland vegetation is rare in open coast areas. Vegetated wetlands form in backlying areas which are subject only to infrequent storms such as the 100-year storm. When such events occur, wetland vegetation causes waves to dampen and break, dissipating much of their energy. Root systems of Atlantic coastal vegeta-

tion, such as those of Spartina alternaflora, bind and protect the soil against erosion.

Mangrove forests found in Florida and, to a lesser extent, Louisiana, are particularly important wave buffers.[7] Red and black mangroves grow to a height of 20 to 35 feet for a distance of 1 to 10 miles inland from the coast. They take root in standing water and have complicated root and above-ground systems. During hurricanes they substantially reduce the force of storm waves and may actually build up the land by trapping sediments. A study of how mangroves retard erosion revealed that when Hurricane Hattie struck the Caribbean in 1961, with 200-mile-per-hour winds and 15-foot tides, islands covered with natural vegetation suffered little permanent damage and in some instances actually accumulated new material from the storm.[8] In contrast, islands cleared of vegetation were severely eroded.

NFIP standards require protection of mangroves within defined velocity zones if it can be shown that any proposed alteration would increase potential flood damage. However, the standards disregard other forms of vegetation that may have the same potential.[9]

Efforts are being made to protect coastal wetlands and mangroves through wetland protection, coastal zone management, and pollution control programs. The Corps generally denies Section 404 permits for alteration of mangroves and other coastal wetlands. Florida is enforcing mangrove protection measures through its setback requirements, pollution permit systems, and similar measures. Virtually all coastal states have adopted coastal wetland protection measures.

Inland wetlands also reduce wave and erosion damages along lakes and rivers and provide a buffer to pollution associated with flooding. Massachusetts, Rhode Island, and other states regulate activities in

The extensive root structure and flexible stems of mangroves resist erosion and storm waves.

Photo by Jon Kusler

inland wetlands. Many local communities, particularly in states like Florida, Massachusetts, and Virginia, have adopted wetland protection ordinances.

Waterfowl and Wildlife

Due to the abundance of water and vegetation, floodplains provide habitat for much of the nation's wildlife. Wetlands along the Gulf Coast provide nesting and feeding grounds for many species of waterfowl. Mississippi River floodplains are major duck and geese resting and feeding grounds during fall and spring migrations. The prairie potholes of the Midwest are nesting areas for about 50% of the nation's ducks. The vegetated floodplain corridors along western rivers and streams are particularly important to birds and fish. Many animal species such as raccoons, deer, moose, turtles, and salamanders spend a portion of their lives in floodplains. Inland floodplains normally accessible to open water along lakes and streams provide nursery habitat for fish such as northern pike and walleye. Florida mangroves provide protection for shrimp and for the fingerlings of commercial fish such as mullet, snook, and snapper. The value of the nation's nearshore and continental shelf fishing annually exceeds one-half million dollars. Nine out of 10 commercially important fish species either pass their entire lives in estuaries or require estuaries as nursing grounds.

Over 35% of the nation's rare and endangered species live all or a portion of their time in wetland areas.[10] Such species include the Everglade kite, the whooping crane, the Sandhill crane, the bald eagle, the American crocodile, and the Florida panther.

Most state coastal and inland wetland regulation and acquisition programs and the Federal 404 permit program are designed, in part, to protect duck nesting and fish spawning grounds. However, state and federal floodplain regulations rarely emphasize wildlife protection as