Breaking the Disaster Cycle:
Future Directions in Natural Hazard Mitigation

Structural Approaches to Hazard Mitigation; Assessing Structural Approaches

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Structural Approaches to Hazard Mitigation; Assessing Structural Approaches

- **Objectives:**

  6.1 Understand the use of structural approaches to hazard mitigation and their alternatives.

  6.2 Identify types of structural approaches used for mitigating different types of hazards.

  6.3 Review the history and context of structural mitigation approaches.

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- **Objectives:**

  6.4 Describe procedures for analyzing costs and benefits of structural projects.

  6.5 Discuss case studies of structural projects initiated by the Corps of Engineers and FEMA.

  6.6 Discuss opportunities and problems with structural approaches from the point of view of community stakeholders during a structured discussion session.

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- **Objective 6.1**
  - Understand the use of structural approaches to hazard mitigation and their alternatives:
    - Work against forces of nature
    - Move nature rather than move people
    - Enables cities to be built along waterways
    - Saves lives
    - High cost
    - Environmentally destructive
    - Philosophical shift in 1960s to hazard mitigation through features of natural environment (wetlands, floodplains, etc.)

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A levee on the Mississippi River in Missouri. (Source: FEMA)

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- **Figure 6.1 Non Structural Approaches**

Acquisition and Relocation

- Land Use Regulations
  - Zoning
  - Subdivision ordinances
- Building codes and construction standards (including elevation of homes)
- Insurance
- Beach nourishment

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Beach nourishment in Ocean City, MD. (Source: Rutgers University)

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- **Objective 6.2**
  - Identify types of structural approaches used for mitigating different types of hazards:
    - Shoreline measures
      - ✓ Seawalls
      - ✓ Breakwaters
      - ✓ Groins
      - ✓ Jetties
    - Floodplain measures
      - ✓ Dikes
      - ✓ Levees

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- **Figure 6.2 Structural Approaches**

Coastal

Parallel to Shore:

- Seawalls
- Bulkheads
- Revetments
- Breakwaters

Perpendicular to Shore:

- Groins
- Jetties

Riverine

- Levees
- Dams
- Weirs

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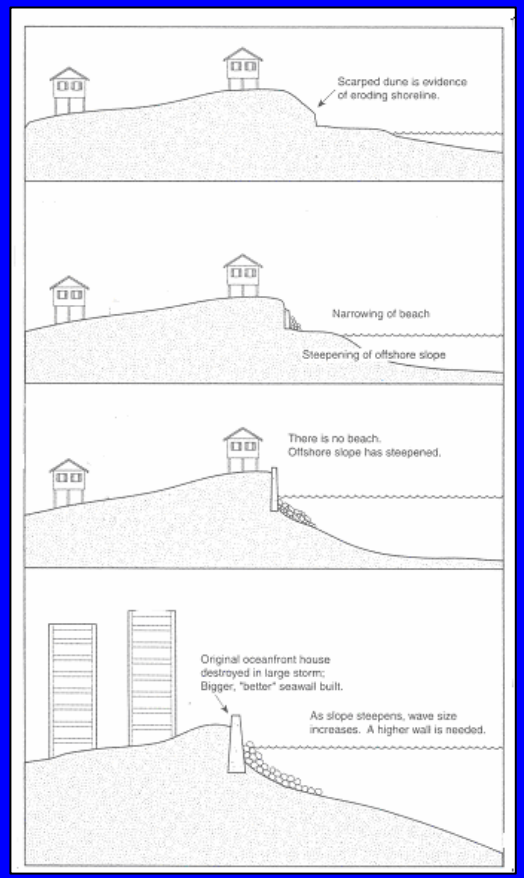
- **Figure 10.3 Saga of a Seawall**



1) An eroding shoreline threatens buildings.
2) In response, homeowners build seawall.
3) Overtime, the wall's size is increased, and the beach has disappeared.
4) Fifty years later, the seawall is huge, the beach is gone, the shore face has steepened, and the house is gone. Condominiums replace beach cottages, but no beach remains for visitors to enjoy.

Source: Adapted from Pilkey and Dixon, 1996:42

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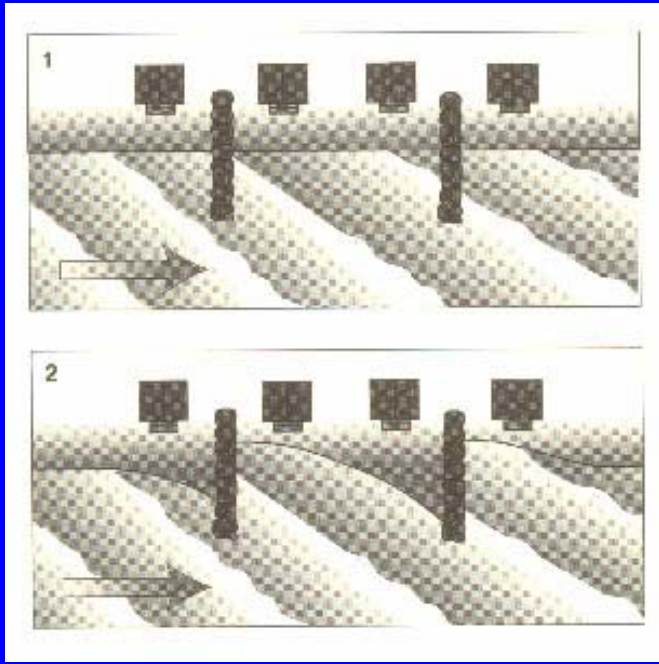
- **Figure 6.4 Impact of Groins**



Groins trap sand moving in the littoral drift along the shore, helping some beachfront property owners, but robbing others of sand.

Source: Cornelia Dean, 1999

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- **Objective 6.3**
  - Review the history and context of structural mitigation approaches:
    - Floodplain management means flood control
      - ✓Federal involvement increased incrementally
      - ✓Rise and fall of large scale dam projects
      - ✓Midwest flood disasters early 1990s

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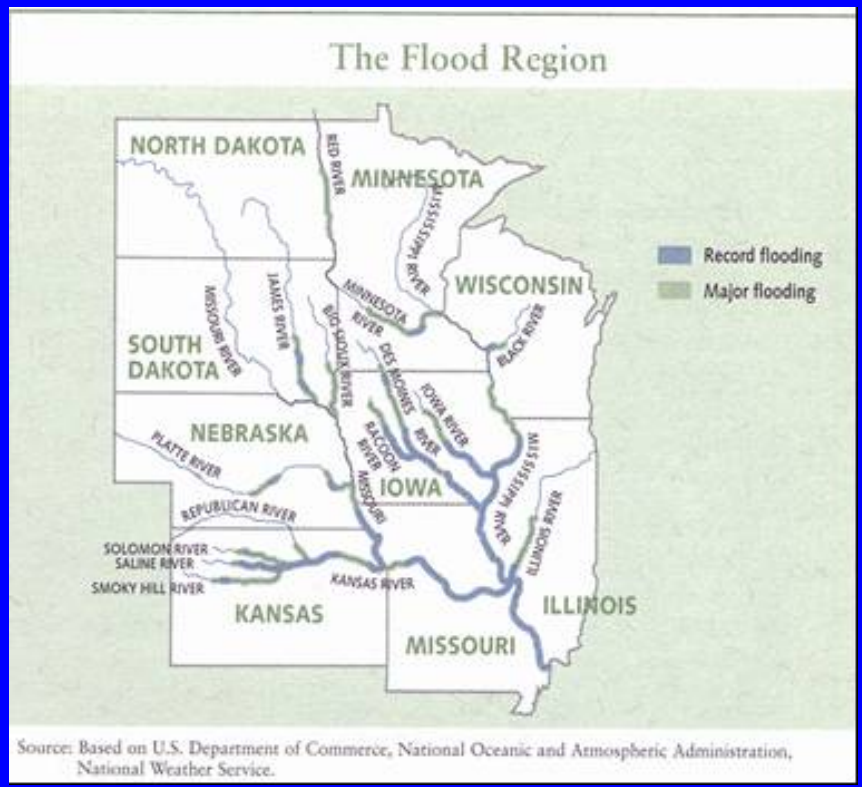
- **Figure 6.5 Flood region: 1993 Midwest Flood**



Source: Faber, 1996, p.3

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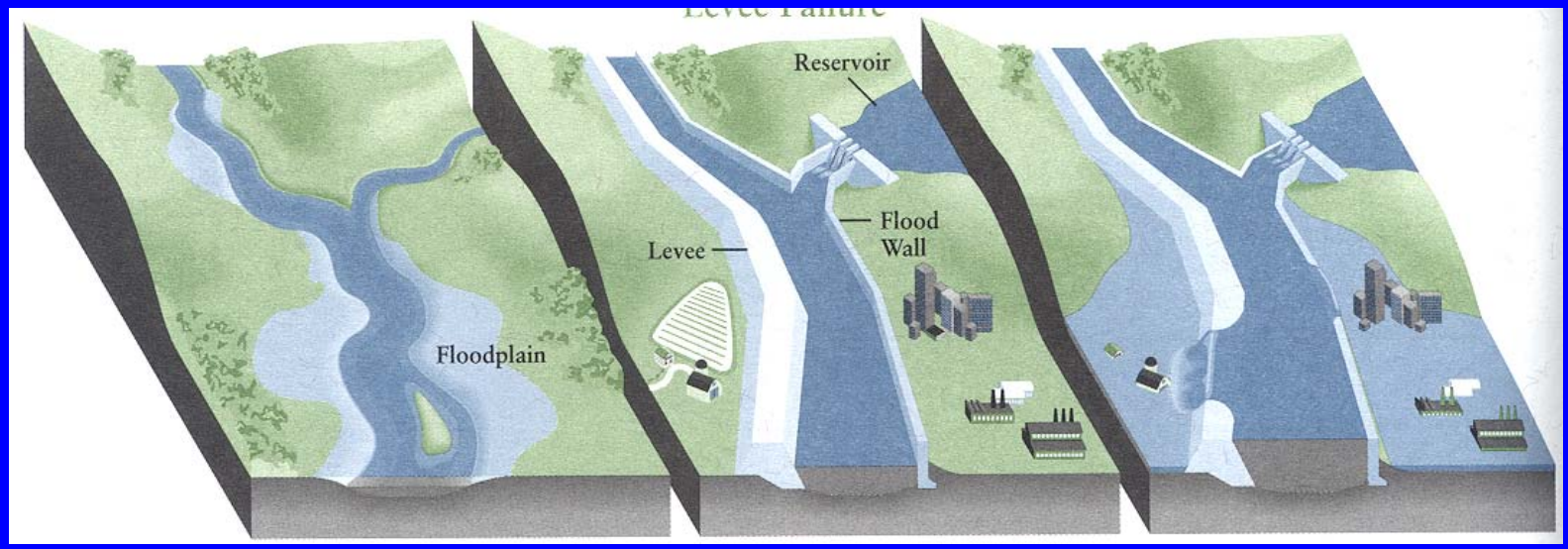
- **Figure 6.6 Levee Failure**



Source: adapted from Faber, 1996, p. 6.

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- **Figure 6.7 Pros & Cons of Structural Approaches**

Pros

- Protects property
- Allows development of hazard areas (e.g., floodplain)
- Provides sense of security

Cons

- Environmental impacts (loss of wetlands & floodplains)
- Costly
- Creates false sense of security, which may lead to greater damages in future
- Coastal: Accelerates erosion and may result in loss of beach
- Riverine: Exacerbates flooding downstream

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- **Objective 6.4**
  - Describe procedures for analyzing costs and benefits of structural projects:
    - What kinds of costs should be included in cost-benefit analysis?
    - Uncertainty
    - Value of development in floodplains

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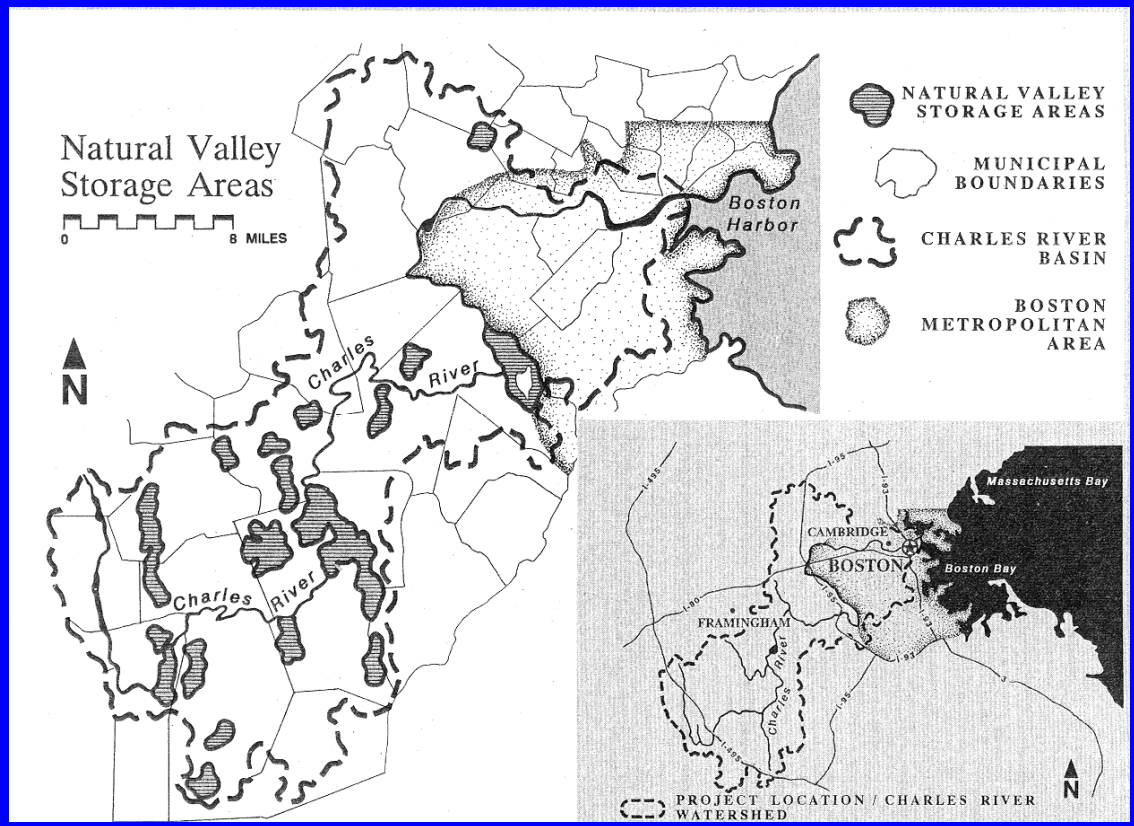
- **Figure 6.8 Charles River, Massachusetts**



Source: U.S. Department of the Interior, 1991, p. 4.

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- **Objective 6.5**
  - Discuss case studies of structural projects initiated by the Corps of Engineers and FEMA:
    - Grand Forks, North Dakota
    - Princeville, North Carolina
    - Soldiers Grove, Wisconsin

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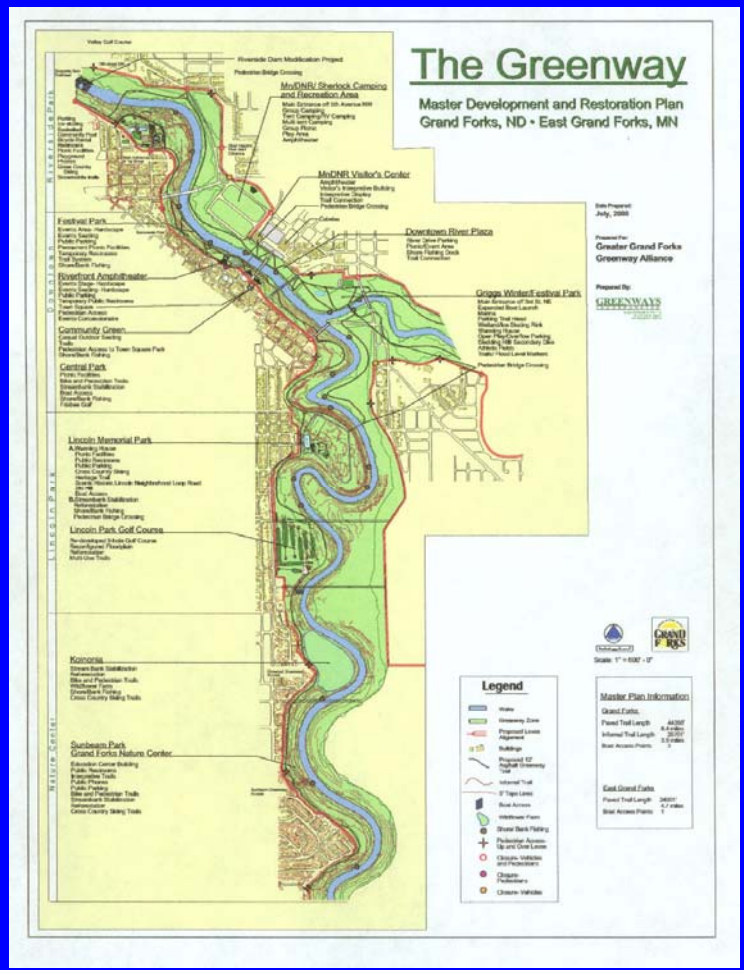
- **Figure 6.9 Grand Forks Greenway**

  Source: City of Grand Forks, ND



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- **Figure 6.10 Princeville, NC**

Source: FEMA

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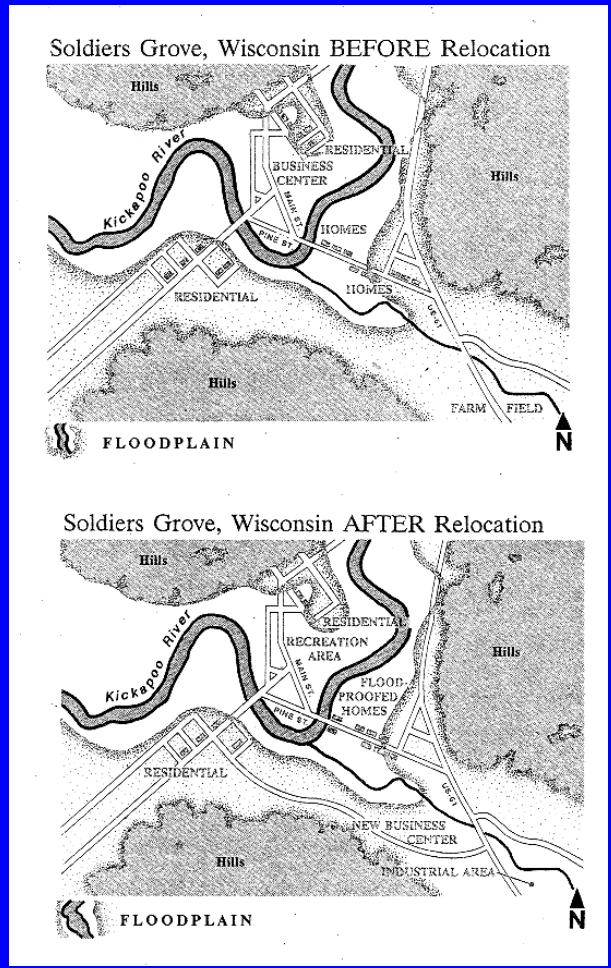
- **Figure 6.11 Soldiers Grove, Wisconsin: Before and After**

  Source: U.S. Department of the Interior, 1991 p. 28.



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- **Objective 6.6**
  - Discuss opportunities and problems with structural approaches from the point of view of community stakeholders during a structured discussion session:
    - Downtown business owner
    - Chamber of commerce
    - Tax watch association
    - Environmental organization
    - Homeowners association
    - Mayor of downstream community
    - Local planner
    - Farmer