History of U.S. Flood Policy

CEVE 412
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Outline

• Mississippi River
• Flood Control in the U.S.
• Historical Floods
• Formation of the NFIP/FEMA
• Transition to Flood Management
The Mississippi River

- 41% of the continental U.S.
- 1.25 million sq mi
- 31 states
- 92% of the U.S. agricultural exports
  - 60% of all U.S. grain exports
  - 78% of the world’s exports in feed grains & soybeans
  - Majority of the U.S. livestock
Natural Levees

A. During floods water slowed at banks, silts are deposited.

B. In between floods slow moving river deposits silt in riverbed.

C. With each flood the levees are built up. Between floods the river bed is built up too.

River may flow well above the level of the flood plain.
Avulsion

• **Avulsion** occurs when the river breaks through its natural levees to establish a shorter (steeper) path to the ocean/sea/gulf

• **Oxbows** are lakes that are formed from former channels that are cutoff at both ends

• **Bayous** are abandoned distributaries fed only by rainwater or sea water
Historic Mississippi Outlets
Man-made Levees

• Earthen embankments built on the natural levees parallel to the river channel and designed to protect the area behind it from high flows in the main channel

• Levees must be high enough to prevent enough overtopping and broad enough to resist deterioration from hydraulic piping
Levee Failure Modes

- Overflow (A)
- Sliding outer slope (E)
- Erosion first bank (I)
- Wave overtopping (B)
- Micro-instability (F)
- Settlement (J)
- Sliding inner slope (C)
- Piping (G)
- Drifting ice (K)
- Shearing (D)
- Erosion outer slope (H)
- Collision (L)
Levee Failures
Early Levees

- New Orleans, LA
  - 1718-1727
  - 5400 ft long, 18 ft wide
- States required that farmers build levees along the areas they owned along the Mississippi
- Heightened continuously between 1850-1927 because the bed of the Mississippi River kept rising
Swamp Acts 1849-1850

• Floods in 1844, 1849, 1850
• Federal gov’t gave the states land within the river floodplain
• States could sell the land to the public and use the money to build levees and drainage to reclaim the land for agriculture
• No coordination between states and levee districts resulted in frequent overtopping/failure; non-uniform
Mississippi River Commission (1879)

- Civil War & severe floods had left levees in disrepair
  - Mississippi River was the most important economic feature on the continent
  - Confederate forces had blocked navigation
  - Union forces had blown up levees

- Federal government created the MRC for flood control and navigation
  - Built a uniform levee system
1917 Flood Control Act

- Severe floods on the Ohio River in 1913
  - 415 deaths
  - $200 million damage
- 1st time the federal government allowed expenditure of funds for flood control
  - Inherently accepting responsibility for flood control
  - USACE continued to pursue a levees only approach (despite that it was obvious agriculture and land development was contributing to the problem)
Mississippi River Flood 1927

- Greatest Flood of the Mississippi River Valley on record
  - 27,000 square miles
  - 246 deaths
  - 1,000,000 people displaced
- 1st time MRC levees failed
- Private insurers dropped coverage
- Triggered massive flood control legislation
Flood Control Act of 1936

• Gave federal government responsibility for flood control AND disaster relief (via federal loans)
  • USDA would reduce rainfall-runoff
  • USACE would prevent flooding
• Between 1936-1952, $11 billion was spent to build flood control structures, but... the floods kept happening
• In 1956 Congress passed the National Flood Insurance Act, but no funding was made available
1950s & 60s

- USACE, USGS, and USDA began developing methods for evaluating flood hazards
  - Precipitation Totals
  - Flow velocities
  - Water elevations
  - Flood frequencies
- HEC-1, 2, 3, and 4
A National Flood Insurance Program

• National Flood Insurance Act (1968)
  • Congress funded the NFIP
    • Subsidized flood insurance to homeowners in communities that actively participate in flood mitigation
  • Established guidelines for mapping flood hazards
  • 100-year floodplain was established as the national minimum standard for delineating the Special Flood Hazard Areas (SFHAs)
What is a “100-year” floodplain?
Flood Insurance Rate Maps (FIRMs)
Growing Costs
Hurricanes Katrina, Ike, and Sandy
Biggert Waters & HFIAA

• Biggert Waters Flood Insurance Reform Act (2012)
  • Balance the FEMA budget within 10 years by increasing flood insurance premiums to actuarial rates
  • Reducing or removing subsidies for second-homes and repetitive loss properties (primarily vacation homes in coastal areas)
  • Increase premiums from $300 to $20-30K per year

• Homeowner Flood Insurance Reform Affordability Act (HFIAA) (2014)
  • Repealed and modified Biggert-Waters
  • Reinstated some subsidies and slowed down premium rate increases
Discussion Questions

• What is the flood control paradox? How does this play out in the example of the Old River Structure on the Mississippi?

• What does Tarlock mean by an “incomplete” transition from flood control to risk management?

• How have U.S. flood policies encouraged development in flood prone areas?
Flood Control Paradox
Old River Structure on the Mississippi
Addicks & Barker Reservoirs
Hurricane Harvey
Extra Slides
Floodplain Management

ENCROACHMENT

FILL

BASE FLOOD ELEVATION (BFE)

NORMAL CHANNEL FLOW

FLOODWAY

FLOOD FRINGE

100-YEAR FLOODPLAIN

FLOODPLAIN
Flood Prevention
Flood Proofing
Flood Accommodation
Emergency Response
The “dancing floodplain”

- Environmental Characteristics
- Hydrologic & Hydraulic Modeling
- Riverine SFHA Delineation
- Flood Risk Regulations
- Mitigate Riverine Flood Losses

- Extreme Rainfall
- Disconnect between risk delineation and losses
- Changing land use conditions
- Climate non-stationarity
The “dancing floodplain”
Coastal Flooding

- Galveston, 1900
- Hurricane Camille, 1969
- Hurricane Katrina, 2005
Infrastructure Report Card