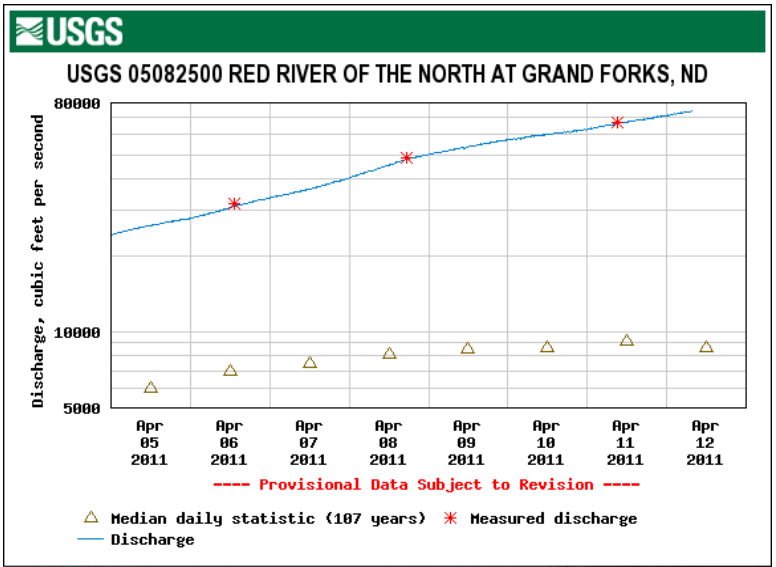
# LECTURE #20: Flooding Monitoring & Mitigation

**Date: 7 April 2021**

## I. Monitoring

- important website for real-time monitoring of streams/rivers:
  - https://waterwatch.usgs.gov/

- stream gages
  - devices that measure stream height and/or discharge rate
  - provide the data to create a hydrograph
  - mentioned this topic in the last lecture when introducing hydrographs
    - *you'll see it again in the recitation this week*
    - system of devices on most large creeks, streams, rivers
    - operated by the USGS
      - ➢ example: past conditions at the Red River, ND *(right)*





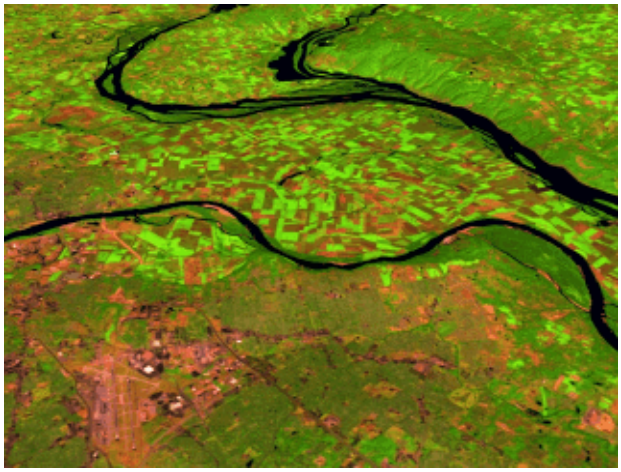
  - relatively simple design
    - *not* in the river channel but connected to it through several inlet pipes
    - pipes empty into a well where the water level is the same as the current river level
    - water level is monitored by a float
    - data are recorded on a local storage device *(hard drive)*

        - data also transmitted real time using either short-wave or cell phone networks

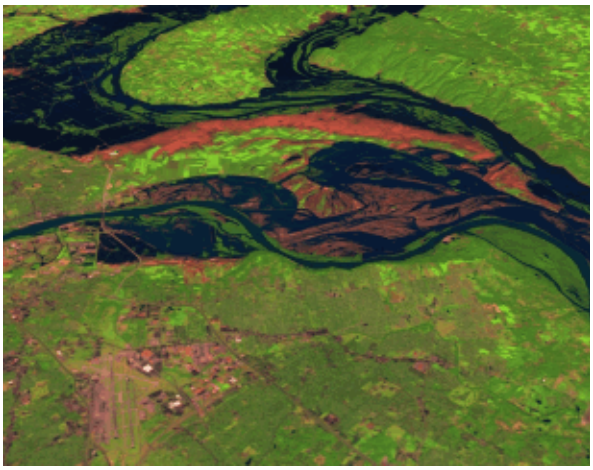
- use of satellite data
- <u>example:</u> 1993 Midwest Floods
    - topic of the video you will watch
    - the greatest in recorded history in the Mississippi River valley
    - displacement of jet stream for months
        - produced consistently high rainfall in one region

    - 150% of normal rainfall over large area of US
        - heaviest in headwater regions of Missouri and Mississippi Rivers

    - flooding: most extreme in St. Louis area
        - south of confluence of Missouri and Mississippi Rivers



**St. Louis - 1988**



**St. Louis - 1993**

## II. Flash Flooding:

- *very* rapid rise in stream levels
    - typically occur in normally dry stream beds *(ephemeral)*
    - occur commonly in semi-arid regions, where there is:
        - clay-rich soil
        - infrequent precipitation
        - very little infiltration

- high hazard conditions
    - unexpected by public
    - short notice
    - highly erosive & damaging


**Flash Flooding – Cave Creek, AZ**

- <u>case study:</u> flash flooding of Washington Blvd. in Pittsburgh
  - Aug. 19, 2011 at 4:30pm *(rush hour)*
  - 1.79 inches of rain in 30 min!
    - volume = 208 Olympic sized swimming pools
    - 10 feet of water
    - sewer capacity was exceeded
    - killed 4 people


**Flash Flooding – Washington Blvd., Pittsburgh**

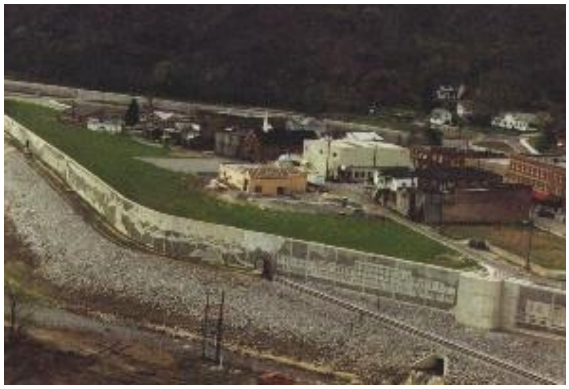
## III. Flood Control and Mitigation

- <u>flood mitigation</u>: structures, efforts, policies designed to minimize flooding effects/hazards

- <u>flood control</u>: structures, efforts, policies that reduce/divert stream flow (discharge)

  - floodway
    - eliminate new building on floodplains
    - most existing structures are relocated
    - greenway corridor - designed to slow, absorb, or store floodwater

  - floodwall
    - reinforced concrete structure parallel to river bank
    - stabilizes bank
    - barrier to flood water
    - if overtopped, floodwall acts as reverse dam



**floodwall**

**dam**

  - dams
    - provide water supply
    - hydroelectric power generation
    - recreation
    - flood control by holding back potential flood waters

- channelization
  - modification of channel:
    - straightening
    - clearing
    - widening
    - deepening
    - lining with concrete
  - that can change:
    - magnitude of erosion
    - sediment load
    - water turbidity
    - stress to aquatic plants and animals

**channelization**

- levees
  - ridges of sediment deposited along stream banks during floods
    - or can be man-made
    - prevent subsequent flooding from small increases in stream flow
  - urban areas
    - levees artificially enlarged by adding a concrete cap/wall
    - prevents flooding but also prevents soil nutrient replenishment
  - can vary greatly depending on cost

**sandbag levee**

**The Netherlands**

**New Orleans** *(post-Katrina)*

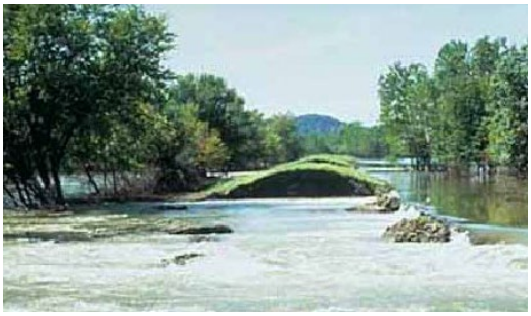
## IV. Assigned Video: *Flood!*

- aired on Nova (PBS) in 1996
- documents the 1993 “Great Flood” along the Mississippi River
  - examines the causes and the science of flood monitoring
  - describes the failures and potential failures of all the flood protection (mitigation) structures

- details the response by FEMA and the Army Corp of Engineers
- explores the human response and impact
- presents one very novel way that a town along the Mississippi River was spared because of creative engineering

- summary
  - 534 counties in 9 states were declared for federal disaster
  - costs
    - $4.2 billion (direct federal aid)
    - $1.3 billion (federal flood insurance)
    - ~ $6 billion (state, county, private)
    - **Total:** ~ $15 billion *(in 1993 dollars)* / ~ $26 billion today
  - relocation
    - 30,000 sq. miles flooded
    - 50,000 homes destroyed
    - 20% (~ 54,000 people) who lived in the flood plain

- past flood control measures
  - US Army Corps of Engineers (1930-1940's)
  - built 275 levees, large flood walls, channelization
    - designed to contain a 500-year flood
    - 1 in 500 chance that a flood that large can occur any year
    - only in large urban areas (like St. Louis, MO)
  - over time, other communities built their own controls
    - mostly earthen levees
    - designed for 100-yr floods
  - failures: breached levees
    - built by Corps of Engineers
      - total of 42 failed
      - *85% successful*
    - 1400 non-federal levees
      - total of 800 failed
      - *43% successful*



- effects
  - economic:
    - bridges closed/collapsed across Mississippi River
    - businesses closed due to lack of water and power
    - loss of productivity during clean-up operations
  - health:
    - sewage treatment plants flooded & sewage released
    - mosquito breeding grounds enlarged
    - release of harmful chemicals
  - biological:
    - positive: waterfowl attracted, reclamation of old wetlands
    - negative: large loss of domestic animals and grazing lands