Massachusetts Surface Water and Groundwater Network

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Outline

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- Brief History
- Map View of the Network
  - Surface Water
  - Groundwater
- Evolution of Streamgaging
- Historical Floods
  - March-April 2010 Flood
- Importance of Flood Frequency Analyses
- Brief Look at Groundwater

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USGS Mission

- Collecting data on a systematic basis to determine the quantity, quality, and use of surface and ground water.
- Conducting interpretive water-resource appraisals to describe the consequences of alternative plans for developing land and water resources.
- Conducting basic and problem-oriented research in hydraulics, hydrology, and related fields.
- Developing information on water-related natural hazards such as floods, landslides, mudflows, and land subsidence.
- Coordinating the activities of all Federal agencies in the acquisition of water data.
- Disseminating data and findings through reports, maps, and other forms of public media.
- Providing scientific and technical assistance in the hydrologic fields to other Federal agencies, to State and local agencies, and, on behalf of the U.S. Department of State, to international agencies.

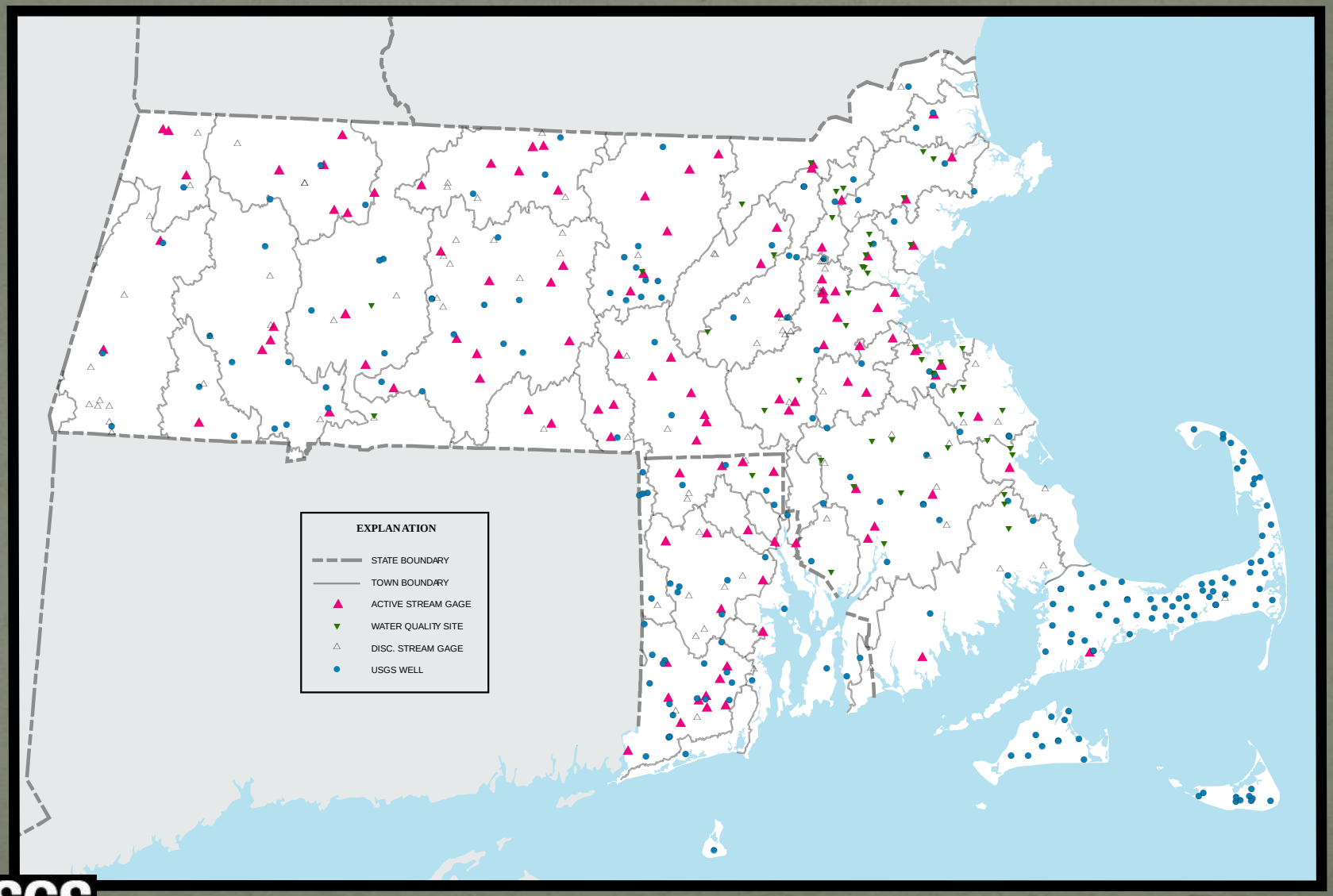
Brief History

- Streamgaging began in 1889 with the nation's first streamgage on the Rio Grande River at Embudo, New Mexico.
- Streamgaging is now done in all 50 states, Washington DC, Puerto Rice, American Samoa, Guam, Northern Mariana Islands, and the Virgin Islands.

Brief History

- Cooperative Program established in 1928
- USGS and cooperating agency put up 50 percent of costs
  - Of course, this has evolved over the years as politics, priorities, and funding levels have changed (or, in some cases, not changed)
  - The work is more expensive now than ever before.
    - Newer, more sophisticated and expensive technology
    - Response times are increased many time over for flood response and coordination (=more expensive)

Map of the Network



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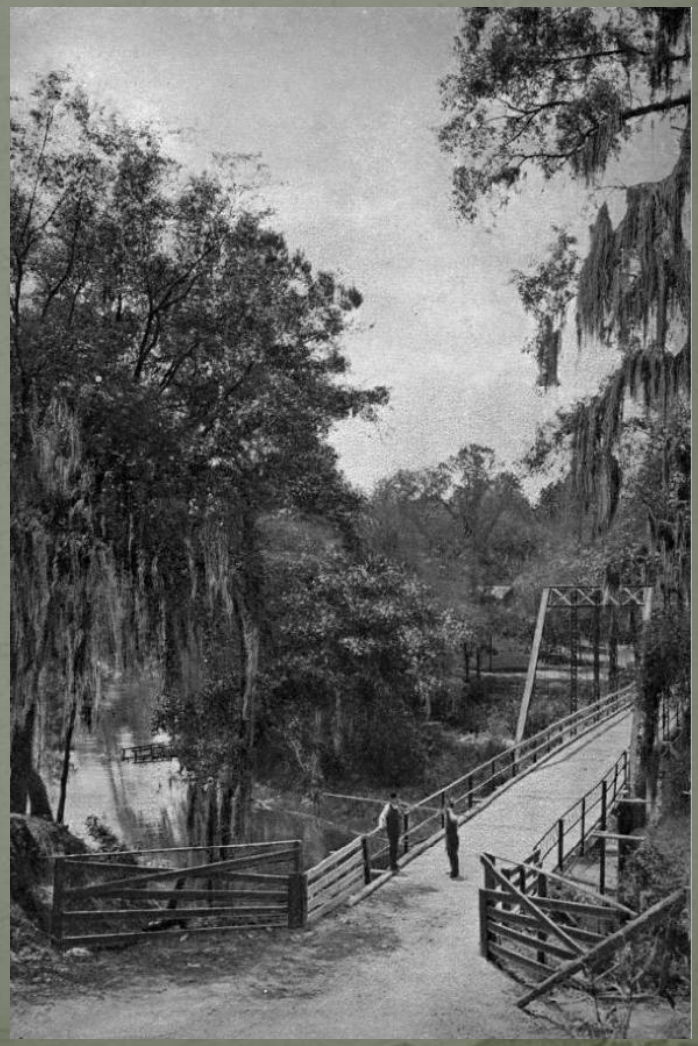
Evolution of Streamgaging: Stage



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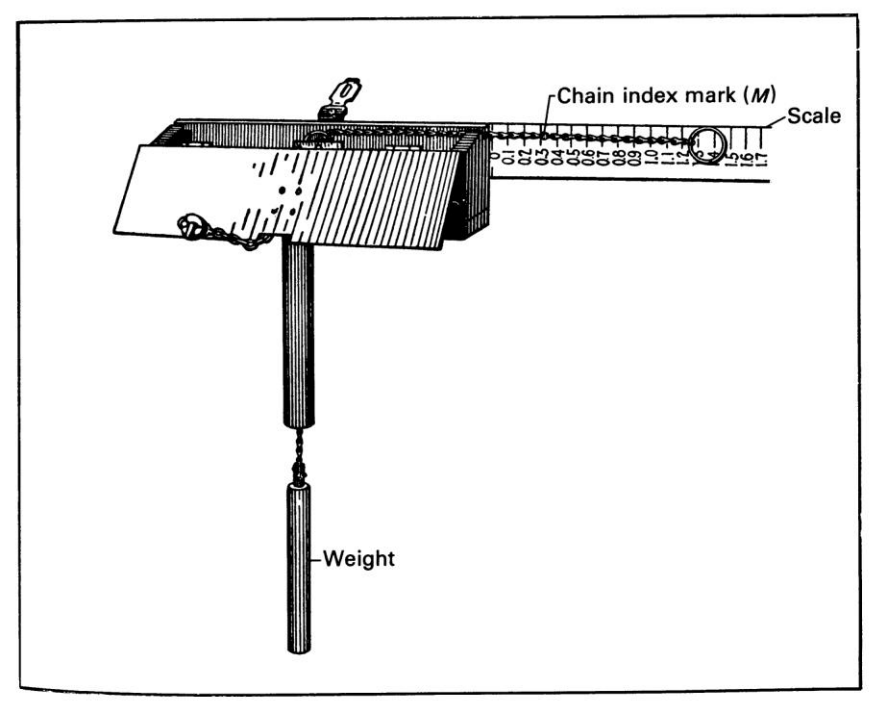

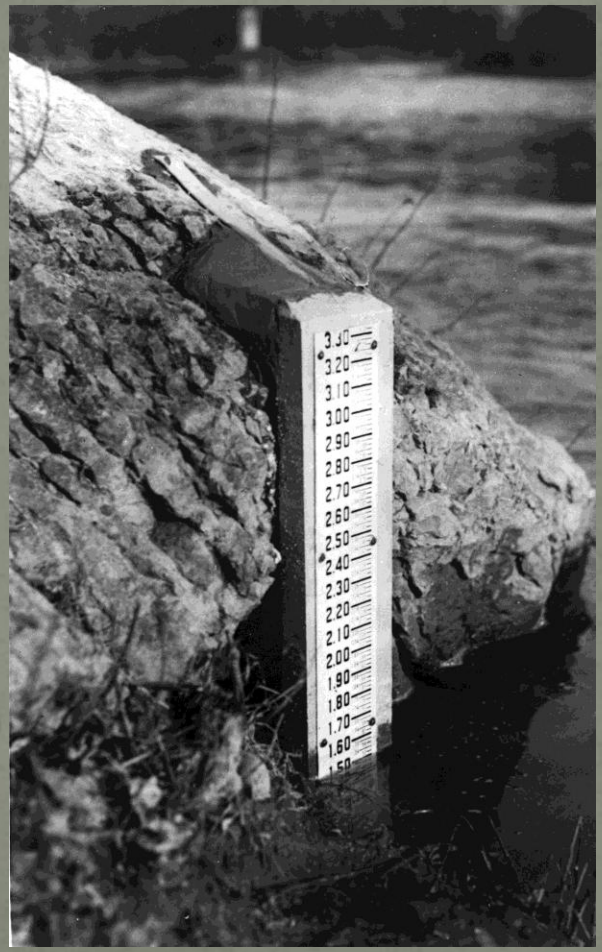

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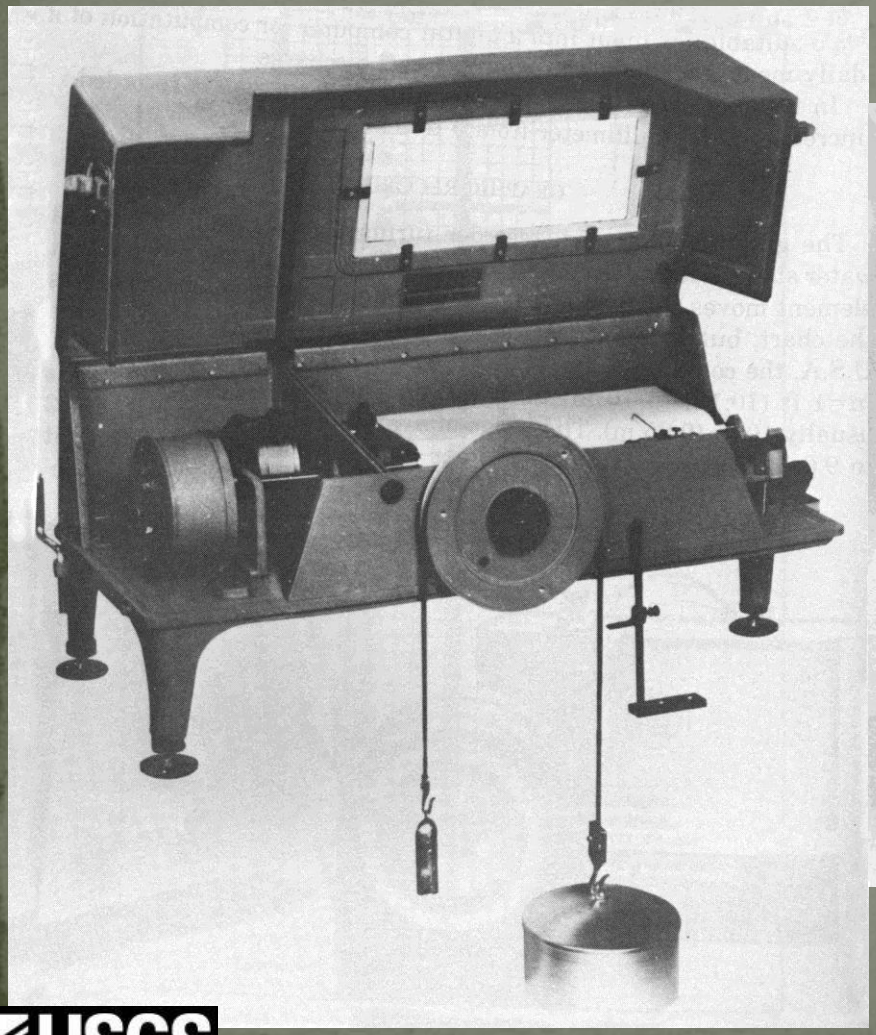

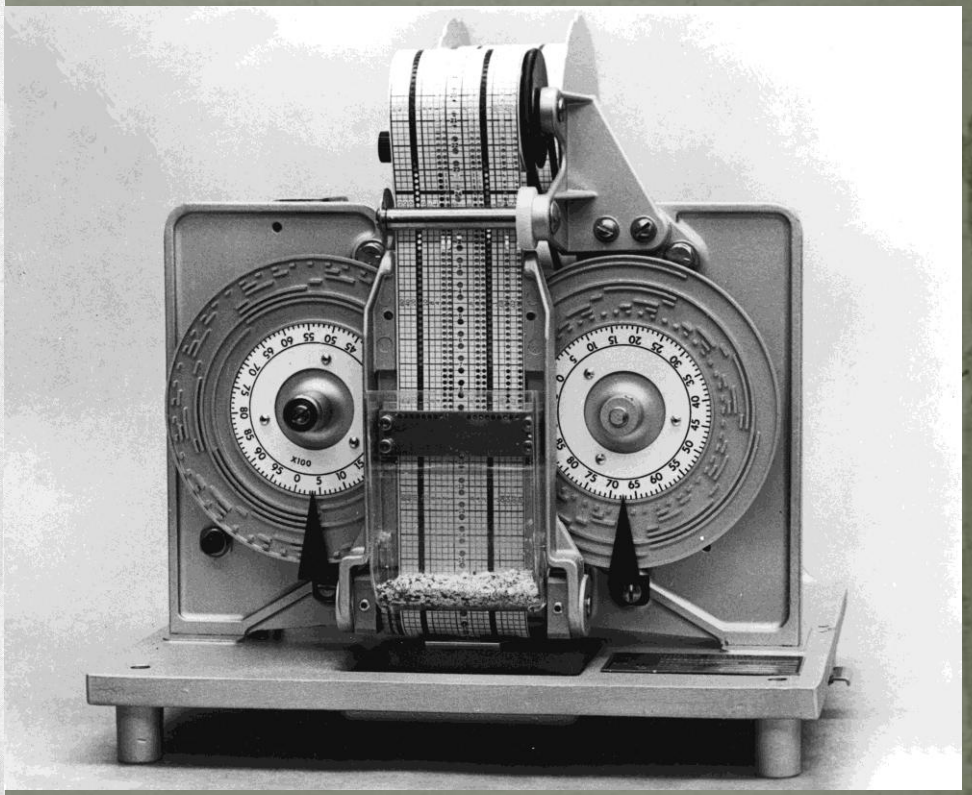

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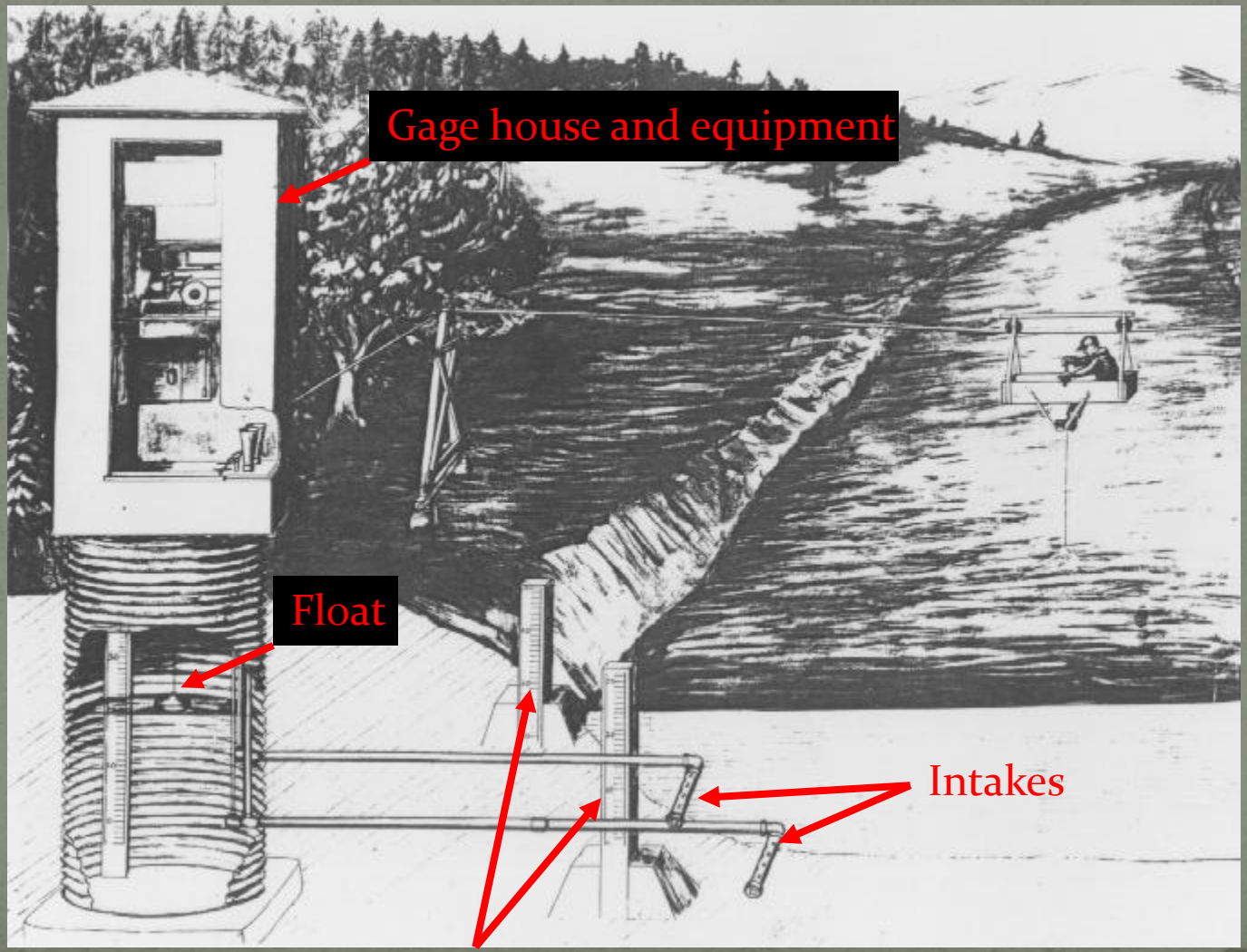

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Evolution of Streamgaging: Stage

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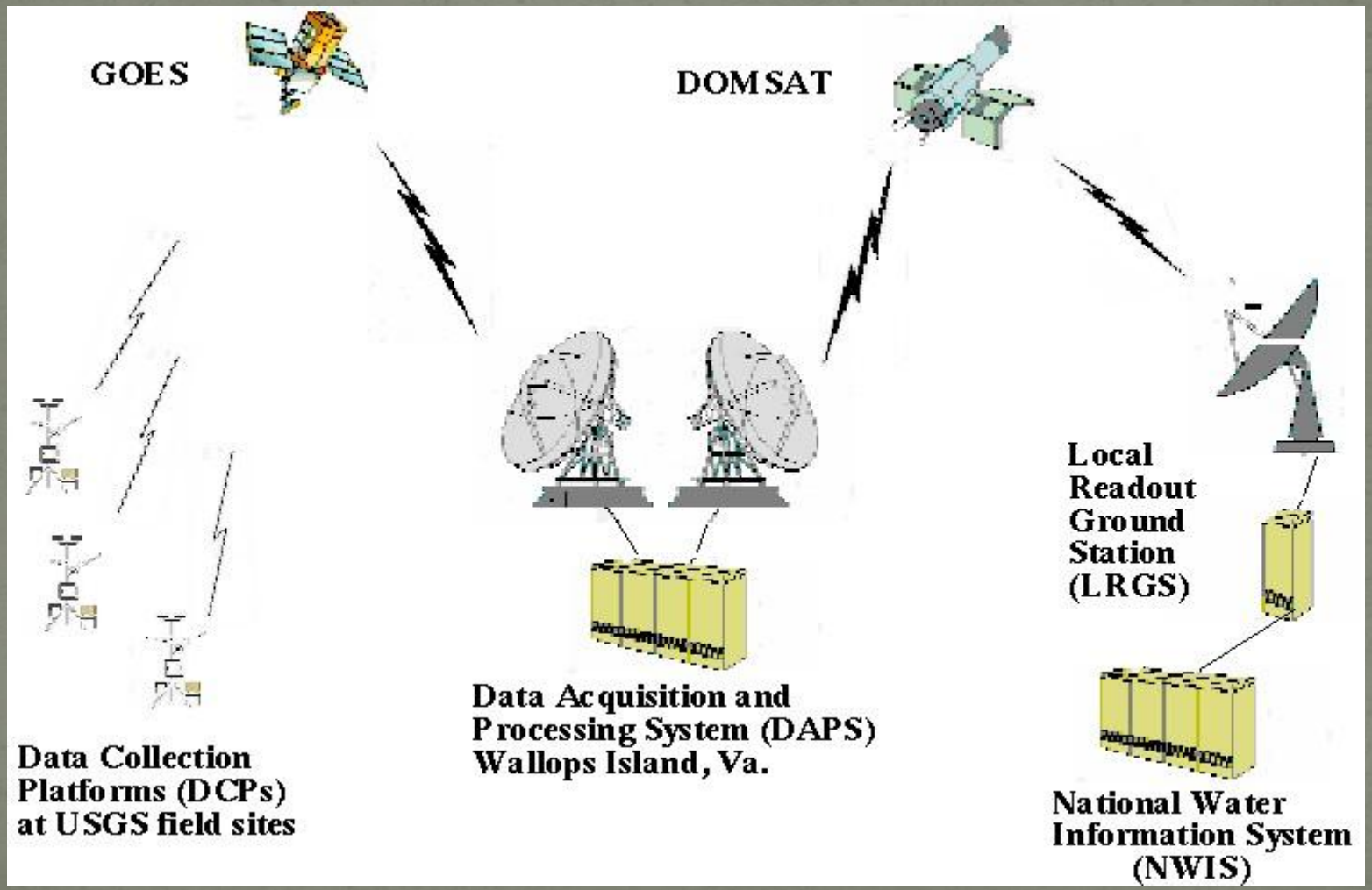
Evolution of Streamgaging



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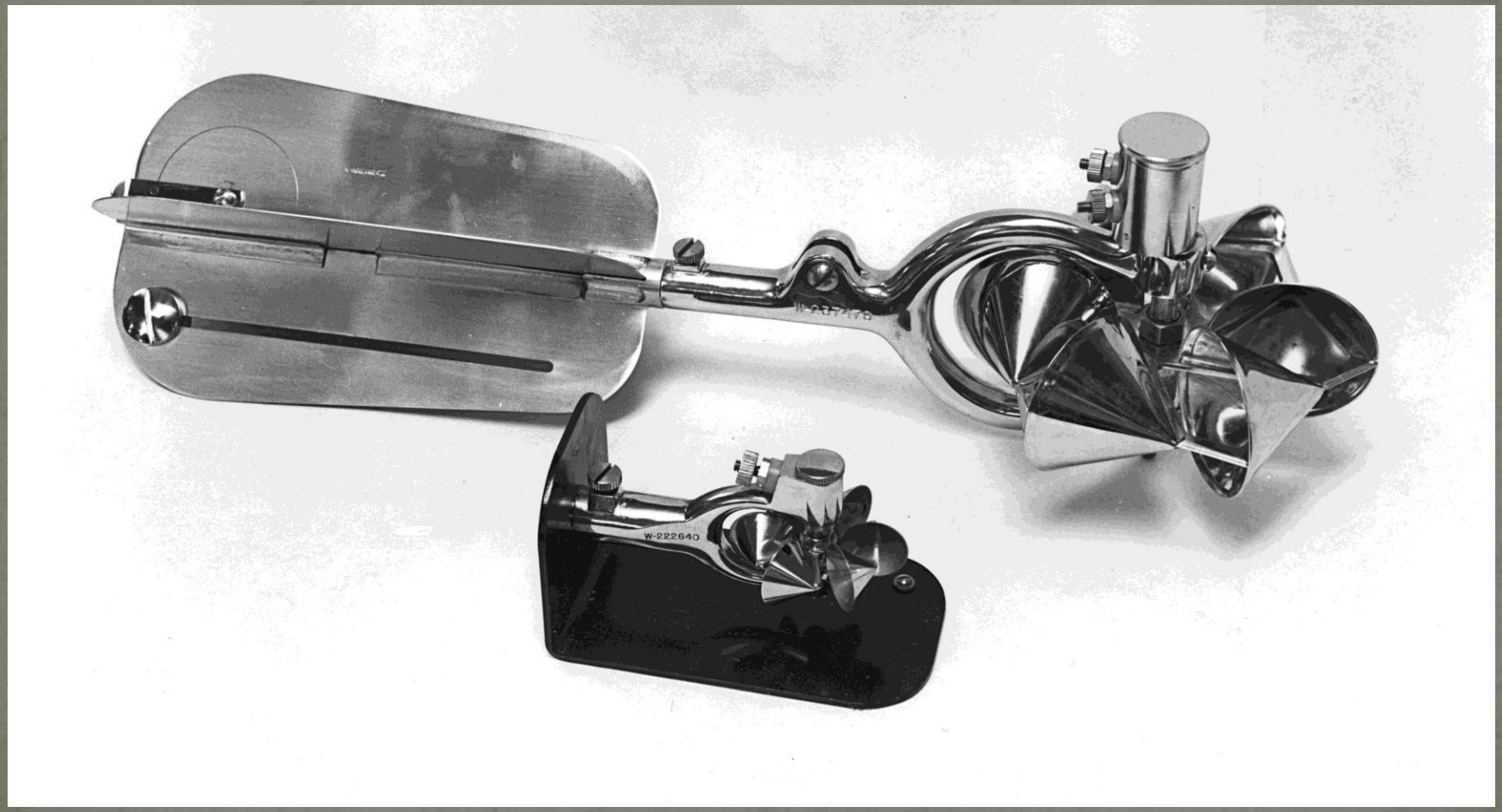
Evolution of Streamgaging: Discharge (mechanical)



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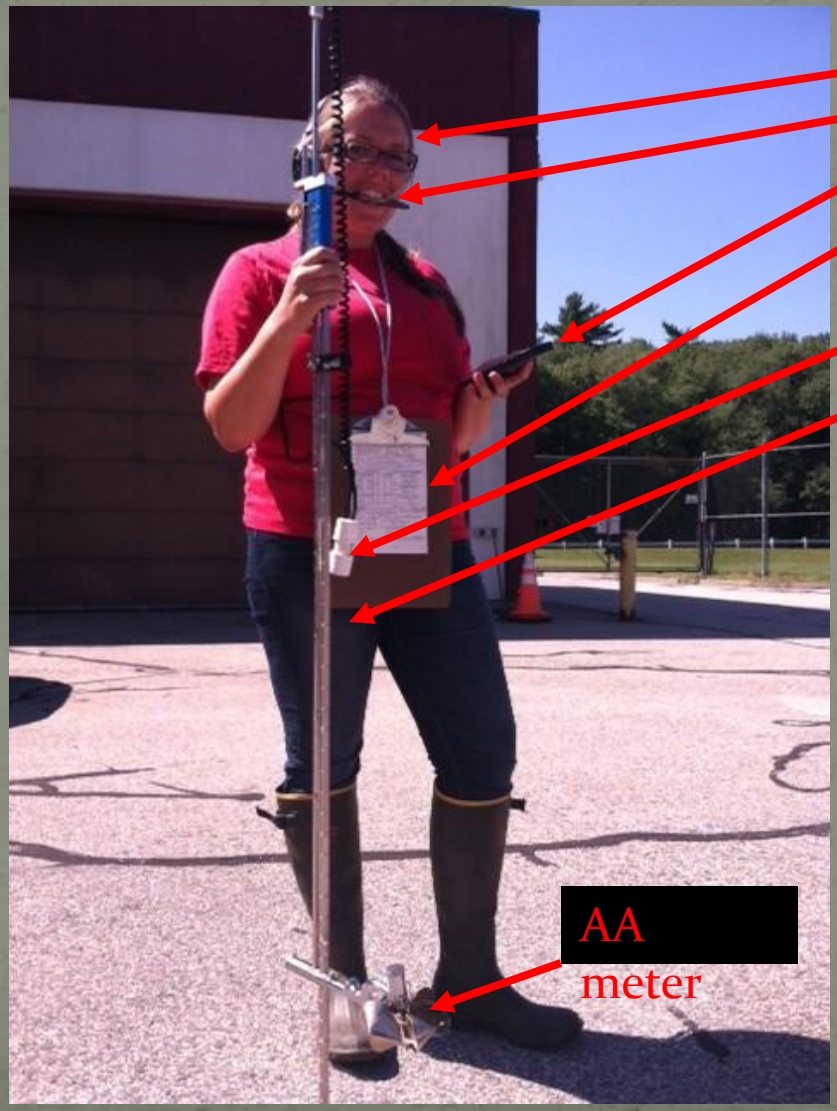

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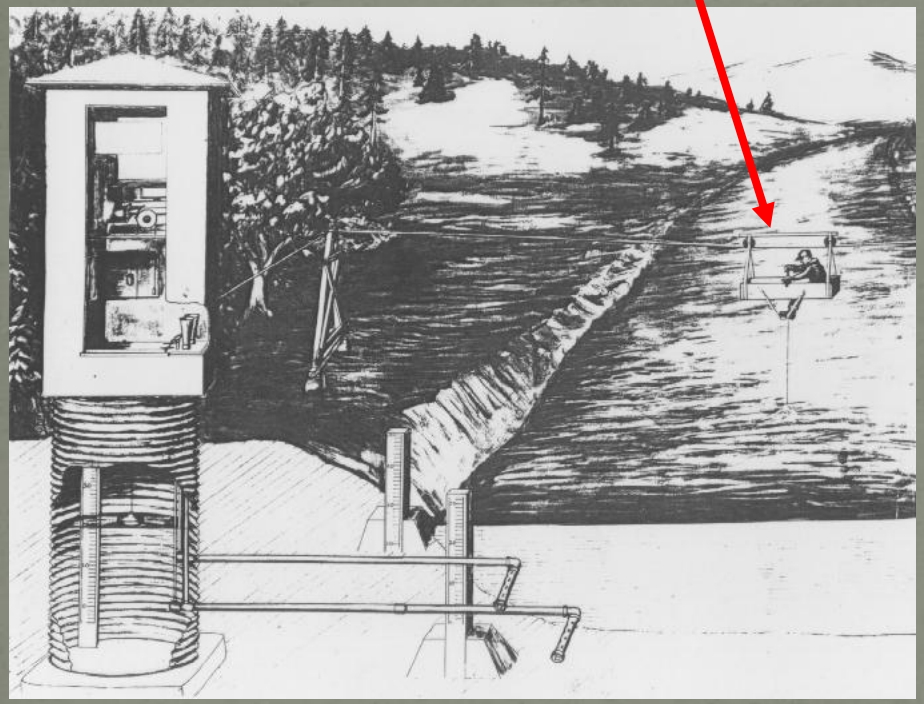

Cable way and car

Evolution of Streamgaging: Discharge (mechanical)

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Evolution of Streamgaging: Discharge (mechanical)

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Evolution of Streamgaging: Discharge (hydroacoustics)

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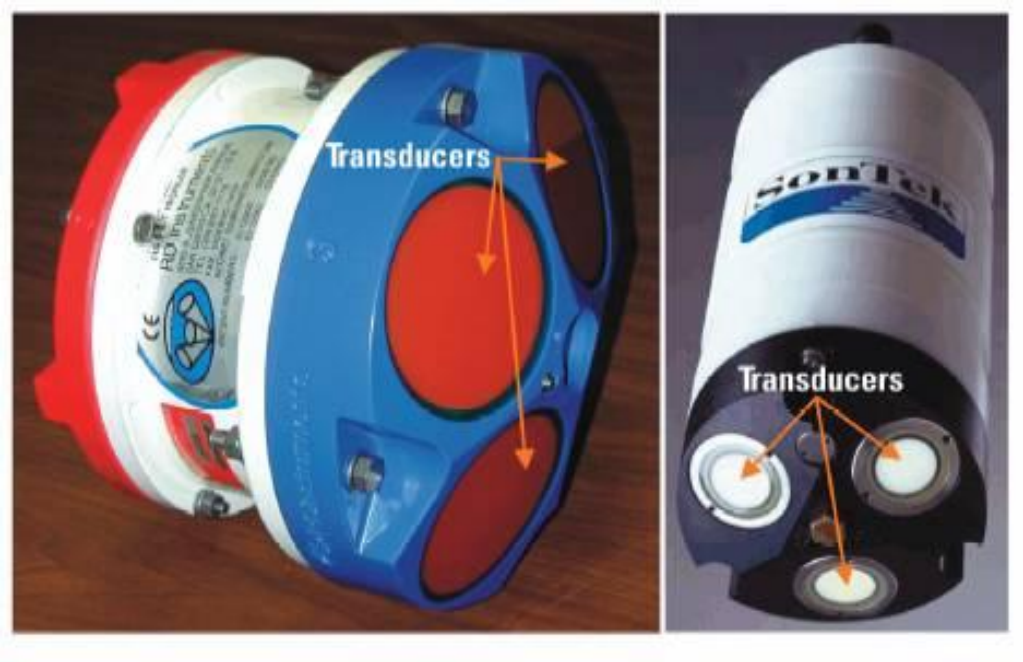
Evolution of Streamgaging: Discharge (hydroacoustics)



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Evolution of Streamgaging: Discharge (hydroacoustics)

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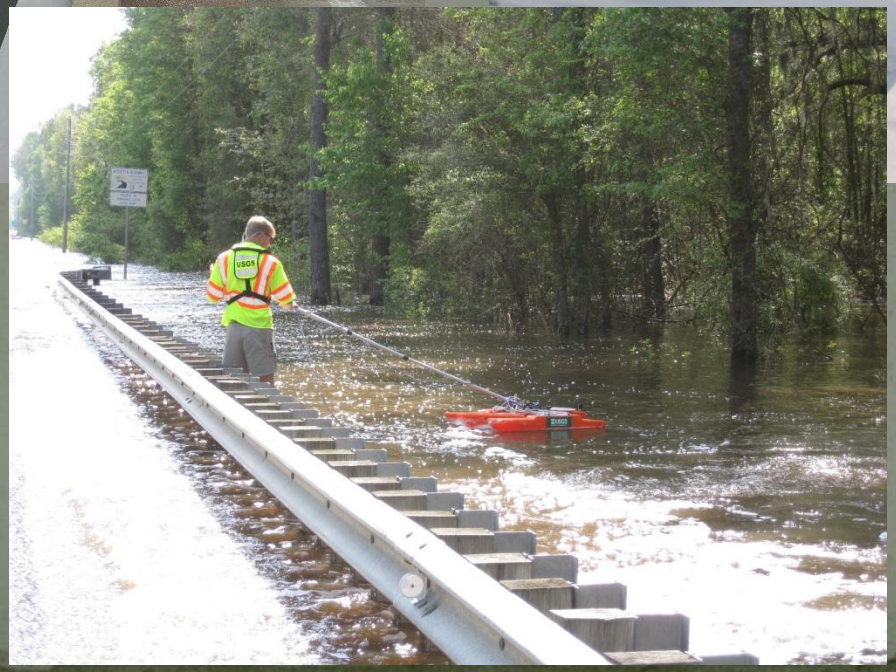

Evolution of Streamgaging: Discharge (hydroacoustics)

Major Floods in Massachusetts

- November 1927
- March 1936
- September 1938
- August-October 1955
- March 1968
- February 1978
- April 1987
- June 1998
- March 2001
- October 2005
- May 2006
- April 2007
- March-April 2010
- August-September 2011

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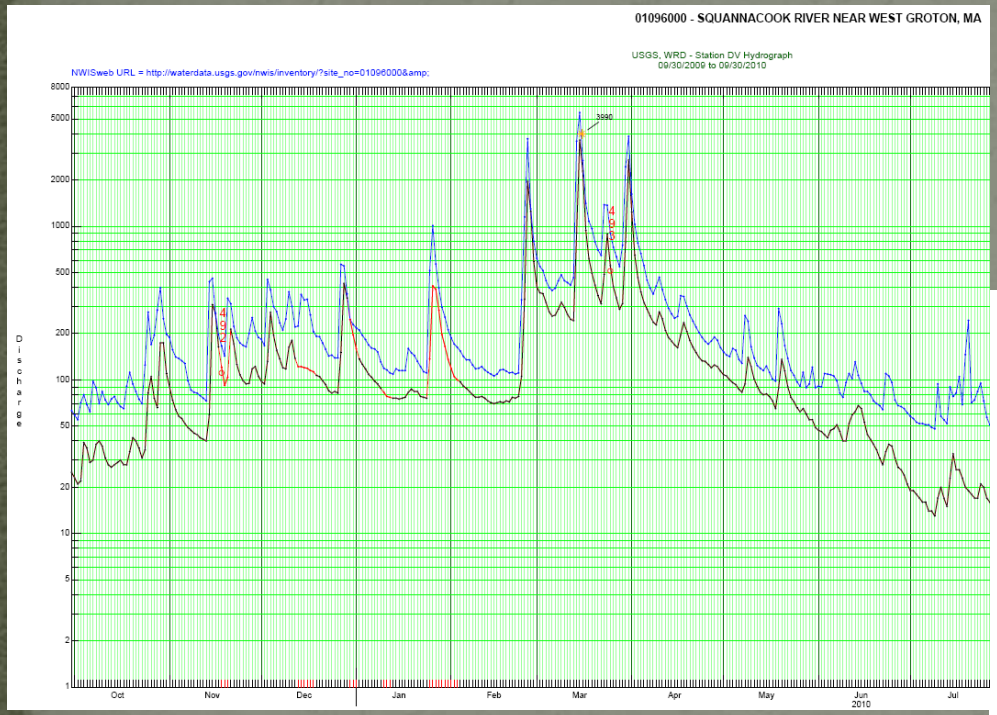
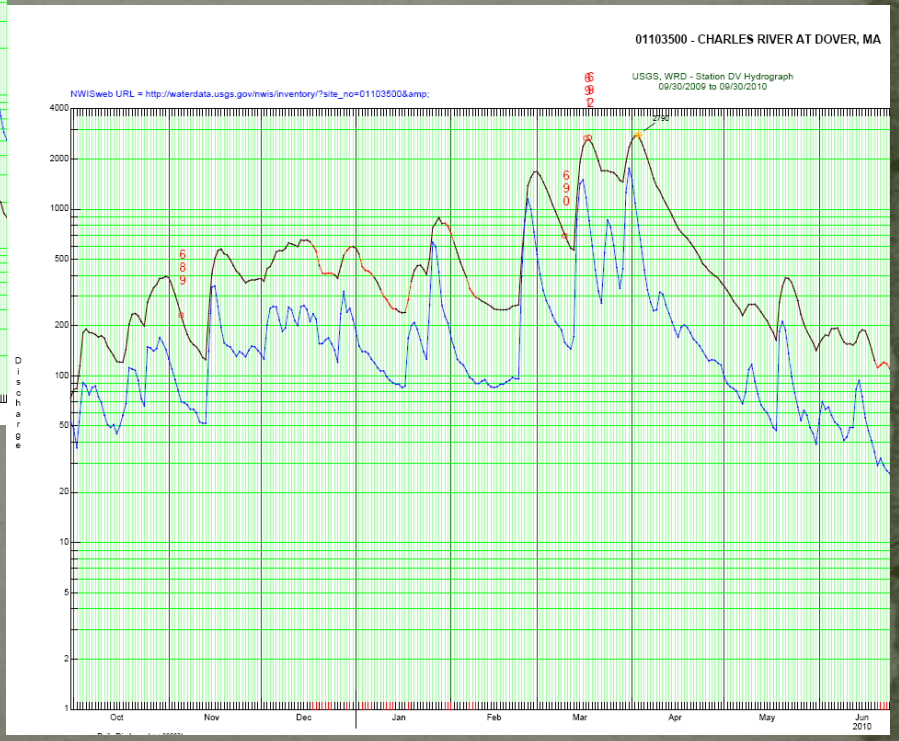
Flood: March-April 2010

- Caused by a series of four rain events moving through the region.
- First event peaked about February 26
- Fourth event peaked about March 31
- The cumulative effects of the four rain events (during about a one month period) produced the record setting flood.
- Peaks of record set at 8 of 30 long-term network gages dating back to 1904.

Flood: March-April 2010





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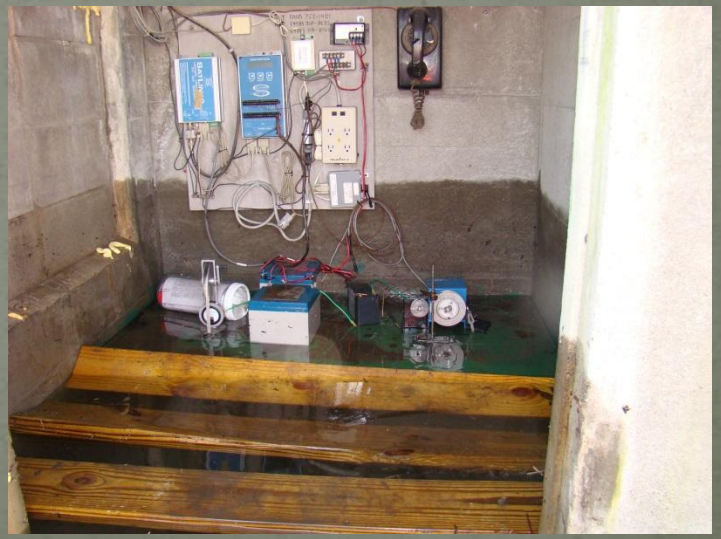
Flood: March-April 2010



Nashua River at East Pepperell, peak March 16, 11,100 cfsl;15.75 ft

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Flood: March-April 2010

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Flood: March-April 2010

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Importance of Flood Frequency

- Why do we need these statistics?
  - Needed for infrastructure design and maintenance (i.e. highway bridges, culverts)
  - Flood forecasting
  - Emergency management operations
  - Environmental management decisions

  (Just to name a few…)

  But…You need to have long-term data!

Importance of Flood Frequency

- You have to have long-term data
  - The more data in the dataset, the better the statistics are
  - Minimum required for flood frequency stats is 10 years; But…run risks with only 10 years (?)
  - At least 30 years is better
  - And, 100 or more years is phenomenal

Importance of Flood Frequency

- Where are our gages with 100 years or more data?

EXISTING CENTURY GAGE

01170500, Connecticut River at Montague City, MA, Mar. 31, 1904 to 2013 (109 yrs)

NEW CENTURY GAGES

01168500, Deerfield River at Charlemont, MA, June 19, 1913 to 2013 (100 yrs)

01173500, Ware River at Gibbs Crossing, MA, Aug. 20, 1912 to 2013 (101 yrs)

01175500, Swift River at West Ware, MA, Oct. 1, 1912 to 2013 (101 yrs)

01176000, Quaboag River at West Brimfield, MA, Aug. 19, 1912 to 2013 (101 yrs)

01185500, West Branch Farmington River near New Boston, MA, May 27, 1913 to 2013 (100 yrs)

01197500, Housatonic River near Great Barrington, MA, May 17, 1913 to 2013 (100 yrs)

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Importance of Flood Frequency

- What happens if these stats are not updated regularly?
  - Risks of building bridges too low
  - Risks of improper flood forecasting
  - Potential infrastructure costs incurred
  - Potential loss of life and property
  - Erroneous management decisions causing detrimental impacts to the environment
  - **Recommended interval for flood frequency analyses is at least once every 10 years**

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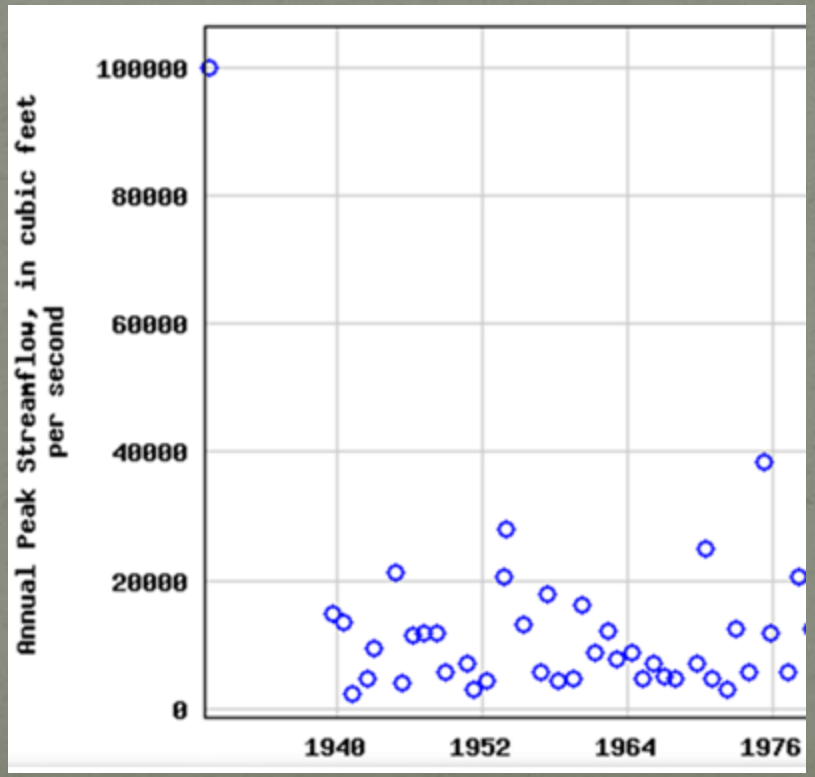
Importance of Flood Frequency

- Example:
  - Most recent analysis in Florida was completed using data up to 2006 (published in 2010).
  - The study was last completed using data up to 1978 (published in 1982)

  - Allot can happen in 28 years!…
    - …And, it did!

Importance of Flood Frequency

02368000 Yellow River at Milligan, Florida; map number 283									
This investigation (2010)	66	8,520	17,300	25,600	39,200	51,900	66,600	83,700	111,000
Bridges (1982)	40	8,310	14,900	20,500	29,200	37,000	45,900	56,100	71,800
Percent change		3	16	25	34	40	45	49	55



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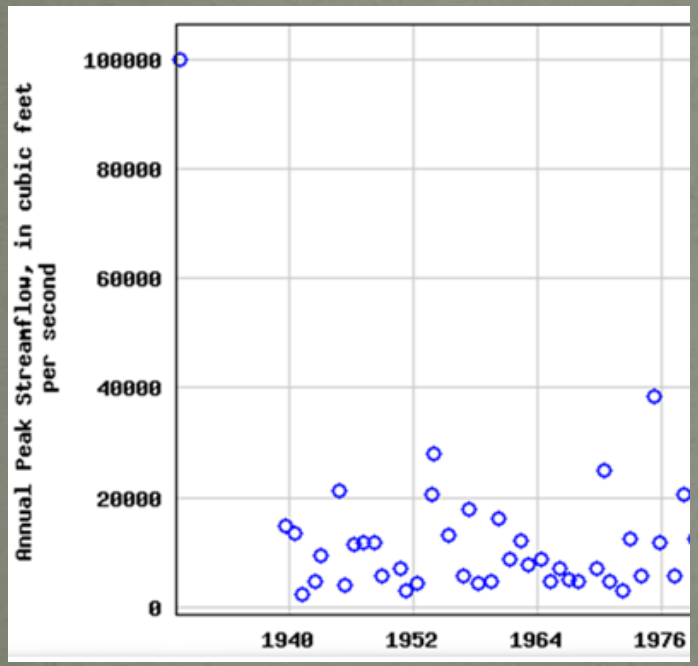

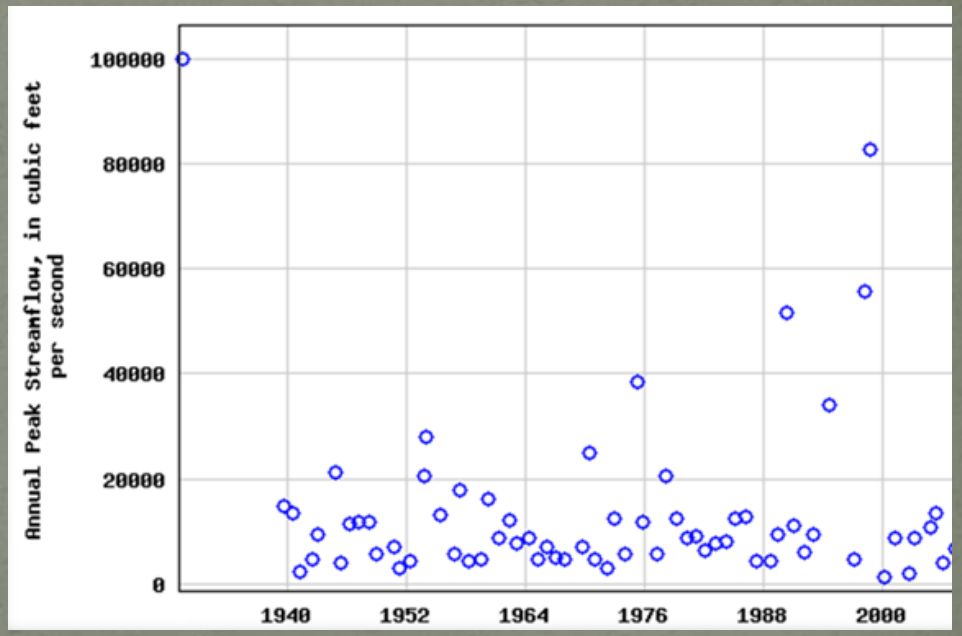

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Importance of Flood Frequency

- Blue prints for a new bridge was already designed (using old statistics) and construction ready to begin
- Bridge was designed too low (just under the 50-year flood level), when it should have been designed at over the 100-year flood level
- Once informed of what the new statistics indicated, the bridge had to be redesigned, costing the agency at least half a million dollars for the blue print

A Brief Look at Groundwater

- Most densely populated network of wells in the country
- Primary uses for the data include:
  - Management decisions from the Drought Management Task Force
  - Septic system site evaluations

A Brief Look at Groundwater

- Secondary uses include:
  - Wet basement concerns by citizens/businesses
  - Data are used by the state geologist for his/her needs and research
  - Water table map updates

- And, it is time for an update of the water table maps

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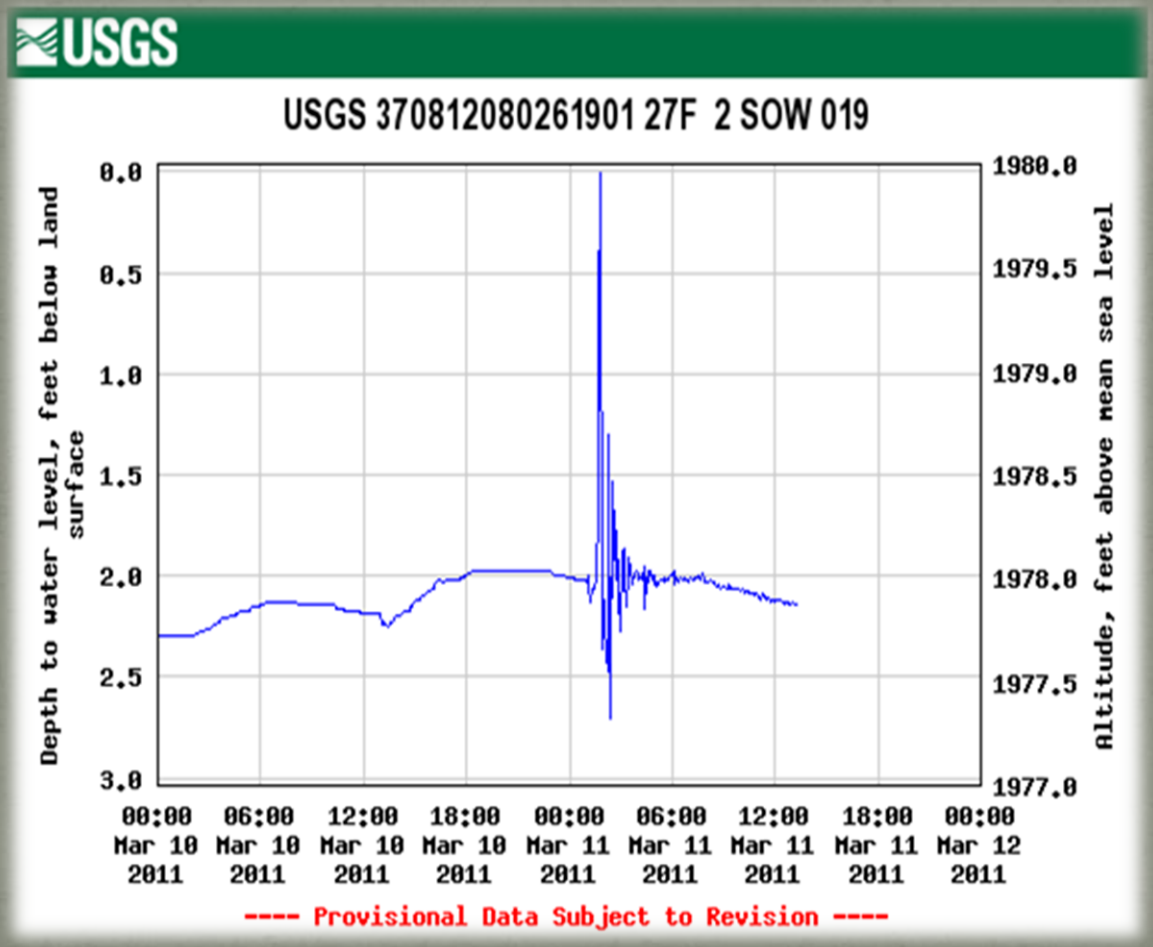
A Brief Look at Groundwater (detour to Virginia)



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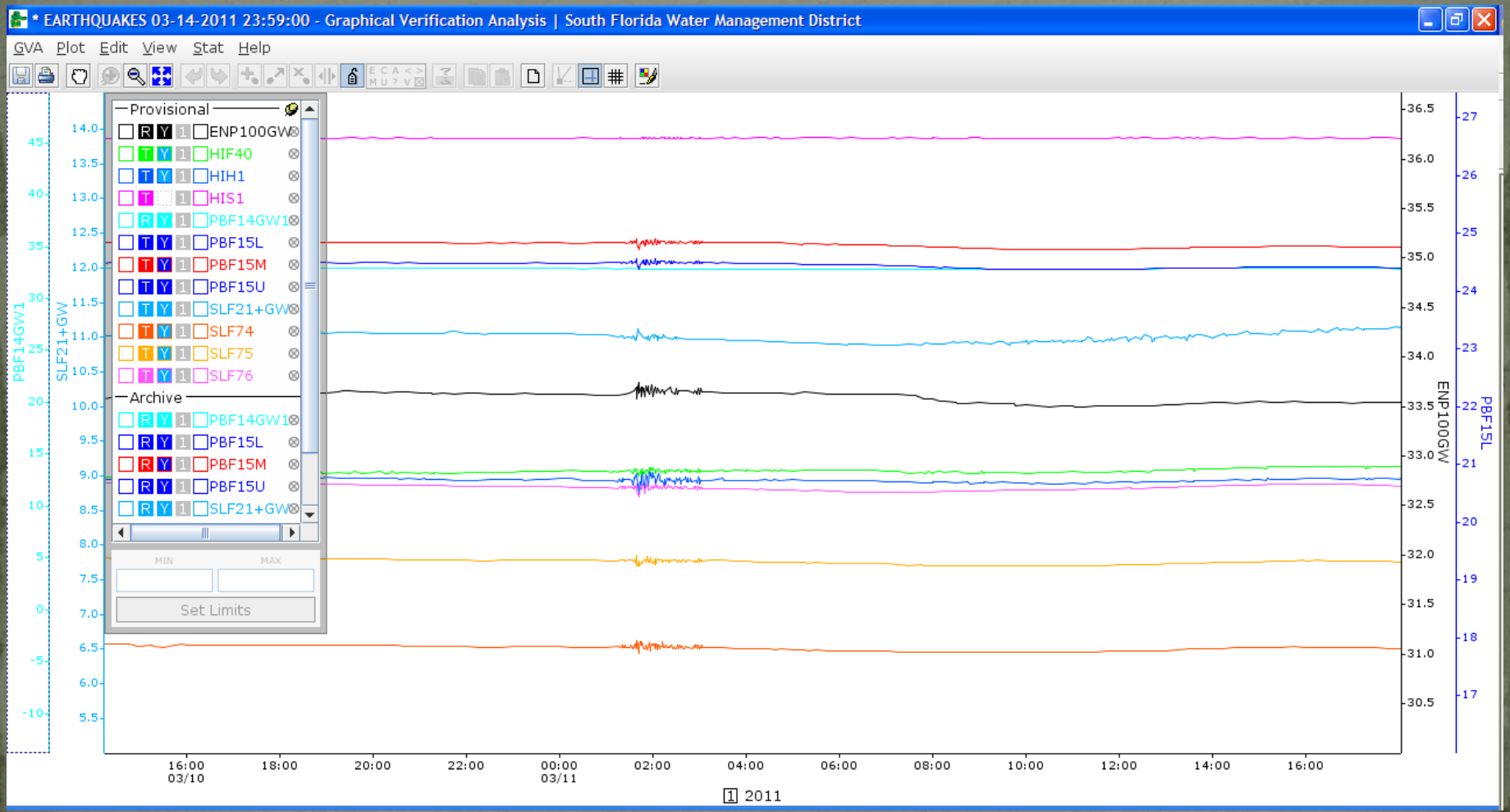
A Brief Look at Groundwater (detour to Florida)



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Trivia: What are we looking at?

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We love our work…

…Sometimes doing it until we die.

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Questions?

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