

# **USGS investigations of Floods on the Skagit River**

**USGS Represented by:**

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Presented by Mark Mastin to the Flood Control Committee on 5/3/04 at County Admin. Building in Mt. Vernon, WA

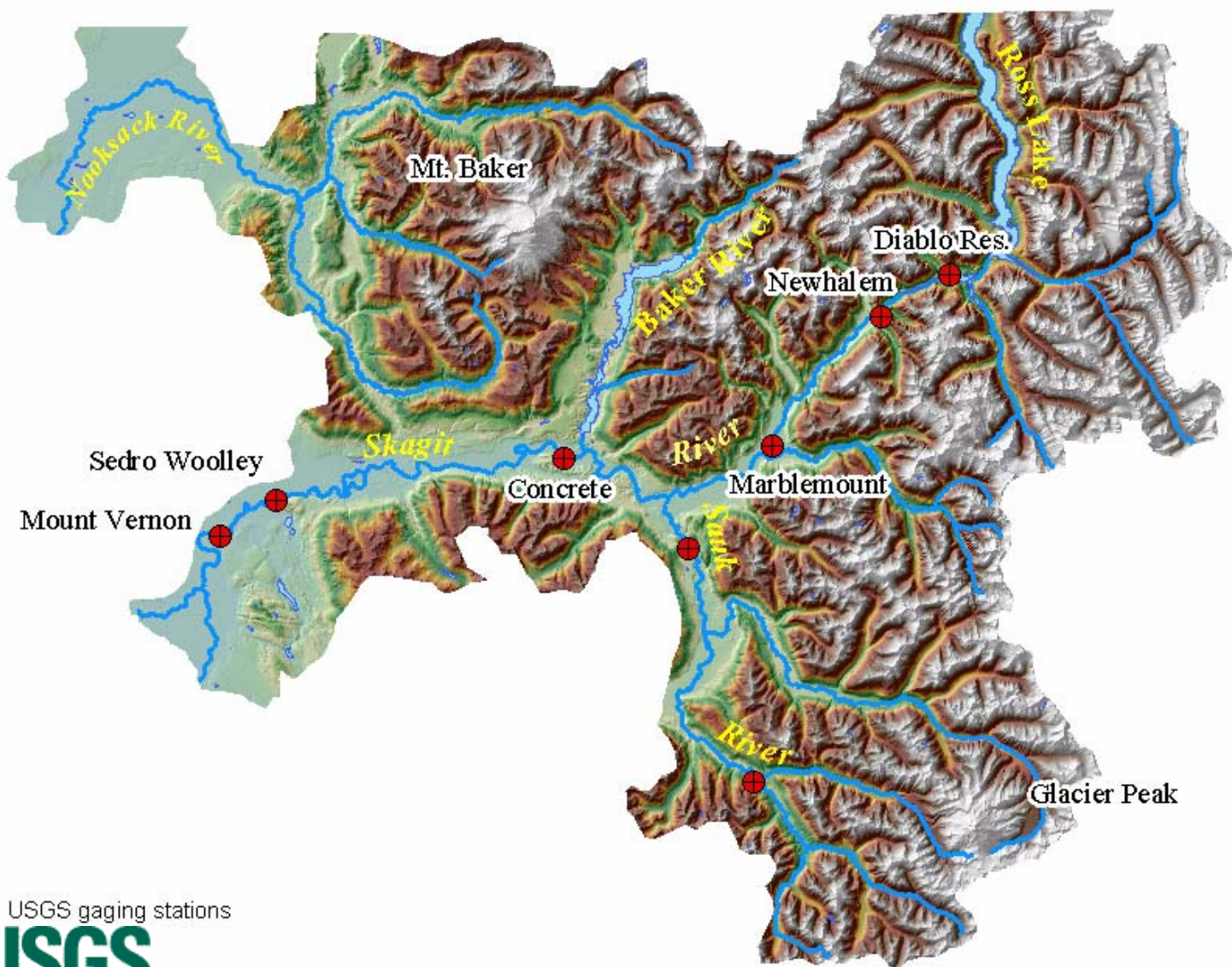


<http://wa.water.usgs.gov>

# **USGS investigations of Floods on the Skagit River**

- **Skagit River Basin and USGS gaging network**
- **Determining flood discharges and inherent errors**
- **James Stewart field work and WSP 1527**
- **Historic Floods at Skagit River near Concrete**
- **Volcanic Activity in the Skagit Basin—  
possible effects on flooding.**

# Skagit River Basin and Vicinity



# USGS Stream-Gaging Network

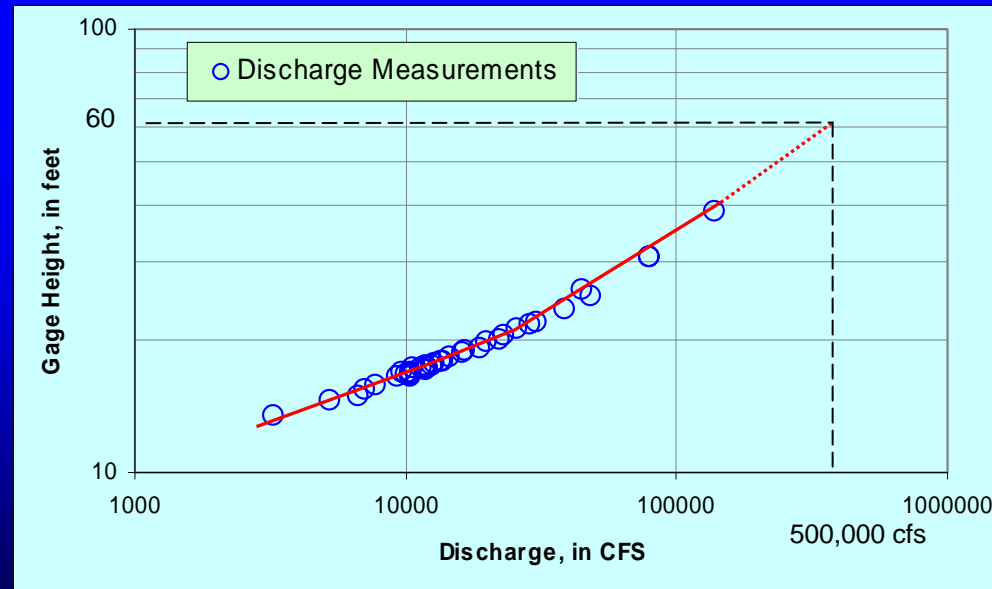
- 54 Discontinued discharge or stage-only stations (earliest is 1911 at Baker Ck. below Anderson Ck.)
- Currently, the network includes:
  - 5 reservoir sites,
  - 10 discharge sites (earliest begins in 1908)
  - one stage-only site (Skagit R. at Sedro Woolley)
- Skagit R. near Concrete gaging station:
  - recording discharge gage, 1924 to present
  - non-recording gage of stage, prior to 1924 for a few years.

# Determining Flood Discharges

- **Stage-Discharge Relationships (Rating Curve)**



- Defined by current-meter measurements
- Peak flows discharges determined by extension.

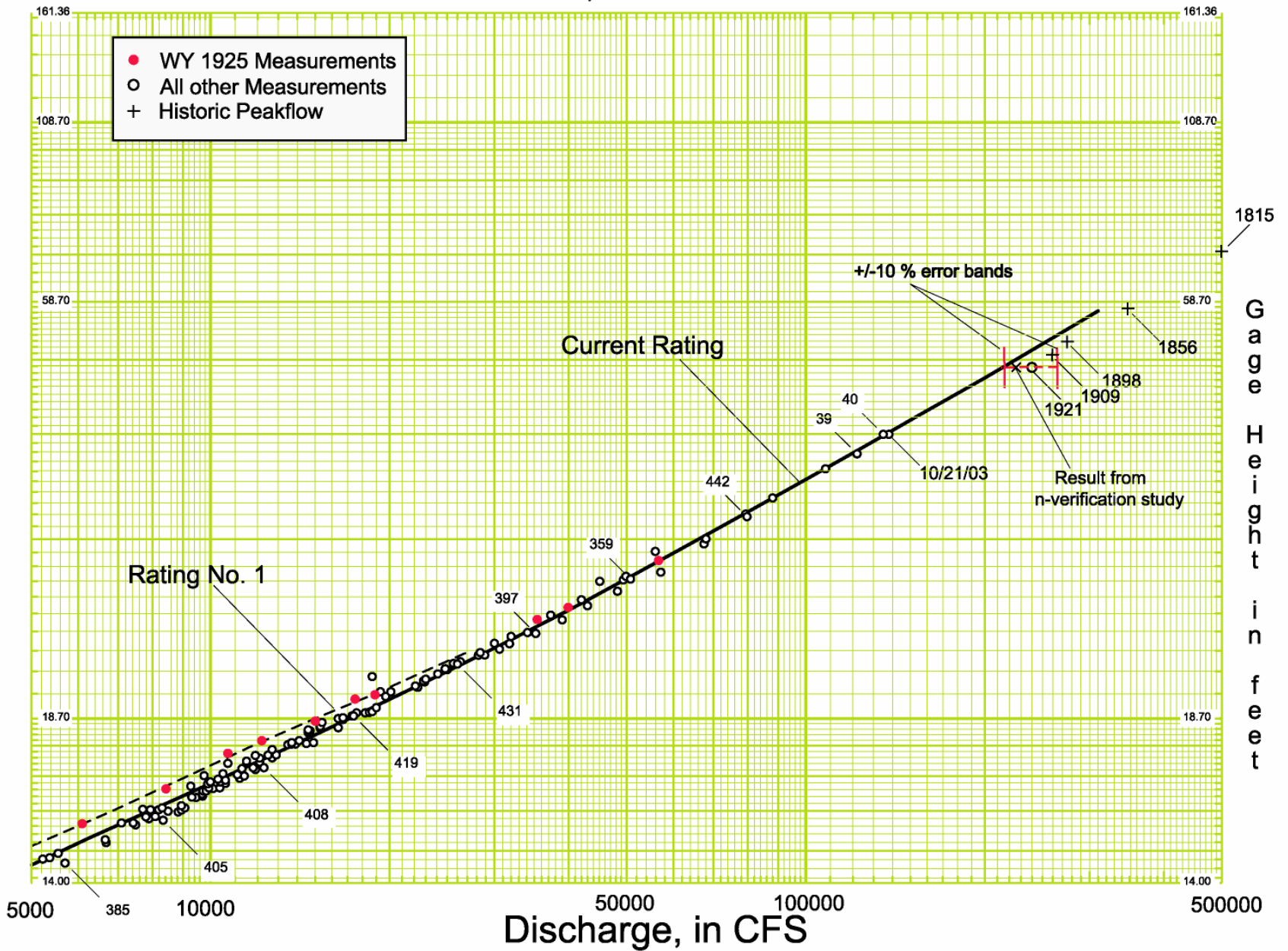


# Determining Flood Discharges

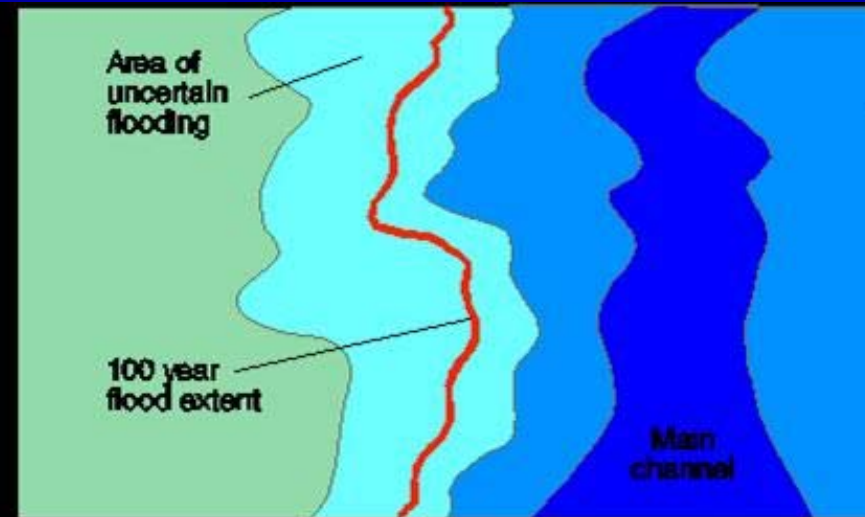
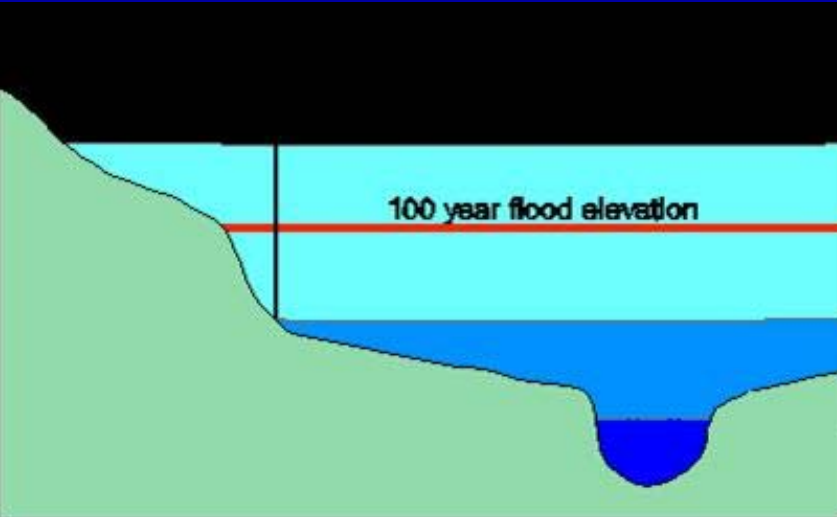
- Indirect Methods
  - Most common method is the Slope-Area Method
    - Manning's Equation  $Q = 1.486/n (AR^{2/3}S^{1/2})$ 
      - Q is discharge
      - n is the roughness coefficient
      - A is cross sectional area
      - R is the hydraulic radius
      - S is the friction slope
  - In the field
    - We measure A and R and estimate Manning's n by comparing with photographs of reaches with known n values and assessing the various roughness components of the reach.
  - In the office
    - S is computed by trial and error using the energy equation
    - Manning's n can be also be determined by n-verification studies

# SKAGIT RIVER NEAR CONCRETE, WA

12194000



# Flood Hydrology is not an exact science



CAP: Western WA Flooding



# The USGS assigns all flow computations an accuracy rating

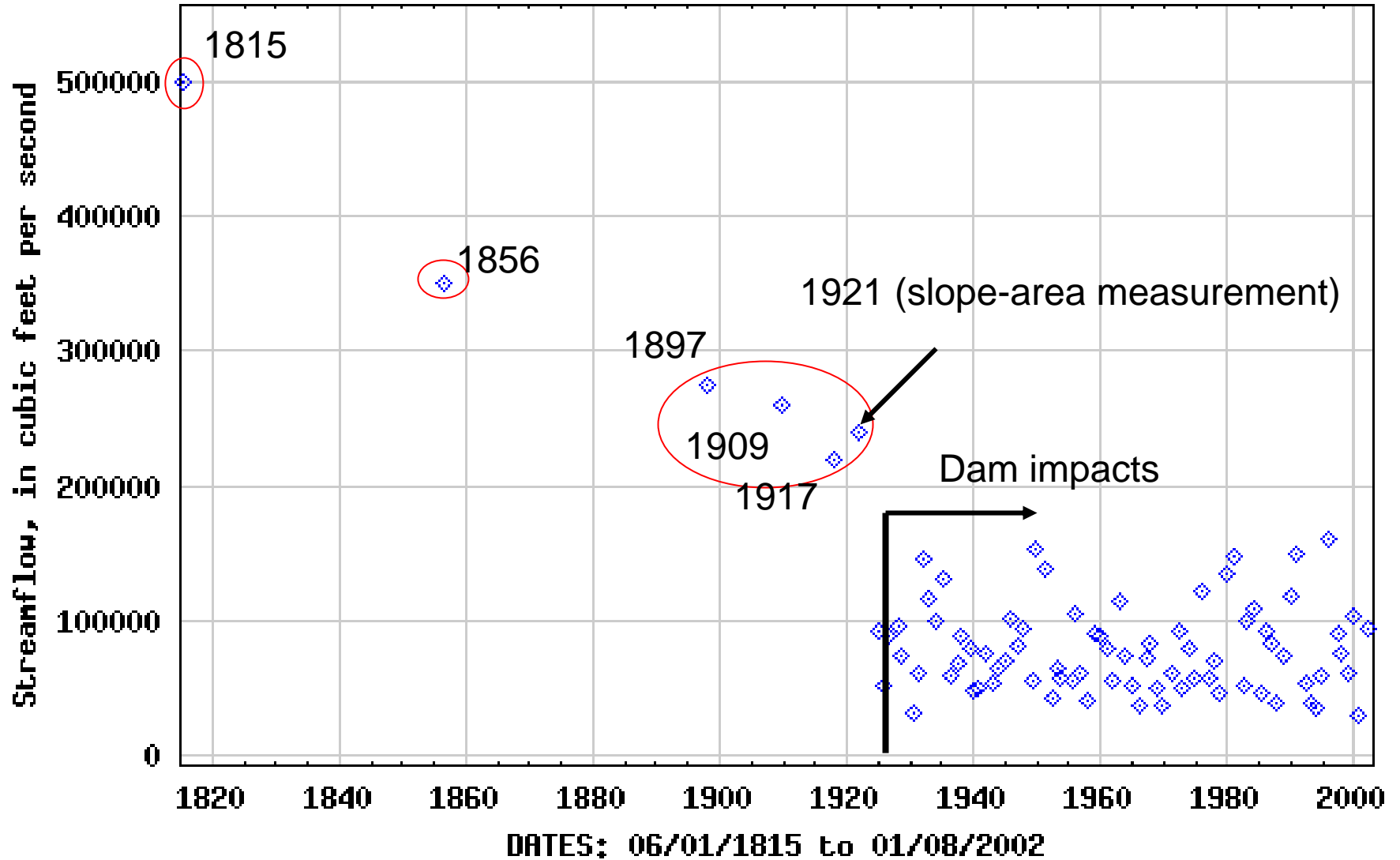
For Indirect Computations, the following applies:

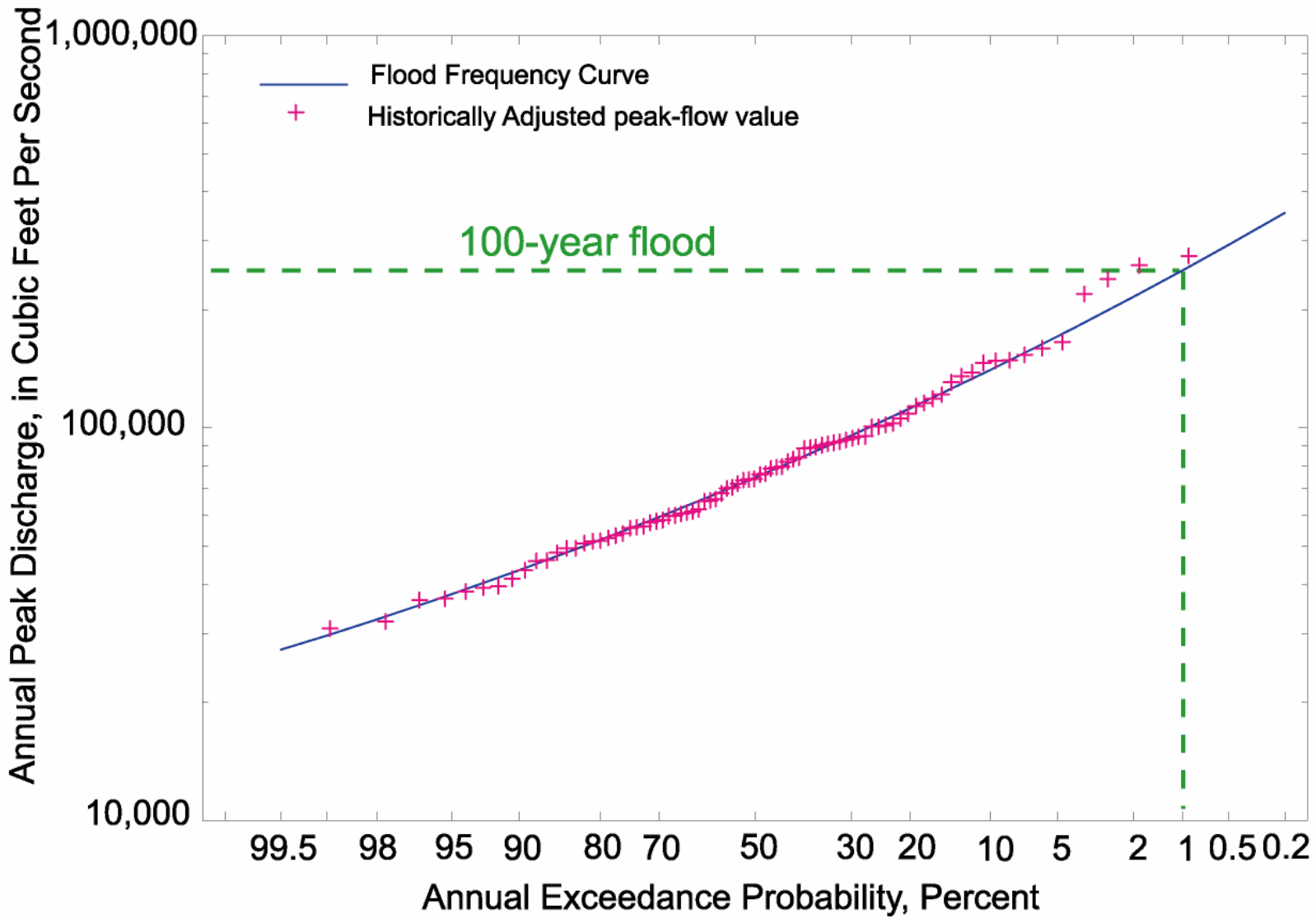
- **Good**—within 10% of the real value
  - **Fair**—within 15% of the real value
  - **Poor**—25% or greater of the real value
- 
- A difference of 30,000 cfs in a flood peak that is estimated at 200,000 cfs is about 15%

# James Stewart field notes and WSP 1527

- James Stewart was a USGS hydrologist who began investigating Skagit floods in 1918 by searching for high-water marks, interviewing locals, and computing peak-flow discharges.
- He was one of the first paleoflood hydrologists – he used all available evidence (observations and statements of locals, all kinds of field evidence)
- His 1918 and 1923 drafts were the basis for the USGS Water Supply Paper 1527, published in 1961 and co-authored with G.L. Bodhaine.
- WSP 1527 represents the definitive USGS position regarding flooding in the Skagit River as of 1961.

# USGS 12194000 SKAGIT RIVER NEAR CONCRETE, WA





# Historical Floods at Concrete

Year	High Water Marks	Discharge
~1815	sand deposit found by assistant County Engineer	*500,000
~1856	distinct line on rock in 1923	*350,000
1897	2 marks—one 1 mile upstream, one on a stump reported 1.5' abv peak	275,000
1909	Stewart found many marks in and near Concrete	260,000
1917	2.5' blw 1909 flood at Reflector Bar	220,000

\*downgraded to estimates in the USGS peak-flow data file