

# Input Data Prerequisites

## DLS-114, Module 1.4



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Dam and Levee  
Safety Programs

March 2026 / Version 1

HOOVER DAM, NV (SOURCE: HDR)

# Learning Objectives

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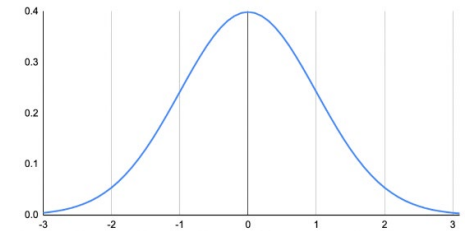
- Give examples of prerequisites and pre-processing
- Explain how unregulated data, critical duration, peak to volume ratio and inflow volume information are used in RMC-BestFit
- Provide examples of how uncertainty is handled in RMC-BestFit



# What Does Independent and Identically Distributed (iid) Mean?

- **Independence: PAST DOES NOT IMPACT THE FUTURE**

- Previous dice roll(s) don't affect next dice roll
- Previous coin toss(s) don't affect next coin flip
- Largest flood in 2020 doesn't affect largest flood in 2021



- **Identically Distributed: SAME PARENT DISTRIBUTION**

- Fair Dice: Equal chance of rolling 1 thru 6 every roll
- Fair Coin: Equal chance of heads or tails each flip
- Unfair Dice: if 50% chance of rolling a 6, and 10% chance of rolling each 1 through 5, still an identical distribution if this is always the dice being rolled
- **Flow Frequency (mother nature is the parent distribution)**

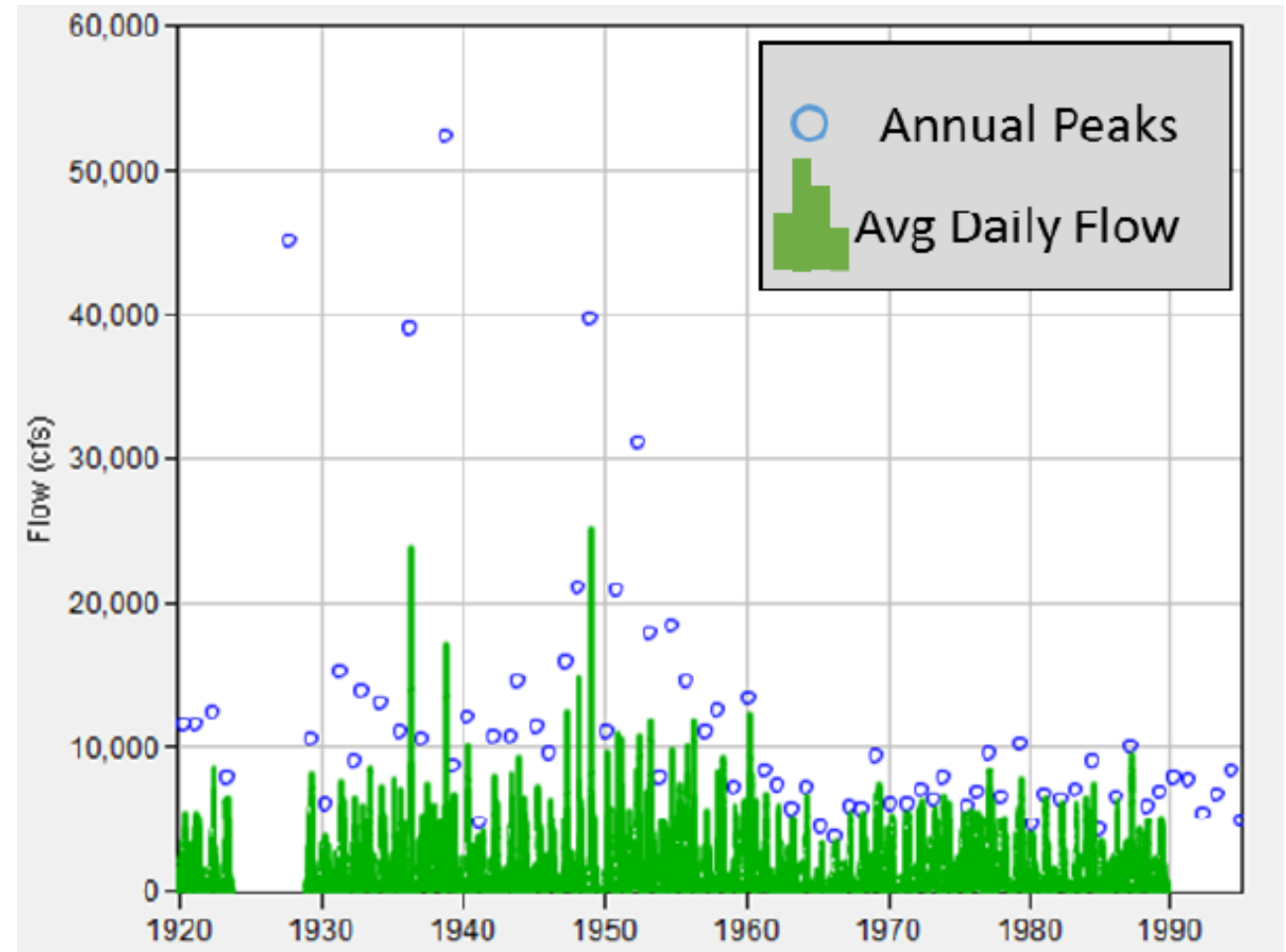


Legend of Aataentsic - The Garden of Arts, Quebec

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# Identically Distributed Peak Annual Flow Data

- Identically Distributed: The peak-flow time series is assumed to be a representative sample of the population of future floods. This can be violated in multiple ways:
  - Visual inspection of a time series plot can reveal obvious changes in the mean or variance



# Why Is It Important to Treat Regulated Data Sets Differently?

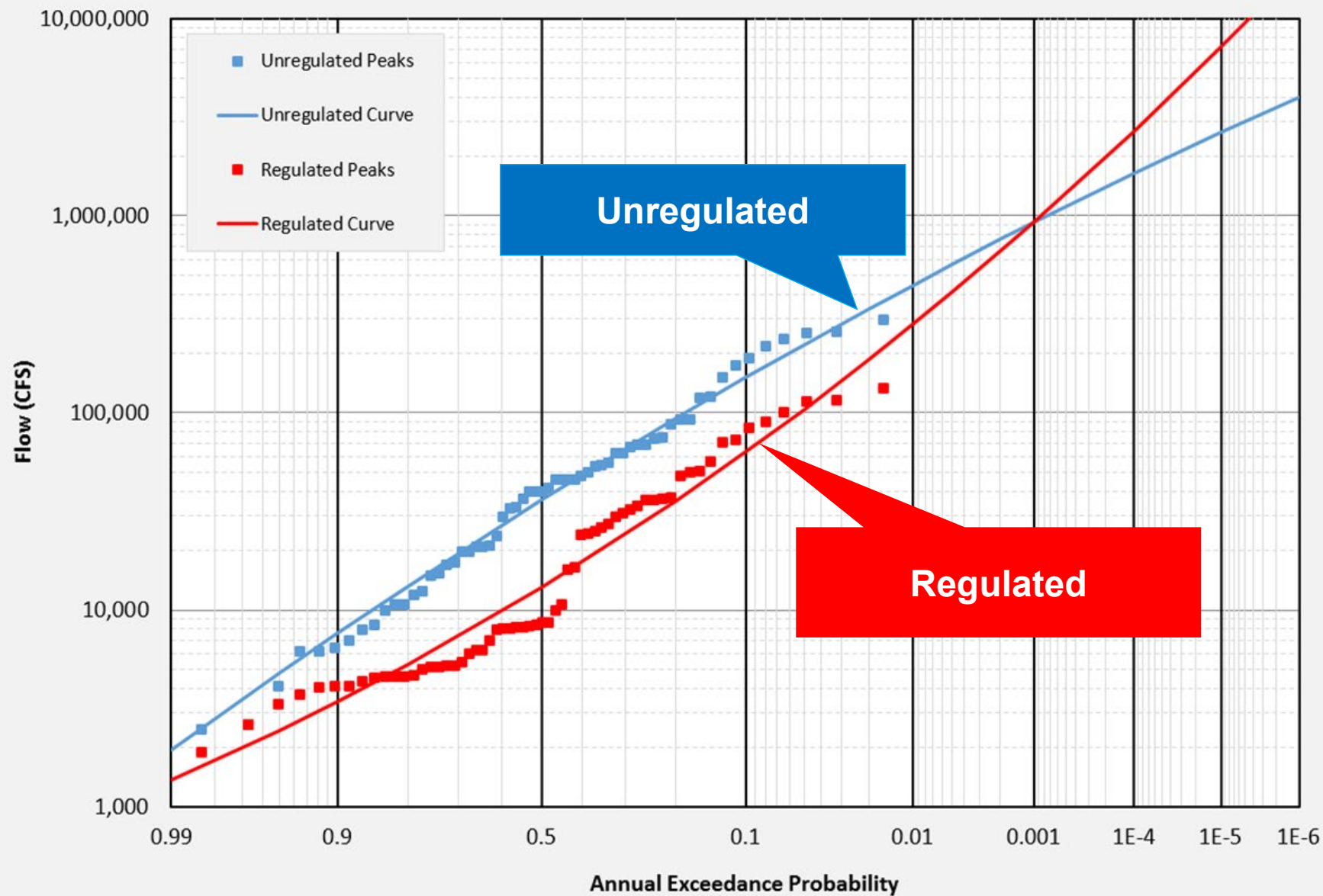
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- Many dams have upstream regulation
- Age of many dams is usually less than 100 years
- **Flow-Frequency Analysis conducted on regulated data can dramatically over or underestimate risk.**
- Upstream regulation often affects annual maximum series
- **Fitting LPIII parameters to significantly regulated data is generally not acceptable**



# Reasons to Use Unregulated Data

- Extrapolation



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# Methods Evaluate Effects of Upstream Regulation

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- Various methods to evaluate effects on Upstream Regulation
  - Outlined in RMC-TR-2021-02 Estimating Flood Hazard for Dams and Levees with Upstream Regulation
  - Research the available data
  - Examine the available flow data
  - Visualize the data and look for trends
  - Plot observed annual maximums
  - Perform tests to look at effects of upstream regulation
    - Kolmogorov-Smirnov (KS) test
  - Watershed



# Methods For Developing Unregulated Dataset

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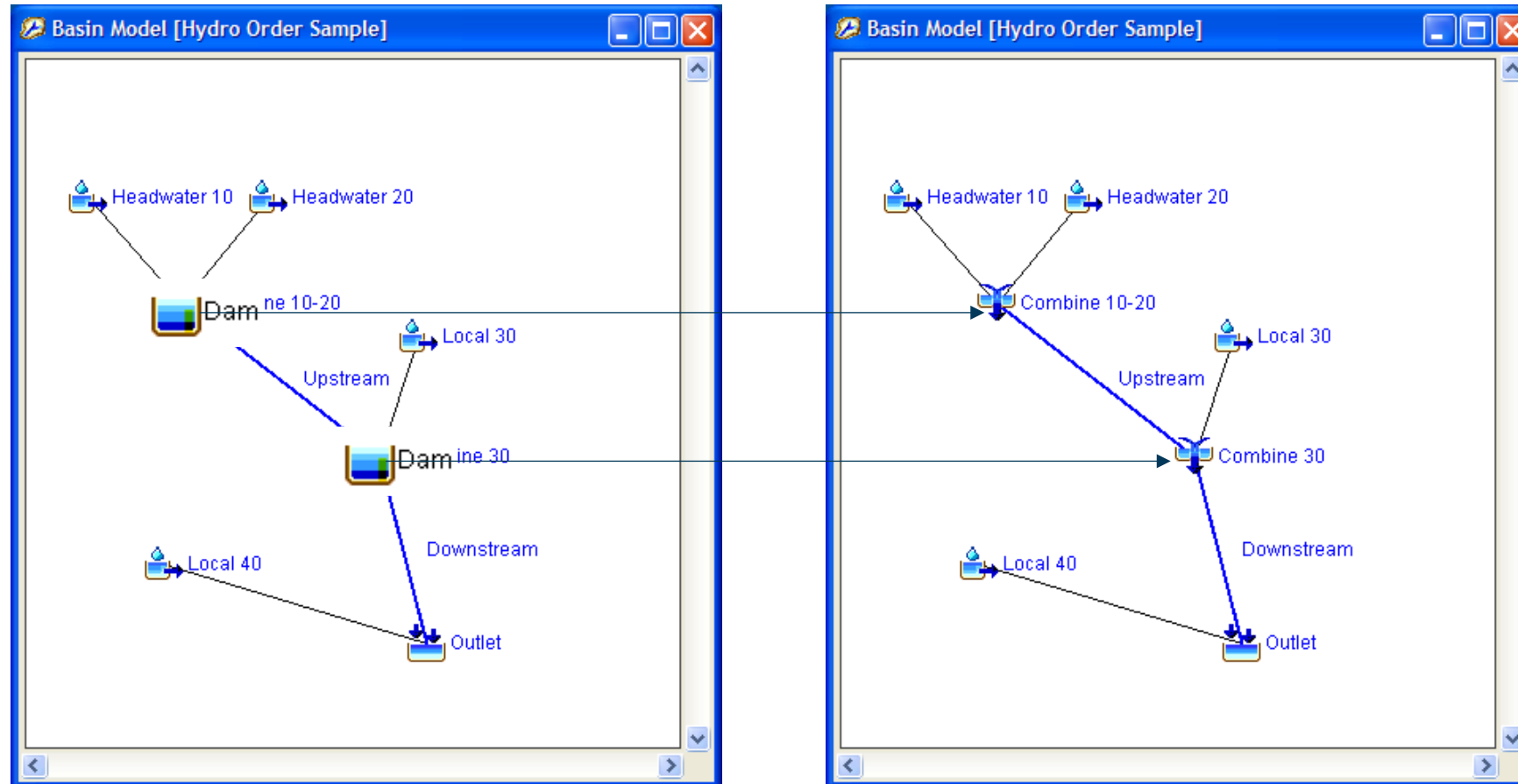
- Methods for Developing Unregulated Dataset  
(USACE TR 2021-02, Section 3)
  - Method 1: Route flows through existing models with (regulated) and without (unregulated) upstream dams
  - Method 2: Route flows through simplified HMS model or spreadsheet
  - Method 3: Used unregulated data prior to upstream regulation.





# Methods For Developing Unregulated Dataset

**Method 1:** Route flows through existing models with (regulated) and without (unregulated) upstream dams



# Methods For Developing Unregulated Dataset

**Method 2:** Route flows through simplified HMS model or spreadsheet

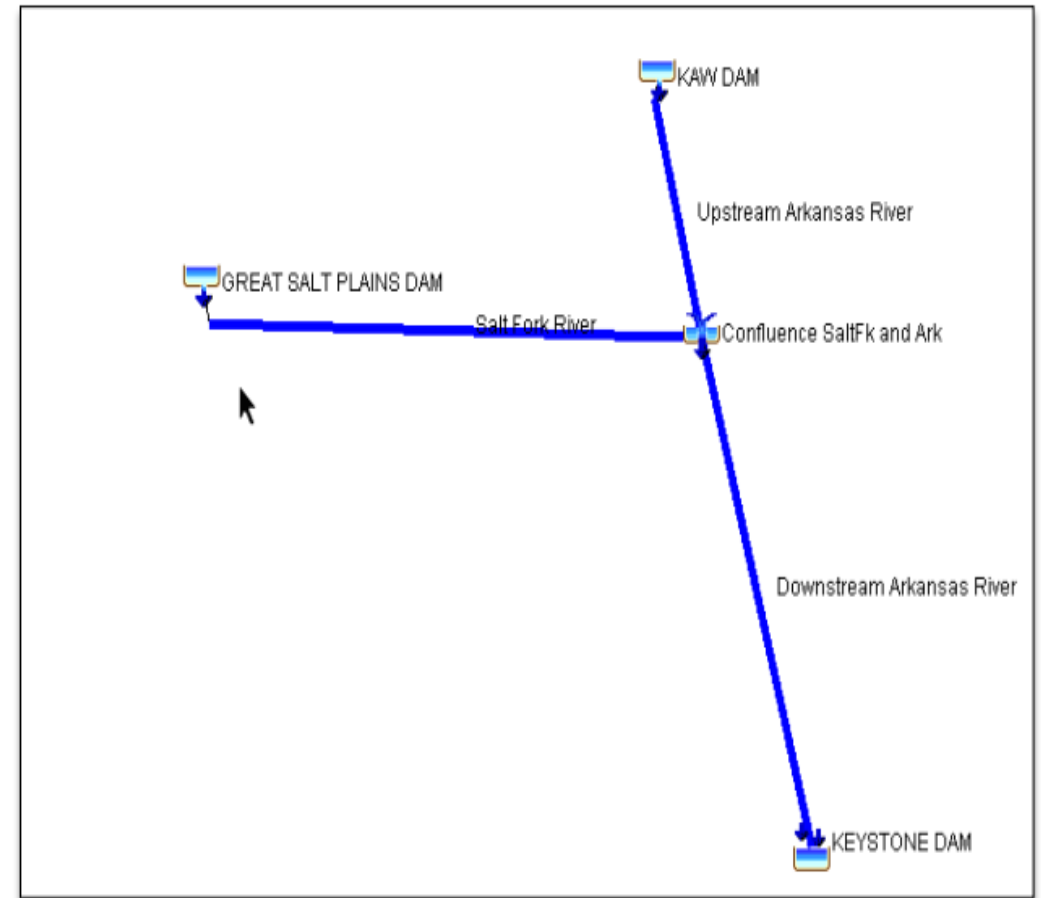
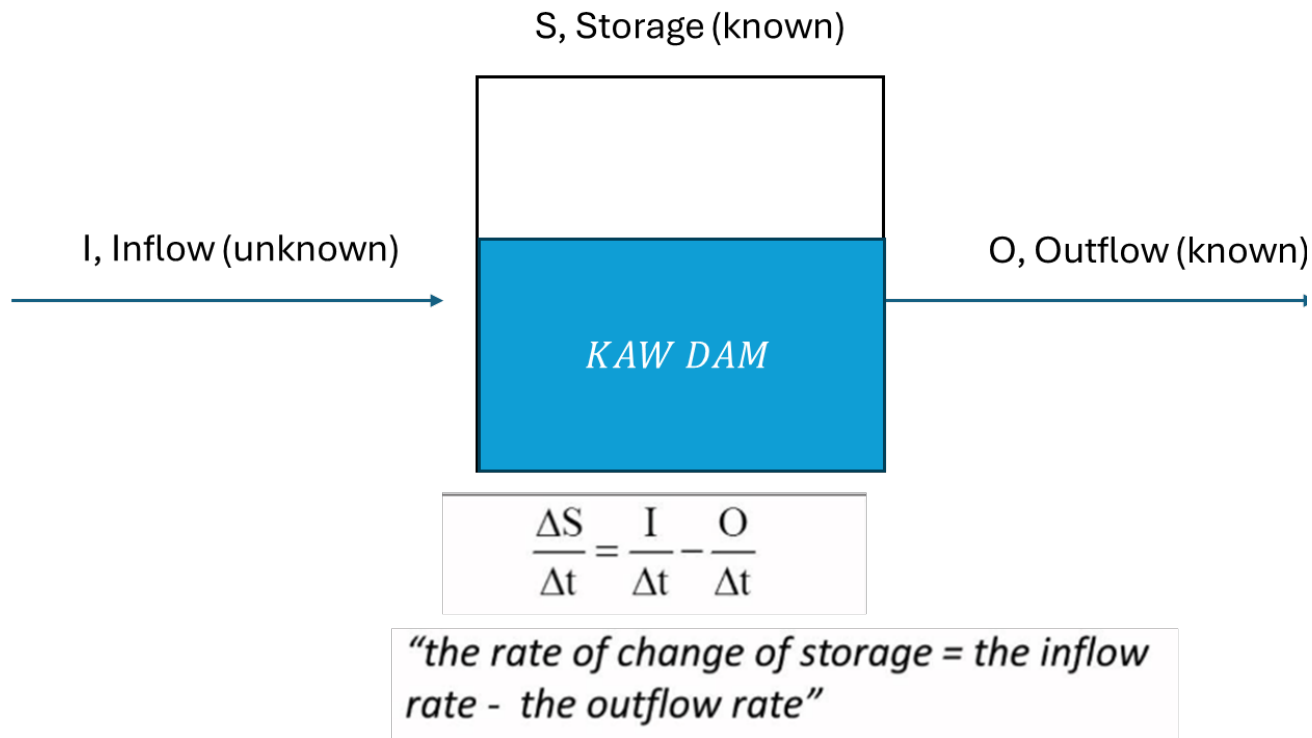


Figure 3-1. Example of a Simple HEC-HMS Stick Model from RMC Workshop

# Methods For Developing Unregulated Dataset

**Method 3:** Used unregulated data prior to upstream regulation.

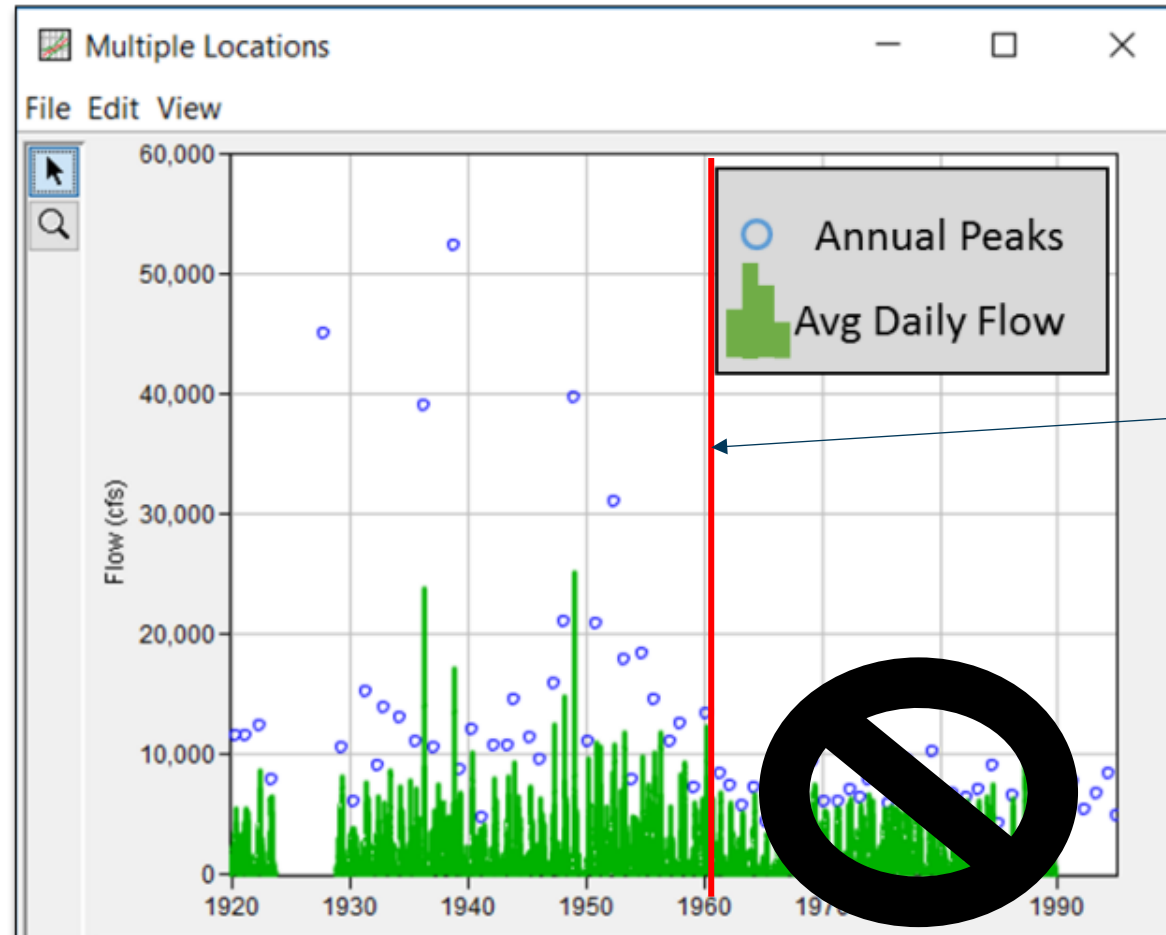
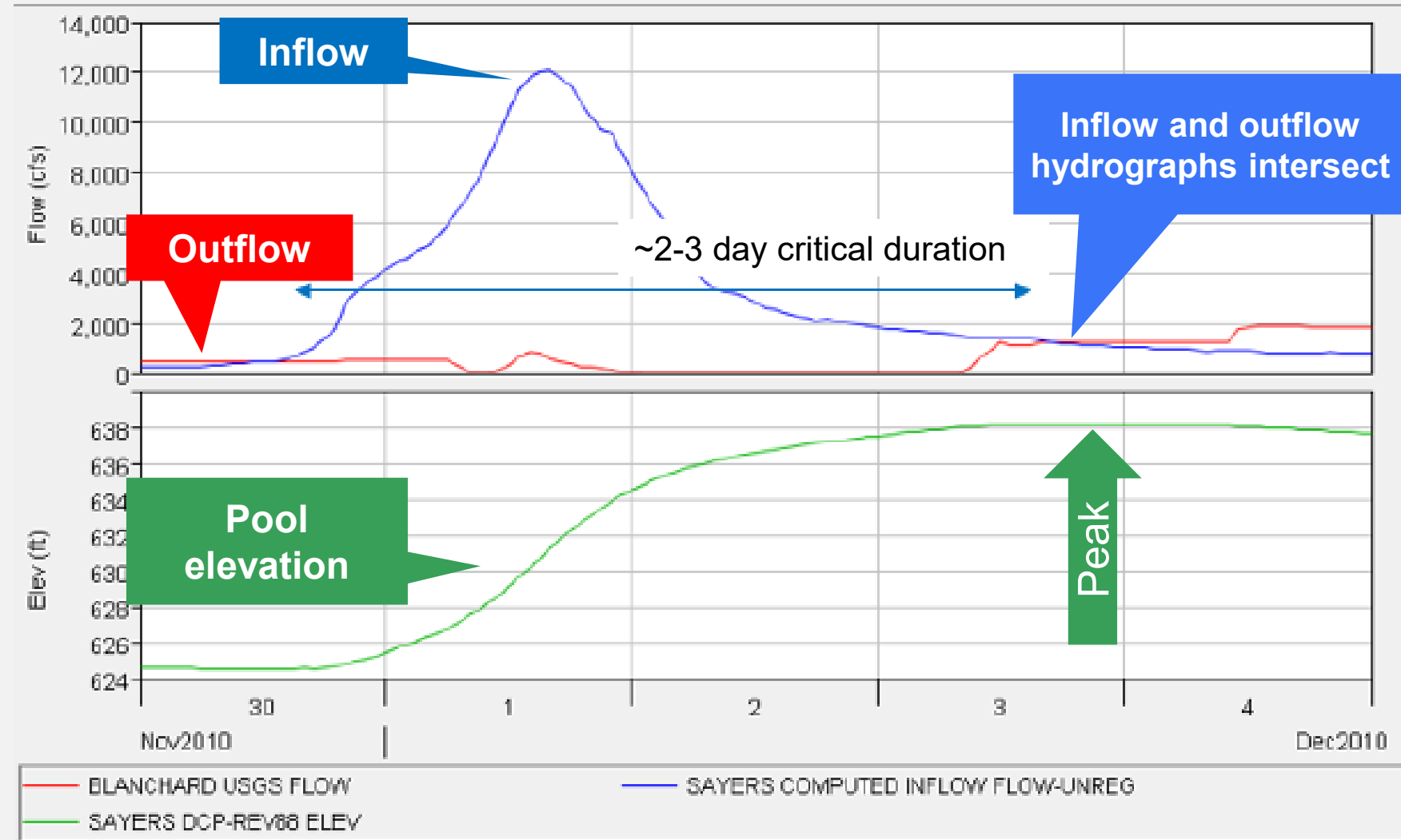


Figure 2-2. Annual Maximum Series and Daily Average Flows

## Estimate Critical Duration

- Duration of inflow hydrograph
- Results in peak stage



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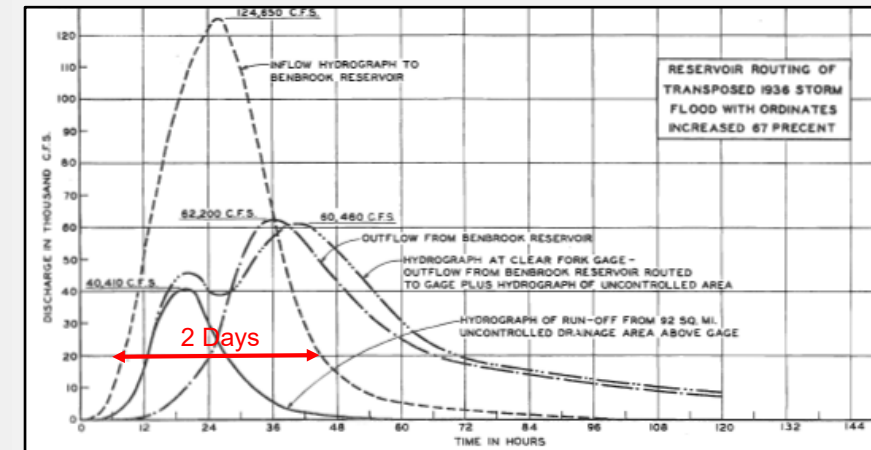
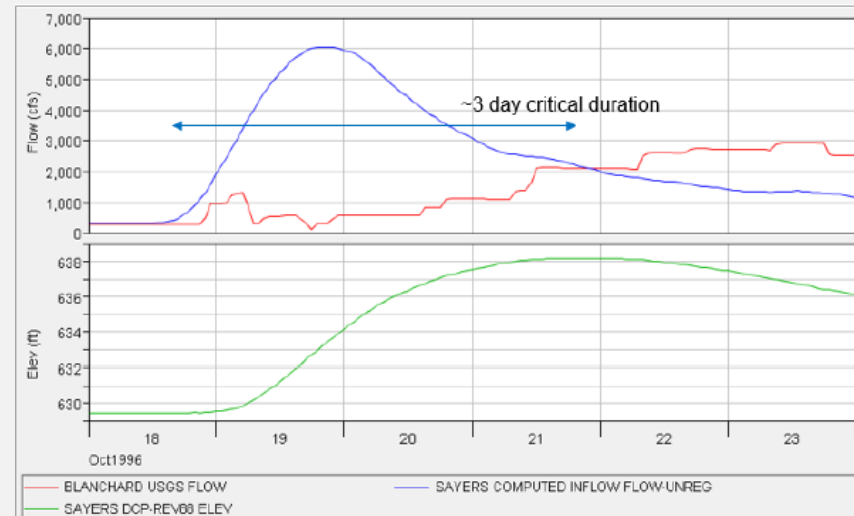
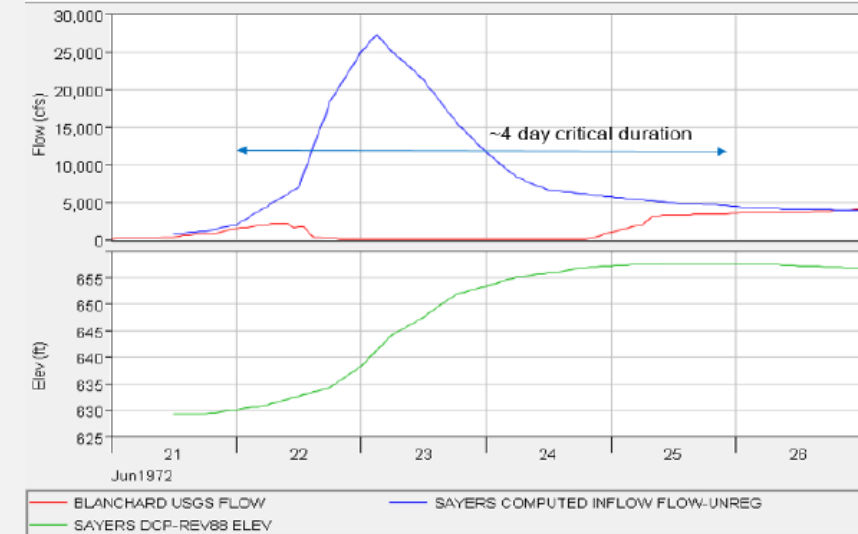
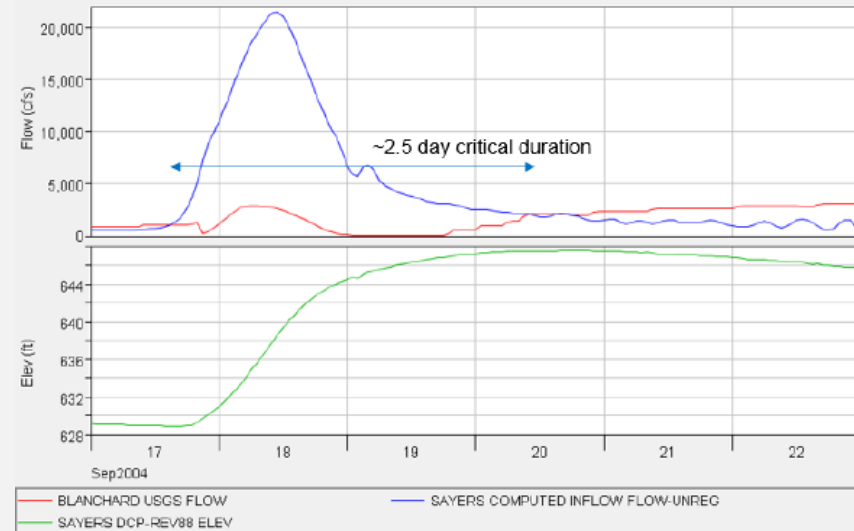
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# Estimate Critical Duration (1 of 2)

- Average
- Observed floods

Date	Elevation (ft-NAVD88)	Critical Inflow Duration (days)
1 May 1990	657.65	4
20 Sep 2004	648.85	2.5
21 Oct 1990	638.42	3
20 Dec 1991	632.30	3
24 Jun 2015	631.76	3
3 Mar 1936	630.35	2
	<b>AVERAGE</b>	<b>2.9 days</b>

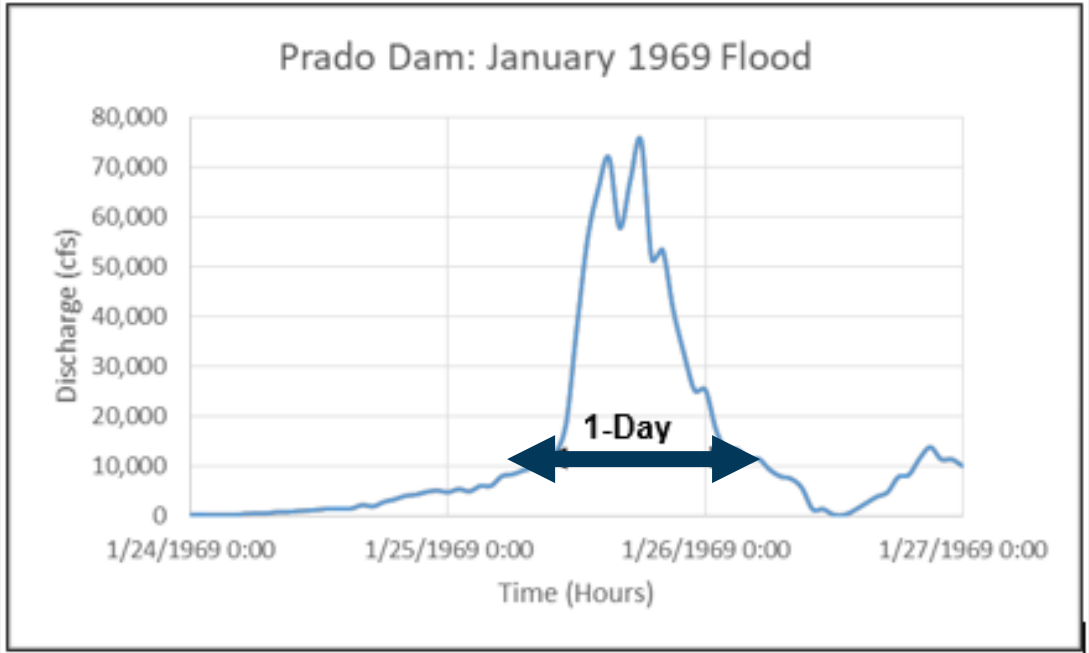
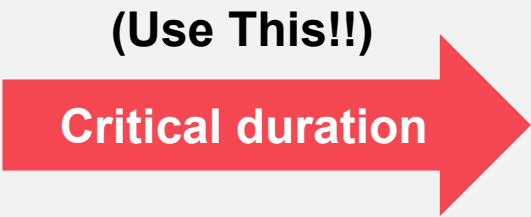
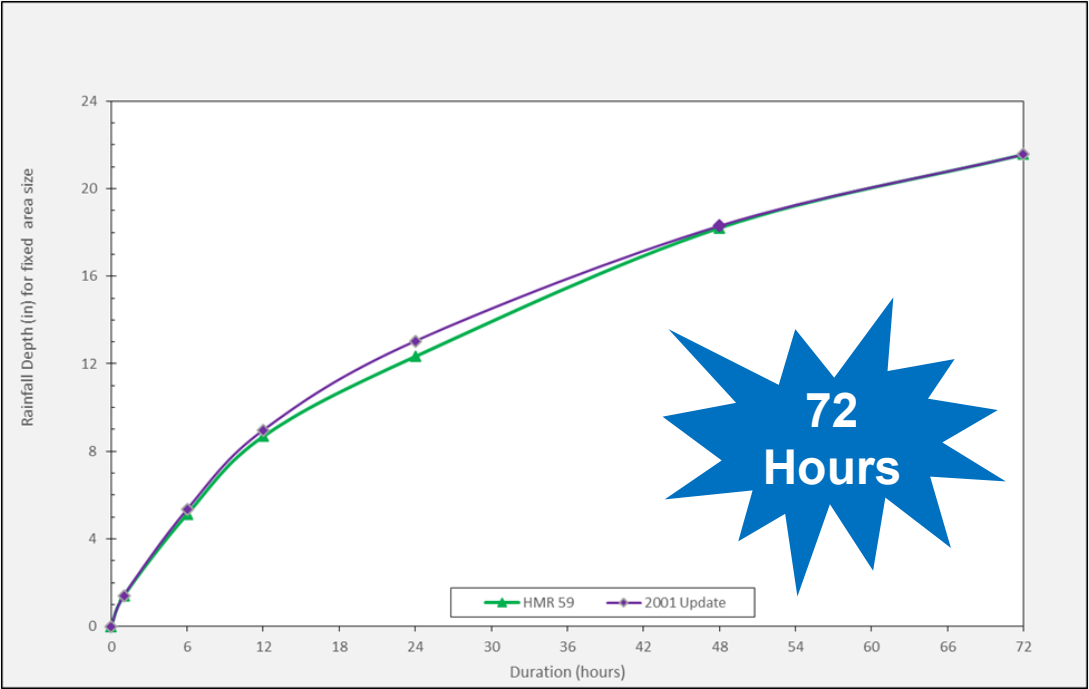
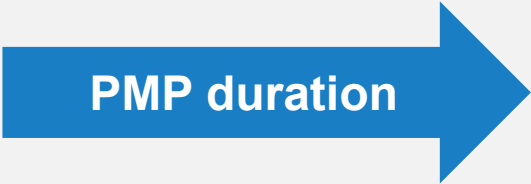


**Adopted Critical Inflow Duration = 3 days**

# Estimate Critical Duration (2 of 2)

- Critical duration versus PMP duration

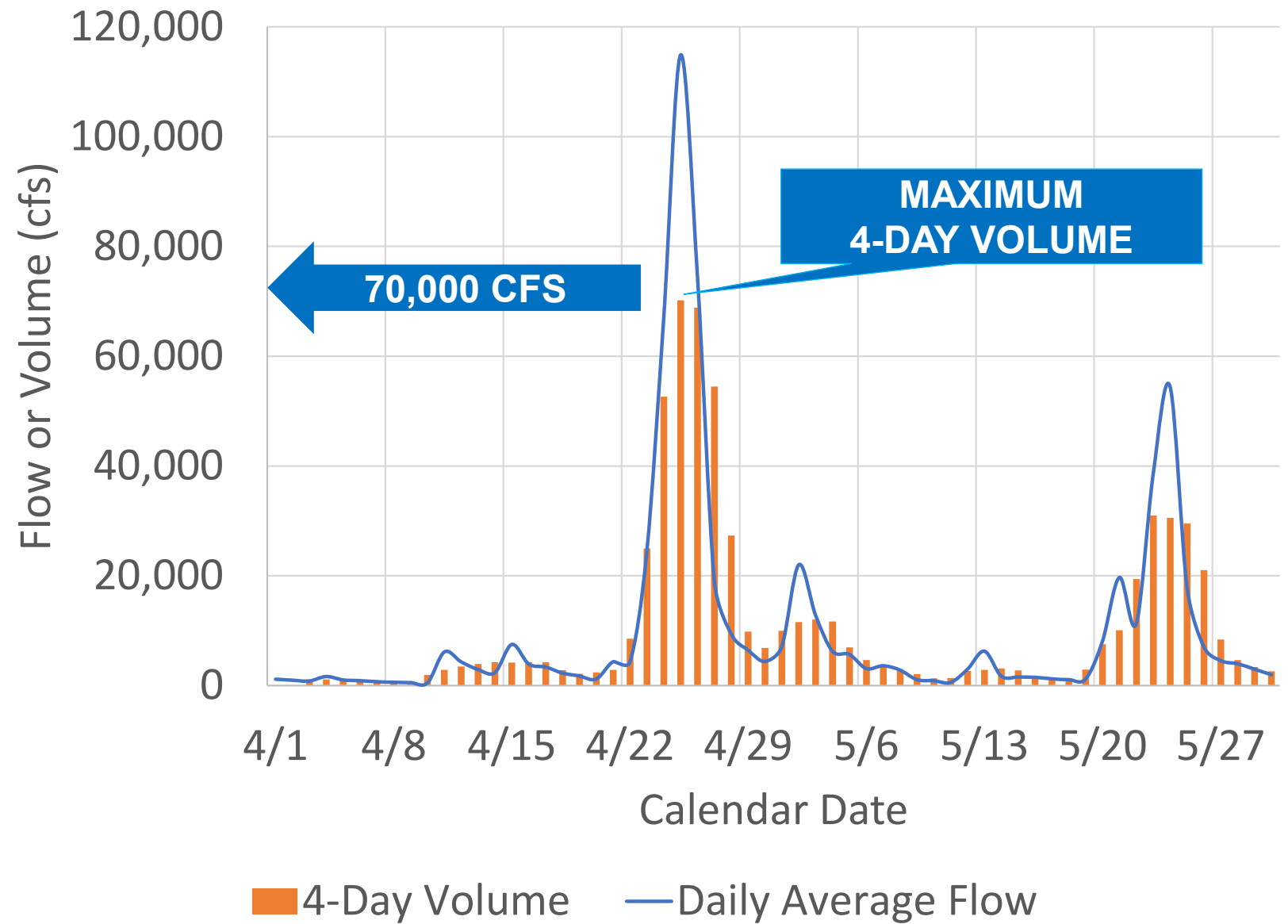
Date	Critical Inflow Duration (days)
January 1969 Flood	1
March 1978 Flood	1.5
February 7 1998 Flood	1
February 23 1998 Flood	1
January 2017 Flood	1
1938 Flood	1
Average Duration	1.1 days



**Adopted Critical Inflow Duration = 1 day**

## Calculate Volume

- Moving average
- Maximum Volume over a duration



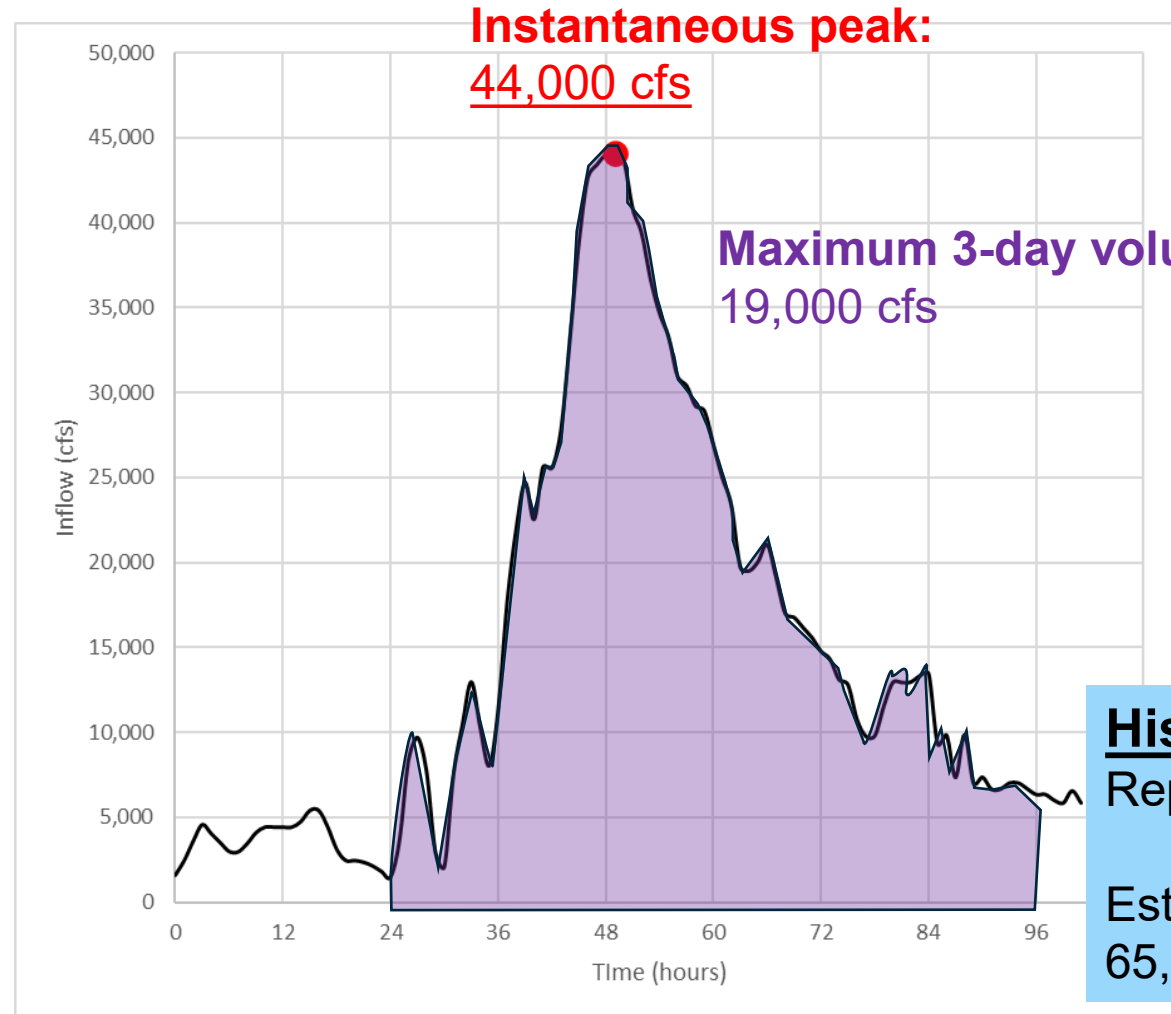
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# Estimate Peak to Volume Ratio

- Have peak flow estimate
- Need volume estimate
- Ratio based on observed floods
- Average ratio for multiple large floods



## Peak to volume ratio

$$\frac{44,000 \text{ cfs}}{19,000 \text{ cfs}} = 2.3$$

## Historic flood

Reported peak = **65,000 cfs**

Estimated 3-day volume  
 $65,000 / 2.3 = 28,300 \text{ cfs}$



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# Uncertainty

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- Historical = uncertainty
- Rules of thumb
- Engineering judgment
- Quantitative estimate of uncertainty



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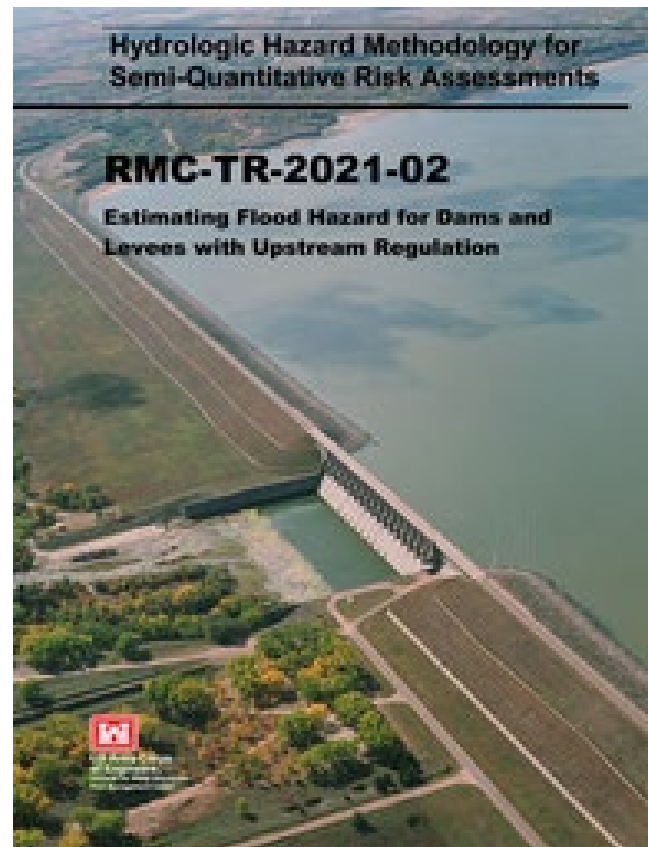
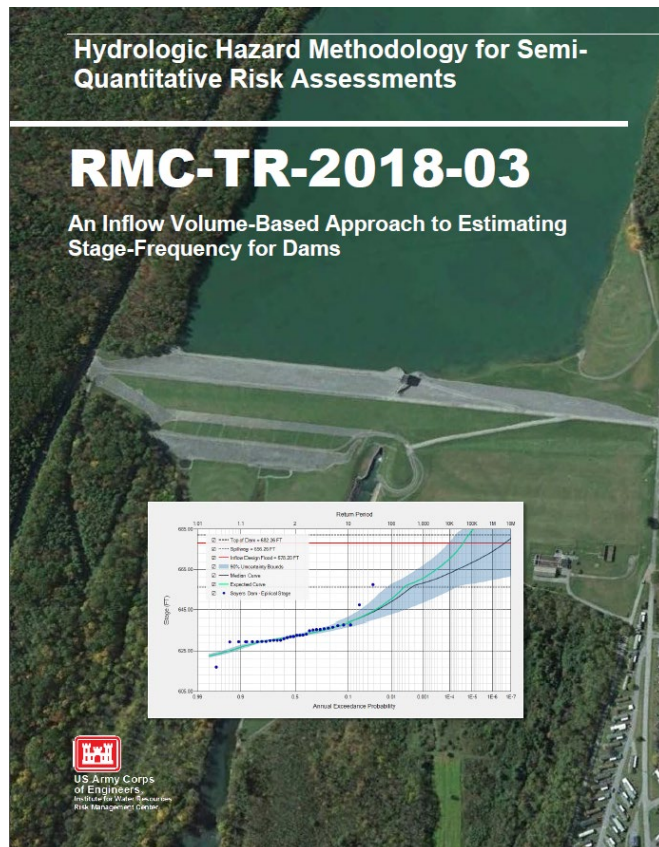


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# Resources

- RMC publications:  
<https://www.rmc.usace.army.mil/Library/RMC-Publications/>



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# Questions