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TNC Environmental Flow Process

John Stark- November 28, 2017 ORBA Summit

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Environmental Flow

The process of managing water quantity, timing, and quality to sustain ecological integrity of riverine ecosystems

- Hydrology is the driving force of a riverine ecosystem
  - directly responsible for its biodiversity
  - alterations to hydrology can severely impact aquatic ecosystems
  - hydrology and geomorphology are the primary drivers of the Shifting Habitat Mosaic (Hauer and others)

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Sustainable Rivers Approach

- Project operations are “tweaked” slightly to recreate critical ecosystem flow components during relatively narrow windows of time
- Structural modification often used to improve water quality at the same time.
- TNC-USACE Green River, KY pilot resulted in improved mussel reproduction, reservoir recreation, and downstream water quality

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Indicators of Hydrologic Alteration (IHA)

- Developed by TNC and USGS
- Assesses 67 ecologically-relevant statistics derived from daily hydrologic data
- Comparative analysis can then help statistically describe how these patterns have changed
- Used by thousands of investigators world-wide

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Role of IHA

- IHA statistics can be used to:
  - Characterize the natural flow regime
  - Assess how flow regime has changed over time
  - Analyze flows provided by different management scenarios
- Aid in developing environmental flow recommendations (in conjunction with biological info)

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Muskingum River Watershed

- Drains 1/5 of the state of Ohio to the Ohio River
- 14 dams alter stream flow and water quality in hundreds of miles of streams
- National Engineering Landmark

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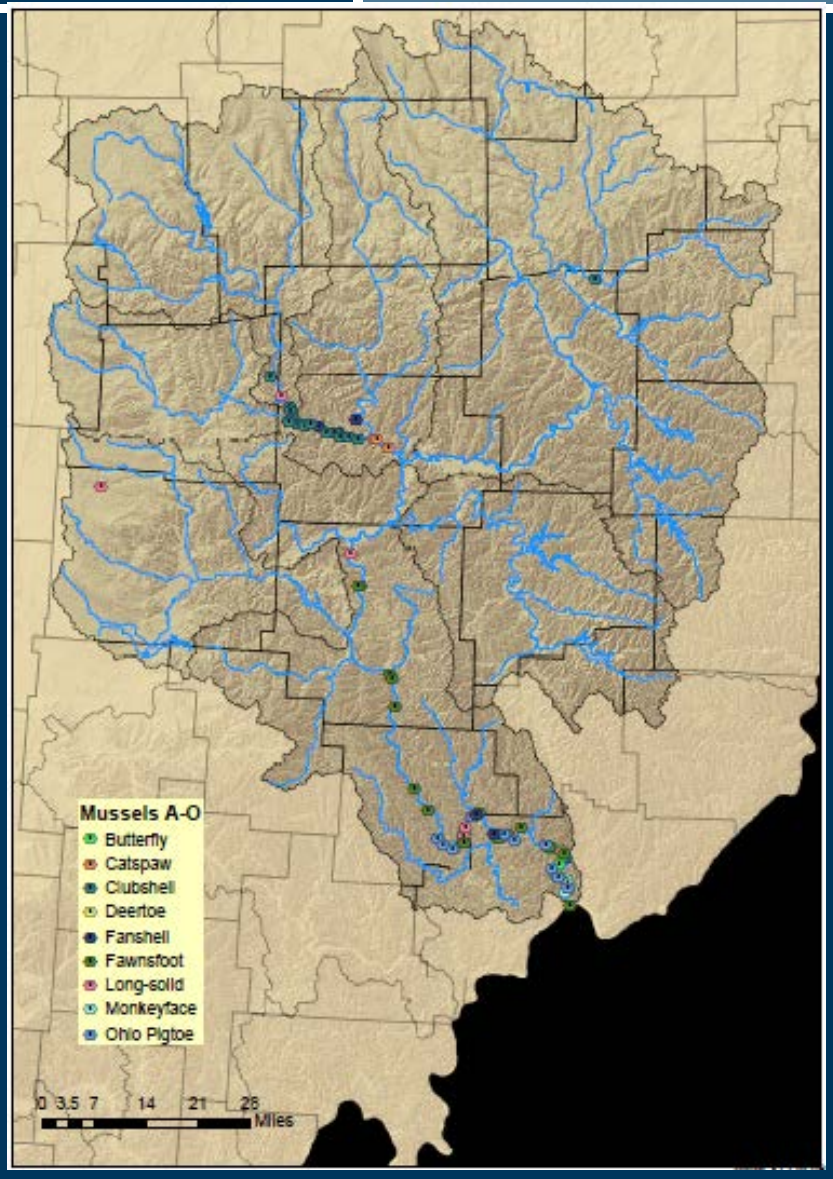
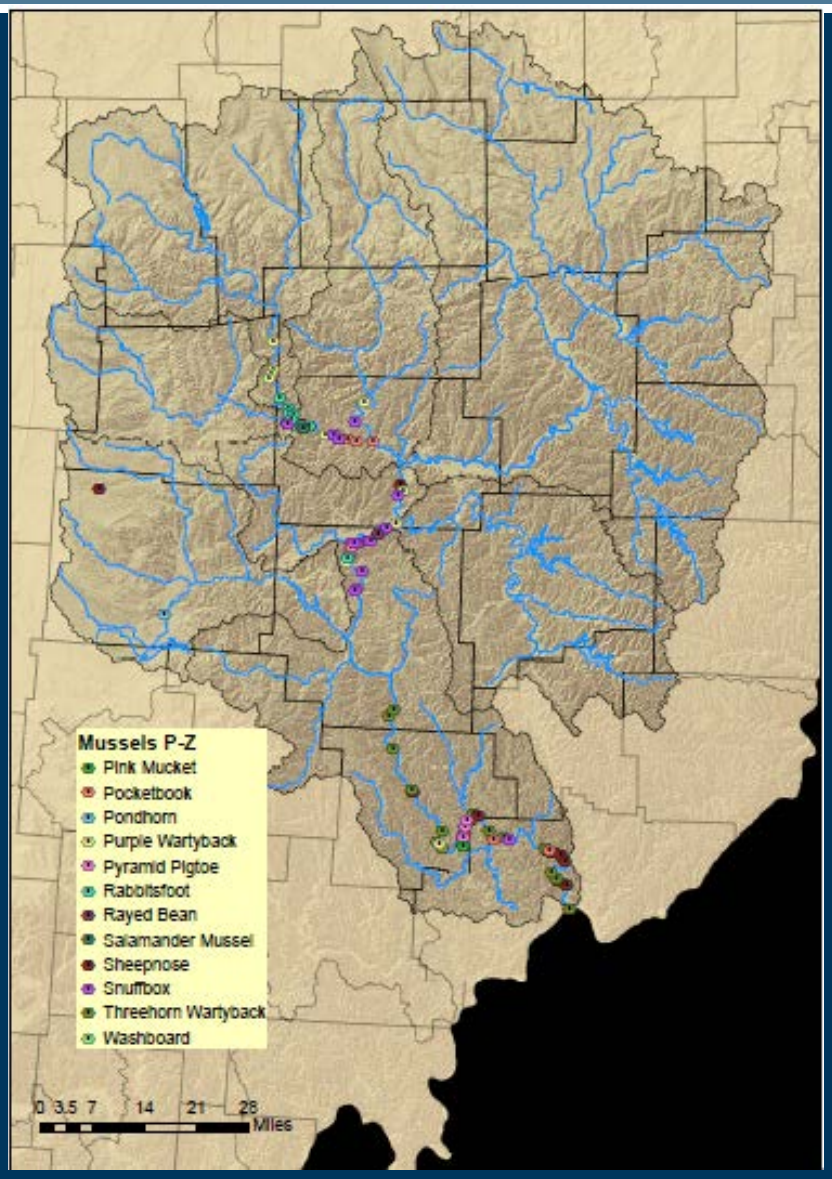
Freshwater Mussel Distribution





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Muskingum Study Concept

- Examine record of pre & post project stream flows at three projects & determine key hydrologic alterations
- Determine reservoir withdrawal zone (temperature/oxygen/ velocity cone) under differing flows and structural modifications
- Monitor tailwater water temperatures, DO, and reservoir fish “loss” under typical reservoir releases, selected test flows, & structural modifications
- Develop consensus for key ecological flow components

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Muskingum Data

- Obtained gaged outflow and modeled reservoir inflows from USGS and Huntington District of USACE
- QA/QC examination resulted in analysis of 1962-1985 period (24 years) at all three dams
- To compare without and with dam conditions, it was necessary to offset 1962-1985 gaged data to 1986-2009 as the with project condition and enter inflows as 1962-1985 without project condition.
- ORBCC climate analysis by NOAA's Ohio River Forecast Center indicates that rainfall patterns had already begun to change by the 1980s.

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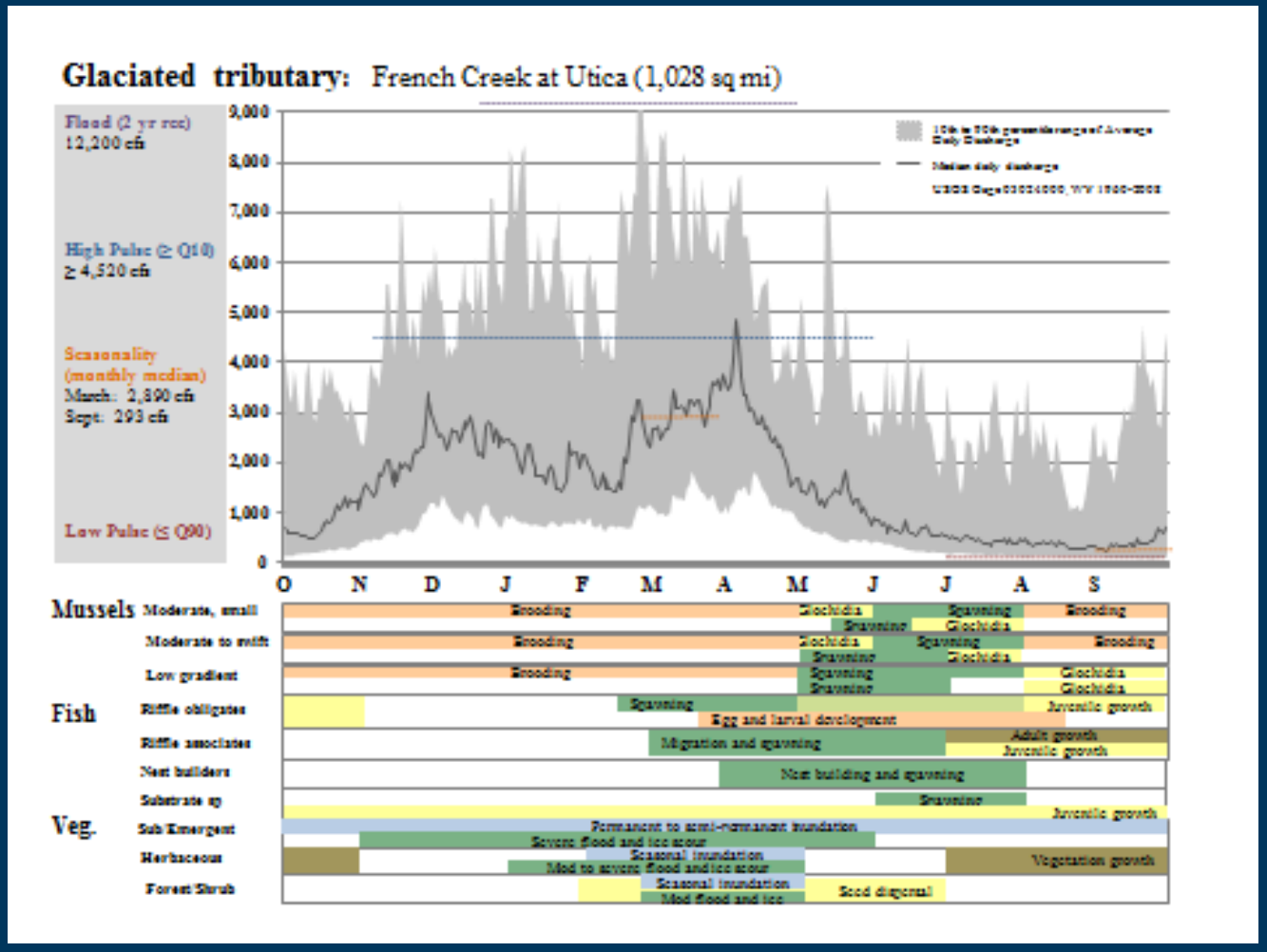
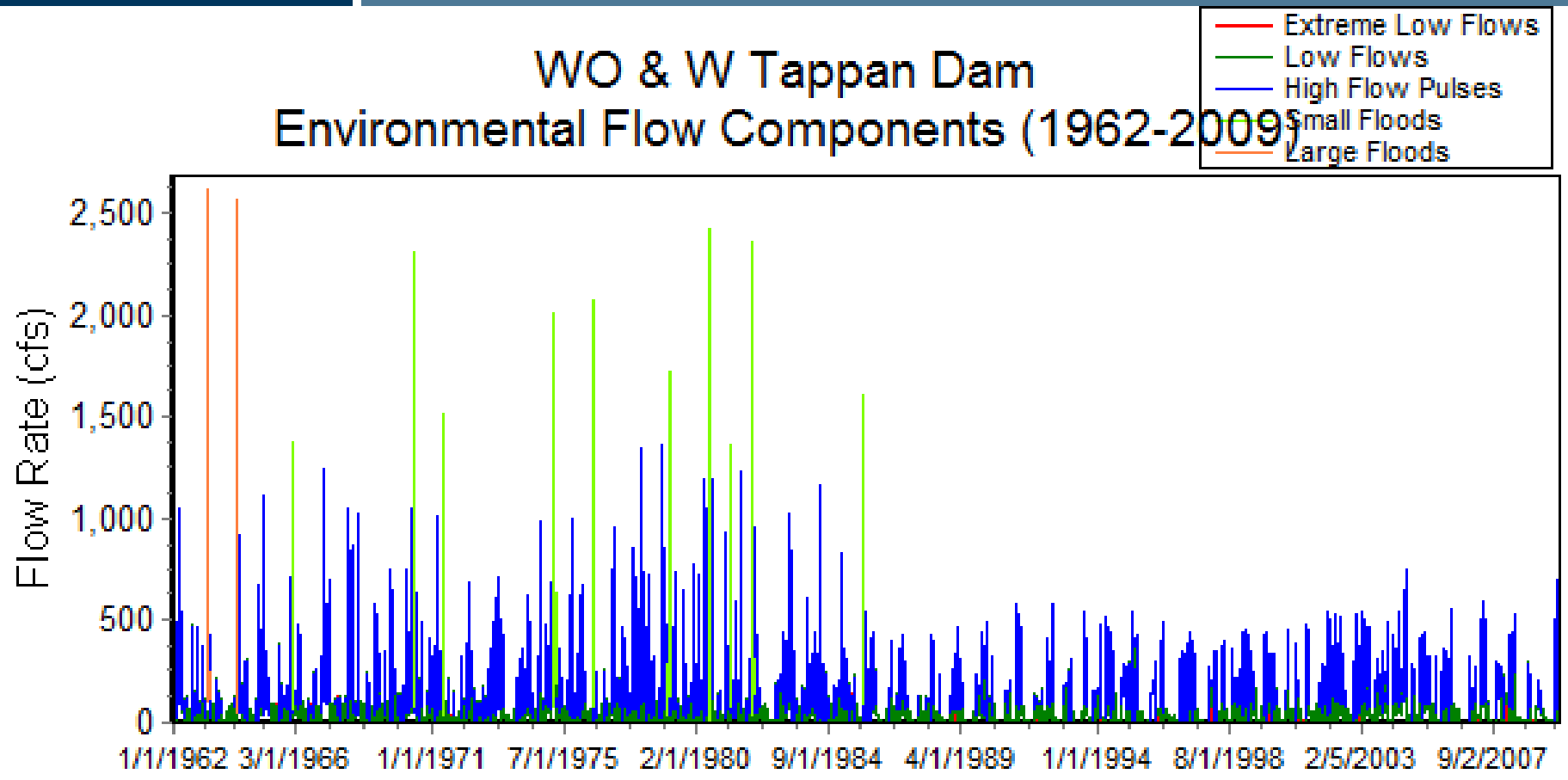
E-flows from Dam Re-operations



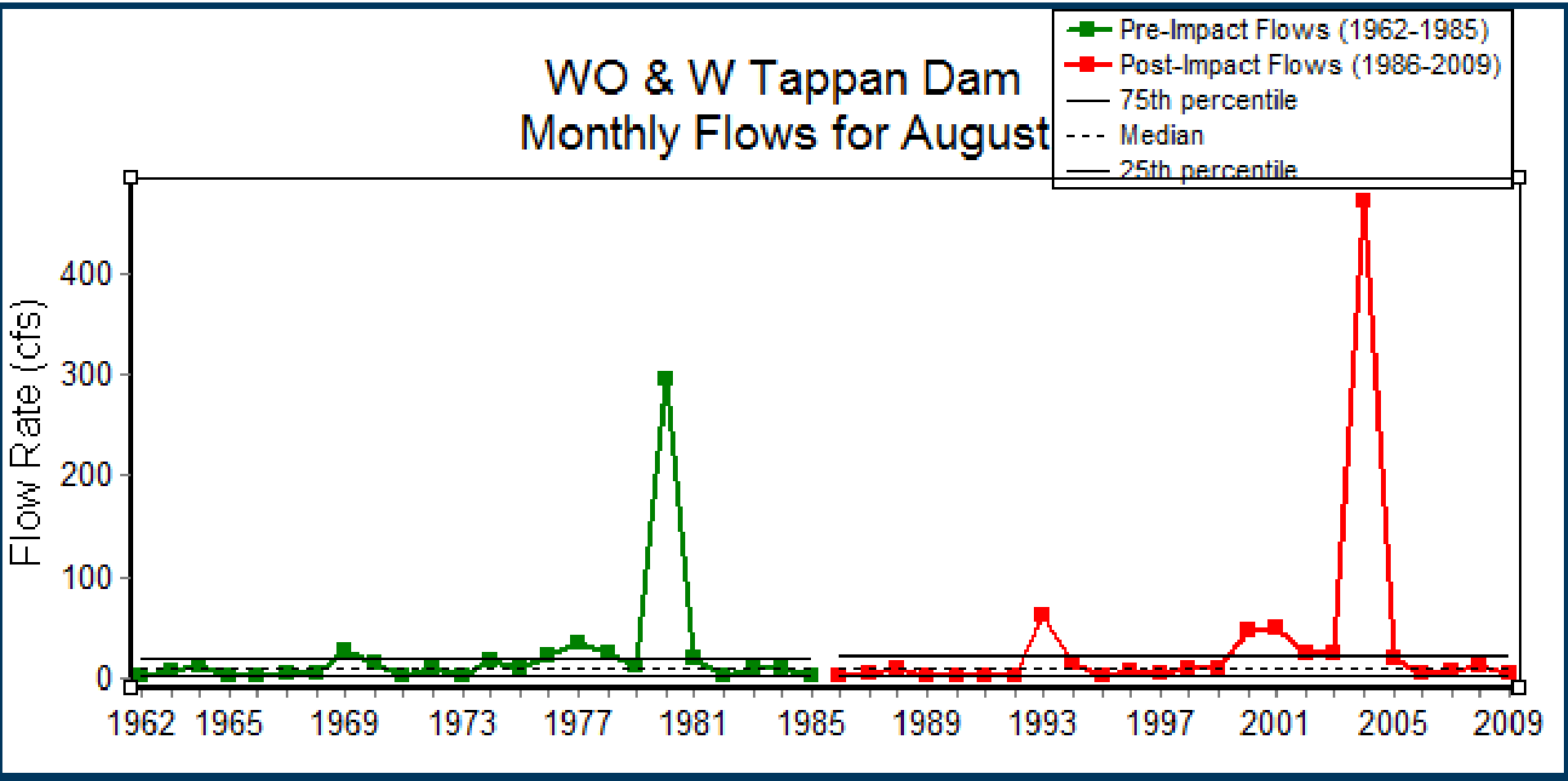
- Most tributary dams are designed to “Catch” spring flood events and “release” them later in the natural low-flow period

Tappan Flow Alterations



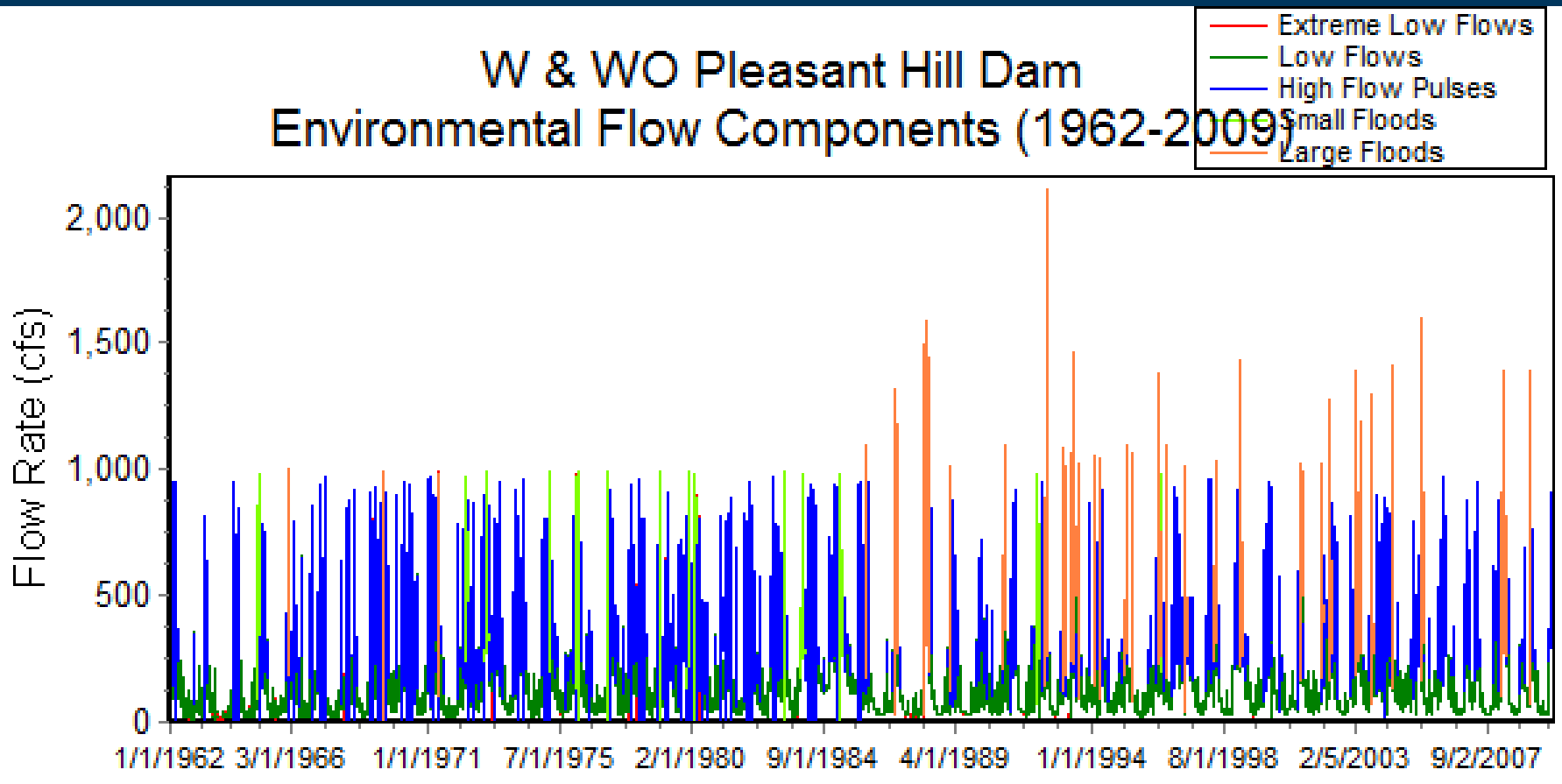
- No small floods, lowered frequency and peaks in high flow pulses. Project also took out large floods as expected.

Tappan Flow Alterations August (Mean Monthly)



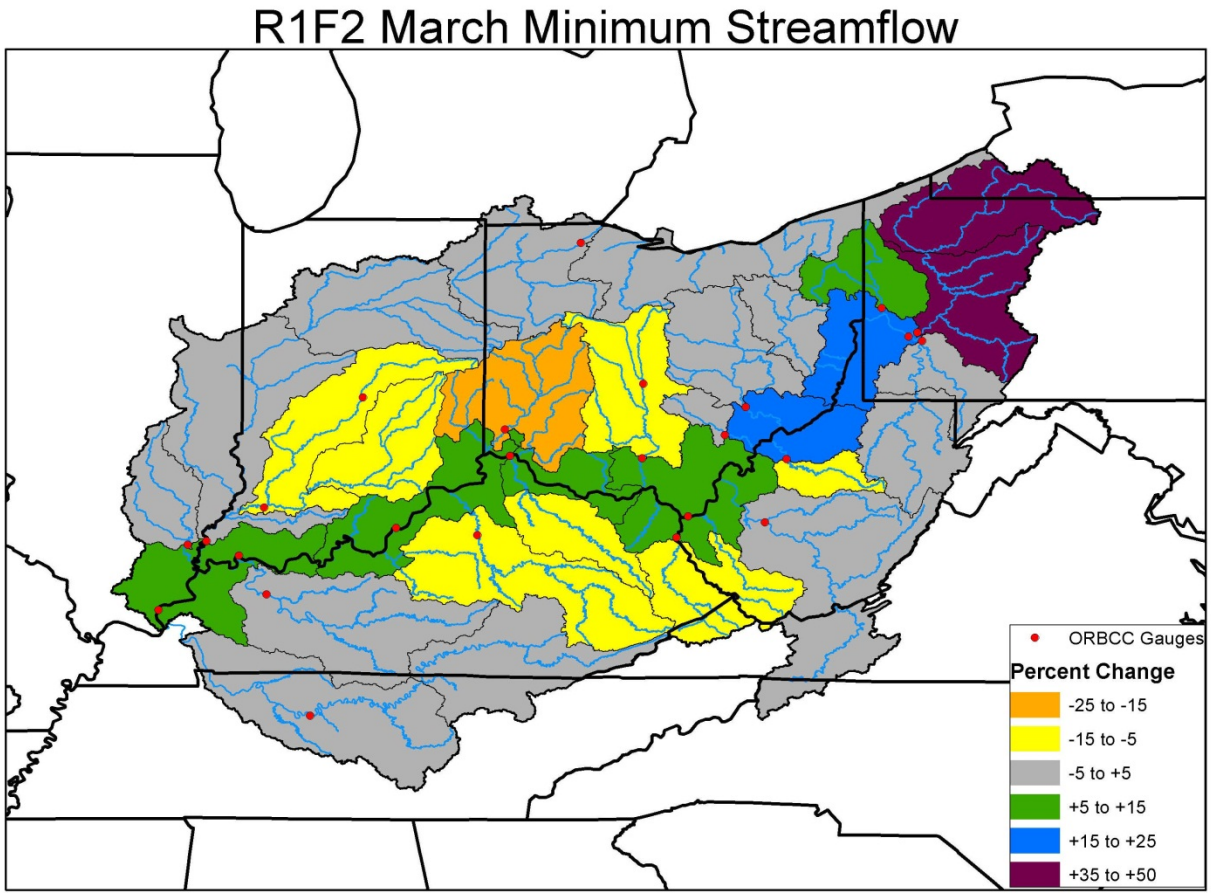
- Means in August greater than WO condition in some years

Pleasant Hill Flow Alterations



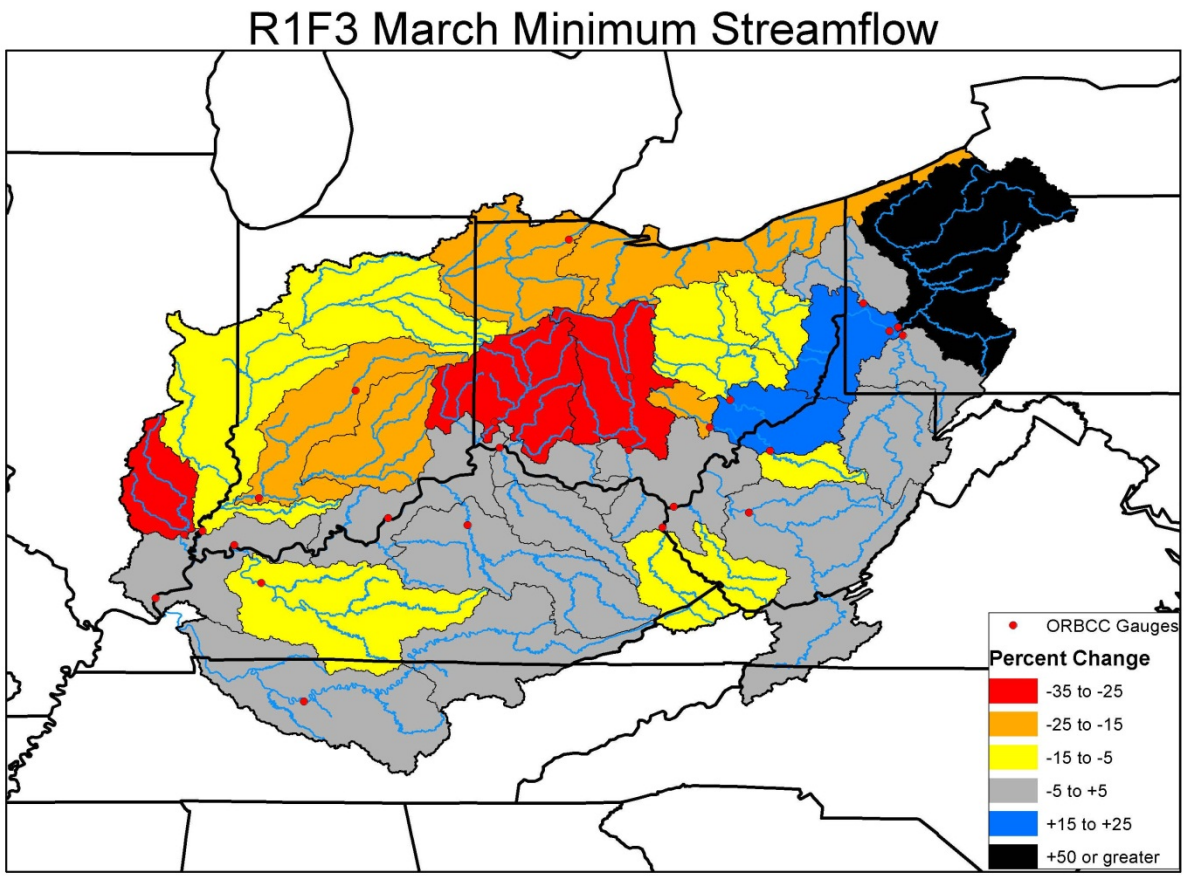
- Less frequent high flow pulses and small floods but it seems that large floods are actually more frequent (operational constraints?)

2041-2070 March % Change Min



- Little or no change to minimum flows except wetter upper Ohio basin and drier in parts of central Ohio Valley

2071-2099 March % Change Min



- More variability and extremes show up north of Ohio River, drying Ohio-Illinois, wetter upper Ohio basin

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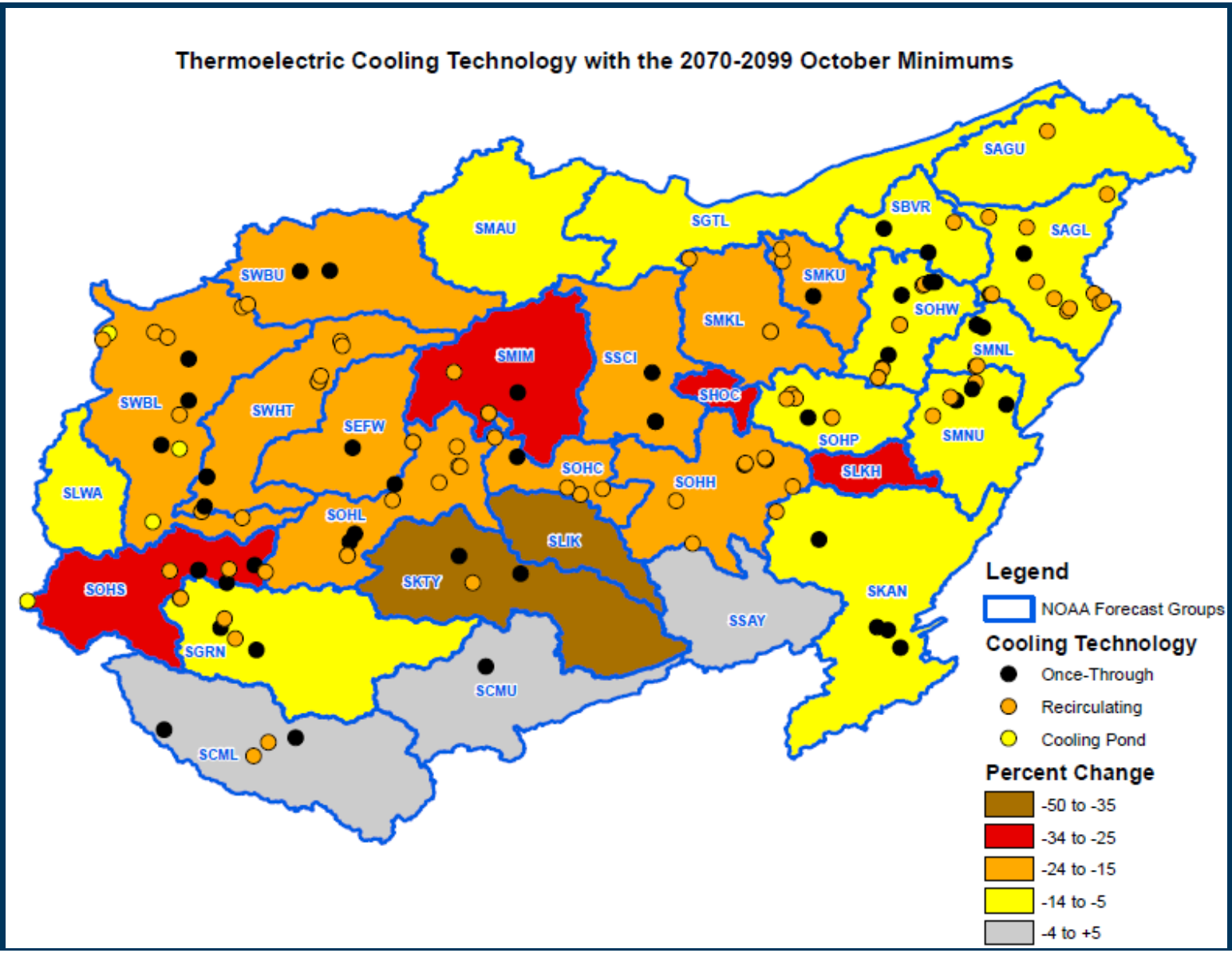
ORBCC Something to Think About in the Future…..