Water Risk Planning Tools for Decision Support in the Electric Power Sector

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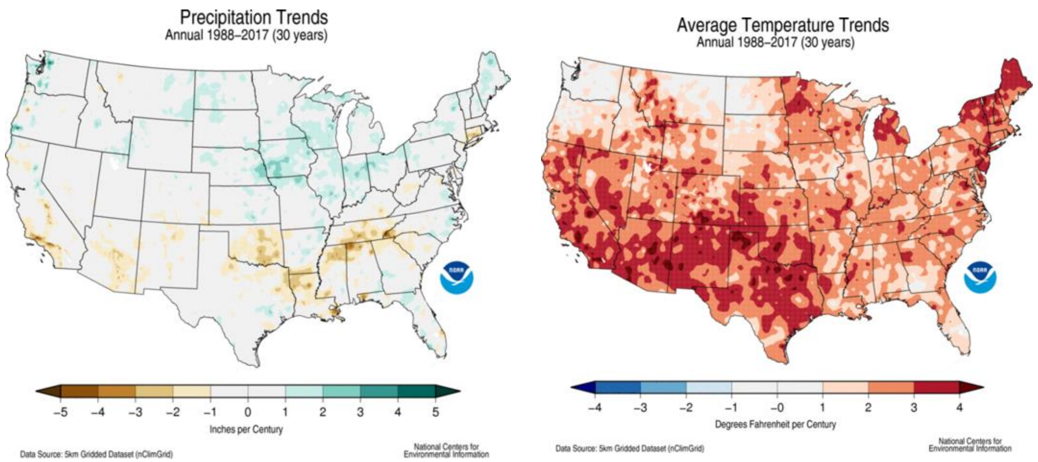
- Power Company Advisory Committee

Teamwork makes the dream work!

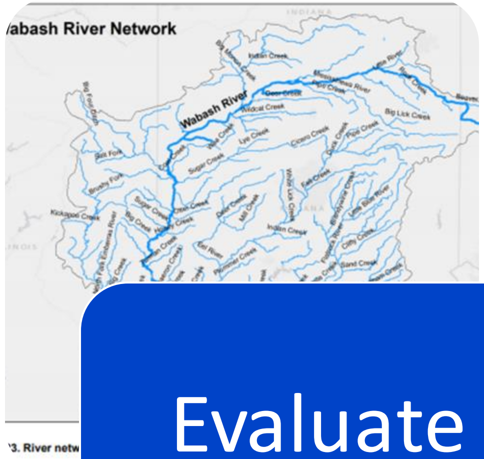
Background

- **Issue**
  - Tools to manage water risk require sustained funding to integrate climate-based and regional assessments that inform adaptation and resiliency strategies.



- **Objectives**
  - Facilitate response to emerging water management stakeholder issues
  - Integrate climate assessments into water supply/quality models
  - Give insights on regional climate risks and adaptation strategies to support long range planning

Steps in the Analysis



Evaluate Hydrologic Models

Design Risk Framework

Develop Adaptation Strategies

Linking Research for Strategic Planning and Tactical Outcomes

Step 1a: Evaluate Hydrological Models

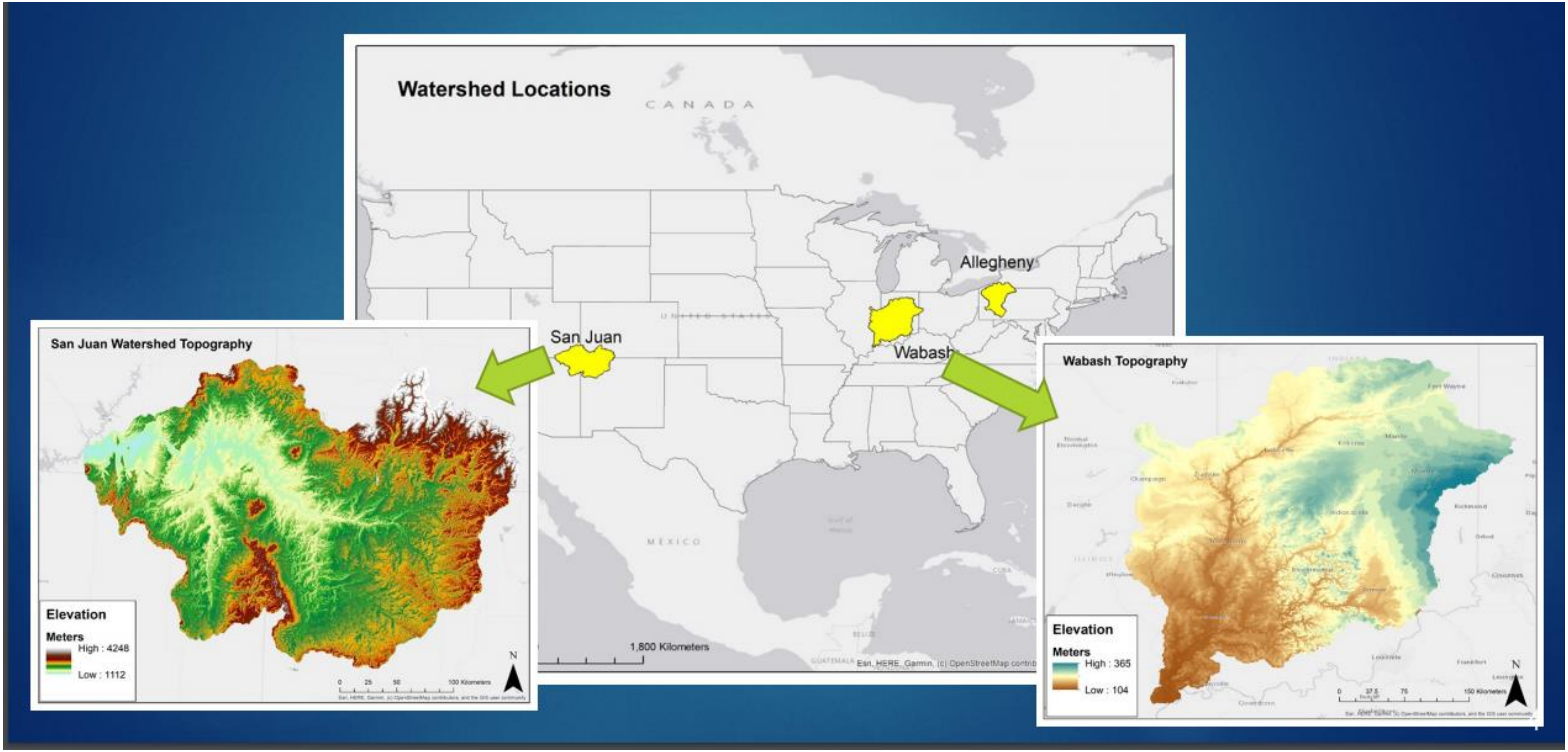
- SWAT
  - Hydrologic and water quality
  - Detailed representation of actual land uses & mgmt. practices
  - Applicable to many regions
  - Can incorporate land use change in same simulation
  - Can model extreme events
  - Easily available with good support

- WARMF
  - Hydrologic and water quality
  - Very good representation of actual land uses
  - Applicable to many regions
  - Can incorporate land use change in simulation in series
  - Can model extreme events
  - Available with good support

- MIKE SHE
  - Hydrology
  - Water quality requires additional programming
  - Very good representation of actual land uses
  - Applicable to many regions
  - Need separate simulations for land use change
  - Can model extreme events
  - Available, with a significant monthly fee

2020 EPRI Report: Evaluation of Hydrological Models for Climate-based Assessments (#3002019495)

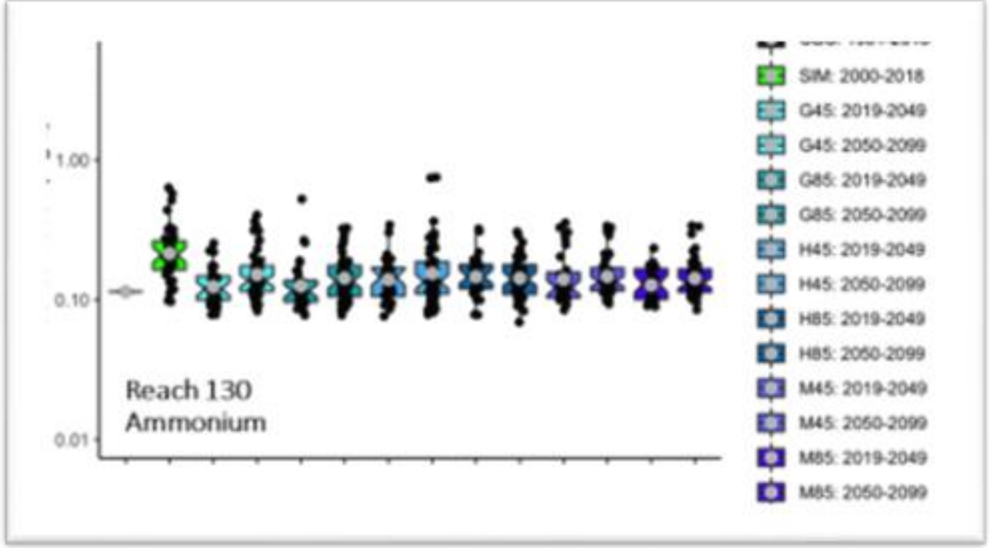
Step 1b - Hydrological Modeling



Data Used

- GCMs selected based on best match of historical climate
  - GFDL ESM2 (USA)
  - Hadley GEM2 (UK)
  - MRI CGCM3 (Japan) or Can ESM2 (Canada)

- IPCC projections
  - RCP4.5 (mid-level emissions)
  - RCP8.5 (high-level emissions)



- Downscaling method – Dynamic vs Statistical

Step 2a - Characterize Risk

Assessment of Risk to Infrastructure

Assessment of Risk to Operations

Assessment of Risk to Supply Chains

Assessment of Water-Related Environmental Regulatory Risk

- **Thermal Generating Facilities** (coal, natural gas, geothermal)
- **Hydro-electric facilities**
- **Land-based renewable generating facilities** (wind, solar, geothermal)
- **Transmission and distribution facilities** (e.g., transmission towers, substations, and utility poles)

Qualitative Risk Assessment

- **Severity** (damage, criticality)
- **Likelihood** (probability of occurrence)

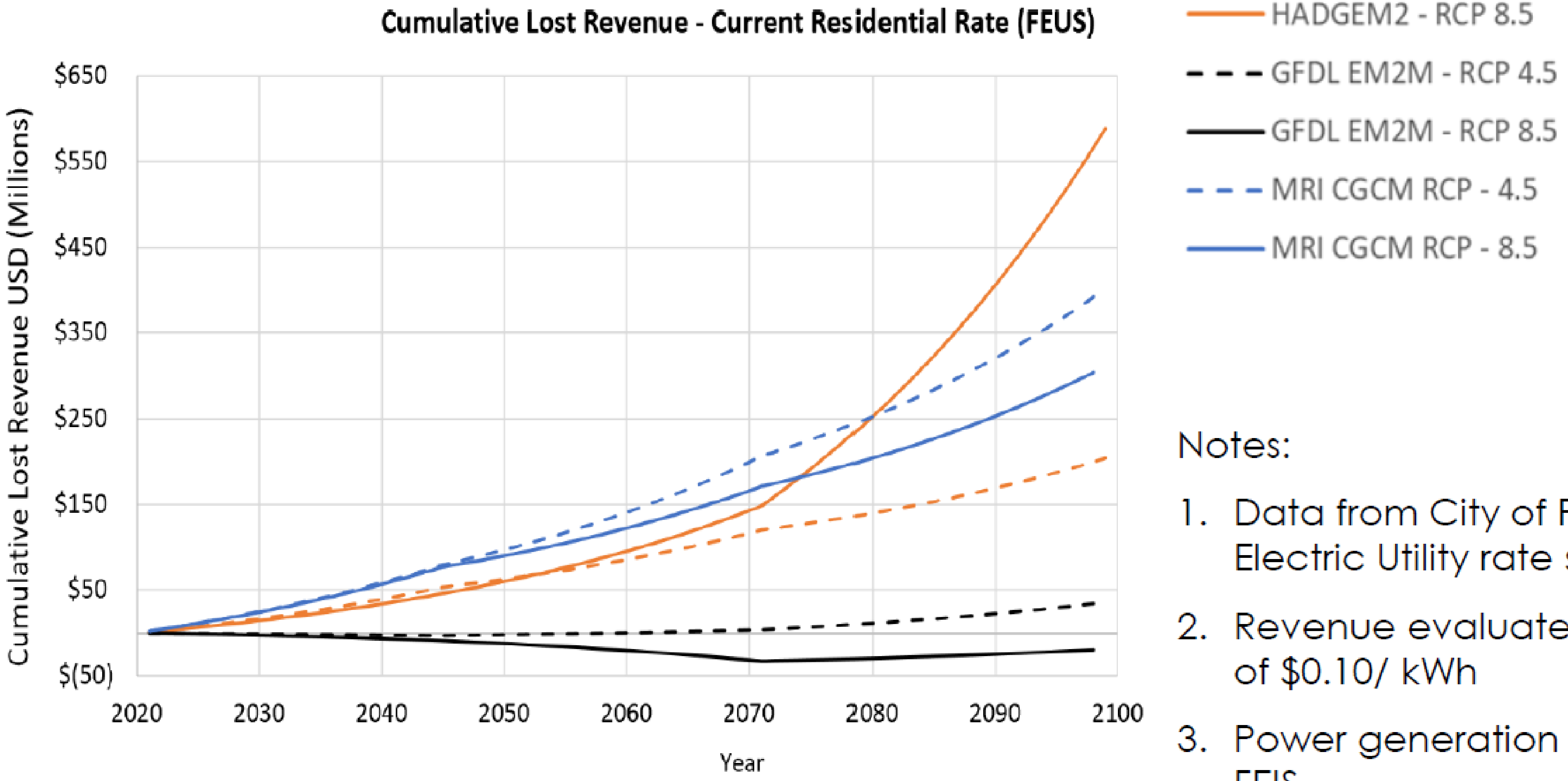
Qualitative Risk Identification and Characterization

Very Likely	n=0	2	1	1
Likely	1	3	2	2
Moderately Likely	0	5	4	1
Less Likely	1	4	2	1
Unlikely	0	1	0	0
	Positive Impact	Low Severity	Medium Severity	High Severity

31 risks identified in total

Step 2b – Quantify Risk

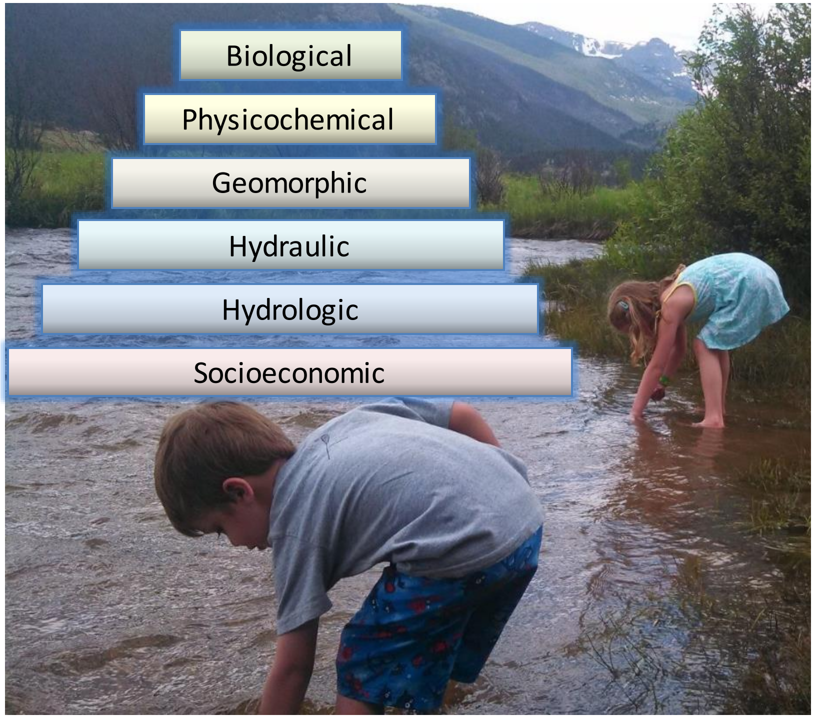
Hydropower example from the San Juan Basin

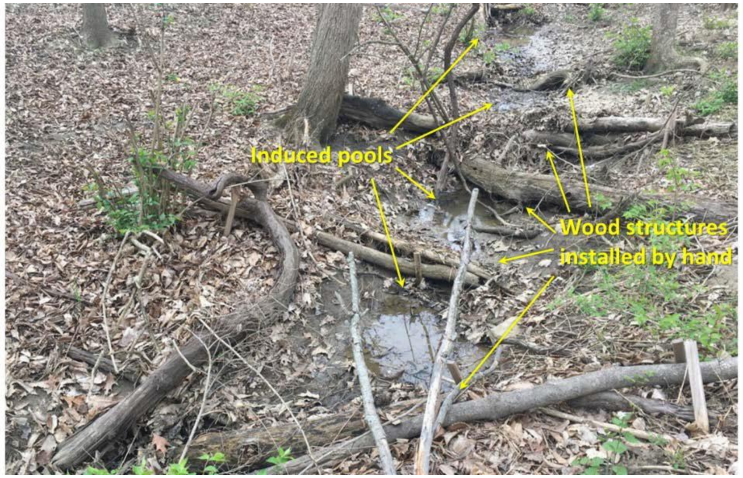


Notes:

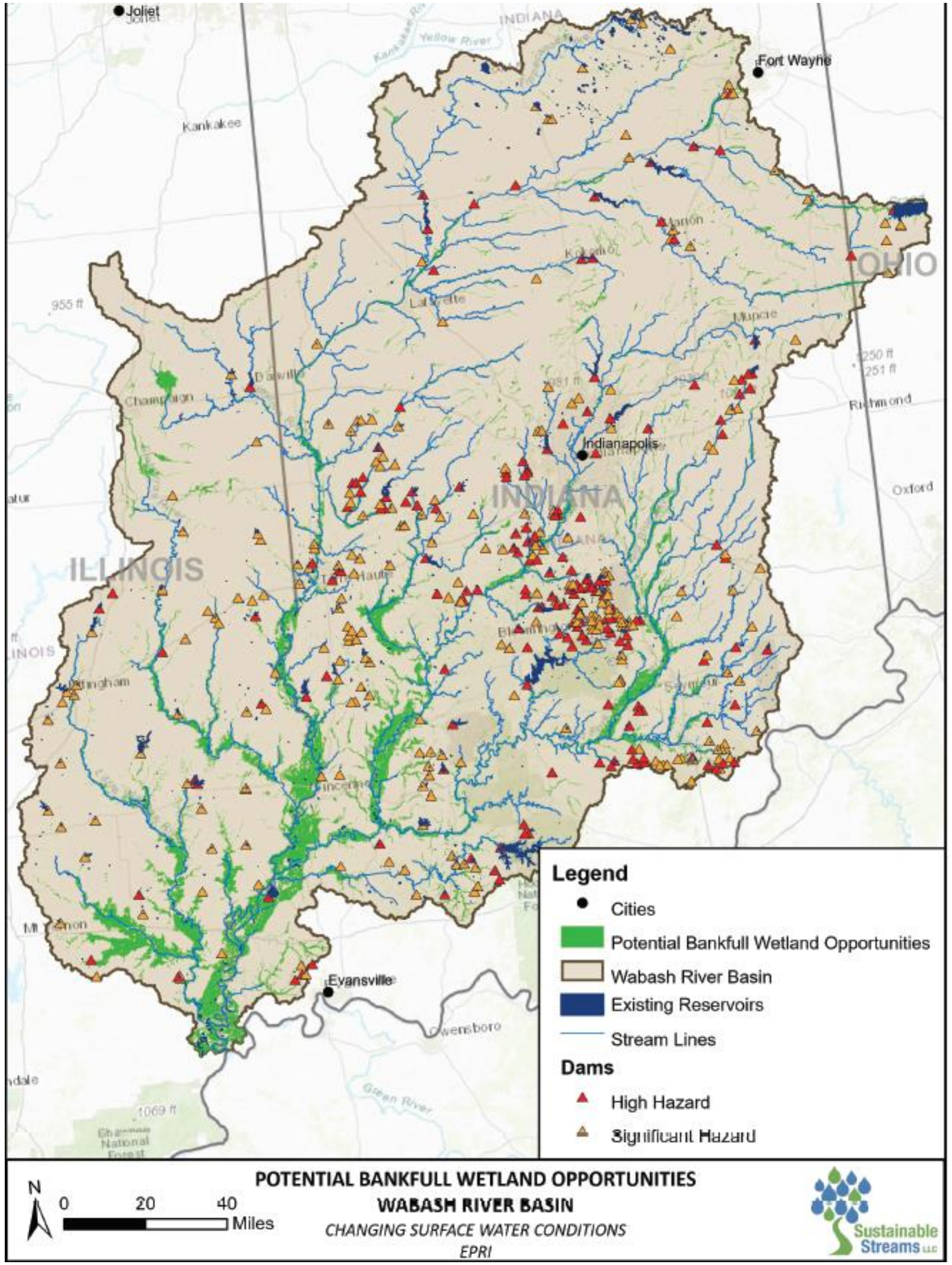
1. Data from City of Farmington, NM Electric Utility rate study
2. Revenue evaluated at residential rate of $0.10/ kWh
3. Power generation from USACE 2011 FEIS

Step 3a – Identify Adaptation Strategies



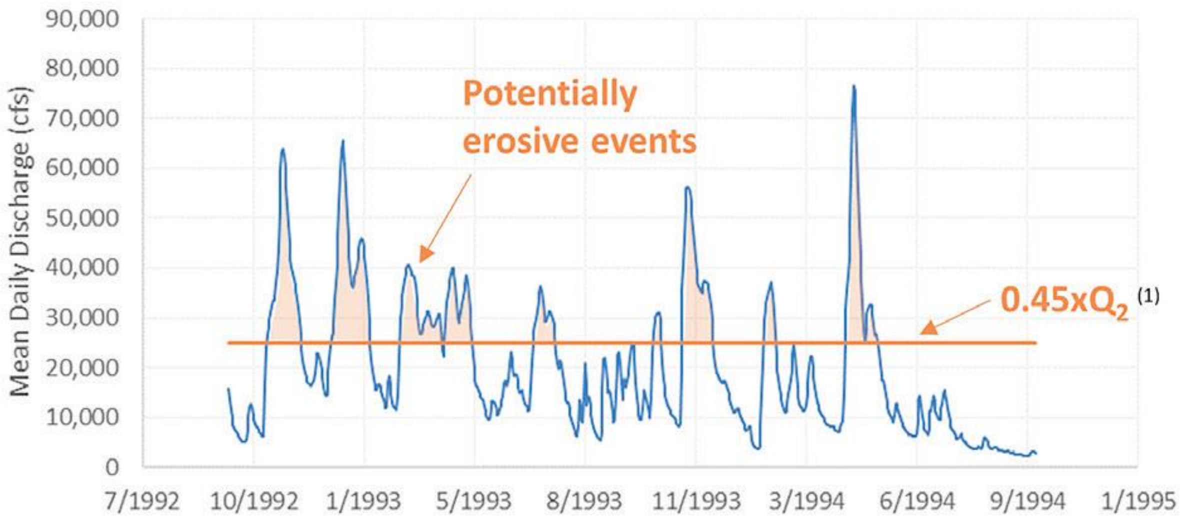


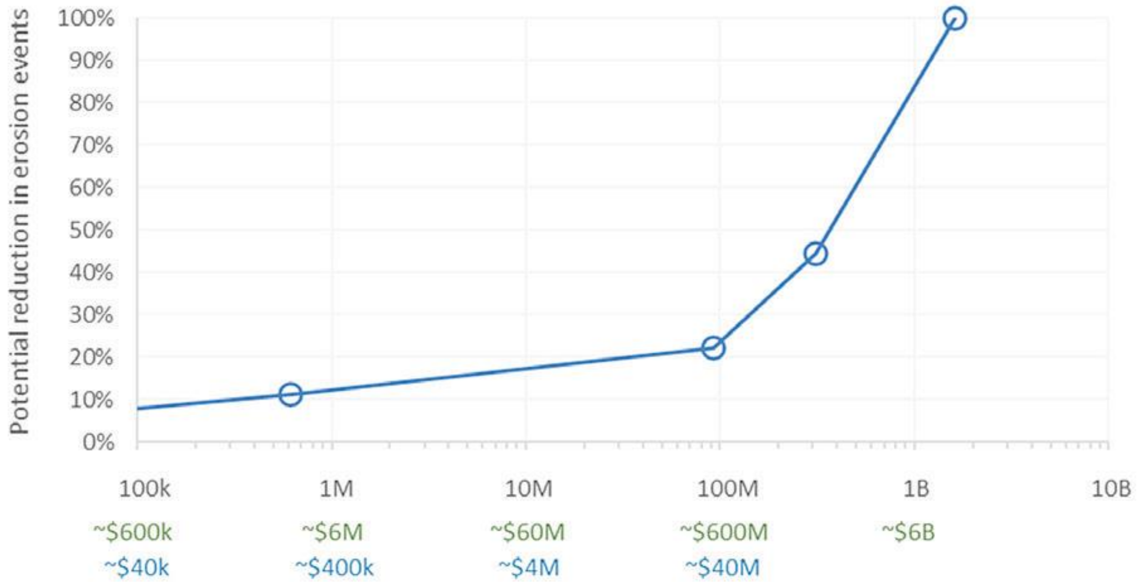
- San Juan River Basin
- Wabash River Basin
- Allegheny River Basin



- Optimization of Existing Storage
- Bankfull Wetlands
- Beaver Reintroduction
- Hand-Placed Logs

Step 3b – Quantify Adaptation Strategies





	~250k m³	~1.25M m³	~25M m³	~120M m³
	~$1.5M	~$7.5M	~$150M	~$750M
Bankfull Wetlands – planning-level excavation cost of $6.20/m³ ($4.75/CY) with free topsoil haul off				
	~$100k	~$500k	~$10M	~$50M
Beaver Reintroductions – planning-level cost of $2,500 per imported colony with each colony creating ~6,200 m³ (~5 acre-ft) of storage				
	~$15M	~$75M	N/A	N/A
Hand-placed Logs – planning-level cost of $5.75/m ($1.75/ft) with volunteer/student labor and professional guidance				
				
Existing Reservoir Optimization – feasibility and cost will vary by watershed/reservoir				

Products - EPRI Reports

- Evaluation of Hydrological Models for Climate-based Assessments (#3002019495) – 2020
- Modeling the Potential Hydrological Implications of Climate Change for the Power Sector: Guidance on the Implementation of Hydrologic Models (#3002023102) - 2021
- Potential Water-Related Risks to the Electric Power Industry Associated with Changing Surface Water Conditions (#3002017809) – 2020
- Quantifying the Potential Impacts of Water-Related Risks Associated with Climate Change to the Power Industry (#3002021684) - 2022
- Minimizing Risks to the Electric Power Industry from Changing Surface Water Conditions (#3002017808) – 2020
- Conceptual Watershed-scale Opportunities to Minimize Risks of Changing Surface Water Conditions — A Pilot Analysis of Three River Basins (#3002021683) - 2021

Manuscripts in progress

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