BUREAU OF RECLAMATION

Keswick Warming Analysis

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Overview

- Keswick Reservoir
- Keswick Temperatures
- Thermal Analysis
  - Shasta HEC5Q Modifications
  - Meteorology
  - Modeling Workflow
  - Compute
- Results
- Next steps

Shasta Dam. USBR NCAO. 2022.

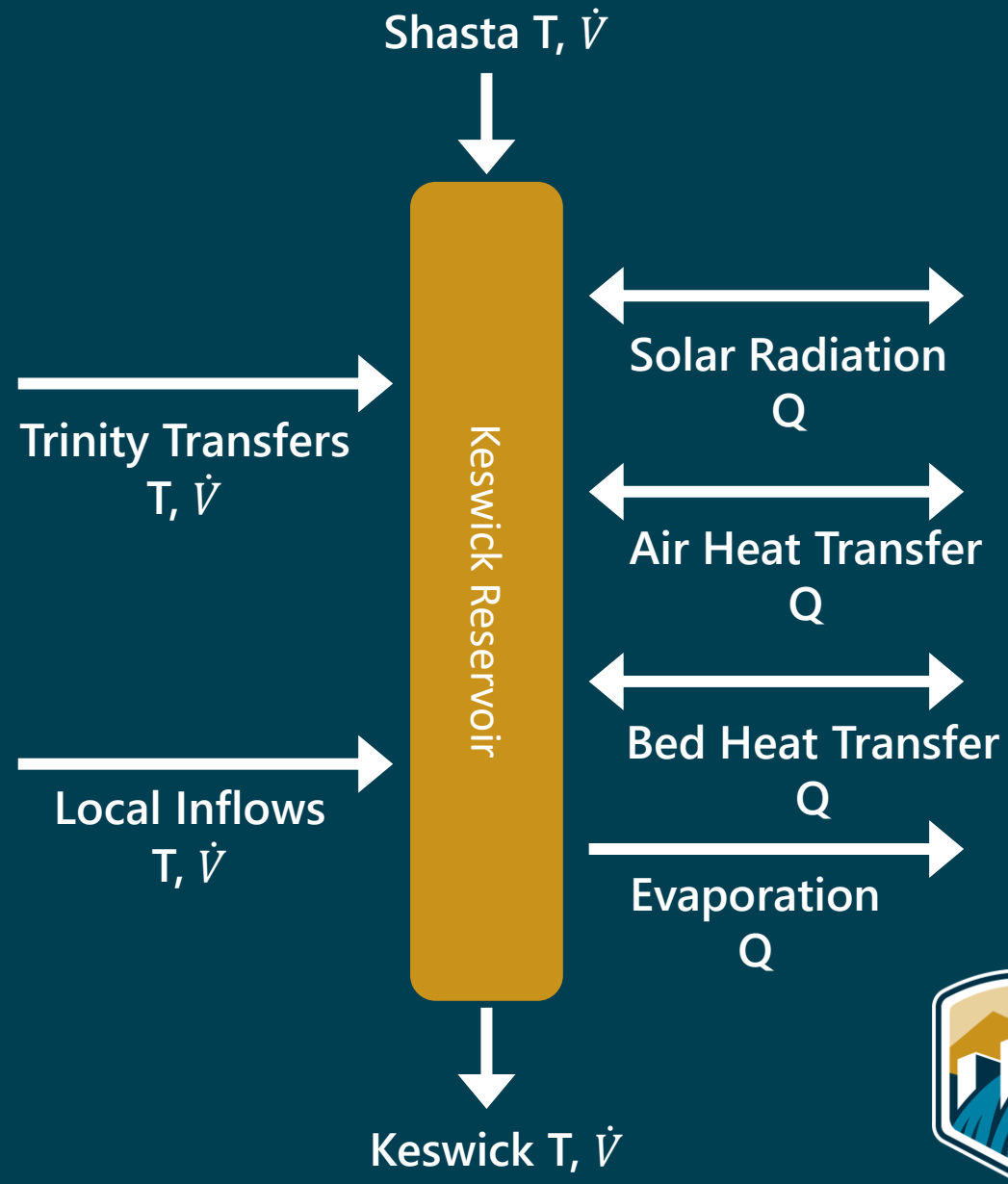
Keswick Reservoir

- Afterbay to Shasta Reservoir
- Geometry
  - About 10 miles long and 0.1 miles wide
  - On average, less than 40 feet deep
  - Combines river and reservoir features
- Relatively short residence time
  - 23,800 AF at full pool

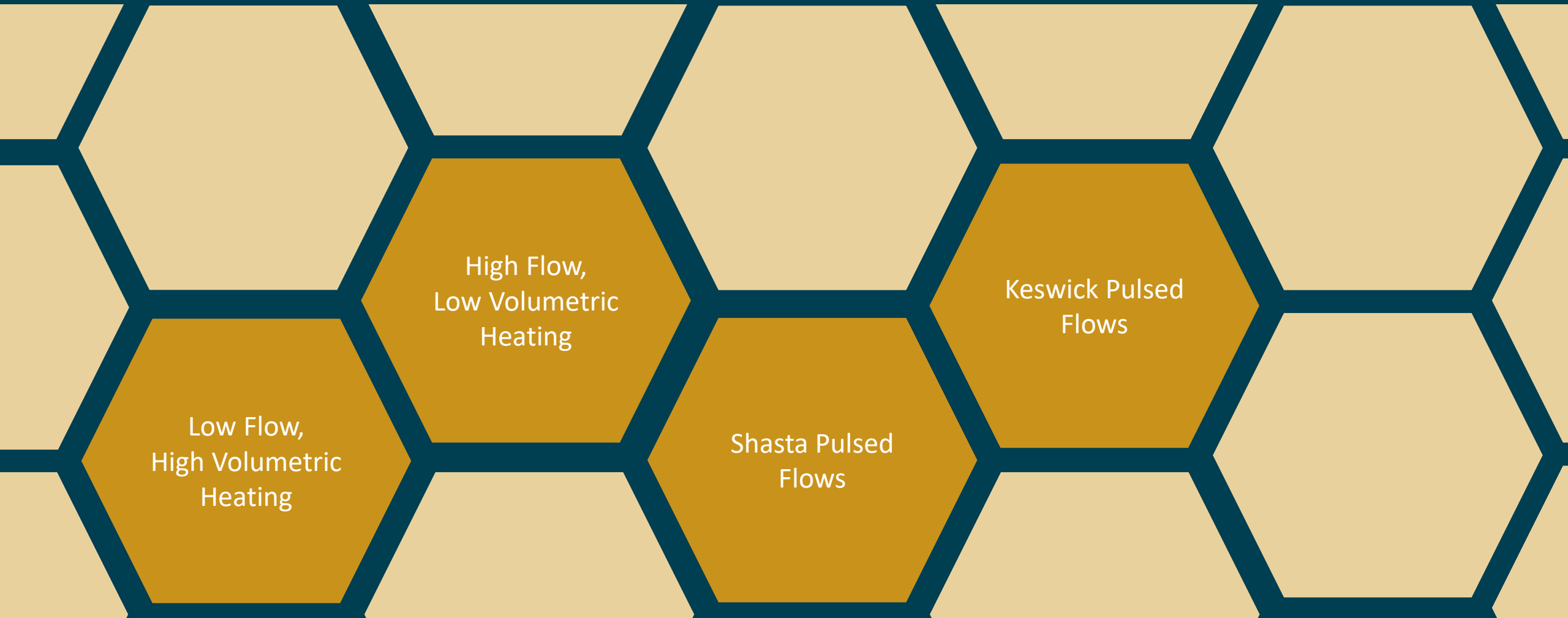
Water Temperature Modeling Platform: Model Development, Calibration, Validation and Sensitivity Analysis [DRAFT]. USBR. 2023

Keswick Warming

- Temperature control releases at Shasta Dam
- Travel through Keswick
  - Cools during winter, early spring
  - Warms during summer, fall
- Keswick has no temperature control and rarely stratifies
- Keswick release governs temperatures further downstream



Temperature Management Strategies



Thermal Analysis

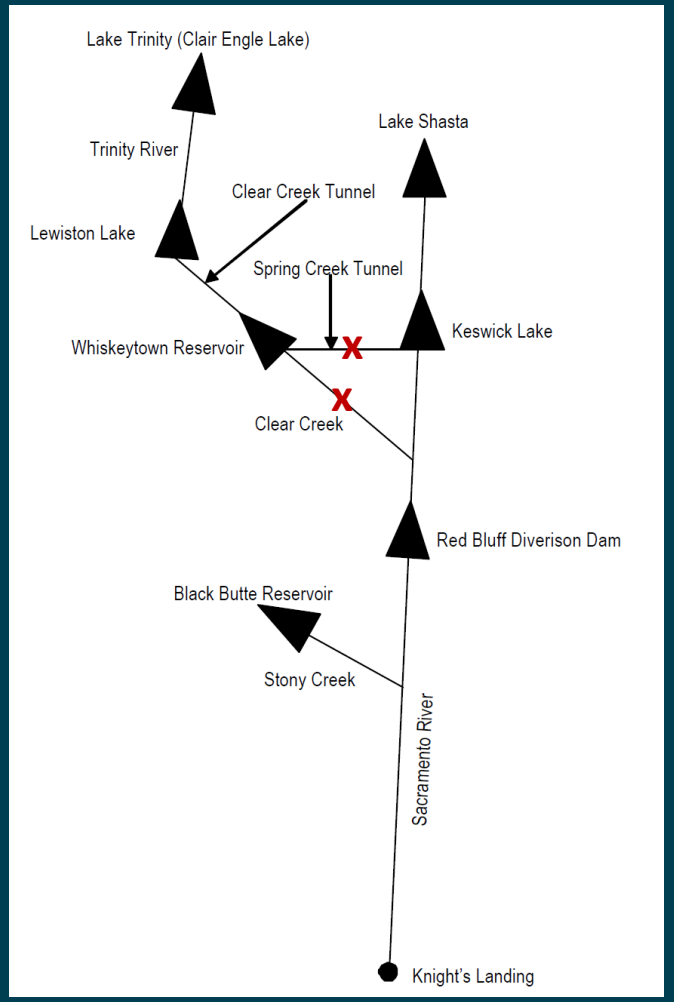
- Baby and bathwater approach
- Use the temperature models to build a parametric analysis framework
- Run models as many times as needed to construct temperature map as a function of parameters
- Use parameter map to help guide future decisions

Parameters

- Shasta release rate
- Shasta release temperature
- Meteorology
- Trinity Transfers

Shasta HEC5Q Modifications

- Treat Shasta as an infinite reservoir at a fixed temperature
- Modified HEC5Q source code to allow daily reset of the reservoir temperature
- Modified input series to have the same fixed inflow and outflow rates
- With and without Trinity transfers

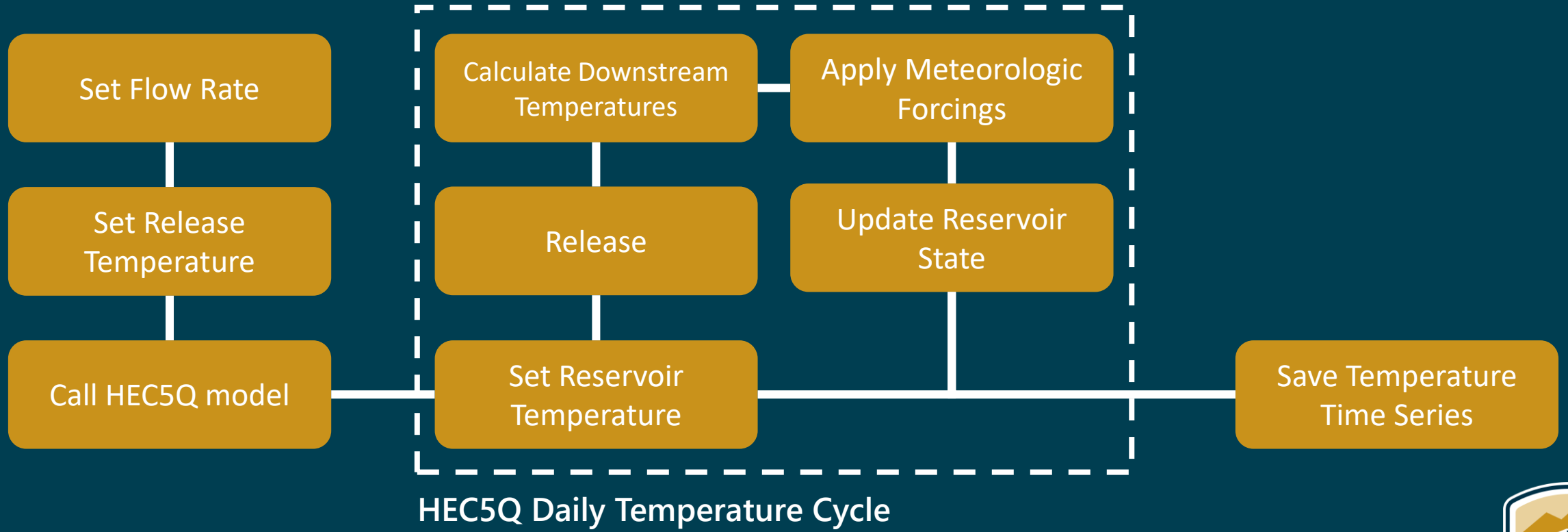


Upper Sacramento River Water Quality Modeling with HEC-5Q: Model Calibration and Validation, RMA. 2003

Meteorology

- Nonsensical to use fixed inputs
- Use entirety of the historical and 2035 CT meteorologic series
- Each case ran against all meteorologic years

Modeling Workflow



Compute

- 81 years from 1921-2002
- Half degree release temperature increments from 48 to 63 F
- 250 cfs increments from 250 cfs to 20,000 cfs

Number of Solves	=	Years	x	Temperatures	x	Release Increments
200,880	=	81	x	31	x	80

x

5 minutes per solve

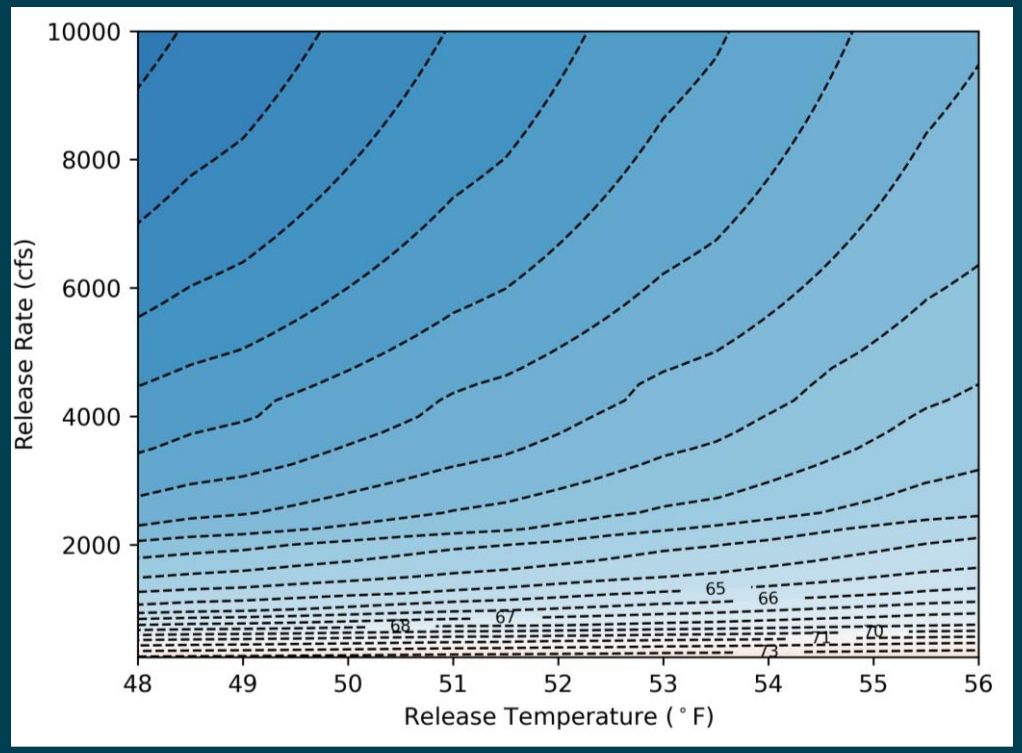
17,000 core hours = 700 core days

Reclamation Standard Workstation
6 cores -> 117 days

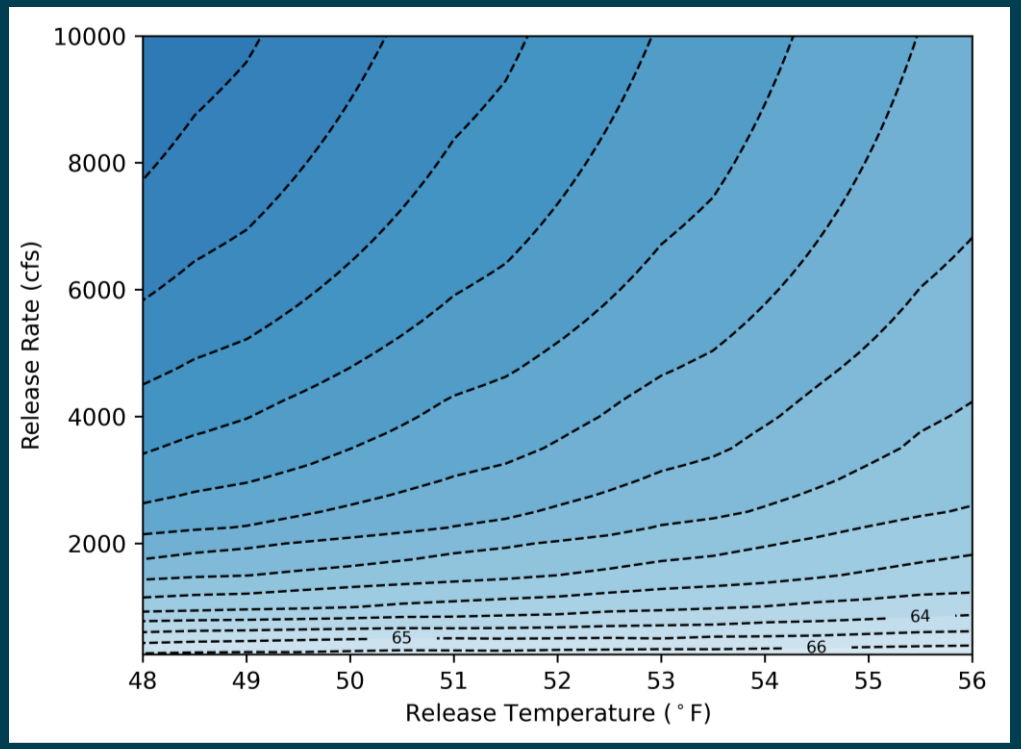
Results

- Timeseries for compliance locations
  - Minimum, maximum, mean by month

July

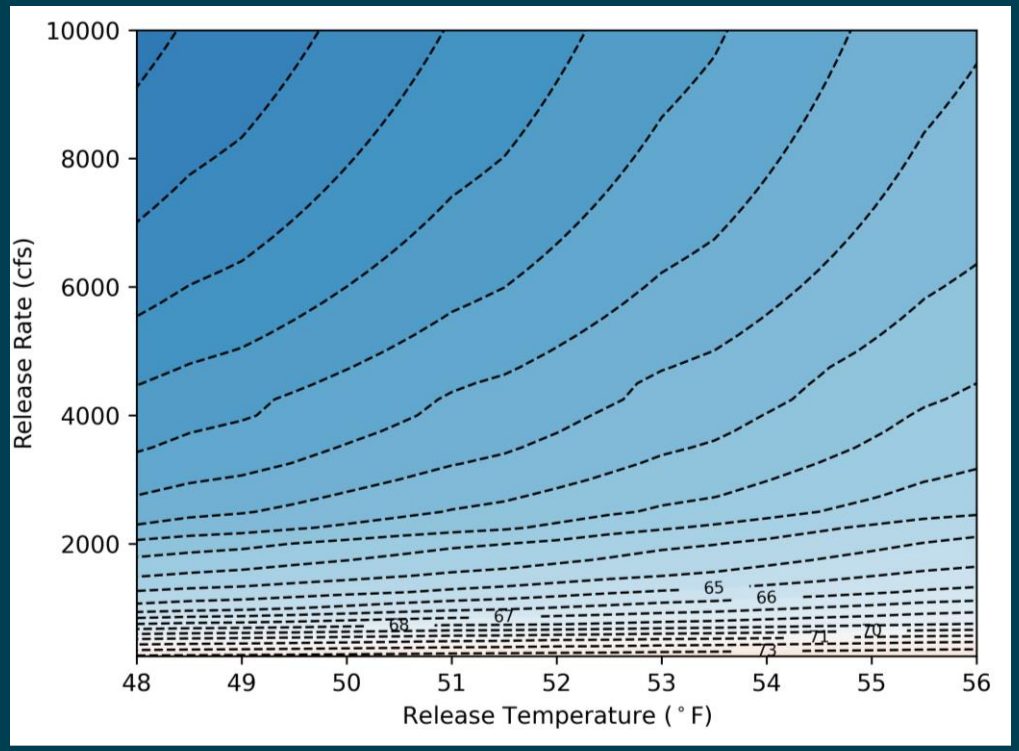


August

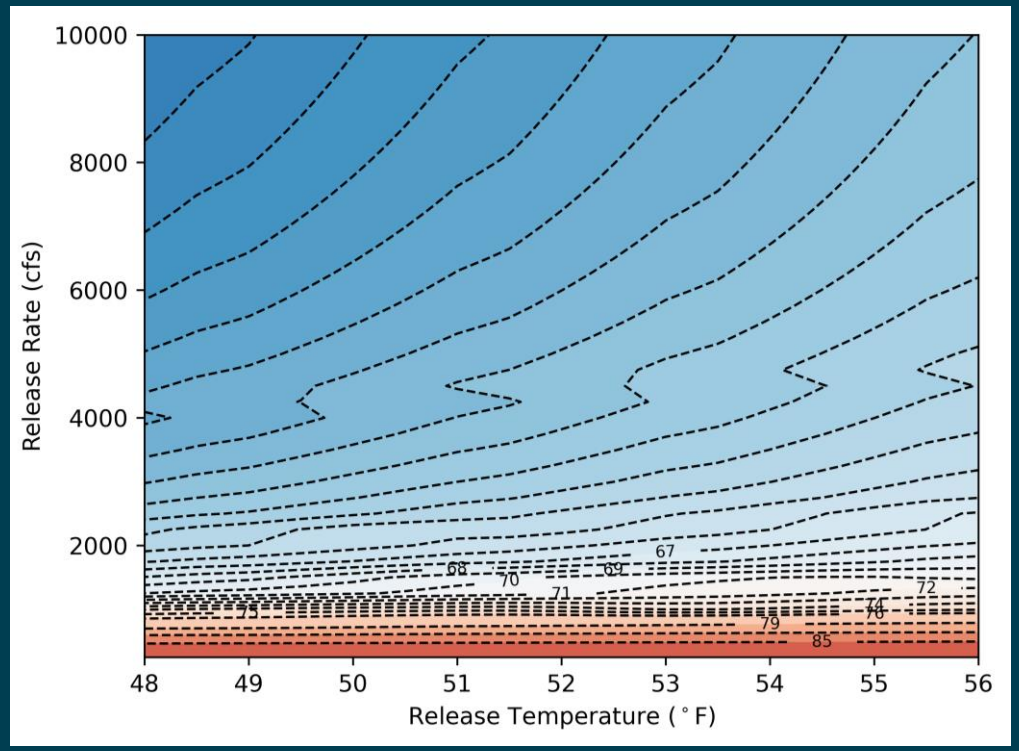


Results

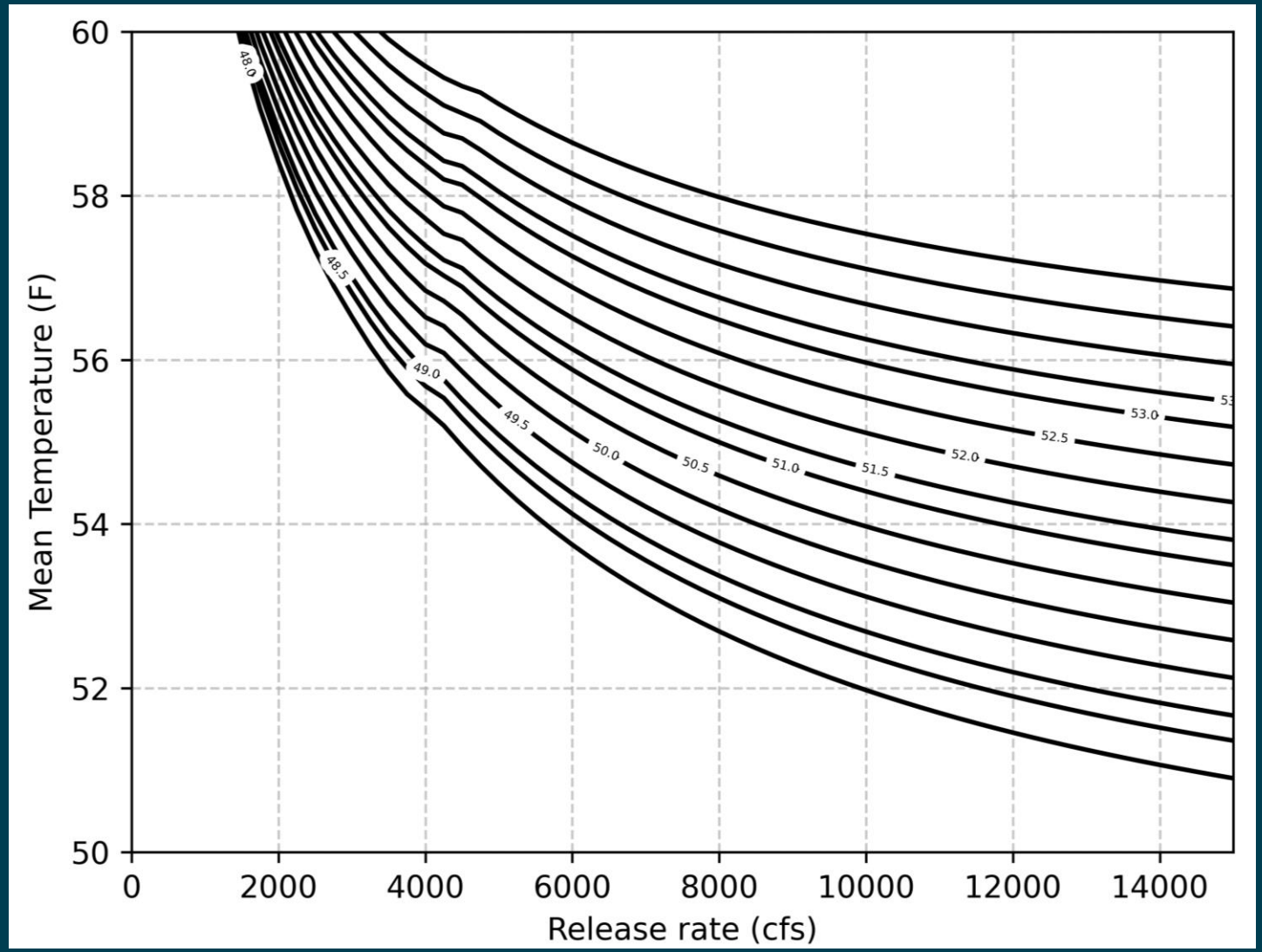
July – With Transfers



July – Without Transfers



Results


Mean Temperature (F)
60
58
56
54
52
50
0
2000
4000
6000
8000
10000
12000
14000
Release rate (cfs)
48.0
48.5
49.0
49.5
50.0
50.5
51.0
51.5
52.0
52.5
53.0

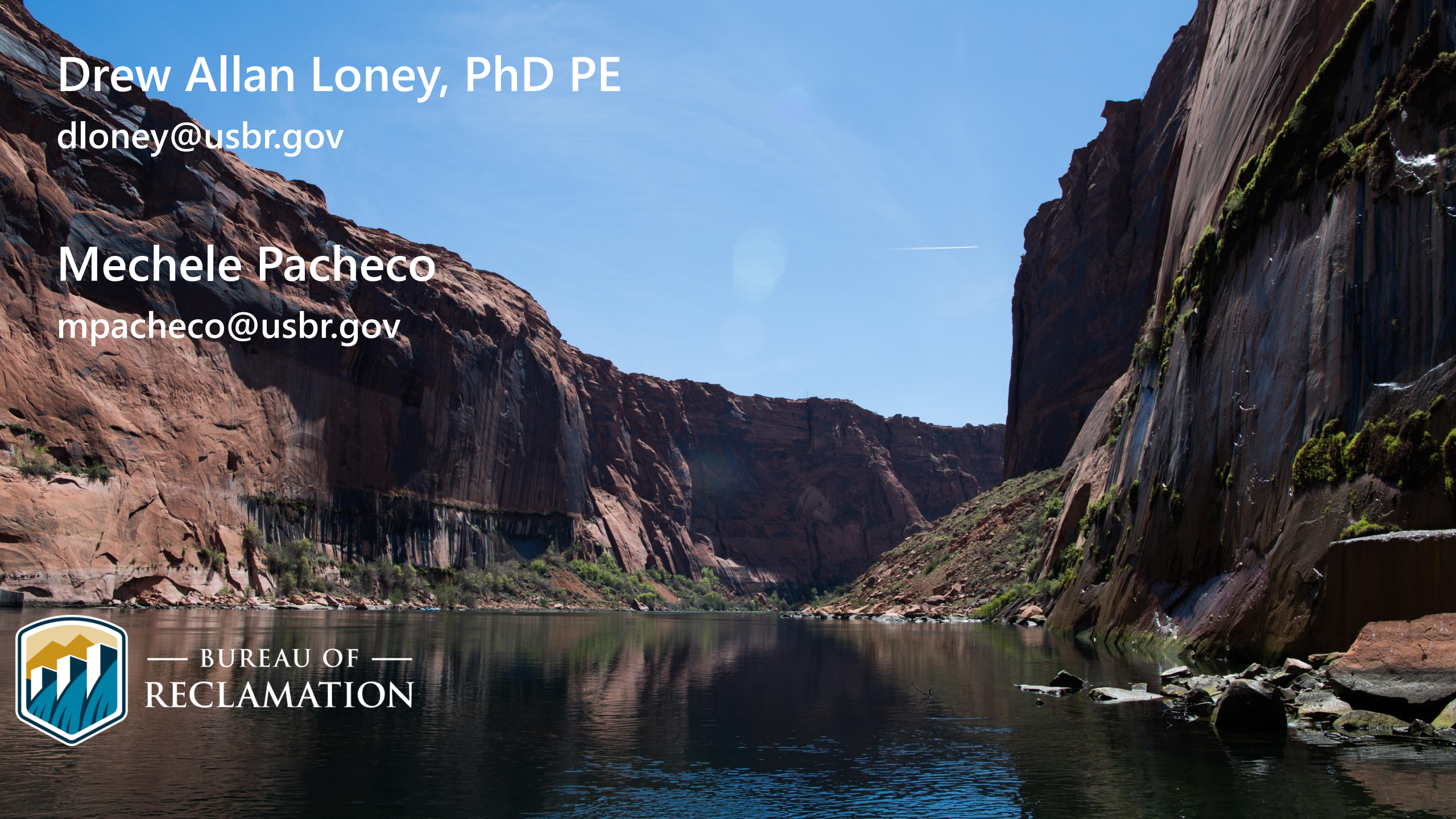
Use Cases

- Accelerate the temperature/operations modeling cycle
  - Potentially develop integrated temperature logic for CalSim 3
  - Still need to confirm values with final temperature analysis

- Real time operations
  - Guide adjustments to release temperatures and flows
  - Help with heat wave response
  - Better manage cold water pool resources

Next Steps

- Finish LTO Consultation
- Determine if other parameters, compliance locations should be added
- Explore decision support tools
  - Simplify workflow for real time operations
  - Explore feasibility of Calsim 3 incorporation



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