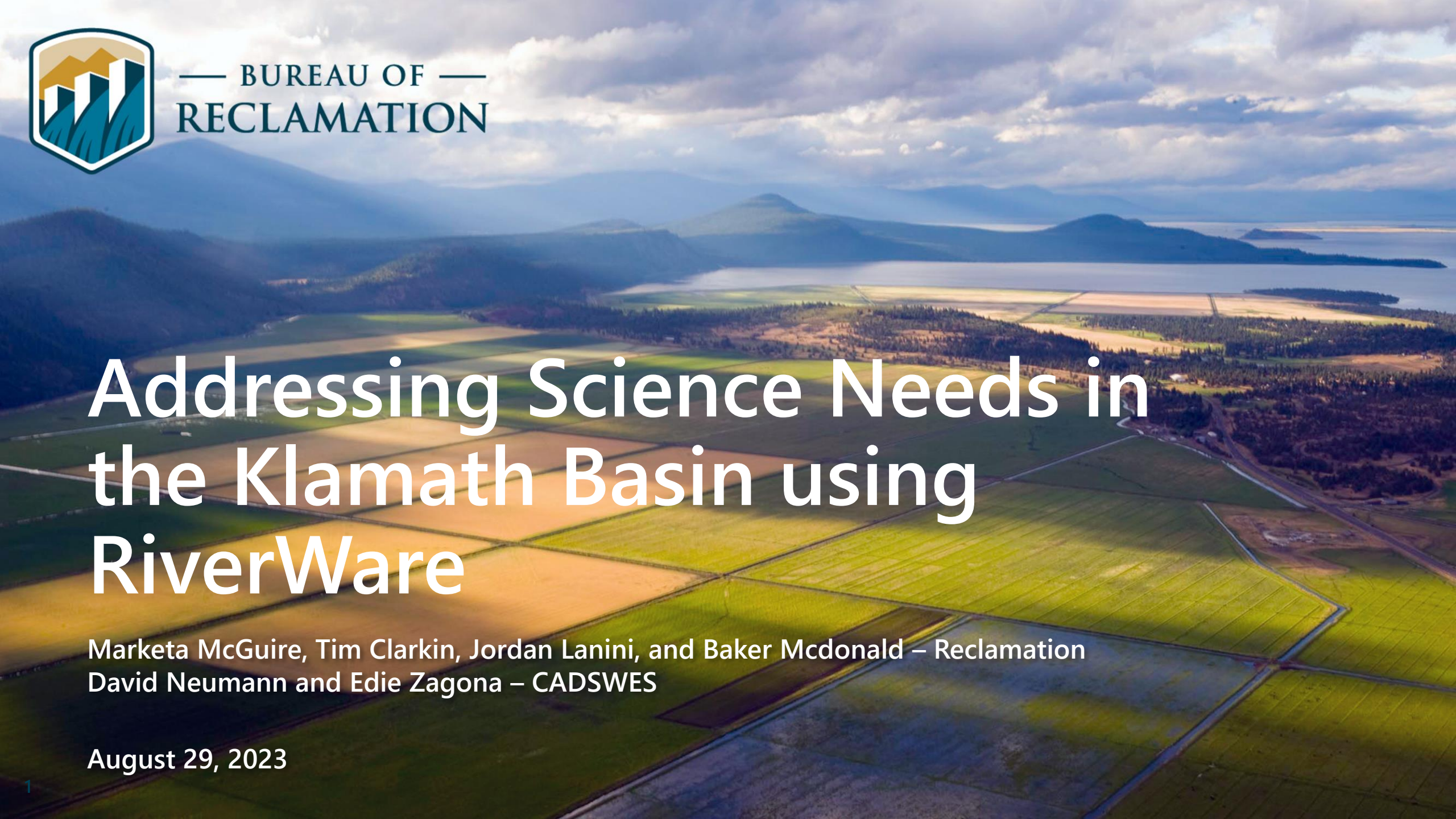


BUREAU OF RECLAMATION

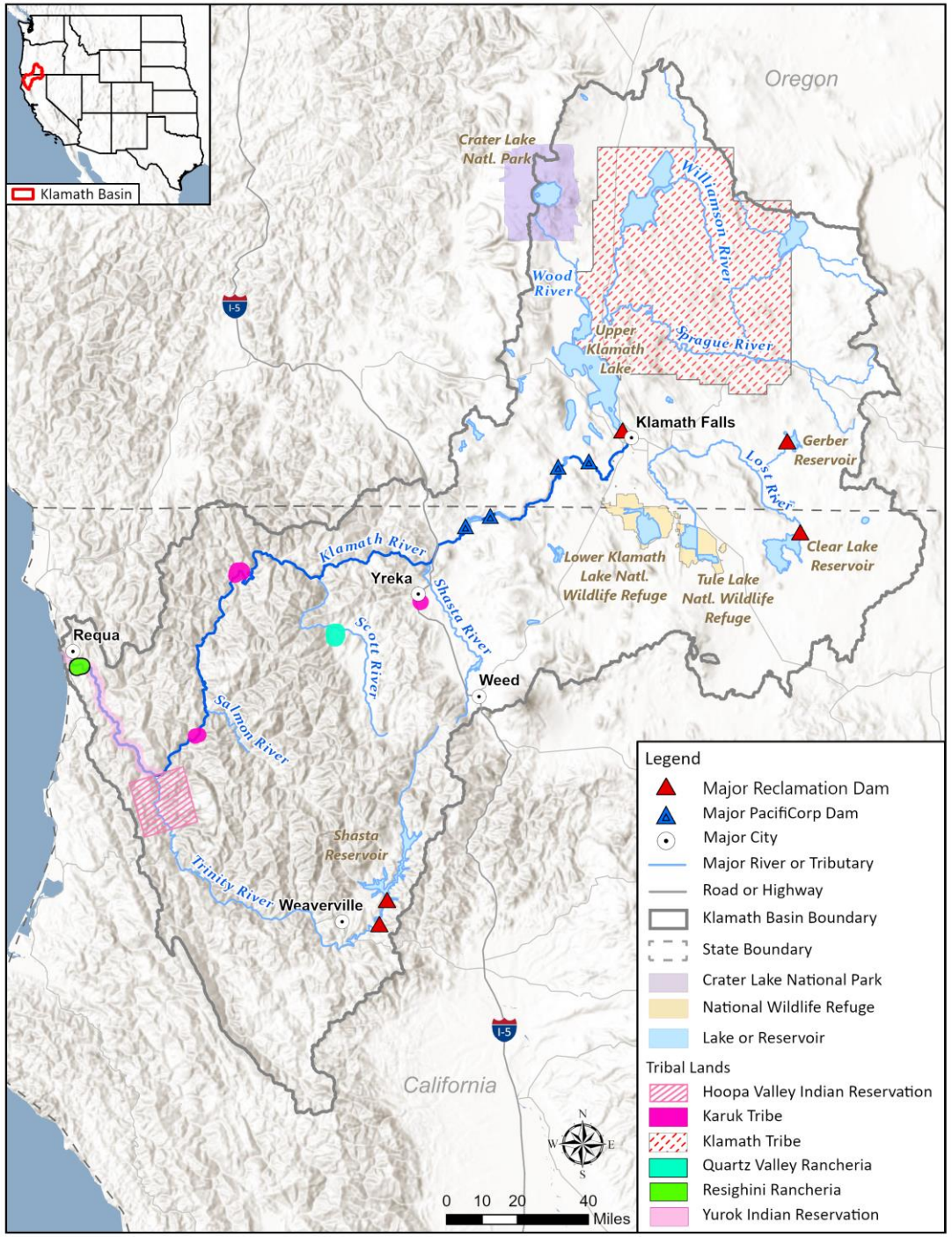
# Addressing Science Needs in the Klamath Basin using RiverWare

Marketa McGuire, Tim Clarkin, Jordan Lanini, and Baker Mcdonald – Reclamation
David Neumann and Edie Zagona – CADSWES

August 29, 2023

# Outline

- Water Management Setting
- Klamath Planning and Operations Model (KPOM)
  - Motivation
  - Model Scope
  - Next Steps
- Klamath Revised Natural Flow Study
  - Motivation
  - Model Concept



# Water Management Setting

- Frequent ESA consultations for Klamath Project operations
- 1988 ESA listing of Lost River and shortnose suckers as endangered
- 1997 ESA listing of SONCC coho salmon as threatened species
- Oregon water rights adjudication
- Variable hydrology, no carryover reservoir storage
- Frequent policy changes
- Recent drought years have resulted in little to no Klamath Project water supply allocation (e.g. 2021 was first year A-canal diverted no water)


SONCC coho salmon


shortnose sucker


Lost River sucker

# KPOM Motivation

**Operations**:

- Proposed Action (PA) Calculator (Excel tool)
- KROM (RiverWare)

**Planning**:

- Klamath Basin Planning Model (KBPM; WRIMS Model)
- DSS Files
- PA Viewer (Excel Tool)

**Planning and Operations:**

KPOM (RiverWare Model)

Operations Mode

Planning Mode

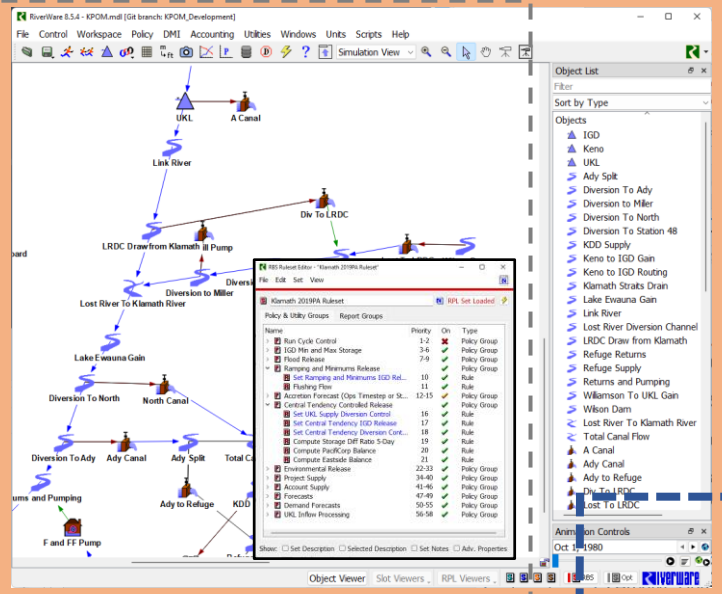
Scenario and Alternatives

Output Tools

Visualization Tools

# Klamath Planning and Operations Model (KPOM)

KROM



**Ops Mode (OM)**
- 17 month run
- Operations Start Timestep
- Observed then Forecasted
- Many Inputs, Parameters, and Overrides

**Results:**
**Plots Tables**
**Charts Metrics**

**Scripts**

**Planning Mode (PM)**
- 40 year run
- Historical Flows
- Supply forecasts
- Iterate to converge
- Results and Metrics
- Analyze alternatives
- Export Results
- Comparison Plots

Operations Schedules And Reports

Documentation

Spreadsheet:
- Observed Data
- Exceedances

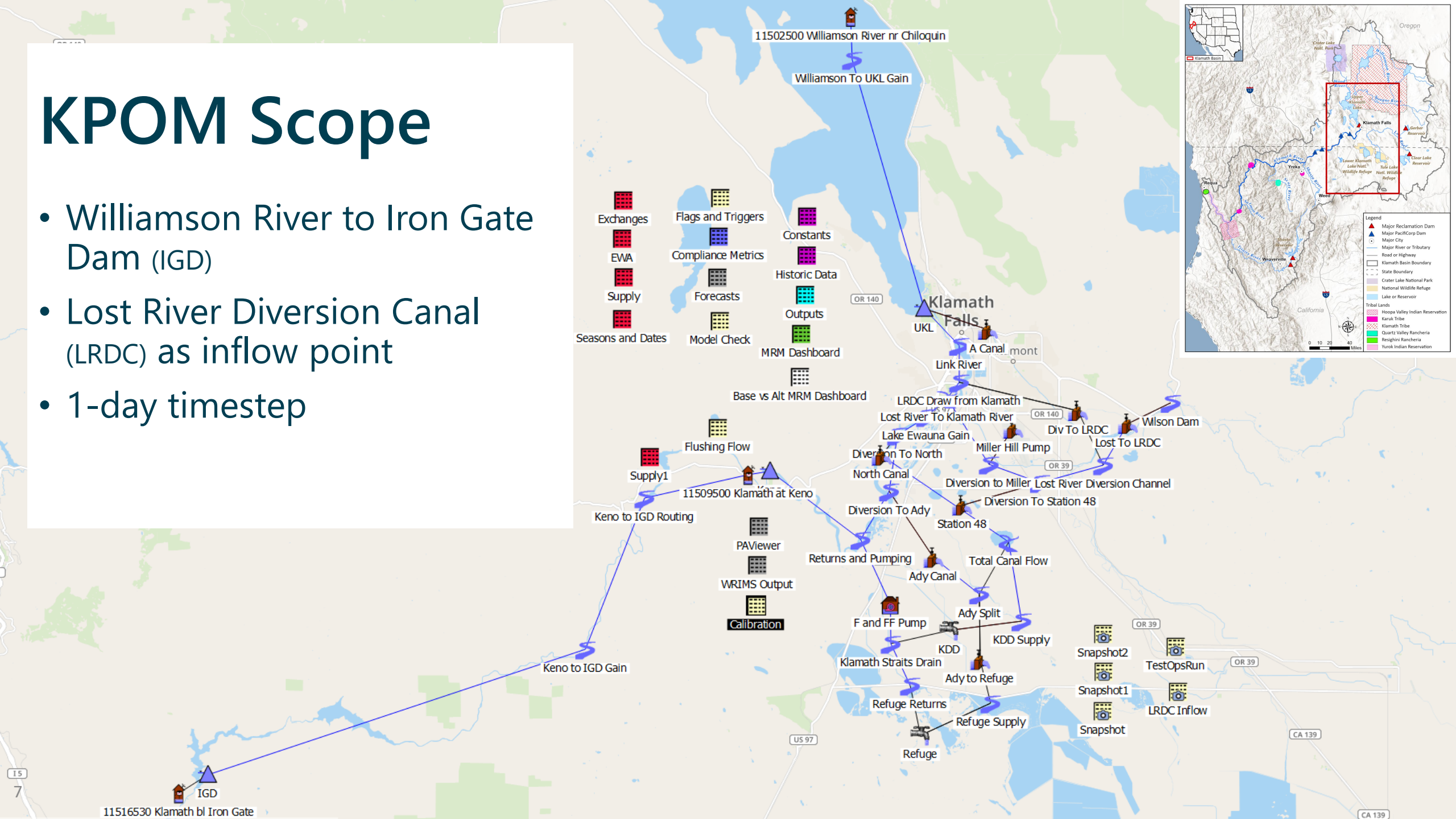
- Historical Data
- Water Supply Forecast Data

PA Viewer

WRIMS DSS Results

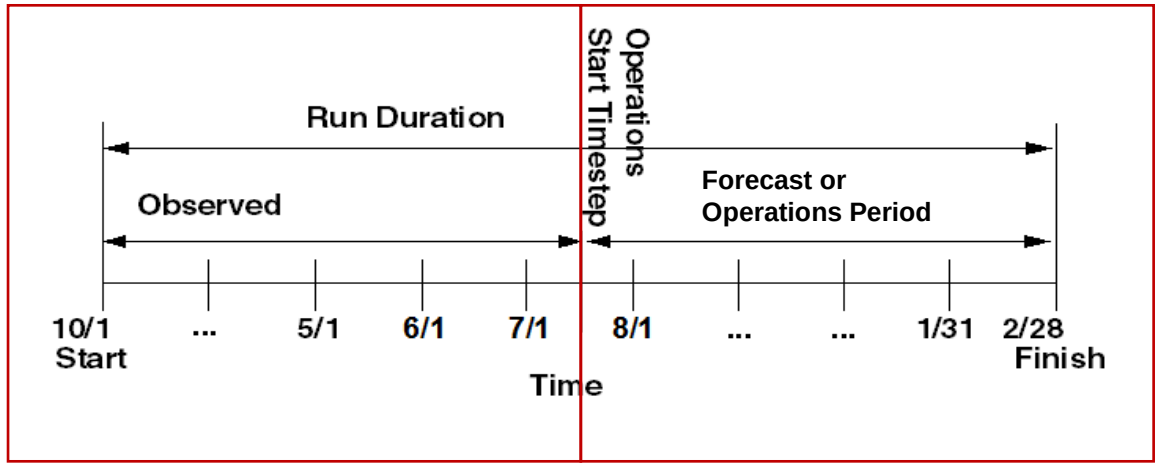
# KPOM Scope

- Williamson River to Iron Gate Dam (IGD)
- Lost River Diversion Canal (LRDC) as inflow point
- 1-day timestep



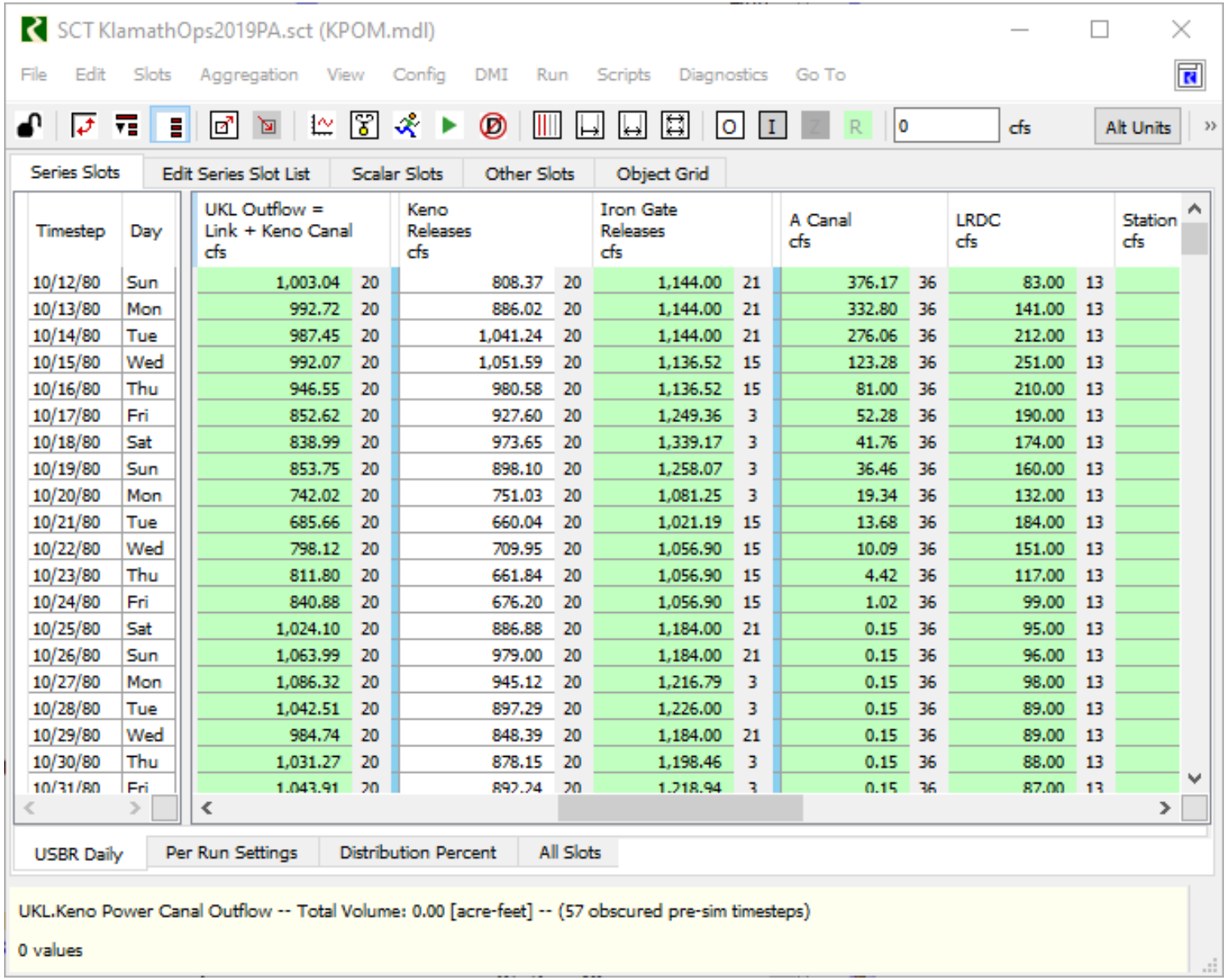
# Operations Mode Purpose and Goals

- Run every day (say today is 7/15)
- Use observed data up through yesterday to track what happened
- Use predicted data today through the end of the year to estimate
  - Reservoir releases
  - Diversions
  - Reservoir levels
  - Supply volumes
  - Environmental Water Account volumes
- Ensure ESA Compliance



# Viewing Results

- Plots
- Tables of Metrics
- System Control Tables (SCTs)
- Output to Excel, Text, HTML, Images




| Timestep | Day | UKL Outflow = Link + Keno Canal cfs | | Keno Releases cfs | | Iron Gate Releases cfs | | A Canal cfs | | LRDC cfs | | Station cfs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/12/80 | Sun | 1,003.04 | 20 | 808.37 | 20 | 1,144.00 | 21 | 376.17 | 36 | 83.00 | 13 | |
| 10/13/80 | Mon | 992.72 | 20 | 886.02 | 20 | 1,144.00 | 21 | 332.80 | 36 | 141.00 | 13 | |
| 10/14/80 | Tue | 987.45 | 20 | 1,041.24 | 20 | 1,144.00 | 21 | 276.06 | 36 | 212.00 | 13 | |
| 10/15/80 | Wed | 992.07 | 20 | 1,051.59 | 20 | 1,136.52 | 15 | 123.28 | 36 | 251.00 | 13 | |
| 10/16/80 | Thu | 946.55 | 20 | 980.58 | 20 | 1,136.52 | 15 | 81.00 | 36 | 210.00 | 13 | |
| 10/17/80 | Fri | 852.62 | 20 | 927.60 | 20 | 1,249.36 | 3 | 52.28 | 36 | 190.00 | 13 | |
| 10/18/80 | Sat | 838.99 | 20 | 973.65 | 20 | 1,339.17 | 3 | 41.76 | 36 | 174.00 | 13 | |
| 10/19/80 | Sun | 853.75 | 20 | 898.10 | 20 | 1,258.07 | 3 | 36.46 | 36 | 160.00 | 13 | |
| 10/20/80 | Mon | 742.02 | 20 | 751.03 | 20 | 1,081.25 | 3 | 19.34 | 36 | 132.00 | 13 | |
| 10/21/80 | Tue | 685.66 | 20 | 660.04 | 20 | 1,021.19 | 15 | 13.68 | 36 | 184.00 | 13 | |
| 10/22/80 | Wed | 798.12 | 20 | 709.95 | 20 | 1,056.90 | 15 | 10.09 | 36 | 151.00 | 13 | |
| 10/23/80 | Thu | 811.80 | 20 | 661.84 | 20 | 1,056.90 | 15 | 4.42 | 36 | 117.00 | 13 | |
| 10/24/80 | Fri | 840.88 | 20 | 676.20 | 20 | 1,056.90 | 15 | 1.02 | 36 | 99.00 | 13 | |
| 10/25/80 | Sat | 1,024.10 | 20 | 886.88 | 20 | 1,184.00 | 21 | 0.15 | 36 | 95.00 | 13 | |
| 10/26/80 | Sun | 1,063.99 | 20 | 979.00 | 20 | 1,184.00 | 21 | 0.15 | 36 | 96.00 | 13 | |
| 10/27/80 | Mon | 1,086.32 | 20 | 945.12 | 20 | 1,216.79 | 3 | 0.15 | 36 | 98.00 | 13 | |
| 10/28/80 | Tue | 1,042.51 | 20 | 897.29 | 20 | 1,226.00 | 3 | 0.15 | 36 | 89.00 | 13 | |
| 10/29/80 | Wed | 984.74 | 20 | 848.39 | 20 | 1,184.00 | 21 | 0.15 | 36 | 89.00 | 13 | |
| 10/30/80 | Thu | 1,031.27 | 20 | 878.15 | 20 | 1,198.46 | 3 | 0.15 | 36 | 88.00 | 13 | |
| 10/31/80 | Fri | 1,043.91 | 20 | 892.24 | 20 | 1,218.94 | 3 | 0.15 | 36 | 87.00 | 13 | |

# Planning Mode Goals

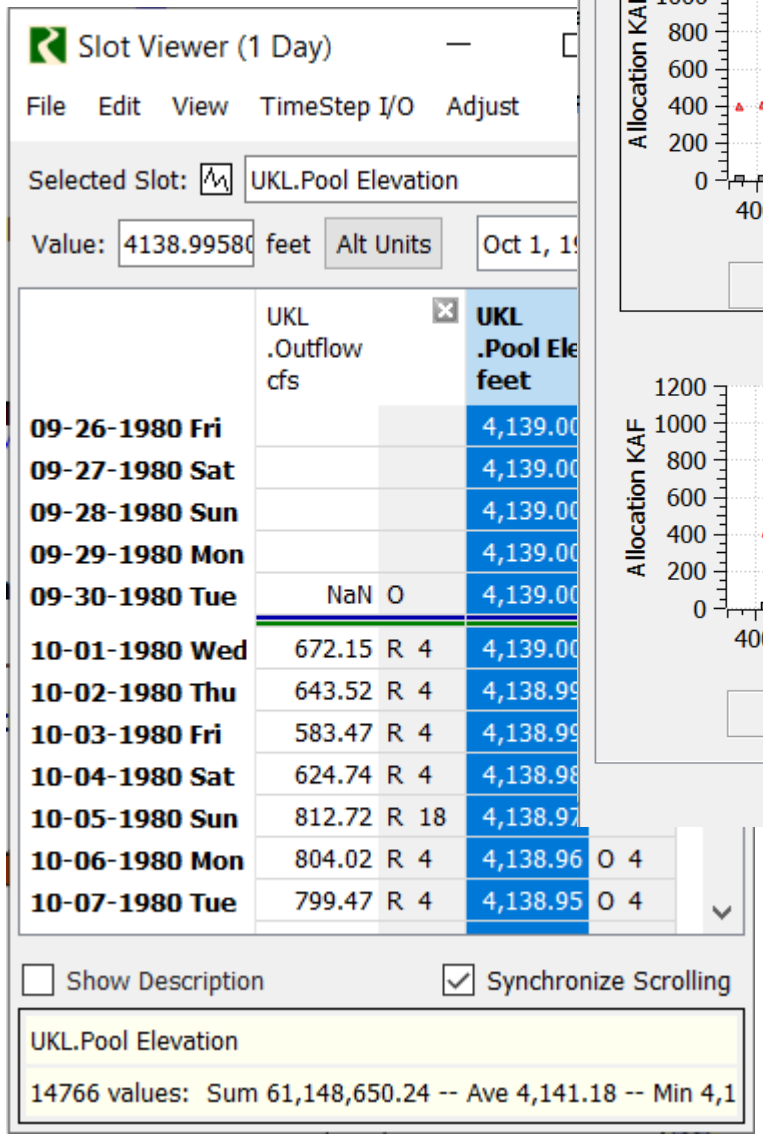
- Determine impacts of:
  - Alternative inflows or demands
  - Different policy
  - Changes to infrastructure
- Possible Uses:
  - ESA consultation
  - Dam removal studies
  - Other long-term planning studies

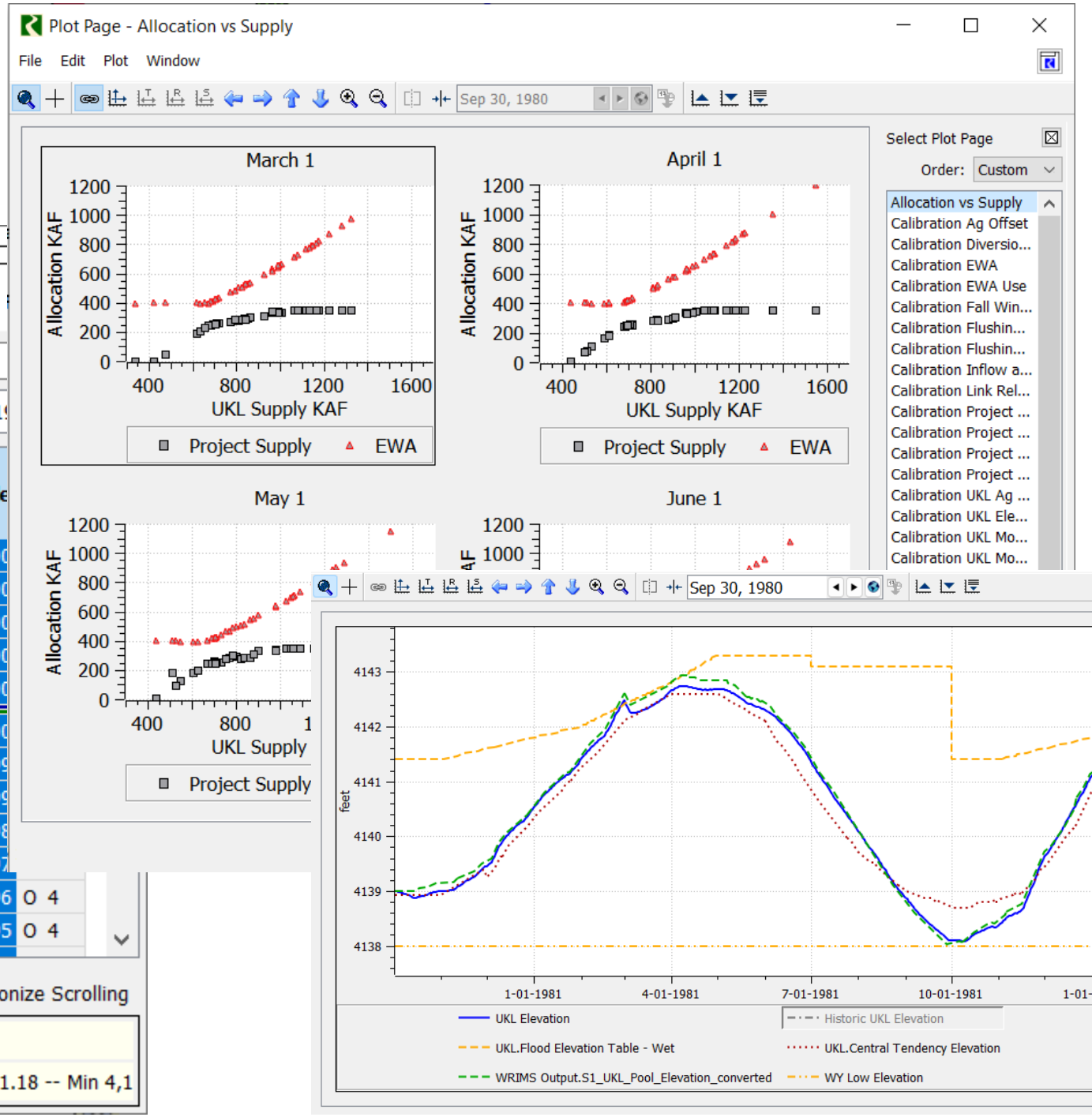
*Photo: Link River Dam*

- In general, we tried to mimic KBPM/WRIMS policy

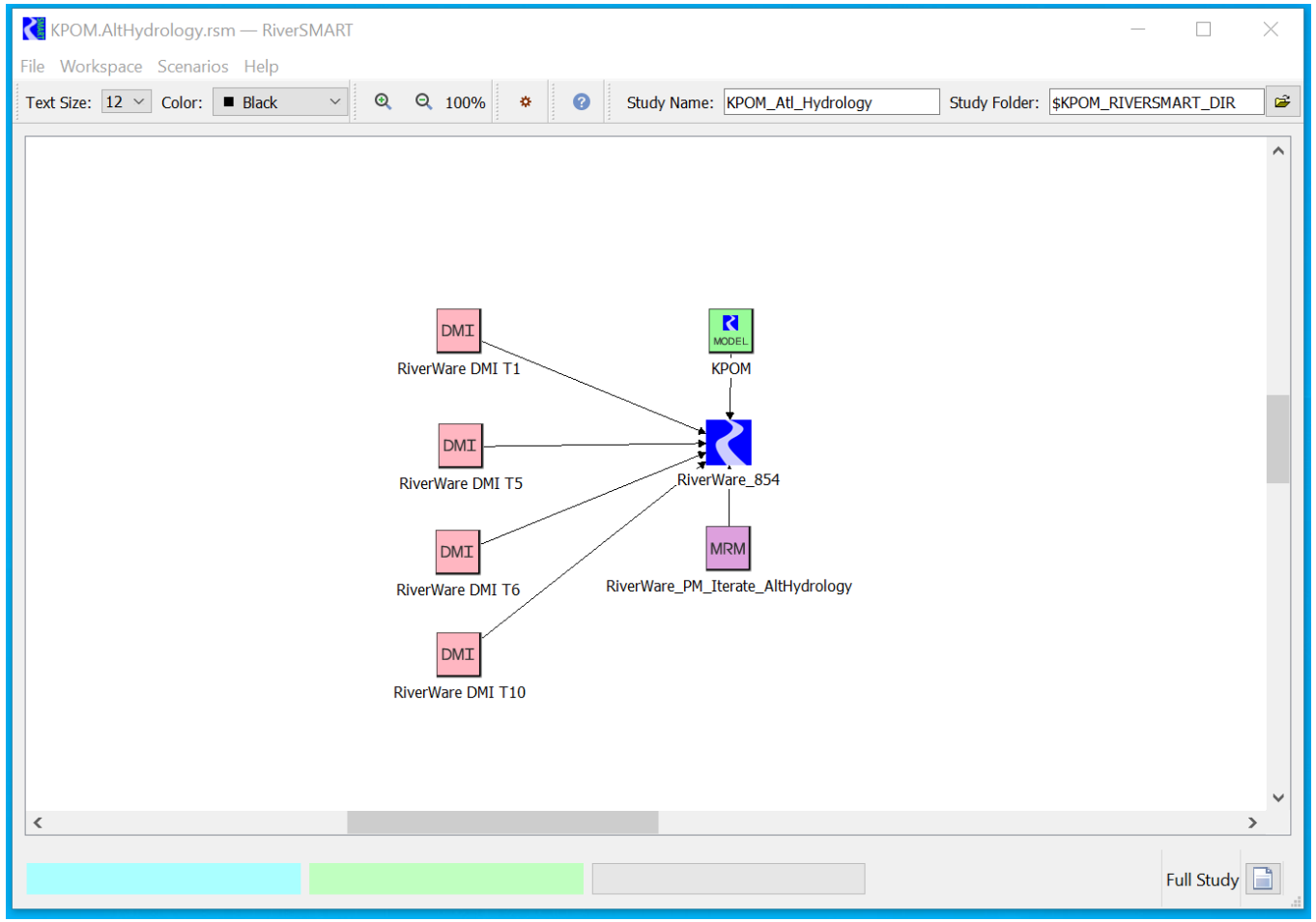
# Viewing Results

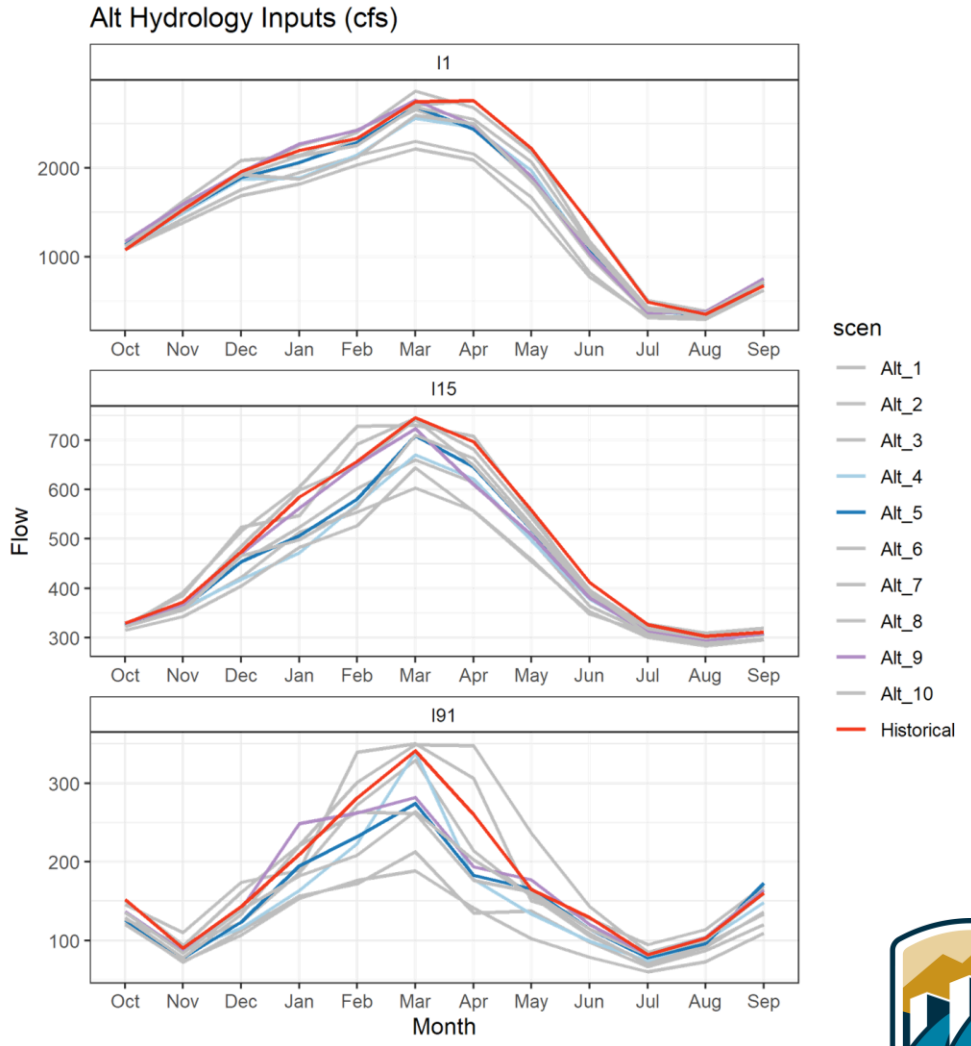
- Data in Slots
- Plots
  - 1 Year
  - Full POR
- Metrics and summary data in slots



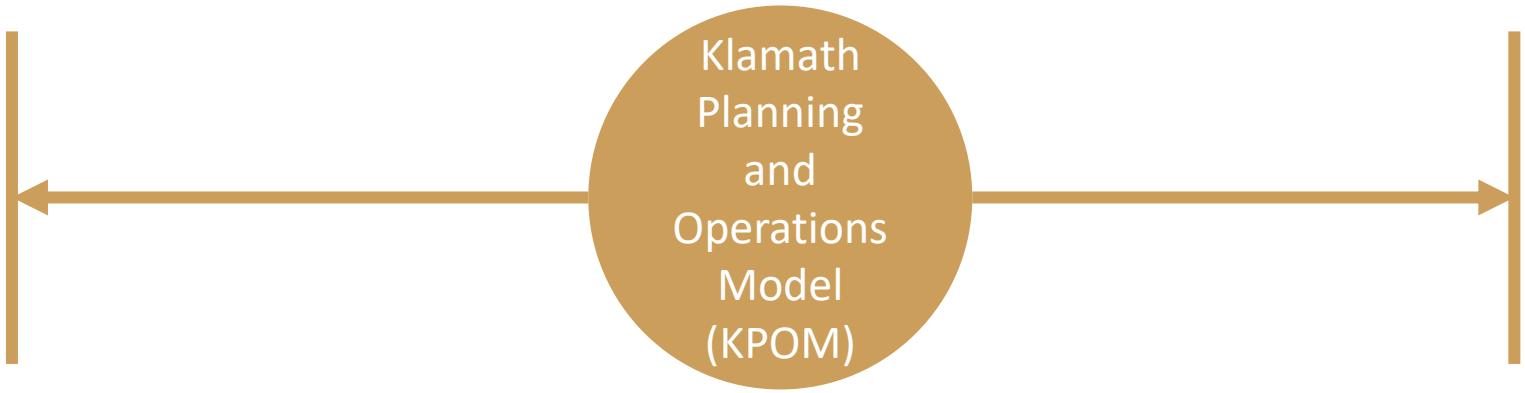



# Hydrologic Scenarios are run in RiverSMART



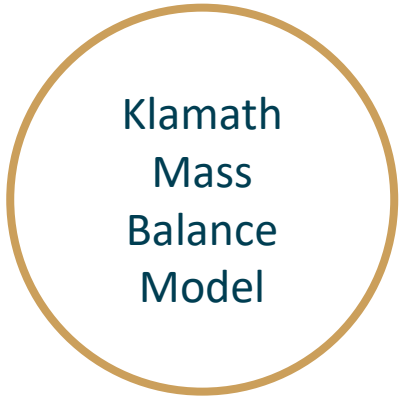



# Current RiverWare in the Klamath Basin




Daily Operations
(KROM, completed 2020)

Long-Term Planning
(KPOM, completed 2022)

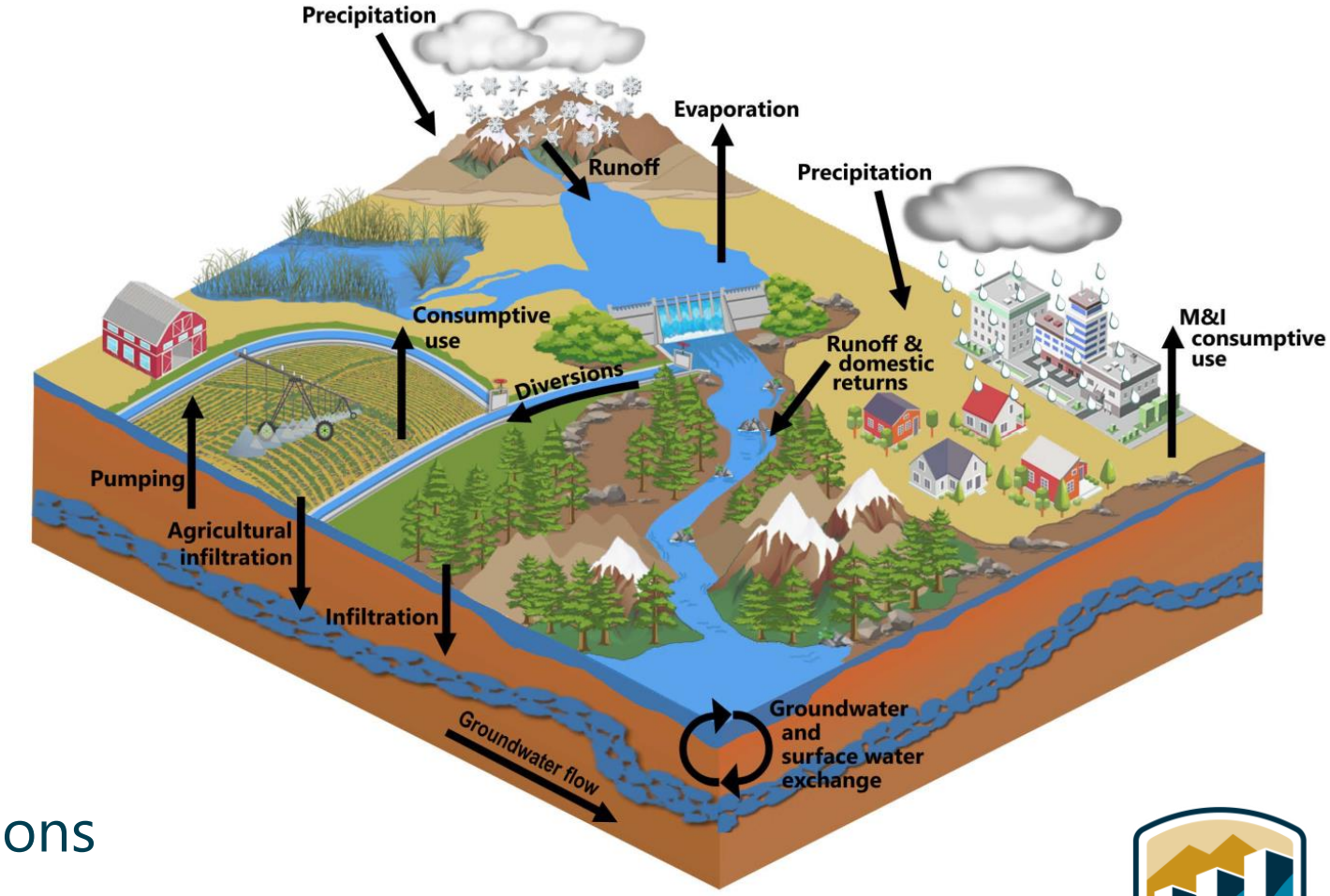



Klamath Revised Natural Flow Study

- *Will run water years 1981-2020*
- *Conceptual model structure*
- *Model objects linking this model with KPOM*
  - *e.g. gage objects*
- *Historical observations and modeled historical data as inputs*

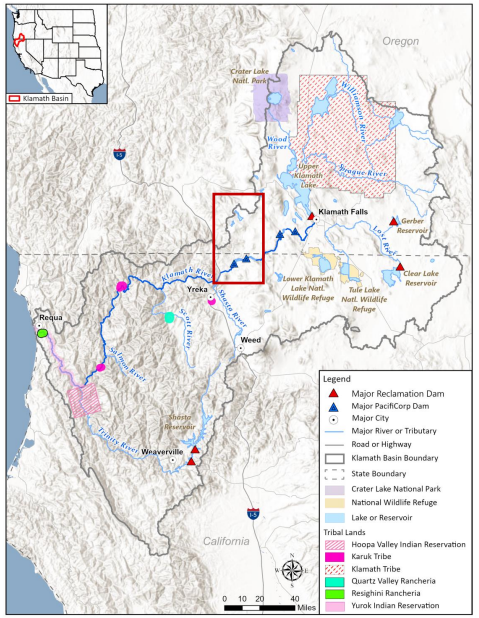
# Klamath Revised Natural Flow Study

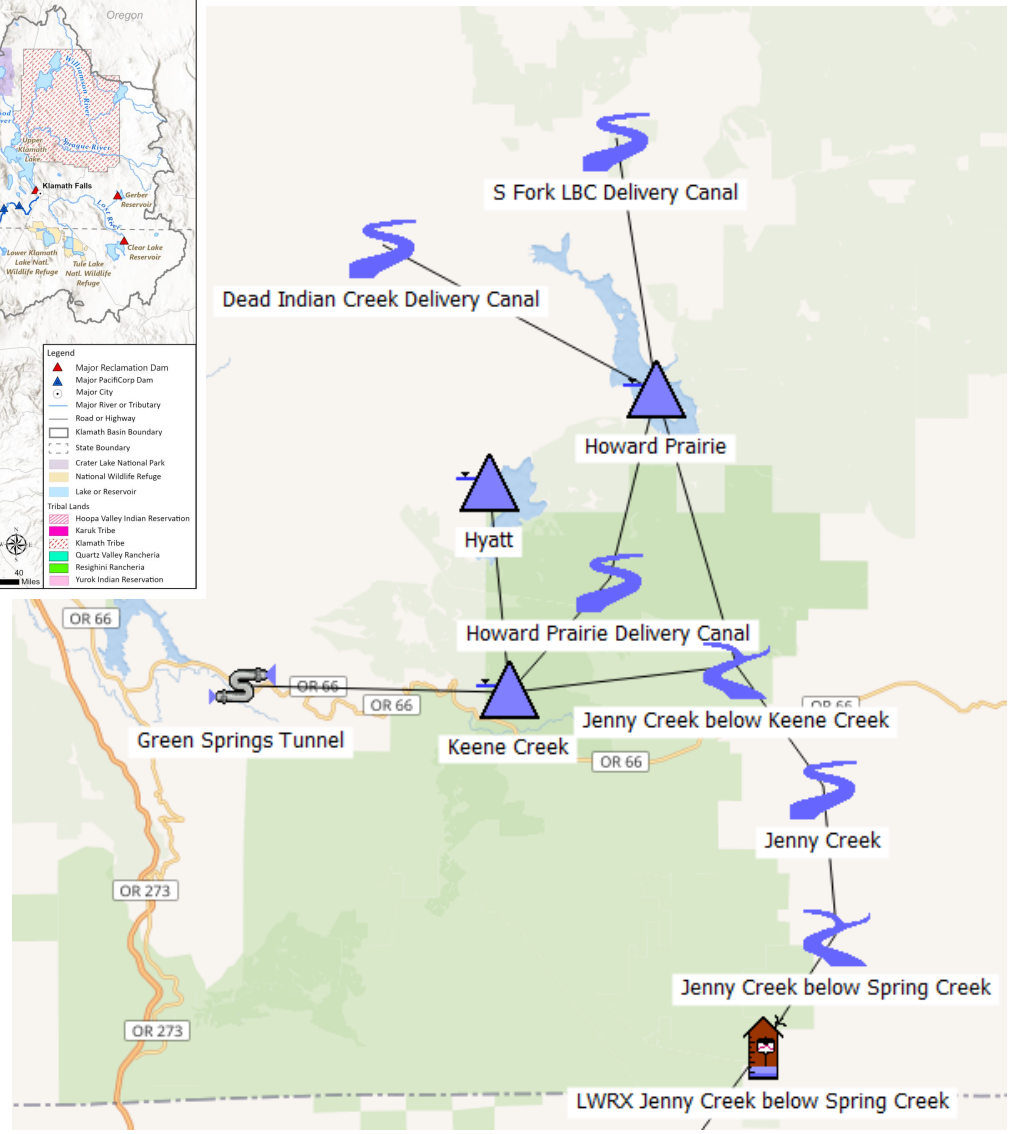
- Purpose
  - Estimate daily flows at chosen locations in the Klamath River basin, removing the significant effects of human development (pre-development)
- Use of RiverWare
  - Integrates outputs from models that simulate current and pre-development hydrologic conditions and consumptive uses

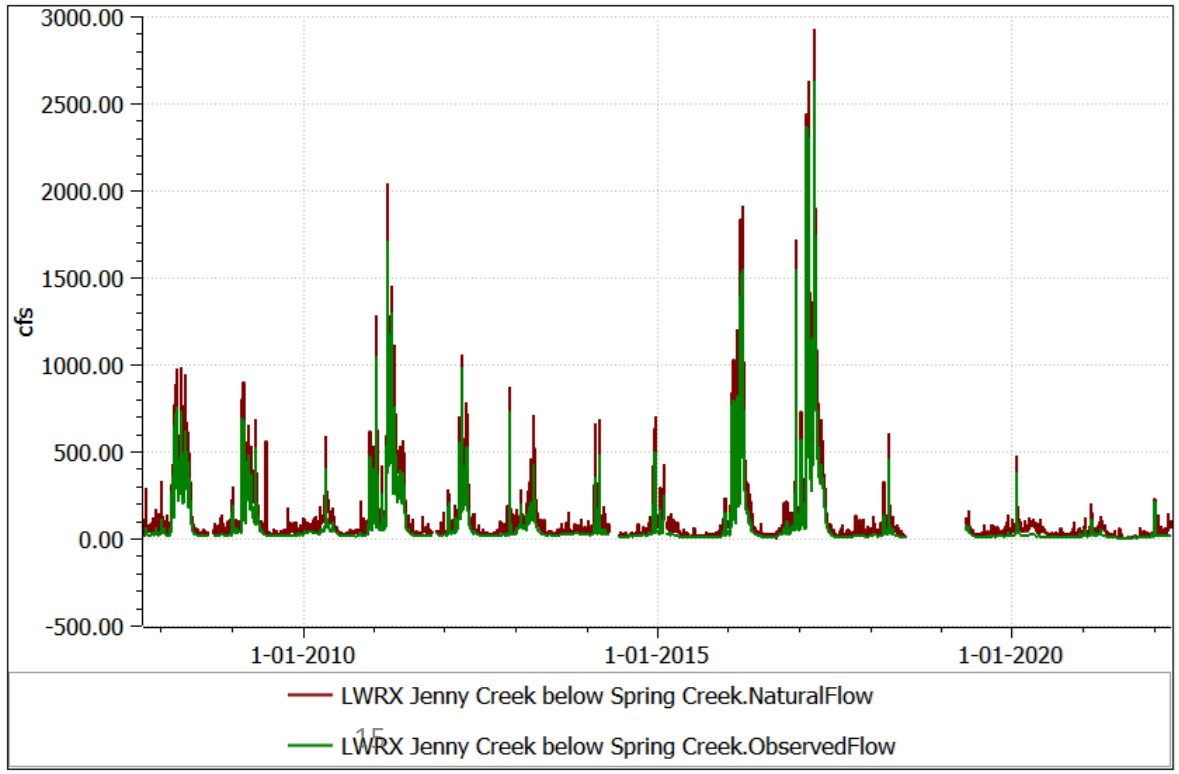


# Jenny Creek Natural Flow Example

- Initial estimate of natural flow in Jenny Creek basin



# Wrap up

- RiverWare meets multiple modeling needs to support science initiatives in the basin
- KNFS RiverWare model facilitates
  - Transparency
  - Reproducibility
  - Updatability
- Next steps
  - Further adopt as operations and planning tool – update policy
  - Complete first generation KNFS model by next User Group Meeting?

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*Photo: Big Springs, Shasta River Basin*


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