Photo credit: John Hannon, Reclamation

WTMP Project Summary and Future Work

Randi Field and Drew Alan Loney

Reclamation

Project Achievements

- WTMP project team has accomplished:
  - Modern set of water temperature modeling and assessment tools
  - Professional and robust documentation
  - Consistency across Operations and Planning studies
  - Practical and efficient data management tools for small staffing
  - Advanced exploration of uncertainty
  - Harnessing technology with data management, framework models and automated reporting
  - Building internal and external modeling expertise
 - Subjecting work products to independent review

Robust Documentation

- Thorough details of model selection, model development, and data organization
- Comprehensive sets of model results
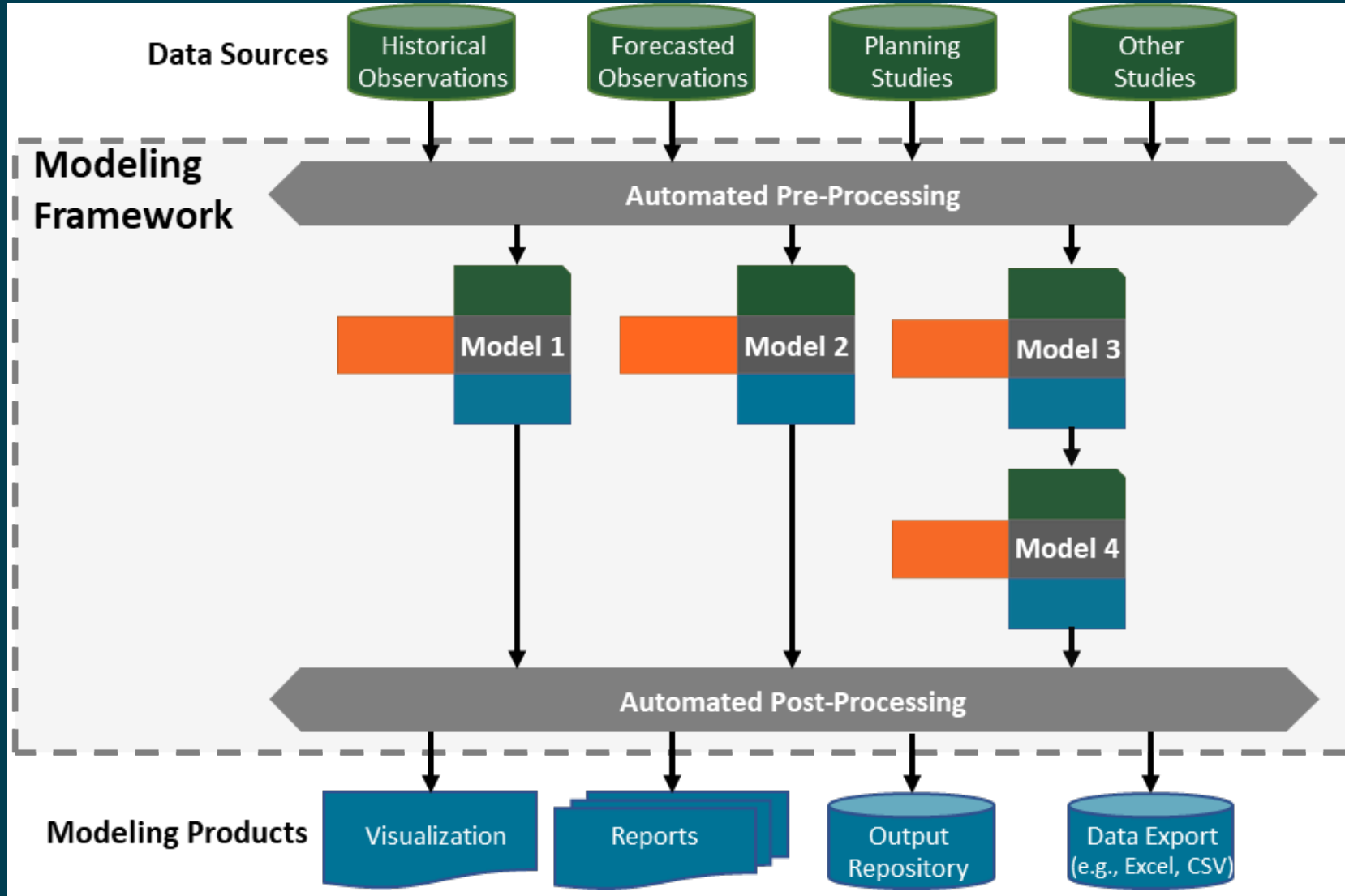- MTC presentations, meeting summaries, and sub-group discussions
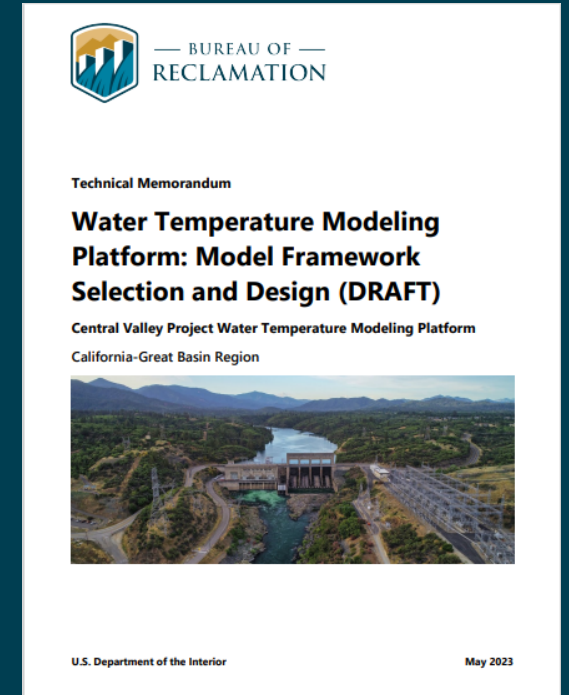
Data Management System (DMS)

- **Significant improvement of data collection and organization**

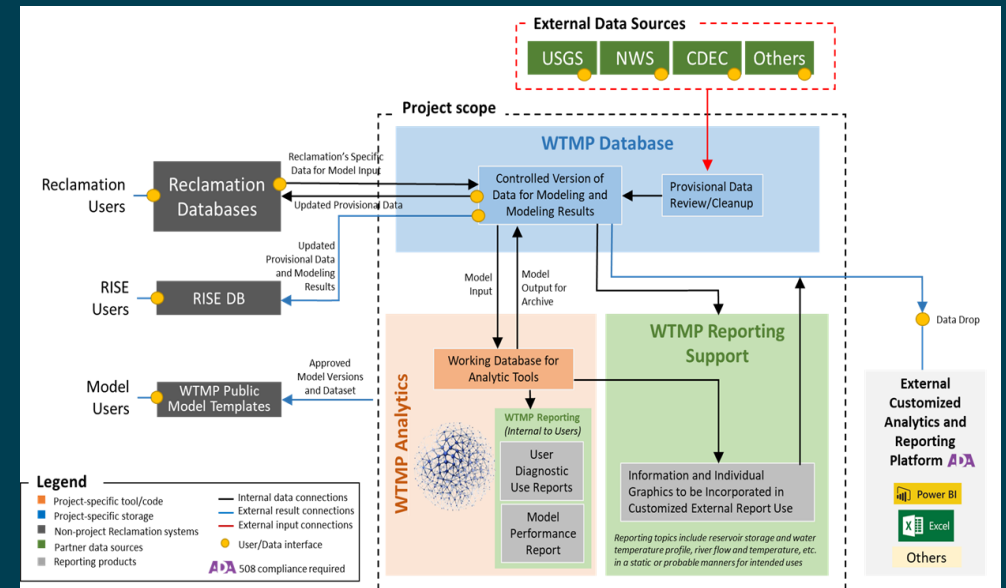- **Efficient methods for maintaining data quality control and producing 'model ready' data sets.**
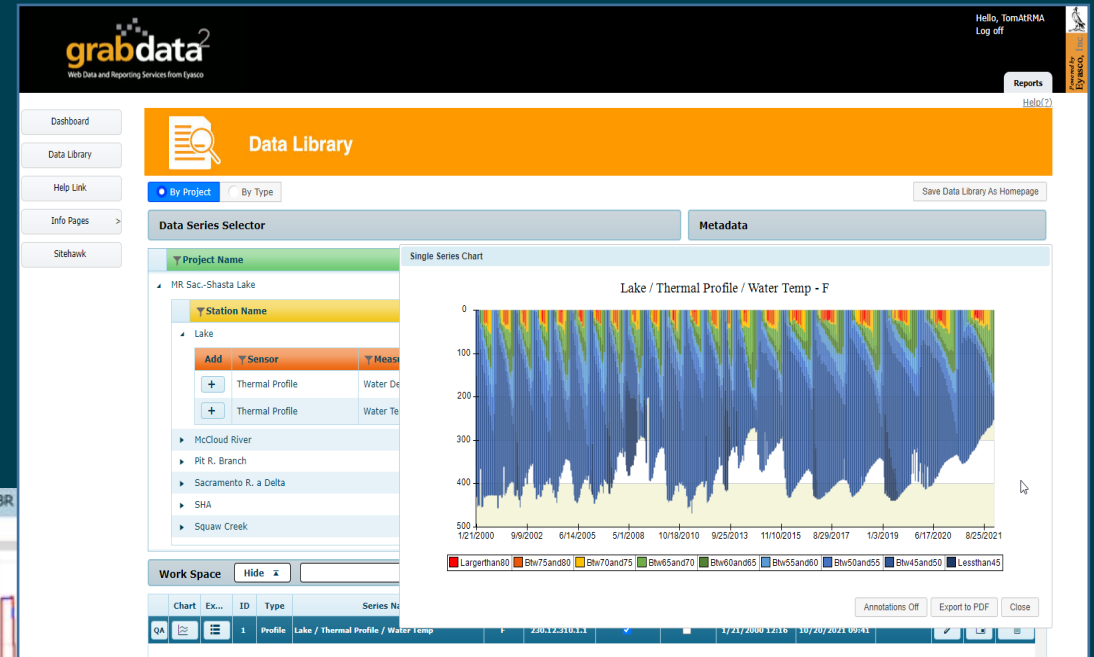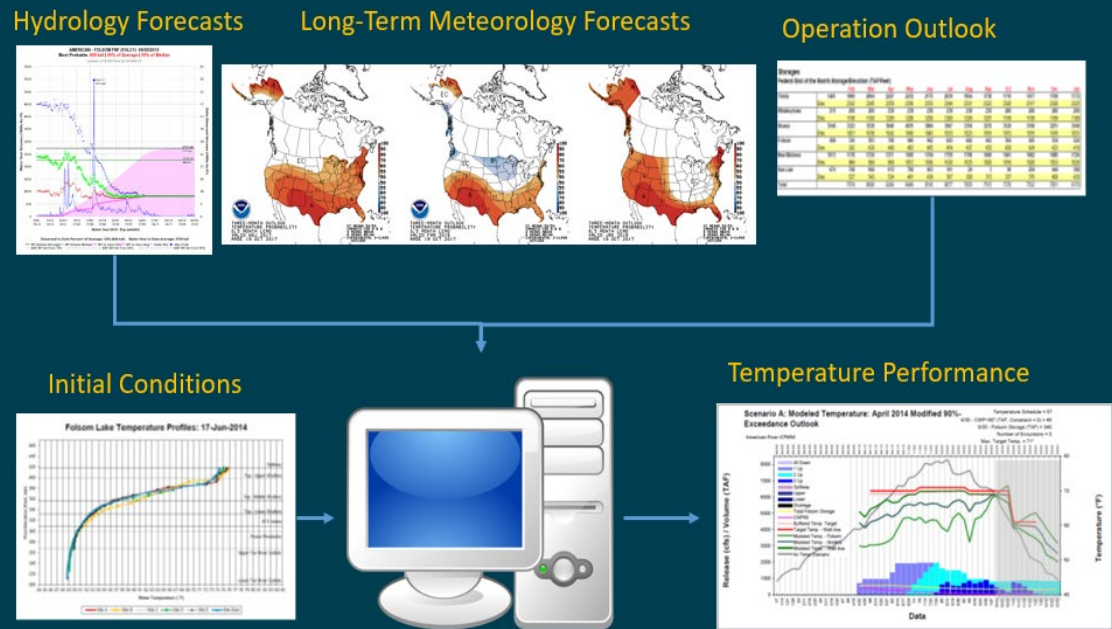
WTMP Analytics Framework

Improved Workflow

- **Manual Model Run: Labor intensive, less flexibility, and higher likelihood of error**

- **WTMP: Efficient, greater flexibility, automated, and data management**

# Seasonal Temperature Management Plan Simulation Workflow

- Forecast data preparation
  - Extract recent reservoir temperature profiles and river conditions from DMS
  - Gather CVP Operations Outlook Spreadsheets
  - Estimate future Meteorologic Conditions from Position Analysis, Local 3-Month Temperature Outlook, NCAR Ensemble Forecasts (planned)
  - Established and User Defined Temperature Target Sets
- Ensemble simulation exploring variability in operations, meteorology, and temperature target objectives
- Automated reporting from ensemble output
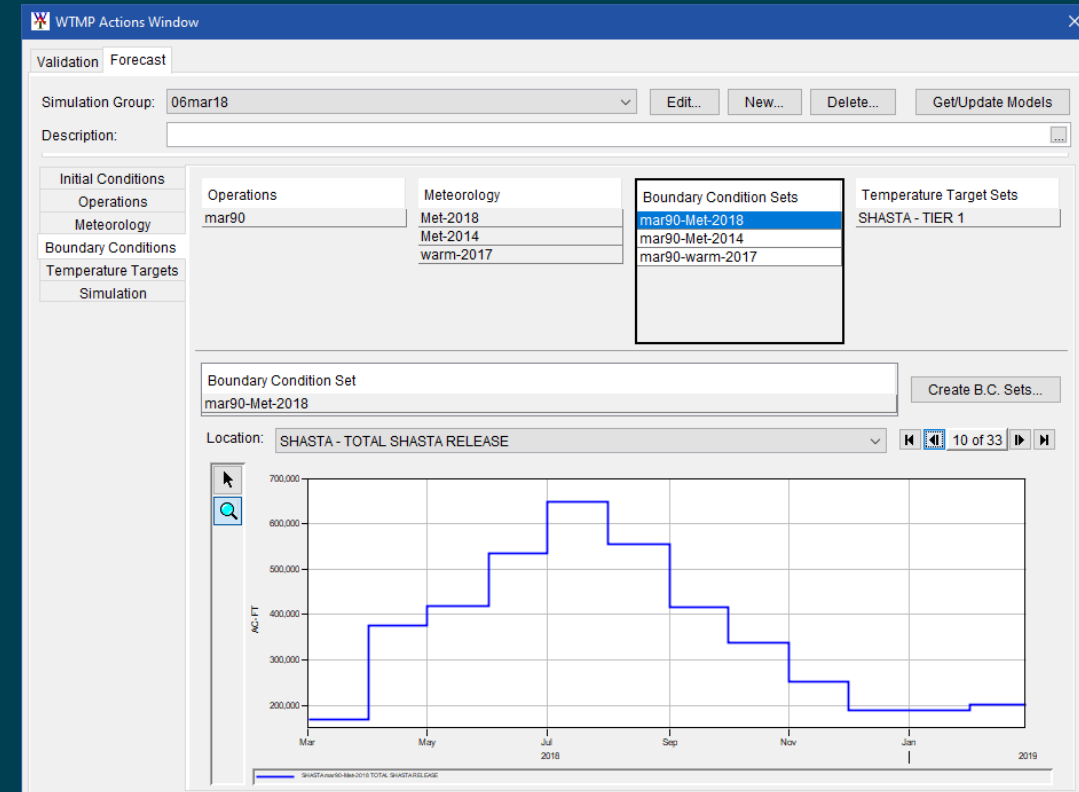
End-of-Year Hindcast/Validation Workflow

Easily perform simulations for the previous year checking performance of the models against field data

- Set up a simulation group for the recent period selecting the models to test

- Extract historical data from DMS
  - Model Ready Data for boundary conditions
  - QA-ed observed data for comparison to model results

- Perform simulations

- Create and review automated reports
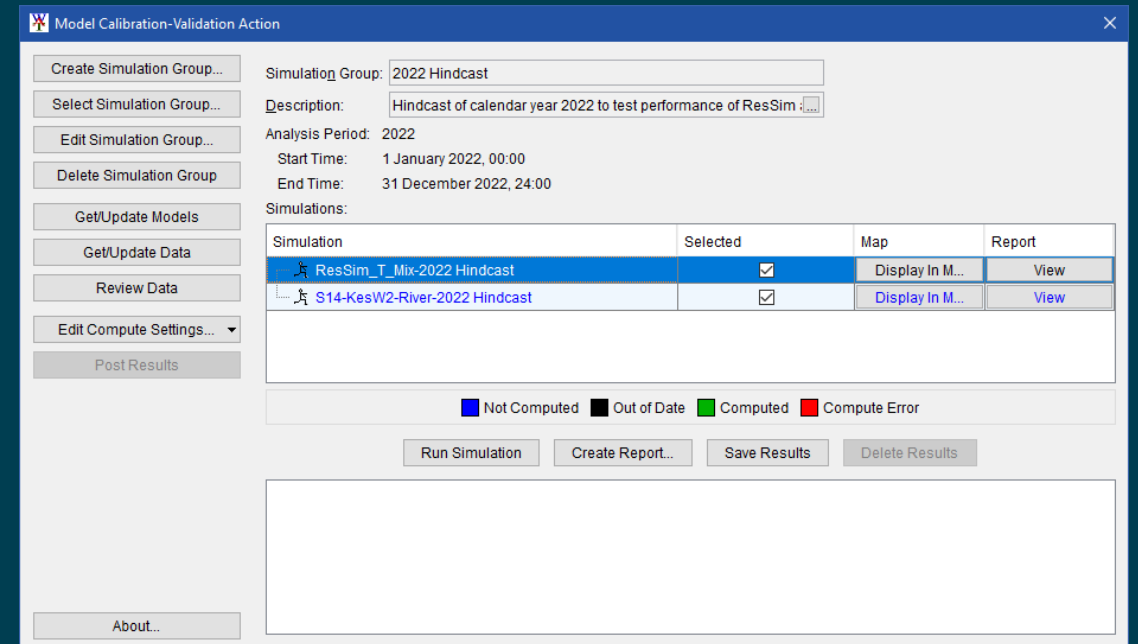
Enhanced Visualization: Example Contour Plots for Reservoir Conditions (HEC-ResSim)
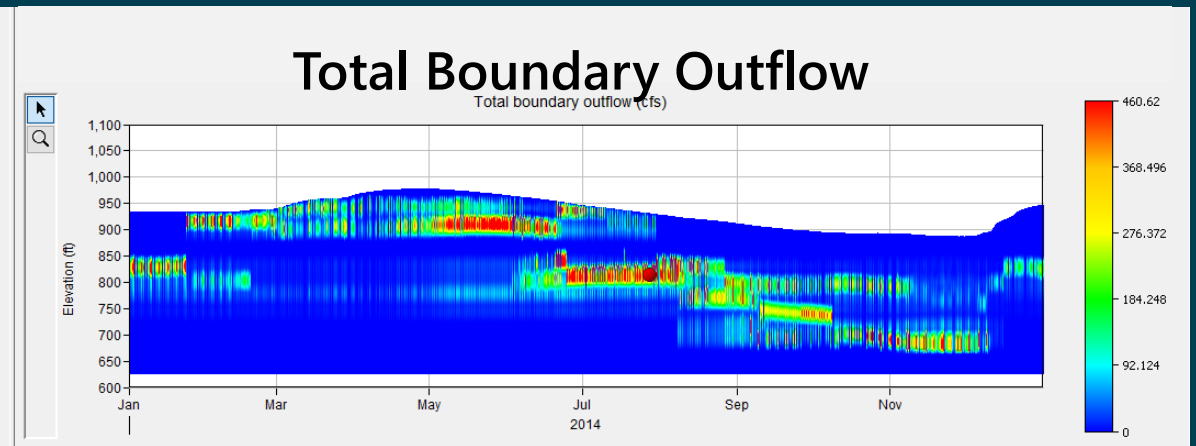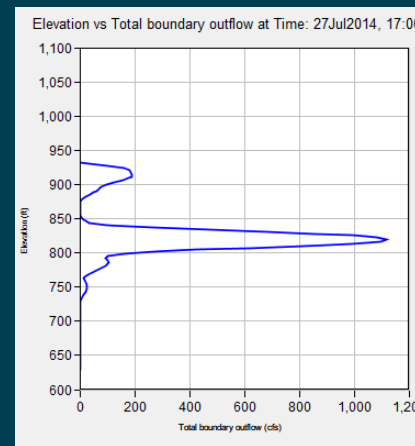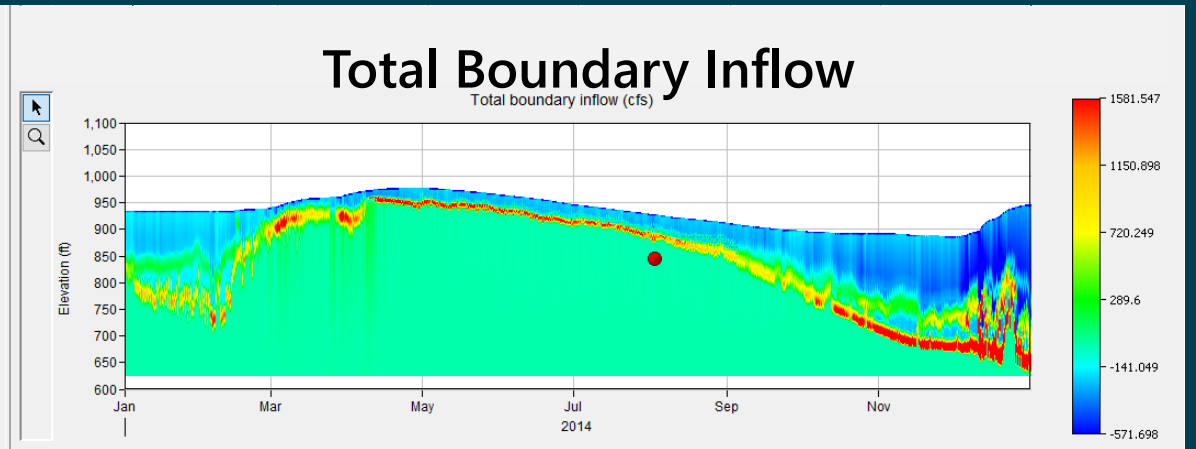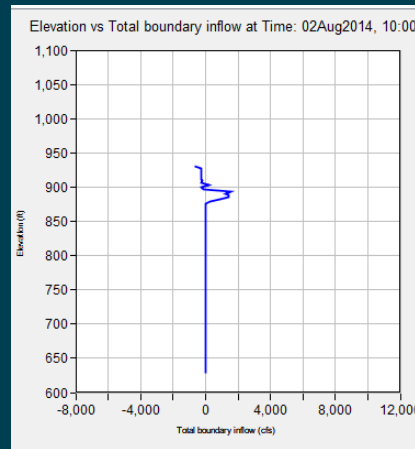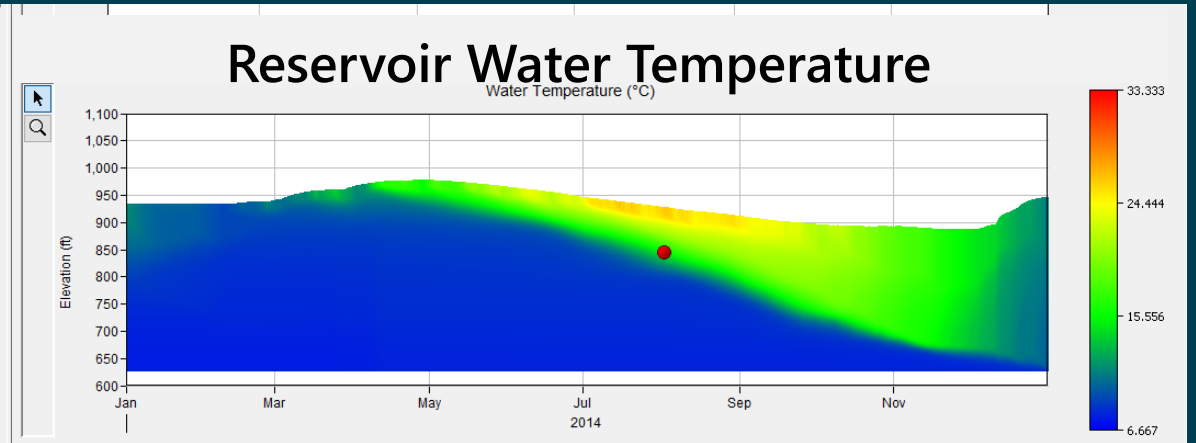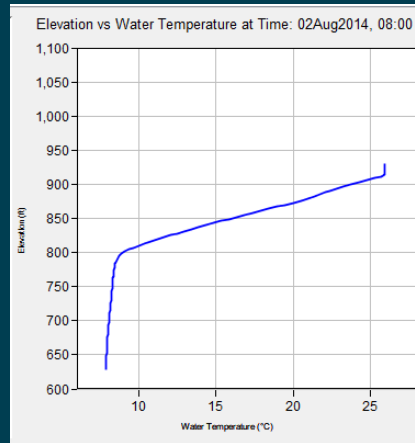
WTMP Automatic Reporting

- Purposes
  - Rapid creation of key output tables and graphics to facilitate results review by modelers
  - Creation of tables and graphics that could be incorporated in other reporting and presentation products

- Implementation
  - Every defined report is scripted and accessible through WTMP user interface
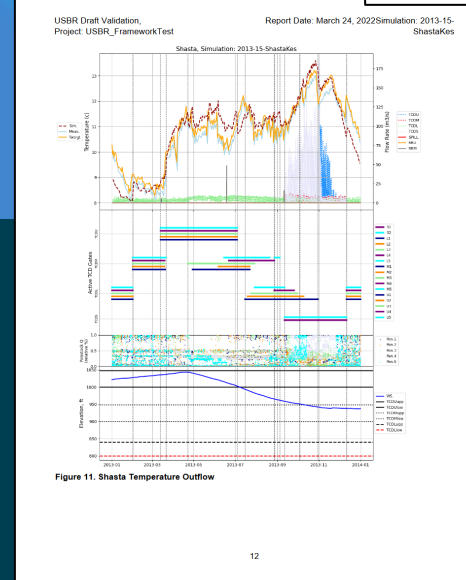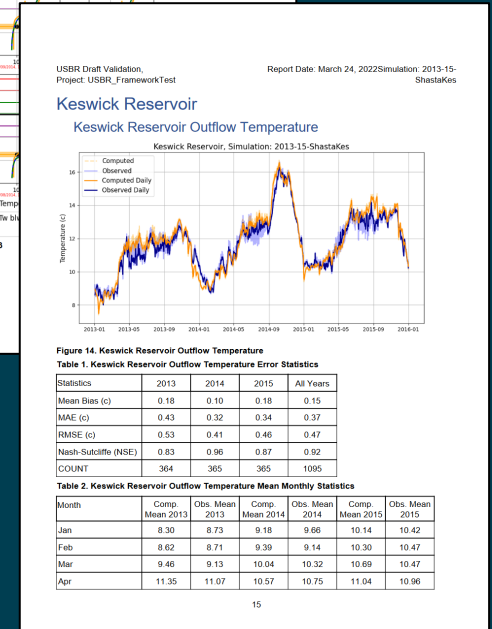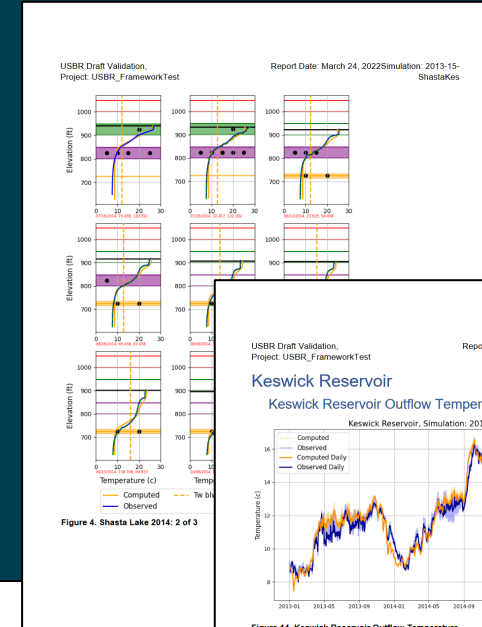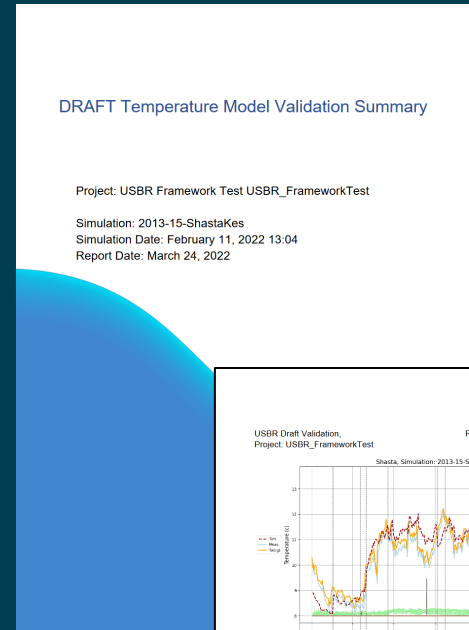
Efficiencies Using the Framework

- Test case:
  - Exploration of uncertainty in linked and unlinked CE-QUAL-W2 models at Trinity/Lewiston/Whiskeytown/Keswick/Shasta
  - Short turnaround
  - High confidence model set-up boundary/initial conditions
  - Automated reporting

Model Development Perspective

- The effort is a 3 ½ year project, with predefined tasks and deadlines.
- Developing three basins is a daunting but necessary undertaking supporting CVP temperature management.
- WTMP has achieved impressive milestones.
- We understand while this may mark the end of the development phase (and the purpose of the peer review), this is just the beginning of the next phase of model application and exploration. We expect to use the tool and discover further insights.

On-Going Research (Part I)

- Reclamation's Science and Technology Grant Program: NCAR
  - Evaluating Water Temperature Modeling and Prediction in the Sacramento River Basin
  - Evaluate existing meteorological forecasting methods and skill
  - Test new methods to improve meteorological inputs and inflow temperature
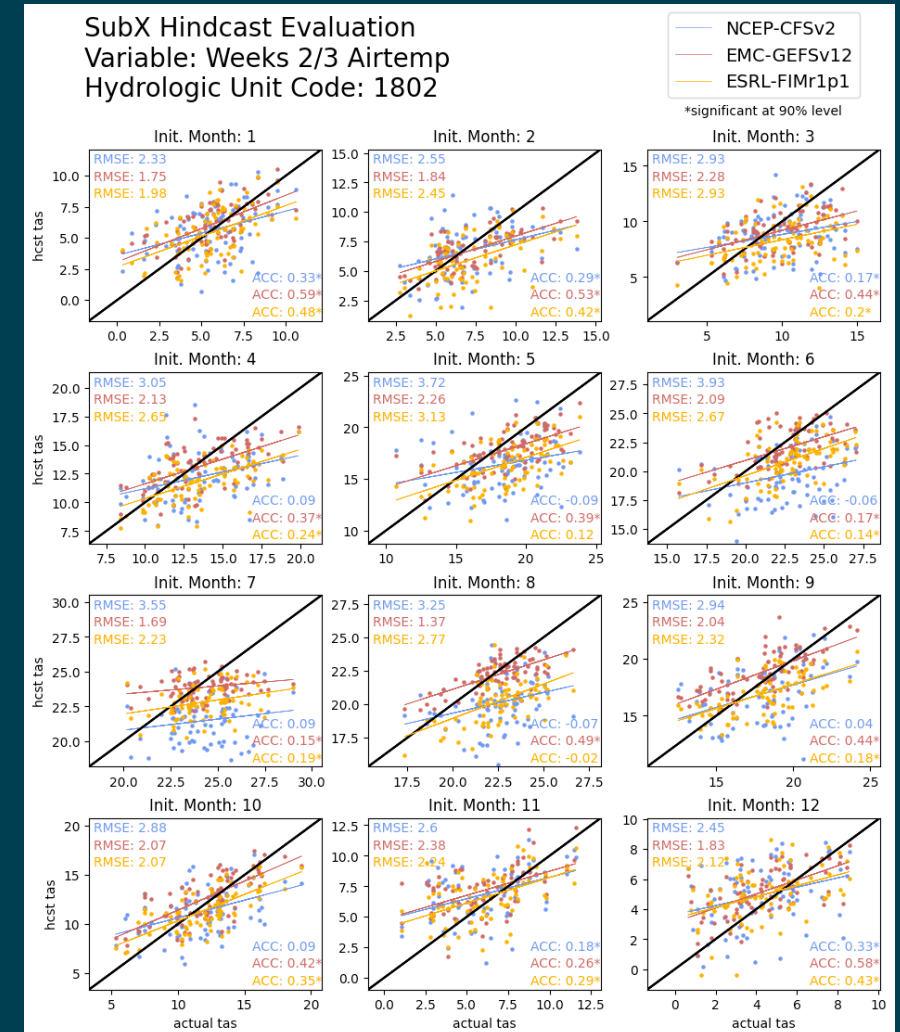
On-Going Research (II)

- **Delta Stewardship Council: UC Davis**
  - Shasta TCD local flow patterns
  - ADCP and ADVP testing
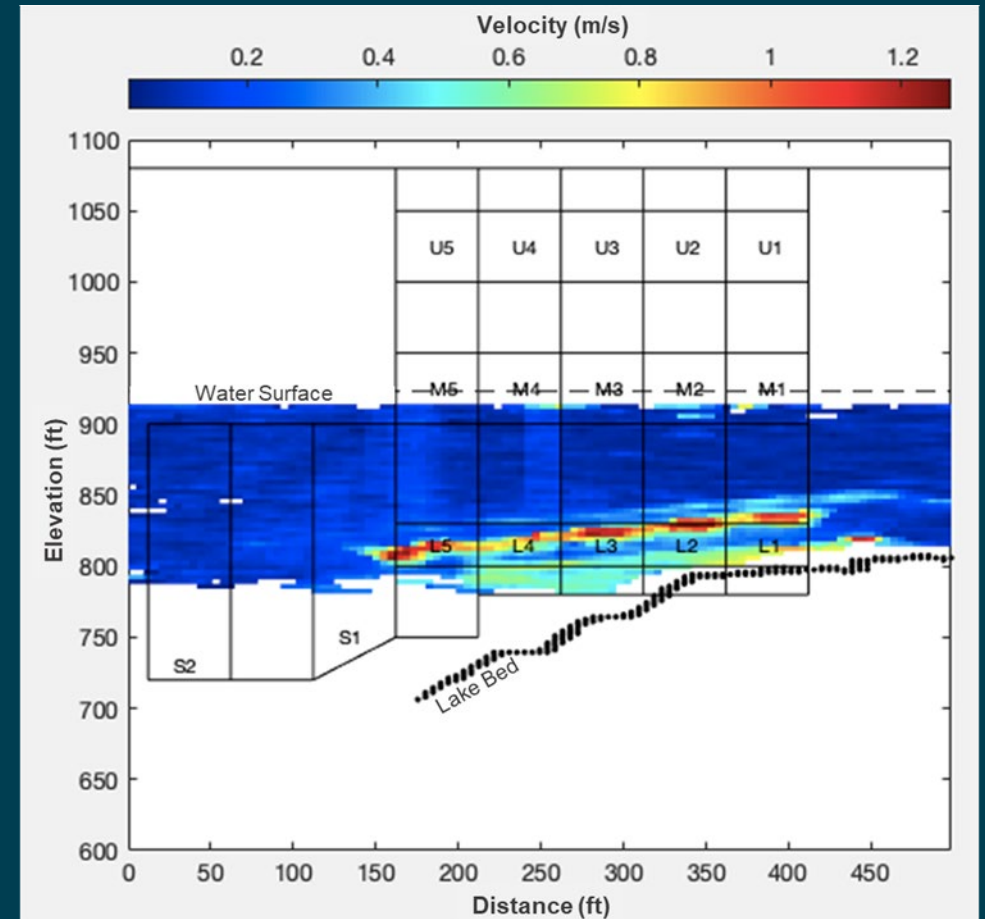
WTMP Roll Out Products (Part I)

1. Model Platform -GitHub

2. Data interface – RISE

3. Technical Memorandums

4. Peer Review Reports
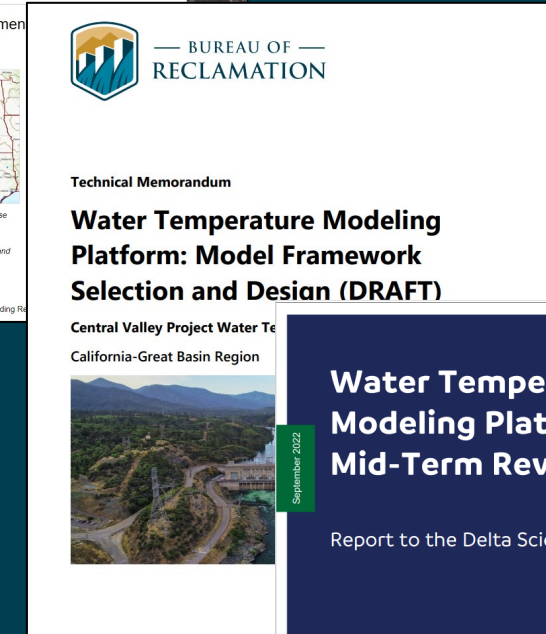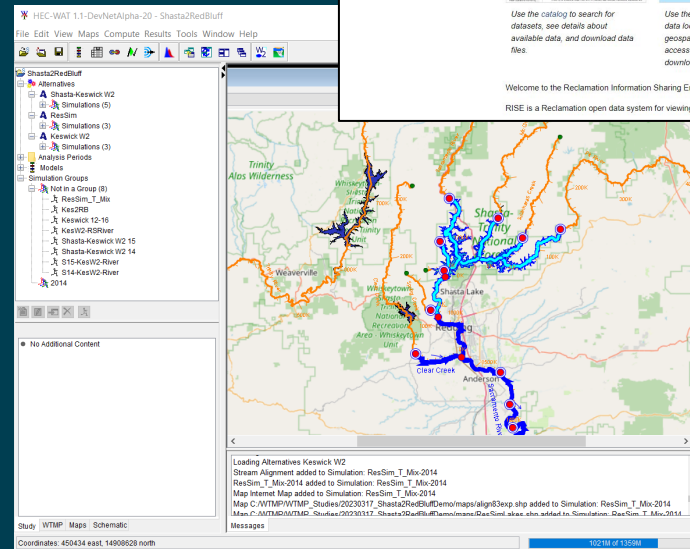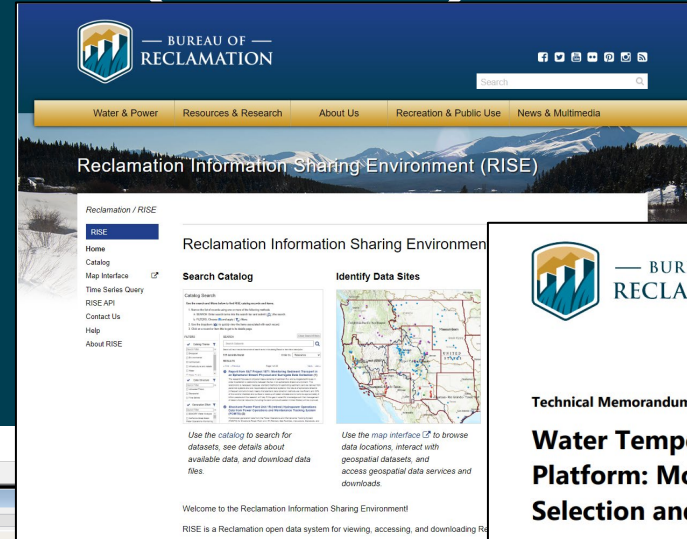
WTMP Product Rollout (II)

- Continued supporting activities include:
  - Continued/improved data collection for improving quality of model analytics
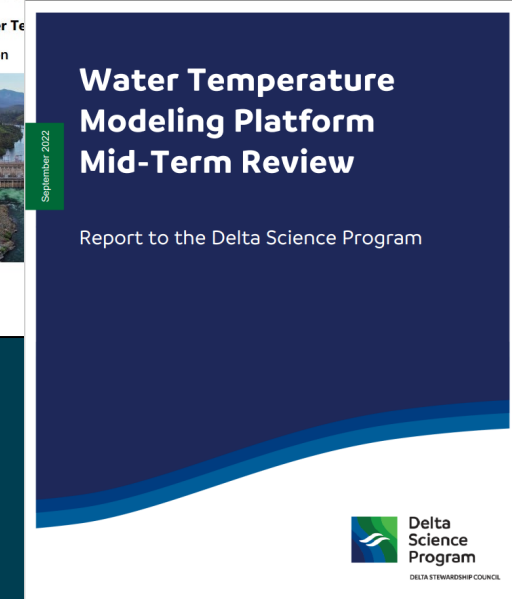 - Model refinement and updates as facilities are upgraded/modified and new facilities are constructed, if applicable
  - Re-assessment of modeling needs, associated model development and refinements, and model evaluation/hindcasts, and calibration/re-calibration
  - Response to advancement in technology
  - A potential user group based on the current MTC structure

Milestone Accomplishment and Foundation for Future Work

- Well designed WTMP platform built by consultant team is set for deployment by Reclamation:
  - Making the workflow process "smarter" by leveraging technology
  - Compatible with Reclamation's small staffing pool
  - Implementing an efficient Data Management System
    - Advanced data processing error flagging and gap filling techniques
  - Streamlined software capabilities
    - Built in data retrieval and error checking
    - Multi-ensemble/multi-model functions
    - Automated repetitive tasks (e.g., results reporting and performance evaluation)
    - Flexibility to accommodate changes and technology advancement

Future Work

- **Annual updates**
  - Software updates
  - HEC-WAT Plugin
  - Performance assessments
- **Temperature target translation**
- **Long-term operations development**
  - Workflow enhancements
  - Historical meteorologic data
- **Automated recalibration**
- **Uncertainty & forecasting**

Annual Updates

Beware of bugs in the above code; I have only proved it correct, not tried it.

- Donald Knuth

- Provide routine model performance assessments
  - Address concerns of climate variability
  - Find those areas there's benefit in revisiting
- System provides benefits only as long as it's supported
- Provide ongoing software updates
- Iterate toward continued success

Temperature Target Translation

- Release temperatures are specified at the TCDs, not the compliance locations

- Current approach uses a regression to account for downstream warming to lower the TCD release temperature

- Regression does not account for out-of-set conditions

- Provide direct iteration between compliance locations and TCD temperatures

- Provide additional flexibility in temperature target logic

Long-term Operations

- Current setup is a proof-of-concept
- Build a custom workflow as a new tab on the HEC-WAT plugin
  - Handle Calsim 3 to WTMP conversion
  - Handle scenario development
  - Enable position analysis
- Build historical dataset compatible with Calsim 3 historic hydrology

Automated Recalibration
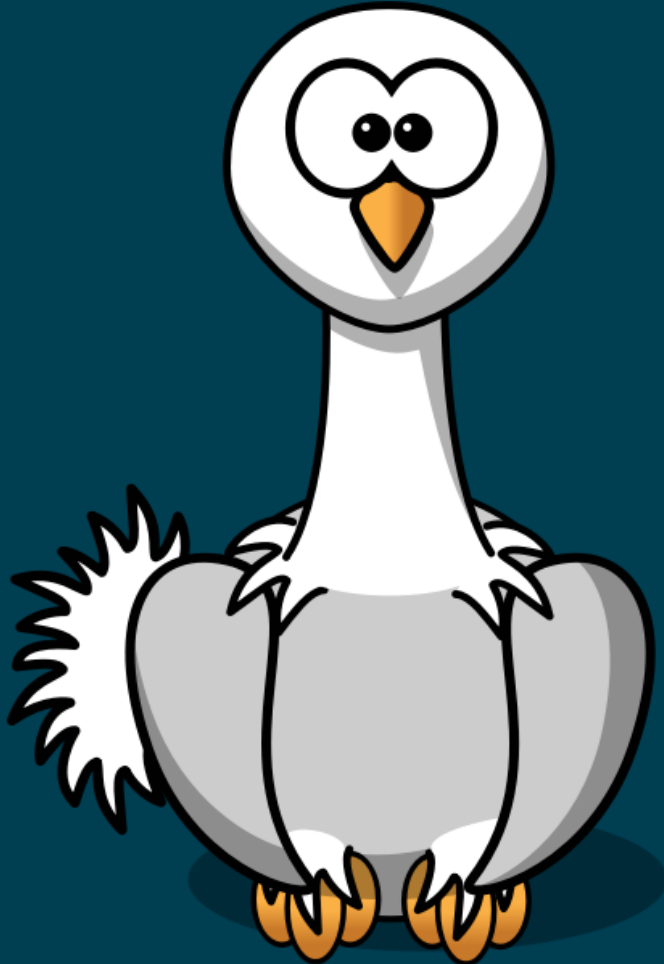
- **Develop repeatable tools to minimize calibration staff/time requirements and standardize calibration**

- **Reclamation maintains the OSTRICH calibration platform**
  - **Cross-platform, HPC enabled toolkit**

- **Demonstrated on CE-QUAL-W2**

- **Create templates and objective functions for each model**

Source: FreeSVG

Uncertainty and Forecasting

- **Multiple methods for uncertainty and forecasting**
  - Continued methodology improvements and new datasets
- **Current effort began to explore uncertainty and forecasting**
- **Continued learning and feedback will add additional capabilities informed by hands on time with the system**
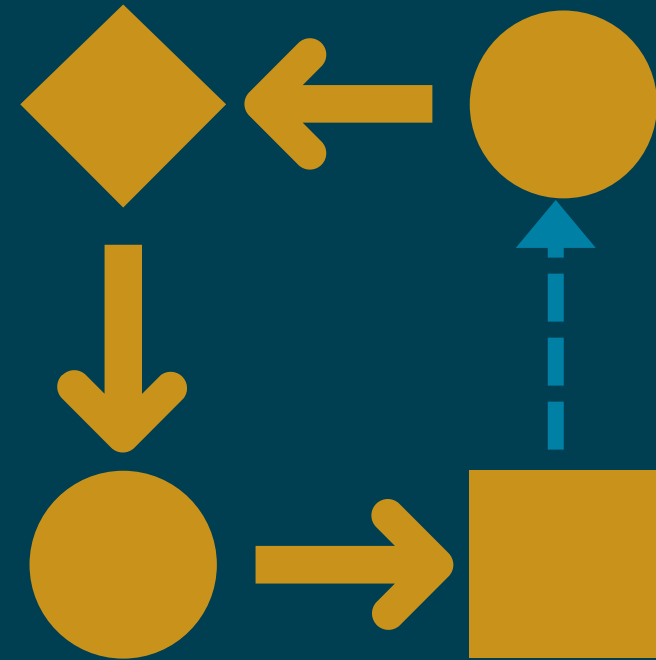
Acknowledgements

- Thank you, we are grateful your help in accomplishing the Final Peer Review milestone:
  - WTMP Team
  - MTC
  - DSC
  - Peer Review Panel

Questions: mppublicaffairs@usbr.gov.
Information:
https://www.usbr.gov/mp/bdo/cvp-wtmp.html

BUREAU OF —
RECLAMATION

Photo credit: John Hannon, Reclamation

Afternoon Break

Photo credit: John Hannon, Reclamation

General Presenter/Review Panel Discussion

Photo credit: John Hannon, Reclamation

Public Comment