

TROA MODEL UNIFICATION AND VERIFICATION

August 27, 2026

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— BUREAU OF —
RECLAMATION



PRECISION
WATER RESOURCES ENGINEERING



TRUCKEE RIVER OVERVIEW

Truckee River Statistics

- Total Length: 142 miles
- Lake Tahoe to Pyramid: 105 miles
- Average Annual Runoff*:
 - Tahoe Basin: 186 KAF
 - Truckee Abv. Farad: 410 KAF
 - Carson River Abv. Lahontan: 290 KAF
- Average Annual Flow at Farad**: 758 cfs



*Note: All locations approximate

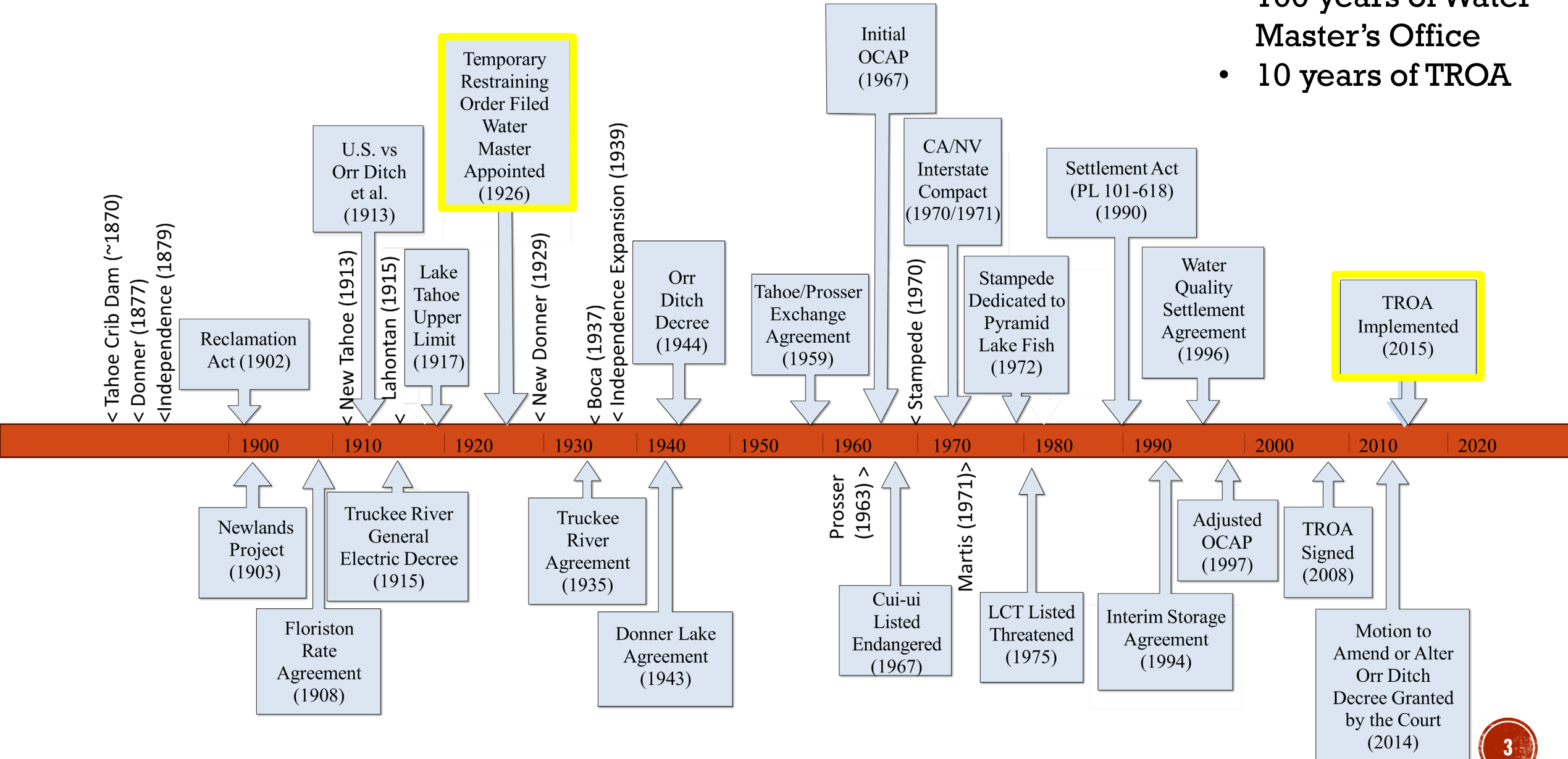
*Based on 1900-2024 naturalized flow dataset

**Based on 1909-2023 USGS Approved flow

TRUCKEE RIVER TIMELINE

Anniversaries

- 100 years of Water Master's Office
- 10 years of TROA

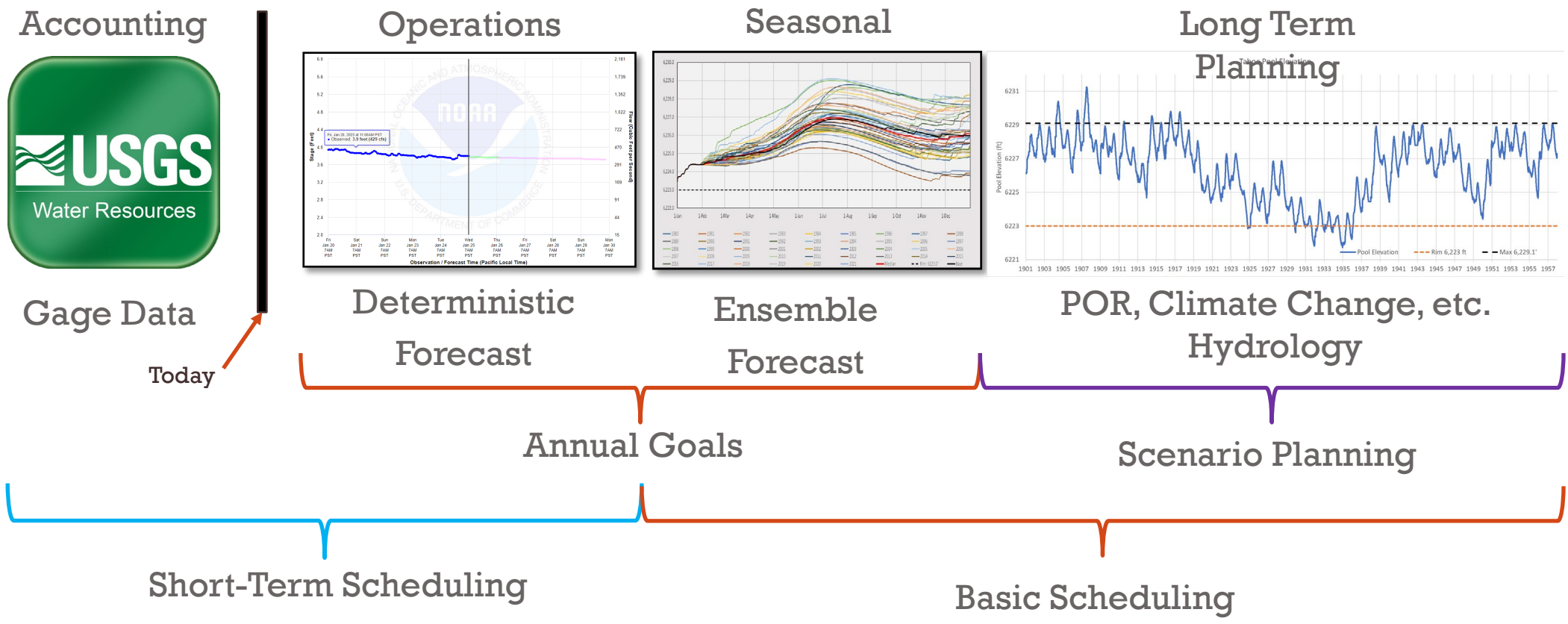


TROA RIVERWARE MODEL DEVELOPMENT TIMELINE

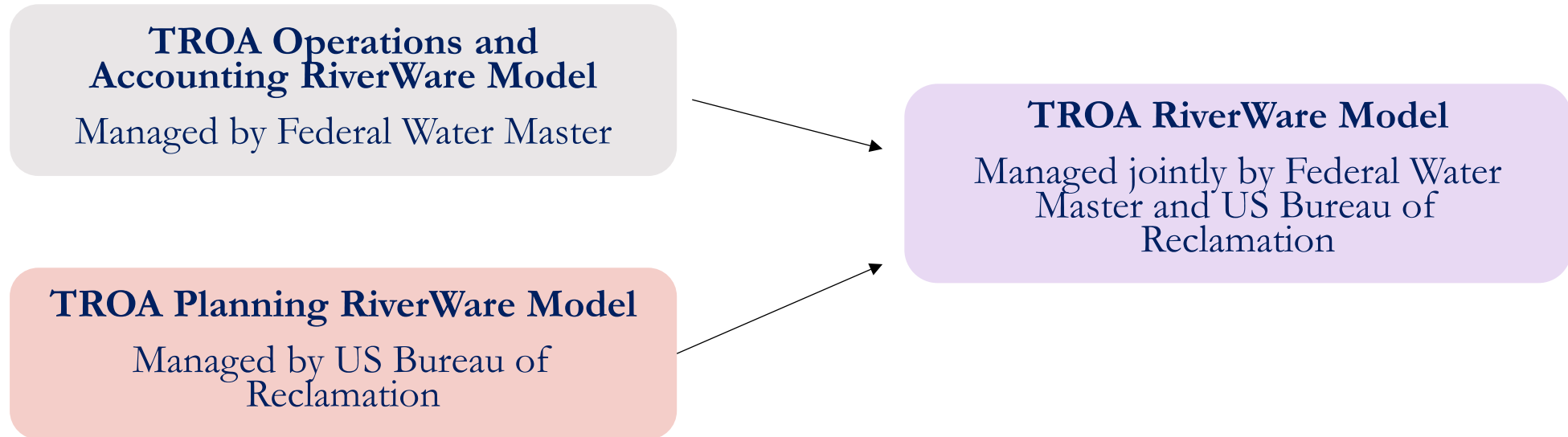
ACTIVITY	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Meet with CADSWES to Discuss RiverWare																											
TRA Operations Model																											
TRA Accounting Model																											
TRA Planning Model																											
TROA Operations Model																											
Meet with TROA Parties*																											
TROA Planning Model																											
TROA Accounting Logic																											
Implement TROA																											
Merge TROA Planning and Operations Models																											

* Regular MOCK TROA meetings with the parties began in 2008, but parties were included in the process early on.

TRUCKEE CARSON MODELING



TROA MODEL UNIFICATION



TROA Model

VERIFICATION METHODOLOGY

TROA Model



**Convert to
Planning Model**



- **Input historic hydrology and initial conditions**
- **Constrain big picture items (parties start of credit water)**
- **Run the model**

WY TROA Accounting Model



**Quantitative and
Qualitative Model
Review**

Quantitative Review

- Nash-Sutcliffe Efficiency (NSE)
- Percent bias (PBIAS)
- Kling-Gupta Efficiency (KGE)

Qualitative Analysis

- Plot key basin timeseries
- Does this look right?

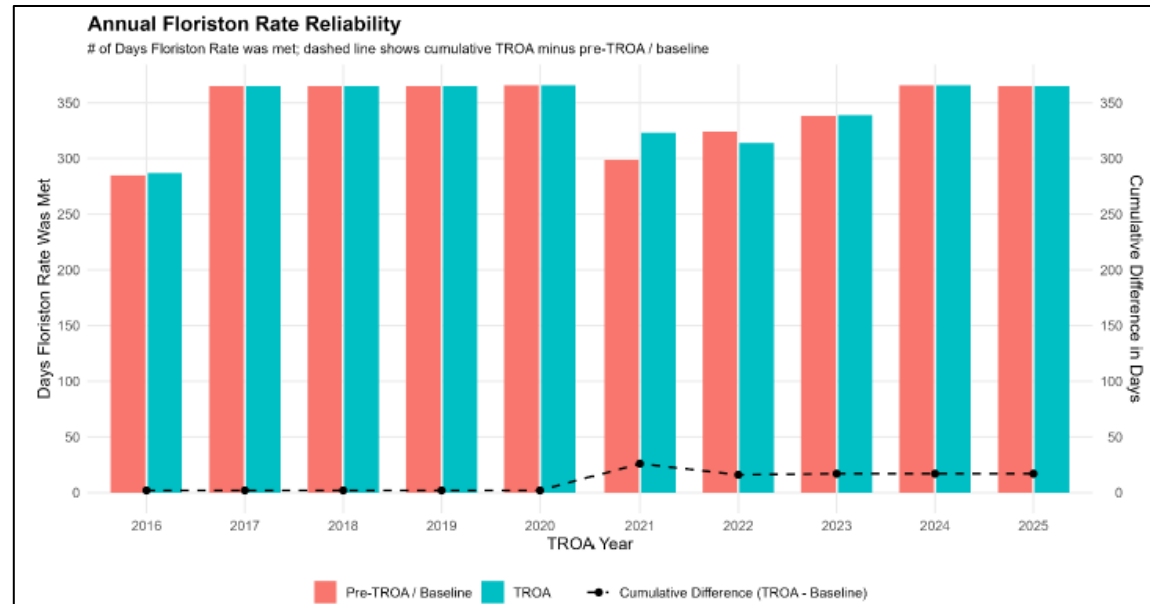
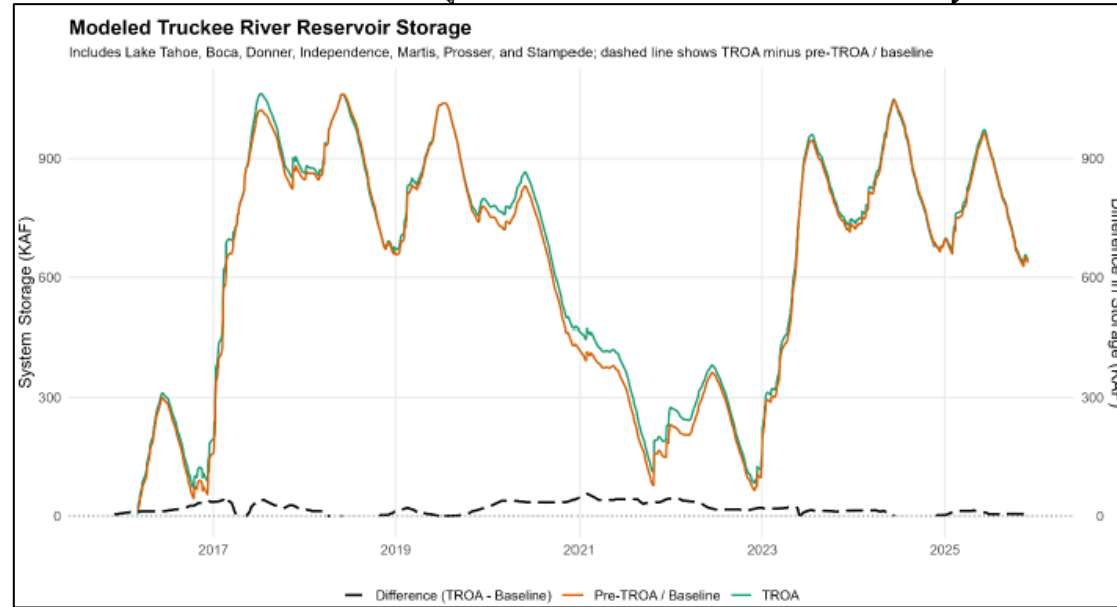
Use Cases

- Historical Reporting
- Development regression testing

1ST TROA 10-YEAR REPORT (2015–2025)

Verification Tool Use Case

- TROA §3.B requires the Administrator to:
 - develop a report after 10-years of TROA implementation
 - evaluate TROA implementation against the requirements set forth in the Settlement Act
- Review
 - hydrologic conditions
 - drought determination
 - Party accounting
- Presents a Planning Model Study of the Truckee under pre-TROA operations vs TROA operations



TROA 10-Year Report

https://www.troa.net/reports/troa_annual_reports/

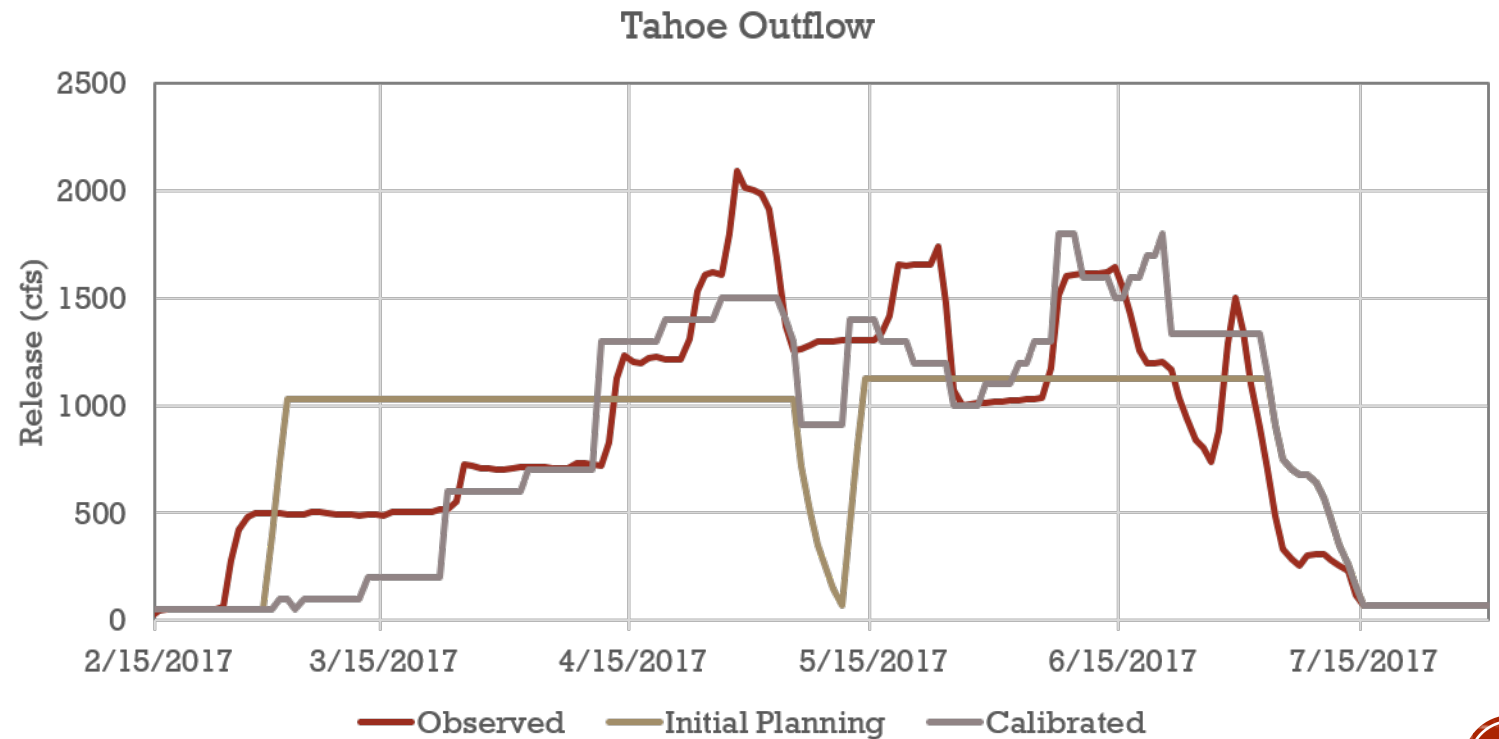
MODEL VERIFICATION STUDY

- Received Party Comments in two-phases
 1. TROA Verification
 - Comparison of Planning Model version of last 10 years of TROA
 - Allow objective and quantitative comparison to historical operations
 - Help determine thresholds when certain decisions were made in the past
 - Allow parties to evaluate past operational decisions
 - More assessable planning tool (smaller dataset, recent history)
 2. Long Term Planning
 - Test model for robustness
 - Evaluate performance in extremes
 - Ensure model functions properly with different datasets

VERIFICATION EXAMPLE: TAHOE RELEASE TO ENSEMBLE

- Comments that modeled Tahoe release is much smoother than historical
- In practice Tahoe operates based on an ensemble
- Model scenarios don't have an ensemble for every day....
- Used verification tool to help write logic to better match historical operations
 - Quantify improvements
 - Vet changes for other years

		Initial Planning	Calibrated	Change
All Days- WY2016-25	NSE	0.77	0.81	0.03
	PBIAS	0.7%	0.7%	0.0%
	RMSE	161	145	-16
Spill Days- WY2016-25	NSE	0.77	0.81	0.04
	PBIAS	-4.0%	-3.8%	0.2%
	RMSE	366	324	-42



MODEL BENCHMARKING

How can you be sure a model change made for conditions this year won't adversely affect model performance in other years?

- The model Verification Allows
 - automated way to rerun Planning models over past 10 years
 - Quantitative comparison of current performance to past performance

<u>Original NNSE</u>												
Slot	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Avg.
Boca.Outflow	0.57	0.87	0.44	0.81	0.66	0.38	0.55	0.68	0.58	0.66	0.38	0.60
Stampede.Outflow	0.39	0.87	0.52	0.77	0.62	0.22	0.45	0.64	0.58	0.59	0.43	0.55
Prosser.Outflow	0.45	0.80	0.41	0.53	0.52	0.29	0.24	0.87	0.34	0.52	0.49	0.50
Tahoe.Outflow	0.96	0.78	0.62	0.85	0.54	0.63	0.61	0.94	0.72	0.55	0.83	0.73
FaradGage.Gage Outflow	0.90	0.96	0.78	0.95	0.92	0.75	0.86	0.97	0.93	0.89	0.72	0.88
Total FR Storage	1.00	1.00	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
Total PLPT Storage	0.99	1.00	0.76	0.88	0.98	1.00	0.33	1.00	0.62	0.84	0.65	0.82
<u>Updated NNSE</u>												
Slot	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Avg.
Boca.Outflow	0.56	0.89	0.53	0.82	0.66	0.38	0.55	0.73	0.61	0.68	0.39	0.62
Stampede.Outflow	0.39	0.90	0.62	0.81	0.62	0.22	0.45	0.68	0.55	0.60	0.43	0.57
Prosser.Outflow	0.49	0.84	0.49	0.60	0.52	0.29	0.29	0.88	0.47	0.52	0.61	0.55
Tahoe.Outflow	0.96	0.78	0.62	0.85	0.54	0.63	0.61	0.94	0.75	0.56	0.83	0.73
FaradGage.Gage Outflow	0.92	0.96	0.82	0.95	0.92	0.75	0.87	0.98	0.93	0.90	0.73	0.88
Total FR Storage	1.00	1.00	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total PLPT Storage	0.99	1.00	0.76	0.88	0.98	1.00	0.32	1.00	0.58	0.84	0.64	0.82
<u>Change NNSE</u>												
Slot	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Avg.
Boca.Outflow	0.00	0.02	0.08	0.01	0.00	0.00	0.00	0.05	0.03	0.02	0.00	0.02
Stampede.Outflow	0.00	0.03	0.10	0.04	0.00	0.00	0.00	0.04	-0.03	0.01	0.00	0.02
Prosser.Outflow	0.04	0.05	0.07	0.07	0.00	0.00	0.05	0.01	0.13	0.00	0.12	0.05
Tahoe.Outflow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00
FaradGage.Gage Outflow	0.02	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01
Total FR Storage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total PLPT Storage	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	-0.01	0.00

THANKS TO COLLABORATORS AND COMMENTERS

- Scott Fennema, USWM
- Patrick Noe, PWRE
- Tony Powell, PWRE
- Shane Coors, PWRE
- Dan Lahde, USBR LBAO
- Kyle O'Connor, USBR LBAO
- Maggi Kraft, USBR LBAO
- Tom Scott, CA DWR
- Curtis Lawler, Stetson Engineers
- Donna Noel, PLPT
- Jake Echeverria, RCI
- Nick White, TMWA
- Jon Simpson, City of Sparks



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