BUREAU OF RECLAMATION

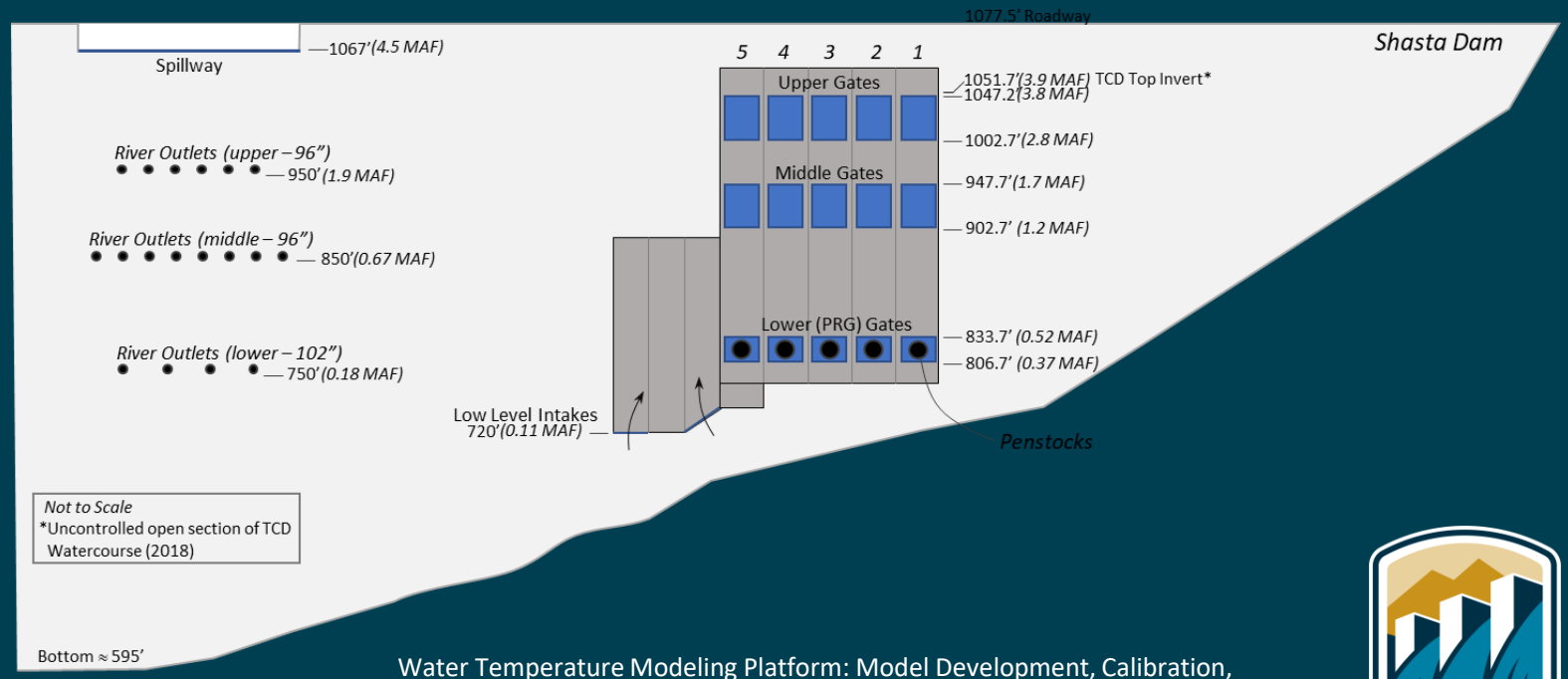
An Optimization Approach for Shasta Temperature Management

Drew Allan Loney, PhD PE
Mechele Pacheco

DRAFT – SUBJECT TO REVISION

Overview

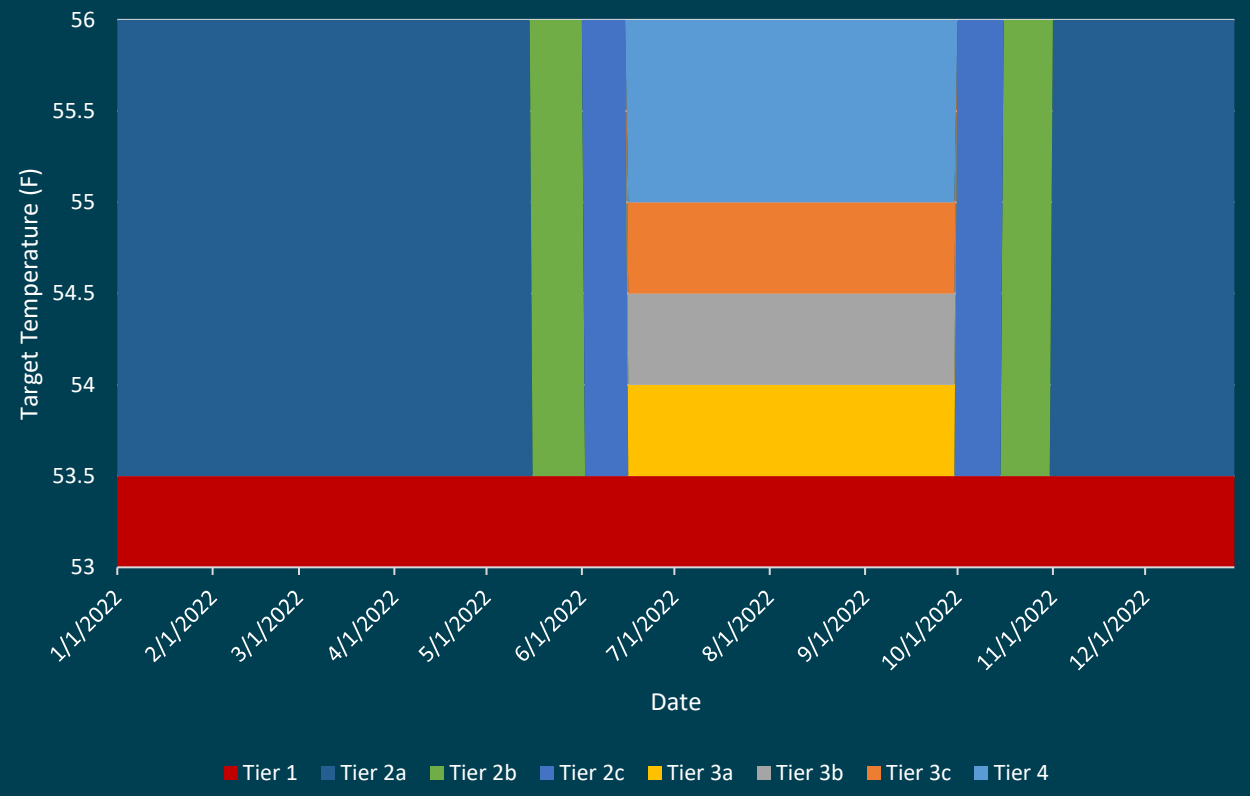
- Previous Work
  - Shasta Temperature Tiers
  - Impacts of Tiers
  - Tier Formulation
  - Initial Results
- Analysis Updates
- Next steps



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

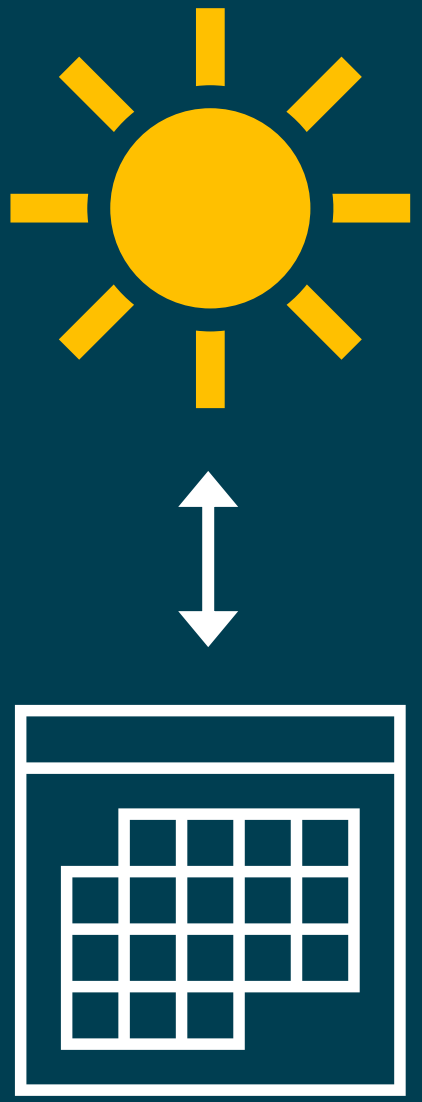
Shasta Temperature Tiers

- Downstream compliance temperatures defined by cold water pool volume (CWP)
- Adapt temperature management to utilize cold water when it's most impactful
- Tiers resulted from the 2019 BiOp process to protect fisheries
- CWP defines tier (<52 F)
  - > 3800 TAF: Tier 1
  - > 2800 TAF: Tier 2
  - > 2500 TAF: Tier 3
  - Otherwise Tier 4



Tier Impacts

- Define when to use cold water pool for fisheries benefit
- Defines tradeoff between holding and using water
  - Accepts warming of water in the reservoir in exchange for later use
  - Accepts hydrodynamic constraints on reservoir releases



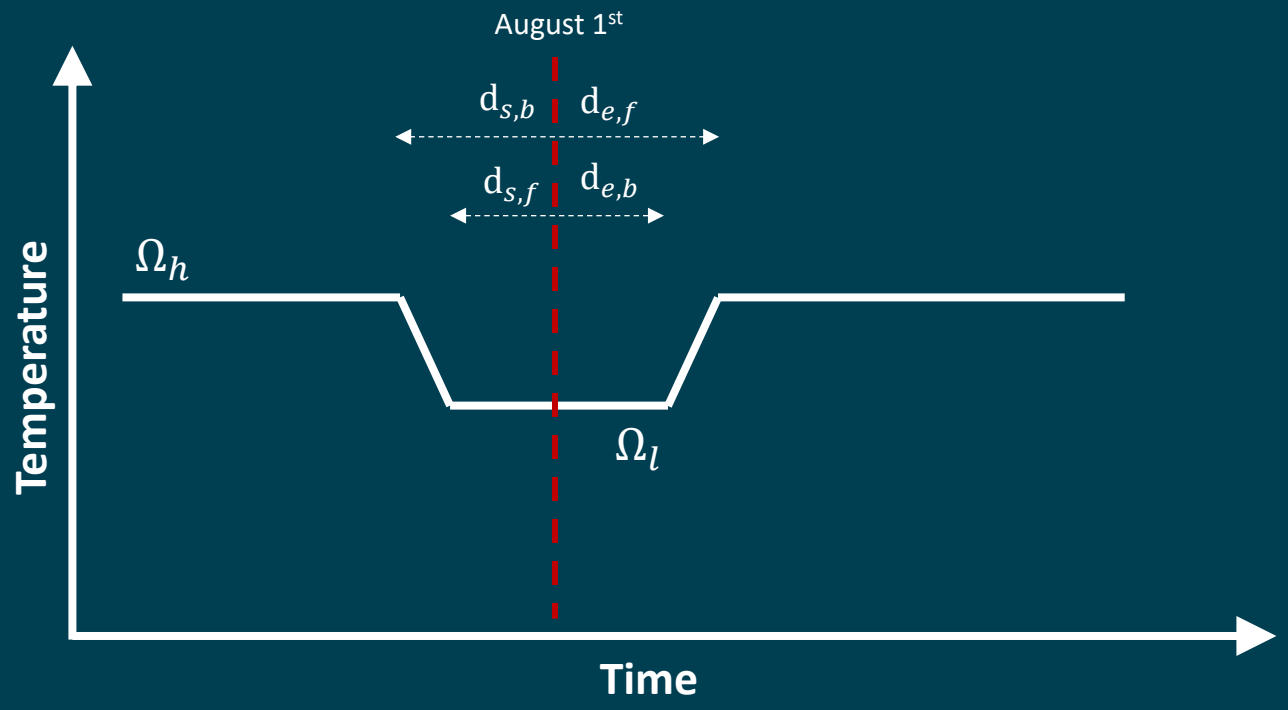
What do we want from our tiers?

- Maximize the fisheries benefit of cold water releases
- Use cold water before it becomes warm water
- Use cold water before while it’s possible to release it

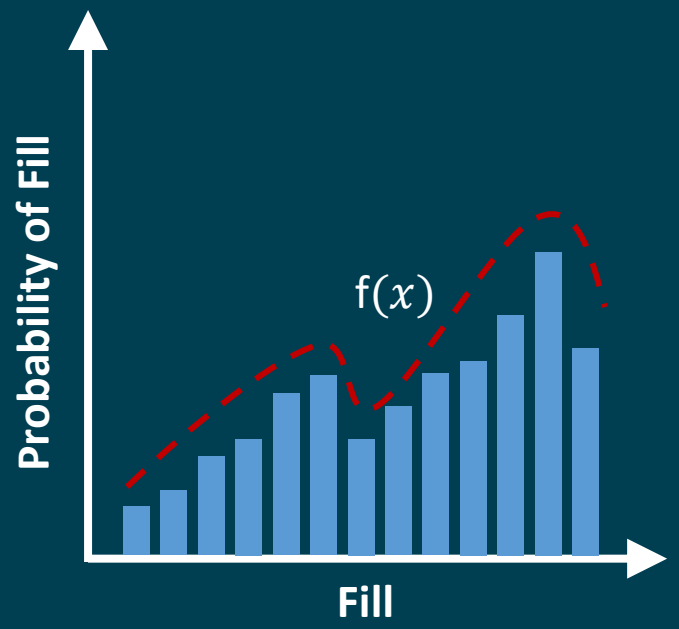
- Possible to optimize tiers against a quantitative objective
  - Use TDM despite not describing full life cycle
  - Life cycle models too computationally intensive
- Keep operations logic fixed across analysis

Tier Formulation

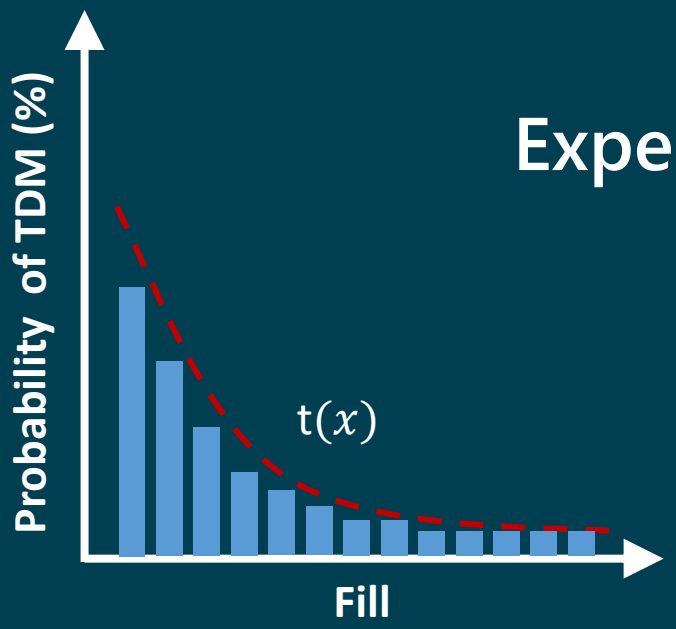
- Tiers defined by:
  - Minimum Temperature
  - Maximum Temperature
  - Four ramp offsets
- Offsets defined to August 1st
- Cold water pool (<52F) volume defines transition between tiers



Expected Value



x

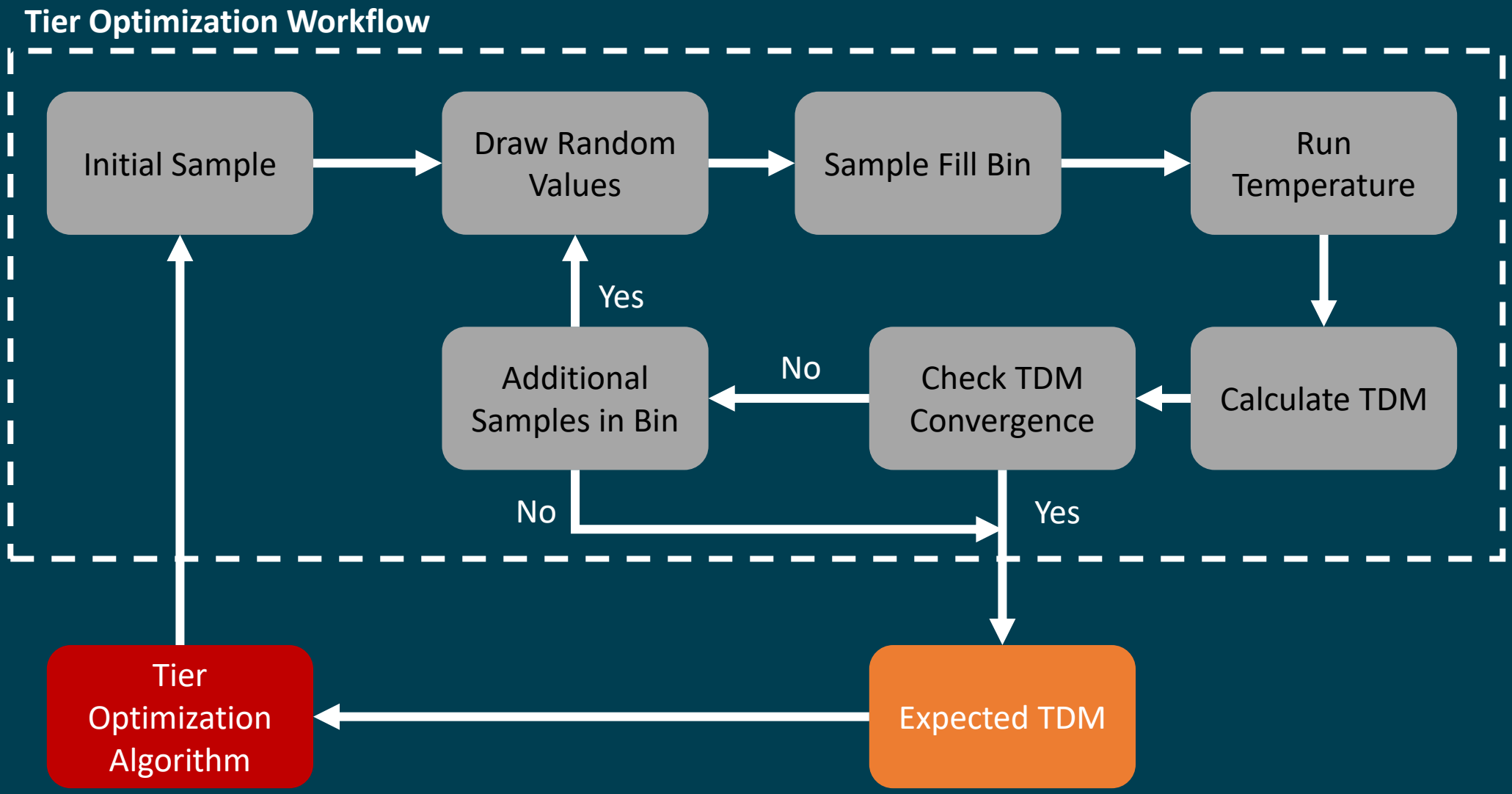


Expected Value of TDM

$= E(x)$

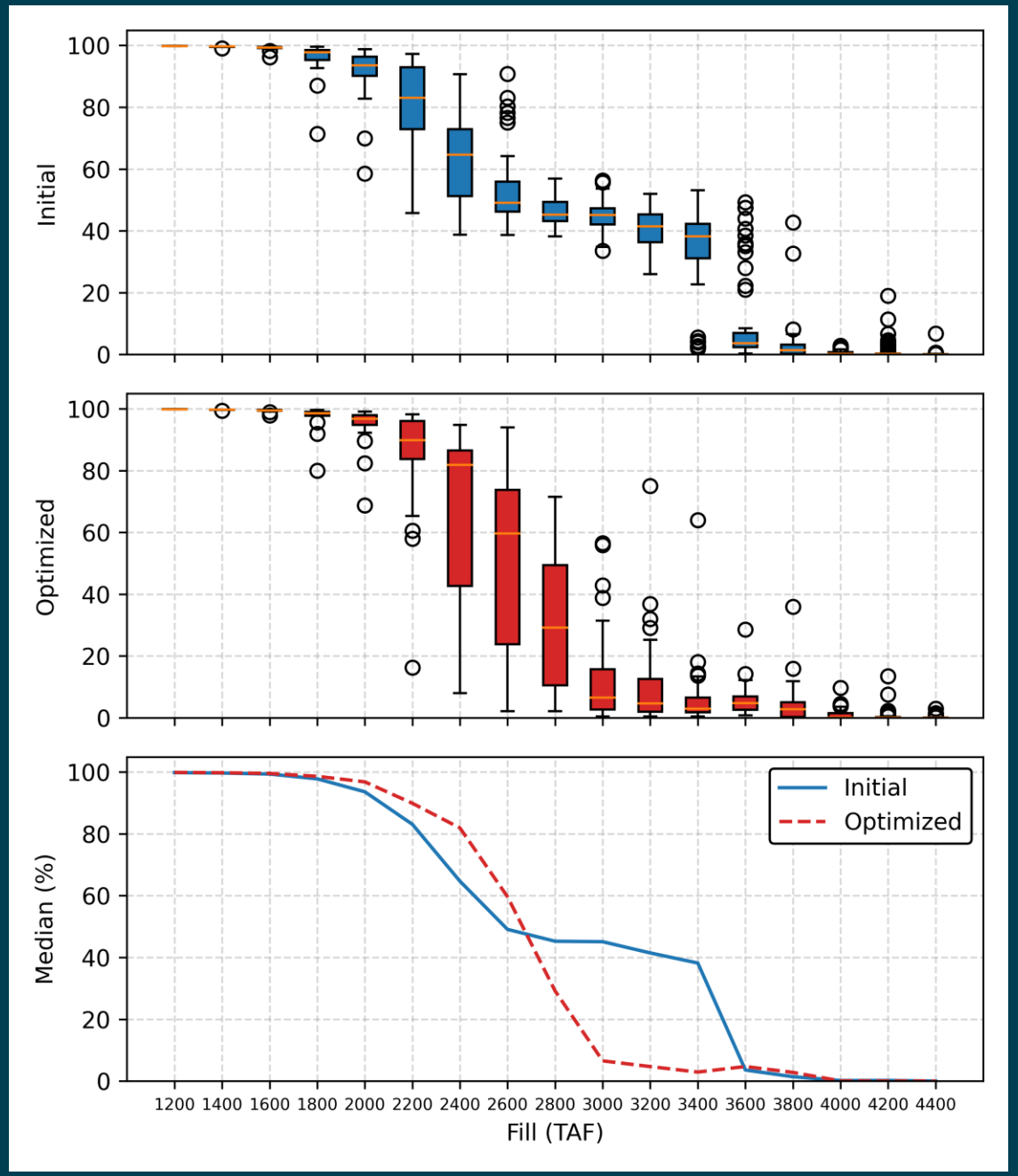
- Carryover analysis population is taken to be statistically representative of fills
- Fill bins are drawn from until convergence (<0.1% change) or until all years computed in bin

Optimization



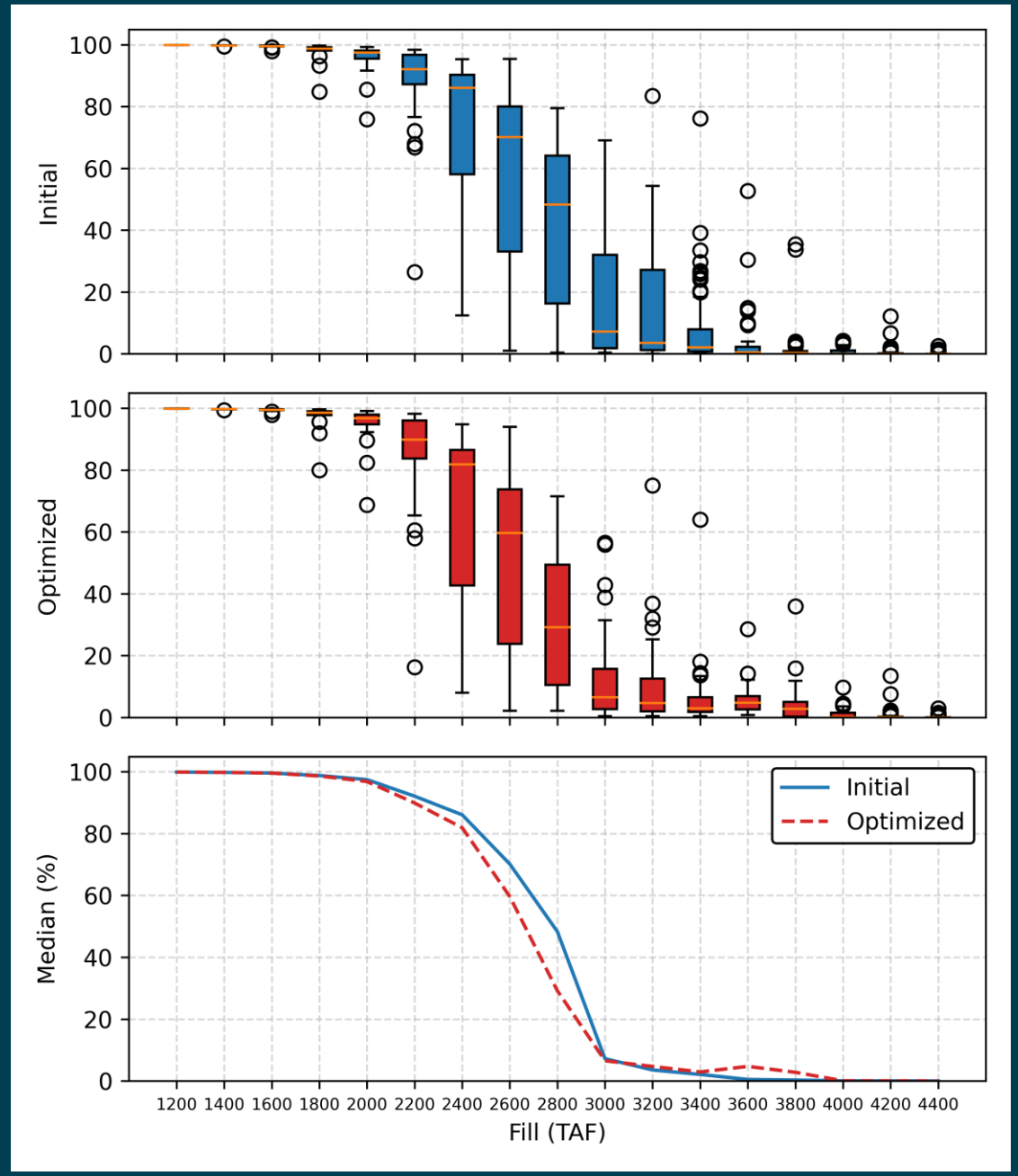
Results – 2019 BiOp Martin TDM

- Optimization can significantly improve performance in the middle fill range
- Lose performance in lower fills, upper fills
  - Tier 1 & 2 tiers collapse
  - Less resolution through Tier 3

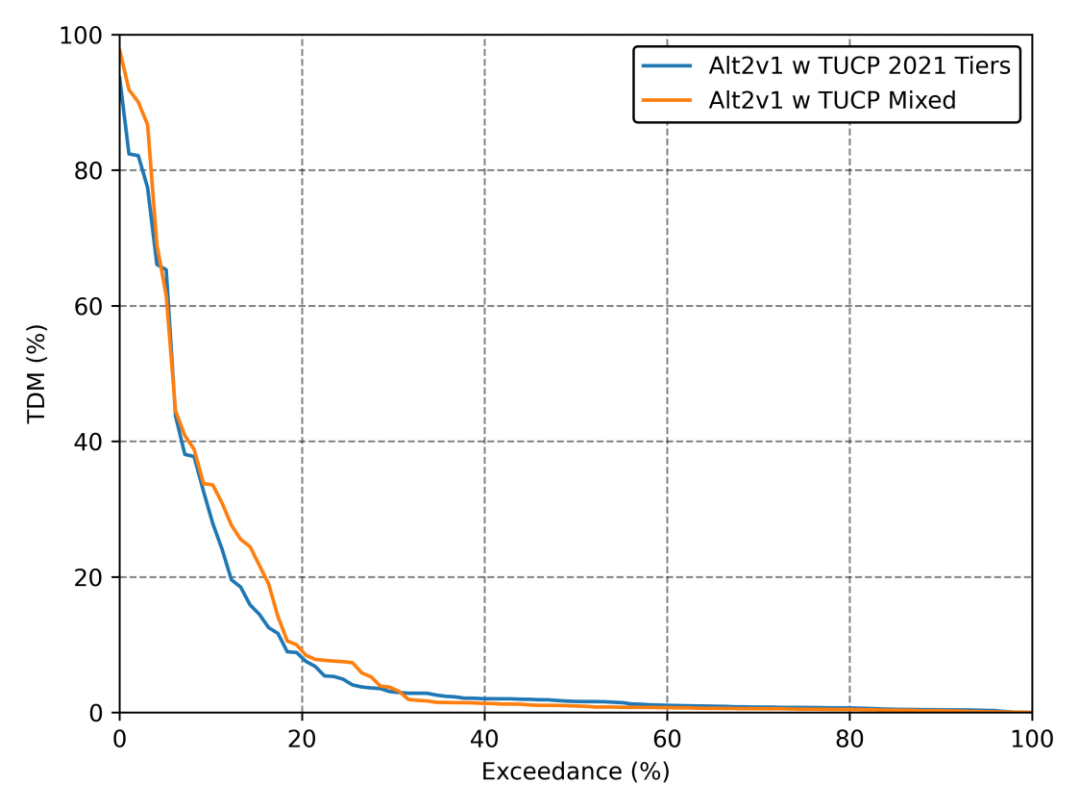


Results – Constant Tiers Martin TDM

- Optimization improves, but struggles with the tier collapse
- Lower tiers generally improve
- Timing affects not strong enough to overcome temperatures
  - Implies either a larger sample or more strategic initial condition



2021 LTO Analysis



- Able to create new tier structure to more effectively use the cold-water pool
- New tiers structure
  - Greater than 3 MAF: 53.5 F
  - Between 3 MAF and 1.5 MAF: 54 F
  - Less than 1.5 MAF: 56 F
  - 60F shoulder shifting between May and June
  - All fixed at Clear Creek compliance location

Analysis Updates

- Revisit to reconfirm analysis outcomes under climate change and new operations
  - Done in collaboration with the BDO Science Division
  - Update for 2022 +/- 15 median climate condition
  - Update with full CS3 period of record

- Carryover sample not available for an expanded sample population
  - Need to make some other assumption about statistical population
  - Treat the CS3 period as a statistically representative sample

Next Steps

- Finish the 2021 LTO
- Reformulate code for new assumptions
  - CalSim 3 period of record
  - New operations scenarios
  - More straightforward sample convergence
  - Include Anderson model as potential metric
- Run the analysis
  - Get coffee, lots of it
- Compare back to the 2021 tiers

Drew Allan Loney, PhD PE
dloney@usbr.gov

Mechele Pacheco
mpacheco@usbr.gov

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