BUREAU OF RECLAMATION

Yakima Basin Reservoir Delta Morphology and Fish Passage

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Disclaimer

- This presentation was presented to the Bull Trout Working Group on July 6th, 2022
- The content includes a background to the study and preliminary results that are likely to be refined through the course of the study

Study Background

- Funded through Reclamation's Science & Technology Program
- Study objectives developed during a funded scoping study with regional partners
- Funding is spread out over 3 years – through September 2024

Key Team Members at TSC

- Tim Randle, PE, Phd, D.WRE
  - Hydraulic Engineer
  - Former manager of the Sedimentation and River Hydraulics Group
- Nathan Holste, PE
  - Hydraulic Engineer
  - Also studying vegetation dynamics on reservoir delta surfaces (Elephant Butte Reservoir, Rio Grande)

Study Objectives

1. Develop a conceptual understanding of geomorphic processes of reservoir delta evolution focusing on how channel flow depth, sedimentation patterns, and inundation dynamics impact fish passage
2. Use the conceptual model to formulate and evaluate solutions that promote sustainable fish passage across reservoir deltas.

Overview

1. Data acquisition, literature review, and georeferencing
2. Site visits and data collection
3. Conceptual model development
   - Topographic surface development and change
   - Reservoir inundation analysis
   - Woody vegetation and channel geometry
4. Solution Evaluation
   - Literature of potential solutions
   - Solution development
   - Solution modeling and analysis
5. Documentation and deliverables

Overview

Year 1

- Data acquisition
- Site visits
- Topographic surface analysis
- Reservoir inundation frequency analysis

Year 2

- Woody vegetation and channel geometry analysis
- Potential solution development
- Solution testing (phase 1)

Year 3

- Solution testing (phase 2)
- Deliverables

Site Visit

Traveled to Yakima Basin in May 2022

Topographic Surface Analysis

Goals

- Quantify topographic change through surface comparisons

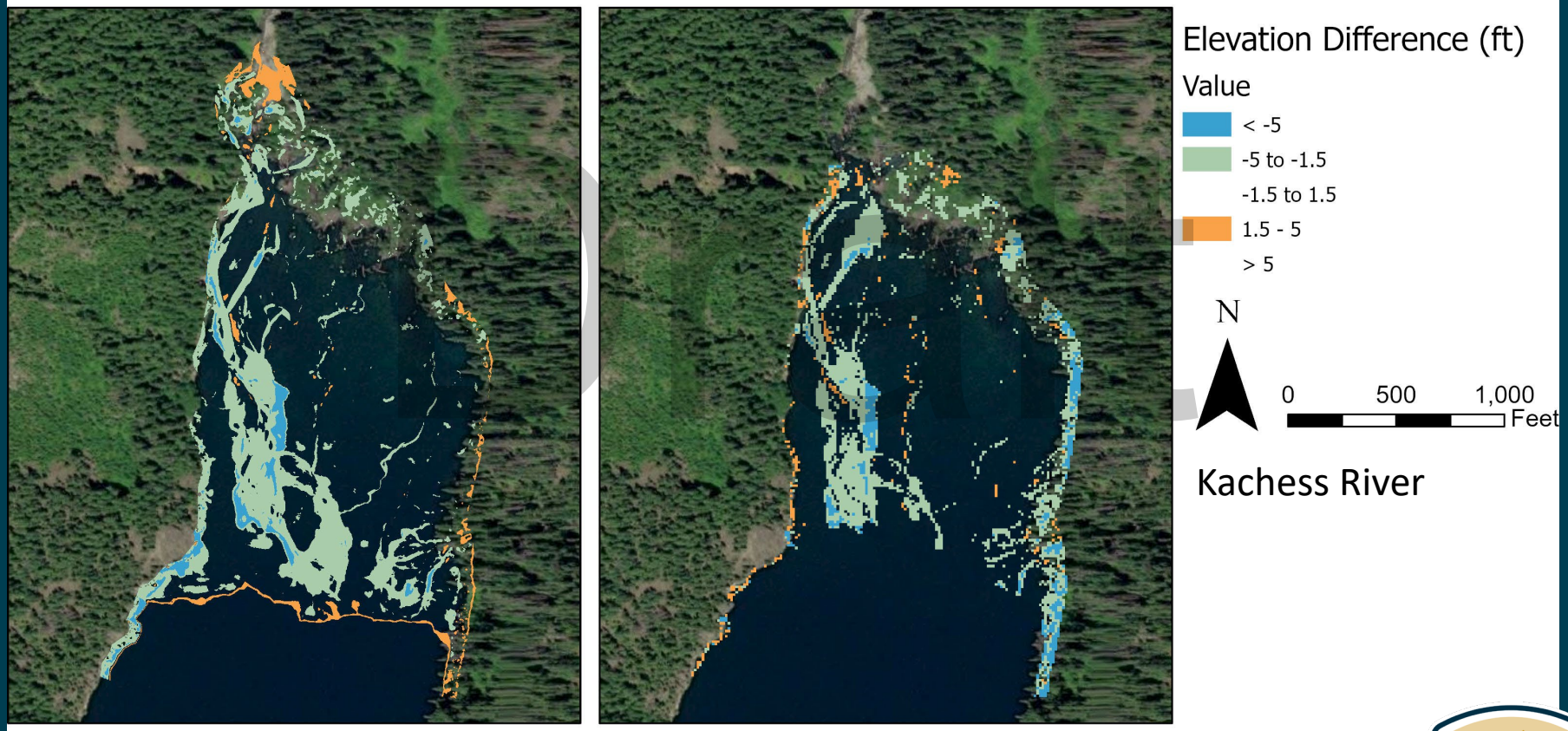
Needs

- Best available topographic surfaces from multiple years

Data Acquisition - Topography

Tributary Delta	Original Topo/Contours	Available Lidar	Bathymetry
Gold Creek (Keechelus)	10 ft (Parker & Storey, 1916)	2000, 2014, 2018	
Box Canyon Creek (Kachess)	10 ft (Parker & Storey, 1916)	2000, 2014	2021
Kachess River	10 ft (Parker & Storey, 1916)	2000, 2018	
Cle Elum	10 ft (Parker & Storey, 1916)	2000, 2014, 2018	
Deep Creek (Bumping)	10 ft (Parker & Storey, 1916)	2000, 2014, 2018	
Indian Creek (Rimrock)		2000, 2017, 2018	
North Fork Tieton (Rimrock)		2000, 2018	
South Fork Tieton (Rimrock)		2000, 2018	

Preliminary Topographic Differences



Reservoir Inundation Frequency

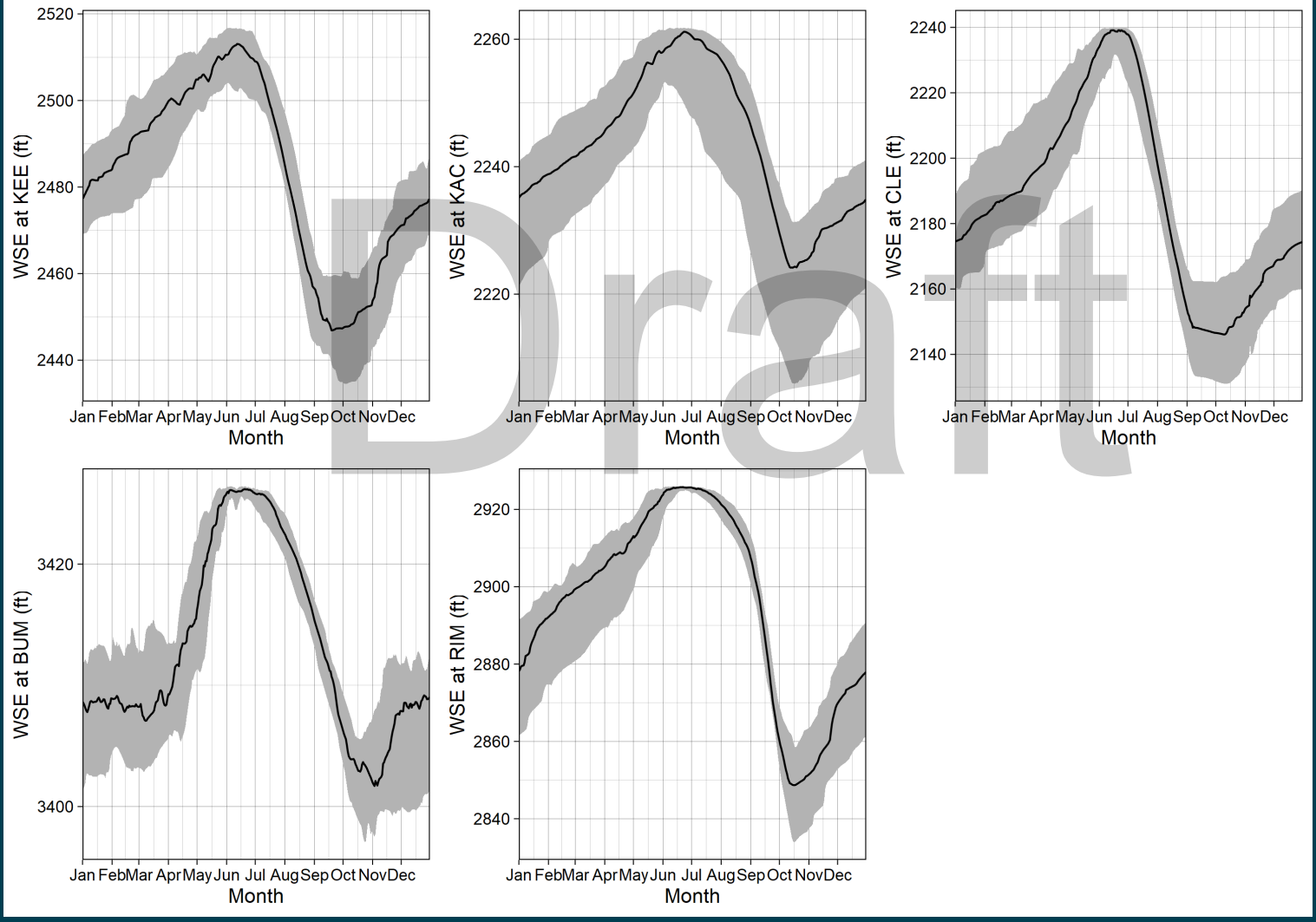
Goals

- Quantify inundation frequencies of delta surfaces
- Quantify typical dates when surfaces are inundated and dried
- Given fish life histories, we could further quantify times of stranding/inaccessibility

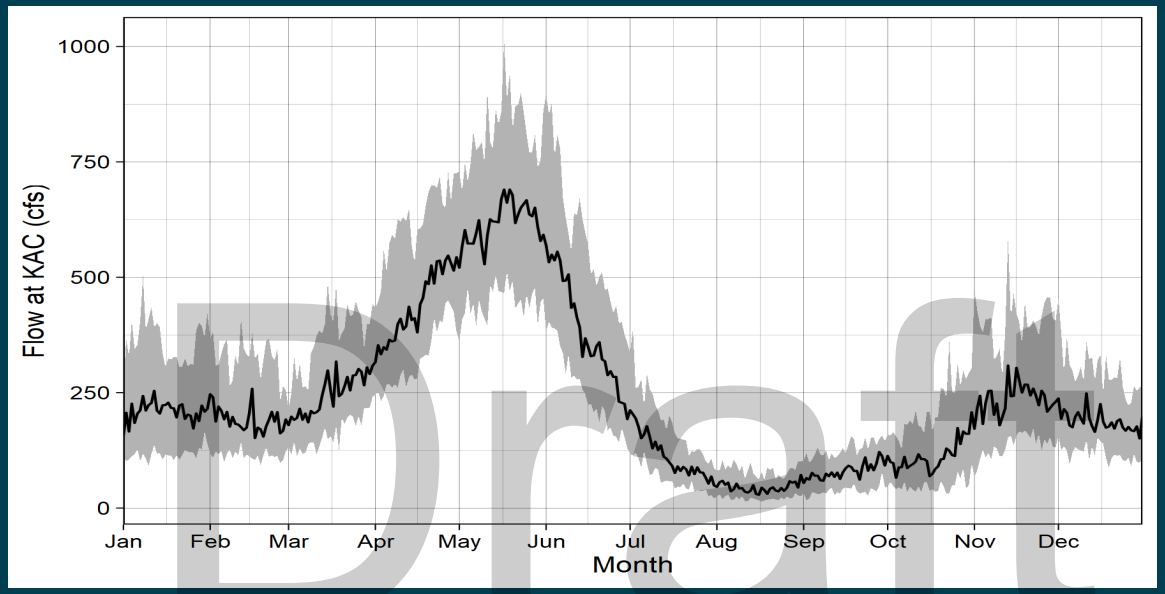
Needs

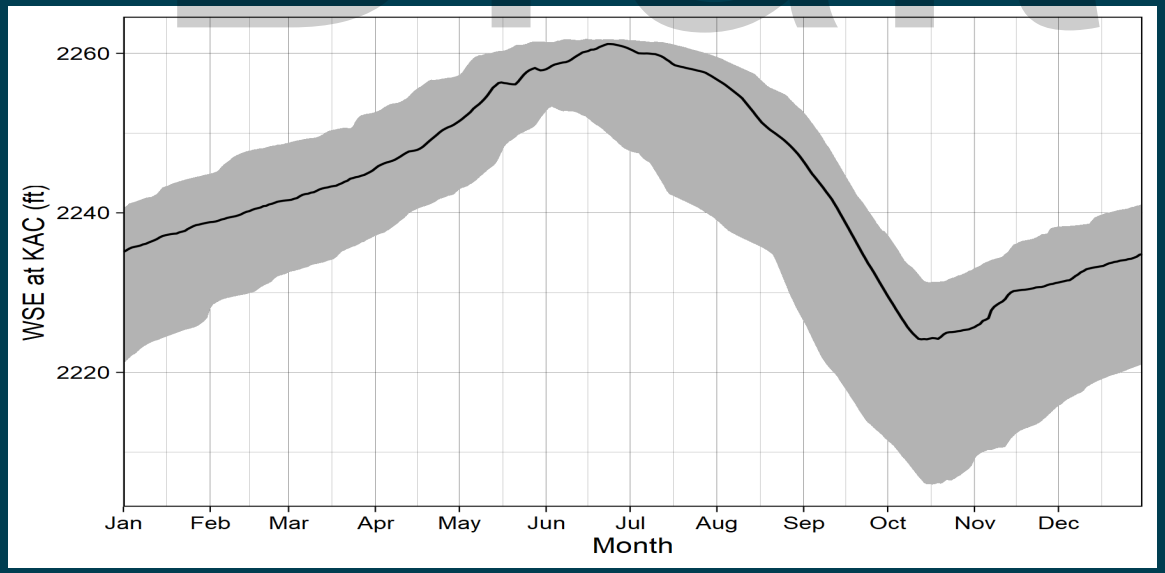
- Best available topographic surface
- Records of reservoir water surface elevations

Reservoir Water Surface Analysis

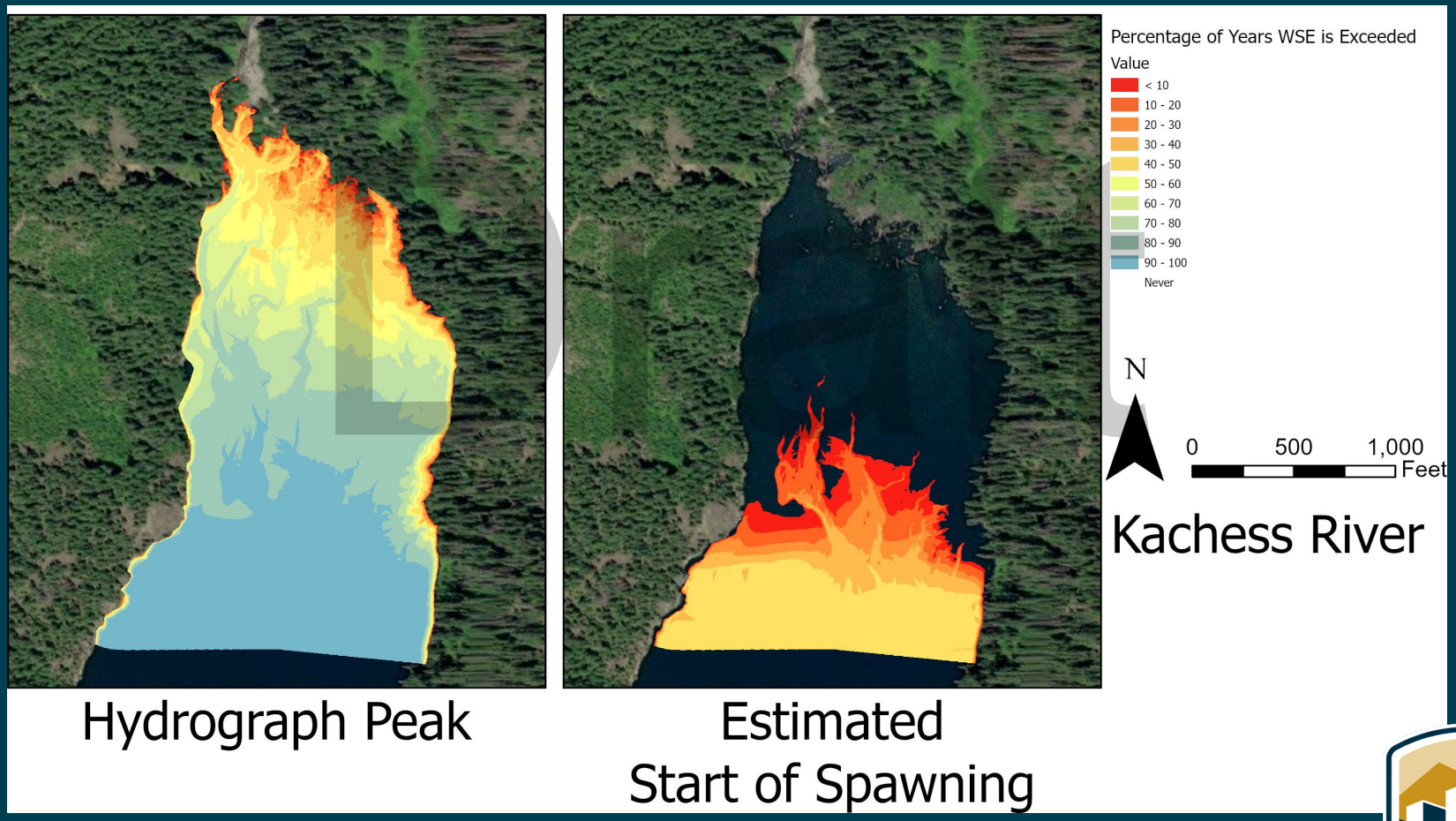


Reservoir Water Surface Analysis





Preliminary
Reservoir Water Surface Analysis



Sediment Transport Modeling

- Possible Approaches
  - 1D sediment transport modeling to investigate evolution of surfaces over time
  - 2D sediment transport modeling of specific storm event

- Possible Approaches to Model Topography
  - Simplified characteristics of longitudinal tributaries that enter reservoirs from upstream valley extent (e.g. Kachess River) vs. lateral tributaries that enter along other reservoir margins (e.g. Box Canyon Creek)
  - More complex topography of specific sites (likely limited to two existing topographies

Sediment Transport Modeling

1. Develop an existing conditions model
2. Model a baseline scenario with no restoration scenario
3. Model baseline conditions under various hydrologic conditions (high vs low pool with same flood events)
4. Model possible strategies to improve longevity of fish passage channels on reservoir deltas

Sediment Transport Modeling

- Potential solutions for modeling
  - Excavate narrower and deeper channels and model as:
    - Concrete channels
    - Naturalized channels
  - Create cohesion and cover using large wood jams and/or pilings
  - Construct peninsulas and islands using delta sediments as material source
  - Sediment removal at downstream end of channel

Summary of Next Steps

- Currently in the 1st year of a 3-year study
  - Goal of 1st year is to quantify hydro-geomorphic conditions on the reservoir delta
- Site visit/data collection trip will occur this fall.
- Beginning of next year will focus on quantifying any changes in vegetation patterns
- Final 1.5 years will focus on solution development and testing using sediment transport modeling analysis

Although research is being led by TSC in Denver, local knowledge and collaboration is needed and valued!

Thank you to all who have already participated in research development and data acquisition

- Richard Visser
- Joel Freudenthal
- Danielle Squeochs

Questions/Comments?

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