ENGINEERING MODELING APPLICATIONS

QUANTIFYING HABITAT FOR THE RIO GRANDE SILVERY MINNOW

MRGESCP Symposium

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PURPOSE AND OBJECTIVES

- Discuss how engineering modeling can provide information for conceptual habitat models.
- Uses RGSM rearing habitat (during the spring runoff) as a case-study.
- Demonstrate challenges to ecosystem modeling.
- Present two Hydraulic Engineering Center (HEC) models which may be used to analyze ecosystem hydraulics:
    - HEC-Ecological Function Model (HEC-EFM)
    - HEC-River Analysis System (HEC-RAS)

Photo credit: Jennifer Bachus, USBR 2016

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INSTREAM FLOW INCREMENTAL METHODOLOGY (USGS, BOVEE, 1998)

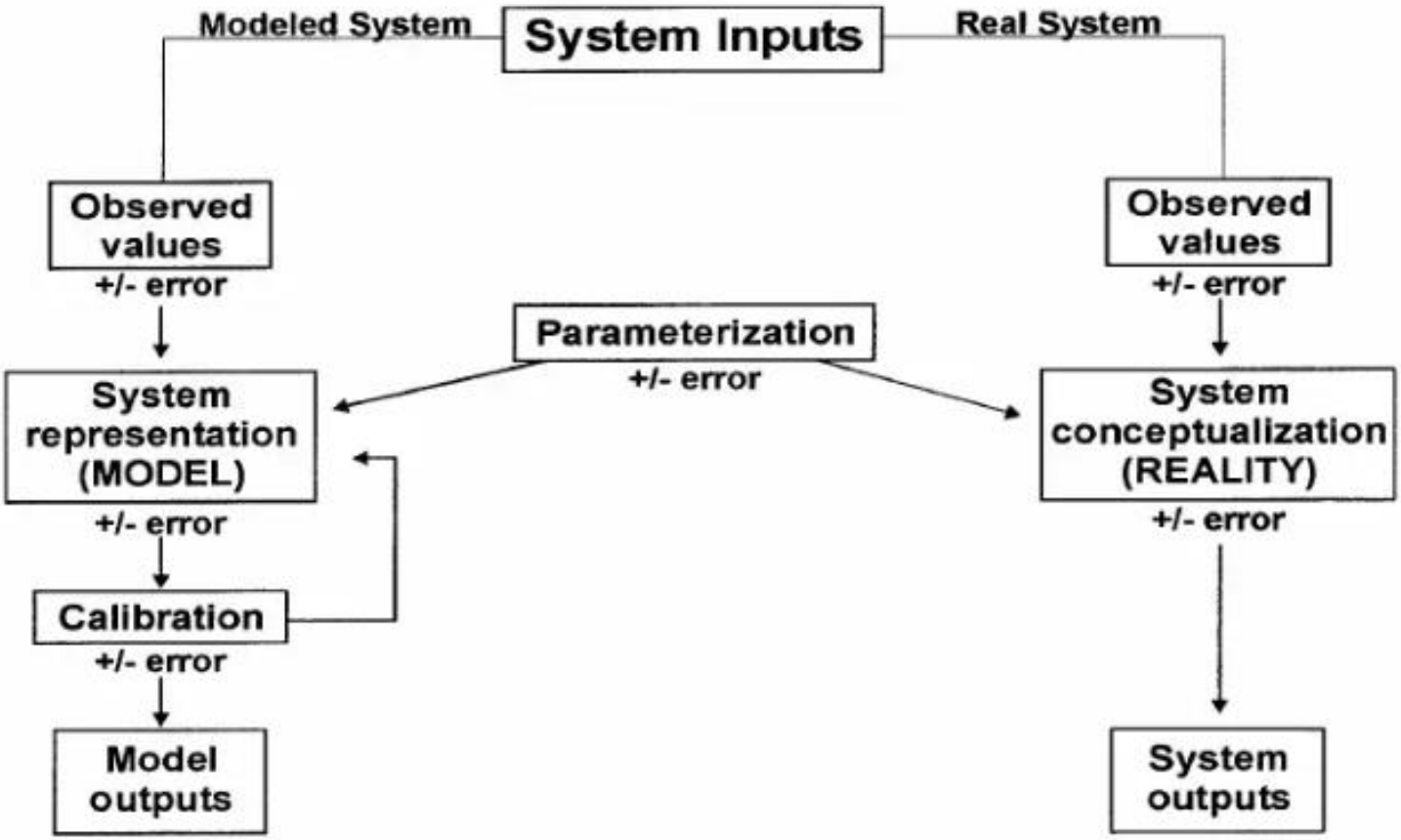

Fig. 1-3. Sources of error when models are used to represent real systems, illustrating the calibration step essential for accurate and realistic model predictions.

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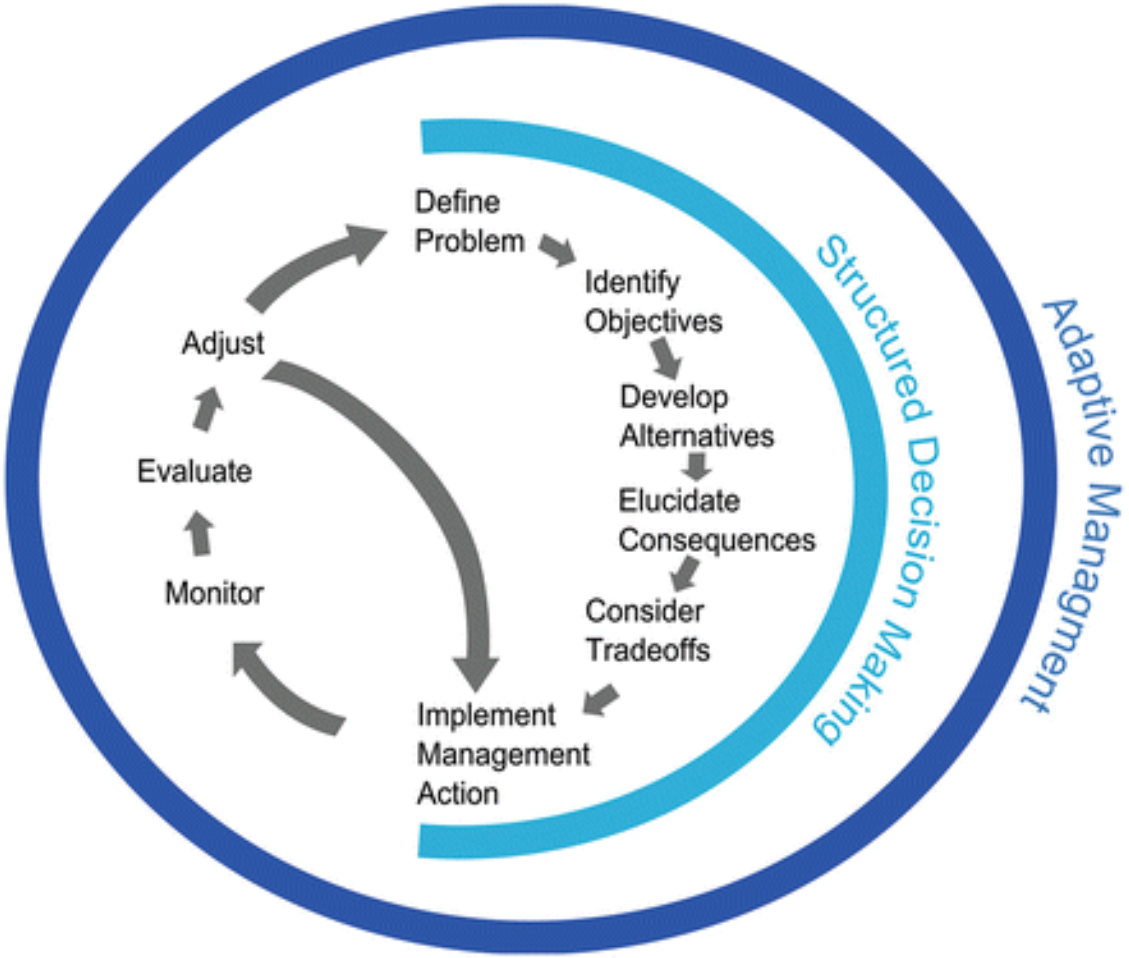
ADAPTIVE MANAGEMENT FRAMEWORK



"There will always be inherent uncertainty… in the dynamics of complex ecological systems, yet management decisions must still be made."

--Allen 2017

Modeling is a repeatable approach, with quantitative results. Simulations can be validated by field observations, and compared to future/alternative management scenarios.

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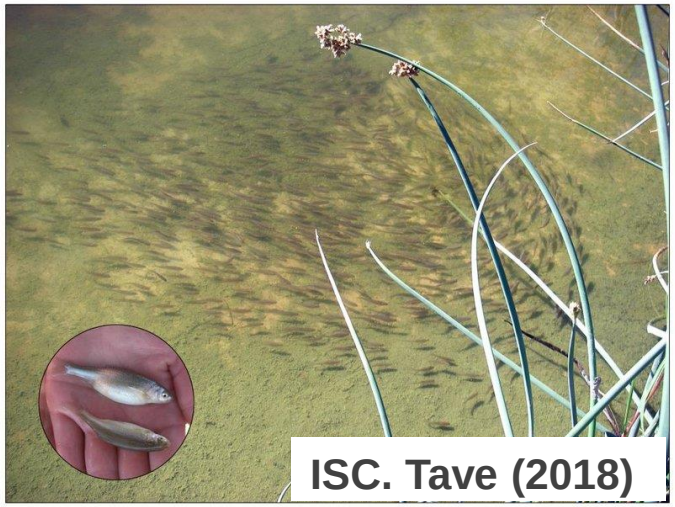
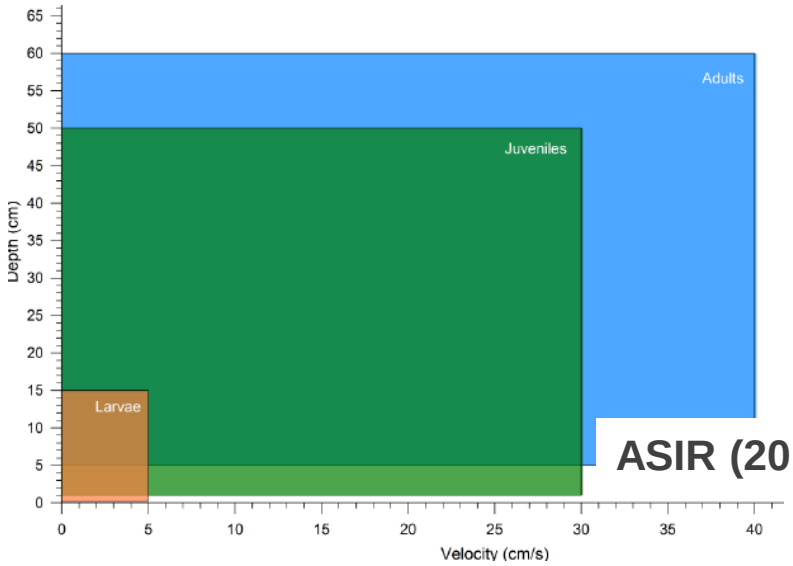
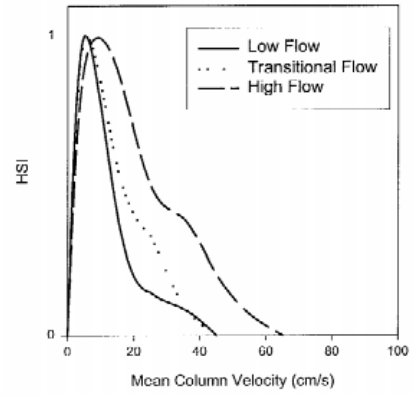
PARAMETERIZATION AND CONCEPTUALIZING THE SYSTEM

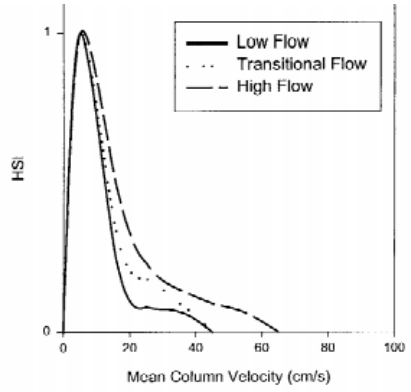


ISC. Tave (2018)



ASIR (2019)





ure 2. Velocity habitat suitability curves for data collected in the nmer (lower panel) and fall (upper panel), for low, transitional, l high flows (see text for an explanation).

Scruton (2002)

(telemetric habitat mapping for Atlantic salmon)

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SYSTEM MODELING

Flow

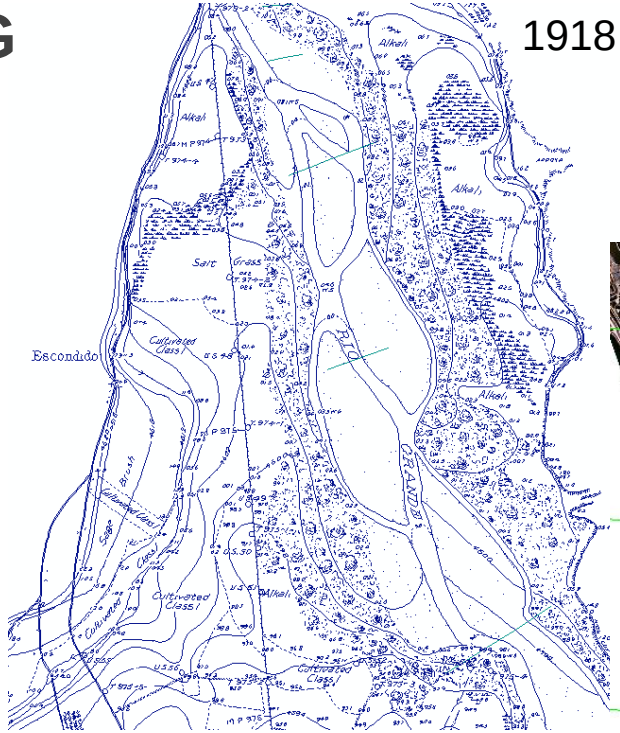
1. Frequency
   - Habitat Structure
2. Magnitude
   - Hydraulics: velocity, depth, shear forces
3. Duration
   - Rate of recession

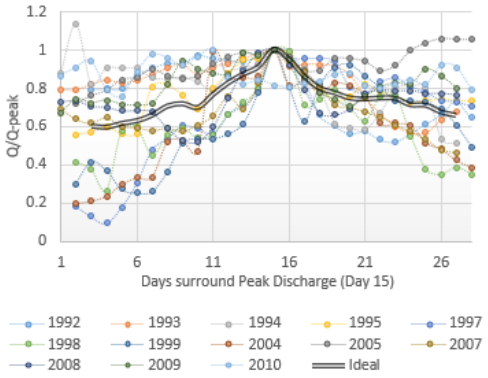
Season

1. Hydrology
   - Monsoons, Spring runoff, water management actions.
   - Life cycle, life history of the species.

Scale

1. Reach-wide
   - Geomorphology
   - In-stream structures
2. Site-specific
   - Engineered Habitat Effectiveness





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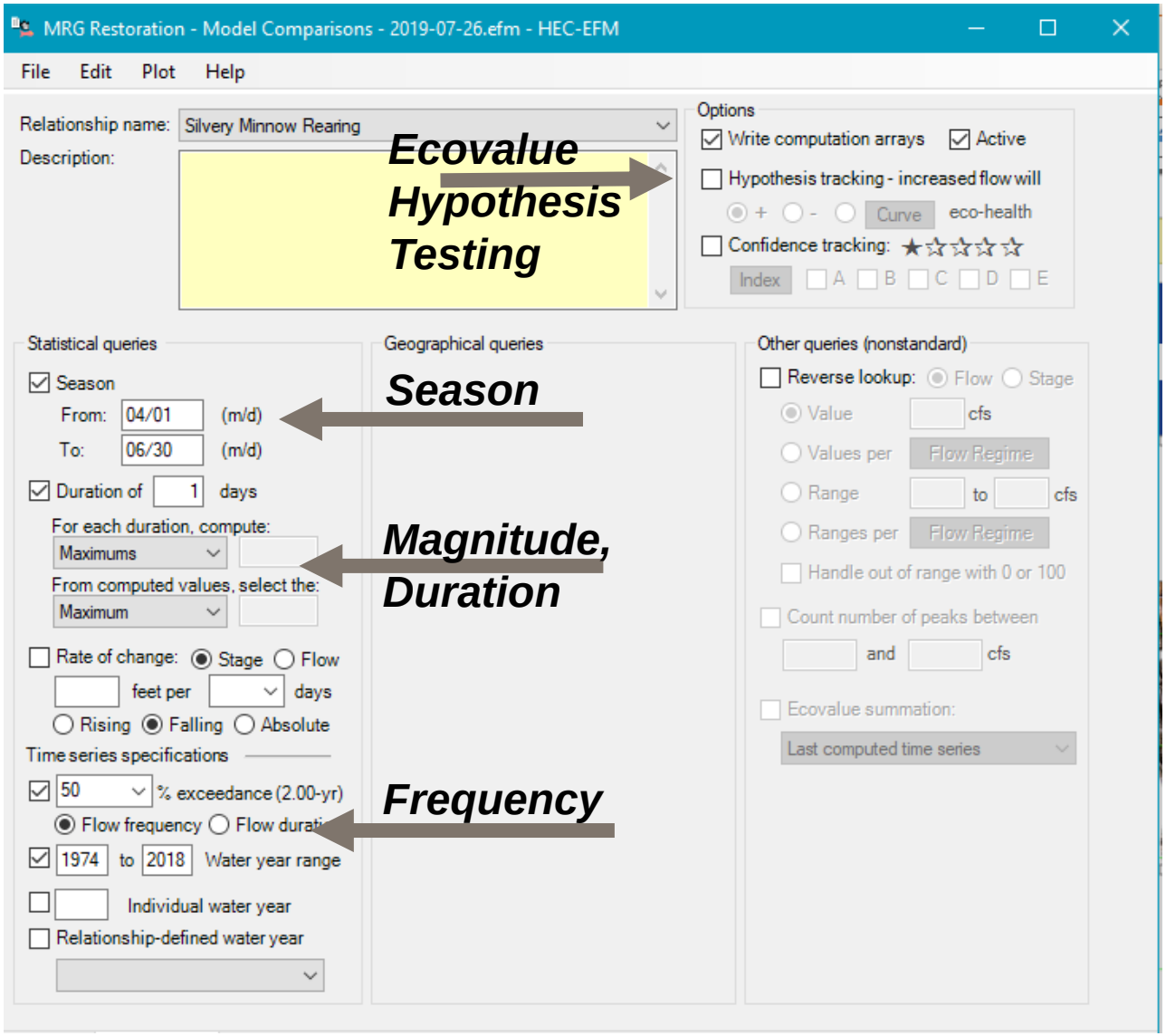
HEC-ECOLOGICAL FUNCTION MODEL



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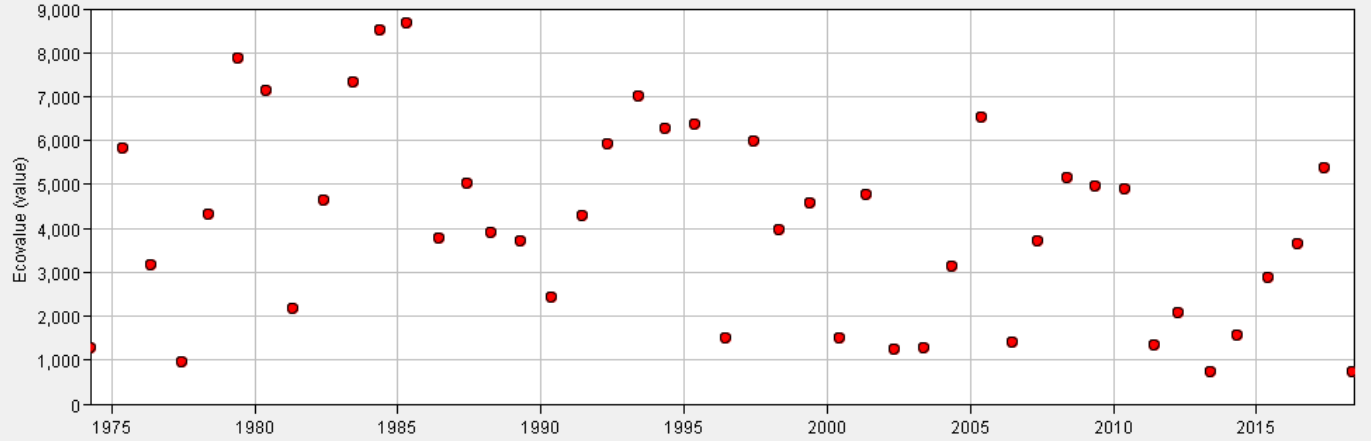

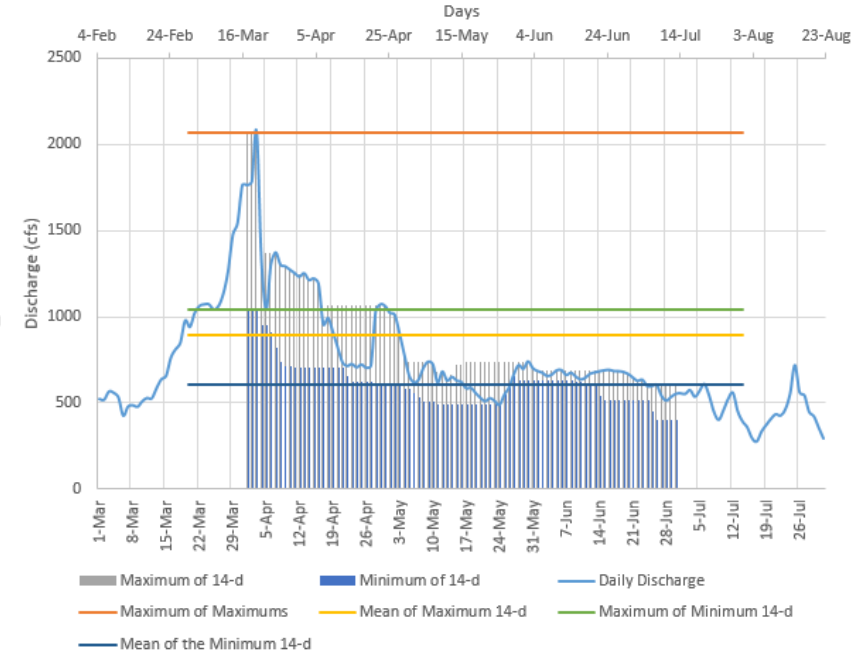

Question: What is the sensitivity of hydrologic analysis in affecting habitat suitability results?

- Hydrologic Characteristics
  - Seasonal duration, magnitude, frequency
  - Absolute maximum, or other annual statistics
- Eco-value Calculations
  - Hydraulic 2-D Mapping
  - Durations, Magnitude, Frequency

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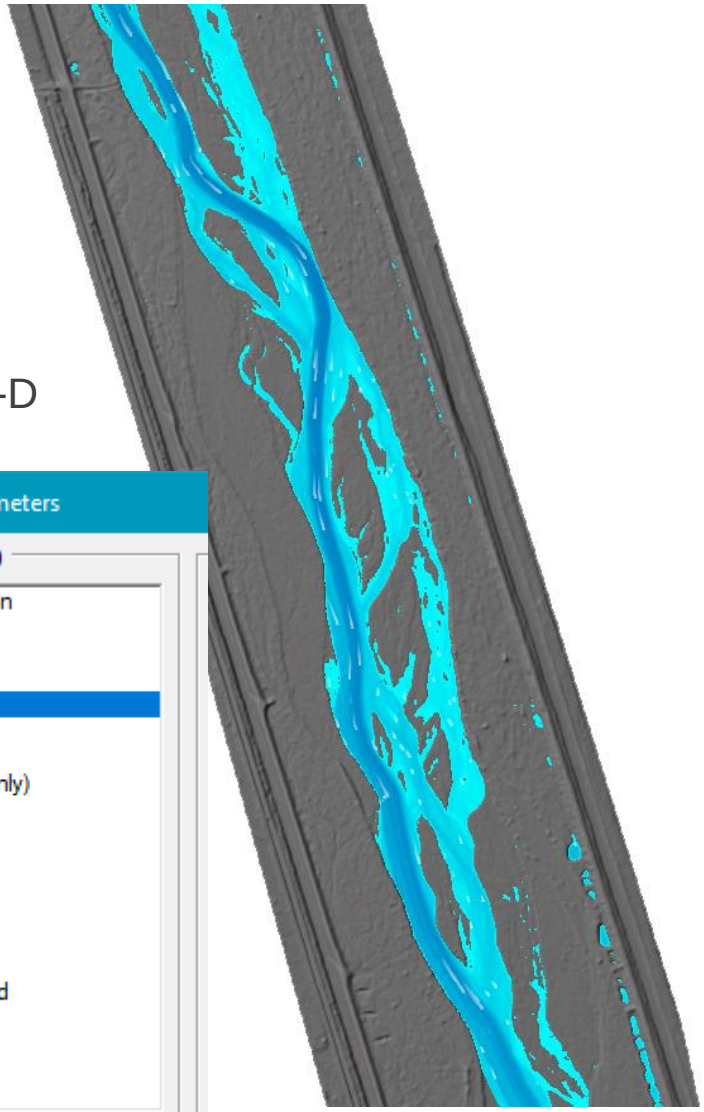
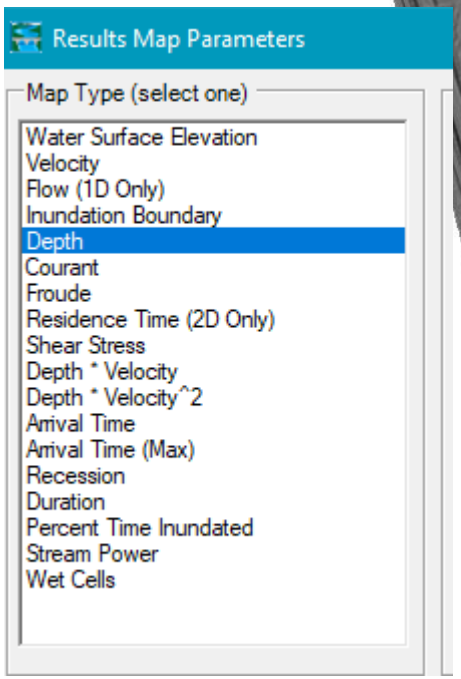
HEC-RIVER ANALYSIS SYSTEM

- 2-dimensional hydraulic modeling is reaching/has reached a golden moment:
  - Data is routinely collected at a resolution relevant to the 2-D Scale
  - Civil 3-D allows for alternatives analysis at a 2-D scale
  - ArcGIS allows for further spatial analysis of 2-D results.

- Provides information that is more informative for site-specific analysis:
  - Better resolution at side channels, embayments, channel edges.
  - Allows for quantitative analysis.





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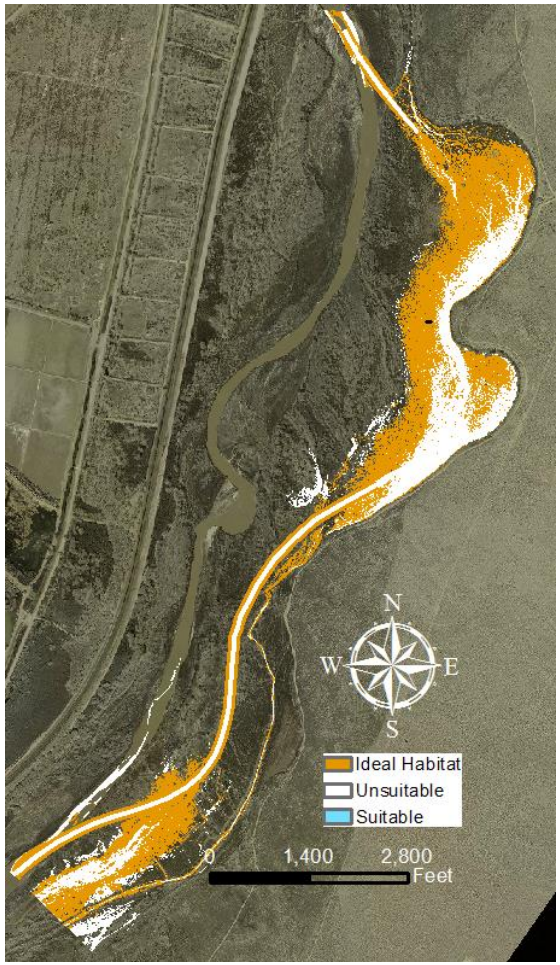
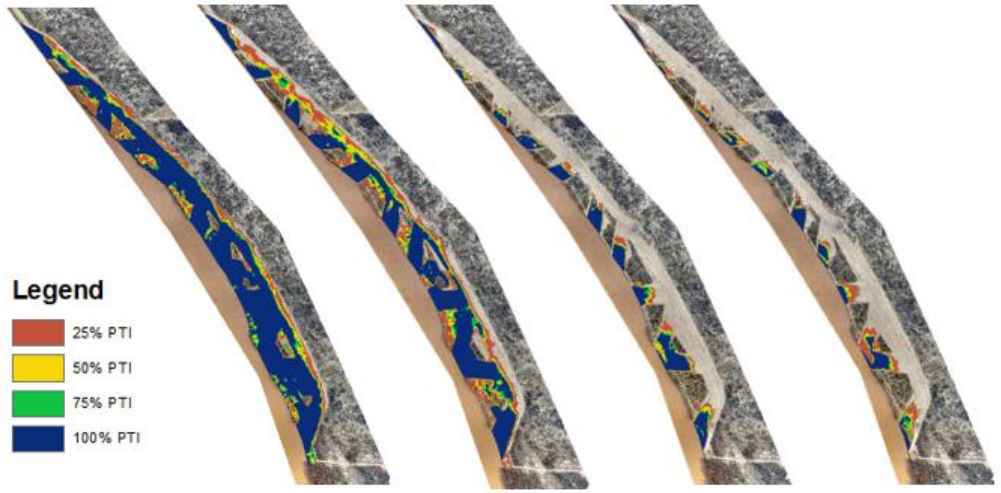
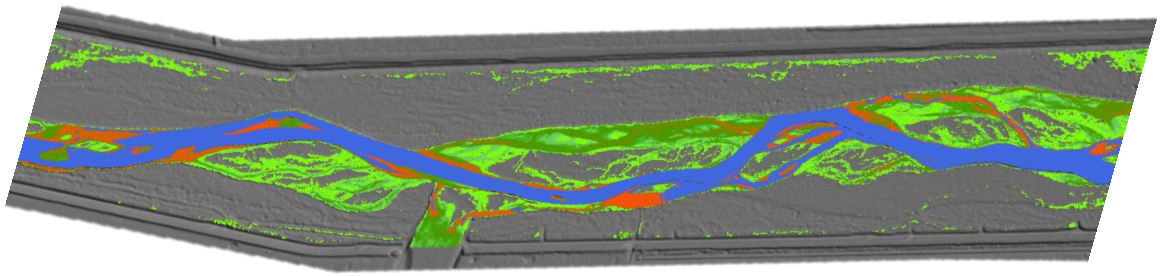
SPATIAL ANALYSIS AND HEC RESULTS



Areas meeting depth and velocity criteria for RGSM.



Percent time inundated (PTI) plots for “normal” spring run-off, for depths appropriate from left to right: all life stages, egg, adult, and excessively deep.



Duration of inundation for the 3-month spring run-off. (Blue = 90 days, to Light Green = 4 days)

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QUESTIONS

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Other Points of Contact regarding these projects

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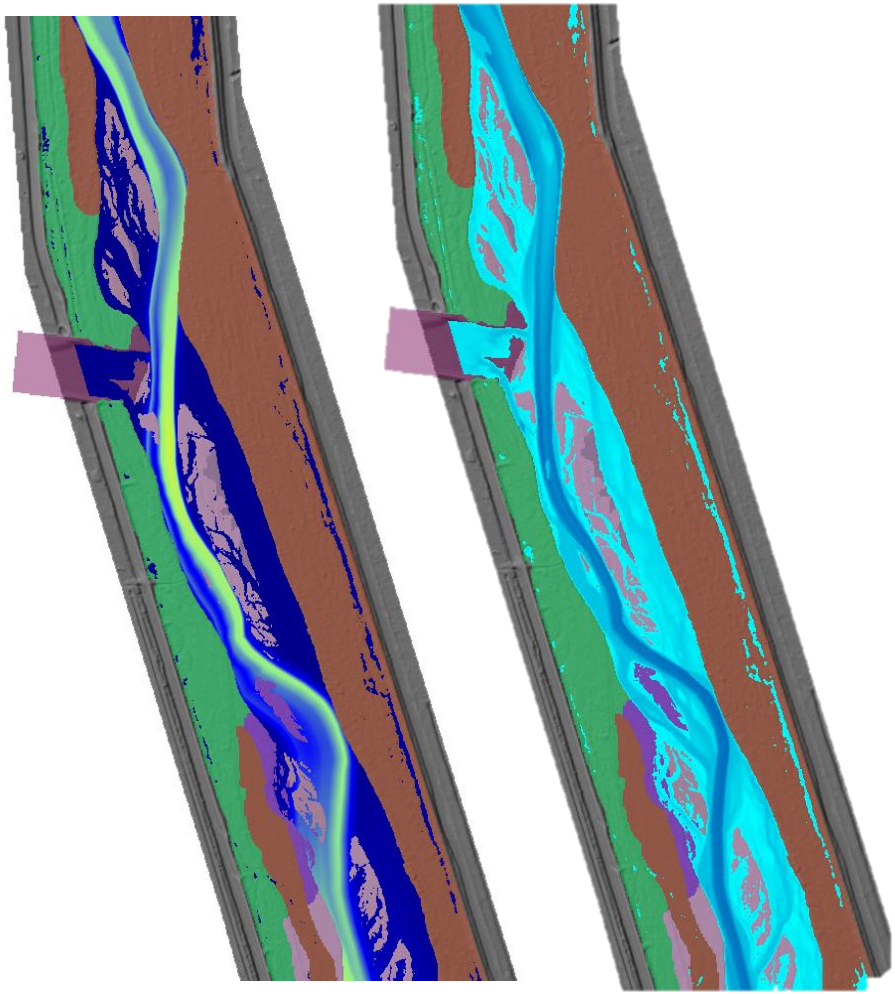

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