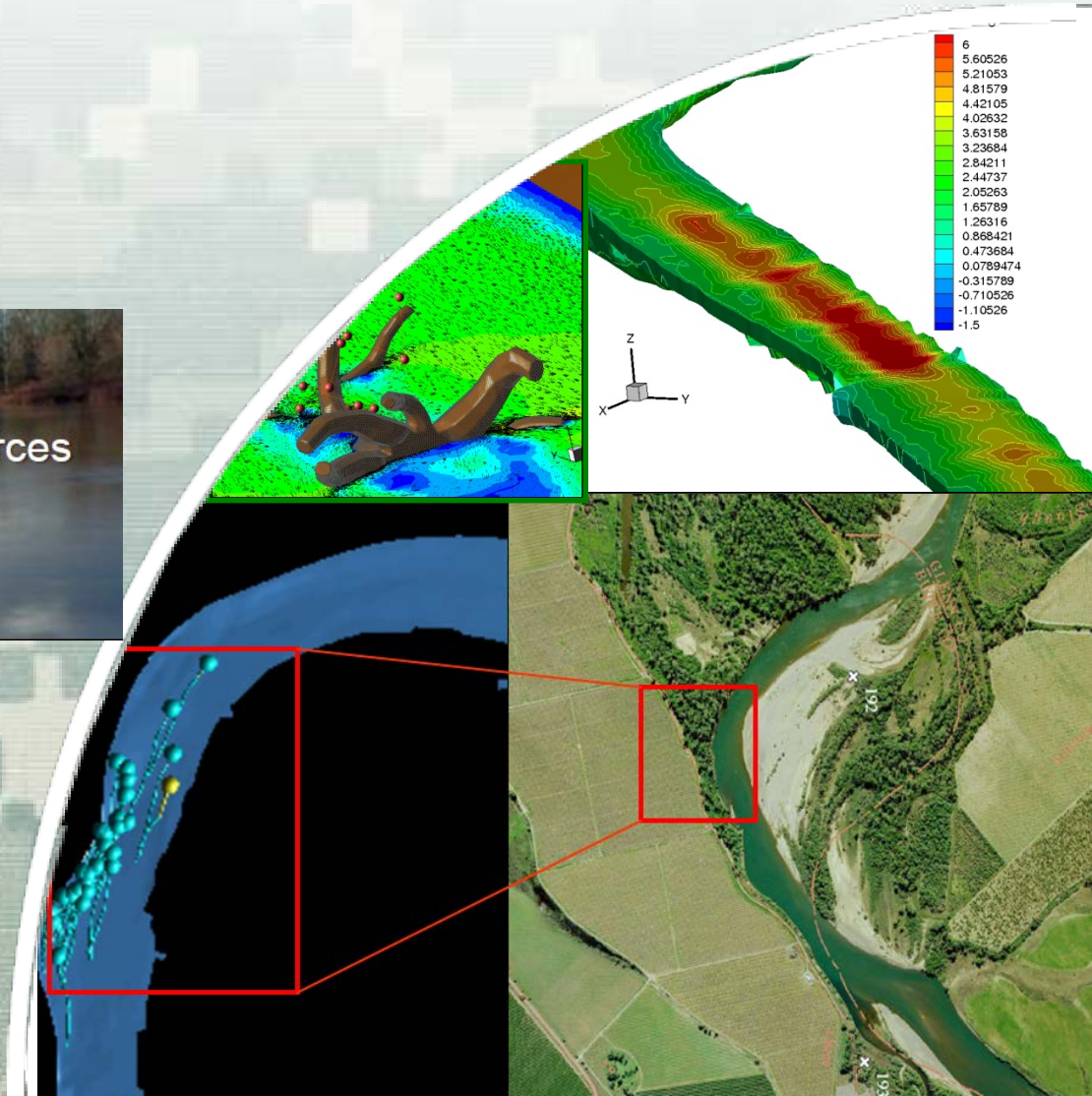
Integrating hydrodynamics and fish physiology to estimate entrainment rates for the Fremont Weir notch



State of California
Department of Water Resources

U.S. Department of the Interior
Bureau of Reclamation

US Army Corps of Engineers
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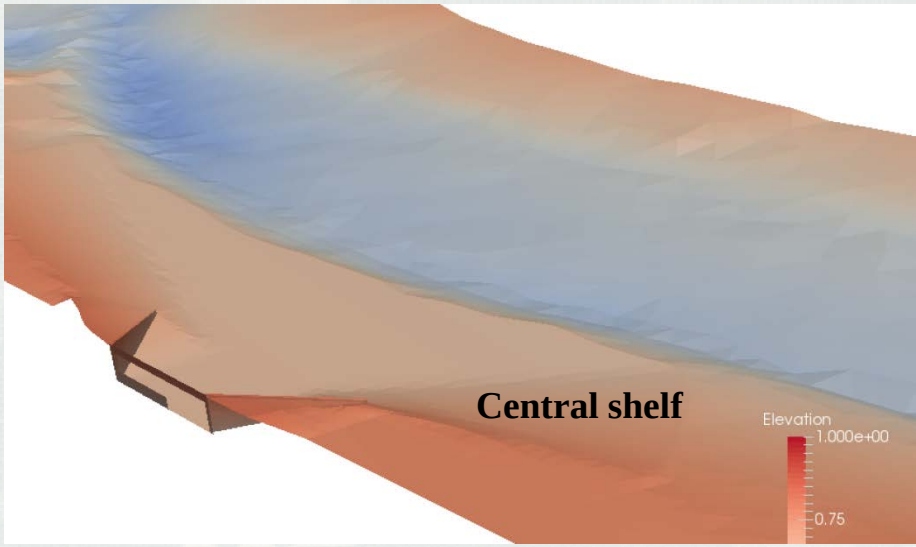
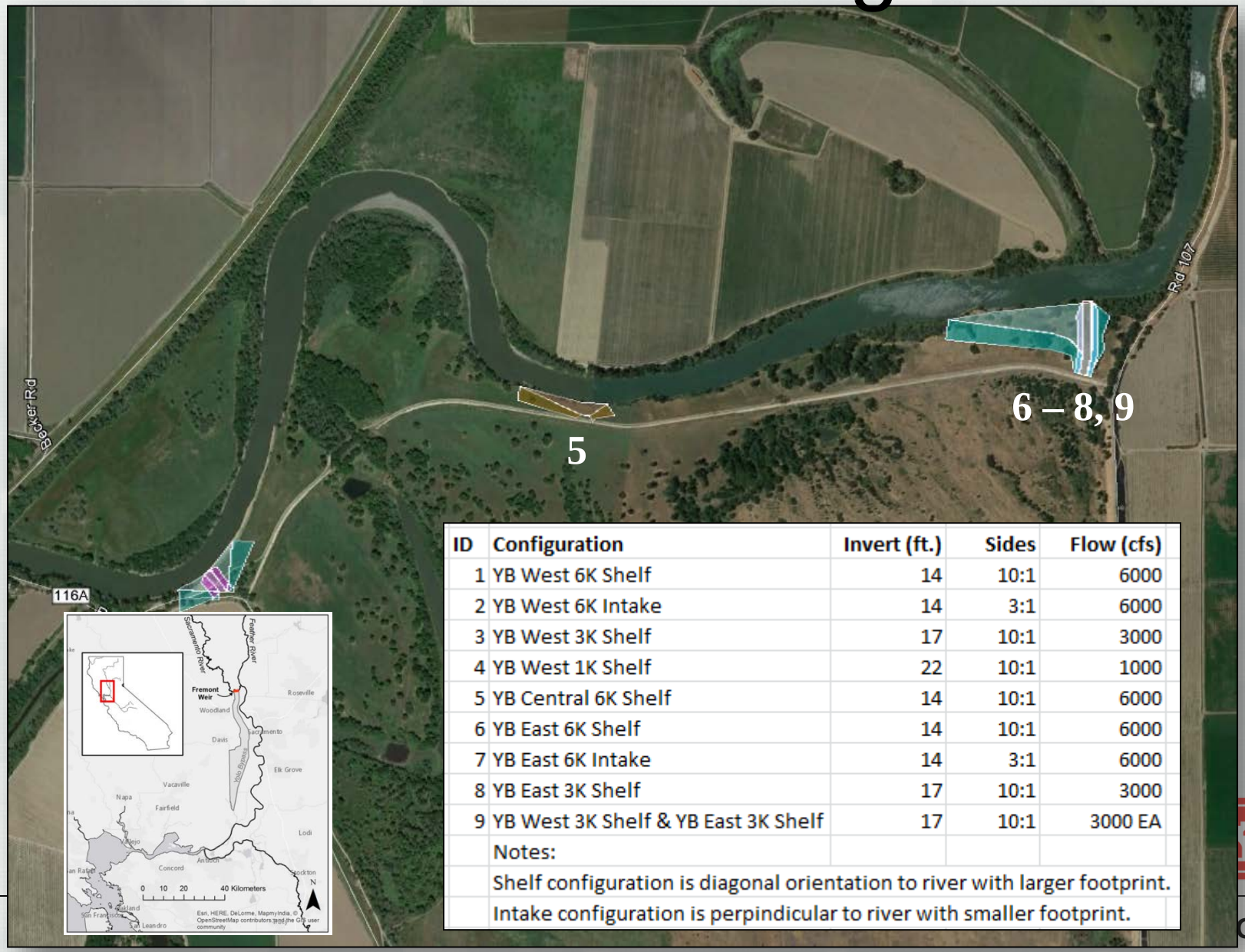
Approach

- Numerical “mock-up” of a the Fremont Weir reach and alternative notch designs – hydraulic and topographic models.
- Compare fish movement simulations with measured data from 2015.
- Run calibrated fish movement model for 9 separate notch scenarios and estimate relative entrainment rates.

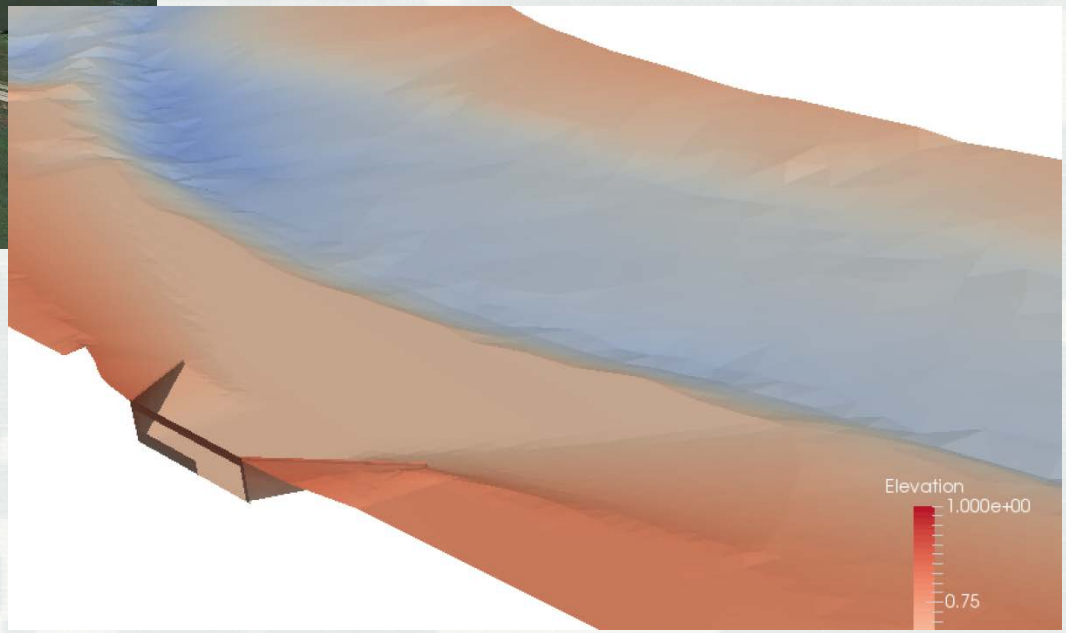


Fish Behavior Configurations



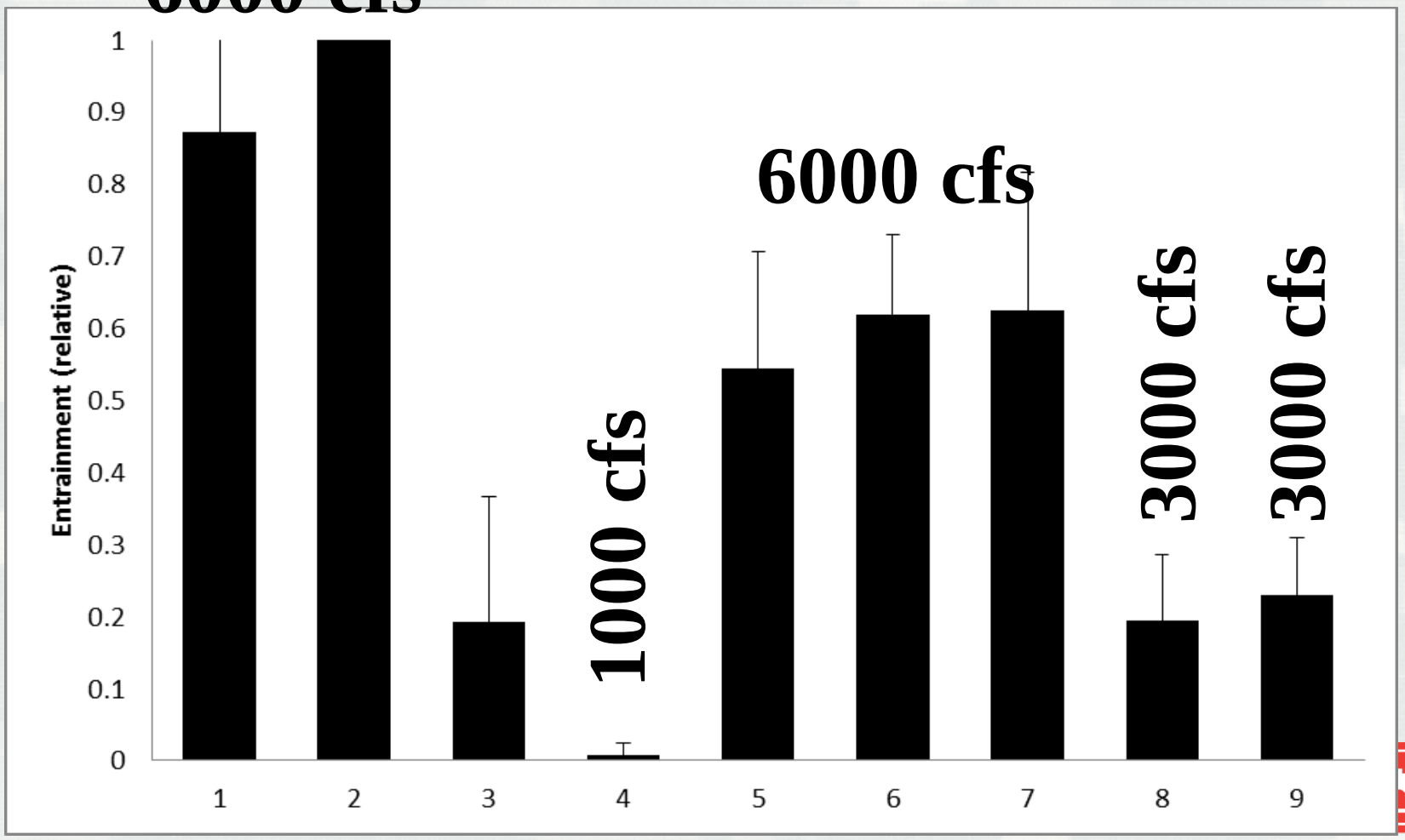
ID	Configuration	Invert (ft.)	Sides	Flow (cfs)
1	YB West 6K Shelf	14	10:1	6000
2	YB West 6K Intake	14	3:1	6000
3	YB West 3K Shelf	17	10:1	3000
4	YB West 1K Shelf	22	10:1	1000
5	YB Central 6K Shelf	14	10:1	6000
6	YB East 6K Shelf	14	10:1	6000
7	YB East 6K Intake	14	3:1	6000
8	YB East 3K Shelf	17	10:1	3000
9	YB West 3K Shelf & YB East 3K Shelf	17	10:1	3000 EA
	Notes:			
	Shelf configuration is diagonal orientation to river with larger footprint.			
	Intake configuration is perpindicular to river with smaller footprint.			

Central Shelf 6,000 cfs

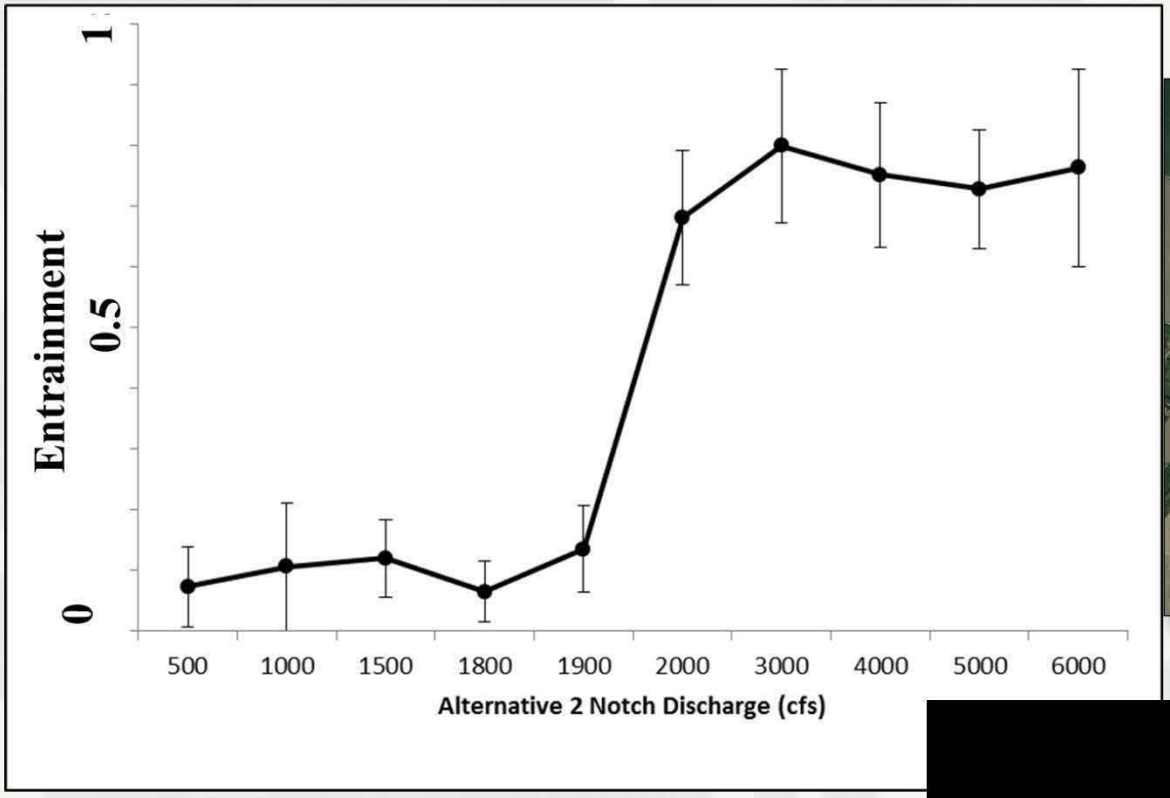


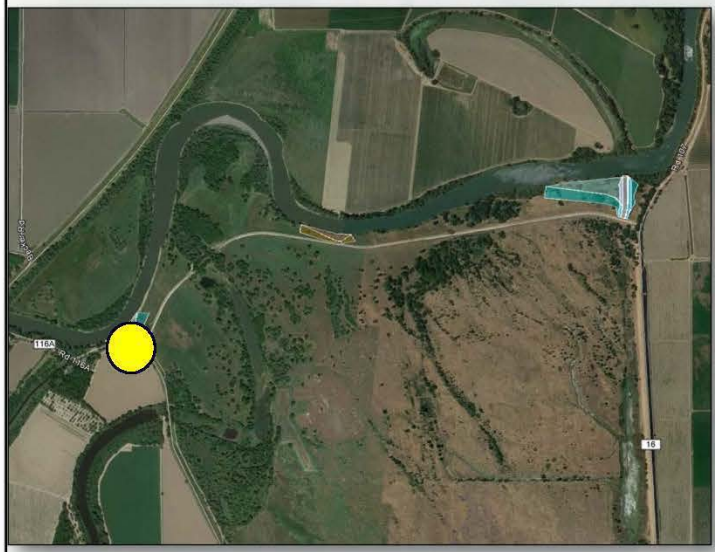
Play video

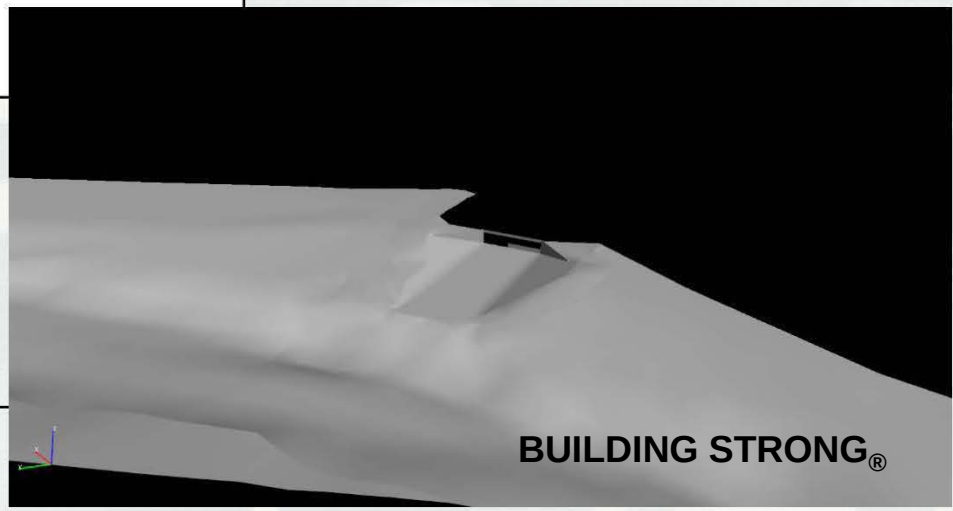
Entrainment estimates



ALT2 – West - 6K - Intake



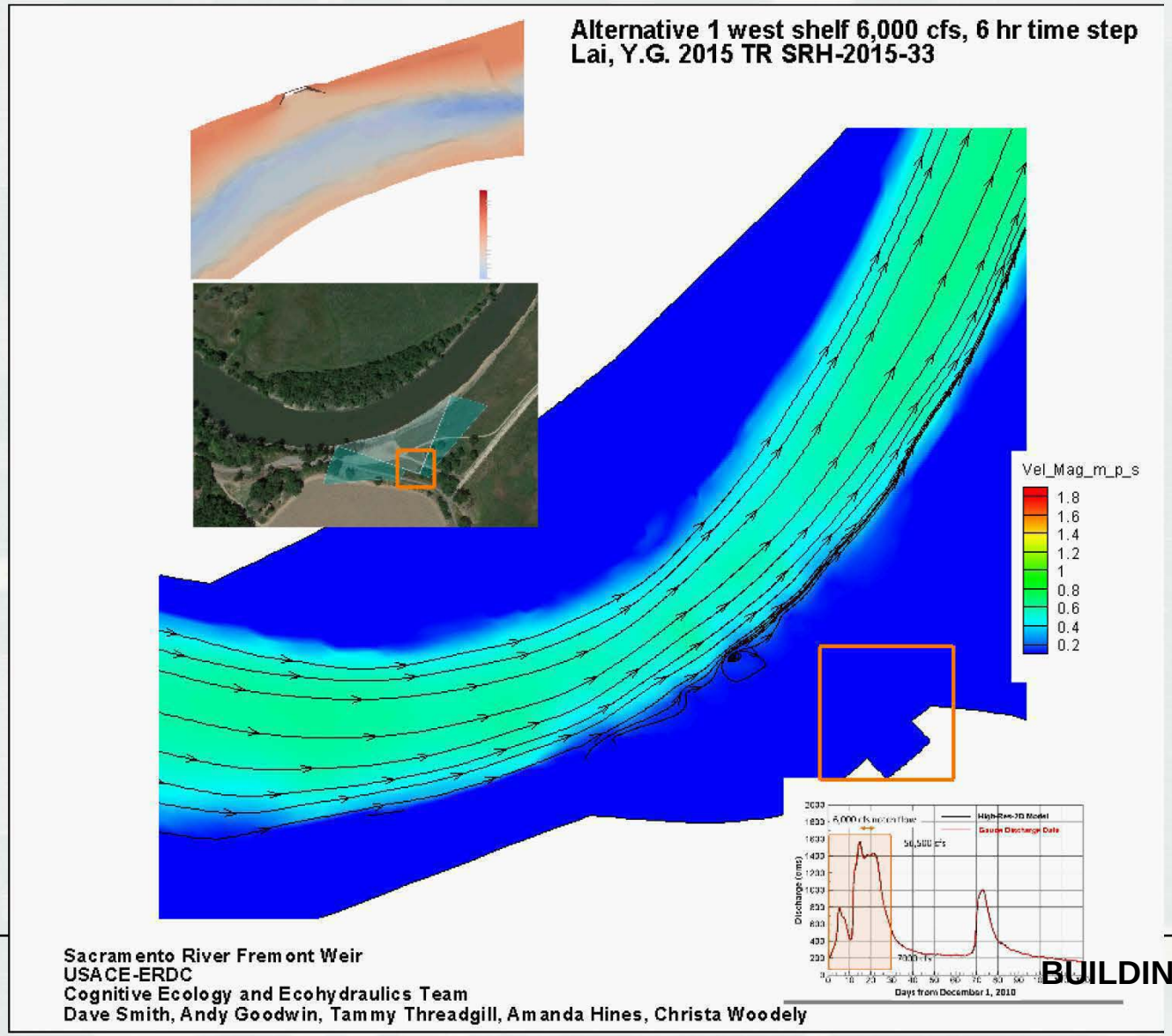




Differences between alternatives

- Entrainment estimates vary across alternatives – good for planning.
- Larger notch flows result in highest entrainment
- Outside bend locations have higher entrainment estimates than straight sections.
- Intake style notch have higher entrainment rates than shelves.
- Alternative 1 and 2 have highest entrainment rates.

Animation Alternative 5



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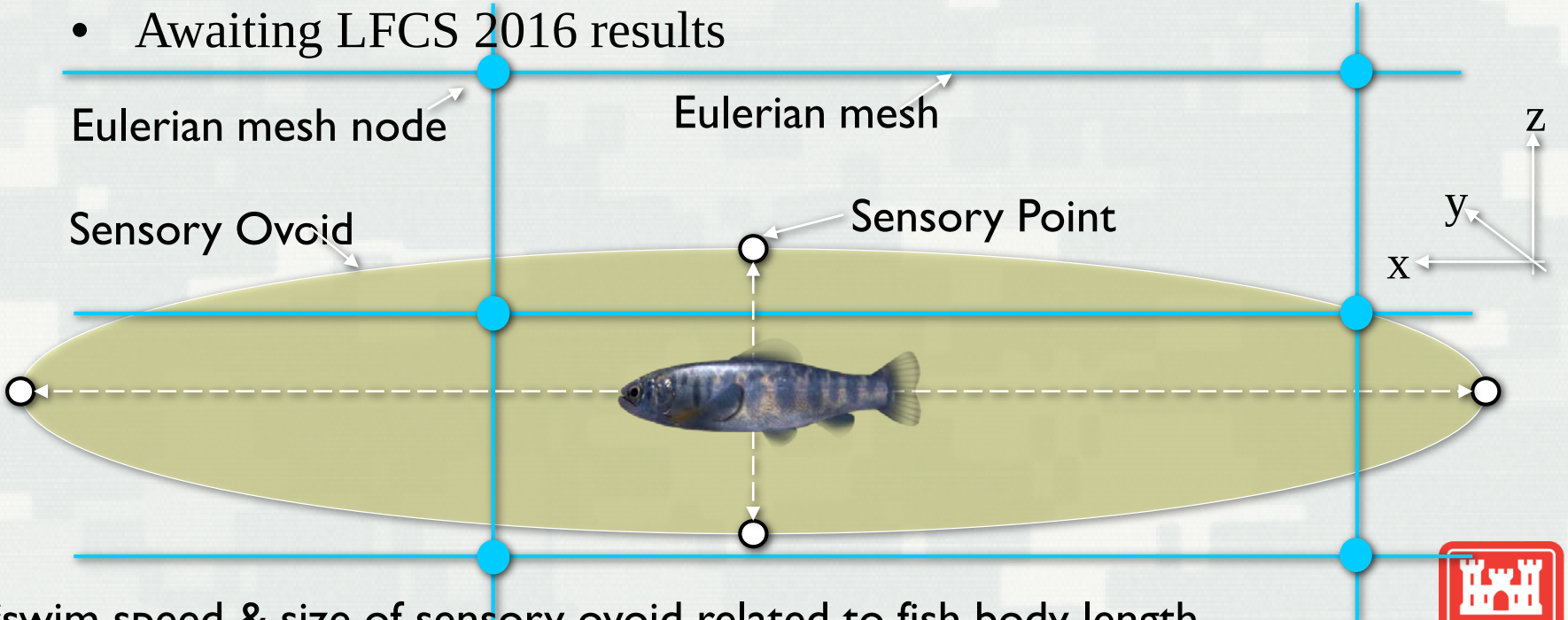
ELAM – Fish movement model

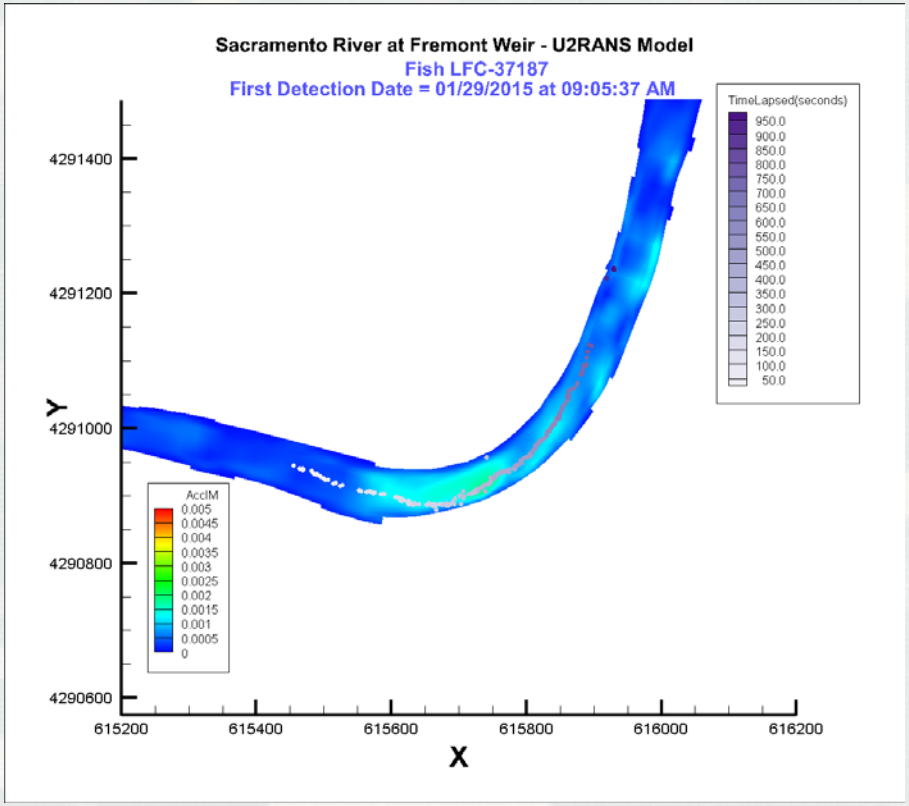
- Developed in Pacific Northwest using 47 data sets
- Extended to other rivers including Sacramento and Stanislaus
- Multiple behaviors – utilized only one behavior and two parameters
- Calibrated to Fremont Weir WRCS and LFCS for 2015
- Awaiting LFCS 2016 results



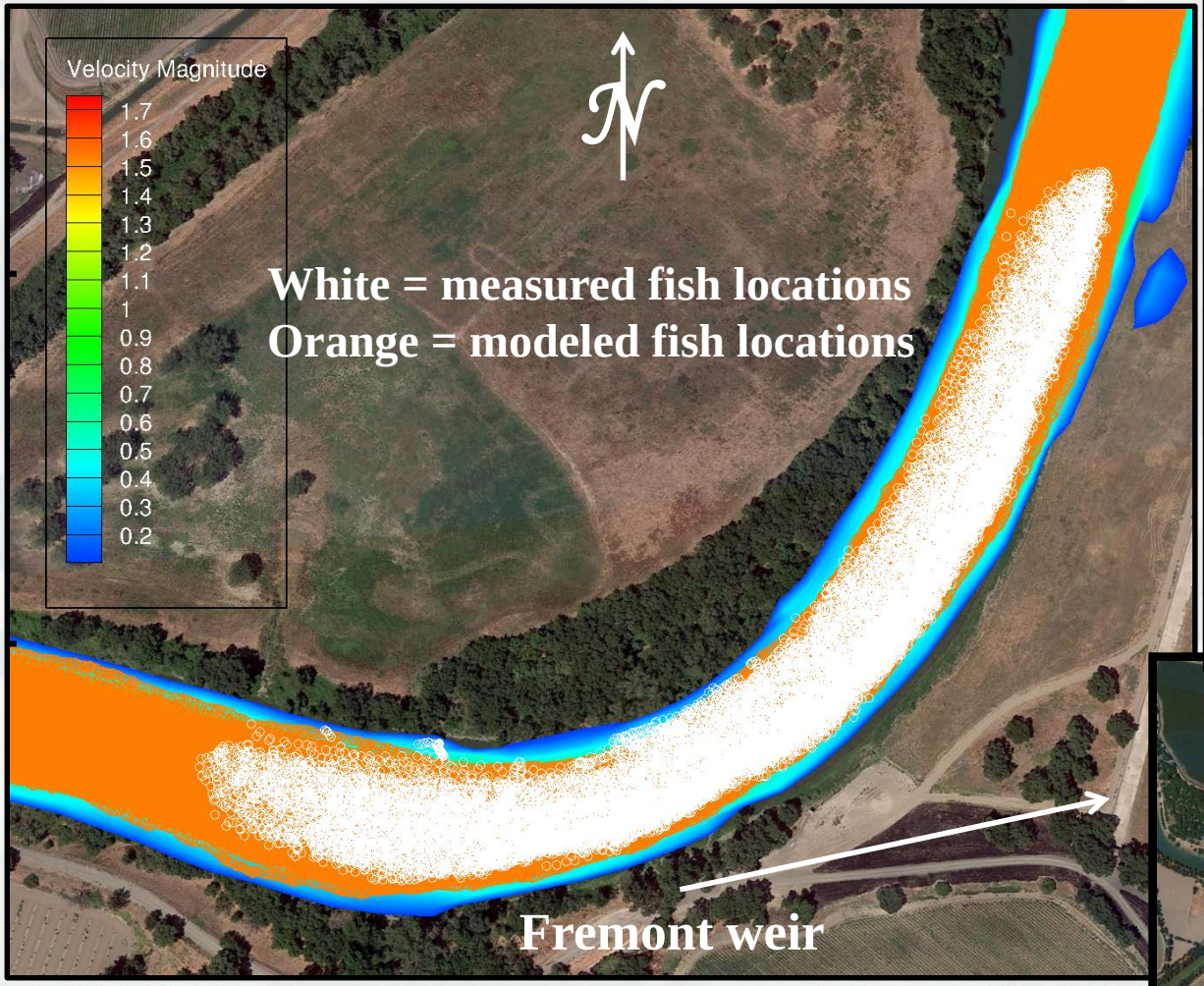
*swim speed & size of sensory ovoid related to fish body length

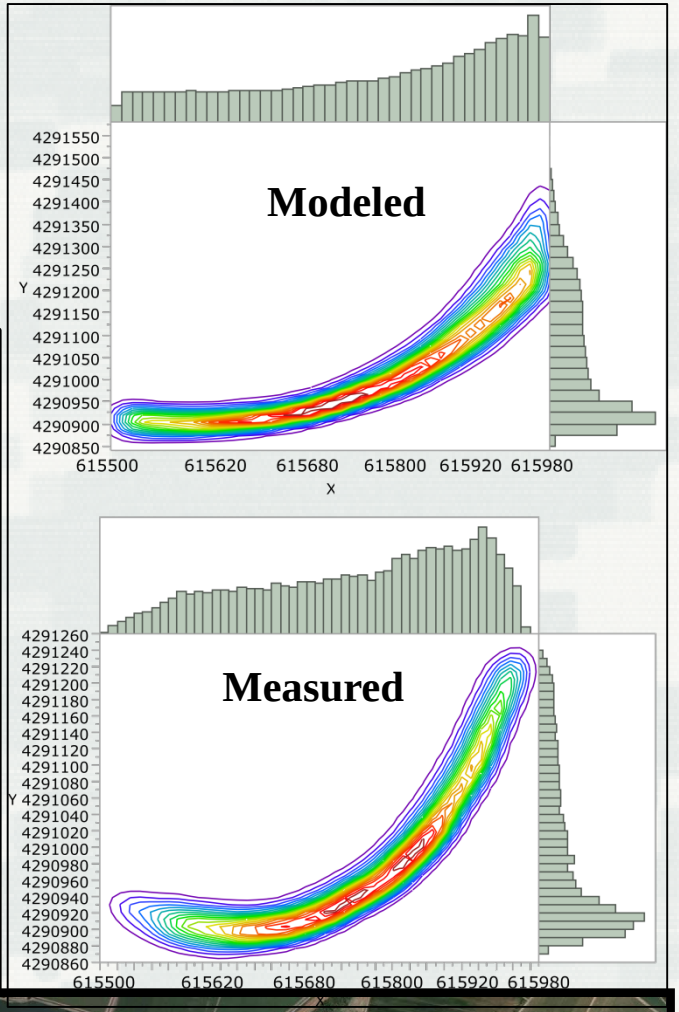
Measured Fish Movement (Steel et al. 2016)

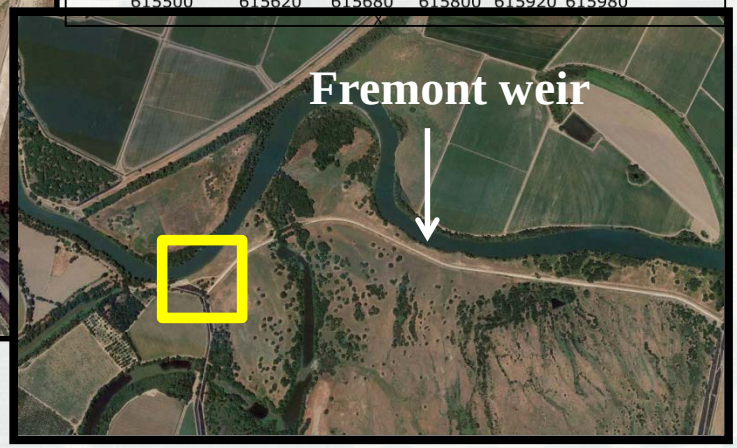
- 2d analysis of 250 winter and 250 late fall run Chinook at Fremont weir under low flow conditions
- Paired release
- No significant differences between winter and late fall run fish



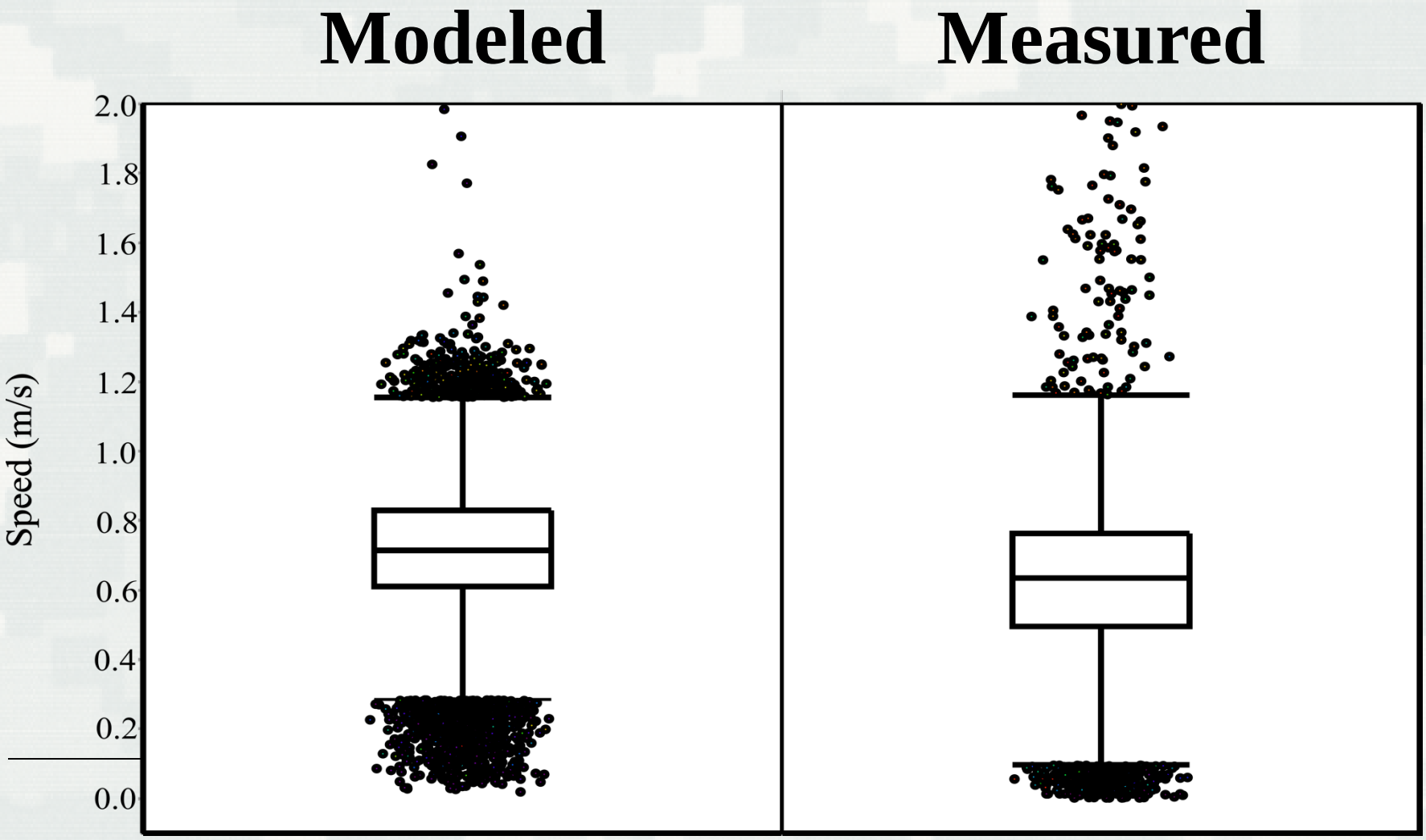
Spatial distribution







Observed and simulated movement speeds



Next steps

- Complete remaining 2D model runs for alternatives
- Assist with design process and select preferred alternative for further design
- Construct and evaluate – assess accuracy

Thank you