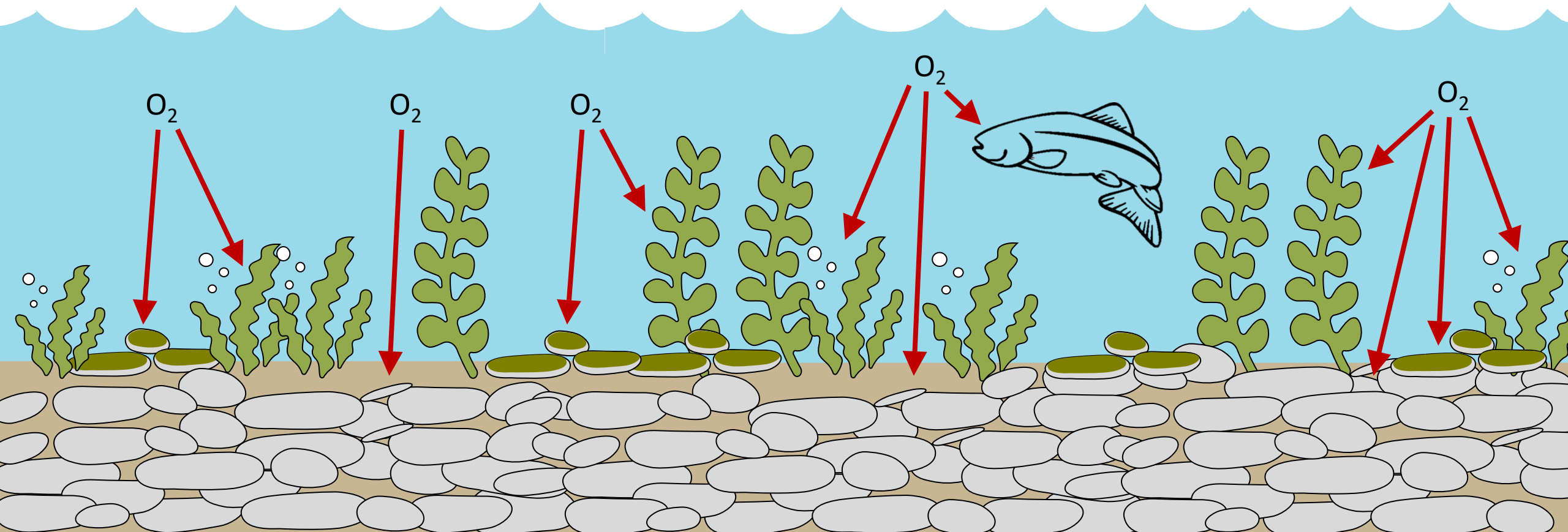
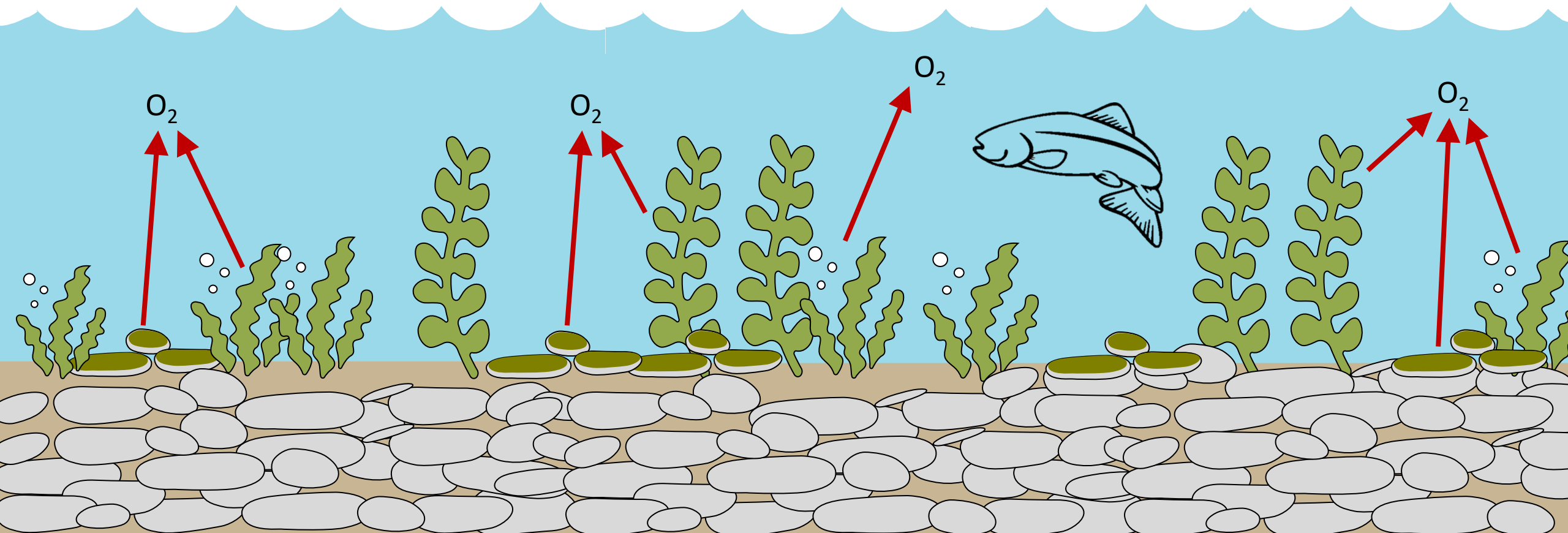
Can aquatic plant removal increase nighttime dissolved oxygen concentration in a lowland river?

Aaron C. Pelly and Sarah S. Roley
School of the Environment | Washington State University

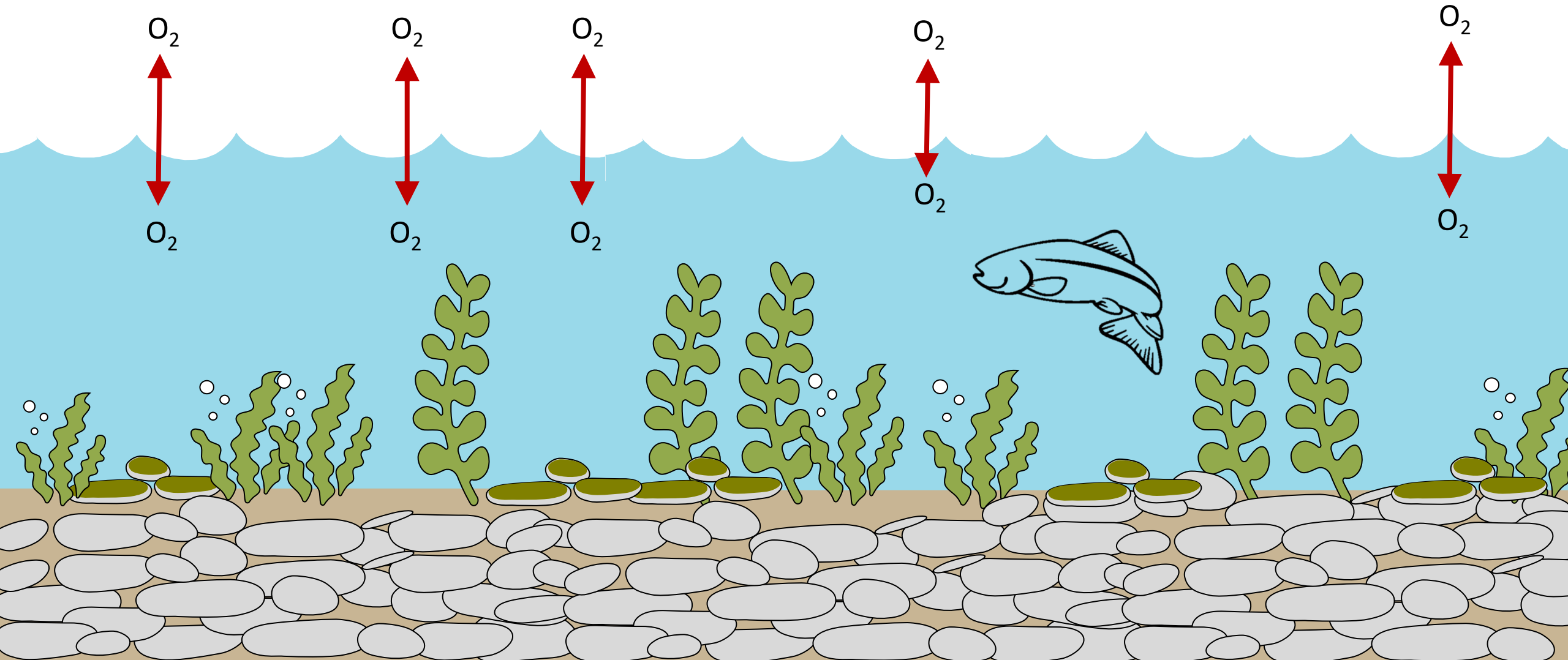
Controls on oxygen: Ecosystem Respiration



Controls on oxygen: Photosynthesis

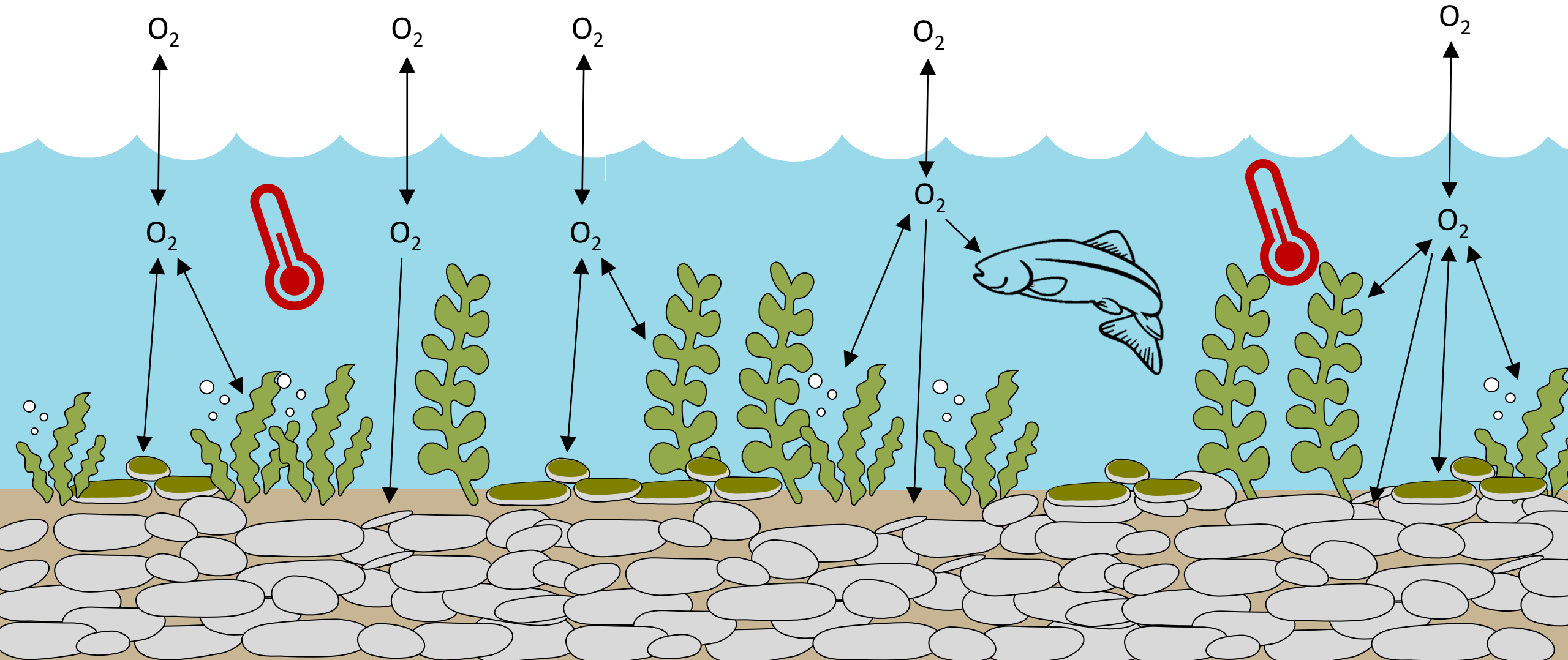


Controls on oxygen: Gas exchange

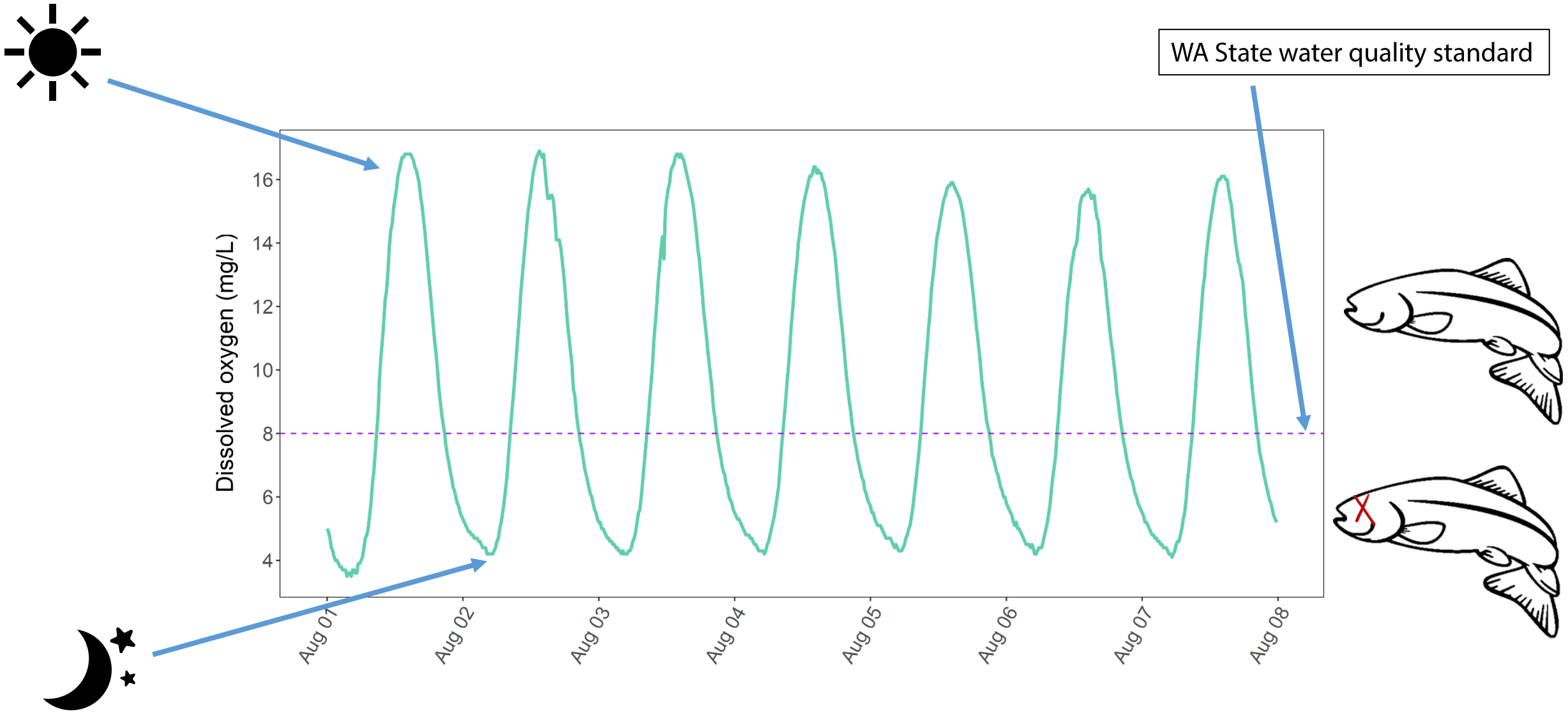


Controls on oxygen: Temperature

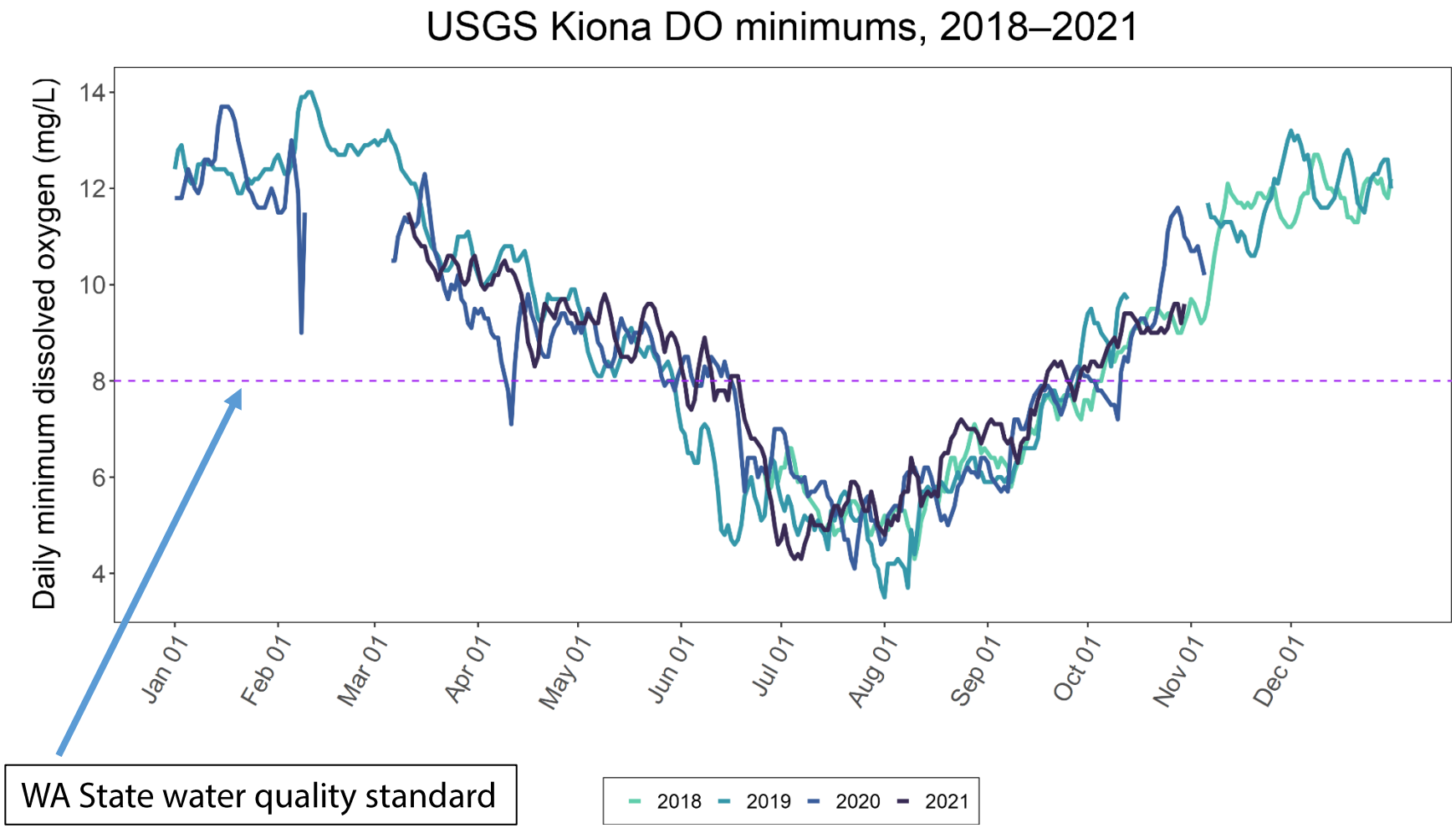
(Temperature affects metabolic rates & how much oxygen the water can hold)



Aquatic plants ↓ nighttime oxygen



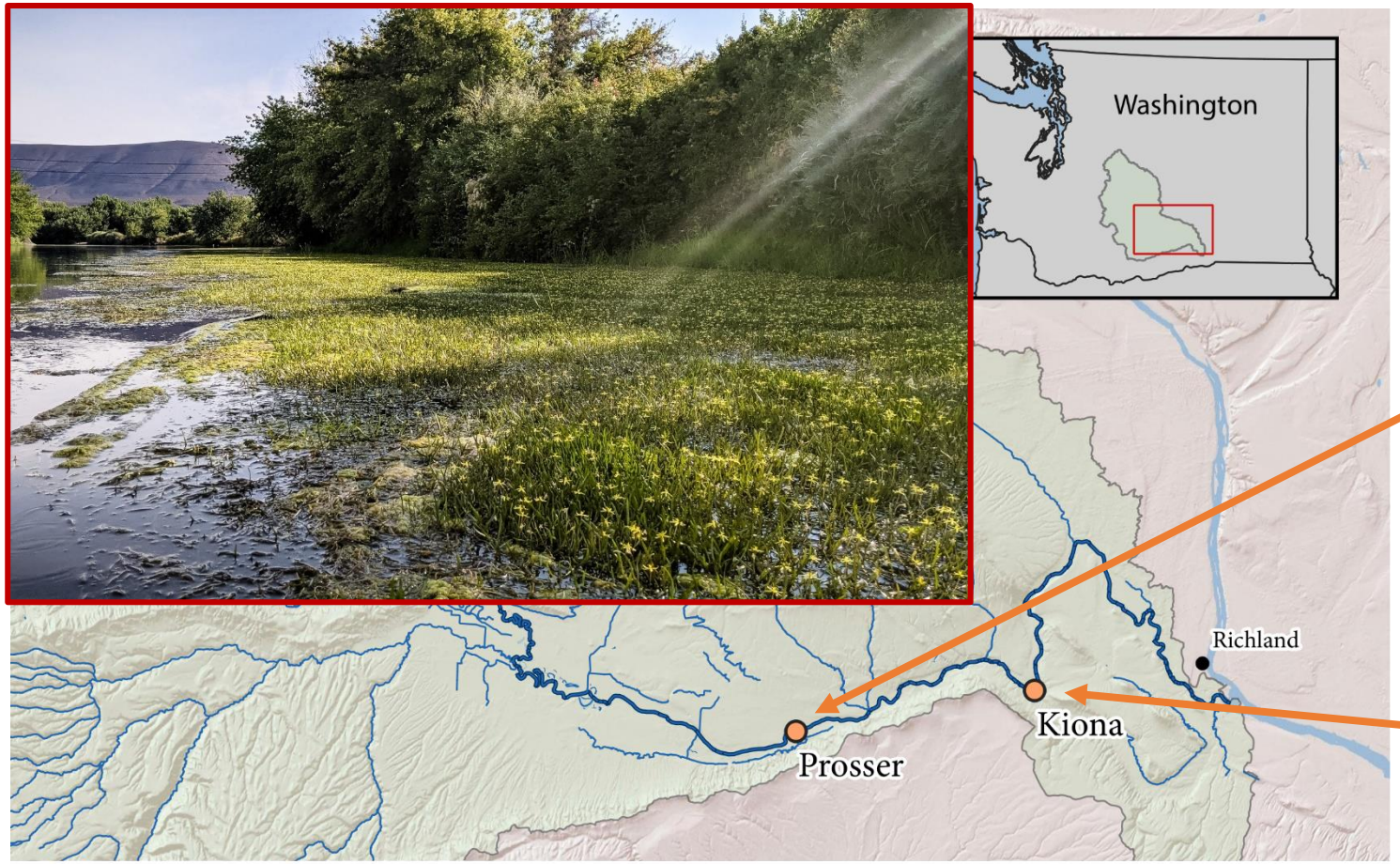
Nighttime oxygen in the lower Yakima River is a barrier to salmonid migration



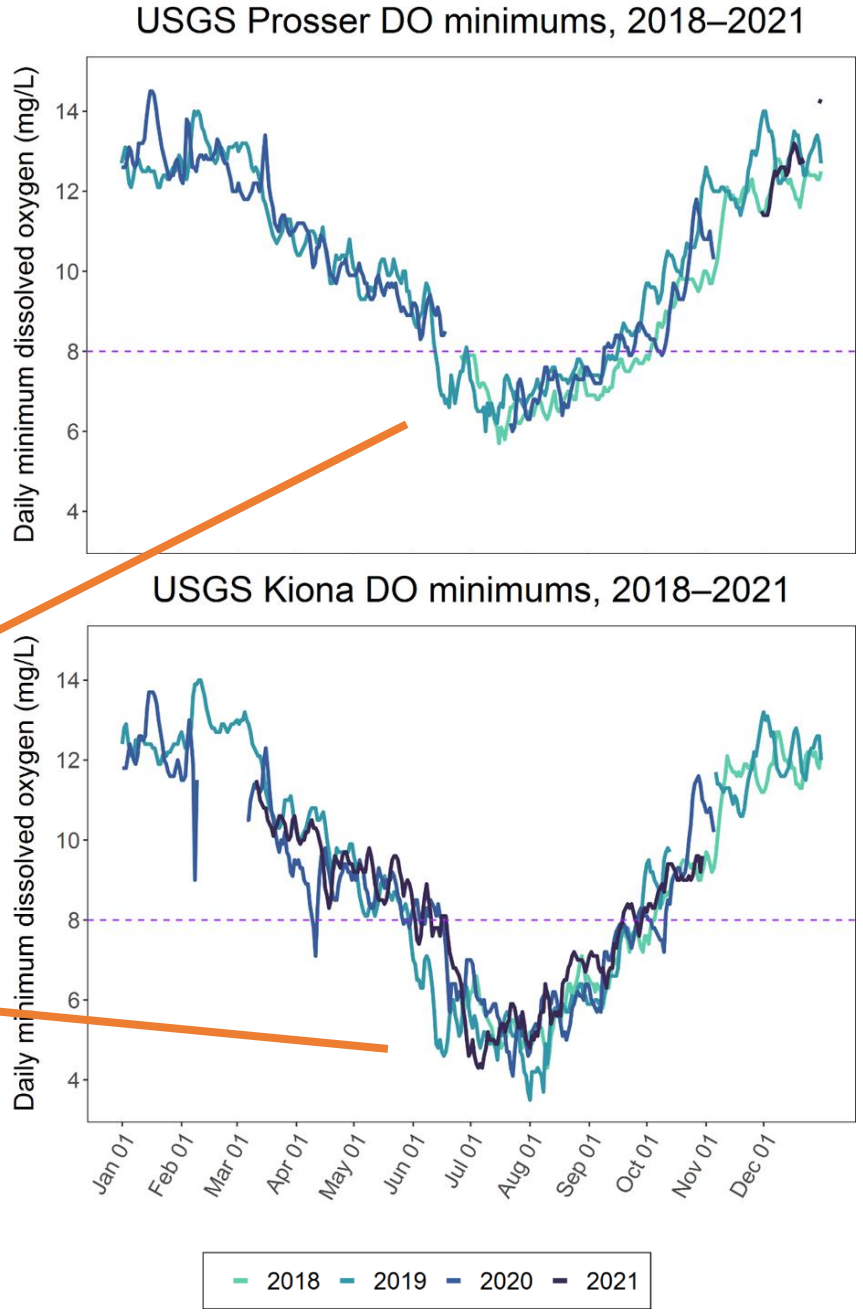
Data: USGS NWIS

Ryan Hagerty/USFWS

Water stargrass (*Heteranthera dubia*) is the likely culprit

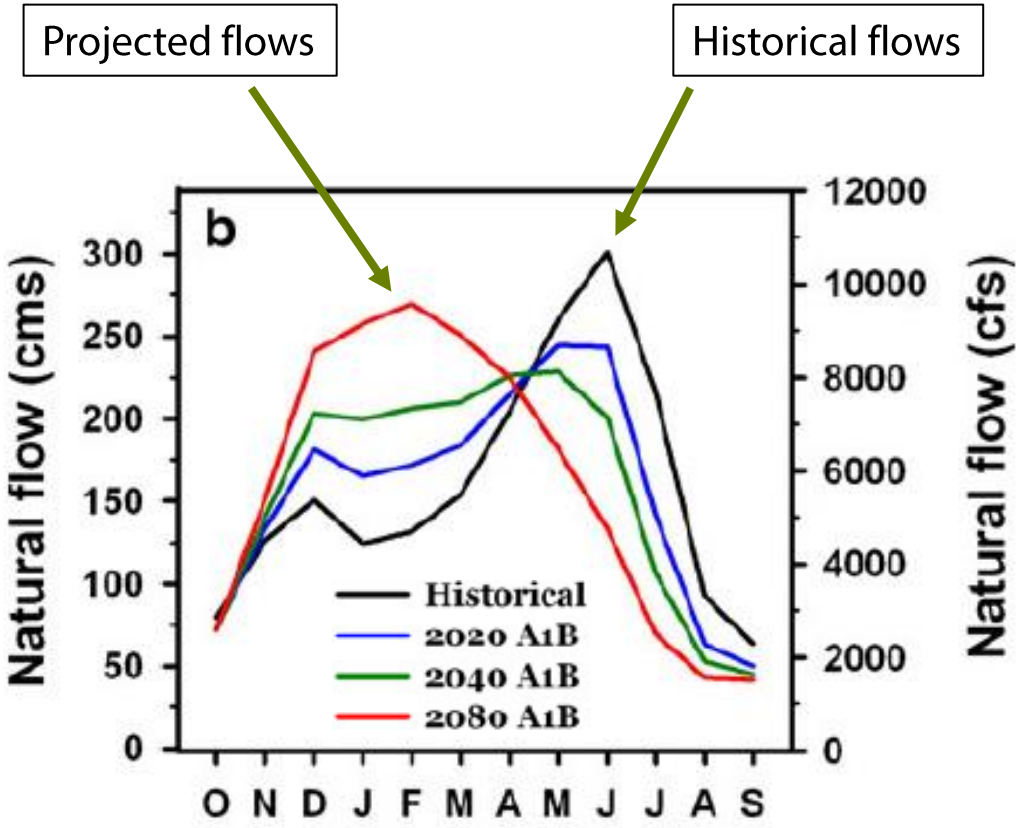


Data sources: USGS, WSDOT, Esri

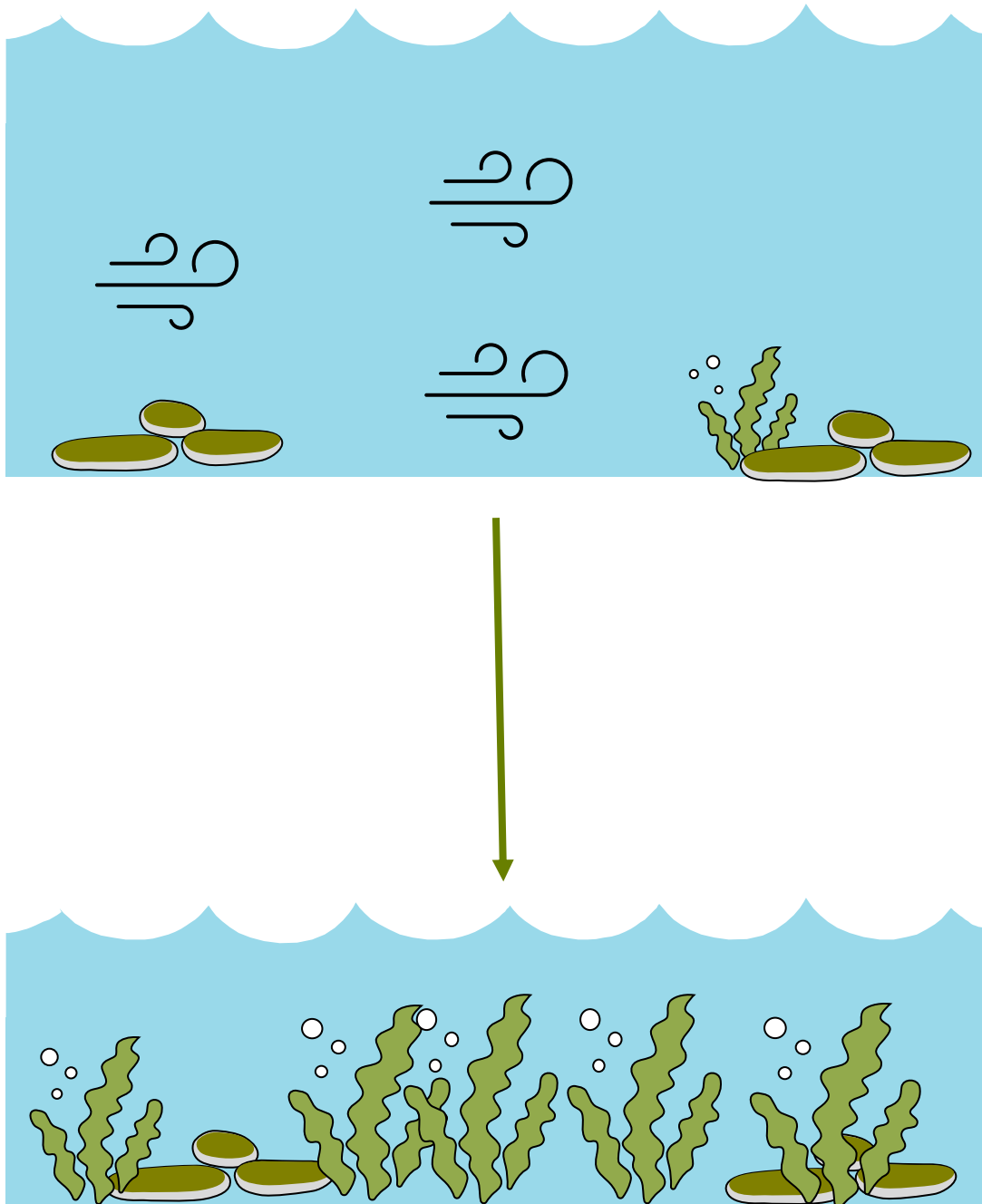


Data: USGS NWIS

Lower flows facilitate water stargrass proliferation



Elsner et al. 2010. Implications of 21st century climate change for the hydrology of Washington State. Climatic Change.

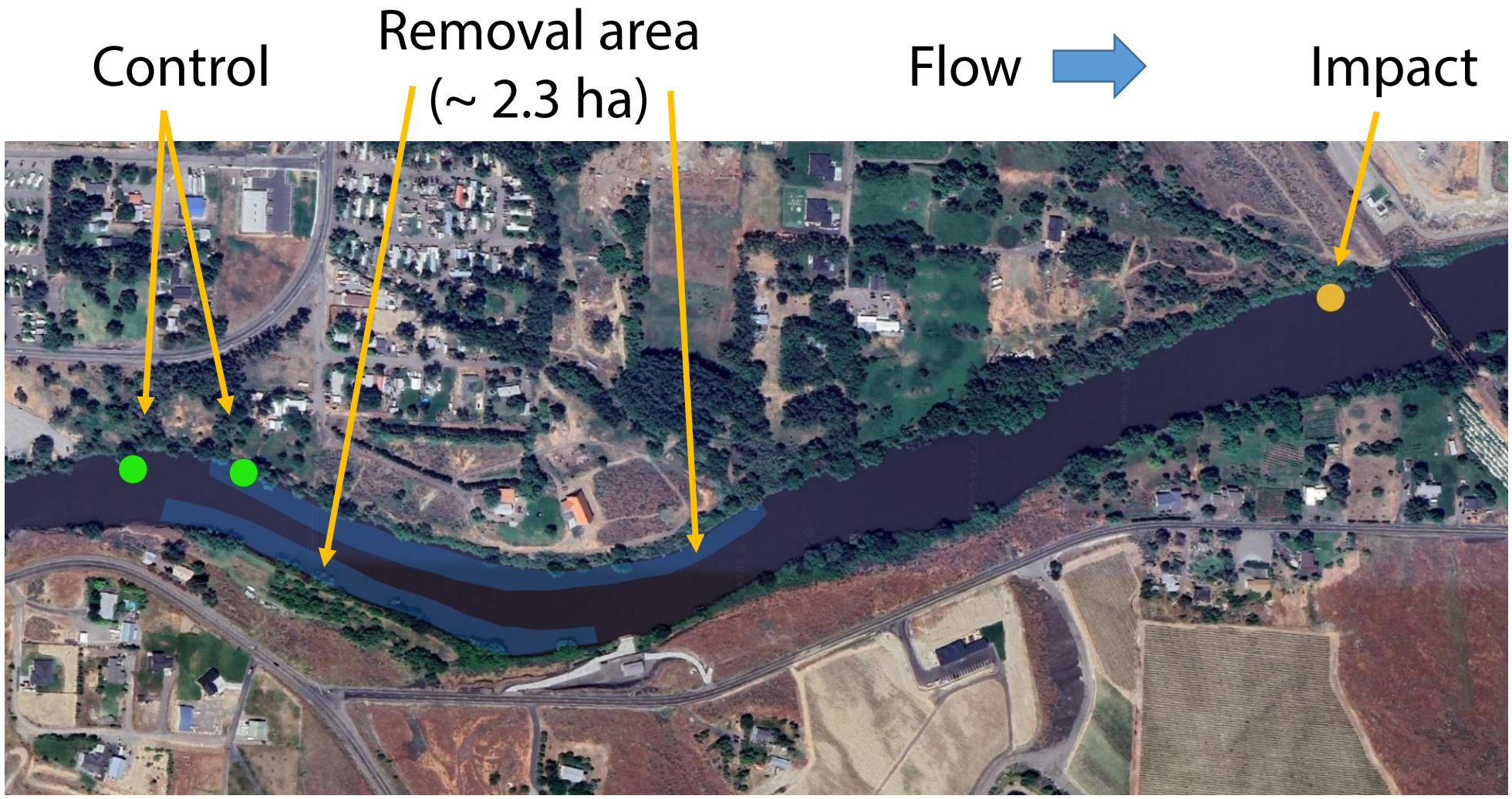


Is plant removal an effective strategy to improve oxygen concentrations?

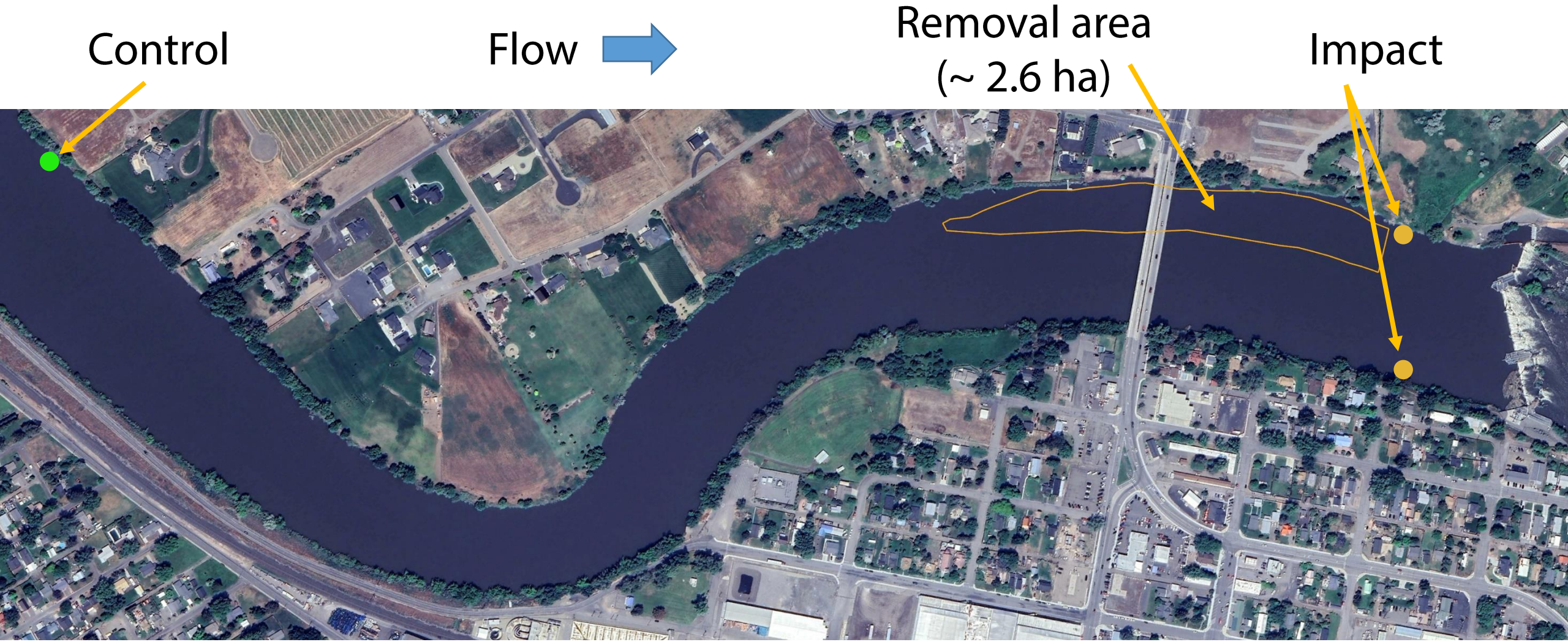
Two plant removal methods

- Mechanical (aquatic plant harvester)
- Flow-driven

Free-flowing reach: Kiona

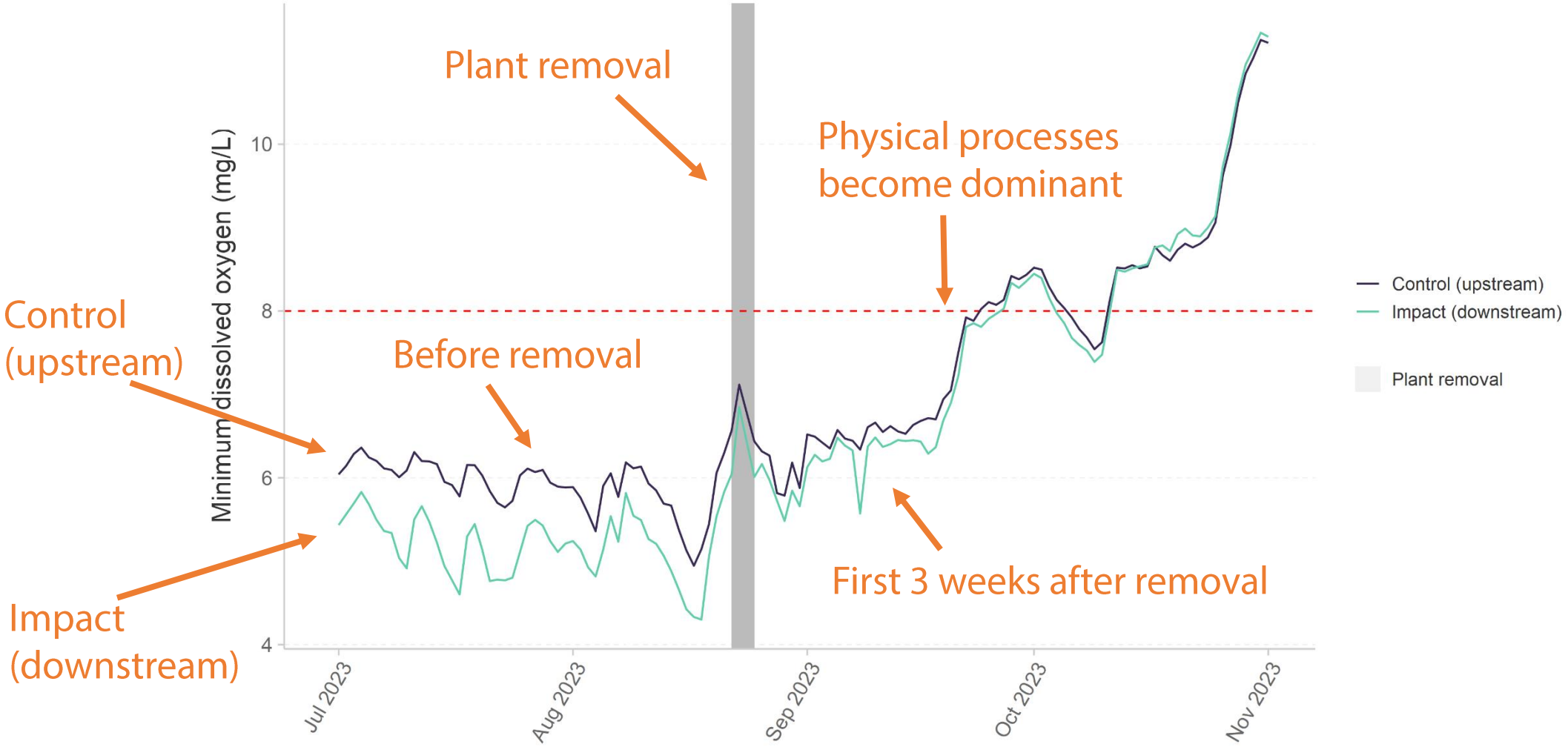


Dammed reach: Prosser



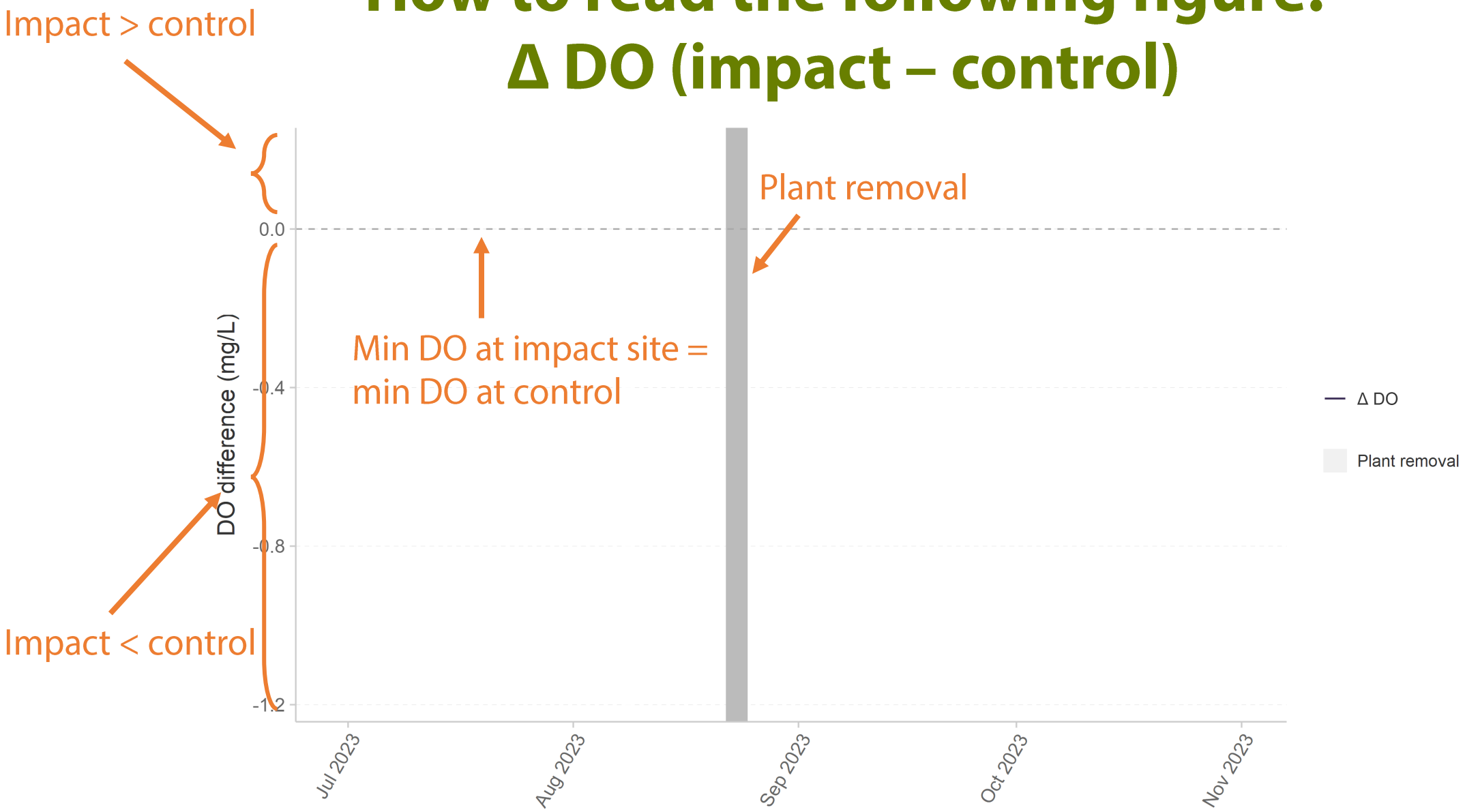
Data source: Google

Free-flowing reach (Kiona): Nighttime minimum DO

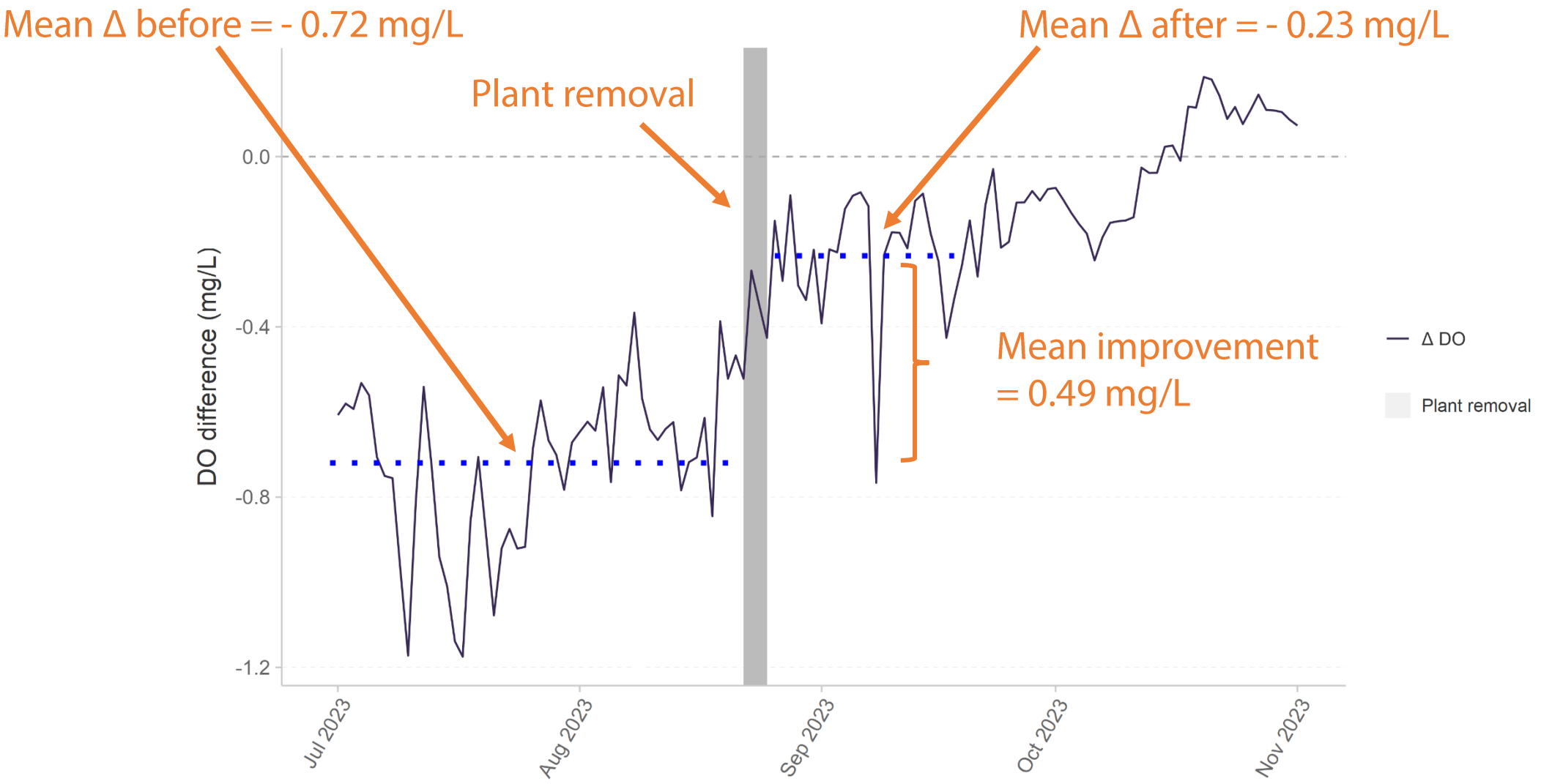


These data are preliminary and are subject to revision

How to read the following figure: Δ DO (impact – control)



Δ DO (impact – control):
Nighttime minimum DO improved by ~ 0.5 mg/L



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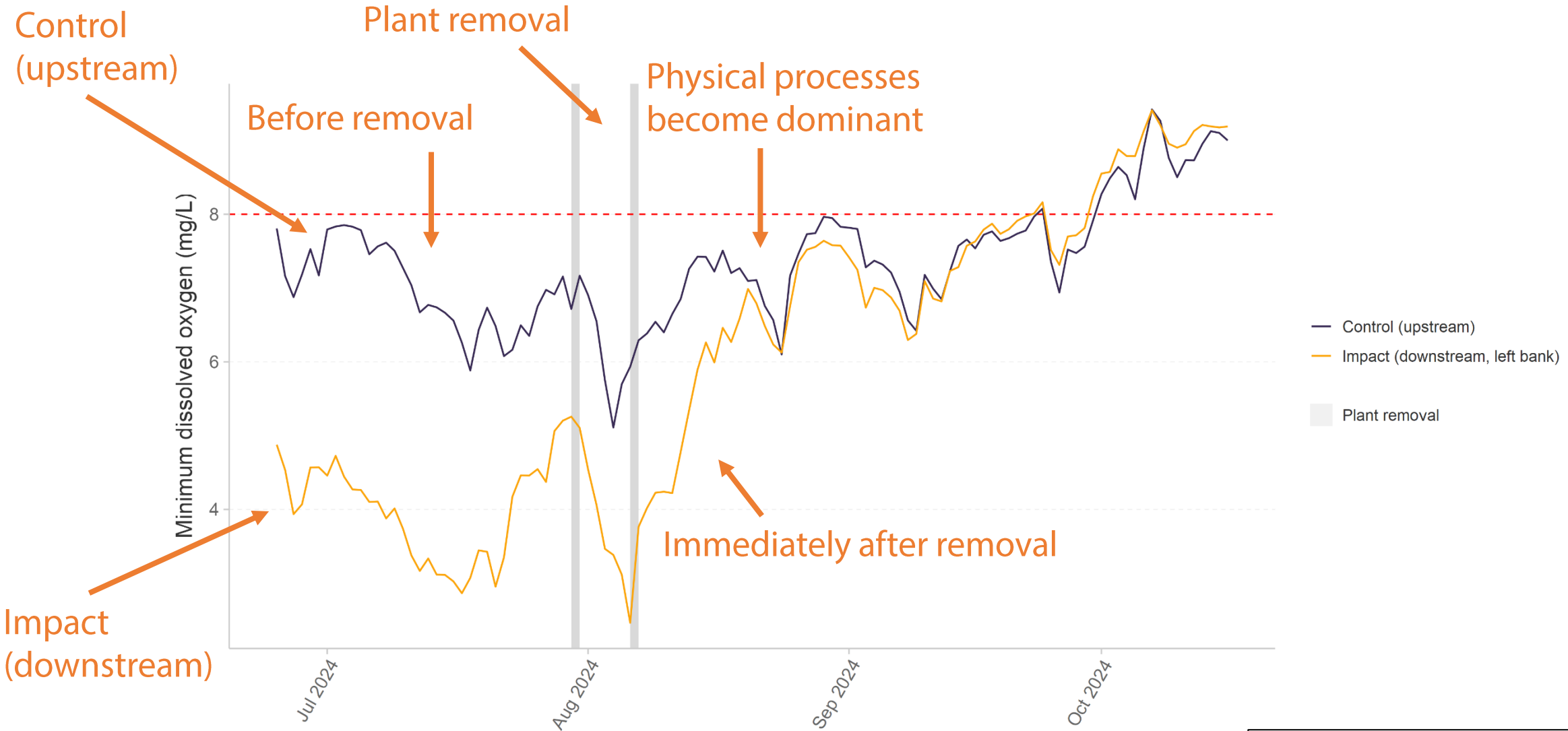
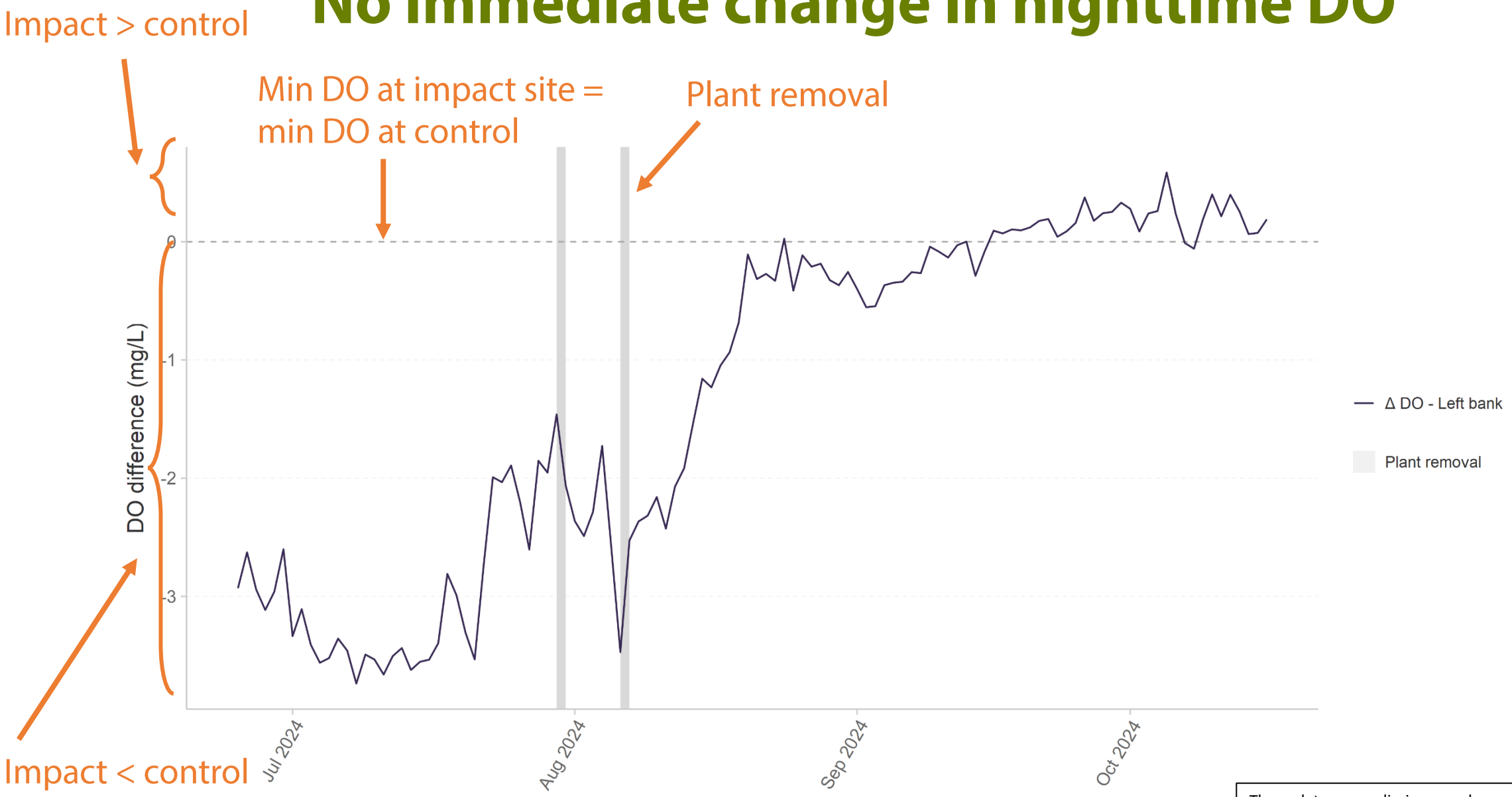
Dammed reach (Prosser): Nighttime minimum DO



These data are preliminary and are subject to revision

Δ DO (impact – control): No immediate change in nighttime DO

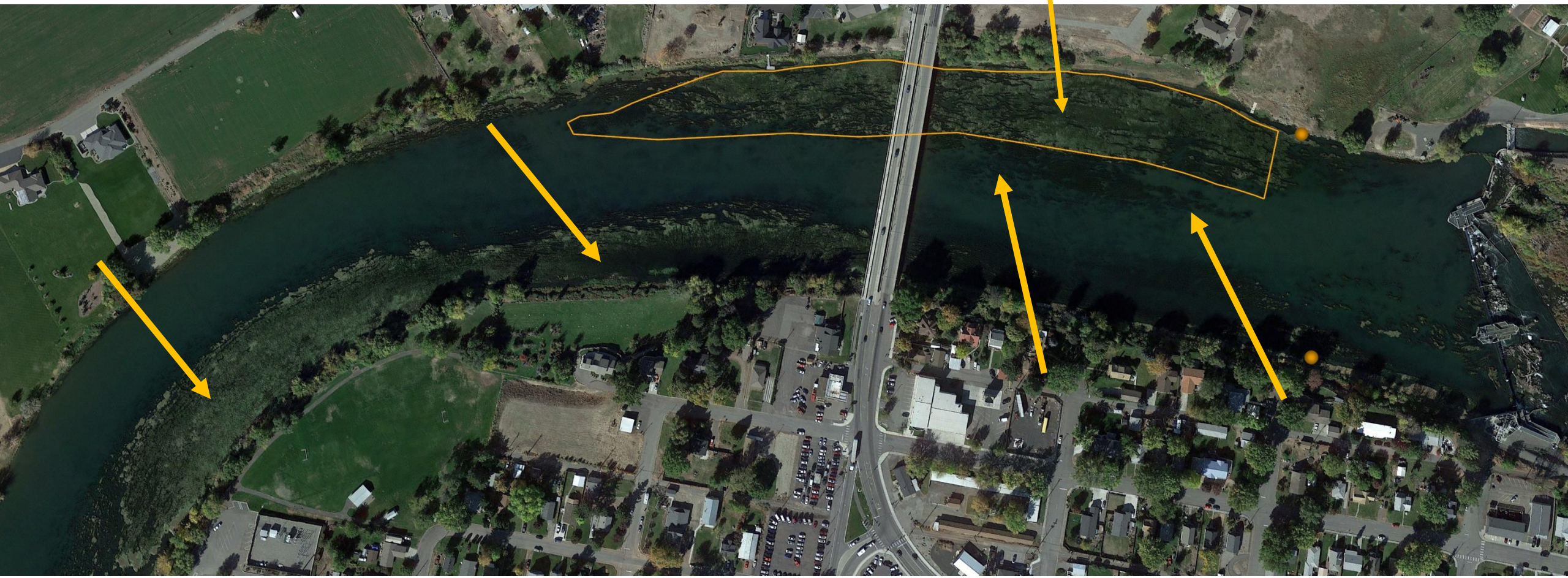


These data are preliminary and are subject to revision

Plants removed represented a relatively small proportion of total plant abundance

Flow

Removal area
(~ 2.6 ha)

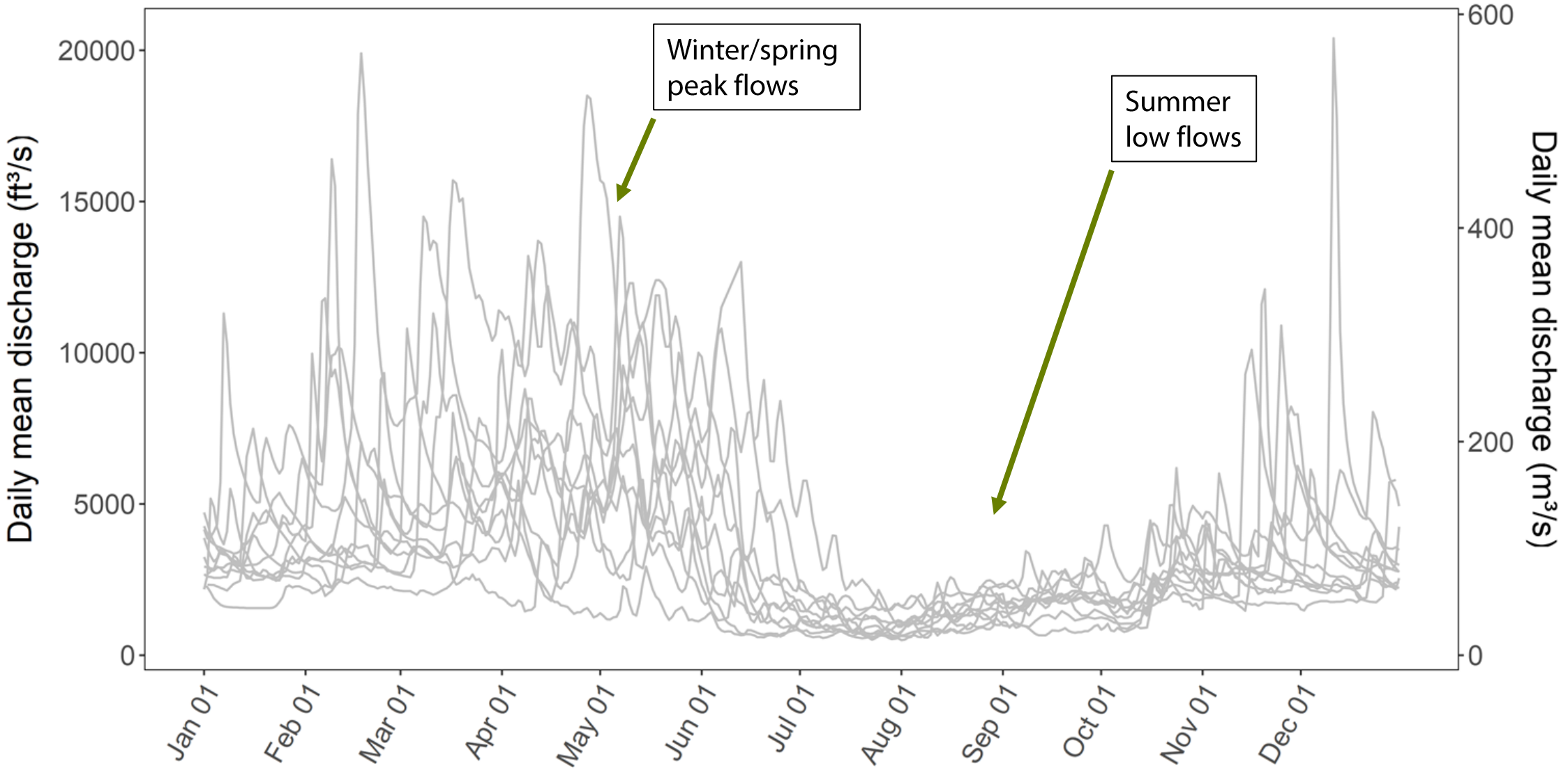


Data source: Google

Sometimes mechanical removal works

- Free-flowing reach: DO improved by ~ 0.5 mg/L
- Dammed reach: No effect

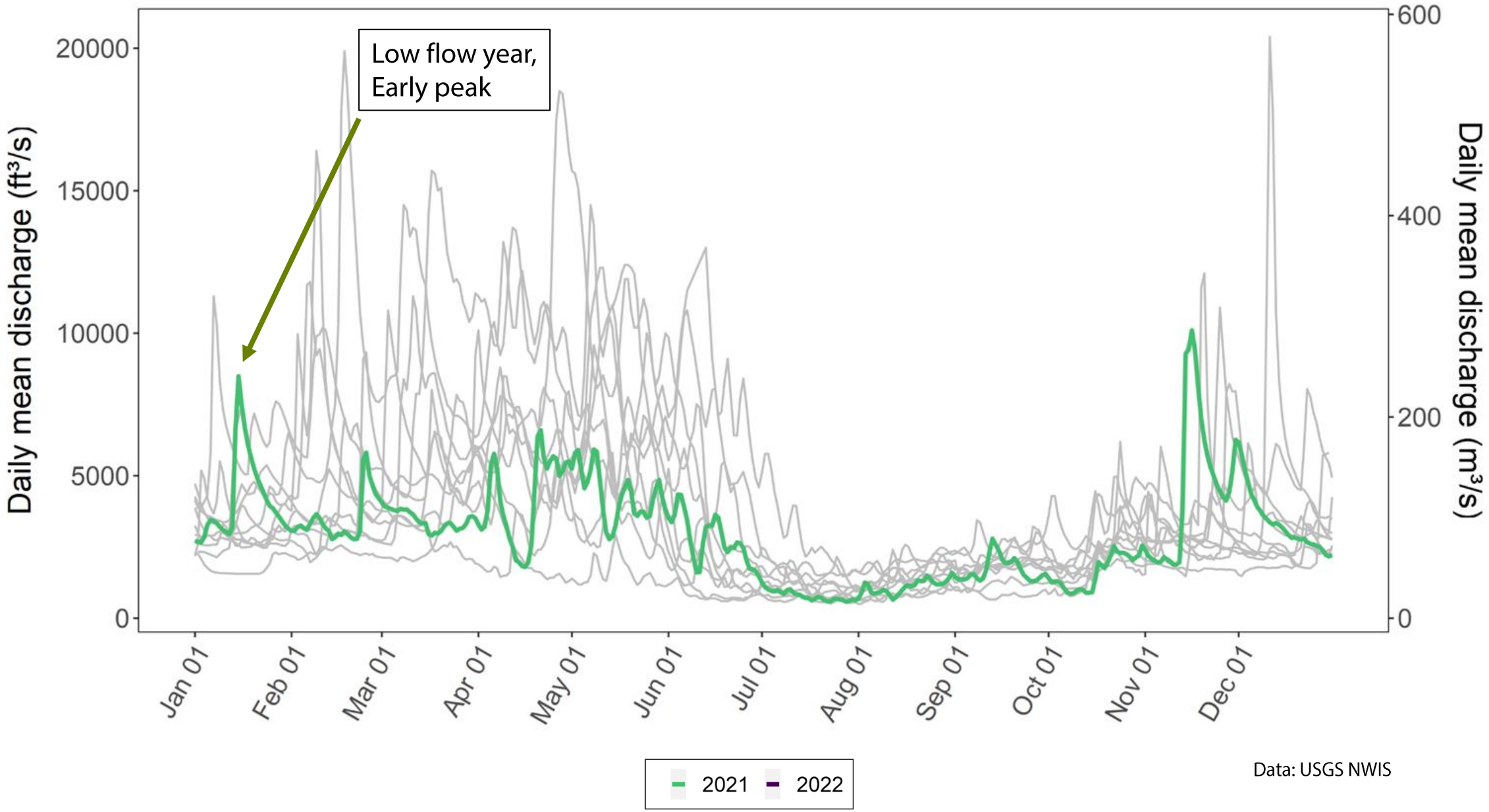
Flow-driven removal: Kiona



Hydrograph: 2012–2022

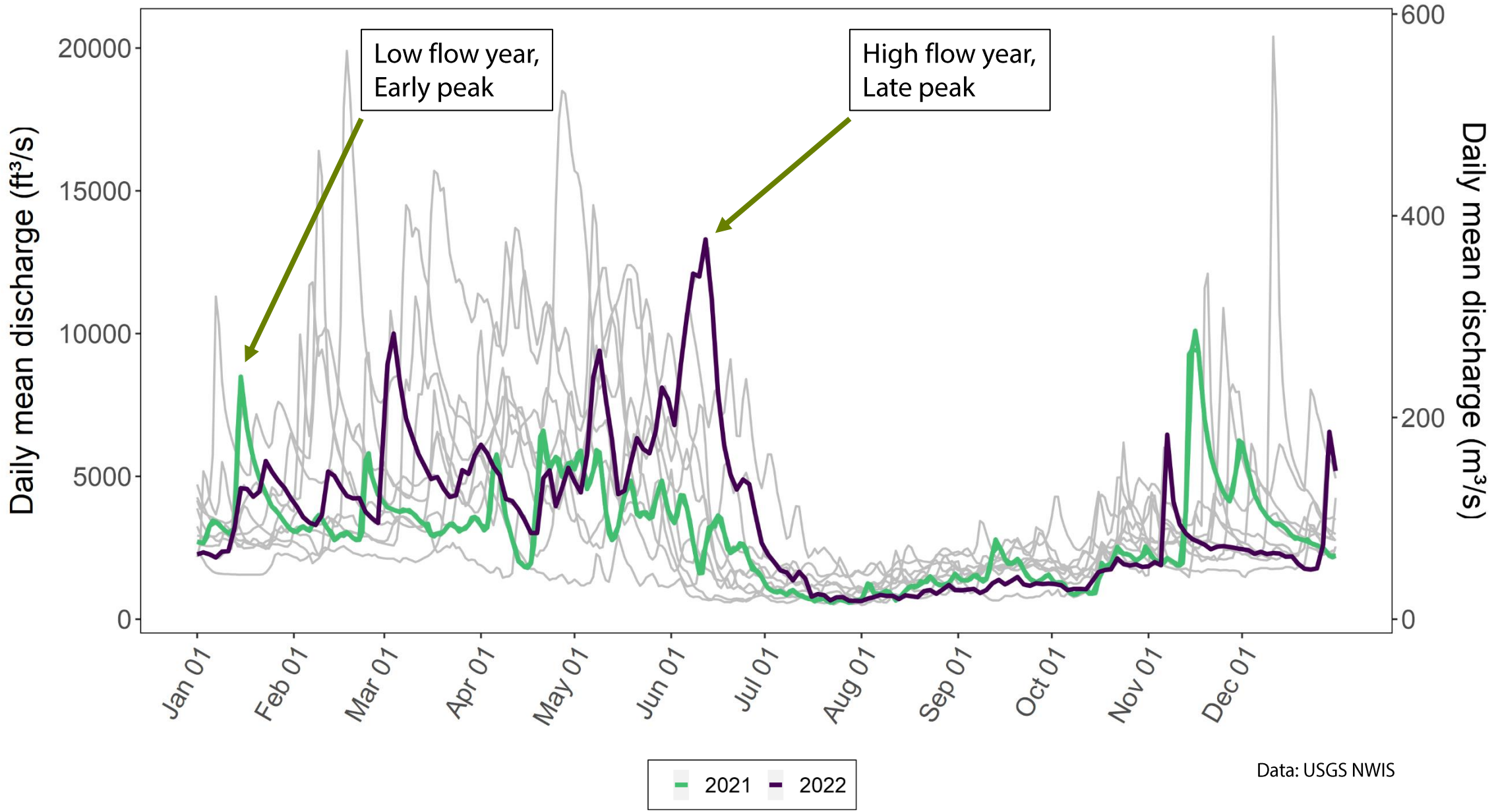
Data: USGS NWIS

Flow-driven removal: Kiona



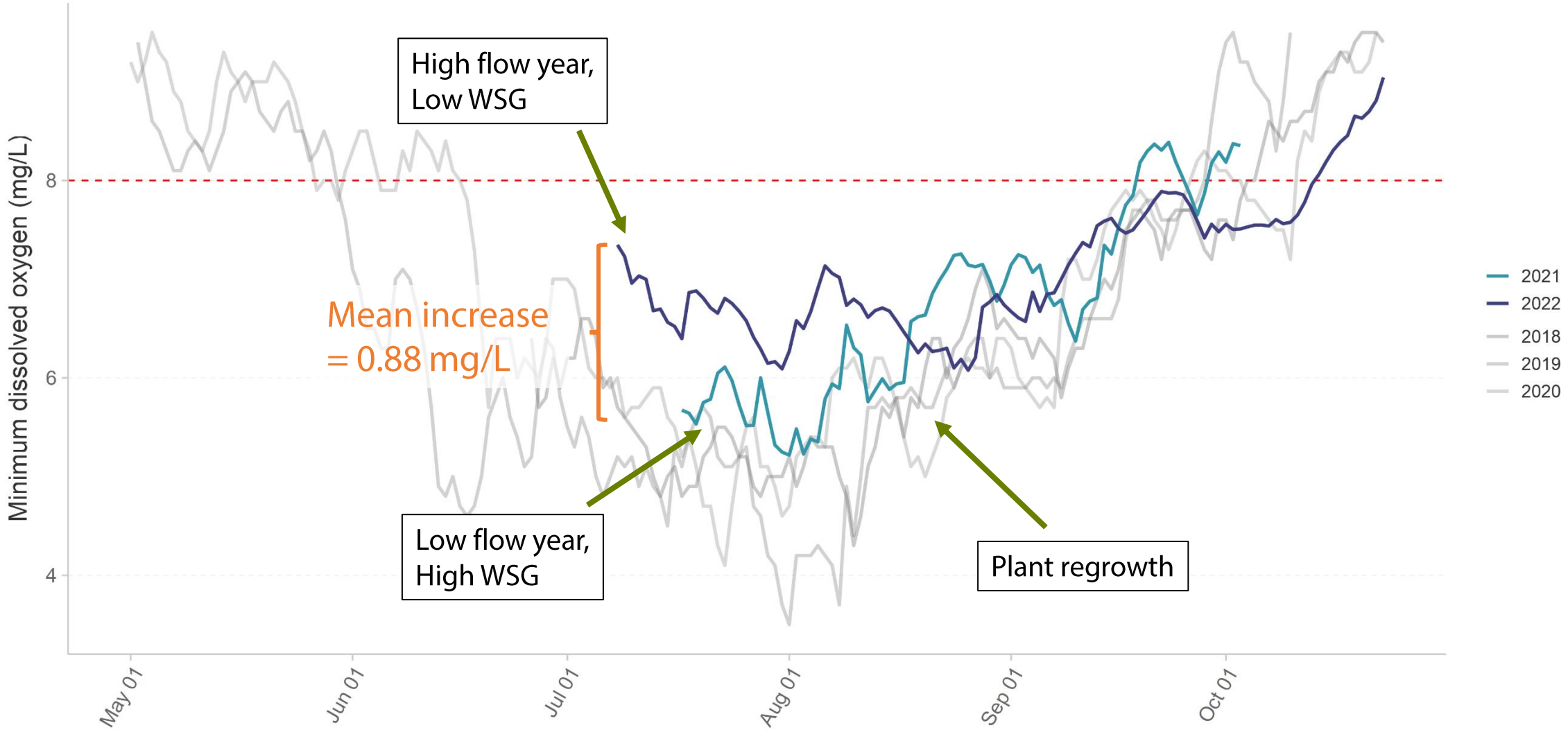
Data: USGS NWIS

Flow-driven removal: Kiona



Data: USGS NWIS

Nighttime DO was highest in the high flow year



These data are preliminary and are subject to revision

Conclusions

WSG dramatically affects DO

Mechanical plant removal can improve low DO

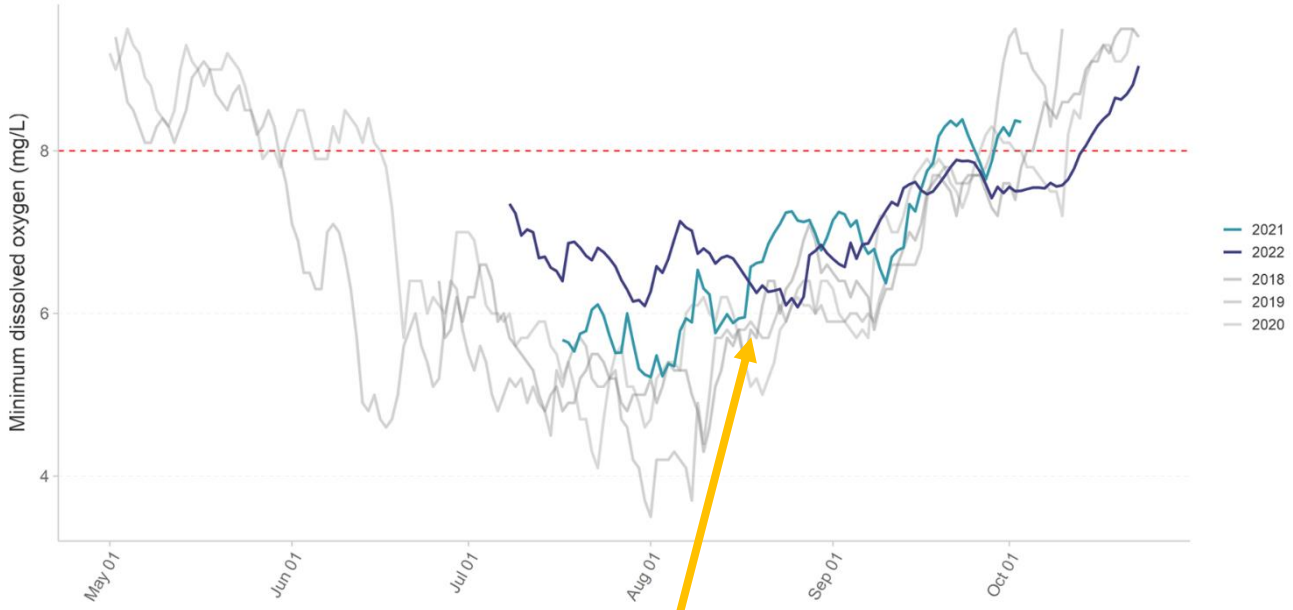
- If a sufficient proportion of plants removed

Flow-driven removal effective across a broader area

- Until plants regrow

Challenging problem

- Likely need multiple, coordinated strategies
- (e.g., flow-driven removal followed by mechanical removal when plants regrow)



Tom Sexton/Benton Conservation District

Contact: aaron.pelly@wsu.edu

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