Applying Natural and Social Science to Co-produce a Hypoxia Forecast with Public Water Systems

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Outline

Introduction

Methods

- Research Coproduction
- Focus Groups

Results

- How are PWS impacted by hypoxia?
- Will a forecast be helpful?

Conclusion

Coproduction Research Approach

Involve intended users of the forecast in research design, implementation, and product dissemination to increase forecast usefulness and usability

Coproduction Approach

- Management Transition Advisory Group (MTAG)
- Annual Stakeholder Meetings
- Focus Group Study

Methods: Focus Group Study

Research Questions:

1. How are PWS who draw water from Central Lake Erie impacted by hypoxia?
2. What are their hypoxia forecast information needs?

Study Metrics:

- **9** Focus Groups
- **10** Treatment Plants
- **32** Participants
- **>12 hrs** interview data

Results of Focus Groups

Research Question 1: How are PWS impacted by hypoxia in Lake Erie?

Results

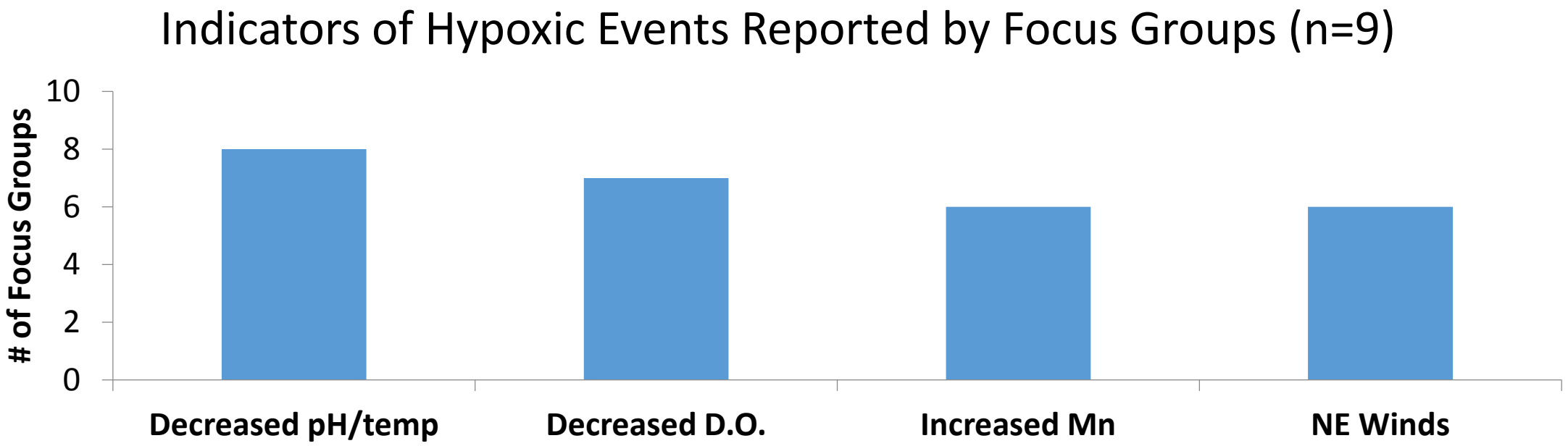
1. Occurrence of hypoxic water intrusion at water treatment plants

2. Response of PWS to hypoxic water

Occurrences of hypoxia at water plants

Knowledge/definitions of hypoxia differed among focus groups

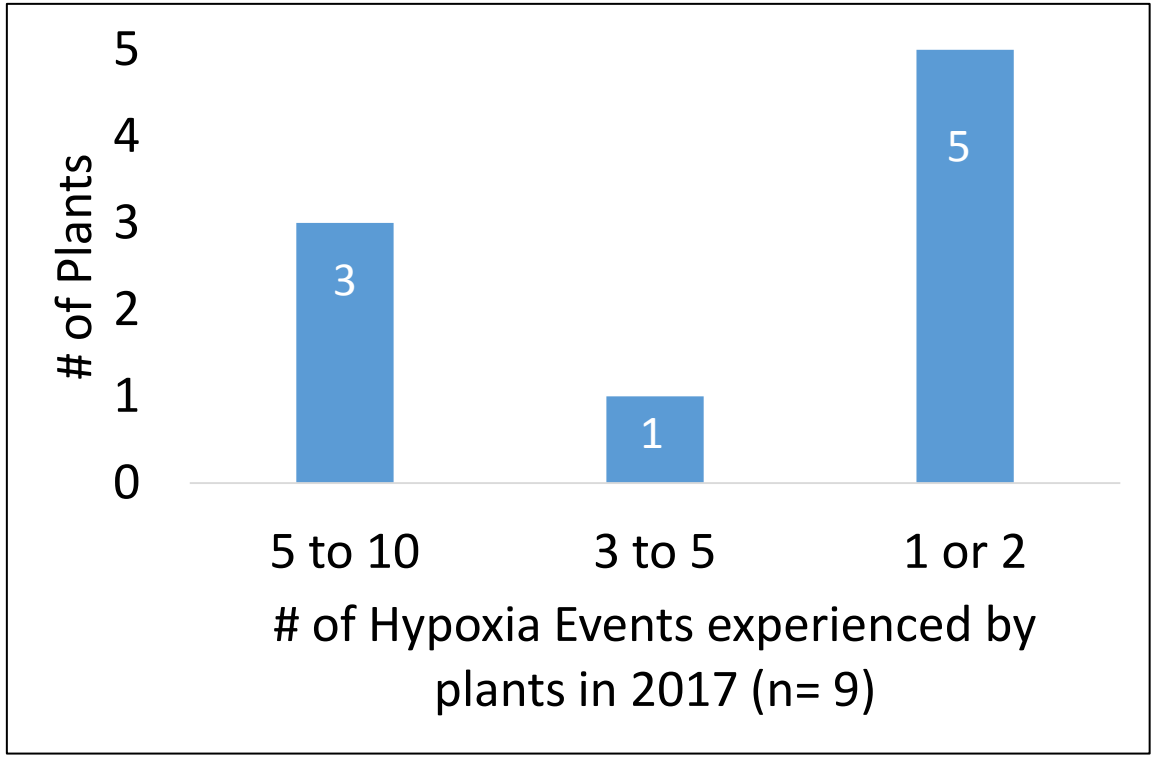
- Strong associations with water quality changes and NE winds
- Most plants expressed concern for drops in pH (service pipe corrosion)
- Not every plant monitors D.O.
- More than half have experienced “yellow water” events



Occurrences of Hypoxia at Water Plants

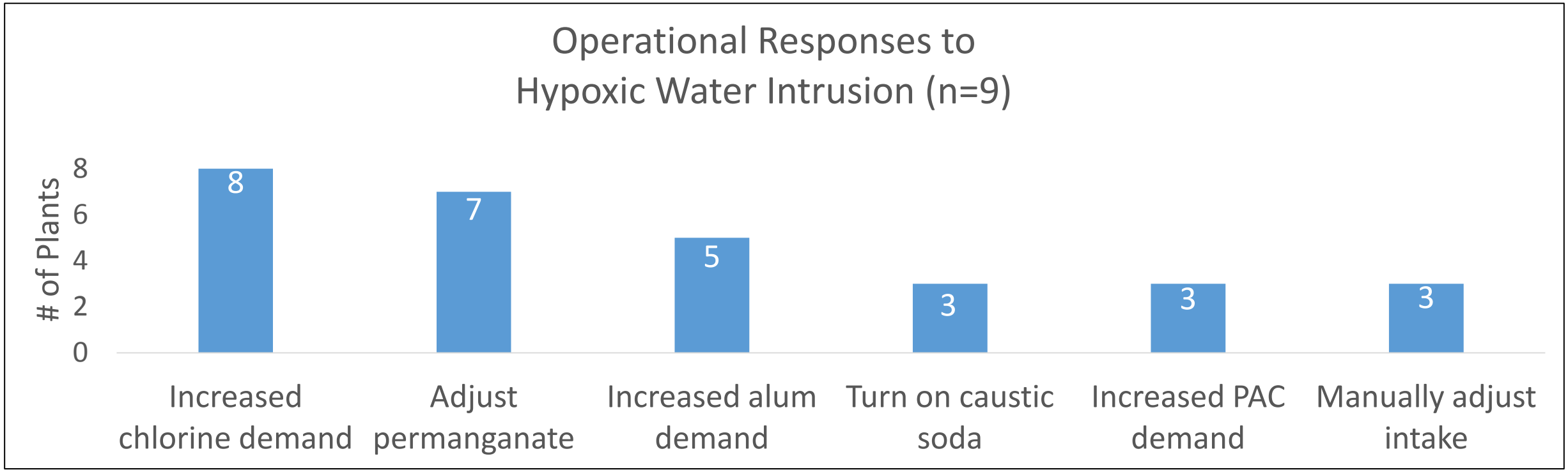
Frequency of hypoxia events

- Every focus group reported experiencing at least 1 hypoxia-like event in 2017
  - Severe events occur more infrequently
  - 6(9) focus groups experienced severe
- Events lasted from a few hours to more than a week
- Most events occur from March - September
  - One reported event in January



Changes in water treatment

*"There have been **various theories about how we should treat hypoxic water**. One is cutting the permanganate off, the other is decreasing the pre-chlorine, increased carbon, increased alum….You've got to be careful oxidizing stuff, because you could cause other issues….But one thing we do for sure is turn off our permanganate."*



Changes in plant operations

- **Increased monitoring**

"We run the raw water temperature and pH every two hours, so if they did see some kind of a drop, you would run it more frequently or keep a lid on it."

- **Communicate water quality changes to other operators, managers, & neighboring plants**

"A lot of times…we talk among ourselves, same way as with other plants. We'll call them and say, "what are you guys doing? What's working well for you?" Sometimes the communication with other plants is helpful…because, it might take a plant down west of us a couple days to get to grips with what's helping everything."

- **Quick and early treatment reduces negative impacts to water quality**

"The sooner we catch any changes….You don't have to make as big of an adjustment with your chemical treatment if you can stay on top of it."

Potential financial impacts

- Direct costs associated with hypoxic water treatment are minimal
- Indirect costs of severe events are likely more substantial.

"I don't think that there's a great financial impact associated with hypoxia. There's more of an aesthetic impact. Just like in Flint, there is nothing that you can do to get the confidence of the people back once you send them yellow water."

Recent Developments:

- At high levels manganese is a neurotoxin
- Transitioning to new Ohio EPA policy: regulating for health risks vs. aesthetic
  - New monitoring & water quality standards for manganese
  - >0.3 mg/L (precautionary advisory); > 1 mg/L (do not drink)

Results of Focus Groups

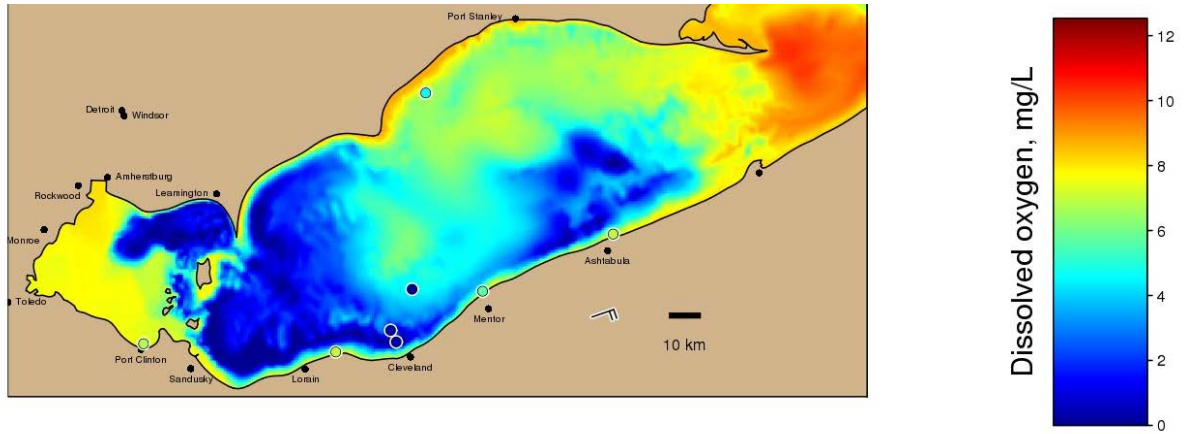
Research Question 2:

What are the hypoxia forecast information needs of PWS?

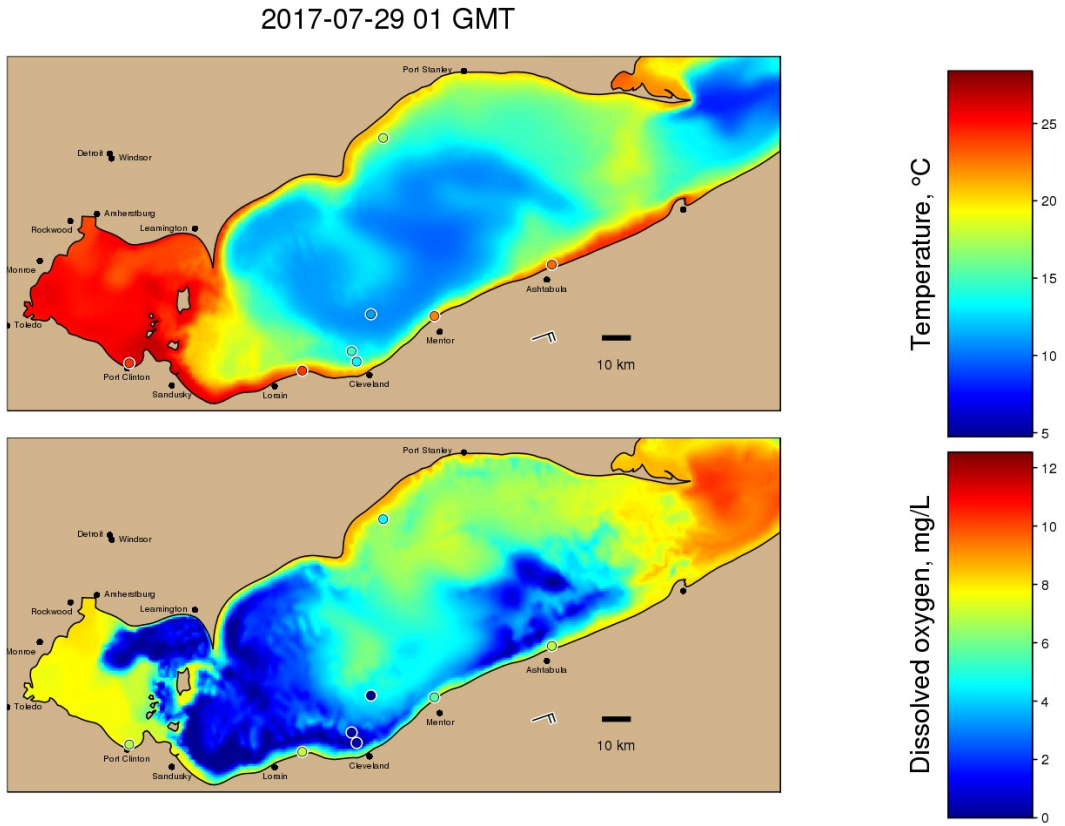
Results

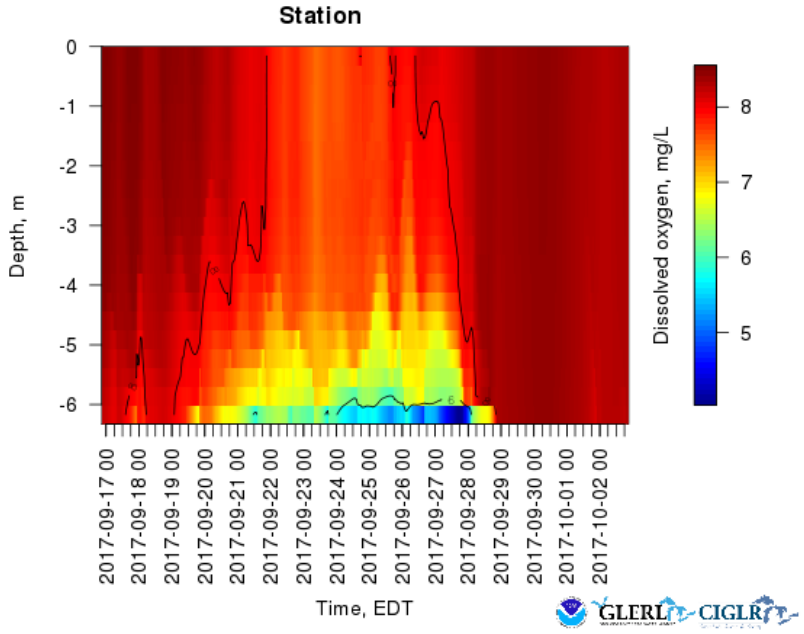
1. Anticipated benefits of a hypoxia forecast

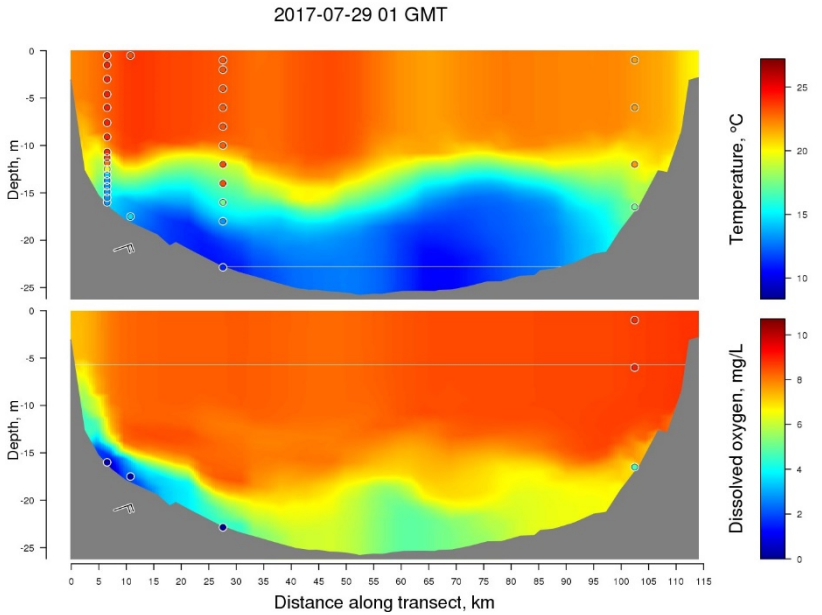
2. Recommendations for development of the hypoxia forecast



Possible Data Views for Hypoxia Forecast







Anticipated Benefits of Hypoxia Forecast

- **Enables early treatment**

  "The biggest thing is making the operators aware that they may see [hypoxic water], to keep a close eye on it. The sooner we catch any changes, the smaller the corrections you have to make to your treatment."

- **Allows for preparation**

  "We would be better prepared. We could let the operators know that this could happen…maybe run some extra monitoring or pay more attention to current monitoring. If we know something is coming, we can check our chemicals to make sure that we've got enough in stock."

Recommendations for development of hypoxia forecast

- Provide forecast between 1-3 days in advance of event
- Include a written description of the forecast along with graphics
- Use different color scales to display D.O. and temperature forecasts
- Allow for viewing of past forecasts
- Limit the information, so that it's easier to digest
- Include pH, temperature, DO, and manganese
- Explain how the wind direction influences the hypoxia forecast
- Preference for intake specific forecasts*

Summary

Hypothesis:

A hypoxia forecast will likely be useful to PWS, because it will enable early detection and treatment of hypoxic water, which will increase treatment efficiency.

Next Steps

- To test this, focus groups will be repeated in 2 years
- Evaluation surveys to measure success of coproduction approach
    - Knowledge, Perceptions, Behaviors

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