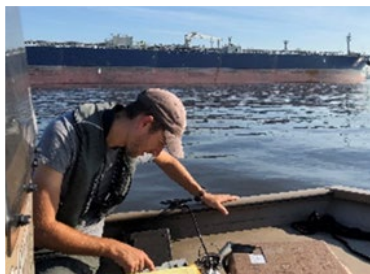


Presented to an advisory committee of the DRBC on April 23, 2026. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

# How the estuary model will be used in context of WLA Study

## Water Quality Advisory Committee



Matthew Amato, PhD  
Joseph Fogarty, PhD  
Li Zheng, PhD

**Thomas Amidon, BCES**  
Namsoo Suk, PhD  
Sarah Beganskas, PhD

**April 23, 2026**  
*Zoom*



# What's the Plan?

## A Strategy to Implement New Dissolved Oxygen Criteria in the Delaware River Estuary

## Resolution for the Minutes adopted in December 2025



- Why is a WLA Study needed?
  - New DO criteria **requires** implementation
  - Multiple discharges in a complex tidal environment must be evaluated together
- What is a wasteload allocation (WLA)?
  - Load of pollutant that can be discharged from a facility while still achieving water quality standards
- Core Elements of Strategy
  - DRBC will perform a WLA Study **in coordination with States** (and WQAC) and EPA
  - Study will provide defensible technical basis for States to derive and impose WQBELs
  - Study will translate DO criteria into specific allocations of ammonia, CBOD, etc
- WLA Study to be completed by June 2027

# What do we expect the WLA Study process to look like?



- Co-Regulators WLA Workgroup
  - 2-3 meetings with all States and EPA
  - 2-3 meetings with individual estuary States
  - Issues to discuss
    - Future scenario assumptions
    - Criteria comparison methodology
    - De minimis / reasonable potential tests
    - Reserve capacity
    - Allocation methodology
    - Many others!
  
- Water Quality Advisory Committee
  - Plan to meet 4 times in next 15 months
  - Provide updates and solicit input

# WLA workgroup met on March 26

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## What did we discuss?



- **Baseline Future Scenarios**
  - **Baseline flow scenarios**
    - Actual: set WWTP flows to seasonal average flows over last 5 years
    - Permitted: set WWTP flows to constant value equal to permitted flow
  - **Baseline water quality scenarios**
    - Set WWTP concentrations to seasonal average concentrations over last 5 years
- **Data requests from States**
  - Permitted flows
  - Last 5 years DMR data for each facility
- **Workgroup participants**

# WLA Study Workgroup Participation

## ■ State participation

### ○ NPDES permit side

- ensure WLAs satisfy regulatory and policy constraints of each State

### ○ TMDL/Assessment side because the WLA is “TMDL-adjacent”

- Loading scenarios will manipulate multiple dischargers
- A reserve capacity will be needed

## ■ Oversight from EPA

## ■ DNREC

- NPDES: John Rebar (Jr), George Mwangi
- TMDL: Sakinat Ahmad, Bhanu Paudel, Josh Barth

## ■ NJDEP

- NPDES: Theresa Guloy, Josie Castaldo
- TMDL: Frank Klapinski, Roop Guha, Helen Pang

## ■ PADEP

- NPDES: Sean Furjanic, Harmonie Hawley
- TMDL: Josh Lookenbill, Kristen Schlauderaff

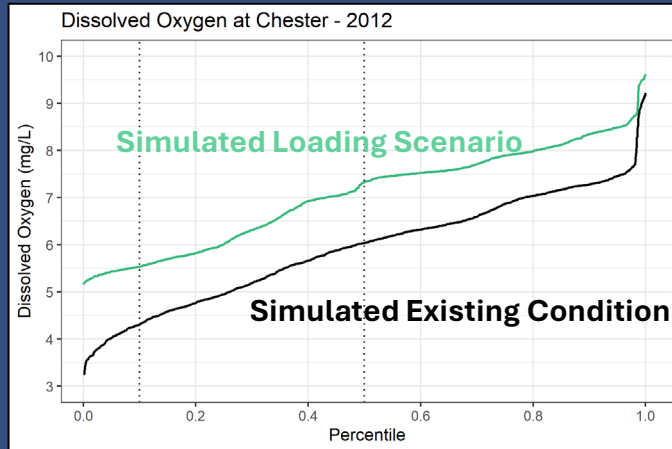
## ■ EPA

- Greg Voigt, Dana Hales

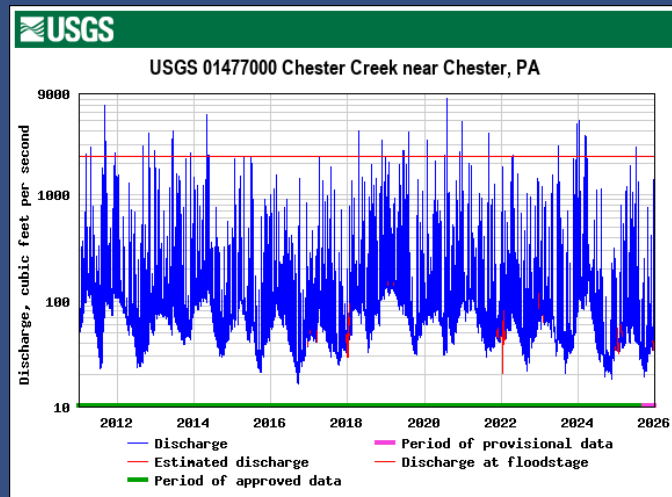
# WLA Study Methodology

What data will be used ...

- From the estuary model?



- From historical data?



## ■ Model Predictions

- Flow scenario model predictions for 2012, 2018, & 2019
    - Temperature and salinity
  - Water quality model predictions for various loading scenarios
    - Dissolved oxygen
  - Daily average and depth averaged
- ## ■ Continuous USGS dissolved oxygen for 15 years from 2011 to 2025

# What is a change factor analysis?

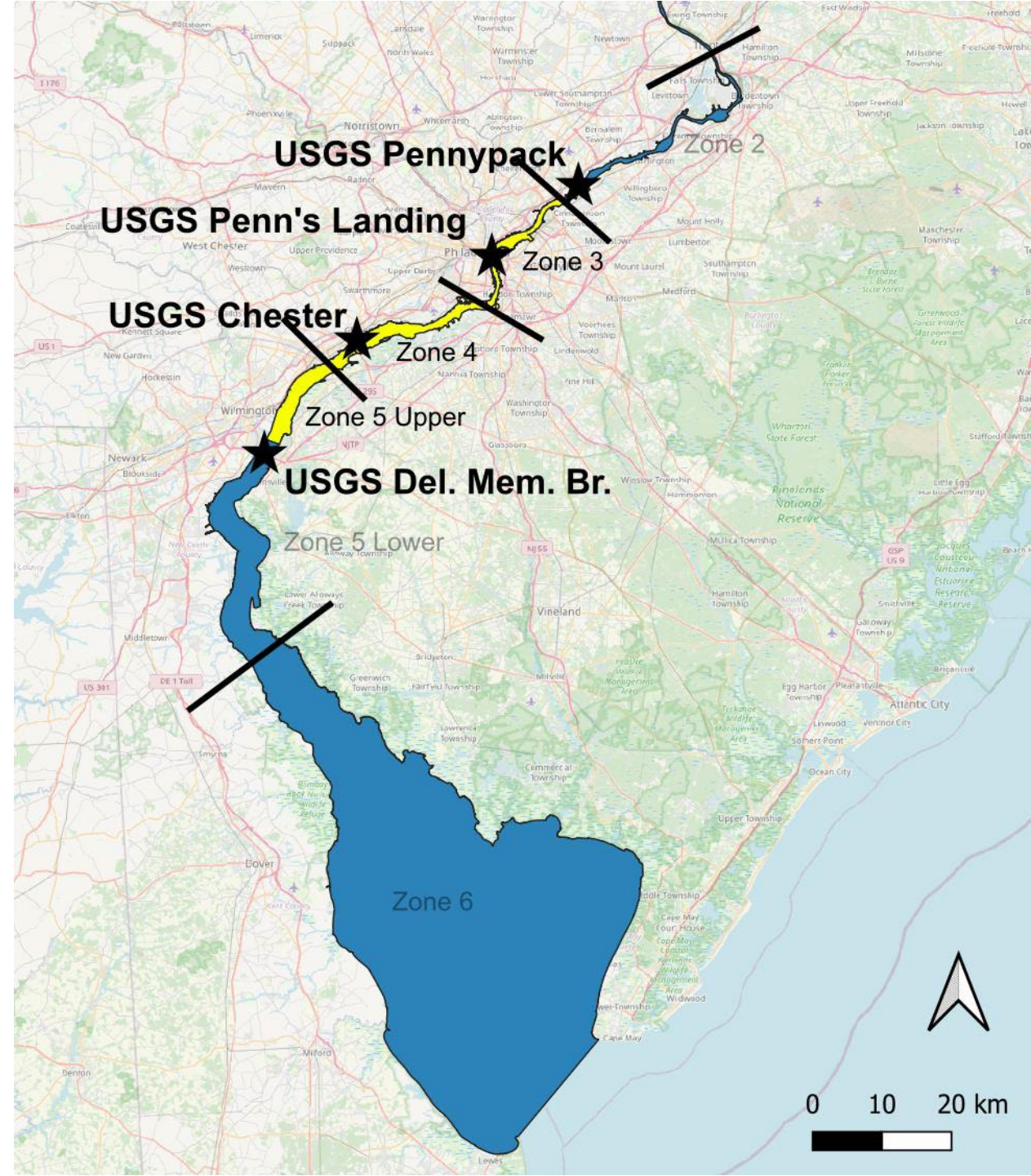
- Commonly applied to address uncertainty in global climate models
- Characterize the **change** that is expected relative to a baseline condition
- Preserves characteristics of the **observed dataset**
- A combination of additive and multiplicative change factors was employed: Linear regression

**“Change Factors”**  
(a.k.a. “delta change factors”)

In climate science, difference between simulated future and simulated historic conditions.

# Why use a change factor analysis?

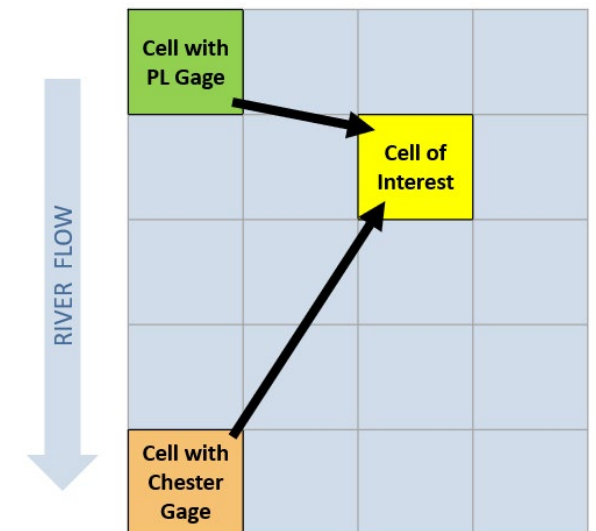
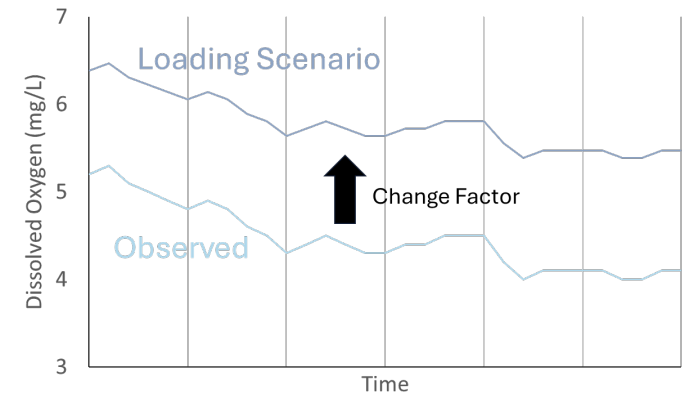
- Leverage the strengths of
  - Estuary DO model and
  - years of continuous observed DO
- Allow estimation of DO ...
  - in **unmodeled years**,
  - at **unmonitored locations** and
  - across different **loading scenarios**
  - **beyond** what is possible with either model output or continuous data **alone**



# How will we use change factor analysis?

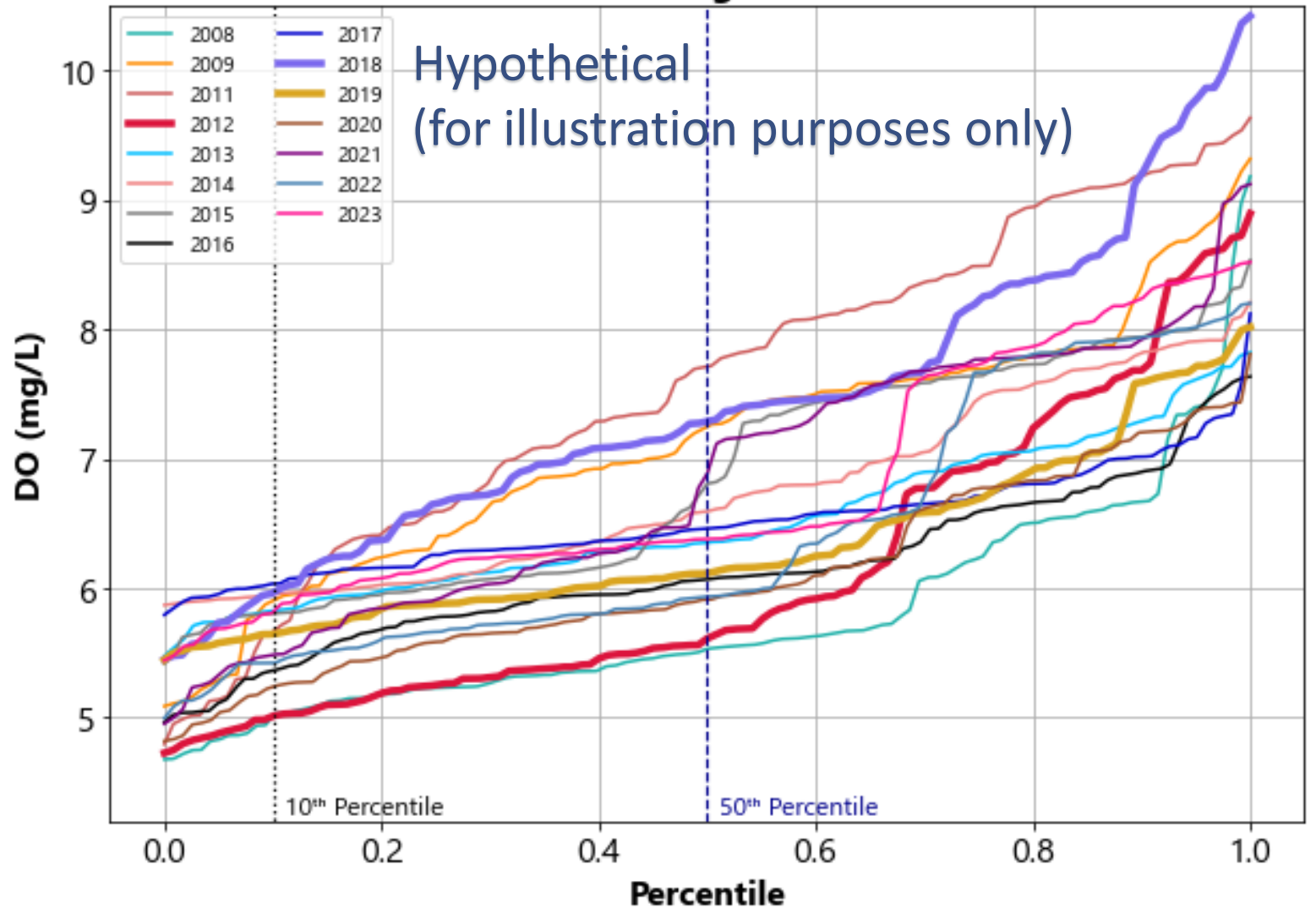
1. Develop and apply a loading scenario change factor to estimate DO at gaged locations over the 15-year period.
2. Develop and apply a spatial change factor to estimate DO at ungaged locations over the 15-year period.

*Change factor analysis will be applied to all 15 years, including modeled years, to provide a **consistent evaluation** that leverages both **model predictions** and **observed data**.*



- Captures simulated years in context of **overall inter-year variability**
- Extends analysis **beyond gage location** while still reflecting observations

**One way to analyze results of a loading scenario  
(could be a particular location, or the minimum DO location)  
Dissolved Oxygen by Year or by Season**



# Wait!!

## What about dissolved oxygen saturation?



- Dissolved oxygen saturation ( $DO_{sat}$ ) is the concentration of dissolved oxygen (DO) in equilibrium with the atmosphere
  - Calculated as a function of temperature, salinity, & atmospheric pressure
- DO can be expressed as a % of  $DO_{sat}$ 
$$\frac{DO}{DO_{sat}} \times 100 = DOSAT$$
- Estuary model simulates DO as a mass and divides by the volume in each cell to provide direct output as a concentration (mg/L)
- Outside the mass balance, the model can derive the secondary variable of DOSAT
$$= DO \times f(\text{temperature, salinity, pressure})$$

How will the WLA  
make use of the model  
to support DOSAT  
criteria without  
introducing additional  
uncertainty?



- All future loading conditions evaluated in WLA Study will have the same temperature, salinity, and pressure conditions
  - Scenarios will only differ in DO concentration
- Model will only be used to calculate the change in DO from one loading scenario to another and one location to another
  - WLA Study will leverage the model's ability to characterize the system's load response relationships



# WLA Study Methodology

What results will the study generate and how do we expect they will be utilized?

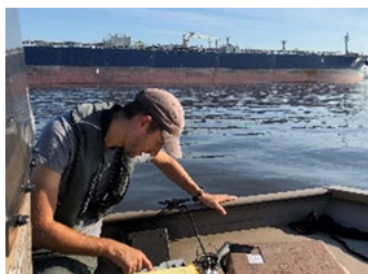


- Iterative evaluation of loading scenarios
  - Each treatment plant will be evaluated independently to identify degree of impact on dissolved oxygen in area of interest
  - Classes of impactful discharges will be adjusted to identify combinations that satisfy criteria
  - Production runs can be 2D or over one year; fine-tuning and confirmation in 3D over 3 yrs → 15 yrs
- Seasonal monthly average loading allocations expected for some discharges
  - Mostly ammonia, also CBOD and DO
  - TN limits not anticipated
  - Winter treatment not expected
- WLAs expected to be readily converted to WQBELs



# Discussion

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**Delaware River Basin Commission**

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