Delta Stewardship Council Funded Research

April 2023

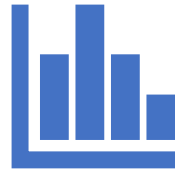**Dylan Stern**
Program Manager I
Delta Science Program

Delta Science Program

DELTA STEWARDSHIP COUNCIL

Today's Talk

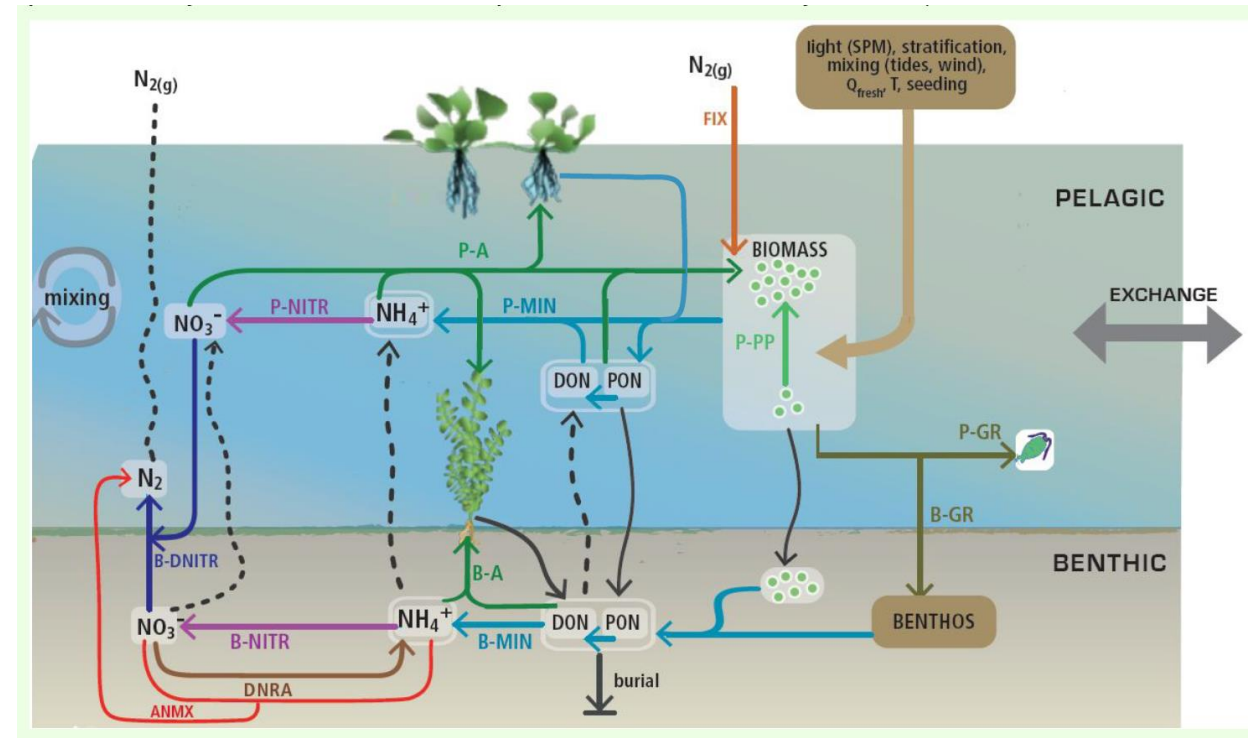**Background and History**

Operation Baseline

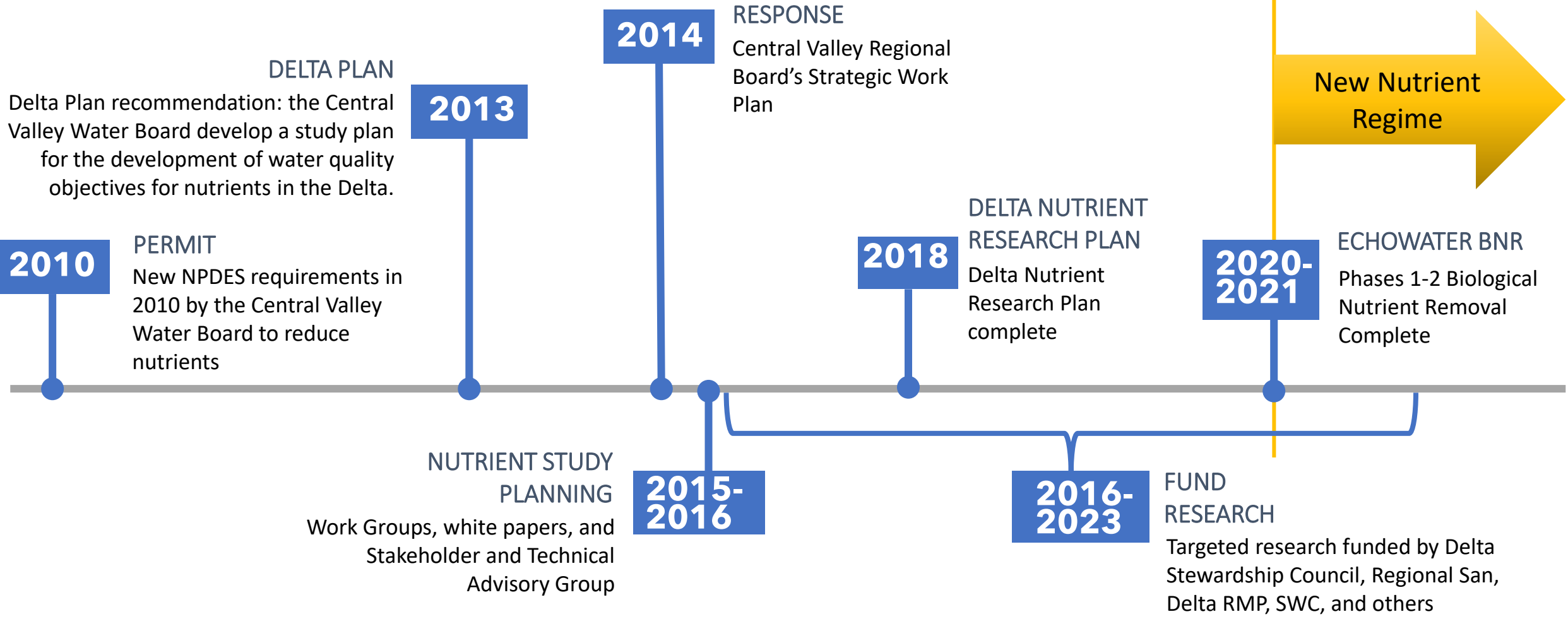*the need to measure (and model)*

Nutrients in the Delta

- Paradox of nutrients in the Delta
  - Plenty of nutrients – anthropogenic sources
  - No eutrophication
  - Low phytoplankton
- Water quality problems related to nutrients in the Delta impacting **food webs, habitat quality and water management**
  - HABs and their toxins
  - Non-native invasive aquatic macrophytes
  - Low DO
  - Low phytoplankton
- **Is there a water quality problem and are nutrients contributing to the problem?**

Senn et al. 2020

History

DELTA PLAN

Delta Plan recommendation: the Central Valley Water Board develop a study plan for the development of water quality objectives for nutrients in the Delta.

2013

2014

RESPONSE
Central Valley Regional Board's Strategic Work Plan

2010

PERMIT
New NPDES requirements in 2010 by the Central Valley Water Board to reduce nutrients

DELTA NUTRIENT RESEARCH PLAN

2018

Delta Nutrient Research Plan complete

2020-2021

ECHOWATER BNR
Phases 1-2 Biological Nutrient Removal Complete

New Nutrient Regime

NUTRIENT STUDY PLANNING

2015-2016

Work Groups, white papers, and Stakeholder and Technical Advisory Group

2016-2023

FUND RESEARCH
Targeted research funded by Delta Stewardship Council, Regional San, Delta RMP, SWC, and others

Operation Baseline Research

Hypotheses & Conceptual Framework

Spatial overlap and habitat suitability

Effluent Zone of Influence (ZOI)

min — max

T4 Beneficial Uses

T3 Indirect Biological Responses

T2 Direct Biological Responses

Non-Nutrient Factors

T1 Ambient N Concentrations

Effluent Point Source

Response Zone A

Response Zone B

Flow

Response Signal Strength:
Magnitude, 'Signal:Noise', Seasonality,

Jan — Dec

'noise'

C. Opportunities & Constraints for Investigations

- Detectability or Study Feasibility

- Ability to assess causal link to upgrade

- Knowledge gaps or data gaps, important parameters, ancillary data needs

Identify data needs and knowledge gaps

Will the response be detectable?

Testable?

How likely is the response and at the ecosystem scale?

Operation Baseline
Pilot Studies

Data Gaps

Sufficient data coverage over space & time	Sediment nutrient flux	Nutrient transformation rates	Improve linked biogeochem models

New Methods

HF ammonium sensor and fluoroprobe for phytoplankton	Benthic flux chamber "sediment Roomba"	Isotope analyses forensic investigation	Nutrient dynamics modeling

Operation Baseline Studies 2019

- **USGS**: use new technologies to better understand changes in nutrients and shifts in phytoplankton communities **using fixed stations and boat measurements**

- **USGS and VIMS**: Modeling work in collaboration with DWR

- **BSA Environmental Services, Inc**: analyzing the tiniest phytoplankton; picophytoplankton
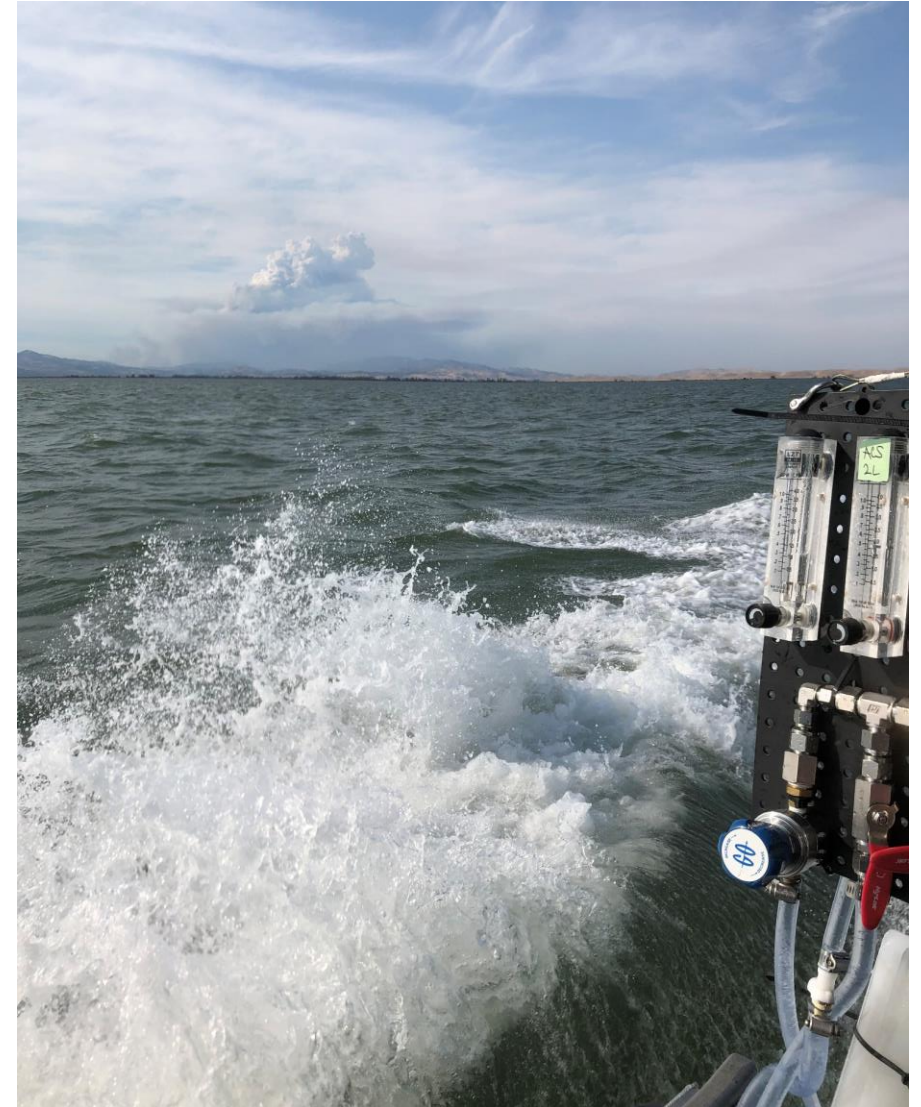
High Frequency Boat Measurements

Flow Through System

Ammonium	GPS
Chlorophyll	Nitrate
Conductivity	pH
Discharge	Phosphate
Dissolved Inorganic Nitrogen	Salinity
Dissolved Organic Carbon	Specific Conductance
Dissolved Organic Matter	Temperature
Dissolved Organic Nitrogen	Turbidity
Dissolved Oxygen	Algal pigments via Fluoroprobe:

Algal pigments via Fluoroprobe:
- Bluegreen Algae (cyanobacteria)
- Cryptophyta
- Diatoms
- Green Algae

July 2018 Ammonium BEFORE

145 uM

July 2022 Ammonium AFTER
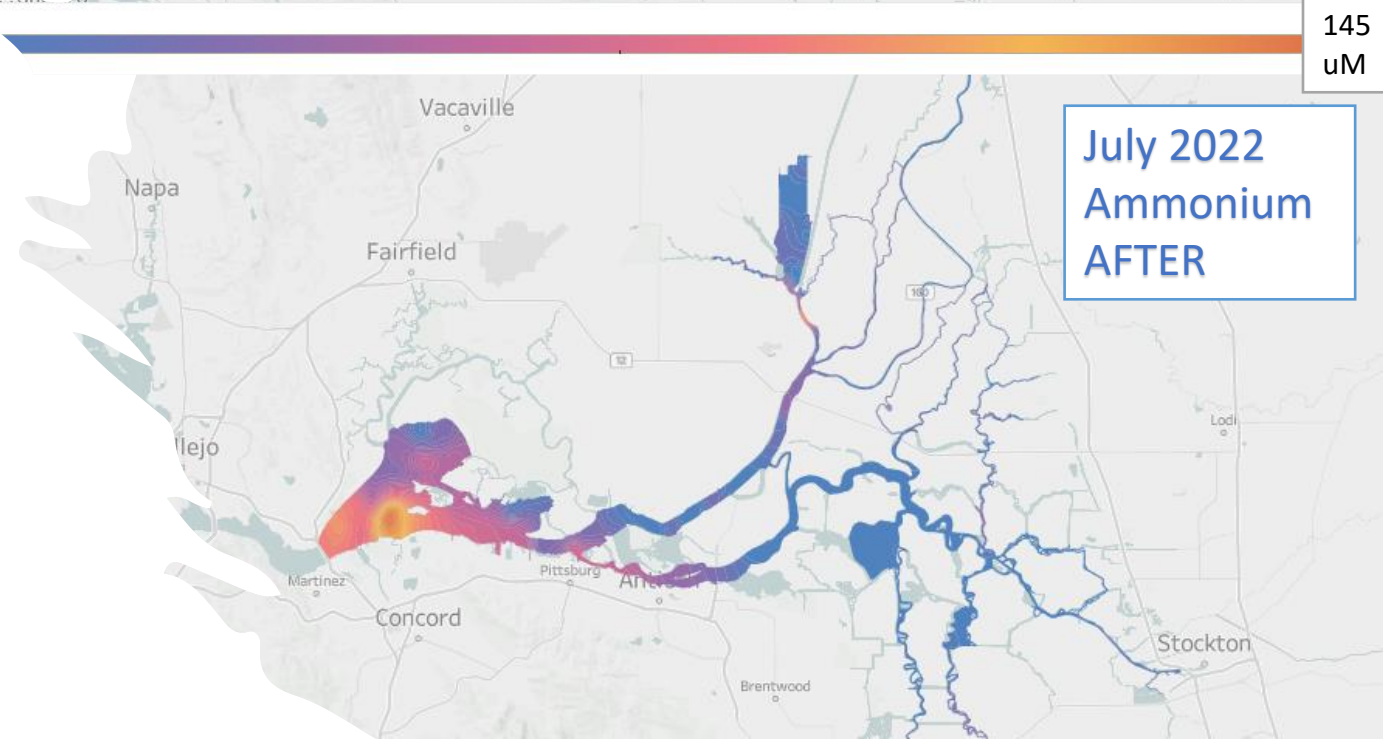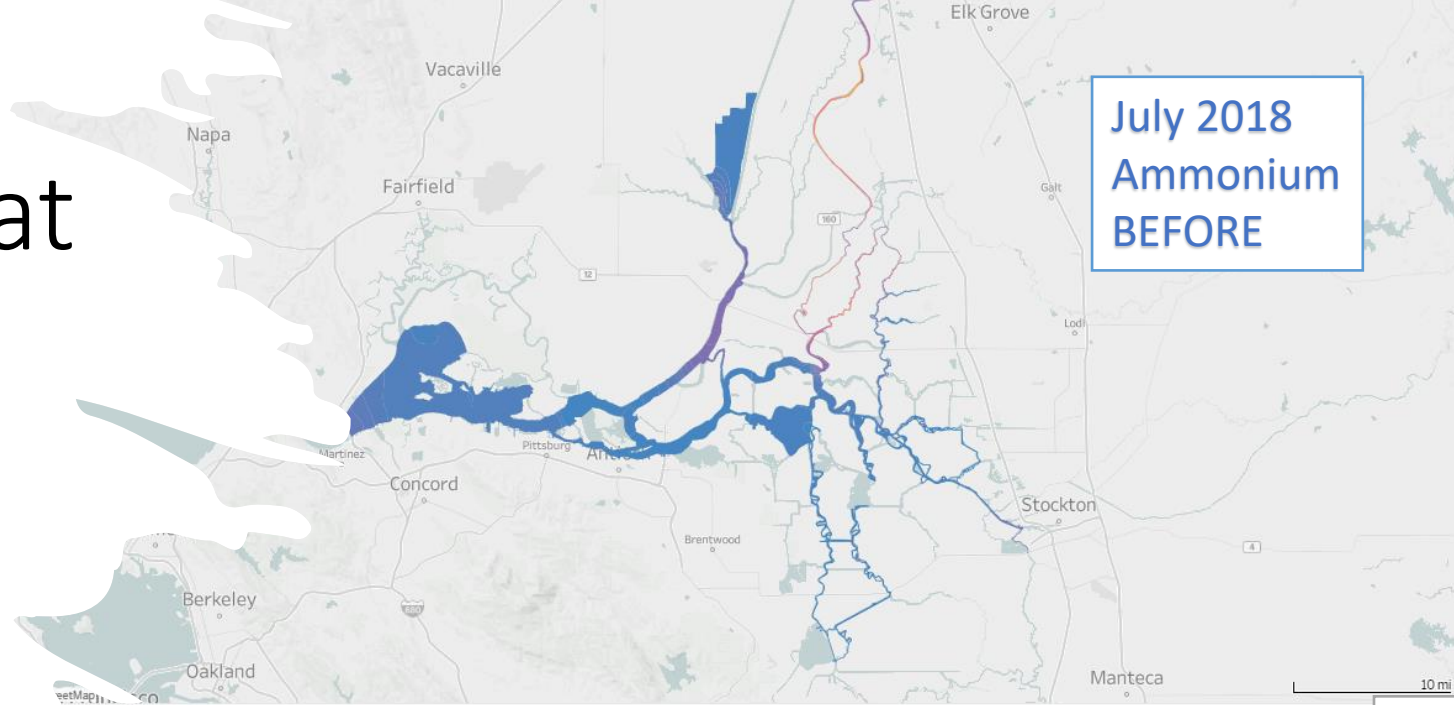
Measuring + Modeling = Progress

Regional San Treated Effluent Nutrient Data
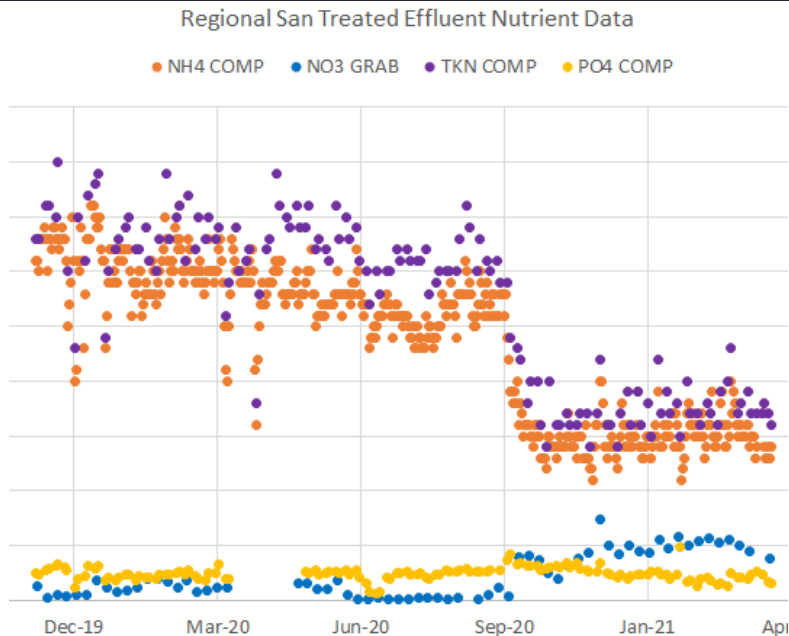
- **Modelers work closely with data collectors and resource managers**

- Prioritize spatial/temporal trend data collection for holistic look at nutrients

- Future work:

- HABs prediction model?

- Improve models for future resource management questions (restoration, infrastructure projects, climate change, etc.)

Collaborators

Thank you to all the collaborators!

Thank you

Connect with us

Scan the QR code
to subscribe to our
listserv

Deltacouncil.ca.gov

@DeltaCouncil

@deltastewardshipcouncil
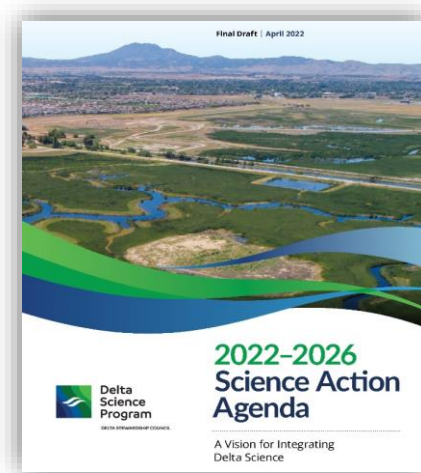
Delta Stewardship Council

@deltastewardshipcouncil

What is the 2022-2026 Science Action Agenda?

A roadmap for science to inform decision-making in the Delta
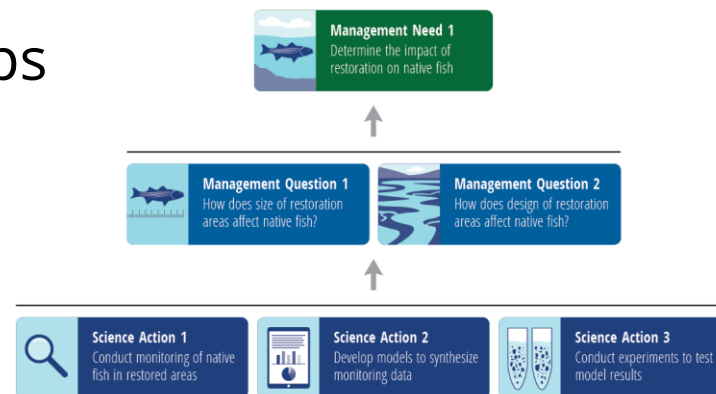
Addresses key challenges:

- complexity of the Delta

- rapidly changing system

- limited resources

- multiple interest groups and science needs

A four-year science agenda for the Delta that:

- prioritizes and aligns science actions to inform management,

- is collaboratively developed,

- builds science infrastructure, and

- identifies major gaps in knowledge

2022-2026 Science Action Agenda

- **Science Action 5C:** Determine how environmental drivers (e.g., nutrients, temperatures, water residence time) interact to cause HABs in the Delta, identify impacts on human and ecosystem health and well-being, and test possible mitigation strategies

- Management Need 2: Enhance monitoring and model interoperability, integration, and forecasting
    - Management Question: What water quality data (e.g., contaminant bioavailability and toxicity, nutrients, water temperature) should be prioritized to add to Delta ecosystem models to evaluate future ecosystem and management changes?
    - Science Action 2B: Develop a framework for monitoring, modeling, and information dissemination in support of operational forecasting and near real-time visualization of the extent, toxicity, and health impacts of harmful algal blooms (HABs)

- Management Need 3:
    - Management question: How can factors (e.g., water flow and residence time, turbidity, water temperature, nutrient concentrations) be managed to encourage productivity in lower trophic food webs while also preventing harmful algal blooms, taste and odor issues, and macrophyte growth?
    - Management question: How do water quality and the multiple elements that contribute to water quality change under different management scenarios, and where is coordinated monitoring needed?

Competitive DSP Projects awarded 2018-2021

1. Assessing sediment nutrient storage and release in the Delta: linking benthic nutrient cycling to restoration, aquatic vegetation, phytoplankton productivity, and harmful algae

   Tomo Kurobe/Tamara Kraus (2018/2019)

2. Harmful algal blooms and cyanotoxins in the Delta: occurrence, distribution, trends and environmental drivers

   Tamara Kraus/Angela Hansen/Brian Bergamaschi (2020/2021)