# Florida Red Tide Mitigation and Technology Development Initiative

# Technology Advisory Council Meeting

**Kevin Claridge**
**Mote Marine Laboratory**
**January 23, 2024**

# TAC Meeting Agenda

- TAC Roll Call and FAR Public Notice
- Red Tide Initiative Overview and Reporting
- Facility/Equipment Updates
- Initiative Progress
- HAB Mitigation Lab to Field Lessons Learned
- HAB Mitigation Regulatory Steps
- Year 5 Funded Projects and Looking Ahead in 2024
- Pending Initiative Legislation
- Leveraging the Initiative: US HAB CTI and DEP Innovative Tech
- Public Comments
- TAC Comments and Recommendations

# TAC Opening Comments

# Florida Red Tide Initiative Overview

- Signed by Florida Governor in June 2019
  - 379.2273 Florida Statutes
  - Mote partnership with Florida Fish and Wildlife Conservation Commission, Research Institute
- $18 million over 6 years ($3 million per year)
  - In Year 5, Sunsets March 2025
- Numerous Reporting Requirements
- Legislative Intent:
  - develop mitigation technologies and approaches to address the impacts of red tide on coastal environments and communities in Florida
- General Structure:
  - Lab space, *Karenia brevis* culture, raceways and mesocosms for:
  - Projects leading to red tide mitigation tools
- Initiative and Beyond
  - Regulatory Oversight
  - Field Implementation

# Initiative Reporting

- **379.2273(2)(d) Florida Statutes:**
  Beginning January 15, 2021, and each January 15 thereafter until its expiration, the initiative shall submit a report that contains an overview of its accomplishments to date and priorities for subsequent years to the Governor, the President of the Senate, the Speaker of the House of Representatives, the Secretary of Environmental Protection, and the Executive Director of the Fish and Wildlife Conservation Commission.

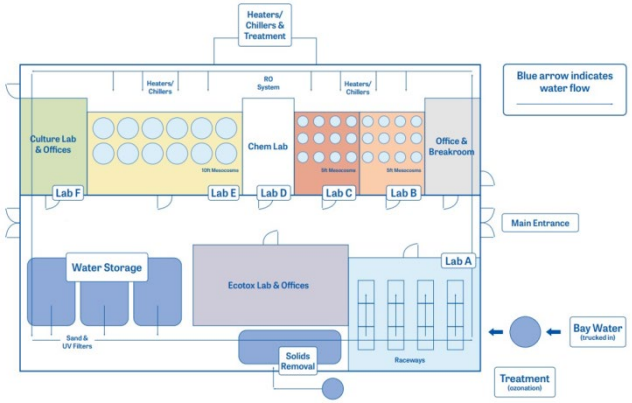
- **FWC-FWRI Contract Reports**
  Technical and Financial
  Regular partnership interactions

- **Project Interim and Final Reports**
  Required by subaward contracts from Mote

- **Mote Red Tide Initiative Website**
  Technology Advisory Council Presentations and Minutes
  Regular Updates
  Project Summaries

# Mitigation and Technology Development Facility

- Mote Aquaculture Research Park
- 150K gallons treated and recirculated seawater from the bay
- Tiered safe setting research through lab-based, large-scale 5ft and 10ft mesocosms, and raceways
- Ecotoxicology Lab
- Large volumes of *Karenia brevis*
- Ecosystem-based testing of mitigation compounds in a controlled setting to prepare for field implementation
- Enhanced air treatment, PPE provided, and air testing for toxins
- Do no additional health or environmental harm
- No charge for facility use, culture, and assistance as part of Initiative
- Boom and Limnocorrals available





Research Mesocosms

Research Raceways

Red Tide Culture


Facility Grand Opening


Partnership Signage

# Tiered Research Process

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
INSTITUTE OF MARINE & ENVIRONMENTAL TECHNOLOGY

NOAA — National Oceanic and Atmospheric Administration — U.S. Department of Commerce

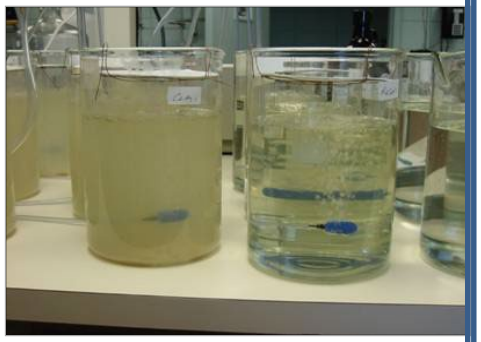
Mote Marine Laboratory

------ US HAB Incubator Funding ---------- ---------- Other Funding ----------

---------- NOAA: Phase I ---------- Phase II ---------- Phase III ------

**Florida: Tier 1** → **Tier 2** → Tier 3 → Tier 4

## Laboratory Experiments & Literature Search



-Effects on the Cells and Toxins in the Lab
-Previous International Use
-Existing Regulatory Approvals

## Mesocosms, Raceways & Collaborations

-Effective with Natural Communities
-Ecological Impacts
-Human Health Concerns
-Logistical Issues
-Economically Feasible

## Canals/Marinas Limnocorrals/Boom Nearshore/Offshore

-Pilot Studies
-Field Demonstrations
-Federal/State/Local Regulatory Approvals
-Engineering Needed
-Public Interactions

## Commercialize Monitor

-Customers
-Intellectual Property
-Efficiency Scaling
-State/Local Budgets
-Deployment Contractors

# Red Tide Initiative Progress

2023 Red Tide Initiative Commercialization Workshop

FLORIDA RED TIDE MITIGATION AND TECHNOLOGY DEVELOPMENT INITIATIVE 379.2273(2)(d)

**ACCOMPLISHMENTS AND PRIORITIES REPORT**

**JANUARY 2024**

Red tides, or red tide harmful algal blooms, are a higher-than-normal concentration of microscopic alga that occur in ocean and coastal waters. Red tides in Florida have been documented since the 1700's and their likely impacts date back to records from Spanish explorers. In Florida, the toxin producing *Karenia brevis* is the species causing most red tides. These blooms can harmfully affect sea life, lead to massive fish kills, cause human respiratory problems, close beaches, and determinately impact shellfish, fishing, hotel, restaurant, recreational, and tourism industries. This report is being provided to meet the requirement of 379.2273(2)(d) Florida Statutes, which states: "Beginning January 15, 2021, and each January 15 thereafter until its expiration (2025), the initiative shall submit a report that contains an overview of its accomplishments to date and priorities for subsequent years to the Governor, the President of the Senate, the Speaker of the House of Representatives, the Secretary of Environmental Protection, and the Executive Director of the Fish and Wildlife Conservation Commission."

**MITIGATING RED TIDE IMPACTS FOR FLORIDA**

The Florida Red Tide Mitigation and Technology Development Initiative is a partnership between Mote Marine Laboratory (Mote) and the Florida Fish and Wildlife Conservation Commission (FWC) codified under 379.2273 Florida Statutes that establishes an independent and coordinated effort among public and private research entities to develop prevention, control and mitigation technologies and approaches that will decrease the impacts of Florida red tide on the environment, economy and quality of life in Florida.

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Available on Mote's Red Tide Initiative Website

- ✓ 300+ Potential Mitigation Compounds Examined for Tiered Testing
- ✓ 5 Request For Proposals
- ✓ 7 Technology Advisory Council Meetings
- ✓ 100+ Proposals Reviewed
- ✓ 35+ Projects Underway or Completed
- ✓ Research Facility Constructed
- ✓ Private/Federal Funding Leveraged
- ✓ Public Website
- ✓ 2 Science to Commercialization Workshops
- ✓ 4 Reports to Governor, Legislature, and Agencies on Accomplishments/Priorities
- ✓ Approximately a dozen promising tools and technologies for field implementation

# Florida Red Tide Mitigation and Technology Development Initiative Partners





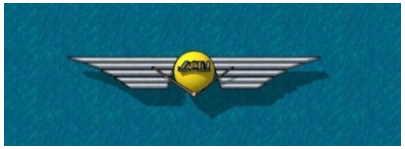


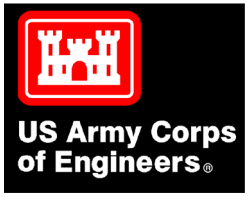




























# Red Tide Mitigation Projects

- BlueGreen Water Technologies, *Efficacy of Lake Guard Oxy Against Karenia brevis Development.* This compound is a proprietary **sodium percarbonate formulation** encapsulated in a food-grade biodegradable agent.

- Greenworld Environmental Alliance, *Mitigation of Karenia brevis cells and toxins using the RTF3 Formula.* RTF3 was developed and is utilized as a **hydrocarbon degrader product** for mitigation of petroleum in the environment.

- Heartland Energy Group, *Non-toxic biodegradable formulation for mitigation of red tide cells and toxins.* The Xtreme **citric acid, lemongrass oil, and soapbark** product is utilized in many wastewater, agricultural, and industrial capacities for water purification, and algae and bacterial treatment.

- Mote Marine Laboratory, *Natural plant algicides and field application method development for targeted red tide mitigation.* This project is finalizing testing on two **naturally-based plant algicides** that have regulatory approvals in liquid and encapsulated form.

- Prescott Clean Water Technologies, *Innovative Use of Advance Oxidation, Nanobubble-Cavitation for Rapid Deployment to Restore Severely Impacted Red Tide Areas Back to Natural Conditions.* This project, collectively called OZONIX, has the option to include **Hydrodynamic Cavitation, Ozone, Ultrasonic Nano-Bubble Cavitation, and/or Electrochemical Oxidation** in its treatment process.

# Red Tide Mitigation Projects

- Tulane University, *Continuation of: A New Approach to the Flocculation, Sinking and Targeted Destruction of Karenia Brevis*. This research is testing specialized **clay, polyalminum chloride as a flocculant, with sodium percarbonate or calcium peroxide**.

- UltraTech International, *Ultra-Archaea Bioremediation Product for Red Tide Mitigation.* Ultra-Archaea is a **culture of over a hundred species of unicellular prokaryotic organisms** that is presently used for clean-up of oil spills, livestock waste, and in food processing wastewater, and sewage treatment.

- University of South Florida's Patel College of Global Sustainability, *Field Deployment of **Low-Power Electromagnetic** treatment for Red Tide Mitigation.* This project is field testing a solar powered, remotely controlled, lightweight, low maintenance, commercial device.

- Woods Hole Oceanographic Institute, University of Rhode Island and University of Maryland Center for Environmental Science, *Double Indemnity for Karenia: modifying clay for improved cell and toxin removal.* This project is finalizing testing of **clay**, commonly used in other portions of the world on marine harmful algal blooms, with **plant-derived algacidal compounds**.

- Others in the Initiative funded (and Non-Initiative funded) research process….UV light, flocculants, algacidal/allelopathic products…

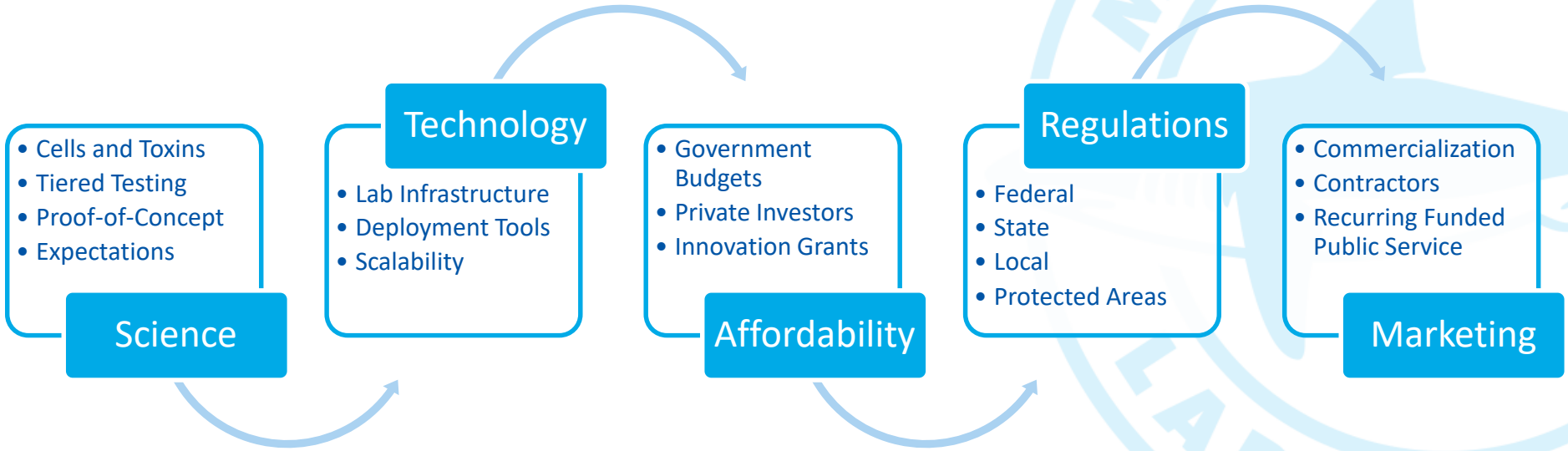
# Red Tide Initiative – Looking Ahead

- Year 6 Field Deployment Funding
- Fall 2024 TAC Meeting
- Build Off Workshops
  - Deployment/Monitoring
  - Scalability
  - Economic Feasibility
  - Permitting/Compliance
  - 2024 Workshop: Field Implementation
- Field Data, Monitoring, and Product Improvement
- US HAB Control Technologies Incubator
- DEP Innovative Technologies Grant Program
- Pending Legislation


**2022 Workshop**

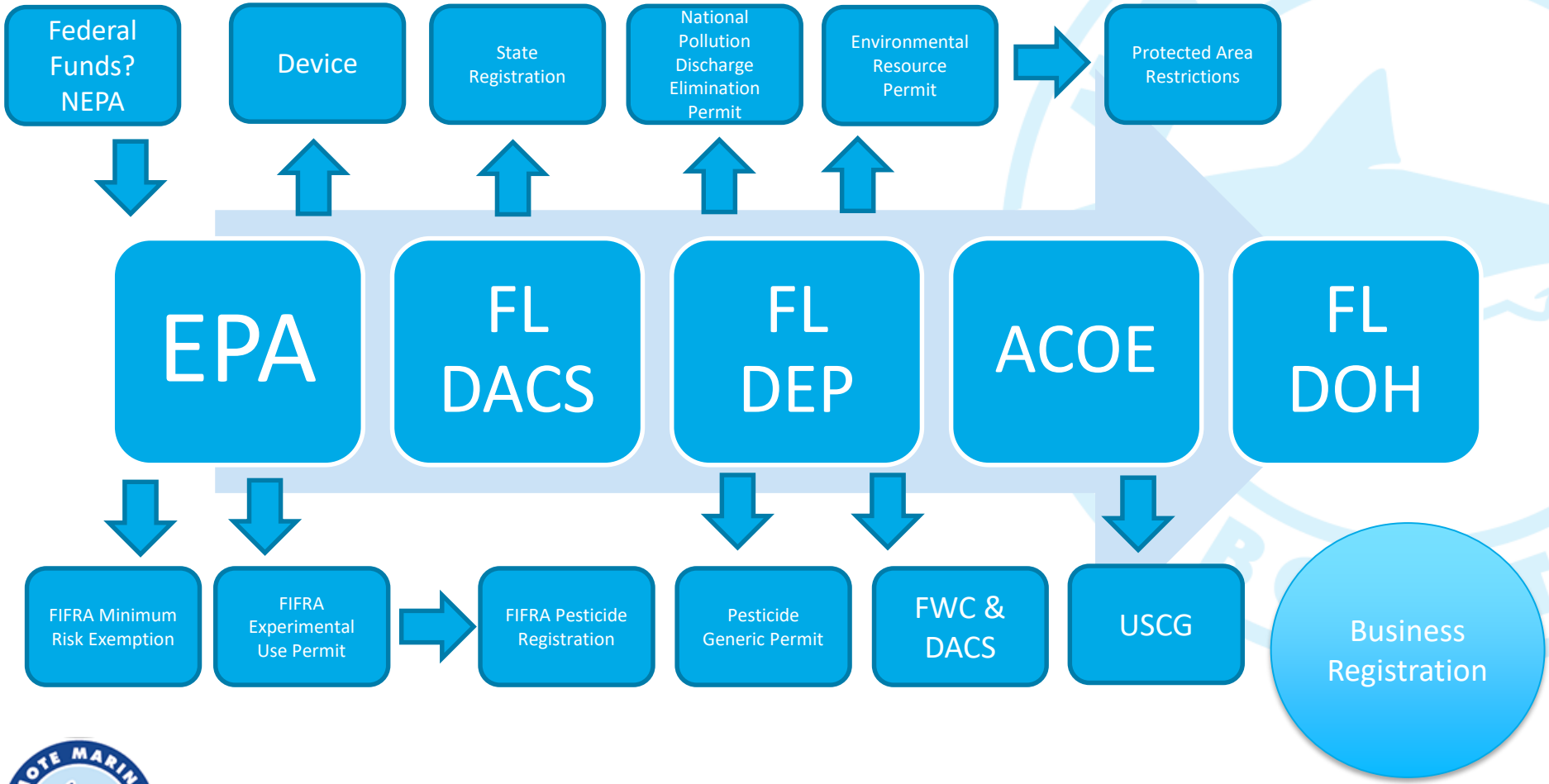
**2023 Workshop**

# HAB Mitigation Science, Technology, Economics, or Regulations, Which Comes First?




## All at the Same Time!

# Florida Harmful Algal Bloom Pilot Field Testing Regulatory Oversight



# Red Tide Initiative – Pending Legislation

- 379.2273 Florida Statutes – Proposed Amendment, FY 2024-25 Session
  - Add (2)(c): Upon successful completion of science-based laboratory testing of potential control and mitigation approaches, the initiative shall develop and have State approval to implement field trial deployment technologies for such control and mitigation approaches in State waters exhibiting red tide bloom concentrations of greater than 10,000 cells per liter. The initiative shall also guide partners in acquiring the appropriate federal, state, and local regulatory approvals to deploy tools and technologies and shall ensure that science-based field monitoring of such deployment is conducted.
  - Amend (4): This section expires June 30, 2027.
  - Add Section 2: Beginning in the 2025-2026 fiscal year, and continuing through the 2026-2027 fiscal year, there is appropriated the sum of $2 million from the General Revenue Fund to the Fish and Wildlife Conservation Commission for the purpose of implementing s. 329.2273, Florida Statutes.
  - Add Section 3: This act shall take effect July 1, 2024.

# US HAB Control Technologies Incubator (US HAB CTI)

- 5 years with option to add 5 more years
- Partners:
  - National Oceanic and Atmospheric Administration
  - University of Maryland, Institute of Marine and Environmental Technology
  - Mote Marine Laboratory

# US HAB CTI Objective

- Fund US extramural lab/tank-based proof of concept, innovative **freshwater and marine** HAB control tool and technology projects to assess their **real-world feasibility**
- Development and implementation **of scalable, environmentally acceptable, cost-effective** HAB control strategies
- Provide guidance to end users and stakeholders on **navigating the relevant licensing and permitting processes** via a Clearinghouse Website
- **Archive tool and technology project data** for use/dissemination to the broader HAB and resource management community

# US HAB CTI Progress

**Year 1: 2023**

**Jan 31: Letter of Intents (65 Received - 11 Encouraged, 22 Maybe)**
**April 10: Full Proposals (25 Received)**
**June: Award Notifications (Total $1M, not exceeding $200K/ea.)**
**Sept 1: 1st Year Project Period Started**

**Year 2: 2024**

**Jan 9: Hosted Webinar**
**Feb 5: Letter of Intent period closes**
**April 15: Full Proposals Due**
**Sept 1: 2nd Year Project Period Starts**

***Increased International collaborations**
- **GlobalHAB International Workshop on Solution to Control HABs in Marine and Estuarine Waters**
- **US, Asia, South America Writing Workshop for Call To Action and HAB Control Method Review**

# US HAB CTI First Year Projects

- New Jersey Institute of Technology: evaluate the use of **nanobubbles and surfactants** on a variety of harmful algal bloom species.
- Southern Illinois University: develop a **molecular tool to inhibit the production of microcystins** by cyanobacteria
- Carnegie Mellon University: study the effect of **TAML/$H_2O_2$** on *Karenia brevis* and brevetoxin.
- Tulane University: study the effect of a **clay/algaecide slurry**, proven effective against *Karenia brevis*, on *Microcystis aeruginosa*.
- Ohio State University: develop a shear stress-moderate **electric field reactor vessel** to treat bloom-affected lake water.
- Greenworld Environmental Alliance: determine an effective concentration of their product **DE-OIL-IT** on brevetoxin and cyanotoxins.
- NeroPure LLC: test their **plant-based product** on multiple Harmful Algal Bloom species and the fate of their toxins in large mesocosms.

# Innovative Technologies Grant Program – 2023-2024

- Heartland Energy Group/Mote: *Non-Toxic Biodegradable Formulation for Eliminating Cyanobacteria and their Toxins in Freshwater Systems* (Xtreme)
- Blue Green Water Technologies/Mote: *Lake Guard Dew Efficacy Towards Nutrient and Harmful Algal Bloom Reductions*
- Innovative Heights/Mote: *The Aquastream Algae Collecting Skimmer Bot: Demonstration of Cyanobacteria Collection and Removal*
- https://protectingfloridatogether.gov

# Public Comments

# TAC Closing Comments and Recommendations