Ohio Department of Higher Education Harmful Algal Bloom Research Initiative (HABRI)

Agency Driven Priorities to Inform Management and Innovation

As highlighted within the request for proposals, due to the nature of this funding, successful proposals **must** include research and/or development in support of Ohio industry, commerce, or business (e.g., water treatment plants, agricultural producers, health care providers, etc.). The priorities listed below accomplish this connection, but we welcome investigators contacting Ohio Sea Grant (winslow.33@osu.edu; fussell.10@osu.edu) to facilitate connections between proposal authors and end-users (e.g., industry, businesses, agencies, etc.). Ohio Sea Grant is also happy to discuss projects that don't address a specific priority below but that might help the state prevent, manage, and/or mitigate nutrient runoff, Harmful algal bloom (HAB) growth, and HAB toxins.

Ohio Environmental Protection Agency (OEPA):

- Strategies and tools to evaluate or mitigate HABs and protect (improve) drinking water source quality:
    - Reservoir management projects that assess the efficacy of cyanobacteria control (e.g., algaecides, ultrasound) and/or nutrient reduction (e.g., alum treatments to upground reservoirs, diversion/treatment train wetlands). Prioritize projects that include objective to develop reservoir management plans with Public Water Systems (PWS).
    - Efficacy studies (pilot demonstrations) of emerging technologies and support for transfer of these technologies to PWS and/or recreational waters. Prioritize technologies for use in drinking water sources with NSF/ANSI/CAN standard 60/61 certification.
    - Projects that couple mitigation strategies with land use best management practices and/or integrate with larger source water protection projects, including development of regional partnerships and source water protection plans.
    - Data analytics tool, potentially linked to or using Geographic Information System (GIS), for water quality monitoring data that will improve timeliness and efficiency to evaluate and share data.
    - Aerial Imagery evaluation tool for surface water bodies in the State.
- Assess outcomes and adoption of drinking water treatment processes for cyanobacteria and cyanotoxins:
    - Document success stories and/or impediments to practical use or adoption.
    - Prioritize projects that include knowledge exchange (e.g., involvement with trade organizations) and cost-benefit analysis for utilities.
- Plan, approach, and/or tool to aid in identification, occurrence, and environmental drivers of emerging cyanotoxins in waters throughout Ohio.
- Urban stormwater nutrient reductions, including dissolved reactive phosphorus (DRP):

    - Are there novel structural or non-structural stormwater best management practices, including runoff reduction tools, that address DRP?
    - Evaluate/identify critical sources of DRP runoff and source controls for urban stormwater (similar to Agricultural Conservation Planning Framework but for urban landscapes).
    - How to better evaluate/monitor total and dissolved phosphorus and nitrogen loads in urban stormwater, including Municipal Separate Storm Sewer System (MS4)?

- Implement a pilot study for the agronomic beneficial reuse of wastewater from communities served by controlled discharge lagoons.

- Develop new or evaluate the effectiveness of existing low-phosphorus additives for cooling water.

- Conduct farm field research on the beneficial use of Lake Erie dredge as an agricultural soil amendment, evaluating its effects on soil health, nutrient retention and exports to waterways, crop yields, and its economic feasibility. Continue current research which is providing information on using dredge sediment as an alternative fertilizer source with optimal nutrient levels to restore soil loss and improve soil health.

- Beneficial Use: HABRI research projects to date demonstrate that materials high in aluminum oxide and iron oxide content can tightly bind phosphorus in soils (examples: foundry sand, drinking water treatment material). Phosphorus binding beneficial uses proposed for study include the following:

    - Laboratory studies have shown that blending drinking water treatment material (DWTM) with manure can reduce DRP loss by 30-50%. However, the logistics of this are challenging. Field studies are needed to further evaluate blending DWTM before land application or applying DWTM within 48 hours of land application of the manure.

    - Field studies to assess the addition of DWTM to buffer strips on the edges of farm fields and to two-stage ditches.

    - Determine if farm fields in Northwest and Central Ohio that have had a history of DWTM use are considered a source of legacy/old P by collecting soil samples and analyzing for the degree of phosphorus saturation (Example: DPS (%) = Mehlich-3 P / (Mehlich-3 Al + Mehlich-3 Fe) × 100). A DPS > 25% usually indicates phosphorus saturation.

    - Field studies to assess the use of DWTM in wetland soil blends to sequester phosphorus in existing wetlands or when creating constructed wetlands.

    - Engineer a ditch water treatment system using DWTM that sequesters phosphorus from tile discharge water prior to its release to the ditch, reaching the larger connected ditch.

    - Create soil blends using DWTM, foundry sand, and Lake Erie dredge in Brownfield remediation projects.

    - Create soil blends using DWTM, foundry sand, and Lake Erie dredge for upland beneficial use and habitat restoration projects.

- Blend DWTM into bioretention collection basins, municipal stormwater systems, and combined sewer overflow systems to sequester phosphorus.

Ohio Department of Natural Resources (ODNR):

- Increasing our understanding of ecosystem functions within wetlands that have been restored, enhanced, or created with a nutrient-reduction focus:
  - What role do plants and/or animals play in nutrient removal and cycling within wetland ecosystems?
  - Development of innovative remote sensing technology and interconnected network that monitors wetland ecosystems that can be connected across a broad spatial range and improve our understanding of wetland functions.
  - What hydrological management regimes optimize nutrient sequestration by wetlands? (e.g., seasonal vs continual pumping)
  - What are the tradeoffs between nutrient removal and wildlife benefits among the different wetland management approaches? For instance, what are the effects on biodiversity or other non-nutrient metrics?
  - Do the water management strategies that optimize nutrient sequestration promote or inhibit the formation of diverse and resilient aquatic communities?
  - Evaluate the effect that the wetland water management strategies aimed at optimizing nutrient sequestration have on the use by, and benefits for, native fishes.
  - Evaluation of temporal dynamics of wetland function relative to nutrient processing (i.e., effectiveness at year 1 vs year 5+)
  - Develop an improved wetland ecosystem model for understanding nutrient cycling within non-flow through wetlands (i.e., coastal, flood plain, and/or isolated wetlands).

- Improving our ability to select sites and predict wetland restoration impact at removing and/or sequestering nutrients and sediments within a watershed:
  - Refining, streamlining methodology for P-reduction estimation when planning/prioritizing/siting nutrient reduction wetlands
  - Role of legacy Phosphorous in newly constructed wetlands
  - How to construct an effective wetland (e.g., site selection, characteristics for an effective wetland, etc.)
  - Determine the effectiveness of different wetland types at removing nutrients and sediments

- Understand the social science around wetland restoration efforts:
  - What impacts landowner's willingness to adopt wetland restoration practices
  - What role does government conservation policies play into this willingness?
  - How do different communities or segments within communities' view wetland restoration efforts?

Ohio Lake Erie Commission (OLEC):

- Research to support metrics or indicators of ecosystem or economic health in the Ohio Lake Erie watershed. This may include survey-based measures of resident satisfaction with, or willingness to pay for, various elements of the Lake Erie ecosystem services, tourism features, or recreation opportunities that may be affected by the presence of HABs. Other possibilities include further development of nearshore indices that include the effects of HABs.

- Social marketing research and development to help the state communicate about nutrient reduction efforts and promote Best Management Practices (BMP) adoption (both urban and agricultural). Investigators will be expected to work with state agency staff to refine the messaging.

Joint ODNR, OEPA, and OLEC:

- Research related to "Old phosphorus", also often referred to as legacy and stored phosphorus. This type of phosphorus loss from fields is typically defined as nutrients that were **not** applied in the most recent cropping season (fall of previous year and spring of current year). These are thought of as nutrients associated with previous/historic nutrient applications. This "Old Phosphorus" can be associated with previous commercial and manure applications. Specifically,

    - What is the percentage of "old phosphorus" leaving agricultural fields relative to the phosphorus applied in the current cropping season.
    - Assessment of the ability of phosphorus absorption structures, drainage ditch design, wetlands, and management practices (e.g., reduced application within tri-state recommendations) to reduce, trap, and/or drawdown the amount of "old phosphorus" leaving an agricultural field.
    - Are there specific soil characteristics associated with "old phosphorus" acres/fields that are prone to both "old phosphorus" loss and storage?
    - How can we effectively and efficiently identify where "old phosphorus" acres are located across the landscape, and more specifically within a field. Further, is it feasible to effectively target the loss of "old phosphorus" from a subset of acres within a larger field.
    - Modeling related to (1) how long would a watershed-wide soil test phosphorus drawdown (a targeting of "old Phosphorus" acres) take under various management scenarios and (2) what amount of "old phosphorus" reduction/trapping would be needed to see a cumulative nutrient reduction at the mouth of the Maumee River. Further, how would we establish an "old phosphorus" baseline to be used within these models.

- Improving our understanding of how seasonal dredging and placement of dredge material from the Toledo Federal Navigation channel affects nutrient load magnitude and bioavailability in Maumee Bay and impacts seasonal western basin HABs. Specifically, research to identify innovative strategies and tools to evaluate the effects of dredging, dredge material placement/management/beneficial use, and dredge timing to reduce HABs.

    - Is there a relationship between the seasonal timing of dredging and dredge material management in western basin HABs?

    - What tools/methods/data need to be developed or collected to assess the seasonal and nutrient load impacts from dredging and dredge material management on western basin HABs?
    - What is the relationship of sediment resuspension and/or internal loading (release of bioavailable phosphorus) on western basin HABs?

- How does Ohio's 2020 dredge material open-lake placement ban change sediment movement, lakebed sediment dynamics, and phosphorus bioavailability in Maumee Bay?

    - To what extent/magnitude does sequestration of dredge material through upland placement or beneficial use remove particulate/bioavailable phosphorus from the western basin? What factors need to be considered when estimating potential reductions in load?
    - What data/tools/methods need to be collected/developed to assess the seasonal impacts of sequestration on western basin HABs?

Ohio Department of Agriculture (ODA):

- Manure-related research synthesis:

    - Literature review or data synthesis on effectiveness of various manure management practices, application methods, application timing, and associated (appurtenant) practices on nutrient loss and runoff for nitrogen and phosphorus? Summarize the existing research and develop research where there are gaps.
    - Literature review or data synthesis of on-farm manure transformation technologies such as solid/liquid separation, nutrient removal, or additives. Results must determine impacts to nutrient transport, application, or cost efficiencies.

- Drainage retention/detention synthesis:

    - Literature review or data synthesis of nutrient reduction capabilities of drainage water management structures, denitrifying bioreactors, saturated buffers, and/or other conservation drainage practices.
    - Literature review or data synthesis of best design parameters of nutrient reduction wetlands to be employed within the agricultural drainage system (e.g., retention time, plantings, etc.) and long-term maintenance practices to continue nutrient reductions.

- Data synthesis:

    - Literature review or data synthesis on changes of rainfall patterns in Northwest Ohio such as intensity and seasonality over the last 30-50 years. Results must contemplate potential nutrient transport changes, if any.

- Nutrient recommendations:

    - Literature review or data synthesis on nitrogen sufficiency rate development methods that include environmental constraints.
    - Assess the "sufficiency approach" to phosphorus (Thoughts On Profitable Fertilizer Rates), which would require the researcher to look at low phosphorus fields and

assess current “crop removal” vs “buildup” rates. Especially relevant now that so much ground is rented.

- Innovative Technologies:
    - Research that demonstrates the use of IoT (Internet of Things) solutions to connect and utilize water quality sensors in-field, edge-of-field, and/or in-stream to help inform nutrient transport and elevated phosphorus production watersheds in the western Lake Erie basin. Project must identify/develop real sensors that could be used and must develop a prescriptive manual for use.

Ohio Department of Health (ODH):

- Health effects and treatment options **for recreational exposure** (including incidental ingestion, inhalation, and dermal contact) to low levels of cyanotoxins and contaminants of emerging concern (e.g., microplastics, pharmaceuticals, etc.)**.**

- Health effects and treatment options for exposure to low levels of cyanotoxins **through drinking water,** with particular focus on sensitive populations, including children, pregnant women, and nursing mothers, as well as the ability to eliminate toxins after exposure.

- Impact of **total body burden from exposure to multiple cyanotoxins** and occurrence of chronic disease, including impacts on neurological and metabolic functions.

- Development and research of improved, commercially available tools for the clinical diagnosis of cyanotoxin poisonings in humans, pets and livestock.

- Evaluation of health impacts to pets and livestock from exposure to cyanotoxins, (especially Anatoxin-a). This could include diagnosis and responsive treatment, and elimination of toxins after exposure.

- Transfer and persistence of cyanotoxins into plants and the food chain, resulting in impacts on sport fish populations, residence time of cyanotoxins in sport fish, and the health effects of sport fish consumption containing cyanotoxins.

- Prevalence and occurrence of all cyanotoxins (other than microcystin) in lakes, ponds, and springs used for recreation and private drinking water supplies.