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Lake Nokomis and Cedar Lake Blue-Green Algae Bloom Mitigation Strategies Project

Rachael Crabb – MPRB Water Resources Supervisor

Overview

- Harmful algal blooms overview
- Project background
- Recommended approaches
- Potential sources of funding
- Steps forward

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What are Harmful Algal Blooms?

- A problem with many names:
  - Harmful algal blooms
  - Blue-green algae
  - Cyanobacteria
- Found in lakes, rivers, ponds in MN and around the world
- **Human health concern** - Can produce toxins such as microcystin that can be harmful to people and animals

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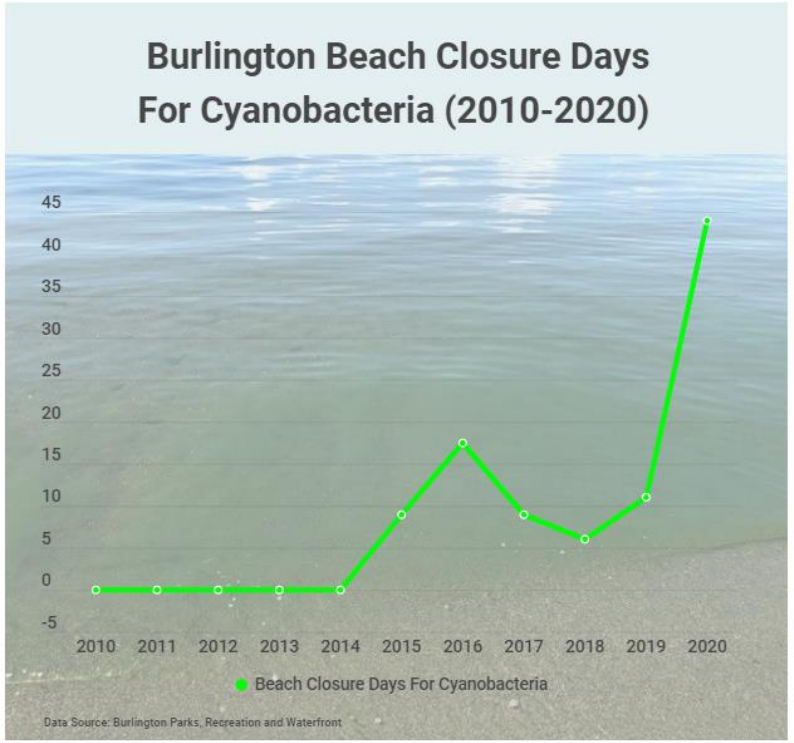
Not only an MPRB issue



Carver Lake beach shut down in Woodbury due to blue-green algae

Photo: CSIRO / CC BY 3.0 / MGN.

KSTP
Updated: July 20, 2021 04:50 PM
Created: July 20, 2021 04:44 PM

The public is being asked to avoid Carver Lake in Woodbury after blue-green algae were found on Tuesday.

Wisconsin DNR @WDNR · Jul 2

BEACH CLOSURE: The beach at Willow River State Park is temporarily closed due to blue-green algae.

ALERT

SWIMMING | BLUE-GREEN ALGAE

Watch now: 5 Madison-area beaches closed due to hazardous blue-green algae

Molly DeVore Jun 4, 2021 0

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Not all “scum” is dangerous

Filamentous green algae is non-toxic

Duckweed, a plant, is non-toxic

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Why now?

- Urban lakes may be more susceptible to blooms
- Increased reports of potential issues with people (eye and sinus)
- Red blooms in Nokomis and Cedar more frequent
- Climate change is an exacerbating factor
    - Earlier Spring
    - Later Fall
    - Rain in Winter

(credit: John Cardwell)

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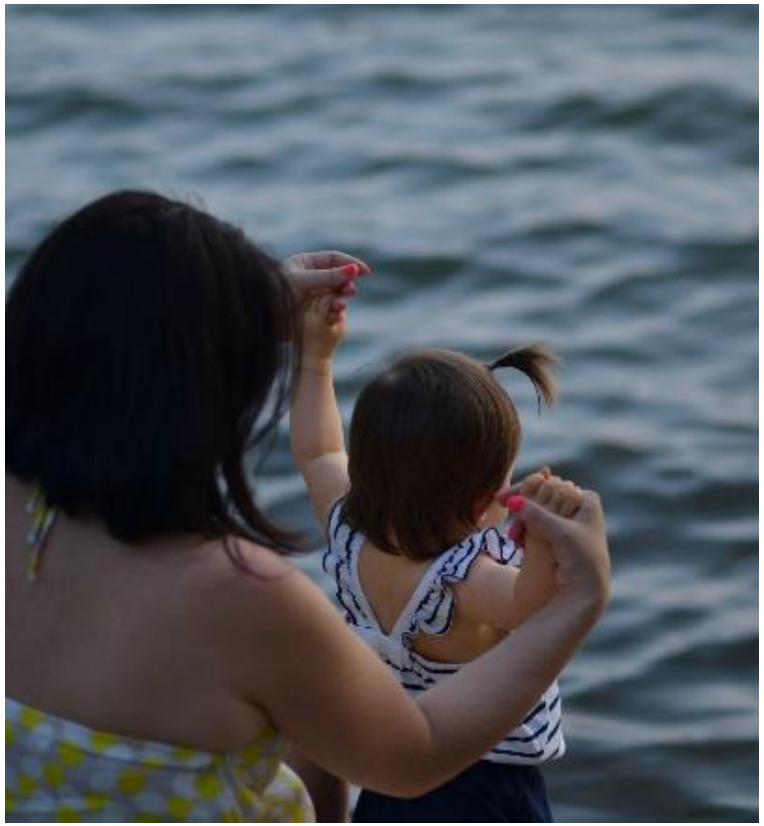
Microcystin (Toxin) Levels

6 micrograms per liter (ug/L)

Is the safe level for swimming (MPCA)



>20 micrograms per liter (ug/L)

Measured in Lake Nokomis in 2021 during swim season

Both lakes are at risk for exceeding World Health Organization and Minnesota Pollution Control Agency (MPCA) standards

How can this problem be studied and mitigated?

After a national consultant search, MPRB hired Barr Engineering Company to complete a study with the following objectives:

1. Identify the specific stressors causing beach season and off-season cyanobacteria blooms in the lakes.

2. Identify structural and nonstructural mitigation strategies to address the stressors resulting in cyanobacteria blooms.

3. Create planning-level cost estimates for most promising strategies.

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Barr Engineering Stressor Analysis

- What is causing increased algal blooms?
  - Phosphorus and nitrogen nutrient enrichment
  - Warming air/water temperature
  - Light
  - ~~Micronutrients~~
  - ~~Zooplankton Predation~~
  - ~~Hydrology/detention time~~

Climate change is likely to exacerbate this issue throughout the 21st Century

BARR

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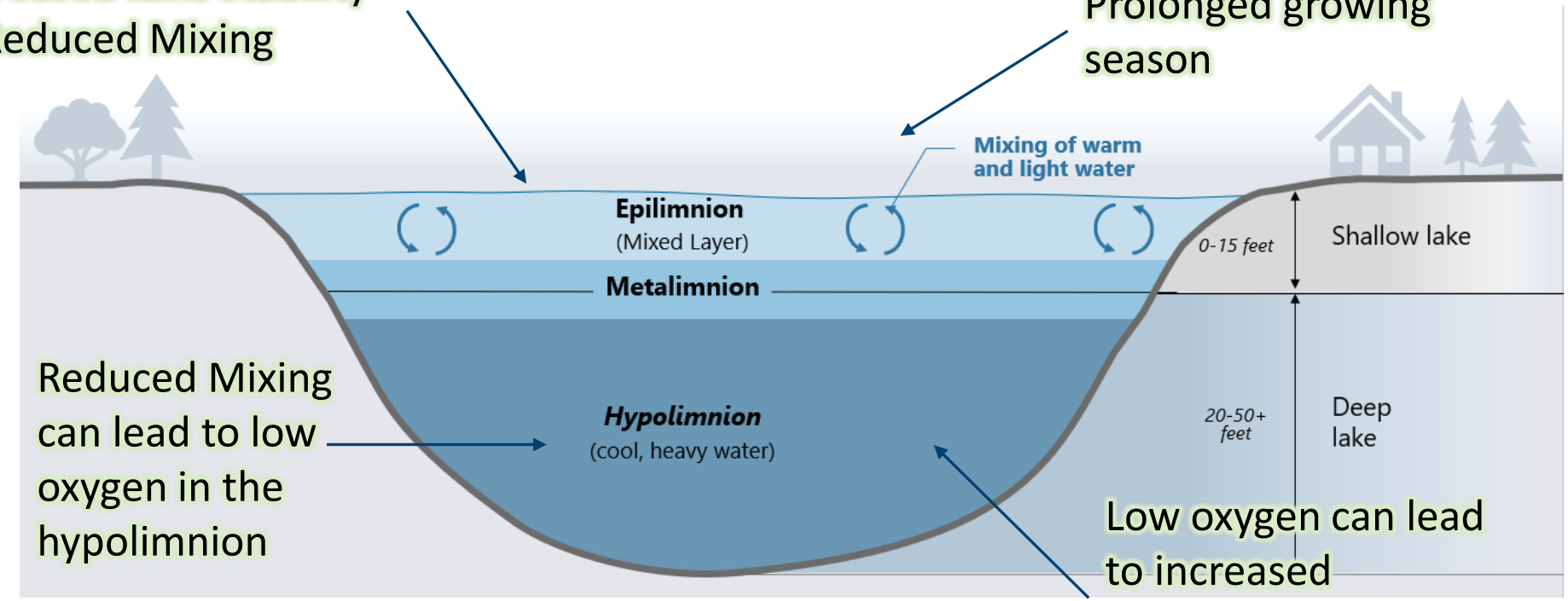
Causal Analysis - Warming Temperatures + Nutrient Enrichment

Increased Lake Stability & Reduced Mixing

Prolonged growing season



Reduced Mixing can lead to low oxygen in the hypolimnion

Low oxygen can lead to increased phosphorus release from sediments

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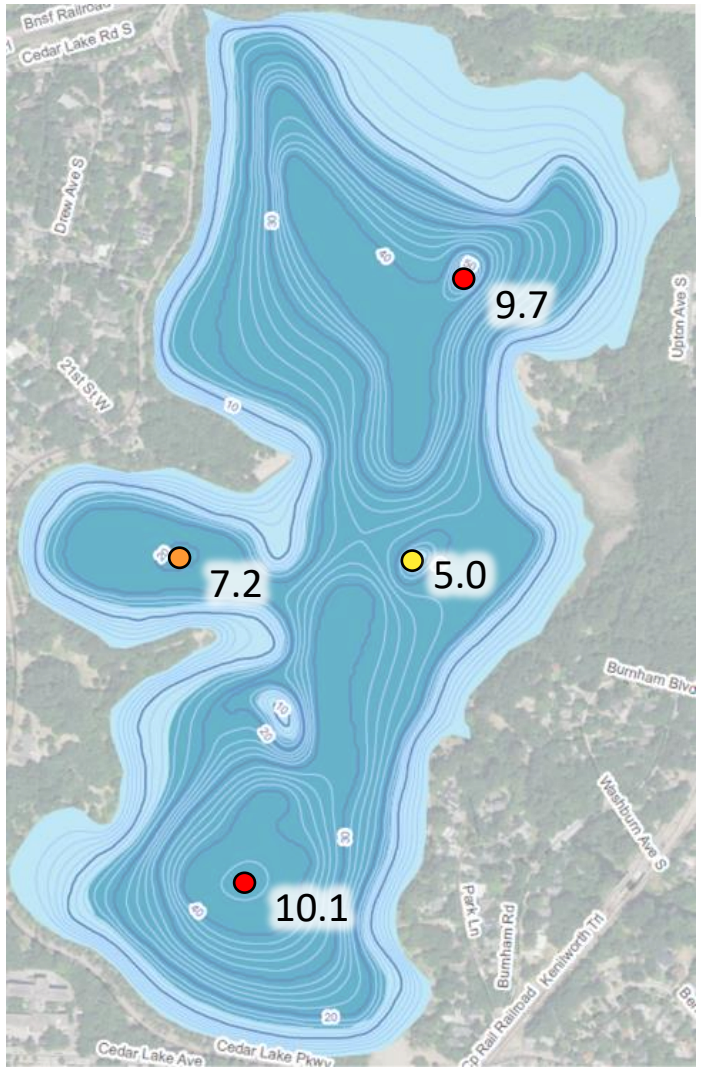
High Sediment Phosphorus Levels

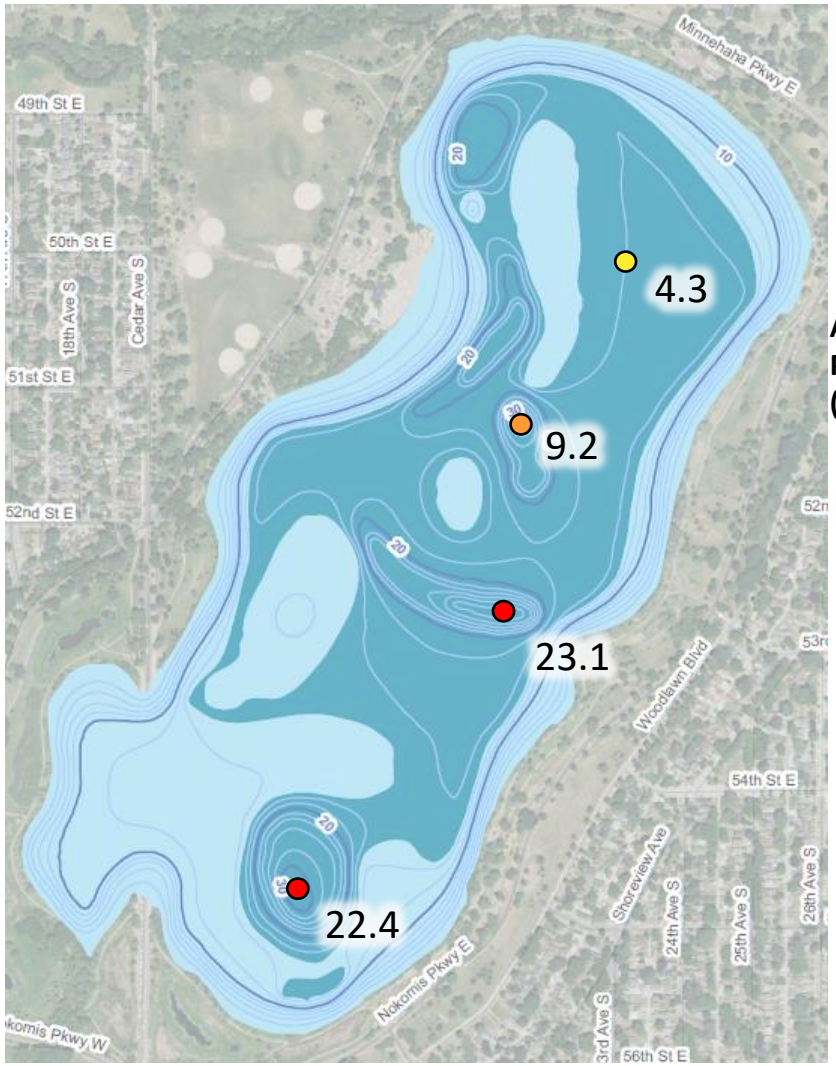


Depth Contours
10'-Contour
2'-Contour
Anoxic Sediment Area
(> 15 ft depth)
(>4.5 m depth)

Anoxic Sediment Total Phosphorus (TP) Release Rate (mg/m²/day)

5.0 — 10.1

Cedar Lake



Depth Contours
10'-Contour
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Anoxic Sediment Area
(> 15 ft depth)
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Anoxic Sediment Total Phosphorus (TP) Release Rate (mg/m²/day)

4.3 — 23.1

Lake Nokomis

Management Options (aka Tools in the Toolbox)

1. External watershed nutrient load reduction
    - Infiltration/Filtration
    - Ponds
    - Wetland Restoration

Deal with “new” phosphorus

2. Internal sediment P load reduction
    - Carp (sediment resuspension)
    - Sediment Inactivation (e.g., alum treatment)
    - Aeration (oxygenation, alum injection)

Deal with “legacy” phosphorus

Algaecides (reactive)

Concept Design Estimate over 20 years for Whole Lake Algaecide Applications Assuming 4% Inflation

Activity	Cedar Hydrogen Peroxide	Cedar Copper Sulfate	Nokomis Hydrogen Peroxide	Nokomis Copper Sulfate
Algaecide Application and Monitoring Plan	$30,000	$30,000	$30,000	$30,000
Additional Monitoring	$619,384	$619,384	$619,384	$619,384
Algaecide Applications	$5,204,672	$1,801,514	$8,462,989	$3,235,865
TOTAL	$5,854,056	$2,450,898	$9,112,373	$3,885,249

2.5 – 9M per lake over 20 years

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Reactive Approach - Algaecides

- Can suppress blooms, but does not solve the root problem
- Most expensive option
- Experimental
- Timing and dosing are critical
- High data collection needs (staff time)
- Ruled out products that would damage lake life (copper)
- Some products that are environmentally safer (peroxide)

2.5 – 9M per lake over 20 years

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Oxygenation - Proactive

Hypolimnetic oxygenation: Cedar Lake

Items	Estimated Cost
Mobilization/Demobilization	$20,000
Safety, erosion control, and site prep	$20,000
Concrete buildings (two) and foundations	$100,000
Electrical extensions/upgrades	$50,000
Direct oxygenation system	$750,000
Site restoration	$20,000
Construction subtotal:	$960,000
Construction contingency (20%)	$192,000
Estimated construction cost	**$1,152,000**
Planning, engineering, and design	$100,000
Present value estimate of 20-year O&M costs	$680,000
Total	**$1,932,000**

Aeration and artificial circulation: Lake Nokomis

Items	Estimated Cost
Mobilization/Demobilization	$20,000
Safety, erosion control, and site prep	$20,000
Precast concrete building, door, fans, and foundation	$160,000
Compressed air system, mechanical piping and electrical	$250,000
Site restoration	$20,000
Construction subtotal:	$470,000
Construction contingency (20%)	$94,000
Estimated construction cost	**$564,000**
Planning, engineering, and design	$100,000
Present value estimate of 20-year O&M costs	$680,000
Total	**$1,344,000**

1.3 – 2M+ per lake over 20 years

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Proactive Approach – Oxygenate bottom water

- Prevents conditions that allows sediment to release phosphorus
- Non- chemical (unless alum injection is added for additional $)
- Proven technology
- Significant infrastructure addition (small buildings, pipes)
- Staff for running the systems (additional $)
- Blooms could occur quickly if systems are off

1.3-2M+ per lake over 20 years

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Sediment Inactivation

Comparison of phosphorus inactivation approaches over a 20-year life cycle per lake

Activity	Cedar Buffered Alum	Cedar Phoslock	Nokomis Buffered Alum	Nokomis Phoslock
Initial application plans and specifications/application observation	$30,000	$30,000	$30,000	$30,000
Laboratory jar testing	NA	$50,000	NA	$75,000
Initial applications	$533,130	$662,899	$787,223	$968,621
Follow up application plans and specifications/application observation	$15,000	$15,000	$15,000	$15,000
Follow up sediment monitoring (3 events)	$75,000	$75,000	$75,000	$75,000
Follow up application[1]	$151,762	$188,702	$224,093	$275,730
TOTAL	$804,892	$1,021,601	$1,131,316	$1,439,351

[1]Estimate based on 20% of the original dose

1-1.5M per lake over 20 years per lake

Proactive Approach – Sediment Inactivation

- Bind phosphorus, so it cannot release
- Alum vs Phoslock
- Alum has a longer history of use, including in the Minneapolis lakes
- Dose and project longevity is more defined for alum
- Lake chemistry in our region suitable for alum use
- Alum is more cost effective

1-1.5 M per lake over 20 years

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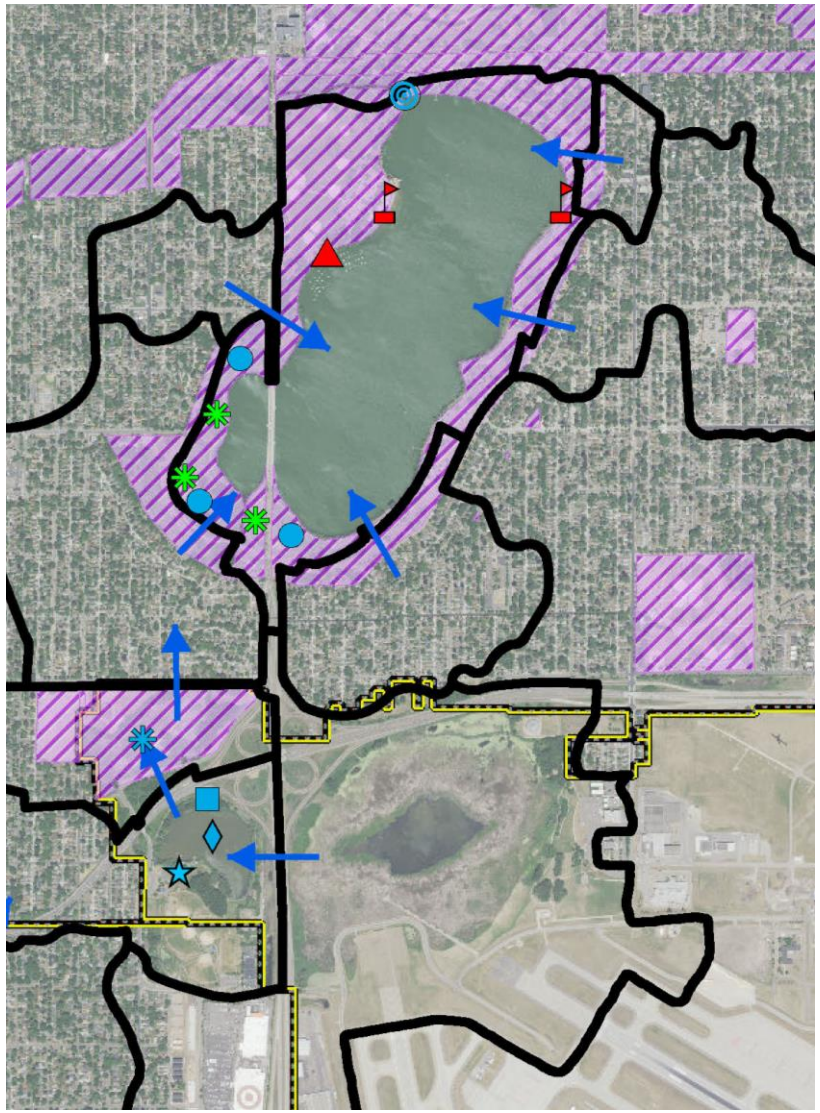

Recommended Strategies

Lake Nokomis

Control Phosphorus Internal Load

- Continue Carp Management
- Continue Watershed Nutrient Control
- Consider Aquatic Vegetation Management

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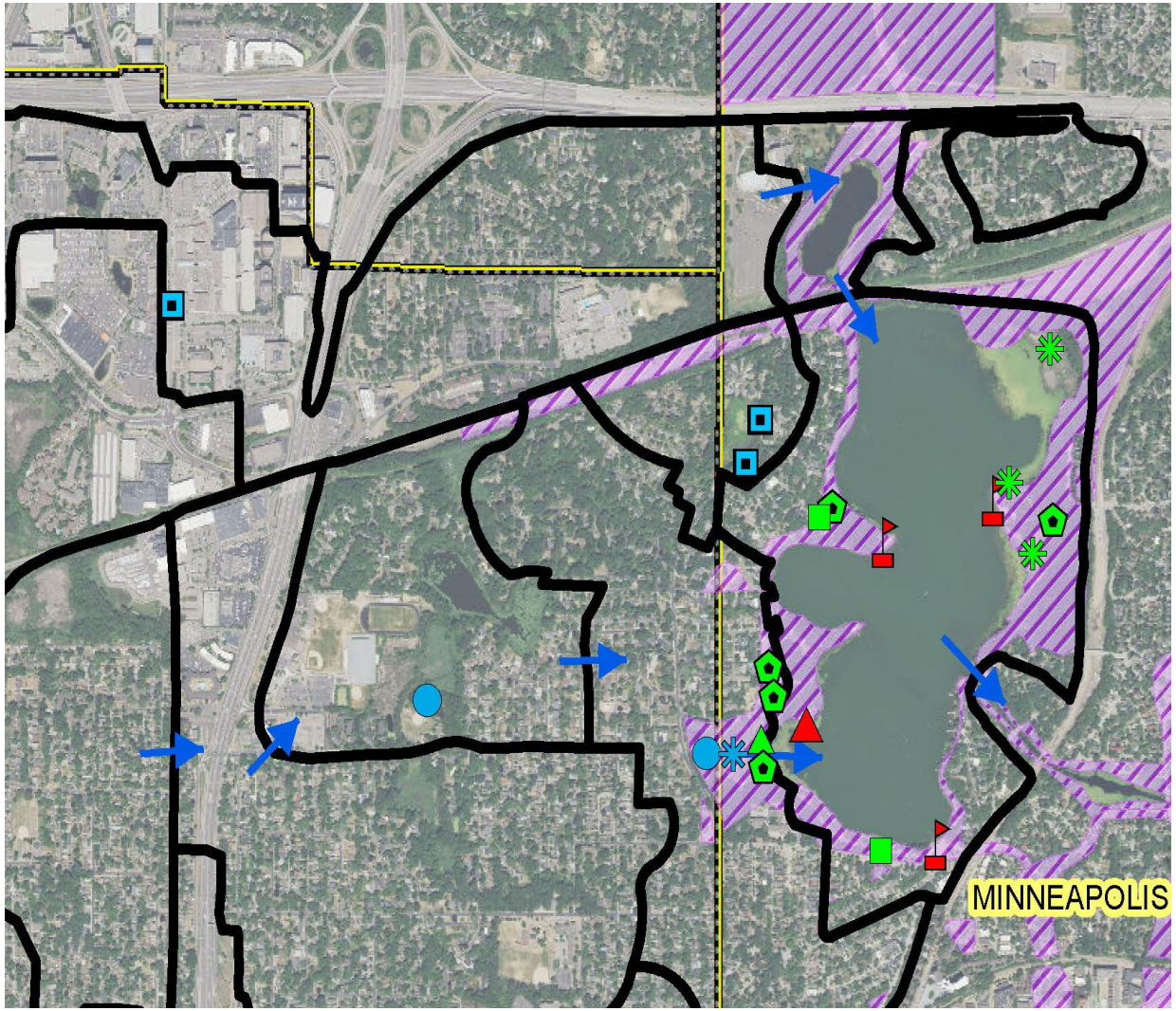

Recommended Strategies

Cedar Lake

Control Phosphorus Internal Load

- Continue Watershed Nutrient Control
- Consider Aquatic Vegetation Management

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Project Summary and Next Steps

- Harmful Algal Bloom Study Completed
- Management Strategies Identified (alum)
- Engaging Partners
- **Choose project(s) for implementation**
- **Update Plans**
- **Position for grant availability**
- **Lake vegetation planning**

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Potential Funding Source: Clean Water Fund

- Very competitive
- Funds similar projects statewide
- Prioritizes collaborative projects
- Requires that the project appears in a Local Surface Water Management Plan
  - MPRB does not have this type of plan
  - Projects currently not in MCWD or Minneapolis eligible plans
  - Partnership needed

CLEAN WATER LAND & LEGACY AMENDMENT

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New Water-Focused Partnership

- MPRB, City of Minneapolis, Minnehaha Creek Watershed District
- Modern version of successful Chain of Lakes Clean Water Partnership
- Involves creation of *MOU/Cooperative Agreement* and Steering Committee

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Partnership Structure

Partnership Implementation Plan

Minneapolis City of Lakes

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MINNEHAHA CREEK WATERSHED DISTRICT

Policy Steering Committee

- Two Policy Makers per partner
- Meet twice annually
- Review PIP
- Seek full agency support on timeline with budget

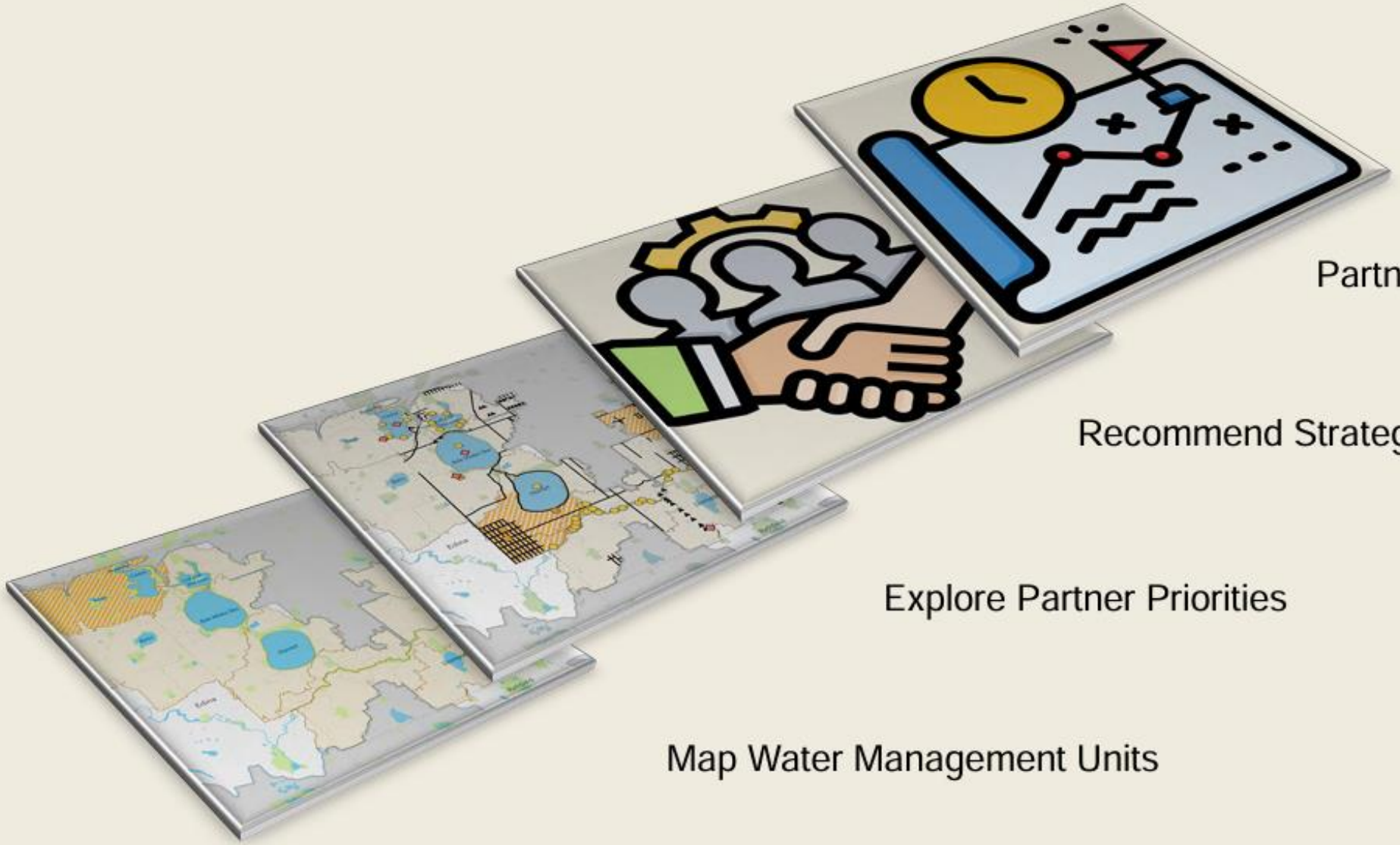
Coordinating Team

- Meet three times annually
- Guide Technical Team
- Frame PIP to Policy Makers
- Evaluate Pilot Partnership Performance

Technical Team

- Staff from all three agencies
- Meet Quarterly to identify opportunities
- Annually in March recommend PIP
- 5-Year Projects, Funding, Timelines

Long Range Planning

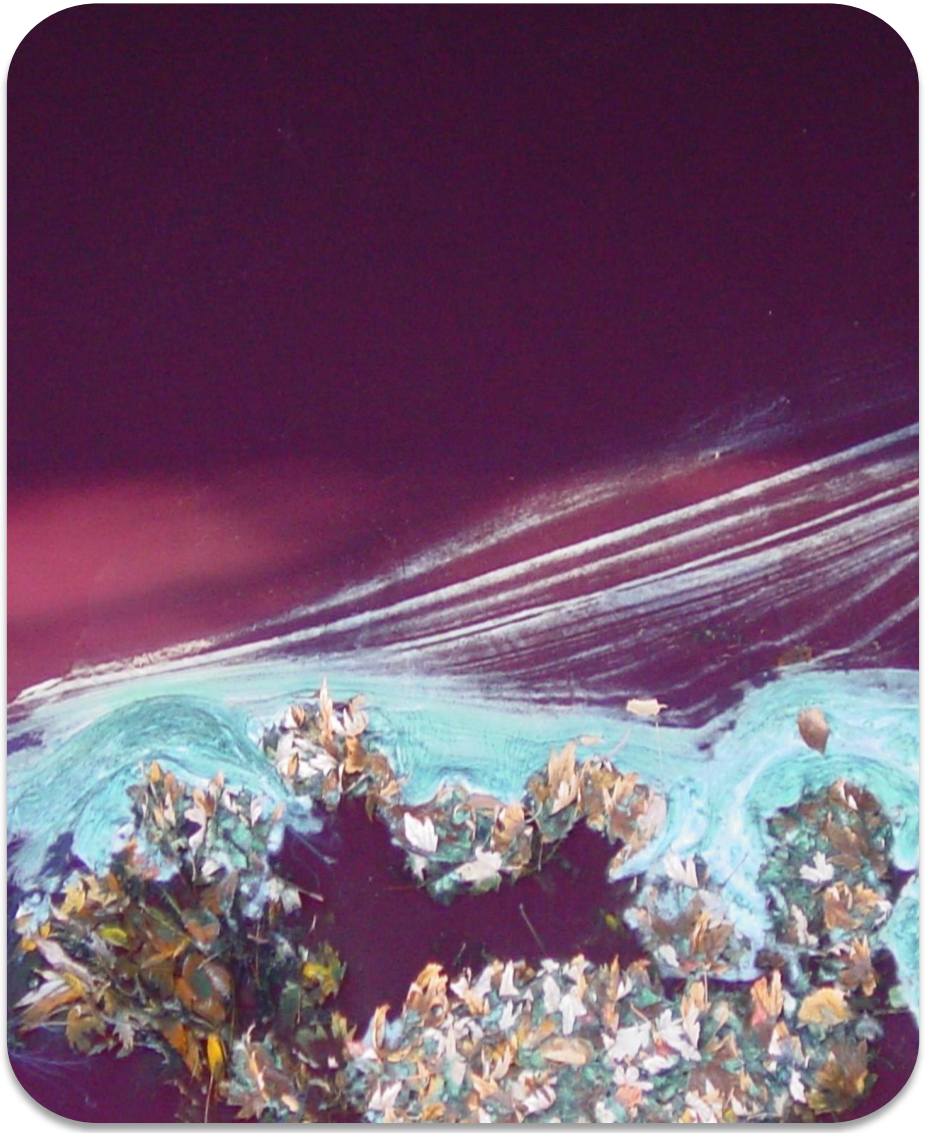


Partnership Implementation Plan

Recommend Strategic Alignment

Explore Partner Priorities

Map Water Management Units



Summary

- Harmful Algal Blooms in lakes
- Beach Monitoring ongoing
- Management Strategies Identified
- Engaging Partners
- Seeking funding for Implementation

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Questions?