Newman Lake WQ Improvement Project Update
Public Meeting March 5, 2024
Presentation Agenda – follows project scope

• Summarize Lake Analysis
• Summarize Water Quality Goals and Evaluation Criteria
• Summarize Alternatives Analysis and Priority Ranking
• Recommendations
• Implementation
2023 Monitoring Campaign

• More insight into water quality dynamics by adding more parameters
  - Iron, manganese, ammonia-N, and bottom Chl-α to calculate O₂ demand
  - Phytoplankton – spring to fall
  - Zooplankton – spring to fall

• More vertical profile data
  - Temperature
  - DO
  - Conductivity
TP by layer

- Surface TP is watershed plus bottom TP mixed up from middle
- Middle TP shows bottom influence
- Bottom TP caused by iron reduction (lack of oxidization)
Major finding: No need for hypolimnetic alum injection

• There is **more than enough iron** to keep P in sediments
• The problem is that there is not enough oxygen for iron to bind P in sediments
• Improving oxygenation is the solution
• Alum is not necessary to bind P in hypolimnion
Whole lake experiment

- Turn off cone in August 2023
- Compare data between cone off and cone on

Temperature, °C

Percent DO saturation
Total iron (Fe)

- Oxidized Fe works like alum to bind P
- Speece cone oxidizes most Fe
- Need more O₂ to oxidize all Fe
Defining design $O_2$ demand

Parts of oxygen demand

- Sum of parts is $678 \text{ kg } O_2/d$
- Reoxygenation rate from zero to saturation:
  - 30 days $\rightarrow 863 \text{ kg } O_2/d$
  - 60 days $\rightarrow 432 \text{ kg } O_2/d$
- Total $= \text{ Parts } + \text{ 30-day rate } = 1,541 \text{ kg } O_2/d$
- Paul Gantzer calculated $1,360 \text{ kg } O_2/d$ by other means given conditions of 2023
- Parts $+ \text{ 60-day rate } = 1,110 \text{ kg } O_2/d$ is a safe value, but 30-day rate is conservative
Water Quality Goals and Evaluation Criteria

- Chartering session workshop in early October after 2023 Water Quality Data was available.
- Define water quality goals and evaluation criteria.
- Identified key assumptions and constraints, defined critical success factors, and confirmed criteria to be used for alternatives evaluation.
- Criteria were linked to the established goals.
Water Quality Goals

- Meet requirement of TP TMDL 20 ug/L
- TP less than 12 ug/L
- Improve water clarity to 3-4 m SD year round
- No algae blooms greater than 20,000 cells per mL
- Microcystin < 8ug/L or lower if practical
- Water quality able to support a cold-water fishery
- No human *E. coli* detections
Criteria

- Water quality impacts
- Reliability
  - Equipment Complexity and ability to maintain
- Timeline to observed water quality impacts
- Operational flexibility
  - Future nutrient loading
- Safety and Security
- Regulatory Requirements
- Efficient
Recommended Technology – Linear Diffuser

Linear diffuser Installations in the US

Technology developed by a federal agency (TVA) in 1990s
## Current Alternatives for Upgrading Oxygen Supply

*Plus 100% or minus 50% accuracy range with a 30% contingency; does not include engineering, administration, permitting, or sales tax.*

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Design Oxygen Delivered to Hypolimnion, kg O₂/d</th>
<th>Scope</th>
<th>OPCC, $M*</th>
<th>Operational Considerations</th>
</tr>
</thead>
</table>
| 1           | 1,603                                         | • New Linear Diffuser  
• Rehab existing AS-L  
• New compressor for existing AS-L  
• New AS-L PSA and compressor | 1.64 | Will need to run both AirSEPs to meet design criteria |
| 2           | 1,911                                         | • New Linear Diffuser  
• Rehab existing AS-L  
• New compressor for existing AS-L  
• New AS-N PSA and compressor | 1.69 | May be able to meet HOD running only the larger AirSEP (AS-N provides 1,110 kg O₂/d) |
| 3           | 2,219                                         | • New Linear Diffuser  
• Rehab existing AS-L  
• New compressor for existing AS-L  
• New AS-P PSA and compressor | 1.87 | Will likely be able to meet HOD running only the larger AirSEP (AS-P provides 1,418 kg O₂/d) |
| 4           | 2,836                                         | • New Linear Diffuser  
• Two new AS-P PSA system and compressors (completely redundant) | 2.16 | May be oversized |
Alternatives Selection Considerations

• **Cost:** Current cost estimates serve mainly to compare alternatives (plus 100% or minus 50% accuracy range with a 30% contingency)

• **Effectiveness**
  - Speece cone designed for 1,300 kg O$_2$/d, but provides ~ 560 kg O$_2$/d
  - Every alternative provides much more oxygen than the Speece cone
  - Design criteria based on HOD is 1,541 kg O$_2$/d (could be as low as 1,110 kg/d)
  - HOD calculations were conservative

• **Operations: Cost of running 1 Vs. 2 compressors**
  - Alt 1: run both sides
  - Alt 2: possibly run one side (60-day reoxygenation criterion)
  - Alt 3: probably run one side (30-day reoxygenation criterion)
Discussion

• Budget vs. oxygen delivery
• Choice involves redundancy
• Working oxygenation system eliminates hypolimnetic alum addition, reduces need for other alum use – cost savings
Other Recommendations

• Carp Study:
  - Determine age class structure and density of carp population to determine how close the carp population is to the critical water quality threshold of 89 pounds per acre.
  - Estimate at least qualitatively the potential for a successful recruiting year to raise carp populations above 100 kg/ha.
  - Perhaps create a conceptual carp management plan suggested by study results.

• Surface Alum Treatment: Re-visit after linear diffuser installation.
Newman Lake does not look like it has excessive carp

- What went right?
- Carp need flooded fields to recruit
- Flooding now rare
- Hypothesis: Carp are dying out
Task 4 – Implementation Plan

- Identify and prioritize recommended improvements for Newman Lake over the short-, and longer-term. The plan will include the following sections:
  - Background
  - Current lake water quality conditions
  - Newman Lake water quality goals
  - Recommendations for near term Newman Lake water quality improvements
  - Recommendations for ongoing Newman Lake management and longer-term improvements
Bidding Strategy

The bidding documents will include two bid alternates to allow a final decision on what to construct to take place after bidding when more costs are known. The two bid alternates will be:

1. Bid Alternate 1, which will include drawings and specs for Compressor Building upgrades from the 2022 Newman Lake Capital Grant Project (P12574), which was put out to bid but not constructed.

2. Bid Alternate 2, which will provide greater oxygen generating capacity than Bid Alternate 1. The details of Bid Alternate 2 will be developed during pre-design by refining Alternatives 2, 3, and 4.
Thank You
Alternatives Scoring

Water Quality Impacts, Operational Flexibility, Reliability, Efficiency, Timeline to Observed Water Quality Impacts, Safety and Security, Regulatory Requirements

Alternative 2 (Rehab/Replace PSA) vs Alternative 3 (Full PSA Replacement)
Discussion

• Budget Vs. oxygen delivery.

• Operational choices influence question of efficacy
  ○ Operate March-November
    ▪ March: Catch up with winter DO drop to start stratification season at saturated DO
    ▪ Stratification season: Necessary
    ▪ Post-stratification: Stop when average DO vertical profile is at saturation

• Working oxygenation system eliminates hypolimnetic alum addition, reduces need for other alum use – cost savings
How much oxygen does the linear diffuser system need to deliver?

- Past studies: Several possible oxygen demand values
- Whole lake experiment results: Find the right number and compare to studies
- Options: All will work. Which one has the best value?

- Cone can’t deliver more than 560 kg O₂/d
- Design was 1300 kg O₂/d
Whole lake experiment

- Turn off cone in August 2023
- Compare data between cone off and cone on

Temperature, °C

Percent DO saturation
What key data do we get by turning off the cone?

• Learn full effect of anoxia without interference from cone

• Hypolimnetic oxygen demand has several parts
  • Settled algae, measured as chlorophyll-a
  • Iron
  • Manganese
  • Ammonia

• Get the data from 1m above bottom

• Run the oxygen demand chemistry on each part
Example: Total iron (Fe)

- Speece cone does oxide some iron, but not enough
- Iron binds phosphate if oxidized (ferric iron), back to this later
Major and minor players in oxygen demand

- Sum of parts is \( 678 \text{ kg O}_2/\text{d} \)
- Need more to raise DO from zero to saturation in 30 days → \( 863 \text{ kg O}_2/\text{d} \)
- Total = \( 1,541 \text{ kg O}_2/\text{d} \)
- Paul Gantzer calculated \( 1,360 \text{ kg O}_2/\text{d} \) by other means for the conditions we found in 2023
Iron and phosphorus

- Lack of iron oxidization drives almost half of Newman Lake phosphorus budget
- If oxidized, is there enough iron to lock TP in sediments?
- Literature says if Fe:P ratio > 15:1, yes.
- Whole lake experiment found Fe:P = 62:1
- Conclusions:
  - Get the oxygen in
  - Forget alum
TP

• TMLD goal 20 µg/L attainable if internal TP quenched
• Community goal of 12 µg/L (4.0 m Secchi disk depth) looks feasible
# Early Alternatives for Upgrading Oxygen Supply

<table>
<thead>
<tr>
<th>Alternative No.</th>
<th>Design Intent</th>
<th>Oxygen Supply</th>
<th>Oxygen Delivered (kg/d)</th>
<th>Notes</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Utilize Existing PSA</td>
<td>• Rehab Existing PSA</td>
<td>1,494</td>
<td>Existing PSA No longer supported</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>• Meets HOD without redundancy</td>
<td>• Rehab Existing AS-L</td>
<td>1,687</td>
<td>Provide at least 2X existing oxygen supply</td>
<td>$1.2M-$1.6</td>
</tr>
<tr>
<td>3</td>
<td>• Provides some redundancy</td>
<td>• Replace Both PSA’s</td>
<td>Maximize oxygen delivered based on space and cost.</td>
<td>Provide at least 3X existing oxygen supply</td>
<td>$1.7M-$2.3</td>
</tr>
<tr>
<td>4</td>
<td>• High end of SOD based HOD</td>
<td>• Replace Both PSA</td>
<td>5,200</td>
<td>Risk of destratification Too high</td>
<td></td>
</tr>
</tbody>
</table>