Development of a Treatment Train to Remove P from Streamflow in the St. Albans Bay Watershed

Phase 1: Regulatory Feasibility Evaluation

Venue: NEIWPC 2018 Annual NPS Conference, Glens Falls, NY
Date: April 26, 2018
Presented by: Gabe Bolin and Dave Braun
Introduction

• St. Albans Bay experiences regular cyanobacteria blooms that impair the recreational use and enjoyment of the bay. In recent years, property values have declined.

• The cumulative effects of agricultural BMP will take time – certainly years and possibly decades – to produce significant measured improvements in water quality.

• The Vermont Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan states that higher nutrient loading from agricultural runoff in a handful of sub-watersheds, including St. Albans Bay, will require implementation of creative solutions and innovative restoration techniques to achieve the goals of the TMDL.

• In St. Albans Bay, in-lake chemical (alum) treatment has been considered, but has not been pursued largely because high tributary P loadings are predicted to negate treatment effectiveness over a short period of time.
Project Scope

Phase 1: Regulatory Feasibility Evaluation

- Evaluate regulatory feasibility of developing a facility to remove phosphorus from streamflow in the St. Albans Bay Watershed
- Engage federal, state, and local officials in considering the potential benefits of and challenges to development of a P treatment train facility.

Stone is acting as a technical resource and a facilitator in this process. We are NOT a developer nor a purveyor of a proprietary treatment system.

Funded by the Lake Champlain Basin Program
Rationale

$ per pound of P: Pound for pound, treating high P streams may be cost effective relative to other P reduction strategies.

Relationship with agricultural conservation practices: In theory, a treatment train facility could extend and enhance ongoing agency programs, not replace the need for implementing BMPs.

Multiscale solution: A Treatment Train facility holds certain advantages not present at the smaller scale of individual farms or developments.
- Electric power to run pumps, chemical feeds, and mixers
- Reliable, year-round access
- Staffed by a trained operator
- Performance could be optimized throughout the year
- Streamflow is perennial
# Advisory Committee

<table>
<thead>
<tr>
<th>Organization</th>
<th>Individual</th>
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</thead>
<tbody>
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Why Jewett Brook?

Total phosphorus concentrations in Lake Champlain tributaries
1992 - 2016*

*Rock River sampling initiated in 2007
Jewett and Stevens brooks initiated in 2009
Mill River initiated in 2010
Putnam Creek was discontinued in 2015
Mouth of Black Creek wetland
October 27, 2017
Grand Lake St. Marys
Grand Lake St. Marys
Grand Lake St. Marys
Grand Lake St. Marys

Currently three treatment trains implemented:

- Prairie Creek (drainage area = 6 mi\(^2\))
- Coldwater Creek (drainage area = 20 mi\(^2\))
- Beaver Creek
- Acquiring land for 4\(^\text{th}\) treatment train

Coldwater Creek

- 2.5 MGD (~1/3 of annual flow volume)
- P removal efficiencies:
  - Late spring and summer – 80% TP; 50-60% SRP
  - Fall – 30% TP; low SRP removal
  - System shut down in winter
- Alum injection was discontinued due to cost and high P removal in constructed wetlands
Coldwater Creek Treatment Train

Initial Settling Pond (15’ deep)

Other Details:
- Rock spillways between ponds
- Interior road network
- Sized for regular dredging
- Area breakdown
  - 10-15% deep pool
  - 10-15% medium depth
  - 70% shallow marsh

Medium wetland cells (4-5’ deep)

Shallow wetland cells (1-2’ deep)
Prairie Creek Treatment Train—Cell #3
Grand Lake St. Marys

Temperature: Monitored at outflow; no observed plumes in lake due to dilution

Impacts to fisheries: Larvae pulled into TT, whereas adults/juveniles ok; addressed with screens

Long term plan for sediment removal
- No dredging yet
- At Prairie Creek, the main settling basin was 15’ deep, now 4’
- Investigating beneficial reuse (fill, potting soil, etc.)

Alum discontinued
- Effective but cost excessive
- When used residence time ⬇️, water treated ⬆️

Operation details (for Coldwater Creek TT)
- Monitoring data inform operations
- Pumping rate ⬇️ if P removal rate ⬆️

Ownership: Mercer County owns land; transfer to Ohio DNR in process
Evaluating a Treatment Train for Jewett Brook

If the intake is located in the backwater zone of Lake Champlain, multiple concerns related to water level fluctuations would be negated.

However, there are several potential impacts to fish that will need to be mitigated:

1) Physical impact of water intake on larval fish (entrainment & impingement)
2) Temperature in mixing zone at discharge location
3) Potential change in streamflow pattern

This project is unique among projects VT F&W has considered in that water could be withdrawn from relatively shallow depth in a wetland during the spawning period. Larval fish could be vulnerable to entrainment, flow reversal, and increased water temperatures.
Potential Treatment Flow Ranges

Jewett Brook Treatment Train
Proposed Treatment Flow Ranges

Total Mean Annual Flow
1,262.7 MGD

0-4 MGD Treatment Range (67.3% of Annual)
0-3 MGD Treatment Range (57.4% of Annual)
0-2 MGD Treatment Range (44.2% of Annual)
Regulatory Feasibility – Required Permits

Confirmed:

- VTDEC - Wetlands
- VTDEC – Lakes and Ponds Encroachment Permit
- VTDEC – Wastewater Program Discharge Permit
- State Floodplain Permit – or – Municipal Flood Hazard Permit
- Town of St. Albans Building Permit
- USACE – 401 Water Quality Certification (*including conditions identified by VT F&W to protect fish populations*).

Potential:

- VTDEC – Stream Alteration (if move current location)
- VTDEC - Streamflow Protection Rule (if move current location)
- VTDEC – Lakes and Ponds Shorelands Permit (if constructed wetlands are within 250’ of mean water of lake)
### Outstanding Resource Concerns – VT F&W

#### Species of concern - fish (northern pike) and waterfowl

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<tr>
<th>Concern</th>
<th>Potential Impact/Stressor</th>
<th>Potential Mitigation</th>
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<tbody>
<tr>
<td><strong>System intake</strong></td>
<td>Physical impacts/mortality to larval fish</td>
<td>Design intake screen to minimize larval fish mortality</td>
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<td></td>
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<td>Adjust intake flow rate / intake pipe diameter</td>
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<tr>
<td><strong>System discharge</strong></td>
<td>Elevated water temperature at discharge location</td>
<td>Impacts to be assessed through modeling in Phase 2</td>
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<td>Discharge water through riparian wetlands or BMP</td>
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<td>Shade wetland cells</td>
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<tr>
<td><strong>System hydrology</strong></td>
<td>Potential change in flow patterns altering larval fish movement</td>
<td>Impacts to be assessed through modeling in Phase 2</td>
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<td><strong>Water surface fluctuations</strong></td>
<td>Entrapment, out-migration concerns; exacerbating natural fluctuations</td>
<td>Withdraw water from backwater zone</td>
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<tr>
<td><strong>% flow removed</strong></td>
<td>Loss of water depth during dry/wet weather conditions</td>
<td>Withdraw water from backwater zone</td>
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Outstanding Resource Concerns - Wetlands

Wetlands permit application will need the following:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Detail</th>
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<tbody>
<tr>
<td>Wetland functions and values</td>
<td>Need assessment to determine if functions and values could be adversely affected</td>
</tr>
<tr>
<td>Decommissioning plan</td>
<td>A decommissioning plan for the treatment train is recommended</td>
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<tr>
<td>Avoidance and minimization</td>
<td>Evaluate all practical alternatives to impact; show that in selecting the facility site we have exhausted all options that do not impact wetlands</td>
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<tr>
<td>Wetlands restoration potential</td>
<td>If the project site has low wetlands restoration potential, more favorable; if project is in area with high wetlands restoration potential, not as favorable</td>
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Outstanding Resource Concerns – Lakes and Ponds

The Lakes and Ponds Program will require the following:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Encroachment Permit</td>
<td>Required by any project that proposes work at, below, or beyond mean water level of public waters. Our intake pipe will be ~12&quot; diameter and will require a permit.</td>
</tr>
<tr>
<td>Shoreland Permit</td>
<td>Required when impacts to land use are proposed within 250 feet of a lake’s mean water level. If constructed wetlands are within 250 feet, a permit will be required.</td>
</tr>
</tbody>
</table>

- No mitigation required, just file permits.
- Shoreland permit needed if area already cleared of trees and constructing wetlands in a corn field? We may be improving the land use and status of the shoreland.
Outstanding Resource Concerns – Wastewater

The Wastewater Program will require the following:

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<tr>
<th>Topic</th>
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<tbody>
<tr>
<td>Water Quality</td>
<td>Will need to show in permit that the discharge causes no significant changes in pH or temperature</td>
</tr>
<tr>
<td>Chemical Treatment for P</td>
<td>If we propose to use alum or similar coagulant, the Wastewater Program will perform a Reasonable Potential Determination (RPD) – an assessment to determine if a discharge has a reasonable potential to cause, or contribute to a water quality impact or excursion above the water quality criteria.</td>
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- pH impacts are not expected; mitigation for temperature impacts was discussed on the VT F&W slide
- Mitigation regarding the RPD is difficult to determine at this time
The USACE will require the following:

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<tr>
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<tbody>
<tr>
<td>Wetland Disturbances</td>
<td>If the project disturbs more than 10,000 SF of wetlands (regardless of class) there are two options: 1) provide for mitigation, or 2) pay an in-lieu fee.</td>
</tr>
<tr>
<td>Section 10 of the Rivers and Harbors Act</td>
<td>The 401 WQC will be reviewed in terms of the Section 10 R&amp;H Act which has certain conditions for structures being built or improved upon in navigable waterways (i.e., the length and height of a structure in the waterway).</td>
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Proposed Schedule

Phase 1: Regulatory feasibility evaluation (nearing completion)
- Evaluate feasibility from a regulatory standpoint
- Establish level of interest/support among federal, state, and local government bodies

- Analyze P loading pattern and potential for achieving TMDL loading targets
- Assess treatability though jar testing and literature review
- Evaluate potential facility sites
- Delineate wetlands on potential site(s)
- Develop conceptual design and perform cost analysis
- Compare with alternatives (more BMPs)

Phase 3 (2019): Engineering and permitting

Phase 4 (2020): Acquire land and establish facility operating agreements

Phase 5 (2021): Construction
Questions?

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Lake Champlain Levels

105 Years of Lake Elevation Data at Burlington, Vermont

Record High: 103.19 ft on May 6, 2011

Record Low: 92.61 ft on December 4, 1908

USGS 04294500 LAKE CHAMPLAIN AT BURLINGTON, VT
FOR WATER YEARS 1907 - 2011
Grand Lake St. Marys

Ownership

• Mercer County owns the land associated w/TTs; will transfer to Ohio DNR

Lake Facilities Authority

• Has taxing authority, but has not exercised this to generate revenue
• Funded through grants, support from Mercer and Auglaize Counties, and private donations
• Both counties have civic foundations; the Mercer County Foundation recently purchased a new pump

Operation Details (for Coldwater Creek TT)

• In normal operating mode, maintenance requires ~ 3-4 hours/week. DNR staff mows
• Time required to adjust pumping rate to maintain appropriate water levels in each season (i.e., emergent vegetation susceptible to flooding in spring)
• Monitoring data used to inform operations; pumping rate decreased if P removal rate declines
• No attempt to optimize P removal by timing pumping with respect to storm events
Title with large image only