Winter 1-2014

2014 Update Mtg: Recommendations for Reducing Phosphorus Loss in Cranberry Floodwaters

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USDA-ARS
Recommendations For Reducing Phosphorus Loss in Cranberry Floodwaters
Who Cares?

- The State (Mass DEP)
  - Total Maximum Daily Load (TMDL) established on White Island Pond
  - TMDL for Monponsett Pond in development
- The Industry
  - Perception matters
  - Cascading effect – you may not be the problem, but may suffer the consequences
- The Research Community
  - Multiple groups, academic and advocacy, are pursuing this research
What Do We Know?

- Not a whole lot, but some
- Two studies on cranberry P loss
    - “Most rigorous” of nutrient loss studies
    - Concentration-discharge approach
    - Daily measurements, assumed negligible groundwater loss
    - Cranberry bog P loss of 9.9 kg ha\(^{-1}\) yr\(^{-1}\)
  - DeMoranville and Howes
    - Assumed steady state to calculate discharge, measured P in grab samples
    - Cranberry bog P loss of 3.5 kg ha\(^{-1}\) yr\(^{-1}\) for organic non-flow through bog
Howes and Teal
Howes and Teal

Outlet Flows

$10^3 \text{ m}^3 / \text{day}$

$\text{m}^3 / \text{s}$

PO4

$\mu$M

May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
Cranberry Bog P loss = 9.9 kg P ha\(^{-1}\) yr\(^{-1}\)
White Island Pond

Final Total Maximum Daily Load of Total Phosphorus for White Island Pond, Plymouth/Wareham, MA

Assuming these same bogs are acting as flow-through bogs, the high land use export coefficient of 9.9 kg/ha/yr from Howes and Teal (1995) is applied to the bog areas listed above. This result:
### TABLE 2. Summary Phosphorus Coefficients used in Nutrient Loading Model of Brockton Water Supply System

<table>
<thead>
<tr>
<th>LU/LC Type</th>
<th>Phosphorus Loading Coefficients</th>
<th>kg/ha/yr</th>
<th>LU/LC Type</th>
<th>Phosphorus Loading Coefficients</th>
<th>kg/ha/yr</th>
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<tr>
<td>Brushland/Succesional</td>
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<td>0.17</td>
<td>Non-forested wetland</td>
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<td>Cemetery</td>
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<td>Nursery</td>
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<td>Open Land</td>
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<td>Orchard</td>
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<td>Cropland</td>
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<td>3.07</td>
<td>Participation Recreation</td>
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<td>0.91</td>
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<tr>
<td>Forest</td>
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<td>Pasture</td>
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<tr>
<td>Forested Wetland</td>
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<td>Powerline/Utility</td>
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<td>Saltwater Sandy Beach</td>
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<td>High Density Residential</td>
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<td>Saltwater Wetland</td>
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<td>Water</td>
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<td>Water-Based Recreation</td>
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</table>
Managing P in Floodwaters
Enhance Particulate Settling

![Bar chart showing phosphorus concentration](https://example.com/bar-chart.png)

- **Total P**: 1.5 mg/L (Harvest) vs. 0.5 mg/L (Winter)
- **Dissolved P**: 0.2 mg/L (Harvest) vs. 0.1 mg/L (Winter)
- **Particulate P**: 0.8 mg/L (Harvest) vs. 0.3 mg/L (Winter)

- **Harvest** (n = 103) vs. **Winter** (n = 38)
Peak TP in Harvest Release Water

P Concentration (mg/L)

Harvest Flood (month/day/year)
Depth Effect

![Graph showing depth effect with dates 9/30/12 to 10/6/12 and total P concentration in mg/L. The y-axis represents ditch height in cm, ranging from -100 to 60. The x-axis represents dates from 9/30/12 to 10/6/12, with increments of 2 days.]
Depth AND Velocity Effect

![Graph showing the relationship between flood height and TP concentration over time from 10/24/2012 to 10/29/2012. The x-axis represents Harvest Flood (month/day/year), and the y-axes represent Flood Height (cm) and TP Concentration (mg/L).]
Recommendation 1: Emphasis on Harvest Flood

- All floods are NOT created equal
- Mean harvest TP concentration is 7 times higher than that in the winter flood
- P mass loss needs to be more fully explored for winter flood, but initial results suggest greater P loss during the harvest flood
Most of the P loss is in the particulate fraction, between 70-90% of total P.

Increased holding times is NOT enough, need to slow the releases, too.

Secondary holding structure may facilitate slow release of P laden water.

Recommendation 2: Increase Settling of Particulate P
Moments of high P occur during the later part of the release
- If feasible, use lower pump rate to discharge these floodwaters
- Alternatively, route these high P water to secondary holding ponds
- Amendments may be available to immobilize P in floodwaters
Recommendation 4: Identify High P Sites

- Working on developing environmental threshold test for identifying high P sites
- These sites should receive highest priority in terms of reducing P loss
Recommendation 5: Grower Cooperation

- I am here to help... No, REALLY!
- Excellent relationships with many growers
  - Gary Weston and Curt Young (Federal Furnace)
  - George Rogers, Niki D’Azortino, and others (ADM)
  - Matt Rhodes and Dan Bruffee (Edgewood Farms)
  - Jim Moores and Davie Townes/Boom Boom (Cranberry Station)
- More will be needed for future success
Acknowledgements

- Technical assistance from Cassie Rogers (UMass/ARS) and Peter Kleinman (ARS, University Park, PA)
- Support from Carolyn DeMoranville and the Cranberry Station
- Several grower participants
Questions (for me, not Frank)