Winter 1-2014

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

Casey Kennedy
USDA ARS, Casey.Kennedy@ARS.USDA.GOV

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Casey Kennedy
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

$10^3$ m$^3$/day

m$^3$/s

PO4

µM

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...

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
IAN A BOWLES, SECRETARY
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAURIE BUET, COMMISSIONER
BUREAU OF RESOURCE PROTECTION
GLENN HAAS, ACTING ASSISTANT COMMISSIONER
### TABLE 2. Summary Phosphorus Coefficients used in Nutrient Loading Model of Brockton Water Supply System

<table>
<thead>
<tr>
<th>LU/LC Type</th>
<th>kg/ha/yr</th>
<th>LU/LC Type</th>
<th>kg/ha/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brushland/Succesional</td>
<td>0.17</td>
<td>Non-forested wetland</td>
<td>0.00</td>
</tr>
<tr>
<td>Cemetery</td>
<td>1.83</td>
<td>Nursery</td>
<td>2.91</td>
</tr>
<tr>
<td>Commercial</td>
<td>0.78</td>
<td>Open Land</td>
<td>0.44</td>
</tr>
<tr>
<td><strong>Cranberry Bog</strong></td>
<td><strong>9.90</strong></td>
<td>Orchard</td>
<td>0.55</td>
</tr>
<tr>
<td>Cropland</td>
<td>3.07</td>
<td>Participation Recreation</td>
<td>0.91</td>
</tr>
<tr>
<td>Forest</td>
<td>0.17</td>
<td>Pasture</td>
<td>1.08</td>
</tr>
<tr>
<td>Forested Wetland</td>
<td>0.00</td>
<td>Powerline/Utility</td>
<td>0.62</td>
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<tr>
<td>Golf Course</td>
<td>1.57</td>
<td>Saltwater Sandy Beach</td>
<td>0.00</td>
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<tr>
<td>High Density Residential</td>
<td>1.02</td>
<td>Saltwater Wetland</td>
<td>0.00</td>
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<tr>
<td>Industrial</td>
<td>1.90</td>
<td>Transitional</td>
<td>0.77</td>
</tr>
<tr>
<td>Junkyard</td>
<td>1.90</td>
<td>Transportation</td>
<td>1.10</td>
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<tr>
<td>Low Density Residential</td>
<td>0.82</td>
<td>Urban/Public Institution</td>
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<tr>
<td>Medium Density</td>
<td>0.90</td>
<td>Very Low Density Residential</td>
<td>0.30</td>
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<tr>
<td>Mining</td>
<td>2.14</td>
<td>Water</td>
<td>0.00</td>
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<tr>
<td>Multifamily Residential</td>
<td>0.97</td>
<td>Water-Based Recreation</td>
<td>0.55</td>
</tr>
</tbody>
</table>
Managing P in Floodwaters
Enhance Particulate Settling

![Bar chart showing phosphorus concentration (mg/L) for Total P, Dissolved P, and Particulate P during Harvest (n = 103) and Winter (n = 38)].
Peak TP in Harvest Release Water
Depth Effect

[Graph showing the relationship between ditch height and total P concentration over a period from 9/30/12 to 10/6/12.]
Depth AND Velocity Effect

![Graph showing the relationship between flood height and TP concentration over time.](chart)

- **Y-axis**: Flood Height (cm)
- **X-axis**: Harvest Flood (month/day/year)
- **Data points** represent TP Concentration (mg/L) over time.
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 3: Target High P Floodwaters

- 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)