A Plan to Address the Total Phosphorus to Sands Pond

Rhode Island Department of Environmental Management
Office of Water Resources
Overview of Tonight’s Presentation

• Introduction
• Pond and Watershed Description
• Water Quality Data
• Pollution Sources
• Required Pollutant Loading Reductions
• Studies and Data Sources
• Pollution Abatement Measures
• Potential Funding Sources
What is a TMDL?

• The Clean Water Act requires states to monitor the quality of their waters and identify waters that do not meet water quality standards and prepare a 303(d) list of impaired waters.
• A prioritized schedule for completion of water quality restoration studies also appears in the 303(d) list.
• The framework for these studies is the Total Maximum Daily Load (TMDL) program, administered by RIDEM Office of Water Resources.
• A TMDL is essentially a prescription designed to restore the health of a polluted water body by indicating the amount of pollutants a waterbody can receive and still meet water quality standards.
• TMDLs identify corrective actions necessary to improve water quality and restore designated uses.
Developing the Sands Pond TMDL

- Compile/Collect data to characterize impairment
- Compare existing conditions to applicable WQ standards
- Determine spatial and temporal extent of impairment
  Combine this with pollution source information
- Determine Pollution Reductions Needed to Meet Water Quality Standards
- Establish/Recommend Pollution Reduction Strategies Meet Target Reductions
- Recommend a Water Quality Monitoring Program to Ensure that Goals are Met
Sands Pond Watershed

Pond Characteristics

- Pond approximately 14.7 acres
- Average depth 7.1 feet
- Watershed approximately 74 acres
- Kettle hole pond
• 1996 USGS Investigative Report
  – Sands Pond is a surface expression of the water table
  – Surface inflow is negligible due to
    • no direct inflow sources (streams or pipes)
    • land use and vegetative cover within surface watershed
    • soil types
  – Groundwater and precipitation are the major sources of water to the pond
Aerial Photo of Sands Pond
Sands Pond Impairments
DEM 2006 303(d) List of Impaired Waters

- Phosphorus
- Turbidity
- Excess algal growth/chlorophyll-a
- Taste and odor
TMDL Water Quality Targets
Phosphorus

• RI Water Quality Standards
  - Criterion 10 (a): Average total phosphorus concentration shall not exceed 0.025 mg/l, unless a different value is needed to prevent eutrophication.
  - Criterion 10(b): None [nutrients] in such concentration that would impair any uses specifically assigned to said class.

• TMDL Target
  - Target phosphorus concentration for Sands Pond was set at the criteria level of 0.025 mg/l
RIDEM Summer 2001 Monitoring

• Three sampling stations established in the pond
RIDEM Total Phosphorus Summer 2001

Water Quality Standard 25 ug/l
Summer Average = 35.5 ug/l
RIDEM Turbidity Summer 2001

Turbidity Levels Sands Pond 2001

<table>
<thead>
<tr>
<th>Date of Sampling</th>
<th>Turbidity (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/15/01</td>
<td></td>
</tr>
<tr>
<td>7/13/01</td>
<td></td>
</tr>
<tr>
<td>8/01/01</td>
<td></td>
</tr>
<tr>
<td>8/10/01</td>
<td></td>
</tr>
<tr>
<td>8/28/01</td>
<td></td>
</tr>
<tr>
<td>9/13/01</td>
<td></td>
</tr>
<tr>
<td>10/05/01</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- SP-1-Shallow
- SP-1-Deep
- SP-2-Shallow
- SP-2-Deep
- SP-3-Shallow
- SP-3-Deep
Chlorophyll-a
RIDEM Summer 2001

Optimum Chlorophyll a goal 10 ug/l

Date of Sampling

13-Jul-01  1-Aug-01  10-Aug-01  28-Aug-01  13-Sep-01  5-Oct-01

SP-1  SP-2  SP-3
# Trophic State Based on Water Quality

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Oligotrophic</th>
<th>Mesotrophic</th>
<th>Eutrophic</th>
<th>Sands Pond Summer Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (ug/l)</td>
<td>&lt;10</td>
<td>10-30</td>
<td>31-100</td>
<td>35.5</td>
</tr>
<tr>
<td>Chlorophyll a (ug/l)</td>
<td>&lt;3.5</td>
<td>3.54-9</td>
<td>9.1-25</td>
<td>11.4</td>
</tr>
<tr>
<td>Secchi Depth (m)</td>
<td>&gt;4</td>
<td>2-4</td>
<td>1-2.1</td>
<td>0.89</td>
</tr>
</tbody>
</table>
Actual and Potential Pollution Sources

• Internal cycling of phosphorus
• Groundwater inputs
• Waterfowl
• Atmospheric deposition
• Natural background conditions (nonpoint sources)
Internal Cycling

• Although more typical of deep lakes, shallow ponds such as Sands Pond may weakly stratify during the summer.
• Decay of organic material consumes oxygen in the bottom waters and sediment of the pond.
• Under anoxic conditions the sediment releases phosphorus.
• Odor of sulfur from disturbed lake sediment indicates anoxic conditions exist.
• High TP concentrations in the summer may indicate phosphorus release from the sediment.
Thomann and Mueller Model Used to Establish Phosphorus Loads

- The basic mass balance for Total Phosphorus in Sands Pond may be expressed as:
  \[ \frac{dP}{dt} = W - K_s PV - QP \]
- and \( K_s = \frac{\nu_s}{H} \)
- where:
  - \( K_s \) = net settling rate of phosphorus
  - \( \nu_s \) = net settling speed
  - \( H \) = mean depth of pond (2.2 m)
  - \( V \) = Volume of the pond (1.3 x 10^5 m^3)
  - \( P \) = Annual average Total Phosphorus concentration in pond
  - \( Q \) = outflow
  - \( W \) = External source loading of phosphorus
## Total Phosphorus Loading and Required Reduction

<table>
<thead>
<tr>
<th>Mean in-pond concentration (ug/l)</th>
<th>Current Load (kg/yr)</th>
<th>TMDL* (kg/yr)</th>
<th>Required Load Reduction (kg/yr)</th>
<th>Required Loading Reduction (% present value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.5</td>
<td>6.2</td>
<td>3.9</td>
<td>2.3</td>
<td>37%</td>
</tr>
</tbody>
</table>

*includes a 10% margin of safety
Sands Pond Water Resources

• Past Studies & Data Sources
  – USGS
  – Block Island Water Company Raw Water Data
  – Chandler Report (2001)
  – Environmental Science Services, Inc. (2002)

• Current Studies
  – RIDEM monitoring (2001)
  – RIDOH Source Water Assessment (2001)
Chandler Report

• Only two species of fish found:
  – Golden shiners and Brown Bullheads
    • Highly tolerant of degraded conditions

• Absence of:
  – Pickerel, bass and sunfish
    • Could have occurred from copper sulfate poisoning or from decreased oxygen levels
Chandler Report

• Possible Causes of Degradation
  – Returning filter backwash into the pond
  – Extreme draw downs of water
  – Pumping well from surrounding groundwater wells
  – Large natural and manmade fluctuations of water levels
  – Copper sulfate treatments
Environmental Science Services, Inc. (ESS)

- ESS hired to determine the quantity and quality of sediments
- Total phosphorus and total kjeldahl nitrogen values both more than twice the upper threshold level = severely polluted
- Proposed solutions
  - Dredging
  - Pond bottom inversion
  - Liner installation
  - Alum treatment
TMDL Implementation

• **Good housekeeping measures**
  – Fertilizer applications, policing pet waste and discouraging waterfowl from residing within the watershed, low or no phosphorus automatic dishwasher detergents

• **Treatment options to reduce the flux of phosphorus**
  – Dredging the bottom of the pond
  – Application of a capping material
  – Application of alum
Potential Funding Sources

- Non-point Source Grants (federal)
- Narragansett Bay and Watershed Restoration Bond Fund (state)
- State Revolving Loan Fund
Questions or Comments on the TMDL Document

Total Phosphorus TMDL for Sands Pond, New Shoreham, Rhode Island

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