Watershed-Scale Assessment of Environmental Impacts and Hazards of Dams: Massachusetts River Restore Program

Karen Pelto, River Restore Coordinator
Brian Graber, Staff Scientist
Riverways Programs

Mitt Romney, Governor
Kerry Healey, Lt. Governor
Ellen Roy Herzfelder, Secretary, Executive Office of Environmental Affairs
David Peters, Commissioner, Department of Fish and Game
River Restore Program

River Restore is dedicated to:

- reconnecting natural and cultural river communities by selective removal of dams and other obstructions
- building interagency communication and cooperation and a network of services for communities and others
- restoring ecological functions and values
- respecting concerns for public safety and historic preservation
• Block fish passage
• Warm temperatures
• Trap sediment and nutrients
• Degrade water quality
Town Brook, 2003
Silk Mill Dam, Yokum Brook
February 2003
Aging Dams:
Satucket River - East Bridgewater

1993

2001
Catastrophic Dam Failure
Office of Dam Safety Hazard Definitions

**High Hazard (Class I)** – Dams located where failure or misoperation will likely cause loss of life and/or serious damage to homes, industrial or commercial facilities, important public utilities, or major transportation arteries.

**Significant Hazard (Class II)** - Dams located where failure or misoperation may cause loss of life and/or serious damage to homes, industrial or commercial facilities, secondary highways or railroads, or cause the interruption of the use of service of important facilities.

**Low Hazard (Class III)** - Dams located where failure or misoperation may cause minimal property damage to others and loss of life is not expected.
<table>
<thead>
<tr>
<th>Hazard</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>352</td>
</tr>
<tr>
<td>SIGNIFICANT</td>
<td>750</td>
</tr>
<tr>
<td>LOW</td>
<td>1,729</td>
</tr>
<tr>
<td>NOT-CLASSIFIED</td>
<td>117</td>
</tr>
<tr>
<td>TOTAL DAMS RECORDED</td>
<td>2,948</td>
</tr>
</tbody>
</table>

* DEM Office of Dam Safety
Index of Environmental Risk

- *Environmental impacts* where dams are contributing to environmental degradation
- *Environmental hazards* where uncontrolled breaches could put public resources at risk

Pilot funded by the Massachusetts Environmental Trust
Environmental Impacts:
Fragmentation
Environmental Impacts:
Inundation
Environmental Impacts:
Degradation
Environmental Hazards:
Perryville Pond on the French River
USGS Water Resources Report 03-4013:
Sediment Quantity and Quality in Three Impoundments in Massachusetts
## Perryville Pond
### Selected Constituent Concentrations in Sediment

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Probable Effect Concentration (PEC)* (mg/kg)</th>
<th>Perryville Site P1A (mg/kg)</th>
<th>Perryville Site P8B (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>33.0</td>
<td>12</td>
<td>54</td>
</tr>
<tr>
<td>Cadmium</td>
<td>4.98</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Copper</td>
<td>149</td>
<td>336</td>
<td>734</td>
</tr>
<tr>
<td>Nickel</td>
<td>48.6</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Lead</td>
<td>128</td>
<td>250</td>
<td>528</td>
</tr>
<tr>
<td>Zinc</td>
<td>459</td>
<td>385</td>
<td>842</td>
</tr>
</tbody>
</table>

* Concentration above which adverse effects are expected for freshwater benthic organisms
AQUALAND Inputs for contaminant and sediment loading
Influence of threats contributing to contamination in impounded sediments
Predicting Contamination in Impounded Sediments

Spatially Explicit Area of Influence
Based on proximity, and strength of influence contributing to the dam
- Upstream watershed area
- Hydrologic Flow Distance
- Resistance or cost surface: land use, slope

‘Pollution’ Loading
Weighting based on roads, land use, and point sources
RANK and break into thirds
Low to High Pollution
1 \rightarrow 2 \rightarrow 3

Sediment/Pollutant Trapping Efficiency
Hydrologic Residence Time (HRT)
= Volume / Flow Surrogate
= Area of Impoundment / Watershed Size
RANK and break into thirds
Low to High HRT
1 \rightarrow 2 \rightarrow 3

Non-point Sediment Loading
Weighting based on land use
RANK and break into thirds
Low to High Sediment
1 \rightarrow 2 \rightarrow 3

= Potential Sediment Contamination Behind Dams
= Pollution + Sediment + Trapping efficiency
RANK and break into thirds
Low to High Expectation for Sediment Contamination
1 \rightarrow 2 \rightarrow 3
Next Steps: Environmental Impact

- Fill data gaps: e.g. GIS layers for dams, cold water fisheries, anadromous fish
- Confirm “impact targets” with biologists, ecologists
- Develop an interactive query system to generate relative rankings for specific “impact targets”
Next Steps: Environmental Hazard

- Develop operational definitions for low, significant, and high environmental hazard

- Validate predictions of low to high expectation for sediment contamination (Regional Impounded Sediment Quality Assessment – USGS)
River Restore Program

FOR MORE INFORMATION, CONTACT...

Karen Pelto, River Restore Coordinator
Brian Graber, Staff Scientist

Riverways Program
Commonwealth of Massachusetts
Executive Office of Environmental Affairs,
251 Causeway Street, Suite 400,
Boston, MA 02114
617-626-1542 www.massriverways.org