Session B6- Dam Removal on Main Street in Historic Pawtuxet Village

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Restoring an Urban River in a Historic Setting
Lower Pawtuxet River, R.I.

Tom Ardito
Narragansett Bay Estuary Program
Sam Whitin, Tom Cook
EA Engineering, Science & Technology
Narragansett Bay Sub-Basins

Avg. Flows, m³/s

- All Rivers = 93
- Taunton = 30
- Blackstone = 21
- Pawtuxet = 10
- (collectively 2/3 of flow)
- Others < 10
- Larger systems flow into northern (upper) reaches of estuary
- Pawtuxet Basin is rural with large reservoirs upstream; highly urbanized downstream
Pawtuxet River Restoration Project Area

NBEP & partners evaluated potential impacts along 7 river miles in two municipalities.
Pawtuxet Falls Dam

- Located at head of tide: 7 river miles to next dam
- 3.5’ hydraulic height; 150’ spillway
- Contributing feature of NHR district—centerpiece of historic village
- Dammed location 200+ years
- Mill power, water supply, recreation
- Concrete structure built 1920’s
Project Goals

Initially:
• Restore historic river herring and American shad runs to 7 river miles of a major Narragansett Bay tributary

Ultimately:
• Improve river, watershed & Bay ecosystems
• Improve water quality
• Mitigate property flooding
• Respect community concerns
Project Challenges

- Highly visible
- Historic location—“Contributing feature”
- Low gradient = large impact area
- Bedrock profile
- Tidal site
- Bridge location
- Industrial legacy
- Recreational, navigational and residential uses
- Few regulatory precedents
Project Partners

Project Lead / Dam Owner:

Pawtuxet River Authority  www.pawtuxet.org
• Non-profit organization created by the R.I. General Assembly in 1972 for the conservation and restoration of the Pawtuxet River

Technical Support:

Narragansett Bay Estuary Program  www.nbep.org
• Collaborative solutions to restore & conserve the Bay & its watershed
• Website for project information

Engineering:
• EA Engineering, Science & Technology, Warwick, R.I.

Construction Funders:
• R.I. Dept. of Environmental Management
• USDA Natural Resources Conservation Service
Other Funders and Partners:
• R.I. Coastal Resources Management Council
• Save The Bay
• Friends of the Pawtuxet
• National Oceanic and Atmospheric Administration
• Rhode Island Foundation
• U.S. Environmental Protection Agency
• R.I. Saltwater Anglers Association
• U.S. Fish & Wildlife Service
• American Rivers

Regulatory Review:
• R.I. Dept. of Environmental Management
• R.I. Coastal Resources Management Council
• U.S. Army Corps of Engineers
• R.I. Historical Preservation & Heritage Commission
Pawtuxet River Restoration

Design Process

Feasibility Study used HEC-RAS to evaluate alternatives:
• Denil fish ladder
• Full dam removal
• Partial dam removal
• Rock ramp fishway

Other studies:
• Sediment transport and exposure evaluation
• Cultural resources (Sxn. 106)
• Wetland surveys
• Contaminant surveys

And tons of outreach!
Pawtuxet River Restoration

Partial Dam Removal

- Ecosystem and flooding benefits comparable to full dam removal
- Optimize depth and attractive flow for shad passage with channel modifications
- Stabilize flood walls
- Presented significant aesthetic & communications challenges
Pawtuxet River Restoration

Project Overview

- Remove most of Pawtuxet Falls Dam in Pawtuxet Village
- Restore seven river miles (up to I-95): restore migratory fish & wildlife, water quality
- Moderate reduction height/depth of water near dam
- Moderate reduction in river width in some areas
- Moderate reduction of property flooding
- Where needed, river bank areas will be stabilized with native vegetation
Pawtuxet River Restoration

Existing Conditions at Pawtuxet Falls
Pawtuxet River Restoration
Falls Restored
(Artist’s Rendering)
Benefits of dam removal alternative

- Restore annual spawning runs of American shad, river herring, and other native fish (est. 100,000 fish per year)
- Improve fresh and salt water fisheries (largemouth bass, stripers, etc.)
- Increase wildlife (herons, turtles, etc.)
Benefits of dam removal alternative, cont’d

• Reduce severity and frequency of flooding

• Improve water quality—faster, cleaner, cooler water

• Restore wetlands & watershed—natural biological connection to Narragansett Bay

• Restore historic feature of the Village—the Falls as Roger Williams saw them
Watershed Wildlife
Anadromous species live as adults in salt water, and must migrate to fresh water to spawn (spring/summer/fall)
Pawtuxet River Restoration
Technical Studies

Studies to Support Design and Permitting

• Restoration Feasibility Study (2004)
• Detailed Engineering Study (2008)
• Hydraulic & Hydrologic Modeling (Flooding and Flow studies)
• Wetland Field and Soil Studies
• Sediment Sampling & Analysis
• Historic Resources Study
• On-site River Surveys
• Numerous Public Meetings/Workshops Conducted
Pawtuxet River Restoration
Regulatory Review

Permit Applications Filed Sept., 2010
- Application to Alter Wetlands & Clean Water Act 401 (RIDEM)
- Coastal Resources Assent (RICRMC)
- Clean Water Act 404 (U.S. Army Corps of Eng.) (sequential)
- State/Federal Historic Review
- Awarded May/June 2011
- 10 months permitting not including pre-application process. ~2 years total.
Pawtuxet River Restoration  
Existing Conditions

- Water quality and habitat are sufficient to support fish run restoration and spawning
- River is highly vulnerable to flooding due to floodplain development and other factors (March, 2010)
- Extensive & valuable wetlands existed before dams
- Sediments are typical of those found in urban rivers
- River is uniformly deep between dam and Rhodes—6’ to 8’ deep with steep, deep sides
- Not much sediment (mud or sand) behind dam—however, the entire river transports large volumes (more than 7,000 tons/year)
- Water quality goals: “fishable, swimmable”
- Lower Pawtuxet WQ does not presently support human contact
Rivers are Active Landscape Features!

Effects of March 2010 Floods
“Oxbow” Wetlands near Fay Field
Rivers are Active Landscape Features!

Effects of March 2010 Floods
“Oxbow” Wetlands near Fay Field
Pawtuxet River Restoration
Effects of Dam Removal

• Maximum reduction in water height:
  • 3.5 feet (low flow at dam)
  • 2 feet (Warwick Ave)
  • Zero change at I-95
• Reduced flooding impacts up to 10 year storms
• No change under very high flows/large floods
• No increase in erosion
• Faster drainage following larger floods
• Maintain sufficient depth for recreational boating
Effect of Pawtuxet Partial Dam Removal
10-yr Storm (10% Chance of Occurring Each Year)

Water Elevation (ft)

Distance Upstream of Dam (ft)

Rhodes on the Pawtuxet    Warwick Ave. Bridge    Elmwood Ave. Bridge

Existing Water Elevation
Proposed Water Elevation
Pawtuxet River Restoration
Cross-Section at Rhodes

PROJECTED CHANNEL CROSS SECTION LOOKING
UPSTREAM AT RHODES-ON-THE-PAWTUXET
Pawtuxet River Restoration
Sediment Analysis

• Findings typical for urban rivers
• Pawtuxet has industrial & urban landuse, with many potential sources of contamination
• Tested for 96 potential contaminants
• 7 contaminants exceeded residential (strictest) state criteria
• Criteria based on long-term ingestion
• No clear Ciba legacy
Pawtuxet River Restoration – Existing CERCLIS Site
<table>
<thead>
<tr>
<th>Organic Chemicals</th>
<th>Heterocyclic &amp; Inorganic Compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>2-Methyl naphthalene</td>
</tr>
<tr>
<td>Benzene</td>
<td>Naphthalene</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td>Pentachlorophenol</td>
</tr>
<tr>
<td>Bromoform</td>
<td>Phenanthrene</td>
</tr>
<tr>
<td>Bromomethane</td>
<td>Phenol</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>Pyrene</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>1,2,4-Trichlorobenzene</td>
</tr>
<tr>
<td>Chloroform</td>
<td>2,4,5-Trichlorophenol</td>
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<tr>
<td>Dibromochloromethane</td>
<td>2,4,6-Trichlorophenol</td>
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<tr>
<td>1,2-Dibromo-3-chloropropane (DBCP)</td>
<td>Pesticides/PCBs</td>
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<tr>
<td>1,1-Dichloroethane</td>
<td>Chlordane</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>Dieldrin</td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td>Polychlorinated biphenyls (PCBs)</td>
</tr>
<tr>
<td>cis-1,2-Dichloroethene</td>
<td>Antimony</td>
</tr>
<tr>
<td>Trans-1,2-Dichloroethene</td>
<td>Arsenic</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>Barium</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>Beryllium</td>
</tr>
<tr>
<td>Ethylene dibromide (EDB)</td>
<td>Cadmium</td>
</tr>
<tr>
<td>Isopropyl benzene</td>
<td>Chromium III (Trivalent)</td>
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<tr>
<td>Methyl ethyl ketone</td>
<td>Chromium VI (Hexavalent)</td>
</tr>
<tr>
<td>Methyl isobutyl ketone</td>
<td>Copper</td>
</tr>
<tr>
<td>Methyl tertiary-butyl ether (MTBE)</td>
<td>Cyanide</td>
</tr>
<tr>
<td>Methylenec chloride</td>
<td>Lead</td>
</tr>
<tr>
<td>Styrene</td>
<td>Manganese</td>
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<td>1,1,1,2-Tetrachloroethane</td>
<td>Mercury</td>
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<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>Nickel</td>
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<tr>
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<td>Selenium</td>
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<tr>
<td>Toluene</td>
<td>Silver</td>
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<td>1,1,1-Trichloroethane</td>
<td>Thallium</td>
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<tr>
<td>1,1,2-Trichloroethane</td>
<td>Vanadium</td>
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<tr>
<td>Trichloroethene</td>
<td>Zinc</td>
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<tr>
<td>Vinyl chloride</td>
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</tbody>
</table>

**Additional Compounds**

1,1-Biphenyl
Bis(2-ethylhexyl) phthalate
Bis(2-chloroethyl) ether
Bis(2-chloroisopropyl) ether
4-Chloroaniline (p-)
2-Chlorophenol
Chrysene
Dibenzo(a,h)anthracene
1,2-Dichlorobenzene (o-DCB)
1,3-Dichlorobenzene (m-DCB)
1,4-Dichlorobenzene (p-DCB)
3,3-Dichlorobenzidine
2,4-Dichlorophenol
Diethyl phthalate
2,4-Dimethyl phenol
Dimethyl phthalate
2,4-Dinitrophenol
2,4-Dinitrotoluene
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
2-Methyl naphthalene
Naphthalene
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Pesticides/PCBs
Chlordane
Dieldrin
Polychlorinated biphenyls (PCBs)
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium III (Trivalent)
Chromium VI (Hexavalent)
Copper
Cyanide
Lead
Manganese
Mercury
Nickel
Selenium
Silver
Thallium
Vanadium
Zinc

**Other Compounds**

- Xylenes (Total)
- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- 1,1-Biphenyl
- Bis(2-ethylhexyl)phthalate
- Bis(2-chloroethyl)ether
- Bis(2-chloroisopropyl)ether
- 4-Chloroaniline (p-)
- 2-Chlorophenol
- Chrysene
- Dibenzo(a,h)anthracene
- 1,2-Dichlorobenzene (o-DCB)
- 1,3-Dichlorobenzene (m-DCB)
- 1,4-Dichlorobenzene (p-DCB)
- 3,3-Dichlorobenzidine
- 2,4-Dichlorophenol
- Diethyl phthalate
- 2,4-Dimethyl phenol
- Dimethyl phthalate
- 2,4-Dinitrophenol
- 2,4-Dinitrotoluene
- Fluoranthene
- Fluorene
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachloroethane
- Indeno(1,2,3-cd)pyrene
Pawtuxet River Restoration

**Problem Definition**

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Result (mg/kg)</th>
<th>RIDEM</th>
<th>RIDEM</th>
<th>I/CDEEC</th>
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</thead>
<tbody>
<tr>
<td>Beryllium</td>
<td>1.32</td>
<td>0.4</td>
<td>1.3</td>
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<tr>
<td>Chrysene</td>
<td>0.458</td>
<td>0.4</td>
<td>780</td>
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<th>RIDEM</th>
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<th>I/CDEEC</th>
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</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>11.6</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Beryllium</td>
<td>1.25</td>
<td>0.4</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>233</td>
<td>150</td>
<td>500</td>
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</tbody>
</table>

**NOTE:** Sediment sample analyte concentrations compared to Rhode Island Department of Environmental Management’s (RIDEM’s) Residential Direct Exposure Criteria (RDEC) and Industrial/Commercial Direct Exposure Criteria (I/CDEEC).
Pawtuxet River Restoration
Sediment Contaminants
and Origins

• **Arsenic** – Naturally occurring, pesticides, manufacturing
• **Beryllium** – Naturally occurring, manufacturing
• **Lead** – Urban runoff, gasoline, manufacturing, naturally occurring
• **PCBs** – Manufactured for variety of uses in 1929-1977
• **Benzo[a]pyrene** – Byproduct of burned petroleum products, asphalt, urban runoff
• **TPH** – Urban runoff, oil, grease, gasoline
• **Chrysene** – Urban runoff, asphalt, creosote
Pawtuxet River Restoration
Conceptual Shoreline Planting Plan
Typical exposure width 2-3 feet, greater at Rhodes
Construction Timeline

- Construction Bids Received 10 June
- Construction Award this week!
- Mobilization early July
- Dam Removal late July/early August, 2 weeks
- Riverbank Planting August/September
- Spring, 2012: River Herring and Shad Return to Pawtuxet River Watershed
Lessons Learned

• Too much outreach is not enough
• Respect community perspectives—but don’t necessarily take them at face value
• Good graphics are critical
• 2010 floods changed everything
• Regulators need outreach & education too
For more information:

Tom Ardito, 401-874-6492
Narragansett Bay Estuary Program
www.nbep.org