Jun 28th, 3:45 PM - 4:05 PM

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 ESTUARY PROGRAM

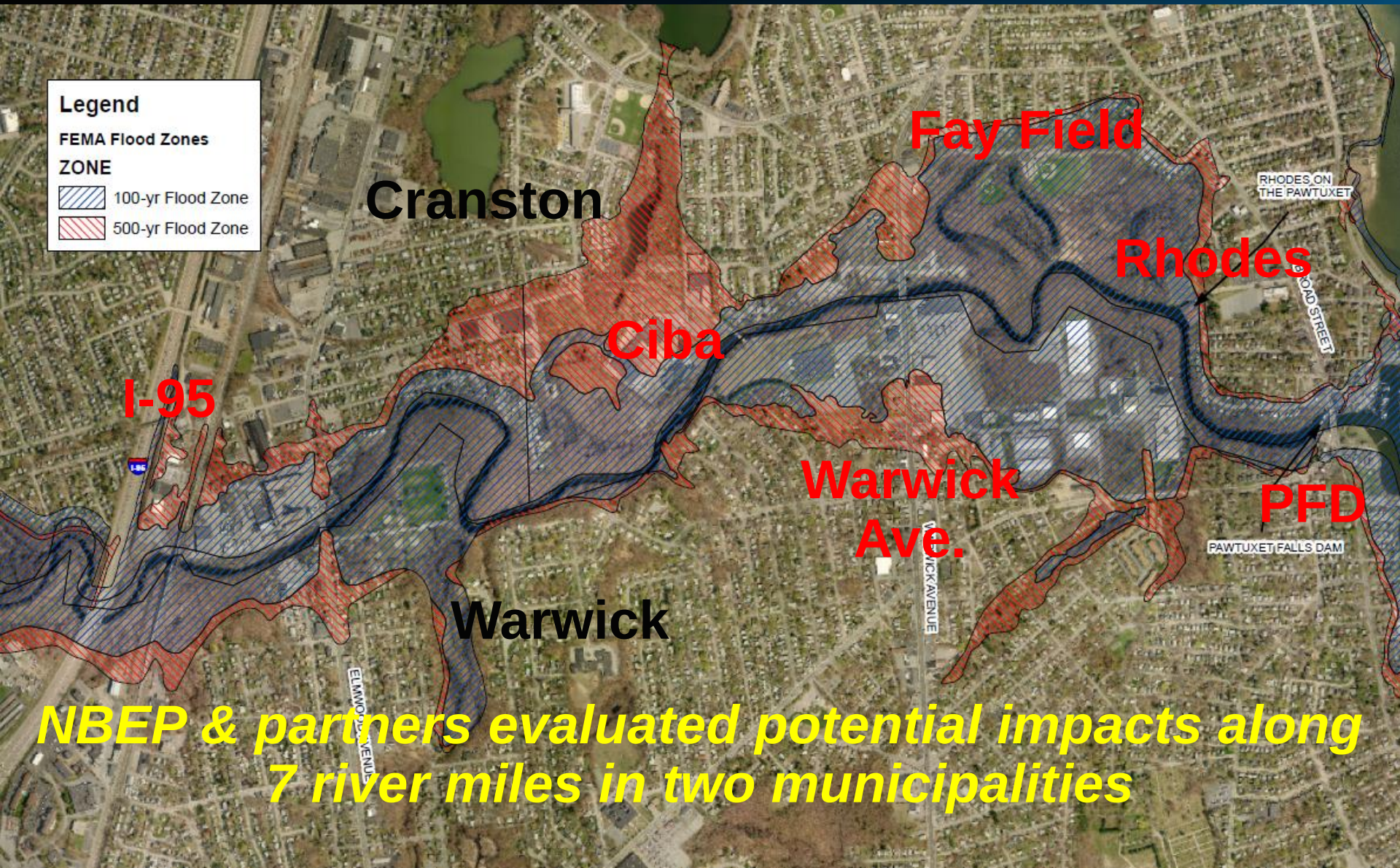
EA Engineering, Science, and Technology, Inc.

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

Project Partners, cont'd.

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

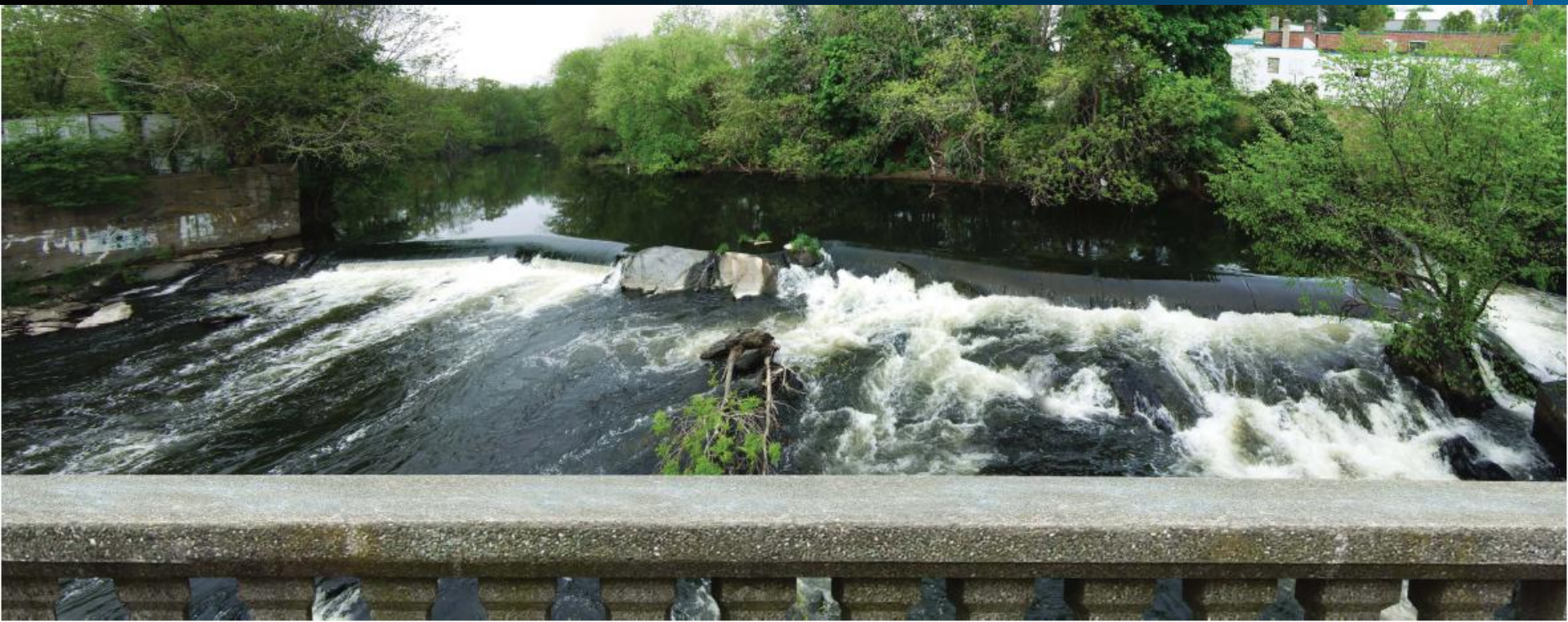
- Ecosystem and flooding benefits comparable to full dam removal
- Optimize depth and attractive flow for shad passage with channel modifications
- Stabilize flood walls
- Presented significant aesthetic & communications challenges

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

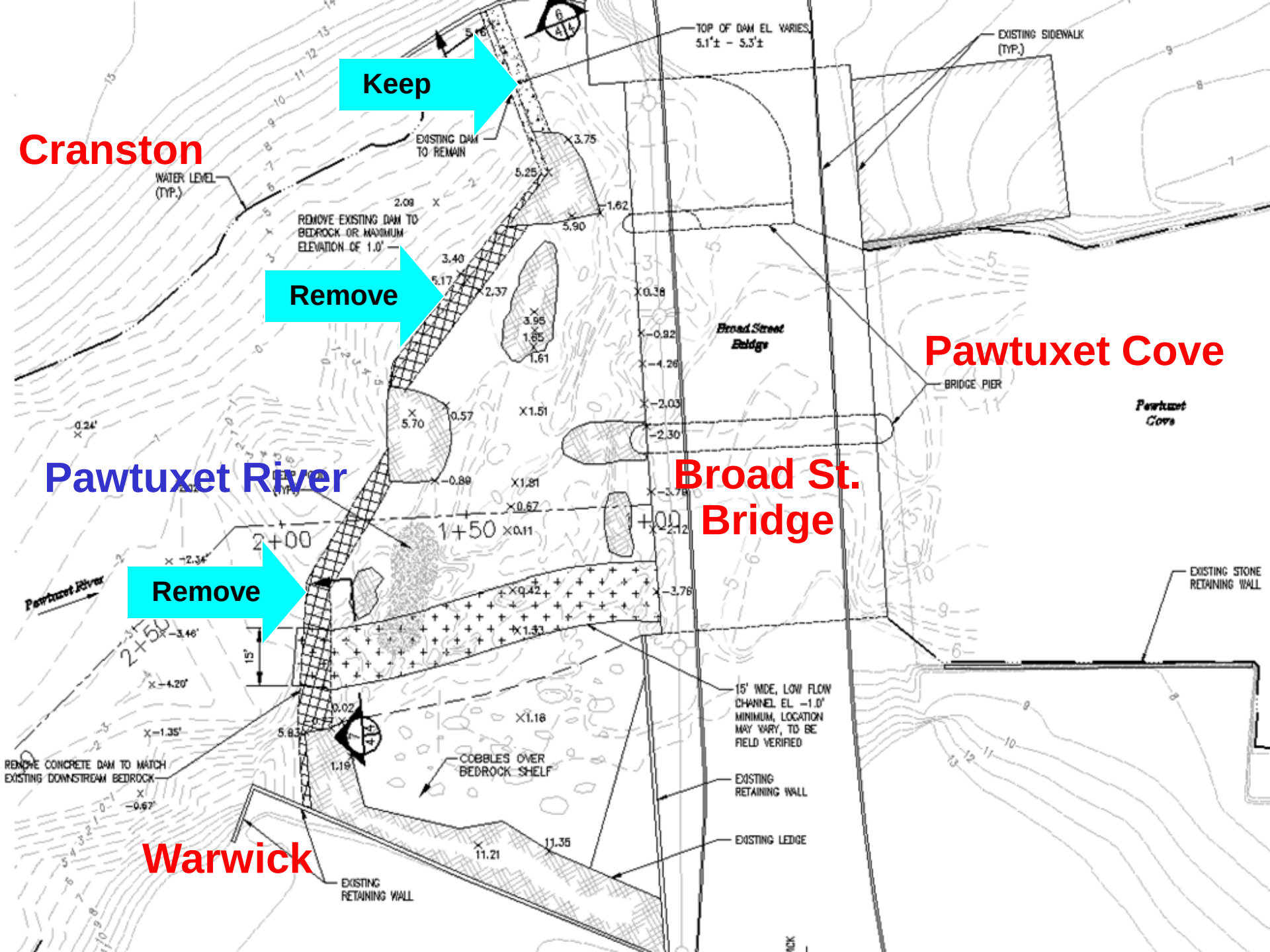
Existing Conditions at Pawtuxet Falls



Pawtuxet River Restoration

Falls Restored

(Artist's Rendering)


Keep
Cranston
TOP OF DAM EL. VARIES
5.1'± - 5.3'±
EXISTING SIDEWALK
(TYP.)
EXISTING DAM
TO REMAIN
WATER LEVEL
(TYP.)
REMOVE EXISTING DAM TO
BEDROCK OR MAXIMUM
ELEVATION OF 1.0'
Remove
Broad Street
Bridge
Pawtuxet Cove
BRIDGE PIER
Pawtuxet
Cove
Pawtuxet River
Broad St.
Bridge
Remove
Pawtuxet River
EXISTING STONE
RETAINING WALL
15' WIDE, LOW FLOW
CHANNEL EL. -1.0'
MINIMUM, LOCATION
MAY VARY, TO BE
FIELD VERIFIED
REMOVE CONCRETE DAM TO MATCH
EXISTING DOWNSTREAM BEDROCK
COBBLES OVER
BEDROCK SHELF
EXISTING
RETAINING WALL
EXISTING LEDGE
Warwick
EXISTING
RETAINING WALL

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

Migratory Fish

River Herring

American Shad

Striped Bass

Watershed Wildlife

Herring Run at Gilbert Stuart Brook

North Kingstown, R.I.

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!

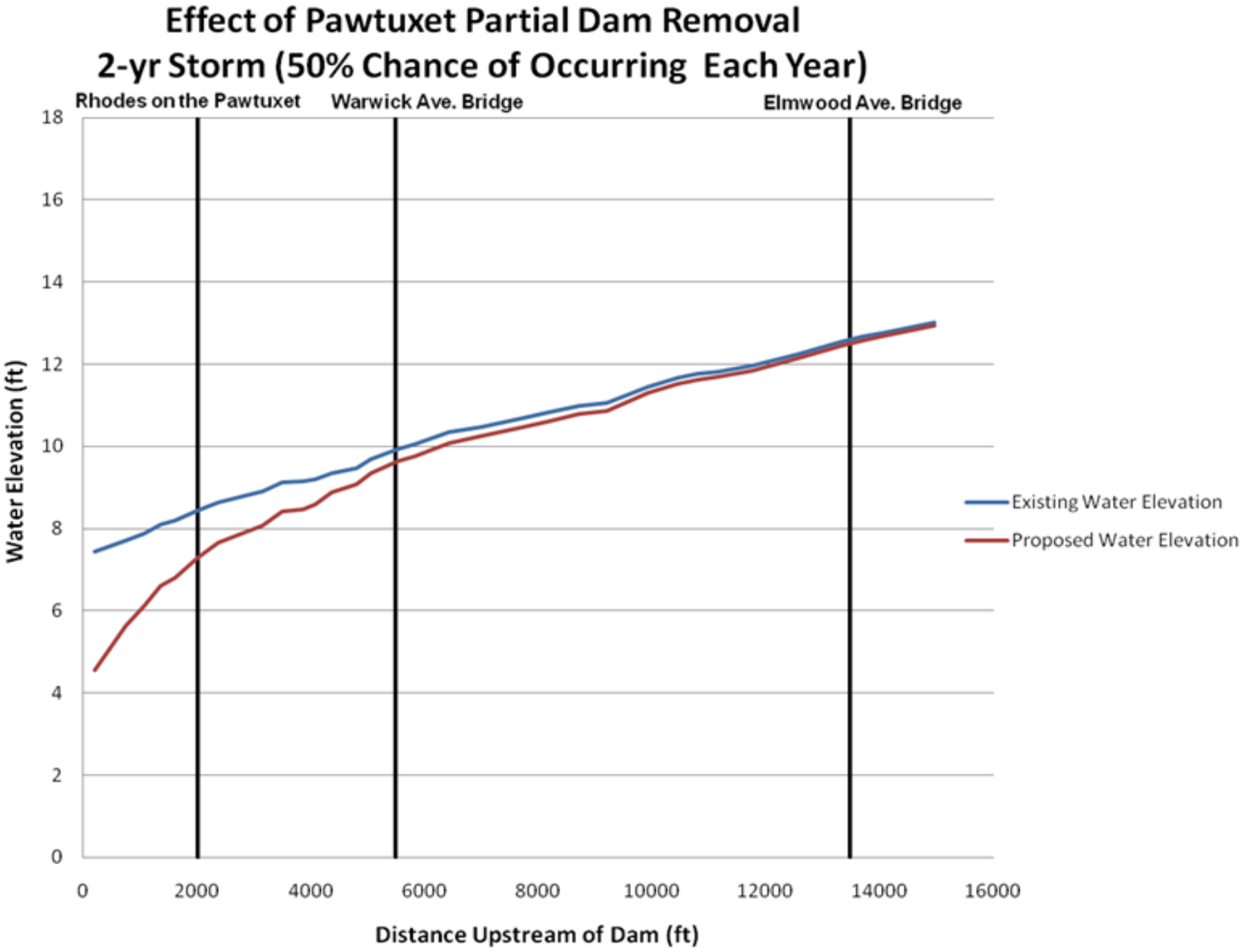
Effects of March 2010 Floods "Oxbow" Wetlands near Fay Field

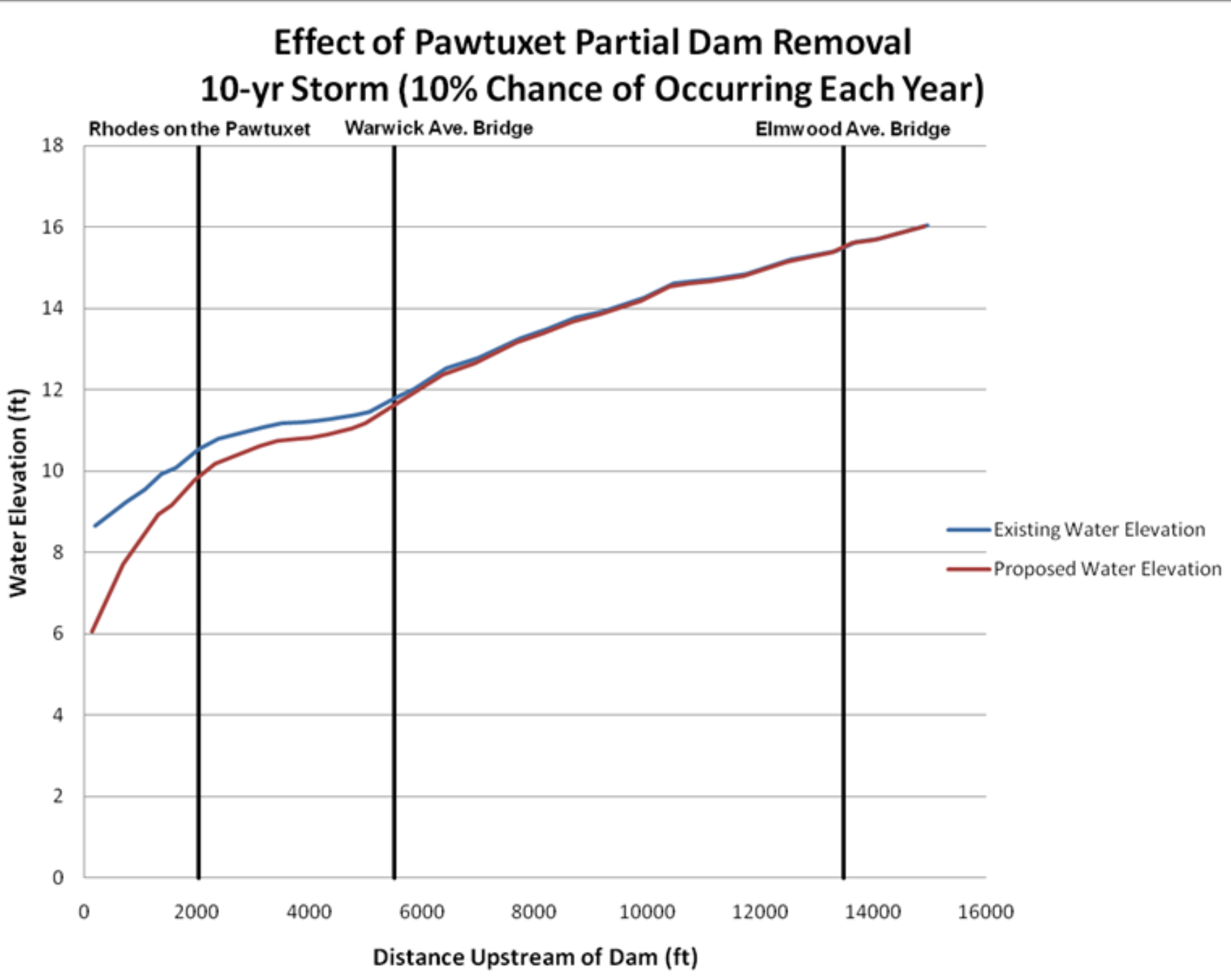
Rivers are Active Landscape Features!

Effects of March 2010 Floods "Oxbow" Wetlands near Fay Field

Pawtuxet River Restoration
Effects of Dam Removal

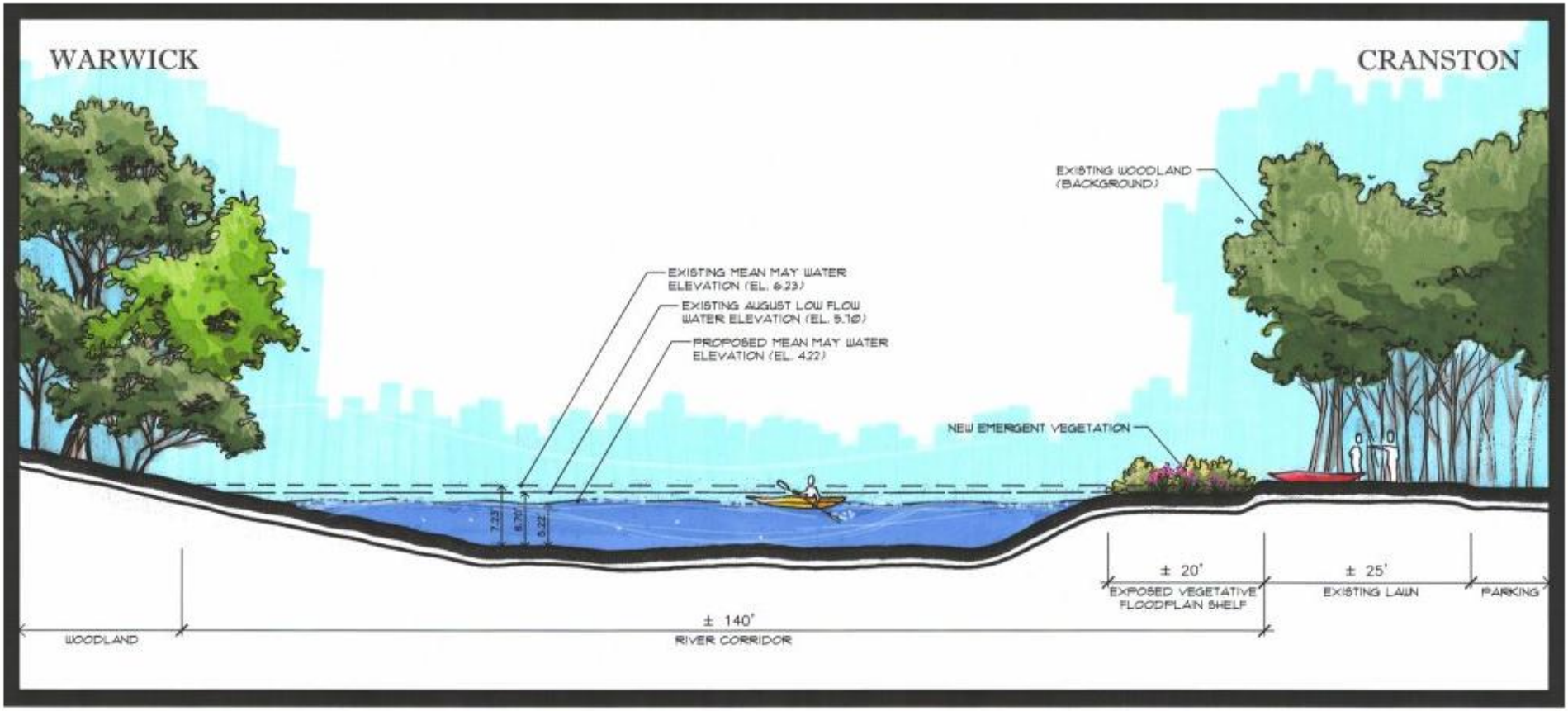
- Maximum reduction in water height:
  - 3.5 feet (low flow at dam)
  - 2 feet (Warwick Ave)
  - Zero change at I-95
- Reduced flooding impacts up to 10 year storms
- No change under very high flows/large floods
- No increase in erosion
- Faster drainage following larger floods
- Maintain sufficient depth for recreational boating


Effect of Pawtuxet Partial Dam Removal
2-yr Storm (50% Chance of Occurring Each Year)
Rhodes on the Pawtuxet
Warwick Ave. Bridge
Elmwood Ave. Bridge
Water Elevation (ft)
18
16
14
12
10
8
6
4
2
0
0
2000
4000
6000
8000
10000
12000
14000
16000
Distance Upstream of Dam (ft)
Existing Water Elevation
Proposed Water Elevation


Effect of Pawtuxet Partial Dam Removal
10-yr Storm (10% Chance of Occurring Each Year)
Rhodes on the Pawtuxet
Warwick Ave. Bridge
Elmwood Ave. Bridge
Water Elevation (ft)
18
16
14
12
10
8
6
4
2
0
0
2000
4000
6000
8000
10000
12000
14000
16000
Distance Upstream of Dam (ft)
Existing Water Elevation
Proposed Water Elevation


TR-10 New Exposure Areas Width
Downstream Left: 3.5 ft
Downstream Right: 23 ft
RHODES ON THE PAWTUXET
RHODES PLACE
BROAD STREET
TR-7 New Exposure Areas Width
Downstream Left: 9.5 ft
Downstream Right: 17.5 ft
PARKWAY AVENUE
PAWTUXET FALLS DAM
TR-4 New Exposure Areas Width
Downstream Left: 6 ft
Downstream Right: 15 ft
BELLOWS STREET
Legend
New Exposure Areas
EA Transect Points
Wetland Resource Areas
Emergent Wetland: Marsh/Wet Meadow
Forested Wetland: Deciduous
Palustrine Open Water
Scrub-Shrub Swamp
Exposure areas calculated from mean August water levels generated in HEC-RAS model and compared to 2 ft contour topographic information.

Pawtuxet River Restoration Cross-Section at Rhodes

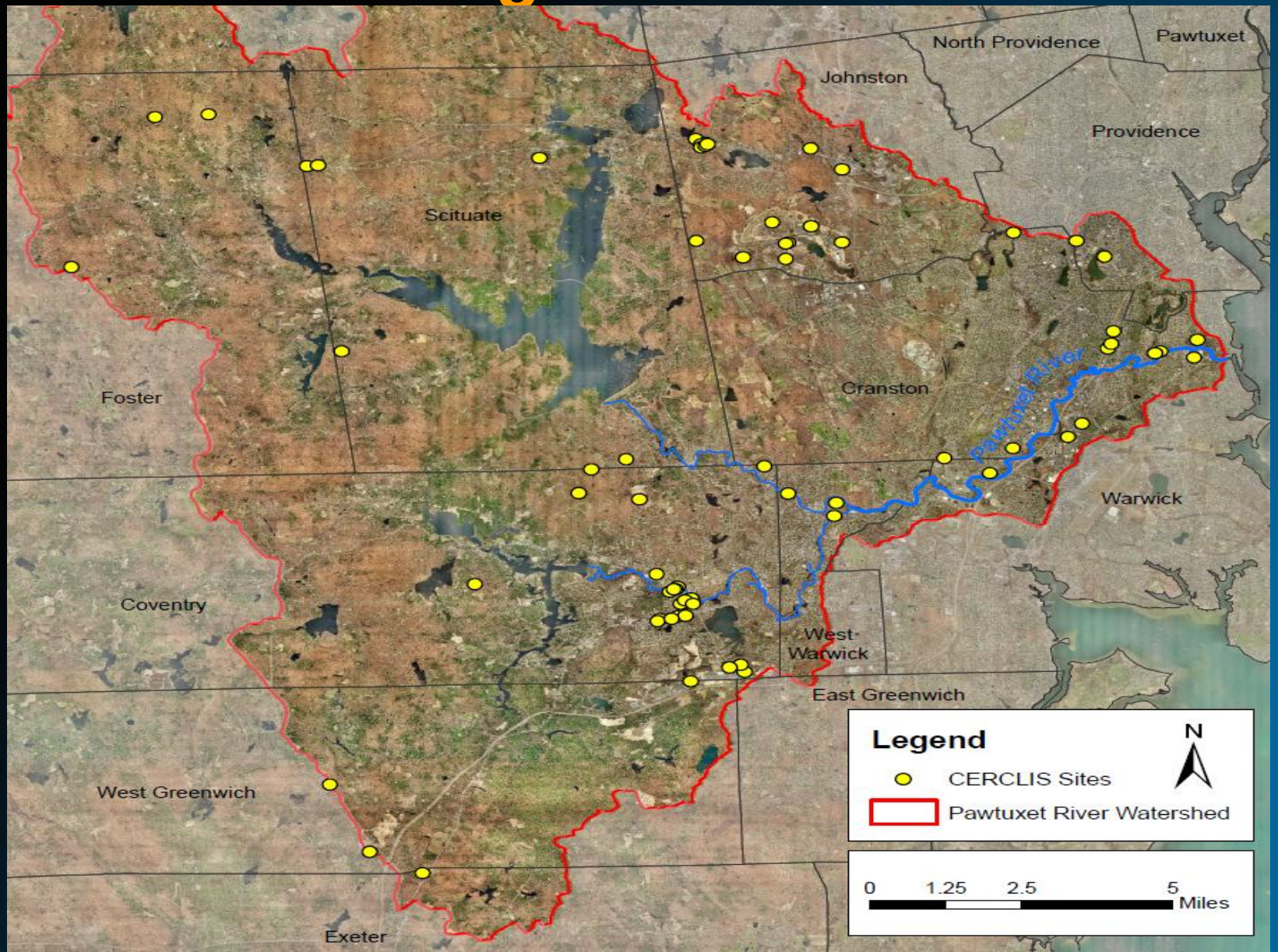


PROJECTED CHANNEL CROSS SECTION LOOKING UPSTREAM AT RHODES-ON-THE-PAWTUXET

Pawtuxet River Restoration
Sediment Analysis

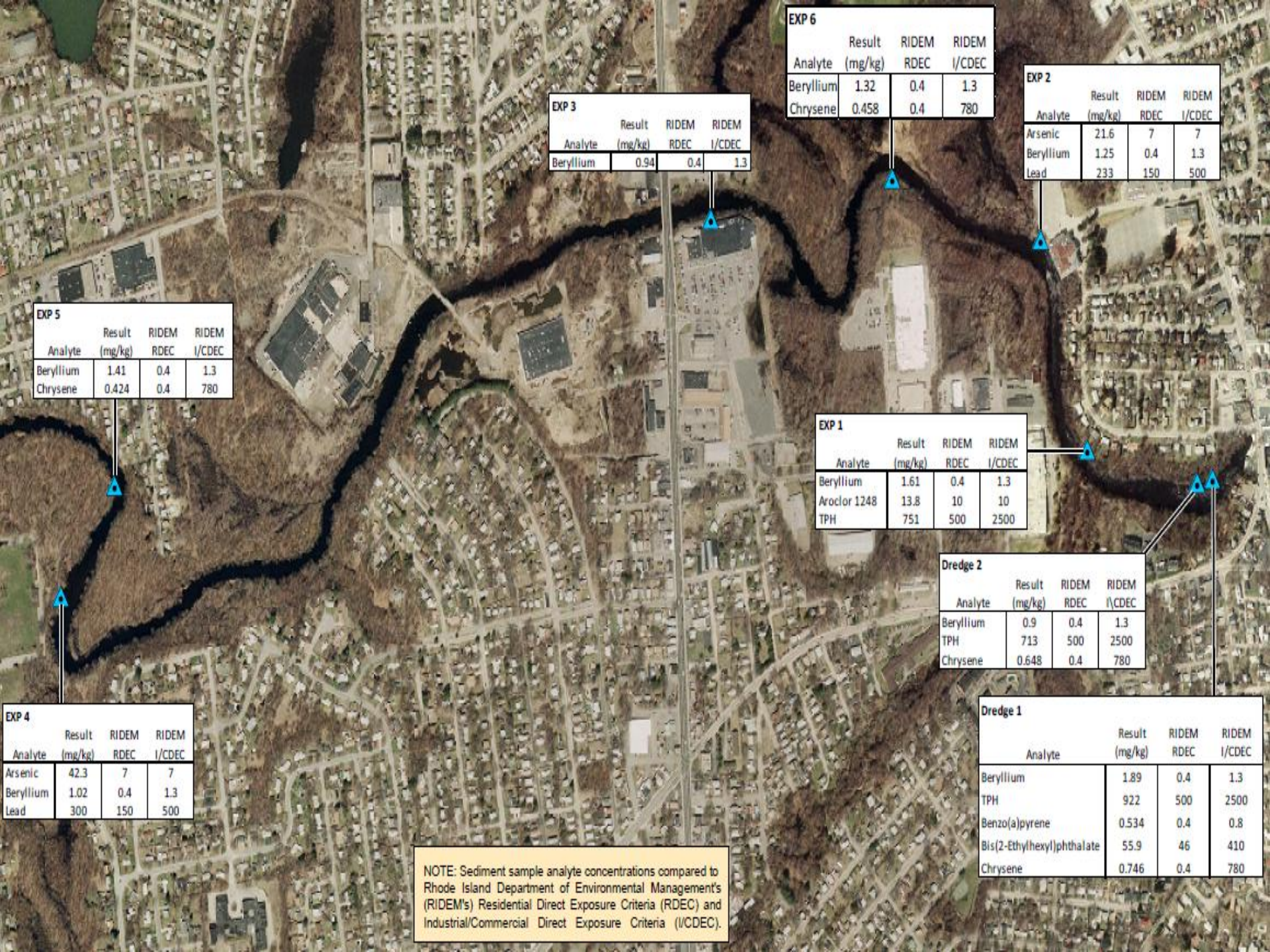
- Findings typical for urban rivers
- Pawtuxet has industrial & urban landuse, with many potential sources of contamination
- Tested for 96 potential contaminants
- 7 contaminants exceeded residential (strictest) state criteria
- Criteria based on long-term ingestion
- No clear Ciba legacy

Pawtuxet River Restoration – Existing CERCLIS Site



Pawtuxet River Restoration
RIDEM Required Sampling List

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chlorobenzene
Chloroform
Dibromochloromethane
1,2- Dibromo-3 -chloropropane (DBCP)
1,1-Dichloroethane
1,2-Dichloroethane
1,1 -Dichloroethene
cis- 1 ,2-Dichloroethene
Trans-1 ,2-Dichloroethene
1,2-Dichloropropane
Ethylbenzene
Ethylene dibromide (EDB)
Isopropyl benzene
Methyl ethyl ketone
Methyl isobutyl ketone
Methyl tertiary-butyl ether (MTBE)
Methylene chloride
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1 -Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl chloride
Xylenes (Total)
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrenea
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)anthracenea
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



EXP 6

Analyte	Result (mg/kg)	RIDEM RDEC	RIDEM I/CDEC
Beryllium	1.32	0.4	1.3
Chrysene	0.458	0.4	780

EXP 3

Analyte	Result (mg/kg)	RIDEM RDEC	RIDEM I/CDEC
Beryllium	0.94	0.4	1.3

EXP 2

Analyte	Result (mg/kg)	RIDEM RDEC	RIDEM I/CDEC
Arsenic	21.6	7	7
Beryllium	1.25	0.4	1.3
Lead	233	150	500

EXP 5

Analyte	Result (mg/kg)	RIDEM RDEC	RIDEM I/CDEC
Beryllium	1.41	0.4	1.3
Chrysene	0.424	0.4	780

EXP 1

Analyte	Result (mg/kg)	RIDEM RDEC	RIDEM I/CDEC
Beryllium	1.61	0.4	1.3
Aroclor 1248	13.8	10	10
TPH	751	500	2500

Dredge 2

Analyte	Result (mg/kg)	RIDEM RDEC	RIDEM I\CDEC
Beryllium	0.9	0.4	1.3
TPH	713	500	2500
Chrysene	0.648	0.4	780

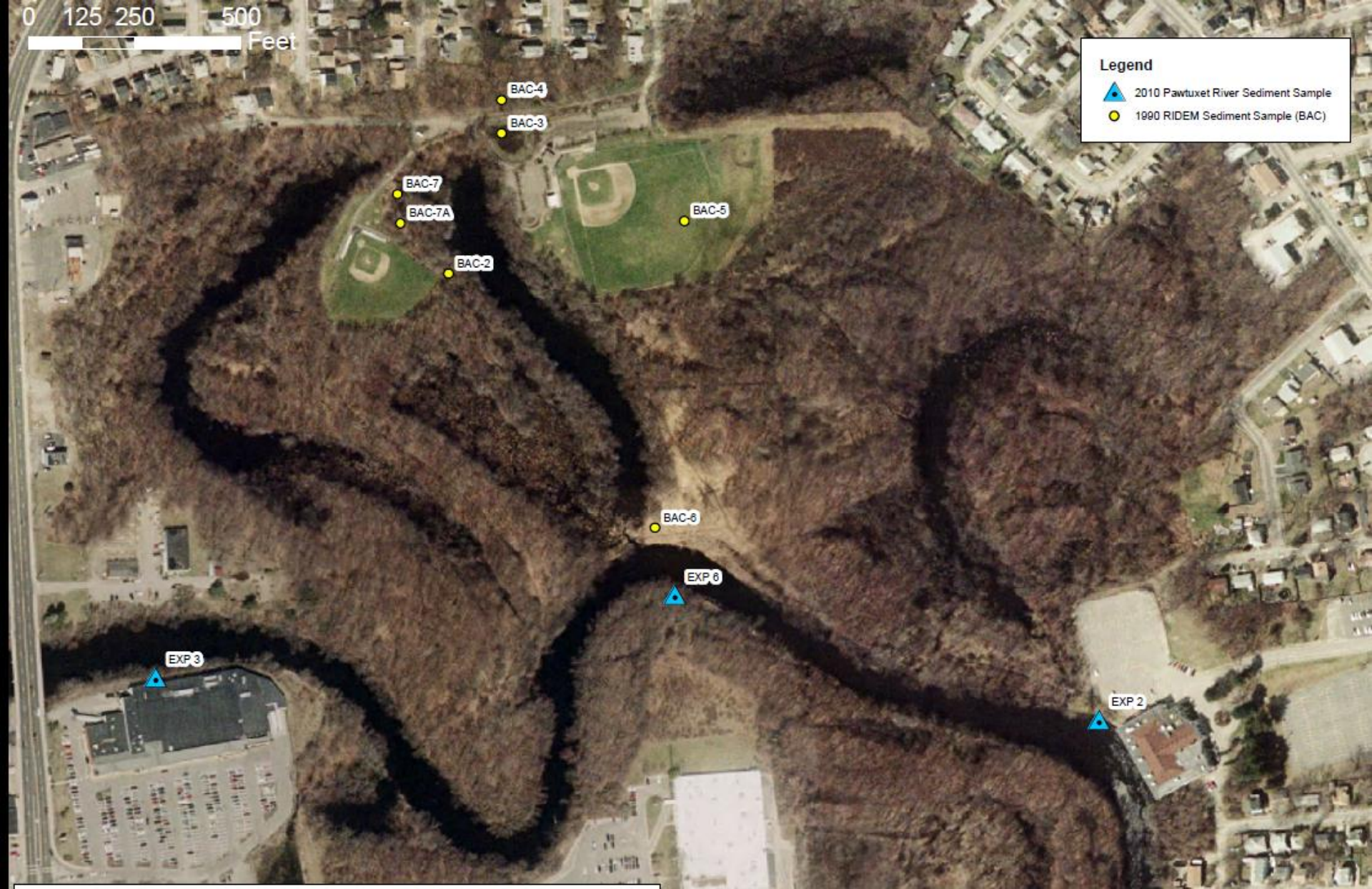
EXP 4

Analyte	Result (mg/kg)	RIDEM RDEC	RIDEM I/CDEC
Arsenic	42.3	7	7
Beryllium	1.02	0.4	1.3
Lead	300	150	500

Dredge 1

Analyte	Result (mg/kg)	RIDEM RDEC	RIDEM I/CDEC
Beryllium	1.89	0.4	1.3
TPH	922	500	2500
Benzo(a)pyrene	0.534	0.4	0.8
Bis(2-Ethylhexyl)phthalate	55.9	46	410
Chrysene	0.746	0.4	780

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/CDEC).



Summary of Sampling in Oxbow Area

Analytes in Exceedances (mg/kg)	1990 RIDEM Soil Samples						
	BAC-2	BAC-3	BAC-4	BAC-5	BAC-6	BAC-7	BAC-7A
Arsenic	4.1	1.8	1.2	12.1	25	15.5	15.5
Beryllium	1	ND	ND	3	2	1	ND
Chromium	11	4	4	16	56	39	38
Lead	34	24	38	9	128	74	77

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
ZONE 2
ZONE 2
ZONE 1
ZONE 1
Woodbury Road
Pawtuxet Falls Dam
Broad Street
Alsace Street
City of Cranston
City of Warwick
Pawtuxet River
Post Road
Narragansett Parkway

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:

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www.nbep.org