

Supporting Site Restoration via Research Translation and Trans-Disciplinary Partnerships

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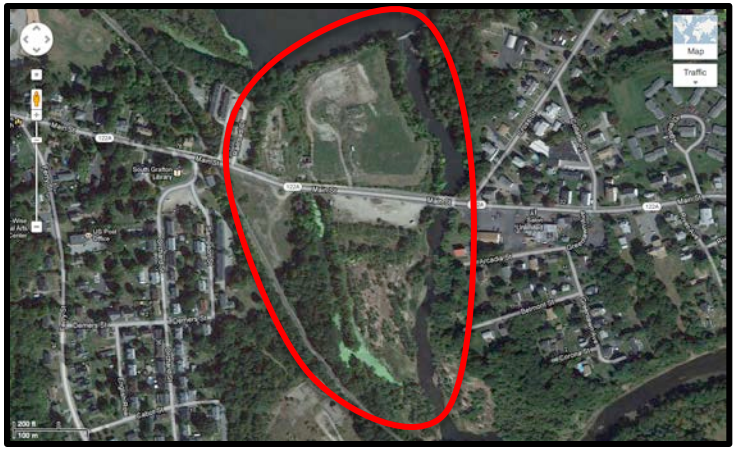
Fisherville Mill Site, Grafton, MA



- Site of former textile mill
- Bounded by Blackstone River, which flows into RI
- Fire completely destroyed mill in 1999
- EPA “completed” cleanup in 2005
- Fisherville Redevelopment Corp. purchased site

No deep pockets for expensive remediation

Engaged developer wants to restore site for town benefit

<u>Contaminants of Concern</u>

- Petroleum – Current contaminant of concern in canal
- Heavy metals – In sediment and floodplains
- Chlorinated organic solvents - Subsurface
- Asbestos – removed in Emergency Action

Mill Villages Park Ribbon Cutting
Flag Day, 2012



The Fisherville & Farnumsville Streetscape Committee
& the Town of Grafton
cordially invite you to attend the

MILL VILLAGES PARK
RIBBON CUTTING CEREMONY

Thursday, June 14, 2012
5:00 p.m.
61 Main Street, South Grafton
Rain or Shine

Guest Speakers.
Light Refreshments provided by The Buggy Whip.

Concert featuring Hanscom Air Force Brass Quintet
Under the Pavilion at 6:30 p.m.
(Rain Location for the concert: Municipal Center Gymnasium)

An engaged community…

<u>Attended by:</u>

- The developer (a local hero)
- The community
- Town staff and policy makers
- EPA (Reg. 1 Administrator Curt Spalding)
- MA Dept. of Environmental Protection
- Local watershed associations, Blackstone Headwaters Coalition
- Brown U, Clark U, JTED
- Local media outlets

Brown SRP's State-based Approach to Complex Exposures

Rhode Island:

State-based approach to complex exposures

Organics-containing MGP waste and subsurface VOCs create challenges for RI DEM:

- Vapor Pressure of SVOCs
- Aqueous solubility of tars and NAPLs
- Vapor Intrusion

Regional Impacts

- RI Impact: We are downstream of the Fisherville Mill Site.
- Window into science that we were not yet engaged in: Fungal degradation study with Clark University, MA
- Real field impact: Bioremediation field-study at Fisherville Mill, MA

National Problems

Sept. 2012: EPA requests help understanding remediation and risk assessment performance at NAPL-contaminated sites.

How We Became Involved

JTED Involvement

Sept. 2011
Voicemail from property owner, Gene Bernat, requesting analytical support:

- TPH Measurements
- Certified labs expensive and results hard to interpret
- No pending/forthcoming litigation

Oct. 2011
Conference call with JT. Ecological Design. Validation Study begins.

Dec. 2011
Bench-top study with Clark U begins.

May. 2012
Darcy Young defends Master thesis, *Bioremediation with white-rot fungi at Fisherville Mill: analyses of gene expression and Bunker C fuel oil degradation.*

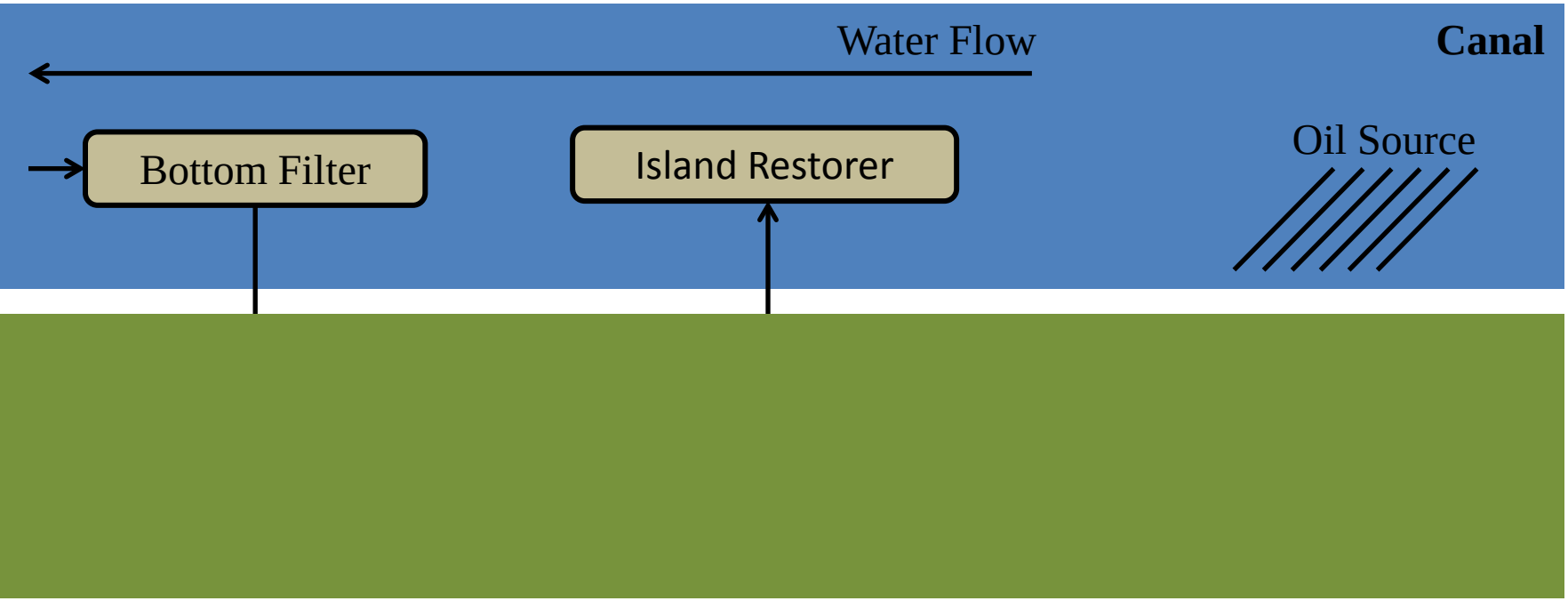
June 2012
Mill Villages Park opens with ribbon cutting ceremony

June – Sept 2012
Field Study with JTED

Oct. 2012
MET Grant Proposal

John Todd Ecological Design's "Eco-Machine"

- Uses white-rot fungi for degradation of Bunker-C heating oil in canal.
- Flow Diagram for JTED system:



John Todd Ecological Design's "Eco-Machine"

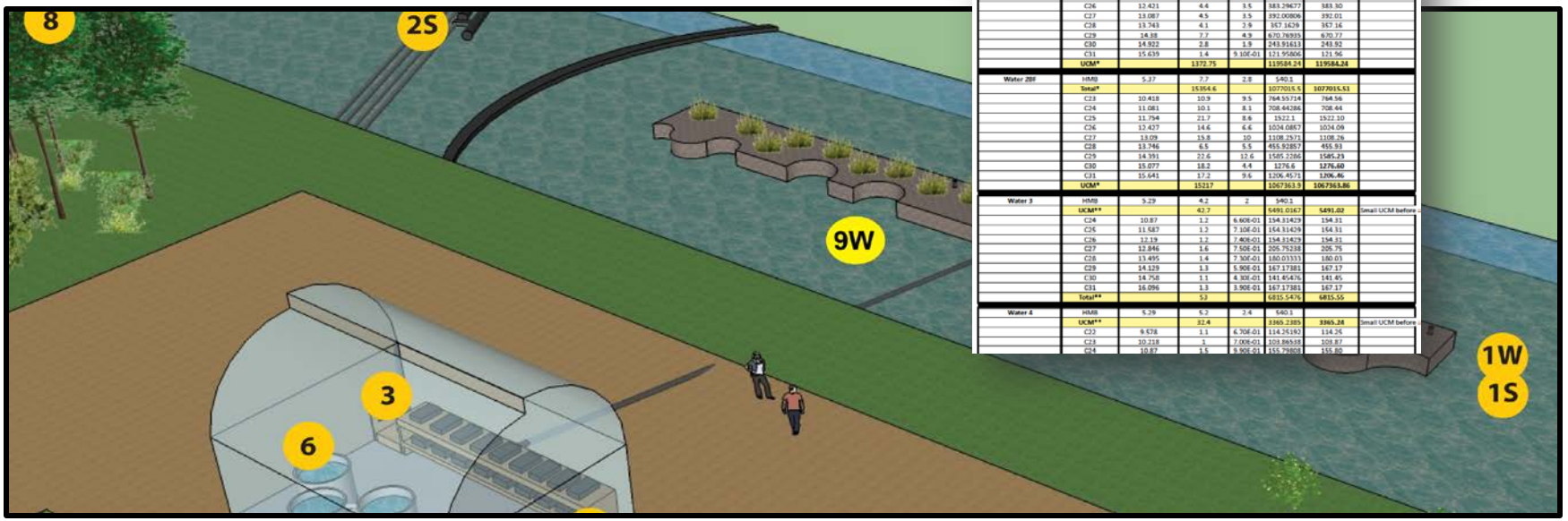
Island Restorer

Bottom Filter

Bioremediation Cells

White-rot fungi

Field Study with JT. Eco Design

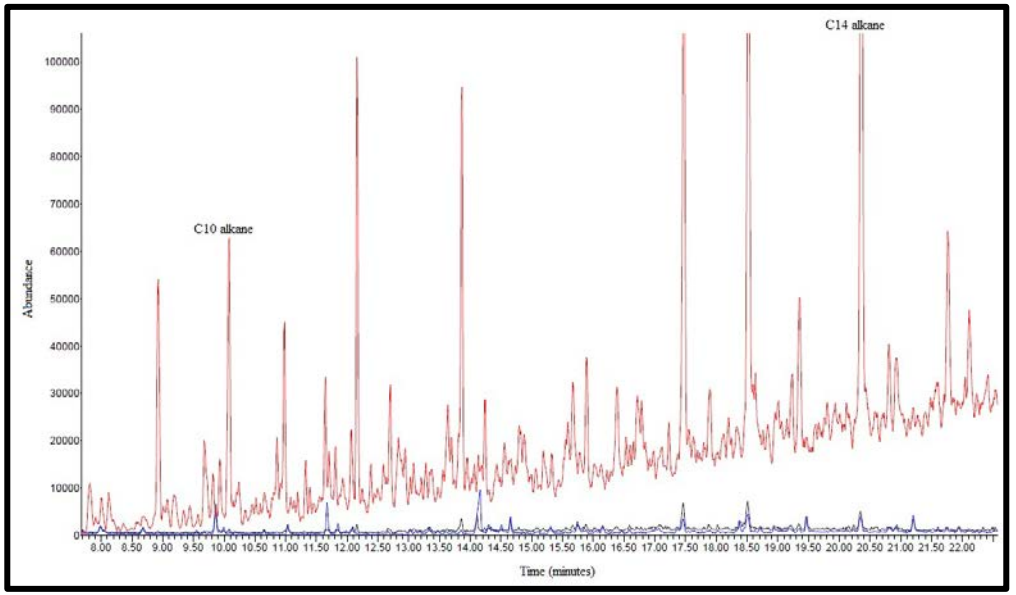


Water Samples

Sample	Subject	Ret. Time (min)	Area	Height	Mass (ng)	Concentration (ng/L)	Remarks
Water 1	HMB	5.375	4.17	1.8	540.1		
	Total*		1139.42		173482.19	173482.19	
	C23	10.416	1.3	1.1	168.3765	168.38	
	C24	11.084	1.3	1.00E+00	168.3765	168.38	
	C25	11.76	4.3	1.4	556.91765	556.94	
	C26	12.422	2	1.5	259.04077	259.04	
	C27	13.087	1.9	1.5	246.08873	246.09	
	C28	13.739	1.9	1.1	246.08873	246.09	
	C29	14.381	2.3	1.1	297.89688	297.90	
	C31	15.643	1	9.40E-01	129.52038	129.52	
	UCM*		1323.42		171409.87	171409.87	
Water 2	HMB	5.37	6.2	2.7	540.1		
	Total*		1413.46		121129.73	121129.73	
	C23	10.416	1.7	1.3	148.09194	148.09	
	C24	11.079	2.3	1.7	200.35968	200.36	
	C25	11.807	11.8	5.4	1027.9323	1027.93	
	C26	12.421	4.4	3.5	383.29677	383.30	
	C27	13.087	4.5	3.5	392.00806	392.01	
	C28	13.743	4.1	2.9	357.1429	357.14	
	C29	14.38	7.7	4.9	670.78935	670.77	
	C30	14.922	2.8	1.9	243.91613	243.92	
	C31	15.639	1.4	9.10E-01	121.95806	121.96	
	UCM*		1372.75		119584.24	119584.24	
Water 20F	HMB	5.37	7.7	2.8	540.1		
	Total*		15354.6		1077015.5	1077015.51	
	C23	10.418	10.9	9.5	764.55714	764.56	
	C24	11.081	10.1	8.1	708.44286	708.44	
	C25	11.794	21.7	8.6	1522.1	1522.10	
	C26	12.427	14.6	6.6	1024.0857	1024.09	
	C27	13.09	15.8	10	1108.2571	1108.26	
	C28	13.746	6.5	5.5	455.92857	455.93	
	C29	14.391	22.6	12.6	1585.2286	1585.23	
	C30	15.077	18.2	4.4	1276.6	1276.60	
	C31	15.641	17.2	9.6	1206.4571	1206.46	
	UCM*		15217		1067363.9	1067363.86	
Water 3	HMB	5.29	4.2	2	540.1		
	UCM**		42.7		5491.0167	5491.02	Small UCM before
	C24	10.87	1.2	6.60E-01	154.31429	154.31	
	C26	11.587	1.2	7.10E-01	154.31429	154.31	
	C26	12.19	1.2	7.40E-01	154.31429	154.31	
	C27	12.846	1.6	7.50E-01	205.75238	205.75	
	C28	13.495	1.4	7.30E-01	180.03333	180.03	
	C29	14.129	1.3	5.90E-01	167.17381	167.17	
	C30	14.758	1.1	4.30E-01	141.45476	141.45	
	C31	16.096	1.3	3.90E-01	167.17381	167.17	
	Total**		53		6815.5476	6815.55	
Water 4	HMB	5.29	5.2	2.4	540.1		
	UCM**		32.4		3365.2385	3365.24	Small UCM before
	C22	9.678	1.1	6.70E-01	114.25192	114.25	
	C23	10.218	1	7.00E-01	103.86538	103.87	
	C24	10.87	1.5	9.90E-01	155.79808	155.80	

- Is the Eco-machine removing bunker-C oil from the canal?
  - Yes: Aliphatic compounds reduced from average 200 ppb in canal to 6 ppb in Eco-machine.
  - Yes: PAHs reduced from average 43 ppt in canal to 0.7 ppt in Eco-machine.
  - But: Unclear which feature (or combination thereof) is doing the job.
  - Challenge: Are flow-rates through Eco-machine low compared to that of canal? Hydrogeology of canal not yet understood.

Bench-top Study with Clark University



- Do white-rot fungi degrade bunker-C oil?
  - Yes, several components. Likely through formation of oxidative enzymes.
- Which components are most susceptible to degradation?
  - Degradation of complex oil compounds (e.g. PAHs) takes longer than degradation of simpler compounds (e.g., alkanes).
- Can we observe changes in gene expression during growth on Bunker C oil and on two different wood substrates?
  - Transcriptome analyses suggest differential gene expression in the presence of Bunker C oil.

Future Opportunities

- Massachusetts Environmental Trust Grant Proposal
  - Letter of inquiry sent Oct. 2012
  - Leader: Blackstone Headwaters Coalition (BHC)
  - Proposed development of a living classroom and applied water resource research laboratory and associated curriculum
  - Consortium: BHC, Mosakowski Institute, Clark U., Brown U. SRP, UVM, JTED, Town of Grafton, Fisherville Redevelopment Company, etc.
  - "The Brown University Superfund Research Program will provide certain analytical services and contribute to experimental design, public outreach activities, and curriculum development."
- Continued operation and analysis of the Eco-Machine by JT Eco. Design
- Basic and applied research opportunities for Brown SRP
  - Many complicated questions remain unanswered
  - Onsite Green Remediation?

What Have We Learned?

- Remediation drives risk assessment process.
  - Aliphatics in water at concentrations approaching (but below) MA DEP regulatory limits.
  - TPH in sediment generally exceeds MA DEP Soil Category Standards.
- Leveraging resources of multiple stakeholders was key to success.
  - Especially when facing limited funds
- Easier for Brown SRP Research Translation Core to become involved at Fisherville Mill site than many others because it was “closed” with no pending or forthcoming litigation.
- Communication was key.
  - Conference calls, emails, meetings, and events
- Field studies are complicated!
  - Is the remediation system working? (Black-box approach). How is the remediation system working? (Basic science approach)
  - The Brown SRP is not an EPA-certified laboratory. What help can appropriately be offered?
- Brown SRP Role: Scientific backup, Looking at new opportunities

Thank You. Questions?