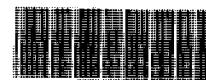


US EPA ARCHIVE DOCUMENT

FINAL AGENDA**[4/20/07]****CENTREDALE DIALOG MEETING #4****Radisson Hotel Providence Harbor****Bayview Room****April 23, 2007**

SDMS DocID

273426**Meeting goals:**

- Update on site activities since July 2006 meeting
- Update on RI/FS schedule and public outreach and communication activities
- Review new information resulting from the detailed analysis of cleanup alternatives [including screening of the dam removal alternatives]

10:30 am COFFEE**10:45 am Review Agenda****11:00 am Update on dam removal alternatives and hydrodynamic model**

- Review results of screening analysis related to dam removal
- Review and discuss questions the planned dam removal hydrodynamic model is designed to answer

11:30 pm Update on RI/FS schedule and public outreach and communication

- Review and update EPA's schedule for completing the RI/FS
- Discuss public outreach/communication surrounding completion of the RI/FS

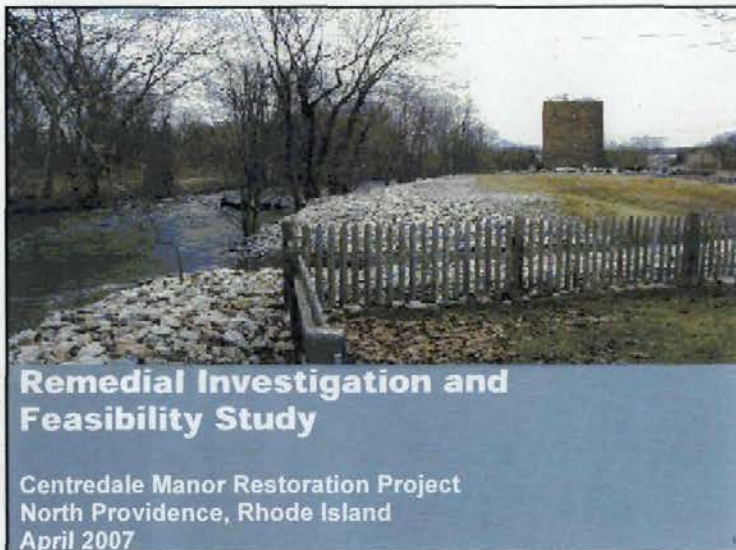
12:15 LUNCH**1:30 pm Update on site activities**

- Review analyses conducted since July 2006 meeting [including groundwater contamination investigation and Oxbow Area studies]
- Questions and discussion

2:45 pm Review new information from detailed analysis of cleanup alternatives

- Review detailed analysis of alternatives including monitoring, institutional controls and disposal options

3:45 pm Review of meeting and next steps**4:00 pm ADJOURN**



Presentation Overview

- **Update on Dam Removal Alternatives**
 - Screening analysis of sediment alternatives with dam removal
 - Hydrodynamic model
- **Update on RI/FS Schedule and Public Outreach**
- **Update on Site Activities**
 - Oxbow area studies
 - Groundwater contamination
- **Feasibility Study – New Information**
 - Detailed analysis of alternatives
- **Next Steps**




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Update on Dam Removal Alternatives

- Screening Analysis of Dam Removal Alternatives
- Hydrodynamic Model



Lyman Mill Dam



Allendale Dam

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Dam Removal Alternatives Screening Analysis

- **Nine Alternatives were Identified with the Dams in Place and Four were Retained from Screening**
- **Three Additional Alternatives were Identified with the Dams Removed**
 - **Alternative 10** Dam Removal and Isolation Capping
 - **Alternative 11** Dam Removal, Excavation, and Disposal or Treatment
 - **Alternative 12** Dam Removal, Partial Excavation, Isolation Capping, and Disposal or Treatment
- **Alternatives were Evaluated Against Threshold Criteria**
 - **Effectiveness**
 - Short and long term effectiveness in providing protection of human health and the environment
 - **Implementability**
 - Technical and administrative feasibility, including ability to construct, reliably operate, and meet regulations until remedy is complete
 - **Cost**
 - Relative present worth costs accurate to +50% to -30% based on various cost estimating

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Dam Removal Alternatives Screening Analysis

• ALTERNATIVE 10 – DAM REMOVAL AND ISOLATION CAPPING

- Divert surface water, place multi-layer cap over pond bottom and remove dams
 - Total cap thickness 4 to 6 ft
 - Three layer cap: sand, gravel, and armor rock
- **Monitoring**
 - Long-term (cap integrity, sediment and fish monitoring)
- **Institutional Controls**
 - Land use controls (e.g., prevent excavation, restricted access for utilities, long-term maintenance of cap)

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Dam Removal Alternatives Screening Analysis

• ALTERNATIVE 11 – DAM REMOVAL, EXCAVATION, AND DISPOSAL OR TREATMENT

- Divert surface water, excavate sediment with chemical concentrations above the RGs throughout entire pond, remove dams, and restore final water body
 - 150,000 cy removed (less under nearshore CDF option)
 - Water body: river channel and small pond areas, rip-rap placed in areas of high flows
 - Four disposal/treatment options
- **Monitoring**
 - Long term (periodic sediment and fish monitoring, CDF integrity)
- **Institutional Controls**
 - Land use controls for CDF (e.g., long-term maintenance of CDF)



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Dam Removal Alternatives Screening Analysis

• ALTERNATIVE 12 – DAM REMOVAL, PARTIAL EXCAVATION, ISOLATION CAPPING, AND DISPOSAL OR TREATMENT

- Divert surface water, excavate sediment with chemical concentrations above the RGs from targeted areas, place isolation cap over areas not excavated, remove dams, and restore final water body
 - 60,000 cy removed
 - Water body: small pond areas, engineered river channel
 - Five disposal/treatment options
- **Monitoring**
 - Long term (sediment monitoring, periodic fish monitoring, cap and/or CDF integrity)
- **Institutional Controls**
 - Land use controls (e.g., prevent excavation, restricted access for utilities, long-term maintenance of cap/CDF)



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Dam Removal Alternatives Screening Analysis

	Dam Removal Alternatives		
	(10) Isolation Capping	(11) Excavation and Disposal or Treatment	(12) Partial Excavation, Isolation Capping, and Disposal or Treatment
Effectiveness	Low	High	High
Implementability	Not implementable	Moderate to Difficult	Moderate to Difficult
Cost	Not applicable	\$49M to \$145M	\$34M to \$76M
Monitoring	Scheduled monitoring and 5-year reviews (perpetuity) Long-term monitoring of cap	Periodic monitoring (support 5-yr reviews) Long-term monitoring of on-site containment facility	Scheduled monitoring and 5-year reviews (perpetuity)
Institutional Controls	Use restrictions Long-term cap maintenance	Use restrictions and long-term maintenance of on-site containment facility	Use restrictions and long-term maintenance of on-site containment facility, engineered channel and capped floodplain areas

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Dam Removal Alternatives Hydrodynamic Model

What Do We Need to do to Further Evaluate the Dam Removal Alternatives?

• Develop Hydrodynamic Model

- Better understand system hydrodynamics with dams removed
- Support design of a stable river channel under a range of flow conditions
- Evaluate effects of dam removal on hydrodynamics and floodplain inundation under high-flow conditions
- Estimate potential effect on flood flows downstream of Manton Dam

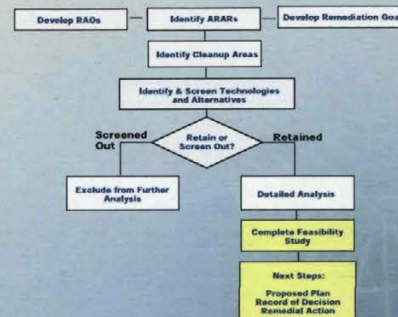


Not the Woonasquatucket River

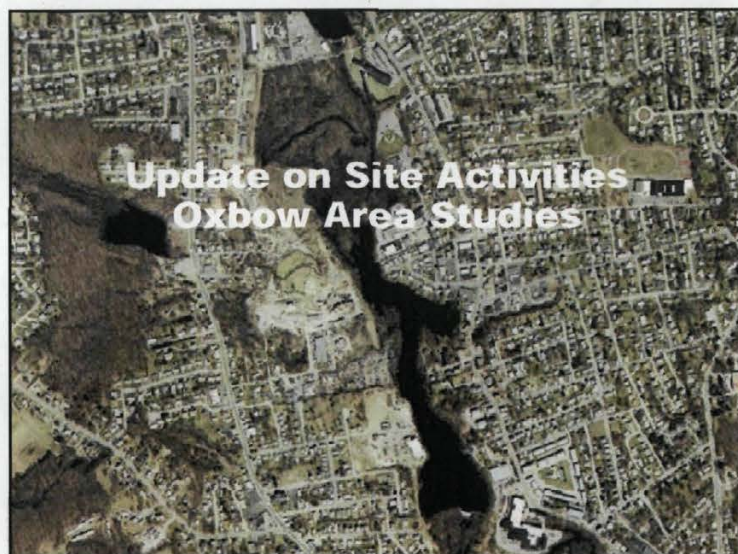
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Update on RI/FS Schedule and Public Outreach

- **Public Meeting, Fall 2007**
 - Detailed Evaluation of Dam Removal Alternatives and Model
- **Feasibility Study Report, Early 2008**
- **Public Meeting, Early 2008**
 - Comparative Analysis of Alternatives and Preview to Proposed Plan
- **Release Proposed Plan to Public, Early 2008**
- **Public Comment/Public Meetings (60-d)**
- **Response to Comment (90-d)**
- **Record of Decision, Summer 2008**



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Feasibility Study Action Areas

- **The Five Action Areas Being Evaluated in the Feasibility Study Include**
 - Allendale and Lyman Mill Pond Sediment
 - Allendale Floodplain Soil
 - Lyman Mill Floodplain Soil (including the Oxbow) and Stream Sediment
 - Source Area Soil
 - Source Area Groundwater

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Oxbow Area Studies

• Key Questions:

- What are the functions and values of the Oxbow habitat?
- Are the public and wildlife at risk?
- How is EPA going to manage risks at the Oxbow?

• Study Components:

- Wetland Study
- Risk Assessment
- Feasibility Study (FS) update



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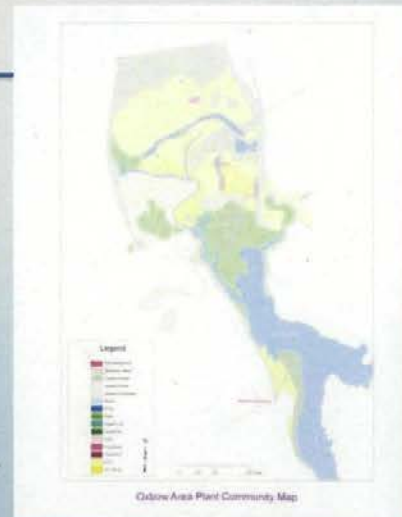
ACOE Oxbow Area Wetland Studies

- Review of Site History
- Wetland Delineation
- Plant Community Mapping
- Qualitative Wetlands Functions and Values Assessment (Corps Highway Methodology)

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Functions and Values

- Groundwater Recharge/Discharge
- Floodflow Alteration
- Fish Habitat
- Sediment/Toxicant Retention
- Nutrient Removal
- Production Export
- **Wildlife Habitat**
- Recreation
- Educational/Scientific Value
- Uniqueness/Heritage

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Wildlife Habitat Considerations

- Significant Size/Uniqueness
- Diverse Plant Communities
- Abundant Food Plants
- Nesting Habitat (waterfowl, songbirds)
- Numerous Snags and Habitat Logs
(most < 8" diameter)
- Possible Vernal Pools

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Oxbow Area Plant Community Map

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Possible Vernal Pools



Possible Vernal Pool

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Conclusions

Oxbow Area Provides Significant Wildlife Habitat

- Unique Area Along Lower Woonasquatucket
- Significant Size
- Diverse Plant Communities
- Possible Vernal Pools

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Oxbow Risk Assessment

Are the Public and Wildlife at Risk?

• Addendum to Baseline Risk Assessment

- Human Health
- Ecological



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Oxbow Risk Assessment Human Health

Are Toxic Contaminants Present?

- Dioxin/furans, PCBs, pesticides, metals

Who is Exposed? How Often?

- Local residents and visitors
 - Recreational activities (e.g., hiking)
- Assumed exposure frequencies (maximum 78 d/yr and average 39 d/yr)



How are People Exposed to Contaminants?

- Direct contact with wetland soil during recreational activities
- Incidental ingestion



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Oxbow Risk Assessment Human Health

How Toxic are the Chemicals?

- Used EPA toxicity data to estimate potential non-cancer and cancer health effects at different exposure levels
 - Non-cancer hazard is comparison of allowable exposure to amount of exposure estimated at the site (hazard index)
 - Cancer risk is the increased probability of getting cancer



Are there Potential Health Risks?

- Incremental non-cancer hazards are below EPA's risk range
- Dermal contact with wetland soil at the Oxbow exceeds EPA's cancer risk range (maximum exposure only)
- Primary contributor to risk is dioxin



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Oxbow Risk Assessment Ecological

Are Toxic Contaminants Present Where Animals Live?

- Dioxin/furans, PCBs, pesticides, metals

What Animals Are Exposed? How Exposed?

- Floodplain invertebrates, *amphibians*, birds, and mammals
- Estimated daily exposure to chemicals in soil and food
- Ongoing exposure to chemicals that bioaccumulate in tissue



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Oxbow Risk Assessment Ecological

How are Wildlife Exposed to Contaminants?

- Direct contact with wetland soil
- Ingestion of biota (e.g., earthworms)
- Incidental ingestion of wetland soil
- Tissue residues (internal exposure)



How Toxic are the Chemicals?

- Site-specific data and EPA toxicity reference values used to assess potential for chemicals to cause harm
 - Comparison of analytical data to soil benchmarks
 - Comparison of estimated earthworm concentrations to tissue benchmarks
 - Comparison of estimated wildlife oral exposures to safe levels

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Oxbow Risk Assessment Ecological

Are there Potential Ecological Risks?

- Floodplain soil invertebrates may be at substantial risk of harm based on comparison to conservative benchmarks
 - Exposure to dieldrin, lindane, DDE, DDD and zinc
 - Other measures used in the baseline suggest less potential risk
- Mammal and bird populations that consume worms and insects appear to be at substantial risk of harm
 - Dioxin (2,3,7,8-TCDD) primary contributor to risk
 - Bioaccumulation hazard
- Mammal populations that consume a broad variety of foods do not appear to be at risk



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Oxbow Risk Assessment Conclusions

• Passive Recreational Visitors and Worm-feeding Mammal and Bird Populations Appear to be At Risk

- Primary contributor to risk is dioxin

• Risk Estimate Uncertainties

- Limited data available
- Potential sampling bias
- Selected exposures not evaluated (e.g., plants, aquatic receptors)
- Exposure and habitat assumptions

• Overall Risk Estimates are Conservative



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Oxbow FS Update

How is EPA Going to Manage Risks at the Oxbow?

• Conduct Feasibility Study (FS)

- Develop remedial action objectives
- Identify potential Applicable or Relevant and Appropriate Requirements (ARARs)
- Develop remediation goals
- Identify cleanup areas
- Identify and evaluate cleanup options



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Oxbow FS Update Remedial Action Objectives

Remedial Action Objectives are designed to:

- Describe what the remedy is expected to accomplish
- Protect human health and the environment
- Prevent or minimize exposure to and migration of contaminants

"Eliminate unacceptable risks to human health and the environment"

Optimize short-term impacts and long-term benefits for animals

Minimize potential downstream migration of contaminated sediment or floodplain soil"

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Oxbow FS Update Remediation Goals

- **No Applicable Federal or State Action Levels**
- **Preliminary Remediation Goals (PRGs)**
 - Range of risk values
 - Specific exposure pathways and chemicals of concern
 - Protective of human health and the environment
- **The Remediation Goal (RG) is the Risk-based PRG or Background; Whichever is Higher**
 - Based on background for dioxin, primary contributor to risk

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Oxbow FS Update Cleanup Area

- **Compare Site Data to Remediation Goals**
- **Evaluate Area Topography, Vegetation, and Land Use**
- **Balance Ecological Risk-reduction Against Habitat Loss**
- **Identify Areas and Volumes for Cleanup**
 - 17.5 acres
 - 35,000 cubic yards (cy)
 - Excavation depth 1 ft



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Oxbow FS Update Screening Analysis

Six Potential Remedial Alternatives Were Identified:

- **Alternative 1 No Further Action**
 - No active remediation
- **Alternative 2 Monitored Natural Recovery**
 - Allow natural processes to address contamination and monitor progress
- **Alternative 3 Enhanced Natural Recovery**
 - Apply thin-layer cover to accelerate natural recovery and monitor progress
- **Alternative 4 Excavation with Disposal or Treatment**
 - Remove contaminated material to uniform depth and dispose in containment facility on-site, incinerate on-site, or dispose off-site
- **Alternative 5 Partial Excavation and Enhanced Natural Recovery with Disposal or Treatment**
 - Remove contaminated material to uniform depth at *targeted* areas and dispose, place thin-layer cover over areas not excavated, and monitor progress
- **Alternative 6 Limited Excavation and Monitored Natural Recovery with Disposal or Treatment**
 - Remove contaminated material to uniform depth at *targeted* areas and dispose, allow natural processes to address contamination in areas not excavated, and monitor progress

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Key Differences in Action Area:

- **Mass removal**
- **Focused excavation to optimize short-term impacts and long-term benefits to animals**
- **Excavate areas**
 - With highest likelihood of human exposure, and
 - Where contaminant migration is most likely
- **Additional sampling to validate footprint**

**Alternative 5
Partial
Excavation**



**Alternative 6
Limited
Excavation**



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Oxbow FS Update Screening Analysis

Preliminary Remedial Alternatives were Evaluated with Respect to Three Evaluation Criteria

- **Effectiveness**
 - Short and long term effectiveness in providing protection of human health and the environment
- **Implementability**
 - Technical and administrative feasibility, including ability to construct, reliably operate, and meet regulations until remedy is complete
- **Cost**
 - Relative present worth costs accurate to +50% to -30% based on various cost estimating

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Oxbow FS Update Screening Analysis - Results

	Non-Removal Actions		
	(1) No Further Action	(2) Monitored Natural Recovery (MNR)	(3) Enhanced Natural Recovery (ENR)
Effectiveness	Not effective	Low	Moderate
Implementability	Routine	Routine	Routine
Cost	\$62K	\$1.2M	\$8M
Monitoring	Periodic monitoring after severe event	Scheduled monitoring and 5-year reviews (perpetuity)	Scheduled monitoring and 5-year reviews (perpetuity) Long-term monitoring of cover
Institutional Controls	None	Recreational use restrictions Future use restrictions (e.g., prevent excavation)	Recreational use restrictions Future use restrictions (e.g., prevent excavation) Long-term maintenance of cover

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Oxbow FS Update Screening Analysis - Results

	Removal Actions with Disposal or Treatment		
	(4) Excavation	(5) Partial Excavation and Enhanced Natural Recovery	(6) Limited Excavation and Monitored Natural Recovery
Effectiveness	High	Moderate to High	Moderate
Implementability	Moderate	Moderate	Moderate
Cost	\$14M to \$48M	\$13M to \$34M	\$8M to \$22M
Monitoring	Periodic monitoring (support 5-yr reviews)	Scheduled monitoring and 5-year reviews (perpetuity) Long-term monitoring of cover Recreational use restrictions	Scheduled monitoring and 5-year reviews (perpetuity)
Institutional Controls	Future use restrictions (e.g., prevent excavation)	Long-term and future use restrictions to reduce human exposure (e.g., restrict access, prevent excavation) Long-term maintenance of cover	Recreational use restrictions Long-term and future use restrictions to reduce human exposure (e.g., restrict access, prevent excavation)

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Oxbow FS Update Screening Analysis - Results

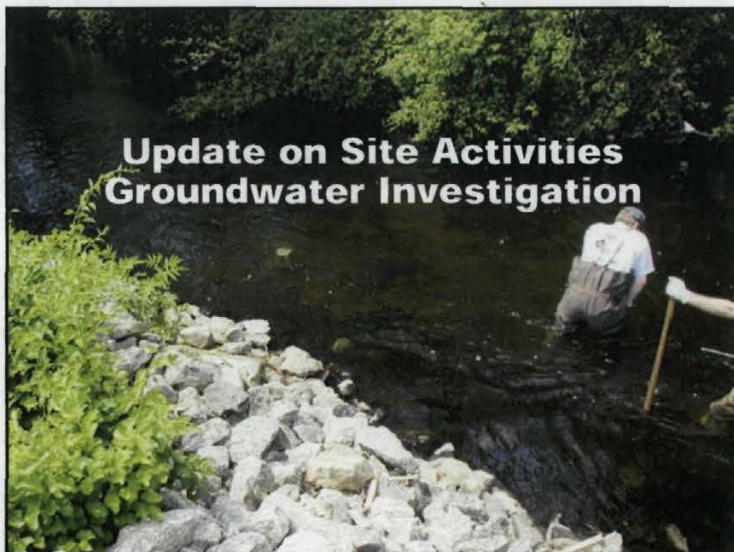
	Disposal or Treatment Options		
	On-site CDF	On-site Thermal Treatment	Off-site Disposal/Treatment
Effectiveness	High	High	High
Implementability	Moderate to Difficult	Moderate to Difficult	Moderate to Difficult
Cost	Low	Moderate	High
Monitoring	Long-term monitoring of CDF	Monitoring during treatment	None
Institutional Controls	Future use restrictions Long-term maintenance of CDF (e.g., limit size of woody growth on top of CDF)	None	None



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Update on Site Activities Groundwater Investigation



Groundwater Investigation

• Key Findings from Remedial Investigation

- Localized volatile organic compound (VOC) and dioxin contamination
- Groundwater from MW-05S has highest concentrations of VOCs and dioxin
- Plume of VOC-contaminated groundwater discharge to river near MW-05S
- *Is contaminated groundwater an ongoing source or migration pathway of dioxin to the river?*

• Groundwater Investigation

- Groundwater flow direction
- Semi-permeable membrane device (SPMD) study



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Groundwater Flow Direction

• Water Level Measurements

- 2 surface water locations
- 23 monitoring wells
- 14 piezometers

• Groundwater Flow Direction

- Shallow groundwater flow generally to south
- Elevated water table at MW-05S



SPMD Study

• What is an SPMD?

- Semi-permeable membrane device
- Low density polyethylene tubing containing a thin film of a pure, high-molecular weight lipid

• How are they Used?

- Mimic biological systems
- Measure bioavailable pollutants that partition across the membrane



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SPMD Study - Design

• SPMDs Deployed at 6 Locations

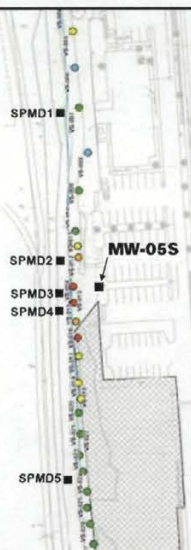
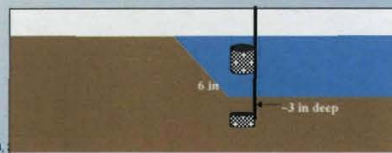
- 1 SPMD in groundwater at MW-05S
- 5 SPMDs in river
- Zone influenced by groundwater plume

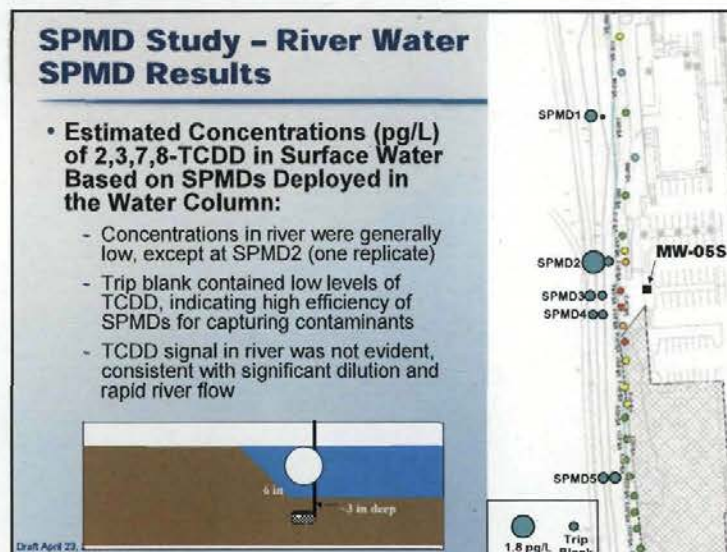
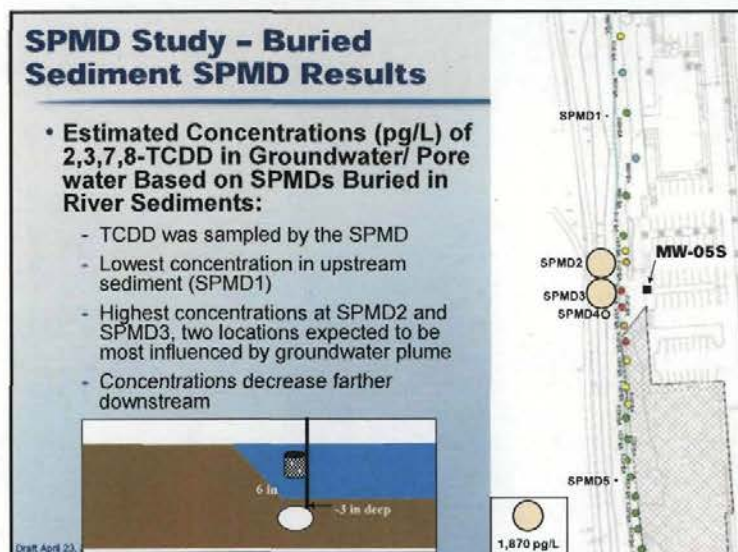
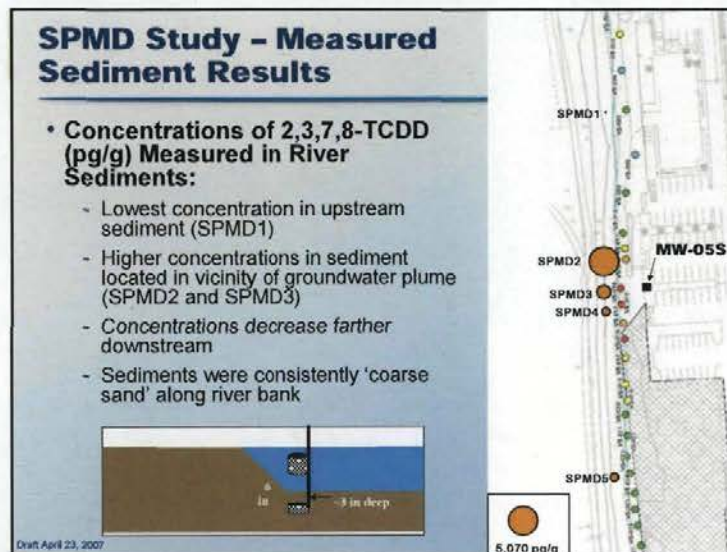
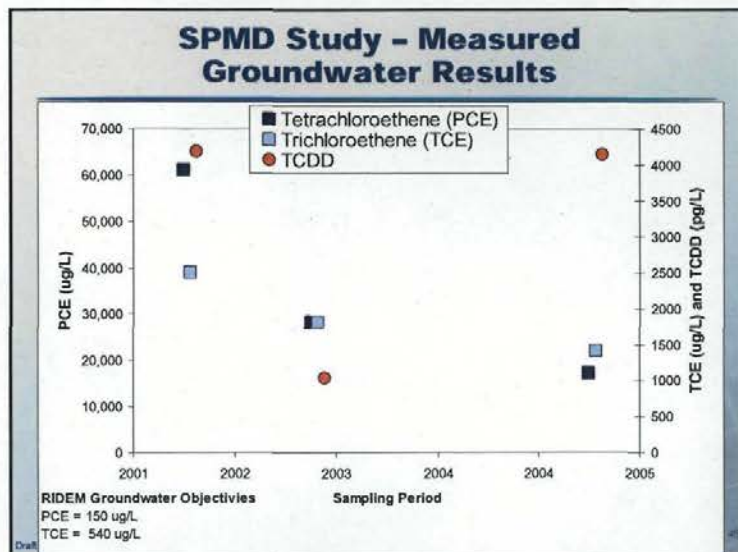
• Co-located Sediments Sampled

• Groundwater Sampled at MW-05S

• Chemical Testing

• Estimated Concentrations in Surrounding Water Using SPMDs





SPMD Study Conclusions

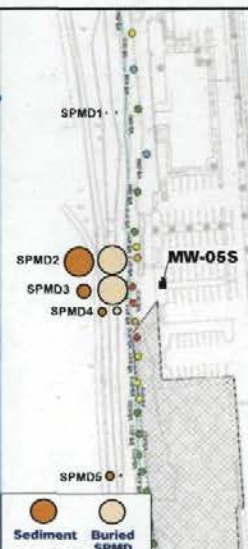
Potential Sources of TCDD to the River

- Pore water associated with contaminated sediment
- Contaminated groundwater flowing through sediment

Contaminated Sediments Likely Not Primary Source

- Uniformly sandy characteristics of river sediment
- Similar patterns in sediment and buried SPMD data except at SPMD3

Contaminated Groundwater Is Likely Ongoing Source or Migration Pathway of TCDD to the River



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Feasibility Study - New Information Detailed Analysis of Alternatives



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Response Actions Considered

Institutional Controls

- Permits, use restrictions

Non-removal Actions

Removal Actions

Dewatering

Treatment

- Incineration, chemical treatment

Disposal

- On-site confinement
- On-site thermal
- Off-site disposal or treatment



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Adapted from: NRC 1997

Retained Alternatives Were Evaluated Against NCP Criteria

- **Overall Protection of Human Health and the Environment**
 - Elimination, reduction, and/or control of site risks
- **Compliance with ARARs**
 - Ability to meet Federal, State, and/or Local ARARs
- **Long-term Effectiveness and Permanence**
 - Residual risk after completion of remedy
- **Reduction of Toxicity, Mobility and Volume Through Treatment**
- **Short-term Effectiveness**
 - Effects to community, site workers, and/or environment during construction/implementation
- **Implementability**
 - Technical and administrative feasibility including potential technical difficulties, reliability, and availability of necessary goods and services
- **Cost**
- **State Acceptance**
 - Issues and concerns of the regulatory agencies to be addressed in the ROD
- **Community Acceptance**
 - Public issues and concerns to be addressed in the Record of Decision (ROD)

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Feasibility Study Action Areas

- **The Five Action Areas Evaluated in the Feasibility Study Include**
 - Allendale and Lyman Mill Pond Sediment
 - Allendale Floodplain Soil
 - Lyman Mill Floodplain Soil (including the Oxbow) and Stream Sediment
 - Source Area Soil
 - Source Area Groundwater

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Allendale and Lyman Mill Pond Sediment Alternatives

Four of the Remedial Alternatives were Retained for Further Evaluation

- **Alternative 1** No Further Action
- **Alternative 5** Isolation Capping
- **Alternative 7** Excavation and Disposal or Treatment
- **Alternative 9** Partial Excavation, Isolation Capping and Disposal or Treatment



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Allendale and Lyman Mill Pond Sediment Alternatives

- **ALTERNATIVE 1 – NO FURTHER ACTION**
 - No active remediation
 - **Monitoring**
 - Periodic monitoring to support five-year reviews
 - **Institutional Controls**
 - RIDOH could maintain fishing advisory

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Allendale and Lyman Mill Pond Sediment Alternatives

- **ALTERNATIVE 5 – ISOLATION CAPPING**
 - Place 2 ft thick sand cap over entire pond bottom using shallow draft water-based equipment
 - 1 ft isolation layer overlain by 1 ft erosion control/habitat layer
 - Top layer designed for 100-yr flood (cobble or coarse gravel at upstream inlets)
 - 190,000 tons of cap material
 - **Monitoring**
 - Design (water depth)
 - Construction quality control (water quality monitoring, post-cap confirmation)
 - Long-term (cap integrity, water/sediment/fish monitoring)
 - **Institutional Controls**
 - Land use controls (e.g., prevent excavation, restricted access for utilities, long-term maintenance of cap)



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Allendale and Lyman Mill Pond Sediment Alternatives

• ALTERNATIVE 7 – EXCAVATION AND DISPOSAL OR TREATMENT

- Lower water levels and excavate sediment with chemical concentrations above the RGs
 - Maximum depth 4 ft; avg depth 2.1 ft Allendale and 2.6 ft at Lyman Mill
 - 150,000 cy removed
 - Post-excavation cap if RGs not achieved
- Dewatering (mechanical)
 - 2 to 3 acres for equipment and sediment stockpiles
- Monitoring
 - Design (sediment cores)
 - Construction quality control (water quality, post-excavation confirmation sampling)
 - Long term (periodic water/sediment/fish monitoring)
- Institutional Controls
 - Land use controls for CDF (e.g., long-term maintenance of CDF)



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Allendale and Lyman Mill Pond Sediment Alternatives

• ALTERNATIVE 9 – PARTIAL EXCAVATION, ISOLATION CAPPING, AND DISPOSAL OR TREATMENT

- Lower water levels, excavate top 2 ft at targeted areas, and place 2 ft thick sand cap over entire pond
 - 60,000 cy removed
 - 190,000 tons cap material
- Dewatering (mechanical)
 - 2 to 3 acres for equipment and sediment stockpiles
- Monitoring
 - Design (water depth)
 - Construction quality control (water quality monitoring, post-cap confirmation)
 - Long-term (cap integrity, water/sediment/fish monitoring)
- Institutional Controls
 - Land use controls (e.g., prevent excavation, restricted access for utilities, long-term maintenance of cap)



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Allendale and Lyman Mill Pond Sediment Alternatives Detailed Analysis Results

Criteria	Alternative			
	(1) No Further Action	(5) Isolation Capping	(7) Excavation and Disposal or Treatment	(9) Partial Excavation, Isolation Capping, and Disposal or Treatment
Overall Protection of Human Health and the Environment	Not effective	Moderate	High	Moderate
Compliance with ARARs	High	Moderate	High	High
Long-term Effectiveness and Permanence	Not effective	Moderate	Moderate to High	Moderate
Reduction of Toxicity, Mobility, or Volume through Treatment	Not effective	Not effective	Not effective	Not effective
Short-term Effectiveness	High	Low	Low	Low
Implementability	Routine	Moderate	Moderate to Difficult	Moderate to Difficult
Cost	\$340K	\$23M	\$44M to \$107M	\$37M to \$62M
Implementation Time	Not applicable	12 months	18 months	16 months

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Allendale Floodplain Soil Alternatives

Two of the Remedial Alternatives were Retained for Further Evaluation

- Alternative 1 No Further Action
- Alternative 5 Excavation and Disposal or Treatment



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Allendale Floodplain Soil Alternatives

• ALTERNATIVE 1 – NO FURTHER ACTION

- No active remediation
- Monitoring
 - Periodic monitoring to support five-year reviews (conducted in conjunction with pond sediment)
- Institutional Controls
 - ICs not component of remedy

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Allendale Floodplain Soil Alternatives

• ALTERNATIVE 5 – EXCAVATION AND DISPOSAL OR TREATMENT

- Excavate top 1 ft in areas that provide ecological floodplain habitat, backfill with clean material, and restore floodplain habitat
 - 3,700 cy removed
- Monitoring
 - Design (floodplain survey)
 - Construction quality control (air and noise monitoring, post-excavation confirmation sampling)
- Institutional Controls
 - No use restrictions anticipated



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Allendale Floodplain Soil Alternatives Detailed Analysis Results

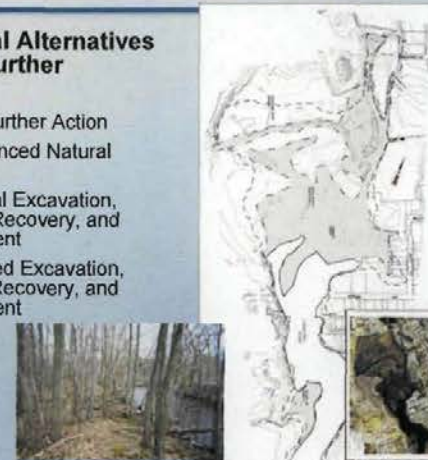
Criteria	Alternative	
	(1) No Further Action	(5) Excavation and Disposal or Treatment
Overall Protection of Human Health and the Environment	Not effective	High
Compliance with ARARs	High	High
Long-term Effectiveness and Permanence	Not effective	High
Reduction of Toxicity, Mobility, or Volume through Treatment	Not effective	Not effective
Short-term Effectiveness	High	Low
Implementability	Routine	Moderate to Difficult
Cost	\$0K	\$1.4M to \$6M
Implementation Time	Not applicable	1 month

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Lyman Mill Floodplain Soil (Oxbow) and Stream Sediment Alternatives

Four of the Remedial Alternatives were Retained for Further Evaluation

- Alternative 1 No Further Action
- Alternative 3 Enhanced Natural Recovery
- Alternative 5 Partial Excavation, Enhanced Natural Recovery, and Disposal or Treatment
- Alternative 6 Limited Excavation, Monitored Natural Recovery, and Disposal or Treatment



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Lyman Mill Floodplain Soil (Oxbow) and Stream Sediment Alternatives

• ALTERNATIVE 1 – NO FURTHER ACTION

- No active remediation
- **Monitoring**
 - Periodic monitoring to support five-year reviews
- **Institutional Controls**
 - ICs not component of remedy

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Lyman Mill Floodplain Soil (Oxbow) and Stream Sediment Alternatives

• ALTERNATIVE 3 – ENHANCED NATURAL RECOVERY

- Place thin-layer cover (3 inches thick) over entire area using a broadcast or spraying technique
 - Apply during dormant season
 - 10,600 tons of cover material
 - Consider water flow control structures
- **Monitoring**
 - Design (sediment/soil sampling)
 - Construction quality control (air and noise monitoring, confirmation of cover placement)
 - Long-term (cover integrity, sediment/soil/biota monitoring)
- **Institutional Controls**
 - Land use controls (e.g., access restrictions, prevent excavation, long-term maintenance of cover)



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Lyman Mill Floodplain Soil (Oxbow) and Stream Sediment Alternatives

• ALTERNATIVE 5 – PARTIAL EXCAVATION, ENHANCED NATURAL RECOVERY, AND DISPOSAL OR TREATMENT

- Excavate top 1 ft at targeted areas, backfill, place thin-layer cover over remaining area, and restore habitat
 - 23,000 cy removed
 - 3,700 tons cover material
- **Monitoring**
 - Design (sediment/soil sampling)
 - Construction quality control (air and noise monitoring, confirmation of cover placement)
 - Long-term (cover integrity, sediment/soil/biota monitoring)
- **Institutional Controls**
 - Land use controls (e.g., access restrictions, prevent excavation, long-term maintenance of cover)



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Lyman Mill Floodplain Soil (Oxbow) and Stream Sediment Alternatives

• ALTERNATIVE 6 – LIMITED EXCAVATION, MONITORED NATURAL RECOVERY, AND DISPOSAL OR TREATMENT

- Excavate top 1 ft at targeted areas, backfill, and restore habitat
 - 14,000 cy removed
- **Monitoring**
 - Design (sediment/soil sampling)
 - Construction quality control (air and noise monitoring, confirmation of backfill placement)
 - Long-term (sediment/soil/biota monitoring)
- **Institutional Controls**
 - Land use controls (e.g., access restrictions, prevent excavation)



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Lyman Mill Floodplain Soil (Oxbow) and Stream Sediment Alternatives Detailed Analysis Results

Criteria	Alternative			
	(1) No Further Action	(3) Enhanced Natural Recovery	(5) Partial Excavation, ENR, and Disposal or Treatment	(6) Limited Excavation, MNR, and Disposal or Treatment
Overall Protection of Human Health and the Environment	Not effective	Low	Moderate	Moderate
Compliance with ARARs	High	High	High	High
Long-term Effectiveness and Permanence	Not effective	Moderate	High	Moderate to High
Reduction of Toxicity, Mobility, or Volume through Treatment	Not effective	Not effective	Not effective	Not effective
Short-term Effectiveness	High	Moderate	Low	Moderate
Implementability	Routine	Moderate	Moderate to Difficult	Moderate to Difficult
Cost	\$220K	\$4M	\$13 to \$31M	\$8M to \$20M
Implementation Time	Not applicable	4 months	10 months	6 months

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Source Area Soil Alternatives

Three of the Remedial Alternatives were Retained for Further Evaluation

- **Alternative 1** No Further Action
- **Alternative 2** Upgrade and Maintain Existing Caps and Parking Lots
- **Alternative 3** Convert to RCRA Caps and Maintain



Basemap

Source Area Topography



Source Area Soil Alternatives

• ALTERNATIVE 1 – NO FURTHER ACTION

- No active remediation
- **Monitoring**
 - Periodic monitoring to support five-year reviews
- **Institutional Controls**
 - ICs not component of remedy

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Source Area Soil Alternatives

• ALTERNATIVE 2 – UPGRADE AND MAINTAIN EXISTING CAPS AND PARKING LOTS

- **Upgrade existing soil covers**
 - Remove existing vegetation
 - Import sand/gravel soil and regrade to 3% slope
 - Cover with topsoil and hydro-seed
- **Upgrade parking lot areas**
 - Place asphalt sealant over entire parking lot areas
- **Monitoring**
 - Construction quality control (air and noise monitoring)
 - Long term (cap integrity)
- **Institutional Controls**
 - Land use controls (e.g., prohibit excavation, restrict access for buried utilities, maintenance of caps and parking lots)

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Source Area Soil Alternatives

• ALTERNATIVE 3 – CONVERT TO RCRA CAPS AND MAINTAIN

- Convert existing soil covers and parking lots to RCRA cover system

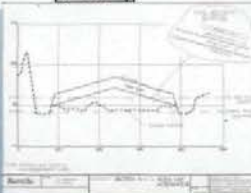
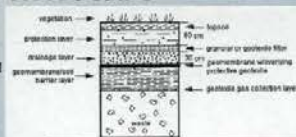
- Remove vegetation, asphalt, and regrade to 3% slope
- Replace topsoil and grass with gravel and asphalt in paved areas
- Total cover thickness 24-30 inches over geomembrane layer
- Relocate utilities to 'clean corridor'

- Monitoring

- Construction quality control (air and noise)
- Long term (cap integrity)

- Institutional Controls

- Land use controls (e.g., prohibit excavation, restrict access for buried utilities, maintenance of caps and parking lots)



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Source Area Soil Alternatives Detailed Analysis Results

Criteria	Alternative		
	(1) No Further Action	(2) Upgrade and Maintain Existing Caps and Parking Lots	(3) Convert to RCRA Caps and Maintain
Overall Protection of Human Health and the Environment	Moderate	High	High
Compliance with ARARs	High	High	High
Long-term Effectiveness and Permanence	Low	High	High
Reduction of Toxicity, Mobility, or Volume through Treatment	Not Effective	Not Effective	Not Effective
Short-term Effectiveness	High	Moderate	Moderate
Implementability	Routine	Routine	Routine
Cost	\$150K	\$4M	\$9M
Implementation Time	Not applicable	4 months	6 months

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Groundwater Alternatives

Five of the Remedial Alternatives were Retained for Further Evaluation

- **Alternative 1** No Further Action
- **Alternative 2** Excavate/Dewater
- **Alternative 3a** Hydraulic Containment Barrier
- **Alternative 4** Passive Reactive Barrier (Biowall)
- **Alternative 5** In-situ Chemical Oxidation



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Groundwater Alternatives

• ALTERNATIVE 1 – NO FURTHER ACTION

- **No active remediation**
- **Monitoring**
 - Periodic monitoring to support five-year reviews (conducted in conjunction with source area soil)
- **Institutional Controls**
 - ICs not component of remedy

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Groundwater Alternatives

• ALTERNATIVE 2 – EXCAVATE/DEWATER

- Focused excavation to ~4 ft at VOC/dioxin impacted area
 - Approximately 3,400 cy removed and disposed off-site
- Dewatering
 - Approximately 40,000 gal extracted groundwater treated and discharged
- Monitoring
 - Design (soil borings and analysis)
 - Construction quality control (air and noise monitoring; water and soil characterization)
- Institutional Controls
 - No future use restrictions anticipated



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Groundwater Alternatives

• ALTERNATIVE 3a – HYDRAULIC CONTAINMENT BARRIER

- Install steel sheet piling completely around impacted area under Brook Village parking lot to prevent groundwater flow to river
 - Approximately 60 feet deep and 600 ft circumference
 - Place surface cover to prevent water infiltration
 - Install piezometers
- Monitoring
 - Construction quality control (air and noise monitoring)
 - Long term (GW elevations)
- Institutional Controls
 - Land use controls (e.g., maintenance of barrier and surface cover)



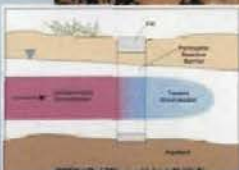
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Groundwater Alternatives

• ALTERNATIVE 4 – PASSIVE REACTIVE BARRIER (BIOWALL)

- Excavate soil and install biowall along impacted area to prevent migration of contaminants in groundwater to river
 - Biowall comprised of plant material, compost, and coarse sand or river rock
 - 30 ft deep, 3 ft thick, 230 ft long
 - 300 cy soil disposed off-site
 - Install groundwater monitoring wells
- Monitoring
 - Design (feasibility testing)
 - Construction quality control (air and noise; soil characterization)
 - Long term (groundwater monitoring)
- Institutional Controls
 - Land use controls (e.g., maintenance of biowall)



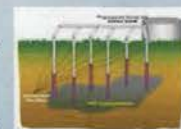
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Groundwater Alternatives

• ALTERNATIVE 5 – IN-SITU CHEMICAL OXIDATION

- Inject hydrogen peroxide using Cool-Ox™ process into groundwater at impacted area in Brook Village parking lot
 - Treated area 60 ft by 160 ft and 12 ft deep; injections at 5 ft intervals
 - Chemical destruction of VOCs; effective oxidation of dioxin also demonstrated (Lundy, 2005)
- Monitoring
 - Construction (noise monitoring)
 - Long term (periodic monitoring to support 5-yr reviews)
- Institutional Controls
 - Land use controls (e.g., restrict future site use of groundwater)



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Groundwater Alternatives Detailed Analysis Results

Criteria	Alternative				
	(1) No Further Action	(2) Excavate/Dewater	(3a) Hydraulic Containment Barrier	(4) Passive Reactive Barrier	(5) In-situ Chemical Oxidation
Overall Protection of Human Health and the Environment	Low	High	Moderate	Moderate	High
Compliance with ARARs	Low	High	High	High	Moderate
Long-term Effectiveness and Permanence	Low	High	Moderate	Moderate	Moderate
Reduction of Toxicity, Mobility, or Volume through Treatment	Not Effective	Low	Not Effective	Moderate	High
Short-term Effectiveness	High	Moderate	Moderate	Moderate	High
Implementability	Routine	Moderate	Moderate	Moderate	Routine
Cost	\$0	\$2.2M	\$1.9M	\$1.8M	\$1.2M
Implementation Time	Not applicable	18 months	18 months	18 months	12 months

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Next Steps - RI/FS Schedule and Public Outreach

- **Public Meeting, Fall 2007**

- Detailed Evaluation of Dam Removal Alternatives and Model

- **Feasibility Study Report, Early 2008**

- **Public Meeting, Early 2008**

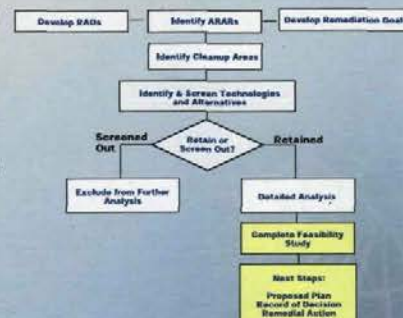
- Comparative Analysis of Alternatives and Preview to Proposed Plan

- **Release Proposed Plan to Public, Early 2008**

- **Public Comment/Public Meetings (60-d)**

- **Response to Comment (90-d)**

- **Record of Decision, Summer 2008**



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ACOE Oxbow Area Wetland Studies

- Review of Site History
- Wetland Delineation
- Plant Community Mapping
- Qualitative Wetlands Functions and Values Assessment (Corps Highway Methodology)

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2

Site History

1894 USGS Topo



1939 USGS Topo



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3

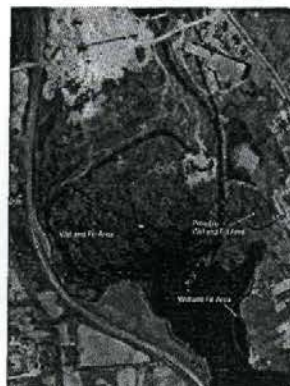
1939 Aerial Photo



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Areas Filled Since 1939



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Methods - Wetland Delineation

- ACOE 3-parameter approach
 - soils
 - vegetation
 - hydrology
- Distinct Topographical Boundary in Most Areas

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Methods- Plant Community Mapping and Vegetation Studies

- Aerial Photo Interpretation
(2003 black and white stereo imagery)
- Field Verification of Community Maps
- Plant Community Composition
 - Meander Surveys
 - Plot Studies
 - Limited data for spring flora

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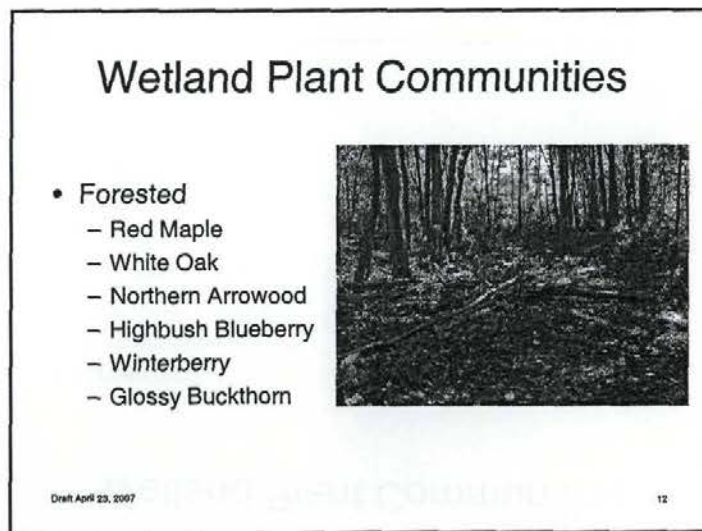
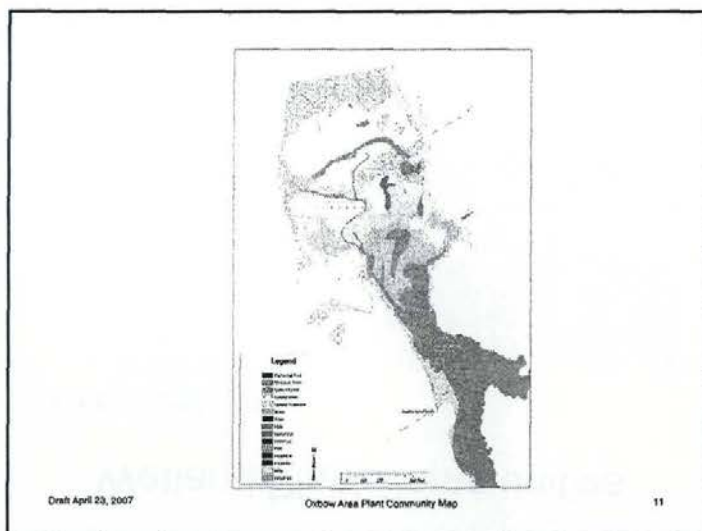
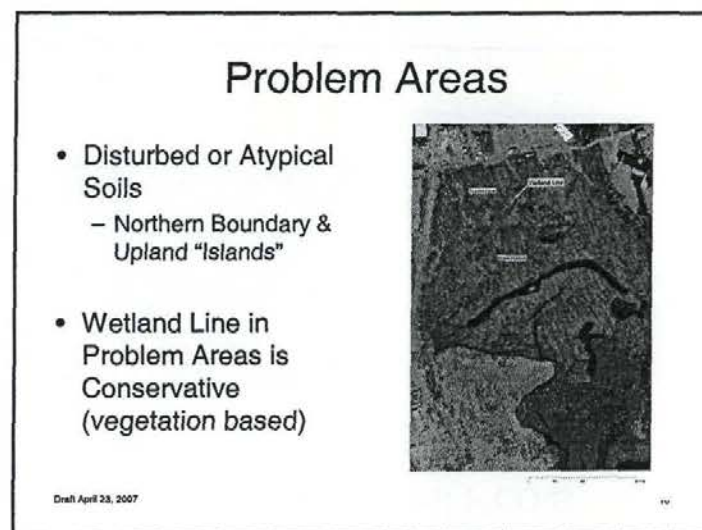
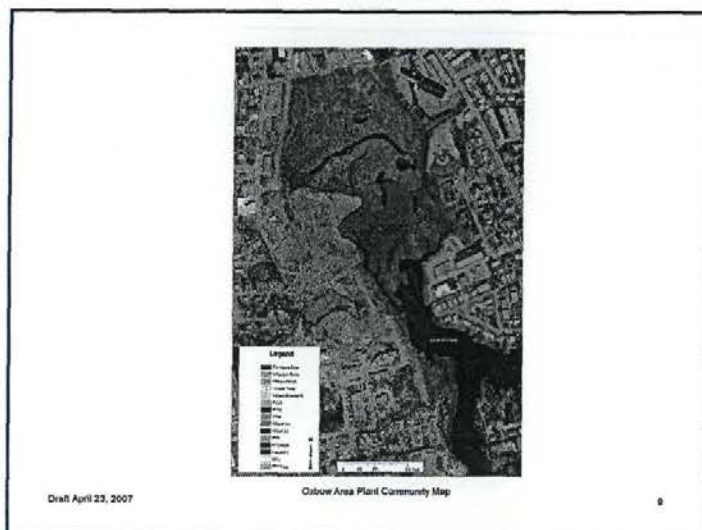
7

Methods Wetland Functions and Values

- ACOE Highway Methodology
- Qualitative Wildlife Habitat Evaluation

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Wetland Plant Communities

- Forested/Shrub
 - Red Maple
 - Northern Arrowwood
 - Highbush Blueberry
 - Winterberry
 - Red Osier Dogwood
 - Glossy Buckthorn
 - Cinnamon Fern
 - Royal Fern



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Wetland Plant Communities

- Emergent
 - Purple Loosestrife
 - Swamp Loosestrife
 - Swamp Rose
 - Smartweeds
 - Morning Glory
 - Arrowhead



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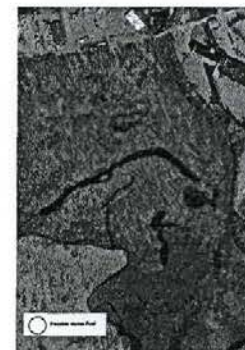
Invasives

- Oriental Knotweed
- Oriental Bittersweet
- Purple Loosestrife
- Glossy Buckthorn
- Tree of Heaven
- Bush Honeysuckle
- Phragmites
- Japanese Barberry
- Garlic Mustard

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Possible Vernal Pools



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Functions and Values

- Groundwater Recharge/Discharge
- **Floodflow Alteration**
- **Fish Habitat**
- Sediment/Toxicant Retention
- Nutrient Removal
- Production Export
- **Wildlife Habitat**
- **Recreation**
- Educational/Scientific Value
- Uniqueness/Heritage

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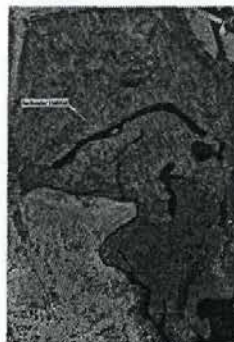
Floodflow Alteration



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Fish Habitat



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Wildlife Habitat Considerations

- Significant Size/Uniqueness
- Diverse Plant Communities
- Abundant Food Plants
- Nesting Habitat (waterfowl, songbirds)
- Numerous Snags and Habitat Logs
(most < 8" diameter)
- Possible Vernal Pools

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Recreation

- Some Trails Present
- Evidence of Fishing
- Off Road Vehicles Use
- No Hunting Permitted in Johnston
- Access to Emergent & Shrub Wetlands
Very Limited by Soft Soils

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Conclusions

Oxbow Area Provides Significant Wildlife Habitat

- Unique Area Along Lower Woonasquatucket
- Significant Size
- Diverse Plant Communities
- Possible Vernal Pools

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