Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX A-1

RESOURCE AGENCIES CORRESPONDENCE

US Army Corps
of Engineers®
New England District

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

March 28, 2007

Reference:	Project Malden River Ecosystem Restoration Project	Location Malden, Everett and Medford, MA

Mr. John R. Kennelly
Chief of Planning
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

Dear Mr. Kennelly:

This is in response to your letter requesting a final Fish and Wildlife Coordination Act report in relation to the Malden River Ecosystem Restoration Project in Malden, Everett and Medford, Massachusetts. The project's primary objectives are to reduce negative impacts to water quality; to restore riverine migratory corridors; to reduce negative impacts caused by sediment quality; the restoration of degraded benthic habitat; and the enhancement or restoration of freshwater wetlands.

Endangered Species Comments

Based on information currently available to us, no federally-listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service (Service) are known to occur in the project area. Preparation of a Biological Assessment or further consultation with us under Section 7 of the Endangered Species Act is not required.

This concludes our review of listed species and critical habitat in the project location and environs referenced above. No further Endangered Species Act coordination of this type is necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available.

Fish and Wildlife Coordination Act Comments

Based on our review of the information provided, we have no objection to this project with regard to the Fish and Wildlife Coordination Act. Accordingly, these comments do not preclude future evaluation and recommendations by the U.S. Fish and Wildlife Service, pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401: 16 U.S.C. 661 et seq.), should project conditions change.

Thank you for your coordination. Please contact us at 603-223-2541 if we can be of further assistance.

Sincerely yours,

William J. Neidermyer

William J. Neidermyer
Assistant Supervisor, Federal Activities
New England Field Office

MEMORANDUM FOR RECORD

TO: ALL PARTICIPANTS

FROM: MICHAEL TUTTLE

SUBJECT: MALDEN RIVER ECOSYSTEM RESTORATION

MEETING DATE: 20 MARCH 2007

PREPARATION DATE: 6 APRIL 2007

On Tuesday, 20 March 2007, a meeting was held at the office of Massachusetts Department of Environmental Protection, Northeast Region to discuss the ecosystem restoration approach for the Malden River. This document is considered a record of the discussion.

The participants present were:

- Joanne Fagan – MADEP, Section Chief
- Heidi Davis – MADEP, Environmental Analyst
- Beth Debski, MVDC Coordinator
- Jeff Nangle, Nangle Consulting Assoc.
- Chuck Altobello, Nangle Consulting Assoc.
- Harry Bovee, Preotle, Lane & Assoc.
- Mark Fobert, Tetra Tech Rizzo
- Todd Randall – USACE, Biologist
- Mike Tuttle – USACE, Project Manager

<u>Presentation Overview</u>

Mike and Todd presented the recommended plan for the Malden River Ecosystem Restoration Project. The primary elements of the recommended plan consist of the following:

- Removal of 36,000 cubic yards of wetland soils and 14.9 acres of invasive species along the riverbank corridor and replanting with native wetland plant species;
- Creation of 5.4 acres of emergent wetland within an existing open water area;
- Placement of 4,400 cubic yards of cobble/gravel/sand substrate to create 2.8 acres of fish spawning habitat;
- Miscellaneous debris removal and disposal; and
- Operational changes at the Amelia Earhart Dam to improve fish passage for anadromous species.

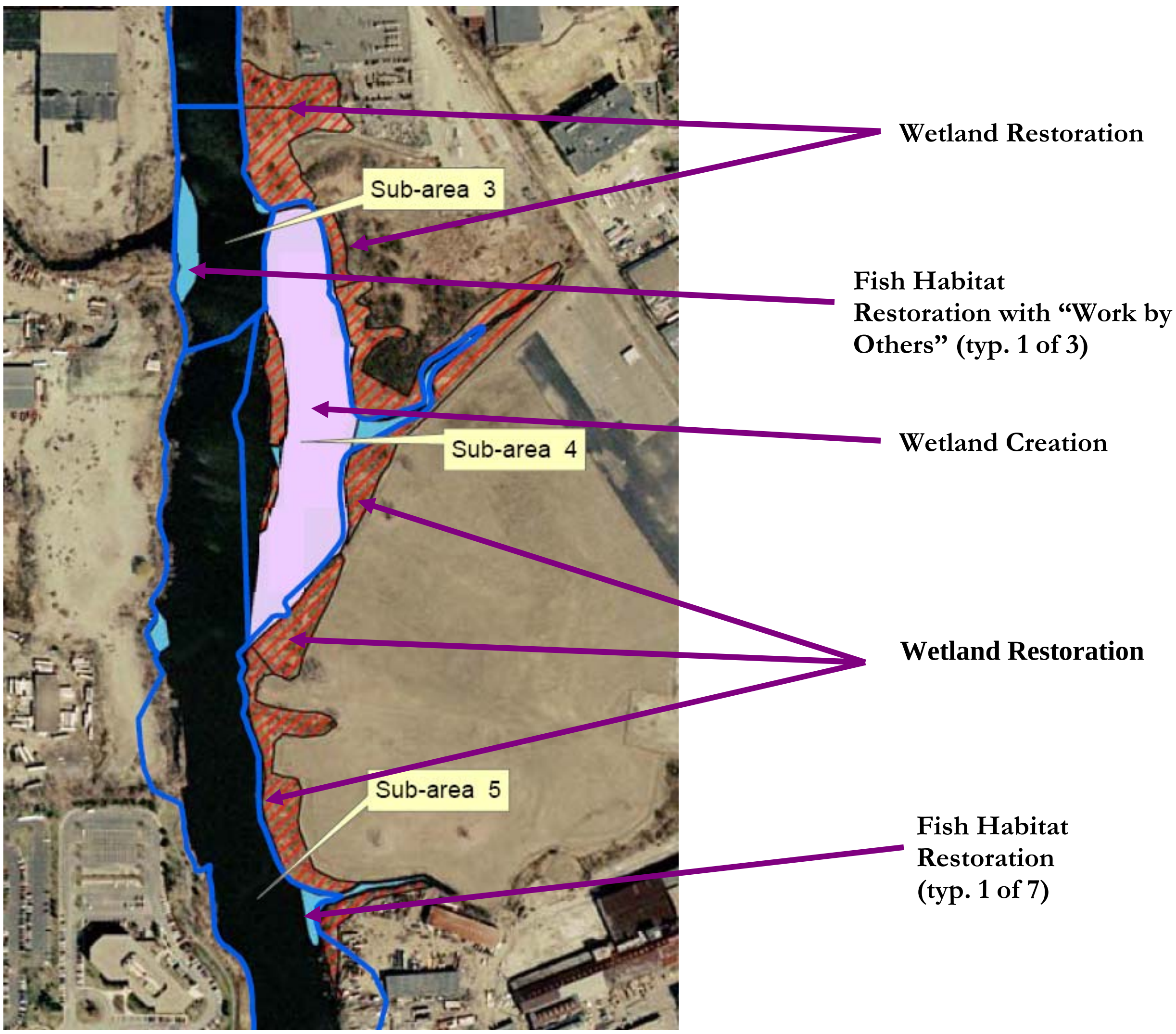
The wetland restoration component of this project involves the removal of 14.9 acres of invasive species and replanting of native wetland species to create a freshwater emergent/shrub wetland. This recommendation consists of cutting, clearing and grubbing existing Phragmites stands, excavation of the Phragmites plants and root matter, placing a layer of clean soil and the planting of native wetland plants. Phragmites stems and root matter will be removed by excavating a minimum depth of 18 inches. The generated volume is estimated at 36,000 cubic yards. This excavated material will be used as a sub-base for the wetland creation component of the recommended plan.

The wetland creation component of this project involves the establishment of a vegetated wetland within the river's oxbow to create 5.4 acres of emergent wetlands. It is anticipated that the majority of the excavated material from the wetland restoration component would be used as a substrate. A one foot layer of new soil would be placed prior to the planting of native wetland seedlings. The required volume of clean fill is estimated at 9,000 cubic yards. A flow control device such as a weir or flashboard riser would be installed within the existing tributary to control flow. The flow control device would diverse the flow and provide improve stormwater treatment.

Thefish habitat restoration component of this project involves the placement 4,400 cubic yards of clean cobble/gravel/sand substrate to create 2.8 acres of fish spawning habitat. Three of the ten proposed areas require work by “others” before placement of the gravel substrate. Another party must remove/dispose a minimum of 3-foot depth of existing river bottom in order to provide a suitable and stable base prior to the placement of the proposed gravel substrate. Negotiations with the responsible parties are ongoing. Ten individual areas comprise the fish habitat restoration measure.

Miscellaneous debris removal and disposal is proposed within the construction work limits. This recommendation involves the removal of existing debris (e.g. shopping carts, tires, appliances, etc.) and transporting to an upland disposal site. The generated volume is estimated at 450 tons. Cost for this proposed action will be non-Federal responsibility.

Fish Passage improvement involves operational changes to the Amelia Earhart Dam locking system. This recommendation consists of expanding the periods of operation of one or more of the locks to provide a more effective passage of fish into the Malden/Mystic River system. This would require operating the locks not only during the daytime periods (which has proved reasonably effective for various herring species), but also during evening and early morning hours during migration periods for other fish species (e.g., rainbow smelt).



Meeting Discussion Topics

Jeff, Harry, and Mark provided an update on the restoration efforts along the Medford side. It was expressed that restoration activities mirrored the goals and objectives of the Federal plan. The native planting specifications were provided by USACE.

Though the proposed wetland restoration component requires Phragmites stem and root matter to be removed by excavating a minimum depth of 18 inches, the objective is to excavate to the first stable substrate layer.

Compensatory flood storage was discussed. The Medford-side restoration efforts have exceeded the minimum requirement for the compensatory flood storage. Credits may be used for the Federal plan. An area adjacent to North Creek has also been identified for additional flood storage, if needed.

The excavated material for the wetland restoration component can be managed under existing State programs. One option involves using the excavated volume of 30,000 cy as a substrate layer to the wetland creation component. Excess material may be reused within the study area as a part of the redevelopment plan for the Rivers Edge project.

The water levels fluctuate approximately 2 feet within the Malden River (elev. 4.5 – 6.5 NGVD). In order to identify the proposed elevation of the wetland creation component, further discussions with MA Department of Conservation and Recreation is warranted.

Closing Comments

If an omission exists or an incorrect statement, please reply to Mike Tuttle, Study Manager at 978-318-8677 or via e-mail michael.r.tuttle@usace.army.mil .

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

January 8, 2007

Reference:	Project	Location
	Ecosystem restoration project	Malden, Everett, Medford, MA

John R. Kennelly
New England District, Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

Dear Mr. Kennelly:

This responds to your recent correspondence requesting information on the presence of federally-listed and/or proposed endangered or threatened species in relation to the proposed activity(ies) referenced above.

Based on information currently available to us, no federally-listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area(s). Preparation of a Biological Assessment or further consultation with us under Section 7 of the Endangered Species Act is not required.

This concludes our review of listed species and critical habitat in the project location(s) and environs referenced above. No further Endangered Species Act coordination of this type is necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available.

Thank you for your coordination. Please contact us at 603-223-2541 if we can be of further assistance.

Sincerely yours,

Anthony P. Tur

Anthony P. Tur
Endangered Species Specialist
New England Field Office

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

December 4, 2006

Engineering/Planning Division
Planning Branch

Mr. Michael Bartlett
U.S. Fish & Wildlife Service
70 Commercial Street, Suite 300
Concord, New Hampshire 03301

Dear Mr. Bartlett:

I am writing in reference to the proposed Malden River Ecosystem Restoration Project in Malden, Everett, and Medford, Massachusetts.

Enclosed please find a compact disk with the draft version of the Detailed Project Report (DPR), Environmental Assessment (EA) and other supporting documentation for the proposed project. The draft DPR/EA and their appendices include maps of the proposed project area, resource characterization studies of the project area, and copies of all coordination documents from federal, state and local agencies.

Please accept this letter, and its enclosures, as the New England District's request for coordination under Section 7 of the Endangered Species Act (ESA) and the Fish and Wildlife Coordination Act (FWCA). We request that you provide this office with any comments and a Final Coordination Act Report (FCAR) on the draft report within 30 days of receipt of this letter.

If you have any questions concerning this request, please contact the project manager, Mr. Michael Tuttle, at (978) 318-8677, or Mr. Todd Randall, at (978) 318-8518.

Sincerely,

John R. Kennelly
Chief of Planning

Enclosure

Same Letter Sent To:

Ms. Maria Tur
US Fish and Wildlife Service
70 Commercial Street, Suite 300
Concord, New Hampshire 03301

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

RECEIVED

MAR 13 2006

MASS. HIST. COMM

March 8, 2006

Engineering/Planning Division
Evaluation Branch

RC. 39041

Ms. Brona Simon, Acting Executive Director
Massachusetts Historical Commission
Massachusetts Archives Building
220 Morrissey Boulevard
Boston, Massachusetts 02125

CONCURRENCE: Brona Simon
4/3/06 BRONA SIMON
DEPUTY STATE HISTORIC
PRESERVATION OFFICER
MASSACHUSETTS
HISTORICAL COMMISSION

xc: Cheryl Andrews-Maltais-THPO
Victor T. Mastone - BUAR

Dear Ms. Simon:

The U.S. Army Corps of Engineers, New England District (NAE), is preparing an environmental assessment for a proposed Malden River Ecosystem Restoration Feasibility Study in Malden, Medford, and Everett, Massachusetts. The proposed project includes removing invasive plant species from degraded freshwater wetland areas, restoring wetland areas by planting with native wetland species, and the creation of new wetland areas, and fish spawning habitat. We would like your comments on this proposed project.

The Coastal Massachusetts Ecosystem Reconnaissance Study, the initial authority for the investigation of the Malden River, was authorized by a resolution adopted by the Committee on Transportation and Infrastructure of the U.S. House of Representatives on July 23, 1997. The reconnaissance study identified the restoration of the Malden River ecosystem as one of the ecosystem restoration areas that warranted a full feasibility investigation.

The Malden River watershed is a sub-basin of the much larger Mystic River watershed. The Malden River watershed is approximately 11 square miles, located in the communities of Wakefield, Stoneham, Melrose, Malden, Medford, and Everett. The Malden River originates from the outflow from Spot Pond in the Fells Reservation and passes beneath or through the cities of Melrose, and Malden, in underground culverts south of Malden Center and flows for approximately 2 miles as open surface water through the densely populated cities of Malden, Everett, and Medford, prior to its confluence with the Mystic River. The study area is defined where the river daylights from the underground culverts south of Charles Street, Malden, to the confluence with the Mystic River Medford, and Everett, with a lower boundary of the Amelia Earhart Dam. Within the study area, four small tributaries flow into the Malden River, Little Creek on the western side, two unnamed tributaries on the east side referred to as north Creek and South Creek, and a small drainage creek referred to as the Mall Creek (Figure 1).

The Malden River was originally an estuarine coastal stream that flowed into the Mystic River, winding through a dendritic network of tidal flats and wetland marshes. About 100 years ago, the bordering cities of Malden, Everett, and Medford, with the Federal and state governments, deepened and straightened a mile-long section of the Malden River to create a new Federal river channel for emerging chemical production, coal gasification and manufacturing firms. These industrial usages included tanneries, naval munitions storage, general petroleum storage, and diverse chemical production (Figure 2). The reconfigured channel of the Malden River became an important industrialized waterway and navigational route from Boston Harbor to the emerging industries developed on land created through the filling of tidal wetlands along its banks.

The combined effects of filling of wetlands and waterways, industrial discharges and disposal practices, channelization and dredging, and unregulated runoff from urban areas, led to the loss of most of the historic estuarine wetland habitats and their associated values to fish and wildlife resources (Figure 3). Alteration of the natural river course and degradation of historic spawning and nursery habitat areas negatively impacted anadromous fish populations. Finally, the construction of the Amelia Earhart Dam in 1966 resulted in a complete ecosystem alteration as the tidally flushing estuarine river was converted into a freshwater impoundment with poor flushing, circulation and water quality.

The proposed ecosystem restoration plan consists of the following actions: removal of 10.4 acres of invasive species along the riverbank corridor within sub-areas 3, 4, and 5; replanting of 10.4 acres with native wetland species within sub-areas 3, 4, and 5; creation of 4.75 acres of emergent wetland within the existing oxbow (sub-area 4); placement of gravel/sand substrate to create 2.76 acres of fish spawning habitat within sub-areas 1, 3, 4, 5, and 6; debris removal and disposal within all sub-areas; and, operation changes at the Amelia Earhart Dam to improve fish passage (Figure 4). The material to be excavated from Malden River wetlands has not undergone chemical testing. However, based on studies from adjacent uplands, NAE assumes the material is contaminated and will require out of state disposal at an approved landfill.

Staging areas may be established to support construction activities. These areas will be used to house temporary project offices, store construction equipment and materials, and to process material and other debris removed. Four proposed staging areas were identified during the feasibility study. All proposed staging areas were previously developed and/or disturbed upland areas. Currently, the most favorable staging site due to its approximation to the proposed work activities, lot size, availability, and estimated real estate costs is the National Grid parcel (Figure 5). Topography, landscape features, and vegetation will be restored in-kind upon completion of restoration work.

The inventory of known prehistoric sites in the hilly, upland sections of the northern Boston Basin and Mystic River drainage is limited. However, there are several clusters of prehistoric quarry/lithic workshop sites near outcrops of fine-grained rocks (rhyolite) in the Melrose and Wakefield sections of Middlesex Fells uplands. Large, base campsites were located around ponds or the head of estuaries. Smaller, task specific sites are found on small tributaries or upland areas. During the Contact Period (1520 to 1620), the Mystic River drainage was one of two concentrations or core areas of settlement in the Boston Basin, the other being on the Neponset River. The Mystic River core also probably extended inland from the estuary to include adjacent uplands with large pond (Spot Pond) and tributary stream systems, such as the Malden River. It is likely that prehistoric sites were once present along the original course of the Malden River; however, any evidence of these sites has likely been destroyed by channelization, wetland filling, and industrial development.

Industrialization along the Malden River began as early as the seventeenth century. By the mid-nineteenth century, industries lined the Malden River, including the Boston Rubber Shoe Company established by Elisha Converse, Malden Chemical Works, tanneries, dye houses, nail factories, forges, machine shops, and factories producing tinware and brittaniaware. Shoemaking became a major industry by 1837. During the late nineteenth and early twentieth centuries, the Malden River was deepened and straightened to create a new Federal river channel for these manufacturers as well as chemical manufacturers, coal gasification, and general petroleum storage (Figure 2). Tidal wetlands were filled to create land for these industries.

NAE believes that the degree of disturbance from dredging, filling, channelization, and industrialization has caused the proposed ecosystem restoration project area to lack archaeological integrity. The proposed plan is to restore some of the degraded wetlands, and create fish habitat, within areas that were historically part of the Mystic River estuarine system and that have been severely impacted by heavy industrial activity. We anticipate that the proposed restoration plan should have no effect on historic properties. We would appreciate your concurrence.

If you have any questions, please contact Ms. Kate Atwood, NAE Archaeologist at (978) 318-8537.

Sincerely,

John R. Kennelly
Chief of Planning

Enclosures

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

March 8, 2006

Engineering/Planning Division
Evaluation Branch

Mr. Victor T. Mastone, Director
Massachusetts Board of Underwater Archaeological Resources
251 Causeway Street, Suite 800
Boston, Massachusetts 02114-2136

Dear Mr. Mastone:

The U.S. Army Corps of Engineers, New England District (NAE), is preparing an environmental assessment for a proposed Malden River Ecosystem Restoration Feasibility Study in Malden, Medford, and Everett, Massachusetts. The proposed project includes removing invasive plant species from degraded freshwater wetland areas, restoring wetland areas by planting with native wetland species, and the creation of new wetland areas, and fish spawning habitat. We would like your comments on this proposed project.

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The Malden River watershed is a sub-basin of the much larger Mystic River watershed. The Malden River watershed is approximately 11 square miles, located in the communities of Wakefield, Stoneham, Melrose, Malden, Medford, and Everett. The Malden River originates from the outflow from Spot Pond in the Fells Reservation and passes beneath or through the cities of Melrose and Malden in underground culverts south of Malden Center and flows for approximately 2 miles as open surface water through the densely populated cities of Malden, Everett, and Medford, prior to its confluence with the Mystic River. The study area is defined where the river daylights from the underground culverts south of Charles Street, Malden, to the confluence with the Mystic River Medford, and Everett, with a lower boundary of the Amelia Earhart Dam. Within the study area, four small tributaries flow into the Malden River, Little Creek on the western side, two unnamed tributaries on the east side referred to as north Creek and South Creek, and a small drainage creek referred to as the Mall Creek (Figure 1).

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The proposed ecosystem restoration plan consists of the following actions: removal of 10.4 acres of invasive species along the riverbank corridor within sub-areas 3, 4, and 5; replanting of 10.4 acres with native wetland species within sub-areas 3, 4, and 5; creation of 4.75 acres of emergent wetland within the existing oxbow (sub-area 4); placement of gravel/sand substrate to create 2.76 acres of fish spawning habitat within sub-areas 1, 3, 4, 5, and 6; debris removal and disposal within all sub-areas; and, operation changes at the Amelia Earhart Dam to improve fish passage (Figure 4). The material to be excavated from Malden River wetlands has not undergone chemical testing. However, based on studies from adjacent uplands, NAE assumes the material is contaminated and will require out of state disposal at an approved landfill.

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If you have any questions, please contact Ms. Kate Atwood, NAE Archaeologist at (978) 318-8537.

Sincerely,

John R. Kennelly
Chief of Planning

Enclosures

Similar Letter Sent To:
Ms. Cheryl Andrews-Maltais, Tribal Historic Preservation Officer
Wampanoag Tribe of Gay Head, Aquinnah
20 Black Brook Road
Aquinnah, Massachusetts 02535-1546

Ms. Brona Simon, Acting Executive Director
Massachusetts Historical Commission
Massachusetts Archives Building
220 Morrissey Boulevard
Boston, Massachusetts 02125

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

March 8, 2006

Engineering/Planning Division
Evaluation Branch

Ms. Brona Simon, Acting Executive Director
Massachusetts Historical Commission
Massachusetts Archives Building
220 Morrissey Boulevard
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Industrialization along the Malden River began as early as the seventeenth century. By the mid-nineteenth century, industries lined the Malden River, including the Boston Rubber Shoe Company established by Elisha Converse, Malden Chemical Works, tanneries, dye houses, nail factories, forges, machine shops, and factories producing tinware and brittaniaware. Shoemaking became a major industry by 1837. During the late nineteenth and early twentieth centuries, the Malden River was deepened and straightened to create a new Federal river channel for these manufacturers as well as chemical manufacturers, coal gasification, and general petroleum storage (Figure 2). Tidal wetlands were filled to create land for these industries.

NAE believes that the degree of disturbance from dredging, filling, channelization, and industrialization has caused the proposed ecosystem restoration project area to lack archaeological integrity. The proposed plan is to restore some of the degraded wetlands, and create fish habitat, within areas that were historically part of the Mystic River estuarine system and that have been severely impacted by heavy industrial activity. We anticipate that the proposed restoration plan should have no effect on historic properties. We would appreciate your concurrence.

If you have any questions, please contact Ms. Kate Atwood, NAE Archaeologist at (978) 318-8537.

Sincerely,

John R. Kennelly
Chief of Planning

Enclosures

Similar Letter Sent To:
Ms. Cheryl Andrews-Maltais, Tribal Historic Preservation Officer
Wampanoag Tribe of Gay Head, Aquinnah
20 Black Brook Road
Aquinnah, Massachusetts 02535-1546

Mr. Victor T. Mastone, Director
Massachusetts Board of Underwater Archaeological Resources
251 Causeway Street, Suite 800
Boston, Massachusetts 02114-2136

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

March 8, 2006

Engineering/Planning Division
Evaluation Branch

Ms. Cheryl Andrews-Maltais, Tribal Historic Preservation Officer
Wampanoag Tribe of Gay Head, Aquinnah
20 Black Brook Road
Aquinnah, Massachusetts 02535-1546

Dear Ms. Andrews-Maltais:

The U.S. Army Corps of Engineers, New England District (NAE), is preparing an environmental assessment for a proposed Malden River Ecosystem Restoration Feasibility Study in Malden, Medford, and Everett, Massachusetts. The proposed project includes removing invasive plant species from degraded freshwater wetland areas, restoring wetland areas by planting with native wetland species, and the creation of new wetland areas, and fish spawning habitat. We would like your comments on this proposed project.

The Coastal Massachusetts Ecosystem Reconnaissance Study, the initial authority for the investigation of the Malden River, was authorized by a resolution adopted by the Committee on Transportation and Infrastructure of the U.S. House of Representatives on July 23, 1997. The reconnaissance study identified the restoration of the Malden River ecosystem as one of the ecosystem restoration areas that warranted a full feasibility investigation.

The Malden River watershed is a sub-basin of the much larger Mystic River watershed. The Malden River watershed is approximately 11 square miles, located in the communities of Wakefield, Stoneham, Melrose, Malden, Medford, and Everett. The Malden River originates from the outflow from Spot Pond in the Fells Reservation and passes beneath or through the cities of Melrose, and Malden, in underground culverts south of Malden Center and flows for approximately 2 miles as open surface water through the densely populated cities of Malden, Everett, and Medford, prior to its confluence with the Mystic River. The study area is defined where the river daylights from the underground culverts south of Charles Street, Malden, to the confluence with the Mystic River Medford, and Everett, with a lower boundary of the Amelia Earhart Dam. Within the study area, four small tributaries flow into the Malden River, Little Creek on the western side, two unnamed tributaries on the east side referred to as north Creek and South Creek, and a small drainage creek referred to as the Mall Creek (Figure 1).

The Malden River was originally an estuarine coastal stream that flowed into the Mystic River, winding through a dendritic network of tidal flats and wetland marshes. About 100 years ago, the bordering cities of Malden, Everett, and Medford, with the Federal and state governments, deepened and straightened a mile-long section of the Malden River to create a new Federal river channel for emerging chemical production, coal gasification and manufacturing firms. These industrial usages included tanneries, naval munitions storage, general petroleum storage, and diverse chemical production (Figure 2). The reconfigured channel of the Malden River became an important industrialized waterway and navigational route from Boston Harbor to the emerging industries developed on land created through the filling of tidal wetlands along its banks.

The combined effects of filling of wetlands and waterways, industrial discharges and disposal practices, channelization and dredging, and unregulated runoff from urban areas, led to the loss of most of the historic estuarine wetland habitats and their associated values to fish and wildlife resources (Figure 3). Alteration of the natural river course and degradation of historic spawning and nursery habitat areas negatively impacted anadromous fish populations. Finally, the construction of the Amelia Earhart Dam in 1966 resulted in a complete ecosystem alteration as the tidally flushing estuarine river was converted into a freshwater impoundment with poor flushing, circulation and water quality.

The proposed ecosystem restoration plan consists of the following actions: removal of 10.4 acres of invasive species along the riverbank corridor within sub-areas 3, 4, and 5; replanting of 10.4 acres with native wetland species within sub-areas 3, 4, and 5; creation of 4.75 acres of emergent wetland within the existing oxbow (sub-area 4); placement of gravel/sand substrate to create 2.76 acres of fish spawning habitat within sub-areas 1, 3, 4, 5, and 6; debris removal and disposal within all sub-areas; and, operation changes at the Amelia Earhart Dam to improve fish passage (Figure 4). The material to be excavated from Malden River wetlands has not undergone chemical testing. However, based on studies from adjacent uplands, NAE assumes the material is contaminated and will require out of state disposal at an approved landfill.

Staging areas may be established to support construction activities. These areas will be used to house temporary project offices, store construction equipment and materials, and to process material and other debris removed. Four proposed staging areas were identified during the feasibility study. All proposed staging areas were previously developed and/or disturbed upland areas. Currently, the most favorable staging site due to its approximation to the proposed work activities, lot size, availability, and estimated real estate costs is the National Grid parcel (Figure 5). Topography, landscape features, and vegetation will be restored in-kind upon completion of restoration work.

The inventory of known prehistoric sites in the hilly, upland sections of the northern Boston Basin and Mystic River drainage is limited. However, there are several clusters of prehistoric quarry/lithic workshop sites near outcrops of fine-grained rocks (rhyolite) in the Melrose and Wakefield sections of Middlesex Fells uplands. Large, base campsites were located around ponds or the head of estuaries. Smaller, task specific sites are found on small tributaries or upland areas. During the Contact Period (1520 to 1620), the Mystic River drainage was one of two concentrations or core areas of settlement in the Boston Basin, the other being on the Neponset River. The Mystic River core also probably extended inland from the estuary to include adjacent uplands with large pond (Spot Pond) and tributary stream systems, such as the Malden River. It is likely that prehistoric sites were once present along the original course of the Malden River; however, any evidence of these sites has likely been destroyed by channelization, wetland filling, and industrial development.

Industrialization along the Malden River began as early as the seventeenth century. By the mid-nineteenth century, industries lined the Malden River, including the Boston Rubber Shoe Company established by Elisha Converse, Malden Chemical Works, tanneries, dye houses, nail factories, forges, machine shops, and factories producing tinware and brittaniaware. Shoemaking became a major industry by 1837. During the late nineteenth and early twentieth centuries, the Malden River was deepened and straightened to create a new Federal river channel for these manufacturers as well as chemical manufacturers, coal gasification, and general petroleum storage (Figure 2). Tidal wetlands were filled to create land for these industries.

NAE believes that the degree of disturbance from dredging, filling, channelization, and industrialization has caused the proposed ecosystem restoration project area to lack archaeological integrity. The proposed plan is to restore some of the degraded wetlands, and create fish habitat, within areas that were historically part of the Mystic River estuarine system and that have been severely impacted by heavy industrial activity. We anticipate that the proposed restoration plan should have no effect on historic properties. We would appreciate any comments you may have at your earliest convenience.

If you have any questions, please contact Ms. Kate Atwood, NAE Archaeologist at (978) 318-8537.

Sincerely,

John R. Kennelly
Chief of Planning

Enclosures

Similar Letter Sent To:
Ms. Brona Simon, Acting Executive Director
Massachusetts Historical Commission
Massachusetts Archives Building
220 Morrissey Boulevard
Boston, Massachusetts 02125

Mr. Victor T. Mastone, Director
Massachusetts Board of Underwater Archaeological Resources
251 Causeway Street, Suite 800
Boston, Massachusetts 02114-2136

Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX A-2

PUBLIC INVOLVEMENT

US Army Corps
of Engineers®
New England District

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

July 1, 2008

Engineering/Planning Division
Planning Branch

Ms. Michele V. Leone
National Grid
25 Research Drive
Westborough, Massachusetts 01582

RE: Malden River Ecosystem Restoration Study, National Grid Comments on "Draft" Project Report

Dear Ms. Leone:

The U.S. Army Corps of Engineers appreciates your agency's review of the "Draft" Malden River Ecosystem Restoration Detailed Project Report & Environmental Assessment dated November 2007. The Project Development Team (PDT) has reviewed your letter dated January 10, 2008 and the comments related the environmental aspects of the project.

The PDT's responses are as follows:

Comment 1 & 2 (Page 2, 1st paragraph): Elimination of sediment removal in the Malden River Restoration Plan.

Response: The PDT offers this clarification of the contaminated sediment removal measures discussed in the Report. During the initial screening process, all restoration opportunities were tabulated and ranked based on risk/success. Costs did not weigh in this initial screening. The contaminated sediment removal alternatives initially examined consisted of complete river bottom dredging and partial dredging with a capping component.

During the completion of the formulation process, the PDT determined that all contaminated sediment removal measures would be eliminated from further study. A pre-established goal for the PDT was to complete this feasibility study under the current General Investigation Program and then transition to the Section 206 Ecosystem Restoration Program Authority. Please be reminded that proposed implementation costs weighed in on the decision making process.

Due to the lack of ecological risk or the assumption of risk reduction associated with any complete or partial sediment removal, this paragraph has been rewritten.

Page ES-iv paragraph 2 has been rewritten as follows:

"Ten individual areas comprise the fish habitat restoration measure. Fish habitat restoration involves the placement 4,400 cubic yards of clean gravel/sand substrate to create 2.8 acres of fish spawning habitat. Three of the ten proposed areas require work by "others" before placement of the gravel substrate. Another party must remove/dispose a minimum of 3-foot depth of existing river bottom in order to provide a suitable and stable base prior to the placement of the proposed gravel substrate. Negotiations with the responsible parties are ongoing. If responsible party negotiations are unsuccessful, these 3 sites will be eliminated from the NER recommended plan."

Comment 3 (Page ES-ii, 3rd paragraph): Wetland soil testing.

Response: Wetland restoration will involve the *Phragmites* removal over 14.9 acres, which will consist of cutting, grubbing and disposing off-site the *Phragmites'* stands. A minimum depth of 18-inches of existing material will be excavated, and screened to remove *Phragmites*' rhizome matter and other undesirable items. These items will be disposed off-site. The screened material, volumes estimated at 36,000 cubic yards, will be placed as a sub-base for the wetland creation component of the Project. A minimum 12 inch depth of clean wetland soil would be placed over the sub-base. An herbicide treatment will be applied prior to the capping. Any reuse of the excess excavated material will also contain an herbicide treatment and capping of new soil. The finished elevation of the wetland creation is proposed at 103.6 feet MDC datum, approximately 6 inches below the mean surface water level for Malden River. During the development of the plans and specifications the wetland soils will be evaluated for their suitability as sub-base material. The PDT will also evaluate uses of the excess material for creating small island habitats within the oxbow.

Once Project Approval is obtained and the Project Cooperation Agreement is executed, a condition survey and chemical testing program will be conducted over the project area. The survey results may require the PDT to adjust the restoration limits. Example, a small isolate pocket of *Phragmites* located within sub-area 2 may be considered for inclusion to the Recommended Restoration Plan. The chemical testing analysis will determine what percentage of the proposed excavated material will be designated for upland disposal.

Comment 4 (Page 40, 1st & 2nd paragraphs): Activities within the Federal Navigation Project (FNP).

Response: An existing authorized FNP channel exists in the Malden River corridor. However, the Government has not performed any dredging activities since the 1910's and does not anticipate any future Federal dredging activity in the river.

Comment 5 (Page 69, 1st paragraph) & 6 (Page 16, section 5.1.1.2): Information in Appendix E does not support removal of sediments.

Response: The use of the sediment toxicity model was intended to assist the PDT in the prioritization of restoration measures for the river. While the values generated by the model for the benthic habitat restoration phase of the project were of lesser value than the wetland restoration and wetland creation phases, increases in benthic habitat value were observed under the dredging and capping scenario. These increases were viewed by the PDT as positive benefits to the Malden River ecosystem.

Comment 7 (Page 21. 2nd paragraph) & 8 (Page 28, subsection Sediment Quality): Existing sediment quality data.

Response: Due to human error, incomplete versions of Appendix E and F were released along with the draft report. Revised versions which contain data relevant to comments 7, 8 & 9 were forward to you and your engineers on June 16, 2008. Specifically, data relevant to comment 7 and 8 can be found in Tables F-1 through Table F-19.

In addition the following sentence has been deleted from Page E-3, paragraph 1 –" *As a result, sediments and soils from the Malden River system may pose potentially unacceptable ecological risks to wildlife in the area.*"

Comment 9 (Page 51, section Sub-Area 1): No basis that the dredging and capping will meet ecological restoration objectives.

Response: Fishery habitat restoration involves improving spawning habitat by placement of a sand and gravel substrate. Two areas adjacent to the Medford Street Bridge have been identified for fishery habitat restoration. This restoration measure is dependent on work being performed by others. Another party must remove a minimum of 3-foot depth of existing river bottom in order to obtain a suitable and stable base prior to the placement of the spawning habitat substrate.

Comment 10 (Appendix E, Page E-8, section 2.4.1): Sediment chemistry following restoration.

Response: As noted in response to comment #7, incorrect versions of Appendix E & F were released with the draft report. The incorrect version erroneously reported the use of TEC values as a basis of comparison of before and after dredging scenarios. The PDTs analysis did in fact use actual chemical concentrations at depth in the no capping scenario and PEC values in dredging and capping scenarios.

USGS/MADEP study not in same watershed as project area.

As noted in the model result reported in Table 21 of Appendix E, the dredging only scenario does in some locations increase chemical concentrations to limited degrees.

However, in all scenarios that involve dredging and capping, chemical concentrations in the sediments are shown to decrease.

Comment 11 (Appendix E, Page E-5, section 1.3): Using bulk sediment chemistry to predict habitat value.

Response: As stated in the response to comment #7, the use of the predictive model to develop habitat units for the Malden River restoration project was for the prioritization of restoration goals. The use of the Ingersoll *et. al.* (2000) model was used effectively in the Corps feasibility study for the screening of restoration alternatives for the Muddy River (Brookline, Massachusetts). The PDT believes that the use of the predictive model was effective in providing a means of examining the restoration needs in the Malden River and weighing potential benefits against cost.

Comment 12 (Appendix E, Page E-7, 1st paragraph): Did the report only use data from Nangle.

Response: Data from the Nangle reports were used because of site specificity. During the plan formulation process, data from other studies outside of the project area were considered. However, given that the Nangle data set was located in the Malden River restoration areas being considered, the PDT felt that it accurately represented the conditions present in the river.

Comment 13 (Appendix E, Page e-14, section 3.2.2): Information in Appendix E does not support removal of sediments.

Response: Refer to the response to comment #5.

In closing, we thank National Grid for your support and concerns in ensuring a successful endeavor for the habitat restoration of the Malden River corridor. We look forward to working with you in the future. If you have any questions in regards to this letter or the study, please contact Mr. Michael Tuttle at (978) 318-8677.

Sincerely,

John R. Kennelly
Chief of Planning

Copy Furnished:

Elizabeth Debsky (MVDC)
200 Pleasant Street, Suite 621
Malden, Massachusetts 02148

nationalgrid

Michele V. Leone
Lead Senior Environmental Engineer
Site Investigation and Remediation

January 10, 2008

Mr. Michael Tuttle
Project Manager
USACE - New England District
696 Virginia Road
Concord, MA 01742-2751

Re: Comments on Draft "Malden River Ecosystem Restoration Detailed Report & Environmental Assessment" dated November 2007

Dear Mr. Tuttle:

This letter presents National Grid's technical comments on the environmental aspects of the above-referenced document. The particular sentence or section being commented upon is identified in bold italics, followed by the related comment.

Detailed Report, *Page 2, 1st paragraph*. There is a specific discussion of the elimination of sediment removal from the restoration plan. An estimated 170,000 cubic yards of sediment (all of the sediment in the river) exceed sediment screening benchmarks and it is estimated to cost over $20M to remove all this material. The Plan states that "dredging the entire river is not expected to be necessary to achieve significant ecological benefits. Significant ecological benefits may be achieved by work performed by other responsible parties. Remedial actions that address the historic[al] oil and hazardous material releases to the river should be undertaken through the Massachusetts Contingency Plan Compliance Program and U.S. EPA Brownfields Program Removal."

There is no information in the Report on ecological risk or the assumption of risk reduction ("ecological benefits") associated with any partial or complete sediment removal. Massachusetts Contingency Plan (MCP) and Brownfields projects may or may not determine that sediment removal is necessary. The MCP work performed for the portion of the Malden River upstream of the USACE project adjacent to the National Grid former MGP site, did not in fact find a Significant Risk under the MCP, and did not recommend sediment removal.

The Malden River Portion of the Former Malden MGP Site begins at the outfall of the Malden River culvert located at the upstream end of the River and extends approximately 1400 feet downstream. Supplemental Method 3 Risk Characterization activities had indicated that a condition of "No Significant Risk" existed in the Malden River portion of the Site for human health, safety, public welfare, and the environment. However, a condition of No Significant Risk was not initially concluded for exposure to carcinogenic polynuclear aromatic hydrocarbons (cPAHs) via fish ingestion. The fish bioaccumulation pathway was re-evaluated using an updated biota-sediment accumulation factor (BSAF) value and site-specific measured total organic carbon (TOC) data and the analysis showed that the Malden River portion of the Site posed No Significant Risk to human health and the environment. Additional sediment visual and analytical data were collected after this conclusion was reached to confirm that it was still the case. Consequently, the Phase III Remedial Action Plan (RAP) concluded that a Permanent Solution can be achieved through implementation

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of No Further Remedial Action in the River, with a Class A-2 Response Action Outcome submitted to MADEP in June 2007.

Detailed Report, ***Page 2, 1st paragraph.*** The document notes that "removal of contaminated material can be accomplished as an add-on to the Corps Ecosystem Restoration Project," separately without federal participation or with federal funds under Section 312(b) of WRDA. This reference to removal to be performed by "other responsible parties" appears to lack a systematic evaluation as part of the overall restoration protocol. If removal is performed "as an add-on," would these other actions precede the USACE restoration? If so, on what schedule? If they are performed "in the future," how would the permitting and the access/bank disruptions affect the plantings and other restoration features?

Detailed Report, ***Page ES-iii, 3rd paragraph.*** The detailed Report states that "most of the excavated material from the wetland restoration component would be used as substrate." However, in the letter to the USACE Chief of Planning to the Massachusetts Historic Commission dated March 8, 2006 it is stated: "the material to be excavated from the Malden River wetlands has not undergone chemical testing. However, based on studies from adjacent uplands, NAE assumes the material is contaminated and will require out of state disposal at an approved landfill." The disposition of this material needs to be clarified.

Detailed Report, ***Page 40, 1st and 2nd paragraphs.*** Dredging and/or capping "are not cost effective means of restoration of the water column within the entire River system." "Rather, partial removal and capping would be a more practical option." If capping were to be contemplated for a portion of River within the federal navigation channel, how would cap disturbance be prevented during future channel maintenance dredging?

Detailed Report, ***Page 69, 1st paragraph.*** "The assessment of benefits from benthic habitat restoration relied on a sediment toxicity model by Ingersoll *et al.* (2000) that relates sediment toxicity to benthic invertebrates to concentrations of PAHs, metals, and PCBs in sediment." A detailed critique of the Ingersoll publication and its applicability to the River is beyond the scope of these comments. However, available sediment toxicity data in the River and the information presented in Appendix E do not support removal of affected sediments as key to benthic restoration.

Detailed Report, ***Page 16, Section 5.1.1.2.*** "Elevated levels of semi-volatile compounds (SVOCs), most likely from past releases, are considered the primary sediment quality issue." "Remediation efforts to control ongoing sources… will not significantly improve existing sediment quality without removal or remediation." However, the analyses presented in Appendix E ("Ecological Benefits Report") do not support the position that sediment constituents are responsible for ecological deterioration in the River, nor do data collected by National Grid as part of the former MGP site evaluations under the MCP.

Detailed Report, ***Page 21, 2nd paragraph.*** The document states that pollutant levels in some areas of the Malden River are up to five orders of magnitude above ecological screening benchmarks. Using the information presented, we were unable to confirm this. We were also unable to confirm the conclusion of "unacceptable ecological risks" related to sediment and soil quality as noted in ***Page E-3, 1st paragraph.***

Detailed Report, ***Page 28, Sediment Quality.*** "Sediment quality is probably the most important 'driver' of environmental restoration in the Malden River." ***1st bullet.*** "The highest levels of semivolatile organics are present near the Medford Street Bridge and at the confluence of Little Creek and the Malden River." It is noted that SVOCs are present in sediment at levels exceeding MCP UCLs (presumably those for soil) and that separate phase product may be present in sediments in these areas. Regarding free-phase product, the text does not cite any specific observations of NAPL nor do we know of any observations of NAPL. The text seems to be speculating on NAPL presence based on the SVOC concentrations and there is also no discussion of variation with depth.

Detailed Report, *Page 51, Section Sub-Area 1*. "Elevated concentrations of coal gasification residuals were identified within the sediment deposits along the easterly and westerly banks of the Medford Street Bridge." "Benthic restoration involves dredging the entire Sub-Area 1 to remove contaminated sediment and recapping with clean material." "Another party must remove a minimum of 3 feet of the existing river bottom to obtain a suitable and stable base prior to the placement of the substrate." There is a similar discussion on ***Page 53, 1st paragraph of the Detailed Report*** for Sub-Area 3. These statements appear to assume that a basis, presumably under the MCP, will be found for sediment removal, that such removal will include 3 feet of sediment and that the "cap" will meet ecological restoration objectives. There does not appear to be a basis to support these assumptions.

***Appendix E, Page E-8, 2.4.1, Bulk Sediment Chemistry*.** Sediment deposits following capping (e.g., ongoing inputs) were assumed to have concentrations equal to the threshold effects concentrations (TECs) cited by MADEP (this guidance was updated in 2005 and no longer cites TECs for all analytes). Regardless, these concentrations are well below concentrations that would be expected to be present in newly accumulating sediments. For example, in a large USGS/MADEP study[1] completed of the Mystic River Valley (112 sediment sampling locations), the surficial sediment sample just upstream of the confluence of the Mystic and Malden Rivers contained 16 mg/kg fluoranthene; the TEC is 0.42 mg/kg. The assumption that sediments will be "clean" following removal of existing material does not appear to account for typical urban conditions. Also, as indicated in Table 21, concentrations of most listed chemicals (arsenic, six metals, and total PAHs) would decrease little or even increase (PAHs in Sub-Area 3) after removal of the top 4 feet of sediment due to exposure of impacted sediments currently located at depth.

***Appendix E, Page E-5, 1.3 Goals and Objectives*.** The second of the three goals of the ecological evaluation is to "analyze bulk sediment chemistry to assess benthic invertebrate habitat quality." ***Appendix E, Page E-8, 2.5.1, Benthic Invertebrates*.** The report uses probable effects concentration quotients (PEC-Qs) based on bulk sediment chemistry to predict Habitat Sustainability Indices (HSIs) for benthic life. This approach has certain technical limitations and in fact, bulk sediment quality is a poor predictor of habitat quality.

***Appendix E, Page E-7, 1st paragraph*.** Only data from the Nangle reports were included in the evaluations, although there appears to be a substantial quantity of other data that exists for the study area. Do the Nangle data supersede the rest of the data?

Appendix E, Page E-14, 3.2.2, Benthic Invertebrates, and Table 22*.** The predicted improvement in Habitat units (HUs) associated with sediment removal were minimal. In addition, the No Action Alternative predicts *Hyallela azteca* survival rates ranging from 23 to 63% (50% for Sub-Area 1). In fact, as documented Haley & Aldrich's Phase II CSA Report for the Former Malden MGP Site dated December 2001, sediment toxicity tests done by AMEC on the sediments adjacent to the former MGP site found *H. azteca* survival from 67 to 86%, with no relationship to bulk sediment concentrations of PAHs or other analytes. Predicted HUs for Sub-Area 1 went from 0.8 under No Action to 1.1 under either a dredging or dredging and capping alternative. The greatest increase in HU associated with dredging and capping was 3.9 for Sub-Area 3. In contrast, HU gains ranged up to 23 for invasive removal, up to 35 for wetland restoration, and up to 22 for wetland creation. These estimates indicate that sediment removal is of small predicted ecological benefit compared with the other restoration options. Nonetheless, the document states (Appendix E, page E-14***) that "although the overall changes in HUs appear to be slight, marked

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[1] Breault, Robert F., John L. Durant, and Albert Robbat, Jr., 2005. Sediment Quality of Lakes, Rivers, and Estuaries in the Mystic River Basin, Eastern Massachusetts, 2001-03, U.S. Dept. of Interior and U.S. Geological Survey.

improvements in benthic invertebrate survivability are predicted." This statement appears to directly contradict the evaluation's own findings and indicates a possible bias toward the benefits of sediment removal that are not necessarily supported technically.

Thank you very much for the opportunity to comment on the proposed ecosystem restoration plan. Please feel free to contact me with any questions at 508-389-4296 or via email at michele.leone@us.ngrid.com.

Sincerely,
National Grid

MVLeone

Michele V. Leone

cc: File

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

February 19, 2008

Engineering/Planning Division
Planning Branch

Mr. John Reinhardt, President
Mystic River Watershed Association
20 Academy Street, Suite 203
Arlington, Massachusetts 02476

RE: Malden River Ecosystem Restoration Study, MyRWA Comments on "Draft" Project Report

Dear Mr. Reinhardt:

The U.S. Army Corps of Engineers appreciates your agency's review of the "draft" Malden River Ecosystem Restoration Detailed Project Report & Environmental Assessment dated November 2007. The Project Development Team (PDT) has reviewed your letter dated January 8, 2008, and the comments related to *Phragmites* management, operational changes at Amelia Earhart Dam and long term maintenance program.

The PDT offers this clarification of the proposed *Phragmites* removal process of the restoration. Wetland restoration will involve the *Phragmites* removal over 14.9 acres, which will consist of cutting, clearing, grubbing and disposing off-site the *Phragmites'* stands. A minimum depth of 18-inches of existing material will be excavated, and screened to remove *Phragmites*' rhizome matter and other undesirable items. These items will be disposed off-site. The screened material, volumes estimated at 36,000 cubic yards, will be placed as a sub-base for the wetland creation component of the Project. A minimum 12-inch depth of clean wetland soil would be placed over the sub-base. An herbicide treatment will be applied prior to the capping. Any reuse of the excess excavated material will also contain an herbicide treatment and capping of new soil.

Coordination with the Department of Conservation and Recreation, operators of the Amelia Earhart Dam, will continue. The comment that the proposed project will not result in changes to how the dam operates (Table 5-1) refers to water surface levels/drawdown. The Report recommends more frequent openings of the locks during the anadromous fish migration seasons to allow greater numbers of fish to enter the Malden and Mystic Rivers.

In regards to your comments on the cost per acre of invasive species removal across the sub-areas, the disparity between sub-areas 1 thru 5 compared with sub-area 6 reflects risk and uncertainties. During the feasibility study evaluation, no sediment chemistry data was available. Cost contingencies related to access difficulties, additional staging areas and disposal requirements are incorporated into the cost per acre of invasive species removal.

The PDT has acknowledged that an Operations and Maintenance Manual will be required upon completion of the restoration project. Though no permanent structures are proposed, a maintenance program will outline implementable activities for the local sponsor. Upon project completion, a 3-year monitoring program will be conducted by the PDT. The observation findings will be forward to MVDC. Correction of any identified deficiencies will be the responsibility of the local sponsor, MVDC. The Project Cooperation Agreement contains local sponsor responsibilities for the Operations, Maintenance, Replacement, Repair and Rehabilitation of the Project upon completion.

Once Project Approval is obtained and the Project Cooperation Agreement executed, a condition survey will be conducted over the project area. The survey results may require the PDT to adjust the restoration limits. Example, a small isolate pocket of *Phragmites* located within sub-area 2 may be considered for inclusion to the Recommended Restoration Plan.

In closing, we thank MyRWA for your support and concerns in ensuring a successful endeavor for the habitat restoration of the Malden River corridor. If you have any questions in regards to this letter or the study, please contact Mr. Michael Tuttle at (978) 318-8677.

Sincerely,

John R. Kennelly
Chief of Planning

Copy Furnished:
Elizabeth Debsky (MVDC)
200 Pleasant Street, Suite 621
Malden, Massachusetts 02148

MYSTIC RIVER WATERSHED ASSOCIATION
20 ACADEMY STREET, SUITE 203
ARLINGTON, MA 02476

January 8, 2008

Michael Tuttle
Project Manager
USACE - New England District
696 Virginia Road
Concord MA 01742

RE: Malden River Ecosystem Restoration
Comments on Draft Detailed Project Report

Dear Mr. Tuttle:

The Mystic River Watershed Association (MyRWA) is a non-profit organization dedicated to protecting and restoring the watershed's water quality, open space and habitat. The Mystic River Watershed includes the Malden River, which is the focus of the proposed ecosystem restoration project. MyRWA has reviewed the Draft Detailed Project Report released in November 2007, and has the following comments.

The report presents the results of a detailed environmental assessment and a plan for an ecosystem restoration of the Malden River corridor in Malden, Everett and Medford MA. As the draft report documents, this riverine system, which once included extensive tidal marsh habitat, has been severely degraded by channelization, industrial pollution and urban runoff. The construction of the Amelia Earhart dam hindered the passage of anadromous fish, including an important herring run. In recent years, however, efforts have been made by many parties to reverse the damage to the Malden River ecosystem. The extraordinary collaboration of numerous parties, as reflected in the USEPA Brownfields Showcase Community designation for the Malden River corridor, has created new hope for this urban watershed. The proposed restoration plan, with the U.S. Army Corps of Engineers (USACE) as Federal lead and the Mystic Valley Development Corporation (MVDC) as local lead, is a critical component of these efforts.

The plan calls for restoration of impacted wetland and riparian habitat, the creation of wetland habitat, and physical improvements to riverine habitat for native fish species. **Overall, MyRWA enthusiastically endorses this project.** We believe that the proposed actions, in concert with removal of contaminated sediments and other actions by PRPs, improvements in the Department of Conservation and Recreation's operation of the

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Amelia Earhart dam, and improved stormwater management in the adjacent communities, will result in restoration and protection of significant ecological habitat functions.

MyRWA has a number of **specific questions and comments** about the plan, as presented in the draft report:

Management of removed *Phragmites*: The report states on page 79 that "*Phragmites* stubs and root matter will be removed by excavating a minimum depth of 18 inches. The generated volume is estimated at 36,000 cubic yards. This excavated material will be used as a sub-base for the wetland creation component of the NER plan." The re-use of this excavate is likely to result in the spreading and re-growth of *Phragmites*. The decision to re-use excavated material containing *Phragmites* rhizome matter is especially confusing, given the following statement on page 81 of the draft report:

> With regard to *Phragmites*, nearly all parts of the plant are capable of regeneration, including seed heads, freshly cut stalks, and especially rhizome material (Burdick et al., 2003). Removal of all plant parts cut during eradication to an approved disposal destination (e.g. incinerator) is absolutely essential to prevent the accidental spread within or outside of the study area.

MyRWA strongly recommends that all *Phragmites* plant materials be managed in a way that prevents any spread and re-growth. We request that the report specify how the excavate will be treated to prevent re-growth where ever it is finally placed, and that – given that the MVDC will be responsible for at least 6,000 cubic yards of this material – the report specify what types of on-site use are appropriate.

Operation of the Amelia Earhart dam: The draft report notes the need for changes in the DCR's operation of the dam, to allow increased passage of herring and other anadromous fish. Table 5-1 on page 37 suggests that the proposed project will not result in changes to how the dam operates. We urge that continued coordination and negotiation with the DCR be explicitly included as a part of the restoration plan, to ensure that appropriate changes in dam operation are defined and implemented.

Invasives removal in Sub-area 2: MyRWA questions the elimination of invasive species removal and replanting in Sub-area 2. Considering that removal is planned for Sub-area 3 and there are no natural barriers between the sub-areas, this would seem to create an unnecessary maintenance burden on MVDC to prevent re-infestation. Removal in Sub-area 2 would create a *Phragmites*-free zone up to the Medford Street Bridge, since Sub- area 1 is reportedly clear currently. We request that invasives removal be included for Sub-area 2.

Long-term maintenance: MyRWA believes that an Operations & Maintenance Plan should be included in the restoration plan. The draft Detailed Project Report (p. 72) specifies a 50-year project life. Long-term success seems unlikely without an explicit O/M plan. In Section 6.5 Operation and Maintenance, the draft Report suggests that an O/M plan is not needed because "no permanent structures are proposed..." (p. 90).

However, the draft Report also indicates that flow control devices (weirs or flashboards) may be required (p.43). These are structures that would require maintenance to operate as intended for 50 years.

The draft Detailed Report also states that it is the MVDC that has "... responsibility for 100 percent of the Operations, Maintenance, Replacement, Repair and Rehabilitation (OMRR&R)" (p. 96). However, the report does not define what actions are required. The Environmental Assessment (EA) refers to 'long-term' annual surveys for *Phragmites*, monitoring of the Amelia Earhart dam procedures, and maintenance of shoreline and riparian vegetation (p. 16). The restoration plan needs to specify the actions and time periods involved. For example,

- Is 'long-term' in the EA the same 50 years specified in the Detailed Report?
- Is maintenance dredging anticipated, as implied in the EA (p. 5)?
- If *Phragmites* are found during post-construction monitoring, who is responsible for removing it? The EA in 3.3 Monitoring, Post Construction (p. 16) specifies four inspections per year for three years, with results provided to the project sponsor, but does not address responsibility for remedial measures. Is it the responsibility of the construction contractor (warrantee essentially) to remove the re-infestation at the behest of MVDC or is MVDC solely responsible for the work? If MVDC takes no action, does USACE have any authority to compel action?

Other questions and comments:

1. Why is Sub-area 6 disproportionately sized? Its total area is about twice the area of all the others combined, and its bordering banks and nearly ten-times that of Sub-area 1 (Report, p. 51). If Sub-area 6 were broken down so that the so-called "Mall Creek" wetland section was evaluated separately, what would the incremental cost for invasive species removal have been?

2. Why do costs per acre of invasive species removal vary so markedly across Sub-areas? Based on the costs in the Report, Table 5-7 (p. 70), and the acreage in Table 5-5 (p. 67), invasive species removal costs range from $115,000 per acre in Sub-area 5 to $801,000 per acre in Sub-area 3. Given that the cost per acre in Sub-area 6 is less than the Sub-area 3, how is that the Cost/Output (Report, Table 5-9) is higher for Sub-area 6 than for Sub-area 3?

3. Page 19 of the draft Detailed Report refers to the MyRWA monitoring effort and erroneously states that the monitoring occurs weekly. Monitoring on the Malden River occurs monthly.

Conclusion

Subject to these comments, MyRWA enthusiastically endorses the proposed Malden River Ecosystem Restoration Plan. Because of the time required to develop detailed restoration designs and for the USACE and the MVDC to obtain the required permits and approvals, the proposed schedule does not anticipate completion of the work until 2012. We urge prompt review and approval of the recommended plan, so that the long-delayed restoration of this valuable urban habitat can get underway as soon as possible

Thank you for the opportunity to comment on this important project.

Sincerely,

John Reinhardt
President

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

February 19, 2008

Engineering/Planning Division
Planning Branch

Ms. Penny M. Panoulias
Preotle Lane & Associates Ltd.
535 Madison Avenue, 33rd Floor
New York, New York 10022

RE: Malden River Ecosystem Restoration Study - PLA Comments on "Draft" Project Report

Dear Ms. Panoulias:

The U.S. Army Corps of Engineers appreciates your firm's review of the "draft" Malden River Ecosystem Restoration Detailed Project Report & Environmental Assessment dated November 2007. The Project Development Team (PDT) has reviewed your email dated January 8, 2008, and the comments related to wetland creation component of the proposed recommended plan.

The PDT offers this clarification of the proposed wetland creation within the existing 5.4 acre oxbow. Wetland creation involves the establishment of an emergent vegetated wetland by placing a minimum depth of 18-inches of screened material obtained under wetland restoration component. The screened material, volumes estimated at 36,000 cubic yards, will be placed as a sub-base for the wetland creation component of the Project. A minimum 12-inch depth of clean wetland soil would be placed over the sub-base. An herbicide treatment will be applied prior to the capping. The finished elevation of the wetland creation is proposed at 103.6 feet MDC datum, approximately 6-inches below the mean surface water level for Malden River. During the development of the plans and specifications, the PDT will evaluate uses of the excess screened material for creating small island habitats within the oxbow.

In closing, we thank PLA for your support and concerns in ensuring a successful endeavor for the habitat restoration of the Malden River corridor. We look forward to working with you in the future. If you have any questions in regards to this letter or the study, please contact Mr. Michael Tuttle at (978) 318-8677.

Sincerely,

John R. Kennelly
Chief of Planning

Tuttle, Michael R NAE

To: Penny M. Panoulias
Cc: preotlelane@aol.com
Subject: RE: Comments on Malden River Ecosystem Restoration Study

-----Original Message-----
From: Penny M. Panoulias [mailto:pmpanoulias@preotlelane.com]
Sent: Tuesday, January 08, 2008 4:42 PM
To: Tuttle, Michael R NAE
Cc: preotlelane@aol.com
Subject: Comments on Malden River Ecosystem Restoration Study

Thank you for the opportunity to comment. On behalf of Preotle, Lane & Associates, our initial thoughts are as follows:

1. There is a reference to the Tufts University Boathouse being in the construction phase. Please note that construction of the Boathouse has been completed for some time and the Boathouse opened in 2006. (We were not sure whether this study was meant to be updated or not.)

2. With respect to the wetlands on Phase I of the River's Edge project, on the other side of the river, Preotle, Lane & Associates as the master developer has created or restored an acre and a half of wetlands on this site. In addition, we have added over 8,000 plants in the 10-acre riverfront park which will be open to the public along the Malden River, of which approximately 2,000 plants are in the aforementioned 1.5-acre of wetlands. For active recreation the Park includes over a mile of paths for walking, running, rollerblading and bicycling. A series of stabilized aggregate paths branch from the main path and are closer to the river and provide dramatic views of the river and the 1.5-acre wetlands.

3. Our consultants have concerns that the recommendation of filling the meander area ("Sub are 4") would significantly detract from the views of the existing open water body and have a negative impact on the public's enjoyment of such views, a major factor in the creation of this picturesque public amenity. Further, our recent experience has been that creating and maintaining aesthetically pleasing wetlands is quite challenging as well as expensive. Would there be a way to make significant water quality improvements to the area without doing all that filling? Perhaps before this worthwhile project proceeds further, there could be a discussion on this?

Two other considerations about the filling proposal: First, if a pedestrian or multi-use recreational pathway loop along and connecting both sides of the river is ever created, as per the Malden River Park Study that was done in 1999, the Restoration Study's proposed treatment greatly reduces the diversity of types of landscape opportunities at the edge of the river, thereby reducing the opportunities to make it a stimulating park environment.

Second, by filling the meander, the proposal also undoes the most significant remaining historic alignment of the Malden River, and with it the opportunity for the future interpretation of how the river once existed.

In addition, we are attaching for your information our submission to the Waterways Division of the Massachusetts Department of Environmental Protection (Request for Minor Project Modification, Waterways License # 11377), River's Edge Phase 1 Development, which provides a great deal of information as well as photographs which are illustrative of the massive amount of efforts required in such undertakings.

Please let us know if we can help in any other way or provide any further information.

Penny M. Panoulias
Preotle, Lane & Associates Ltd.
535 Madison Avenue, 33rd Floor
New York, NY 10022
Tel. 212-754-3030

U.S. Army Corps
Of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Public Notice

Date: December 10, 2007

Comment Period Closes: January 10, 2008

Evaluation Branch, Engineering/Planning Division

MALDEN RIVER ECOSYSTEM RESTORATION PROJECT
MALDEN, MEDFORD, AND EVERETT, MASSACHUSETTS

Interested parties are hereby notified that the U.S. Army Corps of Engineers, New England District (USACE-NAE), in partnership with the Mystic Valley Development Commission (MVDC), is proposing the restoration of aquatic and riparian habitats and the improvement of anadromous fish passage in the Malden River located in Malden, Medford, and Everett, Massachusetts (Figure 1). This project is carried out under the authority of Section 206 of the Water Resource Development Act of 1996 (P.L. 104-303) as amended, and under the provisions of Section 404 of the Clean Water Act of 1977. This public notice provides information about the ecosystem restoration project and documents all pertinent laws and regulations that are applicable.

Project Description:

The Malden River restoration project involves restoring various degraded components of the river's ecosystem. The project will restore wetland areas that have been altered by filling, changes in hydrology, and colonization by non-native invasive species. The project will also create new wetland habitat in the river as well as enhance the availability of the river to anadromous and resident fish species in the system. The project has been designed to provide the highest quality habitat that the system could reasonably support and sustain.

Specifically, the project involves the removal of approximately 14.9 acres of the invasive species *Phragmites australis* by either cutting and grubbing or herbicide spraying and the replanting of the areas with native scrub-shrub wetland species. The project also involves the creation of a 5.4 acre emergent marsh within the confines of the river's former natural channel. Additionally, the fish habitat enhancement component of this project includes improving 2.8 acres of spawning habitat within the river by placing various substrates at tributary confluences and other appropriate locations. The various restoration measures are depicted in Figure 2.

Purpose and Need for Work: The purpose of this project is to restore aquatic and riparian habitat, and improve fisheries habitat in the Malden River. The Malden River watershed is a degraded riverine ecosystem. It has been subject to the effects of gradual urbanization for several centuries. The effects of development on the river's aquatic resources have been significant. The bordering lands consist predominately of former tidelands bound by rail lines along each bank that were previously filled with razed building materials, industrial wastes and dredged material to support early industrial development. All tributary streams and associated wetlands have been filled or altered to varying degrees. Construction of the Amelia Earhart Dam in the 1960's converted the waterway from a tidally influenced salt-water estuary to a freshwater system. Riparian wetlands along the riverbanks are dominated by non-native invasive plant species such as *Phragmites*, which are crowding out native species, and limiting the diversity of riparian and wetland plant communities. In its current condition, riverbank frontage has little ecological resource value. The degraded conditions that exist in the river will remain static unless restoration efforts are undertaken.

Restoration Alternatives: Based on the historic and existing conditions, restoration goals and objectives were developed for the Malden River. The primary goal of the Malden River Ecosystem Restoration Project is to restore the ecosystem to the highest quality that it can reasonably support and sustain. The objectives described below support this overall goal. In accordance with the USACE ecosystem restoration guidelines, the major restoration objectives for the Malden River Feasibility Study are:

- Restoration and creation of freshwater wetlands to provide habitat for native fish and wildlife;
- Provide accessibility to the Malden River for anadromous and resident fishery species.

Seventeen alternatives, which included various wetland restoration, wetland creation, and fish habitat improvement measures, were identified and analyzed in all possible combinations to identify cost effective plans. Thirteen plans were retained and considered by USACE-NAE and MVDC.

Federal & State Coordination: The proposed work is being coordinated with the following:

Federal Agencies:
U.S. Environmental Protection Agency, Region 1, Boston, MA
U.S. Fish and Wildlife Service, Concord, NH
NOAA, National Marine Fisheries Service

Federally Recognized Tribes:
Wampanoag Tribe

State Agencies:
Massachusetts Executive Office of Energy and Environmental Affairs
Massachusetts Department of Environmental Management
Massachusetts Department of Environmental Protection
Massachusetts Division of Fish and Wildlife
Massachusetts Historical Commission
Massachusetts Water Resources Authority
Massachusetts Department of Recreation & Conservation (formerly Metropolitan District Commission)

Local Agencies:
City of Malden

City of Medford
City of Everett
Mystic River Watershed Association

Private Groups:
Citizens' Groups
River's Edge (formerly TeleCom City)
Mass Electric
Keyspan
Tufts University

Endangered Species: The proposed project is not expected to affect any Federal or State listed threatened or endangered species.

Environmental Impacts: A draft Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) have been prepared for this restoration project and are available for public review. The District will finalize the EA and FONSI after considering public and agency comments. Excavation and filling impacts are expected to be minor and temporary. A preliminary determination has been made that an Environmental Impact Statement for the proposed restoration is not required under the provisions of the National Environmental Policy Act of 1969.

Cultural Resources: The proposed restoration project is not expected to impact any structures or sites of historic, architectural, or archaeological significance as defined by the National Historic Preservation Act of 1966, as amended. Coordination has been completed with the Massachusetts State Historic Preservation Officer and the Wampanoag Tribe Tribal Historic Preservation Officer, concurring with our no effect determination.

Federal Consistency with Coastal Zone Management: The restoration project will be conducted to the maximum extent practicable, in a manner consistent with the approved Coastal Zone Management Program of the Commonwealth of Massachusetts.

Clean Water Act: A Clean Water Act, Section 404(b)(1) evaluation was completed for the project. State Water Quality Certification will be obtained prior to implementation.

Compliance: This Public Notice is being issued in compliance with all applicable environmental laws and regulations (see Attachment A).

Additional Information: Any person who has an interest that may be affected by the restoration of the Malden River may request a public hearing. The request must be submitted in writing to me within 30 days of the date of this notice and must clearly set forth the interest that may be affected and the manner in which the interest may be affected by this activity.

Please bring this notice to the attention of anyone you know to be interested in the project. Comments are invited from all concerned parties and should be directed to the District Engineer at 696 Virginia Road, Concord, MA 01742, ATTN: Engineering/Planning Division (Mr. Michael Tuttle, 978-318-8677), within 30 days of this notice.

11 Dec 2007
Date

Curtis L. Thalken
Colonel, Corps of Engineers
District Engineer

US ARMY CORPS OF ENGINEERS
New England District

December 2007

Attachment A

PERTINENT LAWS, REGULATIONS AND DIRECTIVES

Clean Air Act, as amended (42 U.S.C. 1221 et. seq.)

Clean Water Act, as amended (33 U.S.C. 1251 et. seq.)

Coastal Zone Management Act of 1972, Sections 307 (c)(1) and (2)[16 U.S.C. 760c-760g]

Code of Federal Regulation, Title 33, PART 335 through 338, Army Corps of Engineers Civil Works Projects Involving The Discharge of Dredged or Fill Material Into Waters of The U.S. or Ocean Waters

Endangered Species Act of 1973, as amended (16 U.S.C. 668aa-668cc)

Estuary Protection Act (16 U.S.C. 1221 et. seq.)

Executive Order 11988, Floodplain Management, 24 May 1977

Executive Order 11990, Protection of Wetlands, 24 May 1977

Executive Order 12898, Environmental Justice, 11 February 1994

Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks. 21 April 1997

Federal Water Project Recreation Act, as amended (16 U.S.C. 4601 – 12 et. seq.)

Fish and Wildlife Act of 1956 (16 U.S.C. 472a, et. seq.)

Fish and Wildlife Coordination Act (16 U.S.C. 661-666c)

Land and Water Conservation Fund Act of 1965, as amended (16 U.S.C. 4601 – 4 et. seq.)

Magnuson-Stevens Fishery Conservation and Management Act and amended by the Sustainable Fisheries Act of 1996

Migratory Marine Game-Fish Act (16 U.S.C. 760c-760g)

National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347)

National Historic Preservation Act of 1966 (16 U.S.C. 470)

Water Resources Development Act of 1996, as amended (P.L.104-303)

MYSTIC VALLEY DEVELOPMENT COMMISSION

Malden Government Center
200 Pleasant Street
Suite 621
Malden, MA 02148

Phone 617-381-7711
Fax 617-381-7776
www.telecomcitymass.com

September 15, 2003

List of Invitees Attached

Re: Malden River Ecosystem Restoration Feasibility Study

To Whom It May Concern:

Please join the Mystic Valley Development Commission (MVDC), the U.S. Army Corps of Engineers – New England District (Corps), and ENSR International at an important working meeting regarding the Malden River Ecosystem Restoration Feasibility Study. See the attached Fact Sheet for general information regarding the study. The meeting is scheduled for Thursday, September 25th, from 10 am to 1:30 pm in the Mayor's Conference Room on the 6th floor at Malden City Hall. A lunch of pizza and drinks will be provided and we will work through lunch. A draft agenda is also attached.

The purpose of the meeting is to discuss ecosystem restoration alternatives being considered for evaluation in Phase I of the study. Restoration alternatives will cover wetland restoration, water quality restoration to improve fish passage/habitat and sediment quality restoration to improve benthic habitat. We need your help in narrowing the possible alternatives to a focused list of candidate alternatives for further evaluation. We have selected you based on your involvement in the study to date, your involvement in the watershed, your relevant experience and/or for representation of your agency's interests. We are inviting representatives from a number of federal, state and local agencies so as to involve as many key agencies as possible in this up front planning effort.

This meeting will be a one-time event. A smaller group of MVDC and Corps representatives will continue working and meeting with ENSR as the project moves forward and a number of public meetings will be held as the study progresses towards a final recommendation for a restoration strategy. Participants are welcome to remain involved to the extent they are able.

We look forward to seeing you there and appreciate you taking the time to work with us on the Malden River study. Please reply via telephone or email regarding whether you will be able to attend the meeting, so that we can plan accordingly. Thank you.

Sincerely,

Ginny Lombardo, Environmental Engineer
Showcase Community Coordinator

LIST OF INVITEES FOR MALDEN RIVER STUDY MEETING ON SEPTEMBER 25, 2003:

US Army Corps of Engineers:	Mike Tuttle Michael.R.Tuttle@nae02.usace.army.mil Chris Hatfield Christopher.L.Hatfield@nae02.usace.army.mil Barbara Newman Barbara.H.Newman@nae02.usace.army.mil Todd Randall Todd.A.Randall@nae02.usace.army.mil Ian Osgerby Ian.T.Osgerby@nae02.usace.army.mil
MVDC:	Ginny Lombardo glombardo@telecomcitymass.com Stephanie Muccini-Burke stephani.burke@comcast.net
ENSR:	Mike Worthy mworthy@ensr.com Dave Mitchell dmitchell@ensr.com
Mass Electric:	Michele V. Leone Senior Environmental Engineer National Grid/Massachusetts Electric Co. 55 Bearfoot Road Northborough, MA 01532 michele.leone@us.ngrid.com
KeySpan:	Patricia Haederle, CPG Lead Project Manager KeySpan Energy Delivery New England 52 Second Avenue Waltham, Massachusetts 02451 phaederle@keyspanenergy.com
Nangle Consulting Associates:	Jeffrey Nangle Nangle Consulting Associates 960 Turnpike Street Canton, MA 02021 nca2@mindspring.com
EPA:	Joseph Lemay US EPA Region I One Congress Street Suite 1100 (HBO) Boston, MA 02114-2023 lemay.joe@epa.gov
EOEA:	Kwabena Kyei-Aboagye Jr. EOEA 251 Causeway Street, Suite 900 Boston, MA 02114 kwabena.kyei-aboagye@state.ma.us
MA DEP:	Scott Greene MA DEP Bureau of Waste Site Cleanup One Winter Street

	Boston, MA 02110 scott.greene@state.ma.us
	Heidi Davis MA DEP One Winter Street Boston, MA 02110 heidi.davis@state.ma.us
USGS:	Rob Breault USGS 10 Bearfoot Road Northborough, MA 01532 rbreault@usgs.gov
MDC:	Mike Galvin MDC Engineering Department 20 Somerset Street Boston, MA 02108 mike.galvin@state.ma.us
Mystic River Watershed Assoc.:	Nancy Hammett MyRWA 20 Academy Street Arlington, MA 02476 nancy@mysticriver.org
NMFS:	Eric Hutchins NOAA One Blackburn Drive Gloucester, MA 01930 eric.hutchins@noaa.gov
	John Catena NOAA One Blackburn Drive Gloucester, MA 01930 john.catena@noaa.gov
US Fish and Wildlife Service:	William Neidermyer US Fish & Wildlife Service 70 Commercial Street, Suite 300 Concord, NH 03301 William_Neidermyer@fws.gov
City of Medford:	Lauren DiLorenzo, Community Development Director Medford City Hall – Room 308 85 George P. Hassett Drive Medford, MA 02155 ldilorenzo@medford.org

Kim Lundgren
Medford City Hall – Room 300
85 George P. Hassett Drive
Medford, MA 02155
klundgren@medford.org

City of Malden:

Michelle Romero, Principal Planner
Malden City Hall
200 Pleasant Street, Room 615
Malden, MA 02148
mromero@cityofmalden.org

City of Everett:

Beth Debski, Community Development Director
Everett City Hall
484 Broadway
Everett, MA 02149
beth.debski@ci.everett.ma.us

Patrick Johnson
Everett Police
Marine Division
45 Elm Street
Everett, MA 02149
epdmarine@aol.com

Preotle, Lane & Associates:

John Preotle
Preotle, Lane & Associates Ltd.
535 Madison Ave
New York, NY 10022

Malden River Ecosystem Restoration Feasibility Study
Preliminary Alternatives Evaluation
September 25, 2003; 10:00 am–1:30 pm
Malden City Hall

Invited Attendees: *U.S. Army Corps of Engineers, New England Division (CENAE); Mystic Valley Development Commission (MVDC); ENSR International; United States Environmental Protection Agency (U.S.EPA); Mass Electric; KeySpan; Nangle Consulting Associates; Preotle, Lane & Associates (PLA); Massachusetts Executive Office of Environmental Affairs (EOEA), Massachusetts Department of Environmental Protection (MA DEP); Metropolitan District Commission (MDC); United States Geological Survey (USGS); Mystic River Watershed Association; National Marine Fishery Service (NMFS); United States Fish and Wildlife Services (U.S.F&WS) and Cities of Everett, Malden and Medford, MA.*

INTRODUCTIONS
- Introduction of Project Team Members
- Summary/Chronology of Brownfields Showcase Community Grant
- Project Timeline

GOALS OF MALDEN RIVER STUDY
- Project Task Breakdown
- USACOE ecosystem restoration goals
  - Restoration/enhancement of coastal wetlands
  - Restoration of sediment quality to improve benthic community
  - Restoration of water quality to improve fish passage/habitat
- Telecom City development/vision
- Other on-going watershed projects

CONCEPTUAL SITE MODEL
- Identification of impairments/constraints to be addressed
- Identification of potential beneficial outputs
- Graphic schematic summarizing preliminary Malden River CSM

FOCUSING OF ECOSYSTEM RESTORATION ALTERNATIVES
- Identification of potential candidate alternatives
  - Alternatives for restoration of wetlands
  - Alternatives for restoration of sediment quality
  - Alternatives for restoration of water quality
- Matrix of advantages and limitations of potential candidates alternatives
- Evaluation and recommendation of list of candidate alternatives to be further investigated

UPCOMING EVENTS
- Evaluation and Finalization of the Recommended Alternatives
- Upcoming Schedule
- Next Meeting

US Army Corps of Engineers
New England District

Fact Sheet

MALDEN RIVER ECOSYSTEM RESTORATION STUDY

January 2003

696 Virginia Road, Concord, Massachusetts 01742-2751

LOCATION: The Malden River rises in the city of Melrose, flows 4 ½ miles in a southerly direction and empties into the Mystic River. The Malden River flows through the cities of Malden, Medford and Everett to its confluence with the Mystic River above the Amelia Earhart Dam in Everett. The 'study area' refers to the surface waters of the Malden River and adjacent land areas between Malden Square and the Amelia Earhart Dam. The 'study area' is located approximately five miles north of Boston.

BACKGROUND: The Mystic Valley Development Commission (MVDC) is a tri-city legislative body established by the Commonwealth of Massachusetts and approved by the cities of Malden, Medford and Everett. MVDC is in the process of redeveloping a 200-acre Brownfields parcel, which includes a large portion of the Malden River. As a result of the Showcase Community designation, the MVDC has partnered with the Corps of Engineers on an effort to restore the Malden River ecosystem. TeleCom City, a MVDC master-planned development, is being pursued as a public-private partnership that will include office, research & development and manufacturing facilities and approximately 60 acres of public open space, the Malden River Park. The Malden River Park will include a river-side trail and river overlooks. The restoration and remediation of the Malden River are critical to the success of the overall project and to the protection of public health.

AUTHORITY: On July 23, 1997, the U.S. House of Representatives, Committee on Transportation and Infrastructure authorized the Secretary of the Army to conduct a Reconnaissance Study encompassing the watersheds of the Massachusetts and Cape Cod Bays, as defined by the Environmental Protection Agency designated National Estuary Program, to enhance ecosystem restoration. The Reconnaissance Study recommended four habitat types for further New England District investigation. The four habitat types are the restoration of tidal and freshwater wetlands, riverine migratory corridors, benthic habitats containing contaminated sediments, and degraded shellfish beds. Malden River was one of the restoration sites determined to be in the Federal interest. The Malden River Ecosystem Restoration Feasibility Study will focus on the restoration of freshwater wetlands, riverine migratory corridor and contaminated sediments remediation. The U.S. Army Corps of Engineers has a partnership agreement with TeleCom City. The Feasibility Study cost is $356,600, which will be cost shared 50 percent Federal and 50 percent local sponsor.

MAJOR FEATURES OF THE STUDY: The Feasibility Study will be limited to the Malden River, the lower Mystic River and their surrounding landscapes. The Feasibility Report will provide all the necessary documentation to permit project implementation by the U.S. Army Corps of Engineers under an existing authorized program(s), if applicable, or authorized by U.S. Congress for construction of a Federal project(s), if justified.

THE FEASIBILITY REPORT WILL INCLUDE:

- ♦ Investigation of site characteristics including subsurface explorations and sediment testing.
- ♦ Formulation of practical alternatives for riverine restoration.
- ♦ Consideration of multiple purpose potential of environmental restoration projects.
- ♦ An assessment of the environmental effects of the possible solutions.
- ♦ Investigation of possible impacts to cultural resources.
- ♦ Coordination with U.S. Fish and Wildlife Service.
- ♦ Preparation of typical design drawings and quantity estimates.
- ♦ An estimation of project costs and benefits.

SCHEDULE: It is expected that the Final Feasibility Report will be completed by the Spring 2005.

CALCULATIONS AND COMPUTATIONS

Project: Attendees - Malden River Restoration

Project Number: Computed by: Date: 9/25/03

Subject Checked by: Date:

Name	Association	Phone	Email
Mark Gerath	ENSR/Corps of Engineers	978/589-3188	MGerath@ENSR.com
Craig MacPhee	ENSR	978/589 3064	cmacPhee@ENSR.com
SCOTT GREENE	MA DEP/BWSC	(617) 654-6565	scott.greene@state.ma.us
MICHELE LEONE	MASS ELECTRIC	508-421-7564	michele.leone@us.ngrid.com
CARL TAMMI	ENSR	978 589-3065	ctammi@ensr.com
Michael Galvin	DCR	617 722-5611	mike.galvin@state.ma.us
Kristen Welsh	NCA	781-821-0521	nca2@mindspring.com
~~Peter~~ Hollands	MRA	617 3817711	phollands@telecomcitymass.
Kim Lundgren	City of Medford	781 393 2137	~~klu~~ klundgren@medford.o
Beth Debski	City of Everett	617-394-2245	beth.debski@ci.everett.ma.us
Patrick Johnston	Everett Police Marine	617-905-3747	EPDMARINE@AOL.com
LT. Pat McAdam	EPD Marine	617 798 1001	MVPINNACLE@Comcast.ne.
Ginny Lombardo	EPA/MVDC	6173817711	glombardo@telecomcitymass.c
TODD RANDALL	USACE	978 318 8518	todd.a.randall@usace.army.mil
Ian T. Osgerby	USACE	978 318 8631	ian.t.osgerby@usace.army.
Barbara Newman	USACE	978318 8575	Barbara.h.newman@usace.army.
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Chris Hatfield	USACE	978 318 8520	Christopher.L.Hatfield@nae02.usace.army.mil
Jeff Nangle	NCA	7818210521	nca2@mindspring.com
Joe Lemay	EPA	617 918 1328	lemay.joe@epa.gov
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Tom Sokoloski	Rizzo	508 903 2416	tsokoloski@rizzo.com
Dave Mitchell	ENSR	978 589 3000	dmitchell@ensr.com

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MYSTIC VALLEY DEVELOPMENT COMMISSION

Malden Government Center
200 Pleasant Street
Suite 621
Malden, MA 02148

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To: File

From: Ginny Lombardo, Showcase Community Coordinator

Date: September 30, 2003

Subj: Notes from Malden River Study Working Meeting

On September 25, 2003, the MVDC, the US Army Corps of Engineers - New England District and ENSR International hosted a working meeting to discuss restoration alternatives and measures being considered for evaluation in the Malden River Ecosystem Restoration Feasibility Study. See Attachment 1 for the list of attendees. See Attachment 2 for the Agenda. See Attachment 3 for the presentation slides. See Attachment 4 for Table 1, which is a spreadsheet of "Preliminary Environmental Restoration Measures Screening" information.

The following notes on discussion at the meeting relate to comments on the information presented in Table 1.

No Action

- Comments on the "No Action" measure: Discussion was held regarding the basis for the "partial" potential benefits to the riverine corridor and benthic habitat under a "no action" scenario. ENSR representatives explained that the more heavily contaminated sediments from the industrial age will continue to be buried with less contaminated soils from urban runoff and hazardous waste sites will continue to be cleaned up under the MCP. Therefore, it was assumed that some partial improvements to the riverine corridor and benthic habitat would occur even without implementation of a Corps-sponsored restoration effort.

Watershed-Based Restoration Measures

- Comments on BMPs measure: Attendees explained that the Cities and MyRWA are actively working on the implementation of stormwater BMPs. It was discussed that it was important to evaluate what the Cities and MyRWA are doing and planning and to consider these efforts in the study. However, these efforts are already being implemented by others, so this study should not duplicate work being done and should not waste too much study funding on this measure.
- Comments on Rerouting/Bypassing of Stormwater Flows: Attendees were generally in agreement with the elimination of this measure. However, an attendee did recommend the inclusion of Little Creek and the "other" creek of the Everett side of the river for evaluation of stormwater flow/quality/treatment.

- Comments on Control of Toxic Releases at Hazardous Waste Sites: An attendee suggested that the MA DEP be requested to evaluate hazardous waste sites along the Malden River that are continuing sources of contamination and be asked to work aggressively with these site owners to cleanup their sites.
- Comments on Watershed Flow Management: ENSR representatives explained the potential complications and unlikelihood of significant benefit from water storage and release upstream of the Malden River on water quality. This is due to potential competing uses for water in Spot Pond. ENSR explained that they retained this measure in order to conduct the actual calculations in order to document the infeasibility of this measure and that it would likely be eliminated early in the Phase I study.
- Comments on Incorporate Vegetated Upland Buffers: ENSR representatives explained that this measure was eliminated because the developed area around the Malden River would not accommodate additional upland buffers.

Hydrology-Based Restoration Measures

- Discussion of the measures under this sub-section revolved around the MDC operations at the Amelia Earhart Dam, specifically on the impacts of reinstituting some level of tidal cycling. Concerns were voiced regarding the impact of changing the Malden River and Lower Mystic River from freshwater to brackish or saltwater; how this would be received by the communities, the marina owners, and boat owners; the potential for odors and other nuisance problems. An attendee noted the potential problem of stratification of the salt water and fresh water and the potential of this to exacerbate the dissolved oxygen problem. ENSR representatives talked about the potential for a tide gate and partial tidal cycling. ENSR representatives stated that they would be working within the limitations of the dam's primary purpose of flood control. All of the measures under this sub-section were retained.

In-Stream Restoration Measures

- Comments on both In Situ Chemical and Biological Treatment: Attendees suggested that chemical and/or biological treatment be retained because they may be appropriate to consider in certain areas (e.g., shoreline, hot spots), as an incremental measure implemented in conjunction with another primary alternative.
- Comments on Monitored Natural Recovery: Attendees questioned that effectiveness of this measure for restoration of benthic habitat.
- An attendee suggested the addition of a measure to provide an effective fish ladder at the Amelia Earhart Dam.

Wetland Restoration Measures

- Comments on Herbicide Treatment: An attendee requested that herbicide treatment be considered for elimination since communities are working to eliminate the use of pesticides and herbicides in the watershed.
- An attendee suggested the addition of reestablishing/daylighting filled or culverted tributaries. ENSR representatives stated that they have not ruled out replacing/restoring historic wetland areas.

Other Comments Noted:

- One ENSR representative characterized the main impediments to the ecological health of the Malden River, in order of importance, as: (1) no flushing/low dissolved oxygen, (2) contaminated in situ sediments, (3) stormwater and (4) loadings from hazardous waste sites. Other attendees generally agreed, although one suggested switching the last two categories.
- Attendees requested that, in evaluating restoration of the Malden River, consideration be given to the potential indirect impacts of restoration measures on the Mystic River.

- Everett representatives explained a planned cleanup on the Island End River and the potential for collaboration (e.g., as part of the planned cleanup, a CAD cell is planned – possibly the Malden River project could dispose of contaminated sediments within this planned CAD cell and share costs for the CAD cell design and construction).
- Attendees expressed concerns that the human health aspect of restoring the river ultimately needs to be addressed. If this project results in more people coming back to the river, then someone needs to judge the relative safety on human health for each restoration alternative.

Yes

[redacted] NO

Tuttle, Michael R NAE

From: Tuttle, Michael R NAE

Sent: Tuesday, November 25, 2003 2:56 PM

To: 'michele.leone@us.ngrid.com'; 'phaederle@keyspanenergy.com'; '[redacted]' '[redacted]' 'scott.greene@state.ma.us'; 'heidi.davis@state.ma.us'; 'rbreault@usgs.gov'; 'mike.galvin@state.ma.us'; 'nancy@mysticriver.org'; '[redacted]' 'john.catena@noaa.gov'; 'William_Neidermyer@fws.gov'

Cc: 'nca2@mindspring.com'; 'dmitchell@ensr.com'; 'glombardo@telecomcitymass.com'; 'stephani.burke@comcast.net'

Subject: Malden River Ecosystem Study - Alternative Analysis Meeting

Importance: High

You are hereby invited to participate in the Malden River Ecosystem Restoration Study - Alternative Analysis Meeting. **The meeting will be held at the Corps of Engineers' Concord facility [Concord Park, 696 Virginia Road, Concord, MA] on 10 December 2003 at 1:00 pm.** The meeting will present the four restoration candidates developed under the Phase I.

Under Phase I, the Project Team [Mystic Valley Development Commission, ENSR & Corps] evaluated the existing conditions/studies/reports and developed conceptual restoration "building blocks". The "building blocks" confirmed the study goals/objectives and have assisted in the development of the combined restoration candidates. The developed "building blocks" are as follows:

- Fish Habitat improvement (debris removal & substrate placement)
- Fish Habitat Improvement (sediment removal by dredging)
- Water Quality Enhancement (aeration and/or artificial mixing)
- Wetland Restoration (invasive species removal and replanting with native species)
- Wetland Restoration (wetland restoration of existing PSS wetland and daylighting culvert)
- Wetland Restoration (wetland creation of PAB/PEM within old river channel)
- Fish Habitat Improvement (dam operation enhancement/fish ladder improvements)

The restoration candidates considered for further evaluation under Phase II are

- **Alternative "G"** - Removal of existing debris follow by placement of clean gravel substrate at tributary confluences. Combined & Invasive Species Removal by cutting, clearing, herbicide spraying, burning and/or regrading follow by Native Species replanting.

- **Alternative "H"** - Removal of existing debris follow by placement of clean gravel substrate at tributary confluences; Invasive Species Removal by cutting, clearing, herbicide spraying, burning and/or regrading follow by Native Species replanting; Wetland Creation (PSS) Restoration of existing wetland and daylighting of existing culverted stream; & Wetland Creation (PAB/PEM) Creation of emergent wetland within the existing oxbow.

- **Alternative "I"** - Removal of existing debris followed by placement of clean gravel substrate at tributary confluences; Invasive Species Removal by cutting, clearing, herbicide spraying, burning and/or regrading follow by Native Species replanting; Wetland Creation (PSS) Restoration of existing wetland and daylighting of existing culverted stream; Wetland Creation (PAB/PEM) Creation of emergent wetland within the existing oxbow; & sediment removal by dredging.

- **Alternative "J"** - Combination of removal of existing debris follow by placement of clean gravel substrate at tributary confluences and selective sediment removal by dredging. [*Comment*: dredge spoils to be considered for reuse on-site/creation of emergent wetlands. Alternative calls for excavation of 2-3 feet and the placement of 1-foot of clean gravel substrate.] In addition, this option may be combined with alteration to water level control at the Amelia Earhart dam and/or improvements to the existing fish passage (sluice structure).

A follow-up e-mail with the meeting's agenda will be forward to the invitees next week!

Please respond by e-mail on your availability to attend by 9 December 03.

Sincerely

Michael R. Tuttle
Study Manager

U.S. Army Corps of Engineers, New England District
696 Virginia Road
Concord, MA 01742-2751

Tel # (978) 318-8677, Fax # (978) 318-8080

Malden River Ecosystem Restoration Feasibility Study
Alternatives Analysis Meeting Agenda
December 10th 2003; 1:00 – 4:00 p.m.
CENAE headquarters, Concord, MA

Invited Attendees: *U.S. Army Corps of Engineers, New England District (CENAE); Mystic Valley Development Commission (MVDC); ENSR International; United States Environmental Protection Agency (U.S.EPA); Mass Electric; KeySpan; National Grid; Nangle Consulting Associates; Preotle, Lane & Associates (PLA); Massachusetts Executive Office of Environmental Affairs (EOEA), Massachusetts Department of Environmental Protection (MA DEP); Metropolitan District Commission (MDC); United States Geological Survey (USGS); Mystic River Watershed Association; National Marine Fishery Service (NMFS); United States Fish and Wildlife Services (U.S.F&WS) and Cities of Everett, Malden & Medford.*

1. Introduction
- Introduction of Project Team Members
- Review of USACOE Ecosystem Restoration Program Objectives

2. Brief Chronology of Phase I Tasks to date
- Highlights of 1st Public Meeting
  - Potential ecosystem restoration measures identified
  - Meeting invitee and Stakeholder comments
- Process for Development of Potential Environmental Restoration Alternative Plans

3. Proposed Ecosystem Restoration Alternatives
- Identification of restoration components (i.e., "building blocks")and restoration plans
- Overview of proposed Ecosystem Restoration Alternatives

a.) No Action Alternative
  - Potential Current/Future Conditions without remediation
  - Actions to be done by Others

b.) **Invasive Wetland Species Replacement and Fish Habitat Enhancement** (Alternative "G")
  - Invasive species (*Phragmites*) removal combined with regrading followed by native wetland species replanting.
  - Removal of shoreline debris followed by placement of clean gravel substrate at tributary confluences

c.) **Wetland Restoration and Fish Habitat Enhancement** (Alternative "H")
  - Invasive species (*Phragmites*) removal combined with regrading followed by native wetland species replanting
  - Restoration of existing Palustrine Scrub-Shrub (PSS) wetland south of former GE Site and daylighting of existing culverted stream
  - Removal of shoreline debris followed by placement of clean gravel substrate at tributary confluences.

December 10th Meeting

Mass & Ct Conference Room

1300 – 1600 hrs

Sponsored by Mike Tuttle Ext 677

Attendees

Dave Mitchell – ENSR
Peter Jackson – ENSR
Carl Tammi – ENSR
Dave Klinch – ENSR
Mike Worthy – ENSR

Ginny Lombardo – MVDC

Jeff Nangle – Nangle Associates
~~Christian~~ KRISTINE Welsh – Nangle Associates

Michele Leone – National Grid

Trish Haederle - Keyspan

Bill Neidermyer – US Fish & Wildlife Service

Scott Greene - DEP

NANCY HAMMETT FRIENDS of MYSTIC RIVER ASSOCIATION

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Jeff Nangle	NCA	[illegible]
Kristen Welsh	NCA	
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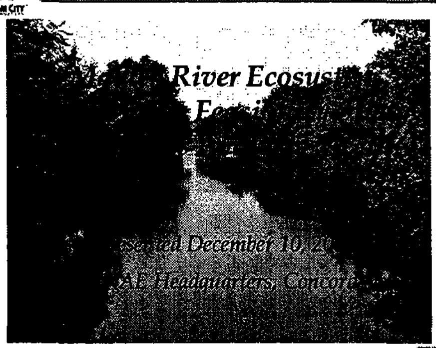
CHRIS HATFIELD	USACE	Christopher.hatfield@usace.army.mil
Pete Jackson	ENSR	PJackson@ensr.com



Main Purpose of Today's Meeting

- *To Give Stakeholders an Opportunity to Comment on the Candidate Alternative Ecosystem Restoration Plans for the Malden River*

MR Alternative Analysis Mtg Invitees

- *Federal & State Agencies*
  - CENAE (USCOE, NE District)
  - U.S. EPA (NE Region)
  - U.S.G.S.
  - U.S. F&WS
  - NMFS
  - NOAA
  - MA DEP
  - Metropolitan District Commission
- *Stakeholders & Firms*
  - MVDC
  - Cities of Everett, Malden and Medford
  - MyRWA
  - Mass Electric
  - National Grid
  - KeySpan
  - Preotle, Lane & Associates
  - Nangle Consult. Associates
  - ENSR International

Overview of Presentation

- *Introduction*
- *Brief Chronology of Phase I Tasks to Date*
- *Proposed Ecosystem Restoration Alternatives*
  - No Action Alternative
  - Invasive Wetland Species Replacement and Fish Habitat Enhancement
  - Wetland Restoration and Fish Habitat Enhancement
  - Wetland Restoration/Creation and Fish Habitat Enhancement
  - Benthic and Fish Habitat Enhancement
- *Process of Selection of Preferred Alternatives*
- *Upcoming Project Events*

CENAE Ecosystem Restoration Goals

- *CENAE Ecosystem Restoration Goals are focused on 3 primary resource areas:*
  - Restoration of water quality to improve fish passage and habitat (riverine migratory corridors)
  - Restoration of sediment quality to improve benthic (bottom) community habitat
  - Restoration or enhancement of coastal wetlands
- *Other forms of restoration may be applicable but may not be fundable by CENAE*

Phase I Activities

- *In July 2003, the CENAE hired ENSR to assist in preparing a Feasibility Study report that examines various restoration alternatives including their costs and benefits.*
- *During Phase I, ENSR reviewed existing data, identified data gaps, conducted a preliminary screening of ecosystem restoration alternatives, and further refined alternatives. These alternative plans will be fully evaluated during Phase II.*

Phase I Activities (continued)

- ***Preliminary Alternatives Evaluation Meeting conducted at Malden City Hall in Sept. 2003***
  - *presented Conceptual Site Model of Malden River*
  - *identified potential restoration measures*
  - *discussed preliminary alternative plans*
  - *obtained stakeholder feedback and comments*
- ***Candidate restoration alternative plans evolved via discussions w/ CENAE & MVDC***
- ***Alternatives Analysis Meeting at Concord***

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Malden River Conceptual Site Model

- ***Existing impairments and constraints***
  - *Upstream Water Quality and Stormwater Inputs*
  - *Water Circulation and Stagnation*
  - *Channelization and Riparian Zone Limits*
  - *MCP and other legacy sites GW inputs*
  - *Toxic sediment accumulations and lack of depth*
  - *Invasive Wetland Species*
  - *Anthropogenic trash and debris*
  - *Lack of public access and limited recreation*

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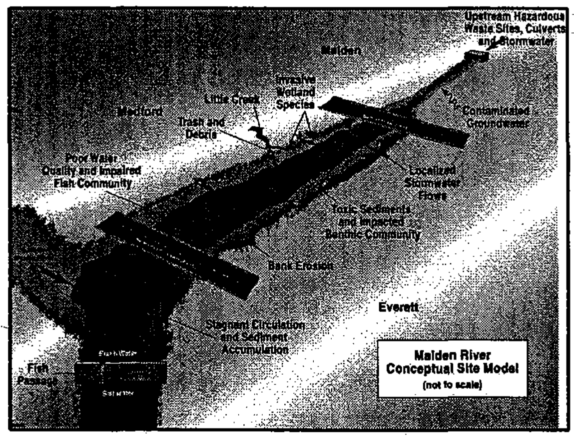

Environmental Restoration Measures

- ***Functional groupings discussed at 9/03 mtg:***
  - ***Watershed-Based Restoration Measures***
  - ***Hydrology-Based Restoration Measures***
  - ***In-Stream Restoration Measures***
  - ***Riparian Wetland Restoration Measures***
- ***Applicability and Potential Benefits***
  - ***Restoration of water quality to improve fish habitat***
  - ***Restoration of sediment quality to improve benthic (bottom) community habitat***
  - ***Restoration or enhancement of coastal wetlands***

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Development of Potential Ecosystem Restoration Alternative Plans

- ***Further researched potential technical feasibility and effectiveness of measures***
  - *discarded unfeasible or ineffective measures*
  - *retained potentially effective measures as "building blocks"*
- ***Combined building block measures into a series of alternative plans, refined with CENAE, MVDC***

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Environmental Restoration Measures retained:

- ***Water Quality Enhancement** (aeration/mixing)*
- ***Fish Habitat Improvement***
  - *Debris removal and spawning substrate placement*
  - *Sediment removal by dredging*
  - *Dam operation enhancement / fish ladder improvements*
- ***Wetland Restoration***
  - *Invasive species removal and replacement with native spp.*
  - *Wetland restoration of existing PSS wetland in South Tributary and daylighting of culvert*
  - *Wetland creation of PAB/PEM within old oxbow*

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Environmental Restoration Measures which were eliminated:

- ***Watershed and Hydrology-based Measures***
  - *Increased Summer Watershed Flows - Spot Pond is MRWA emergency water supply with no excess volume*
  - *Re-routing/by-passing of Stormwater Flows*
  - *Increased Flushing by Changed Management of the Operations at Amelia Earhart Dam*
    - » ***Surface water (pool) Elevation Management***
    - » ***Re-institution of Estuarine Tidal Cycling***

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ER Measures also eliminated:

- ***In-Stream Restoration Measures***
  - *Extensive Dredging of Sediment in MR Channel*
    - » ***No significant impact on sediment toxicity; no clean layer to dredge to, minimal improvement in fish and benthos***
    - » ***No target depth to achieve (e.g., for aquatic plant control)***
    - » ***Very expensive for dredging and disposal***
  - *Capping of Sediment- Full or Thin Layer Cover*
  - *In Situ Chemical Treatment/Stabilization or Biological Treatment of Sediment*
  - *Re-configuration of Channel Location/Morphology*

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Other Relevant ER Measures:

- ***Watershed-Based Restoration Measures Not eliminated but retained as Actions to be Performed by Others***
  - *Adoption/installation of Best Management Practices (BMPs) in Watershed*
  - *Control Toxic Releases at Hazardous Waste Sites*

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Alternative Ecosystem Restoration Plans

- ***Considered entire length of river, but mostly focused on area between Malden St. and Route 16 bridges and three small tributaries***
  - *Better opportunities for wetland restoration and habitat improvements. Upper river is channelized with very thin riparian zone*
  - *Potential for stormwater treatment of tributaries*
  - *Address areas of greater sediment contamination and potential for dredge material disposal and dewatering*
  - *Potential complementary functions with TeleCom City*

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Malden River Aerial View from North

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No Action Alternative Plan

- ***Evaluation of Current and Future Conditions in the absence of restoration***
  - *No significant changes in present ecosystem*
  - *Potential Monitored Natural Sediment Recovery*
- ***Includes Actions to be performed by others***
  - *EPA Phase II Stormwater Management*
  - *MCP Site Cleanups*
  - *Shoreline cleanups and volunteer action*

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Malden River Wetlands: Existing Conditions

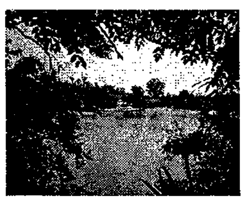
- *In-stream habitat primarily riverine, but also includes emergent and scrub-shrub wetlands. Impacted by contaminated sediment and poor water quality*
- *Wetland function and value severely impaired relative to stormwater treatment, flood storage and habitat functions*
  - *Impaired by previous alteration, filling, and invasion of monotypic stands of Phragmites*
  - *Adjacent wetlands associated with tributaries degraded by urban activities*

Wetland Restoration Alternative Plans

- *Alternative "G" - removal/replacement of invasive species (Phragmites), debris removal, gravel substrate*
- *Alternative "H" - removal/replacement of invasive species, debris removal, gravel substrate placement, restoration of PSS wetland at South Creek and daylighting of culvert*
- *Alternative "I" - removal/replacement of invasive species, debris removal, gravel substrate placement, restoration of PSS wetland at South Creek, daylighting of culvert, creation of PEM wetland in former oxbow and removal of sediment in two locations, potential to reuse in oxbow.*

MR Wetlands: Proposed Restoration Benefits

- *Increased wetland species diversity and function*
- *Reduced toxic load in sediments and stormwater treatment*
- *Improved wildlife and fish habitat value*
- *Ancillary benefit - improved aesthetics and recreational value*



WQ and Fish Habitat Improvement Restoration Alternative Plan

- *Alternative "J" - debris removal, gravel substrate; selective sediment removal. Potential water level manipulation/construction to improve fish passage at Earhart dam. Evaluation of aeration/artificial circulation*

Malden River Sediment Dredging

- *Dredge sediments to 3-ft depth in two locations with 1-ft of clean material placed over as a cap*
- *Area 1 - confluence of Little Creek and MR*
  - *Sediment w/ highest levels of As, Cr, and Hg*
  - *Highest VOC and second highest SVOC concentrations*
  - *Volume to be dredged = approximately 20,000 CY*
- *Area 2 - Medford Street Bridge Area*
  - *Hotspot for SVOCs (10,000 ppm vs. 2,000 ppm ambient)*
  - *Volume to be dredged = approximately 11,000 CY*

Malden River Dredged Material Disposal

- *Total Volume of Proposed Dredged Material equal approximately 31,000 CY*
- *Assumptions*
  - *Disposal of 31, 000 ± CY of contaminated sediments necessary*
  - *Assumes no beneficial re-use at the site as worst-case scenario. Beneficial off-site use may be identified, but hard to predict*
  - *Upland disposal will require dewatering, transportation, and disposal*

Sediment Dewatering and Disposal

- Assumes use of former GE Site for dewatering, storage, and access for hauling,
  - Assume hydraulic dredging used for sediment removal with discharge into geotextile bags for dewatering
  - Will need approximately 10 acres of GE site for geotextile bag dewatering method
  - Area may be reduced based on site-specific performance of the dewatering bags (i.e., shows faster dewatering)
- Beneficial uses could include batching in asphalt plant or use as landfill cover

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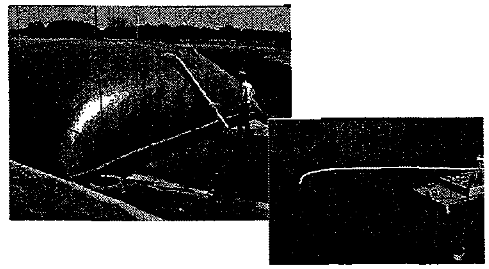
Dredged Material Dewatering



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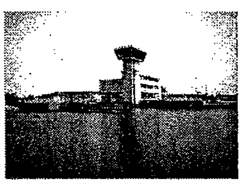
Fish Passage at Amelia Earhart Dam



- Current fish "ladder" structure not effective, passage by lockage
- Fish passage adequate but not ideal; effective for alewife but not for smelt
- Evaluation of potential operational or structural changes need to improve fish passage at structure

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Evaluation of Ecosystem Alternatives

- Start with baseline evaluation of current ecosystem measures and functions
- Evaluate proposed restoration alternatives as to potential ecosystem improvements and cost-effectiveness
- Consider future conditions and potential effects on non-ecological goals or objectives
- Rank and select alternatives

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Wetland and Habitat Restoration - Measurement of Functional Value

- Malden River ecosystem functions & values
  - Wetland Area and Riparian Corridors
  - Wetland diversity and functionality
  - Wildlife Habitat Improvement
  - Benthic Habitat Quality
  - Anadromous fish passage
  - Resident fish community

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Complementary Functions - Areas of Potential Improvement

- Malden River non-ecological objectives
  - Local Public Access and improved navigation
  - Water-based Recreation
  - Shoreline-based Recreation
  - Mitigation of potential human exposure concerns
  - Aesthetics and Viewsheds

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Next Steps

- ***At end of Phase I (Feb. '04), ENSR will narrow five alternative plans down to three, including No Action alternative to go into Phase II***
- ***Process of Selection of Final Array of Preferred Environmental Restoration Alternative Plans***
  - *Evaluation of Ecosystem Outcomes and Costs*
  - *Tradeoff Analysis*
  - *Evaluation of Complementary Functions*
  - *Stakeholder Comments/Inputs*

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Selection of Preferred Alternative Plans

- ***Evaluation of Ecosystem Outcomes and Costs***
  - *Comparison/evaluation of increased ecosystem values and functions (e.g., wetland habitats)*
  - *Comparison of costs associated with ecosystem gain*
  - *Comparison to No Action alternative*
- ***Evaluation of Complementary Functions***
  - *Potential positive/adverse effects on other water quality uses such as recreation and for local public access*
  - *Potential positive/adverse effects on Telecom City*

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Phase I Schedule Milestones

- ***Sept 03 Technical Meeting - Identify candidate restoration measures for evaluation with the assistance from relevant public agencies.***
- ***Dec 03 Alternative Analysis Meeting - Present the restoration alternatives being considered.***
- ***Feb 04 Phase I Report - Provide the CENAE and MVDC with a comprehensive list of candidate restoration alternatives to receive detailed evaluation during Phase II.***

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Malden River Phase II Tasks

- ***Selection of Preferred Ecosystem Restoration Plan***
- ***Public Review Opportunities***
- ***Hydraulic/Hydrologic Analyses***
- ***Resource Inventories***
- ***Restoration Alternatives Analysis***
- ***Quantities/Cost Estimates***
- ***NEPA Documentation***
- ***Preparation of Feasibility Report***

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Malden River Ecosystem Restoration Feasibility Study
Alternatives Analysis Meeting Minutes
Held on December 10th 2003 @ USACE, Concord, MA

Attendees:

Ginny Lombardo – MVDC
Jeff Nangle – Nangle Associates
Kristen Welsh – Nangle Associates
Scott Greene – MA DEP
Michele Leone – National Grid
Tricia Haederle – Keyspan
Nancy Hammett – Mystic River Watershed Associates
Mike Worthy – ENSR
Dave Mitchell – ENSR
Carl Tammi – ENSR
Peter Jackson – ENSR
Dave Klinch – ENSR
Chris Hatfield – USACE
Barbara Newman – USACE
Todd Randall – USACE
Mike Tuttle – USACE

1. Introduction

- Introduction of Project Team Members
- Review of USACOE Ecosystem Restoration Program Objectives
    1. Restoration of tidal and/or freshwater wetlands, which includes the removal of invasive species and the replanting of native species.
    2. Enhancement of the riverine migratory corridor
    3. Improvement of the benthic habitat
    4. Restoration of the degraded shellfish beds (Identified within the Mass & Cape Cod Bays General Investigation, however, not warranted for further evaluation for the Malden River Project).

2. Brief Chronology of Phase I Tasks to date

- Highlights of 1st Public Meeting
    - Potential ecosystem restoration measures identified
        - → Replication of lost wetland habitat
        - → Restoration of the river to its natural/historical river course
        - → Dredging and on-site reuse or off-site disposal of contaminated sediments
        - → River flow alteration
        - → Aeration and/or mechanical mixing

- ❖ Process for Development of Potential Environmental Restoration Alternative Plans

  The team developed a decision matrix, which assisted in the identification of the Restoration Alternative Plan candidates. The Phase I report will recommend a minimum of 4 restoration alternatives for a more detailed evaluation to be conducted in Phase II. The No Action alternative is included as one of the four restoration candidates. The Feasibility Study Report will be developed during Phase II.

3. Proposed Ecosystem Restoration Alternatives

- ❖ Identification of restoration components (i.e., "building blocks") and restoration plans

  Evaluating the existing conditions/studies/reports, the team developed conceptual restoration referred to as "building blocks". The "building blocks" confirmed the study goals/objectives and have assisted in the development of the combined restoration candidates. The "bluilding blocks" are

  - ♦ Fish Habitat Improvement by means of debris removal & substrate placement.
  - ♦ Benthic Habitat Improvement by means of sediment removal by dredging.
  - ♦ Water Quality Enhancement by means of aeration and/or artificial mixing.
  - ♦ Wetland Restoration by means of invasive species removal and replanting with native species. A component for all combined alternative candidates.
  - ♦ Wetland Restoration by means of restoring existing wetland and daylighting culvert.
  - ♦ Wetland Restoration by means of creating wetland within oxbow.
  - ♦ Fish Habitat Improvement by means of fish passage improvements at the Amelia Earhart Dam.

- ❖ Overview of proposed Ecosystem Restoration Alternatives – Refer to the attached Plans

a.) No Action Alternative

- Potential Current/Future Conditions without remediation
- Actions to be done by Others – includes Best Management Business Practices, Principle Responsible Parties actions, ...

b.) **Invasive Wetland Species Replacement and Fish Habitat Enhancement** (Alternative "G")

- Invasive species (*Phragmites*) removal combined with regrading followed by native wetland species replanting.
- Removal of shoreline debris followed by placement of clean gravel substrate at tributary confluences

c.) **Wetland Restoration and Fish Habitat Enhancement** (Alternative "H")

- Invasive species (*Phragmites*) removal combined with regrading followed by native wetland species replanting
- Restoration of existing Palustrine Scrub-Shrub (PSS) wetland south of former GE Site and daylighting of existing culverted stream
- Removal of shoreline debris followed by placement of clean gravel substrate at tributary confluences.

d.) **Wetland Restoration/Creation and Fish Habitat Enhancement** (Alternative "I")
- Invasive species (*Phragmites*) removal combined with regrading followed by native wetland species replanting
- Restoration of existing Palustrine Scrub-Shrub (PSS) wetland south of former GE Site and daylighting of existing culverted stream
- Enhancement of existing emergent marsh wetland east of former Monsanto Site
- Wetland Creation of PAB/PEM (Palustrine Aquatic Bed/Palustrine Emergent Marsh) emergent wetland within the old oxbow (former channel)
- Dredging of limited areas of problematic sediments with dredged material to be considered for reuse on-site/creation of emergent wetlands with clean cap
- Removal of shoreline debris followed by placement of clean gravel substrate at tributary confluences.

e.) **Benthic and Fish Habitat Enhancement** (Alternative "J")
- Removal of shoreline debris followed by placement of clean gravel substrate at tributary confluences.
- Dredging of areas of problematic sediments with excavation of 2-3 feet of contaminated sediment and the placement of 1-foot cap of clean gravel substrate
- Potential alteration to operational controls at the Amelia Earhart dam to allow improvements to fish passage

4. Process of Selection of Preferred Alternatives

❖ Evaluation of ecosystem benefits (outcomes) and costs
- Comparison and evaluation of wetland habitat and ecosystem values
- Comparison of costs/benefits associated with outcomes
- Comparison to the No Action Alternative

❖ Complementary Functions with Non-ecosystem issues
- Telecom City site development
- Access and recreation

5. Project Schedule

❖ Upcoming Schedule – Phase I Deadlines and Reporting

ENSR Submission of the Phase I Report is scheduled for 20 Jan 04
Review and Comment Period for USACE, MVDC & Stakeholders 21 Jan 04 thru 17 Feb 04
ENSR Submission of the Final Phase I Report is scheduled for 16 March 04

❖ Phase II tasks and funding

Phase II Negotiations between USACE & ENSR 23 Feb 04 thru 5 Mar 04
Phase II Option Award 19 Mar 04
Phase II Effort by ENSR 22 Mar 04 thru 6 Aug 04
Interim Findings Report Submission 9 Aug 04

❖ Future Stakeholder Involvement

Phase I Report Review & Comment 21 Jan 04 thru 17 Feb 04

Tuttle, Michael R NAE

From: Tuttle, Michael R NAE
Sent: Friday, June 10, 2005 9:05 AM
To: 'joe.dalton@mail.house.gov'; 'beth.debski@ci.everett.ma.us'; 'ldilorenzo@medford.org'; 'EPD.Marine@comcast.net'; 'tlinc02155@aol.com'; 'nancy@mysticriver.org'; 'julie@mysticriver.org'; 'kenneth.krause@comcast.net'; 'joanne.fagin@state.ma.us'; 'heidi.davis@state.ma.us'; 'mike.glavin@state.ma.us'; 'paul.dipietro@state.ma.us'; 'eric.hutchins@noaa.gov'; 'john.catena@noaa.gov'; 'william_neidermyer@fws.gov'; 'michele.leone@us.ngrid.com'; 'phaederle@keyspanenergy.com'; 'john.obrien2@exeloncorp.com'; 'rrago@haleyaldrich.com'; 'preotlelane@aol.com'; 'gary.caldwell@tufts.edu'; 'fahey.kl@mellon.com'; 'brian.israel@aporter.com'; 'cmaietta@combinedproperties.com'; 'barbara.riley@ae.ge.com'; 'gstead@cityofmalden.org'
Cc: 'phollands@telecomcitymass.com'; 'stephanieb@ppcinc.com'; 'nca2@mindspring.com'; 'lombardo.ginny@epa.gov'; Randall, Todd A NAE
Subject: Malden River Ecosystem Restoration Study - Stakeholder's Meeting
Importance: High

Good Morning All:

You are cordially invited to a Stakeholder's Meeting for the Malden River Ecosystem Restoration Study to be held on 13 July 2005 at 10:00 am at the New England District's Concord facility.

The U.S. Army Corps of Engineers has partnered with the Mystic Valley Development Commission to conduct an Ecosystem Restoration Feasibility Study on the Malden River. Phase I of the study focused on a data collection effort, which identified feasible alternatives emphasizing on wetland restoration, water quality restoration to improve fish passage/habitat and sediment quality restoration to improve benthic habitat. The comprehensive evaluation of available site information had led to the development of numerous "building blocks" or restoration components that were recommended for further development within Phase II. The Phase I Report was completed in August 2004.

In Phase II, the Study Team has redefined the restoration components into categories and sub-sections within the study area. Each restoration component within their respective sub-section have been evaluated for its ecological value, cost, implementability and sustainability relative to the restoration goals. This will be the main topic of discussion at the Stakeholder's Meeting.

The attachments include a Project Information Sheet, the Invite List and directions to our facility.

On behalf of the Mystic Valley Development Commission, we look forward to your participation in this July 13th Stakeholder's Meeting. Due to security purposes, please email or call to confirm your participation.

Sincerely,

Mike

US Army Corps of Engineers
New England District

Project Information Sheet

Malden River Ecosystem Restoration Feasibility Study
Medford, Malden & Everett, Massachusetts

June 7, 2005 696 Virginia Road, Concord Massachusetts, 01742-2751

STUDY NAME: Malden River Ecosystem Restoration Feasibility Study

STUDY AUTHORITY: On July 23, 1997, the U.S. House of Representatives, Committee on Transportation and Infrastructure authorized the Secretary of the Army to conduct a reconnaissance study encompassing the watersheds of the Massachusetts and Cape Cod Bays, as defined by the Environmental Protection Agency designated National Estuary Program, to enhance ecosystem restoration. The Reconnaissance Study recommended four habitat types for further New England District investigation. The four habitat types are the restoration of tidal and freshwater wetlands, riverine migratory corridors, benthic habitats containing contaminated sediments, and degraded shellfish beds. Malden River was one of the restoration sites determined to be in the Federal interest.

A Federal navigation channel exists within the study area. Adopted in 1912 and modified in 1915, the project provided for a 6-foot deep channel, 100 to 150 feet wide, extending approximately 1.5 miles from the confluence of the Mystic River to the Medford Street Bridge

CONGRESSIONAL DISTRICT: Massachusetts – 7th (Markey)

STUDY SPONSOR: Mystic River Development Commission (MVDC) is a tri-city legislative body established by the Commonwealth of Massachusetts to address commonly shared issues such as land development and river restoration opportunities within the Malden River watershed.

LOCATION AND DESCRIPTION: The Malden River watershed is a sub-basin of the much larger Mystic River watershed. The Malden River watershed is approximately 11 mi^2, located in the towns of Wakefield, Stoneham, Melrose, Malden, Medford and Everett. The Malden River originates from the outflow from Spot Pond in the Fells Reservation and passes beneath or through the cities of Melrose and Malden in underground culverts or channelized conveyances. The river daylights from two sets of stormwater culverts south of Malden Center and flows for approximately 2 miles as open surface water through the densely populated cities of Malden, Everett and Medford prior to its confluence with the Mystic River. The 'study area' is defined where the river daylights from the underground culverts south of Charles Street, Malden to the confluence with the Mystic River in Medford and Everett with a lower boundary of the Amelia Earhart Dam. With the 'study area', four small tributaries flow into the Malden River, Little Creek on the western side, two unnamed tributaries on the east side referred to as North Creek and South Creek, and a small drainage creek referred to as the Mall Creek (see Figure 1).

The Malden River channel is approximately 6 feet deep by 100 to 150 feet wide from the Medford Street Bridge in Malden to its confluence with the Mystic River. In locations outside of the channel, water depths have been observed to be as shallow as 2 feet.

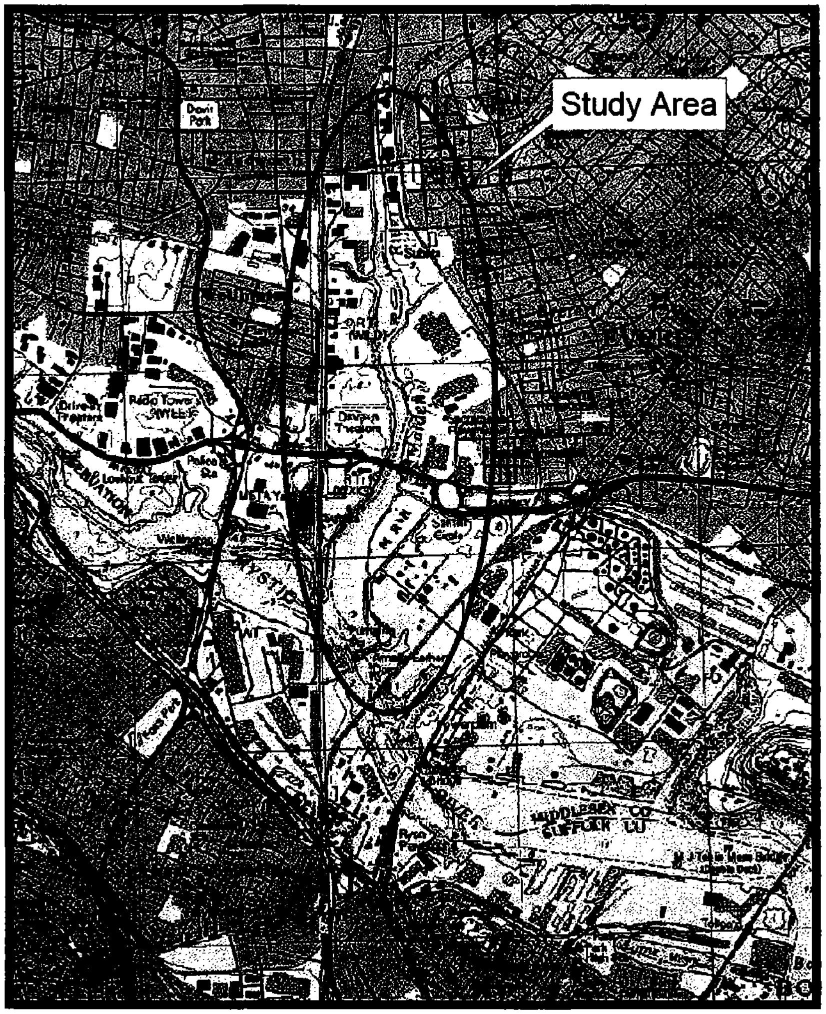


Figure 1 – Study Area

EXISTING ECOGICAL PROBLEMS: The existing ecological impairments to the Malden River have been recognized as degraded water quality, degraded wetland habitat and poor sediment quality.

Current sources of contamination to the water quality of the Malden River include contaminated sediments, stormwater, leaching groundwater, and product discharge. Degraded water quality is exacerbated by the lack of flushing in the river, either by sufficient freshwater inflow or by tidal exchange. Low channel gradients and little inflow result in low water velocities, creating impoundment-like conditions throughout the Malden River.

Primary causes for wetland habitat loss include filling for industrial and commercial development, channelization for navigation, and historic dredging by Federal, state and private interests. Wetlands that currently remain have undergone varying effects of anthropogenic degradation because of impacted stormwater runoff, industrial contamination, invasive species colonization, habitat fragmentation, and discontinuation of tidal cycling. The cumulative effects of wetland loss and degradation on the Malden River system are significant, and include: 1) reduced nutrient, toxicant, and suspended solids removal from stormwater, 2) loss of nesting and foraging habitat and travel corridors for wildlife, 3) reduced floodwater storage, 4) reduced erosion protection along the river's shoreline, 5) loss of macroinvertebrate habitat among submergent and emergent wetlands, and 6) reduced shade, cover, and structure

General conclusions regarding the current characterization of the sediment quality in the Malden River are as follows:

- Semi-Volatile Organic Compounds (SVOC) are present at levels several orders of magnitude above the ecological screening bench marks throughout the river. The highest levels of semi-volatile organics are present near the Medford Street Bridge and at the confluence of Little Creek and the Malden River. SVOCs are present at levels exceeding the MA Department of Environmental Protection's Upper Concentration Limits (UCL) only in these areas. Separate phase pollutants may be present in sediments in these areas. SVOCs are present at elevated levels (over 100 ppm) in the immediate vicinity of the Medford Street Bridge.
- Metals were not detected at levels exceeding the UCLs, but they exceed the ecological screening benchmarks throughout the river. The highest levels of combined metals (e.g., arsenic, lead, zinc) are present above the Revere Beach Parkway. Elevated lead and zinc levels are present at various locations throughout the river.
- The thickness of sediment ranges from 2 to 18 feet. Pollutants are present at all depths.
- Stormwater discharges as well as atmospheric deposition will continue to provide a degree of pollutant loading in the system.

RESTORATION OBJECTIVES: The overall goal of the Feasibility Study is to determine feasible restoration activities that will restore the Malden River ecosystem to the highest quality that it can reasonably support and sustain. The primary objectives of the Feasibility Study are:

- Reduction of current impacts to water quality, reduction of water quality standard exceedances, and restoration of riverine migratory (anadromous fish) corridors;
- Reduction of current impacts caused by poor sediment quality and restoration of degraded benthic habitat: and
- Enhancement or restoration of freshwater coastal wetlands.

The secondary objectives (or non-ecosystem issues) that address identified watershed stakeholder concerns include:

- Increase recreational use of the river;
- Increase public access to the river; and
- Reduce potential human health concerns regard surface water or sediment exposure.

CURRENT PROJECT STATUS: The Malden River Ecosystem Restoration Feasibility Study Phase I Report resultant was the development of numerous "building blocks" or restoration components that were recommended for further development within Phase II. These "building blocks" were directed towards the three restoration goals of the Study: wetlands restoration, benthic habitat restoration and fisheries habitat restoration.

Under Phase II, each of the selected "building blocks" have been evaluated for its ecological value, cost, implementability and sustainability relative to the corresponding restoration goals.

Further evaluation required the study area to be divided into six sub-sections (see Figure 2). Each sub-section contains five management plans, which are focused on improving the environmental conditions in the Malden River. The plans are comprised of the removal of invasive species, the removal of invasive species coupled with restoration of wetlands, the creation of wetlands, the contaminated sediment remediation, and the enhancement of fish habitat and fish passage.

The costs of the alternative restoration plans are compared with the environmental benefits within the framework of an incremental cost analysis, which will identify the most cost effective alternatives. An incremental cost analysis examines how the costs of additional units of environmental output increase as the level of environmental output increases. For this analysis, the environmental outputs are measured in habitat units. The incremental analysis identified 39 (out of a possible 1,584) alternatives as cost effective plans. The Stakeholder's Meeting will expand on this process and elaborate on the best buy plans identified during this analysis.

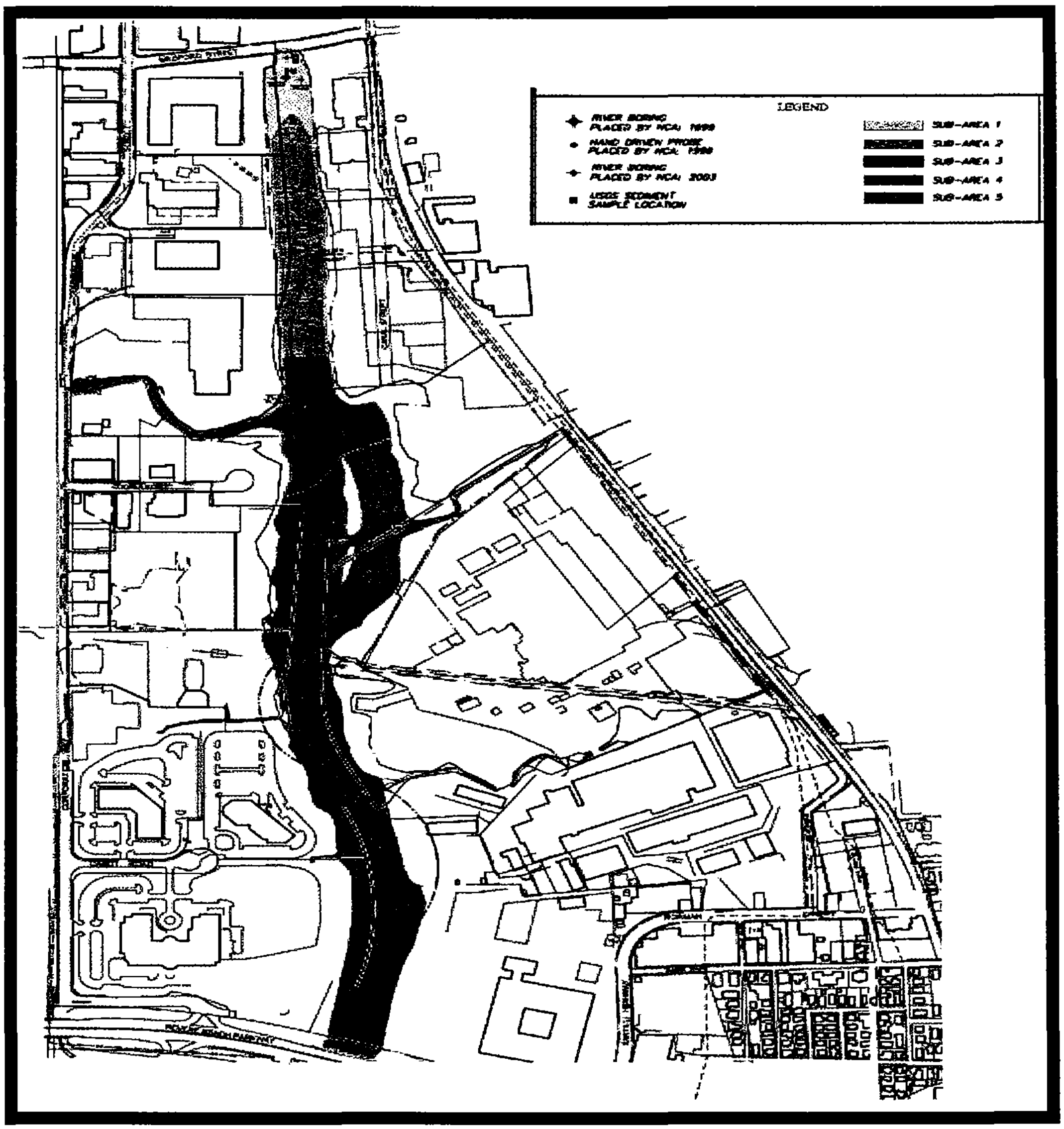


Figure 2 – Malden River Sub-Areas

CONTACT: For additional information on this project, please contact the Project Manager, Mr. Mike Tuttle, at the New England District at 978-318-8677 or at Michael.r.tuttle@usace.army.mil

Malden River Ecosystem Restoration Feasibility Study

July 13, 2005 – Stakeholder's Meeting

- Mike Tuttle – Study Manager
- Todd Randall - Ecologist

Brief Project Background Malden River

- July 23, 1997, US House of Reps authorized Coastal Massachusetts General Investigation.
- Reconn. Study identify restoration sites within Mass & Cape Cod Bays' watersheds.

Brief Project Background Malden River

- Malden River identified as a potential restoration site in the Federal Interest.
- Corps Ecosystem Restoration Mission.
  - Restoration of Tidal & Freshwater Wetlands.
  - Restoration of Riverine Migratory Corridor.
  - Restoration of Benthic Habitat.

Brief Project Background Malden River

- October 2002, Agreement signed between Mystic Valley Development Commission and US Army Corps of Engineer.

MYSTIC VALLEY DEVELOPMENT COMMISSION

US Army Corps of Engineers

Feasibility Study Approach

- Feasibility Study broken into 2 Parts
- Phase I Focus – Data Collection & Review, Forecasting, & Formulation of Alternatives (Completed in August 04).
- Phase II Focus – Evaluate & Compare Alternatives, & Determine Recommended Alternative Plan (Ongoing).

Corps' 6-step Planning Process

- Step 1 - Problem Identification & Opportunities (Phase I)
- Step 2 – Inventorying and Forecasting Conditions (Phase I)
- Step 3 – Formulating Alternative Plans (Phase I & II)
- Step 4 – Evaluating Alternative Plans (Phase II)
- Step 5 – Comparing Alternative Plans (Phase II)
- Step 6 – Selecting a Plan (Phase II)

- Urbanization
- Wetland Loss
- Poor Sediment Quality
- Decline in Habitat Quality for Fisheries, Waterfowl & Wildlife
- Poor Water Quality
- Low Diversity of Macroinvertebrates
- Poor Flushing & Circulation
- Inadequate Operations for Fish Passage

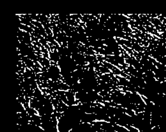
- Improve Waterfowl Habitat
- Improve Benthic Habitat
- Improve Fisheries Habitat
- Create Habitat Diversity
- Improve Water Quality
- Enhance Recreation

Dam operations prevent tidal flushing, create poor circulation and lead to poor water quality

Existing Ecological Impairments

Future Without Project

- Continued Degradation of Wetlands
- Elimination of Fisheries Habitat
- Continued Degradation of Benthic Habitat
- Increase in Human Health Risks
- Continued Degradation of Waterfowl Habitat
- Loss of Recreation Uses
- Continued Poor Water Quality



Future With Project

- Enhance Aquatic Habitat for Fisheries
- Improvement of Waterfowl Habitat
- Improvement of Benthic Habitat
- Improvement of Water Quality
- Restore a Balanced Diversity among Habitats

- "Building Blocks" Concept
  - No Action
  - Wetland Restoration
  - Invasive Species Control
  - Fish Habitat Enhancement
  - Wetland Creation
  - Benthic Restoration
  - Fish Passage Improvement
  - Water Quality Improvement

- Fish Habitat Enhancement by placement of appropriate spawning substrate.
- Invasive Species Control by removal followed by re-establishment of native wetland species.
- Improvement of Water Quality by means of natural filtration.

- Wetland Restoration by "daylighting" sections of South Creek.
- Wetland restoration by creating an emergent marsh wetland within the oxbow.
- Benthic Restoration by dredging existing contaminant sediments and capping with clean substrate.
- Improvement of migratory fish passage by changing the operational procedures at Amelia Earhart Dam

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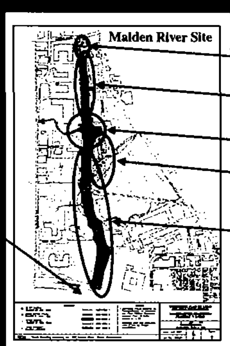


- Forecast With Project Conditions for Each Alternative
- Compare With Project Condition to Without Project
- Characterize Effects
- Determine Each Alternative Costs
- Develop Environmental Outputs

MALDEN RIVER STUDY AREA

SUB-AREA DIVISION RESTORATION ALTERNATIVES

	No Action	Invasive Species Removal	Wetland Restoration (1' clean fill w/ planting)	Wetland Creation (>1' fill and planting)	Sediment Removal	Fish Habitat Improvement
Sub-area 1		0	0	0	1.24	0.07
Sub-area 2		1.29	1.29	0	1.0	0
Sub-area 3		3.37	3.37	1.55	4.23	0.69
Sub-area 4		3.39	3.39	3.87	3.29	0.84
Sub-area 5		3.78	3.78	0	1.79	0.42
Sub-area 6		14.23	14.23	0	0	0.79

Values in acres

EVALUATION METHODS

- Habitat Evaluation Procedure (HEP)


Green Heron

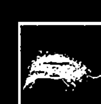

Marsh Wren


Common Yellowthroat

- Predictive Sediment Toxicity Model

Sediment toxicity predicted through the use of a sediment effects ratio (described as a Probable Effects Concentration Quotient (PEC-Q))

MacDonald et al. (2000) Ingersoll et al. (2000)

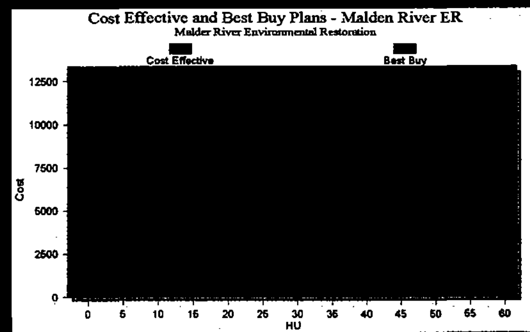


IWR-Plan	Description		
Designator		Cost	HU
A1	Total Remove Invasive Species SA 2	709.4	0.54
A2	Total Remove Invasive Species SA 3	1,028.3	0.67
A3	Total Remove Invasive Species SA 4	1,174.4	1.02
A4	Total Remove Invasive Species SA 5	965.9	2.57
A5	Total Remove Invasive Species SA 6	7,441.7	7.40
B1	Rem Inv Species & Restore Wetland SA 2	727.4	3.65
B2	Rem Inv Species & Restore Wetland SA 3	1,078.2	8.52
B3	Rem Inv Species & Restore Wetland SA 4	1,227.0	9.26
B4	Rem Inv Species & Restore Wetland SA 5	1,008.4	12.41
B5	Rem Inv Species & Restore Wetland SA 6	7,627.3	42.45
C1	Create Wetland SA 3	186.4	7.80
C2	Create Wetland SA 4	468.2	13.47
C3	Create Wetland SA 5	211.7	9.48
D1	Dredging SA 1	2,154.1	0.34
D2	Dredging SA 2	2,042.4	0.12
D3	Dredging SA 3	5,816.8	1.69
D4	Dredging SA 4	4,539.2	2.02
D5	Dredging SA 5	2,461.8	0.35
E1	Place Gravel/Sand SA 1	7.3	0.70
E2	Place Gravel/Sand SA 3	70.0	0.69
E3	Place Gravel/Sand SA 4	71.3	0.84
E4	Place Gravel/Sand SA 5	45.3	0.42
E5	Place Gravel/Sand SA 6	78.2	0.79
	Fish Passage	41.0	81.73

24 plans identified
plus
the No Action

Cost in thousands
of dollars

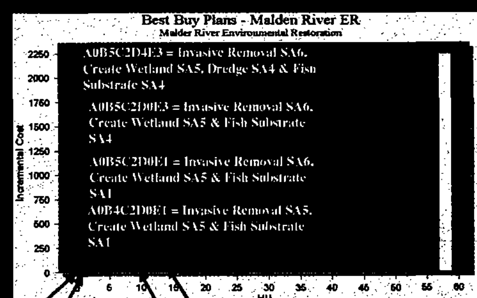
Fish Passage operational changes is included in all restoration components



							Inc. Cost
				Ave.	Inc.	Inc.	per
Increment No.	Plan Designator	Cost	HU	Cost	Cost	HU	Inc. HU
1	A0B0C0D0E0	0.0	0.0	0.0	0.0	0.0	0.0
2	A0B0C0D0E1	7.3	0.70	10.4	7.3	0.70	10.4
3	A0B0C3D0E1	213.8	10.18	21.0	206.5	9.48	21.8
4	A0B0C2D0E1	475.5	14.17	33.6	261.7	3.99	65.6
5	A0B4C2D0E1	1,483.9	26.58	55.8	1,008.4	12.41	81.3
6	A0B5C2D0E1	8,102.8	56.62	143.1	6,618.9	30.04	220.3
7	A0B5C2D0E3	8,166.8	56.76	143.9	64.0	0.14	457.1
8	A0B5C2D4E3	12,706.0	58.78	216.2	4,539.2	2.02	2,247.1

B4 = Invasive Removal & Replanting SA5
C2 = Create Wetland SA4
D4 = Dredging SA4
E1 = Fish Substrate SA1

B5 = Invasive Removal & Replanting SA6
C3 = Create Wetland SA5
E3 = Fish Substrate SA4



No Action

A0B0C0D0E1 = Fish Substrate SA1

A0B0C2D0E1 = Create Wetland SA4 & Fish Substrate SA1

A0B0C3D0E1 = Create Wetland SA5 & Fish Substrate SA1

Alt 6 - A0B5C2D0E1
Cost = $ 8,167,000
Habitat Units = 56.62

Fish Substrate SA1

Create Wetland SA5

Invasive Removal & Replanting SA6

Fish Passage Operational Improvements

Alt 6 - A0B5C2D0E1
Cost = $ 8,167,000
Habitat Units = 56.62

Fish Substrate SA1

Create Wetland SA5

Invasive Removal & Replanting SA6

Fish Passage Operational Improvements

Sponsor & Stakeholder's Options

MVDC accepts the Corps' NER Plan
(a best buy plan, cost-shared 65% Fed/35% nonFed)

or

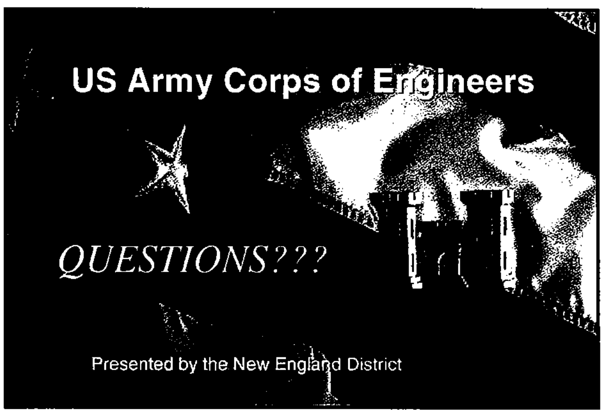
MVDC Selects a 'Locally Preferred' Plan
(not a best buy plan, cost-shared depends on Plan selected)

or

MVDC Requests Add Ons to the Corps' NER Plan
(a best buy plan, cost-shared 65% Fed/35% nonFed, Add Ons 100% nonFed)

Feasibility Study Schedule

- September 05 – Complete Draft Phase II Report
- January 06 – Division Approval to Issue Public Notice
- May 06 – Obtain Project Approval
- July 06 – Initiate Plans & Spec Phase



Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX A-3

OTHER PERTINENT CORRESPONDENCE

US Army Corps
of Engineers®
New England District

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO
ATTENTION OF

July 29, 2005

Engineering/Planning Division
Planning Branch

Mr. Stephen Viggiani
US EPA, Region 1
One Congress Street, Suite 1100-SAA
Boston, Massachusetts 02114-2023

RE: Malden River Ecosystem Restoration Study

Dear Mr. Viggiani:

This letter is intended to provide your agency an update on the Malden River Ecosystem Restoration Feasibility Study. We are currently formulating restoration opportunities within the Malden River site. The initial analysis has identified eight Best Buy plans. These Best Buy plans were presented to the stakeholders on July 13, 2005. The local sponsor, Mystic Valley Development Commission, is reviewing the developed restoration plans.

Our current schedule depicts the completion of the draft feasibility report occurring in September 2005. However, this milestone date will be extended to November 2005, in order to allow the local sponsor to identify a "Locally Preferred" plan.

Enclosed for your review is the PowerPoint presentation and handouts that were distributed during the Stakeholder's Meeting.

If you have any questions or wish to discuss the status of the study further, please contact Mr. Michael Tuttle at (978) 318-8677.

Sincerely,

John R. Kennelly
Chief of Planning

Enclosure

MEMORANDUM – MEETING MINUTES

TO: ALL PARTICIPANTS

FROM: MICHAEL TUTTLE

SUBJECT: MALDEN RIVER ECO RESTORATION

MEETING DATE: 5 MAY 2004

REVISED DATE: 10 MAY 2004

On Wednesday, 5 May 2004, PDT meeting was held at Concord Park to discuss the Phase II options, Program procedures, project schedule, funding, workload, and contracting options.

The participants at the meeting were the following:

- Ginny Lombardo – MVDC
- Jeff Nangle – Nangle Consulting Assoc.
- Chris Hatfield – USACE
- Todd Randall – USACE
- Barbara Newman – USACE
- Mike Tuttle – USACE

Outstanding Issues

1. Awaiting non-Fed FY funds ($118,300). *Update* – Funds received, deposited and available. – **Issue Resolved.**

2. Awaiting submission of the Final Phase I Interim Report/Response Document from ENSR. *Update* – Final Phase I Reports will be picked up on Friday afternoon (7 May 04). – **Issue Resolved**

Meeting Topics

1. The Study Team will review the Final Phase I report and concur whether ENSR had adequately addressed the Team's review comments.

2. The Study Team agreed to proceed with Phase II of the Study. Ultimately, implementation of the restoration strategy may be recommended through Section 206, Aquatic Habitat Restoration, of the Continuing Authorities Program. Any authority transfer would be handled at the completion of the Feasibility Phase. The

206 authority would allow for the project to be implemented by the District with approval of Division (NAD) leaders, rather than requiring OMB and Congressional approval as would be required if implementation was pursued through the GI Authority. The dollar limit under Section 206 is a total project cost of $7.7 million, which breaks down to a maximum Fed participation of $5 million and a minimum local sponsor participation of $2.7 million. In-kind services can be a component of the local sponsor's share.

3. The Corps clarified that any required remedial work (i.e., removal of contaminated sediments) for which there is a viable PRP would need to be pursued as a PRP responsibility and could not be funded by the Corps nor could it be considered part of the local cost share. However, 'add-ons' to the Project could be implemented. The [definition - 'add-on' is a desired feature of the local sponsor that will be included with the recommended NER plan. The local sponsor would assume 100% of the design and construction costs for these 'add-ons']. Further discussion/clarification is warranted.

4. The Study Team discussed pursuing Phase II similar to the approach taken in the Elizabeth River, such that restoration elements would be valued separately for each of the 3 goals of the study (aquatic, wetland & benthic) and then the best-buy plan for each goal would be combined to create the National Ecosystem Restoration (NER) plan. The Study Team discussed that some elements address more than one goal and would need to be considered as such.

5. The Study Team agreed to proceed with a plan to determine the preferred alternative based on ecological value, implement-ability and best economic value. Elements of the NER plan for which there is a viable PRP will be extracted from the plan and PRPs will be pursued to implement these elements. If after that, the NER plan is valued higher than $7.7 million, the Study Team will extract the lowest priority elements (based on ecological value) to lower the cost of the NER plan to below the $7.7 million cap. Those extracted elements will be identified as potential future projects. The remaining elements will be pursued as the recommended alternative.

6. The Corps will review the Muddy River Study Report and the Elizabeth River Study Report and talk to the Project Managers of those studies to ensure that we apply any "lessons learned" to the Malden River Study.

7. Outline of Plan to Proceed:

    a. Corps will talk to management about the findings of Phase I and the general plan for Phase II and get buy-in to our approach for moving forward.

    b. Corps will breakdown Alternatives G, H, I and J into incremental restoration building blocks and group the building blocks into three goal-based categories; wetland restoration, benthic habitat restoration and aquatic habitat restoration.

c. Corps will assess whether any additional data is needed for the habitat value evaluation process on each building block.

d. Corps will establish habitat units/environmental benefits/wetland functional assessment for each building block.

e. Corps will create evaluation methodology for ranking wetland restoration and aquatic habitat restoration building blocks.

f. Nangle and the Corps will work together to create an evaluation methodology for ranking the benthic habitat restoration building blocks. The foregoing work should be completed within 90 days – by early August.

g. Corps will contract with ENSR for further design and detailed cost estimates for each of the building blocks. ENSR should be given approximately 3 months to complete this work – by early November.

h. Corps will complete the cost effectiveness and incremental cost analysis. The results of the incremental cost analysis will be analyzed and used to determine the preferred restoration alternative.

i. Corps will prepare the Real Estate Report and Cultural Resource components of the FS Report.

j. The preferred NER plan may be narrowed based on PRP responsibility and/or cost, as discussed above, to determine the recommended restoration alternative. The Study Team may need to host public meetings at this point to solicit public input on the recommended alternative.

k. Corps will complete the Environmental Assessment for the recommended restoration alternative. The draft Feasibility Report/EA will be available for review in Spring 2005.

Closing Comments

ξ On or around May 26, the Study Team will have a conference call to report on the status of actions 7a though 7d, particularly any data needs identified.

ξ The Corps will update Dave Mitchell of ENSR next week (10 May 04) on the Project approach for Phase II.

If an omission exists or an incorrect statement, please reply to Mike Tuttle, Study Manager at 978-318-8677 or via e-mail before 15 May 2004.

MYSTIC VALLEY DEVELOPMENT COMMISSION

Malden Government Center
200 Pleasant Street
Suite 621
Malden, MA 02148

Phone 617-381-7711
Fax 617-381-7776
www.telecomcitymass.com

March 9, 2004

Steven Viggiani
Senior Enforcement Counsel
U.S. EPA Region I
One Congress Street
Suite 1100 (SEL)
Boston, MA 02114-2023

Re: Funding for Phase II of the Malden River Ecosystem Study

Dear Mr. Viggiani:

The Mystic Valley Development Commission (MVDC) extends its gratitude to you for facilitating the inclusion of funding for Phase II of the Malden River Ecosystem Restoration Feasibility Study in EPA's recent settlement agreement with Excelon Mystic LLC. This funding will ensure the successful completion of the Study, which is the critical first step to the realization of a restored Malden River for the communities of Everett, Malden and Medford.

We have discussed the method of payment with our partners at the U.S. Army Corps of Engineers (Corps), the lead agency for the Study, and have confirmed that Excelon can issue a check for the Study funding directly to the Corps. The check for $118,300 should be made payable to "FAO, CENAE, New England District" and must include a reference on the check to the "MVDC/Malden River Ecosystem Restoration Study". The check can be mailed to:

> Michael Tuttle, Study Manager
> U.S. Army Corps of Engineers
> New England District
> 696 Virginia Road
> Concord, MA 01742-2751.

The MVDC requests that Excelon copy us on the transmittal of the check to the Corps. Thank you again for your assistance in this matter on our behalf.

Sincerely,

Peter Hollands
Project Director

cc: Diane Applegate, Excelon
Michael Tuttle, U.S. Army Corps of Engineers

February 4, 2004

Engineering/Planning Division
Planning Branch

Honorable David Ragucci
Mayor of Everett
Everett, Massachusetts 02149

Dear Mayor Ragucci:

Enclosed is a quarterly financial summary for the Malden River Ecosystem Restoration Study, which is being conducted by the New England District, U.S. Army Corps of Engineers, under a cost sharing agreement with the Mystic Valley Development Commission (MVDC). This financial status report presents the actual costs of the study through the end of December 2003.

Negotiations with ENSR on Phase I of the feasibility study were completed in July 2003. Phase I requires ENSR to evaluate feasible restoration activities that will restore the Malden River ecosystem to the highest end use resource that it will reasonably support and sustain. The negotiated price for Phase I was $80,860. Phase II will require a comprehensive evaluation of the Phase I restoration candidates, the preparation of environmental documentation, and a Feasibility Study Report.

The enclosed summary identifies the necessary contributed funds required to award the Phase II task order to ENSR. Further cash contributions have been coordinated through MVDC's representative, Ms. Ginny Lombardo.

If you have any questions or wish to discuss the status of the study further, please contact Mr. Michael Tuttle at (978) 318-8677.

Sincerely,

John R. Kennelly
Chief of Planning

Enclosure

Copy Furnished:

Ms. Ginny Lombardo
TeleCom City Showcase
200 Pleasant Street, Room 621
Malden, Massachusetts 02148

C/SSS

CH/PLNG/BR

CF: Plng Br Files, Tuttle C:\Correspondence_EP\Tuttle\RequestFY04Funds.MVDC
Reading Files

Tuttle

July 16, 2003

Tuttle/sa/677

Engineering/Planning Division
Planning Branch

Honorable Michael McGlynn, Chairperson
Mystic Valley Development Commission
200 Pleasant Street, Room 621
Malden, Massachusetts 02148

Dear Honorable McGlynn:

Enclosed is a quarterly financial summary for the Malden River Ecosystem Restoration Study, which is being conducted by the New England District of the Corps of Engineers under a cost sharing agreement with Mystic Valley Development Commission (MVDC). This financial status report presents the actual costs of the study through the end of June 2003.

We have completed negotiations with ENSR on Phase I of the feasibility study. Phase I requires ENSR to evaluate feasible restoration activities that will restore the Malden River ecosystem to the highest end use resource that it will reasonably support and sustain. The negotiated price for Phase I is $80,860.

As you can see in the enclosed summary, we currently do not have the necessary contributed funds to award this task order to ENSR. Further cash contributions for the remainder of this fiscal year's efforts has been coordinated through MVDC's representative Ms. Ginny Lombardo.

If you have any questions or wish to discuss the status of the study further, please contact Mr. Michael Tuttle at (978) 318-8677.

Sincerely,

John R. Kennelly
Chief of Planning

Enclosure

Copy Furnished:

Ms. Ginny Lombardo
TeleCom City Showcase
200 Pleasant Street, Room 621
Malden, Massachusetts 02148

NAE REGULATORY PROGRAM
FACT SHEET

US Army Corps
of Engineers®
New England District

File Number: 200000229
Date Prepared: 18 Mar 2003
Project Manager: Alan R. Anacheka-Nasemann, PWS

Project Name: Telecom City (Mystic Valley Development Commission - MVDC)
Purpose of Work: Establish a Telecommunications Industry Business Park
Waterway: Malden River, adjacent to an existing brownfields site.
Site Address: Malden River at Commercial Drive, Malden, Medford & Everett

Description: The MVDC and Preotle-Lane Associates (NYC development firm) have requested a permit to fill 1.65 acres of jurisdictional but degraded wetlands to construct the first phase of a major business park. USEPA is a proponent of project, which is a brownfields redevelopment Showcase Community, and a USEPA Brownfields Coordinator is assigned to assist Telecom City in this endeavor. Affected wetlands abut abandoned, gutted buildings and include invasive plant species, construction and other debris.

Background/Issues: Application received 30 Aug 2001. Public Notice issued: 25 Sep 2001. The application was withdrawn in March 2002 while the applicant revised the mitigation plan. Applicant reactivated processing in Oct 2002. Mitigation plan was received 19 Dec 02. After review by ERS, final revisions should arrive today, and applicant expects our final decision shortly.

Current Status: On 13 Mar 03, it came to the attention of Ed Reiner (USEPA) that there are two unresolved enforcement cases on two contiguous parcels that are part of this site. One case was deferred on 13 Jul 93 and the other on 4 Feb 94. The former dates to the late 1970s. At that time, we investigated the alleged filling of 1.3 acres of the Malden River and 1.15 acres of wetlands. Aerial photography indicates that these activities occurred between 1968 and 1977. Based on our phase-in dates for jurisdiction, any fill of the wetlands prior to July 1975 is grandfathered; only fill placed between 1975 and 1977 was unauthorized. The 13 Jul 94 memo deferring enforcement action thus admits that our case vis-a-vis wetlands was very weak at that time. The other 1.3 acre fill would have been regulated under §10. There is no evidence that further filling on this parcel occurred after Cease & Desist order (28 Nov 1977).

In the latter case, the violation involved the placement of old barges and filling of approximately 1000 s.f. (0.025 acre) of the Malden River. The agreed upon course of action was that the violator would remove the fill and restore the site. It appears that said removal probably occurred, although this was not verified by the Corps. The subsequent wetland restoration effort failed due to dieback of the planted vegetation. Today, the area is a *Phragmites* wetland.

Both deferral documents state that the Corps will not entertain new applications until/unless the violations are cleared up. However, the Corps did accept, and has been processing, the present application for some time. The previous PM and I were unaware of the past enforcement cases. The applicant has been proceeding in good faith under the current application.

Mr. Reiner has recommended that Telecom City be compelled to show the past, alleged violations on their plans and to receive after-the-fact authorization for them. He has also recommended that the mitigation plan be enhanced to offset the aggregate aquatic resource losses. This is suggested despite the fact that (1) the vast majority of this fill is at least 25 years old; (2) the wetland component may well have occurred prior to the applicable phase-in dates, rendering part of the case moot; (3) available evidence indicates that a cooperative violator at least attempted to remove the more recent 1000 s.f. of fill approximately 13 years ago; and (4) No action has been taken relative to these cases in over nine years. Mr. Reiner has also raised the issue with the EPA Brownfields Coordinator, who is upset to have this apparent roadblock introduced at this late stage in Telecom City's application process.

Next Action: (Recommended) Meet with Chief, Regulatory Division to discuss situation. Possible solutions include, in sequence:

(1) Issue a letter to the applicant/current owner indicating that a preponderance of evidence suggests that the past filling of 1.15 acres of wetlands occurred prior to July 25, 1975 and is therefore authorized by Nationwide Permits issued July 19, 1977;

(2) Inspect the area that involved the 1000 s.f., fill, verify removal, document current conditions, and issue a letter to the applicant/current owner indicating that the removal satisfactorily resolves the violation;

(3) Add the filling of 1.30 acres of navigable waters that occurred between 1968 and 1977 to the applicant's plans. Authorize it under §10 noting that the 404(b)(1) Guidelines do not apply because this is a §10 project only and the 404(b)(1) Guidelines were not in effect at the time the fill was placed; and

(4) Review the final mitigation plan, prepare EASOF and ISSUE PERMIT. Suspense = 18 Apr 03 to meet CECW-OR performance goals.

Staffing: PM _______ SEC CHF_______ BR CHF________

Tuttle, Michael R NAE

To: kwabena.kyei-aboagye@state.ma.us
Subject: Section 312 criteria

Good Morning Kwabena,

The following is the criteria for Section 312:

Section 312 of WRDA 90 authorized the Secretary of the Army to remove contaminated sediments from navigable waters of the U.S. There are two distinct authorities in Section 312.

Section 312(a) provided for removal of contaminated sediments outside the boundaries of and adjacent to a Federal navigation project as part of the operations and maintenance of the project.

Section 312 (b) provided for removal of contaminated sediments for the purpose of environmental enhancement and water quality improvement if such removal was requested by a non-Federal sponsor and the local sponsor agrees to pay 35 percent of the cost of such removal and remediation.

Joint Plan Requirement (Section 312 (c))- The Secretary may only remove and remediate contaminated sediment under subsection (b) in accordance with a joint plan developed by the Secretary and interested Federal, State and local government officials. Such plan must include an opportunity for public comment, description of the work to be undertaken, the method to be used for dredged material disposal, the roles and responsibilities of the Secretary and non-Federal sponsors, and identification of sources of funding.

Costs of disposal of contaminated sediments removed under Section 312 (b) shall be shared as a cost of construction.

Planning for projects to remove and remediate contaminated sediments will be conducted under two phases - reconnaissance and cost shared feasibility study process. Preparation of a feasibility report will meet fully the Section 312 (c) requirement for development of a joint plan. Planning for removal and remediation of contaminated sediments should use fully existing sources of information to expedite the study process, provide reasonable protection for the Corps from liability, and address requirements to ensure compliance with CERCLA's "polluters pays" principle.

Creative solutions and financial partnerships involving all levels of government should be sought in developing plans for removal and remediation of contaminated sediments. Duplication of Federal programs should be avoided and plans for sediment removal and remediation should recognize appropriate Federal, State and Local agency roles. An interagency planning team should be formed to conduct the planning study.

Michael R. Tuttle
Project Manager
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751
Tel: 978-318-8677
Fax: 978-318-8080

FYI FROM M-T-

BOSTON SUNDAY GLOBE

FEBRUARY 2, 2003

Army engineers agree to study Malden River

By John Laidler
GLOBE CORRESPONDENT

It has been known through much of its modern history as a grimy industrial waterway, a reputation gained from the years that factories used it to transport their goods and dump their wastes.

But officials in Everett, Malden, and Medford are developing a new vision of the Malden River as a recreational resource for local residents.

Now, a new study could enable the three cities to take a step toward that goal.

The study, which is being carried out by the US Army Corps of Engineers in partnership with the Mystic Valley Development Commission, will investigate options for cleaning up the river, in particular how to address the pollutants embedded in the river sediments. It also will explore options for restoring wetlands that have been degraded or lost over the years.

The study will encompass an approximately 2-mile stretch of the Malden River from Malden Square to the river's confluence with the Mystic River. It also takes in the Amelia Earhart Dam, a facility run by the Metropolitan District Commission located on the Mystic River.

The commission is the entity established by Everett, Malden, and Medford to oversee development of TeleCom City, the telecommunications park the three cities hope to locate on 200 acres of land on both sides of the Malden River.

As part of its development of TeleCom City, the cities intend to develop a linear park along both sides of the river.

And in a development local officials have hailed as a sign of the river's untapped potential, the Tufts University rowing team has been using the river since the fall of 2001 for practices and regattas.

But the commission recognized that for the river to be truly transformed into a recreational resource, the public needs to be assured that it is safe, said Ginny Lombardo, an environmental engineer with the US Environmental Protection Agency who is in the midst of a three-year assignment to work with the Mystic Valley Development Commission.

She said the study will go a long way toward determining what type of cleanup is needed.

"For the Mystic Valley Development Commission to get a commitment from the Army Corps to look at this 2-mile stretch of urban river was just a really great accomplishment for the MVDC," she said.

"A lot of people don't even realize the Malden River exists because of the past heavy industrialization on both sides of the river," Lombardo said.

The Army Corps and the commission are each picking up half of the estimated $356,000 cost of the project under an agreement they reached last October and formally announced Jan. 15. The program through which the corps is undertaking the study requires a local partner.

Drawing from its own budget and other public and private funding sources, the commission has raised about $60,000 toward its share, close to the $80,000 it needs to generate the first year.

Lombardo said past studies done by the commission and others indicate the river's water is relatively uncontaminated. But she said its quality is poor because of its stagnant condition, which has resulted in low oxygen levels. One way to address that problem may be to adjust the dam to create more water movement.

The significant contamination problem is in the sediments, where the industrial pollutants, discharged over time, have settled, Lombardo said. Options for addressing those contaminants range from dredging the sediment and disposing of it off site, to capping it with clean fill. In the case of contaminated sediments that have been naturally covered by cleaner sediments since the dumping of industrial wastes ended in the mid-1900s, the strategy may be to not disturb them, she said.

Malden River's rejuvenation a big plus from TeleCom City

FYI

Environmental, recreational impact of the TeleCom City project is immense, officials report

MALDEN EVENING NEWS
MALDEN, MA
DAILY 13,710
FRIDAY
DEC 27 2002

New England Newsclip Agency, Inc.

This is the third, and final, in a series of stories that is focusing on the initial construction of TeleCom City, the telecommunications industry and what positive impact the project is having on the environment around the Malden River.

By KEVIN MACCIOLI

US Army

MALDEN- The Malden River.

Malden Redevelopment Authority (MRA) Executive Director Steven Wishoski called it, "Malden's forgotten jewel."

While that certainly is an apt description for the waterway that serves as a tributary for the more well-known Mystic River, and runs parallel to the Commercial Street- Corporation Way corridor, the river, and its banks, may soon become one of the premier resources for residents of the tri-city area.

Virtually abandoned for a number of years, outside of the occasional fisherman, a number of initiatives tied to the TeleCom City project, and a few that are not, could once again reintroduce the river into residents lives via the Malden River Park.

Once a major transportation highway, used for moving goods from mills and companies along the river banks to Boston, the Malden River has recently sat pretty much dormant.

Now, the Mystic Valley Development Commission (MVDC) hopes to bring the river and its shores back to life with the completion of TeleCom City and the waterway's revitalization as a lively spot for people to spend time picnicking, fishing, swimming and playing.

While on the business side, the key component of the TeleCom

TELECOM CITY, Page 8

TeleCom City

Continued from Page One

City project is the development of an unparalleled telecommunications research park, on the environmental side, the key components are the remediation of the Malden River and the addition of over 60 acres of open space, to an area that desperately lacks adequate park space.

Included in the open space will be an all purpose athletic field, to be built during Phase I of the construction, nature areas, bicycle and walking trails, as well as space for people to picnic.

"First the river was used as a highway, then as a dumping ground," said Wishoski. "This project takes the exact opposite approach, in that we want people to use it for recreation."

As part of the TeleCom City project, the MVDC has taken several steps to clean up the land and the river.

While the MVDC recently learned the US Army Corps of Engineers would do a $350,000 study of the river and its sediments, the crowning environmental achievement of the project came back in 2000.

It was then, that TeleCom City was designated a National Brownfields "Showcase Community" by the federal government.

"It's quite an accomplishment," said TeleCom City project director Peter Hollands.

As one of just 12 communities throughout the nation to be given the designation, it gave the MVDC, and TeleCom City, access to resources from 17 federal agencies to assist in the cleanup and revitalization of the site and led to the Army Corps of Engineers study, which Hollands says he hopes will "help bring back the river's recreational and wildlife uses."

"We've already learned the river is cleaner than we thought it was," said Hollands, "and right now we already have some activity out there, with the Tufts University crew teams."

Bringing Tufts to the river is just one step the MVDC and the cities of Malden, Medford and Everett, and Combined Properties, the real estate company whose land Tufts is currently using to house their equipment, have taken to reintroduce the entire river and TeleCom site to local residents.

Deborah Burke, the Marketing Director for the City of Malden, who has worked extremely closely with the MVDC, pointed out when Malden recently held its 350th Anniversary celebration, the river was used as the backdrop for a concert and fireworks show.

"We think we can have more things like that at TeleCom [City]," said Burke.

"We hope it becomes a part of the community again," said Hollands. "It's a great resource."

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

October 8, 2002

Engineering/Planning Division
Planning Branch

Mayor Michael McGlynn, Chairperson
Mystic Valley Development Commission
300 Commercial Street, Suite 27
Malden, MA 02148

Dear Mayor McGlynn:

Enclosed for your signature are six (6) copies of the Feasibility Cost Sharing Agreement for the Malden River Restoration Study. Please sign and date each of the agreements and return them to the Corps Study Manager, Mr. Michael Tuttle at the above address. Once the District Engineer signs each of the agreements, we will forward three copies for your files.

The cost for this feasibility study is $356,600, which will be cost shared 50% Federal and 50% non-Federal. Your total cost share for this study is $178,300. Once the agreements are executed, we will send a second letter to the Commission requesting your share of the study funding for this fiscal year which is estimated to be $80,000.

We look forward to working with you on this study. If you have any questions or require additional information, please contact the Study Manager, Mr. Michael Tuttle, at (978) 318-8677.

Sincerely,

David L. Dulong
Chief of Engineering & Planning
New England District

Enclosures

FEASIBILITY SCOPE

SITE: MALDEN RIVER RIPARIAN CORRIDOR (Site 9)

CONTACTS: Mass EOEA – Kwabena Kyei-Aboagye, Jr.
617-626-1165

Mystic Valley Development Commission's (MVDC) TeleCom City – Ginny Lombardo
617-381-7711

Mystic River Watershed Association
781-316-3438

PROJECT DESCRIPTION:

MVDC is in the process of redeveloping a 200 acre parcel in Malden, Medford and Everett, referred to as the TeleCom City Project. The Malden River runs through the TeleCom City Project area. The creation of a Malden River Park is a component of the project. Malden River is considered an unhealthy river ecosystem. The river sediment are contaminated; the water quality is poor, lacking adequate dissolved oxygen to support aquatic life and the adjacent wetland are dominated by the invasive wetland species *Phragmites australis* (common reed). The Amelia Earhart Dam is considered a contributing factor to the poor quality of both the lower Mystic River and the Malden River.

FEASIBILITY STUDY SCOPE:

- **22 A – Public Involvement:** The purpose of public involvement efforts is to maintain citizen interest, solicit citizen and agency input, and to satisfy the requirements of the National Environmental Policy Act (NEPA). Coordination with Federal, State, local agencies and interest groups throughout the conduct of the feasibility study. Coordinate general public meetings and inter-agency workshop meetings. Provide advertising in local and public newspaper, coordinating with the media, and responding and commenting on inquiries from the general public and congressional interest. **($5,000)**

- **22 B – Institutional Studies:** The purpose of the assessment of non-Federal sponsor's financial capability is to determine whether that ample funds will be available to satisfy the non-federal sponsor's financial obligation for the project. Development of the financing plan to meet the non-Federal sponsor's financial obligations for the project funding and Operation, Maintenance, Replacement, Repair and Rehabilitation (OMRR&R). **($5,500)**

- **22 D – Cultural Resource Studies:** The purpose of the cultural resource studies is to comply with Section 106. Identify potentially significant prehistoric and historic archaeological sites, and historic structures. Efforts will entail determining existing conditions and impacts of alternative plans upon historic resources. Coordinate with various groups interested in the historic value of the study areas. **($3,000)**

- **22 E – Environmental Studies:** The purpose of the environmental studies is to satisfy the compliance requirements of the National Environmental Policy Act (NEPA), Sections 401 and 404 of the Clean Water Act, and other environmental laws and regulations, and provide environmental technical support during the plan formulation and later phases of the project. Preparation of a NEPA document to include documentation of the alternative solution, and the impacts, both positive and negative, of the alternatives on significant resources; assessment and prioritization for the development of environmental restoration solutions; document existing biological resources and physical environment, and provide a baseline for evaluation of potential improvements; and documentation of compliance with all applicable environmental laws and regulations.

Environmental studies will include: background research; site visits, and development of environmental setting; wetland delineation; determination of environmental impacts; preparation of an Environmental Assessment (EA), Findings of No Significant Impact (FONSI), and Section 404(b)(1) evaluation; Coastal Zone Management (CZA) consistency determination; water quality certification; and coordination with non-Federal sponsor to comply with other State regulations. **($65,900)**

- **22 G – Economic Studies:** The purpose of the analysis is to ensure that the economically efficient. Least cost alternative is identified for each possible level of environmental output, and to produce a comparison of the changes in costs associated with increasing levels of outputs. Perform cost effectiveness prior to the incremental analysis in order to eliminate measures that are economically inefficient and ineffective. Provide environmental outputs from the formulated alternatives in terms of acres of wetland, riverine migratory corridor, benthic habitat or shellfish beds restored. **($3,200)**

- **22 H – Real Estate Studies:** Develop a gross appraisal of the costs of lands required for economic evaluation and construction alternative plan including detailed determination of lands, easements, rights-of-way, relocations, and dredged material placement areas. **($4,000)**

- **22 J – Hydrologic and Hydraulic Investigations:** Collect and analyze water quality data and reports for the Malden River and surrounding tributaries to determine non-point source impacts; evaluate combined sewer overflow discharge plan for Malden River and determine impact on Malden River's water quality; evaluate sedimentation issues including time of sedimentation buildup after existing sedimentation are dredged; evaluate Amelia Earhart Dam operation to determine water quality impacts and to improve tidal flushing upstream of the dam; and prepare a report. **($53,300)**

- **22 K – Geotechnical Studies:** Studies will include coordination meetings to discuss alternatives, constructability issues, material analysis, prepare preliminary profiles and cross sections for the design of CAD cell, and analysis of the contaminated material to be removed (dredged). Tasks will include subsurface exploration, the analysis of subsurface conditions, and geotechnical input to the report. **($78,100)**

- **22 N – Surveys and Mapping:** Conduct hydrographic and topographic surveys of the sites of potential restoration projects and/or features, including wetland delineation limits. **($15,000)**

- **22 P -Design and Cost Estimates:** Coordination with various technical elements to establish survey requirements; preparation of survey scope of work; negotiation and oversight of the survey contract; coordination on the design of alternative restoration measures; evaluation of site access and constructability issues; preparation of project plans to include a general site plan, miscellaneous site plans, and sections and details; develop quantity estimates for cost estimating; and preparation of a design report.

  Cost estimating efforts will include abbreviated cost estimates for alternative plans; detailed MCACES cost estimates for the recommended plan; estimates of average annual operations, maintenance, and replacement costs; and estimates for preparation of Plans and Specifications. Contingencies will be developed and applied where areas of uncertainty exists. **($31,000)**

- **22 Q – Study Management and Report Preparation:** Perform activities related to the management of the study including: preparing schedules, distributing and monitoring study funding, leadership in plan formulation, assisting various team members in developing and/or securing information pertinent to the successful conduct of the study, coordinating with all higher Corps authorities and other Federal agencies, developing and preparing the feasibility report, preparing and tracking budgets, monitoring study progress, developing the draft Project Cooperation Agreement, and acting as the primary liaison between the non-federal sponsor and the study team. **($39,600)**

- **22 R – Plan Formulation and Evaluation:** Coordinate and document the formulation and evaluation of alternatives by the Corps and the non-Federal sponsor. The formulation process will have six iterative steps: (1) specify the problems, needs, and opportunities of the study area, (2) inventory and forecast resources, (3) formulate alternative plans, (4) evaluate alternative plans, (5) compare alternative plans, and (6) select a recommended plan. Each alternative plan analyzed will be compared to its respective without project condition; the effects of the with and without condition characterized; and a determination of the plans' completeness, effectiveness, efficiency and acceptability will also be conducted. **($10,000)**

- **22 T – Life Cycle Project Management:** Review and prepare the model language of the Project Cooperation Agreement (PCA) for the project. A letter of intent will be developed which acknowledges the requirements of the local cooperation and expresses good faith intent. Prepare a Project Management Plan (PMP) which is intended to be a "living document" and will be updated based on the proposed projects. **($5,000)**

- **22 U – Washington Level Review:** Ensures that the non-Federal sponsor is afforded an opportunity to participate in any significant effort as a result of Washington level review, "review Support" for the District and the non-Federal sponsor costs are included. **($13,200)**

- **22 Y – Independent Technical Review:** An Independent Technical Review (ITR) team will be established that represents all technical elements providing significant input to the Feasibility Study, as required by Corps policy. The ITR team has the credentials and experience necessary to provide a comprehensive review particularly as it relates to plan formulation, environmental, economic, engineering, and public involvement matters. **($13,200)**

Feasibility Study Cost Estimate Table

Task	Task Cost	In-Kind Services	Total Cost
22A – Public Involvement	$ 5,000		
22B – Institutional Studies	$ 5,500		
22D – Cultural Resource Studies	$ 3,000		
22E – Environmental Studies	$65,900		
22G – Economic Studies	$ 3,200		
22H – Real Estate Studies	$ 4,000		
22J – Hydrologic & Hydraulic Investigations	$53,300		
22K – Geotechnical Studies	$78,100		
22N – Surveys & Mapping	$15,000		
22P – Design & Cost Estimates	$31,000		
22Q – Study Management & Report Preparation	$39,600		
22R – Plan Formulation & Evaluation	$10,000		
22T – Life Cycle Project Management	$ 5,000		
22U – Washington Level Review	$13,200		
22Y – Independent Technical Review	$13,200		
Subtotal	$345,000		
Contingencies (5% of Subtotal Cost)	$17,250		
Total Study Cost	**$362,250**		

Amelia Earhart Dam Study Meeting

MDC Building, 20 Somerset St. 7th Floor, Boston

Thursday, May 9th, 2002

10:30 AM – 12:00 Noon

Proposed Draft Agenda:

1. Introduction by Samantha Overton, MDC
2. Earhart Dam project presentation by Christopher Hatfield, USACOE
3. IWRC Comments by Kwabena Kyei-Aboagye/Karl Pastore
4. Issues and Concerns by the MDC
5. Discussion

~~#1~~

#2 Amelia Earhart Dam

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Project # 4 STUDY OF THE AMELIA EARHART DAM

The Mystic Valley Development Commission (MVDC) is a public body politic and corporate made up of members from the 3 participating cities: Malden, Medford and Everett. MVDC is in the process of redeveloping a 200-acre parcel in Malden, Medford and Everett, referred to as the Telecom City Project. The Malden River runs through the middle of the Telecom City project area. A vital component of the TeleCom City project is the creation of the Malden Park along the banks of the river, which will be opened for public use and enjoyment, and the restoration of the Malden River. In conjunction with the Telecom City project, there has been extensive study of the Malden River. Study has shown that the Malden River is currently an unhealthy river ecosystem. The river sediments are contaminated; the water quality is poor and lacks the necessary dissolved oxygen to support abundant and diverse aquatic life; the wetlands along the riverbanks are dominated by the invasive wetlands species Phragmites australis, which has limited value to wildlife and effectively crowds out other species; and, also, the abundance and diversity of wildlife is limited. There are many factors contributing to the current degraded condition of the Malden River, most noteworthy being the historical industrial activities that led to the contamination of the river.

The Mystic River Watershed Association (MRWA) is a community-based, private nonprofit organization established to protect the Mystic River watershed. In conjunction with the mission of the MRWA, there has been extensive study of the Mystic River watershed. Study has shown that the lower Mystic River is also currently an unhealthy river ecosystem.

One of the main factors contributing to the poor quality of both the Lower Mystic River and the Malden River is the Amelia Earhart Dam, which was constructed in the 1960's, and which is operated by the Metropolitan District Commission (MDC). The dam is immediately downstream of the confluence of the Malden and Mystic Rivers and was installed for flood control. The dam ended the daily tidal flushing of the rivers, and, as a result, the rivers have essentially become a lake or stagnant. The water column is now stratified with low dissolved oxygen that inhibits a diverse river ecosystem.

Deliverables: This project would involve studying the operations of the dam and how the operations affect the rivers. The purpose of this study would be to determine whether the dam could be modeled as a way of identifying different operating procedures that could result in a positive effect on the rivers. The study would consist of the following tasks:

- Review current operational procedures and the basis for these procedures;
- Review any existing studies of the effects of the dam on the rivers;
- Identify limiting factors to operational changes (i.e., mechanical limitations of existing system, flood control restrictions, marina needs);
- Identify data necessary to model the dam, review existing data, and identify data gaps;
- Determine if reintroducing tidal flow to the rivers would be viable and if positive effects would result, including references to other similar systems where tidal flows were reintroduced;
- Evaluate environmental and economic pros and cons of changing the operations of the dam;
- Recommend whether it would be worthwhile to fund a study to model the dam in order to define operational changes to positively influence the rivers.

Duration: 2003-2004

Estimated Cost: $10,000

Environmental Agency: Metropolitan District Commission, EOEA-MWI

Potential Partners: Army Corps of Engineers, EPA, City of Malden, City of Medford, City of Everett, Tufts, Malden River Park Task Force

Project 4 Amelia Earhart Dam Study MDC must be willing to develop scope and manage project. BH Watershed staff will go back and discuss with MDC/IWRC rep. to become more involved in scope development and project implementation and be co-lead with USACE. (There is still an issue as to whether MDC will accept lead. If MDC does not accept lead, project is dropped. ed.) **CIF**

United States
Environmental
Protection Agency
Washington, D.C. 20460

Solid Waste
and Emergency
Response (5101)

EPA 500-F-98-136
May 1998

EPA Brownfields Assessment Demonstration Pilot

Malden, Medford, Everett, MA

Outreach and Special Projects Staff (5101) Quick Reference Fact Sheet

EPA's Brownfields Economic Redevelopment Initiative is designed to empower states, communities, and other stakeholders in economic redevelopment to work together in a timely manner to prevent, assess, safely clean up, and sustainably reuse brownfields. A brownfield is a site, or portion thereof, that has actual or perceived contamination and an active potential for redevelopment or reuse. Since 1995, EPA has funded more than 150 Brownfields Assessment Demonstration Pilots, at up to $200,000 each, to support creative two-year explorations and demonstrations of brownfields solutions. The Pilots are intended to provide EPA, states, tribes, municipalities, and communities with useful information and strategies as they continue to seek new methods to promote a unified approach to site assessment, environmental cleanup, and redevelopment.

PILOT SNAPSHOT

Date of Announcement: May 1998

Amount: $200,000

Profile: The Pilot targets 200 acres of blighted industrial land for redevelopment into a state-of-the-art telecommunications research and development park.

BACKGROUND

EPA has selected the Cities of Malden, Medford, and Everett as a Brownfields Pilot. The three communities are located in an urbanized area five miles north of Boston. The area's manufacturing and industrial activities historically centered around the Malden River and abutting railroads. In recent years, manufacturing has declined in Malden by 13%, Everett by 61%, and Medford by 79%. Each community has a lower per capita income than the state average, and the average poverty rate in the project area is 9.1%.

The three cities have joined together on a project to construct a state-of-the-art telecommunications research and development park, called TeleCom City. The 200-acre area consists of blighted industrial land that once supported power generation and chemical production facilities. The stagnant area is at the fringe of each community, with no public access to the river. Perceived and real contamination hinders economic redevelopment of the area. More than 70% of the site is vacant or used for parking or open storage. The TeleCom City project is overseen by the Mystic Valley Development Commission (MVDC), a tri-city legislative body established by the Commonwealth of Massachusetts and approved by the three cities. Funding support of over $1 million has been granted by Massachusetts, with an additional $30 million committed to this project by the state.

OBJECTIVES

Pilot funds will be used to help prepare the project area for cleanup and redevelopment activities by developing a comprehensive environmental database that will make overall assessment less costly than a parcel-by-parcel approach. The overall objective of the TeleCom City project is to convert 200 acres of underused, blighted industrial land into a telecommunications center that will advance the local and regional economies. To overcome fragmented ownership and liability constraints, the MVDC will obtain ownership control over the project area and establish a consistent set of zoning controls, which will allow for comprehensive environmental testing of the area without the constraints of parcel boundaries. In addition, significant public recreational activities and green space will be provided for the three communities and the general public through reclamation of the environmentally distressed Malden River area.

ACCOMPLISHMENTS AND ACTIVITIES

Activities planned as part of this Pilot include:

- Updating the existing environmental database in Malden;
- Assessing the Malden River Riparian Corridor in Medford and Everett;
- Preparing initial site assessments in Medford and Everett;
- Assessing the abandoned General Electric and Duncan Galvanizing portions of the project area sites; and
- Assessing the road reconstruction area along the western border of the proposed TeleCom City.

The cooperative agreement for this Pilot has not yet been negotiated; therefore, activities described in this fact sheet are subject to change.

CONTACTS

Mystic Valley Development Commission
(617) 381-7711

Regional Brownfields Team
U.S. EPA - Region 1
(617) 573-9681

Visit the EPA Region 1 Brownfields web site at:
http://www.epa.gov/region01/remed/brnfld/

For further information, including specific Pilot contacts, additional Pilot information, brownfields news and events, and publications and links, visit the EPA Brownfields web site at:
http://www.epa.gov/brownfields/

Brownfields Assessment Demonstration Pilot *Malden, Medford, Everett, MA*
May 1998 *EPA 500-F-98-136*

PILOT PROPOSAL NOMINATION

2. Pilot Poroposal Information

a. Project Title Lower Mystic River Watershed (Massachusetts)

b. Location: Target area for proposed project is the lower sub-basin of the Mystic River and its tributaries including the Malden River, Island End River, Little Mystic River, Mill Creek and Chelsea Creek. This section of the watershed includes the communities of East Boston, Malden, Somerville, Medford, Chelsea, Everett, Revere, and Charlestown (Suffolk County, MA).

c. Federal/State Designations: The Lower Mystic River and its tributaries are located within an EPA designated National Estuary Program (NEP), the Massachusetts Bays Program. There are three Massachusetts Designated Port Areas (DPA) located in the project area: Mystic River, Chelsea Creek, and East Boston DPAs. The water bodies are on the 303d list, and there are many sites along the Aberjona River that are on the National Priorities List. Belle Isle Marsh is a designated Area of Critical Environmental Concern (ACEC). The Malden River is in the Mystic Valley Development Commission's (MVDC) Brownfields redevelopment project which is a National Brownfields Showcase Community.

d. Pilot Study Area Population: The Mystic River watershed is located in eastern Massachusetts and covers a 76 square mile area that is home to over 400,000 people in 21 cities. The lower sub-basin of the Mystic River and its tributaries is home to over 153,000 people

e. Project Contact:

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f. Authorization and Funding

The Corps and the Mystic Valley Development Commission (MVDC) have just initiated a congressionally authorized feasibility study of ecosystem restoration opportunities along the Malden River. The study is cost shared equally between the Corps and the MVDC. The study is a spin-off effort of the congressional authorization to conduct a larger investigation of ecosystem restoration opportunities in the Massachusetts and Cape Cod Bay estuaries.

The area receives annual resources as part of the Massachusetts Watershed Initiative (MWI) through the EOEA. MWI focuses resources and staff time to projects that improve water quality, wildlife habitat, protect public health, decrease erosion, restore and protect sediment and soil quality and promote safe use of natural resources.

EOEA has partnered with USGS to initiate a study and mapping project for sediment in the upper Mystic River. There are many active EPA grants including: EMPACT grant to the City of Somerville to do real-time water quality monitoring; and a grant to Tufts University to do a Nutrient Loading Study in the upper and lower basins. Over the past five years, the area has received an additional $280,000 in grants from EPA New England and leveraged additional resources through various sources. The MVDC has also been awarded Brownfields Assessment Pilot funding and utilized this funding for extensive water quality and sediment quality analysis in the Malden River.

3. Criteria

a. <u>Collaboration</u>

The vision of this Pilot Project to remediate and restore contamination and to provide habitat restoration in the Lower Mystic River watershed is a collaboration of EPA New England, the Army Corps of Engineers and the Executive Office of Environmental Affairs' (EOEA) Massachusetts Watershed Initiative. This joint proposal also has the enthusiastic support of the Mystic Valley Development Commission, Massachusetts Coastal Zone Management, the Urban Ecology Institute, City of Chelsea, Tufts University, and the Mystic River Watershed Association.

The Massachusetts EOEA launched the Massachusetts Watershed Initiative (MWI) in December 1993 as a focal point of environmental, business, municipal and government interests. The MWI integrates state environmental programs activities with the federal and local governments, non-governmental organizations, business and other watershed partner projects. The Mystic Watershed Team (brochure enclosed) is a multi-disciplinary group of partners that work together to provide comprehensive watershed protection and is ideally suited to spearhead the EPA/ACOE Pilot Project in the Lower Mystic.

The Mystic Valley Development Commission (MVDC) is a collaboration with Medford, Malden and Everett and is working to redevelopment a 207-acre Brownfields site which includes a large portion of the Malden River. As a result of Showcase Community designation, the MVDC works with the Corps, as one of the federal agency Brownfields partners, on an effort to restore the Malden River. Through this collaboration, the Malden River has been listed in the Coastal Massachusetts Ecosystem Restoration Reconnaissance Report (June 2001). Since the completion of the report, the MVDC has worked with the Corps to initiate an ecosystem restoration feasibility study for the Malden River. That study was initiated in November 2002.

The Mystic River Watershed Association (MyRWA) is a community-based private nonprofit organization formed in the 1970s to protect and improve the quality of the Mystic River and the other water resources in its watershed. Tufts University was founded in 1852, dedicated to productive community partnerships that combine university resources with local needs. The Urban Ecology Institute (UEI) is located at Boston College and runs two model programs: the Urban Ecology Field Studies Program and the Natural Cities program. Both programs engage youth, residents and experts to assess, evaluate, and enhance the health of the Lower Mystic watershed, including forest and riparian corridors.

b. <u>Public Health and Environmental Impacts</u>

The Lower Mystic watershed (drained by Chelsea Creek, Mill Creek, and Malden River) is the most polluted tributary feeding into the Boston Harbor. Chelsea Creek is ranked by EPA as the second most polluted water body in the state. The project areas targeted in this proposal address the most significant environment and public health impacts in the Lower Mystic watershed. Development started in the 1600s and the Lower Mystic now includes many industrial facilities that release hazardous chemicals to soils, groundwater, and surface waters. The Mystic River, Chelsea Creek and neighborhoods of East Boston and Chelsea are part of a Designated Port Area (DPA), which must be preserved for industrial, water-dependant uses. In June 2000, Chelsea Creek was the site of a 58,000-gallon oil spill, the largest in Boston Harbor's history.

East Boston and Chelsea have 398 state-designated hazardous waste sites; five major oil tank farms; the largest rock salt pile in the Northeast, a tannery; airport-related parking; more than 90 freight forwarding companies; and air and noise pollution from the Tobin Bridge, Logan Airport, Route 1A, and heavy truck and residential traffic. Two National Priority List (NPL) Superfund Sites are located on the Aberjona River that are upstream of the Lower Mystic River Watershed (Wells G&H and Industri-Plex). Should the need for remedial action be identified, the CERCLA cleanup would eliminate these Sites as sources of ongoing contamination to the river or larger watershed.

There are also several hundred state-identified hazardous waste disposal sites, and numerous vacant industrial properties in the Lower Mystic watershed. Pollution from industry in the lower watershed threatens air quality, water quality, sediment quality, and recreation.

The area also contains Combined Sewer Overflows (CSOs), that degrade water quality by discharging untreated sewage into the Mystic River during storm events. The large amount of organic matter and stratification in the rivers creates low dissolved oxygen levels, high turbidity, and high quantities of pathogenic bacteria. Elevated concentrations of pollutants in river sediment affects benthic organisms, water quality, estuarine life, and human recreational use. The water quality in local urban rivers is poor and lacks the necessary dissolved oxygen to support abundant and diverse aquatic life; the wetlands along the riverbanks are suffering from the invasive wetlands species *Phragmites australis*, which has limited value to wildlife and effectively crowds out other species; and the abundance and diversity of wildlife is limited.

Recent studies have further verified the extent of environmental impacts in the watershed and on public health. A study conducted by EPA New England estimates that more than one million gallons of oil (emergency spills and releases) contaminates the groundwater flowing out to Chelsea Creek. A June 2000 report names Chelsea and East Boston as respectively the third and fifth "most environmentally overburdened cities in Massachusetts". Results from a community-based comparative risk assessment verified that local residents have high rates of asthma, elevated blood lead levels, respiratory and/or cardiopulmonary disease, cancer, and other diseases. Local residents are also deprived of the environmental and public health benefits from open and green space and have either poor or no access to local parks and the natural environment.

For decades, much of the Lower Mystic basin was virtually inaccessible to the public. As such, the contamination and potential risks associated with the river were ignored. However, contamination must be addressed, and can no longer be ignored, because the projects proposed herein and other planned projects in the watershed will bring the public to the waterfront and afford them access which had historically been denied. The potential risks associated with public access and potential direct contact exposures must be analyzed and addressed. The projects proposed will help address these environmental problems and help reverse a trend of environmental injustices that residents have borne.

c. <u>Community Needs</u>

The communities in the Lower Mystic watershed include Chelsea, East Boston, Revere, Charlestown, Malden, Everett, Somerville and Medford. All of these communities are identified as potential EPA Environmental Justice communities that are disproportionally affected by environmental impacts. The target communities that will be served by this proposal are densely developed. Chelsea is 1.8 square miles with a population of approximately 37,000. Neighborhood population density is 2-3 times the statewide average.

Lower Mystic communities have a disproportionately low percentage of open and green space compared to other Massachusetts communities and have little to no safe, public access to the waterfront. The Lower Mystic communities are organized and working to solve these problems. There are only two public access points on Chelsea Creek - a broken bench behind a gas station and a tiny cement walkway behind an airport parking lot. The Lower Mystic River and Chelsea Creek also serve as the focal point in Boston Harbor for extensive commerce and national security interests. Safe, reliable and efficient waterborne transportation is essential to the area's economic vitality. The community has openly expressed their desire to pursue options regarding sustainable reuse of the Chelsea Creek DPA. Local businesses continue to use Chelsea Creek area as dumping grounds.

Based on input from Lower Mystic communities, the pilot proposal has identified the following community needs:

- Continue stream flow assessment and resolve flood control issues in the Mystic River watershed.
- Evaluate current land-use and opportunities for smart redevelopment within the lower watershed.
- Restore sensitive habitat areas by managing dams, remediate contaminated sediments, restore wetlands, and control invasive species of aquatic plants.
- Protect public health and promote safe, public access to urban rivers.
- Improve water quality by reducing CSOs, fecal coliform and nutrient levels.

d. **Redevelopment/Future Uses**

The projects highlighted under this proposal in the Mystic River and its lower tributaries build upon current community-based comprehensive planning and site restoration efforts. The MVDC is pursuing the redevelopment of a 207-acre Brownfields site along the Malden River in the Cities of Malden, Medford and Everett. This master-planned development, TeleCom City, is being pursued as a public-private partnership that will include over 1.4M square feet of office, research & development and manufacturing space and approximately 60 acres of public open space, the Malden River park. The Malden River Park will include a river-side trail, river overlooks and a canoe launch. The restoration and remediation of the Malden River are critical to the success of the overall project and to the protection of public health. This river has had a significant history of industrial use by a long line of public and private entities. This fact, combined with current non-point source conditions creates an impossible structure for pursuing private entities for cleanup. The planned feasibility study and this pilot proposal, will help restore and revitalize the Malden River and allow it to be restored for the use and enjoyment of the communities.

The Chelsea Creek Action Group and Chelsea Green Space Alliance have spent the last several years creating a community vision for the future of the Chelsea Creek, including tributaries such as the Mill Creek. This process engaged hundreds of residents and created redevelopment plans for targeted parcels for the transformation of industrial and abandoned properties into community resources including parks, open/green space, mixed-use development, affordable housing, and other needs. This project will also service a community that is less able to draw on other sources of funding, due to lack of formal federal designations prior to this Pilot Project and no targeted Congressional appropriations for environmental remediation and subsequent redevelopment of the area.

The City of Everett is in the process of conducting a waterfront assessment that will assist with their decision-making process regarding the reuse/redevelopment of their waterfront. The collection of water quality data from the Mystic River will assist the community in preparing a waterfront pan that will appropriately reserve or develop waterfront areas for public use and enjoyment. In addition, the water column sampling and analysis will provide the City with useful information regarding possible point sources and non-point sources of contamination from their waterfront industrial areas.

e. **Economic Revitalization**

See discussion above regarding future reuse of the surrounding property.

f. **Anticipated Measures of Success**

With the appropriate dedication of resources and the EPA/ACOE Pilot Project designation, this work in the Lower Mystic will achieve a variety of measurable environmental and economic results. Projects in the Lower Mystic River watershed will result in increased data and information on water and sediment quality, increases in open/green space for residents in some communities, increased public access to the waterfront, reduced risks from contaminated sediments, partial restoration of water quality and riparian zones, the revitalization of contaminated properties, and the maintenance of this navigable port resource.

For example, the Mill Creek Restoration Project is a collaborative, community-based effort to restore biological value to badly degraded estuarine wetlands in metropolitan Boston. Tracking the number of acres of wetlands, riparian zones, and open/green space that are preserved or created and assessing the presence of wildlife (andronomous fish, birds) is planned.

As another example, the sediment remediation study will produce the maps, volume estimates, and characterization necessary for the remediation of contaminated sediments, the most intractable environmental problem in this watershed. This study will help assess sediment quality, create high-precision bathymetry maps of the Lower Mystic, and serve as a baseline for measuring current conditions and serve as a foundation for measuring progress on future sediment restoration projects.

This pilot will compliment existing projects and will provide the following critical data for the Lower Mystic:

- Baseline information on contaminated sediment concentrations and volumes
- Sediment assessment in light of toxicity guidelines, and national USGS NAQWA data sets for urban rivers.

- Assessment of differences between historically dredged and non-dredged areas.
- Spatial variability in concentrations.
- Temporal variability (to help assess the effects of 150 years of industrial activity, and the effectiveness of 30 years of environmental controls on the quality of the Mystic River bottom sediment).
- Biota measurements.

The MVDC utilized funding from its Brownfields Assessment Pilot to assess the water and sediment quality of the Malden River. The surface water and sediment sampling program performed will serve as the baseline and framework for the Malden River Ecosystem Restoration Feasibility Study. The sampling program demonstrated the presence of elevated levels of contaminants, PAHs, petroleum hydrocarbons and heavy metal compounds. The water column is stratified with low dissolved oxygen concentrations, and next steps are being identified.

ENVIRONMENTAL LAW
MYSTIC RIVER WATERSHED ASSOCIATION PROJECT
PROJECT # 1, CSOs AND THE VARIANCE

Team Members:
Marilyn McCrory
Keren Prize

December 4, 2002

Our team studied issues surrounding combined sewer overflows in the Mystic River watershed. One goal of the Mystic River Watershed Association (MyRWA) is to achieve a level of water quality in the Mystic River watershed that will allow the waters to be classified as "fishable and swimmable" by 2010. However, water quality is severely compromised by combined sewer overflows (CSOs).

Control of CSOs has been described as "sticky" and "complicated" by nearly everyone our team talked to, from local residents to state and federal regulators. The complications mainly come from balancing the costs and benefits of eliminating CSOs. The only way to eliminate CSO discharges is to separate the combined sewers so that all sanitary discharges go to the wastewater treatment plant and only stormwater discharges are released through the pipe. Unfortunately, sewer separation is very costly. The laws and regulations allow cost and affordability to be considered in determining the best approach to achieving water quality standards. Massachusetts regulators have built "flexibility" into the regulations, allowing CSO permit holders to not eliminate CSOs if it can be proven that doing so would cause "widespread social and economic harm." The vagueness of these terms is one reason that this issue is "sticky" and "complicated."

This memo describes CSOs and explains why they are a problem; reviews federal and state laws and regulations relevant to CSO control; and reviews the history of CSO control in the Mystic River watershed. It concludes with our team's recommendations on actions MyRWA can consider to meet its goals related to CSO control and water quality. This memo is organized as follows:

1. Combined Sewer Overflows: What They Are and Why They Are a Problem

2. MyRWA's Goals Related to CSOs in the Mystic River Watershed

3. Relevant Laws and Regulations

4. History of CSO Control in the Mystic River Watershed

5. Current Status of CSO Cleanup in the Mystic River Watershed

6 Key Issues and the Final Decision Process

7. Recommendations

1. COMBINED SEWER OVERFLOWS: WHAT THEY ARE AND WHY THEY ARE A PROBLEM

A combined sewer is an antiquated type of sewer that is designed to carry both sanitary sewage and stormwater runoff. Under usual conditions, when the sewer is able to contain all of the sewage and runoff, it is all taken to a wastewater treatment plant (WWTP) and safely discharged after receiving treatment. When rainfall and/or melting snow is heavy enough to exceed the carrying capacity of the sewer system, both the precipitation and the sewage are discharged to a receiving body of water rather than to the WWTP.

The term CSO stands for combined sewer overflow and refers to both the combined sewer overflow structure and the discharge from the structure. CSOs are meant to be used in emergency situations, and they are helpful in preventing sewage from backing up into homes and onto the street. However, increased amounts of sewage in water bodies may cause severe contamination, and preventive measures must be taken as the growing population imposes additional strains on the system.

1.1 Why are CSOs a problem?

From a recreational perspective, sewage makes swimming and fishing in the Mystic Watershed dangerous as well as unpleasant. Sewage overflow results in wastewater floatables such as condoms, toilet paper, and tampons floating in the waterways.

Obvious harms result from sewage pollution in waterways. Untreated human sewage is associated with bacteria, viruses, and excess nutrients. Nutrients, such as nitrogen and phosphorus, nourish algae, making their populations skyrocket and creating algal blooms in the receiving water. After the mass amount of algae die, an enormous amount of dissolved oxygen (DO) is used in their decay. Decomposing organisms consume much of the existing oxygen as well breaking down the sewage. This oxygen is therefore not available to fish and other animals, which may die if they do not have a certain amount of DO. This process of nutrient richness is called eutrophication, and it causes the water to have a pea-soup green color and bad odor in addition to killing off the wildlife. The limit for dissolved oxygen concentrations for most cold-water fish is 6 mg/L. The Alewife/Mystic River Advocates reported that DO fell below 5.0 mg/L in 9 of the 49 samples collected. The Massachusetts Water Resources Authority, USGS, and MyWRA measured DO levels as low as 2 mg/L.

Through extensive sampling, the Mystic Monitoring Network[i] observed the results shown in **Table 1**. Untreated sewage accounts for many sites exceeding maximum standards for fecal coliform, total suspended solids, nutrients, and DO, as reflected in Table 1. All of these are important indicators that sewage contamination is particularly bad in a certain area.

Fecal coliform is a fetid bacteria that is found in excrement and can also be used as an indicator of the incidence of disease-causing organisms. Coliform violates criteria by the highest percentage in the Somerville/Arlington location; Somerville is the only town on the table that is known to own CSOs, and Arlington is suspected to have them. This is no coincidence. The large loading of bacteria is especially bad in wide areas where the water slows down. As the particulate matter settles, the sediments are contaminated with fecal bacteria that can stay suspended for weeks up to months.

Total suspended solids (TSS) make water dirty and cloudy with a combination of silts and organic waste particles that are smaller than grains of sand. TSS amounts are reduced by over 85% when sewage water is treated.

Table 1. Percent of All Samples Deviating from Established Criteria by Site

Site	Site Description	Town	Fecal Coliform	TSS	Nitrate	Total Phos.	DO mg/L	DO %
ABR049	Aberjona @ Salem St.	Woburn	55	0	83	11	26	47
ABR028	Aberjona @ Washington St.	Winchester	45	0	100	0	0	5
ABR006	Aberjona @ USGS station	Winchester	40	0	100	58	0	21
UPL001	Upper Mystic Lake @ Mystic Lakes Dam	Medford	0	0	0	47	0	0
MIB001	Mill Brook @ Mt. Pleasant Cemetery	Arlington	75	10	50	84	0	10
MYR071	Mystic River @High St. Bridge	Arlington	10	0	0	0	0	0
WIB001	Winn Brook, outlet to Little Pond	Belmont	65	0	33	88	0	0
ALB006	Alewife Brook @ Broadway	Arlington/ Somerville	85	10	0	63	25	47
MEB001	Meetinghouse Brook, outlet into Mystic River	Medford	45	10	100	11	0	0
MAR036	Malden River @ Medford St.	Malden	42	5	0	24	0	21

The main obstacle to dealing with CSOs is that they are very expensive to fix and there is little state or federal funding. In addition, agencies that have some authority are not uniformly responsive to public concerns about environmental quality. In general, the MWRA is responsible for regional sewer system and long-term CSO control planning. The cities are accountable for taking care of illegal sewage discharges in their municipalities.

Finally, there is very little exact data on the amount of bacteria from CSO and storm drain discharges, and every entity has its own opinion on how much there is and where it is coming from. Some residents feel that there is much more sewage coming from both CSOs and drainpipes than the MWRA acknowledges, and that even more CSOs are active than speculated. There is even controversy about the distinction between which outlets are CSOs and which are drainpipes.

1.2 Where Are CSOs Located?

The MWRA sampling stations and CSOs located in the Mystic Watershed are shown on the map in **Figure 1** (at the end of this document).[ii]

1.3 Who is responsible for the CSOs?

The CSOs shown on Figure 1 are operated by several authorities:

- ·The Massachusetts Water Resources Authority (MWRA)
- ·City of Cambridge
- ·City of Somerville
- ·City of Chelsea

Other communities affected include Arlington, Belmont, Everett, and East Boston. Alewife Brook seems to have the most problems, and it receives waste in water dumped from Cambridge, Somerville, Arlington, and Belmont. Various people we talked to speculate that the last two have illegal sewage connections and possibly even CSOs that are classified as storm drains. Cambridge has done the most to eliminate CSOs, and actually has plans to build a detention basin. This will slow down water from the areas that will have their CSOs separated,. mainly to prevent flooding.

The municipalities are ultimately responsible for sewage contamination from CSOs and storm drains. However, they do receive support from the MWRA, which receives fees from 44 communities.

Table 2[iii] illustrates the various actions that are required to be taken and who is responsible.

A. Actions to Minimize CSO/Sanitary Discharges	**Responsible Party**
Implement Nine Minimum Controls	
Provide estimates of AB/UMR CSO activation's and volumes over the Variance period	MWRA, Cambridge, Somerville
Reevaluate possibility of additional infiltration/inflow controls at key locations	MWRA, Cambridge, Somerville
Identify opportunities for additional SOP measures in	MWRA
local combined systems and assess likely water quality benefits	Cambridge, Somerville (MWRA)
(For AB/UMR sewer member communities) Provide MWRA BMP plan, GIS sewer system mapping, technical assistance as requested, and review community stormwater management plan to identify opportunities for enhanced pollution prevention, if requested.	MWRA
B. Actions to Further Assess CSO/Stormwater Pollutant Loads	
Receiving water sampling for AB/UMR over the Variance period to assess impacts of CSO discharges; submit report annually with results	MWRA
Stormwater sampling at representative stormdrain locations to allow for determinations of stormwater loadings	MWRA, Cambridge, Somerville
C. Assessment of CSO Controls in the Alewife/Upper Mystic Basin	
Prepare and file final report summarizing and assessing information gathered during Variance process	MWRA
Identify "triggers" appropriate for basis to determine when additional CSO controls would yield greater benefits for respective costs	MWRA (with EPA and DEP)

The MWRA is responsible for most actions, while the cities and towns are responsible for more local undertakings, such as implementation and sampling.

2. MYRWA'S GOALS RELATED TO CSOS IN THE MYSTIC RIVER WATERSHED

The goal of the Mystic River Watershed Collaborative is to achieve and maintain a "Class B" level of water quality in the Mystic River and its tributaries by 2010. Class B status will allow the waters to be considered "fishable and swimmable." Water quality classifications are described below under state regulations.

To attain Class B status, all CSO discharges must be eliminated. According to Grace Perez, MyRWA's specific goal is to gain a commitment from the Massachusetts DEP and the Massachusetts Water Resources Authority to eliminate CSO discharges into the Mystic River watershed. Without eliminating CSO discharges, the waters – because they could contain raw sewage, even if only 5% of the time – will never achieve "fishable, swimmable" status.

MyRWA recognizes that eliminating CSOs is expensive, and therefore, that the time horizon for achieving this goal may be long. What MyRWA wants, in the short term, is a firm, public commitment from MWRA to eliminating all CSO discharges. Furthermore, MyRWA believes that DEP support, in the form of an appropriate water quality classification for the Mystic River, is critical to obtaining this commitment. MyRWA believes that if the state downgrades the water quality classification to "Class B_{CSO}," then MWRA will no longer have an incentive to remove CSOs.

3. RELEVANT LAWS AND REGULATIONS

This section provides an overview of the relevant federal and state laws and regulations.

3.1 Federal Laws and Regulations

The key **federal law** that covers combined sewer overflows is the Clean Water Act (33 USC §§1251 – 1387). The objective of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[iv] The goals of the CWA include the following:

1) Eliminate the discharge of pollutants into the navigable waters by 1985
2) Achieve an interim water quality goal that "provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in an on the water" by July 1, 1983
7) Develop and implement programs for the control of nonpoint sources of pollution

Key sections of the CWA that are relevant to CSOs include the following:

- §1251 Congressional declaration of goals and policy
- §1274 Wet-weather watershed pilot projects – authorizes technical assistance and grants to carry out pilot projects related t wet-weather discharge control
- **§1301** Sewer overflow control grants
- §1342 National Pollutant Discharge Elimination System – authorizes EPA and the states to issue permits for pollutant discharges
  - **§1342(q)** Combined sewer overflows (enacted December 2000) – permits for CSO discharges shall conform to EPA's CSO Control Policy of April 11, 1994

- §1311 – Effluent limitations – requires application of the best available technology economically achievable
  - (e) – applies effluent limitations to all point source discharges
  - (m) – modification of effluent limitation requirements for point sources
- §1312 Water quality-related effluent limitations – allows establishment of effluent limitations based on water quality
- §1313 Water quality standards and implementation plans – part (c) requires states to hold public hearings to review water quality standards every three years
- §1314 Information and guidelines – authorizes EPA to establish water quality criteria and regulations on effluent limitations
- §1329 Nonpoint source management programs
- §1316 National standards of performance
- §1342(p) Municipal and industrial stormwater discharges
- §1365 Citizen suits

The act regulates all point-source discharges of pollutants, that is, pollutants discharged from pipes. Point-source discharges are regulated through the National Pollutant Discharge Elimination System (NPDES). The act gives authority to the states to implement the NPDES permit program and to set water quality standards.

The act also encourages public participation in the development, revision, and enforcement of the regulations (§1251(e)). Finally, the act allows citizen suits.

The 2000 amendments to the Clean Water Act added Section 402(q), Combined Sewer Overflows.[v] Combined sewer overflows are defined as point-source discharges and are thus covered under the Clean Water Act: "As point sources, CSOs are subject to the technology- and water quality-based requirements of the CWA. They are not, however, subject to the secondary treatment standards that apply to POTWs."[vi]

Federal **regulations** related to the CWA are promulgated by the U.S. Environmental Protection Agency in the Code of Federal Regulations, Title 40, Protection of Environment. Chapter I, Parts 100 – 149 contains regulations related to water programs. Some key parts relevant to CSOs include the following:

- NPDES permit program (40 CFR Part 122)
- State program requirements (40 CFR Part 123)
- Criteria and standards for the NPDES permit program (40 CFR Part 125)
- Water quality planning and management (40 CFR Part 130)
- Water quality standards and designation of uses (40 CFR Part 131)
- Prior notice of citizen suits (40 CFR Part 135)

The USEPA issued its *Combined Sewer Overflow Control Policy* in April 1994.[vii] The policy establishes four principles to address concerns about cost and flexibility:[viii]

"1) providing clear levels of control...to meet appropriate health and environmental objectives;

2) providing sufficient flexibility to municipalities, especially financially disadvantaged communities, to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements;

3) allowing a phased approach to implementation of CSO controls considering a community's financial capability; and

4) review and revision, as appropriate, of water quality standards and their implementation procedures when developing CSO control plans to reflect the site-specific wet weather impacts of CSOs."

The policy requires CSO permit holders to:

- characterize their sewer systems
- implement nine minimum CSO controls
- develop a long-term CSO control plan

The nine minimum controls are presented in section II.B of the policy:

1. Proper operation ad regular maintenance programs for the sewer system and the CSOs;
2. Maximum use of the collection system for storage;
3. Review and modification of pretreatment requirements to assure CSO impacts are minimized;
4. Maximization of flow to the POTW for treatment;
5. Prohibition of CSOs during dry weather;
6. Control of solid and floatable materials in CSOs;
7. Pollution prevention;
8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts; and
9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

In Massachusetts, the state sets water quality standards based on the CWA. These standards include uses of water bodies, such as uses for drinking water, primary contact recreation (swimming), boating, and fishing, among others. Guidelines to the states in designating uses are set forth in 40 CFR §131.10. These regulations give states the authority to establish subcategories of uses if the state can demonstrate that it is not feasible to attain the designated use.

However, the EPA policy states that, before a state can remove a designated use, it must conduct a **use attainability analysis**. This analysis determines whether a designated use can be achieved if CSO controls are implemented:

> Furthermore, a State may not remove a designated use that will be attained by implementing the technology-based effluent limits required under Sections 301 (b) and 306 of the CWA and by implementing cost-effective and reasonable best management practices for nonpoint source controls. Thus, if a State has a reasonable basis to determine that the current designated use could be attained after implementation of the technology-based controls of the CWA, then the use could not be removed.[ix]

The significance of the use attainability analysis is discussed further below under state regulations.

Our team calls MyRWA's attention to the following aspects of the national CSO control policy, since they may provide some options for further actions:

- Dry-weather discharges from CSOs are absolutely prohibited.[x]
- The policy allows a phased approach to implementing CSO controls.
- Sensitive areas: the long-term CSO control plan must provide controls for overflows to sensitive areas, which include waters with threatened or endangered species and their habitats.

3.2 State Laws and Regulations

The Massachusetts Department of Environmental Protection is the state agency responsible for implementing and enforcing the Clean Water Act. Relevant state laws, regulations, and policies are:

- Massachusetts Clean Waters Act (MGL c. 21, §§26 – 53)
- Massachusetts Environmental Policy Act (MGL c. 30)
- 314 CMR 3.00 – surface water discharge permits
- 314 CMR 4.00 – Massachusetts surface water quality standards
- 310 CMR 41 – funding mechanisms
- Massachusetts Combined Sewer Overflow Policy. [xi]

The Massachusetts CSO policy has not been put into regulations (and was not intended to be).[xii] The Massachusetts policy reiterates EPA policy on implementing the nine minimum controls. All NPDES permit holders for CSOs must implement the nine minimum controls. However, complete elimination of CSOs is not necessarily required.

DEP currently provides the following classification options for water bodies:

Class A	designated uses of the water body include sources of public water supply; no CSO discharges are allowed
Class SA	similar for marine waters
Class B	uses of the water body include habitat for fish, other aquatic life, and wildlife; primary and secondary contact recreation; and public water supply in some cases; suitable for irrigation; no CSO discharges are allowed
Class SB	similar for marine waters
Class B_{cso}	CSO controls allow the water body to meet Class B use standards at least 95% of the time
Class SB_{cso}	similar for marine waters
Class C	uses of the water body include habitat for fish, other aquatic life, and wildlife; and secondary contact recreation
Class SC	similar for marine waters

A variance option is also allowed for a specified period of time if insufficient information is available to determine whether or not the use standards can bee attained. A variance does not permanently change the water body's designated uses. "A variance allows CSO discharges to be in compliance with 'modified' water quality standards in the NPDES permit while additional analyses are conducted and progress in made toward meeting the existing standard." [xiii] The regulations (314 CMR 4.03(4)) allow the state to grant a variance if the applicant demonstrates one of six things. These include:

(c) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place

(f) Controls more stringent than those required by sections 310(b) and 306 of the Act would result in substantial and widespread economic and social impact.

Waters with CSOs in the Mystic River watershed (Alewife Brook, Upper Mystic River, Mystic/Chelsea confluence) are Class B waters, but currently fall in the variance category. However, the proposed water quality standard for these waters, as presented in the MWRA CSO Facilities Plan,[xiv] is B_{cso} or SB_{cso}.[xv]

4. HISTORY OF CSO CONTROL IN THE MYSTIC RIVER WATERSHED

The Massachusetts Water Resources Authority provides water and sewer service to Boston and many surrounding communities. Somerville, Boston, Cambridge, and Chelsea have combined sewer systems connecting to MWRA's sewer system. There are 84 CSO outlet pipes among them, but only 21 currently overflow. Combined rainwater and sewage overflow into Boston Harbor and the Charles, Mystic, and Neponset Rivers when the CSO structures cannot contain it.

The CSO Control Plan was created in 1994 as part of the Federal Court mandate related to the multibillion dollar Boston Harbor project. The MWRA was required to create a plan to reduce and potentially eliminate CSOs. The problem was that they really had no idea how much work this would require in the Mystic Watershed. Before the Clean Water Act, all storm drains were CSOs. Then, after the act was passed in 1970, many CSOs were simply reclassified as storm drains.[xvi] In reality, not much testing was done to check on the status, and it is rare to find a clean storm drain (according to activist and Mystic kayaker, Roger Frymire). Therefore, as more research was done, the MWRA has had to continuously revise its plans as more and more problems were identified. For example, MWRA thought that Arlington and Belmont had separated sewers, when in fact they did not. In addition, MWRA found several illegal connections, where homes were discharging sewage directly into the waterways. In these cases, the cities pay to have the plumbing connected to sewage pipes.

The progression of the CSO problem in the Mystic watershed has been a long, complicated process that started with a $12.1 million solution and is now projected to be in the $200 million range. The 1997 Final CSO Facilities Plan required that the MWRA periodically re-examine, optimize, and expand its CSO Control Plan if new information is discovered during the project design process.

The conditions of the variance call for the MWRA to proceed with CSO projects that are practical and cost effective, and also gather further data on CSO and stormwater loads in the watershed. Because the plan had become more expensive and intricate, in March 1999, a CSO Variance was issued by the Massachusetts DEP for the CSO discharges to the Alewife Brook/Upper Mystic River watershed.

Table 3 shows how dramatic the changes were for the newer plan. Both plans would achieve an 84% reduction in annual CSO volume.

	Frequency of Overflows	Annual CSO Volume (million gal)
Original Plan		
Assumed Existing	16	18.3
Recommended	4	2.9
Revised Plan		
Assumed Existing	63	49.7
Recommended	7	7.4

Table 4 illustrates the main differences between the two plans.

1997 Recommended Plan	Revised Recommended Plan
Separate sewers in the CAMO04 tributary area to reduce CSO discharges	Separate sewers in the CAMO04 tributary area to eliminate CSO discharges (includes construction of a new stormwater outfall and wetland detention basin)
Separate sewers in the CAMO02 tributary area to eliminate CSO discharges.	Increase size of local sewer connection at CAMO02, CAM401B and SOM01A, to reduce CSO discharges at these locations
	Increase size and capacity of Rindge Avenue siphon to reduce CSO discharges at MWRO03; add hydraulic relief gate
Floatables control at remaining CSO outfalls (SOM01A, CAM001, CAM004, CAM400 CAM401)	Separate sewers in the CAM400 tributary area Floatables Control at remaining CSO outfalls (SOMA001A, CAM001, CAM002, CAM004(2), CAM400, CAM401A, CAM401B and MWR003)
Estimated Total Cost: $12.1 M	**Estimated Total Cost: $74.0 M**

A significant addition is the separation of CAM 004, which will require a new stormwater outfall to convey the water to a new wetlands detention basin. The type of pipe installation needed for this work is much more complicated and expensive. The reevaluation concluded that "targeted" separation is much more cost effective and will yield the most water quality benefits.

Table 5 gives an idea about how severe the overflow from each CSO is. Although the volumes are known, the exact concentration of contaminants has not yet been studied. However, it is obvious that CAM 400 is the worst, and that its elimination is most urgent.

Table 5. CSO Volumes

Outfall	**Existing conditions prior to Contract 2A/2B Construction**		**Sewer Separation Alternative A**	
CAM001	Annual Frequency	Annual Volume (MG)	Annual Frequency	Annual Volume (MG)
CAM002	1	0.01	5	0.2
MWR003	7	1.57	4	0.72
CAM004	1	0.06	5	1.03
CAM400	63	24.1	0	0
CAM401A	10	0.8	5	0.27
CAM401B	7	2.74	5	1.65
SOM01A	25	10.5	7	2.24
Totals	**20**	**9.89**	**3**	**1.29**

Table 6 compares the changes in the plans for each CSO.

Outfall	Original Recommended Plan	Revised Recommended Plan
CAMOO1	Provide floatables control	Provide floatables control
CAMOO2	Eliminate CSO outfall by complete separation upstream of regulator	Increase capacity of local connection to interceptor, and provide floatables control
MWROO3	Provide floatables control	Provide hydraulic relief gate at regulator
CAMOO4	Reduce activation frequency by separating area upstream of regulator	Provide floatables control
CAM400	Provide floatables control at regulator (to remain open).	Separate area upstream of regulator, and permanently close regulator upon completion of separation work
CAM401A	Convert existing combined sewers to storm drains, to minimize need for additional new pipe	Provide major new storm drain conduits to improve drainage capacity; provide flushing chambers and grit pits to control deposition in shallowly-sloped pipes
CAM401B	Provide floatables control	Provide new stormwater outfall to Little River, with downstream detention basin to attenuate peak flows
CAM401A	Provide floatables control	Separate combined manholes upstream of regulator, and provide floatables control
CAM401B	Not addressed in original plan; outfall discovered during early field investigations	Relieve siphon downstream of Rindge Avenue combined sewer, and provide floatables control
SOMOIA	Provide floatables control	Increase capacity of local connection to interceptor, and provide floatables control

Other main discoveries that led to an increase in cost, besides the complicated piping on CAM 400, were a previously unknown CSO (CAM 401B), a cross-connection at Vassar Lane, extensive interconnections at CAM004 area, and more illegal sanitary connections. The connections are between sanitary (sewer) and drainage (stormwater) systems. Another finding was the need for new localized projects using innovations such as interceptor connection reliefs, siphon reliefs, and hydraulic relief gates.

The NPC (Notice of Project Change for the Long Term CSO Control Plan) is a document that is updated periodically to thoroughly describe alterations in the possible plans and new discoveries about misinformation on the location and status of CSOs. The most recent copy outlines 19 different alternative plans to reduce or eliminate CSOs. Only one of the plans, the one to separate all CSOs, will allow the Mystic watershed to attain class B status. Of course, this plan is by far the most expensive. The other alternatives include combinations of storage basins, partial CSO elimination, discharge treatment, and relocation. These will all hold MWRA accountable to reduce CSO discharge by 95%. It is important to note that even if total separation is achieved, bacteria will still get into the watershed through the feces of dogs, birds, and other sources.

Environmental Monitoring for Public Access and Community Tracking (EMPACT) is an EPA program that aids communities in quickly amassing and publicizing environmental data. Somerville has received a $363,257 grant from this program to monitor the Mystic River. In addition to sewage contamination, the Mystic River has been overwhelmed with chemicals, hydrocarbons, pathogens, and road salt from stormwater runoff. The Mystic Watershed Collaborative (a partnership between the Mystic River Watershed Association and Tufts University) has been designated to run the project, and it monitors fecal coliform bacteria, dissolved oxygen, conductivity, pH, and water depth at least five times per week. This, in addition to other community awareness programs has helped to stimulate public concern.

5. CURRENT STATUS OF CSO CLEANUP IN THE MYSTIC RIVER WATERSHED

MyWRA, the Alewife/Mystic River Advocates, MWRA, and USGS have been testing samples from the watershed at different locations and intervals to monitor water quality. So far, 6 out of 14 CSO outfall pipes in the Mystic watershed have been closed so that no more sewage can flow from them.

Table 7 is a summary of the cost of work items that have already been completed or committed to be completed.

Element	Total Cost
Outfall Cleaning (Contract 1)	\$452,500
Fresh Pond Parkway (Contracts 2A and 2B)	\$16,171,900
Orchard Street Separation (Contract 3)	\$2,509,500
Engineering on Contracts 1 to 3	\$6,994,400
Floatables Control (Contracts 4 and 5)	\$1,730,400
New CAMO04 Outfall (Contract 12)	\$10,395,000
Berm	\$300,000
MWRO03 Floatables Control	\$300,000
Contingency (Contracts 4,5 and 12)	\$1,649,500
Engineering (Contracts 4, 5 and 12, and amendments)	\$9,560,600
TOTAL	**\$50,063,800**

So far, over \$50 million has been spent, and most of it has gone to work along Fresh Pond and for CAM 004.

Figure 2 shows the systemwide map for the MWRA area. Most of the CSOs to be eliminated are located south of Boston, because the MWRA outlines "sensitive use" areas that should benefit from total separation while just minimum treatment of CSO discharges is deemed sufficient in less-sensitive areas. The total spending of the MWRA for all CSO reduction was originally estimated at \$430 million in 1997, and has now risen to \$530 million.

The Mystic River drains into the Boston Harbor. There are several segments of the Watershed: the Aberjona River, Malden River, Alewife Brook, Mystic River, and the Chelsea River (Segments MA71-01 to MA71-06). The last three of these contain CSOs. The first of two are stably classified as class B, and do not face the danger of reclassification to B_{CSO} Variance.

Cities are given NPDES permits for how much their CSOs can overflow and how many times per year. 6 cities have been given Notices of Noncompliance (NONs) for going beyond their permits, and Belmont exceeded its the most. The city of Somerville was issued NPDES permits to discharge combined sewage through six CSOs to the Alewife Brook. However, the permits expired in September of 1997, and Somerville has supposedly removed five CSOs. The problem is that these permits are enforced only through warnings and do not even have to be renewed until five years after they expire. Somerville was issued several NONs for discharging in excess of what was permitted, but not much else was done. Cambridge also has a permit to discharge into the Alewife Brook through seven CSOs. Its permit expired in April 1998 but is expected to be reissued.

Dry-weather sampling programs have established many storm drains in the Alewife Brook that appear to be discharging wastewater flows. The DEP has issued NONs to towns in the watershed requiring identification and removal of illegal connections to storm drains. This process takes a long time, and these pollution sources are slowly being removed one by one.

6. KEY ISSUES AND THE FINAL DECISION PROCESS

The only way to maintain Class B status is to eliminate CSOs through sewer separation. The DEP CSO guidance document explains ways to evaluate the feasibility of sewer separation.[xvii]

- Cost – to determine if the impact on ratepayers is excessive, using EPA's guidance
- Benefits – allows consideration of impacts of pollution from storm drains
- Protection of sensitive uses – if CSOs are not completely eliminated, alternatives "must provide an equivalent or higher level of environmental benefit..."[xviii]

Discussions with Mr. Kevin Brander of DEP indicated that cost/affordability will be a key criterion in the final decision on water quality classification. Mr. Brander stated[xix] that the following steps will lead up to a decision on water quality standards. These steps are shown in **Figure 3** (Figure 1 in DEP's CSO guidance document).

1) The CSO Control Plan in the Alewife/Mystic watershed must be completed by July 1, 2003. This document is required under the CSO Variance. A notice will be placed in the *Environmental Monitor*, and the document will be subject to the MEPA environmental review requirements (301 CMR 11.00). Public comments will be solicited on the plan.

2) DEP will hold a public forum during the MEPA comment period to allow MWRA to present technical information in the final plan publicly and to hear public comments.

3) DEP will consider the information included in the CSO Plan and public comments, and determine if the recommended plan is the highest feasible level of CSO control. The highest feasible level of CSO control will be determined from the technical analysis of the costs and water quality benefits of the range of CSO control alternatives and on the financial capacity of MWRA and its ratepayers.

4) If CSOs will be eliminated, no change to the present water quality standard is required. If CSOs will be mitigated but not eliminated, DEP will need to develop a Use Attainability Analysis (UAA) for submittal to EPA "to document that achieving a higher level of CSO control is not feasible or appropriate."[xx]

5) In the case of a standards change (which is equivalent to a change in the state regulations - 314 CMR 4.00), DEP must publicly announce its intention of changing the standard, hold a public hearing on the tentative change, and publish a notice in the *Environmental Monitor* so there will be opportunities to provide input and public comment at the hearing and in writing to the MEPA office.

6) EPA, upon receipt of the UAA, will have 60 days to approve the standards change, or 90 days to disapprove the standards change.

7) Upon EPA approval, the standard would be formally changed and a NPDES (discharge) permit would then be issued to the CSO permittees requiring the level of CSO control associated with the highest feasible level of control as identified in the approved CSO control plan (and UAA).

8) The Clean Water Act requires the state to conduct a public review of the water quality standards every three years (triennial review), so any standards changes would be subject to additional review and scrutiny by the public, and the information that supported the standards changes (e.g., affordability) can be revisited during those reviews.

Before EPA makes its decision in October 2003, the main way for the community to voice its opinion is at the public meeting. This will happen after the final CSO plan is submitted on July 1, 2003. It is important for people to comment on the following points:

1) Residents have a right to live by clean water; and the cost is high at first, but will pay off in the future.

3) Residents who do use the Mystic recreationally, or those who would like to (were it clean), can state what it means to them.

3) Children that play along the river and streams can state why they would like the water to be clean.

The public can also appeal certain permits and the decision in general if the Mystic is classified as B_{CSO}.

7. RECOMMENDATIONS

Our team recommends that MyRWA try to influence the decision makers in advance of the public comment period. The following approaches could be considered:

- Request extension of the variance
- Request funding and phasing
- Insist on the triennial review required by the CWA
- Approach Boards of Health
- Demonstrate value of waters to the community
- Collaborate with other watershed associations
- Consider a citizen suit

7.1 Request Extension of the Variance

DEP feels it has enough information to make a decision on water classification. However, MyRWA could request an extension of the variance based on the following:

- Data gaps – Extension of the variance would allow more time to fill in gaps in data presented in MWRA's long-term CSO control plan

- TMDLs – The "demonstration approach" used by MWRA in its CSP Facilities Plan requires calculation of total maximum daily loads.[xxi] The facilities plan should be reviewed to see if it includes TMDLs. If it does not, MyRWA should call this omission to the attention of DEP and EPA

- Dry-weather discharges must be eliminated, per CWA
- Stormwater impacts – Final water quality classification cannot be determined until stormwater controls are implemented
- Sensitive areas – Are there any endangered or threatened species? DEP's Kevin Brander indicated that no one has studied impacts on fish or the levels of pollutants in fish tissue. We suggest that MyRWA contact the Department of Fish & Wildlife and request that it immediately initiate a study of pollution impacts on fish in the Mystic watershed.
- New technologies – An extension may allow time for new CSO control technologies to emerge

7.2 Request Funding and Phasing

MyRWA can also request that implementation of CSO controls be phased in to reduce cost impacts. The CWA (§1342(q)) allows implementation to be phased in, and phasing of implementation would be preferable to a change in water quality status.

To address concerns about the cost of CSO elimination, MyRWA could urge CSO communities to apply for grant funding under recent amendments to the CW:

- Sewer overflow control grant (CWA §1301)
- Wet weather watershed pilot project (CWA §1274)

Cities like Chelsea and Somerville may meet the "financially distressed" criteria for grant funding.

7.3 Insist on the Triennial Review

It appears that DEP has not reviewed the surface water discharge standards in more than three years, as required by §1313 of the CWA. The triennial review provides an opportunity to determine whether or not the B_{CSO} standard violates the CWA. MyRWA should confirm the date of the last triennial review, and then request that EPA direct DEP to review the standards.

7.4 Approach Boards of Health

Massachusetts law (MGL c. 40) gives boards of health the authority to adopt regulations to protect public health, safety, and welfare. MyRWA could approach the boards of health in Cambridge, Somerville, Arlington, Medford, Chelsea, or other communities and urge the adoption of more stringent water quality standards based on public health concerns.

7.5 Demonstrate the Value of the Waters to the Community

Sensitivity of uses is a key criterion in determining water quality classification. Currently, there is a perception among regulators that Alewife Brook is "not a heavily used resource." It is critical for MyRWA to counter this perception and demonstrate to regulators that the Mystic watershed waters are valued by the community. Evidence could be gathered by:

- Conducting surveys
- Collecting signatures and petitions
- Taking photos of community events
- Working with schools to develop curricula using Alewife Brook and the Mystic River as a "living classroom"

7.6 Collaborate with Other Watershed Associations

Areas of collaboration could include:

- Bringing political pressure on DEP and EPA through both state and national representatives and senators
- Initiating a citizen suit under the CWA

7.7 Consider a Citizen Suit

One basis for a citizen suit could be that the Bcso standard does not protect public health or welfare, as required by the CWA (§1313(c)(2)). Furthermore, the B_{CSO} standard does not comply with the CSO Control Policy and therefore violates the CWA. The CSO Control Policy states: "A primary objective of the long-term CSO control plan is to meet WQS, including the designated uses through reducing risks to human health and the environment by eliminating, relocating or controlling CSOs to the affected waters."[xxii]

It can be argued that it is not worth paying almost double the cost just to eliminate the remaining 5% of the CSOs. However, there is so much uncertainty involved, that the payoff might be worth this cost. For instance, the number of residents in the Mystic watershed will continue to increase in the future, leading to more sewage and waste. In addition, global warming is speculated to increase flooding and cause more extreme temperatures. Alternatives to complete sewer separation might lead to short-term solutions, but the only way to ensure that the water will remain clean is total separation.

The precautionary principle applies especially to this case, because there is so much uncertainty. A future drastic event (flood, storm, etc.) has the potential to damage the Mystic waterways to where they would be even more expensive, and maybe even impossible, to repair. In addition, that remaining 5% of CSO discharge may not seem like much, but it is enough to keep the Mystic waterways from being fishable and swimmable. Any amount of raw sewage being dumped into the river makes it unhealthy. It will still lead to an unpleasant color, odor, and the presence of bacteria. The government made a commitment to ensure that citizens live among fishable and swimmable water bodies when it created the Clean Water Act. If the authorities responsible for meeting this commitment are unwilling to do so, then citizens have the right to challenge them. In fact, the CWA (§1251(e)) encourages public involvement in enforcement of the regulations.

LIST OF ABBREVIATIONS

CSO	Combined sewer overflow
DEP	Department of Environmental Protection (Massachusetts)
EOEA	Executive Office of Environmental Affairs (Massachusetts)
EPA	Environmental Protection Agency (U.S.)
MEPA	Massachusetts Environmental Policy Act
MWRA	Massachusetts Water Resources Authority
MyRWA	Mystic River Watershed Association
NON	Notice of noncompliance
POTW	Publicly owned treatment works

Footnotes:

[i] Mystic Monitoring Network Yearly Review: Baseline Water Quality Data for the Watershed, July 2000 – February 2002.
[ii] The map in Figure 1 was supplied by Grace Perez of MyRWA.
[iii] Tables in this document are from the Massachusetts Water Resources Authority, *Notice of Project Change*, 2001.
[iv] 33 USC §1251. Congressional declaration of goals and policy.
[v] U.S. Environmental Protection Agency. *Report to Congress on Implementation and Enforcement of the Combined Sewer Overflow Control Policy.* September 1, 2001.
[vi] Ibid.
[vii] U.S. Environmental Protection Agency. *National Combined Sewer Overflow Control Policy.* April 19, 1994.
[viii] Ibid., p. 9
[ix] Ibid., p. 25
[x] Ibid., p. 31
[xi] Massachusetts Department of Environmental Protection. *Guidance for Abatement of Pollution from CSO Discharges.* August 11, 1997.
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Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX B

HISTORICAL BACKGROUND & DOCUMENTATION

US Army Corps
of Engineers®
New England District

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HISTORIC DOCUMENTATION SUMMARY OF ENVIRONMENTAL STUDIES IN THE MALDEN RIVER CORRIDOR

(February 2003)

(provided by Nangle Consulting Associates, Inc. to Malden River Study Team)

Urban Renewal Plan for
Industrial Urban Renewal Project
Project No. Mass. R-132
Malden Redevelopment Authority
Malden, Massachusetts
20 November 1969

Geotechnical Soil Borings for the Proposed Malden River Double Box Culvert Project
1972
Prepared by Metropolitan District Commission

Technical Report
Project No. MASS R-132
By Skinner & Sherman, Inc.
(Attachment to Appendix F)
25 February 1975

Hydrogeological Investigation Regarding Abandoned Oil Sump
Prepared by Perkins Jordan, Inc.
10 October 1983

Water Quality Monitoring Program
Prepared by Perkins Jordan, Inc.
4 April 1984

Oil and Hazardous Materials Site Evaluation
Lot #2 (changed to Lot #2 DC 11/19/85)
Medford, Massachusetts
Prepared by Haley & Aldrich, Inc.
28 August 1984

Investigation of Sub Floor Tank/Oil Separator Near Ring Roll Area
Prepared by GEAE
12 September 1984

Site Evaluation for Potential of Hazardous Material and Oil
326 Commercial Street
Malden, Mass.
Prepared by Norwood Engineering/
Carr Research Laboratory
September 24, 1984

Review of Phase I – Records Search
Prepared by NUS
10 December 1984

Soils Sampling and Analyses
General Electric,
Everett, Massachusetts
Prepared by E.C. Jordan Co.
8 March 1985

Field Work Plan for
Malden River Site Investigation
Prepared by TRC Environmental Consultants
March 21, 1985

Correspondence to USEPA (Ms. Nancy Piligian)
RE: Installation Restoration Program Phase I
Everett & Lynn Air Force Plants Nos. 28 & 29
Prepared by MDEP
14 June 1985

Draft Report on Malden River Site Investigation
Malden, Massachusetts
Prepared by TRC Environmental Consultants, Inc.
September 1985

Environmental Site Assessment
Site Evaluation for Potential of Hazardous Material and Oil
Malden River Headwall
Malden, Massachusetts
Prepared by Norwood Engineering Co., Inc.
November 19, 1985

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Malden, Massachusetts
Preliminary Report
Soil and Groundwater Investigations
Commercial Street and adjoining areas
Prepared by Norwood Engineering Co., Inc.
January 1986

Final Draft – Appendix F
Environmental Study
Malden, Massachusetts
Prepared by Norwood Engineering Co., Inc.
February 1986

Environmental Site Assessment
Site Evaluation for Potential of Hazardous Material and Oil
Malden Department of Public Works Garage & Wellington Realty Property
Malden, Massachusetts
Volumes I & II
Prepared by TRC Environmental Consultants, Inc.
April 1986

Proposed Remedial Work Plan
Malden Department of Public Works Garage & Wellington Realty Property
Malden, Massachusetts
Prepared by TRC Environmental Consultants, Inc.
April 1986

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Malden, Massachusetts
Volumes I & II
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2 April 1986

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Lombard Trucking Terminal
Malden, Massachusetts
Prepared by TRC Environmental Consultants, Inc.
February 10, 1986
Revised April 1986

Solvent Release - Everett Facility
Oil/Hazardous Material Release/Threat of Release
Prepared by Department of Environmental Quality Engineering
7 November 1986

Analysis Report
(Soil sample taken from pipe trench)
Prepared by GEAE
20 January 1987

Record Search – A Study of the Mystic, Malden and Island End Rivers
In Everett, Charlestown, Somerville, Malden, Medford and Chelsea, Massachusetts
Wehran Engineering Corporation
August 1987

Phase Two Oil and Hazardous Material Site Evaluation
AVCO Everett Research Laboratory, Inc.
Everett, Massachusetts
Prepared by Haley & Aldrich, Inc.
December 9, 1987

Phase I
Parcels 1-4, 1-5, 1-6, 2-1 through 2-5: Mass Electric/ N.E. Electric
170 Medford Street
Malden/Everett, Massachusetts
Prepared by GEI Consultants, Inc.
1988

Report on Oil and Hazardous Material Site Evaluation
Boston Gas Company
Commercial and Center Streets
Malden, Massachusetts
Prepared by Haley & Aldrich, Inc.
August 1988

Report on Oil and Hazardous Material Site Evaluation, Boston Gas Company
Commercial and Charles Streets
Malden, Massachusetts
Prepared by Haley & Aldrich, Inc
September 1988

Phase III – Environmental Studies
Malden, Massachusetts
Prepared by Norwood Engineering Co., Inc.
September 1988

Environmental Site Assessment
Site Evaluation for Potential of Hazardous Material and Oil
Parcel I-3R
Malden, Massachusetts
Prepared by Norwood Engineering Co., Inc.
January 2, 1986
Revised October 1988

Phase IIA Oil and Hazardous Material Site Evaluation
AVCO Everett Research Laboratory, Inc.
Everett, Massachusetts
Prepared by Haley & Aldrich, Inc.
October 20, 1988

Preliminary Site Assessment
GE/Aircraft Engines
Everett, Massachusetts Facility
Prepared by Camp Dresser and McKee, Inc.
December 1988

Memorandum to the Record
RE: Everett Site Investigation - General Electric
Prepared by John Buckley, DEQE
February 15, 1989

Memorandum to DEQE (Harish Panchal)
RE: Everett-General Electric Corporation, Plant #28,
62 Tremont Street
Site Inspection Report MA5570024617
Prepared by John Buckley, DEQE
March 31, 1989

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Everett, Massachusetts Facility
Prepared by Camp Dresser and McKee, Inc.
April 1989

Health and Safety Work Plan
Sewer Improvement Contract 87-S-1
Pearl Street
Malden, Massachusetts
Prepared by Nangle Consulting Associates, Inc.
June 1989

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Malden – Contamination in the Malden River
DEP Case 3-2558
Prepared by Massachusetts Department of Environmental Protection
August 24, 1989

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October 30, 1989

Everett Riverfront Industrial Park, Everett, MA
David Dixon & Associates
January 1991

Phase I Limited Site Investigation
SCL Property 144 and 184 Commercial Street
Malden, Massachusetts
Sterling Clark-Lurton
1991

Phase II - Comprehensive Site Assessment Investigation
GE/Aircraft Engines
Everett, Massachusetts Facility
Prepared by Camp Dresser and McKee, Inc.
February 1991

Aerial Photographic Interpretation of the GE Everett Site
Prepared by Eckenfelder, Inc.
May 1991

Public Health Risk Assessment
GE Everett Facility
Waiver No. 89-03-0311
Prepared by RCG/Hagler, Bailly, Inc.
June 1991

Screening Program Notebook Update
Boston Gas Company
Former Manufacture Gas Plant Properties
Prepared by Haley & Aldrich, Inc.
December 1991

Emergency Response Action Summary, Status Report
Rohm Tech Facility
Malden, Massachusetts
Prepared by Metcalf & Eddy/Zecco
May 28, 1992

Mass Electric/N.E. Electric, 170 Medford Street, Malden/Everett
Prepared by Ransom Environmental Consultants, Inc.
December 1992

Site Status Report
Rohm Tech Facility
Malden, Massachusetts
Prepared by Metcalf & Eddy/Zecco
January 1993

Collection of Groundwater and Surface Water Samples
Prepared by Eckenfelder, Inc.
July 93

Corporation Way/Commercial Street Development Strategy, Final Report
Prepared by Cecil & Rizvi Incorporated, Bonz & Company, Rizzo Associates, Inc.
July 20, 1993

DEP File No. 3-0880, Waiver Application, Supplemental Testing
Former AVCO Facility
2385 Revere Beach Parkway
Everett, Massachusetts
Prepared by Haley & Aldrich, Inc.
11 January 1994

Report on Oil and Hazardous Material Site Evaluation and West End Brook Conduit Sealing, Boston Gas Property
100 Commercial Street
Malden, Massachusetts
DEP Waiver Case 3-0362
Prepared by Haley & Aldrich, Inc
28 February 1994

Report on Supplemental Phase II Comprehensive Site Assessment, Boston Gas Property
100 Commercial Street
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23 March 1994

Report on Supplemental Phase II Risk Characterization, Boston Gas Property
100 Commercial Street
Malden, Massachusetts
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Prepared by Haley & Aldrich, Inc
31 March 1994

Collection of Groundwater Samples for Analysis of Arsenic
Prepared by Eckenfelder, Inc.
June 1994

Assessment IRA Completion Report, Boston Gas Property
100 Commercial Street
Malden, Massachusetts
Waivered Site No. 3-0362, TOR RTN 3-11581
Prepared by Haley & Aldrich, Inc
8 November 1994

Final Phase III Report, Remedial Action Plan
Parcel 2-6: GE/US Air Force Plant No. 28
Waiver Submittal Waiver No. 3-0311
General Electric Aircraft Engines
62 Tremont Street
Everett, Massachusetts
Prepared by Eckenfelder, Inc.
January 1995

Environmental Studies
Textron Defense Systems
2385 Revere Beach Parkway
Everett, Massachusetts
Prepared by the ERM Group
January 30, 1995

Phase I Limited Site Investigation Report
Rohm Tech, Inc.
195 Canal Street
Malden, Massachusetts
Prepared by TRC Environmental Corp.
February 24, 1995

Response Action Outcome (RAO) Statement
Mass Electric/N.E. Electric, 170 Medford Street, Malden/Everett
Prepared by Ransom Environmental Consultants, Inc.
June 1995

Immediate Response Action Plan
RTN 3-12448
West End Brook – Malden River Culverts
Prepared by Haley & Aldrich, Inc.
July 11, 1995

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Malden Massachusetts
Prepared by Haley & Aldrich, Inc.
14 July 1995

Immediate Response Actions (IRA) Status Report
RTN 3-12448
West End Brook – Malden River Culverts
100 Commercial Street
Malden, Massachusetts
Prepared by Haley & Aldrich, Inc.
1 September 1995

Phase I Initial Site Investigation Report and Tier Classification
Parcel 4-15: Eastern Demolition
171R Corporation Way
Medford, Massachusetts
Prepared by Gale Associates, Inc.
October 1995

Notice of Intent
Rohm Tech, Inc.
195 Canal Street
Malden, Massachusetts
Prepared by TRC Environmental Corp.
December 22, 1995

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Prepared for Massachusetts Electric
1996

Response Action Outcome Statement
RTN 3-13231
Textron Systems Division, Inc.
2385 Revere Beach Parkway
Everett, Massachusetts
Prepared by ERM- New England, Inc.
2 February 1996

Immediate Response Actions (IRA) Completion Statement
RTN 3-12448
West End Brook – Malden River Culverts
100 Commercial Street
Malden, Massachusetts
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3 May 1996

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100 Commercial Street
Malden, Massachusetts
RTN 3-13753
Prepared by Haley & Aldrich, Inc
12 May 1996

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RTN 3-13754
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Prepared by Haley & Aldrich, Inc.
July 1996

Bike-to-the-Sea Feasibility Study, Final Draft
Prepared by Central Transportation Planning Staff for the Massachusetts Highway Department
August 1996

Final Report for Fingerprint Analysis
Malden River Culvert Report
Prepared by Battelle
September 9, 1996

Final Environmental Impact Report, EOEA Number 10510 Gateway Center Project, Mystic View Road, Everett, MA
Prepared by Baystate Environmental Consultants, Inc., Bruce Campbell & Associates, Inc., Environmental Science Services
December 1996

Phase II Comprehensive Site Assessment Report
Former Rohm Tech Facility
195 Canal Street
Malden, Massachusetts
Prepared by TRC Environmental Corp.
February 24, 1997

Phase III Remedial Action Plan
Former Rohm Tech Facility
195 Canal Street
Malden, Massachusetts
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February 24, 1997

Phase I Completion Statement and Tier Classification Submittal Report
Parcel 2-6, 62 Tremont Street, Everett
Prepared by Rizzo Associates, Inc.
March 1997

Comprehensive Report of the Lower Mystic River Watershed: Shoreline Survey Results and Analysis for Mystic River, Alewife Brook, Malden River
Prepared by Alewife/Mystic River Advocates
July 1997

Scope of Work
Phase II Comprehensive Site Assessment
Former Manufactured Gas Plan (MGP) Site
Malden, Massachu8setts
RTN 3-0362 and Linked RTNs 3-3757, 3-13310 and 3-13345
Prepared by Haley & Aldrich, Inc.
7 July 1997

Indoor Air Monitoring
GE/Aircraft
Prepared by Eckenfelder, Inc.
September 1997

Summary of Environmental Land Use Characteristics
TeleCom City
Prepared by Nangle Consulting Associates, Inc.
November 1997
Revised December 1997

Collection of Soil Samples for vinyl chloride, hexavalent chromium, PAHs, and VPH/EPH
Prepared by Eckenfelder, Inc.
February 1998

UST Closure Assessment
Prepared by Eckenfelder, Inc.
February 1998

Massachusetts Highway Department Data Submittal
Realignment of Commercial Street/Corporation Way
Malden/Medford, Massachusetts
November 5, 1998

Tier II Extension Submittal, Former Manufactured Gas Plant
100 Commercial Street
Malden, Massachusetts
Release Tracking Numbers 3-0362 and Linked RTNs 3-3757, 3-11581 , 3-12448, 3-13310, 3-13345, 3-13753 and 3-13754
Prepared by Haley & Aldrich, Inc.
15 February 1999

Supplemental Phase II Investigation
Parcel A: Former Malden MPG
Prepared by Haley & Aldrich, Inc
February 1999

Environmental Data Summary
TeleCom City Parcels 4-12, 4-15, 4/16
Medford, Massachusetts
Prepared by Nangle Consulting Associates, Inc.
May 1999

Natural Resource Inventory/Assessment
TeleCom City
Malden, Medford and Everett, MA
Prepared by Wetlands & Wildlife, Inc.
June 28, 1999

Remedial Action Plan
GE Everett Site
62 Tremont Street
Everett, Massachusetts
RTN 3-03011
Prepared by Eckenfelder/Brown and Caldwell
January 1995 Rev. May 1999
Volume I revised August 1999

Report on Tier Re-Classification Submittal and Tier IA Permit Application
Former Malden MGP
Malden, Massachusetts
Prepared by Haley & Aldrich, Inc
October 1999

Hydrology and Hydraulic Evaluation of Amelia Earhart Dam
Prepared by Camp Dresser & McKee
198± updated in 2000±

Interim Data Submittal, Malden River Corridor
USEPA Brownfields Program
TeleCom City
Everett-Malden-Medford, Massachusetts
Prepared by Nangle Consulting Associates, Inc.
January 2000

USEPA Brownfields Pilot Program Work Plan
TeleCom City
Malden-Medford-Everett, Massachusetts
June 1998, Amended August 2000

Response Action Outcome Statement
General Electric Everett Site
71 Norman Street/3 Air Force Road
(A.K.A. 62 Tremont Street)
Everett, Massachusetts
RTN 3-0311
Prepared by Eckenfelder/Brown and Caldwell
August 2000

As-Built and Final Inspection Report for the Comprehensive Remedial Action
GE Everett Site
Everett, Massachusetts
Prepared by Eckenfelder/Brown and Caldwell
August 2000

Phase I – Initial Site Investigation and Tier Classification Submittal
378 Commercial Street
Malden, Massachusetts
RTN 3-0590
Prepared by Rizzo Associates, Inc.
August 18, 2000

The Malden River
Past Legacy-Present Opportunities
History of the Malden River
Power Point Presentation
Prepared by Nangle Consulting Associates, Inc.
October 3,2000

401 Water Quality Certification
Little Creek Culvert Extension, W017400
Prepared by Fay, Spofford & Thorndike
April 2001

Application for Special Project Designation
TeleCom City Project Area "Com-Corp"
Commercial Street, Malden
Corporation Way, Medford
Prepared by Mystic Valley Development Commission
April 9, 2001

Site Investigation Summary Report
TeleCom City Parcels 4-1 to 4-6
265 Corporation Way
Prepared by Nangle Consulting Associates, Inc.
August 2001

Report on Phase II Comprehensive Site Assessment, Former Malden MGP Site
Malden, Massachusetts
RTN 3-0362
Tier IB Permit 7378
Prepared by Haley & Aldrich, Inc.
December 2001

Engineering Evaluation/Cost Analysis Non-Time Critical Removal Actions for Former Solvent Chemical Company, Inc.
TeleCom City
Everett-Malden-Medford, Massachusetts
March 2002
Prepared by Nangle Consulting Associates, Inc.

Immediate Response Actions (IRA) Status Report No. 1 through No. 13 and Update Plan
RTNs 3-0362 and 3-13754
West End Brook – Malden River Culverts
Prepared by Haley & Aldrich, Inc
September 1996 through September 2002

Sediment Survey
Mystic/Malden River
(currently ongoing, soon to be released)
Prepared by United States Geologic Survey

Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX C

COST EFFECTIVENESS, INCREMENTAL ANALYSIS AND RESOURCE SIGNIFICANCE

US Army Corps of Engineers®
New England District

MALDEN RIVER

ENVIRONMENTAL RESTORTARATION PROJECT

MEDFORD & EVERETT

MASSACHUSETTS

Appendix C

Cost Effectiveness, Incremental Analysis,

and Resource Significance

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS
01742-2751

May 2007

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INTRODUCTION

The United States Army Corps of Engineers, New England District (USACE/NED), is preparing a feasibility-level study that identifies habitat restoration opportunities in the Malden River, a small urban waterway located in Medford, Malden and Everett, Massachusetts. The principle goals of the study are to identify environmental restoration needs and opportunities in the Malden River, develop plans and cost estimates for restoration alternatives, assess benefits and costs of alternative restoration plans, select a recommended restoration plan, and prepare appropriate NEPA documentation.

This appendix presents the results of a cost effectiveness and incremental cost analysis conducted for the Malden River project. This analysis was done to aid in selection of a National Environmental Restoration Plan (NER). The analysis identifies those restoration plans that are most cost effective in providing environmental benefits (outputs), eliminates inefficient plans, and determines if plans are cost effective. The analysis aids decision making by ensuring that the least cost solution ("Best Buy Plan") is identified for all possible levels of environmental outputs and examines changes in unit cost for increasing levels of environmental output.

Key steps in the analysis are as follows:

- Define Study Area and Environmental Restoration Objectives
- Develop Methods to Quantify Benefits (Habitat Units)
- Formulate Alternatives and Plan Increments
- Determine Cost and Benefits of Each Alternative and Plan Increment
- Conduct Cost Effectiveness Analysis and Incremental Cost Analysis

STUDY AREA AND ENVIRONMENTAL QUALITY OBJECTIVES

The Malden River is a tributary of the Mystic River located within the cities of Malden, Medford, and Everett, Massachusetts (see Environmental Assessment, Figures EA-1 and EA-2). It is a highly engineered waterway, originating at Spot Pond and flowing through a series of interconnected natural and man-made channels and culverts for approximately 3.5 miles before its confluence with the Mystic River. The study area includes about 40 acres of aquatic habitat.

A detailed description of the aquatic and terrestrial environment associated with the Malden River is provided in the Environmental Assessment (EA) prepared for this study. Like many urban waterways, the Malden River is beset by a host of environmental problems. These include poor water quality (low dissolved oxygen), poor sediment quality, loss of aquatic and wetland habitat due to filling and sedimentation, elevated contaminant levels, and proliferation of invasive species.

The primary objective of this study is to restore aquatic habitat quality in the Malden River study area.

UNITS OF MEASUREMENT AND MODELS

Costs

The cost of construction of each alternative was estimated using the USACE's MCACES cost estimating system. The estimates include cost to develop plans and specifications, engineering and design during construction, construction supervision, and a 20 percent contingency (see Appendix C). Operation and maintenance costs over a 50-year project life are included in the estimate.

Benefits

Benefits were measured in habitat units (HU's) using an approach based on USFWS Habitat Evaluation Procedures (HEP) developed for the Malden River Study (see Appendix E). The HEP study was guided by a "HEP Team" composed of representatives from the USACE, MVDC, and Nangle Associates, Inc.

The underlying assumption of HEP is that the value of habitat for an organisms or a guild (a group of organisms that share a similar habitat and use resources in a similar manner) can be described by a Habitat Suitability Index (HSI) model. HSI models typically denote habitat suitability of a species as the relationship between two or more environmental variables that are deemed to affect the species' presence, distribution, and/or abundance. The HSI is defined as a value between 0.0 and 1.0, with 1.0 representing optimum habitat, and assumed to be positively correlated to habitat carrying capacity. The HSI value is multiplied by the area of available habitat (acres) to obtain Habitat Units (HUs). The HU values provide a quantitative estimate of overall habitat benefits.

The Habitat Suitability Index Models, published by the U.S. Fish and Wildlife Service, contain habitat suitability criteria necessary for all life stages of these species for a specific habitat. As noted earlier, many of the essential water quality (as well as physical habitat) criteria are common to several of the various freshwater lacustrine fish species. These include necessary water quality criteria (i.e. pH, turbidity, temperature, dissolved oxygen) and physical/morphological habitat components (e.g. forage, benthic invertebrates). By grouping specific life requisite criteria common to several target species into a single habitat component, a basic life requisite index for any body of water can be obtained. This can then be applied (using a geometric mean) toward additional species-specific criteria necessary for a target species. For other non-fish species, a group of common wetland criteria can be developed and then multiplied by target wetland species criteria (plus the lacustrine component) output in the same manner.

Four ecological guilds were selected for evaluating habitat benefits. They include a benthic invertebrate guild, a fish guild, a piscivorous (fish-eating) wildlife guild, and a wetland/riparian dependant wildlife guild. Two of these guilds, benthic invertebrates and fish, are typically evaluated at the community level. However, specific species are required to evaluate the piscivorous and wetland/riparian guilds. Therefore, species accounts, life history information, site conditions, and plant communities were evaluated to identify species likely to occur in the study area. At least 175 species were identified as likely to occur in the greater study area (Burt and Grossenheider 1976, Godin 1977, Peterson 1980, DeGraaf and Rudis 1983, Ehrlich et al 1988, Whitaker 1988, Conant and Collins 1991, Behler 1995, Stokes and Stokes 1996, Terres 1996). To focus the HEP study, species that did not have existing USFWS and/or Pennsylvania Modified HEP (PAMHEP) HSI models were eliminated from further consideration, narrowing the list to 25 species. Species that were not closely associated with the potential effects (i.e. upland species) or study goals (i.e. not included in one of the four target guilds) were also eliminated. As a result, 8 species remained for further consideration as evaluation species in the HEP study: belted kingfisher (*Cerlye alcyon*), catbird (*Dumetella carolinensis*), slider turtle (*Pseudemys scripta*), raccoon (*Procyon lotor*), yellow warbler (*Dendroica petechia*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothlypis trichas*), and green-backed heron (*Butorides virescens*).

In order to further reduce the list of candidate species and determine which species would best fulfill the goals and objectives of the HEP study, the variables within each species' HSI model were reviewed with regard to their applicability to the Malden River and the proposed restoration alternatives. Specifically, each species model was evaluated to determine its sensitivity to potential project effects, site contaminants, its association with the targeted guilds, and the availability of toxicity and food ingestion data needed to establish links between the site contaminants and their diet. Table C-1 summarizes the justifications for eliminating species from the HEP study. Based on these evaluations, three species were selected for the Malden HEP study: marsh wren, common yellowthroat, and green-backed heron. The marsh wren and common yellowthroat represent the wetland/riparian dependant wildlife guild, and the green-backed heron represents the piscivorous wildlife guild.

Table C-1 Habitat Evaluation Procedure (HEP) Models

Model	*Status*	*Reasons for Selecting or Not Selecting*

Table C-1 Habitat Evaluation Procedure (HEP) Models

Model	*Status*	*Reasons for Selecting or Not Selecting*
Green-backed Heron	Selected	Applies to the piscivourous feeding guild in wetland areas and contains variables that will be affected by the alternatives.
Belted Kingfisher	Not Selected	Suitable nesting habitat must be located within 1.9 miles of the study area or the overall HSI will equal zero. Based on the surrounding land use, it is unlikely that suitable nesting habitat will be present.
Slider Turtle	Not Selected	The USFWS HEP model available for the slider is only pertinent to populations in the southern United States.
Marsh Wren	Selected	Applies to species nesting in herbaceous vegetation (ei.g, *Typha* and *Phragmites*) and contains variables that will be affected by the alternatives.
Common Yellowthroat	Selected	Applies to species inhabiting shrub communities near open water and wetland areas and contains variables that will be affected by the alternatives.
Yellow warbler	Not Selected	Applies only to cover types dominated by shrubs.
Catbird	Not selected	Does not apply to alternatives being considered.
Raccoon	Not Selected	The variables for the raccoon are not sensitive enough to distinguish improvements in habitat based on the alternatives being considered.

USFWS HEP models were used to assess benefits from wetland restoration activities to fishing eating (piscivirous) wildlife (Green Heron) and wetland dependent songbirds (Common Yellow Throat and Wren). The assessment of benefits from benthic habitat restoration relied on a sediment toxicity model by Ingersoll et. al. (2000) that relates sediment toxicity to benthic invertebrates to concentrations of PAHs, metals, and PCBs in sediment. The fish habitat restoration HU's were based on area (in acres) available to anadromous fish species following increased fish passage efficiency, the quality of which is equal across all alternatives (e.g. 1.0).

An incremental cost analysis examines how the costs of additional units of environmental output increase as the level of environmental output increases. For this analysis, the environmental outputs are measured in habitat units. The analysis is in accordance with IWR Report 95-R-1, Evaluation of Environmental Investments Procedures Manual-Interim: Cost Effectiveness and Incremental Cost Analyses, May 1995. The program IWR-PLAN, developed for the Institute for Water Resources (IWR), was used to conduct the analysis.

An incremental cost curve can be identified by displaying cost effective solutions. Cost effective solutions are those increments that result in same output, or number of habitat units, for the least cost. An increment is cost effective if there are no others that cost less and provide the same, or more, habitat units. Alternatively, for a given increment cost, there will be no other increments that provide more habitat units.

ENVIRONMENTAL PLAN INCREMENTS

Measures to improve environmental conditions in the river include wetland restoration, wetland creation, dredging of contaminated sediments, and fish passage restoration and habitat enhancement. These measures were combined to form 276 alternative restoration plans. A summary of the Best Buy Plans is discussed in the Incremental Analysis section.

RESOURCE SIGNIFICANCE

Policy Guidance

Ecosystem restoration is one of the primary missions of the USACE's Civil Work program (ER 1165-2-501 – Civil Works Ecosystem Restoration Policy). The primary objective of USACE ecosystem restoration efforts is to partially or fully restore a naturalistic, functioning, and self-regulating ecosystems. Restoration of wetlands, other aquatic systems, and riparian areas are most appropriate for USACE involvement. USACE restoration initiatives may also include measures to protect ecosystems from further degradation. Ecosystem restoration and protection initiatives should be conceived in the context of broader watershed management objectives, which may include collaboration with other federal and non-federal agencies, local communities, and other stakeholders.

USACE regulations require the careful evaluation of ecosystem restoration alternatives to assure that a cost effective plan is selected. Information used in selecting the recommended NER plan includes an analysis of the plans outputs (benefits), costs, significance, acceptability to the public and resource agencies, and other factors. Any adverse impacts of the restoration plan are also considered in the evaluation.

Significance

Information on the significance of ecosystem outputs also helps determine whether the value of the benefits of the proposed plan is worth the costs incurred to produce them. Significance of restoration benefits includes an assessment of the institutional, public, and technical support or recognition for an alternative's ecological outputs.

Although the most important evidence of the recognition of the Malden River ecosystem as an important environmental resource is in terms of institutional and public importance, there is also strong technical recognition of the aquatic habitats propose to be restored.

Institutional Recognition

Habitat degradation along the Malden River has concerned public agencies since the 1970's. Numerous investigations by local, state, and federal agencies demonstrate a longstanding interest in the area and concerns about habitat degradation and deterioration of the river and its surrounding wetlands.

The aquatic habitat outputs from the separable elements of the NED and NER plans represent resources of federal significance and institutionally recognized in the Clean Water Act (vegetated wetlands). The additional benefits of forage and passage to spawning grounds for anadromous fish make restoration a critical federal interest in this highly urbanized watershed. Federal interest in establishment and protection of anadromous fish is recognized in the Anadromous Fish Conservation Act and the Fish and Wildlife Conservation Act. Federal interest in invasive species control (*Phragmites*) is institutionally recognized by Executive Order 13112 of February 3, 1999 -- Invasive Species.

Public Recognition

The USACE Environmental Operating Principles strives to achieve environmental sustainability by seeking balance and synergy among human development activities and natural systems. This can be accomplished by designing economic and environmental solutions that supports and reinforces one another.

Public recognition means that some segment of the public recognizes the importance of an environmental resource, as evidenced by people engaged in activities that reflect an interest or concern for that particular resource. Such activities may involve membership in an organization, financial contributions to resource-related efforts, providing volunteer labor and correspondence regarding the importance of the resource.

The Mystic Valley Development Commission (MVDC) is a tri-city legislative body established by the Commonwealth of Massachusetts and approved by the cities of Malden, Medford and Everett to address commonly shared issues such as land development and river restoration. The cities of Malden, Medford and Everett with combined population of 142,000 have embarked on a regional technology development project involving reclamation of 200 acres of industrial land that has supported abroad spectrum of power generation and chemical production facilities for over a century. These entities, as well as other riverfront property owners, watershed associations and citizens of the three host communities share a common goal of restoring this long neglected Malden River Corridor through the construction of public parkland, employment and residential opportunities. The MVDC has partnered with the USACE to conduct a feasibility study to determine possible restoration efforts for the Malden River ecosystem. River's Edge (formerly TeleCom City), a MVDC master-planned development, is being pursued as a public-private partnership that will include office, research & development, manufacturing facilities and approximately 60 acres of public open space. This proposed open space, the Malden River Park, would include a riverside trail, river overlooks and a canoe launch. This River Park is expected to bring members of the community to the river area for recreational/leisure purposes. Therefore, restoration and remediation of the Malden River are critical to the success of the overall project and to the protection of public health.

The public also expresses its recognition of resources significance through membership in many local, regional, state, national and international organization (e.g., Ducks Unlimited, local Chapter of the Nature Conservancy, Mystic River Watershed Association, the National Audubon Society); and through participation in many activities, whether they be resource-specific (e.g., focusing on the river, a type of fish, a watershed), user based (e.g., fishing, bird-watching, hiking, camping), or conservation or management-based.

Public and agency records and scoping meetings with the public as well as non-profit organizations clearly exhibit Public Recognition significance of the proposed alternatives.

Technical Recognition

Technical recognition means that the resources qualify as significant based on an objective scientific evaluation. Significance may vary with spatial scale. For the Malden River, significance was evaluated on the watershed scale and regional landscape scale. USACE planning guidance recommends description of technical significance in terms of one or more of the following ecological concepts: scarcity, representativeness, status and trends, connectivity, critical habitat, and biodiversity. Application of each of these concepts to the Malden River is discussed below.

Scarcity: Scarcity is a measure of the relative abundance of a resource within a geographic area. The Malden River provides about 140 acres of aquatic and wetland habitat in an otherwise heavily developed urban landscape. The river is the only remaining area in Malden that still provides significant aquatic and riparian habitat, including spawning habitat for anadromous fish. Other streams that once flowed freely in the area were culverted long ago and cannot be restored due to dense urbanization. On the watershed scale and regional scale, the Malden River is thus unique, irreplaceable, and highly significant. The rivers' significance is further enhanced because it provides anadromous fish spawning habitat (a scarce resource of regional and national significance).

Status and Trends: This concept involves evaluating how the resource has been altered over time, its current conditions, and prospects for the future. The Malden River system is a remnant of an extensive tidal wetland system, much of which was filled in during the 19th century. The remaining habitat is currently highly degraded, and remains in decline due to proliferation of *Phragmites*, sedimentation, and continued contaminant loading. Without action, conditions are expected to worsen considerably, with lower dissolved oxygen levels, and further loss of aquatic habit due to sedimentation and *Phragmites* expansion. USACE policy guidance indicates that sites with declining trends are more significant than sites that are recovering without human intervention. The Malden River can be considered technically significant since without human intervention there is no potential for recovery of the resource and every reason to expect continued degradation.

Connectivity: This concept involves the degree of linkage of resource areas within a watershed or larger landscape content. The value of natural areas is enhanced by existence of habitat corridors that allow for movement and dispersal of native species between resource areas. Restoration alternatives that improve connectivity are considered technically significant. Restoration of in-stream, wetland and riparian habitat along the Malden River will be significant in providing a resting area (habitat island) for migratory songbirds passing through the highly urbanized Malden-Medford-Everett area. As a tidal riverine system, restoration of the Malden River provides and essential link between freshwater and estuarine and marine habitats. Restoration of fish passage and carrying capacity will link anadromous fish to their spawning grounds.

Limiting Habitat: This is habitat that is essential for the conservation, survival, or recovery of one species listed as rare or endangered under the federal endangered species act or other significant federally listed species. The Malden and Mystic Rivers provide potential spawning habitat for the Blue-black Herring and possible spawning habitat for other anadromous species. This qualifies it as "Essential Fish Habitat" under the Magnuson Stevenson Fisheries Management Act. Given the scarcity of anadromous fish spawning and rearing habitat in the greater Boston area, restoration of the Malden River is considered technically significant.

Biodiversity: The concept of biodiversity concerns the number of the species found in a community (species richness) and the distribution of individuals among species (i.e. how evenly the total number of individuals is divided among species). Restoration alternatives that improve biodiversity (either species richness or evenness) are considered technically significant. The NED/NER plan would eradicate *Phragmites*, increasing the biodiversity (species richness) of emergent wetland and riparian communities. Removal of contaminated sediments would likely increase diversity of the benthic community, by increasing both the number of species and reducing the dominance of tubificid worms and oligiochaetes. Based on these criteria, restoration of the Malden River is considered technically significant.

References

Ingersoll, C.G. et al. *Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines.* USGS Report to USEPA Great Lakes National Program Office. EPA/905/R-00-007

U.S. Army Corps of Engineers, 1995. *Evaluation of Environmental Investments Procedures Manual-Interim: Cost Effectiveness and Incremental Cost Analyses*. IWR Report # 95-R-1.

U.S. Environmental Protection Agency. 1986. *Quality Criteria for Water 1986.* EPA 440/5-86-001.

INCREMENTAL ANALYSIS

The costs of the alternative restoration plans are compared with the environmental benefits, within the framework of an incremental cost analysis, to identify the most cost effective alternatives. An incremental cost analysis examines how the costs of additional units of environmental output increase as the level of environmental output increases. For this analysis, the environmental outputs are measured in habitat units. The analysis is in accordance with IWR Report 95-R-1, Evaluation of Environmental Investments Procedures Manual-Interim: Cost Effectiveness and Incremental Cost Analyses, May 1995; and ER 1105-2-100, Planning Guidance Notebook, Section 3-5, Ecosystem Restoration, April 2000. The program IWR-PLAN, developed for the Institute for Water Resources (IWR), was used to conduct the analysis.

An incremental cost curve can be identified by displaying cost effective solutions. Cost effective solutions are those increments that result in the same output, or number of habitat units, for the least cost. An increment is cost effective if there are no others that cost less and provide the same, or more, habitat units. Alternatively, for a given incremental cost, there will be no other increments that provide more habitat units at the same, or lower, cost.

There are five management plans being evaluated to improve environmental conditions in the Malden River. They are removal of invasive species, removal of invasive species coupled with restoration of wetlands, creation of wetlands, placement of gravel or sand, and provision for fish passage. Project description, project cost, and the number of habitat units created by each plan are shown in Table 1. Costs are discounted at an interest rate of 5 1/8 %. This interest rate, as specified in the Federal Register, is to be used by Federal agencies in the formulation and evaluation of water and land resource plans for the period October 1, 2005 to September 30, 2006. The project economic life is considered to be 30 years.

Column 1 shows plan designators as shown in the IWR-Plan program. Column 2 is a brief description of each plan. Column 3 shows total project implementation cost including interest during construction (IDC). Column 4 shows habitat units (HU) relative to the no action alternative. With the exception of fish passage, the other four management plans are evaluated over six sub-areas. Plans A through E involve the removal of invasive species in sub-areas 2 through 6. Plans F though J add restoration of wetlands to plans A through E. These plans are evaluated sub-areas 2 through 6. Plan K provides for the creation of wetlands in sub-area 4 only. Plans L through P provide for placement of sand/gravel in sub-areas 1 and 3 through 6. Plan Q would allow for the operation of a fish passage at the Amelia Earhardt dam. HU were developed using a Habitat Evaluation Procedures (HEP) analysis.

Table 1. Alternatives Cost and Output

IWR-Plan Designator	Description	Cost ($000)	HU
A1	Total Remove Invasive Species SA 2	792.7	0.54
B1	Total Remove Invasive Species SA 3	1,096.8	0.67
C1	Total Remove Invasive Species SA 4	1,443.9	1.02
D1	Total Remove Invasive Species SA 5	1,091.3	2.57
E1	Total Remove Invasive Species SA 6	8,080.1	4.12
F1	Rem Inv Species & Restore Wetland SA 2	812.1	3.65
G1	Rem Inv Species & Restore Wetland SA 3	1,150.4	8.52
H1	Rem Inv Species & Restore Wetland SA 4	1,500.5	9.26
I1	Rem Inv Species & Restore Wetland SA 5	1,137.1	12.05
J1	Rem Inv Species & Restore Wetland SA 6	8,279.7	39.41
K1	Create Wetland SA 4	1,322.2	15.71
L1	Place Gravel/Sand SA 1	7.8	0.70
M1	Place Gravel/Sand SA 3	75.1	0.69
N1	Place Gravel/Sand SA 4	76.7	0.84
O1	Place Gravel/Sand SA 5	48.7	0.42
P1	Place Gravel/Sand SA 6	84.1	0.79
Q1	Fish Passage	716.4	49.04

Project cost derivation is shown in Table 2. First cost includes all contingencies, overheads, real estate and study costs (Plans & Specifications). Interest during construction (IDC) is then calculated assuming a construction period of 12 months for each alternative. IDC is an economic cost and not a financial cost. It needs to be estimated for purposes of project justification, however it is not a financial cost that will need to be cost shared. Essentially, IDC represents the opportunity cost of funds tied up in investments, before these investments begin to yield benefit. Once project benefit starts IDC stops.

Table 2. Project Cost ($000)

No.	First Cost	IDC	First Project Cost	OM&R Cost	Total Project Cost	Construct. Period (months)
A1	774.2	18.4	792.7	0.0	792.7	12
B1	1,071.3	25.5	1,096.8	0.0	1,096.8	12
C1	1,410.3	33.6	1,443.9	0.0	1,443.9	12
D1	1,065.9	25.4	1,091.3	0.0	1,091.3	12
E1	7,892.1	188.0	8,080.1	0.0	8,080.1	12
F1	793.2	18.9	812.1	0.0	812.1	12
G1	1,123.6	26.8	1,150.4	0.0	1,150.4	12
H1	1,465.6	34.9	1,500.5	0.0	1,500.5	12
I1	1,110.6	26.5	1,137.1	0.0	1,137.1	12
J1	8,087.0	192.7	8,279.7	0.0	8,279.7	12
K1	1,291.4	30.8	1,322.2	0.0	1,322.2	12
L1	7.6	0.2	7.8	0.0	7.8	12
M1	73.4	1.7	75.1	0.0	75.1	12
N1	74.9	1.8	76.7	0.0	76.7	12
O1	47.5	1.1	48.7	0.0	48.7	12
P1	82.1	2.0	84.1	0.0	84.1	12
Q1	0.0	0.0	0.0	716.4	716.4	0

Figure 1 shows all cost effective plans and best buy plans. The vertical axis represents thousands of dollars. The incremental analysis identified 276 (out of a possible 31,104) alternatives as cost effective plans. A plan is not cost effective if compared with another alternative, it provides fewer or the same number of habitat units at a higher cost. Best buy plans are a subset of cost effective plans. For each best buy plan there are no other plans that will give the same level of output at a lower incremental cost. There are 13 best buy plans including the no action alternative.

Figure 2 shows best buy plans that comprise the incremental cost curve. As in Figure 1, the horizontal axis represents habitat units created by each project. However, the vertical axis represents the incremental cost per incremental output as output increases with project size. The units on the vertical axis are thousands of dollars. Best buy plans are a subset of cost effective plans. For each best buy plan there are no other plans that will give the same level of output at a lower incremental cost. There are 13 best buy plans labeled in Figure 2 by their HU and cost.

Figure 1
Cost Effective Plans

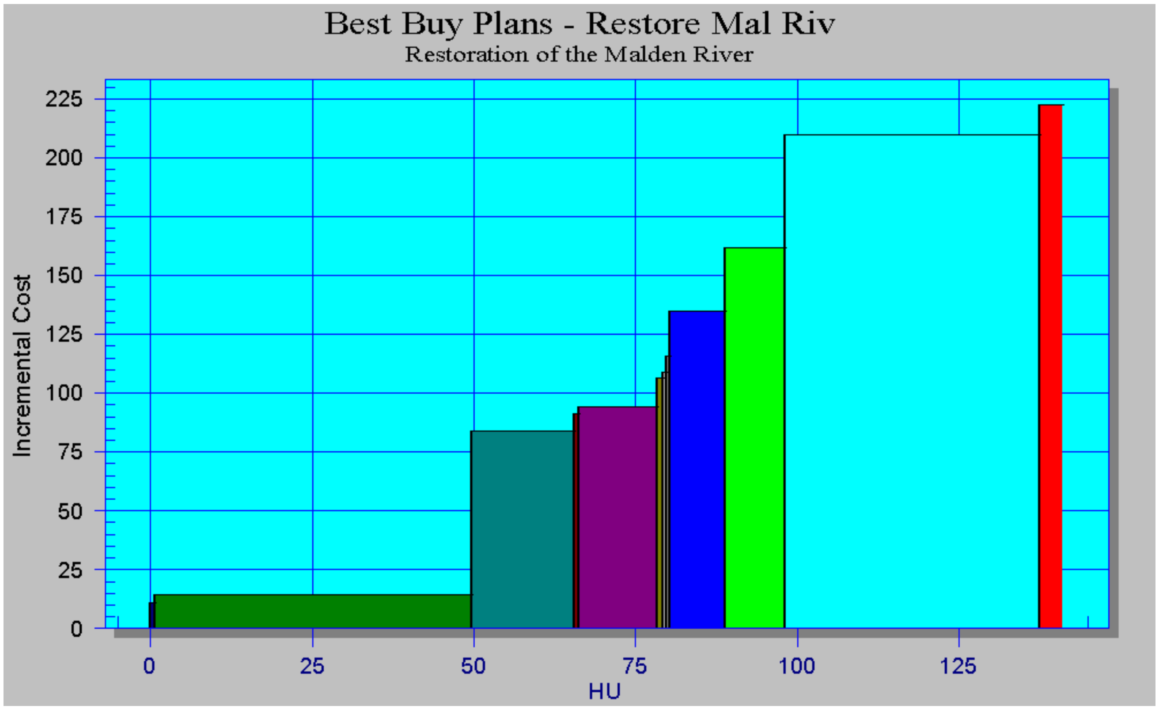

Figure 2
Best Buy Plans

There are 13 increments that comprise the best buy plan curve. The derivative process of the best buys is as follows:

- The first increment is the no action alternative that provides no additional HU with zero cost.
- The second increment provides for the placement of sand or gravel in Sub-area 1. This plan would yield 0.7 HU at a cost of $7,800.
- The third increment provides for the operation of a fish ladder combined with the placement of sand or gravel in Sub-area 1. This plan would provide an additional 49.04 HU with an additional cost of $716,400, resulting in a cost per HU of $14,600.
- The fourth increment is similar to the third with the addition of wetland creation in Sub-areas 3 & 4. This plan would provide an additional 15.71 HU with an additional cost of $1,322,200, resulting in a cost per HU of $84,200.
- The fifth increment would add to increment 4 the placement of sand or gravel in Sub-area 4. This plan would provide an additional 0.84 HU at an additional cost of $76,700, resulting in a cost per HU of $91,300.
- The sixth increment is the same as Increment 5 with the addition of removal of invasive species and restoration of wetlands in Sub-area 5. This plan results in an additional 12.05 HU and an additional cost of $1,137,100 for an incremental cost of $94,400 per HU.
- The seventh increment is the same as Increment 6 with the addition of sand and gravel placed in Sub-area 6. This plan would provide for an additional 0.79 HU at a cost of an additional $84,100, resulting in a cost per HU of $106,500.
- The eighth increment is the same as Increment 7 with the addition of sand and gravel placed in Sub-area 2. This plan would provide for an additional 0.69 HU at a cost of an additional $75,100, resulting in a cost per HU of $108,500.
- The ninth increment is the same as Increment 8 with the addition of sand and gravel placed in Sub-area 5. This plan would provide for an additional 0.42 HU at a cost of an additional $48,700, resulting in a cost per HU of $116,000.
- The tenth increment is the same as Increment 9 with the addition of the removal of invasive species and wetland restoration in Sub-area 3. This plan would provide for an additional 8.52 HU at a cost of an additional $1,150,400, resulting in a cost per HU of $135,000.
- The eleventh increment is the same as Increment 10 with the addition of the removal of invasive species and wetland restoration in Sub-area 4. This plan would provide for an additional 9.26 HU at a cost of an additional $1,500,500, resulting in a cost per HU of $162,000.

- The twelfth increment is the same as Increment 11 with the addition of the removal of invasive species and wetland restoration in Sub-area 6. This plan would provide for an additional 39.41 HU at a cost of an additional $8,279,700, resulting in a cost per HU of $210,100.
- The thirteenth increment, the last increment, adds removal of invasive species and wetland restoration in Sub-area 2 to Increment 12. This plan would provide for an additional 3.65 HU at a cost of an additional $812,100 resulting in a cost per HU of $222,500.

The best buy plan curve is the incremental cost curve. Incremental cost and incremental output are the changes in cost and output when the cost and output of each successive plan in terms of increasing output are compared. Incremental cost per output is the change in cost divided by the change in output, or incremental output, when proceeding to plans with higher levels of output. Table 3 shows incremental cost per habitat unit for each best buy alternative.

Table 3. Incremental Cost Curve ($000).

Increment	Plan	HU	Cost	Incremental Cost	Incremental Output	Cost Per Output
1	A0B0C0D0E0F0G0H0I0J0K0L0M0N0O0P0Q0	0.00	0.0	0.0	0	0.0
2	A0B0C0D0E0F0G0H0I0J0K0L1M0N0O0P0Q0	0.70	7.8	7.8	0.7	11.1
3	A0B0C0D0E0F0G0H0I0J0K0L1M0N0O0P0Q1	49.74	724.2	716.4	49.04	14.6
4	A0B0C0D0E0F0G0H0I0J0K1L1M0N0O0P0Q1	65.45	2,046.4	1,322.2	15.71	84.2
5	A0B0C0D0E0F0G0H0I0J0K1L1M0N1O0P0Q1	66.29	2,123.1	76.7	0.84	91.3
6	A0B0C0D0E0F0G0H0I1J0K1L1M0N1O0P0Q1	78.34	3,260.2	1,137.1	12.05	94.4
7	A0B0C0D0E0F0G0H0I1J0K1L1M0N1O0P1Q1	79.13	3,344.3	84.1	0.79	106.5
8	A0B0C0D0E0F0G0H0I1J0K1L1M1N1O0P1Q1	79.82	3,419.4	75.1	0.69	108.8
9	A0B0C0D0E0F0G0H0I1J0K1L1M1N1O1P1Q1	80.24	3,468.1	48.7	0.42	116.0
10	A0B0C0D0E0F0G1H0I1J0K1L1M1N1O1P1Q1	88.76	4,618.5	1,150.4	8.52	135.0
11	A0B0C0D0E0F0G1H1I1J0K1L1M1N1O1P1Q1	98.02	6,119.0	1,500.5	9.26	162.0
12	A0B0C0D0E0F0G1H1I1J1K1L1M1N1O1P1Q1	137.43	14,398.7	8,279.7	39.41	210.1
13	A0B0C0D0E0F1G1H1I1J1K1L1M1N1O1P1Q1	141.08	15,210.8	812.1	3.65	222.5

In the incremental cost curve (shaded area in Table 3), incremental cost per unit increases with output, or habitat units. Development of the incremental cost curve facilitates the selection of the best alternative. *The question that is asked at each increment is: is the additional gain in environmental benefit worth the additional cost?* In this study, the incremental cost curve consists of 13 points. The largest relative increase in the curve occurs between Increments 3 and 4, an increase of approximately 83 percent. The National Environmental Restoration Plan appears to be increment 11. The Best Buy Plan 12 incremental cost increases about 30 percent between Increment 11 and Increment 12. Additionally, project cost increases from $6,119,000 to $14,398,700, an increase of about 135 percent.

Increment 11 would provide for the removal of invasive species and wetland restoration in Sub-areas 3, 4, and 5; the creation of wetlands in Sub-Area 4; the placement of sand or gravel in Sub-Areas 1, 3, 4, 5, and 6; and the operation of a fish passage.

INCREMENTAL ANALYSIS SUMMARY

The results of the cost effectiveness and incremental cost analyses indicate that there are 276 cost effective alternative restoration plans. Utilizing the output assessment method, there are thirteen (13) Best Buy Plans for consideration. With the exception of Best Buy Plan 2, all Best Buy Plans contain the operational changes at Amelia Earhart Dam component (Q1).

Another common component to all with the exception of Best Buy Plans 2 and 3 is the wetland creation element (K1). This measure provides an output of 15.71 habitat units at a cost of $1,137,100.

Best Buy Plans 6 through 9 consists of the wetland creation (K1) and the removal of invasive species with replanting of native species in sub-area 5 (I1) components in each. An additional fish substrate placement sub-area is added incrementally. The cost of these plans range from $3,260,200 to $3,468,100 with habitat units ranging from 78.34 to 80.24.

Best Buy Plans 9 through 11 warrants consideration as the National Environmental Restoration Plan. Each plan contains the wetland creation (K1), and fish substrate placement in sub-areas 1, 3, 4, 5, and 6. However, Plan 9 contains the removal of invasive species with replanting of native species in sub-area 5 (I1), Plan 10 contains the removal of invasive species with replanting of native species in sub-area 3 and 5 (G1, I1), and Plan 11 contains the removal of invasive species with replanting of native species in sub-area 3, 4 and 5 (G1, H1, I1).

The Best Buy Plan 12 incremental cost increases about 30 percent between Increment 11 and Increment 12. Additionally, project cost increases from $6,119,000 to $14,398,700, an increase of about 135 percent.

Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX D

MCACES COST ESTIMATES

US Army Corps
of Engineers®
New England District

TOTAL PROJECT COST SUMMARY

THIS ESTIMATE IS BASED ON THE THE SCOPE CONTAINED IN THE DECISION DOCUMENT DATED: JULY 2007

PROJECT:	MALDEN RIVER ECOSYSTEM RESTORATION					PREPARED BY:		MICHAEL REMY			
LOCATION:	MALDEN, MEDFORD & EVERETT. MASSACHUSETTS					P.O.C.:		CHRISTOPHER J LINDSAY, 978-318-8472			
		BASELINE ESTIMATE: 23 Feb 2007				AUTHORIZ/BUDGET YEAR: 2008			FULLY FUNDED ESTIMATE		
WORK		EFFECTIVE PRICING LEVEL: 23 Feb 2007				EFFECTIVE PRICING LEVEL: 2008			FY 2008		
BREAKDOWN	FEATURE DESCRIPTION	COST	CNTG	CNTG	TOTAL	COST	CNTG	TOTAL	COST	CNTG	FULL
STRUCTURE		($K)	($K)	(%)	($K)	($K)	($K)	($K)	($K)	($K)	($K)
06.03.73.01	MOB/DEMOB	225	45	20.00%	270	233	46.6	279.6	233	46.6	279.6
06.03.73.02	FISH SUBSTRATE	265	53	20.00%	318	274	54.8	328.8	274	54.8	328.8
06.03.73.03	INVASIVE SPECIES REMOVAL	2141	428.2	20.00%	2569.2	2216	443.2	2659.2	2216	443.2	2659.2
06.03.73.04	NATIVE SPECIES PLANTING	126	25.2	20.00%	151.2	130	26	156	130	26	156
06.03.73.05	WETLAND CREATION - FILL	1282	256.4	20.00%	1538.4	1327	265.4	1592.4	1327	265.4	1592.4
06.03.73.06	DEBRIS REMOVAL	90	18	20.00%	108	93	18.6	111.6	93	18.6	111.6
	TOTAL CONTRUCTION COSTS	**4129**	**825.8**		**4954.8**	**4273**	**854.6**	**5127.6**	**4273**	**854.6**	**5127.6**
01----	REAL ESTATE	500	-	-	500	518	-	518	518	-	518
30----	ENGINEERING AND DESIGN	99	-	-	99	102	-	102	102	-	102
31----	CONSTRUCTION MANAGEMENT	303	-	-	303	314	-	314	314	-	314
	TOTAL PROJECT COSTS	**5031**	**825.8**	20.00%	**5856.8**	**5207**	**854.6**	**6061.6**	**5207**	**854.6**	**6061.6**
							TOTAL FEDERAL COSTS			65%	**$3,940**
							TOTAL NON-FEDERAL COSTS			35%	**$2,122**

DISTRICT APPROVED:

Christopher J Lindsay CHIEF, COST ENGINEERING

10/23/07

DIVISION APPROVED:

______________________ CHIEF, COST ENGINEERING

______________________ APPROVED DATE:

Malden River Restoration Project
A river restoration project
consisting of debri removal,
wetland restoration and wetland
creation.

Designed By: CENAE
Estimated By: CENAE-MR

Prepared By: CENAE-MR

Preparation Date: 02/23/07
Effective Date of Pricing: 02/23/07
Est Construction Time: 730 Days

Sales Tax: 0.0%

Revised Notes 2/23/07:

This is a feasibility level estimate for a river way restoration of the lower Malden River. The estimate includes a 20% contingency. There are six sub-areas to be restored. Each of the six sub-areas have various remediation alternatives, such as: invasive species removal (phragmites, brush and trees), wetland restoration (planting), debri removal, wetland creation (filling), and gravel/sand replacement. Costs are based on cost quide references such as Means Construction Cost Guide, MCACES National Cost Book, and historical information.

Removal of shore debri consists of trash, scrap metal parts, abandoned automobiles and various other discarded materials. Some areas from which debri is removed will require installation of a clean gravel/soil cover. Some areas of wetland will be created by filling, grading and planting. The following markups are applied to the estimate:10% overhead, 7% office overhead, 10% profit, 2.0% bond, 15% cost growth/data base correction), 3% escalation (1 year), 20%(feasibility level)contingency, 6% S&A and 2% E&D.

Assumptions:

1. Assume staging area for materials and equipment will be a 2 acre area adjacent to site #3.

2. There are six areas of restoration in this esitmate. There is only one Mob and Demob contract cost included in this estimate and it is shown in area number three.

3. All areas of phragmites will have the roots and soil removed to a depth of 18", and will be hauled to area 5 and used as fill in the wetland creation area. All areas of clearing and grubbing of phragmites will be capped with 12" on new soil.

4. All areas from which brush and trees are removed will be grubbed to remove roots and stumps to a depth of 18", and the existing soils will be regraded. No backfill of new soils will be required.

5. Wetland [planting) consists of grass like plants such sedges and rushes planted equally spaced at 24" OC.

6. Assume wetland creation(filling) consists of installing 1.5' deep phrag stalk, phrag root and soil fill, 1' deep gravel fill and 6" deep topsoil cover.

7. Assume 24 month construction period.

8. Assume all debri/trash removed removed from the site can be disposed of in a non hazardous waste landfill.

9. Assume all brush, trees, stumps and roots will be ground or chipped back on to the upland area and will become mixed into soil during re-grading.

14 AUGUST 2007 UPDATE : CHRIS LINDSAY

Labor cost updated using Gen Wage Decision MA18, dated July 6, 2007. Equipment rates reviewed and factors (fuel especially) updated to current rates. Material cost reviewed and compared with recent State of MA bid data in the region and were judged reflective of current costs. These changes resulted in a significant increase in project costs even after the data base adjustment was removed.

** PROJECT OWNER SUMMARY - Feature (Rounded to 100's) **

	QUANTY	UOM	CONTRACT	CONTINGN	E&D	S&A	ESCALATN	TOTAL COST	UNIT
33 Restoration Sub Area 1									
33.21 Gravel/Sand Placement	0.07	ACR	6,800	1,400	200	500	300	9,200	130819
TOTAL Restoration Sub Area 1	1.00	EA	6,800	1,400	200	500	300	9,200	9157.31
35 Restoration Sub Area 3									
35.01 Mob, Demob & Work Storage Yard	1.00	EA	224,900	45,000	5,400	16,500	10,200	302,000	301989
35.02 Invasive Species Removal	1.37	ACR	103,600	20,700	2,500	7,600	4,700	139,100	101545
35.21 Gravel/Sand Placement	0.68	ACR	67,700	13,500	1,600	5,000	3,100	91,000	133767
35.26 Wetland Restoration (Planting)	1.00	EA	17,600	3,500	400	1,300	800	23,600	23622
35.31 Debri Removal, Testing, Misc.	1.37	ACR	27,200	5,400	700	2,000	1,200	36,500	26677
TOTAL Restoration Sub Area 3	1.00	EA	441,000	88,200	10,600	32,400	20,000	592,200	592237
36 Restoration Sub Area 4									
36.02 Invasive Species Removal	6.31	ACR	967,100	193,400	23,200	71,000	43,900	1,298,700	205821
~~36.19 Wetland Creation (filling)~~	~~5.37~~	~~ACR~~	~~1,282,300~~	~~256,500~~	~~30,800~~	~~94,200~~	~~58,200~~	~~1,722,000~~	~~320667~~
36.21 Gravel/Sand Placement	0.81	ACR	76,700	15,300	1,800	5,600	3,500	103,000	127162
36.26 Wetland Restoration (Planting)	1.00	EA	69,000	13,800	1,700	5,100	3,100	92,600	92637
36.31 Debri Removal, Testing, Misc.	1.00	EA	34,700	6,900	800	2,600	1,600	46,600	46631
TOTAL Restoration Sub Area 4	1.00	EA	2,429,900	486,000	58,300	178,500	110,300	3,263,000	3262986
37 Restoration Sub Area 5									
37.02 Invasive Species Removal	7.24	ACR	1,070,600	214,100	25,700	78,600	48,600	1,437,600	198570
37.21 Gravel/Sand Placement	0.44	ACR	41,700	8,300	1,000	3,100	1,900	56,000	127167
37.26 Wetland Restoration (Planting)	1.00	EA	39,000	7,800	900	2,900	1,800	52,400	52405
37.31 Debri Removal, Testing, Misc.	1.00	EA	28,200	5,600	700	2,100	1,300	37,800	37809
TOTAL Restoration Sub Area 5	1.00	EA	1,179,400	235,900	28,300	86,600	53,600	1,583,800	1583816
38 Restoration Sub Area 6									
38.21 Gravel/Sand Placement	0.76	ACR	71,900	14,400	1,700	5,300	3,300	96,600	127129
TOTAL Restoration Sub Area 6	1.00	EA	71,900	14,400	1,700	5,300	3,300	96,600	96618
TOTAL Malden River Restoration Project	1.00	EA	4,129,100	825,800	99,100	303,200	187,500	5,544,800	5544814

Malden River Restoration Project
A river restoration project
consisting of debri removal,
wetland restoration and wetland
creation.

Designed By: CENAE
Estimated By: CENAE-MR

Prepared By: CENAE-MR

Preparation Date: 02/23/07
Effective Date of Pricing: 02/23/07
Est Construction Time: 730 Days

Sales Tax: 0.0%

Revised Notes 2/23/07:

This is a feasibility level estimate for a river way restoration of the lower Malden River. The estimate includes a 20% contingency. There are six sub-areas to be restored. Each of the six sub-areas have various remediation alternatives, such as: invasive species removal (phragmites, brush and trees), wetland restoration (planting), debri removal, wetland creation (filling), and gravel/sand replacement. Costs are based on cost quide references such as Means Construction Cost Guide, MCACES National Cost Book, and historical information.

Removal of shore debri consists of trash, scrap metal parts, abandoned automobiles and various other discarded materials. Some areas from which debri is removed will require installation of a clean gravel/soil cover. Some areas of wetland will be created by filling, grading and planting. The following markups are applied to the estimate:10% overhead, 7% office overhead, 10% profit, 2.0% bond, 15% cost growth/data base correction), 3% escalation (1 year), 20%(feasibility level)contingency, 6% S&A and 2% E&D.

Assumptions:

1. Assume staging area for materials and equipment will be a 2 acre area adjacent to site #3.

2. There are six areas of restoration in this esitmate. There is only one Mob and Demob contract cost included in this estimate and it is shown in area number three.

3. All areas of phragmites will have the roots and soil removed to a depth of 18", and will be hauled to area 5 and used as fill in the wetland creation area. All areas of clearing and grubbing of phragmites will be capped with 12" on new soil.

4. All areas from which brush and trees are removed will be grubbed to remove roots and stumps to a depth of 18", and the existing soils will be regraded. No backfill of new soils will be required.

5. Wetland [planting) consists of grass like plants such sedges and rushes planted equally spaced at 24" OC.

6. Assume wetland creation(filling) consists of installing 1.5' deep phrag stalk, phrag root and soil fill, 1' deep gravel fill and 6" deep topsoil cover.

7. Assume 24 month construction period.

8. Assume all debri/trash removed removed from the site can be disposed of in a non hazardous waste landfill.

9. Assume all brush, trees, stumps and roots will be ground or chipped back on to the upland area and will become mixed into soil during re-grading.

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

** PROJECT OWNER SUMMARY - Contract **

		QUANTY	UOM	CONTRACT	CONTINGN	CST GROW	ESCALATN	TOTAL COST	UNIT
33	Restoration Sub Area 1	1.00	EA	26,152	5,230	4,707	1,083	40,191	40191
34	Restoration Sub Area 2	1.00	EA	220,798	44,160	39,744	9,141	339,326	339326
35	Restoration Sub Area 3	1.00	EA	337,142	67,428	60,686	13,958	518,126	518126
36	Restoration Sub Area 4	1.00	EA	1,948,795	389,759	350,783	80,680	2,994,943	2994943
37	Restoration Sub Area 5	1.00	EA	970,948	194,190	174,771	40,197	1,492,170	1492170
38	Restoration Sub Area 6	1.00	EA	1,824,779	364,956	328,460	75,546	2,804,352	2804352
TOTAL	Malden River Restoration Project	1.00	EA	5,328,614	1,065,723	959,151	220,605	8,189,108	8189108

** PROJECT OWNER SUMMARY - Feature **

	QUANTY	UOM	CONTRACT	CONTINGN	CST GROW	ESCALATN	TOTAL COST	UNIT
33 Restoration Sub Area 1								
33.21 Gravel/Sand Placement	0.07	ACR	5,688	1,138	1,024	235	8,741	124871
33.26 Debri Removal, Testing, Misc.	1.00	EA	20,464	4,093	3,684	847	31,450	31450
TOTAL Restoration Sub Area 1	1.00	EA	26,152	5,230	4,707	1,083	40,191	40191
34 Restoration Sub Area 2								
34.02 Invasive Species Removal	1.29	ACR	186,420	37,284	33,556	7,718	286,493	222088
34.26 Wetland Restoration (Planting)	1.00	EA	13,914	2,783	2,504	576	21,383	21383
34.30 Debri Removal, Testing, Misc.	1.00	EA	20,464	4,093	3,684	847	31,450	31450
TOTAL Restoration Sub Area 2	1.00	EA	220,798	44,160	39,744	9,141	339,326	339326
35 Restoration Sub Area 3								
35.01 Mob, Demob & Work Storage Yard	1.00	EA	162,163	32,433	29,189	6,714	249,215	249215
35.02 Invasive Species Removal	1.37	ACR	79,221	15,844	14,260	3,280	121,748	88867
35.21 Gravel/Sand Placement	0.68	ACR	53,911	10,782	9,704	2,232	82,851	121839
35.26 Wetland Restoration (Planting)	1.00	EA	14,780	2,956	2,660	612	22,715	22715
35.31 Debri Removal, Testing, Misc.	1.37	ACR	27,067	5,413	4,872	1,121	41,598	30363
TOTAL Restoration Sub Area 3	1.00	EA	337,142	67,428	60,686	13,958	518,126	518126
36 Restoration Sub Area 4								
36.02 Invasive Species Removal	6.31	ACR	792,958	158,592	142,732	32,828	1,218,632	193127
36.19 Wetland Creation (filling)	5.37	ACR	999,278	199,856	179,870	41,370	1,535,708	285979
36.21 Gravel/Sand Placement	0.81	ACR	64,271	12,854	11,569	2,661	98,773	121942
36.26 Wetland Restoration (Planting)	1.00	EA	57,963	11,593	10,433	2,400	89,078	89078
36.31 Debri Removal, Testing, Misc.	1.00	EA	34,326	6,865	6,179	1,421	52,752	52752
TOTAL Restoration Sub Area 4	1.00	EA	1,948,795	389,759	350,783	80,680	2,994,943	2994943
37 Restoration Sub Area 5								
37.02 Invasive Species Removal	7.24	ACR	875,522	175,104	157,594	36,247	1,345,517	185845
37.21 Gravel/Sand Placement	0.44	ACR	34,914	6,983	6,285	1,445	53,656	121946
37.26 Wetland Restoration (Planting)	1.00	EA	32,790	6,558	5,902	1,357	50,392	50392
37.31 Debri Removal, Testing, Misc.	1.00	EA	27,723	5,545	4,990	1,148	42,605	42605
TOTAL Restoration Sub Area 5	1.00	EA	970,948	194,190	174,771	40,197	1,492,170	1492170
38 Restoration Sub Area 6								

** PROJECT OWNER SUMMARY - Feature **

		QUANTY	UOM	CONTRACT	CONTINGN	CST GROW	ESCALATN	TOTAL COST	UNIT
38.02	Invasive Species Removal	15.33	ACR	1,593,708	318,742	286,867	65,980	2,449,238	159768
38.21	Gravel/Sand Placement	0.76	ACR	60,288	12,058	10,852	2,496	92,652	121910
38.26	Wetland Restoration (Planting)	1.00	EA	143,060	28,612	25,751	5,923	219,857	219857
38.31	Debri Removal, Testing, Misc.	1.00	EA	27,723	5,545	4,990	1,148	42,605	42605
TOTAL	Restoration Sub Area 6	1.00	EA	1,824,779	364,956	328,460	75,546	2,804,352	2804352
TOTAL	Malden River Restoration Project	1.00	EA	5,328,614	1,065,723	959,151	220,605	8,189,108	8189108

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
33 Restoration Sub Area 1	1.00	EA	19,803	1,980	1,525	2,331	513	26,152	26152
34 Restoration Sub Area 2	1.00	EA	167,196	16,720	12,874	19,679	4,329	220,798	220798
35 Restoration Sub Area 3	1.00	EA	255,296	25,530	19,658	30,048	6,611	337,142	337142
36 Restoration Sub Area 4	1.00	EA	1,475,696	147,570	113,629	173,689	38,212	1,948,795	1948795
37 Restoration Sub Area 5	1.00	EA	735,236	73,524	56,613	86,537	19,038	970,948	970948
38 Restoration Sub Area 6	1.00	EA	1,381,786	138,179	106,398	162,636	35,780	1,824,779	1824779
TOTAL Malden River Restoration Project	1.00	EA	4,035,013	403,501	310,696	474,921	104,483	5,328,614	5328614
Contingency								1,065,723	
SUBTOTAL								6,394,337	
Escalation								959,151	
SUBTOTAL								7,353,487	
								220,605	
SUBTOTAL								7,574,092	
								454,446	
SUBTOTAL								8,028,537	
								160,571	
TOTAL INCL OWNER COSTS								8,189,108	

	QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
33 Restoration Sub Area 1									
33.21 Gravel/Sand Placement	0.07	ACR	4,307	431	332	507	112	5,688	81253
33.26 Debri Removal, Testing, Misc.	1.00	EA	15,496	1,550	1,193	1,824	401	20,464	20464
TOTAL Restoration Sub Area 1	1.00	EA	19,803	1,980	1,525	2,331	513	26,152	26152
34 Restoration Sub Area 2									
34.02 Invasive Species Removal	1.29	ACR	141,163	14,116	10,870	16,615	3,655	186,420	144511
34.26 Wetland Restoration (Planting)	1.00	EA	10,536	1,054	811	1,240	273	13,914	13914
34.30 Debri Removal, Testing, Misc.	1.00	EA	15,496	1,550	1,193	1,824	401	20,464	20464
TOTAL Restoration Sub Area 2	1.00	EA	167,196	16,720	12,874	19,679	4,329	220,798	220798
35 Restoration Sub Area 3									
35.01 Mob, Demob & Work Storage Yard	1.00	EA	122,796	12,280	9,455	14,453	3,180	162,163	162163
35.02 Invasive Species Removal	1.37	ACR	59,989	5,999	4,619	7,061	1,553	79,221	57825
35.21 Gravel/Sand Placement	0.68	ACR	40,823	4,082	3,143	4,805	1,057	53,911	79280
35.26 Wetland Restoration (Planting)	1.00	EA	11,192	1,119	862	1,317	290	14,780	14780
35.31 Debri Removal, Testing, Misc.	1.37	ACR	20,496	2,050	1,578	2,412	531	27,067	19757
TOTAL Restoration Sub Area 3	1.00	EA	255,296	25,530	19,658	30,048	6,611	337,142	337142
36 Restoration Sub Area 4									
36.02 Invasive Species Removal	6.31	ACR	600,455	60,046	46,235	70,674	15,548	792,958	125667
36.19 Wetland Creation (filling)	5.37	ACR	756,688	75,669	58,265	89,062	19,594	999,278	186085
36.21 Gravel/Sand Placement	0.81	ACR	48,668	4,867	3,747	5,728	1,260	64,271	79347
36.26 Wetland Restoration (Planting)	1.00	EA	43,892	4,389	3,380	5,166	1,137	57,963	57963
36.31 Debri Removal, Testing, Misc.	1.00	EA	25,993	2,599	2,001	3,059	673	34,326	34326
TOTAL Restoration Sub Area 4	1.00	EA	1,475,696	147,570	113,629	173,689	38,212	1,948,795	1948795
37 Restoration Sub Area 5									
37.02 Invasive Species Removal	7.24	ACR	662,976	66,298	51,049	78,032	17,167	875,522	120928
37.21 Gravel/Sand Placement	0.44	ACR	26,438	2,644	2,036	3,112	685	34,914	79350
37.26 Wetland Restoration (Planting)	1.00	EA	24,830	2,483	1,912	2,922	643	32,790	32790
37.31 Debri Removal, Testing, Misc.	1.00	EA	20,993	2,099	1,616	2,471	544	27,723	27723
TOTAL Restoration Sub Area 5	1.00	EA	735,236	73,524	56,613	86,537	19,038	970,948	970948
38 Restoration Sub Area 6									

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
38.02 Invasive Species Removal	15.33	ACR	1,206,811	120,681	92,924	142,042	31,249	1,593,708	103960
38.21 Gravel/Sand Placement	0.76	ACR	45,652	4,565	3,515	5,373	1,182	60,288	79326
38.26 Wetland Restoration (Planting)	1.00	EA	108,330	10,833	8,341	12,750	2,805	143,060	143060
38.31 Debri Removal, Testing, Misc.	1.00	EA	20,993	2,099	1,616	2,471	544	27,723	27723
TOTAL Restoration Sub Area 6	1.00	EA	1,381,786	138,179	106,398	162,636	35,780	1,824,779	1824779
TOTAL Malden River Restoration Project	1.00	EA	4,035,013	403,501	310,696	474,921	104,483	5,328,614	5328614
Contingency								1,065,723	
SUBTOTAL								6,394,337	
Escalation								959,151	
SUBTOTAL								7,353,487	
								220,605	
SUBTOTAL								7,574,092	
								454,446	
SUBTOTAL								8,028,537	
								160,571	
TOTAL INCL OWNER COSTS								8,189,108	

** PROJECT DIRECT SUMMARY - Contract **

	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
33 Restoration Sub Area 1	1.00	EA	2,271	2,230	2,302	13,000	19,803	19803
34 Restoration Sub Area 2	1.00	EA	48,586	39,667	65,942	13,000	167,196	167196
35 Restoration Sub Area 3	1.00	EA	121,806	65,920	49,570	18,000	255,296	255296
36 Restoration Sub Area 4	1.00	EA	478,627	395,105	580,964	21,000	1,475,696	1475696
37 Restoration Sub Area 5	1.00	EA	198,900	171,377	348,959	16,000	735,236	735236
38 Restoration Sub Area 6	1.00	EA	406,597	309,175	650,014	16,000	1,381,786	1381786
TOTAL Malden River Restoration Project	1.00	EA	1256787	983,475	1,697,750	97,000	4,035,013	4035013
Prime Contractor's Field Overhead							403,501	
SUBTOTAL							4,438,514	
Prime's Home Office Expense							310,696	
SUBTOTAL							4,749,210	
Prime Contractor's Profit							474,921	
SUBTOTAL							5,224,131	
Prime Contractor's Bond							104,483	
TOTAL INCL INDIRECTS							5,328,614	
Contingency							1,065,723	
SUBTOTAL							6,394,337	
Escalation							959,151	
SUBTOTAL							7,353,487	
							220,605	
SUBTOTAL							7,574,092	
							454,446	
SUBTOTAL							8,028,537	
							160,571	
TOTAL INCL OWNER COSTS							8,189,108	

	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
33 Restoration Sub Area 1								
33.21 Gravel/Sand Placement	0.07	ACR	1,025	980	2,302	0	4,307	61528
33.26 Debri Removal, Testing, Misc.	1.00	EA	1,246	1,250	0	13,000	15,496	15496
TOTAL Restoration Sub Area 1	1.00	EA	2,271	2,230	2,302	13,000	19,803	19803
34 Restoration Sub Area 2								
34.02 Invasive Species Removal	1.29	ACR	40,316	38,417	62,430	0	141,163	109429
34.26 Wetland Restoration (Planting)	1.00	EA	7,024	0	3,512	0	10,536	10536
34.30 Debri Removal, Testing, Misc.	1.00	EA	1,246	1,250	0	13,000	15,496	15496
TOTAL Restoration Sub Area 2	1.00	EA	48,586	39,667	65,942	13,000	167,196	167196
35 Restoration Sub Area 3								
35.01 Mob, Demob & Work Storage Yard	1.00	EA	71,832	36,100	14,864	0	122,796	122796
35.02 Invasive Species Removal	1.37	ACR	28,480	16,989	14,520	0	59,989	43787
35.21 Gravel/Sand Placement	0.68	ACR	12,786	11,582	16,455	0	40,823	60034
35.26 Wetland Restoration (Planting)	1.00	EA	7,462	0	3,731	0	11,192	11192
35.31 Debri Removal, Testing, Misc.	1.37	ACR	1,246	1,250	0	18,000	20,496	14961
TOTAL Restoration Sub Area 3	1.00	EA	121,806	65,920	49,570	18,000	255,296	255296
36 Restoration Sub Area 4								
36.02 Invasive Species Removal	6.31	ACR	155,134	145,172	300,150	0	600,455	95159
36.19 Wetland Creation (filling)	5.37	ACR	280,453	236,675	239,560	0	756,688	140910
36.21 Gravel/Sand Placement	0.81	ACR	11,286	10,759	26,624	0	48,668	60084
36.26 Wetland Restoration (Planting)	1.00	EA	29,261	0	14,631	0	43,892	43892
36.31 Debri Removal, Testing, Misc.	1.00	EA	2,493	2,500	0	21,000	25,993	25993
TOTAL Restoration Sub Area 4	1.00	EA	478,627	395,105	580,964	21,000	1,475,696	1475696
37 Restoration Sub Area 5								
37.02 Invasive Species Removal	7.24	ACR	173,724	163,032	326,220	0	662,976	91571
37.21 Gravel/Sand Placement	0.44	ACR	6,131	5,845	14,463	0	26,438	60086
37.26 Wetland Restoration (Planting)	1.00	EA	16,553	0	8,277	0	24,830	24830
37.31 Debri Removal, Testing, Misc.	1.00	EA	2,493	2,500	0	16,000	20,993	20993
TOTAL Restoration Sub Area 5	1.00	EA	198,900	171,377	348,959	16,000	735,236	735236

38 Restoration Sub Area 6

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
38.02 Invasive Species Removal	15.33	ACR	321,298	296,583	588,930	0	1,206,811	78722
38.21 Gravel/Sand Placement	0.76	ACR	10,587	10,092	24,974	0	45,652	60069
38.26 Wetland Restoration (Planting)	1.00	EA	72,220	0	36,110	0	108,330	108330
38.31 Debri Removal, Testing, Misc.	1.00	EA	2,493	2,500	0	16,000	20,993	20993
TOTAL Restoration Sub Area 6	1.00	EA	406,597	309,175	650,014	16,000	1,381,786	1381786
TOTAL Malden River Restoration Project	1.00	EA	1256787	983,475	1,697,750	97,000	4,035,013	4035013
Prime Contractor's Field Overhead							403,501	
SUBTOTAL							4,438,514	
Prime's Home Office Expense							310,696	
SUBTOTAL							4,749,210	
Prime Contractor's Profit							474,921	
SUBTOTAL							5,224,131	
Prime Contractor's Bond							104,483	
TOTAL INCL INDIRECTS							5,328,614	
Contingency							1,065,723	
SUBTOTAL							6,394,337	
Escalation							959,151	
SUBTOTAL							7,353,487	
							220,605	
SUBTOTAL							7,574,092	
							454,446	
SUBTOTAL							8,028,537	
							160,571	
TOTAL INCL OWNER COSTS							8,189,108	

R2029: Malden River Restoration No Crew Database - No Crew Summaries or Reprice

* * * END OF ERROR REPORT * * *

Gravel/Sand Placement	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Restoration Sub Area 1								
Changes made 12/13/05 per Todd Randall Request. Remove wetland fill from Sub Area 3 and change fill in Sub Area 4 to 4.75 acre area (3.84 acres originally in SA 4 plus 1.53 acr from SA 3 minus .6 acres in SA 3).								
Gravel/Sand Placement								
Costs to install sand/gravel in area of the river after removal of sediments.								
Base course, sand, washed & graded, compacted, small areas, assume 1' depth required.	113.00	CY	2.17 246	1.67 189	20.37 2,302	0.00 0	24.22 2,737	24.22
Hauling, hwy haulers, 12 CY, 24 mile round trip @ base wide rate	113.00	CY	6.90 779	7.00 791	0.00 0	0.00 0	13.90 1,570	13.90
TOTAL Gravel/Sand Placement	0.07	ACR	1,025	980	2,302	0	4,307	61528
Debri Removal, Testing, Misc.								
Costs for debri removal from river and shorline areas. Though not identified at this time some costs may be incurred to test dredge sediments and removed debri prior to disposal.								
Misc. existing trash/rubbish removed from river and disposal fees at landfill. Includes loading and transportation.	50.00	TON	20.00 1,000	20.00 1,000	0.00 0	60.00 3,000	100.00 5,000	100.00
Possible misc. testing costs for sediments and trash .	1.00	LS	0.00 0	0.00 0	0.00 0	10000.00 10,000	10000.00 10,000	10000
Hauling, hwy haulers, 12 CY, load and haul, 24 mile round trip.	25.00	CY	9.85 246	10.00 250	0.00 0	0.00 0	19.85 496	19.85
TOTAL Debri Removal, Testing, Misc.	1.00	EA	1,246	1,250	0	13,000	15,496	15496
TOTAL Restoration Sub Area 1	1.00	EA	2,271	2,230	2,302	13,000	19,803	19803
Restoration Sub Area 2								
Invasive Species Removal								
Costs for removal of phragmites stalks, grubbing and removal of stubs and roots. Top 1.5' foot of soil to be removed and disposed of. Assume all invasive species in this area are Phragmites.								
Clear & grub, chipping stumps, to 18" deep, 12" dia- assume material will be used as fill	100.00	EA	14.10 1,410	5.27 527	0.00 0	0.00 0	19.36 1,936	19.36

Invasive Species Removal	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
on site.								
Grading for grubbed areas, bulk,			29.17	10.11	0.00	0.00	39.28	
semi-grade, 2 passes w/grader	62.00	CSY	1,809	627	0	0	2,436	39.28
Topsoil/sand material, delivery			5.19	4.00	30.00	0.00	39.19	
and installation, graded to 1'D, cap entire area of invasive species/phrag removal	2081.00	CY	10,808	8,324	62,430	0	81,562	39.19
Clearing, phragmites and other			800.02	509.66	0.00	0.00	1309.68	
udesirable plants, wet area.	1.29	ACR	1,032	657	0	0	1,689	1309.68
Hauling, hwy haulers, 12 CY,			4.93	5.00	0.00	0.00	9.93	
haul phrag stalkes, 3 mi round trip, dump onsite for fill.	562.00	CY	2,769	2,810	0	0	5,579	9.93
Clear & grub, grubbing of			0.59	0.90	0.00	0.00	1.48	
phragmites stubs and roots, 11	4320.00	CY	2,534	3,872	0	0	6,406	1.48
Hauling, hwy haulers 12 CY, 3			4.62	5.00	0.00	0.00	9.62	
mile round trip- grubbed phrag roots and soil, load and haul to onsite location to be used as fill.	4320.00	CY	19,955	21,600	0	0	41,555	9.62
TOTAL Invasive Species Removal	1.29	ACR	40,316	38,417	62,430	0	141,163	109429
Wetland Restoration (Planting) assume sedges or rushes seedlings at 24" OC spacing.								
sedges or rushes-individual			0.50	0.00	0.25	0.00	0.75	
seedlings at 24" OC	14048	EA	7,024	0	3,512	0	10,536	0.75
TOTAL Wetland Restoration (Planting)	1.00	EA	7,024	0	3,512	0	10,536	10536
Debri Removal, Testing, Misc. Debri removal from shorline and river, and disposal in landfill.								
Misc. existing trash/rubbish			20.00	20.00	0.00	60.00	100.00	
removed from shore and river and disposal fees at landfill. Includes loading and transportation.	50.00	TON	1,000	1,000	0	3,000	5,000	100.00
Possible misc. testing costs for			0.00	0.00	0.00	10000.00	10000.00	
sediments, trash and grubbed materials.	1.00	LS	0	0	0	10,000	10,000	10000

Debri Removal, Testing, Misc.	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Hauling, hwy haulers, 12 CY, load and haul, 24 mile round trip.			9.85	10.00	0.00	0.00	19.85	
	25.00	CY	246	250	0	0	496	19.85
TOTAL Debri Removal, Testing, Misc.	1.00	EA	1,246	1,250	0	13,000	15,496	15496
TOTAL Restoration Sub Area 2	1.00	EA	48,586	39,667	65,942	13,000	167,196	167196

Restoration Sub Area 3

Mob, Demob & Work Storage Yard

Changes made 12/13/05 per Todd Randall Request. Remove wetland fill from Sub Area 3 and change fill in Sub Area 4 to 4.75 acre area (3.84 acres originally in SA 4 plus 1.53 acr from SA 3 minus .6 acres in SA 3.

1/26/07 PM requests changes to project, include only one M&D in just area #3, instead of one in each of the 6 areas. This results in increase to the one M&D because of requirements change.

Item	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Outside Electricians			40.18	0.00	0.00	0.00	40.18	
	80.00	HR	3,215	0	0	0	3,215	40.18
Outside Equip. Operators, Medium			35.24	0.00	0.00	0.00	35.24	
	80.00	HR	2,819	0	0	0	2,819	35.24
Outside Carpenters			35.83	0.00	0.00	0.00	35.83	
	40.00	HR	1,433	0	0	0	1,433	35.83
Outside Laborers, (Semi-Skilled)			27.04	0.00	0.00	0.00	27.04	
	320.00	HR	8,654	0	0	0	8,654	27.04
Outside Truck Drivers, Heavy			27.99	0.00	0.00	0.00	27.99	
	80.00	HR	2,239	0	0	0	2,239	27.99
Cleanup, site debris clean up & removal- clean up storage and stagging areas.			670.11	34.45	0.00	0.00	704.56	
	2.00	ACR	1,340	69	0	0	1,409	704.56
Fencing, 11 ga, chain link, 6' high-install temp fencing and remove it after project completion.			12.00	1.49	3.28	0.00	16.77	
	1200.00	LF	14,400	1,788	3,936	0	20,124	16.77
Office trailer, rent per month, furnished, no hookups, 50' x 10'			0.00	0.00	295.00	0.00	295.00	
	24.00	MO	0	0	7,080	0	7,080	295.00
Toilet, portable chemical, rent per month-assume two on the job			0.00	0.00	80.17	0.00	80.17	
	48.00	EA	0	0	3,848	0	3,848	80.17

Mob, Demob & Work Storage Yard	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Hauling, hwy hauler 12 CY, 24			6.46	6.56	0.00	0.00	13.02	
mile round trip-for disposal of	3227.00	CY	20,852	21,162	0	0	42,015	13.02
Excavating, bulk, dozer, large			3.81	1.33	0.00	0.00	5.14	
area, open site, shaping w/small dozer	3227.00	CY	12,306	4,286	0	0	16,593	5.14
Clear & grub, cut & chip medium			2286.16	1237.98	0.00	0.00	3524.13	
trees, 10" dia	2.00	ACR	4,572	2,476	0	0	7,048	3524.13
TRK,HWY, 46,000 GVW, 6X4, 3 AXLE			0.00	35.40	0.00	0.00	35.40	
	80.00	HR	0	2,832	0	0	2,832	35.40
LDR,FE, WH, 3.00 - 3.25 CY			0.00	33.07	0.00	0.00	33.07	
	80.00	HR	0	2,645	0	0	2,645	33.07
TRAILER, LOWBOY, 75T (68.0MT)			0.00	10.51	0.00	0.00	10.51	
3 AXLE (ADD TOWING TRUCK)	80.00	HR	0	841	0	0	841	10.51
TOTAL Mob, Demob & Work Storage Yard	1.00	EA	71,832	36,100	14,864	0	122,796	122796
Invasive Species Removal								
Clearing, phragmites, wet area,			800.02	509.66	0.00	0.00	1309.68	
disposal, hand cut small areas	0.30	ACR	240	153	0	0	393	1309.68
Hauling, hwy haulers, 12 CY, 3			4.93	5.00	0.00	0.00	9.93	
mi round trip - load and haul phrag stalks and dump on site as fill.	131.00	CY	645	655	0	0	1,300	9.93
Clear & grub, grubbing shrub and			0.59	0.90	0.00	0.00	1.48	
tree roots, 11 CY scraper - 1.07 acres, 18" deep.	2589.00	CY	1,518	2,321	0	0	3,839	1.48
Clearing, brush w/dozer & brush			300.04	191.14	0.00	0.00	491.19	
rake, medium brush-- adjusted to triple original unit cost because of small quanitity in urban area.	1.07	ACR	321	205	0	0	526	491.19
Clear & grub, tree rmv, cutting			119.77	46.42	0.00	0.00	166.19	
& chipping, 6" - 12" dia	131.00	EA	15,690	6,082	0	0	21,771	166.19
Clear & grub, grubbing of			0.59	0.90	0.00	0.00	1.48	
phragmites stubs and roots, 11	726.00	CY	426	651	0	0	1,077	1.48

Invasive Species Removal		QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
	Hauling, hwy haulers, 12 cy -3 mile round trip, load and haul phrag roots and dump onsite as fill.			4.62	5.00	0.00	0.00	9.62	
		726.00	CY	3,354	3,630	0	0	6,984	9.62
	Topsoil/sand material, delivery and installation, graded to 1'D, cap entire area of invasive species/phrag removal			5.19	4.00	30.00	0.00	39.19	
		484.00	CY	2,514	1,936	14,520	0	18,970	39.19
	Grading for grubbed areas, bulk, semi-grade, 2 passes w/grader			29.17	10.11	0.00	0.00	39.28	
		66.00	CSY	1,925	667	0	0	2,593	39.28
	Clear & grub, chipping stumps, to 18" deep, 12" dia average.			14.10	5.27	0.00	0.00	19.36	
		131.00	EA	1,847	690	0	0	2,537	19.36
	TOTAL Invasive Species Removal	1.37	ACR	28,480	16,989	14,520	0	59,989	43787
Gravel/Sand Placement									
	Base course, sand, washed & graded, compacted, 6"D, large areas			5.19	4.00	15.00	0.00	24.19	
		1097.00	CY	5,697	4,388	16,455	0	26,540	24.19
	Hauling, hwy haulers, 12 CY, 24 mile round trip @ base wide rate			6.46	6.56	0.00	0.00	13.02	
		1097.00	CY	7,089	7,194	0	0	14,283	13.02
	TOTAL Gravel/Sand Placement	0.68	ACR	12,786	11,582	16,455	0	40,823	60034
Wetland Restoration (Planting)									
	sedges or rushes-individual seedlings at 24" OC			0.50	0.00	0.25	0.00	0.75	
		14923	EA	7,462	0	3,731	0	11,192	0.75
	TOTAL Wetland Restoration (Planting)	1.00	EA	7,462	0	3,731	0	11,192	11192
Debri Removal, Testing, Misc.									
	Misc. existing trash/rubbish removed from shore and river and diposal fees at landfill. Includes loading and transportation.			20.00	20.00	0.00	60.00	100.00	
		50.00	TON	1,000	1,000	0	3,000	5,000	100.00
	Possible misc. testing costs for sediments, trash and grubbed materials.			0.00	0.00	0.00	15000.00	15000.00	
		1.00	LS	0	0	0	15,000	15,000	15000

Debri Removal, Testing, Misc.	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Hauling, hwy haulers, 12 CY, load and haul, 24 mile round trip.			9.85	10.00	0.00	0.00	19.85	
	25.00	CY	246	250	0	0	496	19.85
TOTAL Debri Removal, Testing, Misc.	1.37	ACR	1,246	1,250	0	18,000	20,496	14961
TOTAL Restoration Sub Area 3	1.00	EA	121,806	65,920	49,570	18,000	255,296	255296
Restoration Sub Area 4								
Invasive Species Removal								
Clear & grub, chipping stumps, to 18" deep, 12" dia average			14.10	5.27	0.00	0.00	19.36	
	100.00	EA	1,410	527	0	0	1,936	19.36
Topsoil/sand material, delivery and installation, graded to 1'D, cap entire area of invasive species/phrag removal			5.19	4.00	30.00	0.00	39.19	
	10005	CY	51,961	40,021	300,150	0	392,132	39.19
Clearing, phragmites, wet area, disposal, hand cut small areas			800.02	509.66	0.00	0.00	1309.68	
	6.31	ACR	5,048	3,216	0	0	8,264	1309.68
Hauling, hwy haulers, 12 CY, 3 mi round trip, load phag stalks and haul and dump onsite for fill.			4.93	5.00	0.00	0.00	9.93	
	1373.00	CY	6,764	6,865	0	0	13,629	9.93
Clear & grub area frome which shrubs and trees removed 11 CY scraper.			0.59	0.90	0.00	0.00	1.48	
	1210.00	CY	710	1,085	0	0	1,794	1.48
Clearing, brush w/dozer & brush rake, medium brush-assume 50% of acreage is brush and tree covered - adjusted to triple original unit cost because of small quanitity in urban area.			300.04	191.14	0.00	0.00	491.19	
	0.50	ACR	150	96	0	0	246	491.19
Clear & grub, grubbing of phragmites stubs and roots to depth of 18".			0.59	0.90	0.00	0.00	1.48	
	15270	CY	8,956	13,687	0	0	22,642	1.48
Hauling, hwy haulers, load and haul 3 mile round trip 12 CY of phrag roots and soil and dump as fill.			4.62	5.00	0.00	0.00	9.62	
	15270	CY	70,537	76,350	0	0	146,887	9.62

Invasive Species Removal	QUANTY UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Grading for grubbed areas, bulk, semi-grade, 2 passes w/grader		29.17	10.11	0.00	0.00	39.28	
	329.00 CSY	9,598	3,326	0	0	12,925	39.28
TOTAL Invasive Species Removal	6.31 ACR	155,134	145,172	300,150	0	600,455	95159

Wetland Creation (filling)

12/13/05 Change per Todd Randall request: Remove wetland fill from Sub Area 3 and change fill in Sub Area 4 to 4.75 acre area (3.84 acres originally in SA 4 plus 1.53 acr from SA 3 minus .6 acres in SA 3).

12/13/05 Change per Todd Randall request: Depth of wetland creation fill changed from 1.5' to 3'. Assume double quantities of excavation, hauling and gravel fill will make the proper adjustment.

	QUANTY UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Excavate & load, wheeled loader, 1.5 CY bucket, lt , - excavate to depth of 3'.		0.76	0.27	0.00	0.00	1.04	
	25991 CY	19,823	7,085	0	0	26,908	1.04
Loam or topsoil, frtn loader, 1.5 CY, spread from pile, 6" deep finish grade- material and delivery included		8.40	3.00	20.00	0.00	31.40	
	4332.00 CY	36,368	12,996	86,640	0	136,004	31.40
Hauling excavated earth, hwy haulers, 12 CY, 3 mi round trip, load and haul offsite.		6.90	7.00	0.00	0.00	13.90	
	25991 CY	179,265	181,937	0	0	361,202	13.90
Base course, gravel delivered, bank run, 1' D, incl grading		5.19	4.00	17.65	0.00	26.84	
	8664.00 CY	44,996	34,657	152,920	0	232,573	26.84
TOTAL Wetland Creation (filling)	5.37 ACR	280,453	236,675	239,560	0	756,688	140910

Gravel/Sand Placement

	QUANTY UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Base course, sand, washed & graded, compacted, 12 "D, large areas - includes material and delivery		2.17	1.67	20.37	0.00	24.22	
	1307.00 CY	2,840	2,188	26,624	0	31,652	24.22
Hauling, hwy haulers, 12 CY, 24 mile round trip @ base wide rate		6.46	6.56	0.00	0.00	13.02	
	1307.00 CY	8,446	8,571	0	0	17,017	13.02
TOTAL Gravel/Sand Placement	0.81 ACR	11,286	10,759	26,624	0	48,668	60084

Wetland Restoration (Planting)	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Wetland Restoration (Planting)								
sedges or rushes-individual			0.50	0.00	0.25	0.00	0.75	
seedlings at 24" OC	58522	EA	29,261	0	14,631	0	43,892	0.75
TOTAL Wetland Restoration (Planting)	1.00	EA	29,261	0	14,631	0	43,892	43892
Debri Removal, Testing, Misc.								
Misc. existing trash/rubbish			20.00	20.00	0.00	60.00	100.00	
removed from shore and river and diposal fees at landfill. Includes loading and transportation.	100.00	TON	2,000	2,000	0	6,000	10,000	100.00
Possible misc. testing costs for			0.00	0.00	0.00	15000.00	15000.00	
sediments, trash and grubbed materials.	1.00	LS	0	0	0	15,000	15,000	15000
Hauling, hwy haulers, 12 CY,			9.85	10.00	0.00	0.00	19.85	
load and haul, 24 mile round trip.	50.00	CY	493	500	0	0	993	19.85
TOTAL Debri Removal, Testing, Misc.	1.00	EA	2,493	2,500	0	21,000	25,993	25993
TOTAL Restoration Sub Area 4	1.00	EA	478,627	395,105	580,964	21,000	1,475,696	1475696
Restoration Sub Area 5								
Invasive Species Removal								
Clear & grub, chipping stumps,			14.10	5.27	0.00	0.00	19.36	
to 18" deep, 12" dia- assume	100.00	EA	1,410	527	0	0	1,936	19.36
Clearing, phragmites, wet area,			800.02	509.66	0.00	0.00	1309.68	
disposal, hand cut small areas	6.74	ACR	5,392	3,435	0	0	8,827	1309.68
Hauling, hwy haulers, 12 CY, 3			4.93	5.00	0.00	0.00	9.93	
mi round trip, load and haul phrag stalks, dump onsite for fill.	2936.00	CY	14,465	14,680	0	0	29,145	9.93
Clear & grub, grubbing, tree and			0.59	0.90	0.00	0.00	1.48	
brush area, 11 CY scraper-3.57	1210.00	CY	710	1,085	0	0	1,794	1.48
Clearing, brush w/dozer & brush			300.04	191.14	0.00	0.00	491.19	
rake, medium brush-adjusted to	0.50	ACR	150	96	0	0	246	491.19

Invasive Species Removal	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Topsoil/sand material, delivery and installation, graded to 1'D, cap entire area of invasive species/phrag removal			5.19	4.00	30.00	0.00	39.19	
	10874	CY	56,474	43,497	326,220	0	426,191	39.19
Clear & grub, grubbing of phragmites stubs and roots to a depth of 18".			0.59	0.90	0.00	0.00	1.48	
	16311	CY	9,566	14,620	0	0	24,186	1.48
Hauling, hwy haulers, 12 CY load and haul phrag roots and soil , 3 miles roundtrip and dumped on site as fill.			4.62	5.00	0.00	0.00	9.62	
	16311	CY	75,345	81,555	0	0	156,900	9.62
Grading for grubbed areas, bulk, semi-grade, 2 passes w/grader			29.17	10.11	0.00	0.00	39.28	
	350.00	CSY	10,211	3,539	0	0	13,750	39.28
TOTAL Invasive Species Removal	7.24	ACR	173,724	163,032	326,220	0	662,976	91571
Gravel/Sand Placement								
Base course, sand, washed & graded, compacted, 6"D, large areas			2.17	1.67	20.37	0.00	24.22	
	710.00	CY	1,543	1,188	14,463	0	17,194	24.22
Hauling, hwy haulers, 12 CY, 24 mile round trip @ base wide rate			6.46	6.56	0.00	0.00	13.02	
	710.00	CY	4,588	4,656	0	0	9,244	13.02
TOTAL Gravel/Sand Placement	0.44	ACR	6,131	5,845	14,463	0	26,438	60086
Wetland Restoration (Planting)								
sedges or rushes-individual seedlings at 24" OC			0.50	0.00	0.25	0.00	0.75	
	33106	EA	16,553	0	8,277	0	24,830	0.75
TOTAL Wetland Restoration (Planting)	1.00	EA	16,553	0	8,277	0	24,830	24830
Debri Removal, Testing, Misc.								
Misc. existing trash/rubbish removed from shore and river and diposal fees at landfill. Includes loading and transportation.			20.00	20.00	0.00	60.00	100.00	
	100.00	TON	2,000	2,000	0	6,000	10,000	100.00

Debri Removal, Testing, Misc.	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Possible misc. testing costs for sediments, trash and grubbed materials.			0.00	0.00	0.00	10000.00	10000.00	
	1.00	LS	0	0	0	10,000	10,000	10000
Hauling, hwy haulers, 12 CY, load and haul, 24 mile round trip.			9.85	10.00	0.00	0.00	19.85	
	50.00	CY	493	500	0	0	993	19.85
TOTAL Debri Removal, Testing, Misc.	1.00	EA	2,493	2,500	0	16,000	20,993	20993
TOTAL Restoration Sub Area 5	1.00	EA	198,900	171,377	348,959	16,000	735,236	735236
Restoration Sub Area 6								
Invasive Species Removal								
Clear & grub, chipping stumps, to 18" deep, 12" dia- assume			14.10	5.27	0.00	0.00	19.36	
	500.00	EA	7,048	2,634	0	0	9,682	19.36
Clearing, phragmites, wet area, disposal, hand cut small areas (see sub-area 2 for formula for quantities)			800.02	509.66	0.00	0.00	1309.68	
	12.18	ACR	9,744	6,208	0	0	15,952	1309.68
Hauling, hwy haulers, 12 CY, 3 mi round trip, load and haul phrag stalks, dump onsite as fill.			4.93	5.00	0.00	0.00	9.93	
	5300.00	CY	26,112	26,500	0	0	52,612	9.93
Clear & grub, grubbing, 11 CY scraper-3.57 x 43560=155509sf/27=5760/2(6") = 2879cy			0.59	0.90	0.00	0.00	1.48	
	984.00	CY	577	882	0	0	1,459	1.48
Clearing, brush w/dozer & brush rake, medium brush- adjusted to triple original unit cost because of small quanitity in urban area.			300.04	191.14	0.00	0.00	491.19	
	3.05	ACR	915	583	0	0	1,498	491.19
Hauling, hwy haulers, 12 CY of grubbed phrag root and soil, load and haul, 3 mile round trip, dump onsite as fill.			4.62	5.00	0.00	0.00	9.62	
	29476	CY	136,158	147,380	0	0	283,538	9.62
Topsoil/sand material, delivery and installation, graded to 1'D, cap entire area of invasive species/phrag removal			5.19	4.00	30.00	0.00	39.19	
	19631	CY	101,954	78,526	588,930	0	769,410	39.19

Invasive Species Removal	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Clear & grub, grubbing of phragmites stubs and roots to depth of 18".			0.59	0.90	0.00	0.00	1.48	
	29476	CY	17,288	26,419	0	0	43,707	1.48
Grading for grubbed areas, bulk, semi-grade, 2 passes w/grader			29.17	10.11	0.00	0.00	39.28	
	737.00	CSY	21,501	7,451	0	0	28,953	39.28
TOTAL Invasive Species Removal	15.33	ACR	321,298	296,583	588,930	0	1,206,811	78722
Gravel/Sand Placement								
Base course, sand, washed & graded, compacted, 6"D, large areas			2.17	1.67	20.37	0.00	24.22	
	1226.00	CY	2,664	2,052	24,974	0	29,690	24.22
Hauling, hwy haulers, 12 CY, 24 mile round trip @ base wide rate			6.46	6.56	0.00	0.00	13.02	
	1226.00	CY	7,922	8,040	0	0	15,962	13.02
TOTAL Gravel/Sand Placement	0.76	ACR	10,587	10,092	24,974	0	45,652	60069
Wetland Restoration (Planting)								
sedges or rushes-individual seedlings at 24" OC			0.50	0.00	0.25	0.00	0.75	
	144440	EA	72,220	0	36,110	0	108,330	0.75
TOTAL Wetland Restoration (Planting)	1.00	EA	72,220	0	36,110	0	108,330	108330
Debri Removal, Testing, Misc.								
Misc. existing trash/rubbish removed from shore and disposal fees at landfill. Includes loading and transportation.			20.00	20.00	0.00	60.00	100.00	
	100.00	TON	2,000	2,000	0	6,000	10,000	100.00
Testing for trash, debris and grubbed materials materials.			0.00	0.00	0.00	10000.00	10000.00	
	1.00	LS	0	0	0	10,000	10,000	10000
Hauling, hwy haulers, 12 CY, load and haul, 24 mile round trip.			9.85	10.00	0.00	0.00	19.85	
	50.00	CY	493	500	0	0	993	19.85
TOTAL Debri Removal, Testing, Misc.	1.00	EA	2,493	2,500	0	16,000	20,993	20993
TOTAL Restoration Sub Area 6	1.00	EA	406,597	309,175	650,014	16,000	1,381,786	1381786

Debri Removal, Testing, Misc.	QUANTY	UOM	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
TOTAL Malden River Restoration Project	1.00	EA	1256787	983,475	1,697,750	97,000	4,035,013	4035013

Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX E

ECOLOGICAL BENEFITS REPORT

US Army Corps
of Engineers®
New England District

MALDEN RIVER FEASIBILITY STUDY

MALDEN, EVERETT, AND MEDFORD, MASSACHUSETTS

APPENDIX E

ECOLOGICAL BENEFITS REPORT

US Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

April 2007

TABLE OF CONTENTS

SUPPLEMENTAL DATA

ACRONYMNS AND ABBREVIATIONS

AVS/SEM	Acid volatile sulfide/simultaneously extractable metals
COPEC	chemicals of potential ecological concern
DO	dissolved oxygen
DOQ	digital orth-quad
EPH	extractable petroleum hydrocarbons
Ft	Feet
GIS	Geographic Information Systems
GPS	Global Positioning System
HEP	habitat evaluation procedure
HIS	habitat suitability index
HU	habitat units
NEPA	National Environmental Policy Act
OW	open water
PAHs	polynuclear aromatic hydrocarbons
PAMHEP	Pennsylvania Modified Habitat Evaluation Procedure
PCBs	polychlorinated biphenyls
PEC-Q	probable effects concentration quotient
PGC	Pennsylvania Game Commission
SI	suitability index
TOC	total organic carbon
TPH	total petroleum hydrocarbons
USACE/NED	United States Army Corps of Engineers, New England District
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VPH	volatile petroleum hydrocarbons

1.0 INTRODUCTION

The United States Army Corps of Engineers, New England District (USACE/NED), is in the process of preparing a feasibility-level study that identifies habitat restoration opportunities in the Malden River, a small urban waterway located in Malden, Medford, and Everett, Massachusetts. The principle goals of USACE/NED's study are to identify environmental restoration needs and opportunities in the River, develop plans and cost estimates for restoration alternatives, assess benefits and costs of alternative restoration plans, select a recommended restoration plan, and prepare appropriate NEPA documentation.

The USACE and the Mystic Valley Development Commission (MVDC) have determined habitat benefits (measured in habitat units) for three restoration components (wetland, benthic, and fish habitat restoration). The restoration components were analyzed in various combinations along with a No-Action alternative. This Ecological Benefits Report is designed to evaluate the relative habitat benefits for each of the various combinations of wetland, benthic and fish restoration components. This report provides a summary of the habitat evaluations and other analyses conducted for the Malden River Study. It includes a brief introduction to the Habitat Evaluation Procedures (HEP) study conducted, including existing conditions, the HEP process, and the goals and objectives of this evaluation (Section 1.0); a presentation of the methods used throughout the data collection, analysis, and documentation (Section 2.0); and the results of the HEP study (Section 3.0).

1.1 Site Description

The Malden River is a tributary of the Mystic River located within the cities of Malden, Medford, and Everett, Massachusetts. It is a highly engineered waterway, originating at Spot Pond and flowing through a series of interconnected natural and man-made channels and culverts for approximately 3.5 miles before its confluence with the Mystic River. The study area includes about 40 acres of aquatic and wetland habitat.

The Malden River watershed is a sub-basin of the much larger Mystic River watershed. The Malden River watershed is approximately 11 square miles, located in the towns of Wakefield, Stoneham, Melrose, Malden, Medford and Everett (see Figure E-1). The Malden River originates from the outflow from Spot Pond in the Fells Reservation and passes beneath or through the cities of Melrose and Malden in underground culverts or channelized conveyances through much of the upper watershed. It daylights from two sets of stormwater culverts south of Malden Center and flows for approximately 2 miles as open surface water through the densely populated cities of Malden, Everett and Medford prior to its confluence with the Mystic River, just upstream of the Amelia Earhart Dam. Four small tributaries flow into the Malden River below Malden center; Little Creek on the western side, two unnamed tributaries that both enter from the east and are referred to hereafter as North Creek and South Creek and a small drainage (Mall Creek) flows between the Revere Beach Parkway and the Gateway Mall.

The Malden River Federal channel is on average 6 feet deep by 100 to 150 feet wide from the Medford Street Bridge in Malden to its confluence with the Mystic River, approximately 2 miles (Fort Point Associates, 2003). In locations outside of the channel, water depths have been observed to be as shallow as 2 feet (D. Klinch, pers. observation). Spot depth elevations compiled during river assessment studies and corresponding bathymetric profiles for the river system may be referenced in Appendix F (Figures F-1 and F-2). The Malden River has an estimated surface area of 54 acres (from the stormwater culvert to the confluence with the Mystic River) and an approximated volume of 14,700,000 ft3 (110 million gallons), based on preliminary provisional USGS bathymetric data.

Figure E-1 Malden River Watershed

The Malden River watershed has been subject to the effects of gradual urbanization for several centuries. The results of development on river and aquatic resources have been significant. The majority of tributary streams and associated wetlands have been filled or culverted. Construction of the Earhart Dam in the mid 1900's converted part of the waterway from a tidally influenced salt-water estuary to a freshwater system. Water quality has deteriorated as an array of natural and man-made contaminants are carried off the land surface during rainstorms and deposited into the river. Poor water quality and sediment quality and degraded fish and benthic invertebrate communities have been documented. Non-native invasive species of flora such as *Phragmites* and knotweed have proliferated, crowding out native species, and limiting the diversity of riparian and wetland plant communities. Sediment testing conducted by Nangle Associates indicates that Malden River sediments and the surrounding riverbank soils contain elevated levels of contaminants, including metals, petroleum hydrocarbons, polynuclear aromatic hydrocarbons (PAHs), and pesticides (Nangle 2000, 2003, 2005).

To assist in the evaluation of ecosystem characteristics, in particular the development of incremental building blocks for an alternatives analysis, the entire study area was divided into six (6) smaller sub-areas. Each of the six distinct sub-areas of the Malden River (see Environmental Assessment, Section 10, Figure EA 5-4) was evaluated independently. The following sections describe the general characteristics of each of these smaller study areas.

1.1.1 Sub-Area 1

Sub-area 1 represents the input or northerly limits of the Malden River study area immediately adjacent to and downstream of the Medford Street Bridge crossing. This portion of the Malden River was straighten and deepen under the U.S. Rivers and Harbors Act (June 14, 1880). Sub-area 1 consists of approximately 60,000 square feet of surface area, with an average depth of 6.2 feet ± along the river centerline. Sub-area 1 contains approximately 900 linear feet of bordering banks. Elevated concentrations of coal gasification residuals were identified within the sediment deposits along the easterly and westerly banks of the Medford Street Bridge.

1.1.2 Sub-Area 2

Sub-area 2 extends southerly from Sub-area 1 to TeleCom City Rivers Edge Parcel 5-2 and encompasses a majority of the early 1970's dredging project. Sub-area 2 consists of approximately 221,000 square feet of surface area, with an average depth of 7.0 feet ±. Sub-area 2 contains approximately 2,200 linear feet of bordering banks. The advancement of test borings within Sub-area 2 revealed a high degree of river competency reflective of the historic dredging activities that have been conducted in this portion of the project study area.

1.1.3 Sub-Area 3

Sub-area 3 represents the Little Creek portion of the project study area. Sub-area 3 consists of approximately 208,500 square feet of surface area, with an average depth of 4.6 feet ±. Sub-area 3 contains approximately 1,400 linear feet of bordering banks. The greatest degree of sediment variations and contaminant accumulation within the Malden River exists at its confluence with Little Creek. Sediment accumulation is highest along the easterly banks of the Malden River, reflective of once tidal dispersion and settling patterns. During Nangle Consultant Associates, Inc initial assessment of baseline characteristics, Sub-area 3 was identified as a target area for further evaluation due to the nature of sediment deposition and corresponding magnitude of coal tar constituents. The evaluation of contaminant distribution in Sub-areas 1 and 3 suggests that separate and discrete source conditions are responsible for contaminant distribution identified during site characterization. Figure 4-2 illustrates surface water depths decline in both easterly and westerly directions away from the centerline of the Malden River within Sub-Area 3.

1.1.4 Sub-Area 4

Sub-area 4 is an oxbow of the original Malden River that appears to have not been disturbed during the historic dredging activities. This oxbow receives surface water recharge from an unnamed creek (Report referenced as North Creek) situated along the northerly boundary of TeleCom City Rivers Edge Parcel 2-5. Sub-area 4 consists of approximately 250,400 square feet of surface area, with an average depth of 2.4 feet ±. Sub-area 4 contains approximately 4,100 linear feet of bordering banks.

1.1.5 Sub-Area 5

Sub-area 5 extends southerly from Sub-area 3 to Route 16 Revere Parkway Bridge. Sub-area 5 consists of approximately 682,000 square feet of surface area, with an average depth of 8.4 feet ±. Sub-area 5 contains approximately 6,400 linear feet of bordering banks. Sub-area 5 receives surface water recharge from unnamed creek (Report referenced as South Creek) situated along the southerly boundary of Parcel 2-5.

1.1.6 Sub-Area 6

Sub-area 6 extends southerly from Route 16 Revere Parkway Bridge to the Amelia Earhart Dam. Sub-area 6 consists of approximately 1,995,000 square feet of surface area, with an average depth of 9.5 feet ±. Sub-area 5 contains approximately 8,500 linear feet of bordering banks. Sub-area 6 receives surface water recharge from unnamed creek (Report referenced as Mall Creek) situated along the northerly boundary of the Gateway Mall.

1.2 Habitat Evaluation Procedures

Several restoration alternatives have been proposed for the Malden River Study. These alternatives have the potential to directly and indirectly impact the existing natural resources in the Study Area. USACE/NED has used the HEP methodology (USFWS 1980) in previous studies (i.e., Muddy River Flood Control Project, Stewart's Creek Salt Marsh Restoration Project) and determined that HEP is adequate to quantify effects (beneficial and adverse) in terms of wildlife habitat units and can be used to assist in the development and identification of the most ecologically beneficial restoration alternative. Also, HEP enables a comparison of future wildlife habitat units of the No-Action alternative to the future wildlife habitat units of the various restoration alternatives.

HEP provides information for two general types of wildlife habitat comparisons, the relative value of different areas at the same point in time, and the relative value of the same area at different points in time. This information is useful in baseline and impact assessments to evaluate proposed actions that potentially result in a change in either habitat quantity or quality. Through the use of HEP, the relative value of wildlife habitats can be quantitatively assessed through a final numerical output (McCrain 1992) that is technically defensible, replicable, and consistently applicable in a variety of different habitat types. HEP and Pennsylvania Modified HEP (PAMHEP) (a modified HEP version also used in this study) is based on combining a measure of habitat quantity with an index of habitat quality to determine habitat values (USFWS 1980, Pennsylvania Game Commission [PGC] 1980). The underlying assumption of HEP is that the habitat for a given wildlife species can be described by a Habitat Suitability Index (HSI) model.

HSI models typically denote habitat suitability of a species as the relationship between two or more environmental variables that are deemed to affect the species' presence, distribution, and/or abundance. The HSI is defined as a value between 0.0 and 1.0, with 1.0 representing optimum habitat, and is assumed to be positively correlated to carrying capacity (USFWS 1980, PGC 1980). The HSI value is multiplied by the area of available habitat to obtain Habitat Units (HUs). The HU values provide a quantitative estimate of overall habitat benefits.

The HEP models were used to evaluate the wetland restoration alternatives for the Malden River. However, no existing HEP models were available to adequately evaluate the benthic restoration and fish habitat restoration components of this study. In order to quantify habitat units for the benthic restoration component of this study, a predictive model was used to assess the toxicity of the sediments. The model (described in detail in section 2.5.1) calculates HSIs based on predicted survivability of benthic organisms. Habitat units for fish passage and fish habitat restoration were also developed. Habitat units for fish passage were defined as 60% of the total open water available in the project area (in acres), while the habitat units for improved fish habitat were defined as acres of suitable substrate restored for spawning.

1.3 Goals and Objectives

The specific goal of this appendix is to calculate the habitat benefits (*i.e.*, HUs) associated with the restoration alternatives proposed for the Malden River system. The following objectives were established:

1. Assess wetland/terrestrial habitat quality and quantity through the use of HSI models of selected evaluation species.
2. Analyze bulk sediment chemistry to assess benthic invertebrate habitat quality.
3. Analyze current fish passage procedures to assess the availability of fish habitat.

The overall goal of the Malden River Restoration Project is to improve habitat conditions in the River for fish and wildlife species. Habitat improvement will be accomplished through the removal of invasive species, the re-establishment of native wetland species, the creation of additional wetland habitat, the remediation of contaminated sediments, the diversification of substrate type, and the adjustment of fish passage procedures through the Amelia Earhart dam.

2.0 METHODS

This section presents the methodology used during the Malden River ecological benefits study. Established HEP and PAMHEP models were used to evaluate wetland restoration alternatives, while a predictive toxicity model and acreages of accessible areas were used to evaluate benthic habitat restoration and fish passage restoration, respectively.

In this section, the species selection process is discussed in Section 2.1, cover type mapping is outlined in Section 2.2, field survey methods are presented in Section 2.3, the laboratory analysis and procedures are briefly discussed in Section 2.4, and the habitat assessment for each of the targeted species is presented in Section 2.5. In addition, Section 2.6 describes the process used to develop the various restoration alternatives.

2.1 Species Selection

Four ecological guilds were selected for the purpose of evaluating habitat benefits. They include a benthic invertebrate guild, a fish guild, a piscivorous (fish-eating) wildlife guild, and a wetland/riparian dependant wildlife guild. Two of these guilds, benthic invertebrates and fish, are typically evaluated at the community level. However, specific species are required to evaluate the piscivorous and wetland/riparian guilds. Therefore, species accounts, life history information, site conditions, and plant communities were evaluated to identify species likely to occur in the study area. At least 175 species were identified as likely to occur in the greater study area (Burt and Grossenheider 1976, Godin 1977, Peterson 1980, DeGraaf and Rudis 1983, Ehrlich *et al* 1988, Whitaker 1988, Conant and Collins 1991, Behler 1995, Stokes and Stokes 1996, Terres 1996). To focus the HEP study, species that did not have existing USFWS and/or Pennsylvania Modified HEP (PAMHEP) HSI models were eliminated from further consideration, narrowing the list to 25 species. Species that were not closely associated with the potential effects (*i.e.*, upland species) or study goals (*i.e.*, not included in one of the four target guilds) were also eliminated. As a result, 8 species remained for further consideration as evaluation species in the HEP study: belted kingfisher (*Cerlye alcyon*), catbird (*Dumetella carolinensis)*, slider turtle (*Pseudemys scripta*), raccoon (*Procyon lotor*), yellow warbler (*Dendroica petechia*), marsh wren (*Cistothorus palustris)*, common yellowthroat (*Geothlypis trichas)*, and green heron (*Butorides virescens*).

In order to further reduce the list of candidate species and determine which species would best fulfill the goals and objectives of the HEP study, the variables within each species' HSI model were reviewed with regard to their applicability to the Malden River and the proposed restoration alternatives. Specifically, each species model was evaluated to determine its sensitivity to potential project effects, site contaminants, its association with the targeted guilds, and the availability of toxicity and food ingestion data needed to establish links between the site contaminants and their diet. Table 1 summarizes the justifications for eliminating species from the HEP study. Based on these evaluations, three species were selected for the Malden HEP study: marsh wren, common yellowthroat, and green heron. The marsh wren and common yellowthroat represent the wetland/riparian dependant wildlife guild, and the green heron represents the piscivorous wildlife guild.

2.2 Cover Types

To evaluate the Malden River Study area in terms of wetland and aquatic habitat quality and quantity, a cover type map of the wetland areas was prepared. Specifically, a 2000 color, 1:5,000 scale digital ortho-quad (DOQ), printed at a scale of 1:3,600 (1 inch = 300 feet), was used to outline the cover types present within the study area. Standard photo-interpretation methods were used to distinguish different/unique cover type signatures on the DOQ. Unique cover type signatures were delineated and designated by polygons and digitized and geo-referenced in GIS software ARCView®, then transferred into ARC/INFO® GIS for additional editing (ESRI 1992-1998, 2000-2007). Wetland classification systems of Cowardin *et al*. (1979) and Tiner (1985) provided the foundation for cover type identification.

2.3 Field Surveys

Site-specific information was required to define certain habitat quality parameters. Field surveys were conducted by Nangle Associates (2000, 2003, 2005) to collect the sediment samples necessary for defining the habitat quality of the bottom sediments. In addition, the field procedures used by USACE to measure the habitat variables of the selected HEP evaluation species are presented.

2.3.1 Sediment Sampling

The sediments and soils in and adjacent to the Malden River have been sampled and tested to varying degrees. The river sediments have been extensively sampled in the upper reaches of the river while the lower reaches have had limited sampling (Nangle, 2000, 2003, 2005). A detailed description of the sediment chemistry in the Malden River can be found in the Environmental Assessment for this project while the data used in the predictive model can be found in section 2.4 of this appendix. Wetland soils in some of the wetlands adjacent to the river have been tested for contaminants. Additionally, many adjacent upland areas have been extensively studied as part of various remediation efforts (Jordan Co. 1985; GEI Consultants 1986; Haley and Aldrich, 1988, 1997; Camp Dresser & McKee 1991).

For planning purposes of this study, wetland soils were assumed to contain elevated levels of contaminants. Actual sampling and testing of the wetland soils will occur during the plans and specifications phase of this project. The sediment chemistry of the river sediments reported by Nangle

(2000, 2003, 2005) was used for input into the predictive models used to evaluate benthic habitat restoration.

2.3.2 HEP Data

In accordance with PAMHEP guidelines (PGC 1980), field measurements were collected within compartments representative of each of the vegetated wetland cover types identified within each study area. Compartments of cover types were sampled as needed to accurately assess the quality of the cover type in a given study area.

The habitat suitability of each compartment was determined by visually assessing the overall habitat conditions within the entire compartment. For the green heron, the compartment included the vegetated cover type being assessed as well as any waterbodies adjacent to the compartment. Each field team member independently assigned a value to the habitat variables presented below for each of the evaluation species:

- Marsh Wren (USFWS, Gutzwiller and Anderson, 1987)
  - Variable 1 (V1): Growth form of emergent hydrophytes
  - Variable 2 (V2): Percent canopy cover of emergent herbaceous vegetation
  - Variable 3 (V3): Mean water depth
  - Variable 4 (V4): Percent canopy cover of woody vegetation

- Common Yellowthroat (PAMHEP, Palmer and Hartman, 1994a)
  - Variable 1 (V1): Percent area in shrub crown cover
  - Variable 2 (V2): Average height of shrubs
  - Variable 3 (V3): Percent of grass or grass-like plants in ground cover
  - Variable 4 (V4): Proximity to wetlands

- Green Heron (PAMHEP, Palmer and Lange, 1994b)
  - Variable 1 (V1): Distance to clumps of deciduous shrubs and trees
  - Variable 2 (V2): Littoral substrate composition (of compartment and/or adjacent waterbody)
  - Variable 3 (V3): Percent of water less than 10 inches deep (of compartment and/or adjacent waterbody)
  - Variable 4 (V4): Percent of water surface covered by emergent vegetation, woody vegetation, logs, and/or trees (of compartment and/or adjacent waterbody).

Specifically, in increments of 0.10, the field team members selected a number between zero and one, with a rating of zero representing unsuitable habitat conditions and a rating of one representing optimal habitat conditions. The suitability index curves for each evaluation species, the field data forms, and a printout of the raw field data are provided in Appendix E-1 and E-2.

2.4 Sediment Chemistry Analysis

Sediment chemistry used for the predictive toxicity model, which was used to calculate habitat benefits for the benthic restoration component of this study, was taken from Nangle (2000, 2003,2005). Bulk sediment chemistry sampling and testing procedures used are described in Nangle (2004).

2.4.1 Bulk Sediment Chemistry

Sediment samples from various locations in the Malden River were analyzed for SVOCs, VOCs, EPHs, TOC, PCBs, and metals (Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn) by Nangle Associates (2000, 2003, 2005). This sediment chemistry data set (detailed in Table 21) was used to evaluate both current conditions and predicted future conditions associated with various benthic habitat restoration alternatives for the Malden River. A detailed description of the various restoration alternatives and the associated dredging activities is provided in Section 2.6. For the purpose of this evaluation, the sediment data collected by Nangle (2000,2003, 2005) from 0 to 4 feet in depth were assumed to reflect current conditions. Future sediment concentrations were estimated as concentrations present below 4 feet of the existing sediments (the project dredging depth) for each of the sub-areas of the river.

For the modeling described in section 2.5.1, the following information/assumptions were applied according to the restoration plans:

- For no action scenarios, it was assumed that current sediments would mix with newly deposited sediments over time. Specifically, it was assumed that over the course of 25 years, approximately six inches of new sediment would be deposited, and that this material would mix evenly (*i.e.*, 1:1 ratio) with the underlying sediments. To reflect likely reductions in sediment concentrations due to future source controls, newly deposited sediments were assumed to contain 50 percent of contaminants present in current surface sediments with the exception PCBs (non-detect at 0.05 mg/kg).
- Total organic carbon concentrations (TOC) at the surface and at depth were assumed to remain constant over time. TOC concentrations of newly deposited sediments were assumed to be the same as those in current sediments. TOC concentrations were assumed to mix evenly over time as described for sediments.
- Nangle (2000, 2003, 2005) collected sediment cores from the Malden River system and evaluated bulk sediment concentrations at varying depths. These data were used to represent concentrations of chemicals in sediment exposed following proposed dredging activities. Specifically, chemical concentrations reported at depths approximately equivalent to the depth of proposed dredging. The data evaluated are summarized in Table 21.
- For capping scenarios, probable effects concentrations (PECs) (see Appendix F) were used as the concentrations of contaminants in the sediments following capping activities.

2.5 Habitat Assessment

This section presents the methods used to quantify the habitat suitability of the Malden River study area and determine the effect of site contaminants and invasive species on the area's habitat value for benthic invertebrates, fish, piscivorous wildlife, and wetland/riparian dependent songbirds.

2.5.1 Benthic Invertebrates

The benthic invertebrate community includes a wide array of organisms living in close association with the sediments. Many of these organisms burrow into sediments, while others live at the sediment water interface. Due to their direct exposure to surface sediments, benthic invertebrates are a key indicator species when evaluating the potential effects of sediment-associated contaminants. Numerous laboratory-based toxicity tests have been developed for the purpose of evaluating the potential toxicity of field-collected sediments.

One of the primary goals of this evaluation was to consider the potential habitat benefits associated with reducing sediment contamination (see Appendix F for existing sediment quality conditions in the Malden River). However, although there are diversity indices with which to evaluate the relative health of an ecological community, there are currently no available HSI models for evaluating benthic habitat quality. In addition, sediment quality is typically not considered as a habitat parameter. Therefore, it was necessary to develop an approach for calculating HSIs for this component. For the purpose of this evaluation, it was assumed that sediment chemistry would be the key measure of sediment quality associated with any observed response of benthic invertebrates. This assumption is supported by the research of MacDonald *et al*. (2000) and Ingersoll *et al*. (2000) who found that sediment toxicity could be predicted in freshwater systems through the use of a sediment effects ratio described as a Probable Effects Concentration Quotient (PEC-Q).

As described by MacDonald *et al*. (2000) and Ingersoll *et al*. (2000), the PEC-Q is derived by a three-step process developed by Long *et al*. (1998). In the first step, the concentration of each chemical in a given sample is divided by its respective sediment quality criteria, in this case defined as a Probable Effects Concentration (PEC) as derived by MacDonald *et al*. (2000). The resulting ratio is defined as a PEC quotient or PEC-Q. The PEC-Qs for each chemical are then summed and divided by the number of individual chemicals evaluated to derive a mean PEC-Q for each sample. Derivation of the mean PEC-Q facilitates comparisons between stations, particularly in situations where differing numbers of chemicals have been evaluated. Based on a sample size of 175, MacDonald *et al*. (2000) found that the incidence of toxicity in freshwater sediments could be predicted in up to 94.4 percent of sediments considered through use of the mean PEC-Q.

Ingersoll *et al*. (2000) further evaluated this relationship, exploring different methods of deriving the mean PEC-Q. They found that the best predictive relationship was associated with mean PEC-Qs calculated by equally weighting the contribution of metals, PAHs and PCBs in the evaluation of sediment chemistry and toxicity. Specifically, they calculated the geometric mean of the average PEC-Q associated with the metals, the PEC-Q with total PCBs and the PEC-Q associated with total PAHs. The geometric mean of the three PEC-Qs were used in place of the arithmetic mean based on the assumption that it provides a better measure of central tendency.

To calculate HSI values for benthic invertebrates in the Malden River Study Area under future conditions, mean PEC-Qs were generated for various alternatives in each sub-area according to the method described by Ingersoll *et al*. (2000). Percent survival was then predicted for each alternative using the regression relationship reported (Ingersoll *et a*l., 2000). The predicted results based on the regression equation were used for both the current (no action) and future HSI calculations.

Using this method, HSI values were calculated for the benthic restoration scenario (Table 21) using sediment concentrations for the Malden River and reference area estimated as described in Section 2.4.1. A capping and a non-capping scenario were run. Baseline HSI values are equivalent to the values predicted for the no action plan. The specific HSI values and a summary of the calculations used to derive them are provided in Table 22.

2.5.2 Fish

A resident, pollution-tolerant, warmwater fishery currently dominates the Malden River. Selected fishes from this assemblage include: carp (*Cyprinus carpio*), yellow perch (*Perca flavescens*), brown bullhead (*Ictalurus nebulosus*), and the catadromous American eel (*Anguilla rostrata*) (MADMF, 2003). The adjoining Mystic River and Lower Mystic Lake system is currently known to support an anadromous fish run, which includes blueback herring (*Alosa aestivalis*) and alewife (*Alosa pseudoharengus*). Mystic River Watershed Association (MRWA) volunteers have presented anecdotal evidence of blueback herring in the Malden River. Based upon the observations of MRWA, herring and potentially other anadromous fish are present annually near outfalls and creek mouths along the Malden River in readily observable numbers. However, state and federal regulatory agencies have not documented any significant fishery in the Malden River (MADMF/NMFS, 2003).

The anadromous fish run into the Malden River, Mystic River, and Lower Mystic Lake system is restricted by the Amelia Earhart dam, a lock and dam structure that spans the mouth of the Mystic River. The dam was constructed in 1966 for flood control purposes. Currently, the sole means of passing anadromous fish through the dam is via lock operation by the Department of Conservation and Recreation (DCR). While the frequency and duration of lock operations and the number of fish passed is not known, it is known that blueback herring numbering over one million arrive at the Lower Mystic Lake to spawn each year (MADMF, 2003). Amelia Earhart dam operations occur in the daytime hours only, inhibiting night-migrating anadromous fish such as smelt from moving upstream. Based upon discussions with the MADMF, numbers of smelt and shad that were known to migrate upstream prior to dam construction became nonexistent within several years of installation. Therefore, the fish passage impairment through the dam is assumed to be a significant factor in the absence of a good quality anadromous fishery in the Malden River. Other factors such as lack of water flow and suitable habitat conditions (as exists in the Mystic River) may be of equal importance. However, based on the long-term restoration goals for the Malden River, the lower reach of the Malden River (from confluence with the Mystic River to the culverted upstream sections of the River) has the potential to attract and support a significant population of anadromous fish. Improvements to the Malden River system needed to improve the anadromous fish run would include: 1) improved water quality, 2) increased flow volume in the River, 3) an increase in the availability of good quality spawning habitat, and 4) improved passing procedures through the dam. While improving water quality and increasing flows in the system are outside the scope of this project, many entities such as local, state and federal government agencies, private interest groups, and non-governmental organizations are currently addressing these issues to aid in the overall improvement of the Malden and Mystic River systems. Therefore, this study concentrated only on improving the availability of spawning habitat and improving the passing procedures of anadromous fish through the dam and assumes that these programs will generate sufficient improvement in water quality to sustain the anadromous fishery.

The availability of spawning habitat will be improved by placing appropriate substrate in selected areas throughout the River. Habitat units for this component were defined as acres of suitable substrate placed in each sub-area. The improvement of passing procedures for anadromous fish will be accomplished by developing and implementing an operations manual that will optimize locking procedures by extending the seasonal duration of passing, the frequency of openings for passing, and the temporal duration. Habitat units for the passing of anadromous fish were defined (in acres).

2.5.3 Piscivorous and Wetland Dependant Wildlife

As presented in the following sections, the habitat assessment for piscivorous wildlife and wetland dependant wildlife includes the calculation of HSI values using PAMHEP models.

2.5.3.1 Habitat Suitability Index Values

The relationship between a given habitat variable and an estimate of that habitat's suitability for a particular species are expressed by mathematical equations and described graphically using suitability index curves and histograms presented in each species' HSI model (Appendix F-2). Therefore, in order to determine the HSI values for the various cover types in the Malden River Study area, the field team visually assessed each variable according to the HSI model and assigned it a Suitability Index (SI) based on the suitability curves and histograms. In accordance with the PAMHEP models, the habitat suitability of an area is directly related to the most limiting life requisite; therefore, the common yellowthroat's and green heron's HSI values are equal to the lowest average SI value for all the habitat variables within a specific cover type. The marsh wren's HSI value for each cover type was calculated based on the following equation: $(V1 \times V2 \times V3)^{1/3} \times V4$ (Gutzwiller and Anderson 1987). Table 15 presents the SI data and HSI values for all the cover types for each of the species.

2.6 Development of the Restoration Plans

Based on environmental, economic, and engineering constraints, several restoration plans (Plans) were developed by the Malden River project delivery team. The following provides a brief description of the actions associated with USACE/NED's proposed No-Action and restoration activities at all six of the study sub-areas.

Sub-Area 1

- No-Action:
  - Contaminated sediments exposed.
- Benthic Restoration:
  - Dredge selected areas to remove contaminated sediments.
- Fishery Restoration:
  - Improve spawning habitat.
  - Improve fish passage.

Sub-Area 2

- No Action
  - Herbaceous vegetation and *Phragmites* will encroach at a constant rate into the waterways.
  - Contaminated sediments exposed.
- Benthic Restoration:
  - Dredge selected areas to remove contaminated sediments.
- Wetland Restoration:
  - Eradicate all wetland *Phragmites*.
  - Plant riverbanks with native wetland species
- Fishery Restoration:
  - Improve fish passage.

Sub-Area 3

- No Action
  - Herbaceous vegetation and *Phragmites* will encroach at a constant rate into the waterways.
  - Contaminated sediments exposed.
- Restoration Dredge:
  - Dredge selected areas to remove contaminated sediments.
- Wetland Restoration:.
  - Eradicate all wetland *Phragmites*.

Sub-Area 3 (cont.)

- Plant riverbanks with native wetland species.

- Fishery Restoration:
    - Improve spawning habitat.
    - Improve fish passage.

Sub-Area 4

- No Action
    - Herbaceous vegetation will encroach at a constant rate into the waterways.
    - Contaminated sediments exposed.
- Restoration Dredge:
    - Dredge selected areas to remove contaminated sediments.
- Wetland Restoration:
    - Eradicate all wetland *Phragmites*.
    - Plant riverbanks with native wetland species.
- Wetland Creation:
    - Create wetlands in existing open water habitat
- Fishery Restoration:
    - Improve spawning habitat.
    - Improve fish passage.

Sub-Area 5

- No Action
    - Herbaceous vegetation will encroach at a constant rate into the waterways.
    - Contaminated sediments exposed.
- Restoration Dredge:
    - Dredge selected areas to remove contaminated sediments.
- Wetland Restoration:
    - Eradicate all wetland *Phragmites*.
    - Plant riverbanks with native wetland species
- Fishery Restoration:
    - Improve spawning habitat.
    - Improve fish passage.

Sub-Area 6

- No Action
    - Herbaceous vegetation will encroach at a constant rate into the waterways.
    - Contaminated sediments exposed.
- Restoration Dredge:
    - Dredge selected areas to remove contaminated sediments.

<u>Sub-Area 6 (cont.)</u>

- Wetland Restoration:
  - Eradicate all wetland *Phragmites*.
  - Plant riverbanks with native wetland species.
- Fishery Restoration:
  - Improve spawning habitat.
  - Improve fish passage.

2.7 Habitat Unit (HU) Calculations

This section presents the methods used to calculate the value of the habitat in the Malden River Study area and express it in terms of HUs for benthic invertebrates, fish, piscivorous wildlife, and wetland dependent wildlife. HUs are equal to the quantity of the habitat (*i.e*., acres) multiplied by the quality of the habitat (*i.e*., HSI value).

2.7.1 Piscivorous Wildlife and Wetland Dependant Wildlife

As described in Section 2.5.3, the HSI values for piscivorous and wetland/riparian species for each cover type were calculated by incorporating 2004 field data into suitability indices for each variable in each species' HSI model equations. To calculate the number of HUs for each sub-area, acreages of predicted cover type within all sub-areas were multiplied by each species' corresponding HSI value for that particular cover type in a given study area. Table 20 presents the HU values calculated for the piscivorous and wetland dependant species. Tables 2-19 present all the HEP data tables and calculations for the green heron, marsh wren, and common yellowthroat.

2.7.2 Benthic Invertebrates

To calculate HUs for the benthic invertebrate community, the HSIs (as described in Section 2.5.1) were multiplied by the total open water acreage to be dredged. Table 22 presents a summary of the HUs calculated.

2.7.3 Fish

For the purpose of calculating HUs for the fish community, the total open water acreage of the project area (81 acres) was calculated (i.e., the HSI was assumed to be 1) and 60% of that value (49) was used for the HU. In addition, acreages were determined for the areas that were defined as suitable for the placement of material to provide spawning habitat. Table 23 presents a summary of the HUs calculated.

3.0 RESULTS

This section presents a summary of the HUs generated for the Malden River HEP study. In particular, baseline HU results are discussed in Section 3.1, future HU and weighted HU results are presented in Section 3.2.

3.1 Baseline Conditions

3.1.1 Piscivorous and Wetland Dependant Species

Baseline HSI and HU values for the piscivorous and wetland dependant species were generated from HEP field data collection activities conducted in the project area in 2004. Baseline HUs are based on acreages of habitat available in the given study area at the time of field sampling (*i.e.*, year 2004). The overall suitability of wetland habitat in the Malden River area is relatively low, with most HSI values for individual species below 0.60. Table 20 provides the overall HSI values for each wetland restoration alternative throughout the sub-areas as well as the HUs.

3.1.2 Benthic Invertebrates

The predictive toxicity model was used to develop the baseline conditions (HSI values) for the No Action alternative. The HUs for no action for sub-areas 1, 2, 3, 4, and 5 were 0.79, 0.79, 2.33, 0.96, and 1.29 respectively.

3.1.3 Fish

The baseline conditions for the fish passage component, based on professional judgment, were assumed to be approximately 40% of existing open water habitat in the project area. The HU used for the baseline for the project area was 32.4. Appropriate fish spawning habitat was assumed to be non-existent, so a HU of 0 was used.

3.2 Future HUs

3.2.1 Piscivorous and Wetland Dependant Species

Future HU values for the piscivorous and wetland dependant species were based on acreage changes resulting from the removal of *Phragmites* and other non-native species cover and the restoration or creation of functional wetlands. Table 20 provides a summary of HUs for each species and sub-area. In general, all the action alternatives improved habitat quality for targeted species.

3.2.2 Benthic Invertebrates

Future HUs for benthic invertebrates were based on predictive toxicity modeling results of selected areas within sub-areas. A dredge and non-capping scenario as well as a dredge and cap scenario was run with the model. The HUs for the non-capping action alternatives for sub-areas 1, 2, 3, 4, and 5 were 1.10, 0.78, 2.44, 1.95, and 1.46 respectively. These values tended to increase in relation to the no action HUs. Although the overall changes in HUs appear to be slight, marked improvements in benthic invertebrate survivability are predicted. The HUs for the capping action alternatives for sub-areas 1, 2, 3, 4, and 5 were 1.13, 0.91, 3.86, 3.00, and 1.63 respectively. The dredge and cap alternatives provided more HUS than the no action and the non-cap alternatives.

3.2.3 Fish

Future HUs for fish passage were based on 60% of the total open water in the project area. The future HU was assumed to be 49. In addition, HUs were calculated for the areas that will be enhanced by the placement of substrate for spawning. The future HUs for sub-areas 1, 3, 4, 5, and 6 were 0.07, 0.69, 0.84, 0.42, and 0.79 respectively.

3.3 Summary

The use of various models and professional judgement decisions were used to create habitat units for six sub-areas of the Malden River. The HUs were developed to allow a comparison of various proposed action alternatives to the existing conditions. The HUs developed in this report will be incorporated into an Incremental Analysis that will evaluate the ecological benefits realized by various actions and the estimated costs of each action.

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5.0 TABLES

Table 1. Habitat Evaluation Procedure (HEP) models reviewed for the piscivorous and wetland dependant species guilds for the Malden River Restoration Feasibility Study.

Model	**Status**	**Reasons for Selecting or Not Selecting**
Green-backed Heron	Selected	Applies to the piscivourous feeding guild in wetland areas and contains variables that will be affected by the alternatives.
Belted Kingfisher	Not Selected	Suitable nesting habitat must be located within 1.9 miles of the study area or the overall HSI will equal zero. Based on the surrounding land use, it is unlikely that suitable nesting habitat will be present.
Slider Turtle	Not Selected	The USFWS HEP model available for the slider is only pertinent to populations in the southern United States.
Marsh Wren	Selected	Applies to species nesting in herbaceous vegetation (i.e, *Typha* and *Phragmites*) and contains variables that will be affected by the alternatives.
Common Yellowthroat	Selected	Applies species inhabiting shrub communities near open water and wetland areas and contains variables that will be affected by the alternatives.
Yellow warbler	Not Selected	Applies only to cover types dominated by shrubs.
Catbird	Not selected	Does not apply to alternatives being considered.
Raccoon	Not Selected	The variables for the raccoon are not sensitive enough to distinguish improvements in habitat based on the alternatives being considered.

MARSH WREN HEP MODELS

Table 2. Marsh Wren HEP Model Results in Subarea 1

Alternative	Growth form of Emergent Hydrophytes	SI (V_1)	% Canopy Cover of Emergent Herbaceous Vegetation	SI (V_2)	Mean Water Depth (cm)	SI (V_3)	% Canopy Cover of Woody Vegetation	SI (V_4)	Overall Marsh Wren HSI
1	4	0.0	0	1.0	>40	1.0	0	1.0	0.0
2	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 3. Marsh Wren HEP Model Results in Subarea 2

Alternative	Growth form of Emergent Hydrophytes	SI (V_1)	% Canopy Cover of Emergent Herbaceous Vegetation	SI (V_2)	Mean Water Depth (cm)	SI (V_3)	% Canopy Cover of Woody Vegetation	SI (V_4)	Overall Marsh Wren HSI
1	2	0.5	90	1.0	>40	1.0	10	0.9	0.71
2	2	0.5	100	1.0	>40	1.0	0	1.0	0.79
3	1	1.0	100	1.0	>40	1.0	0	1.0	1.0
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4. Marsh Wren HEP Model Results in Subarea 3

Alternative	Growth form of Emergent Hydrophytes	SI (V_1)	% Canopy Cover of Emergent Herbaceous Vegetation	SI (V_2)	Mean Water Depth (cm)	SI (V_3)	% Canopy Cover of Woody Vegetation	SI (V_4)	Overall Marsh Wren HSI
1	2	0.5	65	0.7	>40	1.0	35	0.70	0.49
2	2	0.5	75	1.0	>40	1.0	25	0.75	0.59
3	1	1.0	90	1.0	>40	1.0	10	0.90	0.90
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 5. Marsh Wren HEP Model Results in Subarea 4

Alternative	Growth form of Emergent Hydrophytes	SI (V_1)	% Canopy Cover of Emergent Herbaceous Vegetation	SI (V_2)	Mean Water Depth (cm)	SI (V_3)	% Canopy Cover of Woody Vegetation	SI (V_4)	Overall Marsh Wren HSI
1	2	0.5	65	0.7	>40	1.0	35	0.70	0.49
2	2	0.5	75	1.0	>40	1.0	25	0.75	0.59
3	1	1.0	90	1.0	>40	1.0	10	0.90	0.90
4	1	1.0	95	1.0	>40	1.0	5	0.95	0.95

Table 6. Marsh Wren HEP Model Results in Subarea 5

Alternative	Growth form of Emergent Hydrophytes	SI (V_1)	% Canopy Cover of Emergent Herbaceous Vegetation	SI (V_2)	Mean Water Depth (cm)	SI (V_3)	% Canopy Cover of Woody Vegetation	SI (V_4)	Overall Marsh Wren HSI
1	2	0.5	70	0.9	>40	1.0	30	0.7	0.53
2	2	0.5	90	1.0	>40	1.0	10	0.9	0.71
3	1	1.0	100	1.0	>40	1.0	0	1.0	1.00
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 7. Marsh Wren HEP Model Results in Subarea 6

Alternative	Growth form of Emergent Hydrophytes	SI (V_1)	% Canopy Cover of Emergent Herbaceous Vegetation	SI (V_2)	Mean Water Depth (cm)	SI (V_3)	% Canopy Cover of Woody Vegetation	SI (V_4)	Overall Marsh Wren HSI
1	2	0.5	65	0.5	>40	1.0	35	0.65	0.41
2	2	0.5	75	1.0	>40	1.0	25	0.75	0.59
3	1	1.0	95	1.0	>40	1.0	5	0.95	0.95
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Common Yellowthroat HEP Models

Table 8. Common Yellowthroat HEP Model Results in Subarea 1

Alternative	% shrub canopy cover	SI (V_1)	Average Shrub Height	SI (V_2)	% grass-like ground cover	SI (V_3)	Proximity to wetlands	SI (V_4)	Overall Common Y-throat HSI
1	0	0.1	0	0.0	0	0.0	Yes	1.0	0.0
2	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 9. Common Yellowthroat HEP Model Results in Subarea 2

Alternative	% shrub canopy cover	SI (V_1)	Average Shrub Height (m)	SI (V_2)	% grass-like ground cover	SI (V_3)	Proximity to wetlands	SI (V_4)	Overall Common Y-throat HSI
1	20	0.1	2-4	0.5	10	0.10	Yes	1.0	0.16
2	30	0.5	1-2	1.0	20	0.20	Yes	1.0	0.50
3	75	1.0	1-2	1.0	25	0.25	Yes	1.0	0.75
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 10. Common Yellowthroat HEP Model Results in Subarea 3

Alternative	% shrub canopy cover	SI (V_1)	Average Shrub Height	SI (V_2)	% grass-like ground cover	SI (V_3)	Proximity to wetlands	SI (V_4)	Overall Common Y-throat HSI
1	40	0.5	2-4	0.5	10	0.1	Yes	1.0	0.36
2	30	0.5	1-2	1.0	10	0.1	Yes	1.0	0.46
3	80	0.7	1-2	1.0	20	0.2	Yes	1.0	0.60
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 11. Common Yellowthroat HEP Model Results in Subarea 4

Alternative	% shrub canopy cover	SI (V_1)	Average Shrub Height	SI (V_2)	% grass-like ground cover	SI (V_3)	Proximity to wetlands	SI (V_4)	Overall Common Y-throat HSI
1	40	0.5	2-4	0.5	10	0.1	Yes	1.0	0.36
2	30	0.5	1-2	1.0	10	0.1	Yes	1.0	0.46
3	80	0.7	1-2	1.0	20	0.2	Yes	1.0	0.60
4	60	1.0	1-2	1.0	40	0.4	Yes	1.0	0.81

Table 12. Common Yellowthroat HEP Model Results in Subarea 5

Alternative	% shrub canopy cover	SI (V_1)	Average Shrub Height	SI (V_2)	% grass-like ground cover	SI (V_3)	Proximity to wetlands	SI (V_4)	Overall Common Y-throat HSI
1	20	0.1	2-4	0.5	10	0.10	Yes	1.0	0.16
2	30	0.5	1-2	1.0	20	0.20	Yes	1.0	0.50
3	75	1.0	1-2	1.0	25	0.25	Yes	1.0	0.75
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 13. Common Yellowthroat HEP Model Results in Subarea 6

Alternative	% shrub canopy cover	SI (V_1)	Average Shrub Height	SI (V_2)	% grass-like ground cover	SI (V_3)	Proximity to wetlands	SI (V_4)	Overall Common Y-throat HSI
1	40	0.5	2-4	0.5	20	0.20	Yes	1.0	0.40
2	40	0.5	1-2	1.0	20	0.20	Yes	1.0	0.51
3	70	1.0	1-2	1.0	30	0.30	Yes	1.0	0.77
4	NA	NA	NA	NA	NA	NA	NA	NA	NA

Green Heron HEP Models

Table 14. Green Heron HEP Model Results Subarea 1

Alternative	Presence of Shrub Habitat	SI (V_1)	% of waterbody covered w/ emergent vegetation, woody vegetation, logs, or trees	SI (V_2)	Permanency of water	SI (V_3)	Overall Green Heron HSI
1	None	0.1	0	0.0	Perm. > 25 cm	0.8	0.30
2	NA	NA	NA	NA	NA	NA	NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA	NA

Table 15. Green Heron HEP Model Results Subarea 2

Alternative	Presence of Shrub Habitat	SI (V_1)	% of waterbody covered w/ emergent vegetation, woody vegetation, logs, or trees	SI (V_2)	Permanency of water	SI (V_3)	Overall Green Heron HIS
1	Shrubs – not overhanging	0.5	0	0.0	Perm. > 25 cm	0.8	0.43
2	Shrubs – not overhanging	0.5	0	0.0	Perm. > 25 cm	0.8	0.43
3	Shrubs – overhanging	1.0	10	0.2	Perm. > 25 cm	0.8	0.66
4	NA	NA	NA	NA	NA	NA	NA

Table 16. Green Heron HEP Model Results Subarea 3

Alternative	Presence of Shrub Habitat	SI (V_1)	% of waterbody covered w/ emergent vegetation, woody vegetation, logs, or trees	SI (V_2)	Permanency of water	SI (V_3)	Overall Green Heron HSI
1	Shrubs – overhanging	1.0	20	0.5	Perm. > 25 cm	0.8	0.76
2	Shrubs – overhanging	1.0	20	0.5	Perm. > 25 cm	0.8	0.76
3	Shrubs – overhanging	1.0	35	0.7	Perm. > 25 cm	0.8	0.83
4	NA	NA	NA	NA	NA	NA	NA

Table 17. Green Heron HEP Model Results Subarea 4

Alternative	Presence of Shrub Habitat	SI (V_1)	% of waterbody covered w/ emergent vegetation, woody vegetation, logs, or trees	SI (V_2)	Permanency of water	SI (V_3)	Overall Green Heron HSI
1	Shrubs – overhanging	1.0	30	0.5	Perm. > 25 cm	0.8	0.76
2	Shrubs – overhanging	1.0	35	0.7	Perm. > 25 cm	0.8	0.83
3	Shrubs – overhanging	1.0	45	1.0	Perm. > 25 cm	0.8	0.93
4	Shrubs – overhanging	1.0	60	1.0	Perm. > 25 cm	0.8	0.93

Table 18. Green Heron HEP Model Results Subarea 5

Alternative	Presence of Shrub Habitat	SI (V_1)	% of waterbody covered w/ emergent & woody vegetation, logs, or trees	SI (V_2)	Permanency of water	SI (V_3)	Overall Green Heron HSI
1	Shrubs – not overhanging	0.5	10	0.2	Perm. > 25 cm	0.8	0.50
2	Shrubs – overhanging	1.0	10	0.2	Perm. > 25 cm	0.8	0.66
3	Shrubs – overhanging	1.0	25	0.5	Perm. > 25 cm	0.8	0.76
4	NA	NA	NA	NA	NA	NA	NA

Table 19. Green Heron HEP Model Results Subarea 6

Alternative	Presence of Shrub Habitat	SI (V_1)	% of waterbody covered w/ emergent & woody vegetation, logs, or trees	SI (V_2)	Permanency of water	SI (V_3)	Overall Green Heron HSI
1	Shrubs – not overhanging	0.5	15	0.2	Perm. > 25 cm	0.8	0.50
2	Shrubs – not overhanging	0.5	15	0.2	Perm. > 25 cm	0.8	0.50
3	Shrubs – overhanging	1.0	25	0.5	Perm. > 25 cm	0.8	0.76
4	NA	NA	NA	NA	NA	NA	NA

Table 20. Overall Habitat Suitability Indices (HSIs) for the piscivorous and wetland dependant species guilds and their associated Habitat Units (HUs).

	Marsh Wren	Common Yellowthroat	Green Heron	Overall HSI	Area (acres)	Habitat Units
sub-area 1						
No Action	0.0	0.0	0.30	0.30	0	0
Invasive Removal	NA	NA	NA	NA	NA	NA
Wetland Restoration	NA	NA	NA	NA	NA	NA
Wetland Creation	NA	NA	NA	NA	NA	NA
sub-area 2						
No Action	0.71	0.16	0.43	1.30	1.29	1.68
Invasive Removal	0.79	0.50	0.43	1.72	1.29	2.22
Wetland Restoration	1.0	0.75	0.66	2.41	1.29	3.11
Wetland Creation	NA	NA	NA	NA	NA	NA
sub-area 3						
No Action	0.49	0.36	0.76	1.61	3.37	5.43
Invasive Removal	0.59	0.46	0.76	1.81	3.37	6.10
Wetland Restoration	0.90	0.60	0.83	2.33	3.37	7.85
Wetland Creation	NA	NA	NA	NA	NA	NA
sub-area 4						
No Action	0.49	0.36	0.76	1.61	3.39	6.05
Invasive Removal	0.59	0.46	0.83	1.88	3.39	7.07
Wetland Restoration	0.90	0.60	0.93	2.43	3.39	8.24
Wetland Creation	0.95	0.81	0.93	2.69	8.09	21.76
sub-area 5						
No Action	0.53	0.16	0.50	1.19	3.78	4.50
Invasive Removal	0.71	0.50	0.66	1.87	3.78	7.07
Wetland Restoration	1.00	0.75	0.76	2.51	3.78	9.48
Wetland Creation	NA	NA	NA	NA	NA	NA
sub-area 6						
No Action	0.41	0.40	0.50	1.31	14.23	18.64
Invasive Removal	0.59	0.51	0.50	1.60	14.23	22.76
Wetland Restoration	0.95	0.77	0.76	2.48	14.23	35.29
Wetland Creation	NA	NA	NA	NA	NA	NA

NA = Not Applicable

Table 21. Sediment chemistry values used in predictive toxicity model. Initial concentrations represent composite data from 0-4 feet in each sub-area. Concentration after dredging values represent composite data below 4 feet.

Area	Chemical	Initial Concentration (mg/kg)	Concentration After Dredging (mg/kg)
Sub-area 1	Total PAHs	3610.00	1193.00
	Total PCBs	0.050	0.050
	Arsenic	35.0	17.0
	Cadmium	12.00	1.10
	Chromium	78.00	45.00
	Copper	310.00	63.00
	Lead	1100.00	170.00
	Nickel	43.00	27.00
	Zinc	1100	190
Sub-area 2	Total PAHs	1446	1192
	Total PCBs	0.050	0.050
	Arsenic	27.500	15.700
	Cadmium	11.000	7.000
	Chromium	116.000	88.000
	Copper	343.000	320.000
	Lead	1970	780
	Nickel	56.00	44.00
	Zinc	2838.00	1038.00
Sub-area 3	Total PAHs	4604.00	7197.00
	Total PCBs	0.050	0.050
	Arsenic	234.20	40.00
	Cadmium	7.00	7.00
	Chromium	242.00	152.00
	Copper	467.00	286.00
	Lead	1120.00	780.00
	Nickel	47.00	48.00
	Zinc	2300.00	863.00
Sub-area 4	Total PAHs	3103.0	813.0
	Total PCBs	0.532	0.532
	Arsenic	250.00	50.00
	Cadmium	7.30	3.20
	Chromium	140.00	120.00
	Copper	220.00	220.00
	Lead	850.00	360.00
	Nickel	46.00	46.00
	Zinc	1100.00	1100.00
Sub-area 5	Total PAHs	917.00	892.00
	Total PCBs	0.050	0.050
	Arsenic	43.20	41.00
	Cadmium	14.00	7.00
	Chromium	536.00	166.00
	Copper	275.00	206.00
	Lead	1100.00	590.00
	Nickel	295.00	38.00
	Zinc	3610.00	813.00

Table 22. Habitat Suitability Indices (HSI) and Habitat Units (HU) generated from the predictive toxicity model for the Malden River sub-areas.					
Plan	Location	Total Acreage	Predicted Survival-*Hyallela*	HSIs-*Hyallela*	HUs - *Hyallela*
No action	Sub-area 1	1.240	50.42	0.64	0.79
	Sub-area 2	1.000	62.50	0.79	0.79
	Sub-area 3	4.230	43.48	0.55	2.33
	Sub-area 4	3.290	23.08	0.29	0.96
	Sub-area 5	1.790	57.13	0.72	1.29
Dredging	Sub-area 1	1.240	70.41	0.89	1.10
	Sub-area 2	1.000	61.83	0.78	0.78
	Sub-area 3	4.230	45.61	0.58	2.44
	Sub-area 4	3.290	46.91	0.59	1.95
	Sub-area 5	1.790	64.66	0.82	1.46
Dredging and Capping	Sub-area 1	1.240	75.19	0.91	1.13
	Sub-area 2	1.000	75.19	0.91	0.91
	Sub-area 3	4.230	75.19	0.91	3.86
	Sub-area 4	3.290	75.19	0.91	3.00
	Sub-area 5	1.790	75.19	0.91	1.63

Table 23. Fish Passage and Fish Spawning Habitat Units (HU)					
Plan	Location	Total Acreage	Baseline HU	Future HU	
Fish Passage	Open Water in Project Area	81.0	32.4	49	
Fish Spawning Enhancement	Sub-area 1	0.07	0	0.07	
	Sub-area 2	0	0	0	
	Sub-area 3	0.69	0	0.69	
	Sub-area 4	0.84	0	0.84	
	Sub-area 5	0.42	0	0.42	
	Sub-area 6	0.79	0	0.79	

Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX F

WATER QUALITY & SEDIMENT QUALITY DATA

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New England District

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Hydrology

No recent or systematic hydrologic study of the Malden River was identified during Phase I and the completion of such a study is likely to be complicated due to the urbanized nature of the watershed as well as the flow and elevation changes dictated by the operations at the Amelia Earhart dam. The following provides a brief overview of three important hydrological features of the Malden River watershed – the Malden River's source at Spot Pond, the confluence with the Lower Mystic River and the changes caused by the presence and operation of the downstream Amelia Earhart Dam.

Spot Pond and Upper Watershed

The Malden River originates from Spot Pond, in the Middlesex Fells Reservation in Stoneham, MA. The surface area of Spot Pond is approximately 298 acres, the largest pond in the Mystic River watershed. The natural watershed of Spot Pond was historically 1,175 acres. However, due to a series of drainage diversions for flood control of surrounding areas, the actual drainage area of the pond (including the pond surface area) is approximately 369 acres (CDM, 2002). Spot Pond discharges into Spot Pond Brook, where it flows for approximately 1 mile in a channel before entering culverts. Spot Pond Brook becomes Malden River within the culvert system, and remains underground for approximately 3 miles until it emerges in the Malden River Federal channel.

Spot Pond was historically used as potable water conveyance in the MWRA system. Since 1997, the pond has been taken off line, and is now used to receive flows from the distribution system, either as part of a flushing event or a system failure and as an extreme emergency source, if there is a loss of suction from other facilities in the system or a transmission failure. If needed as an emergency drinking water supply, the water will be passed through a disinfection process and will require boiling before consumption. MWRA currently operates the pond such that an 8-day emergency water supply is available at all times. For this reason, releases of water from the pond can be restricted.

Lower Mystic Lake and Influence of Amelia Earhart Dam

Historically, the Malden River and Lower Mystic River were tidal estuaries supporting brackish aquatic biota. Saltwater intrusion in the rivers led to saline stratification in the Lower Mystic Lake, first observed in 1860 and consistently present until its reduction in the 1980s. The presence of the saline stratification caused the saltwater to be trapped in the deep pools of the lake, and prevented biannual turnover and complete mixing. At times (during the right combination of strong winds and low lake levels), there were releases of hydrogen sulfide (H2S) from Lower Mystic Lake, causing public nuisance conditions and possible health hazards. Following a 1965 release, a major kill of alewives and barnacle growth on boats and pilings were observed.

The installation of the Craddock Dam in 1908 (on the Mystic River approximately 3 miles downstream of the lake) did not isolate the lake, and periodic excursions of saltwater into the lake occurred when the locks were open. The Amelia Earhart Dam was completed in 1966 (approximately 5 miles downstream of the lake, below the confluence of the Mystic and Malden Rivers) with flood control (i.e., protection from storm surge) as its primary function. The dam maintains the lake level about 3 feet above mean low water, which prevents intrusion of tidal seawater and negates the possibility of reintroduction of saline stratification into the Lower Mystic Lakes. However, this effectively eliminates tidal flow into and flushing of the Mystic and Malden Rivers, and the elimination of saltwater quickly changed the ecosystem from its natural brackish state to freshwater. For this reason, runoff and flushing by upgradient freshwater flows now dominates the system. Due to its urbanized nature, much of this recharge consists of non-point source stormwater runoff, which is being addressed through complementary water quality programs and represents an objective to be addressed by this NER plan. As supported by the basic water quality information compiled within this study and its presence on the Massachusetts 303(d) list for waters not meeting state water quality standards, the present rate of flushing appears directly related to the inability to maintain good water quality in the Malden River.

In the late 1970s, the Lower Mystic Lake Saltwater Removal Project (MDC, 1994) was designed and implemented by MDC and EPA to reduce the volume of saltwater trapped in the deep holes of the lake, as well as the potential for H2S releases. A combination of pumping (removing 8.47 million cubic feet) and a large storm event (removing 16.09 million cubic feet) resulted in the removal of approximately 90% of the saltwater from the holes in the Lower Mystic Lake. This removal led to a larger lake volume available for freshwater habitat and elimination of H2S releases due to the larger depth of freshwater overlying the remaining salt water and a smaller reservoir of sulfide-laden water.

The current operation of the Earhart Dam permits the passage of small volumes of salt water when the locks open. This small volume tends to sink into the deep hole located just upstream of the dam, and does not make its way up the rivers. This water is periodically pumped to the seaward side of the dams during efforts to lower the upstream water level.

Due to the persistent water quality problems in the lake and the extensive effort expended to address these issues, there is considerable concern that any alteration in the operation of the Earhart Dam that allowed more salt water inflow could result in a reintroduction of saline stratification in the Lower Mystic Lake. This concern is driven by historical experience and the fact that there is very little elevation change between the dam and the lake, indicating that the tidal salt water will likely migrate to the lake.

Existing Water Quality and Use

Water quality in the Malden River is generally considered degraded, owing to several sources of contamination, (i.e., contaminated sediments, stormwater, historic releases of OHM) and, in particular, poor flushing and mixing. Several focused studies (e.g. NCA, 2000b) indicate degraded water quality conditions in the river; primarily due to poor mixing and stormwater run-off contributions. In addition, detailed inspections of the river system (Harris 2000) have revealed extensive accumulations of solid waste and debris.

The Mystic River Watershed Association (MyRWA) has been regularly collecting data throughout the Mystic River Watershed since 1999, including one station above the Amelia Earhart Dam. At this location, they collected continuous dissolved oxygen (DO) data during the summer months of 2002 and 2003. The DO sensor was located in 3-6 feet of water, in the lower portion of the water column. In 2002, a dry year, there were 3-4 weeks in July when the DO fell below 5.0 mg/L (the Class B water quality standard). In 2003, a wet year, there were only a few periods in July when DO fell below this water quality standard. These data indicate that low DO conditions are likely seasonally dependent and occur on an annual basis. However, as described below, DO conditions within the river system appear to vary spatially as well as temporally due to a variety of influences such as depth of water column, ambient temperature, sediment quality and proximity to the main recharge areas for the river system.

In August of 1999, baseline DO measurements were performed at fifteen (15) sampling locations along the centerline of the Malden River by Nangle Consultants Associates, Inc. (NCA). In general, DO concentrations ranged from 0.11 to 4.65 mg/l in the lower depths of the Malden River. In contrast, substantially higher DO levels ranging from 9.55 to 15.46 mg/l were measured in shallow water, alluding to the poor mixing attributable to ongoing surface water management practices. In this regard, during various summertime sampling events, reportedly distinct observations of varied zones of surface water transport were evidenced in the form of velocity separation between upper (1± foot) and lower depths of the river. Point measurements of DO collected by MyRWA throughout the watershed on 10/28/03 also indicate that DO in the central reach of the Malden River is considerably lower than at other locations in the Malden or Mystic Rivers.

MyRWA has also performed a focused study to characterize bacteria concentrations and potential sources along the Malden River to complement the baseline data collected monthly (MyRWA, 2002). This effort included the sampling of several locations along the river and pipe discharge on May 28, 2002. Baseline data collected at the Medford Street Bridge indicated a fecal coliform geometric mean of 265/100 ml. Sixty-four percent of the samples violated the primary contact standard (swimming) of 200/100 ml and 23% violated the secondary contact standard (boating) of 1000/100 ml. Three samples from this May 2002 sampling event violated the primary contact standard, while and two violated the secondary contact standard. The two violations of the secondary contact standard both occurred inside the culvert at the upper or northern end of the Malden River channel. MRWA hypothesized that the high level of fecal coliform observed at this location may be attributable to the infiltration or mixing of sewage contamination within the distribution system. Wet weather stormwater quality information has also been provided for Little Creek (NCA, 2000b), which shows a significant variations and degradation of water quality due to fecal coliform and other stormwater constituents.

As part of a remedial investigation associated with the former General Electric site, one of the properties along the easterly banks of the Malden River, several surface water samples were collected and analyzed in 1989 and 1993 (Eckenfelder/Brown and Caldwell, 1999). VOCs, SVOCs and TPHs were either not detected or were detected in low concentrations. Several metals, including cadmium, lead, mercury, and zinc, were detected in one or more of the samples. The authors concluded that these contaminants did not appear to originate in groundwater near the investigation.

Designated Water Use Support in the Malden River

The Malden River is classified by the State of Massachusetts as Class B waters, designated as a habitat for fish, other aquatic life and wildlife, required to meet swimming and boating standards, suitable for irrigation, agricultural and industrial uses and have "consistently good aesthetic value." However, water quality results indicate that the river does not support its designated uses and, as such, it is included on the Massachusetts 303(d) list for organic enrichment/low DO, pathogens, oil and grease, taste, odor, color, suspended solids, and "objectionable deposits." Poor water quality in the Malden River is attributed to the impact of a variety of sources related in large part to historic conditions and ongoing infrastructure, as well as contaminated sediments, stormwater, atmospheric deposition and ongoing transfer of residuals associated with OHM releases that have occurred. As described previously, a primary causal factor is the poor flushing of the river system, due to the shift from an historic tidal estuary to a poorly flushed "freshwater impoundment." Because of the small, highly impervious nature of the watershed, there is little freshwater base flow into the Malden River for extended periods, and groundwater inflow that does occur may be of degraded quality.

The Malden River Federal channel is on average 6 feet deep by 100 to 150 feet wide from the Medford Street Bridge in Malden to its confluence with the Mystic River, approximately 2 miles (Fort Point Associates, 2003). In locations outside of the channel, water depths have been observed to be as shallow as 2 feet (D. Klinch, pers. observation). Spot depth elevations compiled during river assessment studies and corresponding bathymetric profiles for the river system may be referenced in Figures F-1 and F-2, respectively. The Malden River has an estimated surface area of 54 acres (from the stormwater culvert to the confluence with the Mystic River) and an approximated volume of 14,700,000 ft3 (110 million gallons), based on preliminary provisional USGS bathymetric data.

Existing Sediment Quality

A general description of site history and sources of sediment contamination is provided in Appendix B, while a summary of thickness and types of sediments, together with corresponding pollutant concentrations may be referenced from Section 4.0 of this report. This Appendix, together with Appendix E, provides a more detailed discussion of the relationship between sediment quality and the selected components of the NER Plan.

SOURCES OF SEDIMENT CONTAMINATION

The Malden River was originally an extensive tidal wetlands area bisected by a sinuous, meandering channel. Beginning in the 1800's the wetland areas were filled, the path of the river straightened, and the main stem of the river dredged at various times (i.e., 1840's, 1890's, 1930's and 1970's) with additional spot dredging to access specific shoreline properties. Eventually tidal influences were eliminated by installation of flood control structures. With the last of the dredging in the 1970's, sediments have had the opportunity to accumulate undisturbed in the river. Accumulated sediments are underlain by light yellow to blue clay (often referred to as Boston blue clay).

Intensive use of the land along and dependent upon the Malden River began in the mid-1800s as industrial expansion proceeded north from the City of Boston. As described in Appendix B, dredging and realignment of the once meandering Malden River served as the catalyst to a period of unprecedented economic growth and industrial activity which included numerous chemical, rubber products, manufactured gas, asphalt pharmaceutical, foundry and technological initiatives. Following several periods of wartime support, a majority of these facilities relocated to more modern facilities during the mid-1900s. Industries that probably had the greatest impact

Insert Figure F-1 Water Depths

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Insert Figure F-2 Water Depth Ranges

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on sediment quality include manufactured gas plant operations, several asphalt and tar companies, tanneries, metal working plants, and chemical companies (NCA, 1996; 1997; 2000a). Potential sources of pollutants impacting the sediments are primarily related to residuals associated with historic industrial waste deposition practices, with a significant reduction in upland source contributions occurring over the past few decades. In general, current sediment quality in the Malden River is impacted by the following:

- Historic conditions – Historic activities that have impacted sediments include releases of OHM directly to the River, releases of OHM to soil and groundwater, fill deposition and land alteration practices. Because these releases occurred during periods when the river was tidal and being maintained for navigation, pollutants are present in both shallow and deeper sediment layers. Profiles showing vertical variations in sediment covers are described in Appendix D of the Phase I study. Also described in Appendix B is the extensive filling of former tidelands a long the Malden to support the uses described above. Due to the nature of then existing roadway networks, a majority of the fill material appeared to have been generated as a consequence of nearby industrial activities and include a predominance of razed building materials, consisting of concrete, rubber, wood and metal debris, as well as discrete industrial waste products. Historically, pollutants from these fill materials may have seeped directly into the river or dissolved in groundwater then migrated into the river, although current groundwater contributions to adverse sediment quality within the river system appear to be minor. The exception to this behavior may exist at the confluence of the Malden River and Little Creek. While former seeps of non-aqueous phase liquids into culverts and ultimately into the river have occurred, efforts to address specific source areas have been completed by several responsible parties within the river system.

- Current Conditions – Current conditions that continue to influence sediment quality include the mixing of OHM residuals from historic land use practices, particularly cola gasification and metalworking activities, stormwater runoff and atmospheric deposition. Extensive remedial activities have been undertaken within the study area by numerous parties and at this time residuals within sediments, rather than ongoing sources or release appear to represent the most significant unresolved conditions. As described in further detail within the following sections of this Appendix, the nature of sediment quality at the confluence of Little Creek and the Malden River is a primary area of environmental concern, which will be addressed in part by recommended elements of the NER Plan. The Malden River receives stormwater runoff from an extensive urban area and efforts are also ongoing to reduce the influence from stormwater runoff. Metals from coal burning power plants and other sources may accumulate in river sediments via atmospheric deposition.

LOCATION OF SEDIMENT CONTAMINATION

Sediment depths and characteristics have been characterized for major portions of the Malden River study area A cross section depicting sediment in the upper section of the river (from Malden River Culvert Outfall to Medford Street Bridge) is provided in Appendix D of the Phase I study (Haley & Aldrich, 2001). As shown, the depth of water in the upper section is 5 feet or less and sediments consist of organic silt, sands, clayey organic silts and clay. The depth of sediments (defined as the depth to clay) reportedly varies from 2 feet to over ten feet in the upper section of the river. Generally, the thickness of sediment increases with distance from the culvert outfall at the northern end of the river. The top layer of sediment is identified as primarily sand at the culvert outfall and immediately to the south, with the top layer of sediment consisting primarily of organic silt further south.

A profile depicting sediment in the River's Edge   section (from Medford Street to Revere Beach Parkway) is also provided in Appendix D of the Phase I study (NCA, 2003a). The depth of water within the portion of the river system, defined for discussion purposes as River's Edge section is five to ten feet. The depth of water generally increases from north to south. The thickness of sediment in the River's Edge section ranges from approximately 7 to 18 feet. The sediment layer has been measured as being thickest along the banks immediately south of the Medford Street Bridge and the confluence of the River and Little Creek. The top layer of sediment is primarily loose or unstable organic silts and benthic material and generally underlain by the first zone of historic sediment contamination. Contaminant distribution with depth is typically stratified according to variations in the underlying layer of silts, sands, peat and/or clay.

POLLUTANT CONCENTRATIONS IN SEDIMENT

Data on sediment quality is available from a variety of sources (TRC, 1985; Haley and Aldrich, 2001, NCA, 2003a; 2003b). River sediments have been sampled for metals, cyanide, volatile organic compounds (VOCs), PCBs, petroleum hydrocarbon fractions, and pesticides. The primary pollutants of concern in the Malden River are semi-volatile organic compounds (SVOCs) and metals. During the Phase I study, that portion of the River system extending southerly from the Medford Street Bridge to the Revere Beach Parkway was identified as having the highest potential for meeting the objectives of this restoration plan. Accordingly, sediment quality within this portion of the river, referred to as Sub-Areas 1 through 5 has been evaluated in greater detail. To assist in the review of the following environmental data and information, a summary of sediment sampling locations identified to the north of the Medford Street Bridge during the Phase I study is provided as Figure F-3 and a sketch plan of site depicting the approximate location of surface water and sediment samples between the Medford Street Bridge and Revere Beach Parkway has been presented as Figure F-4.

A general summary of the pollutants detected, ranges of concentrations, and average concentration is provided in Tables F-1 to F-4. Included in the tables are generic soil criteria from the MCP, as well as the ecological benchmarks. Generally, the three MCP soil categories (S-1, S-2, S-3), together with Upper Concentration Limits (UCLs), though not applicable to sediments, do provide a benchmark in terms of relative magnitude of contamination present. While presented for comparative purposes only, reference to Table F-1 UCLs for several SVOCs were exceeded at one sampling location VC-23. SVOCs significantly in excess of ecological benchmark screening criteria and UCLs are found in both upper and mid range deeper sediments. The highest levels of SVOCs were found in a mid range sample from VC-23, S-5 (NCA, 2003a), which was collected from 53 to 57 inches below the surface of the sediments. The concentrations of pollutants detected at this location suggest the presence of separate phase wastes. For example, the total concentration of SVOCs in sample VC-23, S-5 was 71,000 mg/kg (i.e., 7.1% of the sample was semi-volatile compounds). Although there is no set standard for determining the concentration of pollutants in soil or sediments that indicate the presence of a separate phase waste, 10,000 mg//kg is used as a guideline by some agencies (RIDEM, 1996). Potential sources for SVOCs, in descending order of contribution, are historic discharges directly to the river (no longer occurring), seeps from sources near the river (efforts to mitigate these sources have been completed and are ongoing), and stormwater runoff (minor contributions).

UCL exceedances for arsenic have been identified at two (2) locations (Table F-2) and the highest levels of arsenic were present at the confluence of Little Creek and the Malden River. Elevated levels (over 1,000 mg/kg) of lead and zinc were also found at various locations in the river. The average concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc in sediments all exceed the Threshold Effect Concentrations or TEC benchmark values cited on Table F-2. As described in Appendix E and subsequent portions of this appendix, approaches for evaluation of potential ecological risks associated with sediment chemistry have been developed by MacDonald and Ingersol, et. al. Levels of VOCs in sediments (Table F-3), with the exception of naphthalene (also evaluated as a SVOC), are generally low. PCB data available are somewhat limited and, as shown in Table F-4, the highest PCB result was 8.5 mg/kg. PCBs have not been identified as a contaminant of concern within the Malden River Corridor. Sediments upstream of the Medford Street Bridge contain elevated levels of SVOCs,

VOCs, and metals. A summary of data in this area is provided in Appendix D. SVOCs exceed 100 mg/kg in several locations and exceed the UCL for benzo(a)pyrene in at least one location. The primary VOC of concern is benzene, which has been detected at levels up to 120 mg/kg.

As described in Section 4.1, at this time, several independent studies for portions of the river have been undertaken, however, human health risk issues have not been fully characterized for the entire river system. In general, potential risks that may exist include exposure to contaminants in the surface water or sediments due to skin contact or fish consumption. There is no evidence that contact recreation (swimming, wading) is conducted at the Malden River on a regular basis, so it is expected that any current potential exposure to surface water or sediments would be incidental and slight. Consumption of fish is a potential human health risk but is likely limited by the lack of public access and the poor state of the Malden River fishery. A human health risk assessment has been conducted for the upper Malden River north of the Medford Street Bridge (Haley and Aldrich, 2001). The risk assessment concluded a condition of No Significant Risk for recreational contact with surface water (child receptor) but could not demonstrate this condition for ingestion of fish caught in the Malden River.

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Human health risk issues in the lower reaches of the Malden River are currently being studied by the MVDC through their consultant NCA and others as a part of ongoing Brownfields and MCP compliance programs. While the evaluation of these risks is the subject of several complementary and ongoing studies referenced within this NER plan, development of recommendations pertaining to human health risks is not within the scope of this study. However, consideration of potential risks to benthic organisms and those habitat populations which serve as the objective of the NER plan is required. Accordingly, the following overview of Malden River sediment quality has been prepared.

Sediment chemistry is often regarded as a primary indicator of potential sediment toxicity, however, USEPA guidance confirms that the use of numerical standards as a measure of sediment chemistry alone is not sufficient to adequately assess the actual toxicity that may be present. More specifically, it has been recommended that measurements of sediment chemistry, toxicity, benthic community structure and tissue chemistry would be preferred for the determination of sediment quality. Although a database has been developed, which describes general sediment chemistry and a limited benthic inventory was completed as a part of this study, the cost and efforts required to complete the above approach to ecological risk characterization are significant and beyond the scope of this current project. Data usability constraints have been offset, however, in part through advances in the development of Sediment Quality Guidelines (SQGs) which have increased reliance that may be given to the use of sediment chemistry in the evaluation of ecological risks.

As described in Appendix E, a greater degree of reliability for predictive indicators of sediment toxicity has been developed through a consensus-based approach by MacDonald and Ingersol, et al. involving the use of Threshold Effects Concentrations (TECs) and Probable Effects Concentrations (PECs). The development of consensus-based values has been achieved by MacDonald by estimating the geometric mean for acceptable SQGs pertaining to threshold limits for sediment toxicity that have been established within the industry.

As stated previously, TEC values are intended to provide a numerical threshold below which no adverse effects to benthic organisms, principally amphipods and midge (*Hyalella azteca* and *Chironomus tentans*, respectively) will occur. PEC SQGs represent an upper threshold where harmful effects were likely, each of these SQGs is a consensus based standard developed from published guidance criteria in an effort to normalize high and low discrepancies through the use of geometric means for the suitable database. A summary of PAH and metals contaminants exceeding their respective PEC values within each of the five Sub-Areas is provided on Tables F-5 through F-14.

It is to be noted that MDEP has recently adopted the use of PEC concentrations as benchmark values for the completion of a Stage I Environmental Screening (310 CMR 40.0995(3). To facilitate the review of environmental data and information presented within this section, detailed sketch plans of site depicting each sub-area within the stretch of the Malden River associated with the River's Edge project have been prepared as Figures F-5 through F-9, respectively. Also shown on Figures F-5 through F-9 are the maximum and minimum PEC value exceedances for metals within each of the sub-areas. A review of this information reveals that a majority of metal and PAH compounds greatly exceed their corresponding PEC values within each of the sub-areas for the River's Edge portion of the Malden River.

To reduce the level of uncertainty that arises from reliance upon numerical standards for discrete compounds contained within complex mixtures of site contaminants, MacDonald, et al. reasoned during the development of consensus based SQGs that the predictive ability of sediment assessment is likely to increase when SQGs are used in combination to classify the toxicity of sediments. Essentially, the occurrence of harmful effects was correlated with mean PEC quotient values for each sample in the database wherein quotient values are obtained by dividing the concentration value of each chemical within the sample by its corresponding PEC. Mean PEC quotients of 0.1, 0.5, 1.0 and 5.0 were then correlated with the incidence of toxicity in several tests resulting in a distinct correlation between increasing mean quotient values and sediment toxicity.

Essentially, this approach is intended to address the following goals:

- Evaluating values between TEC and PEC benchmark levels
- Used for predicting toxicity of contaminant mixtures (i.e., PAHs and metals)
- Provide a more definitive prediction of the probability of sediment toxicity

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Based upon empiric studies, it was generally determined that the incidence of toxicity increased with increasing mean quotient values, with a consistent occurrence of toxicity at mean values greater than 0.5. Accordingly, to further the understanding of potential risks to benthic organisms associated with site sediments, mean PEC quotient values were also developed for each of the samples collected the Malden River system, within Sub-Areas 1 through 5, as presented as Tables F-10 through F-14.

A review of Tables F-10 through F-14 reveals that the geometric mean threshold value of 0.5, above which consistent occurrences of toxicity are likely to occur is exceeded by a factor of 2 within all subareas for copper, lead, zinc and cadmium (Sub-Area 1, 0.99). Indications of elevated arsenic levels were highest in Sub-Areas 1, 3 and 4 and, in general, lead was identified as the metal exhibiting the greatest degree of toxicity potential in each sub-area. This is followed arsenic, zinc and copper, although weighting to the magnitude of contaminant concentrations results in variations of this trend within portions of the river. In this regard, it is to be noted that the contaminant concentrations reported for the River's Edge portion of Malden River sediments reflect, for the most part, targeted or worst case concentration values that were obtained through the evaluation of the physical and semi-quantitative characteristics of sediment quality at the time sample collection. Specifically, sample designations for the purposes of analytical quantification were based upon field screening measurements and the visual inspection of both sediment quality and general geologic stratification of sediment columns obtained during vibra-core and conventional split spoon sampling techniques.

The development of an average PEC quotient value by parameter provides a normalized concentration value for each of the sub-areas, simply for discussion and comparative purposes. To demonstrate the sensitivity of data points with respect to potential sediment toxicity, average metal PEC quotient values by sampling location are also provided on Tables F-10 through F-14 using the approach recommended by MacDonald et.al. without the inclusion of mercury data due to the lack of sufficient toxicity data to support the use of this PEC value. Specifically, given its bioaccumulation potential, mercury has a very low default threshold and toxicity projections based upon this metal are more accurately reflected through the completion of more comprehensive analytical and ecosystem function evaluations.

The quotient value approach has also been expanded by Ingersol et. al. to include commingled or multiple mixtures of contaminants (PCBs, PAHs and metals) wherein an average quotient value for each parameter was determined and an overall mean PEC quotient value for the commingled mixture was then obtained for the sum of each of the parameters.

However, as evidenced from a review of site characterization information, the primary indicators of sediment chemistry concerns involve only metals and PAHs. Accordingly, for PAHs it has been recommended a total PAH PEC value (22.8) be used in the development of a mean value for each sample location to avoid the dominance of certain compounds and account for "double-dipping." For the database corresponding to the evaluation presented within this section, a minimum of 17 PAH compounds were utilized in the calculation of mean quotient values. It is to be noted that USEPA is presently reviewing guidance that would require the use of 18 primary and 16 secondary compounds in this evaluation. However, the effect of this would be to increase or more conservatively exhibit potential sediment toxicity. As evidence from a review of tables F-15 through F-19, it is seen that the normalized PAH PEC values determined the River's Edge portion of the Malden River system already exceed stated toxicity threshold values of concern by several magnitudes of order.

Immediately apparent from a review of the information summarized on Tables F-15 through F-19 is the dominance of single sampling results at discrete locations such as: VP-23 (Area 1); B-8, B-16, VC-1, VC-2, VC-3, VC-15, VC-18, VC-25 and SPD-3D (Area 3); and VC-5 through VC-7 (Area 4) both horizontally across the river bottom and with depth. With consideration of the targeted sampling protocols described above, of equal note are the lower indications of significant PAH accumulations within sediment layers characterized in Areas 2 and 5. This contaminant distribution within site sediments is an important consideration with respect to habitat quality improvements that may be achieved and sustained through the implementation of recommended NER Plan component involving targeted sediment removal and capping strategies.

While benthic activity is typically afforded the highest concern within the upper contact layer (0 – 12 inch depth interval), actual projections of potential contaminant toxicity must consider the physical characteristics and transport pathways that exist within the specific sediment unit under consideration. While once tidally influenced transport of industrial wastes has resulted in the distribution of stratified sediment contamination containing elevated levels of PAHs, this condition varies within the river in response to more recent influences upon historic contaminant deposition. Typically, the upper (0 – 3 foot) layer of sediments within the River's Edge portion of the Malden River has typically been observed to consist of loose and unstable material that is subject to the desorption of contaminants due to disturbances by prop wash from motorboats and a lowering of the Malden River through Dam alterations. During these activities and significant storm events, the opportunity arises for mixing and contact to sediments below the upper 1-foot layer by both benthic and marine life as well as potential users of the river. This potential is of particular concern within Sub-Area 3 or the formerly tidal confluence of the Malden River and Little Creek, as reflected by summary of PEC values for PAHs corresponding to 0 – 3 foot depth interval shown on Figure F-10. In contrast to the River's Edge and more northern portions of the Malden River where sediment quality appears to be attributable to discrete OHM releases for which response actions subject to the provisions of the MCP are ongoing, only limited data (four sediment samples) were identified for the Malden River below the Revere Beach Parkway. However, a review of historic documentation has identified the presence of phthalates attributable to former industrial activity for which MCP response actions were performed.

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TABLE F-1 MALDEN RIVER SEDIMENT QUALITY (Semivolatile Organic Compounds) (ALL DATA IN PARTS PER MILLION)

				MaDEP Soil Criteria*				Ecological		
Compound	**Range**	**No. of Samples**	**Average**	**S-2**	**S-3**	**UCLs**	**Qualitative HH Assessment**	**TECs**	**Qualitative Eco Assessment**	**Changes with Depth?**
Acenaphthene	ND-5,300	38	187	2,500	4,000	10,000	over S-2, 1 location			
Fluoranthene	ND-3,100	42	170	3,000	5,000	10,000	over S-2, 1 location	0.423	possible concern	
Naphthalene	ND-12,000	41	342	1,000	3,000	10,000	**over UCL, 1 location**	0.176	possible concern	highest levels deep
Benzo(a)Anthracene	ND-1500	64	88	40	300	3000		0.108	possible concern	highest levels deep
Benzo(a)Pyrene	ND-1,000	25	60	4	30	300	**over UCL, 1 location**	0.15	possible concern	highest levels deep
Benzo(b)Fluoranthene	ND-94	22	25	40	300	3000	over S-2			
Benzo(k)Fluoranthene	ND-120	25	22	400	3000	10000	not a major contributor			
Chrysene	ND-1700	22	90	10	40	400	**over UCL, 1 location**	0.166	possible concern	highest levels deep
Acenaphthylene	ND-1,500	22	52	1000	1000	10,000	not a major contributor			
Anthracene	ND-3,300	22	146	2,500	5,000	10,000	over S-2	0.0572	possible concern	
Benzo(g,h,I)perylene	ND-76	65	18	2,500	2,500	10,000	not a major contributor			
Fluorene	ND-3,300	65	138	2,000	4,000	10,000	over S-2, 1 location	0.0774	possible concern	
Phenanthrene	ND-10,000	65	420	100	100	10,000	**over UCL, 1 location**	0.204	possible concern	highest levels deep
Dibenzo(a,h)anthracene	ND-41.659	65	6	4	30	300	over S-3, 1 location	0.033	possible concern	
Indeno(1,2,3-cd) Pyrene	ND-88	65	20	40	300	300	over S-2			
Pyrene	ND-4,000	65	226	3,000	5,000	10,000	over S-2, 1 location	0.195	possible concern	
Benzo(e)pyrene	ND-54	4	17							
Biphenyl	ND-1,200	4	393							
Perylene	ND-3.1	4	0.8							
1-Methyl Napthalene	ND-11,000	53	407							
2-Methyl Napthalene	ND-13,000	57	440	1,000	1,000	10,000	**over UCL, one location**			highest levels deep
Carbazole	ND-3,200	4	800							
bis (2-ethyl hexyl) phthalate	ND-3500	41	426	300	500	10000				

* these standards are presented for comparison only, soil criteria are not applicable to sediments

ND = not detected

S-2 = MaDEP direct contact criteria for potentially accessible soils

S-3 = MaDEP direct contact criteria for isolated soils

UCL = MaDEP Upper Concentration Limit

TECs = Threshold Effects Levels

TABLE F-2 MALDEN RIVER SEDIMENT QUALITY (Metals) (ALL DATA IN PARTS PER MILLION)

				MaDEP Soil Criteria*				Ecological		
Metal	Range	No. of Samples	Average	S-2	S-3	UCLs	Qualitative HH Assessment	TECs	Qualitative Eco Assessment	Changes with Depth?
Antimony	ND-14	12	5	30	30	300	not a major contributor			
Arsenic	2.7-250	65	49	20	20	200	**over UCL, 2 locations**	9.79	possible concern	
Barium	9-169	33	85	3000	5,000	10,000	not a major contributor			
Beryllium	ND-1.4	36	0.7	0.8	3	30	not a major contributor			
Cadmium	ND-14	65	5	30	30	300	not a major contributor	0.99	possible concern	
Chromium	9-2,140	58	139	200	200	2000	not a major contributor	43.4	possible concern	
Copper	42-482	42	231	NS	NS	NS	not a major contributor	31.6	possible concern	
Lead	ND-1970	65	592	300	300	3,000		35.8	possible concern	still over 1,000 at depth
Mercury	ND-15.1	57	2	30	30	300	not a major contributor	0.18	possible concern	
Nickel	3-295	42	42	700	700	7,000	not a major contributor	22.7	possible concern	
Selenium	ND-3.1	57	0.8	800	800	8,000	not a major contributor			
Silver	ND-2.7	64	0.3	200	200	2,000	not a major contributor			
Thallium	ND	N/A	Detection Limit	60	80	800	not a major contributor			
Zinc	72-3610**	42	1160	3000	5,000	10,000	possible concern	121	possible concern	

* These standards are presented for comparison only, soil standards are not applicable to sediments
** zinc concentration of 26,200 ppm recorded at culvert to Little Creek
ND = not detected

S-2 = MaDEP direct contact criteria for potentially accessible soils
S-3 = MaDEP direct contact criteria for isolated soils
UCL = MaDEP Upper Concentration Limit
TECs = Threshold Effects Levels

TABLE F-3 MALDEN RIVER SEDIMENT QUALITY (Volatile Organic Compounds) (ALL DATA IN PARTS PER MILLION)

				Post-Dredging		MaDEP Soil Criteria*				
Compound	Range	No. of Samples	Average	Range	Average	S-2	S-3	UCLs	Qualitative Assessment	Changes with Depth?
Benzene	ND-0.08	7	0.019	ND-0.025	0.013	200	900	9000		
2-Butanone	0.44-1.8	4	1.2	1.3	1.3	40	40	10000		
Chlorobenzene	ND-1.2	7	0.3	ND-0.36	0.18	100	100	10000		
1,2 Dichlorobenzene	ND-5.5	4	1.4	5.5	5.5	300	300	10000		
1,3 Dichlorobenzene	ND-0.4	4	0.1	0.4	0.4	500	500	5000		
1,4 Dichlorobenzene	ND-7.4	4	1.9	7.4	7.4	300	2000	10000		
Ethylbenzene	ND-89	16	9	ND-1.75	0.9	500	500	10000		
Isopropylbenzene	ND-22	13	3	ND	Detection Limit					
p-Isopropyltoluene	ND-21	13	4	ND	Detection Limit					
Naphthalene	ND-2600	13	380	1.1	1.1	1000	3000	10000	1 sample over S-2	highest levels deep
n-Propylbenzene	ND-5.6	13	0.5	ND	Detection Limit					
1,2,3 Trichlorobenzene	ND-0.6	4	0.16	0.64	0.64					
1,2,4 Trichlorobenzene	ND-3.4	4	0.9	3.4	3.4	900	900	9000		
1,2,4 Trimethylbenzene	ND-140	13	19	ND	Detection Limit					
1,3,5 Trimethylbenzene	ND-23	13	2	ND	Detection Limit					
o-Xylene	ND-1.6	4	0.7	ND	Detection Limit					
p-m-Xylene	ND-1.9	4	0.9	ND	Detection Limit					
Toluene	ND-32	12	3	0.075	0.075	1000	1000	10000		
n-Butylbenzene	ND-7.4	8	1	NA	0					

* These standards are presented for comparison only, these standards are not applicable to sediments
ND = not detected

S-2 = MaDEP direct contact criteria for potentially accessible soils
S-3 = MaDEP direct contact criteria for isolated soils
UCL = MaDEP Upper Concentration Limit
TECs = Threshold Effects Levels

TABLE F-4 MALDEN RIVER SEDIMENT QUALITY (PCBs) (ALL DATA IN PARTS PER MILLION)

				MaDEP Soil Criteria*					
Compound	**Range**	**No. of Samples**	**Average**	**S-2**	**S-3**	**UCLs**	**Qualitative Assessment**	**Ecological TECs**	**Qualitative Ecological Assessment**
total PCBs	ND-8.5	21	0.67826	2	2	100	2 samples over S-2	0.0598	possible concern

* These standards are presented for comparison only, these standards are not applicable to sediments

ND = not detected

S-2 = MaDEP direct contact criteria for potentially accessible soils

S-3 = MaDEP direct contact criteria for isolated soils

UCL = MaDEP Upper Concentration Limit

TECs = Threshold Effects Levels

Table F-5 Area 1 PEC Exceedances – PAHs (mg/kg)

Parameter	PEC	Minimum Concentration Exceeding PEC	Maximum Concentration Exceeding PEC
Anthracene	0.845	**18** (VC-21 S-1)	**3300** (VC-23 S-5)
Benzo (a) Anthracene	1.05	**28**j (B-12 S-3)	**1500** (VC-23 S-5)
Benzo (a) Pyrene	1.45	**16**j (B-12 S-3)	**1000** (VC-23 S-5)
Chrysene	1.29	**29**j (B-12 S-3)	**1700** (VC-23 S-5)
Fluoranthene	2.23	**54**j (B-12 S-3)	**3100** (VC-23 S-5)
Fluorene	0.536	**11** (VC-21 S-1)	**3300** (VC-23 S-5)
Naphthalene	0.561	**11** (VC-21 S-1)	**12,000** (VC-23 S-5)
Phenanthrene	1.17	**73** (VC-21 S-1)	**10,000** (VC-23 S-5)
Pyrene	1.52	**75**j (B-12 S-3)	**4000** (VC-23 S-5)
Acenaphthene	0.089	**9.8** (VC-21 S-1)	**5,300** (VC-23 S-5)
Acenaphthylene	0.128	**8.9** (VC-21 S-1)	**1,500** (VC-23 S-5)
Benzo (b) Fluoranthene	13.4	**21j** (B-12 S-3)	**ND (405)** (VC-23 S-5)
Benzo (k) Fluoranthene	13.4	**20** (VC-21 S-1)	**ND (405)** (VC-23 S-5)
Benzo (g,h,i) perylene	3.2	**ND (15)** (B-12)	**ND (405)** (VC-23 S-5)
Dibenzo(a,h) Anthracene	0.135	**5.5** (VC-21 S-1)	**ND (405)** (VC-23 S-5)
Indeno (1,2,3) Pyrene	3.2	**ND (15)** (B-12)	**ND (405)** (VC-23 S-5)
2-Methylnaphthalene	0.201	**5.7** (VC-21 S-1)	**13,000** (VC-23 S-5)

Table F-6 Area 2 PEC Exceedances – PAHs (mg/kg)

Parameter	PEC	Minimum Concentration Exceeding PEC	Maximum Concentration Exceeding PEC
Anthracene	0.845	**0.89** (B-11 S-5)	**27j** (B-10 S-2)
Benzo (a) Anthracene	1.05	**1.5** (B-11 S-5)	**27** (B-11 S-3)
Benzo (a) Pyrene	1.45	**17.5** (B-10 S-2/B-13 S-3)	**20** (B-11 S-3)
Chrysene	1.29	**1.3** (B-11 S-5)	**23.j** (B-10 S-2)
Fluoranthene	2.23	**18**j (B-13 S-3)	**43**j (B-10 S-2)
Fluorene	0.536	**17.5** (B-13 S-3)	**25**j (B-10 S-2)
Naphthalene	0.561	**15** (B-13 S-3)	**43**j (B-10 S-2)
Phenanthrene	1.17	**1.3** (B-11 S-5)	**83**j (B-10 S-2)
Pyrene	1.52	**3.5** (B-11 S-5)	**54**j (B-10 S-2)
Acenaphthene	0.089	**ND (15)** (B-13 S-3)	**35.0j**(B-10 S-3)
Acenaphthylene	0.128	**0.41** (B-11 S-5)	**ND (17.5)** ((B-10 S-2,B-13 S-3)
Benzo (b) Fluoranthene	13.4	**16** (B-10 S-2)	**21** (B-11 S-3)
Benzo (k) Fluoranthene	13.4	**15** (B-11 S-3)	**ND (20)** (B-10 S-2,B-13 S-3)
Benzo (g,h,i) perylene	3.2	**6.6** (B-11 S-3)	**ND (15)** (B-10 S-2,B-13 S-3)
Dibenzo(a,h) Anthracene	0.135	**ND (0.5)** (B-11 S-3)	**ND (17.5)** (B-10 S-2,B-13 S-3)
Indeno (1,2,3) Pyrene	3.2	**6.3** (B-11 S-3)	**ND (15)** (B-10 S-2,B-13 S-3)
2-Methylnaphthalene	0.201	**9.5** (B-11 S-3)	**33.0j** (B-10 S-2)

Table F-7 Area 3 PEC Exceedances – PAHs (mg/kg)

Parameter	PEC	Minimum Concentration Exceeding PEC	Maximum Concentration Exceeding PEC
Anthracene	0.845	**3.2** (VC-24 S-2)	**430** (B-8 S-1A)
Benzo (a) Anthracene	1.05	**1.2** (VC-24 S-2)	**270** (B-8 S-1A)
Benzo (a) Pyrene	1.45	**0.86** (VC-24 S-2)	**210** (B-8 S-1A)
Chrysene	1.29	**14** (VC-2 S-6) dup	**250** (B-8 S-1A)
Fluoranthene	2.23	**3** (VC-24 S-2)	**650** (VC-20 S-3)
Fluorene	0.536	**0.96** (VC-24 S-2)	**430** (VC-20 S-3)
Naphthalene	0.561	**2.2** (VC-2 S-2)	**770** (B-8 S-1A)
Phenanthrene	1.17	**2.9** (VC-24 S-2)	**1300** (B-8 S-1A)
Pyrene	1.52	**2.6** (VC-24 S-2)	**820** (B-8 S-1A)
Acenaphthene	0.089	**0.83** (VC-24 S-2)	**610** (B-8 S-1A)
Acenaphthylene	0.128	**0.48** (VC-24 S-2)	**54** (VC-1 S-5)
Benzo (b) Fluoranthene	13.4	**15** (VC-25 S-2)	**65** (VC-20 S-3)
Benzo (k) Fluoranthene	13.4	**14** (VC-25 S-2)	**90** (B-8 S-1A)
Benzo (g,h,i) perylene	3.2	**4.4** (VC-2 S-6 dup)	**43** (B-8 S-1A)
Dibenzo(a,h) Anthracene	0.135	**0.16** (VC-24 S-2)	**ND (35)** (B-6 S-1B, B-8 S-1A)
Indeno (1,2,3) Pyrene	3.2	**4.7** (VC-2 S-6 dup)	**44j** (B-8 S-1A)
2-Methylnaphthalene	0.201	**1.4** (VC-2 S-6 dup)	**790** (B-8 S-1A)

Table F-8 Area 4 PEC Exceedances – PAHs (mg/kg)

Parameter	PEC	Minimum Concentration Exceeding PEC	Maximum Concentration Exceeding PEC
Anthracene	0.845	**17** (VC-12 S-2)	**210** (VC-5 S-3)
Benzo (a) Anthracene	1.05	**1.2** (VC-12 S-1)	**140** (VC-5 S-3)
Benzo (a) Pyrene	1.45	**13** (VC-12 S-2)	**87** (VC-5 S-3)
Chrysene	1.29	**1.4** (VC-12 S-1)	**160** (VC-5 S-3)
Fluoranthene	2.23	**2.5** (VC-12 S-1)	**270** (VC-5 S-3)
Fluorene	0.536	**0.87** (VC-12 S-2)	**170** (VC-5 S-3)
Naphthalene	0.561	**2.3** (VC-12 S-2)	**190** (VC-5 S-3)
Phenanthrene	1.17	**1.2** (VC-12 S-1)	**600** (VC-5 S-3)
Pyrene	1.52	**2.4** (VC-12 S-1)	**340** (VC-5 S-3)
Acenaphthene	0.089	**0.11** (VC-12 S-1)	**140** (VC-5 S-3)
Acenaphthylene	0.128	**0.41** (VC-12 S-1)	**92** (VC-6 S-3)
Benzo (b) Fluoranthene	13.4	**17** (VC-7 S-5)	**46** (VC-5 S-3)
Benzo (k) Fluoranthene	13.4	**17** (VC-12 S-1)	**59** (VC-5 S-3)
Benzo (g,h,i) perylene	3.2	**6.5** (VC-12 S-2)	**43** (VC-5 S-3)
Dibenzo(a,h) Anthracene	0.135	**0.21** (VC-12 S-1)	**14** (VC-5 S-3)
Indeno (1,2,3) Pyrene	3.2	**7** (VC-12 S-2)	**48** (VC-5 S-3)
2-Methylnaphthalene	0.201	**0.4** (VC-12 S-1)	**250** (VC-5 S-3)

Table F-9 Area 5 PEC Exceedances – PAHs (mg/kg)

Parameter	PEC	Minimum Concentration Exceeding PEC	Maximum Concentration Exceeding PEC
Anthracene	0.845	**0.875** (B-1 S-2A)	**35** (B-5 S-2A)
Benzo (a) Anthracene	1.05	**7.8** j (B-5 S-3B)	**35** (B-5 S-2A)
Benzo (a) Pyrene	1.45	**8.75** (B-5 S-3B)	**35** (B-5 S-2A)
Chrysene	1.29	**8.2** j (B-5 S-3B)	**35** (B-5 S-2A)
Fluoranthene	2.23	**13**j (B-3 S-2A)	**25**j (B-5 S-2A)
Fluorene	0.536	**0.875** (B-1 S-2A)	**35** (B-5 S-2A)
Naphthalene	0.561	**0.75** (B-1 S-2A)	**330** (B-5 S-2A)
Phenanthrene	1.17	**5.5**j (B-5 S-3A)	**40**j (B-5 S-2A)
Pyrene	1.52	**17.5** (B-2 S-2A/B-14 S-2)	**27**j (B-5 S-2A)
Acenaphthene	0.089	**ND (30)** (B-1 S-2A)	**ND (0.75)**(B-5 S-2A)
Acenaphthylene	0.128	**ND (0.875)** (B-1 S-2A)	**ND (35)** (B-5 S-2A)
Benzo (b) Fluoranthene	13.4	**16.0j** (B-4 S-2A)	**ND (40)** (B-5 S-2A)
Benzo (k) Fluoranthene	13.4	**ND (20)** (B-2 S-2A, B-3 S-2A, B-4 S-2, B14 S-2)	**ND (40)** (B-5 S-2A)
Benzo (g,h,i) perylene	3.2	**ND (7.5)** (B-5 S-3B)	**ND (30)** (B-5 S-2A)
Dibenzo(a,h) Anthracene	0.135	**ND (0.875)** (B-1 S-2A)	**ND (35)** (B-5 S-2A)
Indeno (1,2,3) Pyrene	3.2	**ND (75)** (B-1 S-2A)	**ND (30)** (B-5 S-2A)
2-Methylnaphthalene	0.201	**ND (0.875)** (B-1 S-2A)	**30.0j** (B-5 S-2A)

Table F-10 Malden River Sediment Quality Evaluation - Metals

Area 1

Consensus-Based Probable Effects Concentration (PEC)[1]

Location	Depth (feet)	Date	Results (mg/kg)							
			Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Average PEC Quotient Value By location
B-12 S-3	4.7-6.7	08/24/99	36.7	6	98	242	1780	36	1018	
PEC Quotient			**1.11**	**1.20**	**0.88**	**1.62**	**13.91**	**0.74**	**2.22**	**3.1**
VC-21 S-1	0-0.3	6/5/03	8.9	1.9	39	120	360	18	360	
PEC Quotient			**0.27**	**0.38**	**0.35**	**0.81**	**2.81**	**0.37**	**0.78**	**0.82**
VC-21 S-2	0.6-0.9		35	12	78	310	1100	32	1100	
PEC Quotient			**1.06**	**2.41**	**0.70**	**2.08**	**8.59**	**0.66**	**2.40**	**2.56**
VC-21 S-4	2.4-2.8		17	1.1	45	63	170	27	190	
PEC Quotient			**0.52**	**0.22**	**0.41**	**0.42**	**1.33**	**0.56**	**0.41**	**0.55**
VC-22 S-1	0.0-0.3		16	4.4	71	220	760	43	740	
PEC Quotient			**0.48**	**0.88**	**0.64**	**1.48**	**5.94**	**0.88**	**1.61**	**1.7**
VC-23 S-4B	4.2-4.4		120	4.6	150	320	780	17	1400	
PEC Quotient			**3.64**	**0.92**	**1.35**	**2.15**	**6.09**	**0.35**	**3.05**	**2.51**
VC-23 S-4Bdup	4.2-4.4		120	4.5	150	310	780	17	1400	
PEC Quotient			**3.64**	**0.90**	**1.35**	**2.08**	**6.09**	**0.35**	**3.05**	**2.49**
Total Concentration			**353.6**	**34.5**	**631**	**1585**	**5730**	**190**	**6208**	
PEC			**33**	**4.98**	**111**	**149**	**128**	**48.6**	**459**	
Average PEC Quotient Value			**1.53**	**0.99**	**0.81**	**1.52**	**6.40**	**0.56**	**1.93**	

[1]"Prediction of Sediment Toxicity Using Consensus-Based Freshwater Sediment Guidelines," EPA 905/R-00/007, June 2000.

Table F-11 Malden River Sediment Quality Evaluation - Metals

Area 2

Consensus-Based Probable Effects Concentration (PEC)[1]

Location	Depth (feet)	Date	Results (mg/kg)							Average PEC Quotient Value By location
			Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	
B-10 S-2	2.5-4.3	08/24/99	18.8	8	121	-	1290	-	-	
PEC Quotient			**0.57**	**1.61**	**1.09**		**10.08**			**3.34**
B-11 S-3	5-7		26.0	14	122	262	530	55	1201	
PEC Quotient			**0.79**	**2.81**	**1.10**	**1.76**	**4.14**	**1.13**	**2.62**	**2.62**
B-11 S-5	7.3-9.3		18.1	4	32	-	80	-	-	
PEC Quotient			**0.55**	**0.80**	**0.29**		**0.63**			**0.56**
B-13 S-2	2.5-4.3		15.7	7	88	320	780	44	1038	
PEC Quotient			**0.48**	**1.41**	**0.79**	**2.15**	**6.09**	**0.91**	**2.26**	**2.01**
B-13 S-3	4.8-.68		36.5	7	136	277	610	34	1092	
PEC Quotient			**1.11**	**1.41**	**1.23**	**1.86**	**4.77**	**0.70**	**2.38**	**1.92**
B-13C	0-5.3’		27.5	11	116	343	1970	56	2838	
PEC Quotient			**0.83**	**2.21**	**1.05**	**2.30**	**15.39**	**1.15**	**6.18**	**4.16**
Total Concentration			**142.6**	**51**	**615**	**1202**	**5260**	**189**	**6169**	
PEC			**33**	**4.98**	**111**	**149**	**128**	**48.6**	**459**	
Average PEC Quotient Value			**0.62**	**1.46**	**0.79**	**1.15**	**5.87**	**0.56**	**1.92**	

[1]“Prediction of Sediment Toxicity Using Consensus-Based Freshwater Sediment Guidelines,” EPA 905/R-00/007, June 2000.

Table F-12 Malden River Sediment Quality Evaluation – Metals - Area 3
Consensus-Based Probable Effects Concentration (PEC) [1]

Location	Depth (feet)	Date	Results (mg/kg)							Average PEC Quotient Value By Location
			Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	
B-6 S-1B	1-2	8/23 1999	36.6	7	151	230	550	41	1390	
PEC Quotient			**1.11**	**1.41**	**1.36**	**1.54**	**4.30**	**0.84**	**3.0**	**1.94**
B-106 S-1B	1-2		31.4	5	120	177	410	35	1046	
PEC Quotient			**0.95**	**1.00**	**1.08**	**1.19**	**3.2**	**0.72**	**2.28**	**1.49**
B-6 S-2B	3.8-4.8		40.0	7	152	-	570	-	-	
PEC Quotient			**1.21**	**1.41**	**1.37**		**4.45**			**2.11**
B-7 S-2A	1.6-2.4		14.7	1	21	54	110	13	367	
PEC Quotient			**0.45**	**0.20**	**0.19**	**0.36**	**0.86**	**0.27**	**0.80**	**0.45**
B-8 S-1A	0-1		234.2	3	242	-	680	-	-	
PEC Quotient			**7.10**	**0.60**	**2.18**		**5.31**			**3.80**
B-8 S-2A	2.3-3		12.7	2	32	-	190	-	-	
PEC Quotient			**0.38**	**0.40**	**0.29**		**1.48**			**0.64**
B-9 S-1	0-1.2		28.6	6	106	467	1120	47	1440	
PEC Quotient			**0.87**	**1.20**	**0.95**	**3.13**	**8.75**	**0.97**	**3.14**	**2.72**
B-9 S-2B	4.5-5.5		30.9	5	103	172	540	30	746	
PEC Quotient			**0.94**	**1.00**	**0.93**	**1.15**	**4.22**	**0.62**	**1.63**	**1.5**
B-15 S-1	0-2		21.8	7	98	230	1090	47	2300	
PEC Quotient			**0.66**	**1.41**	**0.88**	**1.54**	**8.52**	**0.97**	**5.01**	**2.71**
B-15 S-2A	3.2-4.2		19.3	7	79	233	650	48	1450	
PEC Quotient			**0.58**	**1.41**	**0.71**	**1.56**	**5.08**	**0.99**	**3.16**	**1.93**
B-16 S-1B	1.3-2		32.0	7	179	209	900	20	591	
PEC Quotient			**0.97**	**1.41**	**1.61**	**1.40**	**7.03**	**0.41**	**1.29**	**2.02**
B-16 S-2C	4-4.3		35.4	12	217	286	780	20	863	
PEC Quotient			**1.07**	**2.41**	**1.95**	**1.92**	**6.09**	**0.41**	**1.88**	**2.25**
B-16 S-3C	5.9-6.5		188.2	8	242	482	990	20	1450	
PEC Quotient			**5.70**	**1.61**	**2.18**	**3.23**	**7.73**	**0.41**	**3.16**	**3.43**
B-16C-A	0-2.6		42.3	7	190	260	700	25	732	
PEC Quotient			**1.28**	**1.41**	**1.71**	**1.74**	**5.47**	**0.51**	**1.59**	**1.96**
VC-1 S-1	0-0.5	6/3 2003	55	4.5	160	300	460	23	590	
PEC Quotient			**1.67**	**0.9**	**1.44**	**2.01**	**3.59**	**0.47**	**1.29**	**1.62**
VC-2 S-1	0-1		30	7.0	140		590			
PEC Quotient			**0.91**	**1.41**	**1.26**		**4.61**			**2.05**
VC-3 S-4	1.9-2.2		210	4.5	160	400	560	15	1100	
PEC Quotient			**6.36**	**0.90**	**1.44**	**2.68**	**4.38**	**0.31**	**2.40**	**2.64**
VC-15 S-1	0-0.3	6/4 2003	32	5.1	93		450			
PEC Quotient			**0.66**	**1.41**	**0.88**		**8.52**			**1.59**
VC-18 S-4	6.6-6.8		48	4.0	120		410			
PEC Quotient			**1.45**	**0.8**	**1.08**		**3.2**			**1.64**
VC-20 S-3	1.7-2	6/5 2003	50	2.8	87		500			
PEC Quotient			**1.52**	**0.56**	**0.78**		**3.91**			**1.69**
VC-24 S-2	0.7-0.8		7.2	ND	10		9.6			
PEC Quotient			**0.22**	**0.05**	**0.09**		**0.08**			**0.11**
VC-25 S-1	0-0.3		70	2.6	98		430			
PEC Quotient			**2.12**	**0.52**	**0.88**		**3.36**			**1.72**
VC-25 S-2	0.3-0.5		70	2.2	93		490			
PEC Quotient			**2.12**	**0.44**	**0.84**		**3.83**			**1.81**
Total Concentration			**1340.3**	**116.97**	**2893**	**3500**	**13179.6**	**384**	**14065**	
PEC			**33**	**4.98**	**111**	**149**	**128**	**48.6**	**459**	
Average PEC Quotient Value			**1.77**	**1.02**	**1.13**	**1.81**	**4.48**	**0.61**	**2.36**	

[1] "Prediction of Sediment Toxicity Using Consensus-Based Freshwater Sediment Guidelines," EPA 905/R-00/007, June 2000.

Table F-13 Malden River Sediment Quality Evaluation - Metals

Area 4

Consensus-Based Probable Effects Concentration (PEC)[1]

Location	Depth ± (feet)	Date	Results (mg/kg)							Average PEC Quotient Value by Location
			Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	
VC-4 S-2	4.2-4.5	6/3 2003	79	3.4	120		500			
PEC Quotient			**2.39**	**0.68**	**1.08**		**3.91**			**2.02**
VC-5 S-3	2.3-2.6		96	3.5	120		550			
PEC Quotient			**2.91**	**0.7**	**1.08**		**4.3**			**2.25**
VC-6 S-3	2.1-2.4		87	3.4	130		530			
PEC Quotient			**2.64**	**0.68**	**1.17**		**4.14**			**2.16**
VC-7 S-3	2.1-2.4		69	2.4	87		380			
PEC Quotient			**2.09**	**0.48**	**0.78**		**2.97**			**1.58**
VC-10 S-3	1.2-1.5	6/4 2003	8.6	ND(0.39)	29		8.4			
PEC Quotient			**0.26**	**0.08**	**0.26**		**0.07**			**0.17**
VC-11 S-1	0-0.3		26	5.0	94	220	410	46	1100	
PEC Quotient			**0.79**	**1.0**	**0.85**	**1.48**	**3.2**	**0.95**	**2.40**	**1.52**
VC-12 S-1	0-0.3		4.6	1.4	9.4	49	170	10	210	
PEC Quotient			**0.14**	**0.28**	**0.08**	**0.33**	**1.33**	**0.21**	**0.46**	**0.4**
VC-12 S-2	0.5-0.8		240	7.0	140		800			
PEC Quotient			**7.27**	**1.41**	**1.26**		**6.25**			**4.05**
VC-12 S-2dup	0.5-0.8		250	7.3	140		850			
PEC Quotient			**7.58**	**1.47**	**1.26**		**6.64**			**4.24**
VC-13 S-3	1.5-2.9		50	3.2	120		360			
PEC Quotient			**1.52**	**0.64**	**1.08**		**2.81**			**1.51**
Total Concentration			**910.2**	**36.99**	**989.40**	**269**	**4558.4**	**56**	**1310**	
PEC			**33**	**4.98**	**111**	**149**	**128**	**48.6**	**459**	
Average PEC Quotient Value			**2.76**	**0.74**	**0.89**	**0.90**	**3.56**	**0.57**	**1.42**	

[1]"Prediction of Sediment Toxicity Using Consensus-Based Freshwater Sediment Guidelines," EPA 905/R-00/007, June 2000.

Table F-14 Malden River Sediment Quality Evaluation - Metals

Area 5

Consensus-Based Probable Effects Concentration (PEC)[1]

Location	Depth (feet)	Date	Results (mg/kg)							Average PEC Quotient Value By Location
			Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	
B-1 S-2A	3.7-4.5	8/19 1999	8.8	ND (0.5)	28	42	20	15	72	
PEC Quotient			**0.27**	**0.1**	**0.25**	**0.28**	**0.16**	**0.31**	**0.16**	**0.22**
B-2 S-1	0-1		26.8	6	148	264	670	64	1250	
PEC Quotient			**0.81**	**1.20**	**1.33**	**1.77**	**5.23**	**1.32**	**2.72**	**2.05**
B-3 S-1	0-2	8/20 1999	29.4	9	155	275	850	63	2810	
PEC Quotient			**0.81**	**1.81**	**1.40**	**1.85**	**6.64**	**1.30**	**6.12**	**2.85**
B-3 S-2A	3.5-5		41.0	7	166	206	590	38	813	
PEC Quotient			**1.24**	**1.41**	**1.50**	**1.38**	**4.61**	**0.78**	**1.77**	**1.81**
B-3 S-3A	6-7		2.7	ND (0.5)	9	-	ND (0.5)	-	-	
PEC Quotient			**0.08**	**0.1**	**0.08**		**0**			**0.06**
B-4 S-2	7.6-9.6		30.0	6	188	200	440	31	551	
PEC Quotient			**0.91**	**1.20**	**1.69**	**1.34**	**3.44**	**0.64**	**1.2**	**1.43**
B-104 S-2	7.6-9.6		34.4	8	344	-	730	-	-	
PEC Quotient			**1.04**	**1.61**	**3.10**		**5.7**			**2.86**
B-5 S-2A	2.5-3.5		36.6	8	155	218	480	3	759	
PEC Quotient			**1.11**	**1.61**	**1.40**	**1.46**	**3.78**	**0.06**	**1.65**	**1.58**
B-5 S-3B	6-6.6		8.0	1	58	-	80	-	-	
PEC Quotient			**0.24**	**0.2**	**0.52**		**0.63**			**0.40**
B-14 S-2	2.4-4.4	8/25 1999	43.2	10	191	257	900	61	3610	
PEC Quotient			**1.31**	**2.01**	**1.72**	**1.72**	**7.03**	**1.26**	**7.86**	**3.27**
SP-2	0-7.2	8/24 1999	25.6	14	536	254	1100	295	3280	
PEC Quotient			**0.78**	**2.81**	**4.83**	**1.70**	**8.59**	**6.07**	**7.15**	**4.56**
Total Concentration			**286**	**70**	**1978**	**1716**	**5860.5**	**570**	**13145**	
PEC			**33**	**4.98**	**111**	**149**	**128**	**48.6**	**459**	
Average Pec Quotient VALUE			**0.78**	**1.27**	**1.62**	**1.44**	**4.16**	**1.46**	**3.58**	

[1] "Prediction of Sediment Toxicity Using Consensus-Based Freshwater Sediment Guidelines," EPA 905/R-00/007, June 2000.

Table F-15 Polynuclear Aromatic Hydrocarbon (PAH)-PEC Values – Area 1

Sample Location	B-12	B-12	VC-21	VC-21	VC-21	VC-22	VC-22	VC-23	VC-23	VC-23
Sample Designation	**S-3**	**S-6A**	**S-1**	**S-2**	**S-4**	**S-4B**	**S-5**	**S-4B**	**S-4B dup**	**S-5**
Sample Depth	**56-80"**	**128-148"**	**0-4”**	**7-11”**	**29-33”**	**49-53”**	**71-75”**	**50-53"**		**53-57”**
Date	**8/24/1999**		**6/5/2003**							
SVOCs (mg/kg)										
2-Methyl Naphthalene	92	55.0 j	5.7	150	100	400	930	3800	3600	13,000
Acenaphthene	38.0 j	61.0 j	9.8	220	70	240	440	1400	1200	5,300
Acenaphthylene	ND (17.5)	ND (17.5)	8.9	65	18	64	120	380	370	1,500
Anthracene	26.0 j	46.0 j	18	190	68	190	360	910	830	3,300
Benzo (a) Anthracene	28.0 j	39.0 j	40	170	56	140	220	400	830	1,500
Benzo (a) Pyrene	16.0 j	30.0 j	34	120	40	120	130	250	400	1,000
Benzo (b) Fluoranthene	21.0 j	25.0 j	27	73	23	66	57	ND (100)	230	ND (405)
Benzo (g,h,i) Perylene	ND (15.0)	ND (15.0)	22	69	22	62	56	ND (100)	-	ND (405)
Benzo (k) Fluoranthene	ND (20.0)	10.0 j	20	74	22	62	64	ND (220)	76	ND (405)
Chrysene	29.0 j	32.0 j	40	160	54	130	200	440	400	1,700
Dibenzo (a.h) Anthracene	ND (17.5)	ND (17.5)	5.5	20	5.9	14	19	ND (100)	29	ND (405)
Fluoranthene	54.0 j	70.0 j	96	350	110	330	420	800	780	3,100
Fluorene	26.0 j	40.0 j	11	190	62	190	360	900	900	3,300
Indeno (1,2,3-cd) Pyrene	ND (15.0)	ND (15.0)	25	79	25	65	65	ND (100)	88	ND (405)
Naphthalene	250	130	11	420	120	520	770	2700	2400	12,000
Phenanthrene	79	150	73	570	190	560	980	2800	2300	10,000
Pyrene	75.0 j	100	85	370	120	390	520	1100	1100	4,000
Total SVOCs	819.00	853.00	531.90	3290.00	1105.90	3543.00	5711.00	16500.00	15533.00	61725.00
PEC	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80
Total PAH PEC Value	**35.92**	**37.41**	**23.33**	**144.30**	**48.50**	**155.39**	**250.48**	**723.68**	**681.27**	**2707.24**

- Not Tested

ND - Not Detected

J - Estimated results, value is below the calibration/detection limit.

Table F-16 Polynuclear Aromatic Hydrocarbon (PAH)-PEC Values – Area 2

Sample Location Sample Designation	B-10 S-2	B-11 S-3	B-11 S-5	B-13 S-3
Sample Depth	**30-52"**	**60-84"**	**88-112"**	**52-76"**
Date	**8/24/1999**			
SVOCs (mg/kg)				
2-Methyl Naphthalene	33.0 j	9.5	0.1 j	ND (17.5)
Acenaphthene	35.0 j	16	0.1 j	ND (15.0)
Acenaphthylene	ND (17.5)	9.3	0.41	ND (17.5)
Anthracene	27.0 j	15	0.89	ND (17.5)
Benzo (a) Anthracene	ND (17.5)	27	1.5	ND (17.5)
Benzo (a) Pyrene	ND (17.5)	20	1.2	ND (17.5)
Benzo (b) Fluoranthene	16	21	0.92	ND (20.0)
Benzo (g,h,i) Perylene	ND (15.0)	6.6	0.26	ND (15.0)
Benzo (k) Fluoranthene	ND (20.0)	15	0.31	ND (20.0)
Chrysene	23.0 j	24	1.3	ND (17.5)
Dibenzo (a.h) Anthracene	ND (17.5)	ND (0.5)	0.1 j	ND (17.5)
Fluoranthene	43.0 j	39	2.1	18.0 j
Fluorene	25.0 j	18	0.1 j	ND (17.5)
Indeno (1,2,3-cd) Pyrene	ND (15.0)	6.3	0.3 j	ND (15.0)
Naphthalene	43.0 j	50	0.1 j	ND (15.0)
Phenanthrene	83.0 j	41	1.3	30.0 j
Pyrene	54.0 j	53	3.5	28.0 j
Total SVOCs	502.00	371.20	14.47	316.00
PEC	22.80	22.80	22.80	22.80
Total PAH PEC Value	**22.02**	**16.28**	**0.63**	**13.86**

- Not Tested

ND - Not Detected

J - Estimated results, value is below the calibration/detection limit.

Table F-17 Polynuclear Aromatic Hydrocarbon (PAH)-PEC Values – Area 3

Sample Location	**B-6**	**B-6**	**B-8**	**B-8**	**B-9**	**B-9**	**B-109**	**B-15**	**B-16**	**B-16**
Sample Designation	**S-1B**	**S-2B**	**S-1A**	**S-2A**	**S-2B**	**S-4B**	**S-2B**	**S-2A**	**S-3C**	**C-A**
Sample Depth	**13-24"**	**46-58"**	**0-12"**	**28-36"**	**54-66"**	**105-117"**	**54-66"**	**38-50"**	**71-78"**	**0-38"**
Date	**8/23/1999**									
SVOCs (mg/kg)										
2-Methyl Naphthalene	ND (35.0)	25.0 j	790	26.0 j	62.0 j	110	35.0 j	ND (17.5)	130	30
Acenaphthene	ND (30.0)	22.0 j	610	21.0 j	53.0 j	90	43.0 j	ND (15.0)	140.0 j	110
Acenaphthylene	ND (35.0)	ND (17.5)	49.0 j	9.5 j	ND (17.5)	9	ND (17.5)	ND (17.5)	27.8 j	13
Anthracene	ND (35.0)	19.0 j	430	40.0 j	50.0 j	54	37.0 j	ND (17.5)	140	100
Benzo (a) Anthracene	ND (35.0)	ND (17.5)	270	38.0 j	35.0 j	42	33.0 j	28.0 j	84	71
Benzo (a) Pyrene	ND (35.0)	ND (17.5)	210	25.0 j	23.0 j	28	17.0 j	ND (17.5)	50.0 j	48
Benzo (b) Fluoranthene	ND (40.0)	ND (20.0)	15.0 j	29.0 j	25.0 j	28	21.0 j	26.0 j	45.0 j	63
Benzo (g,h,i) Perylene	ND (30.0)	ND (15.0)	43.0 j	12.0 j	10.0 j	11	ND (15.0)	ND (15.0)	18.0 j	26
Benzo (k) Fluoranthene	ND (40.0)	ND (20.0)	90	13.0 j	ND (20.0)	13	14.0 j	ND (20.0)	21.0 j	34
Chrysene	ND (35.0)	ND (17.5)	250	35.0 j	34	40	30.0 j	36.0 j	80	85
Dibenzo (a.h) Anthracene	ND (35.0)	ND (17.5)	ND (35.0)	ND (17.5)	ND (17.5)	2.6	ND (17.5)	ND (17.5)	ND (17.5)	6.6
Fluoranthene	ND (35.0)	31.0 j	500	85	76	110	65.0 j	60.0 j	130	210
Fluorene	ND (35.0)	18.0 j	390	28.0 j	40.0 j	78	38.0 j	ND (17.5)	110	100
Indeno (1,2,3-cd) Pyrene	ND (30.0)	ND (15.0)	44J	14.0 j	12.0 j	12	10.0 j	ND (15.0)	20.0 j	25
Naphthalene	ND (35.0)	93	770	90	110	310	84	ND (15.0)	68	190
Phenanthrene	41.0 j	55.0 j	1300	95	150	220	110	58.0 j	390	340
Pyrene	32.0 j	33.0 j	820	81	83	100	80	73.0 j	240	240
Total SVOCs	593.00	453.50	6572.00	659.00	818.00	1257.60	667.00	466.00	1711.33	1691.60
PEC	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80
Total PAH PEC Value	**26.01**	**19.89**	**288.25**	**28.90**	**35.88**	**55.16**	**29.25**	**20.44**	**75.06**	**74.19**

\- Not Tested

J - Estimated results, value is below the calibration/detection limit.

ND - Not Detected

Table F-17 Polynuclear Aromatic Hydrocarbon (PAH)-PEC Values – Area 3

Sample Location	**VC-1**	**VC-1**	**VC-2**	**VC-2**	**VC-2**	**VC-3**	**VC-3**	**VC-15**	**VC-15**	**VC-15**	**VC-18**	**VC-20**	**VC-24**	**VC-25**	**VC-25**	**SP-3D**
Sample Designation	**S-3**	**S-5**	**S-2**	**S-6**	**S-6 dup**	**S-4**	**S-4 dup**	**S-2**	**S-4**	**S-6**	**S-4**	**S-3**	**S-2**	**S-2**	**S-5**	
Sample Depth	**24-28”**	**57-61”**	**19-23”**	**93-96”**	**93-96”**	**23-26”**	**23-26”**	**5-9"**	**22-26”**	**52-56”**	**79-82”**	**20-24”**	**7-10"**	**4-6”**	**34-37”**	**0-24"**
Date	**6/4/2003**															
SVOCs (mg/kg)																
2-Methyl Naphthalene	23	230	1	1.8	1.4	17	19	21	240	110	220	ND (3.6)	0.15	ND (1.9)	330	24.0 j
Acenaphthene	24	160	1.3	2.5	2.2	23	26	290	190	82	140	380	0.83	6.3	270	23.0 j
Acenaphthylene	34	54	9.4	8.3	5.6	18	25	50	19	37	22	37	0.48	9.6	ND (12.5)	ND (17.5)
Anthracene	57	180	8	14	9.5	63	68	280	170	120	120	380	3.2	21	210	30.0 j
Benzo (a) Anthracene	67	120	16	18	13	57	65	190	90	86	69	190	1.2	22	120	17.0 j
Benzo (a) Pyrene	46	71	11	13	10	36	42	120	48	53	40	100	0.86	18	100	13.0 j
Benzo (b) Fluoranthene	35	30	7	5.6	3.5	18	20	71	35	29	29	65	0.67	15	48	13.0 j
Benzo (g,h,i) Perylene	24	28	7	6.2	4.4	16	16	61	24	22	19	50	0.51	10	46	ND (15.0)
Benzo (k) Fluoranthene	34	42	7.3	6.1	1.3	20	27	73	27	27	24	61	0.67	14	69	ND (20.0)
Chrysene	72	110	18	18	14	58	65	180	82	84	62	180	1	27	120	23.0 j
Dibenzo (a.h) Anthracene	8	9.2	2	1.9	1.4	4.8	5.4	18	6.9	7.7	5.8	15	0.16	3.4	ND (12.5)	ND (17.5)
Fluoranthene	140	240	35	32	22	100	120	470	300	170	230	650	3	48	270	43.0 j
Fluorene	23	150	0.86	4.6	2.8	32	36	270	200	85	140	430	0.96	ND (1.2)	180	20.0 j
Indeno (1,2,3-cd) Pyrene	28	32	8	6.6	4.7	17	20	70	28	25	24	57	0.58	9.1	38	ND (15.0)
Naphthalene	17	120	2.2	2.4	2.8	14	15	120	590	82	570	39	0.18	3	280	24.0 j
Phenanthrene	120	460	3.6	29	17	140	150	810	530	290	370	1100	2.9	6.6	620	78.0 j
Pyrene	150	310	36	41	28	120	140	480	250	200	200	550	2.6	48	360	56.0 j
Total SVOCs	902.00	2346.20	173.66	211.00	143.60	753.80	859.40	3574.00	2829.90	1509.70	2284.80	4287.60	19.95	264.10	3086.00	449.00
PEC	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80	22.80
Total PAH PEC Value	**39.56**	**102.90**	**7.62**	**9.25**	**6.30**	**33.06**	**37.69**	**156.75**	**124.12**	**66.21**	**100.21**	**188.05**	**0.88**	**11.58**	**135.35**	**19.69**

\- Not Tested

ND - Not Detected

Table F-18 Polynuclear Aromatic Hydrocarbon (PAH)-PEC Values – Area 4

Sample Location	VC-4	VC-5	VC-6	VC-7	VC-7	VC-8	VC-11	VC-12	VC-12
Sample Designation	S-2	S-3	S-3	S-3	S-5	S-3	S-4	S-1	S-2
Sample Depth	24-26”	28-31”	25-29”	25-29”	46-50”	20-24”	32-35”	0-3”	6-9”
Date	6/3/2003						6/4/2003		
SVOCs (mg/kg)									
2-Methyl Naphthalene	57	250	31	16	41	7.3	3.4	0.46	0.84
Acenaphthene	46	140	61	86	40	35	14	0.11	7.3
Acenaphthylene	70	76	92	55	26	38	8.3	0.41	11
Anthracene	94	210	130	120	57	75	22	0.43	17
Benzo (a) Anthracene	76	140	95	100	46	68	24	1.2	18
Benzo (a) Pyrene	49	87	60	70	31	45	17	1.1	13
Benzo (b) Fluoranthene	33	46	38	38	17	33	12	0.97	6.8
Benzo (g,h,i) Perylene	27	43	29	34	13	24	9.6	0.89	6.5
Benzo (k) Fluoranthene	33	59	35	45	17	30	12	0.8	6.4
Chrysene	88	160	110	110	43	77	25	1.4	17
Dibenzo (a.h) Anthracene	9.1	14	9.2	10	4.7	8.2	2.7	0.21	1.8
Fluoranthene	180	270	210	220	93	140	63	2.5	36
Fluorene	69	170	90	110	39	38	13	0.14	0.87
Indeno (1,2,3-cd) Pyrene	31	48	34	40	15	28	11	0.98	7
Naphthalene	28	190	96	96	33	64	13	0.085	2.3
Phenanthrene	260	600	350	370	150	170	29	1.2	2.6
Pyrene	210	340	270	250	110	160	57	2.4	45
Total SVOCs	1360.10	2843.00	1740.20	1770.00	775.70	1040.50	336.00	15.29	199.41
PEC	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Total PAH PEC Value	**59.65**	**124.69**	**76.32**	**77.63**	**34.02**	**45.64**	**14.74**	**0.67**	**8.75**

- Not Tested

ND - Not Detected

J - Estimated results, value is below the calibration/detection limit.

Table F-19 Polynuclear Aromatic Hydrocarbon (PAH)-PEC Values – Area 5

Sample Location	B-1	B-2	B-3	B-3	B-4	B-5	B-5	B-14
Sample Designation	S-2A	S-2A	S-2A	S-3A	S-2	S-2A	S-3B	S-2
Sample Depth	44-54"	24-36"	40-60"	72-84"	91-115"	32-44"	72-79"	29-53"
Date	8/19/1999							8/24/1999
SVOCs (mg/kg)								
2-Methyl Naphthalene	ND (0.875)	ND (17.5)	ND (17.5)	ND (0.008)	ND (17.5)	30.0 j	ND (8.750)	ND (17.5)
Acenaphthene	ND (0.750)	ND (15.0)	ND (15.0)	ND (0.008)	ND (15.0)	ND (30.0)	ND (7.50)	ND (15.0)
Acenaphthylene	ND (0.875)	ND (17.5)	ND (17.5)	ND (0.008)	ND (17.5)	ND (35.0)	ND (7.50)	ND (17.5)
Anthracene	ND (0.875)	ND (17.5)	ND (17.5)	0.007	ND (17.5)	ND (35.0)	8.3 j	ND (17.5)
Benzo (a) Anthracene	ND (0.875)	ND (17.5)	ND (17.5)	ND (0.003)	14.0 j	ND (35.0)	7.8 j	ND (17.5)
Benzo (a) Pyrene	ND (0.875)	ND (17.5)	ND (17.5)	ND (0.003)	12.0 j	ND (35.0)	ND (8.750)	ND (17.5)
Benzo (b) Fluoranthene	ND (1.0)	ND (20.0)	ND (20.0)	ND (0.003)	16.0 j	ND (40.0)	5.1 j	ND (20.0)
Benzo (g,h,i) Perylene	ND (0.750)	ND (15.0)	ND (15.0)	ND (0.003)	ND (15.0)	ND (30.0)	ND (7.50)	ND (15.0)
Benzo (k) Fluoranthene	ND (1.0)	ND (20.0)	ND (20.0)	ND (0.003)	ND (20.0)	ND (40.0)	ND (10.00)	ND (20.0)
Chrysene	ND (0.875)	ND (17.5)	ND (17.5)	ND (0.003)	17.0 j	ND (35.0)	8.2 j	ND (17.5)
Dibenzo (a.h) Anthracene	ND (0.875)	ND (17.5)	ND (17.5)	ND (0.005)	ND (17.5)	ND (35.0)	ND (8.750)	ND (17.5)
Fluoranthene	0.4 j	ND (17.5)	13.0 j	0.012	16.0 j	25.0 j	19.0 j	ND (17.5)
Fluorene	ND (0.875)	ND (17.5)	ND (17.5)	ND (0.005)	ND (15.0)	ND (35.0)	ND (8.750)	ND (17.5)
Indeno (1,2,3-cd) Pyrene	ND (0.750)	ND (15.0)	ND (15.0)	ND (0.003)	ND (15.0)	ND (30.0)	ND (7.50)	ND (15.0)
Naphthalene	ND (0.750)	ND (15.0)	ND (15.0)	ND (0.008)	ND (15.0)	ND (30.0)	ND (7.50)	ND (15.0)
Phenanthrene	ND (0.875)	ND (17.5)	ND (17.5)	0.008 j	ND (17.5)	45.0 j	5.5 j	ND (17.5)
Pyrene	0.58J	ND (17.5)	18.0 j	0.014	25.0 j	27.0 j	19.0 j	ND (17.5)
Total SVOCs	13.30	292.50	288.50	0.10	282.50	572.00	155.40	292.50
PEC	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Total PAH PEC Value	**0.58**	**12.83**	**12.65**	**0.00**	**12.39**	**25.09**	**6.82**	**12.83**

- Not Tested

ND - Not Detected

J - Estimated results, value is below the calibration/detection limit.

ENSR INTERNATIONAL

Memorandum

To:	Dave Mitchell	**Date:**	3 Nov 2003
From:	Marcia Greenblatt	**File:**	
RE:	Malden River - Spot Pond	**CC:**	Mark Gerath

Emergency Distribution Reservoir Management Study Task 5.2 Spot Pond Reservoir Final Management Plan (including Appendices). Completed by CDM, May, 2002 for MWRA (ENSR has these reports in House). The project included a field program, including water quality measurements, bathymetry and a structures survey, were performed. A summary of the hydraulics and hydrology of Spot pond is provided below.

Spot Pond was historically used as conveyance in the MWRA system. Since 1997, the pond has been taken off line, and is now used to receive flows from the distribution system, either as part of a flushing event or a system failure and as an extreme emergency source, if there is a loss of suction form other facilities in the system or a transmission failure. If needed as an emergency drinking water supply, the water will be passed through a disinfection process and will require boiling before consumption.

Spot Pond has a volume of 2235 million gallons and a surface area of 298 acres at 164' BCB. The maximum depth is 47' and the average depth is 23' at this elevation. The natural area of the watershed is 1175 acres, including the pond surface. However, due to drainage diversions and blocked pipes, the actual watershed is 369 acres, not much bigger than the pond area. Because of this small actual watershed, the water level in the pond is controlled primarily by groundwater flows.

There are 11 dams, two pump stations, a spillway and 2 sluice gates on Spot Pond. There are also many drains around the perimeter of the pond, in varying conditions of functionality. The elevation of the spillway, which drains into Spot Brook, is 161.83'. There is a single stoplog above the spillway, raising the elevation to 162.16'. There has been no flow over the spillway in the past 40 years.

At the East Gatehouse, the Gills Pump Station can move water at 60 mgd into the North High Service Area, if needed in an emergency. The city of Winchester maintains a pump station, and they periodically pump water, either to supplement their supply or to maintain the desired water levels in the pond, and the request of the MWRA.

The operational goals of the MWRA are:

- Maintain a minimum water level sufficient to supply water in an extreme emergency.
- Maintain a maximum water level to provide flood storage, sustain dam safety and avoid unregulated overflows.
- Minimize the need to supplement water in the pond.
- Control downstream releases to avoid exacerbating flooding.

The MWRA wants at least a 5 day supply of water in the pond, or ~328 million gallons (plus any additional volume necessary to maintain pump suction). Based on the stage-volume curve, this is equivalent to a water elevation of 157.5 in the pond.

CDM developed and applied a water budget model to establish operating guidelines based on the needs of MWRA. Because the pond is controlled primarily by groundwater flow, there is negligible inflow in the summer and early fall, and a slow response to precipitation events. Based on historical data, CDM developed a dry, average and wet year to model, with the following results:

Scenario	Net volume of water at the end of the year
Dry	-156 mg
Average	-0.16 mg
Wet	169 mg

Overall, there is a predicted net loss of water from Spot Pond.

CDM recommended an operating range of 157.6' – 160.5'. These recommendations take into account the 500-year design storm and aesthetics. The banks of the pond are heavily rip-rapped at least several feet below 160.5', and CDM recommended a water level sufficient to cover these banks as much as possible, as the pond is highly used as a recreational area.

If water needs to be released from Spot Pond, it can be spilled from the low-level outlet into Spot Pond Brook, pumped into the Winchester Reservoir or withdrawn into the MWRA distribution system.

CDM performed a downstream impact analysis for Spot Pond Brook, encompassing 3000' downstream from the pond. Water flows out of spot pond along the eastern shore through a 24" low-level outlet with a design capacity of 25 cfs. From this outlet, water is piped 1000' and discharges by gravity to form the headwaters of Spot Pond Brook. The Brook flows for 1500' through the Middlesex Fells Reservation and down a steep ravine. Below the ravine, the Brook flows through a small ponded area south of Pond Street and into a 4' x 4' box culvert that contains a broad crested weir. Between the weir and Pond Street, there is a 50' wide open grassy area that could provide storage during a large release. The stream enters 200' long pipe, and exits via a 9' x 3' outlet. The Brook parallels Philips Street, and enters a second culvert under Wyoming Ave. Below this culvert is a 30" MDC culvert, the downstream limit of the impact analysis. This culvert was deemed the control point due to its small cross-sectional area, and the flow capacity of this culvert was determined to be 22 cfs.

Based on the above, water can be released at 21 cfs with no downstream flooding. At this rate, 18.1 mg (the 500-year design storm) can be released over 32 hours.

MWRA has decided to operate the pond at 159-160.5', which maintains aesthetics and provides an 8 day (at 60 mgd) emergency water supply. An official procedure for lowering the pond, including verifying the available conveyance in the downstream path and notifying some of the communities downstream, has been developed by MWRA.

The option to supplement water supply and increase flushing in the Malden River with "excess" water from Spot Pond is not a viable option. On an annual basis, there is no excess water to spill during the dry months of late summer and early fall, when increased freshwater inflow would be most needed in the Malden River. On a long-term basis, Spot Pond is losing overall, and there would not be excess water in even an average rainfall year. Additionally, there would be water quality concerns associated with periodically spilling water into the culverts, channels and streambeds of Spot Pond Brook. **This option will not be considered further in the evaluation of restoration alternatives for the Malden River.**

ENSR INTERNATIONAL

Memorandum

To:	Dave Mitchell	**Date:**	7 Nov 2003
From:	Marcia Greenblatt	**File:**	
RE:	Malden River - Volume	**CC:**	Mark Gerath

We calculated the volume of the Malden River, based on USGS bathymetric mapping. We calculated the volume 2 ways:

1. We assumed that the highest contour in the USGS mapping represented the water surface elevation, and
2. Last week we were surveying bathymetry in the Mystic River, and our surveyor indicated that the water level varied between 106' and 106.4' while he was out there. We used a value of 106.2', but do not have the channel cross-sectional area above 105.8. Therefore we assumed vertical banks. This is probably not that far off. These calculations indicate a surface area of 54 acres for the River.

These values are consistent with an engineering study conducted in 1962 by Charles A. Maguire and Associates. In this report, a stage-volume curve for the Malden River is presented. Based on this curve, a water elevation of 106' results in a volume of approximately 14.7 million cubic feet.

Water Surface Elevation (ft, MDC datum)	Volume (ft3)	Volume (MG)
105.8	14,737,221	110
106.2*	15,670,611	117

*Does not account for additional channel width between 105.8 contour and 106.2 (I.e., assumes straight banks)

ENSR INTERNATIONAL

Memorandum

To:	Dave Mitchell	**Date:**	3 Nov 2003
From:	Marcia Greenblatt	**File:**	
RE:	Malden River – Tidal Exchange at the Earhart Dam	**CC:**	Mark Gerath

I have reviewed the information provided by the MDC regarding water quality issues and the saltwater removal project in Lower Mystic Lake. The objective of this review was to assess the feasibility of going forward with an evaluation of introducing salt water flushing at the AE dam. As we have discussed, allowing tidal may provide significant improvement in water quality, leading to improved fish habitat, restoration of the historically tidal wetlands, and possibly improvements in sediment quality with increased flows in the river. Thus, the reintroduction of tidal flows into the Malden River addresses the three core goals of the Malden River restoration project, and merits a proper evaluation before dismissing the alternative.

The following documents provided the summary information presented here:

MDC. 1994. Lower Mystic Lake Salt Water Removal Project

Ludlam, S.D. and B. Duval. 2001. Natural and Management-Induced Redution in Monomolimnetic Volume and Stability in a Coastal, Merimictic Lake.Lake and Reserv. Manage. 17(2):71-81.

From the above documents, the following is a summary of the issues pertaining to the reintroduction of tidal flushing at the AE dam:

- Historically, the Malden River and Lower Mystic River were tidal estuaries supporting brackish aquatic biota.
- Chemical stratification in the Lower Mystic Lake due to saltwater intrusion was first observed in 1860, and has been consistently present.
- Saltwater intrusion into the Lake may have occurred primarily during large storm events.
- The presence of the chemical stratification causes the saltwater to be trapped in the deep pools of the Lake, and prevents biannual turnover and complete mixing.
- At times (during the right combination of strong winds and low lake levels), there have been releases of H_2S from Lower Mystic Lake, causing public nuisance conditions and possible health hazards. Following a 1965 release, a major kill of alewives and barnacle growth on boats and pilings were observed.
- The installation of the Cradock Dam in 1908 (~3 mi downstream of the lake) allowed periodic excursions of saltwater into the lake when the locks were open.
- The AE dam was completed in 1966 (~5 mi downstream) and maintains the lake level ~1 m above mean low water, eliminating tidal flow into the Mystic and Malden Rivers.
- The elimination of saltwater changed the ecosystem from brackish to freshwater, however there does not appear to be adequate freshwater flow to support a healthy freshwater ecosystem.
- A combination of pumping (removing 240,000 m^3) and a large storm event (removing 456,000 m^3) has removed ~90% of the saltwater from the deep holes in the Lower Mystic Lake. This removal led to a larger lake volume available for freshwater habitat and elimination of H_2S releases due to the larger depth of freshwater overlying the remaining salt water.
-

The negative impacts of saltwater in the Lower Mystic Lakes that persisted long after the closure of the Earhart dam are understood, and the effort that was required to rectify the situation is appreciated. It would be important to ensure that any change in operation of the dam did not result in any significant increase in the saltwater residing in Lower Mystic Lake, which could lead to H_2S releases and degradation of fish habitat. However, the information presented here does not fully demonstrate that there is no way to operate the dam to provide flood protection while allowing for limited tidal exchange. There may be a mode of operation that provides for flushing on lower portions of the Malden River, restoring a brackish marsh habitat, without allowing saltwater excursions into Lower Mystic Lake.

Because of the high stakes of the project, an evaluation of tidal exchange as a means to rehabilitate wetlands, encourage a healthy fishery and improve sediment quality is warranted. The goal of this evaluation is to review available data to fully understand the situation, historically and presently, including lock operation, conditions that cause saltwater intrusion and volume of flushing required to improve water quality. At the completion of this review, it is anticipated that a meeting with DCR will be set up to discuss our ideas. At that time, we can decide if this alternative deems further consideration.

ENSR INTERNATIONAL

Memorandum

To:	Dave Mitchell	**Date:**	3 Dec 03
From:	Marcia Greenblatt	**File:**	
RE:	Malden River - Aeration	**CC:**	

In order to improve water quality in the Malden River, aeration was proposed as an alternative to provide circulation and increase DO in the river. A brief review of aeration application in the Malden River was performed to assess the feasibility of aeration as a water quality improvement alternative.

Artificial improvement of DO concentration in the water column can be achieved by aeration or artificial circulation. Aeration is generally aimed at DO improvements in the hypolimnium. There are three general classes of hypolimnium aeration: mechanical agitation, where water is removed, treated and returned; injection of pure oxygen and injection of air (Cooke et al 1993). These methods are generally applied in at least 12-15 m of water, where it apparatus is situated 1-2 m above the bottom, and can extend up to 10 m into the water column. Artificial circulation, achieved by pumps, jets or bubbled air, can also be implemented to increase DO in the water column. Diffuser pipes are located near the bottom of the water column, and discharge compressed air upwards. The induced vertical circulation of water serves to introduce oxygen into the oxygen-depleted water circulated up from the lower portion of the water column.

An artificial circulation system in the Malden River would serve to increase DO locally. It would provide the most benefit in any areas where stratification has been observed. Although water column profiles have not been collected, it is not believed that significant stratification develops in the Malden River due to the shallow water depths (<6 ft). Additionally, It would be most practical to install such a system at a location identified for other fish habitat improvements, such as placement of substrate. A specific location that would be feasible in the Malden River has not been identified.

Any form of aeration in the Malden River would be a challenge due to shallow water depths. The placement of any apparatus on the bottom may result in sediment scour. An apparatus on the bottom in such shallow water depths could impede with recreational uses of the river. Additionally, any sort of mechanical system requires initial capital expenditure followed by annual O&M costs.

The Mystic River Watershed Association has collected dissolved oxygen data continuously during the summer months at several stations in the Mystic River Watershed, including one station at the Amelia Earhart dam. Figure 2 and Figure 3 present the DO data for 2002 and 2003, respectively. The DO sensor was located in 3-6 feet of water. In 2002, a dry year, there were 3-4 weeks in July where the DO fell below 5.0 mg/L (the water quality standard). In 2003, a wet year, there were only a few excursions in July where DO fell below the water quality standard. These data indicate that low dissolved oxygen is present at this location, likely on an annual basis. However, the low DO condition does not appear to persist throughout the summer season. Nor does stormwater inflow appear to drive low DO at this location. It is possible that low DO persists further upstream in the Malden River, where there is no influence from the Mystic River. Figure 3 presents point measurements of DO collected throughout the watershed on 10/28/03. These observations indicate that DO in the mid section of the Malden River is considerably lower that at other locations in the Malden River and the Mystic River. Additional field measurements would be required to fully characterize the spatial and temporal extent of oxygen deficiencies in the Malden River

In summary, the implementation of artificial circulation is not likely to result in significant water quality improvement in the Malden River. The data do not indicate that low DO concentrations are a persistent water quality issue in the Malden River, and it is unlikely that significant stratification develops in the summer and fall months due to shallow water depths. Finally, shallow water depths make the installation of such a system problematic at best.

Figure 1 Continuous Dissolved Oxygen at the Amelia Earhart Dam, 2002

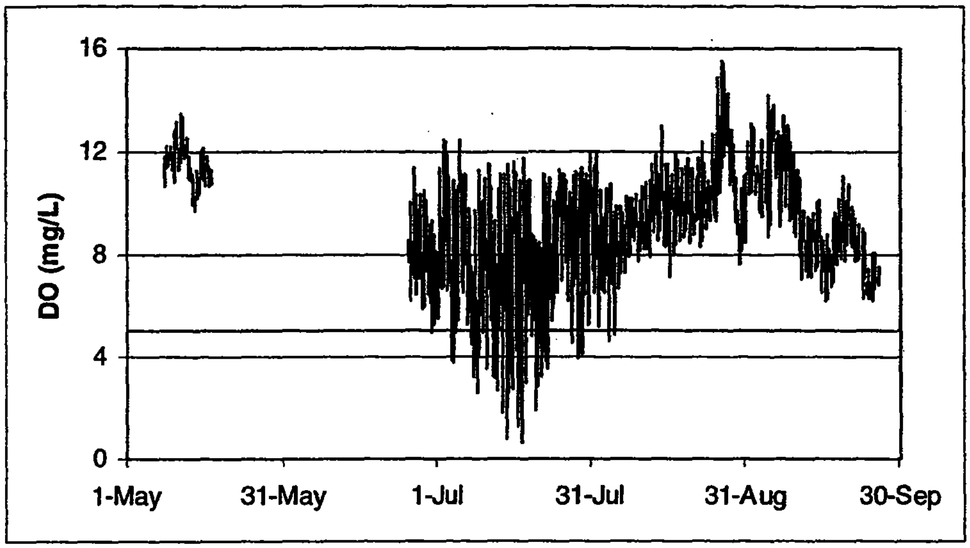


Figure 2 Continuous Dissolved Oxygen at the Amelia Earhart Dam, 2003

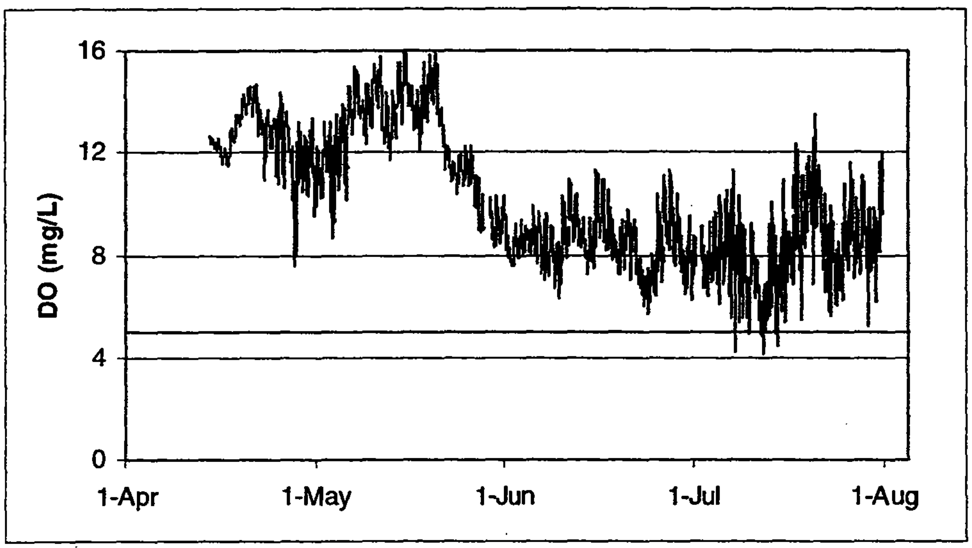
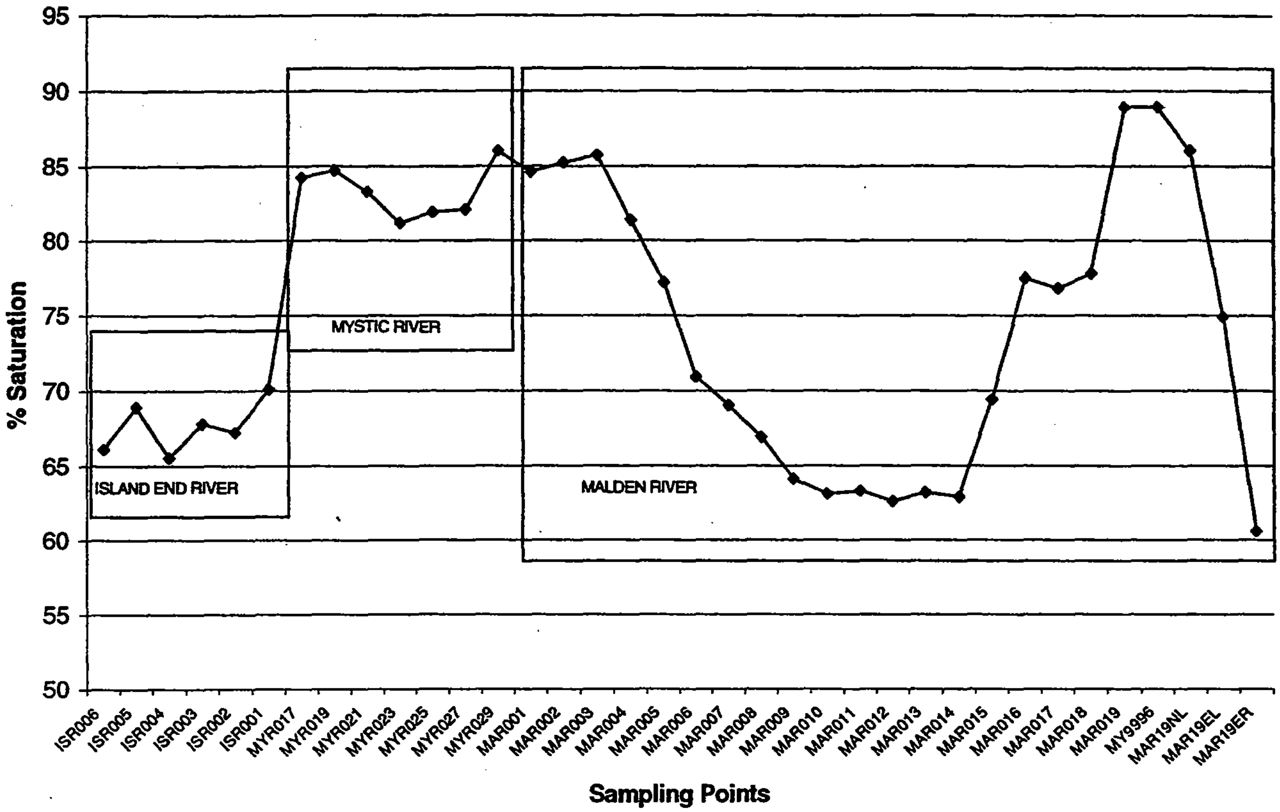


Figure 3 DO on 10/28/03



ENSR INTERNATIONAL

Memorandum

To:	Mike Tuttle, CENAE	**Date:**	January 5, 2004
From:	David F. Mitchell	**File:**	09000-328-140
RE:	Identification of Fish Passage Issues at Amelia Earhart Dam	**CC:**	Ginny Lombardo EPA/MVDC; Marcia Greenblatt, Dave Klinch, and Dave Nyman / ENSR

Dear Mike,

This memorandum is in response to your email of 1/5/04, where you indicated the need to follow-up on the fish passage component of Alternative "J" plan and, in particular, solicit input from NOAA, US F&WS & MDC. You noted that if sufficient new concerns were expressed, a meeting could be scheduled to discuss these issues.

I thought it might be useful to review the steps that ENSR has already taken or will undertake to fully address potential regulatory concerns regarding fish passage at the Amelia Earhart Dam.

- ENSR contacted Dick Quinn (U.S. Fish & Wildlife Service) in 10/03 regarding fish and wildlife habitat in the Malden River;
- ENSR contacted Brad Chase (MA Department of Marine Fisheries) on 10/31/03 to discuss the fish passage issues on the Mystic/Malden Rivers;
- ENSR visited DCR offices (formerly MDC) on 11/6/03 and met with Mike Galvin and Paul DiPetro regarding dam structural characteristics and dam operations;
- ENSR contacted Eric Hutchins (National Marine Fishery Service (NMFS)) on 1/05/04 to discuss any concerns regarding fish passage in the Malden River; and
- ENSR will contact NOAA in the next day or so to see if NOAA has concerns regarding fish passage in the Malden River.

Based on these conversations and available information regarding the Malden River, an estimate of the range of positive outcomes (i.e., benefits) will be made. Similarly, based on evaluation of the dam and existing structural characteristics, the available hydrologic gradient and flows involved, and the ecological requirements of the anadromous fish of interest (alewives, smelt), ENSR will estimate approximate potential costs for the three options:

1.) operational changes to the lock system,
2.) improvement of the existing fish passage sluice structure, and
3.) design and implementation of a new fish passage structure.

This level of cost-benefit comparison will allow evaluation of this alternative restoration plan in a comparable manner to the other 4 alternative plans.

Based on this level of input from the fisheries stakeholder agencies and the need for sufficient information for objective evaluation at the Phase I level, ENSR does not consider it necessary to convene an additional meeting to discuss these items, unless additional issues or strong stakeholder agency interests are identified.

ENSR INTERNATIONAL

Telephone Call Summary Sheet

By: Marcia Greenblatt

Date: 31 October 2003

Talked With: Brad Chase

Project Number:

Of: Mass Marine Fisheries

Project Name: Malden River

Telephone Number: 617-727-3336 ext 111

Subject: Fisheries in the Malden River

I spoke with Brad regarding the current and potential fishery in the Malden River. He was more familiar with the Mystic, and said that he has never seen much spawning habitat in the Malden, primarily due to the culverts. He said that the system is not functioning as a marine fishery due to lack of tidal exchange, and that he would be a strong supporter to opening the system up to even modest tidal exchange. He feels that the elimination of tidal exchange resulted in an ecological disaster in the Mystic River, especially for rainbow smelt. They spawn earlier in the season (when there is not much boat traffic) and at night, and so were not seen by the lock operators, and could not get up river. He said limited access, combined with loss of spawning substrate, led to the end of the rainbow smelt population in the watershed within ~3 years of the installation of the AE dam.

He said that there is a strong culture at the AE dam for the lock operators to let in the Alewives, that the are easy to see, come up during the late spring, and they are well liked, and that the lock operators due a good job passing them.

He said that the fish ladder on the AE dam was a "hopeless design" and that it was never effective at passing fish, and no longer operational.

He says there are potential spawning areas in downtown Medford (fast flowing riffles) that, with some substrate rehabilitation, would be ideal for rainbow smelt. However he is aware that this location is outside of the project area.

From his perspective (marine) there is little value in the Malden River as a fishery without tidal exchange. Even with tidal exchange, he is not sure there is any potential for spawning habitat, as the river is slow moving, and subject to too much stormwater inflow. I asked him about the possibility of habitat in the tribs, if we could perform some restoration activities there, but he wasn't optimistic that a fast moving stream could be maintained since the tribs are fed primarily by stormwater.

Marcia

Signature

Distribution:	(1)	(2)	(3)
	(4)	(5)	(6)
	(7)	(8)	(9)

J:\Govt\Projects\Malden River\Phase I Tasks\Water Quality Review\B.Chase Call.doc

ENSR INTERNATIONAL

Memorandum

To:	Dave Mitchell	**Date:**	7 Nov 2003
From:	Marcia Greenblatt	**File:**	
RE:	Malden River - DCR visit	**CC:**	Mark Gerath

On Thursday afternoon, 6 Nov 2003, I went into the Boston office of DCR (formerly MDC) flood control office to gather available information on the Earhart Dam. While I was there, I chatted informally with Mike Galvin and Paul DiPietro about flows and operations in the Malden and Mystic River watershed.

I reviewed several old (1904-1965) reports discussing water quality in the Mystic River basin, and presenting studies and designs to improve water quality in the basin. Water quality has been a concern in the basin as early as the mid 1800s. Included in the reports were proposed designs for the Earhart Dam, and accompanying hydrologic studies and computer model results. I was not able to obtain the final plans for the Dam, although they do exist at the DCR, and could be obtained if necessary. I was able to ask about the Dam, and found that the final design appears to closely follow the latest design study that I reviewed.

I learned that water is pumped out of the lower pool above the dam prior to and during large storms, maybe once every 2 years.

Mike said that he gets calls from folks along Spot Pond Brook (he thinks along Pond St. in Melrose and/or Stoneham) who say that their backyards flood periodically. This was not addressed in the CDM downstream analysis of Spot Pond, and this area is not under the jurisdiction of the DCR.

Paul provided some additional information on Spot Pond as well as a copy of the MDC Mystic Lake Salt Removal Project report. He mentioned that he feels that the goals of the Malden River restoration project are not well defined, and that objectives (backed by data) should be clearly stated prior to going forward with the project. He told me that he had written the letter regarding the proposal to open up the dam to tidal flushing, and that he was of the strong opinion that this idea is not worth pursuing. He said that the lower pool, immediately above the dam, was very deep, and that small volumes of salt water that may come through the locks will settle to the bottom and not move upstream. However, if the volume of salt water was sufficient to fill this pool, salt water would then extend right up to Lower Mystic Lake due to the low gradient of the Lower Mystic River.

I copied the following pieces of reports:

- Summary and results of a modeling study predicting water levels above the dam and in Mystic Lake under various
- Summary of the proposed dam design, including lock configuration and dimensions
- Pumping operation at AE Dam during large storms in 1996, 1998 and 2001.

1. **Operational changes to the lock system**

This alternative consists of expanding the periods of operation of one or more of the locks, to provide more effective passage of fish. In particular, the operation would be modified to attain greater transfer of Atlantic rainbow smelt. This would require operating the locks not only during daytime periods (which has proved reasonably effective for alewives), but also during evening and early morning hours during the smelt migration period.

The alternative includes the following measures:

- Installation of portable or permanent lighting near the freshwater end of the lock, to employ for attracting fish into the structure during operation;

- Development of a protocol for lock operation to address the transfer of migrating fish, consistent with the prevention of excessive saltwater intrusion into the freshwater basin (locking of fish must be coordinated with tide levels lower than the freshwater basin level);

- Staffing the lock during the anticipated spring fish migration period (March, April, May). This element is assumed to require an evening and a morning shift, each of four hours, staffed by two operators.

- During the first year of modified operation, the operating cycle would be periodically monitored to assess fish capture and transfer. Based on this monitoring, the operating protocol would be modified, if necessary.

2. **Retrofit one of smaller locks to provide a fish passage structure**

This option comprises using one of the locks to develop a fish passage structure, without requiring significant modifications to other elements of the existing dam.

To accomplish this, one of the smaller locks would be discontinued as a boat transfer lock. The gates would be retained to serve as coffer dams during construction of the fishway, and for isolating the fishway for future maintenance or in case of a flood.

The interior of the lock would be redeveloped to install a Denil or steeppass type fishway. A fishway at a 10% gradient would fit easily within the lock (total estimated length of lock is 120 feet), to accomplish up to a 7-foot rise. This rise is anticipated to be sufficient to cover the range from mean low tide to normal operating level of the freshwater basin.

Installation elements include:

- A Denil or steeppass type of fishway constructed within the central part of the lock.

- A concrete baffle wall across the lock at the upstream end of the fishway, fitted with stop logs to adjust flow to the fishway.

- A concrete baffle downstream of the lower end of the fishway, fitted with a self-regulating tidegate, to automatically prevent high tide from exceeding the inlet end of the fishway, thus preventing saltwater influx to the freshwater basin.

3. Installation of a fish bypass channel.

This option comprises a bypass channel around the eastern end of dam, with a culvert under the access roadway. The existing lock structures would not be altered as a part of this modification. Elements of this concept include:

- A naturalized channel excavated in the earthen embankment located at the east end of the existing dam structure. The channel would transition from the normal operating pool of the freshwater basin to the vicinity of mean low water, or somewhat lower. The channel would be concave in cross section, and lined with stone placed to achieve a naturalized "pool-riffle" structure (similar in concept to a "rock ramp fishway"). This type of channel is anticipated to be passable under a wide range of flow conditions, and would be suitable for various fish species and individual sizes within species.

- An inlet structure fitted with stop logs at the inlet end of the channel, to govern flows to the channel.

- A box culvert constructed at the road crossing. The culvert would be installed with the invert submerged below the nominal channel gradient, and back-filled with natural substrate material.

- At the outlet end of the culvert, a self-regulating tide gate would be installed, to allow flows under all conditions except when the tide is higher than the freshwater basin pool elevation. The closure setting of the gate would be set based on the operating invert of the inlet structure, to prevent saltwater influx to the freshwater basin.

Conceptual Cost Estimate
Option 1: Operational Changes to the Lock System

Element	Estimated Cost	Remarks
Allowance for attraction lighting	$10,000	
Total Capital Cost	**$10,000**	
Protocol development	$30,000	Develop lock operation protocol, monitor for first year, and refine protocol
Setup Cost	**$40,000**	
Contingencies	$8,000	20% of estimated setup costs
Permitting	$0	None anticipated
Total Initial Cost	**$48,000**	
Annual Operation	**$38,000 to $40,000**	Monitor fish passage and operate lock during spring migration period of Atlantic rainbow smelt

Title	Date 01/08/04	Dwg.	Project	Proposal

OPTION 1

REVISE LOCK OPERATION TO ENABLE TRANSFER OF RAINBOW SMELT:

MONITOR FOR FISH & OPERATE LOCK -
SPRING MIGRATION:
MARCH / APRIL / MAY

SAY 90 DAYS
2 - 4-HOUR SHIFTS, 2 PEOPLE

90 × 8 × 2 = 1440 HRS

PAY RATE + BENEFITS = $26
$20/hr + 30%

1440 × 26 = $37,440 ANNUAL COST

SAY 38,000 - 40,000 / YEAR

SET UP PROGRAM

DEVELOP PROTOCOL
40 hrs. × 150 = $6,000

FIRST YEAR MONITORING
120 hrs. × 100 = 12,000

REVISE PROTOCOL + REPORT 6,000

$24,000 + EXPENSES

SAY 30,000

CAPITAL COSTS:
ATTRACTION LIGHTS - SAY $10,000

FORM 1052

Conceptual Cost Estimate
Option 2: Retrofit One of Smaller Locks to Provide a Fish Passage Structure

Element	Estimated Cost	Remarks
Internal structural modifications of lock	$70,000	Concrete baffles, piers, alterations to inlet openings, to prepare lock for fishway installation
Fishway structure	$77,000	Assumes Steeppass type fishway. Alternative Denil fishway could double this cost.
Self-regulating tidegate	$100,000	
Total Capital Cost	**$247,000**	
Engineering/survey	$63,000	
Setup Cost	**$310,000**	
Contingencies	$62,000	20% of estimated setup costs
Permitting	$25,000	
Total Initial Cost	**$397,000**	
Annual Operation	**$25,000**	Allowance for routine maintenance and repairs

Title	Date	Dwg.	Project	Proposal
	01/08/04			

OPTION 2
RETROFIT LOCK

INTERNAL STRUCTURAL MODIFICATIONS

CONCRETE BAFFLES TO
ISOLATE FISHWAY COMPARTMENT
2 @ 12,000 — $24,000
MISC SUPPORT PIERS, ETC — 12,000
MODIFY INLET PORTS AND OTHER
MISC. MODIFICATIONS — 30,000

$ 66,000
SAY $ 70,000

STEEPPASS FISHWAY
URI WEBSITE: 10000/FT.
UPDATE FROM 2001 TO 2003 (ENR INDEX)

$$10000 \times \frac{6782}{6281} \approx 10800/\text{ft.}$$

SAY 11,000/ft × 7 — $ 77,000

SELF REGULATING TIDEGATE

PER WATERMAN REP. –
6×6 ≈ $75,000 TO $80000
ADD FOR INSTALLATION 20000

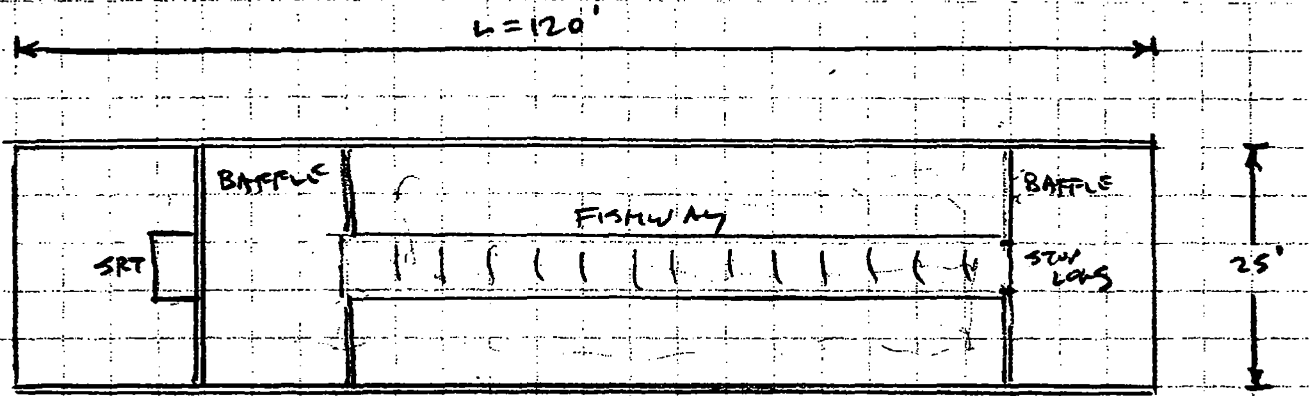
$100000 — $100,000

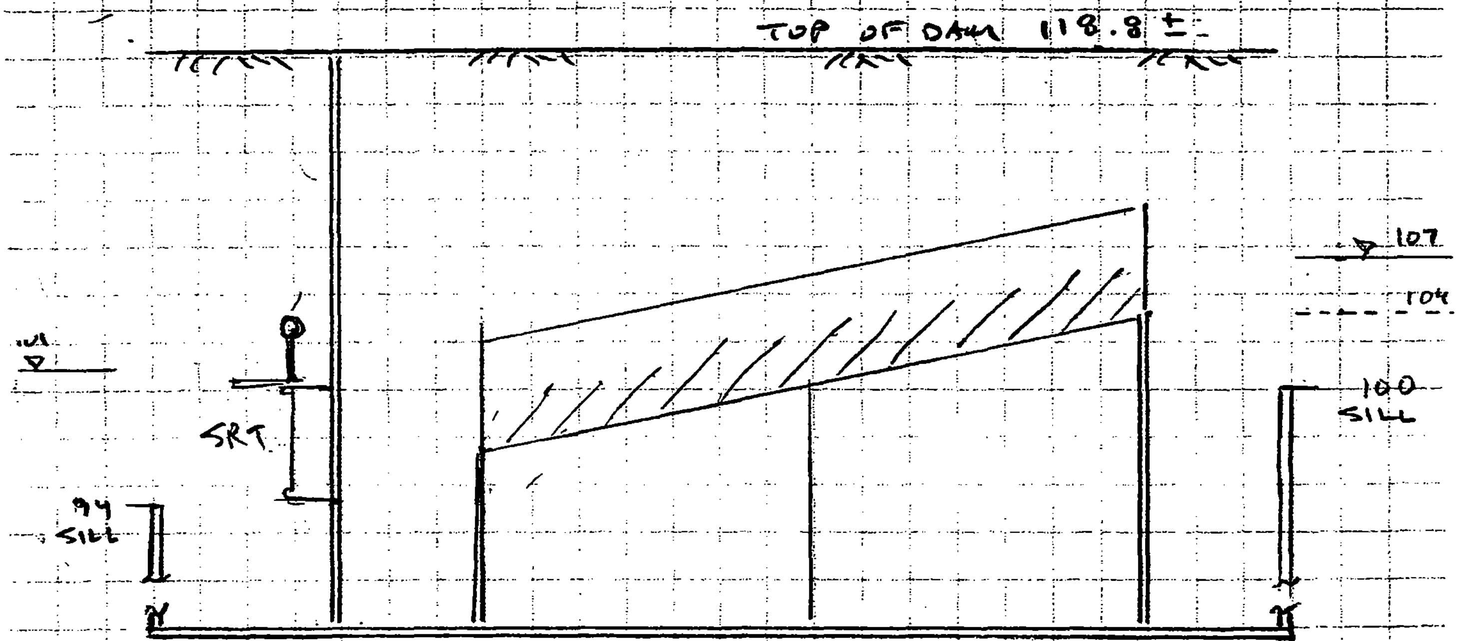
247,000
ADD FOR ENGINEERING @ 25% ± + SURVEY — 63,000

310,000

FORM 1052

Title	Date	Dwg.	Project	Proposal





101 = "AVERAGE" LOW TIDE (MEAN LW ?)

107 = "NORMAL" BASIN LEVEL (?)

104 = STORM PREP LEVEL (?)

SMALL LOCK CONFIGURATION ESTIMATED FROM
CE MAGUIRE ASSOC. REPORT 1962

FORM 1052

Conceptual Cost Estimate
Option 3: Installation of a Fish Bypass Channel

Element	Estimated Cost	Remarks
Channel excavation and lining	$200,000	Does not include disposal costs of contaminated soil material, if required.
Inlet control structure	$60,000	
Box culvert and headwalls	$60,000	
Self-regulating tidegate	$100,000	
Pavement repair and site restoration	$25,000	Includes riparian plantings along channel
Total Capital Cost	**$445,000**	
Engineering/survey/ geotechnical	$130,000	
Setup Cost	**$575,000**	
Contingencies	$115,000	20% of estimated setup costs
Permitting	$50,000	
Total Initial Cost	**$740,000**	
Annual Operation	**$25,000**	Allowance for routine maintenance and repairs

Title	Date 01/08/04	Dwg.	Project	Proposal

OPTION 3

BYPASS CHANNEL

CHANNEL EXCAV. & LINING
2 SECTIONS @ ~150 FT.
EXCAV. + STONE PLACEMENT $200,000

CULVERT
8x8 BOX 36 000
HEADWALLS 20 000
56 000
SAY 60,000 60,000

INLET CONTROL STRUCTURE AT
UPSTREAM END OF CHANNEL -
ASSUME EQUIV. IN SCOPE
TO CULVERT INSTALLATION 60,000

SELF REGULATING TIDE GATE
SIMILAR TO OPTION 2 100,000

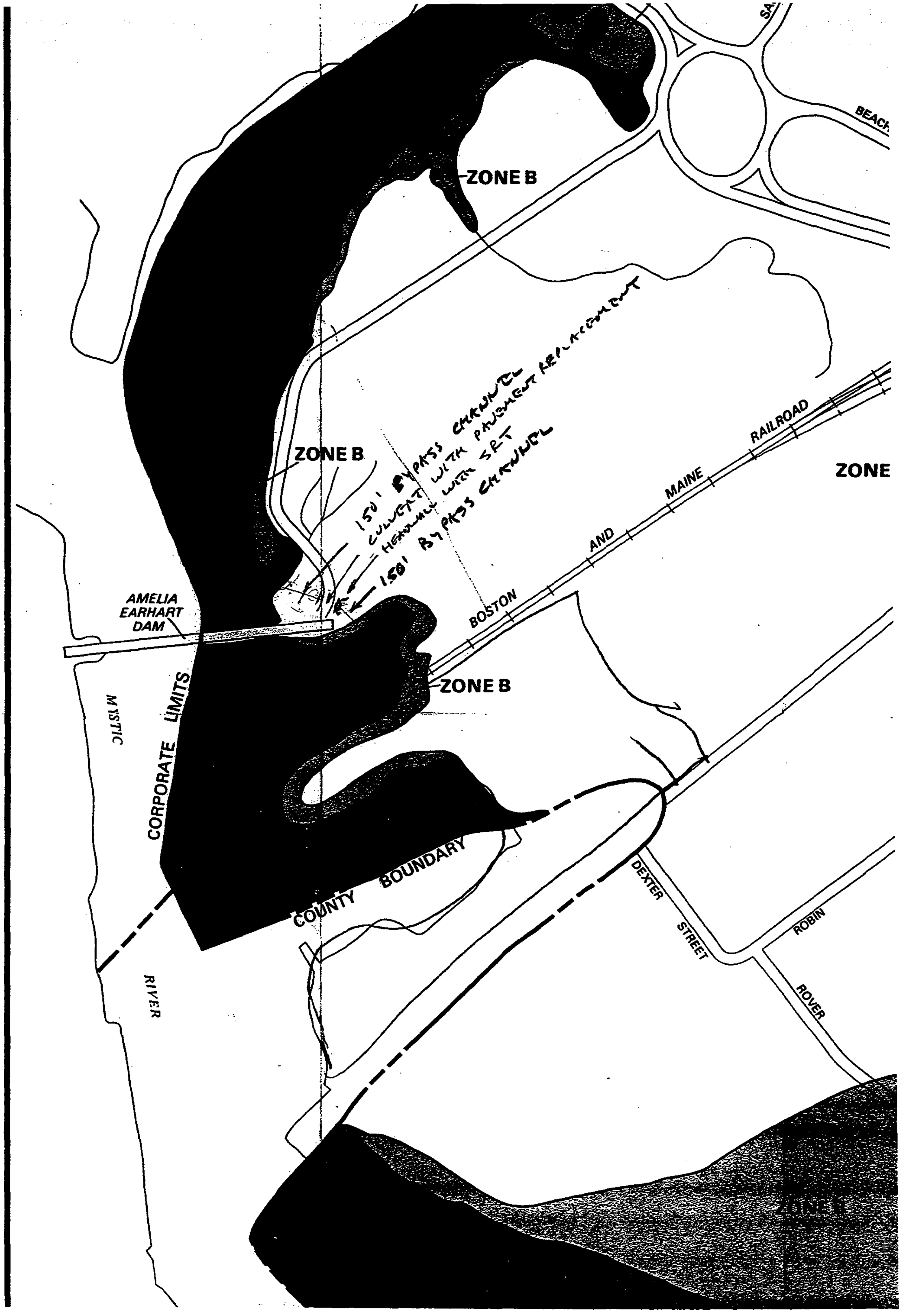
SITE RESTORATION -
PAVEMENT - 5000
PLANTINGS - 20 000
25 000 25,000

CAPITAL COSTS 445,000

ENGINEERING/SURVEY
25% = 112 000
GEOTECH = 15000
127,000
SAY 130,000 130,000

$ 575 000

+ CONTINGENCIES + PERMITTING



ZONE B
BEACH
ZONE B
150' BYPASS CHANNEL
CULVERT WITH PAVEMENT REPLACEMENT
HEADWALL WITH SPT
150' BYPASS CHANNEL
BOSTON AND MAINE RAILROAD
ZONE
AMELIA EARHART DAM
ZONE B
MYSTIC RIVER
CORPORATE LIMITS
COUNTY BOUNDARY
DEXTER STREET
ROBIN
ROVER

Title	Date	Dwg.	Project	Proposal

COST DATA FROM:

MEANS SITEWORK 2000

URI WEBSITE:
www.edc.uri.edu/restoration/html/tech_sci/socio/cost.htm

ENGINEERING NEWS RECORD (ENR) COST INDEX
www.enr.com

X-rates.com (HISTORIC EXCHANGE RATES - CANADA: U.S.)

KATOPODIS, C. 1992. INTRODUCTION TO FISHWAY DESIGN. Department of Fisheries and Oceans, Winnipeg, Manitoba.

WATERMAN INDUSTRIES SRT:
MIKE BRILLON
TECHNOLOGY SALES ASSOC.
PLAINVILLE, MA
508-695-6070 EXT 16 brillontsai@aol.com

FORM 1052

APPENDIX ~~D~~ F DOCUMENTS

The following information is provided in Appendix ~~D~~ F:

1.) A *Data Needs* worksheet used to summarize the existing information about the river sediments and to indicate potential data gaps for both Phase I and Phase II tasks.

2.) Summary tables of available sediment data in the Malden River. This information is organized by and presented in the following manner – river segment, sediment depth, and physical and chemical parameters.

River Segments (going from upstream to downstream):

- *Upper River* refers to sediments located in the river segment from the upstream culverts to approximately 100 ft north of the Medford Street Bridge,
- *Upper Section* of the Study Area refers to sediments located in Area 1, which includes an area approximately 100 ft upstream of the Medford St. Bridge to the Revere Beach Parkway (Route 16) bridge; and
- *Lower River* refers to sediments located in the river downstream of the Route 16 Bridge.

Sediment Depth – sediments are divided between surface sediments (i.e., 0 – 2 ft sediment depth) and sub-surface sediments (i.e., > 2 ft sediment depth).

Parameters – data is provided about the following classes of chemicals

- General parameters - including physical and non-toxic chemical parameters (for surface sediments only;
- Semi-volatile organic compounds (SVOCs) including PAHs, dioxins, and PCBs;
- Volatile organic compounds (VOCs); and
- Metals.

3.) Two profiles of Malden River main channel sediment composition; taken from two larger reports (Haley and Aldrich, 2001; and NCA, 2003a)

Data Needs
TeleComCity Area

General Information

1. **Current and Proposed Uses – Navigation? Recreational Boating? Swimming? Fishing?** *Impacts dredging and capping options*

2. **Water Uses** *Impacts Dredging and Capping Options*

- **Location and description of any potable water intakes –**
- **Location and description of any industrial water intakes –**

Drinking and industrial water are provided by public water supply and there are no private wells in the vicinity of the site (TRC Study, page 3, Volume 1).

- **Location and Description of Discharge points (stormwater, industrial, sewer)**
- **Flood Control/storage (flood insurance and other studies)**

Amelia Earhart Dam?

3. **Nearby Land Use (within ½ mile)** *Primarily impacts ex-situ treatment/transport/disposal options*

- **Industrial**
- **Commercial**
- **Residential**
- **Schools/Daycare Centers**
- **Hospitals**

All the above info should be available through existing reports, aerial photos, or town records

Equipment Access and Staging Areas –TeleComCity Area

1. **Potential access points for barges and dredging equipment (include possible water route from Boston Harbor through the dam)**

2. **Potential Upland Areas for Sediment Drying and Stockpiling**

3. **Potential Upland Areas for Loading Sediment for Off-site Disposal**

4. **Property Ownership/Access Issues**

From Aerial photos, maps, site visit

Bathymetry/General River Information – TeleComCity Area

1. Depths (general description and cross sections, USGS&flood insurance)
Profile of the Telecom City was done by Nangle Consulting Associates in 2000 (Volume 3).

2. Width (general description and cross sections, USGS& flood insurance)
Little Creek: 50' narrows to 15' 300' downstream and opens to 50' at confluence with Malden River (Wetlands & Wildlife, Inc, page 5, Volume2).

3. Wave Height (estimate)
Flood control structures on the mystic river eliminated the tidal nature of the Malden river and inflow of brackish water (TRC study, page 3, Volume 1).

4. Seasonal Conditions (variations in water height, flooding, icing conditions)

5. Presence of Obstacles – *Geophysical Survey?*

Bridges

Large Debris

Sunken Ships

Large Stones

Footings for existing or abandoned structures

Utilities

Piers

6. Depositional Rate

7. Depth of Mixing Layer

8. Water Temperature Profile

9. Dam Operation

Potential Continuing Sources of Contamination – TeleComCity Area

1. List Know Release Sites Along the River (contaminants, soil?, groundwater? Known release to River? NAPL?)

2 spills reported by Wehran Engineering, page14, Volume 1:

General Electric, 1987, <1 quart of Transformer oil

Massachusetts Electric Co., 1984, 10 gallons of Transformer oil.

Numerous spills in mystic River reported.

2. Visible Seeps into River

3. Groundwater Data Along River Banks

On DPW and Wellington Realty property, soil permeabilities ranged from $7.12X10^{-4}$ cm/sec and $2.6x10^{-3}$ cm/sec. Darcien flow velocities were 0.10 feet/day toward the Malden River and 0.28 feet/day toward the Little Creek (TRC study, page 16, Volume 1).

Compounds found on the Wellington property are characteristically coal tars (hydrocarbons); the Lombard property contains solvents; pockets of fuel and waste oil; other areas along the river are known to be contaminated (TRC study, pages20-25, Volume1).

4. Outfalls

9 stormwater and combined sewer overflow discharges (Wehran Engineering study, table 5, Volume 1)

3 NPDES permits issued on the Malden as of 1986 (Wehran Engineering study, table 9, Volume 1)

5. Tributaries

Little Creek (the results of one sediment sample can be found in the TRC study, page 23, Volume 1)

Another small stream appears to originate at a culvert west of the Boston &Maine Railroad, it starts as 5' wide and opens to 50' wide. (Wetlands & Wildlife Inc, page 6, Volume2)

GENERAL PARAMETERS – Upper River

Surface Sediments (0-2 feet)

Parameter	Sample Ids	# Samples	Range	Average	Hotspots
Descriptions					
Particle Size					
Bulk Density					
Bearing Strength					
Liquid Limits					
Plastic Limits					
Total Organic Carbon	USGS9	1		2.28%	
Chemical Oxygen Demand					
Biological Oxygen Demand					
Moisture Content					
PH					
Redox Potential					
Nutrients C N P					
Microbial Plate Count					

GENERAL PARAMETERS – Upper River

Subsurface Sediments (2 feet and deeper)

Parameter	Sample Ids	# Samples	Range	Average	Hotspots
Descriptions					
Particle Size					
Bulk Density					
Bearing Strength					
Liquid Limits					
Plastic Limits					
Total Organic Carbon					
Biological Oxygen Demand					
Chemical Oxygen Demand					
Moisture Content					
PH					
Redox Potential					
Nutrients C N P					
Microbial Plate Count					

CHEMICAL PARAMETERS
Upper Section

Surface Sediments (0-2 foot) Semivolatile Organics, Dioxins, And PCBs

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
TPAHs						
CPAH						
LPAH	370					
HPAH	960					
LNAPL	Any (sheen)					
DNAPL Observed or potential	Any observed or >1000 ppm COI					
Naphthalene	99	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 40	0-0 ND-170000 ug/Kg	0 22140 ug/Kg	
Acenaphthylene	66	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 57	0-0 ND-13000 ug/Kg	0 1927 ug/Kg	
Acenaphthene	16	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 58	0-0 ND-82000 ug/Kg	0 6519 ug/Kg	
Fluorene	23	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 58	0-0 ND-53000 ug/Kg	0 5410 ug/Kg	
Phenanthrene	100	USGS9	1		1050ppb	
Anthracene	220	USGS9 HASED-	1		1050ppb	

		4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	58	ND-58000 ug/Kg	7123 ug/Kg	
2-Methylnaphthalene	38	HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	58	ND-110000 ug/Kg	8866 ug/Kg	
Fluoranthene	160	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 58	ND-83000 ug/Kg	21509ppb 19688 ug/Kg	
Pyrene	1,000	USGS9	1		19608ppb	
Benz(a)anthracene	110	USGS9	1		9300ppb	
Chrysene	110	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 58	ND-36000 ug/Kg	9287ppb 8595 ug/Kg	
Tbenzofluoranthenes	230					
Benzo(a)pyrene	99	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 58	ND-48000 ug/Kg	11130ppb 9463 ug/Kg	
Indeno(1,2,3-c,d)pyrene	34	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 58	ND-15000 ug/Kg	0 1926 ug/Kg	
Dibenzo(g,h,I)perylene	12					
Benzo(g,h,I)perylene	31	USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 57	ND-13000 ug/Kg	0 1434.7 ug/Kg	
1,2-Dichlorobe	2.3	SED-1,2,3,3A,4,4	9	ND		

nzene		D,5,5D,6				
1,4-Dichlorobenzene	3.1	SED-1,2,3,3A,4,4D,5,5D,6	9	ND-16 ug/Kg	1.8 ug/Kg	
1,2,4-Trichlorobenzene	.81					
Hexachlorobenzene	.38					
Dimethyl phthalate	53					
Diethyl phthalate	61					
Di-n-butyl phthalate	220					
Butyl benzyl phthalate	4.9					
Bis(2-ethylhexyl) phthalate	47	HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	58	ND-170000 ug/Kg	12069 ug/Kg	
Di-n-octyl phthalate	58					
Dibenzofuran	15					
Hexchlorobutadiene	3.90					
N-Nitrosodiphenylamine	11					
Phenol	420					
2-Methylphenol	63					
4-Methylphenol	670					
2,4-Dimethyl Phenol	29					
PentaChlo	360					

rophenol						
Benzyl Alcohol	57					
Benzoic Acid	650					
Total PCBs	2					
Pesticides	0.5					
Total Dioxins	0.5					
DDD		USGS9	1		0ppb	
Methoxychlor		USGS9	1		0ppb	
Benzo(b) fluoranth		USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 57	ND-39000 ug/Kg	9343 ppb 10906 ug/Kg	
Dibenz(a,h) anthracene		USGS9	1		0 ppb	
Benzo(k) fluoranth		USGS9 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	1 59	ND-12000 ug/Kg	9300 ppb 3061 ug/Kg	
Benzo (a) anthracene		HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	58	ND-46000 ug/Kg	9115 ug/Kg	
Isophorone		HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	58	ND-6200 ug/Kg	963 ug/Kg	

CHEMICAL PARAMETERS
Upper Section

Surface Sediments (0-2 foot) Volatile Organic Compounds
In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
TVOC	5					
TCVOC	1					
Screen PID						
Trichloroethene						
Tetrachloroethene						
1,1,1 Trichloroethane						
Vinyl Chloride						
1,1 Dichloroethane		SED-1,2,3,3A,4,4D,5,5D,6	9	ND		
Cis 1,2 dichloroethene	Cis and trans combined	SED-1,2,3,3A,4,4D,5,5D,6	9	ND		
Trans 1,2 dichloroethene						
1,1 Dichloroethene		SED-1,2,3,3A,4,4D,5,5D,6	9	ND		
1,2 Dichloroethane		SED-1,2,3,3A,4,4D,5,5D,6	9	ND		
Benzene		SED-1,2,3,3A,4,4D,5,5D,6 HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	9 40	ND ND-23000 ug/Kg	948 ug/Kg	
Ethylbenze		SED-	9	ND-13	1.4 ug/Kg	

ne		1,2,3,3A,4,4 D,5,5D,6		ug/Kg		
Toluene						
Total Xylenes						
Bromomethane		SED-1,2,3,3A,4,4 D,5,5D,6	9	ND		
Carbon Tetrachloride		SED-1,2,3,3A,4,4 D,5,5D,6	9	ND		
Bromoform		SED-1,2,3,3A,4,4 D,5,5D,6	9	ND		
Chloroethane		SED-1,2,3,3A,4,4 D,5,5D,6	9	ND		
Chlorobenzene		SED-1,2,3,3A,4,4 D,5,5D,6	9	ND-15ug/Kg	1.7ug/Kg	
Bromodichloromethane		SED-1,2,3,3A,4,4 D,5,5D,6	9	ND		
1,2,4-Trimethylbenzene		HASED-4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21	40	ND-3600 ug/Kg	310.8 ug/Kg	

SED1-6 is from TRC study, 1997, Volume 3.

The following chemicals were all no detects (ND) for the TRC samples: 2-Chloroethylvinyl ether, Chloroform, Chloromethane, Dibromochloromethane, 1,3-Dichlorobenzene, 1,2-Dichloropropane, cis-1,3-Dichloropropene, trans-1,3-dichloropropene, Methylene chloride.

HASED- samples are from the Haley & Aldrich, Inc. study located in Volume 3. The HASED-samples are sediment samples, so some of the same numbered have multiple samples (different depths).

CHEMICAL PARAMETERS

Upper Section

Surface Sediments (0-2 foot) Metals

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
Arsenic	10	USGS9	1		5 ppm	
Cadmium	1	USGS9	1		1 ppm	
Chromium	100					
Lead	200	USGS9	1		205 ppm	
Nickel	100	USGS9	1		16 ppm	
Mercury (total)	1					
Mercury (organic)	1					
Silver	1	USGS9	1		0.4 ppm	
Barium	20	USGS9	1		48 ppm	
Copper	100	USGS9	1		50.2 ppm	
Zinc	100	USGS9	1		192 ppm	
Selenium	20					
Be		USGS9	1		20.5 ppm	
Na		USGS9	1		0.04%	
Mg		USGS9	1		0.21%	
Al		USGS9	1		0.43%	
P		USGS9	1		0.04%	
K		USGS9	1		0.09%	
Ca		USGS9	1		0.18%	
Sc		USGS9	1		1.2ppm	
Ti		USGS9	1		0.03%	
V		USGS9	1		24ppm	
Mn		USGS9	1		148 ppm	
Fe		USGS9	1		1.36%	
Co		USGS9	1		5 ppm	
Sr		USGS9	1		12.4 ppm	
Y		USGS9	1		4.4 ppm	
Zr		USGS9	1		3 ppm	
Mo		USGS9	1		1 ppm	
Sn		USGS9	1		<10	
Sb		USGS9	1		<5	
La		USGS9	1		8.6 ppm	

W		USGS9	1		<10 ppm	
Bi		USGS9	1		<5 ppm	
Li		USGS9	1		8 ppm	

CHEMICAL PARAMETERS
Upper Section

Subsurface Sediments (>2 foot) Semivolatile Organics, Dioxins, And PCBs

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
TPAHs						
CPAH						
LPAH	370					
HPAH	960					
LNAPL	Any (sheen)					
DNAPL Observed or potential	Any observed or >1000 ppm COI					
Naphthalene	99	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	14	ND-1100000 ug/Kg	212262 ug/Kg	
Acenaphthylene	66	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-33000 ug/Kg	2744 ug/Kg	
Acenaphthene	16	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-630000 ug/Kg	75355 ug/Kg	
Fluorene	23	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-300000 ug/Kg	39617 ug/Kg	HASED-4, HASED-9
Phenanthrene	100					
Anthracene	220	HASED-4,5,6,7,8,9,10,12,13,	17	ND-380000 ug/Kg	46858 ug/Kg	HASED-4

		14,15,17,19,20				
2-Methylnaphthalene	38	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-700000 ug/Kg	129111 ug/Kg	
Fluoranthene	160	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	17	ND-380000 ug/Kg	54622 ug/Kg	
Pyrene	1,000					
Benz(a)anthracene	110					
Chrysene	110	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-150000 ug/Kg	17789 ug/Kg	
Tbenzofluoranthenes	230					
Benzo(a)pyrene	99	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-180000 ug/Kg	17111 ug/Kg	
Indeno(1,2,3-c,d)pyrene	34	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-80000 ug/Kg	5617	HASED-4
Dibenzo(g,h,l)perylene	12					
Benzo(g,h,l)perylene	31	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-99000 ug/Kg	6289 ug/Kg	HASED-4
1,2-Dichlorobenzene	2.3					
1,4-	3.1					

Dichlorobe nzene						
1,2,4-Trichlorob enzene	.81					
Hexachlor obenzene	.38					
Dimethyl phthalate	53					
Diethyl phthalate	61					
Di-n-butyl phthalate	220					
Butyl benzyl phthalate	4.9					
Bis(2-ethylhexyl) phthalate	47	HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-1200000 ug/Kg	104268 ug/Kg	HASED-4
Di-n-octyl phthalate	58					
Dibenzofur an	15					
Hexchloro butadiene	3.90					
N-Nitrosodip henylamin e	11					
Phenol	420					
2-Methylphe nol	63					
4-Methylphe nol	670					
2,4-Dimethyl Phenol	29					
PentaChlo rophenol	360					
Benzyl	57					

Alcohol						
Benzoic Acid	650					
Total PCBs	2					
Pesticides	0.5					
Total Dioxins	0.5					
Benzo (a) anthracene		HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-180000 ug/Kg	20527 ug/Kg	
Benzo (b) fluoranthene		HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-140000 ug/Kg	15311 ug/Kg	HASED-4
Benzo(k) fluoranthene		HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-7000 ug/Kg	961 ug/Kg	
Isophorone		HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	18	ND-73000 ug/Kg	4805 ug/Kg	HASED-4

CHEMICAL PARAMETERS
Upper Section

Subsurface Sediments (>2 foot) Volatile Organic Compounds

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
TVOC	5					
TCVOC	1					
Screen PID						
Trichloroethene						
Tetrachloroethene						
1,1,1 Trichloroethane						
Vinyl Chloride						
1,1 Dichloroethane						
Cis 1,2 dichloroethene						
Trans 1,2 dichloroethene						
1,1 Dichloroethene						
1,2 Dichloroethane						
Benzene		HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	15	ND-120000 ug/Kg	12632 ug/Kg	
Ethylbenzene						

Toluene						
Total Xylenes						
1,2,4-Trimethylbenzene		HASED-4,5,6,7,8,9,10,12,13,14,15,17,19,20	16	ND-67000 ug/Kg	4256 ug/Kg	

CHEMICAL PARAMETERS
Upper Section

Subsurface Sediments (>2 foot) Metals

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
Arsenic	10					
Cadmium	1					
Chromium	100					
Lead	200					
Nickel	100					
Mercury (total)	1					
Mercury (organic)	1					
Silver	1					
Barium	20					
Copper	100					
Zinc	100					
Selenium	20					
Be						
Na						
Mg						
Al						
P						
K						
Ca						
Sc						
Ti						
V						
Mn						
Fe						

Co						
Sr						
Y						
Zr						
Mo						
Sn						
Sb						
La						
W						
Bi						
Li						

GENERAL PARAMETERS – Lower River

Surface Sediments (0-2 feet)

Parameter	Sample Ids	# Samples	Range	Average	Hotspots
Descriptions					
Particle Size					
Bulk Density					
Bearing Strength					
Liquid Limits					
Plastic Limits					
Total Organic Carbon	USGS36,41, 46,47	4	4.17-4.98%	4.575%	
Chemical Oxygen Demand					
Biological Oxygen Demand					
Moisture Content					
PH					
Redox Potential					
Nutrients C N P					
Microbial Plate Count					

GENERAL PARAMETERS – Lower River

Subsurface Sediments (2 feet and deeper)

Parameter	Sample Ids	# Samples	Range	Average	Hotspots
Descriptions					
Particle Size					
Bulk Density					
Bearing Strength					
Liquid Limits					
Plastic Limits					
Total Organic Carbon					
Biological Oxygen Demand					
Chemical Oxygen Demand					
Moisture Content					
PH					
Redox Potential					
Nutrients C N P					
Microbial Plate Count					

CHEMICAL PARAMETERS
Lower River

Surface Sediments (0-2 foot) Semivolatile Organics, Dioxins, And PCBs

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
TPAHs						
CPAH						
LPAH	370					
HPAH	960					
LNAPL	Any (sheen)					
DNAPL Observed or potential	Any observed or >1000 ppm COI					
Naphthalene	99	USGS36,41, 46,47	4	0-2672ppb	668ppb	
Acenaphthylene	66	USGS36,41, 46,47	4	0-0ppb	0ppb	
Acenaphthene	16	USGS36,41, 46,47	4	0-0ppb	0ppb	
Fluorene	23	USGS36,41, 46,47	4	0-0ppb	0ppb	
Phenanthrene	100	USGS36,41, 46,47	4	0-3890ppb	1094.25 ppb	
Anthracene	220	USGS36,41, 46,47	4	0-3900ppb	1100ppb	
2-Methylnaphthalene	38					
Fluoranthene	160	USGS36,41, 46,47	4	0-6882ppb	2501ppb	
Pyrene	1,000	USGS36,41, 46,47	4	0-13334ppb	6292.25 ppb	
Benz(a)anthracene	110	USGS36,41, 46,47	4	0-10207ppb	5173.5ppb	
Chrysene	110	USGS36,41, 46,47	4	0-10180ppb	5141.25 ppb	
Tbenzofluoranthenes	230					

Benzo(a)pyrene	99	USGS36,41,46,47	4	0-21064ppb	9301ppb	
Indeno(1,2,3-c,d)pyrene	34	USGS36,41,46,47	4	0-6636ppb	2301.5ppb	
Dibenzo(g,h,I)perylene	12					
Benzo(g,h,I)perylene	31	USGS36,41,46,47	4	0-5852ppb	2678.75 ppb	
1,2-Dichlorobenzene	2.3					
1,4-Dichlorobenzene	3.1					
1,2,4-Trichlorobenzene	.81					
Hexachlorobenzene	.38					
Dimethyl phthalate	53					
Diethyl phthalate	61					
Di-n-butyl phthalate	220					
Butyl benzyl phthalate	4.9					
Bis(2-ethylhexyl) phthalate	47					
Di-n-octyl phthalate	58					
Dibenzofuran	15					
Hexchlorobutadiene	3.90					
N-Nitrosodiphenylamine	11					
Phenol	420					

2-Methylphenol	63					
4-Methylphenol	670					
2,4-Dimethyl Phenol	29					
PentaChlorophenol	360					
Benzyl Alcohol	57					
Benzoic Acid	650					
Total PCBs	2					
Pesticides	0.5					
Total Dioxins	0.5					
DDD		USGS36,41,46,47	4	0-0ppb	0ppb	
Methoxychlor		USGS36,41,46,47	4	0-0ppb	0ppb	
Benzo(b)fluoranth		USGS36,41,46,47	4	0-10934ppb	6157.5ppb	
Benzo(k)fluoranth		USGS36,41,46,47	4	0-10900ppb	6200ppb	
Dibenz(a,h)anthracene		USGS36,41,46,47	4	0-0ppb	0ppb	

CHEMICAL PARAMETERS
Lower River

Surface Sediments (0-2 foot) Volatile Organic Compounds

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
TVOC	5					
TCVOC	1					
Screen PID						
Trichloroethene						
Tetrachloroethene						
1,1,1 Trichloroethane						
Vinyl Chloride						
1,1 Dichloroethane						
Cis 1,2 dichloroethene						
Trans 1,2 dichloroethene						
1,1 Dichloroethene						
1,2 Dichloroethane						
Benzene						
Ethylbenzene						
Toluene						
Total Xylenes						

CHEMICAL PARAMETERS
Lower River

Surface Sediments (0-2 foot) Metals

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
Arsenic	10	USGS36;41; 46;47	4	14-28ppm	19.5ppm	
Cadmium	1	USGS36;41; 46;47	4	2-4ppm	3ppm	
Chromium	100					
Lead	200	USGS36;41; 46;47	4	169-319ppm	260.75ppm	
Nickel	100	USGS36;41; 46;47	4	28-43ppm	36.25ppm	
Mercury (total)	1					
Mercury (organic)	1					
Silver	1	USGS36;41; 46;47	4	0.7-1.5ppm	1.02ppm	
Barium	20	USGS36;41; 46;47	4	58-96ppm	81.75ppm	
Copper	100	USGS36;41; 46;47	4	112-176ppm	149.75ppm	
Zinc	100	USGS36;41; 46;47	4	498-815ppm	692.5ppm	
Selenium	20					
Be		USGS36;41; 46;47	4	.5-.9ppm	0.7ppm	
Na		USGS36;41; 46;47	4	.09-.16%	0.1175%	
Mg		USGS36;41; 46;47	4	.43-.54%	0.4925%	
Al		USGS36;41; 46;47	4	1.07-1.75%	1.3275%	
P		USGS36;41; 46;47	4	.1-.23%	0.145%	
K		USGS36;41; 46;47	4	.2-.27%	0.24%	
Ca		USGS36;41; 46;47	4	.35-.44%	0.3825%	
Sc		USGS36;41; 46;47	4	2-2.8ppm	2.4ppm	

Ti		USGS36;41; 46;47	4	.05-.05%	0.05%	
V		USGS36;41; 46;47	4	49-75ppm	64ppm	
Mn		USGS36;41; 46;47	4	235-302ppm	274.25ppm	
Fe		USGS36;41; 46;47	4	2.71-3.85%	3.355%	
Co		USGS36;41; 46;47	4	12-15ppm	13.5ppm	
Sr		USGS36;41; 46;47	4	28.3-40.6ppm	34.25ppm	
Y		USGS36;41; 46;47	4	7.8-10.6ppm	9.275ppm	
Zr		USGS36;41; 46;47	4	5.2-6.9%	6.125ppm	
Mo		USGS36;41; 46;47	4	2-3ppm	2.25ppm	
Sn		USGS36;41; 46;47	4	12-37ppm	23.5ppm	
Sb		USGS36;41; 46;47	4	<5ppm	<5ppm	
La		USGS36;41; 46;47	4	12.1-14.7ppm	13.425ppm	
W		USGS36;41; 46;47	4	<10ppm	<10ppm	
Bi		USGS36;41; 46;47	4	<5ppm	<5ppm	
Li		USGS36;41; 46;47	4	23-32ppm	26.5ppm	

CHEMICAL PARAMETERS
Lower River

Subsurface Sediments (>2 foot) Semivolatile Organics, Dioxins, And PCBs

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
TPAHs						
CPAH						
LPAH	370					
HPAH	960					
LNAPL	Any (sheen)					
DNAPL Observed or potential	Any observed or >1000 ppm COI					
Naphthalene	99					
Acenaphthylene	66					
Acenaphthene	16					
Fluorene	23					
Phenanthrene	100					
Anthracene	220					
2-Methylnaphthalene	38					
Fluoranthene	160					
Pyrene	1,000					
Benz(a)anthracene	110					
Chrysene	110					
Tbenzofluoranthenes	230					
Benzo(a)pyrene	99					

Indeno(1,2,3-c,d)pyrene	34					
Dibenzo(g,h,I)perylene	12					
Benzo(g,h,I)perylene	31					
1,2-Dichlorobenzene	2.3					
1,4-Dichlorobenzene	3.1					
1,2,4-Trichlorobenzene	.81					
Hexachlorobenzene	.38					
Dimethyl phthalate	53					
Diethyl phthalate	61					
Di-n-butyl phthalate	220					
Butyl benzyl phthalate	4.9					
Bis(2-ethylhexyl) phthalate	47					
Di-n-octyl phthalate	58					
Dibenzofuran	15					
Hexchlorobutadiene	3.90					
N-Nitrosodiphenylamine	11					
Phenol	420					
2-Methylphe	63					

CHEMICAL PARAMETERS
Lower River

Subsurface Sediments (>2 foot) Volatile Organic Compounds

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
TVOC	5					
TCVOC	1					
Screen PID						
Trichloroethene						
Tetrachloroethene						
1,1,1 Trichloroethane						
Vinyl Chloride						
1,1 Dichloroethane						
Cis 1,2 dichloroethene						
Trans 1,2 dichloroethene						
1,1 Dichloroethene						
1,2 Dichloroethane						
Benzene						
Ethylbenzene						
Toluene						
Total Xylenes						

CHEMICAL PARAMETERS
Lower River

Subsurface Sediments (>2 foot) Metals

In mg/kg – parts per million

Parameter	Level of Interest	Sample Ids	# Samples	Range	Average	Hotspots?
Arsenic	10					
Cadmium	1					
Chromium	100					
Lead	200					
Nickel	100					
Mercury (total)	1					
Mercury (organic)	1					
Silver	1					
Barium	20					
Copper	100					
Zinc	100					
Selenium	20					
Be						
Na						
Mg						
Al						
P						
K						
Ca						
Sc						
Ti						
V						
Mn						
Fe						
Co						
Sr						
Y						
Zr						
Mo						
Sn						
Sb						
La						

Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX G

MASSACHUSETTS AIR QUALITY CONFORMANCE

US Army Corps
of Engineers®
New England District

RECORD OF NON-APPLICABILITY (RONA)

Emissions Calculations for:

Malden River Ecosystem Restoration Project Malden, Medford & Everett, Massachusetts

GENERAL CONFORMITY - RECORD OF NON-APPLICABILITY

Project/Action Name:	*Malden River Ecosystem Restoration Project* *Malden, Medford & Everett, Massachusetts*
Project/Action Point of Contact:	*Michael Tuttle, Study Manager* *phone: 978-318-8677*

General Conformity under the Clean Air Act, Section 176 has been evaluated for the project described above according to the requirements of 40 CFR 93, Subpart B. The requirements of this rule are not applicable to this project/action because:

Total direct and indirect emission from this project/action are estimated at less than 100 tons for Ozone, and are below the conformity threshold value established at 40 CFR 93.153(b) of 100 tons/year of Ozone;

AND

The project/action is not considered regionally significant under 40 CFR 93.153(i).

Supporting documentation and emissions estimates are:

(X) ATTACHED
(X) APPEAR IN THE NEPA DOCUMENTATION (Section 6.8)
( ) OTHER

SIGNED____
Jay Mackay, Chief Environmental Resources Section

GENERAL CONFORMITY - RECORD OF NON-APPLICABILITY

Project/Action Name:	*Malden River Ecosystem Restoration Project, Malden, Medford & Everett, Massachusetts*
Project/Action Point of Contact:	*Michael Tuttle, Study Manager phone: 978-318-8677*

General Conformity under the Clean Air Act, Section 176 has been evaluated for the project described above according to the requirements of 40 CFR 93, Subpart B. The requirements of this rule are not applicable to this project/action because:

Total direct and indirect emission from this project/action are estimated at less than 100 tons for Ozone, and are below the conformity threshold value established at 40 CFR 93.153(b) of 100 tons/year of Ozone;

AND

The project/action is not considered regionally significant under 40 CFR 93.153(i).

Supporting documentation and emissions estimates are:

(X) ATTACHED
(X) APPEAR IN THE NEPA DOCUMENTATION (Section 6.8)
( ) OTHER

SIGNED Jay Mackay
Jay Mackay, Chief Environmental Resources Section

General Conformity Review and Emission Inventory for the Malden River Ecocsystem Restoration Project, Malden, Medford & Everett, Massachusetts

(Worst Case Analysis)

1	2	3	4	5	6	7	8	9	10	11
	Project Emission Sources and Estimated Power						**NOx Emission Estimates**		**VOC Emission Estimates**	
Equipment/Engine Category	**# of Engines**	**hp**	**LF**	**hrs/day**	**Days of Operation**	**hp-hr**	**NOx EF (g/hp-hr)**	**NOx Emissions (tons)**	**VOC EF (g/hp-hr)**	**VOC Emissions (tons)**
Fish Substrate Placement SA 1, 3, 4, 5, 6										
Derrick Barge, 150 HP	1	150	1.00	12	50	90,000	9.200	0.91	1.300	0.13
Truck, 330 HP	1	330	1.00	12	50	198,000	9.200	2.01	1.300	0.28
Phrag Removal & Replanting SA 3, 4, 5										
Excavator, 150 HP	1	150	1.00	12	95	171,000	9.200	1.73	1.300	0.25
Dozer, 440 HP	1	440	1.00	12	182	960,960	9.200	9.75	1.300	1.38
Truck, 330 HP	1	330	1.00	12	190	752,400	9.200	7.63	1.300	1.08
Grader, 140 HP	2	140	1.00	12	130	436,800	9.200	4.43	1.300	0.63
Wetland Creation SA 4										
Excavator, 150 HP	1	150	1.00	12	195	351,000	9.200	3.56	1.300	0.50
Dozer, 440 HP	2	440	1.00	12	195	2,059,200	9.200	20.88	1.300	2.95
Truck, 330 HP	2	330	1.00	12	200	1,584,000	9.200	16.06	1.300	2.27
Debris Removal SA 1, 2, 3, 4, 5, 6										
Excavator, 150 HP	1	150	1.00	12	30	54,000	9.200	0.55	1.300	0.08
Dozer, 440 HP	1	440	1.00	12	45	237,600	9.200	2.41	1.300	0.34
Truck, 330 HP	1	330	1.00	12	50	198,000	9.200	2.01	1.300	0.28
Work/Survey Boat, 140 HP	1	140	1.00	12	75	126,000	9.200	1.28	1.300	0.18
Total Emissions							**NOx Total**	**73.21**	**VOC Total**	**10.34**

Horsepower Hours

hp-hr = # of engines*hp*LF*hrs/day*days of operation

Load Factors

Load Factor (LF) represents the average percentage of rated horsepower used during a source's operational profile. For this worst case estimate, LF is held at 1 for all equipment. Typical is 0.4 to 0.6

Emission Factors

NOx Emissions Factor for Off-Road Construction Equipment is 9.20 g/hp-hr

VOC Emissions Factor for Off-Road Construction Equipment is 1.30 g/hp-hr

Emissions (g) = Power Demand (hp-hr) * Emission Factor (g/hp-hr)

Emissions (tons) = Emissions (g) * (1 ton/907200 g)

Note: Duration of project is 12 months. Calculations are broken down by construction season, and indicate total estimated emissions for one construction year.

Malden River Ecosystem Restoration
Detailed Project Report

APPENDIX H

REAL ESTATE REQUIREMENTS

US Army Corps
of Engineers®
New England District

NEW ENGLAND DISTRICT
U.S. ARMY CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REAL ESTATE PLANNING REPORT
MALDEN RIVER ECOSYSTEM RESTORATION
MALDEN, MEDFORS & EVERETT, MASSACHUSETTS

PREPARED BY: R. JEFFREY TELLER
LEAD APPRAISER

JANUARY 2007

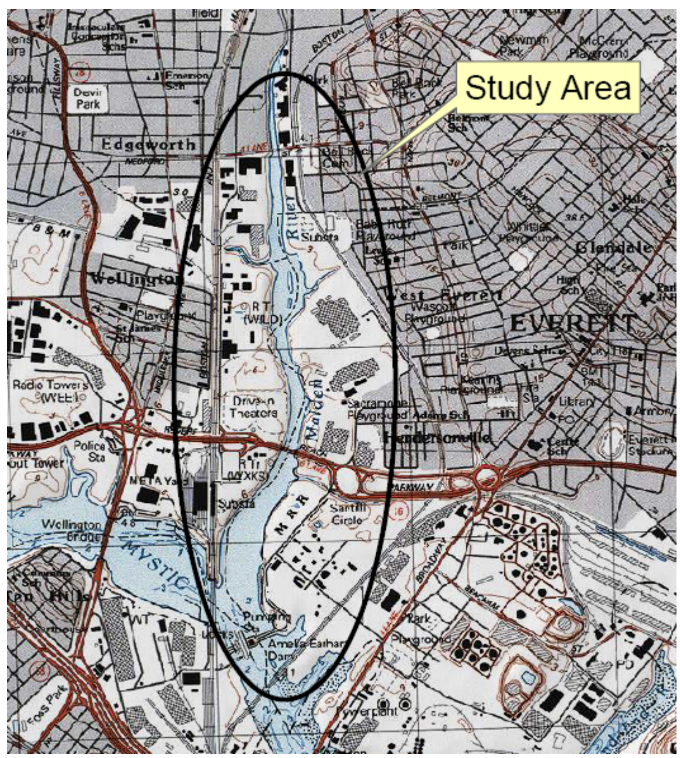
Malden River Ecosystem Restoration

Real Estate Report

1. PURPOSE: The Detailed Project Report for the Malden River Ecosystem Restoration Study dated January 2007 was prepared by the U.S. Army Corps of Engineers, New England District (USACE) and the Mystic Valley Development Commission (MVDC), the local sponsor of the study. The Coastal Massachusetts Ecosystem Reconnaissance Study (CMERS), the initial authority for the investigation of the Malden River, was authorized by a resolution adopted by the Committee on Transportation and Infrastructure of the United States House of Representatives on 23 July 1997. The CMERS identified the restoration of the Malden River ecosystem as one of the ecosystem restoration areas that warranted a full feasibility study.

2. a. PROJECT AREA DESCRIPTION:

The Malden River watershed, a Mystic River sub-basin, is approximately 11 square miles and is located in the towns of Wakefield, Stoneham, Melrose, Malden, Medford and Everett, Massachusetts. The Malden River originates from the outflow from Spot Pond in the Fells Reservation and passes beneath the cities of Melrose and Malden in channelized conveyances through much of the upper watershed. The river daylights from two sets of stormwater culverts south of Malden Center and flows for approximately 2 miles as open surface water through the densely populated cities of Malden, Everett and Medford prior to its confluence with the Mystic River, just upstream of the Amelia Earhart Dam. The Study Area is defined where it daylights from underground culverts in Malden to the confluence with the Mystic River with a lower downstream boundary at the Amelia Earhart Dam.



Locus Map – U.S.G.S. Quad Map 2003

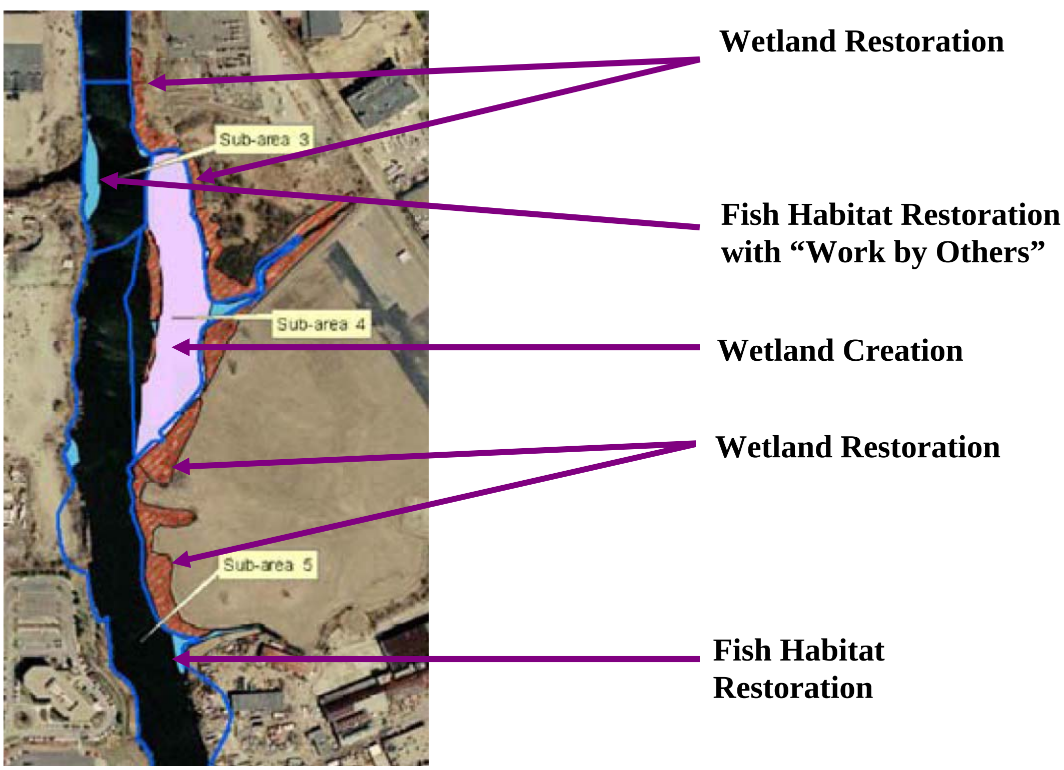
Malden River Ecosystem Restoration

Real Estate Report

2 b. RECOMMENDED PLAN: The primary elements of the recommended National Ecosystem Restoration plan (Figure attached) were developed through the detailed evaluation of the Malden River ecosystem characteristics. The primary elements are as follows:

- Removal of 36,000 cubic yards of invasive species along 14.9 acres of the riverbank corridor and replanting with native wetland species;
- Creation of 5.4 acres of emergent wetland within the existing oxbow;
- Placement of 4,400 cubic yards of gravel/sand substrate to create 2.8 acres of fish spawning habitat; and
- Operational changes at the Amelia Earhart Dam to improve fish passage for anadromous species.

The majority of the recommended restoration improvements are located within sub-areas 3, 4 and 5. These improvements involve wetland restoration, wetland creation and fish habitat restoration, which are highlighted below. The proposed work in sub-area 1 and 6 involves only fish habitat restoration.



Malden River Ecosystem Restoration

Real Estate Report

2. c. OWNERSHIPS: The surrounding lands are owned by multiple property owners, including the city of Malden, the Mystic Valley Development Commission, and private individuals whom have been identified. Plans are being developed which will identify the required construction, staging, and disposal areas.

3. DESCRIPTION OF NON-FEDERAL SPONSOR'S EXISITING OWNERSHIP: The ownership interest are referenced above and on attached excel spreadsheets.

RECOMMENDED ESTATES**:**

The effects of various wetland and sediment restoration alternatives were investigated for their impact on the acquisition of real estate to support the restoration alternatives. No real estate or real property improvements will be required for the proposed wetland restoration activities, based on the findings identified in the Detailed Project Report dated January 2007. However, land areas (Fee Simple Estate) will be needed to **construct** proposed wetland areas, and temporary construction easements (Estate Number 15) will be required for access and staging areas

4. EXISITING FEDERAL PROJECTS: Within the study area, an authorized Federal navigation project exists. Adopted in 1912 and modified in 1915, the River and Harbor Acts provided Malden River with a channel 6 feet deep and 100 to 150 feet wide extending approximately 1.5 miles from its confluence with the Mystic River to the Medford Street Bridge.

5. EXISTING FEDERAL OWNERSHIPS: There are no federally owned lands in the subject area.

6. NAVIGATION SERVITUDE: Navigational servitude does not apply.

7. REAL ESTATE MAPPING: Planning maps are attached as exhibits.

8. INDUCED FLOODING: No induced flooding is anticipated due to the proposed project.

9. BASELINE COST ESTIMATE: The cost estimate for the real estate required is the estimated value of the land required (Fee Simple Estate) and the temporary easements (two acres of land for two construction season) for the project, The estimated cost for the real estate, including administrative costs, is $500,000, based on land areas identified in the Detailed Project report dated March 2007.

10. PUBLIC LAW 91-646 RELOCATIONS: There are no potential Public Law 91-646 relocations required in connection with this project.

Malden River Ecosystem Restoration

Real Estate Report

11. MINERAL/TIMBER ACTIVITIES: There is no present or anticipated mineral or timber harvesting activity in the vicinity of the project that may affect the operation thereof.

12. ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITIES: The Mystic Valley Development Commission is the local sponsor for this project. There is a need to acquire real estate for temporary and construction, staging purpose, monitoring and maintenance. A capability checklist has been executed with the local sponsor and is included as an attached exhibit.

13. ZONING CHANGES: No zoning changes are proposed in lieu of, or to facilitate, real estate acquisitions.

14. FACILITIES AND UTILITIES RELOCATIONS: The proposed project will not require any utility and/or facility relocations.

15. HAZARDOUS, TOSIC, AND RADIOACTIVE WASTE: The Malden River has heavy sedimentation contamination, which may impact adjoining properties. However, the real estate cost estimate was developed based on an "as clean" condition in reference to the adjoining properties required for construction and staging efforts.

16. LANDOWNER SENTIMENT: Landowners and local sponsors are generally in favor of this project, due to existing source point pollution, and specifically for the significant benefits of the restoration project will have on the cities of Malden, Medford and Everett, Massachusetts.

17. ACQUISITION SCHEDULE: The projected schedule has been developed based on the assumption that Federal and non-Federal funds will be available. The tentative schedule for project completion is as follows:

	Estimated Date
Project Approval by Division	September 2008
Execution of Project Cooperation Agreement	October 2008
Initiate Land, Access and Rights-of-Way Appraisals	October 2009
Obtain State & Local Permits	March 2010
Finalization of Detailed Plans and Specifications	May 2010
Complete Land, Access and Rights-of-Way Appraisals	June 2010
Secure Lands and Easements	August 2010
Contract Award	December 2010
Initiate Construction	March 2011
Completion of Construction	June 2013
Monitoring	June 2013 thru November 2016

Malden River Ecosystem Restoration
Real Estate Report

MALDEN REAL ESTATE COST ESTIMATE

Tract No.	Ownership	Acreage	Upland vs Wetland	Interest Required	R/E Costs
*Block 2/3	National Grid	1.37 ac	1.07 ac/0.3 ac	Real Estate (Fee)	$230,000
*Block 2/5	National Grid	3.33 ac	0 ac/3.33 ac	Real Estate (Fee)	$ 70,000
*Block 2/5	National Grid	2.0 ac	2.0 ac/0 ac	Temporary Const.	$110,000
*Block 2/6	General Electric	7.24 ac	0.5 ac/6.74 ac	Real Estate (Fee)	$ 35,000
*Block 4/18	MVDC**	2.18 ac	0 ac/2.18 ac	Real Estate (Fee)	$ 25,000
*Block 4/19	MVDC**	0.80 ac	0 ac/0.80 ac	Real Estate (Fee)	$ 20,000
	Totals	**16.92 ac**	**3.57 ac/13.35 ac**		**$490,000***

*** Does not include Local Sponsor's Administrative Expenses**

** **Non-Federal Sponsor**

Malden River Ecosystem Restoration

Real Estate Report

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Project Name: Malden River Ecosystem Restoration Study

Project Location: Malden River - Everett, Malden and Medford, MA

Project Sponsor: Mystic Valley Development Commission (MVDC)

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

I. Legal Authority: -

Name and title of sponsor's representative providing answers to this section.

Stephen M. Wishoski, Executive Director, MRA

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? *State enabling legislation to create the MVDC
*(yes/no) If yes, list the basis for the legal authority: Section II of Chapter 294 of the Acts & Resolves of 1996

b. Does the sponsor have the power of eminent domain for this project?
(yes/no) If yes, list the basis for the legal authority: " "

c. Does the sponsor have "quick-take" authority for this project? (yes/no)

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? (yes/no)

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? (yes/no)

II. Human Resource Requirements:

Name and title of sponsor's representative providing answers to this section.

Stephen M. Wishoski, Executive Director, MRA

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? (yes/no)

b. If the answer to II. a. is "yes," has a reasonable plan been developed to provide such training? (yes/no)

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? (yes/no)

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? (yes/no)

e. Can the sponsor obtain contractor support, if required in a timely fashion? (yes/no)

f. Will the sponsor likely request USACE assistance in acquiring real estate? (yes/no) (If "yes," provide description)

Project Name: Malden River Ecosystem Restoration Study

Project Location: Malden River - Everett, Malden and Medford, MA

Project Sponsor: Mystic Valley Development Commission (MVDC)

III. Other Project Variables:

Name and title of sponsor's representative providing answers to this section.

Stephen M. Wishoski, Executive Director

a. Will the sponsor's staff be located within reasonable proximity to the project site? (yes/no)
b. Has the sponsor approved the project/real estate schedule/milestones? (yes/no)

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? (yes/no/not applicable)
b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable. (If sponsor is believed to be "insufficiently capable," provide explanation)

V. Coordination:

a. Has this assessment been coordinated with the sponsor? (yes/no)
b. Does the sponsor concur with this assessment? (yes/no) (If "no," provide explanation)

Prepared by:

_____________________ (date) 12-15-06
(signature)

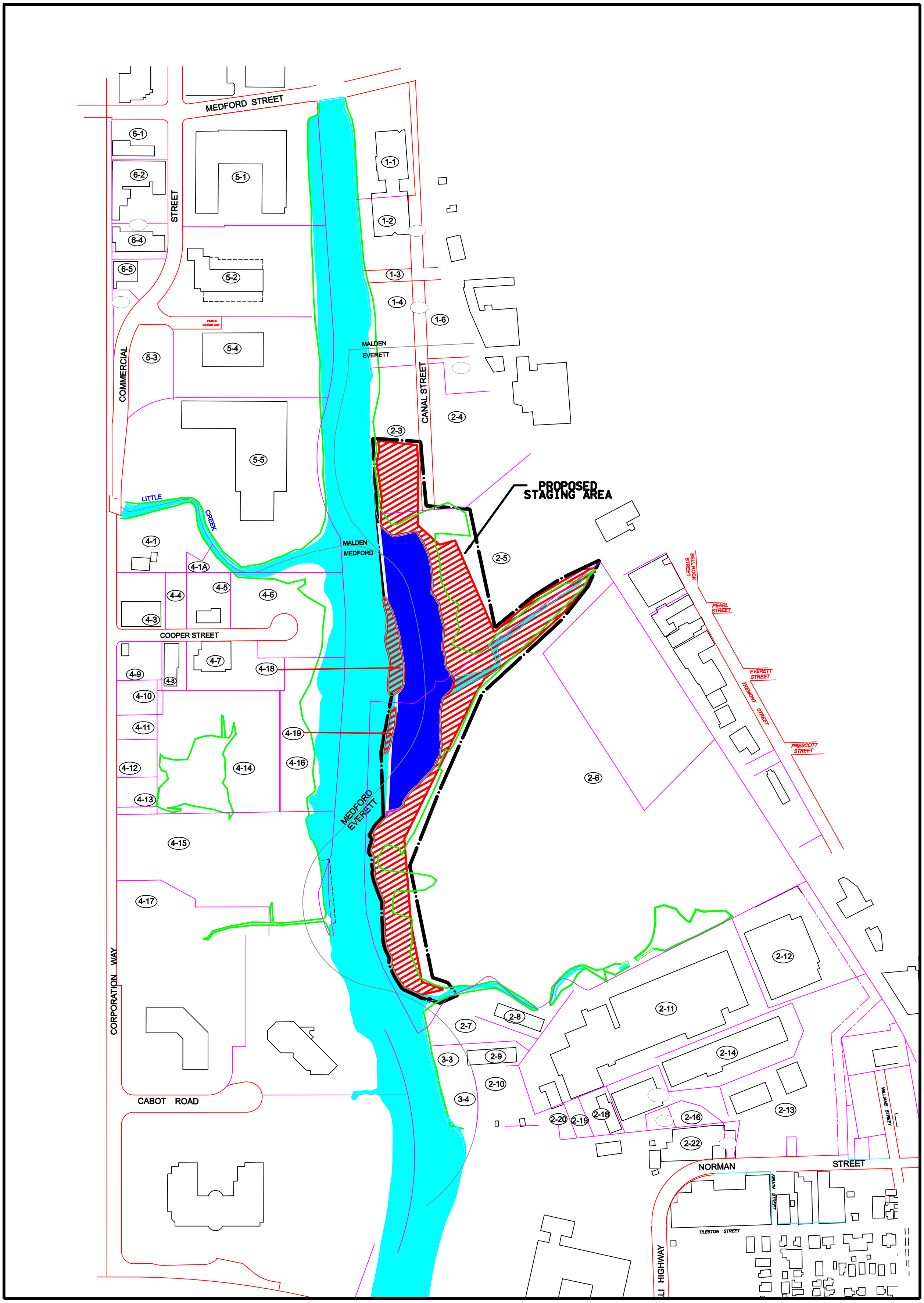
Typed Name: R. Jeffrey Teller

Typed Title: ______________

Reviewed and approved by:

_____________________ (date) 12-15-06
(signature)

Typed Name: Joseph M. Redlinger
Chief, Real Estate Division



LEGEND

PROPOSED CONTRACTOR WORK LIMITS

PHRAGMITE REMOVAL AREA

WETLAND CREATION AREA

EXISTING BUILDING

WETLAND

RIVER

NOTES

Reference: Figure prepared by Toomey-Munson & Associates Inc. from Wetland Resources Location Plan-10-5-99, revised 8-11-00; Haley & Aldrich Phase 2 Site Assessment, Former Malden MGP site-2001.

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

MALDEN RIVER
REAL ESTATE PROPOSED WORK LIMITS

0 200 400
Approximate Scale In Feet

Date: SEPT 2006

Job No: 500.01

N

Figure
8-2

NCA Nangle Consulting Associates, Inc. 960 Turnpike Street Canton, Massachusetts

City of Medford, Massachusetts
Parcel Information

Block	Parcel	Tenant/Common Reference	Parcel Address	City	Assessor Map	Assessor Parcel	assessed value	Land Court Certificate	Deed Book	Deed Page	Document Number	Current Owner	Contact Name	Contact's Firm	Contact Phone	Square Footage of Parcel	acres	
3	1	Strogoff	0 Corporation Way (2-7)	Medford	7-4	9A	2,000.00	204795	1154	45	1000168	Edward M. Strogoff Trust	Edward Strogoff			5,000	0.11	
3	2	Strogoff	0 Corporation Way (2-7)	Medford	7-4	9	2,700.00	204795	1154	45	1000168	Edward M. Strogoff Trust	Edward Strogoff			10,000	0.23	
3	3	Haskell	0 Corporation Way (2-9)	Medford	7-4	8A	20,000.00		01017	0111		Atkins Foster Realty Trust, Robert A. Haskell	Richard Haskell, Robert Haskell			18,200	0.41	41 Brantwood Road, Arlington, MA 02174
3	4	Haskell	0 Corporation Way (3-4)	Medford	7-4	8	20,200.00		01087 01017 00673	0023 0111 0115		Atkins Foster Realty Trust, Robert A. Haskell	Richard Haskell, Robert Haskell		617-427-5355	18,700	0.43	41 Brantwood Road, Arlington, MA 02174
4	B/C	Berkeley Investments	1 Cabot Road	Medford	7-04/ 7/ / / /		30,006,800.00					Cabot Road Partners LLC	Steve Brooks	Berkeley Investments	(617) 439-0088	769,120	17.48	121 High Street, Boston, MA 02110
4	XX	Citizens Bank	20 Cabot Road	Medford	7-04/ 11/ / / /	11.00	15,541,700.00					Middlesex Realty Holdings Group	Joe Mayo		617-988-1910	366,080	8.32	CITIZENS BANK OF MASSACHUSETTS, Corporate Tax Dept, 20 Blackstone Valley Pl, Lincoln, RI 02865
4	1	River's Edge Phase 1	255 Corporation Way	Medford	7-3	16	14,000,000.00		25272 21670	170 139		MVDC	Peter Hollands		781.324.5720	84,944	1.93	
4	2	River's Edge Phase 1	255 Corporation Way	Medford	7-3	15A		201874	1139	124	971329	MVDC				10,000	0.23	
4	3	River's Edge Phase 1	255 Corporation Way	Medford	7-3	15		201874	1139	124	971329	MVDC				36,062	0.82	
4	4	River's Edge Phase 1	255 Corporation Way	Medford	7-3	14		201874	1139	124	971329	MVDC				19,595	0.45	
4	5	River's Edge Phase 1	255 Corporation Way	Medford	7-3	13		201874	1139	124	971329	MVDC				41,295	0.94	
4	6	River's Edge Phase 1	255 Corporation Way	Medford	7-3	12		201874	1139	124	971329	MVDC				280,526	6.38	
4	7	River's Edge Phase 1	15 Cooper Street	Medford	7-3	11		207422	1167	72	1023054	MVDC				80,586	1.83	
4	8	River's Edge Phase 1	9 Cooper Street	Medford	7-3	10		160092	930	147	595329	MVDC				20,027	0.46	
4	9	River's Edge Phase 1	251 Corporation Way	Medford	7-3	9		208567	1173	17	1034295	MVDC				30,144	0.69	
4	10	River's Edge Phase 1	241 Corporation Way	Medford	7-3	8		208567	1173	17	1034295	MVDC				23,338	0.53	
4	10A	River's Edge Phase 1	241 Corporation Way						27406	385		MVDC				23,338	0.53	
4	11	River's Edge Phase 1	225 Corporation Way	Medford	7-3	7		171521			666173	MVDC				16,505	0.38	
4	12	River's Edge Phase 1	211 Corporation Way	Medford	7-3	6		178948	1024	198		MVDC				25,417	0.58	
4	12	River's Edge Phase 1	211 Corporation Way	Medford	7-3	6		178948	1024	198		MVDC				25,417	0.58	
4	13	River's Edge Phase 1	195 Corporation Way	Medford	7-3	4		213055	1195	105	1083194	MVDC				19,999	0.45	
4	14	River's Edge Phase 1	189 Corporation Way	Medford	7-3	5			11547122 79	542 553		MVDC				249,599	5.67	
4	14A	River's Edge Phase 1	189 Corporation Way	Medford	7-3	5		207705	1168	155	1026226	MVDC					-	
4	15	River's Edge Phase 1	171 Corporation Way	Medford	7-3	2			17737	304		MVDC				290,545	6.60	
4	16	River's Edge Phase 1	171R Corporation Way	Medford	7-3	19			17737	0304		MVDC				28,400	0.65	
4	16D	River's Edge Phase 1	171R Corporation Way	Everett				98990			345087	MVDC				318,945	7.25	
4	17	River's Edge Phase 1	129A Corporation Way	Medford	7-3	1			16850 16850 14190	0050 0047 158		MVDC				140,699	3.20	
4	18	River's Edge Phase 1	Island	Medford	7-3	17		25804	173	221	84769	MVDC				95,832	2.18	
4	19	River's Edge Phase 1	Island	Medford	7-3	18		25804	173	221	84769	MVDC				35,000	0.80	