DRAFT

DETAILED PROJECT REPORT

FOR

THE AQUATIC HABITAT RESTORATION

OF

MILFORD POND
MILFORD, MASSACHUSETTS

US Army Corps
of Engineers®
New England District

DECEMBER, 2004

EXECUTIVE SUMMARY

This report presents the feasibility investigation examining the restoration of the aquatic habitat of Milford Pond, located in Milford, Massachusetts. Authorization for this study is provided under Section 206 of the Water Resources Development Act of 1996 (PL 104-303) entitled "Aquatic Ecosystem Restoration". The study was conducted at the request of the Town of Milford.

Milford Pond is located less than 1 mile south of Interstate 495 in the center of the Town of Milford, in Worcester County, Massachusetts. The 120-acre pond is formed by the impoundment of the Charles River with inflow from Huckleberry Brook, Louisa Lake, an intermittent stream and 17 storm water outfalls. The pond outlet flows over a small masonry dam and continues as the main channel of the Charles River through the Town of Milford to Boston Harbor. The overall watershed size is 5440± acres (8.5 square miles), and it extends beyond the municipal boundaries of the Town of Milford into the Towns of Hopkinton and Holliston. Milford Pond was historically a cedar swamp located in the headwaters of the Charles River. In time, the cedar swamp was converted into a pond through the cutting of the large cedar trees and the construction of an impoundment across the Charles River approximately 100 feet downstream of Main Street in the early 1900's. Constructed around 1938, the present dam consists of an earthen embankment with a cast-in-place concrete primary spillway. This intermediate-sized dam, presently owned by the Town of Milford, is approximately 200 feet in length with a reported structural height of 11 feet ±.

Since the late 1970s, a decline in water quality, the proliferation of aquatic weed species, and a significant decrease in the aquatic habitat value of Milford Pond have been observed. Today, Milford Pond is extremely shallow with an average depth of less than two feet. Submergent and floating-leafed aquatic plant species occupy density ranges from 60-100% of the pond area. Emergent wetlands occur along the perimeter of Milford Pond and in a 400-foot wide band along the western shoreline, south of Clark Island. In its current state, Milford Pond does provide wildlife habitat for a variety of aquatic organisms living in emergent wetland and shallow pond communities. However, the fishery habitat value of Milford Pond is greatly reduced by the shallow depths, dense weeds and the low dissolved oxygen in the water resulting from decaying aquatic vegetation. In time, wetland successional processes will result in the gradual total filling of Milford Pond and conversion to emergent wetland community. This succession will result in further decreased areas of open water habitat, and continued loss of fish habitat.

Historically, Milford Pond has been an integral component of the community's seasonal festivals and celebrations including ice fishing tournaments and ice-skating during their Winter Festivals. Community celebrations have been designated to the areas surrounding Milford Pond due to it's serene beauty and abundance of wildlife. The summer season brought the community to Milford Pond for swimming, fishing and

boating. Milford Pond contains several public access points located within the recreational park. These previous activities have been reduced and some cases discontinued due to the current problems: dense, overgrown weeds and shallow depths. Milford Pond is a valuable resource that the Town's people wished to regain. USDA (2000) shows continued loss of scares wetlands, with an estimated acre loss of 42,000 in eastern United States from 1992 – 1997. It is estimated that up to 28-42% of Massachusetts' historical wetlands/open water bodies have been lost (Foote-Smith et al., 1991). There is a high Federal interest in the restoration of wetlands/open water habitats.

Five alternatives were considered for the restoration of Milford Pond: (1) full-scale hydraulic dredging of the entire 120± acre pond basin; (2) hydraulic dredging of a 45± acre section extending from the dam northward past Clark Island; (3) hydraulic dredging of a 21± acre section extending from the dam northward to Clark Island; (4) dam removal; and (5) dam removal with dredging alternative (2). The environmental benefits of each alternative were determined and compared to the existing conditions and the future without project conditions. An incremental analysis was performed as part of this evaluation procedure.

The dam removal alternatives were eliminated early in the incremental analysis procedure, as they were determined to be not environmentally feasible. The intent of dam removal would be to allow the passage of fish, restoring a riverine fisheries habitat to that portion of the Charles River. Although Atlantic salmon no longer migrate into the Charles River, the lower Charles River does support several anadromous species including American shad, American eel, blueback herring and alewife. The Charles River has 20 dams along its length of which the Milford Pond dam is the most upgradient. While the lower five dams are equipped with fish ladders, 14 dams downstream of the Milford Pond dam block anadromous fish passage north to this reach. Therefore, removal of this dam would provide only minimal immediate benefit to the Charles River overall in terms of regional fish migration patterns. In addition, the existing dam is located on a pre-existing natural dam of several feet height, which previously allowed the development of a cedar swamp with accumulation of deep organic peat. Therefore, fish migration would not necessarily be substantially improved by removal of the dam. However, a fish ladder could be considered at a future date for any of the alternatives once viable fish passage is provided at the downstream dam sites.

With dam removal, the exposed pond bottom is not expected to revert to the condition that existed prior to original dam construction over 60 years ago, but would most likely be rapidly colonized by invasive wetland species such as cattail, purple loosestrife, and Phragmites. This alternative would also effectively convert the dense cover habitat found in emergent marshy wetland areas, utilized by four State-listed species identified by MA NHESP (king rail, common moorhen, least bittern, and pied-billed grebe), to an area undesirable to these species. Allowing the pond to drain may result in the loss of a major source of recharge to the aquifer beneath Milford Pond, from which the Milford Water Company extracts drinking water. In addition, the lowering of the water level would cause the stream flow from various sources to cut channels into the accumulated soft, highly erodable, surficial sediments, posing significant potential for erosion and sedimentation. Avoidance of this condition would likely require pre-dredging of preferred flow pathways for each of the inlets to the pond basin, sized to an appropriate dimension to provide relative stability. Bioengineering of the new stream banks might also be required in addition to intensive seeding/planting of the newly exposed sediments.

The National Ecosystem Restoration (NER) Plan identified through the incremental analysis process, which compared all of the dredging alternatives, is Alternative 3, dredging a 45±-acre section to a maximum depth of 12 feet or the mineral base beneath the organic sediments, whichever is obtained first. The Town of Milford has selected Alternative 3 as the "Locally Preferred Plan". Under this plan, the areas to be dredged will be towards the southern and eastern portions of the pond, avoiding the Clark well field and the emergent wetlands on the western side of the pond. Dredging of the cattail-dominated marsh south and west of Clark Island will be avoided in order to avoid conflicts with state-listed rare waterfowl species nesting habitat. This dredging alternative will allow for an increase in pond depth and a decrease in aquatic macrophyte growth within a portion of the pond, providing and enhancing deep, open water habitat necessary for promoting the residence of certain fish species in Milford Pond. The shallow, weedy environment will remain in other portions of the pond, providing another element of the required habitat for these species. The dimensions of the resulting open water area will be approximately 3,400 feet long with an average width of approximately 500 feet.

A sediment dewatering and disposal site will be located north of Milford Pond on the opposite side of Dilla Street, to the east of the upgradient Louisa Lake. The project will use about 10 acres of the 20±-acre site, avoiding wetlands and providing necessary setbacks to control erosion and sedimentation. The site can potentially contain the entire volume of sediments to be dredged from the pond, requiring an average depth of 18 feet. Due to irregular topography, heights of the sediment would vary. However, The Town is expected to seek beneficial reuse of the material during the 4 year dredging program, which will minimize the storage area required. Similar dredging programs with similar peaty dredged sediments have had little difficulty in finding users for the material. Sediments will be hydraulically dredged from the pond and transported by dredge pipeline to the sediment dewatering and disposal site. The dredge pipeline will extend from the pond to the site by being placed within the Huckleberry Brook channel and underneath Dilla Street in the existing 5'x3'± box culvert. Temporary easements will be required from three (3) private landowners in order to install, operate, and remove the dredge pipeline between the pond and Dilla Street. Excess water from the dewatering process will utilize the Huckleberry Brook channel to return to Milford Pond.

Various mitigation standards will be implemented to avoid, limit, or offset anticipated impacts associated with the dredging program and sediment processing. The dredging equipment will be designed and operated to control excess turbidity, which will be carefully monitored, both within the pond and at the dewatering station discharge point. The Contractor will be required to prepare and have approved a written fuel and oil containment and spill response plan and an adequate spill response kit present at all times. Only natural, fully biodegradable vegetable oils will be used for operation of all hydraulic equipment associated with the dredging plant. Sedimentation and erosion controls will be used during the development of the sediment material processing site. Following the cessation of all hydraulic dredging and sediment material processing, the entire processing area will be loamed, final graded, seeded, and mulched with erosion controls in place to control any potential erosion or sedimentation to Milford Pond.

As part of its overall efforts to restore Milford Pond, the Town of Milford is actively working to preserve Milford Pond through a combination of water quality improvement projects within the 5000±-acre watershed, aggressive regulation of storm water runoff for new development with the watershed to Milford Pond, and via public education opportunities. Such work is separate from the proposed pond restoration program, although it is recognized that maximal benefit is to be received from the restoration only if storm water management programs are implemented. In a July 2000 "Report On the Proposed Restoration Project for Milford Pond" (BEC 2000), a Storm Water Management Program component was recommended. Twenty-one storm water outfalls that discharge to Milford Pond were assessed and evaluated relative to the installation of various storm water Best Management Practices (BMPs) including sediment forebays, and inlet/outlet modifications. It was recommended that 10 storm water outlets, which were the ones suitable for BMP construction, be reconstructed with hydrodynamic particle separators, sediment chambers, and open sedimentation basins. These constructed BMPs are expected to yield an estimated reduction of 13%, 7%, and 5% of the total annual loads of total suspended solids, total Kjeldahl nitrogen, and total phosphorous, respectively. The estimated costs for implementation of these recommendations was $500,000. Funding is being actively sought by the Town of Milford for implementation during the 2004 and 2005 season. In addition, the Town of Milford is actively regulating development activities with the watershed to require the implementation of storm water management features on all new development. Further, in concert with other programs such as the Charles River Watershed Association, the Town actively works through schools, the Conservation Commission, and other organizations to educate the public on the importance of managing storm water pollution at the source through proper use or reduction in use of fertilizers and vegetative plantings. With these BMPs, the dredged open water areas of the pond are expected to be maintained well beyond the projected 50-year project life.

The estimated costs for restoration include the costs of dam inspection, remediation and maintenance, dewatering and disposal area construction, initial weed harvesting, dredging, and mechanical dewatering closeout. The total estimated cost of the recommended alternative, including contingencies at 25% and real estate costs, is approximately $8.2 million.

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1 Introduction

1.1 Study Authority

Authority to perform this investigation was provided under Section 206 of the Water Resources Development Act of 1996 (PL 104-303) entitled "Aquatic Ecosystem Restoration", which states, in part,

> "The Secretary [of the Army] may carry out an aquatic ecosystem restoration and protection project if the Secretary determines that the project – will restore the quality of the environment and is in the public interest; and is cost-effective."

1.2 Study Purpose and Scope

The purpose of this study is to determine the environmental and economic benefits and costs of the various alternatives for the restoration of Milford Pond in Milford, Massachusetts. The purpose of the proposed restoration project is to improve the aquatic habitat of Milford Pond. The study includes the identification and evaluation of these alternatives within identified planning constraints. This study builds upon several previous detailed studies of Milford Pond and the activities of the Milford Pond Restoration Committee. The previous detailed studies include two diagnostic/feasibility studies (Carr Research Laboratories, 1979; IEP & CDM, 1984), a dredging feasibility report (BEC, 2000), hydrogeologic assessments (Groundwater Assessments Inc., 1987; Whitman and Howard, 1991; IEP, 2000; Marin, 2002), an EIR for Louisa Lake water diversion for public drinking water supply (Metcalf & Eddy, 2000 & 2001), and studies on the adjacent former landfill (Weston & Sampson, 1991, 1994, & 1997). An incremental analysis of project costs and benefits is performed to identify the most efficient plan, and an Environmental Assessment (EA) of the alternatives is performed. The study results in the recommendation of a single plan that achieves the identified goals in an efficient manner while considering the interests of the sponsor. While storm water management is not a direct component of this project, as part of its overall efforts to restore Milford Pond, the Town of Milford is actively working to preserve Milford Pond through a combination of water quality improvement projects within the 5000± acre watershed. Ten storm water outlets into Milford Pond have been identified for BMP construction (BEC 2000), with hydrodynamic particle separators, sediment chambers, and open sedimentation basins. The estimated costs for implementation of these recommendations was $500,000. Funding is being actively sought by the Town of Milford for implementation during the 2004 and 2005 season. In addition, with Town of Milford is actively regulating development activities with the watershed to require the implementation of storm water management features on all new development and promoting public education on the importance managing storm water pollution at the source through proper use or reduction in use of fertilizers and vegetative plantings.

1.3 Study Area

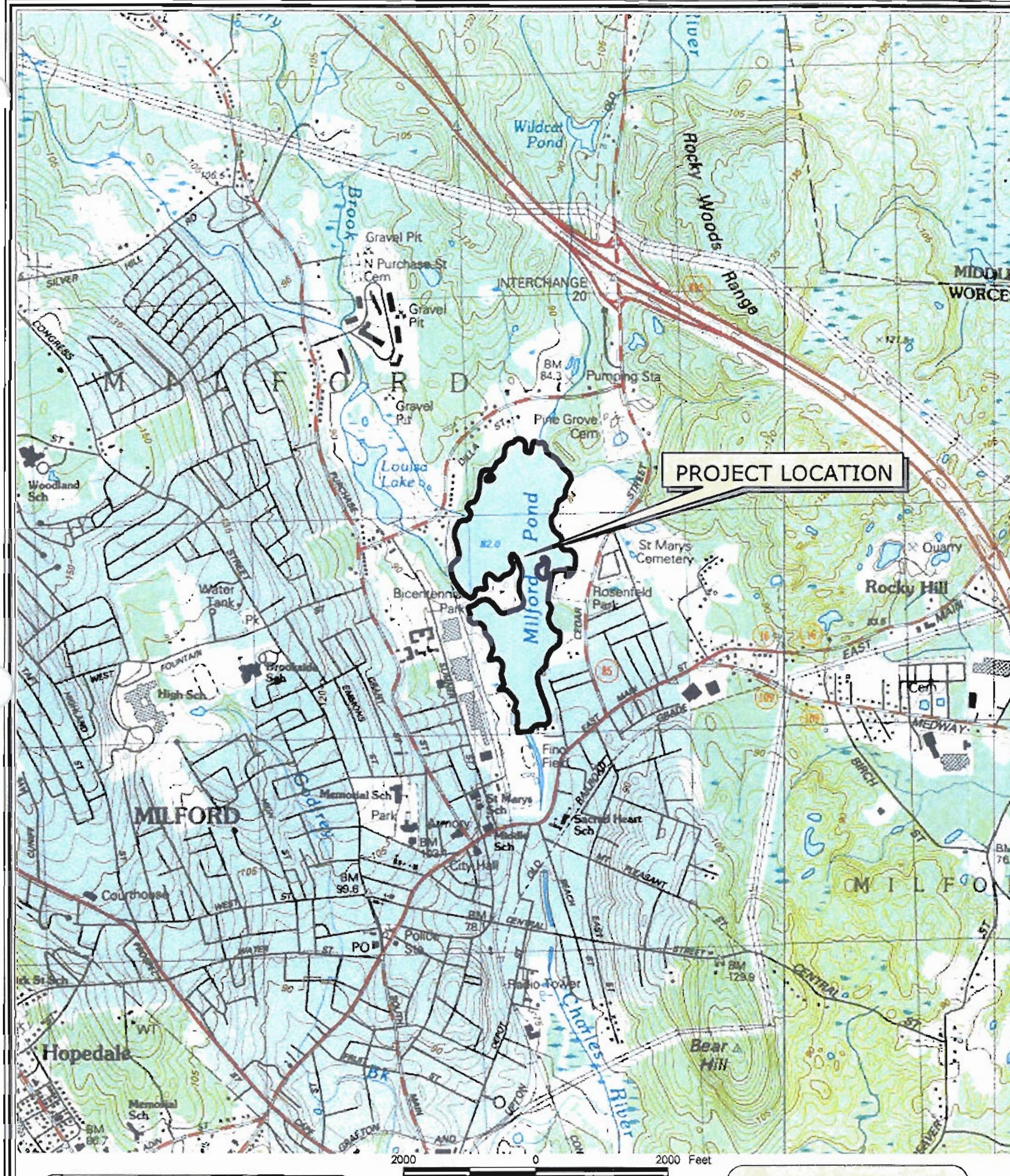
Milford Pond is located less than 1 mile south of Interstate 495 in the center of the Town of Milford, in Worcester County, Massachusetts, as shown in Figure 1-1. The 120-acre pond is formed by the impoundment of the Charles River with inflow from Huckleberry Brook, Louisa Lake, an intermittent stream and 17 storm water outfalls. The pond outlet flows over a small masonry dam, continues as the main channel of the Charles River through the Town of Milford, and eventually flows to Boston Harbor. The overall watershed size is 5440± acres (8.5 square miles), with a watershed to lake ratio of 45:1. It extends beyond the municipal boundaries of the Town of Milford into the Towns of Hopkinton to the north and Holliston to the east. The northern half of the watershed is composed of light residential development and wooded areas, while the southern half is urban. The watershed is shown in Figure 1-2.

1.4 History of Milford Pond

Milford Pond, originally known as Cedar Swamp Pond, was historically a cedar swamp located in the headwaters of the Charles River. The swamp was formed due to the presence of a small waterfall at the swamp's southerly boundary, which acted as a grade control for the riverbed, forming a topographical barrier. As Milford was settled, the lands surrounding the northern portion of the swamp were cleared for farmland, while lands surrounding the southern portion developed into the Town of Milford. In time, the cedar swamp was converted into a pond through the cutting of the large cedar trees and the construction of an impoundment above the small waterfalls along the Charles River. This was done in the early 1900's originally for power generation purposes and for fire protection. As evidenced by the 1920 map of Milford prepared by the Sanborn Map and Publishing Co., the dam appears to have been located across the Charles River approximately 100 feet downstream of Main Street.

The present dam, which was constructed circa 1938 partly in response to severe flooding in 1936 and 1938, raised the water level within the swamp and created the shallow pond that exists today. The dam was constructed as a Public Works Administrative Project (No. Mass. 1446-F). This project was approved at the Milford Town Meeting of June 13, 1938, *". . . for the purpose of improving, reclaiming and draining of the Cedar Swamp Road area . . ."* (Milford Town Records of 1938). The PWA project constructed the present dam presumably to "improve" the upper reaches of the original Cedar Swamp Pond. The dam is currently owned by the Town of Milford.

Early development near the pond included an iron foundry along the southwesterly shore, the construction and operation of a railway along the westerly shore, and a cemetery located northeasterly of the pond. Abutting the easterly shoreline, the Milford landfill operated for several years and has been recently capped and closed and converted to open space available to the town residents as parkland. An icehouse reportedly operated for a number of years along the southeasterly banks of the pond. In 1962, a well field was developed by the Milford Water Company on Clark Island, located in the center of Milford Pond.

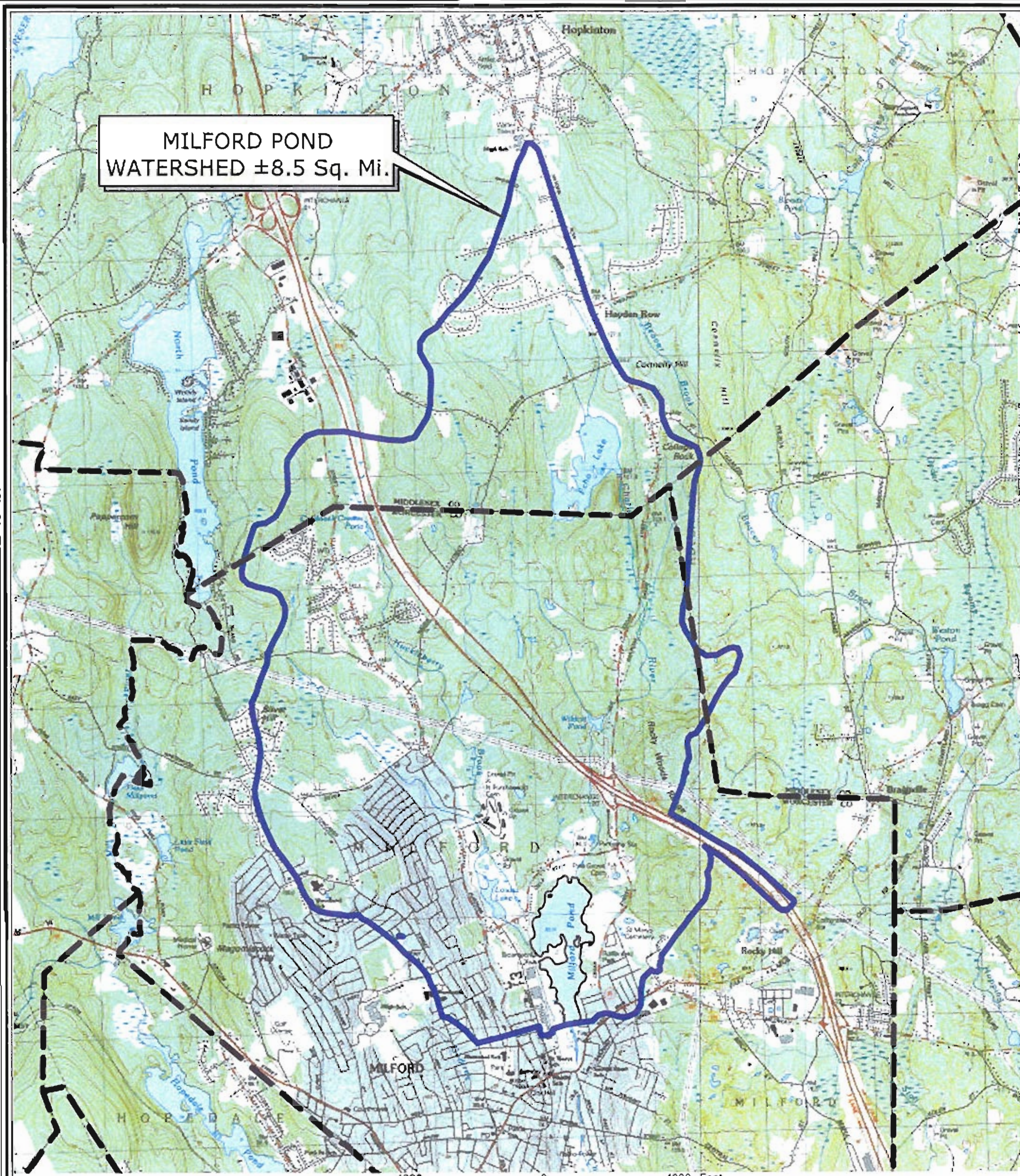


MILFORD POND HABITAT RESTORATION PROJECT
MILFORD, MASSACHUSETTS

USGS TOPOGRAPHIC QUADRANGLE MAPS
MILFORD, 1982 &
HOLLISTON, 1987

BAYSTATE ENVIRONMENTAL CONSULTANTS, INC.
EAST LONGMEADOW, MASSACHUSETTS 01028

FIGURE 1-1: LOCUS MAP



MILFORD POND HABITAT RESTORATION PROJECT
MILFORD, MASSACHUSETTS

USGS TOPOGRAPHIC QUADRANGLE MAPS
MILFORD, 1982 &
HOLLISTON, 1987

BAYSTATE ENVIRONMENTAL CONSULTANTS, INC.
EAST LONGMEADOW, MASSACHUSETTS 01028

FIGURE 1-2: WATERSHED MAP

Since the late 1970s, a decline in water quality, the proliferation of aquatic weed species, and a significant decrease in the aquatic habitat value of Milford Pond have been observed. In 1983, the Town conducted a drawdown of the pond, in order to attempt to reduce the dense growth of aquatic macrophytes. This drawdown extended through the growing season and resulted in the conversion of a large portion of the shallowest aquatic plant community to an emergent plant community and partial conversion to a marsh habitat. The Milford Pond Restoration Committee was formed in 1994 with the goal of improving water quality and aquatic habitat of the pond, thus restoring aesthetic and recreational value of the pond. Since that time, field reviews, bathymetric probings, and water and sediment quality investigations have been conducted in an effort to develop the most feasible alternative for restoring Milford Pond.

1.5 Restoration of the Aquatic Fisheries Habitat

Recent fish surveys have shown that species including yellow perch, brown bullhead, chain pickerel, black crappie, largemouth bass and bluegill sunfish survive in Milford Pond (MA Division of Fisheries and Wildlife, pers. com.). However, the shallow depths throughout the entire pond do not present the optimal habitat for these species and others. Shallow, weedy environments such as Milford Pond provide ample cover vegetation for ambush feeders such as chain pickerel and largemouth bass. The deterioration of open water habitat, however, limits the proliferation of their prey base, such as bluegill sunfish. In addition to the lack of open water habitat, the depleted dissolved oxygen levels due to decomposition of aquatic vegetation limits Milford Pond as a warm water fishery.

The restoration of Milford Pond as a warm water fishery could be accomplished by dredging to re-establish deepwater habitat. The removal of aquatic macrophyte communities would provide open water and reduce cases of depleted dissolved oxygen. The extent of dredging would determine the degree of habitat alteration. The most diverse fishery would be established with a partial dredging program that would leave some of the current habitat intact.

An alternative to restoring Milford Pond as a warm water fishery is to reopen the Charles River channel via removal of the dam, creating a riverine fishery. Removing the dam would allow anadromous fish passage from downstream reaches. Allowing the river to flow freely would help to restore dissolved oxygen levels and reduce temperatures to conditions capable of supporting fish.

2 Problem Identification

2.1 Existing Conditions

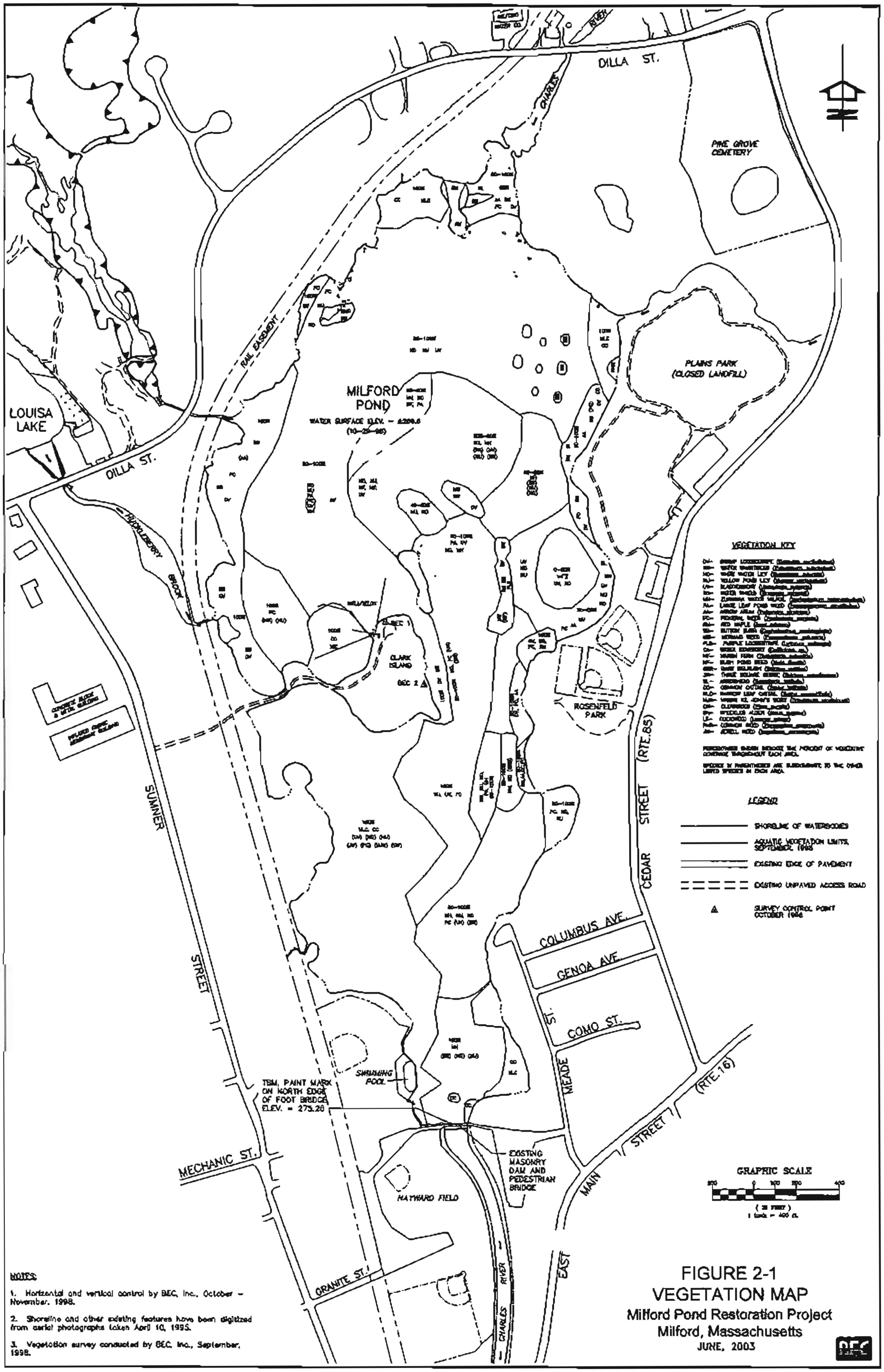
Milford Pond is a 120±-acre waterbody located in the center of the Town of Milford, less than 1 mile south of I-495 near the headwaters of the Charles River. The pond is shaped linearly and oriented on a north-south axis, with a length and width of approximately 4500 feet and 1400 feet, respectively. It has a shoreline length of 16,609± ft. and an average depth of less than two feet throughout most of its area. It has an estimated total lake volume of 162± acre-feet. Based upon 2000 and 2002 BEC surveys, the submergent and floating-leafed aquatic plant species exist throughout the pond area and occupy density ranges from 60-100% of the pond area, as shown in Figure 2-1. Figure 2-2 is a photo of Milford Pond taken from the dam.

Surrounding the pond are the open space and parklands and dense urban areas. The former Milford landfill, which has recently been capped and converted to open space parkland and named Plains Park, abuts the northeasterly shore. Other park/open space areas include Rosenfeld Park on the eastern central shore, and the Fino Field recreational complex and Votolano Field to the south and southwest. To the north and west of the pond are developed residential and urban areas.

The dam impounding Milford Pond consists of an earthen embankment with a cast-in-place concrete primary spillway, which is a gravity section founded on earth. A steel sheeting cutoff wall, presumably driven to bedrock, is imbedded in the bottom of the concrete section. The crest of the spillway is approximately four feet higher than the downstream channel. Flashboards, which are normally in place, raise the normal water surface 12-14" above the spillway's crest. This intermediate-sized dam, owned by the Town of Milford, is approximately 200 feet in length with a reported structural height of ±11 feet. This dam, therefore, has a maximum storage potential of approximately 690-acre feet. Access to the dam is provided via a concrete pedestrian bridge, which is restricted to vehicular traffic.

2.2 Problem Identification

Today, Milford Pond is extremely shallow with an average depth of less than two feet based upon bathymetric survey (BEC, 2000). The historic cedar swamp led to a thick peat layer at the bottom of the pond that provides nutrients for vegetation. In addition, sediments are deposited in the pond via runoff from the urban and wooded watershed, introducing additional nutrients that create eutrophication in the pond. Dense communities of aquatic macrophytes blanket the shallow pond bottom and grow throughout the water column. Areas of emergent and floating leafed vegetation continue to rapidly convert open water areas to emergent marshland, a process that if left unimpeded will eventually transform the entire pond to wet meadow and swamp. The shallow depths currently cause winter fish kills due to thick ice and snow formation, and summer fish kills occur due to the decomposition of organic matter creating anoxic conditions. The lack of deep water and abundant aquatic vegetation provides poor habitat



NOTES:

1. Horizontal and vertical control by BEC, Inc., October – November, 1998.

2. Shoreline and other existing features have been digitized from aerial photographs taken April 10, 1995.

3. Vegetation survey conducted by BEC, Inc., September, 1998.

FIGURE 2-1
VEGETATION MAP
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

for fisheries. In addition, persistent odors from the decomposition of vegetative material within the pond have been a regular complaint of neighbors and patrons of the many municipal parks and open spaces, which surround the pond.

Figure 2-2 Milford Pond View from Dam

In addition to witnessing the rapid decline in the habitat quality of the pond, especially relative to fisheries, Milford Pond is evolving into a nuisance resource to the Town residents. The overgrowth of weeds is aesthetically unappealing and inhibits the use of the pond as a recreational resource. Many town residents recall a time when the pond provided opportunities for fishing, boating, swimming and ice-skating and have a strong desire to see these uses restored. The Milford Pond Restoration Committee (MPRC) was formed in 1994 to direct efforts in restoring Milford Pond as a valuable aquatic habitat and social resource.

2.3 Future Without Project Conditions

The future without-project condition assumes that all efforts for the restoration of Milford Pond would cease. In its current state, Milford Pond does provide wildlife habitat for a variety of aquatic organisms living in emergent wetland and shallow pond communities. However, the fishery habitat value of Milford Pond is greatly reduced by the dense weeds and the low dissolved oxygen in the water resulting from decaying aquatic vegetation. In time, wetland successional processes will result in the gradual total filling of Milford Pond and conversion to emergent wetland community. This succession will result in further decreased areas of open water habitat, and continued loss of fish habitat.

3 Plan Formulation

3.1 Planning Objectives and Constraints

The objectives for plans formulated are as follows:

1. To restore areas of open water aquatic habitat with a depth sufficient to discourage dense aquatic weed growth;
2. To enhance total aquatic habitat for fin fish species;
3. To improve water quality, including nutrient and dissolved oxygen levels and water clarity;
4. To preserve habitat values for waterfowl, including State-listed species; and
5. To restore a balance between open water aquatic habitats, the dense aquatic weed beds, and emergent wetlands.

The constraints on the project include:

1. The need to avoid adverse impacts to the Clark Island well fields, which are part of the Town of Milford's community water supply; and
2. All proposed dredge spoils will be placed at the Town's designated disposal site, Consigli parcel.
3. The refusal of the Town of Milford to participate in an alternative which would not result in the restoration of Milford Pond as a community resource providing recreational opportunities, including fishing, boating, swimming and ice-skating.

3.2 Restoration Alternatives Considered

In order to fashion potential management solutions for Milford Pond, alternative strategies were evaluated to restore balance to the aquatic and wetland habitat potential. The various alternatives were developed, reviewed and selected by the Milford Pond Restoration Committee, which has worked over the past decade to further the efforts to restore this important waterbody as a community resource. Restoration alternatives considered include: the full scale dredging of the pond; the partial dredging of the pond; dam removal; and dam removal with partial dredging. The three dredging alternatives evaluated differ in their areal extent: 21 acres, 45 acres, and the entire pond basin.

3.2.1 Complete Dredging of Pond Basin

This alternative would involve the full-scale dredging of the entire pond basin using hydraulic equipment, resulting in the restoration of deep, open water habitat throughout the entire 120-acre pond basin. Approximately 1,000,000 CY of soft sediment would be removed from the pond bottom, resulting in a depth of 12 feet over the entire pond. A full pond dredging program would limit aquatic macrophyte growth and lead to an overall improvement of ambient water quality and deep, open water habitat. However, a full dredging program would not result in the overall maintenance and improvement of aquatic habitat within Milford Pond due to the reduction in shallow, weedy environments necessary for a balanced ecosystem. Full-scale dredging would significantly impact emergent wetland and shallow pond communities found in Milford Pond. This alternative is technically feasible but costly.

3.2.2 Partial Dredging of Pond Basin

This alternative would involve the dredging and restoration of open water area primarily in the southern and eastern regions of the 120± acre pond. Two alternatives are considered: the dredging of approximately 21± acres and the dredging of 45± acres. The two partial pond dredging alternatives were selected by the Milford Pond Restoration Committee. These alternatives were based upon the practical geographical configuration of the pond, and where Clark's Island formed a natural dividing point of the overall pond basin, as well as environmental constraints associated with the other wetland resource types that have developed within the pond basin. Dam removal alternatives would pose permitting difficulties and unacceptable environmental impacts. Dredging of a fraction of the pond area would result in the restoration of deep-water aquatic habitat in the southern portion of the pond, while maintaining the current shallow, weedy habitat in other areas of the pond. In either case, dredging the cattail dominated marsh south and west of Clark Island would be avoided in order to avoid conflicts with rare waterfowl species habitat. Partial dredging would increase pond depths and decrease aquatic macrophyte growth within a portion of the pond, providing and enhancing deep, open water habitat necessary for promoting the residence of certain fish species in Milford Pond. The remaining shallow, weedy environment currently found in Milford Pond is also an element of the required habitat for these species, providing cover. The presence of both deep, open water and shallow, weedy areas provides the optimal habitat for fish species and other wildlife. Partial pond dredging would also increase ambient water quality by decreasing potential sources of nutrients within Milford Pond. Decreases in aquatic macrophyte growth and increases in overall ambient water quality would lead to a restoration of the fisheries habitat of Milford Pond.

Partial dredging only affects a portion of this 120±-acre waterbody, limiting potential for adverse environmental impacts. Under the proposed plan, nearly 75± to 100± acres of pond will remain undisturbed, preserving the emergent wetland areas located in the western portion of Milford Pond. The predicted life span of the 45± acre dredging project is approximately 360 years, at which time it is expected that at least half of the open water area would begin to experience the problems currently plaguing Milford Pond. This assumes that half of the open water area would be filled with sediment to a depth of 6 feet, with the remaining half filled to a depth of 8 feet, and does not account for sediment capture within the undredged portions of the pond. The project life expectancy would vary with the total area dredged, becoming shorter for a smaller area and longer for a larger area. From an engineering perspective, a partial pond dredging program is a technically feasible and cost effective means of restoration.

3.2.3 Dam Removal

Under this alternative, the Milford Pond dam would be removed and the pond would be allowed to drain. This alternative would provide the potential opportunity for a riverine fishery to be established in this portion of the Charles River, with the opening of anadromous fish passage. Under this alternative, the stream flows from the Charles River, Huckleberry Brook, and storm water inputs would potentially cut into the accumulated soft, highly erodable, surficial sediments to establish new stream channels, which would emerge and develop over several years until relatively stable channels were established through an area of emergent marsh and swampland. Therefore, prudent design would require bioengineering of new stream channels at appropriate grades, with a full revegetation plan for the newly exposed sediments. No removal of vegetation would occur and water depths would remain at or below their present state.

The quality of the riverine fishery to be restored under this alternative would depend greatly on fisheries downstream of this reach. Although Atlantic salmon no longer migrate into the Charles River, the lower Charles River does support several anadromous species including American shad, American eel, blueback herring and alewife. The Charles River has 20 dams along its length of which the Milford Pond dam is the most upgradient. While the lower five dams are equipped with fish ladders, 14 dams downstream of the Milford Pond dam block anadromous fish passage north to this reach. Therefore, removal of this dam would provide only minimal immediate benefit to the Charles River overall in terms of regional fish migration patterns. In addition, the existing dam is located on a pre-existing natural dam of several feet height, which previously allowed the development of a cedar swamp with accumulation of deep organic peat. Therefore, fish migration would not necessarily be substantially improved by removal of the dam. However, a fish ladder could be considered at a future date for any of the alternatives once viable fish passage is provided at the downstream dam sites.

An additional significant adverse effect of this alternative would be on the active well field (Clark Island Wellfield) located within the pond basin. Allowing the water to drain from Milford Pond would have a significant impact on the aquifer below that supplies drinking water for the Milford Water Company. Already, this well field suffers in production under periods of severe drought when the pond levels are naturally lowered. The Clark Island Well Field produces more than half of the total groundwater source of drinking water to the area and between 13% and 36% of the total daily water demand. Currently, the Milford Water Company is actively seeking additional water supplies to meet existing and anticipated water demands. The loss of this well field would not be a feasible alternative.

The lowered hydrology would also effectively alter the dense cover habitat found in emergent marshy wetland areas that is valuable to the four State-listed species identified by MA NHESP (king rail, common moorhen, least bittern, and pied-billed grebe). This adverse effect on rare species habitat would likely render this alternative unpermittable.

Finally, the recreational potential of the resulting watercourse would not agree with what the Milford town residents are seeking, and it is unlikely that such an alternative would receive local support.

3.2.4 Dam Removal with Partial Dredge

This alternative involves removal of the dam while dredging approximately 45± acres of the Milford Pond area. The 45± acre partial dredging alternative was paired with the dam removal since this was the preferred dredging alternative size selected by the Milford Pond Restoration Committee, and provides a good representation of the types of issues associated with combining dam removal with dredging. This alternative would have the effect of allowing the river to flow freely while still creating areas of deeper water fisheries habitat. The benefits of this alternative would be the same as those resulting from the partial dredging alternative. However, the shallow aquatic weed beds would be largely eliminated, except to the extent that they redeveloped within the newly dredged pond basin. This alternative would have most of the same deficits as those resulting from dam removal without any dredging.

4 Evaluation of Alternatives

4.1 Introduction

This section describes the with project and without project conditions and the analyses of the various alternatives considered to achieve the planning objectives as previously discussed in Section 3.1. The analyses address issues such as potential changes in water quality and benthic environment, changes in habitat suitability, economic costs, and acceptability to the sponsor.

4.2 Without Project Conditions

The without project condition assumes that all efforts for the restoration of Milford Pond would cease. If this were to occur, wetland successional processes would result in the gradual total filling of Milford Pond and conversion to emergent wetland community. This succession would result in further decreased areas of open water habitat, and continued loss of fish habitat.

4.2.1 Hydrographic Survey and Site Mapping

Existing site mapping consisted of a U.S. Geological Survey 7.5 minute topographic map, and a depth map, organic sediment thickness map and aquatic vegetation map created for an alternatives analysis conducted in 1979. In 1998, BEC, Inc. mapped the existing pond bathymetry and pond cross-sections, and extent of aquatic vegetation, as shown in Figures 4-1, 4-2, and 2-1.

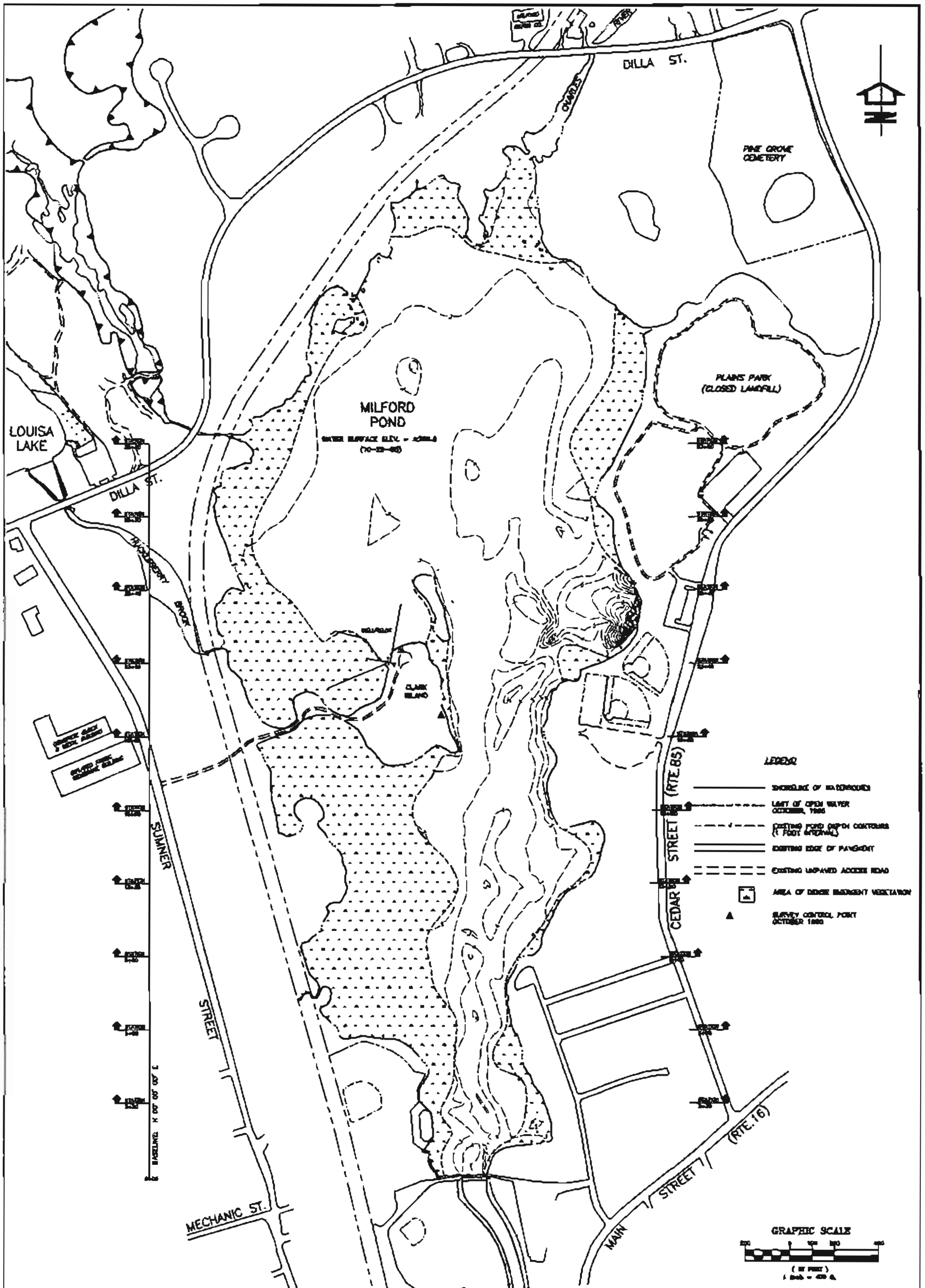
4.2.2 Environmental Analysis

The draft Environmental Assessment (EA) included at the end of this report thoroughly discusses environmental conditions in the impacted area. Findings are summarized only briefly in the following sections.

4.2.2.1 Water Quality

The major contributing waters to Milford Pond consist of inflows from the Charles River, Louisa Lake, and Huckleberry Brook. The overall quality of these contributing waters is acceptable and generally consistent with Class B waters, according to Surface Water Quality Standards (SWQS; MADEP, 1998). Class B waters are designated as a habitat for fish, other aquatic life, and wildlife, and are suitable for primary and secondary contact recreation. Based upon these designations, Milford Pond would be considered a Class B waterbody.

Carr (1979), IEP/CDM (1986), and BEC (2002) have conducted water quality investigations for Milford Pond. Measured nutrient, chlorophyll-a, and dissolved oxygen levels as well as field observations of shallow depths and dense macrophyte growth strongly suggest that Milford Pond is eutrophic. The most common limiting nutrient for plant growth in freshwater aquatic ecosystems is phosphorous. Observed phosphorous and nitrogen levels confirm eutrophic conditions in the pond.



NOTES:

1. Horizontal and vertical control by BEC, Inc., October – November, 1998.

2. Shoreline and other existing features have been digitized from aerial photographs taken April 10, 1995.

3. Water depths indicated on this plan indicate the top of organic mucks and other natural deposits forming the existing bottom of Milford Pond. Depths shown obtained from sediment probings conducted by BEC, Inc., October – November, 1998.

FIGURE 4-1
MILFORD POND BATHYMETRY
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

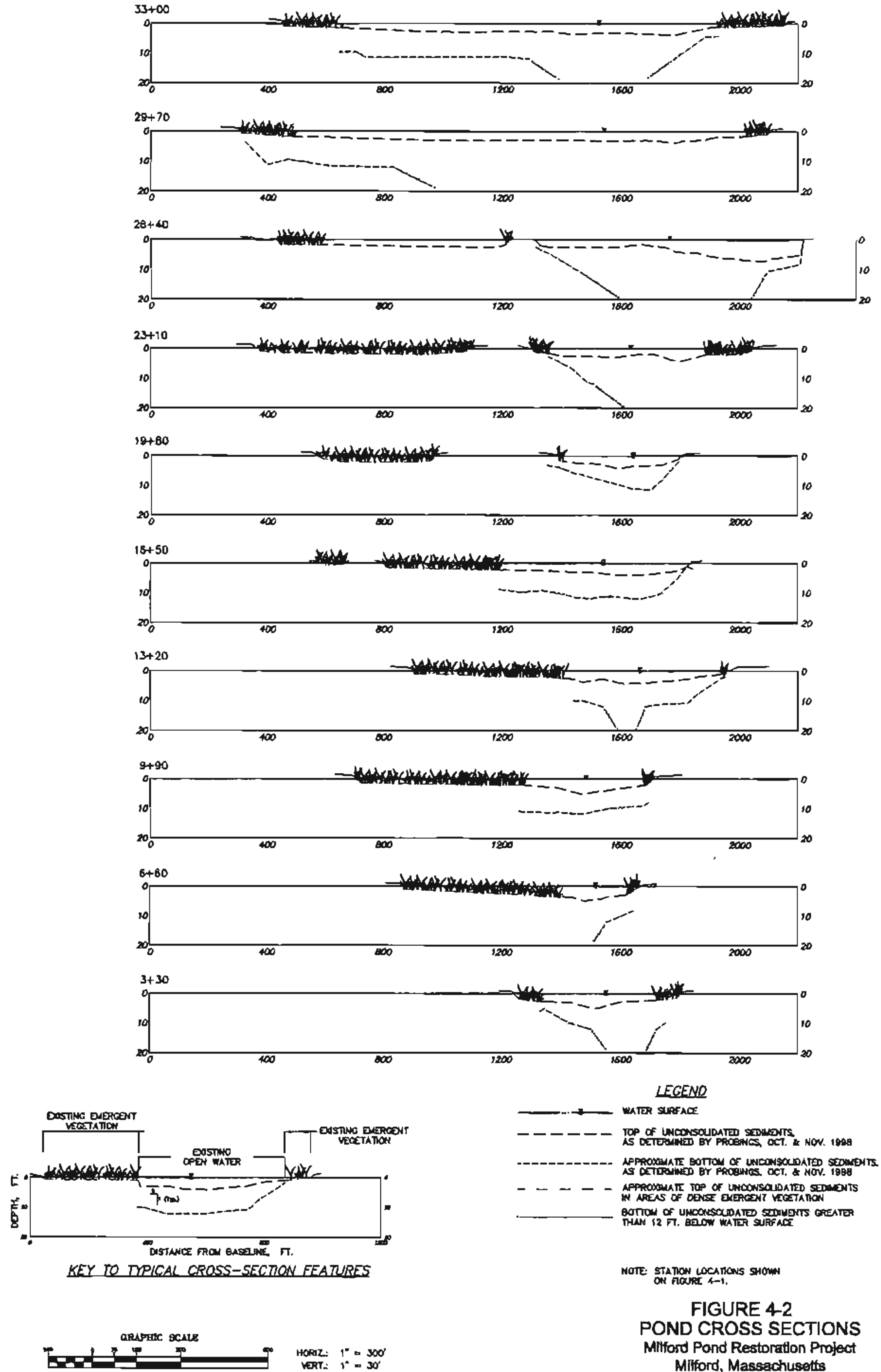


FIGURE 4-2
POND CROSS SECTIONS
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

Depleted dissolved oxygen saturation levels have been documented in Milford Pond, especially in the late summer months when thermal stratification prevents the replenishment of oxygen to the bottom waters. This occurs readily along the eastern side of Milford Pond, opposite of Clark Island, the only remaining deep water spot in pond. This stratification leads to dissolved oxygen profiles exhibiting supersaturated conditions (due to photosynthetic oxygen generation) at the water surface and a marked decrease with depth. While thermal stratification is not a large factor in the remaining shallow portions of the lake, the oxygen depletion remains problematic throughout the pond. Oxygen depletion can readily occur when dense surface aggregations of aquatic weed growth inhibit vertical mixing. The highly organic sediments have a large respiratory consumption of oxygen and even mild density or thermal stratification can result in a shallow oxygen profile. In addition, the lack of offsetting photosynthetic oxygen generation during nighttime leads to a dissolved oxygen deficit in poorly mixed waters. Levels measured within Milford Pond are within the acceptable range for biological activity, but below the optimal level of greater than 70% saturation. After fall turnover, the DO levels become more uniform throughout the water column. Depleted oxygen saturations in Milford Pond are most likely the result of increased biological activity, resulting in vegetative decomposition by aerobic bacteria, which utilize large amounts of oxygen within the water column. Analysis of dissolved oxygen levels further supports the classification of Milford Pond as a eutrophic waterbody.

Additional parameters provide insight into the water quality of Milford Pond and its tributaries. Milford Pond, with pH ranging from 5.7 to 6.6, is more acidic than most waterbodies, which have a pH range from 6.5-8.5. Waters entering Milford Pond are highly colored, with high turbidity levels caused by the presence of dissolved or particulate matter resulting from algal populations and decomposition of organic matter. These levels do not have a major impact upon water quality, but may lead to decreased photic zones, which limit macrophytic plant growth.

4.2.2.2 Sediment Quality

In general, deep organic sediments are the dominant substrate in Milford Pond. These sediments have accumulated over time because of the impoundment of the Charles River. When the dam was built in 1938, Milford Pond formed over deep peaty soils with high organic contents, which were present due to the historical formation of a marsh and the gradual accumulation of upstream sediments. Since this time cultural sedimentation caused by inflow from tributary streams and runoff from the surrounding watershed has led to the formation of an organic sediment substrate overlying these peat soils. The mineral portion of the sediments (i.e., organics removed) are classified as silty loam, sandy loam, loamy sand, and loam, according to the U.S. Department of Agriculture (USDA) Classification System.

Sediment samples have been collected from Milford Pond by IEP/CDM (1986), Weston and Sampson (1994), and BEC (2000 and 2002) and have been investigated for their physical and chemical characteristics. Analyses included nutrients, heavy metals, PCB's, volatile organic chemicals (VOCs), metals, TCLP metals, polynuclear aromatic hydrocarbons (PAHs), and physical parameters including grain size distribution, percent solids, percent volatile solids, and moisture content.

In general, the sediment samples were found to be highly organic, with high nutrient concentrations (phosphorous and nitrogen). This is reflective of the eutrophic conditions of Milford Pond. The elevated levels of total phosphorous (TP) and total Kjeldahl nitrogen (TKN) in the shallow sediment provide an excellent substrate for aquatic plant growth in Milford Pond.

Most of the PAHs tested for were not detected in the majority of the samples. Samples located at the southern end of the pond, near the dam and near Rosenfeld Park and the boat launch, and at the northern end of the pond contained a greater variety of PAHs. Each of the samples, with the exception of one sample located due west of Rosenfeld Park, contained detectable quantities of the PAH perylene as the primary PAH. Low concentrations of the PAHs benzo (ae) pyrene, benzo (b) fluoranthene, and benzo (k) fluoranthene were detected in one of the 1999 samples. The first two of these contaminants were found in concentrations, which slightly exceed the Method 1 S-1 and S-2 Standards of the Massachusetts Contingency Plan (MCP) at 310 CMR 40.000. None of the PAHs detected in the May 2002 samples were in concentrations above the Massachusetts Contingency Plan (MCP) S-1 or S-2 standards (for GW-1).

Contaminant concentrations were low for most metals in comparison to non-urban soil concentrations for Massachusetts (DEP, Final Interim policy WSC/ORS-95-141). The only metals that were found in levels exceeding the MA DEP's Background concentrations for non-urban soils concentrations were barium, cadmium, mercury, zinc and selenium.

Polychlorinated Biphenyls (PCBs) and pesticides were not detected in the laboratory analysis. Detectable levels of extractable petroleum hydrocarbons (EPH) were observed, which exceeded the S-1/GW1 standards of the MCP at 310 CMR 40.000 in 3 of 15 samples (by up to 40%). These were in the C11 – C22 aromatics range and located at the southern end of the pond and to the northwest of Rosenfeld Park. However, the average concentrations for the sediments were well below the standard. Benzene, 1,1-dichloroethane, methylene chloride, and p-Isopropyltoluene (p-Cymene) were the only volatile organic compounds (VOCs) detected in the sediments since 1984. While additional sampling at the dredged material disposal site may be required as part of the permit conditions for the dredging program, the levels observed are not likely to prevent the proposed dredging program for Milford Pond or limit disposal of the sediments.

4.2.2.3 Benthic Environment

A study of benthic macroinvertebrates was conducted as part of the D/F Study performed by IEP/CDM. Samples were taken at four sampling stations on May 9, 1984 and December 4, 1984. These sampling stations were located upstream of the Charles River, Huckleberry Brook, and Louisa Lake inflows and at the Milford Pond outflow. Macroinvertebrate communities found upstream of the Charles River and Huckleberry

Brook inflows exhibited a good diversity of pollution intolerant, facultative, and pollution tolerant forms, including blackflies, stoneflies, mayflies, midge larvae, *Asellus* (isopod), and *Hyalella* (amphipod). The presence of these species indicates well-oxygenated unpolluted water. Macroinvertebrate communities recorded near the Louisa Lake inflow and the Milford Pond outflow exhibited a fair diversity of pollutant-tolerant and facultative forms, including *Asellus*, *Hyalella*, midge larvae, and mollusks. These species are indicative of degraded water quality and benthic habitat.

4.2.2.4 Fisheries and Threatened and Endangered Species

Data on fisheries resources was obtained from the *Final EIR for Utilization of Louisa Lake Overflow for Public Water Supply* (Metcalf & Eddy, December 2001, EOEA #11394) and from ACOE. Yellow perch, brown bullhead, chain pickerel, black crappie, largemouth bass, and bluegill sunfish have all been observed in Milford Pond. These species are commonly found in ponds and lakes throughout the northeast and are typical of shallow, still waters such as Milford Pond. Ambush feeders such as chain pickerel and largemouth bass thrive in weedy environments such as Milford Pond due to the presence of ample cover vegetation. However, the rapid deterioration of open water habitats could threaten to limit habitat for their prey base. Bluegill sunfish are a key food resource for piscivorous fish, but typically occupy a habitat niche requiring open water and aquatic macrophyte cover. Additionally, decomposition of aquatic vegetation has resulted in low dissolved oxygen levels during summer months. Low dissolved oxygen levels have the potential to result in fish kills.

In order to maintain and improve Milford Pond as a warm water fisheries habitat, deep water areas must be provided. The hydraulic dredging of Milford Pond will result in a decrease in aquatic macrophyte communities and the restoration of deep-water habitat for fisheries. The restoration program will help to restore an ecological balance to this eutrophic system.

The Massachusetts Natural Heritage and Endangered Species Program (MA NHESP; MA Division of Fisheries & Wildlife) has identified the occurrence of four State-listed species near the project area. These species include the pied-billed grebe, least bittern, king rail, and the common moorhen, which all nest in freshwater marshes with emergent vegetation communities including cattails. Although cattails and other emergent vegetation are important to the habitat of these birds, three of the species, the pied-billed grebe, the least bittern, and the common moorhen, also utilize open water for flying or feeding.

4.2.3 Historic and Archeological Resources

The Town of Milford was originally incorporated in 1780 as a farming community with agricultural land located primarily on the fertile floodplains of the Charles River and on prime agricultural soils located in upland areas. The area of what is currently Milford Pond, once known as Cedar Swamp, was a valuable community asset to early colonists and was divided into small proprietary allotments for individual landowners. Lumber cut from the towering cedar trees was highly durable and was used for the construction of homes and cedar shingles by early colonists. The earliest industry in the Town of

Milford was the manufacture of shoes and boots beginning in 1795. The discovery of valuable deposits of structural-grade granite allowed for the development of a small granite quarrying industry to follow. These industries expanded over time and led to an ever-increasing population base in the town.

The present dam on Milford Pond was constructed in 1938 in response to severe flooding within the downtown area of Milford. As this structure is greater than 50 years old, it may be eligible for listing on the National Register of Historic Places. Coordination with the Massachusetts Historical Commission (MHC) would be sought prior to any repair, restoration or replacement of the dam.

According to the MHC, there are two recorded historical sites in the vicinity of Milford Pond. These are the structural foundation remains of the Louisa Lake Ice Company northwest of Dilla St. adjacent to Louisa Lake, and the Pine Grove Cemetery at the Cedar and Dilla St. intersection. However, no known sites are in the project area. However, unrecorded archeological sites might be present due to the favorable environmental setting.

4.3 With Project Conditions

Historically, Milford Pond was an important community resource serving as the centerpiece of the Town's recreational complex. Today, recreational activities on Milford Pond are restricted due to eutrophication, sedimentation, and aquatic macrophyte and emergent vegetation growth. The aesthetic values of Milford Pond are significantly impaired due to decreased access, loss of open water habitat, and odors caused by decomposing vegetation. These issues have been a regular complaint of neighbors and patrons of the many municipal parks and open spaces, which surround the pond. The following sections present the changes that would occur in the environmental conditions in and around Milford Pond with the partial or full hydraulic dredging of the pond, or with the removal of the dam. The environmental conditions evaluated include habitat, biological and physical characteristics.

The dredging component of each of the alternatives would seek to restore at least a portion of the pond to a depth that would inhibit or prohibit growth of rooted aquatic macrophytes, and would result in the removal of nutrients that are associated with the shallower, culturally deposited sediments. This would remove the infestation of aquatic vegetation and restore an area of open water beneficial to the establishment of a healthy warm-water fishery. In addition, this would allow at least a portion of the pond to be used by the Town residents for recreational purposes. The degree of open water restoration and effects on emergent marshland areas would depend on the dredging alternative chosen. In the alternatives involving dredging, a sediment processing area would be developed north of Milford Pond on the opposite side of Dilla Street, to the east of the upgradient Louisa Lake.

4.3.1 Complete Dredge

4.3.1.1 Environmental Analysis

The complete dredging of Milford Pond would result in the restoration of approximately 120± acres of open water habitat areas. The immediate margins of the northern and western portions of the pond, as well as some cove areas, would be preserved to avoid wetland habitat and preserve some of the littoral zone vegetation. In addition, Clark well field to the north of Clark Island would be avoided. Approximately 1,000,000 cubic yards of organic peat and muck sediments would be removed from the pond bottom.

Dredging would result in increased pond depths within the shallower portions of the pond and elimination of the aquatic vegetation and a significant quantity of the nutrient-rich organic sediments that support aquatic macrophyte growth. This reduction of the internal nutrient source would improve water quality, creating more diversity in the benthic habitat and lessening the opportunity for macrophyte infestation. The regrowth of aquatic macrophytes would most likely occur within the shoreline littoral zone, but at a lesser density, providing an aquatic weed bed more beneficial to warm water fishery habitat than currently exists. Currently, anoxic conditions due to the decomposition of vegetative matter by aerobic bacteria allow the release of phosphorous compounds to the water column from the sediments. In addition, low dissolved oxygen levels may result in fish kills. With the lessening of aquatic plant growth, dissolved oxygen levels will be restored with a positive impact on both nutrient levels and fisheries habitat. An overall improvement of ambient water quality would have a positive impact downstream. Existing benthic populations would be impacted by the dredging process, but the preserved portions of Milford Pond would provide seed stock for benthic community regeneration. The benthic community should proliferate and diversify with the proposed pond restoration.

This alternative would also allow for the resumption of boating during summer months, enhanced recreational fishing, and ice-skating during the winter for the maximal amount of area. Reductions in aquatic macrophyte growth and water quality improvements would also increase the aesthetic appeal of Milford Pond by decreasing odors associated with anaerobic decomposition of pond vegetation and eutrophic conditions.

Negative aspects associated with the dredging of the entire pond include the removal of some desirable aquatic weed bed habitat in the littoral zone and emergent marsh vegetation that provides habitat for waterfowl and mammals, and the displacement of existing wildlife communities and creation of an ecosystem with less habitat diversity. The entire pond would be converted to deep, open water habitat, which would eliminate the possibility for the creation of a mixed habitat and may limit the diversity of wildlife and fish populations. The removal of emergent marsh vegetation that provides habitat for protected species of waterfowl (king rail, common moorhen, the pied-billed grebe, and the least bittern) would prove detrimental to these species. In addition, there may be potential adverse impacts to the local water supply (Clark Island Well Field) due to removal of protective peat layers that currently filters the induced infiltration that partially support the water supply of the aquifer.

In all of the alternatives involving dredging, the sediment processing area would be developed north of Milford Pond on the opposite side of Dilla Street, to the east of the upgradient Louisa Lake. Due to space limitations, all of the dredging alternatives would utilize mechanical dewatering using belt filter press technology to manage the hydraulically dredged material. The hydraulic dredging process would pump the organic sediments in a slurry-state to storage tanks at the mechanical dewatering site. Mechanical mixers will maintain the sediments in suspension in the tanks. The slurry will then be pumped from the tanks to several trailer-mounted mechanical dewatering units located nearby. After removing the solids, clean water would be returned to the pond. The sediment volume in the peaty sediments of Milford Pond is decreased by about one-third by this process.

Environmental impacts associated with sediment processing site include the alteration of the soils at the sediment processing site and clearing of the trees on about 10 acres of upland, in addition to already cleared portions of the site, to be used for dredged material disposal. The dredging project would use about half of the 20± acre site, avoiding wetlands and providing necessary setbacks to control erosion and sedimentation. For the full pond dredging program, this site would not be able to contain the entire volume of sediments to be dredged from the pond and the Town would need to seek alternate placement or beneficial reuse of the material during the dredging program in order to minimize the storage area required

The sediment processing site would be restored by seeding the dredged materials during and after the dredging operation to provide a stabilized and vegetated site. The upland disposal site will be revegetated upon completion of the project, seeding the dredged sediments with a grass and wildflower seed mix to provide site stability. Gradually, shrub and sapling growth will develop within this area, evolving to a woodland community over several decades. These impacts are short-term over the life of the project and long-term effects are considered insignificant as full restoration of these areas is proposed.

4.3.1.2 Construction Cost

The estimated costs for dredging include the costs of dewatering area construction, initial weed harvesting, dredging, and mechanical dewatering closeout, as shown in Table 6-1 of the EA. The total estimated cost, including contingencies at 25%, is approximately $17.9 million for dredging the entire pond, not including the real estate costs of the sediment disposal area already purchased by the Town.

4.3.2 Partial Dredge

4.3.2.1 Environmental Analysis

A partial dredging program would involve removing organic peat and muck sediments from the pond bottom within limited areas of the pond. Two areas were considered for partial dredging, including a 45 acre section extending from the dam northward past Clark Island and a 21 acre section extending from the dam northward to Clark Island. The areas to be dredged would be towards the southern and eastern portions of the pond, avoiding the Clark Island Well Field and the emergent wetlands on the western side of the pond.

The majority of the environmental effects associated with a partial dredging program would be similar to those associated with the complete dredging program, as discussed in Section 4.3.1.1. An increase in depth and a reduction in aquatic macrophyte growth throughout selected areas of the pond would provide open, deep water habitat essential for improving the diversity of fisheries in the pond. However, unlike the complete dredging alternative, a partial dredging program would supply deep open water areas while allowing some shallow pond habitat to remain, for a mixed habitat capable of supporting a diverse fish population. This habitat restoration would benefit other wildlife, such as wading and dabbling birds and aquatic mammals (e.g., muskrat) in addition to the fish species. In the case of partial dredging, the cattail dominated marsh south and west of Clark Island would be preserved in order to avoid conflicts with rare waterfowl species habitat. With the subsequent increase in pond volume, the annual average flushing rate of Milford Pond would decrease from approximately 57 to 23 times per year.

While the removal of existing organic sediments would alter the benthic habitat, partial dredging only impacts a fraction of the 120±-acre waterbody. Overall, habitat diversity within Milford Pond will be improved as some shallow pond and emergent wetland habitat will be converted to open water habitat, while a portion will be preserved in its present state. Existing wildlife communities will be preserved, while new communities will develop in restored sections of the pond.

Both of the partial dredging alternatives would also provide the restoration of some of the historical recreational uses and aesthetic values, albeit to a lesser extent than previously existed or as provided by the full pond dredging alternative. However, the partial dredging program would preserve habitat more favorable for rare waterfowl and other species, which may be of value to the residents of Milford. The removal of existing emergent vegetation in the area immediately surrounding the Town swimming pool in the southeasterly corner of the pond will eliminate safety and health issues associated with the dense vegetative growth immediately adjacent to this area.

Negative environmental impacts associated with the partial dredging program are less than those associated with complete dredging and may include the removal of some desirable aquatic weed bed habitat in the littoral zone, and potential adverse impacts to the local water supply (Clark Island Well Field). Only one of the partial dredging scenarios would impact a relatively small area of the Clark Island Well Field.

The differences in the environmental effects between the 45-acre dredging alternative and the 21-acre dredging alternative involve the proportion of open water, aquatic weed beds, and emergent marsh habitat. The critical existing emergent wetland habitat would be protected with both alternatives. The 21-acre partial dredging program would minimally meet the goals and objectives of the Milford Pond Restoration Committee and the overall habitat improvement objectives by improving the environmental quality and fisheries habitat of the pond. The shallow aquatic weed bed in the northern portion of the pond would be unaffected. One-sixth of the pond basin would have restored open water habitat with restored pond depth, providing a less desirable mix of open water, aquatic weed beds, and emergent marsh habitat. Under the 45-acre dredging scenario, 25% of the pond basin would remain in emergent wetland beds, with the remaining basin split almost equally between the existing dense aquatic weed beds and restored open water. Most of the shallow aquatic weed bed in the northern portion of the pond would be unaffected. One-third of the pond basin would have restored open water habitat with restored pond depth, providing the most desirable mix of open water, aquatic weed beds, and emergent marsh habitat.

Sub-alternatives to create wetland islands from the excavated sediments in the undredged portions of the pond were eliminated due to extreme conflicts with rare species habitat, and loss of flood storage potential.

As for the other dredging alternatives, the sediment processing area would be developed north of Milford Pond on the opposite side of Dilla Street, to the east of the upgradient Louisa Lake clearing trees from about 10 acres of upland of the 20± acre site. The site can potentially contain the entire volume of sediments to be dredged from the pond, requiring an average depth of 18 feet for the 45 acre dredging program and about half that for the 21 acre dredging program. Due to irregular topography, heights of the sediment would vary. However, the Town is expected to seek beneficial reuse of the material during the 4 year dredging program, which will minimize the storage area required. Similar dredging programs with similar peaty dredged sediments have had little difficulty in finding users for the material. The sediment processing site would be restored by seeding with a grass and wildflower seed mix to provide site stability.

4.3.2.2 Construction Cost

The estimated costs for dredging include the costs of dewatering area construction, initial weed harvesting, dredging, and mechanical dewatering closeout. The total estimated cost, including contingencies at 25%, is approximately $7.3 million for the 45 acre dredging alternative and $3.7 million for the 20 acre dredging alternative, not including the real estate costs of the sediment disposal area already purchased by the Town. Costs are detailed in Tables 6-2 and 6-3 of the EA.

4.3.3 Dam Removal

4.3.3.1 Environmental Analysis

This alternative entails removing the dam that currently impounds Milford Pond, thus allowing the pond to drain and returning the area to swampland. The Charles River would be allowed to return to its natural course and flow freely through the swamp and on to the Boston Harbor. Natural environmental processes would be allowed to function with dam removal, but the ability of the exposed pond bottom to revert to the condition that existed prior to original dam construction over 60 years ago is unlikely. The exposed pond bottom would most likely be rapidly colonized by invasive wetland species such as cattail, purple loosestrife, and Phragmites.

Removal of the dam would provide minimal benefit to the Charles River overall in terms of fish habitat. Although Atlantic salmon no longer migrate into the Charles River, the lower Charles River does support several anadromous species including American shad, American eel, blueback herring and alewife. The Charles River has 20 dams along its length of which the Milford Pond dam is the most upgradient. While the lower five dams are equipped with fish ladders, there remain 14 dams downstream of the Milford Pond dam that block anadromous fish passage north to this reach. Therefore, removal of this dam would provide only minimal immediate benefit to the Charles River overall in terms of regional fish migration patterns. In addition, the existing dam is located on a pre-existing natural dam of several feet height, which previously allowed the development of a cedar swamp with accumulation of deep organic peat. Therefore, fish migration would not necessarily be substantially improved by removal of the dam. However, a fish ladder could be considered at a future date for any of the alternatives once viable fish passage is provided at the downstream dam sites.

Allowing the pond to drain may have a significant impact on the hydraulic properties of the aquifer beneath Milford Pond, from which the Milford Water Company extracts drinking water. The Milford Water Company operates wells that are located on Clark Island in the center of Milford Pond. Based on data from an 11-day pumping test of the Clark Island Well Field, Groundwater Associates (1987) concluded that the Clark Island Well Field receives the majority of its recharge from leakage through the overlying peat layer that separates Milford Pond from the aquifer, and from upgradient sources to the north and northwest. Already, this well field suffers in production under periods of severe drought when the pond levels are naturally lowered. The Clark Island Well Field produces more than half of the total groundwater source of drinking water to the area and between 13% and 36% of the total daily water demand. This suggests that the draining of Milford Pond would result in the loss of a major source of recharge to the aquifer and may reduce the volume of water that can safely be pumped from the wells that are operated by the Milford Water Company. Further information about the hydrogeology of Milford Pond and the Clark Island Well Field can be found in Appendix K.

The reduced water levels would also have a negative impact on the emergent marshy wetland habitat that currently serves as nesting areas for four State-listed bird species by MA NHESP (king rail, common moorhen, least bittern, and pied-billed grebe).

The removal of the dam also poses significant potential for erosion and sedimentation unless significant measures are taken to avoid such impacts. The lowering of the water level will cause the stream flow from various sources to cut channels into the accumulated soft, highly erodable, surficial sediments. Stream flows for the Charles River, Huckleberry Brook, and storm water inputs would cut into the sediments to establish new stream channels, which would emerge and develop over several years until relatively stable channels were established. Avoidance of this condition would likely require pre-dredging of preferred flow pathways for each of the inlets to the pond basin, bioengineering of the new stream banks, and intensive seeding/planting of the newly exposed sediments.

The implementation of this alternative would be unlikely to restore recreational opportunities for Milford town residents. In addition, the dam itself may be eligible for listing on the National Register of Historic Places, as it was constructed more than 50 years ago.

4.3.3.2 Construction Cost

The estimated costs for dam removal include the costs of dewatering area construction, initial weed harvesting, dredging near the dam and within the stream channels to be restored, mechanical dewatering closeout, stream bioengineering, revegetation and landscaping efforts for the wetland areas including invasive species control. The total estimated cost, including contingencies at 25%, is approximately $7.2 million for the dam removal and alteration of the 120 acre Milford pond basin (Table 6-4 in EA).

4.3.4 Dam Removal with Partial Dredge

4.3.4.1 Environmental Analysis

This alternative involves removal of the dam while dredging approximately 45± acres of the Milford Pond area. The benefits of this alternative would, in part, be the same as those resulting from the partial dredging alternative, including the restoration of deep, open water, warm water fisheries habitat while maintaining emergent wetland environments. However, the shallow aquatic weed beds would be largely eliminated due to the lowering of the water level, except to the extent that they redeveloped within the newly dredged pond basin. As discussed for the dam removal alternative, there would be only very limited potential to improve migratory fish passage due to downstream obstructions and the natural dam presence, although a fish ladder could be considered at some future time, if appropriate. Some stream bioengineering would be required to avoid erosion through unstable sediments.

While providing some new deep water habitat, this alternative would have most of the same deficits expected with the dam removal alternative. There would be likely adverse impact to the public water supply from Clark Island Well Field and the rare waterfowl species habitat. In addition, the benefit to fisheries habitat is uncertain given the significant fish migration barriers downstream. This alternative would only partially restore historical recreational opportunities, such as boating, for the Town of Milford.

4.3.4.2 *Construction Cost*

The estimated costs for dam removal with dredging, presented in Table 6-5 of the EA, include the costs of dewatering area construction, initial weed harvesting, dredging near the dam and within the stream channels to be restored, mechanical dewatering closeout, stream bioengineering, revegetation and landscaping efforts for the wetland areas including invasive species control. The total estimated cost, including contingencies at 25%, is approximately $6.6 million for the dam removal and the 45 acre dredging alternative, not including the real estate costs of the sediment disposal area already purchased by the Town.

4.4 Summary

Each alternative and its associated costs are summarized in Table 4-1.

Table 4-1. Milford Pond Habitat Restoration Alternatives and Costs

Alternative	Construction Cost	Real Estate Cost*	Study Cost	IDC	Total Cost
No Action	$0	$0	$0	$0	$0
Complete Dredge	$16,100,000	$736,000	$300,000	$1,482,000	$18,600,000
Partial Dredge – 45 acre	$6,732,000	$736,000	$300,000	$317,000	$8,086,000
Partial Dredge – 21 acre	$3,316,000	$736,000	$300,000	$114,000	$4,466,000
Dam Removal	$6,666,400	$67,000	$300,000	$200,000	$7,233,400
Dam Removal with Partial Dredge	$5,346,300	$906,000	$300,000	$184,000	$6,736,300

*Costs reflect Town land purchase in 2003 for dredged material disposal site

5 Comparison of Alternatives

5.1 Environmental Benefits

Some of the environmental benefits of dredging are virtually the same for either the partial or full dredging alternatives. Benefits of dredging over the without project condition include:

1. The improvement of fisheries habitat due to increased pond depths and elimination of the aquatic vegetation within portions of the pond, which will benefit fish species such as largemouth bass, black crappie, and rainbow trout;
2. The removal of a significant quantity of the nutrient-rich organic sediments that support aquatic macrophyte growth;
3. The proliferation and diversification of the benthic habitat and communities;
4. The increase of open water will benefit the waterfowl dabbling and resting habitat;
5. An overall improvement of ambient water quality including dissolved oxygen and nutrient levels, which would have a positive impact on fisheries habitat and downstream conditions; and
6. The reduction in density of aquatic macrophytes within the shoreline littoral zone, providing an aquatic weed bed more beneficial to warm water fishery habitat than currently exists.

The full dredging alternative would result in the conversion of all shallow water and emergent marsh environments to that of deep, open water habitat, while the partial dredging alternative would allow some of the shallow water and emergent marsh areas to remain. This partial dredging alternative provides an additional environmental benefit in that it creates an ecological community with a diverse habitat, suitable for a variety of species, instead of only the deep, open water habitat.

Dam removal could potentially benefit the Charles River and riverine fisheries by removing the barrier to river flow and anadromous fish passage. Fish species, including Atlantic eel, shad, alewife and blueback herring, swim upriver from the sea to spawn. However, the presence of many downgradient dams along the river that presently block passage of these fish, limits any present benefit to be gained from dam removal, although the future removal of these dams or installation of fish ladders could lead to the restoration of these fish populations. For Milford Pond, the investigation of the potential benefit to be gained from a fish ladder might be appropriate to some future date.

Table 5-1 summarizes the effects on habitat resulting from the various restoration alternatives.

5.2 Water Quality

The water quality in Milford Pond will improve with either a partial or full dredging program. The removal of nutrient rich sediments will reduce the opportunity for macrophyte infestation, allowing the restoration of dissolved oxygen levels that are currently depleted due to the decomposition of vegetative matter. The removal of the

Table 5-1. Summary of the Overall Habitat for Historic and Existing Species in Milford Pond for With and Without Project Conditions

Species	No Action	Complete Dredge	Partial Dredge	Dam Removal	Dam Removal & Partial Dredge
Brown Bullhead	Existing poor quality aquatic habitat will persist and likely increase over time.	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.	Restoration of desirable balance of open water habitat and shallow, aquatic weed bed habitat	Significant loss of aquatic weed bed and open water habitats	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.
Black Crapple	Existing dense aquatic weed growth and silty pond bottom with lack of pond depth and gravel bottom provides poor quality littoral zone, and deepwater and gravel spawning habitat that will persist and likely increase over time	Improved deepwater and spawning habitat, but some loss of desirable shallow, aquatic weed bed habitat, except on margins of pond. Exposure of gravel spawning areas.	Restoration of desirable balance of deep water habitat, exposed gravel bottom, and shallow, less dense aquatic weed bed habitat	Significant loss of aquatic weed bed and open water habitats	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.
Bluegill	Existing poor quality aquatic habitat will persist and likely increase over time.	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.	Restoration of desirable balance of open water habitat and shallow, aquatic weed bed habitat	Significant loss of aquatic weed bed and open water habitats	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.
Chain Pickerel	Existing poor quality aquatic habitat will persist and likely increase over time.	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.	Restoration of desirable balance of open water habitat and shallow, aquatic weed bed habitat	Significant loss of aquatic weed bed and open water habitats	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.
Largemouth Bass	Existing dense aquatic weed growth and silty pond bottom with lack of pond depth and gravel bottom provides poor quality littoral zone, and deepwater and gravel spawning habitat that will persist and likely increase over time.	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond. Exposure of gravel spawning areas.	Restoration of desirable balance of deep open water habitat and shallow, aquatic weed bed habitat, with exposed gravel spawning areas.	Significant loss of aquatic weed bed and open water habitats	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.
Yellow Perch	Existing dense aquatic weed growth and lack of pond depth provides reduced quality littoral zone, and deepwater and spawning habitat that will persist and likely increase over time.	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.	Restoration of desirable balance of open water habitat and shallow, aquatic weed bed habitat	Significant loss of aquatic weed bed and open water habitats	Loss of desirable shallow, aquatic weed bed habitat, except on margins of pond.
Common Moorhen, Pied-Billed Grebe, Least Bittern	Nesting habitat will remain, but open water feeding habitat will continue to degrade	Loss of most nesting habitat, with maximization of open water feeding habitat	Restoration of desirable balance of emergent marsh nesting habitat, open water and shallow, aquatic weed bed areas	Significant loss of emergent wetland nesting habitat, aquatic weed bed and open water areas	Significant loss of emergent wetland nesting habitat, aquatic weed bed and open water areas
Black Duck	Nesting habitat will remain, but open water feeding habitat will continue to degrade	Loss of most nesting habitat, with maximization of open water feeding habitat	Restoration of desirable balance of emergent marsh nesting habitat, open water and shallow, aquatic weed bed areas	Significant loss of emergent wetland nesting habitat, aquatic weed bed and open water areas	Significant loss of emergent wetland nesting habitat, aquatic weed bed and open water areas

nutrient source in the sediments and the restoration of dissolved oxygen levels will also greatly reduce the release of nitrogen and phosphorous to the water column. These impacts will be more pronounced with a complete pond dredging than with a partial pond dredging program. Water quality improvements with dam removal are associated with the restoration of the river channel. A free flowing river would increase dissolved oxygen levels within the channel, reducing the release of nutrients to the water column from the sediments below.

5.3 Incremental Analysis

An incremental analysis is presented in Appendix B. A summary of the results is included in this section of the report. The incremental analysis measured the habitat benefits associated with the restoration of Milford Pond by various dredging alternatives. Although the historical habitat (before the dam construction) was a cedar swamp, created by the bedrock rise located under the existing dam, the objective of this 206 project as submitted by the sponsor is to restore the degraded *aquatic* habitat to its modern historic condition. This consisted of a 120+ acre pond (including the fringing wetlands), with associated lacustrine/warmwater fish habitat.

Milford Pond is believed to have historically supported a warm water fish assemblage, which included largemouth bass, yellow perch, bluegill and pumpkinseed sunfish, and bullhead species. Almost the entire necessary deeper and open water habitat utilized by many of these species has been eliminated by sediment deposition, as well as excessive growth of aquatic vegetation. The shallower (littoral) habitat in the pond necessary for reproduction and nursery has become overgrown with dense stands of rooted and floating aquatic vegetation. The present fish assemblage (as determined by fish sampling in August of 2002) consists of bluegill and pumpkinseed sunfish, chain pickerel, largemouth bass and yellow perch. It should be noted that the catch per unit effort (CPU) for Milford Pond was lower compared to other bodies of water in New England and there are only two year classes represented for largemouth bass. This is evidence that the health of the fisheries population in Milford Pond is compromised by the overall reduced depths, which limit overwintering and forage habitat, as well as the dense growths of aquatic weeds which mechanically hinder the access to food, as well as contribute to water quality problems in the pond.

Milford Pond also supports extensive fringing emergent as well as open water aquatic bed wetlands. Emergent wetland areas provide habitat for numerous avian wetland species, including four state listed threatened or endangered species. These are the king rail, common moorhen, pied billed grebe, and least bittern. These wetlands (with the open water) also provide habitat for other waterfowl species, including mallard duck, Canada goose and great blue Heron. It is also presumed that black duck inhabit Milford Pond. It should be noted that the habitat requirements for all of these waterfowl (as well as the other avian species noted above) depend upon the presence of open water (for foraging/dabbling) as well as the emergent wetland (for cover, and/or nesting). Therefore, the reduction of open water shallow habitat by the filling in of the pond and excessive weed growth can negatively effect waterfowl habitat as well, particularly habitat for dabbling ducks such as mallards and black ducks.

The desired output is the restoration of historical fisheries while preserving the beneficial characteristics of the fringing emergent and open water aquatic bed wetlands for avian species. Therefore, it is necessary to compare the approximate habitat value of the pond in its current state to that expected with the various dredging alternatives in terms of its suitability to support both fish and waterfowl. Dredging is expected to improve the open and deepwater areas of Milford Pond, restoring the pond to its more recent historic depths. This is expected to not only improve fish habitat, but may also increase the amount of open water habitat utilized by many wetland avian species including migratory waterfowl such as black and mallard duck. However, in some dredging alternatives, the amount of emergent and or aquatic bed vegetation may be reduced with resulting possible negative effects to some of the wetland/waterfowl habitat. In order to measure the benefits of the various restoration alternatives to the various habitat types, an evaluation of the quality and quantity of habitat suitable for various species (both aquatic and wetland) is necessary.

5.3.1 Methods

The U.S. Fish and Wildlife Service has developed Habitat Suitability Index Models for its Habitat Evaluation Procedures (HEP) Methodology, which measure the suitability of a given habitat for one or more species. These models use habitat criteria (variables) that are necessary to support various species (and their life stages) in a given habitat. These habitat criteria (variables) are generally measurable in a given area of habitat, and range in value from zero (0 = unsuitable) to one (1 = optimal). By measuring each of these variables, summing and/or obtaining a geometric or arithmetic/weighted mean for them, an overall value of the habitat (i.e. Habitat Suitability Index or HSI) can be obtained for a given species in a given habitat. When comparing various alternatives, the individual habitat variables can be estimated as to their expected change under each of the alternatives. The final HSI obtained for each variable for a given species can then be multiplied by the acres of the restoration project to obtain another value, Habitat Units, which are a measure of the overall quality of the habitat (for that species) in the project area that will result from the restoration.

When evaluating an entire ecosystem, generally a group of species is selected which represent the various habitat types. The total Habitat Units calculated for each species are summed for each alternative and compared to determine which alternative provides the most effective restoration (based upon total habitat units gained by the project). When determining the habitat units for several species, it is possible for some of the same variables (which are essential to all species) to be measured and incorporated more than once (i.e. once for each target species). Therefore, a model, which can evaluate certain required habitat criteria common to more than one species, may be preferable to one that evaluates each individual species, and could provide a more general and/or alternative way of evaluating the overall quality and/or quantity of a habitat for a certain function.

The Habitat Suitability Index Models (noted earlier), 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 (i.e. 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 (by 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 as well, and then multiplied by target wetland species criteria (as well as the lacustrine component) output in the same manner.

For example, most warm water/lacustrine habitats in New England support a warm water fish assemblage that includes species such as bluegill and pumpkinseed sunfish, yellow perch, brown bullhead, chain pickerel, black crappie, and largemouth bass. Generally, since these fish are typically found in lacustrine habitats, they have similar habitat requirements, which are common to more than one individual species. All of them (with the possible exception of brown bullhead) have similar dissolved oxygen requirements. Therefore, by measuring the range of dissolved oxygen levels in a specific habitat, the suitability of that habitat for a number of species that generally use this habitat and share similar dissolved oxygen requirements can be determined. Additional basic habitat requisites (such as forage habitat, pH, turbidity) that are common to a group of species can be measured, and then used as a general basic habitat model for a given type of habitat which supports a range of species. Species-specific habitat requirements can then be added, based upon target species, and weighted according to that species importance the ecosystem. The entire group of basic as well as species specific habitat requisites can then be either summed or multiplied (either to obtain a weighted and/or geometric mean) to obtain an overall habitat index which will rate the quality of the habitat to support a variety of species common to the area, as well as individual target species. The same approach can be applied to other ecosystem components in a given project (such as wetlands) to obtain a total value ranging between zero and one. The model summarized below utilizes this method in order to obtain a measure of the habitat quality of Milford Pond under various restoration alternatives. A more complete description of the model is included in Appendix B.

5.3.1.1 General Habitat Requisites

General habitat criteria that are necessary to support lacustrine fish species that presently and historically occupied Milford Pond were selected. These include the basic requisites for fisheries and/or aquatic life, which will change in response to dredging and for which data sets are available. The general requisites evaluated for fish are dissolved oxygen, turbidity, temperature, benthic invertebrates, cover, and forage. In addition, general habitat criteria necessary to support avian species that may take advantage of the fringing wetlands habitat around Milford Pond were selected and incorporated into the model. These include (1) the percent of emergent and scrub shrub wetland vegetation containing cattail and sedges adjacent to open water, (2) the percent of open water less than 3 feet deep, and (3) the ratio of open water to emergent vegetation. These requisites are discussed in the complete analysis included in Appendix B.

5.3.1.2 Habitat Requisites for Target Species

Specific habitat requisites for several target lacustrine fish species were selected, which are also expected to change in response to dredging. These were considered partially-independently of the basic habitat requisites that are necessary to support any type of fishery, in that they apply to an individual species, but also depend on the basic habitat requisites being met. The species-specific requisites for target fish species include littoral habitat, spawning substrate, and deepwater habitat. This target fish grouping can consist of one or more target species, weighted according to their importance in the ecosystem and/or habitat restoration priority. The target fish species selected for this analysis are Largemouth bass, Calico bass, and Yellow Perch.

Specific habitat requisites for waterfowl were also selected. These include (1) the density of the rooted (including emergent) vegetation present in the open water areas, (2) the percent of backwater supporting insect larvae, and (3) the percent of nesting habitat (i.e. scrub shrub/emergent vegetation) within 1 mile of water. These were evaluated for one target species, Black Duck (*Anas rubripes*). Appendix B includes a discussion of all species-specific habitat requisites.

5.3.2 Calculations

Habitat Units for each of the Milford Pond dredging alternatives were calculated according to the method noted above, where the Indices obtained for both the lacustrine (i.e. fisheries) habitat and wetland (i.e. waterfowl) habitat were applied to the total acres of each of these respective habitat types that will become available with each alternative. The formula and calculations for obtaining the Habitat Units, as well as the final values, are presented in Appendix B.

5.3.3 Incremental Cost Curve

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 would provide more habitat units at an equal or lesser cost.

Management plans to improve environmental conditions at Milford Pond include different dredging scenarios. The dam removal and dam removal with partial dredging warranted no further analysis due to their environmental impacts to the existing rare species habitat, the adverse impacts to water supply at the Clark Island Well Field, loss of recreational opportunities and the local sponsor's anticipated goals for Milford Pond.

The without project condition (no action) provides approximately 119 habitat units. The alternative to dredge 120 acres provides less value at about 64 habitat units, while the alternatives to dredge smaller areas provide more habitat units than the no action alternative. The alternatives to dredge 20 acres and 45 acres provide about 130 habitat units and 142 habitat units, respectively.

The cost of each plan, including contingencies, overheads, real estate and study costs was used in the comparative analysis. With the exception of the no action alternative, which the sponsor does not favor, dredge 20-acres alternative has the lowest cost. The incremental analysis identified three (out of a possible four) alternatives as cost effective plans. The dredging 120-acres alternative is not cost effective because compared with the other dredging alternatives it provides fewer 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 two best buy plans including the no action alternative and dredging 45 acres, which comprise the best buy plan curve. The best buy plan curve is the incremental cost curve. The alternative to dredge 45 acres of Milford Pond would provide an additional 23.42 habitat units over the without project alternative at an incremental cost of $8,071,500. The incremental cost per habitat unit is $344,640.

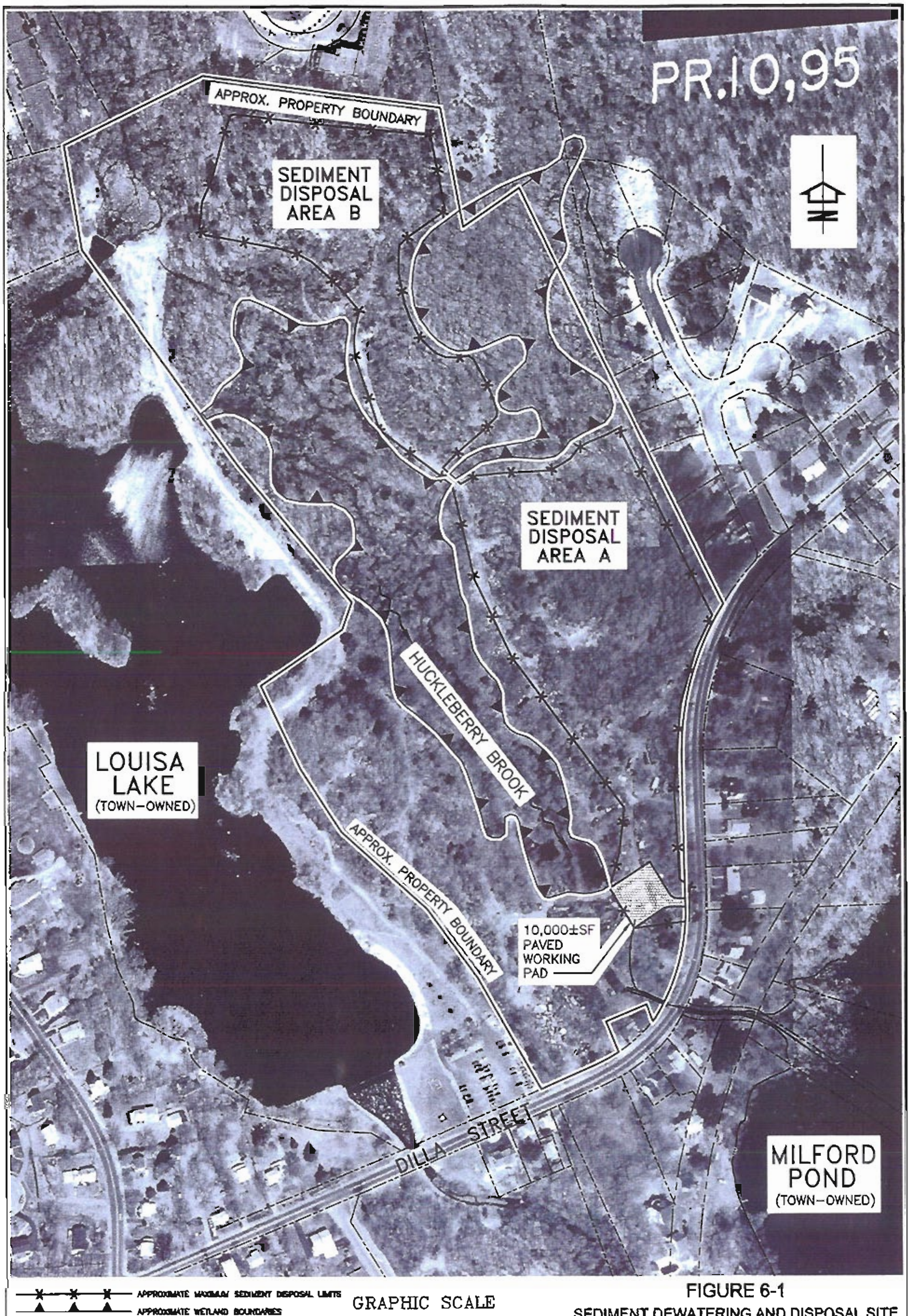
Recommended Alternative

6.1 Introduction

Based upon the results of the incremental analysis, the National Ecosystem Restoration (NER) is Alternative 3, Partial Dredging (45± acres). The Town of Milford has selected Alternative 3 as the "Locally Preferred Plan". This partial dredging program achieves the desired restoration for Milford Pond, balancing the restoration of aquatic habitat with the preservation of the emergent wetland and dense aquatic weed bed habitats within the Milford Pond basin. The partial dredging program also protects the Clark Island Well Fields as well as the critical habitat for rare waterfowl species previously observed within the pond environment. Dredging will remove the accumulated, nutrient rich surface sediments and attached plant material, simultaneously restoring waterbody depth and removing the surficial sediments, which accelerated the excessive macrophyte growth.

Hydraulic dredging would be utilized as the appropriate methodology for dredging the pond, with mechanical means such as belt filter press technology to dewater the sediments, ensuring easy handling of the sediments during disposal and the return of clean filtrate to the pond. The hydraulic dredging process will pump the organic sediments in a slurry to the mechanical dewatering and disposal site, to be located north of Milford Pond on the opposite side of Dilla Street, to the east of the upgradient Louisa Lake (see Figure 6-1). This 42.2± acre parcel, formerly known as the "Consigli parcel", was purchased by the Town in June 2002 (see Quitclaim Deed, Worcester District Registry of Deeds, Book 26960, Page 124). The disposal site is a 20± acre parcel located north of Milford Pond on the north side of Dilla Street. The site is to the east of Louisa Lake and the west of Monhegan Circle, a subdivision ending in a cul-de-sac. The parcel is generally rectangular in shape, with the long axis extending northward from Dilla Street. The disposal site is in Town of Milford ownership and has been partially used for sand excavation, equipment storage, and earth materials. The site is partially cleared with a dirt roadway extending the length of the parcel from south to north. The remainder of the site is wooded wetlands or uplands. The disposal area consists of approximately 10 acres of wooded uplands.

The partial dredging program attains substantial ecological benefits compared to the "No Action" project condition. Compared to the full dredging program, the partial dredging program achieves a balance to total ecosystem enhancement, avoiding the total restoration of one habitat type (i.e., open water) at the expense of emergent wetland and dense aquatic weed bed habitats, which are also desirable relative to fish, waterfowl, and herpetile species habitats. Although a greater total cost than the smaller 20 acre partial dredging alternative, the 45 acre partial dredging alternative better achieves a balanced ecosystem, with roughly equal habitat areas among the major habitat types, and is therefore somewhat more cost effective.



NOTES:

1. PROPERTY BOUNDARIES HAVE BEEN DIGITIZED FROM MILFORD ASSESSOR'S PLANS AND ARE APPROXIMATE ONLY.

2. AERIAL PHOTOGRAPHY TAKEN APRIL 10, 1995.

FIGURE 6-1
SEDIMENT DEWATERING AND DISPOSAL SITE
FORMER CONSIGLI PARCEL
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

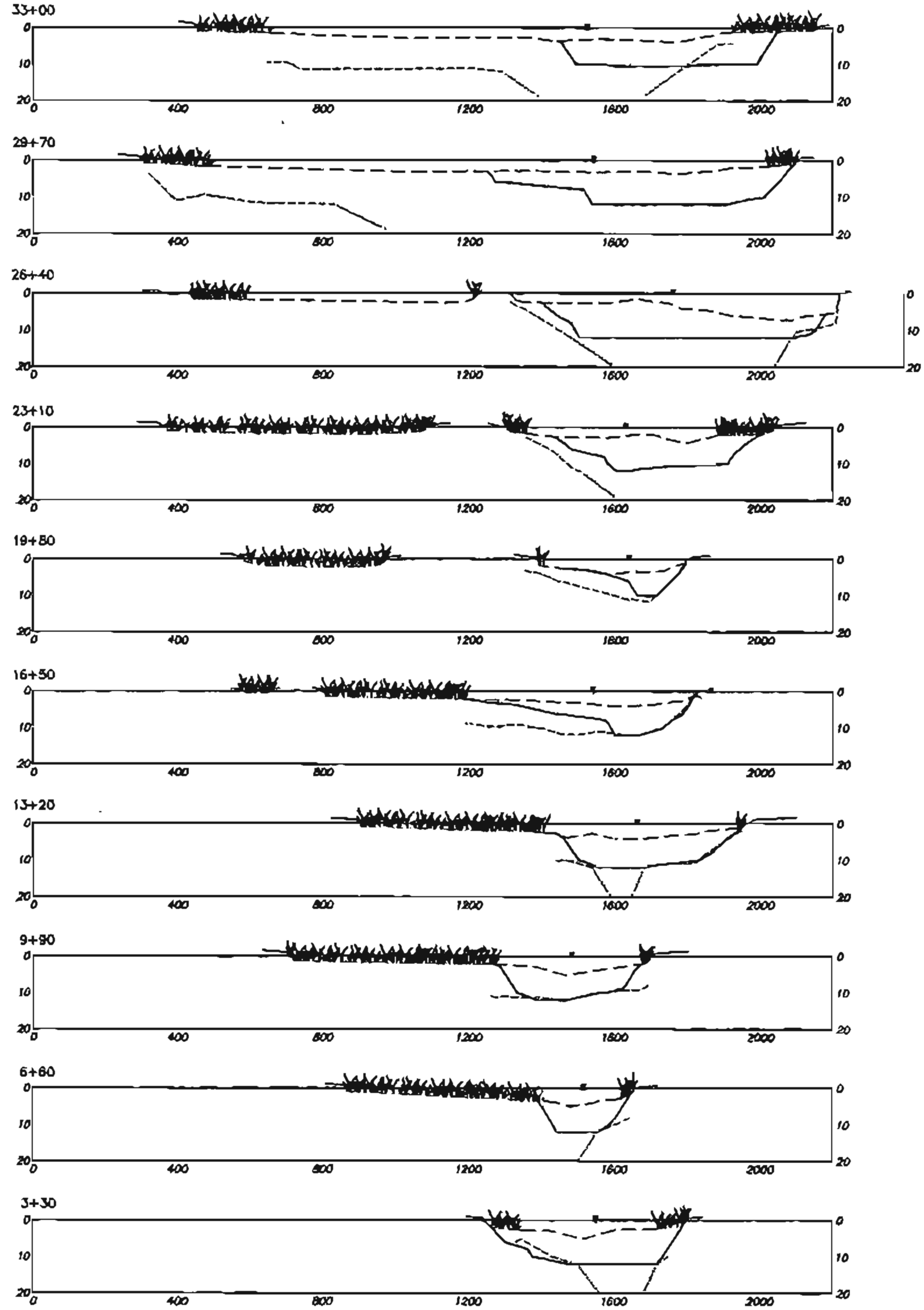
The No Action alternative assumes that all efforts for the restoration of Milford Pond would cease. In its current state, Milford Pond does provide wildlife habitat (91 HUs out of 119 total HUs) for a variety of aquatic organisms living in emergent wetland and shallow pond communities. However, the fishery habitat value of Milford Pond is greatly reduced by the dense weeds and the low dissolved oxygen in the water resulting from decaying aquatic vegetation. In time, wetland successional processes will result in the gradual total filling of Milford Pond and conversion to emergent wetland community. This succession will result in further decreased areas of open water habitat, and continued loss of fish habitat. Alternative 3, Dredging 45 ± acres achieves a more balance mix for both habitats (35 HUs for fisheries, 102 HUs for wildlife).

The dam removal options do not achieve a balanced ecosystem restoration due to the significant loss of rare species habitat, as well as the adverse impacts to the Clark Island Well Fields.

The 45 acre partial dredging program would successfully meet all of the goals and objectives of the Milford Pond Restoration Committee as well as the objectives for overall habitat restoration by improving the environmental quality, and fisheries and wetland habitats of the pond. Under this scenario, 25% of the pond basin would remain in emergent wetland beds, with the remaining basin split almost equally between the existing dense aquatic weed beds and restored open water. The critical existing emergent wetland habitat would be protected and most of the shallow aquatic weed bed in the northern portion of the pond would be unaffected. One-third of the pond basin would have restored open water habitat with restored pond depth, providing a desirable mix of open water, aquatic weed beds, and emergent marsh habitat. This is the most desirable balance of emergent wetland, aquatic weed bed and open water habitats of all of the dredging alternatives. Potential impacts to the Clark Island Well Field also would be avoided by leaving a 5 ft organic sediment cap in place to the west of the groundwater divide. The proposed dredging program cross sections are presented in Figure 6-2.

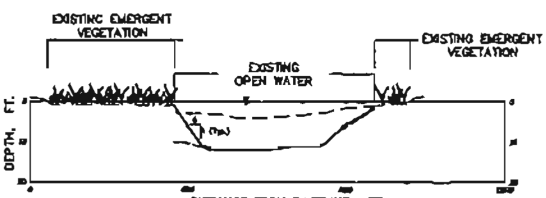
Both of the partial dredging programs would provide enhanced habitat improvement benefits with minimal environmental impacts and a lower cost. These alternatives would also provide the restoration of some of the historical recreational uses and aesthetic values, albeit to a lesser extent than previously existed or as provided by the full pond dredging alternative.

This partial dredging program would minimally meet the goals and objectives of the Milford Pond Restoration Committee and the overall habitat improvement objectives by improving the environmental quality and fisheries habitat of the pond. The critical existing emergent wetland habitat would be protected and the shallow aquatic weed bed in the northern portion of the pond would be unaffected. One-sixth of the pond basin would have restored open water habitat with restored pond depth, providing a less desirable mix of open water, aquatic weed beds, and emergent marsh habitat. Potential impacts to the Clark Island Well Field would be avoided by the lack of dredging in proximity to the field.



LEGEND

- WATER SURFACE
- TOP OF UNCONSOLIDATED SEDIMENTS, AS DETERMINED BY PROBINGS, OCT. & NOV. 1998
- APPROXIMATE BOTTOM OF UNCONSOLIDATED SEDIMENTS, AS DETERMINED BY PROBINGS, OCT. & NOV. 1998
- APPROXIMATE TOP OF UNCONSOLIDATED SEDIMENTS IN AREAS OF DENSE EMERGENT VEGETATION
- BOTTOM OF UNCONSOLIDATED SEDIMENTS GREATER THAN 12 FT. BELOW WATER SURFACE
- LIMITS OF PROPOSED DREDGING PROGRAM



KEY TO TYPICAL CROSS-SECTION FEATURES

NOTE: STATION LOCATIONS SHOWN ON FIGURE 4-1.

HORIZ.: 1" = 300'
VERT.: 1" = 30'

FIGURE 6-2
POND CROSS SECTIONS
PROPOSED DREDGING PLAN
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

6.2 Design Assumptions

1. Dredging activity in immediate proximity to nesting sites of rare waterfowl species will be avoided during the nesting season (April through June).
2. A turbidity standard of 50 NTU around the hydraulic dredge unit and for the return flow will be the applicable standard.
3. Excavated sediment is assumed to be "clean" based upon sediment testing conducted to date, and will not require any special disposal requirements.
4. Work will be performed in three separate stages to facilitate materials storage and removal by Town personal at the dewatering site.
5. An Ellicott MudCat® hydraulic dredge, or its equivalent, would be the type dredge for use on Milford Pond.
6. The dredge will be able to be delivered to the waterbody on a flatbed truck and launched from Town property onto the pond.
7. The total volume of dredging will be 400,000 CY (cubic yards) from a 45±acre portion of the 120±acre total pond area. Following dewatering, the sediments will assume a disposal volume of 240,000 CY.
8. During the actual dredging, the pond would be closed to any recreational use.
9. The production rate of the dredge would be variable depending upon equipment, personnel, and dredged material variability. Potential peak production rates of up to 120 cubic yards per hour could be expected.
10. Any potential large rocks, debris, and stumps would be removed individually with chain and winches after sediments have been removed around them. Removal of stumps and objectionable materials would be included as a pay item in the dredging contract so that any errant debris can be removed at the discretion of the Town.
11. The dewatering unit will likely consist of a belt filter press, with a gravity or rotating thickening unit, sludge pumps, flocculent conditioning system, electrical motor controls, and chutes to discharge the dewatered materials.
12. Polymer flocculent will be added to the sludge immediately before it enters the dewatering unit, improving solid removal efficiency.
13. The recommended storm water management program improvement will be implemented by Town to control future sediment loading to the pond basin.

6.3 Preliminary Construction Sequence

The proposed hydraulic dredging project would proceed in accordance with the following construction sequence:

1. Install sedimentation controls at the dewatering/disposal site. During construction, downgradient areas in the vicinity of wetland resources will be protected by installation and maintenance of accepted best management practices for erosion and sedimentation control. Maintenance will include removal of accumulated soil materials from silt fences and other controls as well as any needed repairs of damaged or weathered controls. Upon completion of all clearing and grubbing associated with preparation of the disposal area, with

erosion controls remaining in place, all disturbed areas will be temporary seeded and mulched to provide stability to the soils. Erosion controls will remain in place until all disturbed areas are final stabilized.

2. Clear and grub sediment dewatering and processing area.
3. Install paved working pad at sediment dewatering and processing area. Construct pipe culvert from dewatering are to Huckleberry Brook for excess water from the dewatering process to return to Milford Pond.
4. Construct continuous-weld high density polyethylene (HDPE) hydraulic discharge line from pond to sediment dewatering and disposal site.
5. Mobilize dredging and processing equipment.
6. Conduct weed harvesting of dredging area to avoid clogging of cutterhead and improve dredging performance.
7. Conduct pre-dredging survey of the top of sediment surface (may be performed prior to step 1 if desired).
8. Initiate dredging of the pond.
9. Monitor turbidity at the dredge and at the return flow from processing site. Amend operations as necessary to control turbidity below 50 NTU standard or other performance standards as may be required for water quality.
10. Replace flashboards at dam and affect other repairs.
11. Consolidate and shape the dewatered sediments within the 12.5±acre sediment disposal portion of the overall dewatering and disposal site. Note that the Town may utilize some of the sediments as a topsoil substitute or soil amendment, pending approval of such through the Massachusetts Water Quality Certification (Section 401 permit) process.
12. Conduct post-dredging survey of new pond bottom surface to determine the volume of material removed from the pond.
13. Demobilize dredging equipment and remove hydraulic discharge line.
14. Restore containment area by removal of paved dewatering area, dressing all slopes, and seeding and planting all disturbed areas and the disposal area.

6.4 Operation and Maintenance

Annual operation and maintenance costs are not anticipated with the preferred alternative, as the Town of Milford is committed to an ongoing storm water mitigation plan which will reduce sediment and nutrient inputs to the pond and increase the life expectancy of the project. The storm water mitigation plan includes maintenance of storm water management features within the watershed to the pond, including routine inspection and removal of accumulated sediments. The life expectancy of the project, without a storm water management plan, is expected to be approximately 50 years. This estimate is based on the assumption that when at least half of the dredged open water area is filled with sediment to a depth of 6 feet, problems with aquatic vegetative growth will return. Sediment capture within the undredged portions of the pond is not accounted for. The implementation of a storm water management program would extend the life expectancy well beyond the projected 50-year project life.

6.5 Real Estate Requirements

All work within the pond and the sediment dewatering/disposal site are within the limits of property currently owned by the Town of Milford. Therefore, for these aspects of the work, there will be no special real estate easements or acquisitions required. However, temporary easements will be required to install and operate the hydraulic discharge pipeline from Milford Pond to the sediment dewatering site on the north side of Dilla Street. The proposed routing for the pipeline is along the existing stream corridor of Huckleberry Brook. This routing takes advantage of the existing culverts beneath the railroad embankment and Dilla Street, thus avoiding traffic and road surface disruption and potential wetland impacts. As the high level flows from Huckleberry Brook are currently diverted into Louisa Lake, placement of the 12" diameter dredge discharge pipeline (maximum estimated size) within the stream channel and culvert will not significantly impair the hydraulic conductivity of Huckleberry Brook.

Three privately-owned parcels must be crossed by the dredge discharge line, as described in the table below and as shown on Figure 6-3.

Table 6-1. Private Property Owners Requiring Temporary Construction Easements

Name	Address	Registry of Deeds Book/Page	Assessors Map# & Parcel#	Assessed Value of Total Property 2003	Easement Required
Joseph Sheedy	29 Dilla St.	5312/309	34-87	$128,200	100 LF of temporary pipeline placement within existing stream channel
Kenneth J. Tessitore	27 Dilla St.	10796/119	34-85	$156,500	100 LF of temporary pipeline placement within existing stream channel
Milford Water Company (private)	Dilla Street Rear	Unknown	27-01	$18,500	70 LF of temporary pipeline placement within existing stream channel

The following parcel is partially located within the shoreline of Milford Pond, but will be avoided by ensuring placement of the dredge discharge pipeline wholly within Town-owned pond property:

Nancy Cavaco	Rear of Dilla St.	8475/212	34-90	$6,200	600± LF of temporary pipeline placement within pond*

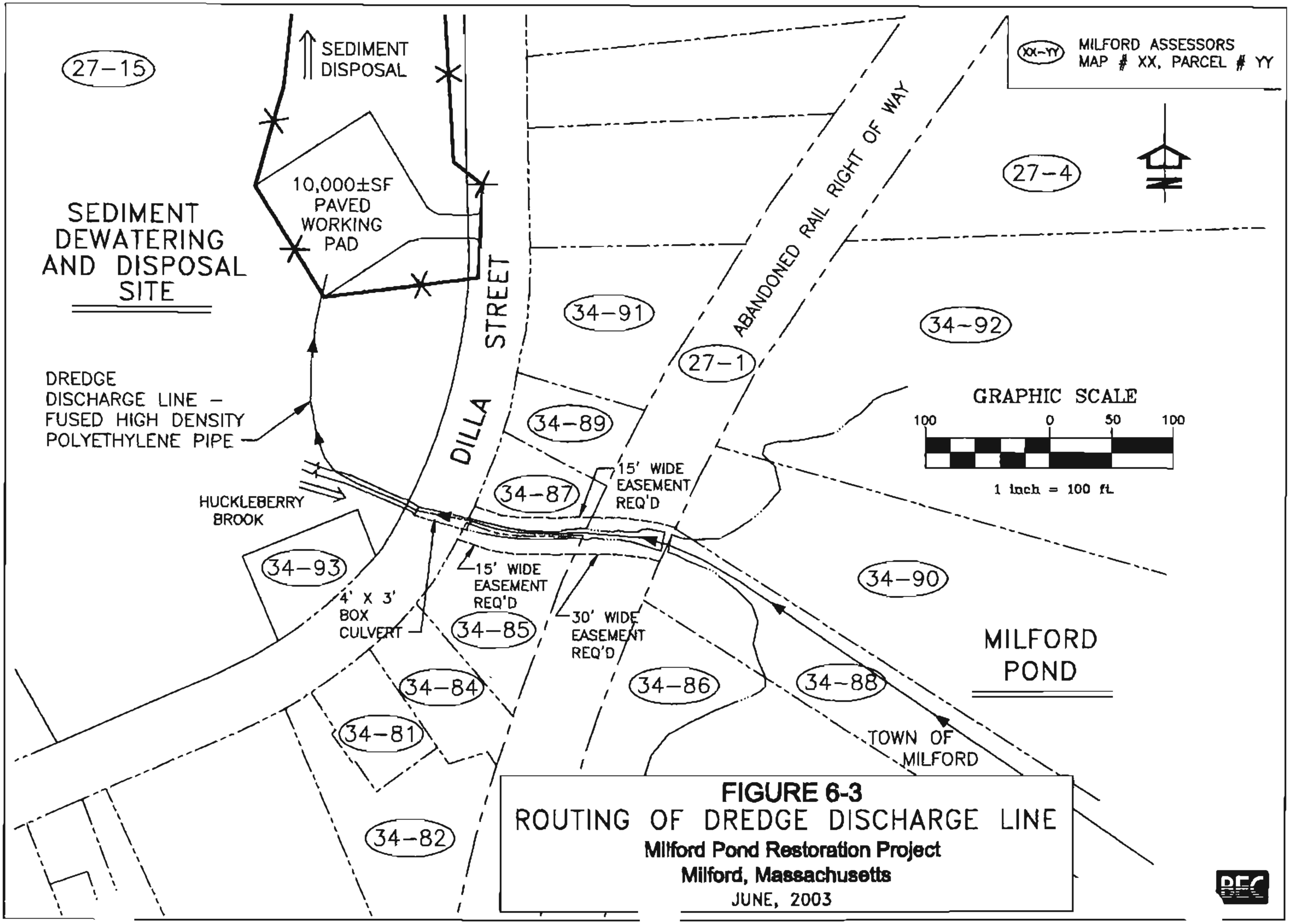


FIGURE 6-3
ROUTING OF DREDGE DISCHARGE LINE
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

6.6 Project Costs

Table 6-2 presents the estimated costs for the NER/Locally Preferred Plan, the partial hydraulic dredging of 45± acres of Milford Pond.

Table 6-2. Estimated Restoration Costs, 45± acres of Milford Pond Basin

Item	Quantity	Units	Total Cost
Engineering, Dam Inspection			$9,250
Mobilization			$26,000
Construct Dewatering Area	14,000	SF	$231,000
Weed Harvesting	20	AC	$121,000
Dredging	400,000	CY	$4,484,000
Closeout Dewatering Area	14,000	SF	$79,000
Demobilization			$8,100
		Subtotal	$4,958,000
		Contingencies (25%)	$1,240,000
		S&A (6.5%)	$403,000
		E&D (2.0%)	$132,000
		Subtotal	$6,732,000
		Real Estate	$736,000
		ERR/EA & Plans & Specification Costs	$390,000
		IDC	$317,000
		Total Project Cost	$8,176,000

7 Non-Federal Responsibilities

7.1 Cost Allocation and Apportionment

A non-Federal sponsor is required to provide at least 35 percent of the implementation costs of Section 206 aquatic ecosystem projects. Implementation costs include preparation of this report, preparation of the project plans and specifications, and construction of the project. The provision of work in-kind can be credited against the sponsor's cost-sharing requirement as specified under EC 1105-2-214, paragraph 12.b, which states, "For section 206 projects, the entire non-Federal share of the total project cost may be credited work in-kind". The Town of Milford is the acknowledged non-Federal sponsor for this project and expects that the 35 percent non-Federal contribution requirement will be met with a combination of funding obtained from the Commonwealth of Massachusetts through its Department of Conservation and Recreation (formerly the Department of Environmental Management), funding provided by the Town, work in-kind provided by Town forces, and by the value realized by use of the Town-owned sediment dewatering and disposal site.

Results from the sediment analysis indicate that the contaminant concentrations were low for most metals in comparison to non-urban soil concentrations for Massachusetts and the only metals that were found in levels exceeding the MA DEP's Background concentrations for non-urban soils concentrations were barium, cadmium, mercury, zinc and selenium. However, costs associated with contaminated sediment disposal will be born by the Town of Milford, the local sponsor.

At this time, the costs for the feasibility studies, plans and specifications, and construction costs are estimated as shown in Table 7-1.

Table 7-1. Total Project Costs and Non-Federal Share

All Implementation Costs		
Preparation of this Report (ERR/EA)		$ 245,000
Plans & Specifications		$ 145,000
Construction & Real Estate		$7,786,000
Monitoring Costs (18 months)		$ 3,000
	Total	**$8,179,000**
Non-Federal Responsibilities (35 percent share)		
LERRD		$ 736,000
Cash/In-Kind		$2,443,000
	Total Non-Federal	**$3,179,000***

*** The Total Cost ($8,179,000) exceeds the current program limits (Fed share not to exceed $5 million for a Section 206 Project), thus the local sponsor would be responsible for 100 percent of the cost over the Project limit.**

7.2 Financial Analysis

The Non-federal sponsor for this project will be the Town of Milford. The Town has acknowledged their cost share requirements in a letter from the Board of Selectmen and the Milford Pond Restoration Committee, dated September 10, 2001 (see Appendices). The Town expects to pay for their share with assistance from the Massachusetts Department of Conservation and Recreation (formerly MADEM), local funds, and the cost share credit they will receive for LERRDs.

8 Schedule for Accomplishments

A 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
Public Notice Period/Response	December 04-February 2005
Finding of No Significant Impact	February 2005
Project Approval by Division	March 20054
Initiate Design Plans & Specifications	April 2005
Obtain State & Local Permits	October 2005
Execution of Project Cooperation Agreement	December 2005
Bid and Award	March 2006
Initiate Construction	
Phase I Dredging	Summer-Fall 2006
Phase II Dredging	Summer-Fall 2007
Phase III Dredging	Summer-Fall 2008
Cleanup and Stabilization of Dewatering and Disposal Site	Spring 2009
Completion of Construction	Spring 2009
Monitoring	Spring 2009 thru Fall 2011

A list of potential permits required for the Recommended Plan has been provided. A Request for Determinations are underway for the Chapter 91 License and NPDES permit.

1. MEPA Certification from MA Executive Office of Environmental Affairs
2. Order of Conditions pursuant to the MA Wetlands Protection Act - Milford Conservation Commission
3. Section 404 Permit – USACE
4. Section 401 Water Quality Certification - MA DEP
5. Chapter 91 License - MA DEP
6. General Permit to Discharge Storm Water from Construction Site (NPDES) – US EPA & MA DEP
7. Special Permit for Processing Site (?) - Milford Planning Board

9 Findings, Conclusions, and Recommendation

9.1 Findings and Conclusions

The aquatic fisheries habitat of Milford Pond is currently degraded due to shallow depths, dense weeds and low dissolved oxygen in the water over much of the pond area. If no action is taken, areas of extremely dense emergent and floating leafed vegetation will continue to expand, rapidly converting open water areas to choked aquatic habitat and increasing emergent marshland. This transformation will further diminish warm water fisheries habitat, as well as degrade the functions and values of the remaining emergent wetland which currently supports nesting habitat for avian waterfowl, which are equally dependent upon the open water habitat for feeding.

Environmental benefits of restoring Milford Pond by dredging a portion of the pond are identified in this Feasibility Study. Dredging 45ρ acres of the 120ρ acre pond would increase depths and reduce aquatic macrophyte growth throughout selected areas of the pond, supplying deep open water areas while allowing some shallow, weedy pond habitat to remain. The presence of both deep, open water and shallow, weedy areas provides the optimal habitat for a diverse fisheries population and other wildlife, such as aquatic birds and mammals. Removal of the aquatic weeds and nutrient rich sediments would also increase ambient water quality by decreasing the potential for dissolved oxygen depletion and sources of nutrients within Milford Pond. Project implementation provides for a net gain of approximately 18 habitat units compared to the without project condition. Dredging a 45ρ acre area of Milford Pond, as preferred by the sponsor, the Town of Milford, is the recommended alternative.

National Environmental Policy Act (NEPA) documentation required for implementation of the proposed actions, in the form of an integrated Environmental Assessment (EA) and a Finding of No Significant Impacts (FONSI), is included in this report.

9.2 Recommendation

It is recommend that the habitat restoration project described in this report be approved and implemented under the authority of Section 206 of the Water Resources Development Act of 1996 (PL 104-303). The total estimated cost of the project is $8,179,000.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are authorized for implementation funding.

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Finding of No Significant Impact

Milford Pond Aquatic Restoration Project
Dredging of Milford Pond
Milford, Massachusetts

The proposed Federal action involves the dredging of approximately 45 acres of Milford Pond in Milford, Massachusetts, in order to deepen the pond to approximately 12 feet and remove the excessive aquatic vegetation and associated sediment. The excessive vegetative growth has eliminated most of the open water habitat and has degraded water quality in the pond. Work is authorized under Section 206 of the Water Resources Development Act of 1996 (WRDA). Approximately 400,000 cubic yards of fine sediment will be removed from Milford Pond, and disposed of at a previously disturbed upland disposal area north of Milford Pond. This will restore open and deepwater habitat to the pond while reducing the amount of nutrient rich sediments, which contribute to the excessive growth of aquatic vegetation. This is expected to benefit both fish and waterfowl. Deepwater areas of the pond will be restored as fish habitat, and water quality is expected to improve due to the removal of the excess vegetation and organic sediment. In addition, open water areas of the pond will be restored for use by waterfowl.

The material will be removed using a Mud Cat hydraulic dredge, and pumped to an approximately 10-acre dewatering and disposal area on the northwest corner of the pond. Dewatering of the material will be done mechanically, using a belt filter press, which removes most of the water from the sediment, and allows transport of the dredged material much sooner than would normally occur without this process. The excess water is returned to the pond, following removal of any remaining suspended solids. The dewatered material will then be distributed over the adjacent 10-acre site. Work is expected to occur on or after the spring or early summer of 2005, at a time that would have the least effect on existing fisheries and wildlife resources. It is anticipated that the project will be completed in one season. No significant long term or short-term adverse impacts to the environment are anticipated.

My determination of a Finding of No significant Impact is based on the Environmental Assessment and the following considerations:

a. The project will restore a degraded aquatic habitat, and increase the fisheries carrying capacity of the Milford Pond ecosystem.

b. The project will have no known negative impacts on any State or Federal rare or endangered species. The dredging will be limited primarily to the open water areas of the pond, leaving the margins and associated wetlands intact. This will maintain the existing habitat for the state listed king rail, common moorhen, pied billed grebe, and least bittern which inhabit the adjacent cattail marsh/emergent wetland. Additionally, construction activities will be conducted during designated windows to minimize potential adverse affects to these species.

c. The project will have no known negative impacts on any prehistoric archaeological sites recorded by the State of Massachusetts.

d. Sediment loading would be minimized by employing erosion control plans and by scheduling the construction during the seasonal low flow/low water period. Detailed erosion control measures will be in place prior to construction activities including those in the water to minimize turbidity.

e. The dredging is not expected to encroach on any of the fringing wetlands, and an extensive buffer strip along the perimeter of the pond will be left intact.

f. The existing water level in the pond will be maintained in order to avoid impacts to existing fisheries, waterfowl and adjacent wetland habitat.

g. Per request of the Town, the dredged material will be stored at the designated site (off Dilla Street) and will be reused by the Town.

Based on my review and evaluation of the environmental effects as presented in the Environmental Assessment, I have determined that the Milford Pond Aquatic Ecosystem Restoration Project is not a major Federal action significantly affecting the quality of the human environment. Therefore, I have determined that this project is exempt from requirements to prepare an Environmental Impact Statement.

Date	Thomas L. Koning Colonel, Corps of Engineers

DRAFT

ENVIRONMENTAL ASSESSMENT

FOR

THE AQUATIC HABITAT RESTORATION

OF

MILFORD POND
MILFORD, MASSACHUSETTS

US Army Corps
of Engineers®
New England District

DECEMBER, 2004

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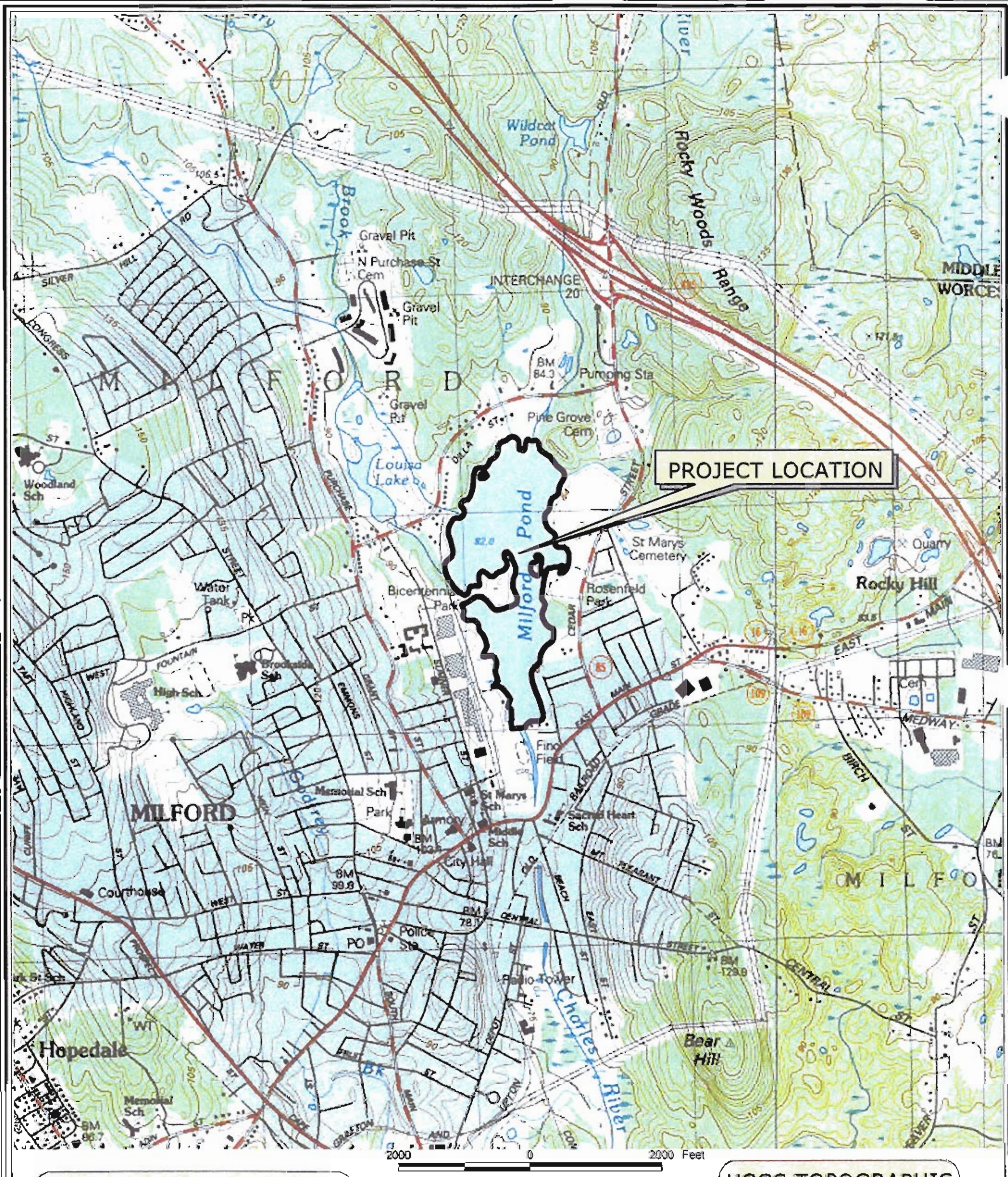
1 Introduction

Milford Pond is a 120± acre hypereutrophic pond located in the center of the Town of Milford, in Worcester County, Massachusetts, less than 1 mile south of I-495 (Figure 1-1). As an impoundment near the headwaters of the Charles River, Milford Pond has undergone significant degradation in environmental quality since its formation about 65 years ago. There has been a continual shift from open water aquatic habitat supporting recreational fisheries to a dense aquatic weed bed diminishing aquatic habitat quality and the development of extensive emergent marsh. While the other emerging habitats also have their appropriate place in the total ecosystem that forms Milford Pond environment, the accelerated pace of change due to human influences from unchecked storm water runoff and nutrient pollution has created an undesirable and unstable ecological shift that has degraded overall habitat quality.

This Environmental Assessment was prepared at the request of the Town of Milford, Massachusetts, to restore Milford Pond's habitat relative to fisheries and wetlands, striking a balance for this ecosystem located within an urban watershed. This assessment was conducted under the U.S. Army Corps of Engineers Continuing Authorities Program for Aquatic Ecosystem Restoration, Section 206 of the Water Resources Development Act of 1996. In addition, the Town of Milford has been committed seeking various means to improve the pond environment. This Environmental Assessment and the proposed improvements are one of several steps being initiated by the Town of Milford to improve the environmental conditions of the pond and to ensure that the restored habitat will be present for future generations to enjoy.

The dam that impounds Milford Pond is a small masonry dam, constructed in the period from 1938-1939 as a Public Works Administrative Project (No. Mass. 1446-F). The dam was built on the Charles River to combat flooding in the area, which historically contained a cedar swamp. This intermediate-sized dam, currently owned by the Town of Milford, is approximately 200 feet in length with a reported structural height of ±11 feet. Other inflows include Louisa Lake, Huckleberry Brook, intermittent streams, and 18-storm water overflow pipes. The pond outlet continues as the main channel of the Charles River, which flows through the Town of Milford and eventually to Boston Harbor. The pond has a watershed area of approximately 5,440 acres, over half of which is developed urban lands (southern, near-pond portion), with the remainder being composed of light residential development and wooded areas (northern section).

The maximum depth of the pond, which was 5 feet when the pond was formed, has decreased to approximately 2 feet today. The shallow depths of the pond, in conjunction with the thick peat deposited by the cedar swamp, have resulted in an extensive macrophytic community. Emergent vegetation is decreasing the open water habitat, and the pond is slowly reverting to a marsh.



MILFORD POND HABITAT RESTORATION PROJECT
MILFORD, MASSACHUSETTS

USGS TOPOGRAPHIC QUADRANGLE MAPS
MILFORD, 1982 &
HOLLISTON, 1987

BAYSTATE ENVIRONMENTAL CONSULTANTS, INC.
EAST LONGMEADOW, MASSACHUSETTS 01028

FIGURE 1-1: LOCUS MAP

In the 1940's and 1950's, Milford Pond was a fisheries resource for local sportsmen who caught "horn pout" (brown bullheads), largemouth bass, and bluegill sunfish. As of 1989, these species were still present in Milford Pond. Nevertheless, the density of the emergent vegetation has contributed to the decline of warm-water fishery in Milford Pond. The low flow through the majority of the pond, as well as thick ice and snow in winter contributes to annual winter fish kills, and summer fish kills occur due to the decomposition of organic matter creating anoxic conditions. However, it is equally realized that the emergent marsh environments are a valuable resource, potentially serving as habitat for four State-listed bird species, according to the Massachusetts Natural Heritage and Endangered Species Program (MA NHESP). Therefore, it is critical that any holistic habitat restoration for the pond seek an appropriate balance between the wetland, marsh, and open water habitats that have always comprised Milford Pond.

In addition to witnessing the rapid decline in the habitat quality of the pond, especially relative to fisheries, Milford Pond is evolving into a nuisance resource to the Town residents. The overgrowth of weeds is aesthetically unappealing and inhibits the use of the pond as a recreational resource. Many town residents recall a time when the pond provided opportunities for fishing, boating, swimming and ice-skating and have a strong desire to see these uses restored. The Milford Pond Restoration Committee (MPRC) was formed in 1994 to direct efforts in restoring Milford Pond as a valuable aquatic habitat and social resource.

Alternatives evaluated in this Environmental Assessment (EA) for the habitat restoration of the Milford Pond ecosystem ranged from dredging to removal of the dam:

- Full dredging of the entire 120± acre pond,
- Dredging 45± acres,
- Dredging 20± acres,
- Dam removal, and
- Dam removal with dredging of 45± acres.

The alternatives were evaluated by considering both the environmental benefits and impacts, and the social resources associated with Milford Pond.

The dredging component of each of the alternatives would seek to restore at least a portion of the pond to a depth that would inhibit or prohibit growth of rooted aquatic macrophytes, and would result in the removal of nutrients that are associated with the shallower, culturally deposited sediments. This would remove the infestation of aquatic vegetation and restore an area of open water beneficial to the establishment of a healthy warm-water fishery. In addition, this would allow at least a portion of the pond to be used by the Town residents for recreational purposes. The degree of open water restoration and effects on emergent marshland areas would depend on the dredging alternative chosen.

The alternatives considering the removal of the existing dam would allow the area to drain and revert entirely to a swamp, with a narrow remaining shallow channel for the Charles River. This alternative would seek a different type of habitat improvement with the establishment of a riverine aquatic habitat and emphasis on emergent wetlands, as opposed to a balance between warm water lacustrine fisheries habitat juxtaposed with emergent wetland habitat. An emergent marshland habitat would dominate the system (most likely extending from the existing cattail dominated marsh in the southwest quadrant of the original pond basin), developing on deep organic sediments that have filled in the pond. Stream flows for the Charles River, Huckleberry Brook, and storm water inputs would cut into the sediments to establish new stream channels, which would emerge and develop over several years until relatively stable channels emerged. This alternative would drastically alter the hydraulic properties of the aquifer located beneath Milford Pond, from which the Milford Water Company extracts drinking water. In addition, significant alteration of wetland resources, loss of rare species habitat for wading birds and waterfowl, and potential invasive wetland plant dominance in newly exposed marsh habitat, are among environmental challenges associated with this alternative.

2 Project Authorization

In April 2001, the Town of Milford and Congressman Richard Neal requested assistance from the Army Corps of Engineers (ACE) under Section 206 of the Water Resources Development Act of 1996 (Aquatic Ecosystem Restoration Program). The request followed the completion of a study by the Town of Milford in July 2000, which laid out a multi-component and tiered approach to improve Milford Pond and the upper Charles River watershed. The ACE responded to this request by initiating an Environmental Assessment for Milford Pond to develop an Aquatic Ecosystem Restoration project for the waterbody. The objective of this Aquatic Ecosystem Restoration project is to restore the Milford Pond's ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. The following Environmental Assessment addresses the impacts of dredging Milford Pond or removing the dam in accordance with the National Environmental Policy Act of 1969.

3 Project History

The Town of Milford has been actively engaged in the study and remediation of Milford Pond since the late 1970's, when a diagnostic study was done for the pond (Carr Research Laboratory 1979), followed by a more formal diagnostic and feasibility study performed in the mid-1980s (IEP, 1986). Both of these earlier studies identified the obvious fact that Milford Pond has undergone significant degradation in environmental quality since its formation about 65 years ago. There has been a continual shift from open water aquatic habitat supporting recreational fisheries to a dense aquatic weed bed diminishing aquatic habitat quality and the development of extensive emergent marsh. Both of the early studies recommended dredging as the only option if the utility of the water body was to be restored. In 1994, the Milford Pond Restoration Committee was formed and in recent years, several studies to determine the feasibility of restoring Milford Pond have been conducted. More recently, a dredging feasibility study was performed (BEC 2000), also identifying storm water and watershed improvements necessary for the preservation of the pond.

Milford Pond, originally known as Cedar Swamp Pond, was historically a cedar swamp located in the headwaters of the Charles River. The swamp was formed due to the presence of a small waterfall at the swamp's southerly boundary, which acted as a grade control for the riverbed, forming a topographical barrier. As Milford was settled, the lands surrounding the northern portion of the swamp were cleared for farmland, while lands surrounding the southern portion developed into the Town of Milford. Cedar Swamp was considered a valuable community asset by early colonists and was divided into small proprietary allotments, which ensured each individual landowner a small share. Lumber from the large cedar trees found in Cedar Swamp was highly prized for its durability. Sawn logs were used in the construction of log cabins and for charcoal production. Early Milford Pond shoreline development included the construction of an iron foundry on the southwestern shore, a rail line along the western shore, and the placement of a cemetery on the northeastern shore. A town landfill, now known as Plains Park, was developed to the south of the cemetery on the northeastern shore of Milford Pond. An icehouse reportedly operated for a number of years along the southeasterly shoreline of the pond. In time, the cedar swamp was converted into a pond through the cutting of trees and the construction of an impoundment above the small waterfalls along the Charles River. The present dam, which was constructed circa 1938 partly in response to severe flooding in 1936 and 1938, raised the water level within the swamp and created the shallow pond that exists today. The maximum depth of the pond when it was formed was five feet.

In the 1940's and 1950's, Milford Pond was utilized by local residents for fishing, boating, swimming and ice-skating. Recent decades have witnessed a decline in water quality and depth (from 5 feet to 2 feet, on average), the proliferation of aquatic weed species, and a significant decrease in the value of the pond's aquatic habitat. The degraded state of the pond has existed since the late 1970s.

While the other emerging wetland habitats provide valuable wildlife habitat in the Milford Pond environment, the accelerated pace of change is the direct result of human influences from unchecked storm water runoff and nutrient pollution. These factors have combined to create an undesirable and unstable ecological shift that has degraded overall habitat quality.

In November of 1998, a meeting of the Milford Pond Restoration Committee was held to discuss and review the progress being made. The history and past use of the pond was discussed. BEC indicated that hydraulic dredging will likely prove the preferred dredging methodology, and a potential containment area was identified adjacent to the pond along Sumner Street. The sediment-sampling program, scheduled for December, was partially completed when poor weather conditions and thin ice prevented further exploration by boat. In January, the sediment sampling (from the ice) and physical and chemical testing were completed.

In numerous meetings with the Restoration Commission, the Milford Pond Restoration Project was initially developed to include approximately 37 acres of pond area, and included dredging to a maximum depth of 12 feet to minimize the pond bottom area within the photic zone and thus minimize dense growth of rooted vegetation. Hydraulic dredging was identified as the most practical methodology to accomplish the desired pond bottom contours, due to the lack of a firm substrate upon which to operate standard excavating equipment, the difficulty of maintaining a dry working environment in the pond, and to avoid the extreme environmental impact a long-term pond drawdown would represent.

An interim report conceptualizing the restoration project was presented at a public meeting of the Milford Pond Restoration Committee in March of 1999. In the following months, BEC and the Restoration Committee refined many of the project elements and thoroughly explored potential sites for containment basins for dewatering of the dredged material prior to disposal. Several locations were considered over the summer of 1999, but each of the potential containment basin sites was eliminated from consideration due to a number of technical and economic factors beyond the Town of Milford's control. The Milford Pond Restoration Committee decided to move forward with the project development using mechanical methods such as belt filter presses to dewater the dredged materials. This methodology has proven to impart the required level of dewatering while requiring minimal land area.

Following their review of the conceptual restoration project, MADEM officials recommended that the project include a significant storm water management component in order to provide additional water quality improvements within Milford Pond. Consequently, the numerous storm water inputs to the pond were individually reviewed and Best Management Practices (BMPs) are now proposed at selected outfalls.

In November of 2000, BEC submitted the *Environmental Notification Form (ENF) on the Restoration of Milford Pond*. Several responses to the ENF from Milford Town residents documented support of the proposed restoration project. The Charles River Watershed Association (CRWA) also provided support to the project in a letter dated December 12, 2000. The CRWA agrees that restoring some areas of open water in Milford Pond and improving recreational potential is important for both the community and the watershed. All response letters to the ENF are included in Appendix C.

The Town is currently working with the U.S. Army Corps of Engineers Continuing Authorities Program for Aquatic Ecosystem Restoration, Section 206 of the Water Resources Development Act of 1996 to arrest the undesirable habitat degradation and restore aquatic and wetland habitats into an appropriate balance to ensure that the restored habitat will be present for future generations to enjoy.

4 Purpose and Need

Today, Milford Pond is extremely shallow with an average depth of less than two feet, as compared to its original average depth of five feet. The historic cedar swamp led to a thick peat layer at the bottom of the pond that provides nutrients for vegetation. In addition, sediments are deposited in the pond via runoff from the urban and wooded watershed, introducing additional nutrients that create eutrophication and impair water quality in the pond. Areas of extremely dense emergent and floating leafed vegetation continue to rapidly convert open water areas to choked aquatic habitat and increasing emergent marshland, a process that if left unimpeded will eventually transform virtually the entire pond to wet meadow and swamp. This transformation will drastically reduce or eliminate warm water fisheries habitat, which currently exists in a degraded state, and also degrade the functions and values of the remaining emergent wetland which currently supports nesting habitat for avian waterfowl, including State protected rare species, which are equally dependent upon the open water habitat for feeding habitat.

Historically, Milford Pond was an important community resource serving as the centerpiece of the Town's recreational complex. Today, recreational activities on Milford Pond are restricted due to eutrophication, sedimentation, and aquatic macrophyte and emergent vegetation growth. The aesthetic values of Milford Pond are significantly impaired due to decreased access, loss of open water habitat, and odors caused by decomposing vegetation. These issues have been a regular complaint of neighbors and patrons of the many municipal parks and open spaces, which surround the pond. Due to the severe level of degradation, the Board of Health has become involved in these issues.

The restoration of the environment of Milford Pond requires a balancing of the aquatic habitat with the emergent marsh wetland habitat. Currently, approximately 25% of the 120-acre pond basin has developed as emergent wetland growth with about 70% of the area supporting dense aquatic weed beds. Only about 5% remains in relatively unimpeded open water within the deepest central locations, although even most of this area has a relatively high density of aquatic weeds. Typically, a roughly equal split between freshwater wetlands and open water habitat is a desirable goal for these resources, with the open water areas including a significant portion with a dense aquatic weed bed to provide a protective cover function for developing juvenile fish. The recreation and stabilization of open water habitat component of Milford Pond, either by dredging or dam removal, is necessary for the health of aquatic and wetland communities and the improvement in water quality and aesthetic value. The restoration of either a lacustrine or a riverine fisheries habitat would benefit the local environment. If No Action is taken, the current condition will continue to be degraded and most likely worsen. Eventually the area would convert to an emergent marsh with the loss of the open water habitat. During the process, there would be a continuation of the degraded water quality and aesthetically poor conditions. Although the succession to an emergent marsh would present an alternate ecosystem with a change in habitat and species composition, the loss of the open water habitat would negatively affect not only the existing fisheries, but also the avian wetland and waterfowl species that inhabit the area. As noted previously, these include several State protected rare species that require a balance of emergent vegetation adjacent to areas of open water for their habitat (i.e. King Rail, Pied Billed Grebe, Least Bittern, and Common Moorhen; see Incremental Analysis for further discussion). With the loss of open water, their habitat would be significantly reduced and/or eliminated. Therefore, the value of restoring the wetland and open water habitat would be preferable in this location due to its potential to support a diverse ecosystem, which includes fish, wetland species, and waterfowl.

In addition, the improvements in water quality will likely have a positive effect upon downstream water quality within the Charles River. The future development of the Milford portion of the regional Upper Charles Trail, the recent creation of Plains Park, and increased usage of existing recreational facilities have stimulated a revival of the Milford Pond recreational complex. The successful restoration of Milford Pond would allow Milford Pond to resume its role as a valuable community resource and focal point.

The restoration of Milford Pond requires compliance with various wetlands and water quality permitting authorities:

- MA Executive Office of Environmental Affairs – MEPA Division – Mandatory EIR
- MA Wetlands Protection Act (local approval);
- Section 404 of the Clean Water Act as administered by the Army Corps of Engineers;
- Section 401 of the Clean Water Act as administered by MA DEP.

All of these permitting authorities will be sensitive to the need to protect wetland resources and habitat for State-listed rare species, thereby placing greater impetus on the need to balance aquatic habitat restoration with a total habitat improvement for the total Milford Pond ecosystem. In addition, the Town of Milford fully recognizes the need to proactively seek opportunities to preserve Milford Pond following restoration by aggressively managing storm water runoff and development within the watershed to the pond. Several measures involving storm water improvements, increased regulation of storm water, and public education are a part of the overall Milford Pond improvements being sought both within and outside of the restoration effort that is part of this Environmental Assessment.

5 Project Description

The Town of Milford is proposing to restore a portion of the 120± acre Milford Pond by hydraulically dredging up to 400,000 cubic yards of accumulated sediment and organic deposits from the pond bottom (). This volume represents the removal of unconsolidated organic sediments from the existing bathymetry down to a maximum depth of twelve feet (12') within an anticipated dredging area of 45± acres. The pond bottom to be excavated contains nutrient-rich soft organic sediments (muck) that have accumulated over recent years, reducing pond depth and allowing for a substantial increase in aquatic plant density and percent cover that severely impacts the warm-water fishery of the pond.

The limits of the dredging project have been established to avoid impacts to important aquatic and wetland habitats that have developed on the eutrophic lake. Only limited areas of the pond will be dredged to avoid impact to emergent wetland vegetation and potential habitat for waterfowl and wading birds, including State-listed rare species. Dredging is proposed to extend from the outlet dam northerly, to a point slightly north of Clark Island. The existing emergent vegetation areas along the westerly boundary of the dredge limits are proposed to remain unaltered except for the area immediately surrounding the Town swimming pool in the southeasterly corner of the pond. The removal of vegetation in this area is justifiable in terms of the existing disturbance of this area by the existing swimming pool development as well as the need to eliminate safety and health issues associated with the dense vegetative growth immediately adjacent to the pool area. The overall project will continue to balance the maintenance of emergent marsh areas with large expanses of dense aquatic vegetation, and deeper open water areas. Almost all of the dense aquatic vegetation will be left untouched in the northern end of the pond to protect the Milford Water Company well fields. The dimensions of the resulting open water area will be approximately 3,400 feet long with an average width of approximately 500 feet.

The hydraulic dredging process will pump the organic sediments in a slurry state to a mechanical dewatering site, as containment sites are not readily available. The mechanical dewatering site will be located north of Milford Pond on the opposite side of Dilla Street, to the east of the upgradient Louisa Lake (). The dewatering site will also serve as the disposal site, although the Town anticipates beneficial use of the material over time as a soil supplement. The site is a 20± acre parcel located north of Milford Pond on the north side of Dilla Street, to the east of Louisa Lake and the west of Monhegan Circle, a subdivision ending in a cul-de-sac. The parcel is generally rectangular in shape, with the long axis extending northward from Dilla Street. The disposal site is in Town of Milford ownership and has been partially used for sand excavation, equipment storage, and earth materials. The site is partially cleared with a dirt roadway extending the length of the parcel from south to north. The remainder of the site is wooded wetlands or uplands.

With mechanical dewatering, the dredged materials will be pumped by the dredge to storage tanks located in the dewatering area on shore. Mechanical mixers will maintain the

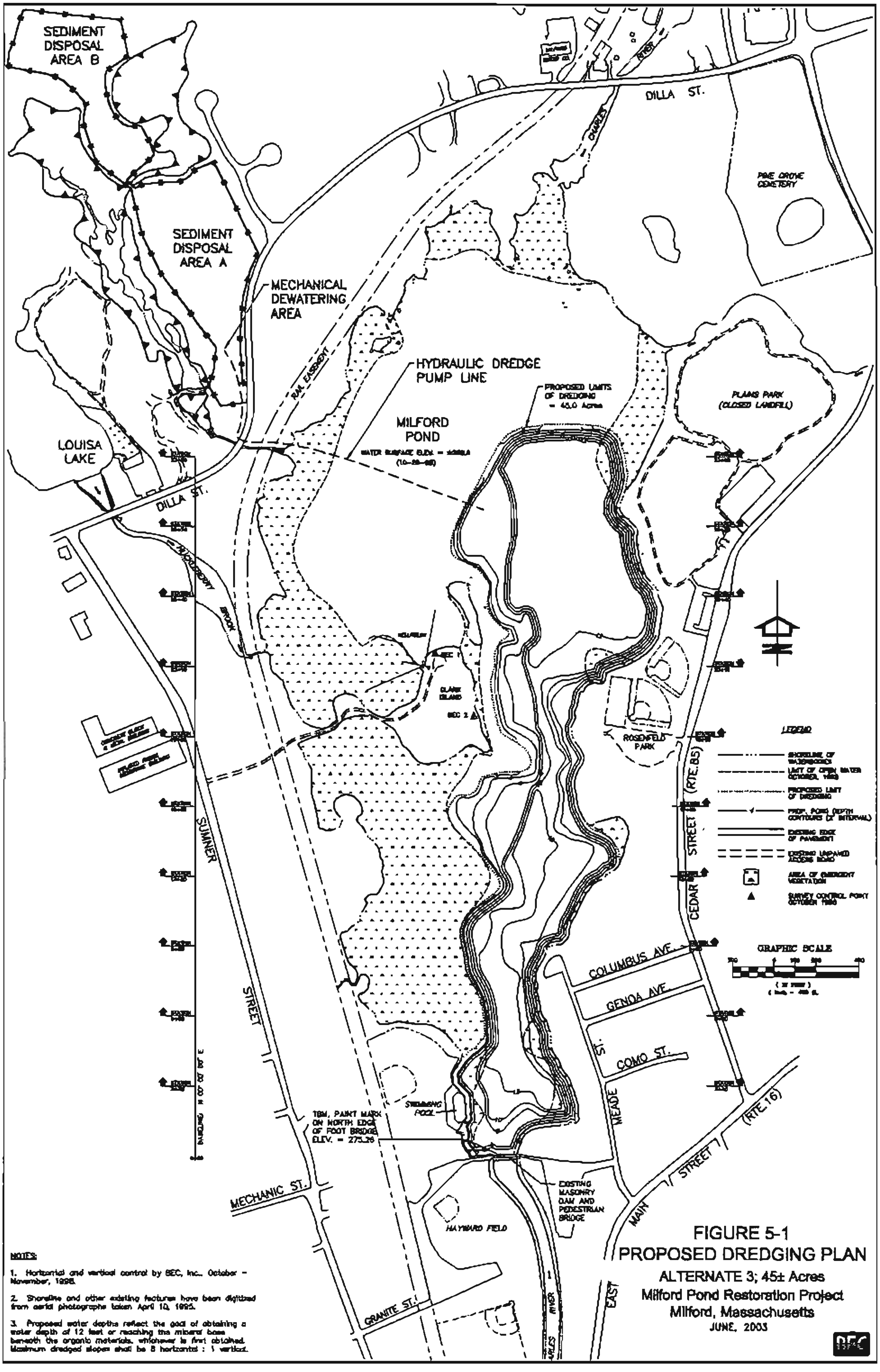


FIGURE 5-1
PROPOSED DREDGING PLAN
ALTERNATE 3; 45± Acres
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

NOTES:

1. Horizontal and vertical control by BEC, Inc., October – November, 1998.
2. Shoreline and other existing features have been digitized from aerial photographs taken April 10, 1995.
3. Proposed water depths reflect the goal of obtaining a water depth of 12 feet or reaching the mineral base beneath the organic materials, whichever is first obtained. Maximum dredged slopes shall be 8 horizontal : 1 vertical.

sediments in suspension in the tanks. The slurry will then be pumped from the tanks to several trailer-mounted mechanical dewatering units located nearby. The continuously operated tanks serve as a buffer or waiting area between the dredge and the dewatering units. Each dewatering unit will likely consist of a belt filter press, with a gravity or rotating thickening unit, sludge pumps, flocculent conditioning system, electrical motor controls, and chutes to discharge the dewatered materials. A polymer flocculent will be added to the sludge immediately before it enters the dewatering unit. The polymer attaches to the solids in the slurry through an electrical and chemical bond, allowing the free water to separate more easily from the solids. The water is then pressed from the solids, which are strained by the filter belt. The excess water, or filtrate, will contain minimal amounts of residual solids as it is returned to the pond.

6 Alternative Analysis

The two principal problems in the Milford Pond ecosystem that have adversely affected overall habitat quality are:

- Loss of water depth within the pond due to sediment infilling and organic accumulation; and
- Excessive aquatic and emergent macrophyte growth, which has choked the remaining open water and diminished aquatic habitat values, but not added comparable wetland wildlife habitat value.

In order to fashion potential management solutions for Milford Pond, alternative strategies were evaluated to restore balance to the aquatic and wetland habitat potential. The various alternatives were developed, reviewed and selected by the Milford Pond Restoration Committee, which has worked over the past decade to further the efforts to restore this important waterbody as a community resource.

The objectives of the habitat restoration for the Milford Pond ecosystem are as follows:

1. Restore areas of open water aquatic habitat with a depth sufficient to discourage dense aquatic weed growth;
2. Enhance total aquatic habitat for fin fish species;
3. Preserve habitat values for waterfowl, including State-listed species; and
4. Restore a balance between open water aquatic habitats, the dense aquatic weed beds, and emergent wetlands.

The constraints on the habitat restoration project include:

1. The need to avoid adverse impacts to the Clark Island Well Fields, which are part of the Town of Milford's community water supply; and
2. The refusal of the Town of Milford to participate in an alternative which would not result in the restoration of Milford Pond as a community resource providing recreational opportunities, including fishing, boating, swimming and ice-skating.

Six alternatives have been identified relative to the restoration of overall habitat:

1. No Action,
2. Complete deepening (dredging) of the entire 120± acre pond,
3. Deepening (dredging) 45± acres,
4. Deepening (dredging) 20± acres,
5. Dam removal, and
6. Dam removal with deepening (dredging) of 45± acres.

Each of these alternatives is discussed individually in the sections below. However, some elements are common to all of the dredging alternatives, including the methodology and depth of dredging. Dredging can be an effective technique to restore aquatic habitat where the quality has been compromised by excessive sediment accumulation, which has supported excessive aquatic macrophyte growth. Dredging removes the accumulated, nutrient rich surface sediments of a lake and any attached plant material, simultaneously restoring waterbody depth and removing the surficial sediments, which accelerated the excessive macrophyte growth. Dredging by dewatering the pond and conventional excavation would not be feasible due to the deep organic sediments extending below the proposed dredging depth of 12 feet and the use of a surface aquifer beneath the pond for a drinking water supply. Therefore, hydraulic dredging would be utilized as the appropriate methodology for dredging the pond under this and all of the dredging alternatives. Due to space limitations, all of the dredging alternatives would utilize mechanical dewatering using belt filter press technology to manage the hydraulically dredged material, allowing dewatering and return flow to the pond of clean water. The hydraulic dredging process will pump the organic sediments in a slurry state to a mechanical dewatering site, as containment sites are not readily available. The mechanical dewatering site will be located north of Milford Pond on the opposite side of Dilla Street, to the east of the upgradient Louisa Lake. The site is a Town owned parcel, partially disturbed with prior excavation, quarrying and mechanical equipment storage. The undisturbed portions include wooded uplands and wetlands.

In dredging projects with the objective of reducing aquatic vegetation growth, it is typically important to remove all of the soft organic and nutrient-enriched bottom sediments to a depth that no longer supports plant regrowth due to limitations of light penetration. In Milford Pond, this would not be feasible, cost effective, or environmentally beneficial to remove all of the organic sediments where they extend below the photic zone. Prior experience has shown that vegetative regrowth of aquatic macrophytes following dredging is inhibited by about 25-75% when nutrient poor inorganic substrates are exposed as the pond bottom by removing the nutrient rich soft accumulated organic sediments, and by increasing the water depth to diminish light penetration to the bottom. While organic bottom sediments will remain in the pond area greater than 12 feet in depth, these sediments likely represent the original wetland soils that had developed prior to the impoundment of Milford Pond. These sediments likely have lesser, less labile nutrient content and will contribute far less to the overall nutrient budget of the dredged pond. The more labile, nutrient rich sediments will have been removed with the dredging. However, in shallower areas, regrowth can continue to be excessive in conditions where high nutrient content surface waters continue to flow through the waterbody. Given the high nutrient loading from the watershed to Milford Pond, it can be expected that additional occasional management efforts for aquatic macrophytes will also be necessary beyond the initial dredging. The three dredging alternatives evaluated differ in their areal extent: 21 acres, 45 acres, and the entire pond basin. The two smaller dredging alternatives were selected by the Milford Pond Restoration Committee based upon the practical geographical configuration of the pond, where Clark's Island formed a natural dividing point of the overall pond basin, as well as environmental constraints associated with the other wetland resource types that have developed within the pond basin.

For all alternatives except dam removal, a full inspection of the dam will be necessary.

6.1 No Action

The "No Action" alternative describes the most likely future condition that could be expected if no alternative is selected for implementation. The without-project condition is the most likely condition expected to exist in the future in the absence of any developed alternative, including known changes in law or public policy. The "No Action" alternative assumes that all efforts for the restoration of Milford Pond would cease. Such an alternative cannot achieve the goals and objectives of the Milford Pond Restoration Program. Milford Pond is a eutrophic lake with an average depth of less than two feet. Shallow depths allow dense communities of aquatic macrophytes to blanket the shallow pond bottom and grow throughout the water column. Fish kills occur in the winter due to thick ice and snow formation, and in the summer due to anoxic conditions created by the decomposition of organic matter. In its current state, Milford Pond does provide wildlife habitat for a variety of aquatic organisms living in emergent wetland and shallow pond communities. However, the fishery habitat value of Milford Pond is greatly reduced by the dense weeds and the low dissolved oxygen in the water resulting from decaying aquatic vegetation. In time, wetland successional processes will result in the gradual total filling of Milford Pond and conversion to emergent wetland community. This succession will result in further decreased areas of open water habitat, and continued loss of fish habitat, as well as loss of the waterfowl habitat, as noted previously. The No Build alternative, therefore, does not achieve any of the objectives of the Milford Pond ecosystem restoration, except for the protection of the Clark Island well fields, and results in the continued loss of fish habitat.

There will obviously be no costs associated with the implementation of the "No Action" alternative, except the lost opportunity cost associated with implementing one of the potential habitat restoration alternatives.

6.2 Complete Dredging of Pond Basin (Alternative 2)

This alternative would involve the full-scale dredging of the entire 120± acre pond basin using hydraulic equipment. Under this alternative, the proposed dredging program would dredge the entire pond to a depth of 12 feet, the maximum estimated depth of the photic zone (Figure 6-1). A full-scale dredging program would result in the restoration of open water habitat throughout the entire 120-acre pond basin. The immediate margins of the northern and western portions of the pond, as well as some cove areas would be preserved to avoid wetland habitat and preserve some of the littoral zone vegetation. In addition, Clark Island Well Field would not be included within the area of dredging to avoid any direct impact to the well field.

From an engineering perspective, the full scale dredging of Milford Pond is a technically feasible, but costly scenario. This program would deepen the lake about 1-10 feet over about 95% of its surface area and would require the removal of about 1,000,000± cubic yards of organic sediments. An initial weed-harvesting program would be necessary immediately before dredging to allow efficient operation of the dredge.

This alternative meets several of the objectives for the habitat restoration of Milford Pond, but fails to meet others. This alternative restore the maximum areas of open water and would preserve some of the emergent vegetation areas within some of the coves, improving aquatic fin fish habitat by restoring water depth to the shallower portions of the pond as well as significantly reducing the existing aquatic macrophyte densities and the probable density of their regrowth. The regrowth of aquatic macrophytes at a lesser density within the shoreline littoral zone will undoubtedly occur and will restore beneficial warm water fishery habitat, providing an aquatic weed bed with significantly less density than currently occurs. Under this scenario, the total aquatic weed beds remaining may be somewhat less than optimal. In addition, dense aquatic and emergent wetlands would be removed near storm water inlets, where an existing water quality benefit is received by filtering the incoming storm water through the dense vegetation. This alternative would seek to protect the Clark Island Well Fields, by not dredging in their immediate vicinity. Nevertheless, this alternative would remove the greatest amount of organic material from the pond and would, therefore, have the greatest potential for an adverse impact, especially in the areas north of well fields, where there is presumed induced recharge from the overlying waters. Finally, this dredging alternative has the greatest potential for adverse impact on waterfowl habitat, including protected State-listed species, which are dependent upon the dense emergent vegetation and shallow aquatic weed beds for nesting and foraging habitat.

This dredging alternative, as well as the partial dredging alternatives discussed below, would require the use of a 20± acre Town-owned parcel for processing of the dredged materials. The site is located north of the pond, north of Dilla St. (Figure 6-1). Due to space limitations, all of the dredging alternatives would utilize mechanical dewatering using belt filter press technology to manage the hydraulically dredged material. The hydraulic dredging process would pump the organic sediments in a slurry state to storage tanks at the mechanical dewatering site. Mechanical mixers will maintain the sediments in suspension in the tanks. The slurry will then be pumped from the tanks to several trailer-mounted mechanical dewatering units located nearby. After removing the solids, clean water would be returned to the pond. The sediment volume in the peaty sediments of Milford Pond is decreased by about one-third by this process.

The project will use about 10 acres of the 20±-acre site, avoiding wetlands and providing necessary setbacks to control erosion and sedimentation. For the full pond dredging program, this site would not be able to contain the entire volume of sediments to be dredged from the pond and the Town would need to seek alternate placement or beneficial reuse of the material during the dredging program in order to minimize the storage area required

Sediments will be hydraulically dredged from the pond and transported by dredge pipeline to the sediment dewatering and disposal site. The dredge pipeline will extend from the pond to the site by being placed within the Huckleberry Brook channel and underneath

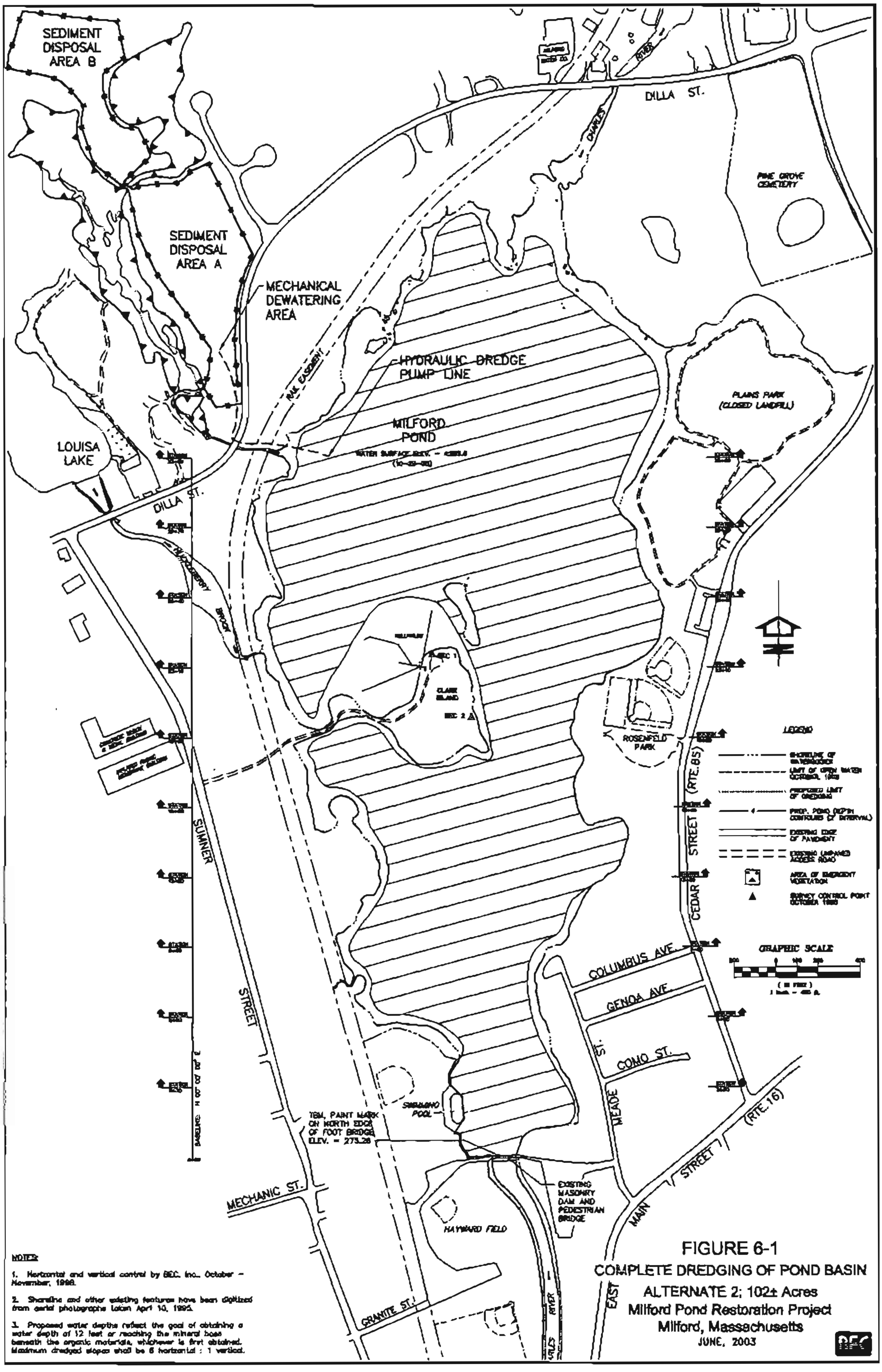


FIGURE 6-1
COMPLETE DREDGING OF POND BASIN
ALTERNATE 2; 102± Acres
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

NOTES:

1. Horizontal and vertical control by BEC, Inc., October – November, 1998.

2. Shoreline and other existing features have been digitized from aerial photographs taken April 10, 1995.

3. Proposed water depths reflect the goal of obtaining a water depth of 12 feet or reaching the mineral base beneath the organic materials, whichever is first obtained. Maximum dredged slopes shall be 6 horizontal : 1 vertical.

and underneath Dilla Street in the existing 5'x3'± box culvert. Temporary easements will be required from three (3) private landowners in order to install, operate, and remove the dredge pipeline between the pond and Dilla Street. Excess water from the dewatering process will utilize the Huckleberry Brook channel to return to Milford Pond.

An approximation of costs is presented in Table 6-1.

Table 6-1. Estimated Dredging Costs for Entire Milford Pond Basin, Alternative 2

Item	Quantity	Units	Total Cost
Engineering, Dam Inspection			$13,000
Mobilization			$36,000
Construct Dewatering Area	14,000	SF	$231,000
Weed Harvesting	120	AC	$276,000
Dredging	1,000,000	CY	$11,400,000
Closeout Dewatering Area	14,000	SF	$79,000
Demobilization			$16,000
		Subtotal	$11,800,000
		Contingencies (25%)	$2,961,000
		S&A (6.5%)	$962,000
		E&D (2.0%)	$315,000
		Subtotal	$16,100,000
		Real Estate	$736,000
		Study Cost	$300,000
		IDC	$1,482,000
		Total Project Cost	$18,600,000

The sediment-processing site will be restored by seeding the dredged sediments with a grass and wildflower seed mix to provide site stability. Gradually, shrub and sapling growth will develop within this area, evolving to a woodland community over several decades. These impacts are short-term over the life of the project and long-term effects are considered insignificant as full restoration of these areas is proposed.

On the positive side, this alternative will also allow for the resumption of boating during summer months, enhanced recreational fishing, and ice-skating during the winter for the maximal amount of area. Reductions in aquatic macrophyte growth and water quality improvements would also increase the aesthetic appeal of Milford Pond by decreasing odors associated with anaerobic decomposition of pond vegetation and eutrophic conditions.

In summary, the positive effects on finfish aquatic habitat are offset by the following negative aspects associated with the dredging of the entire pond:

1. Removal of some desirable aquatic weed bed habitat in the littoral zone;
2. Removal of emergent marsh vegetation that provides habitat for waterfowl and mammals;
3. Removal of emergent marsh vegetation that provides habitat for protected species of waterfowl (king rail, common moorhen, the pied-billed grebe, and the least bittern);
4. Displacement of existing wildlife communities and creation of an ecosystem with less overall habitat diversity; and
5. Potential adverse impacts to the local water supply (Clark Island Well Field) due to removal of protective peat layers that currently filters the induced infiltration that partially support the water supply of the aquifer.

6.3 Partial Dredging (Alternatives 3 & 4)

A partial dredging program would be essentially a reduced version of the dredging alternative for the entire pond (Section 5.2). The same limitations apply including a maximum dredge depth of 12 feet or the mineral base beneath the organic sediments, whichever is first obtained. The areas to be dredged would be towards the southern and eastern portions of the pond, avoiding the Clark Island Well Field and the emergent wetlands on the western side of the pond. Two scenarios were considered under the partial dredging concept:

1. A 45-acre section extending from the dam northward past Clark Island; and
2. A 21-acre section extending from the dam northward to Clark Island.

Both of these project areas would avoid dredging the cattail-dominated marsh south and west of Clark Island in order to avoid conflicts with rare waterfowl species nesting habitat. These two scenarios also share some of the same attributes. They both would increase pond depths and decrease aquatic macrophyte growth within a portion of the pond, providing and enhancing deep, open water habitat necessary for promoting the residence of certain fish species in Milford Pond. Deep water allows for forage, over-wintering, and resting of fish such as yellow perch, brown bullhead, chain pickerel, black crappie, largemouth bass, and bluegill sunfish. The remaining shallow, weedy environment currently found in Milford Pond is also an element of the required habitat for these species, providing cover. A balance of both deep, open water and shallow, weedy areas provides more optimal habitat for these fish species, as well as supporting other wildlife, such as wading and dabbling birds and aquatic mammals (e.g., muskrat).

Environmental impacts associated with the partial dredging program may include:

1. Removal of some desirable aquatic weed bed habitat in the littoral zone; and
2. Potential adverse impacts to the local water supply (Clark Island Well Field) due to removal of protective peat layers that currently filters the induced infiltration that partially supports the water supply of the aquifer.

While the removal of existing organic sediments would alter the benthic habitat; partial dredging only impacts a fraction of the 120p-acre waterbody. Overall, habitat diversity within Milford Pond will be improved as some shallow pond and emergent wetland habitat will be converted to open water habitat, while a portion will be preserved in its present state. Existing wildlife communities will be preserved, while new communities will develop in restored sections of the pond. The four State-listed species identified by MA NHESP include king rail, common moorhen, least bittern, and pied-billed grebe, all of which nest in the dense cover habitat found in emergent wetland areas, such as that preserved in the western portion of Milford Pond. Seasonal dredging to prevent disturbance during nesting periods will further protect priority habitats for these species.

Relative to the Clark Island Well Field, the vertical and horizontal limits of the partial dredging program were determined, in part, under consideration of the Clark Island Well Field. Ground Water Associated (1987), and as confirmed by the current study (Marin, 2002), showed that a groundwater-divide forms near the small island (east of Clark Island) during periods when the Clark Island wells are pumped. A significant area located north of Clark Island is within the zone of influence of the wells. Previous subsurface investigations showed that the sand and gravel aquifer that is pumped by the Clark Island wells is overlain by a layer of peat or possibly layers of peat and clay. The overlying peat layer provides a hydraulic barrier to a certain extent and provides an environment favorable for natural attenuation of pollutants. Only one of the partial dredging scenarios would impact a relatively small area west of the groundwater divide. Further, the programs would be designed to maintain a minimum soft sediment depth of 5 feet as an organic barrier.

Both of the partial dredging programs would provide enhanced habitat improvement benefits with minimal environmental impacts and a lower cost. These alternatives would also provide the restoration of some of the historical recreational uses and aesthetic values, albeit to a lesser extent than previously existed or as provided by the full pond-dredging alternative.

Sub alternatives to create wetland islands from the excavated sediments in the undredged portions of the pond were eliminated due to extreme conflicts with rare species habitat, and loss of flood storage potential.

As for the full pond-dredging alternative, these partial dredging alternatives would require the use of a 20± acre Town-owned parcel for processing of the dredged materials. The site is located north of the pond, north of Dilla St. (Figure 6-1). The site can potentially contain the entire volume of sediments to be dredged from the pond, requiring an average depth of 18 feet for the 45 acre dredging alternative and about half that for the 21 acre dredging alternative. Due to irregular topography, heights of the sediment would vary. However, the Town is expected to seek beneficial reuse of the material during the 4 year dredging program, which will minimize the storage area required. Similar dredging programs with similar peaty dredged sediments have had little difficulty in finding users for the material. The site would be revegetated upon completion of the project as with all of the dredging alternatives.

The following two subsections discuss the specifics of the individual scenarios, projected costs and differentiating benefits and deficits associated with each.

6.3.1 Dredge 45 Acres (Alternative 3, Preferred Alternative)

This alternative would involve the dredging and restoration of open water area of approximately 45ρ-acres of this 120ρ-acre waterbody. Partial dredging of approximately 1/3 of the pond area would result in the restoration of deep-water aquatic habitat in the eastern portion of the pond, from the outlet dam northerly, to a point slightly north of Clark Island. Under the proposed plan, nearly 75ρ acres of pond will remain undisturbed. Estimated costs for this partial dredging scenario are given in Table 6-2.

This partial dredging program would successfully meet all of the goals and objectives of the Milford Pond Restoration Committee as well as the objectives for overall habitat restoration by improving the environmental quality, and fisheries and wetland habitats of the pond. Under this scenario, 25% of the pond basin would remain in emergent wetland beds, with the remaining basin split almost equally between the existing dense aquatic weed beds and restored open water. The critical existing emergent wetland habitat would be protected and most of the shallow aquatic weed bed in the northern portion of the pond would be unaffected. One-third of the pond basin would have restored open water habitat with restored pond depth, providing a desirable mix of open water, aquatic weed beds, and emergent marsh habitat. This is the most desirable balance of emergent wetland, aquatic weed bed and open water habitats of all of the dredging alternatives. Potential impacts to the Clark Island Well Field also would be avoided by leaving a 5 ft organic sediment cap in place to the west of the groundwater divide.

Table 6-2. Estimated Dredging Costs, 45± acres of Milford Pond Basin. Alternative 3

Item	Quantity	Units	Total Cost
Engineering, Dam Inspection			$9,250
Mobilization			$26,000
Construct Dewatering Area	14,000	SF	$231,000
Weed Harvesting	45	AC	$121,000
Dredging	400,000	CY	$4,484,000
Closeout Dewatering Area	14,000	SF	$79,000
Demobilization			$8,100
		Subtotal	$4,958,000
		Contingencies (25%)	$1,240,000
		S&A (6.5%)	$403,000
		E&D (2.0%)	$132,000
		Subtotal	$6,732,000
		Real Estate	$736,000
		Study Cost	$300,000
		IDC	$317,000
		Total Project Cost	$8,086,000

6.3.2 Dredge 21 acres (Alternative 4)

Dredging approximately 21±-acres of the 120±-acre pond would result in the restoration of open water in approximately 1/6 of the area. The dredging would be conducted in the southeastern portion of the pond, extending from the outlet dam to a point just south of Clark Island. Approximately 100± acres of the pond would be allowed to remain in its current state with this alternative.

Estimated costs for this partial dredging scenario are given in Table 6-3.

This partial dredging program would minimally meet the goals and objectives of the Milford Pond Restoration Committee and the overall habitat improvement objectives by improving the environmental quality and fisheries habitat of the pond. The critical existing emergent wetland habitat would be protected and the shallow aquatic weed bed in

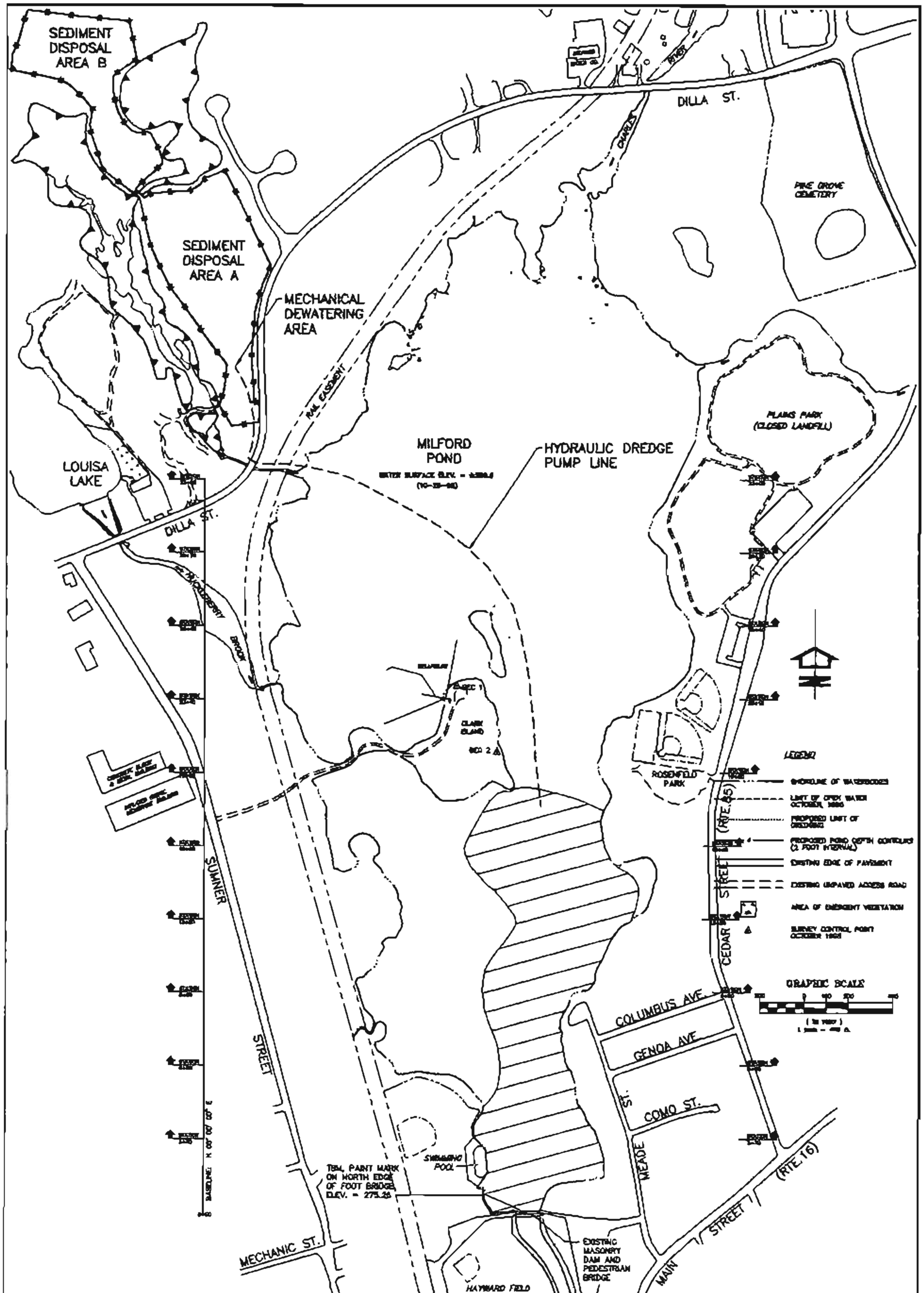


FIGURE 6-2
PARTIAL DREDGING OF POND BASIN
ALTERNATE 4; 21± Acres
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

NOTES:

1. Horizontal and vertical control by BEC, Inc., October – November, 1998.

2. Shoreline and other existing features have been digitized from aerial photographs taken April 10, 1998.

3. Proposed water depths reflect the goal of obtaining a water depth of 12 feet or reaching the mineral base beneath the organic materials, whichever is first obtained. Maximum dredged slopes shall be 5 horizontal : 1 vertical.

Table 6-3. Estimated Dredging Costs, 21±-Acres Milford Pond Basin. Alternative 4

Item	Quantity	Units	Total Cost
Engineering, Dam Inspection			$9,250
Mobilization			$21,000
Construct Dewatering Area	14,000	SF	$231,000
Weed Harvesting	20	AC	$53,500
Dredging	180,000	CY	$2,042,000
Closeout Dewatering Area	14,000	SF	$79,000
Demobilization			$6,500
		Subtotal	$2,442,000
		Contingencies (25%)	$610,000
		S&A (6.5%)	$198,000
		E&D (2.0%)	$65,000
		Subtotal	$3,316,000
		Real Estate	$736,000
		Study Cost	$300,000
		IDC	$114,000
		Total Project Cost	$4,466,000

the northern portion of the pond would be unaffected. One-sixth of the pond basin would have restored open water habitat with restored pond depth, providing a less desirable mix of open water, aquatic weed beds, and emergent marsh habitat. Potential impacts to the Clark Island Well Field would be avoided by the lack of dredging in proximity to the field.

6.4 Dam Removal (Alternative 5)

This alternative entails removing the dam that currently impounds Milford Pond, thus allowing the pond to drain and returning the area to swampland. The Charles River would be allowed to return to its natural course and flow freely through the swamp and on to the Boston Harbor. The intent of dam removal would be to allow the passage of fish, restoring a riverine fisheries habitat to that portion of the Charles River. Although Atlantic salmon no longer migrate into the Charles River, the lower Charles River does support several anadromous species including American shad, American eel, blueback herring and alewife. The Charles River has 20 dams along its length of which the Milford Pond dam is the most upgradient. While the lower five dams are equipped with fish ladders, there remain 14 dams downstream of the Milford Pond dam that block anadromous fish passage north to this reach. Therefore, removal of this dam would provide only minimal immediate benefit to the Charles River overall in terms of regional fish migration patterns. In addition, the existing dam is located on a pre-existing natural dam of several feet height, which previously allowed the development of a cedar swamp with accumulation of deep organic peat. Therefore, fish migration would not necessarily be substantially improved by removal of the dam. However, a fish ladder could be considered at a future date for any of the alternatives once viable fish passage is provided at the downstream dam sites.

Natural environmental processes would be allowed to function with dam removal, but the ability of the exposed pond bottom to revert to the condition that existed prior to original dam construction over 60 years ago is unlikely. Originally, the area was a swamp with American White Cedars (*Chamaecyparis thyoides*). While cedars of reduced abundance and stature persist in the northeast corner of Milford Pond (IEP/CDM, 1986), the exposed pond bottom will most likely be rapidly colonized by invasive wetland species such as cattail, purple loosestrife, and Phragmites.

Allowing the pond to drain may have a significant impact on the hydraulic properties of the aquifer beneath Milford Pond, from which the Milford Water Company extracts drinking water. The Milford Water Company operates wells that are located on Clark Island in the center of Milford Pond. Based on data from an 11 day pumping test of the Clark Island Well Field, Groundwater Associates (1987) concluded that the Clark Island Well Field receives the majority of its recharge from leakage through the overlying peat layer that separates Milford Pond from the aquifer, and from upgradient sources to the north and northwest. This suggests that the draining of Milford Pond would result in the loss of a major source of recharge to the aquifer. Already, this well field suffers in production under periods of severe drought when the pond levels are naturally lowered. The Clark Island Well Field produces more than half of the total groundwater source of drinking water to the area and between 13% and 36% of the total daily water demand. Currently, the Milford Water Company is actively seeking additional water supplies to meet existing and anticipated water demands. The loss of this well field would not be a feasible alternative.

This alternative also poses significant impacts to the rare species habitat within the pond basin. The four State-listed species identified by MA NHESP (king rail, common moorhen, least bittern, and pied-billed grebe) all nest in the dense cover habitat found in emergent marshy wetland areas, such as in the western portion of Milford Pond. The lowered hydrology would effectively convert this habitat to an area undesirable to these species.

The removal of the dam also poses significant potential for erosion and sedimentation unless significant measures are taken to avoid such impacts. The lowering of the water level will cause the stream flow from various sources to cut channels into the accumulated soft, highly erodable, surficial sediments. Stream flows for the Charles River, Huckleberry Brook, and storm water inputs would cut into the sediments to establish new stream channels, which would emerge and develop over several years until relatively stable channels were established. Avoidance of this condition would likely require pre-dredging of preferred flow pathways for each of the inlets to the pond basin, sized to an appropriate dimension to provide relative stability. Bioengineering of the new stream banks might also be required in addition to intensive seeding/planting of the newly exposed sediments.

The potential costs associated with this alternative are outlined in Table 6-4. Included in the potential costs are pre-dredging of stream channels and bioengineering of the new channels to minimize erosion and sedimentation following dam removal. Aggressive follow-up treatment with herbicides to control invasive species is also assumed, except within the immediate recharge areas for the Clark Island Well Field.

Table 6-4. Estimated Dam Removal Costs, Milford Pond Basin, Alternative 5

Item	Quantity	Units	Total Cost
Engineering			$8,000
Mobilization			$6,000
Construct Dewatering Area	14,000	SF	$231,000
Weed Harvesting	5	AC	$7,500
Dredging	25,000	CY	$291,250
Closeout Dewatering Area	14,000	SF	$79,000
Dam Removal & Stream Bank Bio-engineering	5,000	LF	$4,369,000
Demobilization			$1,900
		Subtotal	$4,994,000
		Contingencies (25%)	$1,248,000
		S&A (6.5%)	$325,000
		E&D (2.0%)	$100,000
		Subtotal	$6,666,400
		Real Estate	$0
		Study Cost	$300,000
		IDC	$200,000
		Total Project Cost	$7,166,400

The implementation of this alternative would likely not be desired by the town residents, who through the Milford Pond Restoration Committee have established goals for pond restoration, as opposed to river restoration.

For all of the potential adverse impacts to the well field, rare species, general environmental, as identified above, this alternative was dismissed as not environmentally feasible. Further, the benefit to fisheries habitat is uncertain given the significant fish migration barriers downstream. Therefore, no further analysis or estimation of incremental benefits was performed.

6.5 Dam Removal with Partial Dredging (Alternative 6)

This alternative involves removal of the dam while dredging approximately 45ρ acres of the Milford Pond area. The 45± acre partial dredging alternative was paired with the dam removal since this was the preferred dredging alternative size selected by the pond restoration committee, and provides a good representation of the types of issues associated with combining dam removal with dredging.

This alternative would have the effect of allowing the river to flow freely while still creating areas of deeper water fisheries habitat. The dredging would be performed in the same location as for the 45ρ-acre dredging without dam removal alternative (see Section 0). The benefits of this alternative would, in part, be the same as those resulting from the partial dredging alternative, including the restoration of deep, open water, warm water fisheries habitat while maintaining emergent wetland environments. However, the shallow aquatic weed beds would be largely eliminated, except to the extent that they redeveloped within the newly dredged pond basin. As discussed in Alternative 5, dam removal would not open the river for migratory fish passage due to numerous downstream obstructions.

While providing some new deep-water habitat, this alternative would have most of the same deficits as observed in Alternative 5. There would be likely adverse impact to the public water supply from Clark Island Well Field and the rare waterfowl species habitat. In addition, the benefit to fisheries habitat is uncertain given the significant fish migration barriers downstream. Therefore, this alternative was dismissed as not environmentally feasible and no further analysis or estimation of incremental benefits was performed.

The potential costs associated with this alternative are outlined in Table 6-5. Included in the potential costs are pre-dredging of stream channels and bioengineering of the new channels to minimize erosion and sedimentation following dam removal. Aggressive follow-up treatment with herbicides to control invasive species is also assumed, except within the immediate recharge areas for the Clark Island Well Field.

Table 6-5. Estimated Dam Removal with Partial Dredging Costs, Milford Pond Basin, Alternative 6

Item	Quantity	Units	Total Cost
Engineering			$8,000
Mobilization			$6,000
Construct Dewatering Area	14,000	SF	$231,000
Weed Harvesting	5	AC	$7,500
Dredging	25,000	CY	$2,822,500
Closeout Dewatering Area	14,000	SF	$79,000
Dam Removal & Stream Bank Bio-engineering	2000	LF	$849,000
Demobilization			$1,900
		Subtotal	$4,005,000
		Contingencies (25%)	$1,001,000
		S&A (6.5%)	$260,000
		E&D (2.0%)	$80,000
		Subtotal	$5,346,300
		Real Estate	$736,000
		Study Cost	$300,000
		IDC	$184,000
		Total Project Cost	$6,566,300

6.6 Summary

Table 6-6 summarizes each the beneficial and adverse impacts of each alternative. Also included are the costs of each alternative and the area of impact.

Table 6-6. Alternatives Summary

Alternative	Affected Acreage	Beneficial Impacts	Adverse Impacts	Total Cost
No Action	0 acres	• Protection of Clark Island Well Fields • Expansion of emergent wetland habitat	• Loss of fisheries • Loss of open water habitat • Loss of recreational resource • Odors	$0
Complete Dredge	120 acres dredged + 14 acres sediment processing and disposal	• Restoration of open water habitat to maximum extent possible • Improvement in aquatic fin fish habitat • Restoration in recreational resource to maximum extent possible • Reduction of odors	• Greatest potential for adverse impact on Clark Island Well Fields • Removal of emergent wetland habitat for mammals and waterfowl, including rare species • Removal of some desirable aquatic weed bed habitat in the littoral zone • Displacement of existing wildlife communities • Reduction in overall habitat diversity • Full use of developed and undeveloped portions of Town-owned land for dredged material disposal	$18,600,000
Partial Dredge – 45 acre	45 acres dredged + 14 acres sediment processing and disposal	• Preservation of rare waterfowl species nesting habitat • Restoration of open water habitat • Improvement in habitat diversity with most desirable balance of emergent wetland, aquatic weed bed and open water • Preservation of existing wildlife communities • Restoration in recreational resource • Improvement in aquatic fin fish habitat • Reduction of odors	• Removal of some desirable aquatic weed bed habitat in the littoral zone • Potential for adverse impact on Clark Island Well Fields • Partial use of Town-owned land for dredged material disposal	$8,086,000

Alternative	Affected Acreage	Beneficial Impacts	Adverse Impacts	Total Cost
Partial Dredge – 21 acre	21 acres dredged + 14 acres sediment processing and disposal	• Preservation of rare waterfowl species nesting habitat • Restoration of open water habitat • Marginal improvement in habitat diversity • Preservation of existing wildlife communities • Partial restoration in recreational resource • Improvement in aquatic fin fish habitat • Reduction of odors	• Removal of some desirable aquatic weed bed habitat in the littoral zone • Potential for adverse impact on Clark Island Well Fields • Partial use of Town-owned land for dredged material disposal	$4,466,000
Dam Removal	5 acres dredged + 14 acres sediment processing and disposal	• Restoration of natural riverine habitat • Low potential to improve fish passage	• Opportunity for colonization by invasive wetland species • Loss of major source of recharge to Clark Island Well Field • Loss of emergent wetland habitat for rare waterfowl • Erosion and sedimentation • No improvement in recreational resource; undesired by Town of Milford	$7,166,400
Dam Removal with Partial Dredge	45 acres dredged + 14 acres sediment processing and disposal	• Restoration of natural riverine habitat • Low potential to improve fish passage • Restoration of open water habitat	• Opportunity for colonization by invasive wetland species • Loss of major source of recharge to Clark Island Well Field • Loss of emergent wetland habitat for rare waterfowl • Erosion and sedimentation • Little improvement in recreational resource; undesired by Town of Milford • Partial use of Town-owned land for dredged material disposal	$6,566,300

7 Existing Conditions

7.1 General

Milford Pond is a linear-shaped waterbody oriented on a north-south axis. The pond has a shoreline length of 16,609± ft. and an average depth of less than two feet throughout most of its area. It has an estimated total lake volume of 162± acre-feet. The pond is bordered by numerous parks and urban residential areas. The overall Milford Pond watershed size is 5,440± acres (8.5 square miles), with a watershed to lake ratio of 44:1. It extends beyond the municipal boundaries of the Town of Milford into the Towns of Hopkinton to the north and Holliston to the east, as shown in . Table 7-1 presents the characteristics of Milford Pond.

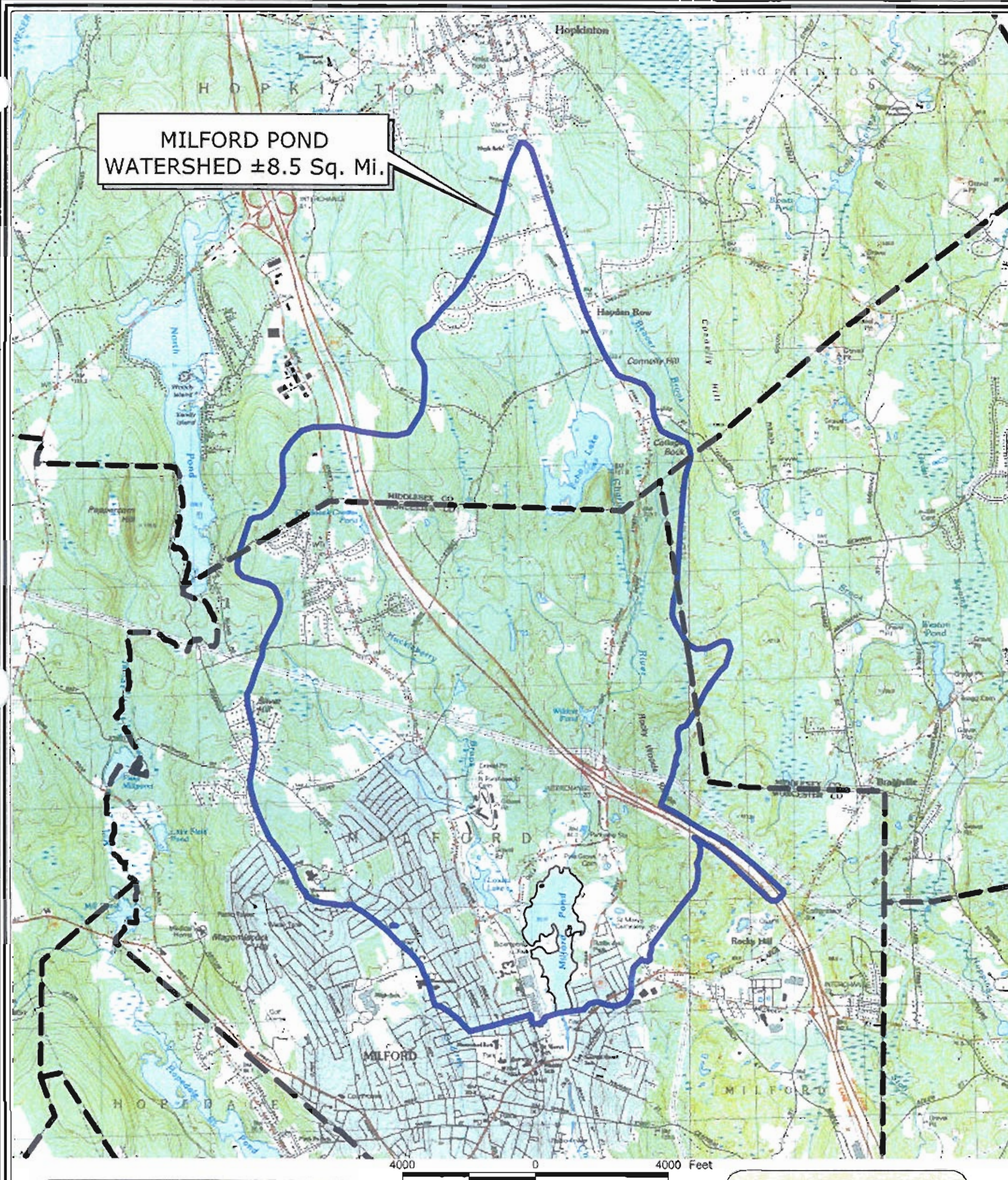
The dam structure, owned by the Town of Milford, is an earthen embankment dam with a cast-in-place concrete primary spillway located near the central portions of the dam. The spillway is a gravity section founded on earth. A steel sheeting cutoff wall, presumably driven to bedrock, is imbedded in the bottom of the concrete section. The crest of the spillway is approximately four feet higher than the downstream channel. Flashboards, which are normally in place, raise the normal water surface 12-14" above the spillway's crest. This intermediate-sized dam is approximately 200 feet in length with a reported structural height of 11 feet. This dam, therefore, has a maximum storage potential of approximately 690-acre feet. Access to the dam is provided via a concrete pedestrian bridge, which is restricted to vehicular traffic.

Also included in the evaluation of existing conditions was the proposed disposal site for dredged materials associated with the dredging alternatives. The disposal site is a 20±-acre parcel located north of Milford Pond on the north side of Dilla Street. The site is to the east of Louisa Lake and the west of Monhegan Circle, a subdivision ending in a cul-de-sac. The parcel is generally rectangular in shape, with the long axis extending northward from Dilla Street. The disposal site is in Town of Milford ownership and has been partially used for sand excavation, equipment storage, and earth materials. The site is partially cleared with a dirt roadway extending the length of the parcel from south to north. The remainder of the site is wooded wetlands or uplands.

7.2 Terrestrial Environment

7.2.1 Geology / Soils

The Town of Milford is located in Worcester County, which is in the central upland region of Massachusetts; also know as the Worcester Plateau. The rugged terrain that characterizes this area is dominated by ridgetops that have a uniform elevation of about 1,100 feet. The surficial geology and soils within this region have been strongly influenced by glacial activity during the Pleistocene era. Soil parent materials consist of glacial till and glacial outwash derived from crystalline rocks, geologically recent alluvial deposits, and, in wet areas, thick deposits of decomposed organic matter. Glacial till consists of unstratified, unsorted clay, silt, sand, and boulders. It is dominated by sand or



MILFORD POND HABITAT RESTORATION PROJECT
MILFORD, MASSACHUSETTS

USGS TOPOGRAPHIC QUADRANGLE MAPS
MILFORD, 1982 &
HOLLISTON, 1987

BAYSTATE ENVIRONMENTAL CONSULTANTS, INC.
EAST LONGMEADOW, MASSACHUSETTS 01028

FIGURE 7-1: WATERSHED MAP

Table 7-1. Milford Pond Characteristics

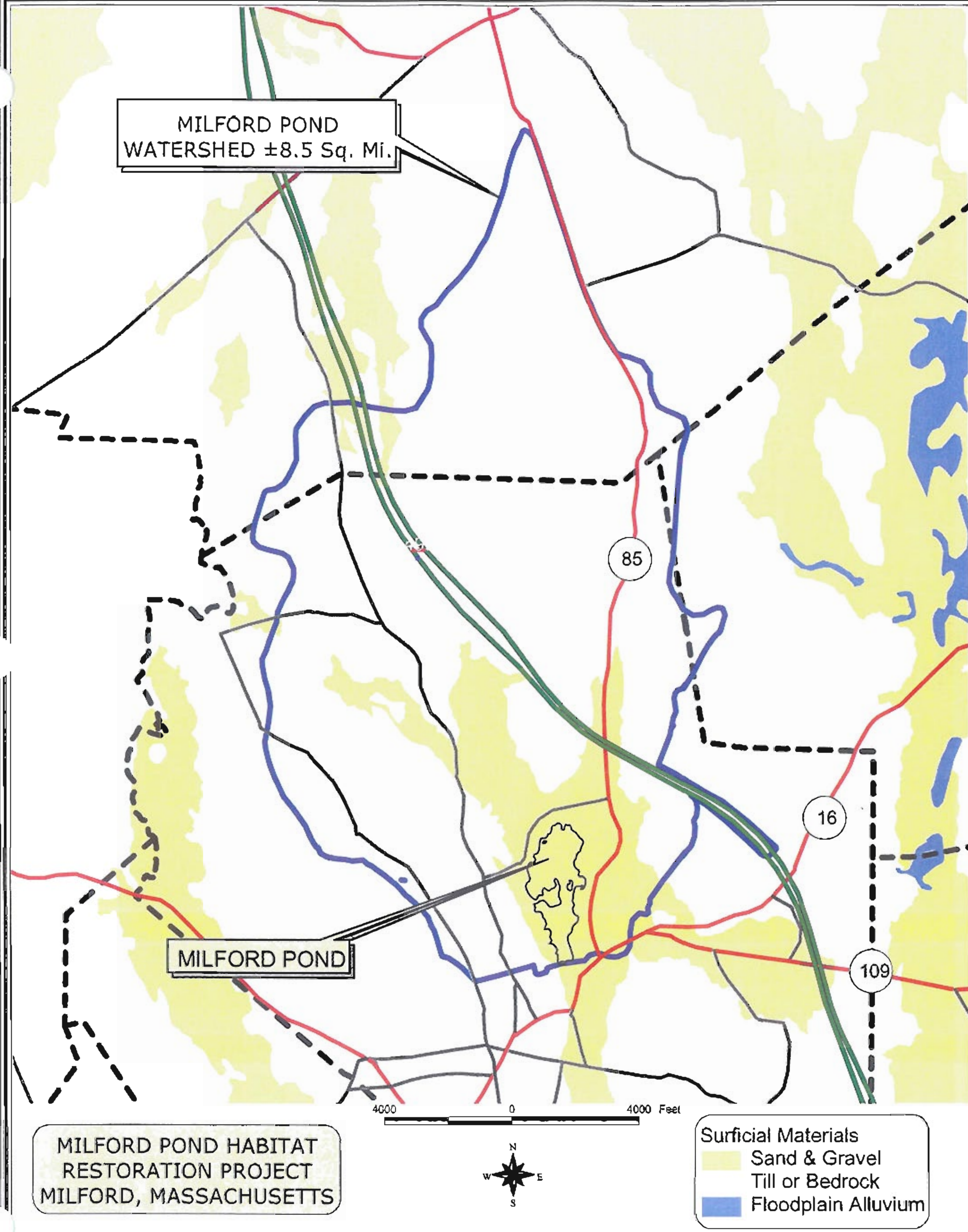
Parameter	Description
Lake Type	Impoundment of Charles River and former pond/wetland complex
Lake Area	120 acres
Watershed Area	5440 acres
Watershed : Lake	44 : 1
Lake Volume	209,000 m^3 (170 acre feet).
Average Depth	< 2 feet
Shore Length	16,609 feet
Shoreline Irregularity	2.04 (ratio of actual shoreline length to shoreline of hypothetical circular lake of same area [8,124 feet])
Major Tributaries	Charles River, Huckleberry Brook, Ivy Brook, and Deer Brook. Other waterbodies found within the Milford Pond watershed include Louisa Lake, Echo Lake, and Wildcat pond.
Outflow Stream	Charles River
Geology	Glacial Till Soils
Groundwater Influence	Underlain by aquifer utilized by Milford Water Company. Water exchange separated by peat layer.
Sediment Type	Peat deposits underlain by sand.
Trophic Status	Eutrophic
Chlorophyll (a)	Range 0-12 mg/m^3
Total N	Range 0.17 to 2.3 mg/l (nitrate + TKN)
Total P	Range <0.01 to 0.20 mg/l
Productivity	Primarily phosphorous limited.
Secchi Disk Transparency	4 to 6 feet

loam, but with variable amounts of gravel, stones and boulders, and has a friable to very firm consistency. Glacial outwash consists of sorted, stratified gravel, sand and silt deposited by glacial melt waters. The recent materials deposited by stream overflow are on flood plains of streams and consist of gravel, sand, silt and clay in various combinations (USDA, 1998).

The bedrock within the Milford Pond drainage basin is the Milford Granite (Carr, 1979). Milford Pond and surrounding areas are underlain by sand and gravel deposits. Regional surficial materials include till or bedrock and floodplain alluvium, in addition to sand and gravel deposits (Figure 7-2).

The proposed dredged material disposal site located to the north of the pond contains a mix of terrain with topography rising in an easterly direction:

- A riparian wetland on the westerly side associated with the former primary channel for Huckleberry Brook prior to it's diversion to Louisa Lake;
- A shrub/wooded wetland on the northeastern portion of the site, draining to the riparian wetlands via an narrow intermittent stream; and
- Outwash uplands within the developed portions of the site, which have been partially mined as sand & gravel deposits; and
- Glacial till soils (Canton soil series) in wooded uplands on the easterly side of the site.



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EAST LONGMEADOW, MASSACHUSETTS 01028

FIGURE 7-2: SURFICIAL MATERIALS

Slabs of quarried granite, as well as exposed bedrock are evident on the east side of the parcel.

Weston and Sampson (1991 and 1994), IEP (1984), Groundwater Associates (1987), and Whitman and Howard (1991) present interpretations of the subsurface characteristics near the Clark Island Well Field and the Milford Landfill. There are general similarities in the characteristics and subsurface profiles presented by the four consulting firms. In general, the depth to bedrock ranges from 18 to 70 feet, with a minimum depth beneath the small island located east of Clark's Island. All reports indicate that there is a sand and gravel aquifer underlying Milford Pond and surrounding area, and that there are layers of peat and/or clay overlying the aquifer. Previous studies consistently report that the thickness of the peat layer generally increases from west to east. West of Clark's Island, layers of peat, fine sand, silt and clay exist at a total thickness of approximately 10 feet. East of Clark's Island, these layers expand to a thickness of approximately 20 to 25 feet. Some of the previous studies indicate that there are distinct layers of peat overlying clay near the small island located east of Clark's Island, while other studies do not confirm the presence of a clay layer. Clark Island and the small island east of it are composed of a north-south trending till ridge.

7.2.2 Vegetation

The vegetative communities surrounding Milford pond are comprised of several small fragmented communities amidst the developed shoreline:

1. Wooded uplands with red maple, red and white oak, white pine and gray birch;
2. Wooded and shrub wetlands with red maple gray birch, alder, and dogwood;
3. Cattail dominated marsh within the pond basin, primarily within the southwestern portions of the pond; and
4. The floating leaved and submerged aquatic vegetation within the pond.

The wooded and scrub-shrub emergent wetland types may be found along the perimeter of Milford Pond and along the Lower Huckleberry Brook and Charles River corridors. The fringing pond wetlands exhibit a classic wetland successional mosaic, in which sediment and organic material accumulation contributes to reductions in open water habitats and speeds the process of wetland succession. As a part of this process, sediment accumulation along the shoreline fringes allows emergent wetland species to expand into open water areas. The vegetation found in these wetlands includes buttonbush, speckled alder, red maple, dogwood, elderberry, and highbush blueberry.

Within the 120± acre Milford Pond basin, the vegetative zones are roughly divided as follows:

- 25% emergent wetland growth
- 70% dense aquatic weed beds
- 5% open water with relatively high density of aquatic weeds.

Emergent wetlands occur along the perimeter of Milford Pond and in a 400-foot wide band along the western shoreline, south of Clark Island. These areas are dominated by primarily broad-leaved and narrow-leaved cattail, swamp loosestrife, tussock sedge, soft rush, water smartweed, arrow arum, and pickerel weed. Some patches of invasive species may be found in this wetland type. Purple loosestrife may be found scattered throughout these areas, while a large patch of *Phragmites* may be found along the eastern shoreline near the former landfill.

The lacustrine limnetic open water habitats occupy the majority of the vegetative assemblages, including dense mats of floating aquatic vegetation and accumulated organic materials resulting in the formation of free-floating peat islands. The floating leaved vegetation found in Milford Pond includes white water lily, yellow pond lily, watershield, and duckweed. These species range in density of growth and may occupy from 60-100% of the pond surface in certain areas. Submerged aquatic plants may also be found growing throughout Milford Pond. The primary species that comprise the open water submersed plant community include Eurasian water milfoil, bladderwort, spatterdock, large leaf pondweed, and bush pondweed. The density of growth of these species typically ranges from 80-100% of the pond area.

Within the proposed dredged material disposal site, there is a mix of vegetative assemblages. On the western side of the parcel, there is a wooded and shrub wetland with dominant species including a red maple, sweet pepper bush, speckled alder and gray birch. A narrow wetland swale also drains a small shrub wetland on the eastern portion of the site to combine flows with the westerly wetland. The remaining non-developed portions of the site is wooded uplands dominated by red oak, black birch, gray birch, sugar maple, white pine, and black cherry. The canopy height is approximately 70-80' with 75% canopy closure. Tree sizes range from 5-18" dbh. The understory is relatively sparse (15-20%). Ground cover species include bracken fern, sweet fern, and sheep laurel. Within the wooded uplands there are numerous boulders and rock slabs associated with past quarrying activities in the region. Topography rises abruptly from west to east with the boulder-strewn, wooded upland forest associated with the undeveloped portions of the parcel.

7.2.3 Wildlife

The wildlife habitat areas in the Milford Pond and dredged material disposal areas reflect the different vegetative assemblages. The wooded uplands and wetlands provide habitat for various songbirds, arboreal and ground dwelling mammals, and various reptiles and amphibians. The emergent wetland areas are extremely productive ecosystems that provide habitat for a variety of aquatic wildlife species, including wading and dabbling birds, as well as the four protected waterfowl species. The topography, soil structure, and plant community composition and structure provides important wildlife habitat functions such as food, shelter, and migratory and breeding areas for wildlife, as well as overwintering areas for mammals and reptiles.

There is also significant habitat degradation associated with human activities, including the residential and industrial development, the former landfill, parkland, and local roadways. Such effects of habitat degradation include:

- Evidence of erosion or sedimentation problems within the watershed;
- Storm water discharge from urban watershed with associated nutrients and various associated contaminants;
- Significant invasion of exotic plants (e.g. milfoil, purple loosestrife, *Phragmites*);
- Disturbance from roads or highways (e.g., fragmentation, historical fill in waterbodies, lack of vegetated riparian areas).

All of these factors contribute directly or indirectly to the actual habitat conditions observed within and surrounding the ponds.

Significant wildlife habitat areas adjacent to the Pond include the following:

- Wooded upland at the northern end of the pond, associated with the cemetery and between the Charles River and Huckleberry Brook inlets;
- The narrow fringing wooded wetland and riparian wetland associated with the Charles River and Huckleberry Brook inlets; and

- The fringing emergent marsh on the west sides of the pond, north and south of Clark Island.

The aquatic vegetation is also a separate habitat area for Milford Pond, the vegetation forming the base of the food web as well as providing structural habitat in the form of cover and escape habitat for fish and invertebrates. However, aquatic habitat is discussed more fully in Section 6.4, and emphasis in this section is placed upon non-aquatic wildlife species, more associated with the wooded pond perimeter.

The persistent emergent marshes associated on the west side of Milford Pond provide nesting and foraging sites for the many wetland dependant birds including various wading and dabbling waterfowl, as well as other aquatic dependent birds. Emergent marsh habitat types occupy 41.5± acres of the nearly 100-acre wetland complex. The majority of this emergent marsh habitat type, 37± acres, is located along the entire western pond margin, from the Charles River inlet to the dammed outlet. A 3.5± acre shrub-dominant emergent marsh is located on the eastern pond margin in close proximity to the closed landfill. Two additional areas of emergent marsh, totaling less than an acre, are located to the North and South of Rosenfeld Park.

Wildlife observed up in the marsh areas included red winged blackbird, white egret, mallard duck, Canada goose, and great blue heron. It was also noted to be suitable habitat for small mammals including the muskrat and amphibians/reptiles such as bullfrog, green frog, eastern garter snake, snapper turtle, and eastern painted turtle. The shoreline habitat also supports many of these same species, as well as habitat for belted kingfisher. The wooded upland habitats surrounding the pond, including the dredged material disposal site, support such cosmopolitan species as eastern chipmunk, eastern gray squirrel, eastern cotton tail, little brown bat, European starling, gray catbird, hairy woodpecker, northern flicker, eastern kingbird, mocking bird, American crow, blue jay, black-capped chickadee and many other species.

7.3 Aquatic Environment

7.3.1 Hydrology

Milford Pond is formed by a man-made impoundment of the Charles River, with additional inflows from Huckleberry Brook, Louisa Lake, an intermittent stream and 17 storm water outfalls. Huckleberry Brook and Louisa Lake flow into the western side of the pond, while the Charles River flows from north to south, eventually reaching Boston Harbor.

The Milford Pond watershed (referred to as the Greater Milford Pond watershed) is approximately 8.5 square miles (5,440 acres) in size and is comprised of seven individual sub watersheds as delineated by MassGIS. These seven sub watersheds include the Upper Huckleberry Brook, Louisa Lake, Lower Huckleberry Brook, Milford Pond, Upper Charles, Lower Charles, and Echo Lake sub watersheds. The Greater Milford Pond watershed consists of area in the towns of Milford, Hopkinton and Holliston. The direct watershed of Milford Pond has an area of about 82 acres and is roughly bordered by Route 495, Route 16 (East Main Street), and Congress Street.

The Greater Milford Pond watershed is characterized by approximately 55% forested area, 26% residential area, and 7% total commercial, industrial and urban areas. In contrast, the local region around Milford Pond is characterized by approximately 27% forested area, 31% residential area, and 17% total commercial, industrial and urban areas. The greater percentages of residential and commercial/industrial area immediately surrounding Milford Pond illustrates that there is concentrated development in this area. The relatively higher percentages of developed area in the localized region are associated with relatively higher percentages of impervious area.

IEP/CDM (1986) analyzed surface and groundwater inflows and direct precipitation in relation to outlet discharge, evaporation, storage change, and Clark Island Well Field withdrawal volumes to develop a hydrologic budget for Milford Pond.

The water budget equation for Milford Pond is:

Surface Inflows + Groundwater Inflows + Direct Precipitation = Outlet Discharge + Evaporation + Storage Change + Clark Island Well Field Withdrawal

Table 7-2 presents the best available estimates of inflow and outflow from available data sources as reported by IEP/CDM (1986). In general, the major contributions of surface water inflows to Milford Pond include flow from Upper Huckleberry Brook via Lower Huckleberry Brook and Louisa Lake, and the Charles River.

Table 7-2. Annual Hydrologic Budget for Milford Pond (IEP/CDM, 1986)

Source	Volume (Million Gallons)	Percent of Total
Inlets		
Surface Inflows	2474	62.0 %
Groundwater Inflow	1392	35.2%
Direct Precipitation	118	2.8%
Total Inflow	**3963**	**100.0%**
Outlets		
Evaporation	71	1.7%
Outlet	3657	93.2%
Clark Island Well Field Withdrawals	189	5.1%
Total Outflow	**3916**	**100.0%**

IEP/CDM (1986) calculated that the majority of water outflow from Milford Pond (93%) occurs via the dam outflow, which discharges to the continuation of the Charles River. The remaining 7% of total water outflow results from withdrawals by the Milford Water Company at the Clark Island Well Field (5%) and loss via evaporation (2%). Vertical groundwater flow caused by seepage was determined to be negligible due to the hydrologic barrier created by the thick peat mat that underlies Milford Pond.

IEP/CDM (1986) calculated a residence time of 0.013 years, corresponding to a turnover ratio of 75 times/year. They estimated that in an average year with 44.2 inches of rainfall, Milford Pond has an average annual residence time of 0.0117 years, resulting in a flushing rate of 85 times per year. They reported that their results are inconsistent with those of the Carr (1979) study, which reported a turnover rate of 41 times per year. Monthly figures, presented by IEP/CDM (1986), showed wide ranges of variability over the course of the year with shorter residence times and faster flushing rates in spring and longer residence times and slower flushing rates exhibited in summer and fall.

In the recent study of Louisa Lake overflow withdrawals, Metcalf and Eddy (2001) estimated the total inflow using the area-ratio transform method. Following this approach, BEC obtained historical streamflow records from the USGS site on the Quinsigamond River at North Grafton (USGS Station 01110000). The Quinsigamond River is within the Blackstone River Basin, located in Worcester County. The watershed area at the station is 25.6 mi^2 (16384 ac). USGS statistics for the station include mean daily flows from 1939 to 2000. The area-ratio transfer method yielded a total annual inflow to Milford Pond of approximately 3151 million gallons (MG) and the volume of the pond (as estimated by BEC, 2000) is 55.4 MG. Under existing conditions, the residence time of Milford Pond is 0.018 years (7 days) and the flushing rate is estimated at 57 times per year. This result is within the range of previously reported flushing rates for Milford Pond.

Physical, biological and chemical processes in a waterbody are impacted by hydraulic residence time of a waterbody. There is some variation in the definitions of "short" (fast flushing system) and "long" (slow flushing system) residence time. In general, waterbodies with residence times on the order of days or weeks are considered to have relatively short residence times, while waterbodies with residence times on the order of months or years are considered to have relatively long residence times. Table 7-3 includes some of the criteria found in the literature. With a flushing rate of 57 times per year, Milford Pond is considered a fast flushing system.

Table 7-3. Residence Time Literature Values

Classification	Residence time	Equivalent Flushing Rate (#/year)	Source
Short Residence Time	<10 days (0.027 yrs)	>37	EPA (1998)
	< 365 days (1 yr)	>1	Chin (2000)
Long Residence Time	>120 days (0.33 yrs)	<3	EPA (1998)
	>365 days (1 yr)	<1	Chin (2000)

7.3.2 Water Quality

The 1997/1998 *Charles River Water Quality Assessment Report*, published by the Massachusetts Department of Environmental Protection (MADEP), classifies the various reaches of the Charles River based upon Surface Water Quality Standards (SWQS). The Charles River, from its headwaters to its outlet in Boston Harbor, is consistent with its National Goal Uses of "fishable and swimmable waters". The Charles River is classified as a Class A (Public Water Supply) waterbody from the outlet of Echo Lake in Hopkinton to Dilla Street in Milford. Dilla Street, located directly north of Milford Pond, marks the southern boundary of the Class A designation of the Charles. Below Dilla Street, the Charles River is designated a Class B waterbody. Class B waters are designated as a habitat for fish, other aquatic life, and wildlife. Primary and secondary contact recreation is appropriate in these areas. Therefore, based upon these designations, Milford Pond would be considered a Class B waterbody. Unfortunately, eutrophic conditions, shallow depths, and dense macrophyte growth limit the potential of this waterbody. The water quality and subsequent wildlife habitat and recreational values of Milford Pond are highly dependent upon the quality of its contributing waters. The major contributing waters to Milford Pond consist of inflows from the Charles River, Louisa Lake, and Huckleberry Brook. The overall quality of these contributing waters is acceptable and generally consistent with Class B waters (i.e.: fishable/swimmable). However, episodic low dissolved oxygen and high levels of phosphorous and nitrogenous compounds frequently degrade overall water quality. The input of nutrient-rich waters exacerbates the eutrophic conditions found in Milford Pond.

IEP/CDM (1986) evaluated the water quality and trophic status of Milford Pond using data they collected and data collected by Carr (1979). Both studies include water quality data from Louisa Lake, Charles River, and Huckleberry Brook and the Milford Pond outlet, as presented in Table 7-4. IEP/CDM (1986) determined that Milford Pond was eutrophic based on measured nutrient, chlorophyll-a, and dissolved oxygen levels. This conclusion is consistent with the results of the Carr (1979) report and the recent field observations conducted by BEC in 2000. Table 7-4 includes data collected by BEC on September 20 and October 16, 2002 from the Charles River inflow and the Louisa Lake outflow (see 3). In general, the data fall within the ranges presented by IEP/CDM (1986) and Carr (1979). Chlorophyll-a, turbidity and iron levels in the Charles River inflow are a bit higher and the conductivity reading is much higher than previously reported levels. The conductivity reading is also higher than previous levels for the Louisa Lake outflow. These levels exceed the range of 50 to 500 µmhos/cm found in most natural waters.

The most common limiting nutrient for plant growth in freshwater aquatic ecosystems is phosphorous. Increased phosphorous levels caused by human activities are a common cause of cultural eutrophication. Phosphorous levels greater than 0.02 mg/l indicate eutrophic conditions. Recorded phosphorous levels as listed in Table 7-4 ranged from 0.01-0.05 mg/l at inlet stations, while total phosphorous levels at the outflow averaged 0.04 mg/l. In addition to phosphorous levels, nitrogenous compounds, including ammonia, nitrate, and Kjeldahl-nitrogen, influence aquatic community productivity.

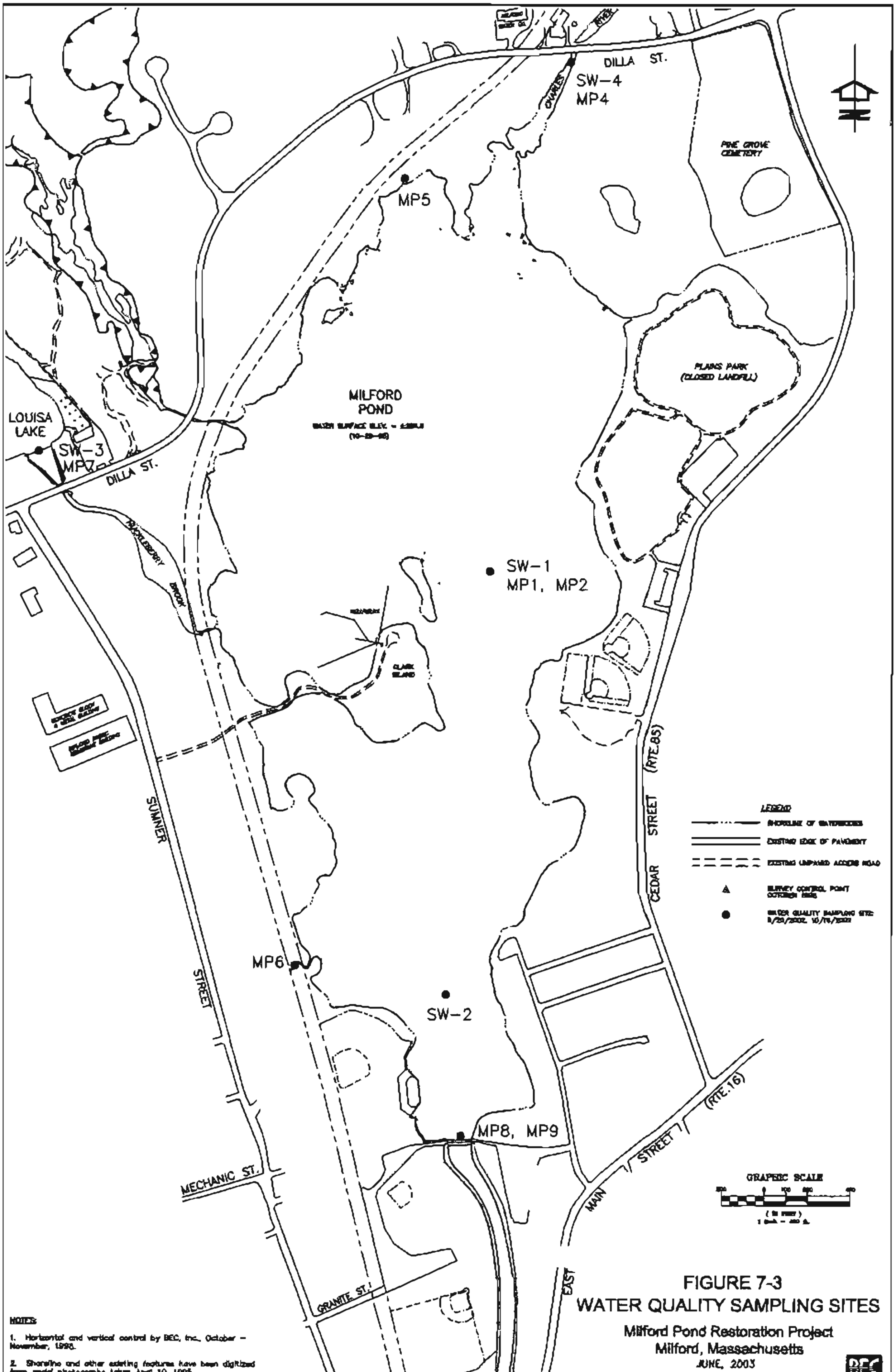


FIGURE 7-3
WATER QUALITY SAMPLING SITES

Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

NOTES:

1. Horizontal and vertical control by BEC, Inc., October – November, 1995.

2. Shoreline and other existing features have been digitized from aerial photographs taken April 10, 1995.

Measurements of all three parameters indicate higher levels recorded at the Milford Pond outlet than at any of the three inlet sampling locations. Measurements indicate that ammonia nitrogen levels often exceed 0.20 ppm, suggesting anaerobic ammonification of the pond. The pond is acting as a source of organic nitrogen caused by overgrowth of macrophytic plant communities. Ammonia levels measured in the Louisa Lake outflow on September 20, 2002 are extremely high, which suggests that the measurement is not representative of conditions within Louisa Lake. The value measured in October of 2002 was not as high; therefore, it is likely that the high value of September is either due to a sampling or laboratory error, or possibly to the presence of Canadian geese that were observed near the sampling location.

On October 16, 2002, additional samples were collected from storm water outfalls located off of Dilla Street and Sumner Street (see Table 7-4; 3). There are no previous data at these locations, but the levels may be compared to those observed at the other inlet sampling stations (Charles River inflow, Louisa Lake outflow, Huckleberry Brook). At the Dilla Street outfall, suspended solids and conductivity are elevated. Nitrate nitrogen is slightly elevated at both locations and is higher than the levels observed in the Milford Pond outflow.

Table 7-4. Milford Pond Inlet/Outlet Water Quality

Sampling Station	Investigator		Chl-a (mg/m^3)	TP (mg/L)	TKN (mg/L)	Ammonia Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Iron (mg/L)
Charles River Inflow	IEP/CDM	R[1]	-	0.02-0.03	0.40-0.71	<0.02-0.05	0.02-0.09	0.23-1.54
		M[2]	12	0.02	0.51	0.04	0.06	0.86
	Carr	R	-	0.01-0.05	0.05-1.2	0.05-0.27	0.08-0.95	0.06-0.44
		M	-	0.02	0.47	0.14	0.35	0.24
	BEC[3] (SW-4; MP4)		47; ND	0.05; 0.02	0.66; 0.3	0.10; 0.15	ND; 0.16	1.9; 0.97
Huckleberry Brook	IEP/CDM	R	-	<0.01-0.04	0.16-0.39	<0.02-0.06	0.01-0.09	0.74-1.10
		M	4.8	0.02	0.30	0.05	0.06	0.93
	Carr	R	-	0.01-0.05	0.20-1.3	0.01-0.39	0.02-1.0	0.10-1.8
		M	-	0.03	0.58	0.16	0.40	0.62
Louisa Lake Outflow	IEP/CDM	R	-	-	0.34-0.58	<0.02-0.14	<0.01-0.17	0.41-0.52
		M	-	0.03	0.46	0.08	0.09	0.46
	Carr	R	-	0.02-0.04	0.25-1.3	0.10-0.50	0.05-0.74	0.09-1.16
		M	-	0.03	0.75	0.26	0.26	0.42
	BEC[3] (SW-3; MP7)		12; ND	0.01; 0.01	0.40; 0.34	20; 0.11	ND[4]; 0.12	0.63; 0.35
Milford Pond Outflow	IEP/CDM	R	-	0.02-0.04	0.63-1.38	0.03-0.65	0.01-0.19	0.36-1.15
		M	0	0.03	0.89	0.30	0.08	0.86
	Carr	R	-	0.01-0.20	0.31-1.2	0.05-0.60	0.05-0.80	0.10-1.04
		M	-	0.04	0.68	0.19	0.29	0.41
Dilla St. (MP5)	BEC[7]		ND	0.03	0.36	ND	2.4	0.38
Sumner St. (MP6)	BEC[7]		ND	0.05	0.5	0.24	1.6	0.14

[1] R = Range
[2] M = Mean
[3] single samples collected September 20, 2002; October 16, 2002.
[4] ND = not detected – indicates the constituent was not present in quantities above the Method Detection Limit (MDL)
[5] SS = Suspended Solids
[6] DS = Dissolved Solids
[7] single samples collected October 16, 2002.

Table 7-4 continued.

Sampling Station	Investigator		pH	SS[5] (mg/L)	DS[6] (mg/L)	Turbidity (NTU)	Conductivity (μmhos/cm)	True Color (c.u.)	Apparent Color (c.u.)
Charles River Inflow	IEP/CDM	R[1]	4.6-6.0	2-15	68-249	0.5-3.5	81-290	40-55	55-150
		M[2]	5.7	6	154	2.3	194	50	90
	Carr	R	4.1-6.6	-	-	0-18	-	-	19-90
		M	5.7	-	-	5	-	-	54
	BEC[3] (SW-4; MP4)		6.7; 6.1	9.8; ND	-	4.5; 3.5	902; 1079	-	-
Huckleberry Brook	IEP/CDM	R	6.0-7.0	2-13	63-106	1.6-4.0	65-138	40-88	40-104
		M	6.6	6	88	2.5	111	56	66
	Carr	R	5.5-7.0	-	-	0.28	-	-	3-118
		M	6.2	-	-	7	-	-	64
Louisa Lake Outflow	IEP/CDM	R	6.1-6.7	5-9	80-103	1.3-1.9	113-131	40-45	55-56
		M	6.4	7	92	1.6	122	42	56
	Carr	R	5.6-6.9	-	-	0-20	-	-	0-80
		M	6.3	-	-	8	-	-	45
	BEC[3] (SW-3; MP7)		6.6; 6.4	ND; ND	-	1.8; 1.7	410; 639	-	-
Milford Pond Outflow	IEP/CDM	R	5.4-7.2	2-13	79-244	2.9-6.0	122-350	40-52	35-200
		M	6.4	9	153	4.5	237	44	102
	Carr	R	5.6-7.8	-	-	0-13	-	-	0-55
		M	6.5	-	-	3	-	-	30
Dilla St. (MP5)	BEC[7]		6.6	37	-	1.2	2604	-	-
Sumner St. (MP6)	BEC[7]		6.5	9.9	-	6.4	342	-	-

[1] R = Range
[2] M = Mean
[3] single samples collected September 20, 2002; October 16, 2002.
[4] ND = not detected – indicates the constituent was not present in quantities above the Method Detection Limit (MDL)
[5] SS = Suspended Solids
[6] DS = Dissolved Solids
[7] single samples collected October 16, 2002.

Tables 7-5 and 7-6 present the results of dry and wet weather water quality sampling conducted by BEC on September 20, 2002 and October 16, 2002, respectively, within Milford Pond itself. The locations from which the samples were collected in September included a mid-pond location just northeast of the Rosenfeld Park Boat Launch and a lower pond location approximately 700 feet north of the dam. In October, the samples were collected at the same mid-pond location as in September, but the lower pond samples were collected right at the dam rather than slightly north of it (see 3). At each location within the pond, one surface sample was collected and another was taken at the pond bottom. In September, surface phosphorous levels are just high enough to confirm eutrophic conditions in the pond, while the deeper levels are much higher. This is a strong indication that phosphorous remineralization is occurring in the bottom sediments under anoxic conditions. The phosphorous levels recorded in October are lower and more uniform than those measured in September, except for the deep lower pond sample. This is indicative of mixing occurring prior to or during the sampling time. The ammonia levels confirm the inlet and outlet measurements that indicate the possibility of anaerobic ammonification occurring in the pond.

Table 7-5. Milford Pond Water Quality (9/20/2002)

PARAMETER		Mid pond surface (SW-1A)	Mid pond depth (SW-1B)	Lower pond surface (SW-2A)	Lower pond depth (SW-2B)
Turbidity	(NTU)	10	15	3.2	9.8
Total Alkalinity	(mg $CaCO_3$/L)	47	46	23	20
Total Suspended Solids	(mg/L)	ND	72	ND	230
Ammonia Nitrogen	(mg/L)	0.767	0.690	0.171	ND
Nitrite Nitrogen	(mg/L)	ND	ND	ND	ND
Nitrate Nitrogen	(mg/L)	ND	ND	ND	ND
Total Kjeldahl Nitrogen	(mg/L)	1.2	3.7	0.61	6.4
Total Phosphorous	(mg/L)	0.02	0.29	0.02	0.48
Orthophosphate Phosphorous	(mg/L)	ND	ND	ND	ND
Chlorophyll-A	(mg/m^3)	13.0	48.5	21.0	95.8
Total Iron	(mg/L)	2.4	5.4	1.9	9.0

Table 7-6. Milford Pond Water Quality (10/16/2002)

PARAMETER		Mid pond surface (MP1)	Mid pond depth (MP2)	Lower pond surface (MP8)	Lower pond depth (MP9)
Turbidity	(NTU)	9	7	1.2	14
Total Alkalinity	(mg $CaCO_3$/L)	43	36	16	16
Total Suspended Solids	(mg/L)	ND	ND	ND	62
Ammonia Nitrogen	(mg/L)	0.822	0.551	ND	ND
Nitrite Nitrogen	(mg/L)	ND	ND	ND	ND
Nitrate Nitrogen	(mg/L)	ND	ND	0.1	ND
Total Kjeldahl Nitrogen	(mg/L)	1.2	0.92	0.32	1.6
Total Phosphorous	(mg/L)	0.01	0.01	0.01	0.12
Orthophosphate Phosphorous	(mg/L)	ND	ND	ND	ND
Chlorophyll-A	(mg/m^3)	ND	ND	ND	ND
Total Iron	(mg/L)	2	1.6	0.49	2.4

IEP/CDM (1986) used measured chlorophyll-a to estimate algal biomass within the water column. This measure would only reflect phytoplankton biomass and not hyper abundance of aquatic plants. Notwithstanding, chlorophyll-a concentrations of 12.0 mg/m^3 measured at the Charles River inlet indicated eutrophic conditions. IEP/CDM (1986) observed somewhat lower, but still relatively high chlorophyll-a concentrations at the Huckleberry Brook inflow and the Milford Pond outflow. As shown in Tables 7-5 and 7-6, chlorophyll-a measurements taken by BEC in September and October of 2002 ranged from none detected to 95.8 mg/m^3, confirming eutrophic conditions.

IEP/CDM (1986) measured dissolved oxygen levels at pond inlets and the Milford Pond outlet to determine oxygen consumption within the pond. Dissolved oxygen levels ranged from a low of 24.5% recorded at the outlet sampling station in August 1984 to super-saturation levels of 120% recorded at inlet sampling stations in early May 1984. Dissolved oxygen levels at the outlet averaged 62.7% saturation. Dissolved oxygen levels measured by BEC in 2002 within Milford Pond ranged from 15% saturation at the mid pond bottom (SW-1) to 83% saturation at the water surface near the dam (MP8; 3). Dissolved oxygen profiles showed a marked decrease with depth during the September sampling event. In October, the DO levels were more uniform throughout the water column, as shown in Figure 7-4. The saturation levels are within the acceptable range for biological activity, but below the optimal level of greater than 70% saturation. Depleted oxygen saturations in Milford Pond are most likely the result of increased biological activity, resulting in vegetative decomposition by aerobic bacteria, which utilize large amounts of oxygen within the water column. Due to the shallow condition of the pond, typical thermal stratification and hypolimnetic oxygen depletion is limited to a small portion of the pond on the east side opposite Clark's Island. However, oxygen depletion remains problematic throughout the pond. Oxygen depletion can readily occur when dense surface aggregations of aquatic weed growth inhibit vertical mixing. The highly organic sediments have a large respiratory consumption of oxygen and even mild density or thermal stratification can result in a shallow oxygen profile. In addition, the lack of offsetting photosynthetic oxygen generation during nighttime leads to a dissolved oxygen deficit in poorly mixed waters. Levels measured within Milford Pond are within the acceptable range for biological activity, but below the optimal level of greater than 70% saturation. After fall turnover, the DO levels become more uniform throughout the water column. Depleted oxygen saturations in Milford Pond are most likely the result of increased biological activity, resulting in vegetative decomposition by aerobic bacteria, which utilize large amounts of oxygen within the water column. Analysis of dissolved oxygen levels further supports the classification of Milford Pond as a eutrophic waterbody.

The analysis of dissolved oxygen levels further supports the classification of Milford Pond as a eutrophic waterbody. The dissolved oxygen data are tabulated in Appendix F.

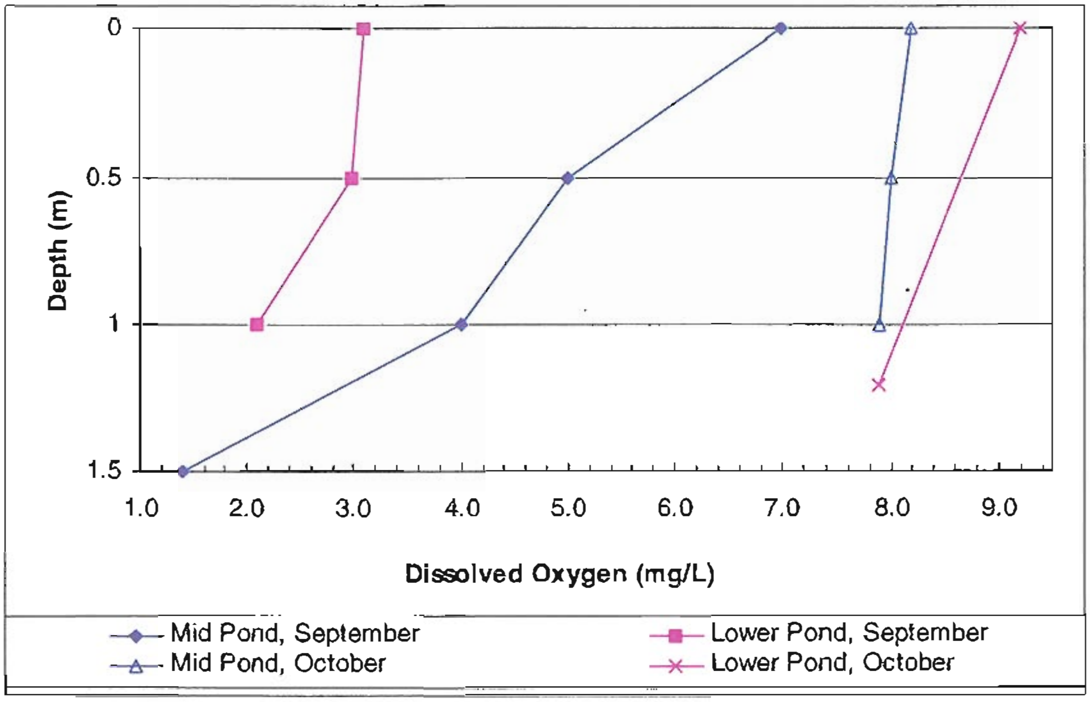


Figure 7-4. Milford Pond Dissolved Oxygen Profiles (2002)

Additional parameters provide insight into the water quality of Milford Pond and its tributaries. Physical parameters measured for the IEP/CDM (1986) study included pH, color, turbidity, suspended and dissolved solid concentrations, and electrical conductivity. Mean pH levels ranged from 5.7-6.6 with the lowest pH levels recorded at the Charles River inflow. The pH levels measured within Milford Pond by BEC in 2002 fell within this range, as shown in Table 7-7, except at the lower pond location in October (MP8, MP9; 3). Milford Pond is more acidic than most waterbodies, which have a pH range from 6.5-8.5. Waters entering Milford Pond are highly colored, with high turbidity levels caused by the presence of dissolved or particulate matter resulting from algal populations and decomposition of organic matter. These levels do not have a major impact upon water quality, but may lead to decreased photic zones, which limit macrophytic plant growth. Analysis of suspended and dissolved solids revealed that levels were highest at the outflow, but averages did not exceed 200 mg/l. The total suspended solids levels measured within the pond by BEC in 2002 were undetected in the surface samples but were as high as 230 mg/L in the bottom samples (Table 7-5), possibly due to disturbance of bottom sediments. Electrical conductivity ranges of pond water reported by IEP/CDM (1986) fell well within natural water ranges of 50 to 500 µS/cm. However, those measured in 2002 exceeded 500 µS/cm at the mid pond location.

Table 7-7. Milford Pond Water Quality Results

Location	Specific Conductivity (µS/cm)	Temperature (°C)	pH	Secchi Disk Depth (ft)	Water Depth (ft)
Mid Pond (9/20/02)				2.6	4.3
Surface	518	20.0	6.17		
Middle	518	19.7	6.14		
Bottom	525	19.1	6.17		
Lower Pond (9/20/02)				3.1	3.3
Surface	427	20.7	6.15		
Middle	426	18.9			
Bottom	425	18.9	6.12		
Mid Pond (10/16/02)				3.6	4.6
Surface	510	11.1	6.44		
Middle	507	11.1			
Bottom	502	11.1	6.56		
Lower Pond (10/16/02)					
Surface	382	12.9	6.87		
Middle	405	11.6	6.97		

7.3.3 Littoral Processes and Sediment Chemistry

In general, deep organic sediments are the dominant substrate in Milford Pond. These sediments have accumulated over time as a result of the impoundment of the Charles River. Prior to dam creation in 1938, a small waterfall, at the base of the present-day pond, served as a grade control for the Charles River. This waterfall created a topographical gradient, which resulted in the formation of a marsh and the gradual accumulation of upstream sediments. When the dam was built in 1938, Milford Pond formed over deep peaty soils with high organic contents resulting from historical wetland formation. Since this time cultural sedimentation caused by inflow from tributary streams and runoff from the surrounding watershed has led to the formation of an organic sediment substrate overlying these peat soils.

BEC (2000) and IEP/CDM (1986) have investigated the physical and chemical characteristics of Milford Pond sediments. As part of the CSA and QRA for the Milford Landfill, Weston and Sampson (1994, 1997) collected sediment samples from Milford Pond in 1991 and 1995. The three samples were collected from sites along the eastern edge of Milford Pond near the Milford Landfill () and were analyzed for VOCs and metals. The IEP/CDM (1986) sediment-sampling program was conducted in December 1984, and consisted of three composite sampling cores collected at different locations throughout the pond (). Sediment samples were analyzed for nutrients, heavy metals, PCB's, and physical parameters. A total of four samples of unconsolidated organic Milford Pond sediments were obtained by BEC on January 11, 1999 (5) for physical and chemical analyses. The physical properties, including size distribution, percent solids, percent volatile solids, and moisture content, were measured. Chemical analyses included nutrients, metals, TCLP metals, PAHs, PCBs and VOCs. An additional fifteen (15) core samples were obtained between May 29 and 30, 2002 from locations within the potential Milford Pond dredge limits (5). The following discussion focuses on the BEC (2002) investigation. Results of the physical and chemical analyses of the IEP/CDM (1996), Weston and Sampson (1994), and BEC (2000) are included for comparative purposes.

Table 7-8 summarizes the maximum, minimum and mean values of the sediment quality parameters for which there was detection for the 15 samples collected in 2002. In general, the sediment samples were found to be highly organic, with total volatile solids ranging from 52 to 80%, with the exception of two samples located near the center of the pond in the vicinity of Rosenfeld Park and the Clark Island Well Field. These samples had total volatile solids of 12 and 23% and had the highest percent total solids and lowest percent total organic carbon (TOC), as compared to the other samples. According to the U.S. Department of Agriculture (USDA) Classification System, Sample COE-8 is a loam, COE-9 is a loamy sand, and COE-10 is a sandy loam. The remainder of the samples are classified as silty loam, according to the USDA Classification System. It should be noted that these classifications are based on the mineral portion of the samples only.

Table 7-8. 2002 Sediment Analysis Summary

	Minimum	Maximum	Mean
Solids, Total (%)	8.6	29	12
Solids, Total Volatile (%)	12	80	58
Total Organic Carbon (%)	6.45	30.8	18.7
Metals			
Arsenic, Total (mg/kg)	0.92	3.9	2.1
Barium, Total (mg/kg)	27	86	60
Cadmium, Total (mg/kg)	ND	1.5	0.35
Chromium, Total (mg/kg)	1.3	5.6	2.9
Lead, Total (mg/kg)	1.2	52	12
Mercury, Total (mg/kg)	0.02	0.11	0.05
PAH			
Perylene (ug/kg)	ND	2200	864
EPH			
C19-C36 Aliphatics (mg/kg)	13	165	90
C11-C22 Aromatics (mg/kg)	24.7	282	141

Most of the polynuclear aromatic hydrocarbons (PAHs) tested for were not detected in the majority of the May 2002 samples and thus are not included in Table 7-8. In general, PAHs are products of incomplete combustion. Inefficient combustion of solid and liquid

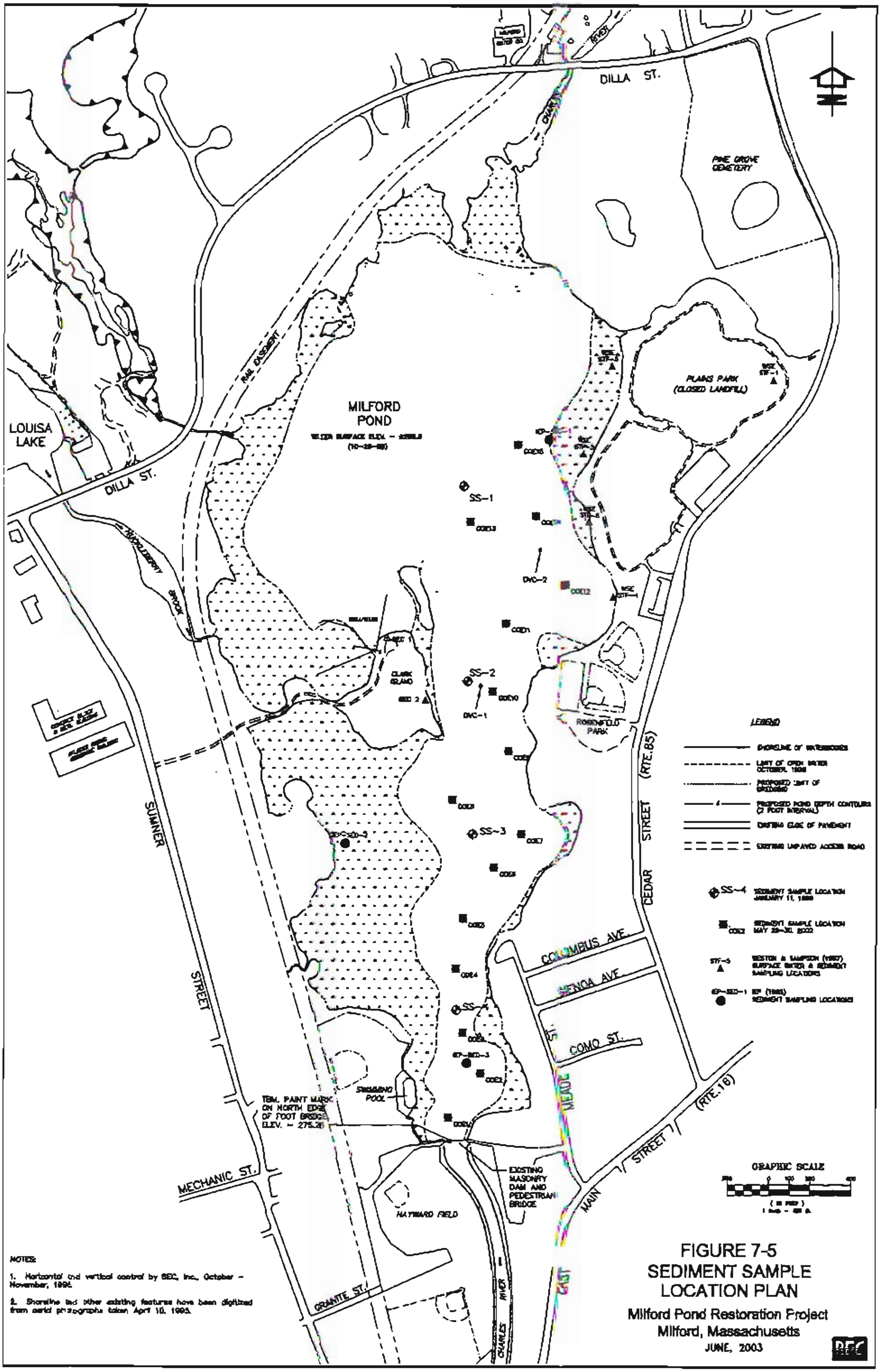


FIGURE 7-5
SEDIMENT SAMPLE LOCATION PLAN
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

fuels such as coal, wood, kerosene, and fuel oil can lead to PAH formation. Common sources of PAHs include diesel and gasoline engines; service stations, coke ovens, and tar plants; heaters, boilers, and furnaces; municipal and hazardous wastes; cigarette smoke, wood stoves, and barbecues; and iron and steel foundries. Toxicological studies have identified several PAHs as carcinogenic. None of the PAHs detected in the May 2002 samples were in concentrations above the Massachusetts Contingency Plan (MCP) S-1 or S-2 standards (for GW-1). Samples COE-1 and COE-2, located at the southern end of the pond, near the dam, and sample COE-9, near Rosenfeld Park and the boat launch, contained a greater variety of PAHs. At the northern end of the pond, COE-12 and COE-13 likewise contained a higher diversity of PAHs. The total PAH values for the samples ranged from below detection limits (COE-10) to a high of 7.8 mg/kg (COE-1).

Each of the samples, with the exception of COE-10 (due west of Rosenfeld Park), contained detectable quantities (0.13-7.2 mg/kg) of the PAH perylene as the primary PAH. Perylene is commonly used as a fluorescent dye and in paints. Anthropogenic sources of perylene include Fuel Oil 5, diesel fuel, and used engine oil, in addition to its use in the manufacture of organic semiconductors. This compound exhibits high photostability and thermal stability and chemical inertness. It is relatively resistive of biodegradation in soils. Perylene is not classifiable as to its carcinogenicity in humans, and there is no MCP standard for perylene. Perylene is also noted to be one of the few PAHs to occur naturally in the environment. This PAH has been identified in natural sediments in pond/lake bottoms. The presence of perylene in sediments may be due to the assimilation of plant material into bottom sediments, and may be considered as an indicator of plant pigments, such as chlorophyll a, in sediments.

Contaminant concentrations were low for most metals in comparison to non-urban soil concentrations for Massachusetts (DEP, Final Interim policy WSC/ORS-95-141). The only metals that were found in levels exceeding the MADEP's Background concentrations for non-urban soils concentrations in the May 2002 sample round were barium and selenium. Selenium was only detected in sample COE-9, near Rosenfeld Park, at a concentration of 1.2 mg/kg. Barium was found in the majority of samples in levels exceeding the MA DEP Background Soil concentrations, but was still significantly below the MCP S-1 standard. For the May 2002 sample set, TCLP testing was only completed if there was a theoretical possibility of TCLP criteria being exceeded for a certain metal, based on the total metals analysis. No TCLP testing was required.

Polychlorinated Biphenyls (PCBs) and pesticides were not detected in the laboratory analysis. An Extractable petroleum hydrocarbon (EPH) test was also completed for the May 2002 sediment samples, according to MA DEP methods. Sample COE-1, located just north of the dam, was the only sample to have detectable levels of EPH in the C9 – C18 aliphatics range. The concentration in this sample was well below the S-1/GW1 standards of the Massachusetts Contingency Plan (MCP) at 310 CMR 40.000. All of the samples saw detectable levels in the C19 – C36 aliphatics range and the C11 – C22 aromatics range. Samples COE-2, COE-3, and COE-11 had levels of C11 – C22 aromatics that exceeded the S-1/GW1 standards of the MCP at 310 CMR 40.000 in 3 of 15 samples (by up to 40%). . Samples COE-2 and COE-3 are located at the southern end of the pond and sample COE-11 is located to the northwest of Rosenfeld Park. While additional sampling at the dredged material disposal site may be required as part of the permit conditions for the dredging program, the levels observed are not likely to prevent the proposed dredging program for Milford Pond or limit disposal of the sediments.

Sediment sample COE-13 was the only sample which contained detectable quantities of a volatile organic compound (VOC) as detected in the 8260 scan. This sample contained low concentrations of p-Isopropyltoluene (p-Cymene), which may be associated with bactericides and insecticides, or natural plant oil. The concentrations detected were significantly below the reportable quantities and there is no MCP standard for this compound. Since this was the only VOC detected for the entire sample set, this value may be indicative of a sampling or laboratory error.

Results of the BEC 2002 sediment investigation are comparable with the previous studies as shown in Table 7-9. The 2002 sediment samples were not analyzed for nutrients, but the 1999 samples showed TP concentrations ranging from 170 to 590 mg/kg and TKN concentrations ranging from 11,000 to 21,000 mg/kg. The nutrient concentrations (phosphorous and nitrogen) in the soft sediments are high and are reflective of the eutrophic conditions of Milford Pond. The elevated levels of TP and TKN in the shallow sediment provide an excellent substrate for aquatic plant growth in Milford Pond.

Of the metals that were not tested in the 2002 samples, cadmium, mercury, and zinc were observed to have concentrations that were higher than the MA DEP's background concentrations for non-urban soils in one of the 1999 samples. This sample was located in the southern end of the pond.

Low concentrations of the PAHs benzo (ae) pyrene, benzo (b) fluoranthene, and benzo (k) fluoranthene were detected in one of the 1999 samples. The first two of these contaminants were found in concentrations, which slightly exceed the Method 1 S-1 and S-2 Standards of the Massachusetts Contingency Plan (MCP) at 310 CMR 40.000.

Table 7-9. Results from Previous Analyses of Sediment Characteristics

Parameter	Range observed by IEP/CDM (collected in 1984)	Range observed by Weston and Sampson (collected in 1991)	Range observed by BEC (collected in 1999)
% Volatile Solids	12.2 – 61.1	-	58 – 80
Total P	-	-	170 – 590
TKN	-	-	11,000 – 21,000
% Moisture	56 - 82	-	90 – 92
Metals			
Arsenic	4.7 - 16	0.5 – 2.8	1.2 – 5.8
Barium	-	10 - 63	-
Cadmium	<3.9 - <13	ND	0.36 – 4.7
Calcium	-	-	6,100 – 13,000
Chromium	5.8 - 13	3 – 12.9	3.1 – 8.4
Copper	12 - 33	2 – 16.3	6.1 – 23
Lead	5.4 - 466	11.8 – 107	24 – 91
Iron	-	30 – 16,800	-
Magnesium	-	-	640 – 1,200
Manganese	-	1 - 133	-
Mercury	<0.31 - <0.77	ND – 0.18	ND – 0.4
Nickel	<3.9 - <13	-	2.6 – 12
Potassium	0 - 5	-	ND
Selenium	-	ND – 0.72	-
Silver	-	ND - 2	-
Zinc	86 - 254	2 - 155	44 – 260
PCBs/Pesticides			ND
alpha - HCH	-	ND - 56	-
4,4-DDD	-	ND - 450	-
4,4'-DDE	-	ND - 160	-
Detected PAHs			
Benzo (ae) pyrene	-	-	ND – 1,700
Benzo (b) flouranthene	-	ND - 148	ND – 1,400
Benzo (k) flouranthene	-	-	ND – 1,500
Benzo (a) anthracene	-	ND – 1,000	-
Perylene	-	-	3,200 – 7,200
Volatile Organics			ND
Benzene		ND - 13	-
1,1, Dichloroethane	ND - 11.1 *	-	-
Methylene Chloride	ND - 31 *	-	-

Note: Metals and nutrients are expressed in mg/kg
PAHs, VOCs, and PCBs/Pesticides in µg/kg
ND=None Detected
* Two of the samples did not have detectable levels of the contaminant. The upper range value was observed in the sample collected near the edge of the Milford Landfill

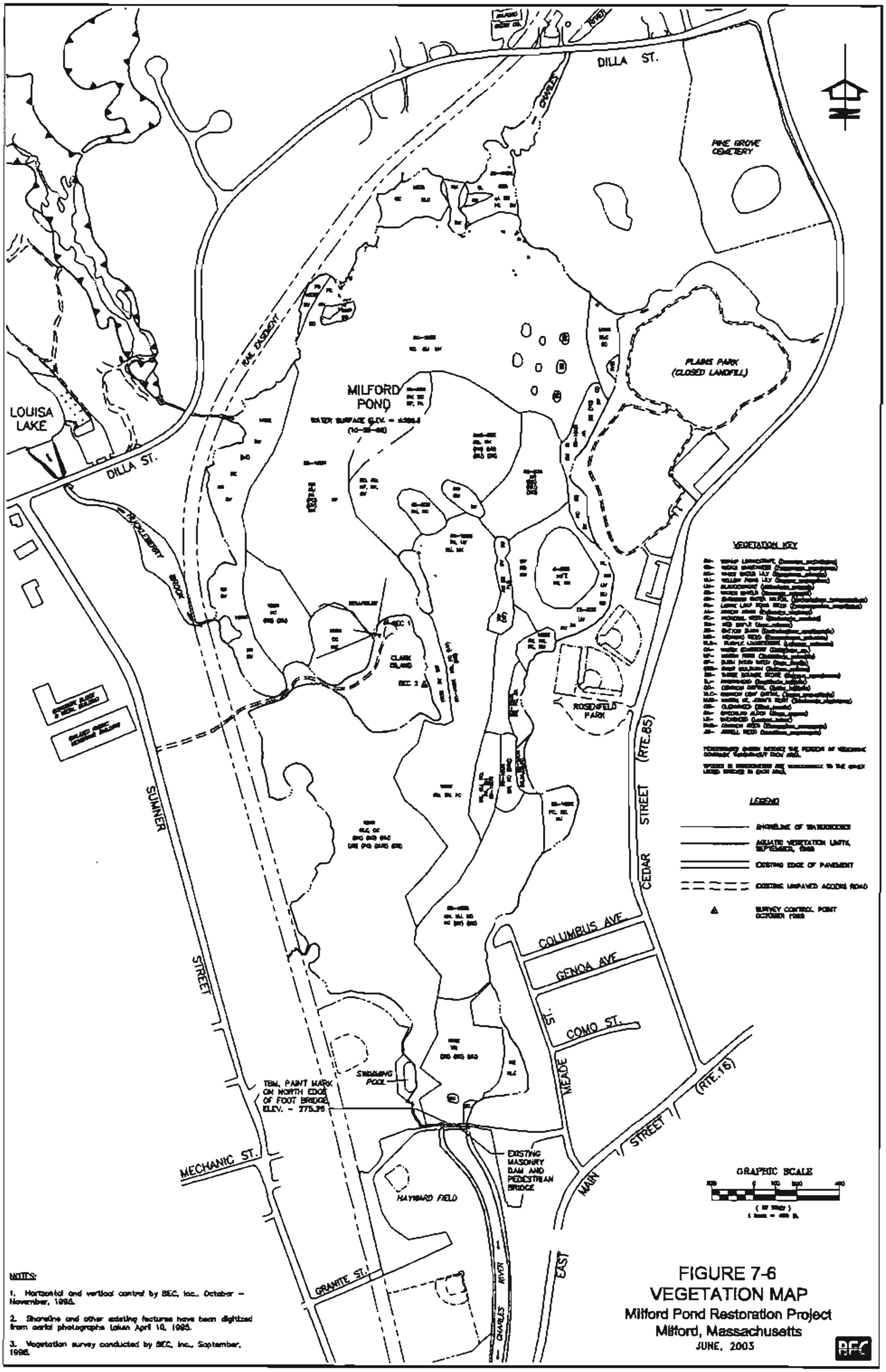
7.4 Biological Resources

Milford Pond has a relatively typical biotic community for a shallow, eutrophic, temperate-zone lake. Data on aquatic habitat was obtained from *the DEIR for Utilization of Louise Lake Overflow for Public Water Supply* (Metcalf & Eddy, 2000), the *D/F Study for Milford Pond* (IEP/CDM, 1986), *Options for the Reclamation of Cedar Swamp Pond* (Carr, 1979), a *Report on the Proposed Restoration Project for Milford Pond* (BEC, 2000), and recent field investigations.

7.4.1 Aquatic Vegetation

Aquatic macrophyte growth in Milford Pond is extremely dense due to the deep organic soils that underlie Milford Pond. These nutrient-rich sediments provide a fertile substrate for aquatic macrophyte growth. These plants are, therefore, neither phosphorous, nor nitrogen limited. In Milford Pond, seasonal light limitations and competition for available growing space are the only limiting factors for macrophyte growth.

On September 22, 1998, Baystate Environmental Consultants (BEC) scientists conducted a survey of Milford Pond resulting in the creation of a map of aquatic vegetation for this waterbody (Figure 7-66, Table 7-10). The aquatic macrophytes found in Milford Pond consist of emergents, submergents, floating-leafed, and free floating plant species. A total of ten submergent or floating-leafed species were identified as part of this investigation. The remainder consisted of peripheral emergent herbaceous species and some shrubs and trees. Submergent and floating-leafed plant species were found throughout the pond area and occupy density ranges from 60-100% of the pond area. Floating-leafed plants found in Milford Pond include white water lily, yellow pond lily, and watershield, while the free-floating component was limited to duckweed. Submergent species found within Milford Pond include bladderwort, Eurasian water milfoil, mermaid weed, water starwort, spatterdock, bush and large leaf pondweeds. Species such as Eurasian milfoil have the potential to become invasive and cause nuisance conditions in northeastern ponds and lakes. Such is the case at Milford Pond.



NOTES:

1. Horizontal and vertical control by BEC, Inc., October – November, 1998.

2. Shoreline and other existing features have been digitized from aerial photographs taken April 10, 1995.

3. Vegetation survey conducted by BEC, Inc., September, 1998.

FIGURE 7-6
VEGETATION MAP
Milford Pond Restoration Project
Milford, Massachusetts
JUNE, 2003

Table 7-10. Aquatic Vegetation

Common Name	Scientific Name
Swamp Loosestrife	*Decodon verticillatus*
Water Smartweed	*Polygonum punctatum*
White Water Lily	*Nymphaea odorata*
Yellow Pond Lily	*Nuphar variegatum*
Bladderwort	*Utricularia vulgaris*
Water Shield	*Brasenia schreberi*
Eurasian Water Milfoil	*Myriophyllum heterophyllum*
Large Leaf Pond Weed	*Potamogeton amplifolius*
Arrow Arum	*Peltandra virginica*
Pickerelweed	*Pontederia cordata*
Red Maple	*Acer rubrum*
Buttonbush	*Cephalanthus occidentalis*
Mermaid Weed	*Prosperinaca palustris*
Purple Loosestrife	*Lythrum salicaria*
Water Starwort	*Callitriche sp.*
Bush Pond Weed	*Naja flexilis*
Giant Bulrush	*Scirpus validus*
Three Square Sedge	*Scirpus americanus*
Arrowhead	*Sagittaria latifolia*
Broad-Leaf Cattail	*Typha latifolia*
Narrow-Leaf Cattail	*Typha angustifolia*
Marsh St. John's Wort	*Triadenum virginicum*
Clearweed	*Pilea pumila*
Speckled Alder	*Alnus rugosa*
Duckweed	*Lemna minor*
Common Reed	*Phragmites communis*
Jewelweed	*Impatiens canadensis*
Tussock Sedge	*Carex stricta*
Green-Headed Coneflower	*Rudbeckia laciniata*
Bittersweet Nightshade	*Solanum dulcamara*

7.4.2 Benthic Environment

A study of benthic macro invertebrates was conducted as part of the D/F Study performed by IEP/CDM (1986). Samples were taken at four sampling stations on May 9, 1984 and December 4, 1984. These sampling stations were located upstream of the Charles River, Huckleberry Brook, and Louisa Lake inflows and at the Milford Pond outflow. Macro invertebrate communities found upstream of the Charles River and Huckleberry Brook inflows exhibited a good diversity of pollution intolerant, facultative, and pollution tolerant forms. Species found in these sampling locations include blackflies, stoneflies, mayflies, midge larvae, *Asellus*, and *Hyalella*. The presence of these species indicates well-oxygenated unpolluted water. Macro invertebrate communities recorded near the Louisa Lake inflow and the Milford Pond outflow exhibited a fair diversity of pollutant-tolerant and facultative forms. Species found in this area include *Asellus*, *Hyalella*, midge larvae, and mollusks. The presence of these species with the absence of pollution intolerant species is indicative of degraded water quality and benthic habitat. Table 7-11 summarizes the benthic analyses.

Table 7-11. Benthic Analyses

Station	May 9, 1984	December 4, 1984
1	Good diversity of pollution-intolerant and facultative forms. Blackfly larvae (very abundant), *Hyalella* (frequent), stonefly nymphs (common), *Asellus* (common), midge larvae (common), mayflies (frequent).	Good diversity of pollution-tolerant and facultative forms. *Asellus* (abundant), midge larvae (frequent), *Hyalella* (frequent), mayfly nymphs (common), cranefly larvae (rare), stonefly nymphs (rare), mollusks (common), alderfly nymphs (rare).
2	Fair diversity of pollution tolerant and facultative forms. *Asellus* (abundant), blackfly larvae (common) non-biting midge larvae (common), mayfly larvae *Siphonurus* (rare), caddisfly case remnants.	Fair diversity of facultative forms. Midge larvae (abundant), mayfly nymphs (common), *Asellus* (common), *Hyalella* (common).
3	Fair diversity of pollution tolerant forms. *Asellus* (common), *Hyalella* (common), midge larvae (very abundant), filamentous algae present.	Fair diversity of pollution-tolerant and facultative forms. Midge larvae (common), *Hyalella* (common), mollusks (common), water beetles (rare), cranefly larvae (rare).
4	No sample obtained.	Fair diversity of pollution-tolerant and facultative forms. *Asellus* (abundant), *Hyalella* (common), midge larvae (common), non-biting midge larvae (rare), mollusks (rare).

Note: Conducted by IEP biologists in 1984. Station 1=Charles River Inlet, Station 2=Huckleberry Brook Inlet, Station 3=Louisa Lake Inlet, 4=Charles River Outlet

7.4.3 Fisheries

Data on fisheries resources was obtained from the *Final EIR for Utilization of Louisa Lake Overflow for Public Water Supply* (Metcalf & Eddy, December 2001, EOEA #11394) and from ACOE. The EIR utilized fisheries data obtained from a Massachusetts Department of Environmental Protection fish toxin monitoring study conducted in 1989. This fish toxin monitoring study utilized gill net and electro shocking sampling techniques. The ACOE fish survey was performed in September of 2002. Table 7-12 presents the available data from these two efforts.

Table 7-12. Fisheries Data

	1989	2002		
Species	Number	Number	Average Length (cm)	Average Weight (g)
Brown Bullhead	4	1	30.2	392.5
Black Crappie	3	1	5.5	2
Bluegill	2	22	8.5	56.1
Chain Pickerel	1	11	24.8	130.7
Golden Shiner	--	9	12.3	18.3
Largemouth Bass	3	7	16.1	258.4
Pumpkin Seed	--	4	6.4	6.7
Yellow Perch	8	2	26.7	229

Yellow perch, brown bullhead, chain pickerel, black crappie, largemouth bass, and bluegill sunfish were captured during both sampling events. These species are commonly found in ponds and lakes throughout the northeast and are typical of shallow, still waters such as Milford Pond. Ambush feeders such as chain pickerel and largemouth bass thrive in weedy environments such as Milford Pond due to the presence of ample cover vegetation. However, the rapid deterioration of open water habitats could threaten to limit habitat for their prey base. Bluegill sunfish are a key food resource for piscivorous fish, but typically occupy a habitat niche requiring open water and aquatic macrophyte cover. Additionally, decomposition of aquatic vegetation has resulted in low dissolved oxygen levels during summer months. Low dissolved oxygen levels have the potential to result in fish kills.

Since the impoundment of the Charles River and subsequent creation of Milford Pond in 1938, local sportsmen for recreational fishing have utilized Milford Pond. In recent years, the suitability of Milford Pond for recreational fishing has been compromised due to cultural eutrophication and uncontrolled weed growth. Comment letters on the ENF provide anecdotal evidence of the recreational fishing history of Milford Pond. In the 1940's and 1950's, Milford Pond was a fisheries resource for local sportsmen who caught "horn pout" (brown bullheads), largemouth bass, and bluegill sunfish. The hydraulic dredging of Milford Pond will result in a decrease in aquatic macrophyte communities and the restoration of deep-water habitat for fisheries. The restoration program will help to restore an ecological balance to this eutrophic system.

7.5 Threatened and Endangered Species

In letters dated July 22, 1999 and April 12, 2002, the Massachusetts Natural Heritage and Endangered Species Program (MA NHESP; MA Division of Fisheries & Wildlife) has identified the occurrence of four State-listed species in the vicinity of the project area (see Appendices C and H). These species include the pied-billed grebe, least bittern, king rail, and the common moorhen.

These State-listed species all nest in freshwater marshes with emergent vegetation communities including cattails. Massachusetts is the northern extent of the king rail's range, while the other three species have wide ranges in the east. Although their ranges are extensive, these birds are limited by paucity of nesting habitat. These species are not strong fliers, and rely on swimming or camouflage to escape predators. Although cattails and other emergent vegetation are important to the habitat of these birds, three of the species also utilize open water for flying or feeding. The pied-billed grebe requires open water to build up speed for flight, while the least bittern feeds at the edges of open water, and the common moorhen feeds by wading or diving in open water. The proposed dewatering/disposal site is located in an upland area that does not contain estimated and priority habitats of these four bird species. The avoidance of potential impacts to these species is discussed in Section 8.5.

The project area contains no federally-listed or proposed threatened or endangered species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS), according to a letter dated May 13, 2002 from USFWS (see Appendix C).

7.6 Wetlands

According to the National Wetlands Inventory (NWI) map, the greater Milford Pond wetland complex may be divided into two major wetland types: lacustrine limnetic open water (L1OW) and palustrine scrub-shrub emergent wetland (PSS1/EM). Lacustrine limnetic open water habitats occupy the majority of the wetland and will be the primary focus of the Milford Pond Restoration Project, while palustrine scrub-shrub emergent wetland types may be found along the perimeter of Milford Pond and will be preserved as habitat for a variety of wildlife species. These wetlands exhibit a classic wetland successional mosaic, in which sediment and organic material accumulation contributes to reductions in open water habitats and speeds the process of wetland succession. As a part of this process, sediment accumulation along the shoreline fringes allows emergent wetland species to expand into open water areas, while dense mats of floating aquatic vegetation accumulate organic materials resulting in the formation of free-floating peat islands. These processes have resulted in a reduction in open water habitat. In Milford Pond, only small pockets of open water habitat remain due to the rapid accumulation of sediment caused by runoff from the surrounding watershed.

Lacustrine limnetic open water wetlands may be characterized as wetland systems situated in a dammed river channel, greater than 20 acres in size, and lacking vegetative cover in the form of trees, shrubs, or persistent emergents. These wetlands extend upward from the littoral boundary and include all deepwater habitats. This wetland type is exhibiting classic wetland successional processes, which have been sped up by development in the surrounding watershed. The continued proliferation of floating leaf and submersed macrophyte species will eventually eliminate any open water habitat from Milford Pond. At present, some open water habitat is available; however shallow water and dense aquatic macrophyte growth limit the value of this habitat.

Palustrine scrub-shrub and emergent wetlands may be characterized as small (less than 20 acres) non-tidal wetlands dominated by emergent broad-leaved deciduous scrub-shrub vegetation. These areas occur along the perimeter of Milford Pond and in a 400-foot wide band along the western shoreline. Emergent wetland areas are extremely productive ecosystems that provide habitat for a variety of aquatic and terrestrial wildlife species.

Regulated resource areas found within Milford Pond include Land Under Water (LUW), Bordering Vegetated Wetland (BVW), Bordering Land Subject to Flooding (BLSF), and Bank resource areas. Analysis of FEMA maps indicates that Milford Pond falls entirely within the 100-year floodplain of the Charles River. Land Under Water (LUW) is defined as the land beneath any creek, river, stream, pond, or lake, which may be composed of organic muck or peat, fine sediments, rocks, or bedrock. This resource area encompasses all land located below the low annual water level of Milford Pond. Areas classified as LUW dominate the majority of Milford Pond including the large band of emergent vegetation located along the western portions of Milford Pond. LUW also is included within the channel of Huckleberry Brook within the Town-owned land to be used as a sediment disposal area under the dredging alternatives.

Bordering Vegetated Wetland, defined as freshwater wetlands, which border on creeks, rivers, streams, lakes, or ponds, with hydric soils, which support a predominance of wetland indicator plants, occupy only a small area of Milford Pond. These areas are located at the inlet of Lower Huckleberry Brook and along the eastern shoreline adjacent to the capped landfill. There are also significant areas of BVW within the Town-owned land to be used for sediment disposal (mostly on the western side), although all such disposal will be located on uplands, outside of the wetlands. Bordering Land Subject to Flooding (BLSF) is defined as an area of low, flat topography that is subject to flooding from a rise in a bordering waterway or waterbody. This resource area is found within the 100-year floodplain of the Charles River and extends from the Bank or BVW around the perimeter of the pond. Bank resource areas are defined as the portion of the land surface, which normally abuts and confines a water body. This resource area occurs between a water body and BVW and adjacent floodplain, or in the absence of these, between a waterbody and an upland. Bank resources areas are located around the perimeter of much of the pond and provide a short transition zone between LUW and the BVW or upland.

7.7 Historical and Archaeological Resources

The Town of Milford was originally incorporated in 1780 as a farming community with agricultural land located primarily on the fertile floodplains of the Charles River and on prime agricultural soils located in upland areas. Milford Pond was originally a natural swamp area, reportedly containing numerous cedar trees lining the banks of the Charles River. A small waterfall at the swamp's southerly end acted as a grade control for the riverbed, forming a topographical barrier, which led to the formation of a wooded swamp. Early colonists considered this area, known as Cedar Swamp, a valuable community asset. Therefore, Cedar Swamp was divided into small proprietary allotments, which ensured each individual landowner a small share. Lumber cut from the towering cedar trees was highly durable and was used for the construction of homes and cedar shingles by early colonists.

In 1795, a fledgling boot and shoe industry began production in the Town of Milford. As this industry expanded, the town developed into a thriving manufacturing center, world renowned for the manufacture of shoes and boots. The discovery of valuable deposits of structural-grade granite allowed for the development of a small granite quarrying industry within the Town of Milford. The construction of a rail line during the 1850's led to the expansion of both the shoe manufacturing and granite quarrying industries. The development of these industries led to an ever-increasing population base that settled in the downtown area. Industrial development, which required large level areas, access to waterpower and transportation resources, clustered along the banks of the Charles. The resulting land use pattern in the lower portion of the Milford Pond watershed became one of concentrated industrial, transportation, and residential uses in the valleys and sparsely developed uplands.

Early development near the pond included an iron foundry along the southwesterly shore, the construction and operation of a railway along the westerly shore, and a cemetery located northeasterly of the pond. These industries contributed to Milford's development as a sub-regional commercial center. Abutting the easterly shoreline, the Milford landfill operated for several years and has been recently capped and closed and converted to open space available to the town residents as parkland. An icehouse reportedly operated for a number of years along the southeasterly banks of the pond. In the early 1900's, Cedar Swamp Pond was originally created for power generation purposes. By 1938, severe flooding within the downtown area led to the construction of the present dam, owned by the Town of Milford. Dam construction, which was completed in 1938, raised the water within the pond to the present levels.

In the period spanning from the early 1940's through the 1960's, Milford Pond became a focal point for community recreation and use. Local residents used the pond for a variety of recreational activities including swimming, fishing, boating, and ice-skating. In 1962, the Milford Water Company developed the Clark Island Well Field for the provision of potable drinking water to residents of Milford.

The construction of Interstate 495 (I-495) in 1965 and the growth of the automobile industry led to widespread residential growth within the Town of Milford. This growth was centered in the northern and western portions of the town and resulted in the development patterns seen in Milford today.

The Massachusetts Historical Commission (MHC) was contacted in October of 2000 regarding historic and archeological resources within the project area. According to a letter dated October 27 and December 8, 2000 from MHC, there were two recorded historical sites in the vicinity: the structural foundation remains of the Louisa Lake Ice Company are northwest of Dilla St. adjacent to Louisa Lake, and the Pine Grove Cemetery is at the Cedar and Dilla St. intersection. MHC also stated that due to the favorable environmental setting, unrecorded archeological sites might be present. However, no known sites were in the project area, and all of the proposed project areas are currently highly disturbed sites, unlikely to contain any cultural resources. In February of 2003, MHC was provided with information regarding the proposed dredging operation and dewatering site. The response from MHC indicated that the project as presently proposed is unlikely to affect any significant historic or archaeological resources (see Appendix C).

Socioeconomic Resources and Environmental Justice

The Town of Milford is primarily a residential and industrial community with a population of approximately 27,000 as of the year 2000. There are two major industrial parks in Milford that are home to businesses such as Boston Digital Corporation, EMC, and Photofabrication Engineering, Inc. Major areas of employment in the town include manufacturing at 24%, trade at 25%, and various services at 31%. In 1990, the median household income in Milford was about $38,000, and the unemployment rate in 2001 was 3.6%, which was just under the statewide unemployment rate of 3.7% (DHCD, 2002; Town of Milford, 2002; Commonwealth of Massachusetts, 2001).

Economic development activities in Milford include downtown revitalization efforts through the Downtown Partnership of Milford Inc. and the promotion of development/redevelopment projects through tax incentives within designated "Economic Opportunity Areas" (EOAs) including Bear Hill Industrial Area, Granite Park and the Downtown Area. Cultural resources in the town include the Milford Cultural Center, a variety of restaurants and hotels, and the Town forest and several public lakes including Milford Pond. Town owned conservation land includes Louisa Lake and bordering lands, and the western shore of Milford Pond from Fino Field annex to Clark's Island. Annual community events include the Portuguese Picnic, the Firefighters' Family Day, summer band concerts and the Welcome Santa Parade (DHCD, 2002; Town of Milford, 2002).

Milford is served by Interstate 495, which runs along the eastern boundary of the Town and provides access to I-95 and the Massachusetts Turnpike. State Routes 16, 85, and 140 pass through the Town. Milford Pond is surrounded by Route 85 (Cedar Street), Route 16 (East Main Street), Dilla Street and Sumner Street. Development around the pond consists of residential areas around its southern half, two cemeteries to the northeast, Bicentennial Park and Hayward Field to the west, and the Town Forest to the north. Industries located near the pond include Snap On Tools, on Cedar Street near East Main Street, and Benjamin Moore on Sumner Street.

Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" requires federal agencies to examine proposed actions to determine whether they will have disproportionately high and adverse human health or environmental effects on minority or low income populations. As of 2000, the Town of Milford had a minority population that was 7.1% of the total population. 6.6% of the housing units within the town are federal or state subsidized housing (DHCD, 2002). An area bordering the western shores of Milford Pond does contain environmental justice populations, according to MassGIS Environmental Justice mapping and the Environmental Justice Policy of the Executive Office of Environmental Affairs ("The Policy"). The Policy defines environmental justice populations as U.S. Census Bureau census block groups that meet one or more of the following criteria:

- ξ The median annual household income is at or below 65 percent of the statewide median income for Massachusetts; or
- ξ 25 percent of the residents are minority; or
- ξ 25 percent of the residents are foreign born, or
- ξ 25 percent of the residents are lacking English language proficiency (EOEA, 2002).

7.9 Protection of Children

Executive Order 13045 "Protection of Children from Environmental Health Risks and Safety Risks" seeks to protect children from disproportionately incurring environmental health or safety risks that might arise as a result of Army policies, programs, activities and standards. Environmental health risks and safety risks include risks to health and safety attributable to products or substances that a child is likely to come in contact with or ingest. Currently, the excessive vegetative growth surrounding the Town swimming pool located on the southwestern corner of Milford Pond may pose a health and safety risk to children that utilize the pool. Risks associated with the pond itself are limited to those associated with any natural body of water.

7.10 Air Quality

The Commonwealth of Massachusetts defines air pollution as the presence in the ambient air space of one or more air contaminants or combinations thereof in such concentrations and of such duration as to: (a) cause a nuisance; (b) be injurious, or be, on the basis of current information, potentially injurious to human or animal life, to vegetation, or to property; or (c) unreasonably interfere with the comfortable enjoyment of life and property or the conduct of business (310 Code of Massachusetts Regulations 7.00).

Ambient air quality is protected by Federal and state regulations. The U.S. EPA has developed National Ambient Air Quality Standards (NAAQS) for certain air pollutants and air quality standards for each state cannot be less stringent than the NAAQS. The NAAQS determined by the EPA set the concentration limits that determine the attainment status for each criteria pollutant. Massachusetts does not attain the public health standard for two pollutants – ozone (O3) for the entire state and carbon monoxide (CO) in a few cities (DEP, 1999).

Under the Federal Clean Air Act and its associated amendments (42 USC 7401 et seq.), the Federal Environmental Protection Agency (EPA) regulates six "criteria" air pollutants:

- ξ Nitrogen dioxide (NO_2)
- ξ Sulfur dioxide (SO_2)
- ξ Lead (Pb)
- ξ Carbon monoxide (CO)
- ξ Particulate matter with a diameter of 10 microns or less (PM_{10})
- ξ Ozone (O_3)

Pollutants can be categorized as "local" or "regional". For example, carbon monoxide is a local pollutant because it forms quickly at the source (automobile exhaust) and dissipates rapidly to the atmosphere. Conversely, ozone is a regional pollutant because its formation involves a long chemical process that results is a chemically stable compound that is transported by prevailing winds. Ozone is formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight. The resulting compound is ozone (O_3), which can negatively affect the respiratory system if present at high concentrations over a prolonged period of time.

The EPA has established health-based National Ambient Air Quality Standards (NAAQS) for these pollutants and the Commonwealth of Massachusetts has in turn adopted its own air standards that mimic the Federal Ambient Air Quality Standards and are administered by the DEP. Based upon comparing the results of monitoring to the NAAQS, areas are categorized as either "attainment" or "non-attainment". The Town of Milford is in attainment for all the criteria pollutants except ozone, as is true for the entire Commonwealth. Most of the northeastern United States is in serious non-attainment for ozone.

While all of Massachusetts is designated a non-attainment, it should be noted that ambient air ozone concentrations are largely controlled by prevailing meteorological conditions (e.g., wind direction, amount of sunlight, and temperature) rather than local emissions. The statewide non-attainment of ozone standards is likely influenced by the transport of emissions from densely populated urban areas of the New York metropolitan area as well as industrial stack emissions from Pennsylvania and West Virginia.

Air quality around Milford Pond is dominated by vehicle emissions due to high traffic within the urban residential area. The primary roadway network within the immediate vicinity of Milford Pond includes Dilla Street to the north, Purchase Street to the west, East Main Street (State Highway 16) to the south, and Cedar Street (State Highway 85) to the east. A secondary roadway network that runs throughout the highly developed center of Milford interconnects these main roadways. The secondary roadway network provides access to the various recreational areas and residential neighborhoods that surround Milford Pond. Regionally, the proximity of the site to I-495 is also a factor. Traffic volume data were taken from *the Traffic Impact and Access Study* conducted by VHB. Daily traffic volume counts were conducted along Cedar Street (Route 85) using automatic traffic recorders (ATR). Monitoring was conducted over a 72-hour period in May and June 1999. The 1999 recorded weekday average daily traffic (ADT) on Cedar Street (Route 85) in the vicinity of Milford Pond was 23,100 vehicles. Nearly 2,090 vehicles were recorded per hour during peak evening commuting hours. Weekend measurements were recorded at an ADT of 25,500 vehicles per day with approximately 1,845 vehicles recorded per hour during peak weekend hours.

7.11 Farmland Soils

The project site consists of Milford Pond and the proposed sediment disposal site. The soils within the Milford Pond area are subaqueous and do not qualify as prime agricultural soils. The Worcester County Soil Survey (Southern Part, 1998) identifies the soils within the proposed sediment disposal site as "Pits, Gravel" on the western portion, adjacent to the wetlands, and as the Canton Soil Series (8-15% slopes, extremely stony), a sandy, well drained glacial till derived soil, on the western portion. Among the Canton soil series, only the less steep, non-stony soils are considered prime agricultural land. Therefore, the project sites do not include any existing or potentially significant agricultural soils.

7.12 Flooding

Flooding in Milford can occur at any time of the year, with major flooding occurring in the fall, winter, and spring seasons. Autumn is a critical season for flood damages due to the potential for hurricanes and their associated torrential rains. The early spring can bring substantial flooding from rainfall and snowmelt. Thunderstorms can bring localized flooding on many of the smaller streams due to intense precipitation, short times of concentration, and highly-developed areas. Major flooding has occurred in the past in the Louisa Lake / Huckleberry Brook areas, both of which outlet into Milford Pond. The 1955 flood was the largest on record for the Charles River and had a recurrence interval just short of 100 years. The average annual rainfall in Milford is approximately 45 inches.

Huckleberry Brook originates in a swampy area in northern Milford. It flows southeasterly through land that is mostly undeveloped but rocky and prone to the generation of large amounts of runoff. The Louisa Lake Flood Control Project was constructed to help alleviate flooding problems in this area. Huckleberry Brook enters Louisa Lake at its northern end, at a diversion structure that keeps baseflow running within the old brook channel and thence into Milford Pond. Heavier flows are directed into Louisa Lake, which provides a flood storage function. Flow from Louisa Lake passes over a low spillway and travels down a channelized stream section before entering Milford Pond.

The Charles River originates at Echo Lake in adjacent Hopkinton. The Charles flows into the northeasterly corner of Milford and is the main feeder stream to Milford Pond. The floodplain of these upper reaches of the Charles River is fairly narrow and undeveloped, with the exception of I-495 and the Route 85 interchange. After exiting Milford Pond, the Charles enters a series of underground culverts and channelized sections and fully daylights just south of West Central Street. From this location to the Milford-Bellingham town line, the floodplain is relatively wide with light to moderate development.

There are no known formal flood control plans or activities in the Town of Milford. Milford Pond is located within the 100-year flood plain. It has been reported that Milford Pond provides downstream flood control, which seems plausible in light of its relatively large area to watershed ratio. The magnitude of flood attenuation provided by Milford Pond is not known.

8 Environmental Impacts

8.1 General

The principal environmental effects sought by the proposed partial dredging program will be beneficial to the waterbody itself and to the surrounding community. The existing loss of water depth within the pond due to sediment infilling and organic accumulation and excessive aquatic and emergent macrophyte growth that has choked the remaining open water and has diminished aquatic habitat values, but not added comparable wetland wildlife habitat value. The objectives of the habitat restoration for the Milford Pond ecosystem are to:

1. Restore areas of open water aquatic habitat with a depth sufficient to discourage dense aquatic weed growth;
2. Enhance total aquatic habitat for fin fish species;
3. Preserve habitat values for waterfowl, including State-listed species; and
4. Restore a balance between open water aquatic habitat, the dense aquatic weed beds, and emergent wetlands; and
5. Avoidance of impacts to the Clark Island Well Fields.

The implementation of a limited hydraulic dredging program will achieve these balanced goals, yielding increased pond depths, with much of the dredged portions with the bottom below the photic zone. This reduction of the pond bottom within the photic zone will lessen the ongoing excessive aquatic macrophyte infestation, which degrades the aquatic habitat. The removal of the surficial sediments will also remove an important internal nutrient source that fuels the growth of the rooted aquatic macrophytes. An increase in depth throughout selected areas of the pond will provide open, deeper water habitat essential for improving the diversity of fisheries in the pond.

It is anticipated that the project will be performed in three phases in a total 4-year period. The anticipated dredged material will be utilized by the Town of Milford as a topsoil supplement over a prolonged period, and may be made available for private use as well.

The long-term environmental effects of a well-designed hydraulic dredging program are perceived to be positive and harmonious with the State and Federal Water Quality Acts. However, there will be short-term environmental impacts during the construction phase of the project. The following is a discussion of the long-term and short-term anticipated environmental effects associated with the proposed restoration project.

8.2 Terrestrial Environment

8.2.1 Geology / Soils

The impacts of hydraulic dredging to the local geology and soils are limited to those associated with the partial dredging and the sediment within the pond itself and the placement of the sediments on the sediment storage and processing site. While the organic peat and muck soils will be removed from certain areas of the pond bottom, the remaining pond sediments will not be altered. The limits and depths of the proposed dredging have been established to preserve the existing beneficial geologic peat layer barrier that filters induced recharge to the Milford Water Company Clark Island Well Field. While there will be alteration of the soils in the centralized processing station site located on the north of Milford Pond and Dilla Street, much of the site is currently disturbed as gravel pits and the entire site will be restored by seeding the dredged materials during and after the dredging operation to provide a stabilized and vegetated site. The highly organic sediments will likely be gradually used as a source topsoil materials by the Town over an extended period of time.

8.2.2 Vegetation

The only anticipated impacts to terrestrial wildlife habitat are related to the shore based processing facility area. The trees will be cleared on about 5-10 acres of upland to be used for dredged material disposal. A vegetated buffer will remain to the east of the disposal area and adjacent to abutting residential properties. Buffers will remain to the north and south to screen the active work areas, and a suitable buffer has been provided to the west of the disposal area, adjacent to the wetland areas associated with Huckleberry Brook.

While the disposal site has been evaluated to ensure that all of the dredged sediments can be safely contained on the site, it is anticipated that the Town will seek to reuse the sediments throughout the active dredging period, thereby minimizing the need for utilization of the entire sediment disposal site. The site will be revegetated upon completion of the project, seeding the dredged sediments with a grass and wildflower seed mix to provide site stability. Gradually, shrub and sapling growth will develop within this area, evolving to a woodland community over several decades. These impacts are short-term over the life of the project and long-term effects are considered insignificant as full restoration of these areas is proposed. While the Town will maintain the area as open space, no formal plans for further reuse are currently being considered. The property abuts other open space owned by the Town to the west and north, and Dilla Street to the south. Other portions of the parcel are under consideration by the Town for potential future active use such as ball fields.

8.2.3 Wildlife

The proposed project will have no effect on the local terrestrial wildlife and only minimal potential impact on aquatic fauna within the pond. During hydraulic dredging, the pond water will remain, allowing the aquatic habitat to be only minimally disturbed during construction. The emergent wetland habitats will be unaffected by the dredging. Waterfowl will continue to use the pond during construction, as habitat will be maintained for the ducks, geese, heron, and kingfisher water birds dependent upon this resource. Hydraulic dredging operations disturbance is expected to be very limited for water fowl, with the birds easily avoiding the active area of dredging, and habituating to the presence of the dredge.

The alteration of lands for construction of the sediment processing area will alter some terrestrial upland habitat. However, the revegetation upon completion of the project to a herbaceous field community will provide alternate wildlife habitat. This change in mature woodland to a herbaceous field growth will alter the wildlife habitat for several decades. Gradually, shrub and sapling regrowth will restore the woodland community.

8.3 Aquatic Environment

8.3.1 Hydrology

Removal of 80.8 MG of sediment from Milford Pond will increase the pond volume to approximately 136.2 MG from the existing pond volume of 55.4 MG. Estimates of the existing annual flushing rate of Milford Pond range from 41 to 85 times per year. Table 8-1. is a summary of the impacts of the dredging program on the flushing rate of Milford Pond. The pumping period is between September 15th and May 15th, during which withdrawals from Louisa Lake for public water supply will occur. Due to seasonal variation in inflows, the existing flushing rate of Milford Pond is 36 and 67 times per year during the non-pumping and pumping periods, respectively. Under dredged conditions, the pond would flush at rates of 15 and 27 times per year during the non-pumping and pumping periods, respectively. This indicates a decrease in the annual average flushing rate of Milford Pond from approximately 57 to 23 times per year by increasing the volume of water in the pond under the proposed dredging program.

Table 8-1. Impacts of the Dredging Program on the Flushing Rate of Milford Pond

Parameter	Existing Conditions		Dredged Conditions	
	Non-Pumping (122 days)	Pumping (243 days)	Non-Pumping (122 days)	Pumping (243 days)
Pond Volume	55.4	55.4	136.2	136.2
Inflow (MG)	673	2478	673	2478
Residence Time (days)	10	5	25	14
Flushing Rate (# per yr)	36	67	15	27

8.3.2 Water Quality

The hydraulic dredging and land-based sediment processing station at Milford Pond will potentially impact short-term water quality in two ways:

1. The operation of a cutterhead dredge will disturb sediments in the immediate area of the dredge, locally increasing water turbidity (i.e., typically <100 ft. away), and

2. Return flow to the reservoir from the sediment containment basins and water will have associated turbidity.

In addition, there is some potential for accidental spillage of petroleum-based fuels and lubricants associated with the dredging and processing machinery. Experience with prior hydraulic dredging projects has indicated that these impacts are either insignificant (e.g., turbidity created by cutterheads is typically not detectable greater than 100 feet from the source) or can be easily mitigated (e.g., return flows from containment/settling areas or clarifiers).

In the long term, water quality will improve due to the removal of nutrient rich bottom sediments that currently release nutrients to the water column and support the growth of aquatic plants. With the lessening of aquatic plant growth, dissolved oxygen depletion due to the decomposition of vegetative matter by aerobic bacteria will decrease. Restoring dissolved oxygen levels and removing the source of nutrients in the sediments will reduce the release of nitrogen and phosphorous to the water column.

8.3.3 Littoral Processes and Sediment Chemistry

The purpose of the proposed dredging program for Milford Pond is to restore aquatic habitat quality via the removal of accumulated fine, unconsolidated organic and sandy sediments, which have been deposited from brook deltas, storm water outfalls and organic accumulation. The dredging of Milford Pond will remove approximately 400,000 cubic yards of organic sediments from the pond bottom. These sediments will be removed from areas of the pond extending from the outlet dam northerly to a point slightly north of Clark Island. Selected areas with high existing aquatic habitat value associated with their littoral zones and other features will be preserved and not altered by the proposed dredging program. The removal of the organic sediment will decrease the nutrient base within the sediments that currently support dense aquatic weed growth. The removal of these shallow, nutrient rich sediments will help establish a less dense, more beneficial density of aquatic vegetation, thereby increasing aquatic habitat value for fisheries.

8.4 Biological Resources

8.4.1 Aquatic Vegetation

Dredging will remove the aquatic vegetation and a significant quantity of the nutrient-rich organic sediments that support aquatic macrophyte growth throughout a portion of Milford Pond. Approximately 45± acres of the pond will be affected, a majority of which has 80 – 100% vegetative coverage.

The dredging program will benefit the ecosystem habitat by:

- Removing the existing dense aquatic weed bed, thereby stemming a significant long-term risk to the health of the pond;
- Increasing light penetration and supporting lower growing aquatic plants;
- Increasing vegetative diversity;
- Increasing diversity of structural habitat related to aquatic macrophytes; and
- Decreasing nocturnal O_2 depletion, potentially supporting a more diverse benthic invertebrate and fish community.

Almost 2/3^{rds} of the littoral shelf areas with dense aquatic vegetation will be left within the pond to provide more than adequate spawning and nursery habitat for target warm-water fish species. In addition, marginal areas of the dredged portions with shallower sediments will redevelop with aquatic macrophyte beds to augment this habitat.

8.4.2 Phytoplankton and Benthic Environment

The dredging of Milford Pond will have a positive effect on the phytoplankton community by removing the nutrient rich sediments that contribute to the nutrient release to the overlying water column, supporting phytoplankton blooms during summer months. This will allow for a more balanced phytoplankton community, desirable as a support of the food web for planktivorous fish, which in turn support the piscivore fish, including the desirable game fish such as largemouth bass.

Some limited benthic communities likely exist in the soft organic sediments of Milford Pond. Macro invertebrate communities found in Milford Pond proper are most likely limited to species capable of surviving in slow moving, low dissolved oxygen habitats. Only minor and temporary impact to the existing benthic invertebrates are anticipated during the dredging program, with the temporary loss of insect larvae of terrestrial insects and some common freshwater snails. Both invertebrate populations will become re-established within 2-3 years, replenished by the seed stock available from the undredged portions of the pond. Therefore, it is anticipated that no long-term adverse affects on the aquatic invertebrates associated with Milford Pond will occur. To the contrary, bringing the pond back from an advanced stage of hypereutrophy towards a more typical eutrophic state, will benefit the benthic community, by exposing coarser, more oxygenated substrate suitable for habitation by a more diverse population.

8.4.3 Fisheries

Pond dredging will result in the deepening of Milford Pond and the creation of open water habitats. The operation of the hydraulic dredge will not directly affect the local fish population since the individual fish readily avoid the cutterhead of the dredge. The aquatic habitat in Milford Pond is primarily limited to shallow pond, with a silty/mucky bottom, and emergent wetland communities. These areas are dominated by a dense growth of aquatic macrophyte species, which provide forage and cover for weed-loving aquatic organisms. Milford Pond, in its current state, has limited habitat diversity for other species of aquatic organisms. Based upon fish toxicology studies conducted by DEP, Milford Pond supports populations of yellow perch, brown bullhead, chain pickerel, black crappie, largemouth bass, and bluegill sunfish. Habitat for these species is limited due to shallow depths with dense weeds impeding oxygenation and fish passage, the lack of gravel spawning beds (crappie and bass) and a lack of deeper open water areas for foraging (crappie, bass and perch). This proposed deepening of the pond should provide increased habitat area for open water species.

8.5 Threatened and Endangered Species

The project area contains no Federally-listed or proposed threatened or endangered species under the jurisdiction of the U.S. Fish and Wildlife Service. However, the MA NHESP has mapped estimated and priority habitats of four State-listed bird species within the

Milford Pond wetland habitat complex, including the pied-billed grebe, least bittern, king rail, and the common moorhen. These four species were stated to occur in the vicinity of the project site by MA NHESP (July, 1999 & April, 2002; Appendix C). These species are protected under the Massachusetts Endangered Species Act (M.G.L.c.131,s.40) and its implementing regulations (310 CMR 10.00). Habitat requirements for all four of the identified State-listed species include large contiguous cattail-dominant emergent marsh. Suitable habitat was found to be present around much of western littoral zones of the pond. This 41.5± acre habitat will be preserved by the proposed dredging program, except for a small, 2-acre area near the municipal swimming pool at the southern end of the pond, near the dam. In this area, the Town swimming pool and baseball field directly border the western shoreline and the eastern shoreline is composed of residential development with landscaped lawns to the waters edge. The human disturbance associated with these high use areas during the breeding seasons of these very secretive and elusive birds is likely to discourage any potential nesting. Thus, no adverse impacts to State-listed birds are anticipated as a result of the conversion of this small portion of emergent vegetation growth to open water habitats. The dewatering site is located in an upland area that does not contain estimated and priority habitats of these four bird species (or other species), therefore no impact to these species from activities within the dewatering site are expected. MA NHESP will be required to comment on the project during the wetland permitting under the MA Wetlands Protection Act. During the Notice of Intent filing to the local conservation commission, MA NHESP will review and comment.

8.6 Wetlands

The Milford Pond Restoration Project will result in the restoration of approximately 45p acres of open water habitat areas, preserving 75p acres of shallow pond and emergent wetland habitat in their current condition. The preservation of these areas will provide suitable habitat for wetland dependent species, while the restoration of open water communities will increase local habitat diversity, providing a more optimal balance for the overall ecosystem of the Milford Pond basin with habitats for fin fish and waterfowl. It is anticipated that the project will conform to the performance standards for BVW and other resources (310 CMR 10.54 to 10.58). There are no anticipated significant adverse impacts to wetland resource areas associated with this project. A hydraulic dredging program does not require a pond drawdown, nor will it alter pond full levels, which have the potential to adversely affect bordering wetland resources. Therefore, the use of this dredging methodology will preserve large tracts of undisturbed wetland resource areas.

Hydraulic dredging does not typically create increased siltation, although a common permit condition requires monitoring of turbidity in proximity to the dredge as well as within the outflow from the sediment processing area. Typically, a turbidity value of 50 NTU is used as a standard that must be met by the project

The dredged material disposal site will require use of lands in close proximity to wetlands as well as the crossing of an intermittent stream to allow access to the rear portion of the site. A detailed erosion and sedimentation control plan will be required to control the potential secondary impacts from the site.

8.7 Historical and Archeological Resources

According to a letters dated October 27 and December 8, 2000 from MHC, there are two recorded historical sites in the vicinity of the project site: 1.) the structural foundation remains of the Louisa Lake Ice Company located northwest of Dilla St. adjacent to Louisa Lake, and 2.) the Pine Grove Cemetery is at the Cedar and Dilla St. intersection (see Appendix C). In a letter dated March 5, 2003, the Massachusetts Historical Commission has concluded that the project as presently proposed is unlikely to affect any significant historic or archaeological resources. No further review of the project as planned is required.

8.8 Socioeconomic Resources and Environmental Justice

The restoration of Milford Pond will not have any disproportionate impacts on socioeconomic resources or environmental justice populations in the Town of Milford. There may be temporary interference with the limited available recreational activities around the pond during periods of active dredging. There will be some temporary increase in truck and other vehicular traffic associated with access to the dredged material processing area located on the western shoreline of Milford Pond. Access to this parcel is through Dilla Street. It is expected that the increase in traffic on Route 85 (Cedar Street) will be insignificant. Minor increases in airborne contaminants and noise associated with the dredging equipment and additional traffic may occur. These negative impacts are temporary, but the long-term impact is a positive one. Milford Pond will become a more valuable cultural resource after it has been restored, providing recreational opportunities, such as boating and fishing, which are not currently available. All residents of Milford will benefit from the pond's improved aesthetic quality and recreational value.

8.9 Protection of Children

Adverse impacts to the safety of children associated with the restoration project are temporary. There will be safety concerns associated with increased truck travel through Route 85 (Cedar Street), a highly utilized travel corridor. The proposed dredging program will affect air quality, principally at the sediment-processing site, due to the operation of diesel vehicles and stationary diesel motors powering the mechanical dewatering machinery and fugitive dust emissions from the sediment stockpile areas. Such air quality emissions are expected to be insignificant and are temporary. The concerns associated with the Town swimming pool will be addressed through this restoration program. The project will not create permanent disproportionate impacts on children.

8.10 Air Quality

The only potential for an effect on air quality from the proposed dredging program will be from the diesel operated hydraulic dredge and the diesel-powered facilities at the sediment-processing site. There would be no significant generation of traffic from the proposed dredging program. The principal pollutants of concern from diesel motors are particulates, carbon monoxide, VOCs and NO_x (precursors of ozone). In this area, the operation of diesel vehicles and stationary diesel motors powering the mechanical dewatering machinery represent minor stationary sources of airborne contaminants. Relative to the automotive emissions generated from Route 85 with an ADT of 23,100± vehicles, such air quality emissions are expected to be insignificant. However, a stationary source permit may be required for the operation of motors at the conveyor belt and for the pump. A diesel powered hydraulic dredge unit operating on Milford Pond is considered a mobile source and would not require separate permitting for air quality emissions. Fugitive dust emissions would also create potential impacts on air quality from the sediment stockpile areas and vehicles associated with the project. Such emissions will be mitigated as described in Section 9. No long-term impacts on air quality are expected and the project is consistent with the State Implementation Plan.

The project will have no long-term impacts on air quality. Construction of the proposed project would cause temporary reduction in local ambient air quality because of fugitive dust and emissions generated by construction equipment. The extent of dust generated would depend on the level of construction activity and on sand composition and dryness. If proper dust suppression techniques were not employed, dry and windy weather could create a nuisance for nearby residents. Equipment operating on the construction site will emit pollutants that contribute to increased levels of criteria pollutants such as carbon monoxide, nitrogen oxides, and ozone. The emissions for construction vehicles and related equipment should have an insignificant impact to local air quality. No changes in local or regional air quality are likely to occur with the construction and operation of the proposed project.

Construction operations and equipment will be required to comply and file notifications with the Massachusetts Air Pollution Control regulations pertaining to Dust, Odor, Construction and Demolition (310CMR 7.09), Noise (310CMR 7.10), and Motor Vehicle Emissions (310CMR 7.11(1)), as well as any applicable local ordinances. Under 310 Code of Massachusetts Regulations (CMR), an air quality approval will not be required from the MA DEP. Therefore, the facility meets the Clean Air Act exemption requirements established by the EPA and is in conformity with the Massachusetts air quality regulations.

8.11 Farmland Soils

Due to the lack of prime agricultural soils or other significant farmland soils, and the lack of active agriculture within the project area, there will be no impact to farmland soils as a result of this project.

8.12 Flooding

The restoration of Milford Pond as presently proposed is not anticipated to have any effects on flooding within the vicinity. The dredging work will affect only land under water and will neither increase nor decrease the available flood storage associated with Milford Pond. Although the pond's volume will be increased significantly by the restoration process, the flood attenuation characteristics of the pond will not change, as all volume changes will occur below the normal pool elevation.

The normal operation of the dredge on Milford Pond, including discharge pipelines to the dewatering site, will not contribute to flooding. The dredged materials disposal area is not located within an area subject to flooding, as identified by FEMA's Flood Insurance Study, 1984. Return flows from the dewatering facilities will be directed into Huckleberry Brook, which has a bankfull capacity many times the anticipated dewatering flowrate.

8.13 Cumulative Impacts

The current degraded condition of Milford Pond is a direct result of the adverse cumulative impact of cultural development within the watershed, contributing nutrients and sediments into the pond basin. The proposed project would address these cumulative impacts in a restoration program, designed to provide long-term improvements to the habitat of the pond. In addition to the proposed restoration efforts to be undertaken as described within this environmental documentation, the Town is seeking additional remedial measures designed to ensure the enhancement and preservation of the long-term benefits of the restoration program. As part of its overall efforts to restore Milford Pond, the Town of Milford is actively working to preserve Milford Pond through a combination of water quality improvement projects within the 5000±-acre watershed, aggressive regulation of storm water runoff for new development with the watershed to Milford Pond, and via public education opportunities. In a July 2000 "Report On the Proposed Restoration Project for Milford Pond" (BEC 2000), a Storm Water Management Program component was recommended. Twenty-one storm water outfalls that discharge to Milford Pond were assessed and evaluated relative to the installation of various storm water Best Management Practices (BMPs) including sediment forebays, inlet/outlet modifications. It was recommended that 10 storm water outlets, which were the ones suitable for BMP construction, be reconstructed with hydrodynamic particle separators, sediment chambers, and open sedimentation basins. The estimated costs for implementation of these recommendations was $500,000. Funding is being actively sought by the Town of Milford for implementation during the 2004 and 2005 season. In addition, the Town of Milford is actively regulating development activities with the watershed to require the implementation of storm water management features on all new development. Further, in concert with other programs such as the Charles River Watershed Association, the Town actively works through schools, the Conservation Commission, and other organizations to educate the public on the importance managing storm water pollution at the source through proper use or reduction in use of fertilizers and vegetative plantings.

The Town of Milford has purchased a parcel of land north of Milford Pond, which will serve as the dredged material disposal area. The property was formally in private ownership and was used as an informal junkyard by the prior owner. The portion of the site identified as the disposal area was covered by several acres of dilapidated and non-operable heavy-duty construction equipment, fire trucks, miscellaneous debris, and other non-desirable objects. In preparation for the Milford Pond Restoration Project, the Town has been actively cleaning up this property by properly disposing of the debris. Upon completion of the pond restoration work, the disposal area will be maintained as open space.

The proposed dredging of Milford Pond, in association with the proposed storm drain/sediment controls discussed above, are expected to have long term positive effects on the ecosystem of Milford Pond. The dredging of the pond is expected to remove the nutrient rich fine sediment that has accumulated there. This sediment has reduced the maximum water depth to approximately 2 feet and created an environment conducive to the proliferation of dense vegetation, which has eliminated most of the open water habitat. The dredging is expected to restore deepwater fish habitat and open water waterfowl habitat. When done in conjunction with the proposed stormwater controls, the inflow of additional sediment into the pond will be significantly reduced, maintaining the restored ecosystem for a longer period of time. Over time, it is anticipated that the deepened pond will allow the proliferation of a more balanced warmwater fish assemblage, where the deeper areas provide for better over-wintering of the larger predator species (i.e largemouth and calico bass) by reducing the potential water quality stresses which occur during the winter in shallow ponds. These would include dissolved oxygen depletion in the shallow water column, resulting from the biological activity occurring in the organic rich sediments, as well as lower pH from reduced photosynthesis. The improved water quality would benefit all species of fish, not only the larger predators. In addition, the deeper areas would provide improved summer fish habitat, providing cooler areas for resting and feeding, while maintaining the shallows for nursery.

The removal of the dense areas of aquatic macrophytes and deepening of the pond will also restore dabbling and open water resting habitat for waterfowl. Currently, most of the open water in the pond becomes choked with vegetation early in the summer, which physically limits its use by waterfowl, which are unable to easily swim through the dense cover. The removal of the excess vegetation is expected to improve the waterfowl habitat by providing the increased dabbling and open water resting areas, which will have an overall positive long term effect on the ecosystem.

It is expected that there will be minimal negative cumulative effects from the proposed dredging of Milford Pond. The existing water level will be maintained, which will avoid the impacts associated with drawdown of the pool. The use of silt curtains will contain the suspended solids within the areas of active dredging and it is likely that most of the motile fish and wildlife species will avoid these areas. The existing fish and invertebrate populations occupying the dredging areas will be temporarily displaced to other areas, however they are expected to return and repopulate once the dredging has been completed. Additional dredging is not anticipated for several years, which will minimize future disturbance to the restored habitat and fish and wildlife populations.

Other activities, which could potentially have cumulative negative effects on the pond, include maintenance of the dam, and weed harvesting, which may be necessary in the future. Construction activities associated with dam maintenance would be confined to the area of the dam itself, and if done without lowering the water level would be unlikely to cause significant negative impacts to the ecosystem since the area would be contained using a cofferdam. Weed harvesting would be done systematically using a mechanical harvester, and would be limited to selected areas in order to minimize negative impacts. Therefore it is unlikely that there will be significant cumulative impacts resulting from the dredging and other activities, which may be conducted at Milford Pond.

Cumulative impacts of the disposal of the dredged material are also likely to be minimal. As noted previously, the disposal area is a disturbed area, which was informally used as a junkyard and therefore covered with various pieces of inoperable equipment. The removal of this equipment, which is being done in preparation for the disposal activities, is expected to have a positive effect on the ecosystem by the elimination of potential sources of hazardous materials that could contaminate the groundwater and/or the surface waters of Milford Pond. Over time this will prevent the potential for the accumulation of contaminants originating from the discarded equipment. As noted, a detailed erosion and sedimentation control plan will be required to control the potential secondary impacts from the disposal site, which may involve temporary use of in close proximity to wetlands as well as the crossing of an intermittent stream to allow access to the rear portion of the site. Once the project is completed, the areas will be stabilized and will become re-vegetated, and therefore cumulative negative impacts are not expected. The area is planned to be maintained as open space, and therefore is expected to have a long term benefit to the ecosystem. As noted the habitat will be altered from mature woodland to herbaceous field, however, this is expected to revert back to woodland over the long term.

9 Environmental Design Standards/Mitigation

This section addresses mitigation standards, which will be implemented to avoid, limit, or offset anticipated impacts associated with the dredging program and sediment processing.

To minimize potential for increases in turbidity during hydraulic dredging operations, a dredge outfitted with a cutterhead specifically designed to minimize turbidity in the dredging area will be used, and the dredge will be properly operated under methods that have been shown to control excess turbidity. Turbidity originating from the cutterheads will be monitored and suitable measures such as turbidity curtains will be employed if necessary to control any turbidity in significant excess of background levels.

The dredge pipeline transporting the sediment slurry to the land-based processing facility will be a continuous high-density polyethylene flexible pipeline with fused, watertight joints that do not have the potential for accidental release of sediment. Potential water quality impacts from the turbid return flow water will be mitigated through the addition of a flocculating agent during the dewatering process. As the dredge slurry is pumped from the dredge pipeline to the dewatering unit, a non-toxic polymer flocculent will be added to the sludge to facilitate sediment and water separation resulting in decreased turbidity levels. The water is then pressed from the solids, which are strained by the filter belt. The outflow from the dewatering station will be monitored to ensure that effluent turbidity standards are being met.

Prior to the start of dredging operations, the Contractor will be required to prepare and have approved a written fuel and oil containment and spill response plan which must address the activities to be required of the Contractor in response to an oil or fuel spill or leak from the dredging plant. An adequate spill response kit will be required on all craft at all times and will be replenished promptly if used. Additional protection of Milford Pond's water quality and wildlife population will be provided by the use of natural, fully bio-degradable vegetable oils in lieu of synthetic or petroleum oils for operation of all hydraulic equipment associated with the dredging plant.

The dredging contractor will institute a short-term water quality-monitoring program as part of the mitigation measures for the dredging activity. During active dredging, water samples will be taken from the return flow discharge location from the containment areas, from the surface of Milford Pond and at the hydraulic dredge location within 100 ft. of the unit. If the samples exceed the turbidity standard, operations will be temporarily ceased until additional mitigation measures are applied to achieve compliance with the standard.

In addition to the turbidity controls utilized for the dredging operations (i.e., dewatering units and monitoring of the return flow to Milford Pond), sedimentation and erosion controls will be needed for the development of the sediment material processing site. To the maximum extent practical, surface water runoff from the site will be redirected to the dewatering units. Erosion controls will be placed at the downgradient perimeter of the developed processing site and at other critical locations. Vegetative buffer filter strips will be used between the processing facility and wetlands and residential development, with the erosion controls protecting the wetland resources.

The emission of fugitive dust during sediment material processing and vehicle movement will be mitigated by the use of a watering truck that will pass over the access way on a daily or more frequent basis, as needed. An anti-tracking pad will be placed along the access way entrance to the processing site prior to reaching Dilla Street to help control sediment movement off of the project site. The access way leading to the dewatering site will be paved to prevent unnecessary fugitive dust emissions or erosion problems.

Potential construction activity noise associated with the dredged material processing site will be mitigated by requiring the contractor to use mufflers on all of the construction equipment to maintain noise at or below 60 decibels (dBA) at the perimeter of the project. Furthermore, work will be limited to normal daytime operational hours during weekdays only. This will limit the impact to neighboring residential communities.

In order to avoid an "attractive nuisance", it is recommended that the dewatering site be fenced to discourage unauthorized entry. To further ensure public safety, signage will be posted in the vicinity of the dewatering site and at the entryway to the processing site off Dilla Street.

Following the cessation of all hydraulic dredging and sediment material processing, the contractor will be required to restore the dewatering site to a fully vegetated state. The sediment storage areas will be planted with herbaceous species for site stabilization and wildlife habitat considerations. All structures will be removed from the parcel and the entire processing area will be loamed, final graded, seeded, and mulched with erosion controls in place to control any potential erosion or sedimentation to Milford Pond.

10 References

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Massachusetts Natural Heritage and Endangered Species Program (NHESP). 1990. "Rare and Endangered Wildlife Fact Sheets-Pied-billed Grebe *(Podilymbus podiceps).*"

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Weston and Sampson. 1991. "Phase I Landfill Study of the Milford Landfill."

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Whitman and Howard. 1991. "Zone II Delineations for the Godfrey Brook, Clark Island, and Dilla Street Well Fields."

11 Coordination

During the conduct of this work, the Corps of Engineers and its contractor BEC Inc. have coordinated with multiple parties in order to ensure input was received from Federal, State, municipal, and public interest groups. Such groups included USFWS, EPA, MA DEP, MA DFW, MA Natural Heritage and Endangered Species Program, MA Historic Commission, MA DEM, City of Milford, and the Milford Pond Restoration Committee.

11.1 Personal Communication

The following persons were coordinated with in the preparation of this report.

Michael Tuttle, Study Manager, U.S. Army Corps of Engineers, Concord, MA.

Michael Penzo, Marin Environmental, Inc., Wakefield, MA.

John Kennelly, U.S. Army Corps of Engineers, Concord, MA.

Townsend Barker, U.S. Army Corps of Engineers, Concord, MA.

Greg Billings, U.S. Army Corps of Engineers, Concord, MA.

Ben Piteo, U.S. Army Corps of Engineers, Concord, MA.

Siamac Vaghar, U.S. Army Corps of Engineers, Concord, MA.

Michael Santora, P.E., Town of Milford, MA.

11.2 Site Visit

A Interagency Coordinated Site Visit was held on May 7, 2002. The following personnel were in attendance:

ATTENDEE	AGENCY
Mike Tuttle	U.S. Army Corps of Engineers
Greg Billings	U.S. Army Corps of Engineers
Mike Santora	Milford Town Engineer
Ken Levitt	U.S. Army Corps of Engineers
Bob Buckley	Milford Conservation Commission
Dave Pincumbe	U.S. Environmental Protection Agency
Ed Reiner	U.S. Environmental Protection Agency
Rinaldi	Massachusetts Department of Environmental Management, Office of Waterways
Peg Savage	Charles River Watershed Association
Anthony A. Grillo	Town of Milford citizen
Achille Detaleri	Town of Milford citizen
Tom Jenkins	Baystate Environmental Consultants, Inc.
Ben Piteo	U.S. Army Corps of Engineers
Siamac Vaghar	U.S. Army Corps of Engineers
John Kennely	U.S. Army Corps of Engineers
John Seaver	Town of Milford Selectman
Larry Dunkin	Milford Town Planner
Shelly Leclaire	Milford Highway Surveyor
Robert Andreano	Milford Tax Collector (retired)
Louis P. Paxento	Milford Capital Planning
Emilio E. Diotalevi	Milford Pond Restoration Committee member
Denise Marie Mize	The Milford Daily News
Anthony DeLuca	Milford Building Commissioner
Reno DeLuzio .	Milford Pond Restoration Committee member
Frank R. Andreath Sr.	Milford Pond Restoration Committee member
Dino DeBartolomeis	Town of Milford Selectman
Debra Atherton	Office of Senator Moore
Robert N. DeMarco Jr.	Milford Pond Restoration Committee member
Marie Partenti	State Representative

A copy of the attendance list is included in Appendix C.

11.3 Correspondence

11.3.1 Coordination Letters

Project coordination letters were mailed to the following people prior to the preparation of this report pursuant to the Federal Fish and Wildlife Coordination Act, Federal Endangered Species Act, and the National Historic Preservation Act:

Environmental Review Staff, MA Natural Heritage & Endangered Species Program, July 2, 1999.

Brona Simon, Massachusetts Historical Commission, September 19, 2000.

Yvonne Unger, Environmental Analyst, MADEP, April 29, 2002.

Brona Simon, Massachusetts Historical Commission, February 27, 2003.

11.3.2 Public Notice

A Public Notice describing the project was [will be] distributed on approximately **DATE**. A copy is [will be] included in Appendix C of this Environmental Assessment.

11.3.3 Public Meeting

NA at this time.

11.3.4 Distribution of the Draft Report

Distribution list will be included in the final report.

11.3.5 Correspondence Received

Cindy L. Campbell, Environmental Review Assistant, MA Division of Fisheries and Wildlife, July 22, 1999.

Christina Vaccaro, Environmental Review Assistant, MA Division of Fisheries and Wildlife, April 12, 2002.

Edward L. Bell, Senior Archaeologist, MA Historical Commission, October 27, 2000.

Dino DeBartolomesis, Milford Board of Selectmen, Milford, MA., September 10, 2001.

Yvonne Unger, Environmental Analyst, MADEP, May 13, 2002.

David M. Webster, Director, Massachusetts State Program Office, USEPA, May 29, 2002.

Edward L. Bell, Senior Archaeologist, MA Historical Commission, March 5, 2003.

Philip Morrison, Wildlife Biologist, US Fish and Wildlife Service, May 13, 2002.

ENF Comment Letters:

Edward L. Bell, Senior Archaeologist, Massachusetts Historical Commission, December 8, 2000.

Eric Worrall, Deputy Regional Director, Massachusetts Department of Environmental Protection, December 18, 2000.

Peggy Savage, Environmental Scientist, Charles River Watershed Association, December 12, 2000.

Michael Santora, P.E., Town Engineer, Milford, MA, November 29, 2000.

Reno DeLuzio, Town Planner, Milford, MA, December 6, 2000.

Anthony F. DeLuca, Jr., CBO/Building Commissioner, Milford, MA, December 4, 2000.

Michael A. Giampietro, Milford Conservation Commission, December 4, 2000.

Michael J. Bresciani, Park Director, Milford, MA, December 5, 2000.

Louis J. Celozzi, Milford, MA, December 4, 2000.

Richard Swift, Milford, MA, December 7, 2000.

Nazzareno Baci, Park Commissioner, Milford, MA, December 6, 2000.

Steven Janock, Milford, MA, December 6, 2000.

Anthony Gillo, Milford, MA, December 12, 2000.

Frank Andreotti, Milford, MA, December 8, 2000.

Ceasar G. Luzi, Milford, MA, December 10, 2000.

John R. Niro, Milford, MA, December 11, 2000.

Phyllis A. Ahearn, Milford, MA, December 9, 2000.

Timothy R. Sweeney, Milford, MA, December 10, 2000.

Gerald M. Moody, Milford, MA, December, 2000.

Matthew J. DeTore, Milford, MA, December 7, 2000.

Michael J. DeTore, Milford, MA, December 7, 2000.

Steven A. Matos, Milford, MA, December 1, 2000.

Donna Horrigan, Milford, MA, December 5, 2000.

12 Compliance with Environmental Federal Statutes and Executive Orders

12.1 Federal Statutes

1. Preservation of Historic and Archeological Data Act of 1974, as amended, 16 U.S.C. 469 et seq.

Not Applicable. The project does not affect historic or archaeological resources.

2. Clean Air Act, as amended, 42 U.S.C. 7401 et seq.

Public notice of the availability of this report to the Environmental Protection Agency will constitute compliance pursuant to Sections 176c and 309 of the Clean Air Act.

3. Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et seq.

A Section 404(b)(1) Evaluation and Compliance Review [**will be**] has been incorporated into this report. An application shall be filed for State Water Quality Certification pursuant to Section 401 of the Clean Water Act.

4. Coastal Zone Management Act of 1782, as amended, 16 U.S.C. 1451 et seq.

Not Applicable. Project is not located in Coastal Zone.

5. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.

Coordination with the U.S. Fish and Wildlife Service (FWS) and/or National Marine Fisheries Service (NMFS) has yielded no formal consultation requirements pursuant to Section 7 of the Endangered Species Act

6. Estuarine Areas Act, 16 U.S.C. 1221 et seq.

Not Applicable. This report is not being submitted to Congress.

7. Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12 et seq.

Public notice of availability to this report to the National Park Service (NPS) and Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans constitutes compliance with this Act.

8. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 et seq.

Coordination with the FWS, NMFS, and Massachusetts state fish and wildlife agencies constitutes compliance with the Fish and Wildlife Coordination Act.

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

Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans constitutes compliance with this Act.

10. Marine Protection, Research, and Sanctuaries Act of 1971, as amended, 33 U.S.C. 1401 et seq.

Not Applicable. This project does not involve the transportation nor disposal of dredged material in ocean waters pursuant to Sections 102 and 103 of the Act, respectively.

11. National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.

Coordination with the State Historic Preservation Office determined that no historic or archaeological resources would be affected by the proposed project

12. National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.

Preparation of this report signifies partial compliance with NEPA. Full compliance shall be noted at the time the Finding of No Significant Impact is issued.

13. Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.

No requirements applicable for projects of the Corps of Engineers or programs authorized by Congress. The proposed Aquatic Ecosystem Restoration Project is being conducted pursuant to the Congressionally-approved continuing authority program: Section 206 of the Water Resources Development Act of 1996.

14. Watershed Protection and Flood Prevention Act as amended, 16 U.S.C. 1001 et seq.

No requirements applicable for projects of the Corps of Engineers.

15. Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271 et seq.

Not Applicable. Site is not a Wild and Scenic River.

12.2 Executive Orders

1. Executive Order 11988, Floodplain Management, 24 May 1977 amended by Executive Order 12148, 20 July 1979.

   Public notice of the availability of this report or public review fulfills the requirements of Executive Order 11988, Section 2(a) (2).

2. Executive Order 11990, Protection of Wetlands, 24 May 1977.

   Public notice of the availability of this report for public review fulfills the requirements of Executive Order 11990, Section 2(b). All wetlands impacts will be mitigated.

3. Executive Order 12114, Environmental Effects Abroad of Major Federal Actions, 4 January 1979.

   Not Applicable. This project is located within the United States.

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

   Not Applicable. This project would not create a disproportionate environmental health of safety risk for children.

12.3 Executive Memorandum

Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA, 11 August 1980.

> Not Applicable. The project does not involve or impact prime or unique agricultural lands.

13 Clean Water Act Section 404(b)(1) Evaluation

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CLEAN WATER ACT SECTION 404 (b)(1) EVALUATION
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT, CONCORD, MA

PROJECT: **Milford Pond Aquatic Ecosystem Restoration Project**

PROJECT MANAGER: Mike Tuttle Phone: (978) 318-8677

FORM COMPLETED BY: Ken Levitt Phone: (978) 318-8114

PROJECT DESCRIPTION:

Milford Pond is located in the headwaters of the Charles River in the center of the town Milford, Worcester County, Massachusetts, approximately 1 mile from Interstate 495. The existing shallow pond is approximately 120 acres, and was formed by impounding the Charles River by constructing a dam at an existing bedrock outcrop. This outcrop formed the natural discharge of what was historically a cedar swamp. The proposed project is to dredge approximately 400,000 acres of clean sediment from the pond in order to deepen it to 12 feet, from its existing maximum depth of approximately 5 feet.

The purpose of this project is to improve the aquatic health of the Milford Pond ecosystem. The proposed project will involve the dredging by Mud Cat of pond sediments and the runback into the system of the suspended solids and dredge slurry water from the disposal site. The dredged material will be disposed of at a previously disturbed upland disposal area. See Environmental Assessment for a full project description. This represents the least environmentally damaging practical alternative.

NEW ENGLAND DISTRICT
U.S. ARMY CORPS OF ENGINEERS
Evaluation of Clean Water Act Section 404(b)(1) Guidelines

PROJECT: **Milford Pond Aquatic Ecosystem Restoration Project**

1. Review of Compliance (Section 230.10(a)-(d)).

a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose. |x| YES |_| NO

b. The activity does not appear to:
1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of Federally listed threatened and endangered species or their critical habitat; and 3) violate requirements of any Federally designated marine sanctuary |x| YES |_| NO

c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values |x| YES |_| NO

d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem |x| YES |_| NO

2. Technical Evaluation Factors (Subparts C-F).

	N/A	Not Significant	Significant*
a. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C).			
1) Substrate.		x	
2) Suspended particulates/turbidity.		x	
3) Water.		x	
4) Current patterns and water circulation.		x	
5) Normal water fluctuations.		x	
6) Salinity gradients.	x		
b. Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D).			
1) Threatened and endangered species.		x	
2) Fish, crustaceans, mollusks and other aquatic organisms in the food web.		x	
3) Other wildlife.		x	
c. Potential Impacts on Special Aquatic Sites (Subpart E).			
1) Sanctuaries and refuges.	x		
2) Wetlands.		x	
3) Mud flats.	x		
4) Vegetated shallows.		x	
5) Coral reefs.	x		
6) Riffle and pool complexes.	x		
d. Potential Effects on Human Use Characteristics (Subpart F)			
1) Municipal and private water supplies.		x	
2) Recreational and commercial fisheries.		x	
3) Water-related recreation.		x	
4) Aesthetics.		x	
5) Parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves.		x	

3. Evaluation and Testing (Subpart G).

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)

1) Physical characteristics.......................... |x|
2) Hydrography in relation to known or anticipated sources of contaminants.............. |x|
3) Results from previous testing of the material or similar material in the vicinity of the project .. |x|
4) Known, significant sources of persistent pesticides from land runoff or percolation ..... | |
5) Spill records for petroleum products or designated hazardous substances (Section 311 of CWA) .... | |
6) Public records of significant introduction of contaminants from industries, municipalities, or other sources ..... | |
7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities .... | |
8) Other sources (specify) .... | |

List appropriate references.

Draft Environmental Assessment for Milford Pond Project

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to require constraints. The material meets the testing exclusion criteria.

|x| YES | | NO

4. Disposal Site Delineation (Section 230.11(f)).

a. The following factors, as appropriate, have been considered in evaluating the disposal site.

1) Depth of water at disposal site .... |x|
2) Current velocity, direction, and variability at the disposal site .... |x|
3) Degree of turbulence .... |x|
4) Water column stratification .... |x|
5) Discharge vessel speed and direction .... | |
6) Rate of discharge .... | |
7) Dredged material characteristics (constituents, amount, and type of material, settling velocities) .... |x|

8) Number of discharges per unit of time .... | |
9) Other factors affecting rates and patterns of mixing (specify) .... | |

List appropriate references:

Draft Environmental Assessment for Milford Pond project

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable

|x| YES | | NO

5. <u>Actions To Minimize Adverse Effects (Subpart H)</u>.

All appropriate and practicable steps have been taken, through application of recommendation of Section 230.70-230.77 to ensure minimal adverse effects of the proposed discharge. |x| YES | | NO

List actions taken.

1) see Environmental Assessment

6. <u>Factual Determination (Section 230.11)</u>.

A review of appropriate information as identified in items 2 - 5 above indicates that there is minimal potential for short or long term environmental effects of the proposed discharge as related to:

a. Physical substrate (review sections 2a, 3, 4, and 5 above). YES |x| NO | |

b. Water circulation, fluctuation and salinity (review sections 2a, 3, 4, and 5). YES |x| NO | |

c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5). YES |x| NO | |

d. Contaminant availability (review sections 2a, 3, and 4). YES |x| NO | |

e. Aquatic ecosystem structure, function and organisms(review sections 2b and c, 3, and 5) YES |x| NO | |

f. Proposed disposal site (review sections 2, 4, and 5). YES | x| NO | |

g. Cumulative effects on the aquatic ecosystem. YES |x | NO | |

h. Secondary effects on the aquatic ecosystem. YES | x | NO | |

7. Findings of Compliance or non-compliance.

The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines ... YES |x | NO | |

DATE

Thomas L. Koning
Colonel, Corps of Engineers
District Engineer