Final Report Engineering and Environmental Studies for the Mill Pond

West Tisbury, Massachusetts

PREPARED FOR:
Town of West Tisbury
1059 State Road
West Tisbury, Massachusetts 02575

PREPARED BY:
ESS Group, Inc.
401 Wampanoag Trail, Suite 400
East Providence, Rhode Island 02915

ESS Project No. W287-000

January 16, 2012

www.essgroup.com

FINAL REPORT
ENGINEERING AND ENVIRONMENTAL STUDIES FOR THE MILL POND
West Tisbury, Massachusetts

Prepared For:

Town of West Tisbury
1059 State Road
West Tisbury, Massachusetts 02575

Prepared By:

ESS Group, Inc.
401 Wampanoag Trail, Suite 400
East Providence, Rhode Island 02915

ESS Project No. W287-000

January 16, 2012

TABLE OF CONTENTS

SECTION **PAGE**

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

ESS Group, Inc. (ESS) was contracted by the Town of West Tisbury (Town) and the Mill Pond Committee (MPC) to evaluate the current status of Mill Pond in order to develop a long term management plan for the preservation of this historic town feature. Mill Pond is an artificially created pond that is reported to have been built in the late 17th century to provide hydropower for grist mills. Subsequent to this the site was also used to power a woolen mill for the production of felted cloth or "satinet" used to make maritime clothing. Throughout its history Mill Pond is believed to have been dredged to maintain water capacity to supply the mills. More recently the pond was dredged in 1948 and again in 1970 to maintain its open water characteristics and aesthetics.

The goal of this study was to develop an acceptable long term plan for restoring and maintaining the pond in a fashion that would retain the pond's historic character as an open water amenity within the town while also maintaining the site's aesthetic appeal and value as an ecological resource. Mill Pond currently suffers from its advanced state of cultural eutrophication, as indicated by the excessive sedimentation in the pond, which has greatly reduced its volume. Eutrophication refers to the process by which a pond gradually fills in over time with nutrient-rich sediment and aquatic plants. Over time this process results in the pond environment slowly changing into a wetland. In small impounded systems, such as Mill Pond, the process of eutrophication is generally faster than it would be in a natural system since the dam retains sediment that might otherwise be transported downstream. Given this, we evaluated the range of realistic options and costs associated with a variety of in-lake and watershed level management techniques that might be feasible for slowing or even resetting the effects of the eutrophication process. Management techniques that were a primary focus of our evaluation included:

- Weed management through mechanical harvesting or hand-pulling
- Mechanical hydro-raking
- Winter water level drawdown
- Sediment dredging (both mechanical and hydraulic)

Other techniques that we also considered as part of this investigation included, aeration of pond, chemical treatments or shading dye for weed growth management, and nutrient inactivation to manage inputs from the watershed.

2.0 PREVIOUS STUDIES AND DATA

Our evaluation was conducted in consultation with the members of the MPC and we would like to thank them for their guidance, local knowledge and support throughout this study. We would also like to specifically thank Kent Healy (Keeper of the Mill Pond Dam) for his assistance with the groundwater and hydrologic analysis of the Mill Pond system, Bill Wilcox (Martha's Vineyard Commission) for providing his assistance with the sediment loading and water quality components of our analysis, The Polly Hill Arboretum for providing us with their detailed botanical study of the watershed, and Bob Woodruff for providing the local bird species list.

Specific data sources and studies reviewed in support of the development of this long-term pond management plan included the following:

- Aquatic Control Technology, Inc. 2006. Mill Pond Baseline Assessment and Management Plan. December 2006.
- The Polly Hill Arboretum. 2011. Botanical Survey of Mill Pond and Upstream Ponds of the Mill Brook Watershed. March 1, 2011.
- 2011. Bird List for Mill Pond (Provided by Bob Woodruff).

- William Wilcox. 2011. Mill Brook 2010 Water Quality Assessment. Draft Final Report. January 2011.
- William Wilcox. 2009. Mill Brook Stormwater Runoff Assessment. Final. March 2009.

In addition to the above cited sources of information, ESS also reviewed other publicly accessible sources of data such as MassGIS which provides data on the location of public water supply wells, Natural Heritage and Endangered Species Program protected habitat, and various land use characteristics within the watershed of Mill Pond.

3.0 DESCRIPTION OF MILL POND AND THE WATERSHED

ESS has compiled a summary of the general characteristics of Mill Pond and its watershed (Section 3.1) as it may pertain to setting the context for development of the long term restoration and management plan for the site. In addition to this summary, ESS was also asked to assess, in detail, the characteristics of the sediment within the pond (Section 3.2) to assess its quantity and quality as may pertain to its removal and potential reuse. In addition, we were asked to evaluate the current value of the habitat provided by the pond and its associated wetlands (Section 3.3) and wildlife use of the pond (Section 3.4) so that these valuable resources would not be overlooked when designing a comprehensive long term restoration approach.

3.1 Pond and Watershed Features

3.1.1 Watershed Features

The Mill Pond watershed covers approximately 3,027 acres in the towns of West Tisbury and Chilmark (Figure 1). Given the primarily coarse surficial geology of the area, the actual watershed boundary is difficult to define. Additionally, water diversions may direct surface water outside of the watershed, thereby altering the relationship between watershed area and discharge. As noted by Mr. Kent Healy, the primary flow diversion occurs just south of Scotchman’s Lane, where a canal diverts water southwest to Parsonage Pond. Several other small surface diversions to ponds and wetland areas along Mill Brook are also present downstream. Of the flow that reaches Mill Pond, some is diverted away from Mill Brook into a second outlet at the southwest end of Mill Pond. This water ends up flowing into Factory Brook and Maley’s Pond.

Despite the geological and anthropogenic complexities of the watershed, a watershed boundary was estimated for Mill Pond. The Mill Brook portion of the Tisbury Great Pond watershed provided by Mr. Kent Healy was used to define much of the upper watershed for Mill Pond. ESS completed this boundary for the lower watershed to the outlet of Mill Pond using USGS topographic quadrangles.

Land use within the watershed is primarily forest (2,213 acres), followed by pasture (247 acres), residential (187 acres), and agriculture (163 acres) (Figure 2). Wetlands and water comprise 143 acres of the watershed, of which Mill Pond itself covers approximately 2.5 acres. The remaining watershed area is split between open land (57 acres), commercial (6 acres), recreation (5 acres), and urban public/institutional (1 acre). The state land use layer used to derive watershed land uses for this study also indicated that mining covered and additional five acres of the watershed. However, this is not reflective of current watershed land use (Bob Woodruff, personal communication).

3.1.2 In-pond Features

Mill Pond is not in a mapped floodplain zone.

Mill Pond is not in a mapped floodplain and the closest public water supply well is located just to the north of Music Street. Therefore, pond management activities are unlikely to present a significant risk for flooding or to water supplies. However, estimated habitat of rare wildlife and priority habitat of rare species do occur within Mill Pond, according to the Massachusetts Natural Heritage and Endangered Species Program (Figure 3). The potential for these species to occur in or around Mill Pond are discussed in more detail in Sections 3.3 and 3.4.

Pond bathymetry and soft sediment thickness were derived from a site survey conducted by WSP Sells between November 22 and November 24, 2010. Survey points were collected on-site, including 52 in Mill Pond itself. Points collected in Mill Pond included elevations for both the top and bottom of the soft sediment layer in the pond as well as a water surface elevation at the spillway. ESS used these survey data to create updated pond bathymetry and sediment isopach maps (Figures 4 and 5, respectively) and to calculate both the water and soft sediment volume of the pond, base on a pond water elevation of 12.25 feet (per the WSP Sells survey).

Mill Pond has a total water volume of 6,900 cubic yards, with a maximum depth of just over 8 feet and an average depth of 1.7 feet. The deepest part of the pond is at the southeast end near the primary outlet to Mill Brook (Figure 4).

Soft sediment volume is estimated to be 3,150 cubic yards, with a maximum thickness of just over 4 feet and an average thickness of 0.8 feet. The thickest soft sediment deposits are located in the southeast end of Mill Pond (Figure 5).

3.1.3 Hydrologic and Sediment Loading Estimates

Using a low end hydrologic estimate of 1.5 cfs/mi^2 to account for watershed flow diversions, the annual hydrologic load for Mill Pond would be approximately 216 million cubic feet (6.11 billion liters) per year. The flushing rate for Mill Pond would be approximately 3.2 times per day. This is similar to previously estimated rates (Wilcox, 2011).

These estimated flow rates were used with the TSS data reported by Wilcox (2009) for an upstream station (Scotchman's Crossing) and the Mill Pond outlet to obtain an estimate of sediment accumulation rate in Mill Pond. Under dry weather conditions, Mill Pond appears to be a slight exporter of TSS. However, under wet weather conditions, sediment loading to the pond far exceeds transport out of the pond. Over the long run, we estimated that sediment in the pond accumulates at an average annual rate of approximately 18.7 cubic yards. This value should be accompanied by the following caveats.

1. Because TSS data were used to develop this relationship, the sediment accumulation rate estimate does not account for *additional sediment sources*, such as bedload transport, direct stormwater inputs, aquatic macrophyte and algal growth, or annual leaf drop from the woody plants that grow along much of the pond's western and northern perimeter.
2. It also does not account for *TSS removed* from the system by diversion of flows in Mill Brook between Scotchman's Crossing and Mill Pond. Although the magnitude of these missing elements is not known, it can at least be assumed that they would influence the sediment accumulation rate in opposing directions.
3. This estimate is based on limited data from studies completed by the Martha's Vineyard Commission.

Given the limited data available for developing a sediment accumulation rate for Mill Pond and the possibility that upstream flow diversions could increase or decrease at any time, this rate should be used with caution. Additionally, changes in the watershed or modifications to the hydrologic regime, pond volume, or normal pool elevation of the pond could significantly alter the sediment accumulation rate going forward.

Lastly, it is very important to note that the Mill Pond system is a perched system in relation to the groundwater table. This was confirmed by examining groundwater elevation data, collected by Dr. Kent Healy during the course of this study, at wells placed in the immediate vicinity of the pond. The pond was created by impounding a stream and it is believed that over time the sediment accumulating within the pond has increased the pond's ability to retain water. Longer term data on water elevations taken at the pond by Dr. Healy indicate that the water levels do fluctuate considerably, but that there typically is still a loss of water from the pond to the ground water system around the pond. Given this, management actions that target the removal of accumulated sediment should be cognizant of this fact to ensure that if the finer overlying sediments are to be removed, the potential for increased permeability is accounted for in the restoration design. Such actions as including a clay layer or a geotextile liner at the downgradient end of the pond would typically be employed to address this issue.

3.2 Sediment Sampling and Analyses

Sediment sampling was conducted from a boat on November 11, 2010 to determine the feasibility of dredging as a management option at Mill Pond. Sampling locations were selected with the soft sediment thickness measured during the site survey in mind. Sediment sampling focused on the central and southern portion of Mill Pond because these areas would be most likely to be targeted for dredging. The shallow waters of the northern pond support emergent vegetation and provide valuable wildlife habitat, making this a less desirable location for dredging. Samples were collected using a decontaminated Russian (flag style) peat corer to characterize the vertical profile of soft sediments at each location. Given that this is a feasibility-level analysis rather than a permitting effort, three cores were obtained and composited into a single sample for screening level analysis (Figure 6), as allowed by DEP guidelines. For volatile organic compound (VOC) analysis, a sample was collected from one of the cores (Sed 1) prior to homogenization. Cores were logged, photographed (Appendix A), and sampled in the field, in a manner consistent with our standardized sediment sampling procedures (ESS, 2008).

Sediment samples were transferred to a state certified laboratory within the appropriate holding time for all analyses. The lab conducted the following bulk physical and chemical analyses:

- Bulk Physical: grain size analysis, moisture content, and total volatile solids.

- Bulk Chemical Analysis: metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), polychlorinated biphenyls (PCBs), extractable petroleum hydrocarbons (EPHs) with target polycyclic aromatic hydrocarbons (PAHs).

Bulk physical analyses indicate that fines (silt and clay) make up less than 10% (dry weight) of the sampled sediments (Figure 7). Gravel sized particles also make up only a small fraction of the dry weight (<10%). Total volatile solids, which are an indication of organic content, contribute approximately 10.9% of the sediment dry weight.

Bulk chemical analyses indicate likely exceedance of beneficial use standards for several contaminants, including the heavy metals arsenic and nickel, as well as the polycyclic aromatic hydrocarbon (PAH) benzo(a)pyrene. Arsenic is often high in Massachusetts soils and sediments due to natural and human-accelerated atmospheric deposition over many years. Nickel is commonly found in roof and road runoff and is quickly deposited in pond sediments (Sarkar, 2002). Benzo(a)pyrene may be contributed by various sources, including runoff from surfaces treated with creosote and coal tar (old utility poles and road sealant are two common examples). Full results of the bulk chemical analyses are tabulated in Table A.

Table A. Sediment Quality at Mill Pond, West Tisbury, MA

Analyte	CAS #	SED-1	RL	MCP[1]	BUD[2]	Lined Landfill[4]
Metals - mg/kg-dry						
Arsenic	7440-38-2	27.4	14	20	11	40
Barium	7440-39-3	97.5	14	1000	1000	NR
Cadmium	7440-43-9	ND	3	2	0.8	30
Chromium (total)	7440-47-3	ND	14	30	11	1000
Copper (analyzed wet)	7440-50-8	13.8	NR	1000	NR	NR
Lead	7439-92-1	25.4	14	300	19	2000
Mercury	7439-97-6	3.96	0.231	20	8.7	10
Nickel	7440-02-0	18.8	14	20	7.2	NR
Selenium	7782-49-2	ND	14	400	200	NR
Silver	7440-22-4	ND	14	100	66	NR
Zinc	7440-66-6	109	14	2500	280	NR
EPH Ranges - mg/kg-dry						
Adjusted C11-C22 Aromatics		ND	42	1000	480	NR
C09-C18 Aliphatics		ND	42	1000	780	NR
C19-C36 Aliphatics		ND	42	3000	3000	NR
Unadjusted C11-C22 Aromatics		ND	42	1000	48	NR
1-Chlorooctadecane (%REC)		78.9	NR	NR	NR	NR
o-Terphenyl (%REC)	84-15-1	85.7	NR	NR	NR	NR
EPH Target Analytes - mg/kg-dry						
Acenaphthene	83-32-9	ND	0.278	4	3.9	NR
Acenaphthylene	208-96-8	ND	0.278	1	1.1	NR
Anthracene	120-12-7	ND	0.278	1000	0.001	NR
Benzo(a)anthracene	56-55-3	ND	0.278	7	3.7	NR
Benzo(a)pyrene	50-32-8	ND	0.278	2	0.66	NR
Benzo(b)fluoranthene	205-99-2	ND	0.278	7	3.7	NR
Benzo(g,h,i)perylene	191-24-2	ND	0.278	1000	1000	NR
Benzo(k)fluoranthene	207-08-9	ND	0.278	70	37	NR
Chrysene	218-01-9	ND	0.278	70	370	NR
Dibenz(a,h)anthracene	53-70-3	ND	0.278	0.7	0.66	NR
Fluoranthene	206-44-0	ND	0.278	1000	1000	NR
Indeno(1,2,3-cd)pyrene	193-39-5	ND	0.278	7	3.7	NR
Methylnaphthalene, 2-	91-57-6	ND	0.278	0.7	0.66	NR

Table A. Sediment Quality at Mill Pond, West Tisbury, MA

Analyte	CAS #	SED-1	RL	MCP[1]	BUD[2]	Lined Landfill[4]
Naphthalene	91-20-3	ND	0.278	4	0.66	NR
Phenanthrene	85-01-8	ND	0.278	10	10	NR
Pyrene	129-00-0	ND	0.278	1000	1000	NR
Total PAH Target Concentration		ND	0.278	NR	NR	100
2,2'-Difluorobiphenyl (%REC)		89.1	NR	NR	NR	NR
2-Fluorobiphenyl (%REC)	321-60-8	66.2	NR	NR	NR	NR
VOC - µg/kg						
Methyl ethyl ketone	78-93-3	ND	347	4000	350	NR
PAH - µg/kg						
Acenaphthene	83-32-9	ND	208	4000	3900	NR
Acenaphthylene	208-96-8	ND	312	1000	1100	NR
Anthracene	120-12-7	ND	208	1000000	1000000	NR
Benz(a)anthracene	56-55-3	ND	208	7000	3700	NR
Benzo(a)pyrene	50-32-8	782	83	2000	660	NR
Benzo(b)fluoranthene	205-99-2	ND	208	70000	3700	NR
Benzo(g,h,i)perylene	191-24-2	ND	417	1000000	1000000	NR
Benzo(k)fluoranthene	207-08-9	ND	417	70000	37000	NR
Chrysene	218-01-9	ND	208	70000	370000	NR
Dibenz(a,h)anthracene	53-70-3	ND	208	700	660	NR
Fluoranthene	206-44-0	ND	208	1000000	1000000	NR
Indeno(1,2,3-cd)pyrene	193-39-5	ND	208	7000	3700	NR
Methylnaphthalene, 2-	91-57-6	ND	312	700	660	NR
Naphthalene	91-20-3	ND	312	4000	660	NR
Phenanthrene	85-01-8	ND	208	10000	10000	NR
Pyrene	129-00-0	ND	521	1000000	1000000	NR
2-Fluorobiphenyl (%REC)	321-60-8	45.9	NR	NR	NR	NR
Nitrobenzene-D5 (%REC)	4165-60-0	57.2	NR	NR	NR	NR
Terphenyl-d14 (%REC)	98904-43-9	60.7	NR	NR	NR	NR
Other - %						
Total Volatile Solids	TVS	10.9	0	NR	NR	
Polychlorinated Biphenyls - µg/kg - dry						
Aroclor 1016	12674-11-2	ND	139	2000	44	NR
Aroclor 1221	11104-28-2	ND	278	2000	44	NR
Aroclor 1232	11141-16-5	ND	139	2000	44	NR
Aroclor 1242	53469-21-9	ND	139	2000	44	NR
Aroclor 1248	12672-29-6	ND	139	2000	44	NR
Aroclor 1254	11097-69-1	ND	139	2000	44	NR
Aroclor 1260	11096-82-5	ND	139	2000	44	NR
Decachlorobiphenyl Sig 1 (%REC)	2051-24-3	75.2	NR	NR	NR	NR
Decachlorobiphenyl Sig 2 (%REC)		56.7	NR	NR	NR	NR
Tetrachloro-m-Xylene Sig 1 (%REC)	877-09-8	72.1	NR	NR	NR	NR
Tetrachloro-m-Xylene Sig 2 (%REC)		67.4	NR	NR	NR	NR
VOCs - µg/kg - dry						
1,1-Dichloropropene	563-58-6	ND	139	NR	NR	NR
1,2,3-Trichlorobenzene	87-61-6	ND	139	NR	NR	NR
1,2,4-Trimethylbenzene	95-63-6	ND	139	NR	NR	NR
1,3,5-Trimethylbenzene	108-67-8	ND	139	NR	NR	NR
1,3-Dichloropropane	142-28-9	ND	139	NR	NR	NR
2,2-Dichloropropane	590-20-7	ND	347	NR	NR	NR
2-Chlorotoluene	95-49-8	ND	347	NR	NR	NR
2-Methoxy-2-Methylbutane	994-05-8	ND	139	NR	NR	NR
4-Chlorotoluene	106-43-4	ND	347	NR	NR	NR
4-Isopropyltoluene	99-87-6	ND	139	NR	NR	NR

Table A. Sediment Quality at Mill Pond, West Tisbury, MA

Analyte	CAS #	SED-1	RL	MCP[1]	BUD[2]	Lined Landfill[4]
Bromobenzene	108-86-1	ND	139	NR	NR	NR
Bromochloromethane	74-97-5	ND	347	NR	NR	NR
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	ND	139	9000	660	NR
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	ND	139	1000	660	NR
Dichloroethane, 1,1'-	75-34-3	ND	347	400	200	NR
Dichloroethane, 1,2-	107-06-2	ND	139	100	5	NR
Dichloropropane, 1,2-	78-87-5	ND	139	100	5	NR
Dichloropropene, 1,3-	542-75-6	ND	139	10	19	NR
Diethyl Ether	60-29-7	ND	139	NR	NR	NR
Diisopropyl Ether	108-20-3	ND	139	NR	NR	NR
Ethyl-t-Butyl Ether	637-92-3	ND	139	NR	NR	NR
Isopropylbenzene	98-82-8	ND	139	NR	NR	NR
n-Butylbenzene	104-51-8	ND	139	NR	NR	NR
n-Propylbenzene	103-65-1	ND	139	NR	NR	NR
sec-Butylbenzene	135-98-8	ND	139	NR	NR	NR
tert-Butylbenzene	98-06-6	ND	139	NR	NR	NR
Tetrahydrofuran	109-99-9	ND	347	NR	NR	NR
trans-1,2-Dichloroethene	156-60-5	ND	139	100	92	NR
1,2,4-Trichlorobenzene	120-82-1	ND	139	2000	660	NR
1,4-Dichlorobenzene	106-46-7	ND	139	700	660	NR
Hexachlorobutadiene	87-68-3	ND	139	6000	300	NR
Naphthalene	91-20-3	ND	347	4000	660	NR
1,1,1,2-Tetrachloroethane	630-20-6	ND	139	100	25	NR
1,1,1-Trichloroethane	71-55-6	ND	139	30000	19000	NR
1,1,2,2-Tetrachloroethane	79-34-5	ND	139	5	5	NR
1,1,2-Trichloroethane	79-00-5	ND	139	100	5	NR
1,1-Dichloroethene	75-35-4	ND	139	3.00	NR	NR
1,2-Dibromo-3-chloropropane	96-12-8	ND	139	NR	NR	NR
1,4-Dioxane	123-91-1	ND	27800	200	14	NR
2-Chloroethyl vinyl ether	110-75-8	ND	139	NR	NR	NR
2-Hexanone	591-78-6	ND	347	NR	NR	NR
4-Methyl-2-pentanone	108-10-1	ND	139	NR	NR	NR
Acetone	67-64-1	ND	347	6000	330	NR
Acrylonitrile	107-13-1	ND	139	NR	NR	NR
Benzene	71-43-2	ND	139	2000	150	NR
Bromodichloromethane	75-27-4	ND	139	100	5	NR
Bromoform	75-25-2	ND	139	100	7	NR
Bromomethane	74-83-9	ND	139	500	10	NR
Carbon disulfide	75-15-0	ND	139	NR	NR	NR
Carbon tetrachloride	56-23-5	ND	139	10000	390	NR
Chlorobenzene	108-90-7	ND	139	1000	28	NR
Chloroethane	75-00-3	ND	139	NR	NR	NR
Chloroform	67-66-3	ND	139	400	5	NR
Chloromethane	74-87-3	ND	139	NR	NR	NR
cis-1,2-Dichloroethene	156-59-2	ND	139	300	13	NR
Dibromochloromethane	124-48-1	ND	139	5	5	NR
Dibromomethane	74-95-3	ND	139	NR	NR	NR
Dichlorodifluoromethane	75-71-8	ND	139	NR	NR	NR
Ethylbenzene	100-41-4	ND	139	40000	190	NR
Ethylene dibromide	106-93-4	ND	139	100	5	NR
Methyl ethyl ketone	78-93-3	ND	347	4000	350	NR
Methyl Tert-Butyl Ether	1634-04-4	ND	139	100	140	NR
Methylene chloride	75-09-2	ND	139	100	NR	NR

Table A. Sediment Quality at Mill Pond, West Tisbury, MA

Analyte	CAS #	SED-1	RL	MCP[1]	BUD[2]	Lined Landfill[4]
Styrene	100-42-5	ND	347	3000	NR	NR
Tetrachloroethene	127-18-4	ND	139	1000	NR	NR
Toluene	108-88-3	ND	139	30000	1300	NR
trans-1,3-Dichloropropene	10061-02-6	ND	139	NR	NR	NR
Trichloroethene	79-01-6	ND	139	300	NR	NR
Trichlorofluoromethane	75-69-4	ND	347	NR	NR	NR
Vinyl Chloride	75-01-4	ND	139	600	280	NR
Xylenes, Total	1330-20-7	ND	347	400000	420	NR
1,2-Dichloroethane-D4 (%REC)	17060-07-0	103	NR	NR	NR	NR
4-Bromofluorobenzene (%REC)	460-00-4	89.9	NR	NR	NR	NR
Dibromofluoromethane (%REC)		81.7	NR	NR	NR	NR
Toluene-d8 (%REC)	2037-26-5	95.5	NR	NR	NR	NR
Other - mg/kg-dry						
Phosphorus, Total (As P)	7723-14-0	1530	3	NR	NR	
Bulk Physical Results						
Percent Moisture		64.0	1			

Notes:
Dilution factor for all results is 1
ND: Not Detected
NR: Not Reported

Result exceeds Soil Cat 1, GW 1 - Sediment
Result exceeds BUD guidelines

1: MADEP, 2006. Massachusetts Contingency Plan
2: MADEP, 2004. Draft Interim Guidance Document for Beneficial Use Determination Regulations 310 CMR 19.060
3: Long and Morgan, 1995. The Potential for Biological Effects of Sediment- Sorbed Contaminants Tested in the National Status and Trends Program
4: MADEP, 1997. Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Department of Environmental Protection Policy # COMM-97-001

3.3 Wetland Resource Characterization

A Professional Wetland Scientist (PWS) delineated wetland resource areas at Mill Pond during a site visit conducted November 15, 2010. These resource areas are jurisdictional under the West Tisbury Bylaw, Wetlands Protection Act (WPA) and its Regulations, and Section 404 of the Clean Water Act. Wetland resource areas were delineated in accordance with the WPA, its associated Regulations and the Interim Regional Supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (2009). As outlined in the WPA Regulations and the ACOE Manual, hydrophytic vegetation, hydric soils and hydrology were used to identify wetland areas.

Resource areas associated with Mill Pond include land under water (LUW), inland bank, and bordering vegetated wetland (BVW) associated with a pond. The section below provides a summary of the wetland resource areas associated with Mill Pond that may be useful toward future permitting efforts for whatever restoration alternative may be selected.

3.3.1 Land Under Waterbodies and Waterways

As defined at 310 CMR 10.56 of the Regulations, land under waterbodies and waterways (LUWW) includes land beneath any creek, river, stream, pond or lake. The land may be composed of organic muck or peat, fine sediments, rocks or bedrock and is presumed to support the eight interests protected under the WPA.

LUWW is found beneath the entirety of Mill Pond. The upper boundary of LUWW is the mean annual low water level. Mill Pond contains approximately 2.5-acres of LUWW, comprised of sediment with depths ranging from 0.5 to 4.0 feet. Land under water within Mill Pond likely protects groundwater and fisheries, provides wildlife habitat and prevents pollution. The pond does not fall within any DEP-approved Zone II wellhead protection areas, so the LUWW most likely does not play a role in protecting public drinking water supplies. It may serve to protect private water supplies as the pond is mapped within a high yield aquifer.

3.3.2 Bordering Vegetated Wetland (BVW)

As defined at 310 CMR 10.55 of the Regulations, bordering vegetated wetlands (BVW) are freshwater wetlands that border on creeks, rivers, streams, ponds and lakes. Soils within a BVW are saturated and/or inundated such that they support a plant community in which hydrophytic vegetation is dominant.

A thin fringe of BVW exists along portions of the shoreline of the pond. Dominant wetland plants within the emergent community include soft-stem bulrush (*Scirpus validus*), bur-reed (*Sparganium sp*), tussock sedge (*Carex stricta*), water willow (*Decodon verticillatus*), and lurid sedge (*Carex lurida*). Dominant scrub-shrub plants include speckled alder (*Alnus incana*), swamp rose (*Rosa palustris*), highbush blueberry (*Vaccinium corybosum*), leatherleaf (*Chamaedaphne calyculata*), steeplebush (*Spiraea tomentosa*) and meadowsweet (*Spiraea latiflolia*).

3.3.3 Inland Bank

As defined at 310 CMR 10.54, bank is the portion of the land surface which normally abuts and confines a water body. Bank is presumed to function to support the eight interests protected under the WPA. Inland bank was flagged around the west, south and east shorelines of the pond. In these areas, the upper bank boundary is the first observable break in slope. The bank of the pond is well vegetated with herbaceous and shrub species.

3.3.4 Bordering Land Subject to Flooding

As defined at 310 CMR 10.57, bordering land subject to flooding (BLSF) is an area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds or lakes. The boundary of BLSF is the estimated lateral extent of the 100-year floodplain, which was obtained from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM). According to the FIRM for the site (Community-Panel Number 250 07C0093H, dated July 6, 2010), there is no 100-year floodplain associated with Mill Pond.

3.3.5 Rare Species and Certified Vernal Pool Review

Based on a review of the latest data from the Massachusetts Natural Heritage and Endangered Species Program (NHESP) Atlas, Mill Pond is located within an area identified as “PH 15” and “EH 29” according to the most recent Natural Heritage Atlas (13th Edition). Based on available information this is designated habitat for the American Brook Lamprey (*Lampetra appendix*) and the Water-willow stem borer (*Papaipema sulphurata*).

3.4 Wildlife Habitat Evaluation

This wildlife habitat evaluation has been prepared in accordance with requirements of the Massachusetts Wetlands Protection Act (M.G.L Chapter 131 Section 40) and its implementing Regulations (310 CMR 10.00). Any proposed in-pond management actions, such as dredging of the pond, will likely impact an area of land under water (LUW) which will exceed the 10% threshold to support wildlife habitat at 310 CMR 10.56(4) (a) 4. Work in LUW which exceeds thresholds “*may be permitted if they will have no adverse effects on wildlife habitat*”, as determined by the procedures contained in 310 CMR 10.60. Therefore, the purpose of this effort is to evaluate the potential for adverse effects to the wildlife habitat functions within the resource area associated with a proposed pond restoration project.

In accordance with 310 CMR 10.60 (2) (a) regarding wildlife habitat characteristics, study areas within the project area were evaluated (topography, wildlife usage, soil structure, plant community composition and structure) for their ability to provide important habitat function and value. This evaluation was also conducted following the guidelines established in the March 2006 DEP document *Massachusetts Wildlife Habitat Protection Guidelines for Inland Wetlands.*

An ESS Wetland Scientist observed wildlife species present on the site and collected data on November 15, 2010. An "Appendix B – Detailed Wildlife Habitat Evaluation Form" was completed at the project site for the LUW. The Field Data Form identifies several important habitat features which, if present, may provide habitat for specified wildlife. These habitat features include, but are not limited to: the presence/type of food sources, standing dead trees (snag), tree cavities, cover/perches/basking habitat, rocks in stream bed, dens and nests, and emergent wetlands. Because the evaluation only concerned the impact area to LUW, none of the habitat features listed on the form applies (i.e. number of snags). The data obtained were also used to describe the physical characteristics of the impact area and relate them to the ability of the resource area to provide wildlife habitat as it relates to topography, substrate and structure.

The study examined the following as outlined in 310 CMR 10.60 (2):

Land Under Water (LUW): Impacts to food, shelter and breeding areas for wildlife as well as overwintering for areas for reptiles and amphibians.

3.4.1 LUW Evaluation

The potential impact area consists of the entirety of the pond bottom extending to the bank. The substrate of the LUW consists of a combination of organic rich muck underlain by sand. There was little to no rooted aquatic vegetation observed at the time of the survey but the pond bottom is known to support abundant populations of coontail (*Ceratophyllum demersum*), thin-leaf pondweed (*Potamogeton pusilis*), watercress (*Nasturtium officinale*) and ribbon-leaf pondweed (*Potamogeton epihydrus*). The water column was dense with filamentous green algae and duckweed (*Lemna minor*) was observed the waters surface. Semi-aquatic or emergent rooted vegetation associated with the pond included bur-reed, tussock sedge and water willow. These three dominant emergent plant species cover much of the shoreline of the pond and may continue to encroach into deeper waters of the pond as they accumulate sediments among their roots and shoots over time.

Mill Pond supports a warm-water fishery, as sunfish and yellow perch have been observed utilizing the pond. Surprisingly, the pond is reported to be stocked by Division of Fish and Wildlife with various size classes of rainbow trout in the early spring of each year (MassDFW, personal communication, 2010). However it is unlikely that the pond is capable of supporting long-term populations of cold water fish species due to the shallow nature of pond. The permanent open water body is attractive for resident waterfowl such as Mallard (*Anax platyrhynchos*), Canada Goose (*Branta canadensis*), exotic Mute Swan (*Cygnus olor*), and wading birds such as Great Blue Heron (*Ardea herodias*). Additionally, migrant waterfowl such as American Widgeon (*Anas americana*) and Ring-necked Duck (*Aythya collaris*) may also use the pond on a seasonal basis (Bob Woodruff, personal communication).

There were no underwater logs or large boulders observed on the pond bottom that could potentially provide cover habitat for fish or other aquatic species. Because the pond bottom lacks any underwater habitat structure, it likely only provides limited cover for amphibians and reptiles, but may provide overwintering/hibernacula habitat.

3.4.2 Rare Species

As stated above, Mill Pond is located within an area identified as Priority Habitat (PH 15) for the American Brook Lamprey (*Lampetra appendix*) and the Water-willow stem borer (*Papaipema sulphurata*). The American Brook Lamprey is a primitive eel-like fish that lives in clear, cool streams.

Larvae live and feed in areas with substrate consisting of fine sand and muck, often in backwaters or stream margins. Adults live in clear, cool streams and spawn in pea gravel substrates. Lampreys are vulnerable to sedimentation, water temperature increases and extreme water level changes. Mill Pond does not appear to provide the necessary habitat for adult populations of American Brook Lamprey, but may provide habitat for its larvae.

The water-willow stem borer is a moth that inhabits shallow portions of coastal plain ponds where water-willow grows. A large stand of water-willow exists at the inlet of the pond. Although the water-willow stem borer was not observed at the time of the site visit, this area does provide the required habitat to support this species.

4.0 MANAGEMENT OPTIONS AND RECOMMENDATIONS

The stated management goal for Mill Pond was to develop an acceptable long term plan for restoring and maintaining the pond in a fashion that would retain the pond's historic character as an open water amenity while also maintaining the site's aesthetic appeal and value as an ecological resource. Given the number of issues currently impacting Mill Pond, including excessive aquatic weed/algae growth, excessive sediment accumulation and excessive nutrient and sediment loading, a wide range of management options should be considered and evaluated. Among these the most applicable to resolving the issues facing Mill Pond include:

- Aeration of pond
- Chemical treatments
- Shading dye
- Nutrient inactivation
- Weed management through mechanical harvesting/hand-pulling
- Mechanical hydro-raking
- Winter water level drawdown
- Sediment dredging (both mechanical and hydraulic)

A review of each of the management options with regard to their ability to achieve the defined management objectives is presented below and summarized with additional details in Appendix B.

ESS also reviewed a no-action alternative to assess the impacts of implementing no additional management actions at Mill Pond. This alternative is contemplated first, followed by each of the other management options.

4.1 No-action Alternative – Not Recommended

If no additional management actions are implemented at Mill Pond, it is likely that the pond will have the following responses.

1. Sediment will continue to slowly accumulate in the pond, both from external (sediment loading, leaf drop, etc.) and internal (plant and algae growth) sources. Although volume of the pond may fluctuate due to individual hydrologic events and flow diversions, a net accumulation of sediments is expected. Eutrophication is a process characterized by positive feedback loops, which tend to ***accelerate*** the rate of pond filling unless action is taken to interrupt the process.

2. Emergent wetland plants will colonize and stabilize new shallow water habitats as sedimentation continues, providing additional wetland habitat. These areas will be less likely to scour during high flow events in the future due to the stabilizing effect of plant roots.
3. Nursery habitat for young-of-the-year fish may increase in the short term as shallow water habit is made available. Shallow water areas may further improve nursery habitat as submersed and emergent vegetation increase in coverage and provide more cover. However, larger fish (including spring-stocked trout) would be increasingly confined to the main channel as the pond fills and habitat volume for them shrinks, potentially reducing fishing opportunities at Mill Pond. Over the long term, nursery habitat may or may not persist as a perennial feature. Its seasonal availability can be expected to become increasingly sensitive to water level in the pond, as influenced by weather patterns and water diversion activities.
4. The pond will be less attractive to most migratory waterfowl as open water habitat shrinks. Resident waterfowl species such as Canada Goose, Mallard, and Mute Swan may persist, especially if adjacent grassy areas, which they can use for grazing and loafing, are maintained. Wading birds may increase in the short term as more shallow water habitat is made available. However, the expected decrease in fish habitat could eventually reduce the availability of preferred food for some wading bird species and lead to a long term decline. Passerine species that utilize wetland or wetland edge habitats may increase over the long term.
5. Potential for recreational usage (e.g. fishing and/or watercraft) will be reduced over time.

This approach is not currently recommended, primarily because it would result in contraction of Mill Pond and curtail the recreational and ecological services that the pond has historically provided. These run contrary to the primary management goal of preserving the pond as an open water amenity.

4.2 Aeration and/or Destratification – Not Recommended

Aeration and/or destratification (or circulation) is used to treat problems with algal growth and low oxygen concentrations that may occur in smaller ponds. Air diffusers, aerating fountains, and water pumps are typical types of equipment that may be installed to increase circulation in a pond. The cost of purchasing, installing, and maintaining pond circulation equipment becomes substantial as pond size increases. Likewise, the effectiveness of the equipment tends to decline with pond size as it is difficult to achieve sufficient circulation in large ponds.

This approach is not currently recommended for Mill Pond, primarily because sedimentation and excessive aquatic plant growth (rather than planktonic algal growth) are the targets for restoration of the pond. Additionally, Mill Pond's high flushing rate would minimize the effects of any aeration since the aerated water would quickly pass downstream.

4.3 Chemical Treatment (Herbicides) – Not Recommended

Herbicides remain a controversial aquatic weed control measure in many communities because of their association with pesticides, which is generally perceived to be negative. However, as we learn more about the suite of side effects that comes with alternative physical and biological management options, chemical control measures continue to be used as part of most balanced pond management plans.

Although no herbicide is completely safe or harmless, a premise of federal pesticide regulation is that the potential benefits derived from use outweigh the risks when registered herbicides are applied according to label recommendations and restrictions. Current herbicide registration procedures are far more rigorous than in the past and the ability of applicators to target applications of herbicides further improves the relative safety of using these chemicals for nuisance aquatic plant control.

Chemical treatment is usually the most cost effective means by which to reduce aquatic weed biomass over the short term. When integrated with other management strategies at the watershed and in-pond level, herbicides can play a useful role in controlling unwanted nuisance growths of aquatic plants.

Costs for permitting an herbicide treatment are typically low but could be somewhat high if there is any significant opposition to the treatment. Permits could be denied, appealed, or rigorously conditioned, the last of which could add cost both through constraints on the treatment process and monitoring expenses.

For Mill Pond diquat (trade name Reward) could be used in the short term to control unwanted nuisance plants growths. Since diquat is a contact herbicide, it does not typically kill rooted portions of aquatic vegetation and follow-up applications may be needed to control growth each year. Given the fact that invasive species do not currently appear to be a problem in Mill Pond, herbicide treatment with diquat is not recommended at this time.

Emergent plant growths in Mill Pond could be controlled with glyphosate (trade name Rodeo) on a selective basis, if needed. However, this is not currently recommended, as the emergent species present are native and do not present a significant detriment to use of the pond by wildlife or enjoyment of the pond for recreation.

4.4 Shading Dye – Not Recommended

Dyes are used to limit light penetration and therefore restrict the depth at which rooted plants can grow. In essence, they mimic the effect of light inhibition that might be expected during periods of high turbidity or prolonged ice and snow cover. Natural periods of low light are an important variable in determining plant composition and abundance, and use of dyes can produce similar effects. They are only selective in the sense that they favor species tolerant of low light or with sufficient food reserves to support an extended growth period (during which time the plant could reach the euphotic zone). Dyes tend to reduce the maximum depth of plant growth, but are relatively ineffective in shallow water (less than 6 ft or 1.8 m deep). Dyes are unlikely to make a significant difference in plant growth within shallow bodies of water like Mill Pond. Additionally, maintaining a high concentration of dye in the pond would be extremely difficult, given its very high flushing rate. Therefore, the use of dies is not currently recommended.

4.5 Nutrient Inactivation – Not Recommended

Nutrient inactivation typically targets dissolved phosphorous (the form most readily available to plants and algae) and involves the addition of alum (aluminum sulfate) or similar compounds to bind to this phosphorous to allow it to settle into the pond sediments. In its simplest form, nutrient inactivation is conducted by applying alum directly to the pond as a single dose. More sophisticated nutrient inactivation programs involve proportional injection of alum into stormwater sources or tributaries so that phosphorous is inactivated before it even enters the pond.

Nutrient inactivation is typically used to control algae blooms and improve water clarity. These are not considered to be key target issues for the shallow waters of Mill Pond, where nuisance growth of aquatic plants and accumulated sediment are the primary problems. Therefore, nutrient inactivation is not recommended.

4.6 Macrophyte Harvesting – Recommended for Small Scale Control Only

Macrophyte harvesting covers a wide range of techniques, including mechanical harvesting and hand pulling. Mechanical harvesting, which involves cutting and pulling aquatic plants from a specially-equipped watercraft, is most effective in the short term. As mechanical harvesting simply sets plants back for the season, its use should be reserved for scenarios where there is an immediate but temporary need for widespread reduction of nuisance plant cover.

Mechanical harvesting is not currently a recommended management option for Mill Pond because it is relatively expensive, typically results in only single season control, and may not be physically feasible, given the shallow water and potential access constraints for the harvester.

The simplest form of harvesting is hand pulling of selected plants. Depending on the depth of the water at the targeted site, hand pulling may involve wading, raking, snorkeling, or SCUBA diving. Hand pulling often involves collection of pulled plants and fragments in a mesh bag or container that allows for transport and disposal of the vegetation. In deeper water, frequent trips to the surface are necessary to dispose of full bags. The intensive nature of this work limits its application to small areas, typically much less than one acre in size. Hand pulling can directly confirm removal of entire individual plants, typically resulting in longer control of plant growth in targeted areas.

In a small pond like Mill Pond, hand pulling would be a feasible and a reasonably cost-effective method of aquatic plant control over select areas where weed-free access is desired. However, hand pulling is most effective as a “clean-up” control method to be used in conjunction with other methods, especially where aquatic plant beds are particularly dense or extensive.

4.7 Hydroraking and Rotovation – Not Recommended

Hydroraking uses a backhoe-like machine mounted on a barge to remove plants directly from pond sediments. Depending on the attachment used, plants are scooped, scraped, or raked from the bottom and deposited on shore for disposal. Rotovation is essentially underwater rototilling of pond sediments. Rotating blades cut through roots, shoots, and tubers, dislodging and expelling them from their growing locations. Some operations are also outfitted to collect some or most of the rotovated plant materials. Both hydroraking and rotovation are most useful for local control of water lilies and other plants with large rhizomes or tubers, as these methods can physically remove or destroy the bulky portions of the plant.

Access to Mill Pond would be difficult for hydroraking or rotovation operations. Developing adequate access (e.g., a ramp) or hiring a crane to lift the treatment vessel into Mill Pond would be unlikely to provide sufficient benefit to offset both the monetary cost and the ecological consequences of disturbance to the pond ecosystem and its shoreline. Therefore, use of these methods for aquatic plant control at Mill Pond is not recommended.

4.8 Water Level Control (Drawdown) – Not Recommended

Drawdown involves lowering the water level of a pond to expose shallow bottom sediments and associated plants to drying and/or freezing. It is most effective against species that reproduce mainly by vegetative means. Although drawdown can be conducted at any time, the interaction of drying and freezing that occurs with winter drawdown is usually most effective. Drawdown would likely be most effective on submerged plants in Mill Pond, which tend to be most sensitive to winter freezing and desiccation.

In order to effectively draw down a pond, there must be an adjustable discharge structure that allows the water level to be safely controlled. The water level must be drawn down to a sufficient depth and for a long enough period of time to allow bottom sediments to at least partially de-water. Drawdown would allow for some decomposition of organic sediments through exposure to the air, thereby slowing the rate at which sediments accumulate in the pond. However, it is unlikely that this would be enough to reverse the many years of accumulation of sediments behind the dam.

Currently, only a partial drawdown is possible using the flashboard system at the spillway. The maximum drawdown that could be accomplished by removing flashboards is approximately 2.0 feet, which, if implemented, would be only marginally effective for management of plant growth in the pond.

Additionally, any manipulation of the water level in Mill Pond would need to be approved by and coordinated with the owner of the dam. Currently, the West Tisbury Garden Club owns the dam. The Town would need to either acquire permission to draw down the pond or purchase the dam from the West Tisbury Garden Club prior to drawdown. Consultation with the West Tisbury Fire Department is also recommended as water from Maley's Pond (fed by a diversion from Mill Pond) is apparently used for fire fighting (Stantec Constulting, Inc., 2011).

If drawdown is pursued as a management strategy, a drawdown feasibility study would first be needed in order to file a Notice of Intent with the West Tisbury Conservation Commission.

4.9 Dredging – Recommended as Long-Term Option

Dredging works as a plant control technique when either a light limitation is imposed through increased water depth or when enough soft sediment is removed to reveal a less hospitable substrate for plant growth. Since light limitation through increased depth is unlikely to be achieved in Mill Pond, control will depend on excavation to a hard bottom (coarse sand or gravel in this case). This means that any dredging to control rooted plants must remove all soft sediment in the target area. It may not be necessary to dredge the entire pond to achieve a satisfactory level of plant control, but it would be necessary to do a thorough job in any area where control is to be achieved or greater depths are desired.

Dredging in Mill Pond could be an effective long-term control technique for nuisance aquatic plants, but will be costly. The challenges of a project of this type are not unreasonable. The key factor influencing the approach and costs for moving forward with a dredge program at Mill Pond will be the ability to draw down the pond to allow for dredging within the drained basin to occur using conventional excavation equipment. This is most likely an environmentally sound and feasible approach if conducted during the winter months when wetland areas associated with the pond would be dormant. This approach would allow for sediment to be dewatered within the basin itself by pulling the sediment up to the margins of the pond to allow water to drain back into the main portion of the basin.

If conventional "dry" dredging is not determined to be feasible for Mill Pond due to equipment access issues or drawdown concerns, hydraulic dredging would be a viable alternative. Hydraulic dredging is generally more expensive than conventional dredging for projects of this scale and it would require a larger and more sophisticated containment area. Alternatively, advanced dewatering techniques such as the use of Geotubes (geotextile fabric for dewatering) or a belt-filter press machine could be used instead but these would add additional costs over traditional dewatering containment. All of these external sediment dewatering options will require land adjacent to the pond to be made available for the dewatering process. The town lot would be adequate space for the use of a belt-filter press machine, but a larger area would be required for either the use of the Geotubes (>0.5 acres) or a standard dewatering basin (> 1 acre). There is a relatively clear private lot to the north east of the pond that would be ideal; however, the ability to use this location has not been investigated as part of this study.

Water level control within the pond may be less of a problem, as a near total drawdown could be accomplished by removing flashboards at the southeastern spillway. Additional pumping may be required to maintain low water levels during the dredging; however there is sufficient grade to allow for this to occur. A mechanism for pumping water to Maley's Pond to preserve its capacity as a water supply for the West Tisbury Fire Department should also be considered as part of the dredging drawdown plan.

The amount of material to be removed and the type of disposal or reuse will also have a significant impact on the cost of dredging. Environmental permitting for dredging projects is moderately complex and will require at least nine months to a year before the project could receive all required approvals. Federal (USACE 404), state (MEPA Certificate and 401 Water Quality Certificate) and local permits (Notice of Intent filed for Order of Conditions from the conservation commission) are all required, and would necessitate considerable advance information and review time. Additionally, this project could trigger the need for federal consistency review by the Office of Coastal Zone Management (CZM) since all of Martha's Vineyard is located within the coastal zone.

With an estimated soft sediment volume of approximately 3,150 cubic yards in Mill Pond (Appendix C), the cost of a traditional dry dredging project (not including permitting) would likely run between $110,000 and $160,000 for removal of all of the soft sediments. Costs could increase if sediment cannot be reused or disposed of on-Island. Permitting and design prior to dredging is likely to add an additional cost of up to $35,000 to $40,000 (if federal consistency review with CZM is required) to this total, bringing the complete dry-dredge project cost to approximately $150,000 to $200,000. Hydraulic dredging for a similar scale project would range between $215,000 and $250,000 including permitting and design depending on the method of dewatering selected.

Beyond the standard removal of all soft sediment, it is possible to achieve the goals of maintaining open water habitat and aesthetics while also significantly improving habitat quality, water quality, and the long term value of the dredge project by designing either a *complementary wetland system* or a sediment trap within the upper portion of the pond. These options would significantly extend the life of the pond restoration effort. ESS has created conceptual designs for each of these options.

The first option would envision the enhancement of wetland habitat within the upper half of the pond and the creation of a much deeper open water basin in the lower half of the pond (Figure 8). The intent is to create an emergent wetland system at the inlet end of the pond that would filter water, trap nutrients and sediments, allow for maintenance dredging over time as required, and enhance the ecological value and beauty of the resource. The lower section of the pond would be deepened to a depth that would preclude the growth of rooted plants due to light limitation and would also enhance the pond's ability to provide suitable fish habitat. This approach would allow some of the material from the dredge effort to be reused within the basin of the pond itself to create the wetland features thus offsetting some of the construction costs. However, there would also be the need to import additional suitable material to create structures that would need to be stable features. Such a project would envision removing approximately 7,400 cy, nearly double the previously described project. Given this, the construction cost for this created wetland system and over dredge project would be on the order of $355,000 to $405,000 including all permitting and design costs. This assumes on-Island reuse or disposal.

One advantage of the addition of the created wetland system approach over a basic sediment removal project is that this approach addresses the source of the sediment and nutrients and may qualify to be funded through a Section 319 Non-Point Source Grant from MassDEP. These grants do require in-kind matching funds of 40% to be provided to a project but these can be met in a number of ways other than actual cash commitments (e.g. volunteer time to the project from MPC, the town highway department, or town officials). Section 319 NPS Grant applications are typically due on or around June 1 each year.

The second option would create a primary open water basin in the lower half of the pond but would also dredge a smaller second basin at the pond inlet (Figure 9). This smaller basin would serve as a sediment trap for materials transported down Mill Brook. By locating the sediment trap in a narrow area at the northwestern end of the pond, much of it will be accessible for future maintenance clean-out from the existing berm on the western shoreline of Mill Pond. The two basins would be connected by buried pipes to relieve pressure on the shallow berm separating the upper and lower basins. This option would target removal of approximately 15,600 cy and would cost on the order of $450,000 to $700,000, including permitting and design costs (assuming on-Island reuse or disposal).

Chemical content of the material to be dredged is an important consideration in determining the feasibility of reuse or disposal. Disposal costs could vary greatly depending on whether the material can be beneficially reused on island. If the material removed from the basin is clean and deemed useful as a soil amendment, the material may potentially be sold to local garden suppliers or landscape businesses which would make the project more economically feasible. However, material that is not suitable for beneficial use would need to either be amended with clean material (potentially from within the basin) to dilute the concentrations to suitable levels or trucked off-Island for suitable disposal. Either of these options would increase the cost of the project and, depending upon the level of implementation, could potentially make dredging a less cost effective option.

Based on the sediment sampling results obtained as part of this study (Table 1), sediment may need to be disposed of in a lined landfill or, at a minimum, amended slightly prior to stockpiling or beneficial use. MassDEP will make a final determination on suitable reuse options for the material as part of the permitting process.

If dredging is considered to be a viable option, the next steps would be:

1. Assessment of specific scope and extent of dredge program including possible funding options.
2. Additional chemical and physical analysis of the sediments in areas targeted for dredging.
3. Development of a more advanced engineering design for submission to permitting authorities.

4. Initiation of the permitting process including an Environmental Notification Form filing for MEPA (Massachusetts Environmental Policy Act) review, filing a local Notice of Intent under the Wetlands Protection Act, filing for a Section 401 Water Quality Certificate from MassDEP, and seeking a U.S. Army Corps of Engineers Section 404 Permit for dredging. Federal consistency review through CZM may also be necessary.

These four activities might be expected to cost between $30,000 and $40,000 for Mill Pond given the work already completed as part of this study, but are essential if dredging is to be pursued as a management option. Additional design costs would include final engineering design following the permitting process (incorporating any accepted changes resulting form these reviews) along with the development of a bid specification package for the project.

5.0 SUMMARY

Mill Pond is an artificially created system that is no longer used for its original purpose which was to provide power to a variety of mills. Records indicate that the pond has historically been dredged every 40 to 50 years and it has been over 40 years since the pond was previously dredged. Although a range of options could be considered that would alleviate some of the systems resulting from the ponds accumulated sediment, these approaches would only further delay the need to dredge.

Given the relatively high levels of phosphorus and sediment currently passing through Mill Pond and its relatively low overall water volume, chemically treating or mechanically removing large areas of aquatic plant growth is not recommended since these approaches would provide very short-term results which over the long-term would ultimately prove to be ineffective and costly approaches.

Macrophyte harvesting through hand pulling techniques is one preferred method of aquatic plant control at Mill Pond, if raising funds proves difficult or if continued maintenance of the pond is seen as a preferred goal over restoration. The method is well-suited to small ponds in addition to being selective, which can allow for the preservation of some plants to provide habitat for fish and wildlife. Furthermore, hand pulling is relatively inexpensive, especially if volunteer labor is available.

Dredging provides a more reasonable and long-lasting solution, but may also prove to be the most costly alternative. Instead of simply removing the plants, dredging removes accumulated sediments and restores water depth that are ultimately the result of eutrophication at Mill Pond. Dredging “resets” the pond and is the only alternative which achieves the restoration goal of increasing pond depth.

A basic dredge project designed to remove all or most of the 3,150 cy of accumulated fine sediment from the pond basin would likely cost between $150,000 and $200,000 inclusive of permitting and design costs. A more advanced project design including the development of a sediment and pollutant trapping wetland system within the upper portions of the pond would cost on the order of $355,000 to $405,000, inclusive of design and permitting costs, but over half of this cost may be able to be covered by grant funding. An alternative design that incorporates a sediment trap near the pond inlet would cost more to implement, approximately, $450,000 to $700,000. It could also be more difficult to acquire grant funding toward this project since a sediment trap would be far less effective at removing nutrients (the primary focus of the Section 319 grant program).

Unfortunately, the options for restoration of Mill Pond are relatively limited at this point in time and the only true solution is a relatively expensive one. Fortunately, a dredge project such as the ones envisioned above would be expected to last between 30 and 70 years before additional dredging might be required. Given this, the cost of restoring the pond through dredging really amounts to an annual cost of between $5,000/yr to $6,700/yr for basic dredging with a projected effective lifespan of 30 years. Annual costs for the wetland treatment system could be as little as $2,000/yr (assuming grant support at 60% and a 70-year lifespan) for a dredging project that includes increasing the depth on the lower portion of the basin and constructing a wetland treatment system in the upper portion of the basin. The other design option of constructing a sediment forebay at the upper end of the pond also envisions an increase in the depth of the lower basin and could be expected to have a similar lifespan (70 years). However, this option is less likely to obtain grant support through the Section 319 grant program. Therefore, annual costs would likely range from $6,400/yr to $10,000/yr plus periodic maintenance costs to remove accumulated sediments from the sediment forebay.

The lifespan of each dredge project option could be extended even further by implementing a storm water improvement program within the watershed that would target the reduction of sediment sources from the Mill Pond watershed. Such a program could be implemented for relatively little cost to the town since much of the initial assessment work has already been performed by the Martha's Vineyard Commission (Wilcox, 2009; Wilcox, 2011). Conceptual designs for the recommended solutions will need to be developed in order to apply for grant funding; however, a significant portion of the costs for the actual implementation of the stormwater improvement program (envisioned as a combination of storm water BMPs and educational efforts) could be funded through the same Section 319 NPS Grant that would potentially fund the dredge project at the pond.

6.0 REFERENCES

Aquatic Control Technology, Inc. 2006. Survey Report, Mill Pond Baseline Assessment and Management Plan – West Tisbury, MA.

Commonwealth of Massachusetts Division of Fisheries and Wildlife. June 2007. Water-willow Stem Borer Species Information Form.

Commonwealth of Massachusetts Division of Fisheries and Wildlife. August 2008. American Brook Lamprey Species Information Form.

ESS Group, Inc. 2008. Standard Operating Guidelines for Collection of Sediments from Freshwater Environments. May 9, 2008.

Massachusetts Department of Environmental Protection. March 2006. Massachusetts Wildlife Habitat Protection Guidance for Inland Wetlands.

Polly Hill Arboretum. 2011. Botanical Survey of Mill Pond and upstream ponds of the Mill Brook Watershed. March 1, 2011.

Sarkar, B. 2002. Heavy Metals in the Environment. New York: Dekker.

Stantec Consulting Services, Inc. 2011. Site Reconnaissance, Preliminary Evaluation, and Opinion of Probable cost for Dam Removal. Old Mill Pond Dam, West Tisbury, Massachusetts.

U.S. Army Corps of Engineers, 2009. Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, ed. J.S. Wakeley, R. W. Lichvar, and C.V. Noble. ERDC/EL TR-09-19. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

William Wilcox. 2009. Mill Brook Stormwater Runoff Assessment. Final. March 2009.

William Wilcox. 2011. Mill Brook 2010 Water Quality Assessment. Draft Final Report. January 2011.

7.0 GLOSSARY OF TERMS AND ABBREVIATIONS

Abiotic: A term that refers to the nonliving components of an ecosystem (e.g., sunlight, physical and chemical characteristics).

Algae: Typically microscopic plants that may occur as single-celled organisms, colonies or filaments.

Anoxic: Greatly deficient in oxygen. Anoxic environments do not typically support organisms that require oxygen.

Aquifer: A water-bearing layer of rock (including gravel and sand) that will yield water in usable quantity to a well or spring.

Aquatic plants: A term used to describe a broad group of plants typically found growing in water bodies. The term may generally refer to both algae and macrophytes, but is usually intended to be synonymous with the term macrophyte.

Bathymetric Map: A map illustrating the bottom contours (topography) of a lake or pond.

Bedload: The portion of the total sediment load that is transported by rolling or saltating along the bed of a stream.

Best Management Practices: Any of a number of practices or treatment devices that reduce pollution in runoff via runoff treatment or source control.

Biomass: A term that refers to the weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Biomass is often measured in grams per square meter of surface.

Biovolume: Similar to biomass but refers to the volume, rather than the weight, of biological matter.

Biota: All living organisms in a given area.

BUD Critera: Beneficial Use Determination criteria. These guidelines are used to determine how dredged materials may be re-used (e.g., for soil amendment, etc.).

Cultural Eutrophication: The acceleration of the natural eutrophication process caused by human activities, typically occurring over decades as opposed to thousands of years.

Ecosystem: An interactive community of living organisms, together with the physical and chemical environment they inhabit.

Endangered/Threatened Species: An animal or plant species in danger of extinction that is recognized and protected by state or federal agencies.

Erosion: A process of breakdown and movement of land surface that is often intensified by human disturbances.

Eutrophic: A trophic state (degree of eutrophication) in which a lake or pond is nutrient rich and sustains high levels of biological productivity. Dense macrophyte growth, fast sediment accumulation, frequent algae blooms, poor water transparency and periodic oxygen depletion in the hypolimnion are common characteristics of eutrophic lakes and ponds.

Eutrophication: The process, or set of processes, driven by nutrients, organic matter, and sediment addition to a pond that leads to increased biological production and decreased volume. The process occurs naturally in all lakes and ponds over thousands of years but can be accelerated by human activities (see Cultural Eutrophication).

Exotic Species: Species of plants or animals that occur outside of their normal, indigenous ranges and environments. Populations of exotic species may expand rapidly and displace native populations if natural predators are absent or if conditions are more favorable for the exotic species' growth than for native species.

Filamentous: A term used to refer to a type of algae that forms long filaments composed of multiple cells.

Groundwater: Subsurface water found in soil pore space and rock fractures.

Habitat: The natural dwelling place of an animal or plant; the type of environment where a particular species is likely to be found.

Herbicide: Any of a class of compounds that produce mortality in plants when applied in sufficient concentrations.

Invasive Species: A species that spreads aggressively, often dominating habitats to which it is well-adapted.

Isopach Map: A map illustrating the thickness of sediments within a lake or pond.

Limnology: The study of lakes and other inland waters.

Littoral Zone: The shallow, highly productive area along the shoreline of a lake or pond where rooted aquatic plants grow.

Macrophytes: Macroscopic vascular plants present in the littoral zone of lakes and ponds.

Nonpoint Source: A source of pollutants to the environment that does not come from a confined, definable source such as a pipe. Common examples of non-point source pollution include stormwater runoff and septic system leachate.

Nutrient or Light Limitation: The limitation of growth imposed by the depletion of an essential nutrient or diminishment of available light.

Nutrients: Elements or chemicals required to sustain life, including carbon, nitrogen, and phosphorus, among others.

pH: An index derived from the inverse logarithm of the hydrogen ion concentration that ranges from zero to 14 indicating how acidic or basic an aqueous solution is.

Photosynthesis: The process by which plants use chlorophyll to convert carbon dioxide, water and sunlight to oxygen and cellular products (carbohydrates).

Phytoplankton: Algae that are freely suspended in the water.

Pollutants: Elements and compounds introduced into the environment at levels in excess of the concentration of chemicals that would naturally occur.

Positive Feedback Loop: A process in which an initial input (of nutrients, sediment, etc.) leads to increased inputs with each cycle, resulting in the acceleration of the process itself (e.g., eutrophication). As opposed to a negative feedback loop, which tends to be self-correcting, a positive feedback loop tends to increase the instability of a system.

Sediment: Organic and mineral particles deposited in water bodies through various processes.

Stormwater Runoff: Runoff generated as a result of precipitation or snowmelt.

Suspended Load: The portion of the total sediment load that is transported in suspension and rarely comes in contact with the stream bed.

TSS: Total suspended solids, a direct measure of all suspended solid materials in the water.

Turbidity: A measure of the light scattering properties of water; often used more generally to describe water clarity or the relative presence or absence of suspended materials in the water.

Vegetated Buffer: An undisturbed vegetated land area that separates an area of human activity from the adjacent water body; can be effective in reducing runoff velocities and volumes and the removal of sediment and pollutant from runoff.

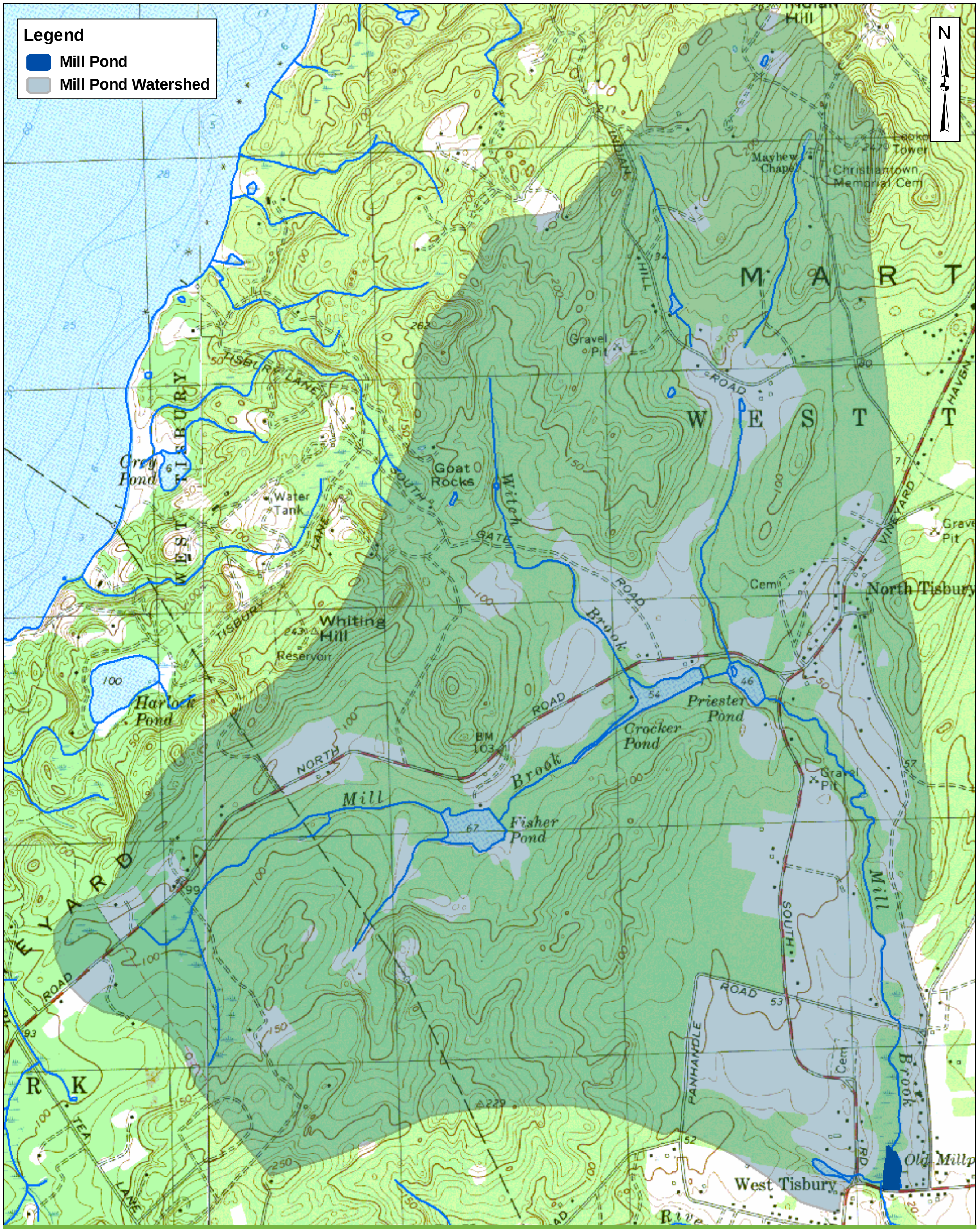
Water Column: The continuous liquid portion of a surface water body located between the interface with the atmosphere at the surface and the interface with the sediment at the bottom.

Water Quality: A term used to reference the general chemical and physical properties of water relative to the requirements of living organisms that depend upon that water.

Watershed: The surrounding land area that drains into a water body via surface runoff or groundwater recharge and discharge.

Zooplankton: Microscopic animals that are freely suspended in the water column.

Figures



MILL POND

West Tisbury, Massachusetts

Scale: 1" = 2,000'

0 1,000 Feet

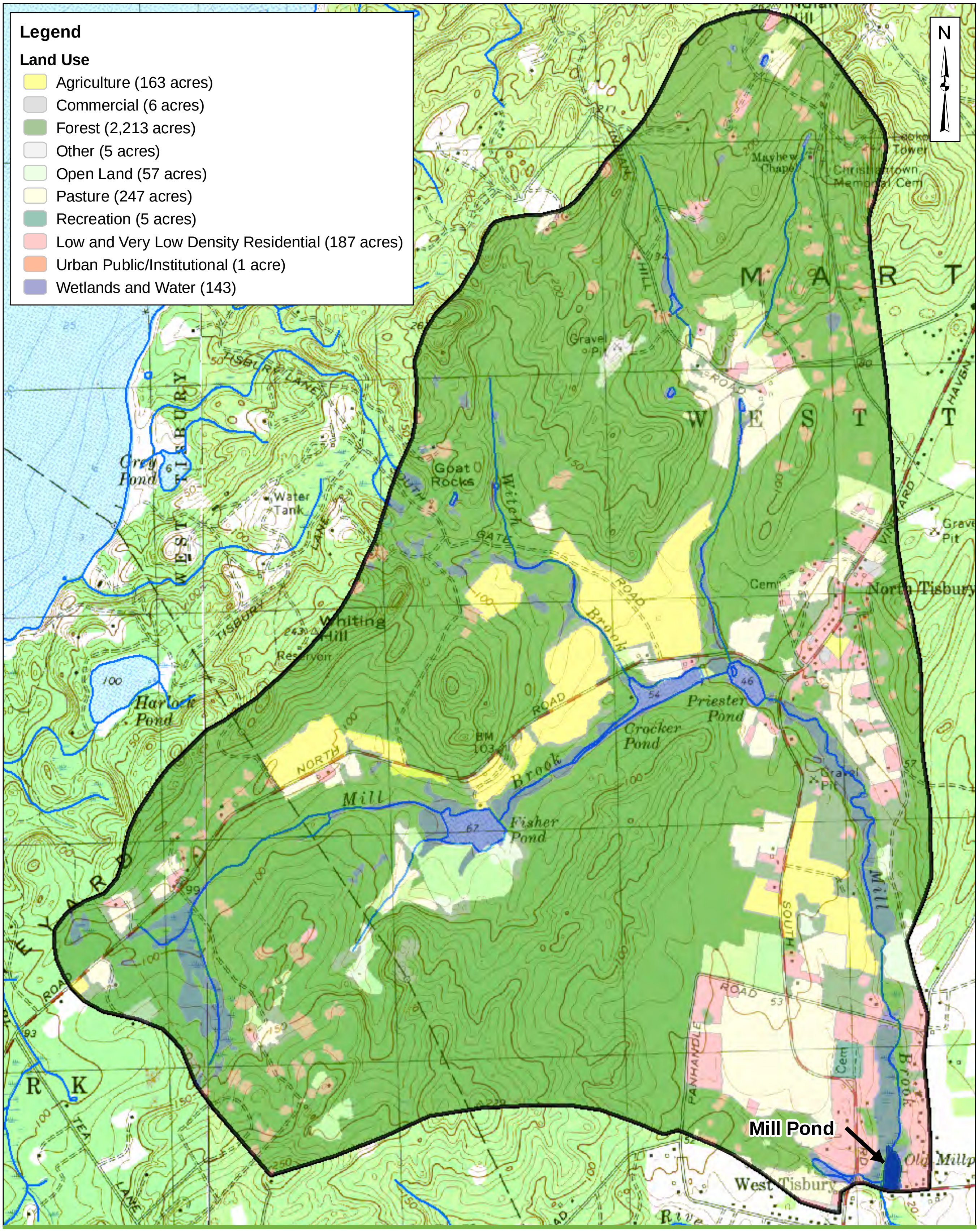
Source: 1) MassGIS, USGS DRG, 1972-78; 2) MassGIS, Streams, 2005
3) K. Healy and ESS, Watershed Boundary, 2011

ess group
environmental consulting & engineering services

Mill Pond Watershed

Figure 1

Location: G:/GIS-Projects/W287-West-Tisbury/00-mxd/Land-Use.mxd



MILL POND
West Tisbury, Massachusetts

Scale: 1" = 2,000'

0 1,000 Feet

Source: 1) MassGIS, USGS DRG, 1972-78; 2) MassGIS, Land Use, 2005
3) K. Healy and ESS, Estimated Watershed Boundary, 2011

ess group
environmental consulting & engineering services

Mill Pond Watershed
Land Use

Figure
2

Location: G:/GIS-Projects/W287-West-Tisbury/00-mxd/Rare-species.mxd

MILL POND
West Tisbury, Massachusetts

Scale: 1" = 500'

0 500 Feet

Source: 1) MassGIS, USGS DRG, 1972-78
2) MassGIS, NHESP Datalayers, 2008

Rare Species Distribution

ess group
environmental consulting
& engineering services

Figure
3

Location: G:/GIS-Projects/W287-West-Tisbury/00-mxd/Bathy-Sediment-rev1.mxd

MILL POND
West Tisbury, Massachusetts

Scale: 1" = 80'

0 80 Feet

Water Depth (Feet)

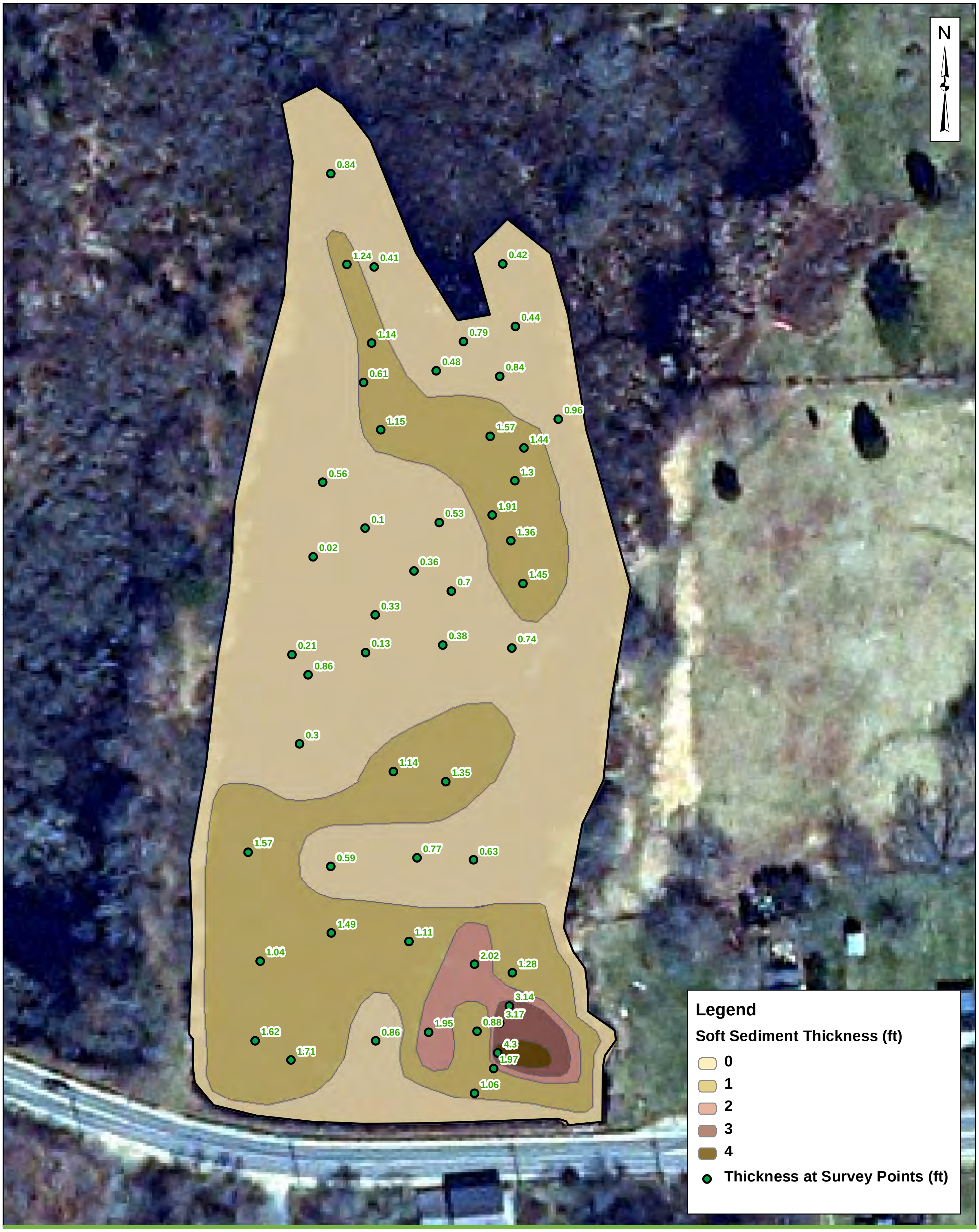
0 3 6
1 4 7
2 5 8

Mill Pond Bathymetry

ess group
environmental consulting & engineering services

Source: 1) MassGIS, Half-Meter Resolution Orthophotos, 2005
2) WSP Sells, Bathymetry, 2010

Figure 4



ess group
environmental consulting & engineering services

MILL POND
West Tisbury, Massachusetts

Scale: 1" = 80'

0 80 Feet

Source: 1) MassGIS, Half-Meter Resolution Orthophotos, 2005
2) WSP Sells, Sediment, 2011

Mill Pond Isopach Map
(Soft Sediment Thickness)

Figure
5

Location: G:/GIS-Projects/W287-West-Tisbury/00-mxd/Sed-sample.mxd

ess group
environmental consulting & engineering services

MILL POND
West Tisbury, Massachusetts

Scale: 1" = 80'

0 100 Feet

Source: 1) MassGIS, Half-Meter Resolution Orthophotos, 2005
2) ESS, Sediment Core Locations, 2010

Water Depth (Feet)

Sediment Cores

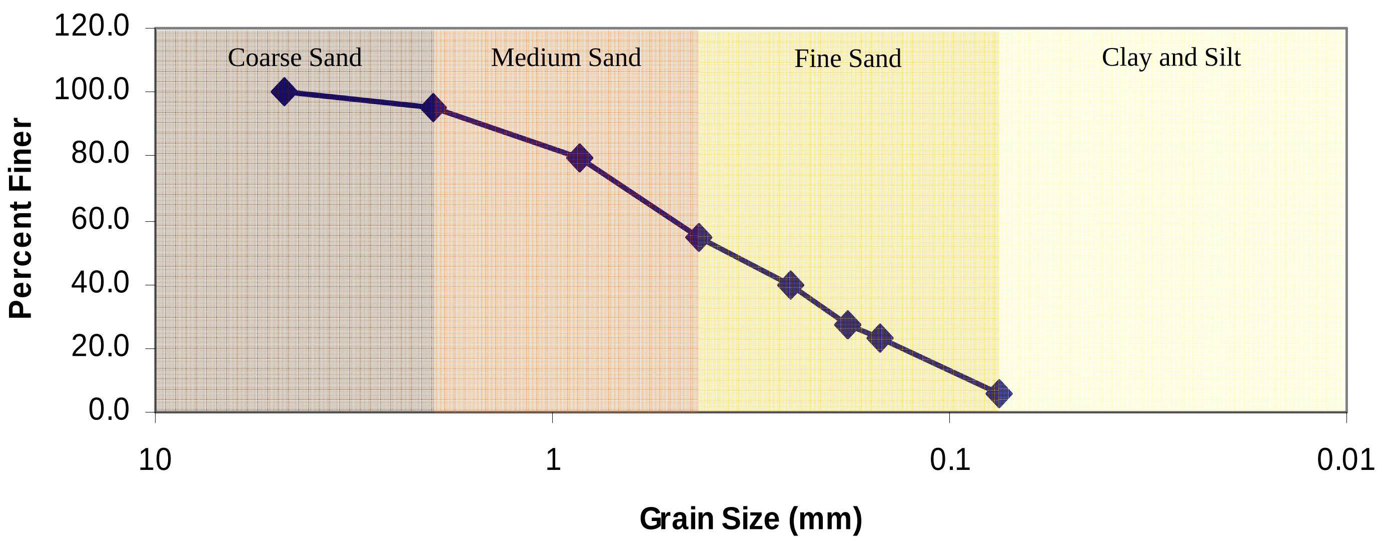
Sediment Sample Locations

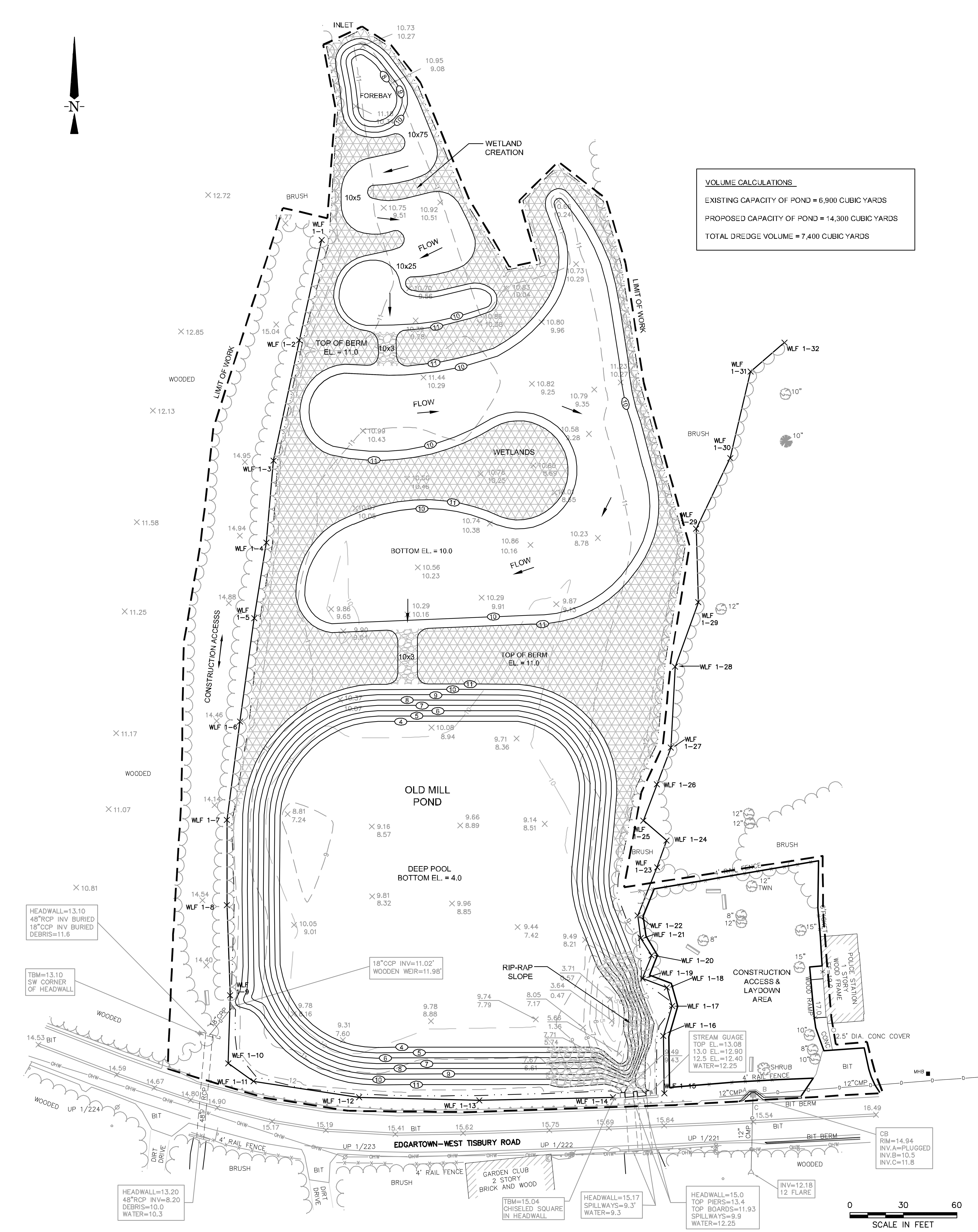
Figure
6

Sediment grain size analysis

Standard Sieve No.	4	10	20	40	60	80	100	200
USCS [1]	**Coarse Sand**	**Coarse Sand**	**Medium Sand**	**Medium Sand**	**Fine Sand**	**Fine Sand**	**Fine Sand**	**Fine Sand**
mm	4.75	2	0.85	0.425	0.25	0.18	0.15	0.075

[1] Classification for grain sizes within that size class based on the Unified Soil Classification System





VOLUME CALCULATIONS

EXISTING CAPACITY OF POND = 6,900 CUBIC YARDS

PROPOSED CAPACITY OF POND = 14,300 CUBIC YARDS

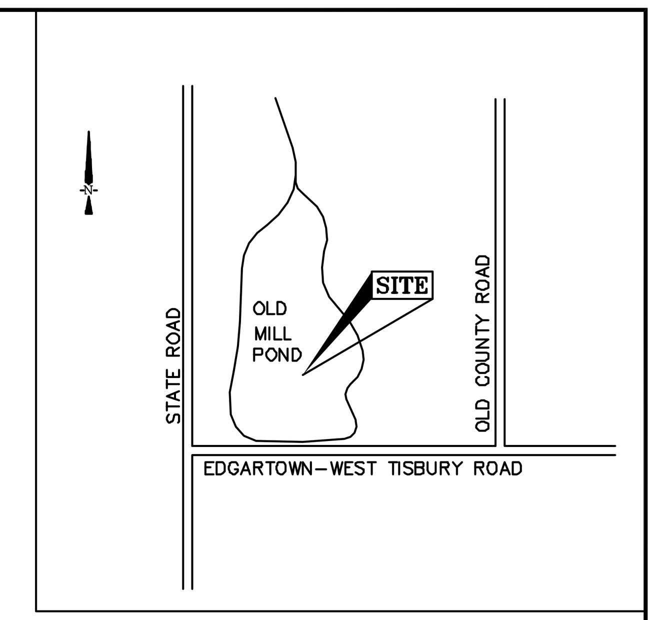
TOTAL DREDGE VOLUME = 7,400 CUBIC YARDS

UTILITY STATEMENTS

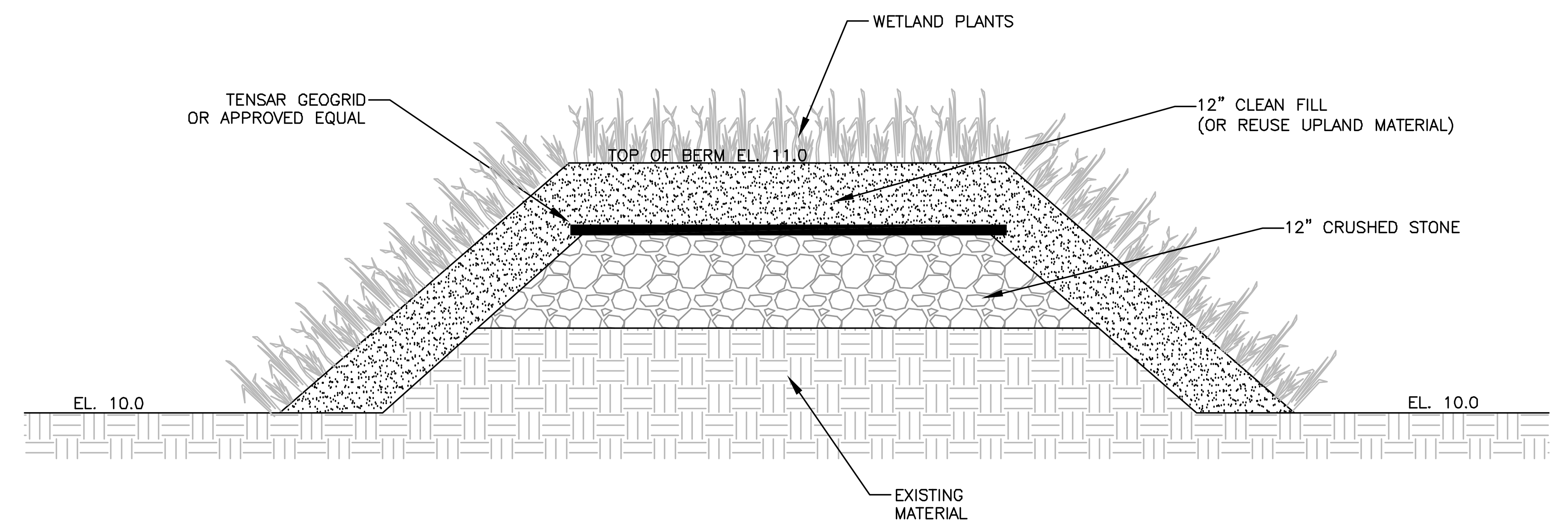
THE LOCATION OF THE UTILITIES AS SHOWN HEREON HAVE BEEN COMPILED FROM VISIBLE STRUCTURES ONLY. NO OTHER INFORMATION WAS RESEARCHED OR OBTAINED FROM VARIOUS SOURCES. THE ACTUAL LOCATION OF ALL UTILITIES AND UNDERGROUND STRUCTURES SHALL BE CONSIDERED APPROXIMATE AND SHALL BE VERIFIED BY THE OWNER PRIOR TO ANY CONSTRUCTION. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICES OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED.

NOTES

1. THIS PLAN WAS PREPARED FROM AN ACTUAL ON THE GROUND FIELD SURVEY CONDUCTED BY WSP SELLS BETWEEN NOV 22 AND NOV 24, 2010.
2. THE HORIZONTAL DATUM SHOWN HEREON IS THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD-83).
3. THE VERTICAL DATUM SHOWN HEREON REFERENCES THE NATIONAL GEODETIC VERTICAL DATUM OF 1927 (NAD-27) USING THE REFERENCE MARK TBM=15.04 FROM THE PREVIOUS FLOOD INSURANCE RATE MAPS.

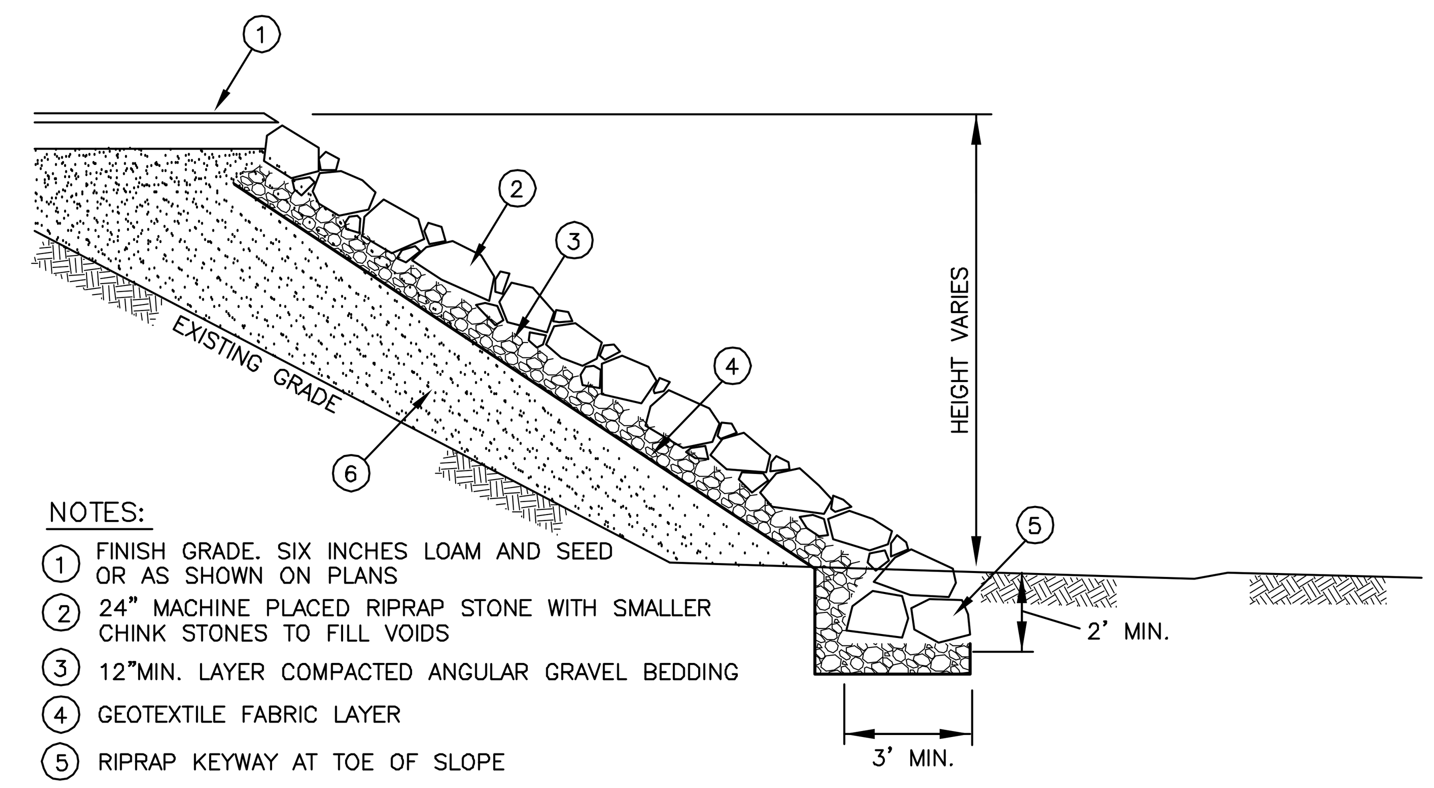


LOCUS MAP



TYPICAL WETLAND CREATION SECTION

N.T.S.



NOTES:

1. FINISH GRADE. SIX INCHES LOAM AND SEED OR AS SHOWN ON PLANS
2. 24" MACHINE PLACED RIPRAP STONE WITH SMALLER CHINK STONES TO FILL VOIDS
3. 12"MIN. LAYER COMPACTED ANGULAR GRAVEL BEDDING
4. GEOTEXTILE FABRIC LAYER
5. RIPRAP KEYWAY AT TOE OF SLOPE
6. SUITABLE COMPACTED BACKFILL MATERIAL
7. SLOPES STEEPER THAN 2:1 SHALL BE HAND PLACED

TYPICAL RIPRAP SLOPE SECTION

N.T.S.

LEGEND

- MASS. HIGHWAY BOUND FOUND
- CATCH BASIN
- DRAINAGE OUTFALL
- GUY WIRE ANCHOR
- CONIFER TREE (SIZE)
- DECIDUOUS TREE (SIZE)
- SHRUB
- STREAM GUAGE
- WOODEN POST
- UTILITY POLE
- UTILITY POLE W/ RISER
- UTILITY POLE W/LIGHT
- TOP AND BOTTOM OF SILT
- RIP-RAP
- WETLAND FLAGS FOUND
- CONC. POST WOODEN GUARDRAIL
- WOODEN FENCE
- DRAIN LINE
- UNDERGROUND ELECTRIC
- OVERHEAD WIRES
- EDGE OF WATER
- TREE LINE
- TOP OF SILT INTERMEDIATE CONTOURS
- TOP OF SILT INDEX CONTOURS
- PROPOSED CONTOUR
- CONSTRUCTION ACCESS & LAYDOWN
- WETLAND CREATION
- DIRECTION OF FLOW
- LIMIT OF WORK

CONCEPTUAL DESIGN ONLY

ESS Group, Inc.
Engineers
Scientists
Consultants
100 Fifth Avenue, 5th Floor
Waltham, Massachusetts 02451
p 781.419.7696
f 781.622.2612
www.essgroup.com

No.	REVISION	DATE	APP BY

DRAWN BY: ELU	CHECKED BY: PRW
DESIGNED BY: ELU	APPROVED BY: PRW

Town of West Tisbury
Edgartown-West Tisbury Road
West Tisbury, Massachusetts

Old Mill Pond Dredge Plan

PROJECT No.: W287-000	DRAWING No.
DATE OF ISSUE: September 2011	8
SHEET No.: 1 of 1	
SCALE: As Shown	

NOTES

1. THIS PLAN WAS PREPARED FROM AN ACTUAL ON THE GROUND FIELD SURVEY CONDUCTED BY WSP SELLS BETWEEN NOV 22 AND NOV 24, 2010.
2. THE HORIZONTAL DATUM SHOWN HEREON IS THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD–83).
3. THE VERTICAL DATUM SHOWN HEREON REFERENCES THE NATIONAL GEODETIC VERTICAL DATUM OF 1927 (NAD–27) USING THE REFERENCE MARK TBM=15.04 FROM THE PREVIOUS FLOOD INSURANCE RATE MAPS.

UTILITY STATEMENTS

THE LOCATION OF THE UTILITIES AS SHOWN HEREON HAVE BEEN COMPILED FROM VISIBLE STRUCTURES ONLY. NO OTHER INFORMATION WAS RESEARCHED OR OBTAINED FROM VARIOUS SOURCES. THE ACTUAL LOCATION OF ALL UTILITIES AND UNDERGROUND STRUCTURES SHALL BE CONSIDERED APPROXIMATE AND SHALL BE VERIFIED BY THE OWNER PRIOR TO ANY CONSTRUCTION. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICES OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED.

VOLUME CALCULATIONS

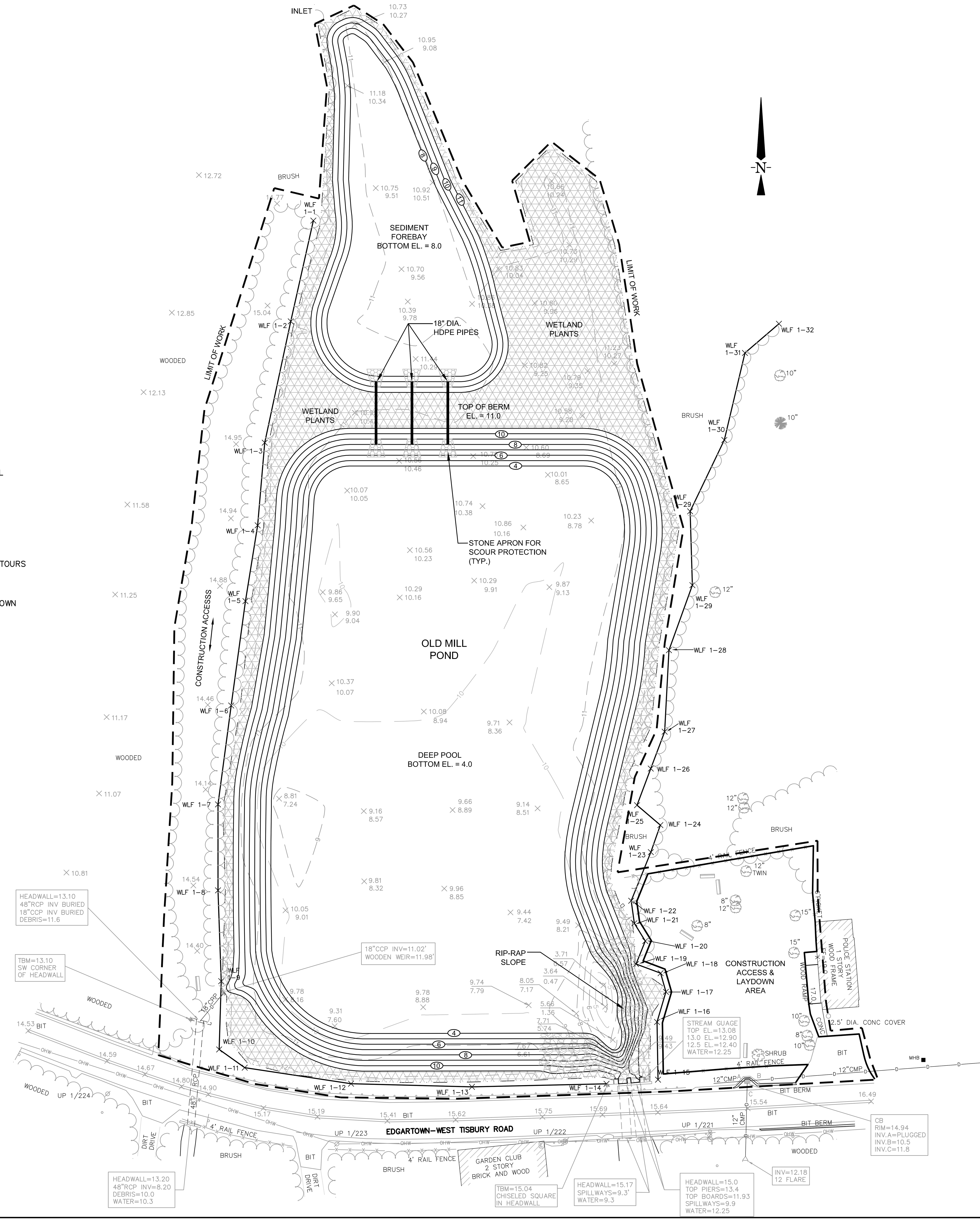
EXISTING CAPACITY OF POND = 6,900 CUBIC YARDS

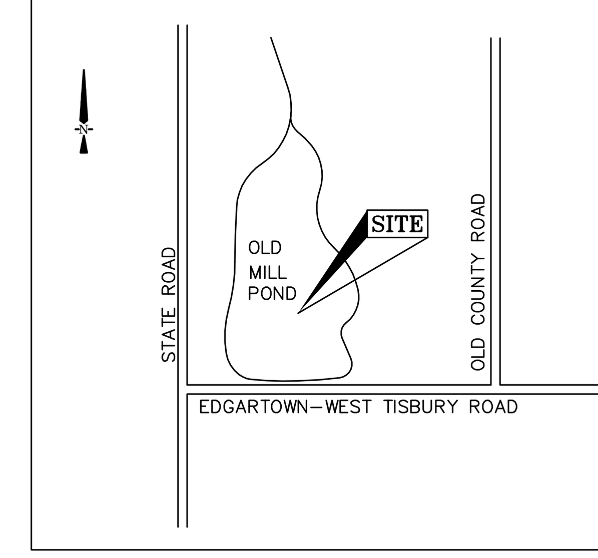
PROPOSED CAPACITY OF POND = 22,500 CUBIC YARDS

TOTAL DREDGE VOLUME = 15,600 CUBIC YARDS

LEGEND

- MHB MASS. HIGHWAY BOUND FOUND
- CATCH BASIN
- DRAINAGE OUTFALL
- GUY WIRE ANCHOR
- 10" CONIFER TREE (SIZE)
- 8" DECIDUOUS TREE (SIZE)
- SHRUB
- STREAM GUAGE
- WOODEN POST
- UTILITY POLE
- UTILITY POLE W/ RISER
- UTILITY POLE W/LIGHT
- 9.96 / 8.85 TOP AND BOTTOM OF SILT
- RIP-RAP
- WLF 1–29 WETLAND FLAGS FOUND
- CONC. POST WOODEN GUARDRAIL
- WOODEN FENCE
- DRAIN LINE
- UNDERGROUND ELECTRIC
- OHW OVERHEAD WIRES
- EDGE OF WATER
- TREE LINE
- 9 TOP OF SILT INTERMEDIATE CONTOURS
- 10 TOP OF SILT INDEX CONTOURS
- 4 PROPOSED CONTOUR
- CONSTRUCTION ACCESS & LAYDOWN
- WETLAND CREATION
- LIMIT OF WORK





LOCUS MAP

0 30 60
SCALE IN FEET

FOR CONCEPTUAL PURPOSES ONLY

ESS group
environmental consulting & engineering services
100 Fifth Avenue, 5th Floor
Waltham, Massachusetts 02451
p 781.419.7696
www.essgroup.com

No.	REVISION	DATE	APP BY

DRAWN BY: ELU	CHECKED BY:
DESIGNED BY: ELU	APPROVED BY:

Town of West Tisbury
Edgartown-West Tisbury Road
West Tisbury, Massachusetts

Old Mill Pond
Dredge Plan

PROJECT No.: W287	DRAWING No.
DATE OF ISSUE: January 2012	9
SHEET No.: 1 of 1	
SCALE: 1"=30'	

DATE: Jan 16, 2012 – 11:54AM
FILENAME: H:\W287 – West Tisbury\001\W287–Dredge Plan 02.dwg

Appendix A

Photo Log

Photograph No. 1:
Core at Sed-1, 0-18 inches

Photograph No. 2:
Core at Sed-1, 18-33 inches

Photograph No. 3:
Core at Sed-2, 0-15 inches

Photograph No. 4:
Core at Sed-2, 15-30 inches

Photograph No. 5:
Core at Sed-3, 0-15 inches

Photograph No. 6:
Mill Pond Outlet

Appendix B

Mill Pond Management Matrix

Management Options for Mill Pond

Method	Advantages	Disadvantages	Expected Response of Target Species	Location/Habitat in which Method Is Most Effective	Seasonal Timing	Efficacy over Time	Permits Needed	Cost	Feasibility Considerations	Professional Recommendation
No Action	-No immediate monetary cost -Recreational and ecological trade-offs will benefit uses associated with shallow wetlands and fragmented streams	-Reduced flow attenuation/flood control -Recreational and ecological trade-offs will be detrimental to uses associated with small ponds	Increase in macrophyte density and biovolume	Not applicable	Not applicable	Not applicable	None	No immediate monetary costs	Completely feasible.	Not recommended
Aeration and/or Destratification	-Locally disrupts growth of algae and reduces unsightly algal scums -Improves dissolved oxygen levels in deeper habitats	-Can spread invasive plant fragments -Costs increase and benefits tail off with increasing pond size	Decrease in algal growth but could encourage invasive plant growth through fragmentation	Small coves with high recreational usage and a propensity for nuisance algae blooms	Summer	Low	Yes – new NOI must be filed with town	High to very high, depending on extent of treatment and the type/number of units	Not feasible or warranted for system with high flow-through, particularly since pond is too shallow to stratify.	Not recommended
Chemical Treatments (Herbicides)	-One of the fastest ways to control nuisance plants -See below for specific benefits	-Certified applicator needed -Recreational use, irrigation, and drinking restrictions after application -Possible resistance of some populations of target species -Possible toxicity to non-target organisms -See below for specific drawbacks	Decrease in macrophyte and/or algae density and biovolume.	Varies with herbicide used and plant species targeted	Varies but usually early summer	Low to Moderate	Yes – new NOI must be filed with town	Varies widely with herbicide used and plant species targeted	Not warranted for rooted vegetation given the relative lack thereof. Not feasible for floating vegetation or algae due to the large flow through the pond.	Not recommended

Management Options for Mill Pond

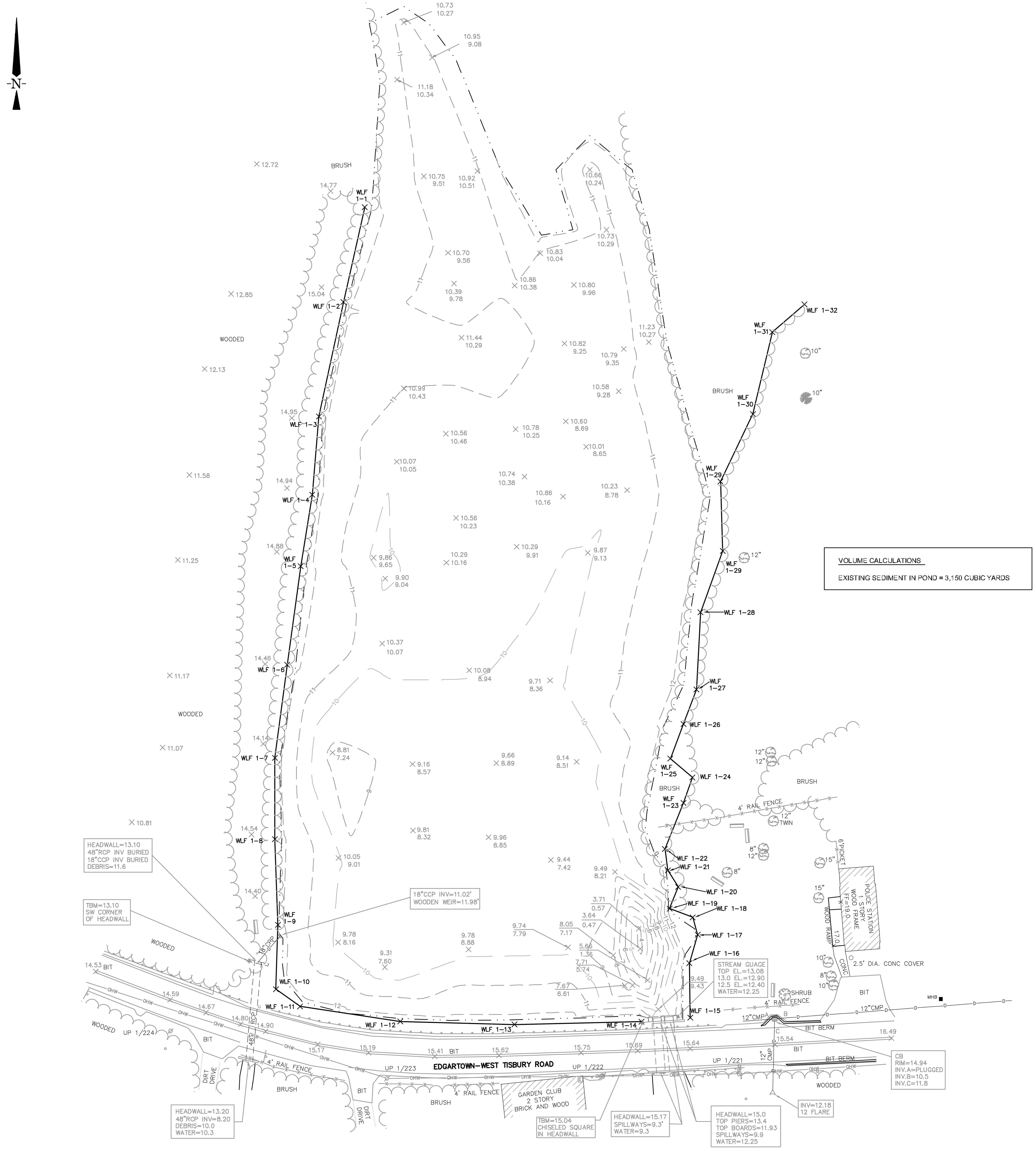
Method	Advantages	Disadvantages	Expected Response of Target Species	Location/Habitat in which Method Is Most Effective	Seasonal Timing	Efficacy over Time	Permits Needed	Cost	Feasibility Considerations	Professional Recommendation
Dredging	-Increases water depth -Provides opportunity to "start over"	-Alters existing habitats and potentially disrupts non-target organisms -Temporary stress to pond organisms (increased turbidity, reduced plant cover, noise, drying out) -Removed sediment must be disposed of or reused -Additional design and permitting required (one or more years)	Decrease in macrophyte density and biovolume No change in algae growth or abundance	Areas with deep layers of fine sediments	Anytime, but fall-winter is preferred	High – benefits of whole pond dredging are likely to last for decades. May be most appropriate for Mill Pond with wetland habitat modification at head of pond. Construction of sediment forebay could extend project life for decades.	-Section 404 permit (federal) -CZM federal consistency review -Section 401 Water Quality Certificate (state) -new NOI (town)	A dredging project could cost ~$35,000 to design and permit with additional costs to execute based on volume of material Assume ~$30-50 per cubic yard of sediment removed with additional costs for wetland modification or sediment forebay construction	Access for dredging equipment should not be an issue; however, locating sites for sediment disposal may pose a challenge.	Recommended. May be easier to fund and longer-lasting if combined with wetland modification at head of pond.
Dye Addition	Reduces growth of plant and algae species with high light requirements and insufficient food reserves	-Relatively ineffective in shallow water -Possible downstream impacts	Decrease in algal and macrophyte density and biovolume	Small, deep ponds or possibly within enclosures at higher concentrations	Spring-summer	Low – effects unlikely to last more than one season	Yes – new NOI must be filed	$50 per acre	Pond has too much flow and is too shallow for dyes to be effective.	Not recommended
Hydroraking and Rotovation	-Hydroraking is less complicated and expensive than dredging but provides some of the same benefits -Rotovation is a fast way to cut macrophyte growth at the roots	-Loose fragments may spread the infestation of invasive milfoils -Time-consuming -Disposal of collected materials may be problematic -Temporary increase in turbidity	Decrease in macrophyte density and biovolume	Excessively dense water lily beds	Spring-summer	If thorough, may be effective for several years	Yes, an NOI must be filed in town	$5,000 per acre plus trucking costs (if removed to an offsite location)	Not feasible in shallow waters at northern end and is not effective on algal mats. Would result in excessive turbidity in Mill Pond.	Not recommended
Macrophyte Harvesting	Directly removes plant biovolume from the water column	Loose fragments may spread the infestation of invasive species	Decrease in macrophyte density and biovolume	Good for clearing areas essential for boating. Not applicable in Mill Pond.	Summer	Low (mechanical harvesting) to high (diver harvesting of entire plants from isolated beds)	Yes, an NOI must be field with town	$3,000/acre on Vineyard	Not feasible with algal mats or floating plants and within most of the shallow portions of the pond. Would result in excessive turbidity in Mill Pond.	Not recommended

Management Options for Mill Pond

Method	Advantages	Disadvantages	Expected Response of Target Species	Location/Habitat in which Method Is Most Effective	Seasonal Timing	Efficacy over Time	Permits Needed	Cost	Feasibility Considerations	Professional Recommendation
Nutrient Inactivation (Alum)	-Quickly reduces availability of nutrients in water column -May reduce recycling of nutrients from the sediments	-Temporary: does not address watershed nutrient loading -May not efficiently sequester nutrients in sediments -May be toxic to non-target organisms -Large pH swings possible	Decrease in algal density and biovolume	Directly in-lake or via stream dosing station	Varies	Low – In Mill Pond would require re-treatment twice annually. Establishing a dosing station to treat inflows would be ideal but costly	Yes, an NOI must be filed in town	High - $2,500/acre or $15,000 per year or $120,000 for dosing station and annual budget of $5,000 to $7,000 per year for alum	Algae blooms are a problem but other treatment options such as copper would be more applicable over short term. Goal should be to continue to reduce nutrients from watershed.	Not recommended
Water Level Control (Drawdown)	-Operating costs are usually low -Controls summer plant growth through off-season action -Provides additional flood control -Works well for shorelines	-May impact sensitive non-target organisms -Water quantity (downstream) or supply (wells) impacts possible -Reduction of area/time period available for winter recreation (and potentially spring fishing) -Seed-producing species may increase in density Potential impact to Maley's Pond (anecdotally used for fire fighting)	Decrease in macrophyte density and biovolume	Shorelines and shallows. Works best where the drop-off is rapid.	Winter	Moderate	-NOI must be filed in towns	Operational costs are low, if appropriate infrastructure is already in place. Otherwise, costs would escalate to pump water downstream. Initial study and Drawdown Operations Plan likely to cost ~$8,000.	Drawdown could be difficult to implement if discharge control structure is inadequate.	Not currently recommended but could be further explored through a feasibility study.

Appendix C

Baseline Site Survey

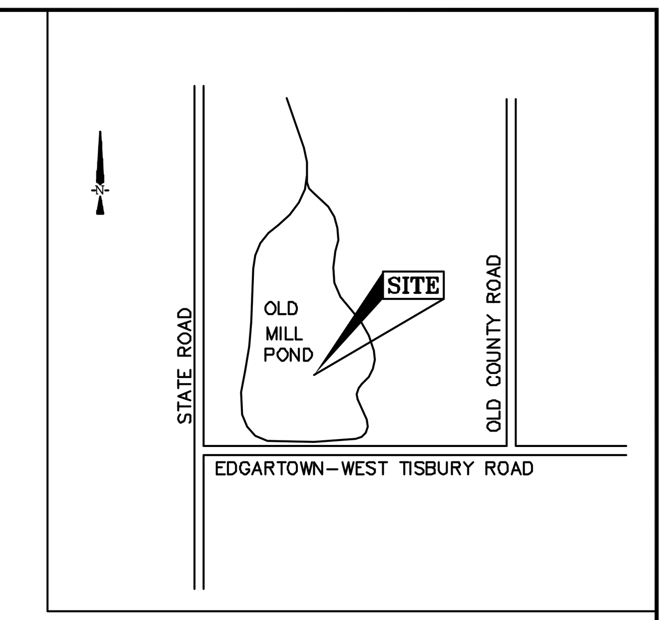


UTILITY STATEMENTS

THE LOCATION OF THE UTILITIES AS SHOWN HEREON HAVE BEEN COMPILED FROM VISIBLE STRUCTURES ONLY. NO OTHER INFORMATION WAS RESEARCHED OR OBTAINED FROM VARIOUS SOURCES. THE ACTUAL LOCATION OF ALL UTILITIES AND UNDERGROUND STRUCTURES SHALL BE CONSIDERED APPROXIMATE AND SHALL BE VERIFIED BY THE OWNER PRIOR TO ANY CONSTRUCTION. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICES OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED.

NOTES

1. THIS PLAN WAS PREPARED FROM AN ACTUAL ON THE GROUND FIELD SURVEY CONDUCTED BY WSP SELLS BETWEEN NOV 22 AND NOV 24, 2010.
2. THE HORIZONTAL DATUM SHOWN HEREON IS THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD-83).
3. THE VERTICAL DATUM SHOWN HEREON REFERENCES THE NATIONAL GEODETIC VERTICAL DATUM OF 1927 (NAD-27) USING THE REFERENCE MARK TBM=15.04 FROM THE PREVIOUS FLOOD INSURANCE RATE MAPS.



LOCUS MAP

0 30 60

SCALE IN FEET

LEGEND

MASS. HIGHWAY BOUND FOUND	WETLAND FLAGS FOUND
CATCH BASIN	CONC. POST WOODEN GUARDRAIL
DRAINAGE OUTFALL	WOODEN FENCE
GUY WIRE ANCHOR	DRAIN LINE
CONIFER TREE (SIZE)	UNDERGROUND ELECTRIC
DECIDUOUS TREE (SIZE)	OVERHEAD WIRES
SHRUB	EDGE OF WATER
STREAM GUAGE	TREE LINE
WOODEN POST	TOP OF SILT INTERMEDIATE CONTOURS
UTILITY POLE	TOP OF SILT INDEX CONTOURS
UTILITY POLE W/ RISER	
UTILITY POLE W/LIGHT	
TOP AND BOTTOM OF SILT	

CONCEPTUAL DESIGN ONLY

ESS Group, Inc.

Engineers
Scientists
Consultants

100 Fifth Avenue, 5th Floor
Waltham, Massachusetts 02451
p 781.419.7696
f 781.622.2612
www.essgroup.com

No.	REVISION	DATE	APP BY

DRAWN BY: ELU	CHECKED BY: PRW
DESIGNED BY: ELU	APPROVED BY: PRW

Town of West Tisbury
Edgartown-West Tisbury Road
West Tisbury, Massachusetts

Old Mill Pond Existing Conditions

PROJECT No.: W287-000	DRAWING No.
DATE OF ISSUE: September 2011	4
SHEET No.: 1 of 1	
SCALE: 1"=30'	