

# THE WETLAND REMEDIATION SITE AT THE FORMER RAYTHEON FACILITY WAYLAND, MASSACHUSETTS 2004 WETLAND RESTORATION MONITORING REPORT

December 2004



July 2004



August 2004

## **Prepared For:**

Raytheon Company  
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Mailstop 1880  
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## **Prepared By:**

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<b>Project Name:</b>	2004 Wetland Restoration Monitoring Report
	Former Raytheon Facility
<b>Project Location:</b>	Wayland, Massachusetts
<b>Mitigation Site Location:</b>	Sudbury River Floodplain
<b>ACOE Permit #:</b>	200300294, September 19, 2003
<b>MADEP Water Quality Cert. #:</b>	322-533, September 15, 2003
<b>Wayland OOC #:</b>	322-533, September 26, 2003
<b>EOEA Compliance:</b>	12984 July 17, 2003
<b>Date Restoration Completed:</b>	February 2004
<b>Field Monitoring Dates for 2004:</b>	May 13, July 6, and August 25
<b>Monitoring Report:</b>	Year 1 of 5
<b>Prepared By:</b>	Woodlot Alternatives, Inc. (Woodlot)
<b>Woodlot Project Number:</b>	99123.81

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## 1.0 BACKGROUND

The remediation project at the former Raytheon Facility in Wayland, Massachusetts (Exhibit 1) was permitted through several regulatory agencies under the auspices of the Massachusetts Contingency Plan. The project received an Individual Permit from the Army Corps of Engineers (ACOE), Toxic Substances Control Act (TSCA) approval through the U.S. Environmental Protection Agency, an Environmental Impact Report through the Massachusetts Executive Office of Environmental Affairs (EOEA), Water Quality Certification from the Massachusetts Department of Environmental Protection (MADEP), and an Order of Conditions (OOC) from the Wayland Conservation Commission (WCC).

The remediation project involved excavating contaminated floodplain soils from approximately 2.0 acres of floodplain wetlands and transporting those contaminated soils to the proper disposal facilities under the appropriate manifests. Exhibit 2 provides the surveyed topographic elevations of the excavation area after the contaminated soils were removed. The contaminated soils were replaced with manufactured soils, and the manufactured soils were graded to pre-remediation project elevations (Exhibits 3A and 3B). A small swale was graded to replace the existing swale. As designed, the new swale was longer and meandered more to provide improved water quality functions. The remediation project area was planted with selected wetland herbaceous species and seeded with a wet meadow seeding mix (Appendix A). Several upland areas were disturbed during the remediation project. These areas were reclaimed and planted with upland trees and shrubs and seeded with an erosion control mixture.



View looking southwest from the outfall August 2004.

## 2.0 RESTORATION GOALS, OBJECTIVES, AND STANDARDS FOR SUCCESS

The following goals, objectives, and Standards for Success are from the approved wetland restoration plan (Plan) for the remediation project (Woodlot 2003).

### 2.1 GOALS

The goal of the Plan was to restore wetland functions that were impacted during the remediation project. The primary functions targeted for restoration include flood protection, fish and wildlife habitat, sediment and toxic retention, nutrient production/removal/transformation, food chain qualities, uniqueness and heritage, aesthetics, and education/scientific values. Secondary functions targeted for restoration include sediment stabilization, erosion control, and endangered species habitat.

### 2.2 OBJECTIVES

To achieve the Plan goals, the following objectives need to be met: establish emergent wetland vegetation in the restored area; establish forested buffers within disturbed upland areas; re-grade the restored floodplain to improve the water quality and floodplain functions of the wetland system; and establish initial control of invasive species such as purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*).



Common arrowhead (*Sagittaria latifolia*), wild millet [i.e., barnyard grass (*Echinochloa crus-galli*, FACU)], pickerelweed (*Pontederia cordata*), and cat-tails (*Typha x glauca*) August 2004.

### 2.3 STANDARDS FOR SUCCESS

#### 2.3.1 Hydrology and Soils

To meet the standard for success criteria for hydrology, final grading of the remediation project area must be consistent with the original contours. The hydrology of the remediation project area was not altered during the remediation project. Pre-remediation project hydrology is retained by restoring pre-existing topographic elevations. Pre- and post-remediation project topographic elevations were surveyed and are presented in Exhibits 3A and 3B, which document that the final grading is consistent with the original contours.

The soils used for restoration were a mixture of sand, loam, silt, clay, and 12% organic matter, which is consistent with the variable composition of floodplain soils. Soils are considered hydric if they are frequently ponded or flooded for a long or very long duration during the growing season. In these cases, underlying soil morphologic criteria may not occur and are not necessary for a designation as a hydric soil (New England Hydric Soils Technical Committee 2004).

#### 2.3.2 Vegetation

##### *Species Composition and Percent Areal Cover*

To meet the standard for success criteria for wetland vegetation, the remediation project area must be comprised of 75% areal coverage of wetland plants by the second growing season. The remediation project area must then achieve a 90% areal coverage of wetland vegetation for three consecutive growing seasons.

### *Planted Stock Survivorship and Woody Volunteers*

To meet the standard for success criteria for planted stock survivorship and woody volunteers, at least 90% of the installed buttonbush (*Cephalanthus occidentalis*) must survive for three consecutive years following the initial planting.

### *Invasive Species Control*

To meet the standard for success criteria for invasive species control, common reed and purple loosestrife populations must be controlled.



Vegetation sample plot dominated by soft-stemmed bulrush (*Scirpus tabernaemontanii*, OBL), August 2004.

### 2.3.3 Erosion Control

To meet the standard for success for erosion control, erosion problems at the remediation project area must be prevented and soil stability must be maintained. This process was primarily a concern during remediation and active restoration activities. There is some minor potential for erosion problems in the future, but the establishment of wetland and upland vegetation should prevent and control any future erosion problems.

### 2.3.4 Wildlife Use

To meet the standard for success for wildlife use, wetland and aquatic-dependant species must occur at the remediation project area. It is anticipated that numerous wildlife species will be observed foraging and breeding in the wetland system. Wetland-dependent species would include marsh birds, herons and egrets, wetland-dependent songbirds, and species that use wetlands and uplands such as a variety of hawks, whitetail deer (*Odocoileus virginianus*), and other songbirds. Aquatic species would include turtles, fish, aquatic insects, and frogs.

### 3.0 MONITORING METHODS

Monitoring of the remediation project area assesses hydrology and soils, vegetation composition and coverage, planted stock survivorship, invasive plants, erosion control, and wildlife use. Monitoring was done in accordance with the methods outlined in the approved Plan for the project (Woodlot 2003). Monitoring site visits took place on May 13, July 6, and August 25, 2004.

#### 3.1 HYDROLOGY AND SOILS

Specific monitoring of hydrologic and hydric soil criteria was not proposed or required through the issued permits. However, observations of the extent and depth of inundation and soil saturation conditions were made. These wetland characteristics have been established based on the continuation of the historic hydrologic regime.

#### 3.2 VEGETATION

##### 3.2.1 Species Composition and Percent Areal Cover

Vegetation was sampled on August 25, 2004, using 20 one-meter<sup>2</sup> plots randomly spaced throughout the remediation project area (Exhibit 4). Data collected in each plot included a list of species present, estimated percent areal cover by species, and percent areal cover of bare ground and water for each plot. The data was tabulated and averaged across plots. Areal cover data can exceed 100% due to overlapping layers of vegetation. For example, tall species will overhang middle and smaller sized plants, creating a multi-layered effect. A meander survey was used to identify plants present in the area but not contained in the sample vegetation plots. Plant taxonomy and nomenclature follows *The Vascular Plants of Massachusetts: A County Checklist* (Sorrie and Somers 1999).

##### 3.2.2 Planted Stock Survivorship and Woody Volunteers

Observations were made of the planted buttonbush while locating sampling plots and while conducting meander surveys along the swale. These areas were reviewed during all three monitoring visits. Locating these plantings was difficult due to dense herbaceous vegetation. Observations were also made regarding volunteering buttonbush shrubs while walking the meander surveys and locating the sampling plots. Meander surveys were used to identify and assess shrub survival and volunteers.

##### 3.2.3 Invasive Species

Sampling plots and meander surveys were used to identify and assess the extent of invasive plant species including purple loosestrife and common reed. The sampling plots were used to provide a quantitative assessment of any invasive species that were located in the plots. Observations were made during the meander surveys to provide additional detail regarding the presence and location of invasive species.



An example of a sparsely vegetated ponded area August 2004.

### 3.3 EROSION CONTROL

The remediation project area was visually evaluated for evidence of erosion during regular site visits. Furthermore, observations were made regarding the presence and stability of erosion control devices.

### 3.4 WILDLIFE USE

Incidental wildlife observations were recorded during each site visit.

## 4.0 2004 MONITORING RESULTS

### 4.1 HYDROLOGY AND SOILS

Based on observations made, hydrologic conditions range from shallow inundation to seasonally saturated depending on the season and on the location in the remediation project area.

### 4.2 VEGETATION

#### 4.2.1 Species Composition and Percent Areal Cover

The results of the 2004 vegetation plot sampling (Appendix B) and the meander survey (Appendix C) indicate that half of the remediation project area had attained 75% areal cover of wetland species. The average relative percent coverage of wetland species was 65.6% after only one growing season with a range of 5-92%. As expected, areas that remained ponded for longer periods during the growing season had less areal cover, which is expected as prolonged inundation inhibits the establishment of herbaceous vegetation. The total areal cover ranged from 40-127%<sup>1</sup> within the remediation project area.

Major plant communities in the remediation project area include emergent marsh and a developing shrub swamp. The emergent marsh community was dominated by native hydrophytes and wild millet. The most commonly occurring native hydrophytes in the sample vegetation plots were nodding bur-marigold (*Bidens cernua*, OBL), rice cut-grass (*Leersia oryzoides*, OBL), yellow sedge (*Cyperus esculentus*, FACW), and soft-stemmed bulrush. *The Aquatic and Wetland Plants of Northeastern North America* (Crow and Hellquist 2000) describes the wild millet habitat as moist to wet ground, marshes, shores, ditches, and cultivated fields. It can be very common and vigorous in wetland areas, and it does not appear to be an indicator of upland conditions at the remediation project site. Wild millet does provide an abundant seed source for wildlife, but because it is an introduced grass, it is not desirable as a dominant species.

As per the Plan, standing water was present in the swale during each of the monitoring visits, including in July when conditions were the driest of the three site visits. Soft-stemmed bulrush and nodding bur marigold were also observed in the swale.

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<sup>1</sup> Areal cover can exceed 100% due to overlapping layers of vegetation.





Restoration area facing northwest, August 2004. Restoration area facing southwest, August 2004.

#### 4.2.2 Planted Stock Survivorship and Woody Volunteers

The 25 planted buttonbush were somewhat obscured by the dense herbaceous vegetation, but they were alive and had new growth. No dead stock was found. Volunteer buttonbush was also observed, and it is anticipated that buttonbush will quickly colonize areas of the remediation project site.

Woody volunteers observed in the remediation project area included buttonbush, black willow (*Salix nigra* FACW+), red maple (*Acer rubrum*, FAC), silver maple (*Acer saccharinum*, FACW), and poplar seedlings (*Populus* ssp FACU). The poplar seedlings were too young to determine to species.



Fruiting buttonbush, August 2004.

#### 4.2.3 Invasive Species

Purple loosestrife and common reed were observed in the remediation project area and are being controlled by cutting the flowering and seed heads (i.e. “deadheading”). The wild millet is also being controlled by deadheading to reduce its dominance.

The OOC does not allow the use of herbicide to control invasive plant populations. Therefore, the cutting and off-site disposal of seed heads is being used to slow the spread of these species in the remediation project area. However, if monitoring identifies a problem where an invasive plant is becoming dominant, it is crowding out the native species, and it is reducing the overall species diversity, a species-specific management plan will be developed.

*Typha x glauca* (a cat-tail hybrid between *T. latifolia* and *T. angustifolium*) was also observed during the monitoring visits. It has the capacity to form dense, monotypic colonies and its spread is being monitored.



Swale and outfall area during July 2004.

#### 4.3 EROSION CONTROL

The upland areas disturbed during the remediation project have been reclaimed and planted with upland trees and shrubs and seeded with an erosion control seeding mixture. While a few plantings exhibited yellowing leaves, the majority appeared to be doing well, and the herbaceous seed mix was becoming established. No erosion was observed in the remediation project area.

#### 4.4 WILDLIFE USE

A complete list of wildlife observations in the remediation project area is presented in Appendix C. Water dependent species observed included least sandpiper (*Calidris minutilla*), spotted sandpiper (*Actitis macularia*), great blue heron (*Ardea herodias*), black duck (*Anas rubripes*), Virginia rail (*Rallus limicola*), painted turtle *Chrysemys picta*), bullfrog (*Rana catesbeiana*), common green darner dragonfly (*Anax junius*), and orange blue damselfly (*Enallagma signatum*).



A remediation area planted with upland trees and shrubs, August 2004.

### 5.0 SUMMARY AND RECOMMENDATIONS

#### 5.1 SUMMARY

The remediation project is meeting the Standards for Success. The site exhibits wetland hydrology and is densely vegetated and dominated by hydrophytes. Numerous wetland-dependent species were observed using the area for foraging and breeding.

Purple loosestrife, common reed, wild millet, and hybrid cat-tail occur at the site. The cutting and off-site disposal of seed heads is being used to slow the spread of purple loosestrife and reduce the amount of wild millet in the remediation project area. The spread of each species is being monitored, and species-specific controls will be recommended as needed.

#### 5.2 RECOMMENDATIONS

- 1) Continue to remove seed heads from purple loosestrife and wild millet;
- 2) Remove seed heads and rhizomes of common reed;

- 3) Remove cat-tail seed heads as practical without undue disturbance to the wetland, and;
- 4) Continue to monitor the remediation project area as outlined in the Plan.



View looking west with abundant nodding bur-marigold, yellow flowers, August 2004.

## 6.0 LITERATURE CITATIONS

- Crow, G .E. and C. B. Hellquist. 2000. Aquatic and Wetland Plants of Northeastern North America. University of Wisconsin Press, 2527 Daniels Street, Madison , WI 53718.
- DeGraaf, R. M. and M. Yamasaki. 2001. New England Wildlife: Habitat, Natural History, and Distribution. University Press of New England, Hanover, New Hampshire.
- Massachusetts Department of Environmental Regulation. 2002. Massachusetts Inland Wetland Replication Guidelines.
- New England Hydric Soils Technical Committee. 2004. Field Indicators for Identifying Hydric Soils in New England. Version 3.
- Sorrie, B. A. and P. Somers. 1999. The Vascular Plants of Massachusetts: a County Checklist. Massachusetts Division of Fisheries and Wildlife, Natural Heritage & Endangered species Program, Westborough, Massachusetts 0158.
- U.S. Army Corps of Engineers. 1987. Technical report Y-87-1, Corps of Engineers Wetlands Delineation Manual. Department of the Army, Vicksburg, Mississippi.
- USFWS 1996. 1996 National List of Vascular Plants That Occur in Wetlands. U.S. Fish and Wildlife Service. 1996.
- Woodlot Alternatives, Inc. and Environmental Resources Management Inc. 2003. Regulatory Permit Application for Wetland Impacts Resulting from Remediation of Oils and Hazardous Materials in Sudbury River Floodplain Wetlands, Wayland, Massachusetts.

**Exhibit 1**

**Site Location Map**



PREPARED BY:



**WOODLOT**  
ALTERNATIVES, INC.  
ENVIRONMENTAL CONSULTANTS

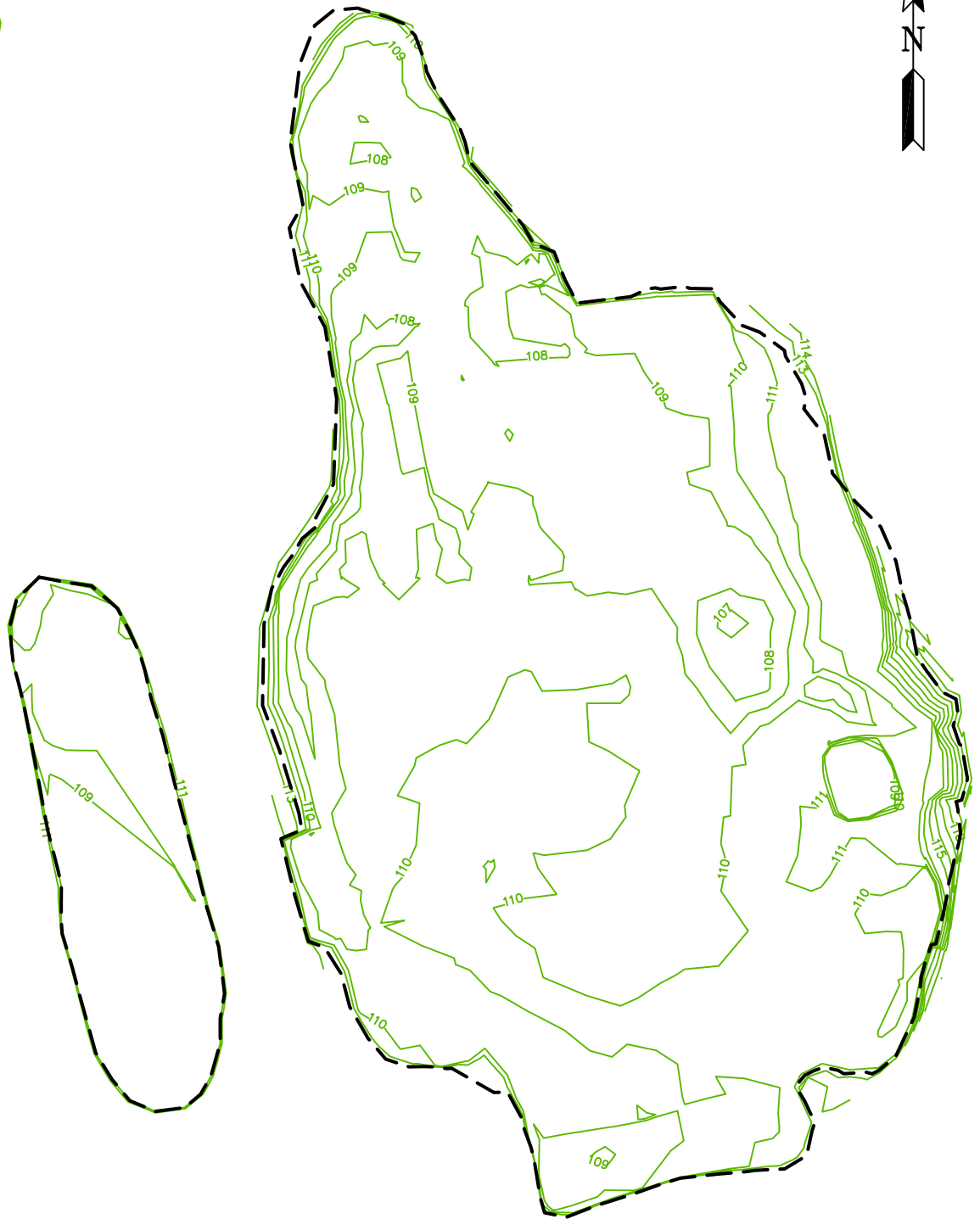
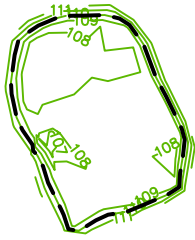
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*Exhibit 1*  
*Site Location Map*  
*Boston Post Road*  
*Wayland, Massachusetts*

REV.

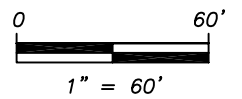
## **Exhibit 2**

### **Cut Contours and Actual Excavation Area**



**LEGEND**

- EXCAVATION CONTOURS BEFORE REMEDIATION
- - - EXTENT OF EXCAVATION AREA



PREPARED BY:



**WOODLOT**  
ALTERNATIVES, INC.  
ENVIRONMENTAL CONSULTANTS

DATE: December 2004

SCALE: 1" = 60'

JOB NO. 99123

FILE: Exhibit2 Excavation.dwg

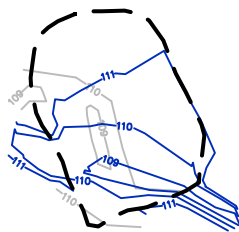
*Exhibit 2*  
*Cut Contours and Actual Excavation Area*  
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REV.

**Exhibit 3A**

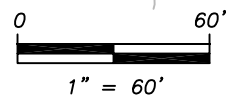
**Pre- and Post-Remediation Contours**





**LEGEND**

- POST-REMEDATION CONTOURS
- PRE-REMEDATION CONTOURS
- - - - - EXTENT OF EXCAVATION AREA



PREPARED BY:



**WOODLOT**  
ALTERNATIVES, INC.  
ENVIRONMENTAL CONSULTANTS

DATE: December 2004

SCALE: 1" = 60'

JOB NO. 99123

FILE: Exhibit3A-Remediation.dwg

*Exhibit 3A*  
*Pre- and Post-Remediation Contours*  
*Boston Post Road*  
*Wayland, Massachusetts*

REV.

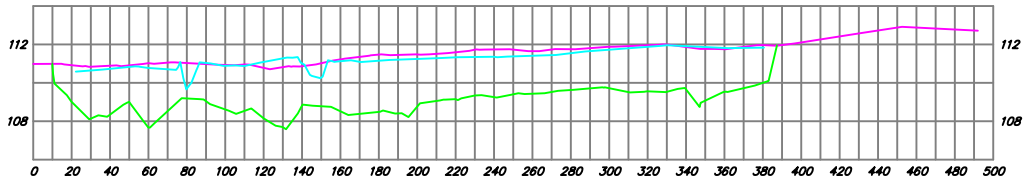
**Exhibit 3B-1**

**Topographic Cross Sections for Area C**

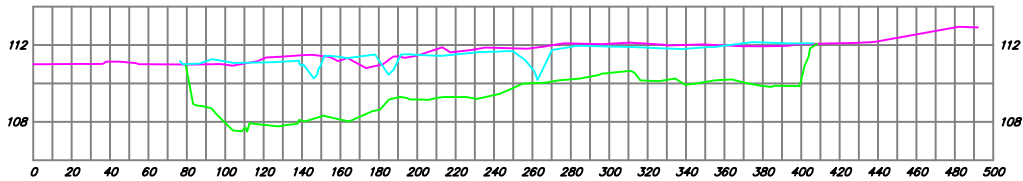
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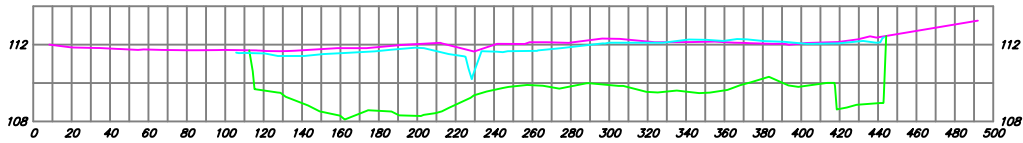
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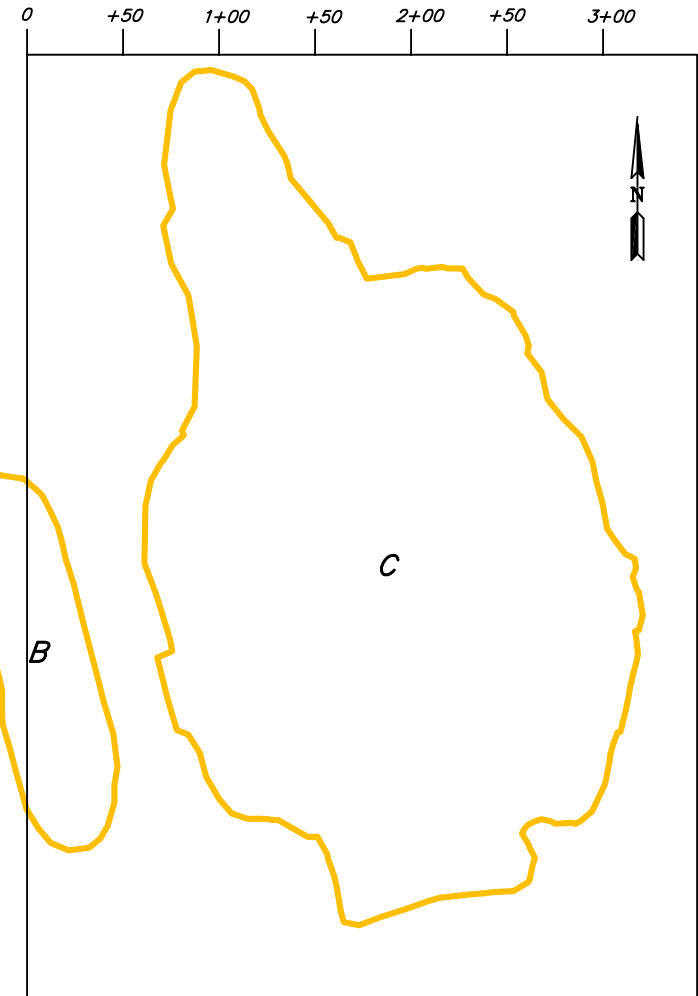
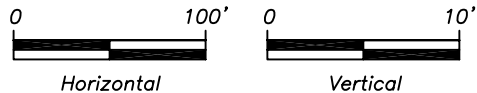
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- FINISH GRADE
- ORIGINAL GRADE
- CUT GRADE



NOTE(S):

1. Cross sections provided by A-Plus Construction Services Corp

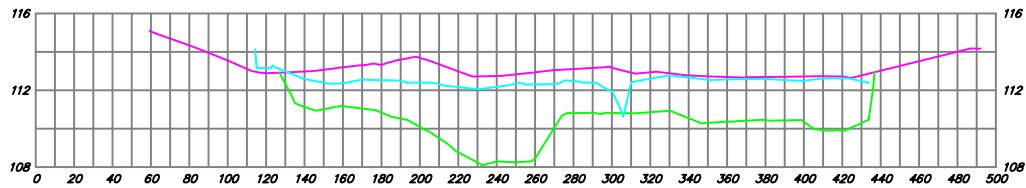
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**Exhibit 3B-2**

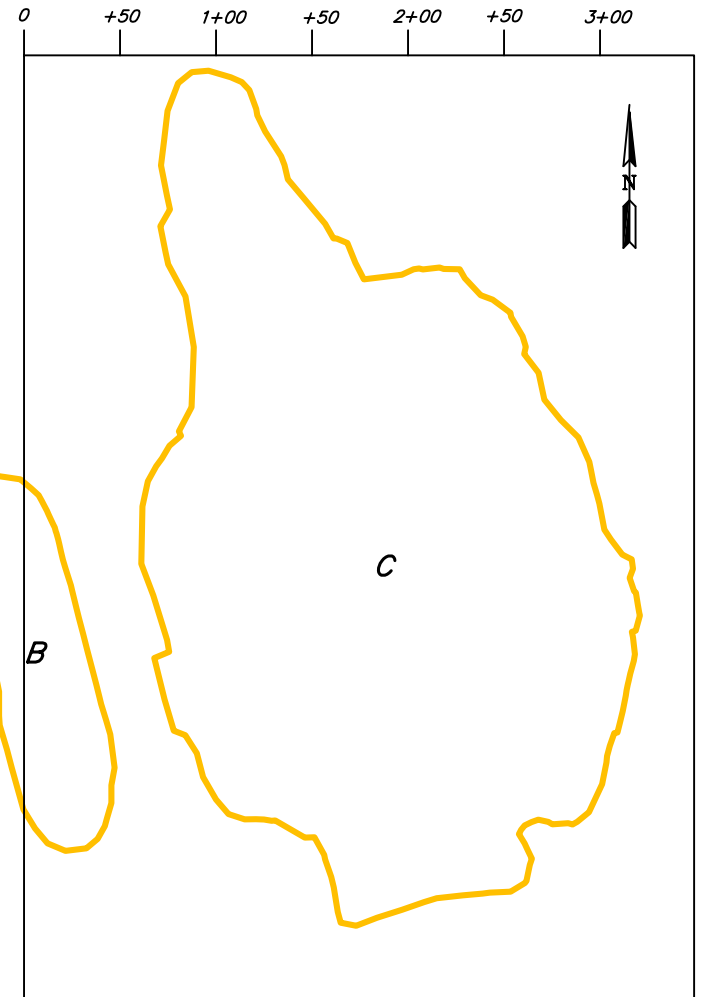
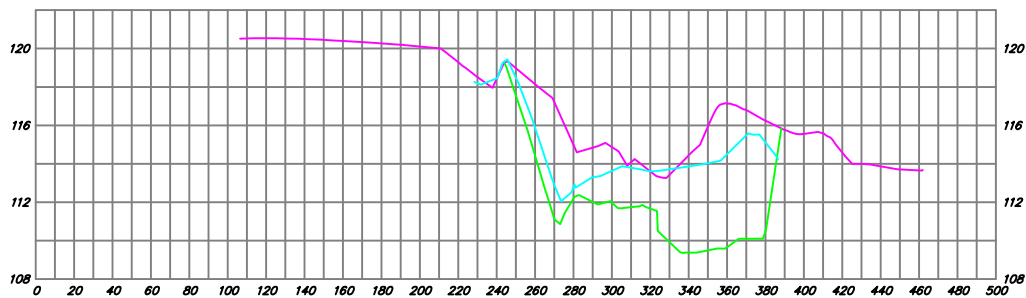
**Topographic Cross Sections for Area C (continued)**

Area C (cont.)

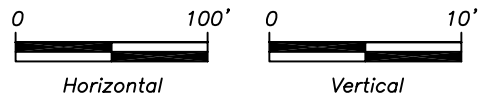
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3+00



- FINISH GRADE
- ORIGINAL GRADE
- CUT GRADE



NOTE(S):

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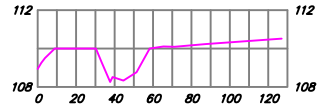
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**Exhibit 3B-3**

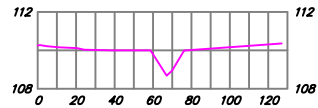
**Topographic Cross Sections for Areas A and B**

# Area A

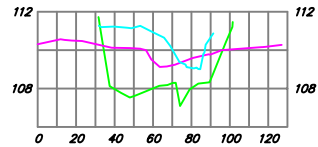
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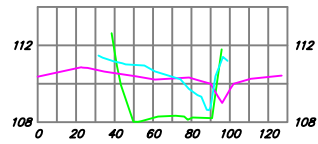
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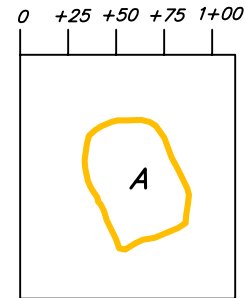
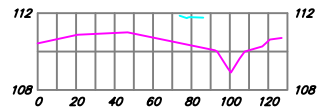
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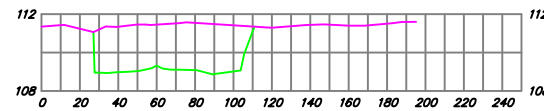


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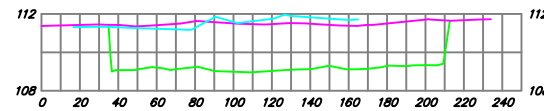


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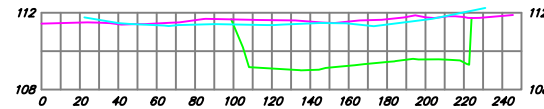
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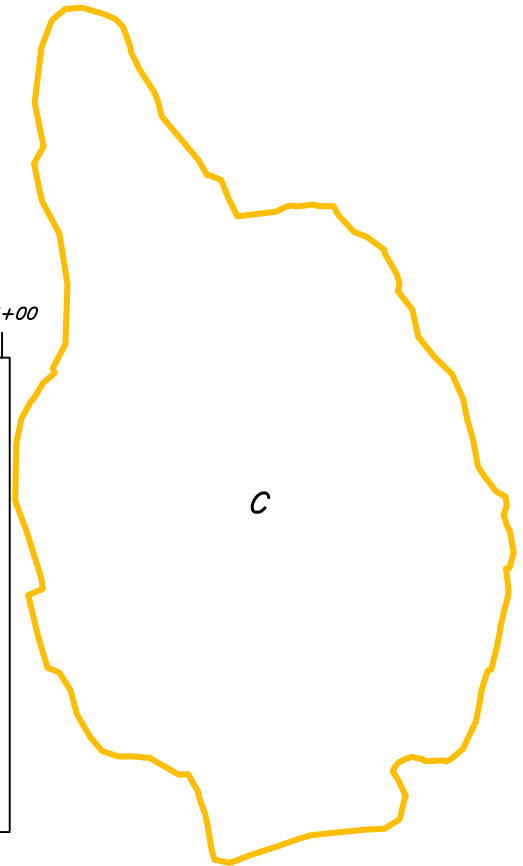
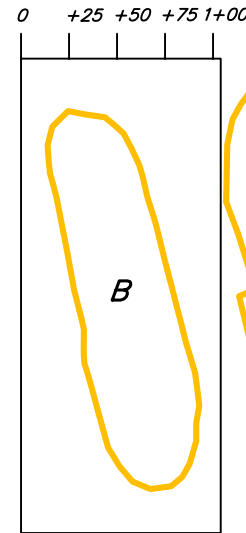
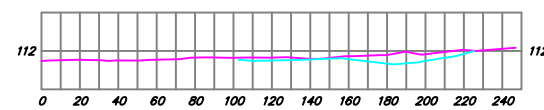
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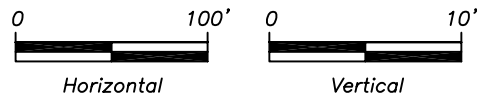
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- FINISH GRADE
- ORIGINAL GRADE
- CUT GRADE



NOTE(S):

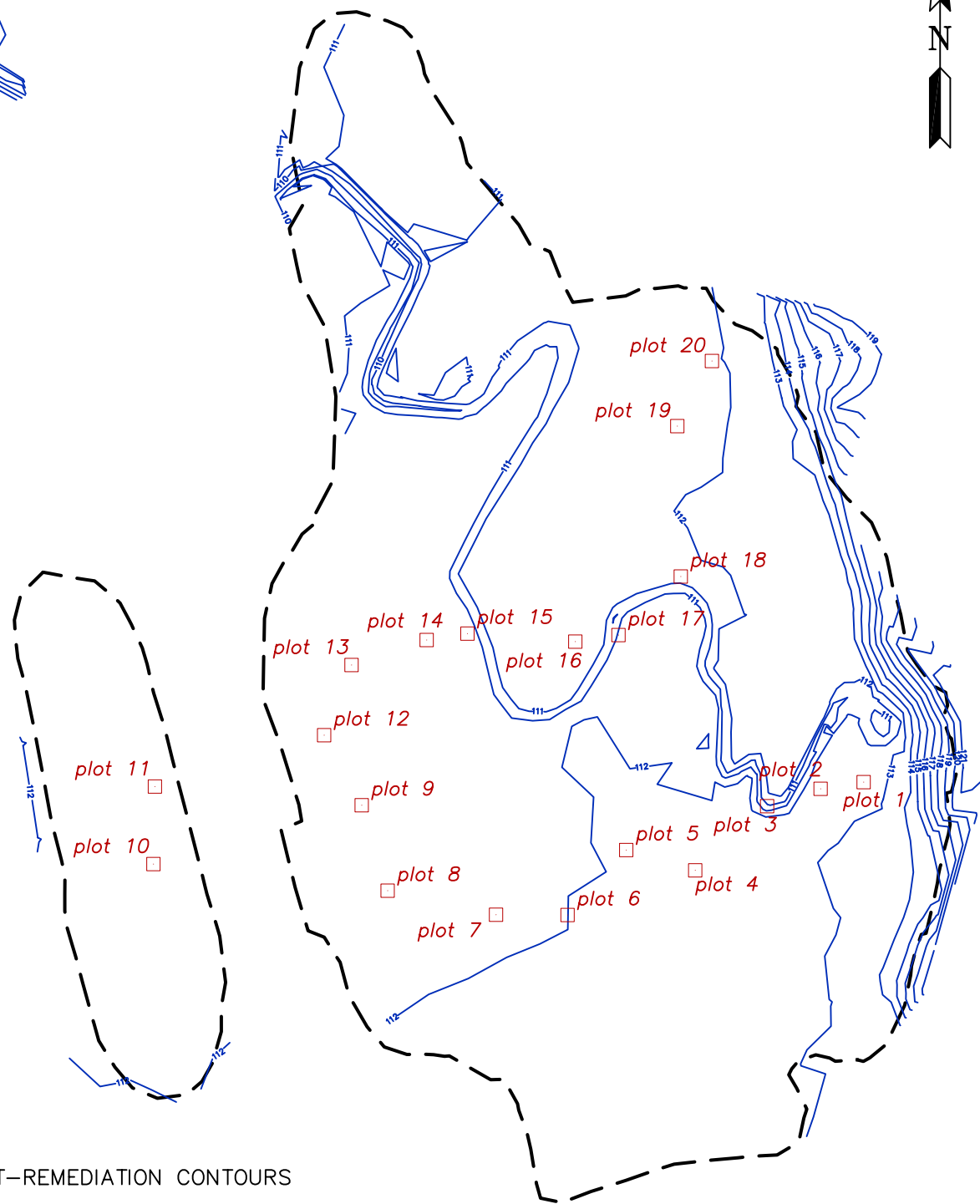
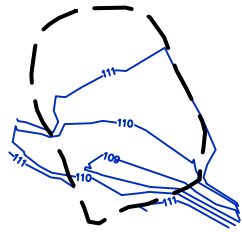
1. Cross sections provided by A-Plus Construction Services Corp

PREPARED BY: <b>WOODLOT</b> ALTERNATIVES, INC. ENVIRONMENTAL CONSULTANTS	DESIGN:	DATE: November 2004	DRAWING NAME:	<b>Exhibit 3B-3 - Topographic Cross Sections</b>  <b>Boston Post Road - Wayland, Massachusetts</b>	FIGURE NO.
	DRAFT:	JOB NO: 99123	PROJECT:		
	CHECKED:	SCALE: As Shown			
	FILE NAME: Exhibit3B_XSections.dwg				

**Exhibit 4**

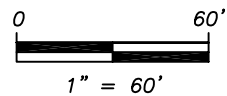
**Summer 2004 Vegetation Plots**





**LEGEND**

- POST-REMEDICATION CONTOURS
- EXTENT OF EXCAVATION AREA
- VEGETATION SAMPLE PLOT LOCATION



PREPARED BY:



**WOODLOT**  
ALTERNATIVES, INC.  
ENVIRONMENTAL CONSULTANTS

DATE: December 2004

SCALE: 1" = 60'

JOB NO. 99123

FILE: Exhibit4-Veg\_Plots.dwg

*Exhibit 4*  
*Summer 2004 Vegetation Plots*  
*Boston Post Road*  
*Wayland, Massachusetts*

REV.

## **Appendix A**

### **Planted Stock Summary of Installations**

### Final Planting List of Species and Quantities

Species	Actual	Zone
sweet flag ( <i>Acorus calamus</i> )	2,050	middle/upper
bluejoint ( <i>Calamagrostis canadensis</i> )	6,200	upper
soft-stemmed bulrush ( <i>Schoenoplectus tabernaemontanii</i> ) / ( <i>Scirpus validus</i> )	9,350	lower/middle
fowl mannagrass ( <i>Glyceria canadensis</i> )	3,150	middle
northern blue flag ( <i>Iris versicolor</i> )	4,100	middle/upper
soft rush ( <i>Juncus effusus</i> )	2,000	upper
rice cut-grass ( <i>Leersia oryzoides</i> )	11,250	lower/middle
cardinal flower ( <i>Lobelia cardinalis</i> )	2,100	upper
fowl meadowgrass ( <i>Poa palustris</i> )	1,000	middle/upper
pickerelweed ( <i>Pontederia cordata</i> )	7,500	lower/middle
common arrowhead ( <i>Sagittaria latifolia</i> )	6,050	lower/middle
hard-stem bulrush ( <i>Scirpus acutus</i> )	9,350	lower
Olney's bulrush ( <i>Scirpus americanus</i> )	3,050	lower
creeping spike-rush ( <i>Eleocharis palustris</i> )	500	middle
bur-reed ( <i>Sparganium americanum</i> )	2,000	middle/upper
smartweed ( <i>Polygonum</i> spp.)	4,000	lower/middle
marsh fern ( <i>Thelypteris palustris</i> )	25	upper
ostrich fern ( <i>Matteuccia struthiopteris</i> )	25	upper
sensitive fern ( <i>Onoclea sensibilis</i> )	25	upper
buttonbush ( <i>Cephalanthus occidentalis</i> )	25	swale
quaking aspen ( <i>Populus tremuloides</i> )	55	upland
<b>Total</b>	<b>73,805</b>	

## **Appendix B**

### **Table of Vegetation Sampling Results**

2004 WETLAND RESTORATION MONITORING - FORMER RAYTHEON FACILITY, WAYLAND, MASSACHUSETTS

Table of Sampling Plot Data. Data collected 8/25/2004.

Plant Species	NWI Status <sup>1</sup>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Species Occurrence in Plots	Total % Cover in Plots	Average Cover Per Plot
<i>Acorus americanus</i>	OBL					20																1	20	1
<i>Alisma triviale</i>	OBL					3																1	3	0.15
<i>Ambrosia artemisiifolia</i>	FACU									1												1	1	0.05
<i>Bidens cernua</i>	OBL	25	30	5	85		15		75	75	25	5			10	25	55	50	20		15	14	515	25.75
<i>Calamagrostis canadensis</i>	FACW+																			1		1	1	0.05
<i>Chenopodium album</i>	FACU+	1						1	1		1				1		1					6	6	0.3
<i>Cyperus esculentus</i>	FACW	45	35	3	2		5	10		4					1	3			5		8	10	121	6.05
<i>Digitaria sanguinalis</i>	FACU							1				1										18	2	0.1
<i>Echinochloa crusgalli</i>	FACU	25	25	10	15	30	25	50	15	10	10	20	5	35	20	15	40	40	90	95	25	20	600	30
<i>Iris versicolor</i>	OBL			5						5		20										17	30	1.5
<i>Leersia oryzoides</i>	OBL	25	15	30							5	5		25		60		15				8	180	9
<i>Ludwigia palustris</i>	OBL									1												1	1	0.05
<i>Lythrum salicaria</i>	FACW	3	5	12			1				1	5							2			6	29	1.45
<i>Polygonum careyi</i>	FACW																		1			1	1	0.05
<i>Polygonum pensylvanicum</i>	FACW																		1			1	1	0.05
<i>Polygonum persicaria</i>	FACW		1		2		3	3	8		2	3	3	3	5	8	3	3		2		13	49	2.45
<i>Populus spp.</i>	FACU						1	1		1											1	4	4	0.2
<i>Rorippa sp</i> <sup>2</sup>	FACW							1														1	1	0.05
<i>Sagittaria latifolia</i>	OBL			8		45	5	3									3	3				6	67	3.35
<i>Salix nigra</i>	FACW+					2	15	15														2	32	1.6
<i>Scirpus tabernaemontanii</i>	OBL			15									70								10	3	95	4.75
<i>Seterai faberi</i>	OBL							3	5	1	3			1	3				2	2	3	9	23	1.15
<i>Typha latifolia/T.glauca</i>	OBL						3															1	3	0.15
Vegetative grasses	FACW	3					1		25	15	1					15						6	60	3
Tree/shrub seedling	NA		1										1									2	2	0.1
Bare Ground/saturated					10		30	25	5	5											25	6	100	5
Standing Water		15	15	50		100		10		15	60	30	30	40	75	15	10	5	5	3		18	478	23.9
Total Percent Vegetative Cover for Plot		127.0	112.0	88.0	104.0	100.0	74.0	88.0	129.0	112.0	49.0	59.0	79.0	64.0	40.0	111.0	117.0	111.0	121.0	100.0	62.0		1847.0	92.4
Total % Hydrophytic Cover for Plot <sup>2</sup>		101.0	86.0	78.0	89.0	70.0	48.0	35.0	113.0	101.0	37.0	38.0	73.0	29.0	19.0	96.0	76.0	71.0	31.0	5.0	36.0		1232	61.6
Relative % Hydrophytes: Corps Method		79.5	76.8	88.6	85.6	70.0	64.9	39.8	87.6	90.2	75.5	64.4	92.4	45.3	47.5	86.5	65.0	64.0	25.6	5.0	58.1		1312.166236	65.6

Notes:

<sup>1</sup>FAC = facultative, 34 – 36% occurrence wetlands; FACU = facultative upland, 1 – 33% occurrence in wetlands.

<sup>2</sup> Areal cover can exceed 100% due to overlapping layers of vegetation.

FACW = facultative wetland, 67 – 99% occurrence in wetlands; OBL = obligate wetland, greater than 99% occurrence in wetlands.

UPL = obligate upland species >99% occurrence in non-wetlands in Northeast region.

## **Appendix C**

### **Plant Meander Survey**

**2004 Plant Meander Survey of the Wetland Restoration Project  
Data Collected May 13, July 6, and August 25, 2004**

<b>Species</b>	<b>Common Name</b>	<b>NWI Rating</b>	<b>Introduced or Native</b>
<i>Callitriche sp</i> (vegetative)	water star-wort	OBL	Native
<i>Eleocharis obtusa</i>	soft-stemmed spike-rush	OBL	Native
<i>Eleocharis palustris</i>	creeping spike-rush	OBL	Native
<i>Eupatorium perfoliatum</i>	boneset	FACW+	Native
<i>Peltandra virginica</i>	arrow arum	OBL	Native
<i>Polygonum amphibium</i>	erect smartweed	OBL	Native
<i>Pontederia cordata</i>	pickerel- weed	OBL	Native
<i>Sium suave</i>	water parsnip	OBL	Native
<i>Sparganium eurycarpum</i>	giant bur-reed	OBL	Native

## **Appendix D**

### **2004 Wildlife Observations**



**2004 Wildlife Observations at the Wetland Restoration Site  
May 13, July 6, and August 25, 2004**

Common Name	Species	Habitat Use On-site
<b>Amphibians and Reptiles</b>		
bullfrog	<i>(Rana catesbeiana)</i>	Inundated wetland: foraging and breeding.
painted turtle	<i>(Chrysemys picta)</i>	Inundated wetland: foraging. Upland: breeding.
<b>Birds</b>		
gray catbird	<i>(Dumetella carolinensis)</i>	Upland: foraging and breeding. Wetland: foraging.
northern flicker	<i>(Colaptes auratus)</i>	Upland: foraging and breeding. Dry wetland: foraging.
killdeer (adult and young)	<i>(Charadrius vociferus)</i>	Exposed mud and shallow pools: foraging. Dry wetland: foraging and breeding.
common yellowthroat	<i>(Geothlypis trichas)</i>	Wetland and upland: foraging and breeding.
American goldfinch	<i>(Carduelis tristis)</i>	Upland: foraging and breeding. Wetland: foraging.
song sparrow	<i>(Melospiza melodia)</i>	Wetland and upland: foraging and breeding.
blue jay	<i>(Cyanocitta cristata)</i>	Upland: foraging and breeding. Wetland: foraging.
Red-winged blackbird	<i>(Agelaius phoeniceus)</i>	Wetland: foraging and breeding.
American robin	<i>(Turdus migratorius)</i>	Dry wetland and upland: foraging and breeding.
willow flycatcher	<i>(Empidonax traillii)</i>	Wetland: foraging and breeding.
mourning dove	<i>(Zenaida macroura)</i>	Dry wetland: foraging. Upland: foraging and breeding.
swamp sparrow	<i>(Melospiza georgiana)</i>	Wetland: Foraging and breeding.
least sandpiper	<i>(Calidris minutilla)</i>	Exposed mud and shallow pools: foraging.
spotted sandpiper	<i>(Actitis macularia)</i>	Exposed mud and shallow pools: foraging.
black duck	<i>(Anas rubripes)</i>	Wetland: foraging.
tree swallow	<i>(Tachycineta bicolor)</i>	Wetland and upland: foraging over.
northern rough-winged swallow	<i>(Stelgidopteryx serripennis)</i>	Wetland and upland: foraging over.
yellow warbler	<i>(Dendroica petechia)</i>	Wetland and upland: foraging and breeding.
common grackle	<i>(Quiscalus quiscula)</i>	Wetland: foraging. Upland: foraging and breeding.
brown-headed cowbird	<i>(Molothrus ater)</i>	Wetland: foraging. Upland: foraging and breeding.
great blue heron	<i>(Ardea herodias)</i>	Inundated wetland: foraging.
northern cardinal	<i>(Cardinalis cardinalis)</i>	Dry wetland and upland: foraging and breeding.
Red-tailed hawk	<i>(Buteo jamaicensis)</i>	Dry wetland: foraging. Upland: foraging and breeding.
mallard	<i>(Anas platyrhynchos)</i>	Wetland: foraging
Virginia rail	<i>(Rallus limicola)</i>	Wetland: foraging and breeding.
<b>Mammals</b>		
white-tailed deer	<i>(Odocoileus virginianus)</i>	Wetland and upland: foraging, bedding, and breeding.
raccoon	<i>(Procyon lotor)</i>	Wetland and upland: foraging and breeding.
eastern cottontail (adult and young)	<i>(Sylvilagus floridanus)</i>	Dry wetland and upland: foraging and breeding.
gray squirrel	<i>(Sciurus carolinensis)</i>	Upland: foraging and breeding.
<b>Insects</b>		
common green darner	<i>(Anax junius)</i>	Wetlands: foraging and ovipositing.
orange bluet	<i>(Enallagma signatum)</i>	Wetlands: foraging.
painted lady butterfly	<i>(Vanessa cardui)</i>	Dry wetlands and uplands: foraging.
eastern tiger swallowtail	<i>(Papilio glaucus)</i>	Dry wetlands and uplands: foraging and puddling.
water striders	<i>(Gerridae)</i>	Ponded water: foraging.