

**Pennington Borough  
Howe's Arboretum Plan**

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Very large Silver Maple with roots anchoring a tributary of the Stoney Brook in Howe's Woods

## **Introduction**

In 2017, Pennington Borough received an ANJEC Open Space Stewardship Project Grant to create a plan to develop “Howe’s Arboretum” within woodland (“Howe’s Woods”) located adjacent to the Toll Gate Elementary School. Multiple Borough representatives participated in the process of formulating and refining the plan, which is presented below. Representatives included Catherine Chandler (Council Member), Joann Held (Environmental Commission), Harry Compton (Environmental Commission), Arthur Firestone (Environmental Commission), John Hayton (Volunteer), Alan Hershey (Open Space Committee), Eileen Heinzl (Borough Administrator), AnneMarie Hofacker (Parks and Recreation), Beverly Mills (Council Member), Gabriel Rosko (Shade Tree Commission), Margret vanVuuren (Hopewell Valley Green Team), and Judy Venosky (Volunteer).

The plan presented in this report is a result of field investigations and planning meetings from October 2017 through March 2018.

## **Field Assessment**

A field survey was conducted in October 2017 by M. Van Clef (focusing on shrubs, vines and wildflowers) and J. Hayton (focusing on trees). The primary purpose was to formulate a plan for the future arboretum, but also included identification of existing conservation values and their threats (primarily focused on deer browse and invasive species). Findings are summarized below and a complete plant species list is provided in Table 1.

### **Conservation Values**

Howe’s Woods represents a second growth forest arising from agricultural land abandoned in the mid-1900’s. The forest harbors the headwaters of an unnamed tributary of Stony Brook.

A total of 66 species of plants were documented (see Table 1), including 35 native species and 31 non-native species. The tree canopy is co-dominated by American Elm, Silver Maple, American Sycamore, Black Gum, Norway Maple (non-native) and Catalpa (non-native). The forest contains several older and very large native trees growing along the stream edge (where they were presumably allowed to grow while farming operations were still occurring). The shrub layer is dominated by non-native species (e.g., Autumn Olive, Multiflora Rose) with smaller amounts of native shrubs (e.g., Spicebush, Blackhaw Viburnum). The herbaceous layer is similarly dominated by non-native species (e.g., Japanese Stiltgrass) with very small amounts of a few representative species of the native flora.

### **Invasive Species and Deer Browse**

Deer browse and invasive species impacts are significant throughout Howe’s Woods, which demonstrate the ‘Infested Forest Syndrome’ characterized by forests growing on former agricultural areas and subject to intense browsing pressure from a severely overabundant deer population. There is a canopy of mature native trees, but native tree seedlings, shrubs and wildflowers are sparse, and where present, severely browsed by deer. Invasive non-native species that are not favored by deer are predominant throughout the woods.

Large invasive trees common in the tree canopy include Norway Maple and Catalpa. There are twelve species of invasive shrub species. While all of these species have current impacts or future impacts if allowed to continue to spread, there are several species that pose the greatest threats and treatment should be considered in the near future. These species include Oriental Photinia, Five-leaf Akebia, Linden

Viburnum and English Ivy. The prohibition on use of herbicides to treat invasive species on school property necessitates diligence in control efforts involving repeated cutting / mowing, especially within and immediately adjacent to arboretum plantings (See below).

## **Arboretum Master Plan**

### **Introduction**

Howe's Woods was evaluated to determine the best course of action to create an educational native plant arboretum plan. It was decided to create two deer exclosures on either end of the trail system as it enters from the mowed playground areas (See Map 1). Area #1 will be 0.1 acres and Area #2 will be 0.2 acres. These areas will be planted with native shrubs and wildflowers. An additional 0.4 acres, located within 10-foot bands on either side of the trail system, will be planted with native trees. A total of 1,100 native plants will be installed at the arboretum. Educational signage will be installed within planting areas and a bench will be installed within each of the deer exclosures. The three-year project timeline and budget is included as Table 3, with additional details provided below.

### **Invasive Species Control Recommendations**

The entire area is located on HVRSD property, with restrictions on the use of standard herbicides to control invasive species. Therefore, strategies are limited to mechanical methods (organic herbicides might be considered in the future). Without the use of standard herbicides to control invasive species, the task will be exceptionally challenging, requiring multiple treatments to contain infestations that cannot be eliminated with single standard herbicide application.

The first step will include the use of a forestry mower to cut all invasive species within the 0.7-acre arboretum planting area (both exclosures and along the trails). These mowers are capable of cutting all invasive shrubs within the planting areas. Trailside planting areas should be mowed twice annually to weaken invasive shrubs and minimize potential impacts on planted trees.

A forestry mower will be used for initial clearing within deer exclosures (prior to fence installation and planting). Thereafter, repeated hand cutting will be required to control invasive species. Generally, invasive tree seedlings/saplings and shrubs should be cut after resprouts reach a height of 2-3 feet (this maximizes weakening of root systems). Woody vines should be cut from trees and ground-layer growth should be cut with a weed whacker twice per year. Annual (Japanese Stiltgrass) and biennial (Garlic Mustard) invasive species should be hand-pulled prior to seeding, which would be mid-August and late May, respectively. Perennial herbaceous species should be hand-pulled twice per year (hand pulling should only be attempted when ground is moist to wet). Digging of invasive species should be avoided as this activity is likely to lead to a proliferation of annual and biennial weeds.

In the near term, cutting of large invasive canopy trees (Norway Maple, Catalpa) is not recommended. The removal of these trees, and increase in sunlight, will cause a significant increase in growth of invasive shrubs and herbaceous species that will be very difficult to control. Cutting of invasive canopy trees is not recommended until after invasive shrubs have been repeatedly cut for at least five years.

Unfortunately, the invasive Emerald Ash Borer will be eliminating all mature ash trees on the property. It was estimated that 75 larger ash trees are present, with 37 located with falling distance of Exclosure #2 (none are located within falling distance of Exclosure #1). It is recommended that the 37 trees that will

fall into the enclosure be cut prior to fence installation, remaining trees may require felling as they die over the next 5-10 years to avoid risk to users of Howe's Woods.

### **Native Species Planting Recommendations – Trees**

The 20-foot planting area along trails will be planted with 100 larger native tree species. To improve survival and create an immediate impact, larger trees (Ball & Burlap; ca. 3.5-inch caliper or approximately 15-20 feet tall) should be installed for the arboretum. Recommended species are provided in Table 4. Spring or fall planting should be selected based upon requirements of selected species. Each tree will receive a tree guard to prevent buck rub damage and a marker to identify the species.

### **Native Species Planting Recommendations – Shrubs and Wildflowers**

The planting of native shrubs and wildflowers must be preceded with the installation of deer enclosure fencing. The fencing should be constructed of galvanized metal woven wire with a minimum height of 7.5 feet above ground. Both enclosures will straddle the existing trail so that all visitors pass through the areas.

A total of 1,000 native shrubs and wildflowers will be planted within the deer enclosures (see Table 4). Species will include 100 shrubs in 2-gallon pots (typically 2-3 feet tall), 400 wildflowers in 2-quart pots (typically > 1 foot tall) and 500 wildflower seedlings in 'plug' trays. This strategy maximizes potential plant diversity, while providing a large number of plants to initiate recovery within the enclosures. Plantings should occur as a series of tightly planted clusters (e.g., 0.5 to 1 foot on center) to minimize competition from invasive species or other weeds. Raw wood chips should be placed around all new plantings to facilitate establishment (i.e., maintaining soil moisture and discouraging weed growth).

**Table 1. Howe's Woods Plant Species List  
Sorted by Growth Form, then Nativity**

<b>Growth Form</b>	<b>Common Name</b>	<b>Nativity</b>	<b>Notes</b>
Fern	Sensitive Fern	Native	
Grass	Bluejoint Grass	Native	
Grass	Path Rush	Native	
Grass	Sedge species	Native	
Grass	White Grass	Native	
Grass	Wood Reed	Native	
Grass	Japanese Stiltgrass	Non-Native	
Shrub	Allegheny Blackberry	Native	
Shrub	Blackcap Raspberry	Native	
Shrub	Blackhaw Viburnum	Native	
Shrub	Ribes species	Native	
Shrub	Spicebush	Native	
Shrub	Amur Honeysuckle	Non-Native	
Shrub	Autumn Olive	Non-Native	
Shrub	Japanese Barberry	Non-Native	
Shrub	Japanese Holly	Non-Native	
Shrub	Linden Viburnum	Non-Native	
Shrub	Morrow's Honeysuckle	Non-Native	
Shrub	Multiflora Rose	Non-Native	
Shrub	Oriental Photinia	Non-Native	
Shrub	Privet	Non-Native	
Shrub	Wineberry	Non-Native	
Shrub	Winged Burningbush	Non-Native	
Shrub	Yew	Non-Native	
Tree	American Beech	Native	
Tree	American Elm	Native	Canopy sub-dominant
Tree	American Holly?	Native	
Tree	American Sycamore	Native	Canopy sub-dominant
Tree	Black Gum	Native	Canopy sub-dominant
Tree	Pin Oak	Native	
Tree	Sassafras	Native	
Tree	Silver Maple	Native	Canopy sub-dominant
Tree	Sweetgum	Native	
Tree	Tulip-poplar	Native	
Tree	White Ash	Native	Canopy dominant; 67 trees in southern portion of woods, 10 trees in northern portion

**Table 1. Howe's Woods Plant Species List (continued)**  
**Sorted by Growth Form, then Nativity**

<b>Growth Form</b>	<b>Common Name</b>	<b>Nativity</b>	<b>Notes</b>
Tree	Wild Black Cherry	Native	
Tree	Catalpa	Non-Native	Canopy dominant
Tree	Norway Maple	Non-Native	Canopy dominant
Tree	Siebold's Crabapple	Non-Native	
Tree	Sweet Cherry	Non-Native	
Vine	Grape species	Native	
Vine	Poison-ivy	Native	
Vine	Virginia Creeper	Native	
Vine	Asiatic Bittersweet	Non-Native	
Vine	Autumn Clematis	Non-Native	
Vine	English Ivy	Non-Native	
Vine	Five-leaf Akebia	Non-Native	
Vine	Japanese Honeysuckle	Non-Native	
Vine	Lesser Periwinkle	Non-Native	
Vine	Wintercreeper	Non-Native	
Wildflower	Field Aster	Native	
Wildflower	Jewelweed	Native	
Wildflower	Jumpseed	Native	
Wildflower	Pokeweed	Native	
Wildflower	Sanicle species	Native	
Wildflower	Violet species	Native	
Wildflower	Virginia Stickseed	Native	
Wildflower	White Avens	Native	
Wildflower	White Snakeroot	Native	
Wildflower	Burdock	Non-Native	
Wildflower	Garlic Mustard	Non-Native	
Wildflower	Gill-over-the-Ground	Non-Native	
Wildflower	Indian Strawberry	Non-Native	
Wildflower	Lady's Thumb	Non-Native	
Wildflower	Lesser Celandine	Non-Native	
Wildflower	Wood-sorrel	Non-Native	

**Table 2. Ash Trees Located Near Deer Exclosure Planting Area #2**

<b>Tree Number</b>	<b>Tree Diameter (inches)</b>	<b>Latitude</b>	<b>Longitude</b>
1	12.1	40.32108553000	-74.78696753000
2	8.2	40.32107187000	-74.78696602000
3	Not Measured	40.32103825000	-74.78689075000
4	11.1	40.32101562000	-74.78688539000
5	12.1	40.32100640000	-74.78691582000
6a	5.4	40.32094832000	-74.78695412000
6b	9.2	40.32094832000	-74.78695412000
7	12.1	40.32092040000	-74.78695898000
8	Not Measured	40.32089475000	-74.78686393000
9	12.7	40.32088730000	-74.78684214000
10	5.7	40.32077448000	-74.78723584000
11	7.6	40.32077540000	-74.78725445000
12	6.7	40.32077791000	-74.78730440000
13	7.6	40.32076014000	-74.78732343000
14	4.1	40.32075218000	-74.78732544000
15	9.2	40.32075017000	-74.78733466000
16	Not Measured	40.32081387000	-74.78737162000
17	8.2	40.32083441000	-74.78733759000
18	Not Measured	40.32086047000	-74.78721103000
19	Not Measured	40.32088914000	-74.78698002000
20	11.4	40.32104010000	-74.78700718000
21	7.9	40.32101269000	-74.78704188000
22	7.3	40.32101026000	-74.78704565000
23	19.4	40.32099852000	-74.78706535000
24	9.5	40.32097883000	-74.78717825000
25	11.7	40.32094714000	-74.78717817000
26	7.6	40.32094505000	-74.78718823000
27	9.1	40.32093574000	-74.78721564000
28	8.2	40.32094337000	-74.78721614000
29	Not Measured	40.32094697000	-74.78722519000
30	5.4	40.32094429000	-74.78725336000
31	Not Measured	40.32093407000	-74.78725470000
32	Not Measured	40.32094731000	-74.78728755000
33	Not Measured	40.32095125000	-74.78729250000
34	Not Measured	40.32095754000	-74.78730725000
35	7.3	40.32099014000	-74.78729711000
36	6.0	40.32099215000	-74.78729795000
37	8.2	40.32099576000	-74.78729233000
<b>Average</b>	<b>9.0</b>		
<b>Minimum</b>	<b>4.1</b>		
<b>Maximum</b>	<b>19.4</b>		

**Table 3. Project Timeline and Budget**

<b>Task</b>	<b>Estimated Cost</b>	<b>Completion Timeline</b>	<b>Volunteer Hours</b>	<b>Notes</b>
<b>Year 1</b>				
Contractor - Forestry Mower Clearing - Initial clearing of invasive shrubs	\$1,500	June 1	5	Includes 10 feet on either side of trail (0.5 acres) and within deer exclosures (0.3 acres)
Contractor - Forestry Mower Clearing - Second clearing of invasive shrubs	\$1,500	September 1	5	Includes 10 feet on either side of trail (0.5 acres) and within deer exclosures (0.3 acres)
Materials - Native Trees (large) for along trail	\$35,000	November 30	50	100 trees x \$350 per tree (Pinelands Nursery or Octoraro Nursery)
Materials - Tree Guards	\$700	November 30	10	100 guards x \$7 per guard - 48" tall x 4" diameter (www.industrialnetting.com)
Materials - Tree Identification Markers	\$350	November 30	10	100 markers x \$3.50 per marker w/ 11" stake - 1.25" x 3.5"(www.alumaphoto-plateco.com)
<b>Year 2</b>				
Contractor - Cutting Ash Trees Threatening Deer Exclosures	\$\$\$	March 1	0	A total of 37 trees were mapped with an average diameter of 9 inches (range of 4 to 19 inches).
Contractor - Installation of deer fencing	\$4,200	March 30	5	Exclosure 1 (300 linear feet) + Exclosure 2 (400 linear feet) = 700 linear feet x \$6/linear foot (includes 4 gates) = \$4,200 (Bash Contracting)
Volunteers - Hand Clearing of Invasive Species	\$0	June 1	40	Includes deer exclosures (0.3 acres)
Materials - Educational Signage	\$1,300	June 1	35	4 x signs (11" x 17"), full color with metal mounting plate and post (Pannier Graphics)



**Table 3. Project Timeline and Budget (continued)**

<b>Task</b>	<b>Estimated Cost</b>	<b>Completion Timeline</b>	<b>Volunteer Hours</b>	<b>Notes</b>
Materials - Native Shrubs, Wildflowers and Grasses	\$3,625	June 1	60	Exclosure 1 (0.1 acres) + Exclosure 2 (0.3 acres) = 0.4 acres x 2,500 plants per acre = 1,000 plants. Utilize 500 plant plugs (\$1.25 per plant or \$625), 400 quart pots (\$5 per plant or \$2,000) and 100 2-gallon pots (\$10 per plant or \$1,000) = \$3,625 or 1,000 plants (Pinelands Nursery, Wild Ridge Nursery, New Moon Nursery, North Creek Nursery). Includes placement of raw wood chips around all plantings.
Contractor - Forestry Mower Maintenance Clearing	\$1,000	June 1	5	Includes 10 feet on either side of trail (0.5 acres)
Volunteers - Hand Clearing of Invasive Species	\$0	July 31	40	Includes deer exclosures (0.3 acres)
Volunteers - Hand Clearing of Invasive Species	\$0	September 1	40	Includes deer exclosures (0.3 acres)
Contractor - Forestry Mower Maintenance Clearing	\$1,000	September 1	5	Includes 10 feet on either side of trail (0.5 acres)
<b>Year 3</b>				
Volunteers - Hand Clearing of Invasive Species	\$0	June 1	40	Includes deer exclosures (0.3 acres)
Contractor - Forestry Mower Maintenance Clearing	\$750	June 1	5	Includes 10 feet on either side of trail (0.5 acres)
Volunteers - Hand Clearing of Invasive Species	\$0	September 1	40	Includes deer exclosures (0.3 acres)
Contractor - Forestry Mower Maintenance Clearing	\$750	September 1	5	Includes 10 feet on either side of trail (0.5 acres)
<b>Totals</b>	<b>\$51,675</b>		<b>400</b>	

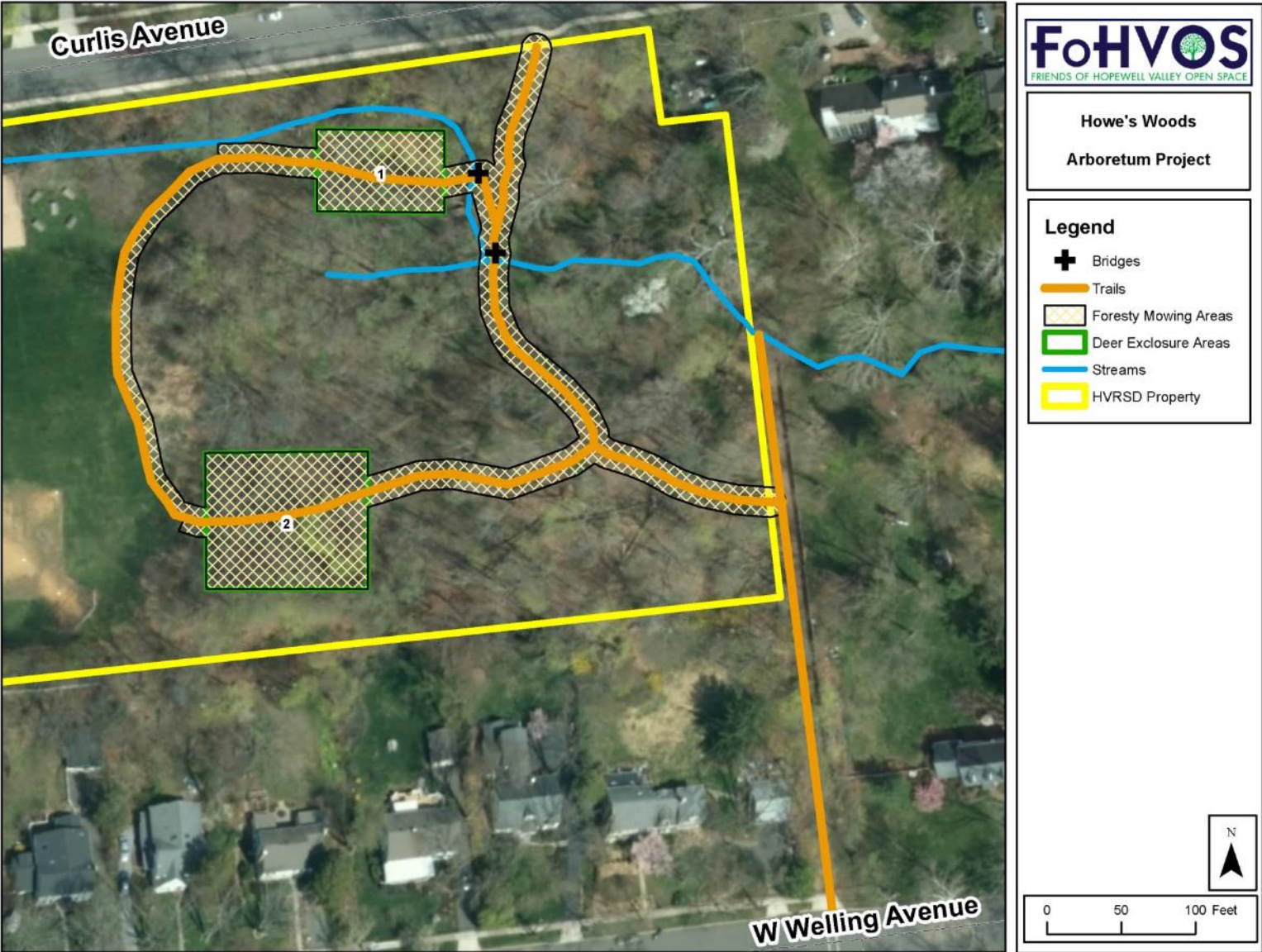
**Table 4. Recommended Native Species Plantings**

<b>Plant Type</b>	<b>Species</b>	<b>Pot Size</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
Tree	Ironwood	B&B	10	\$350	\$3,500
Tree	Hackberry	B&B	10	\$350	\$3,500
Tree	Flowering Dogwood	B&B	10	\$350	\$3,500
Tree	Tulip-poplar	B&B	10	\$350	\$3,500
Tree	Black Gum	B&B	10	\$350	\$3,500
Tree	Sycamore	B&B	10	\$350	\$3,500
Tree	Pin Oak	B&B	10	\$350	\$3,500
Tree	Northern Red Oak	B&B	10	\$350	\$3,500
Tree	Black Cherry	B&B	10	\$350	\$3,500
Tree	River Birch	B&B	10	\$350	\$3,500
<b>Tree Total</b>			<b>100</b>		<b>\$35,000</b>
Shrub	Shadbush	2-gallon	10	\$10	\$100
Shrub	Sweet Pepperbush	2-gallon	10	\$10	\$100
Shrub	Hearts a'burstin	2-gallon	10	\$10	\$100
Shrub	Spicebush	2-gallon	10	\$10	\$100
Shrub	Pasture Rose	2-gallon	10	\$10	\$100
Shrub	Common Elderberry	2-gallon	10	\$10	\$100
Shrub	Highbush Blueberry	2-gallon	10	\$10	\$100
Shrub	Arrowwood Viburnum	2-gallon	10	\$10	\$100
Shrub	Blackhaw Viburnum	2-gallon	10	\$10	\$100
Shrub	Gray Dogwood	2-gallon	10	\$10	\$100
<b>Shrub Total</b>			<b>100</b>		<b>\$1,000</b>
Wildflower/Grass	Black Cohosh	1-quart	20	\$5	\$100
Wildflower/Grass	Wild Leek	1-quart	20	\$5	\$100
Wildflower/Grass	Spikenard	1-quart	20	\$5	\$100
Wildflower/Grass	Poke Milkweed	1-quart	20	\$5	\$100
Wildflower/Grass	Stoneroot	1-quart	20	\$5	\$100
Wildflower/Grass	Bottlebrush Grass	1-quart	20	\$5	\$100
Wildflower/Grass	White Wood Aster	1-quart	20	\$5	\$100
Wildflower/Grass	Bigleaf Aster	1-quart	20	\$5	\$100
Wildflower/Grass	Purple Joepyre	1-quart	20	\$5	\$100
Wildflower/Grass	Wild Geranium	1-quart	20	\$5	\$100
Wildflower/Grass	Woodland Sunflower	1-quart	20	\$5	\$100
Wildflower/Grass	Two-flowered Cynthia	1-quart	20	\$5	\$100
Wildflower/Grass	Turk's Cap Lily	1-quart	20	\$5	\$100
Wildflower/Grass	Cardinal Flower	1-quart	20	\$5	\$100
Wildflower/Grass	Giant Solomon's Seal	1-quart	20	\$5	\$100
Wildflower/Grass	Miterwort	1-quart	20	\$5	\$100
Wildflower/Grass	Golden Ragwort	1-quart	20	\$5	\$100
Wildflower/Grass	Woodland Stonecrop	1-quart	20	\$5	\$100
Wildflower/Grass	Wreath Goldenrod	1-quart	20	\$5	\$100
Wildflower/Grass	Rue Anemone	1-quart	20	\$5	\$100

**Table 4. Recommended Native Species Plantings (continued)**

<b>Plant Type</b>	<b>Species</b>	<b>Pot Size</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
Wildflower/Grass	Nodding Onion	Plug	50	\$1.25	\$63
Wildflower/Grass	Blue Wood Aster	Plug	50	\$1.25	\$63
Wildflower/Grass	Turtlehead	Plug	50	\$1.25	\$63
Wildflower/Grass	Helen's Flower	Plug	50	\$1.25	\$63
Wildflower/Grass	Great Blue Lobelia	Plug	50	\$1.25	\$63
Wildflower/Grass	Foxglove Beardtongue	Plug	50	\$1.25	\$63
Wildflower/Grass	Wild Petunia	Plug	50	\$1.25	\$63
Wildflower/Grass	Zig-zag Goldenrod	Plug	50	\$1.25	\$63
Wildflower/Grass	Pennsylvania Sedge	Plug	50	\$1.25	\$63
Wildflower/Grass	Marginal Wood Fern	Plug	50	\$1.25	\$63
<b>Wildflower/ Grass (plugs) Total</b>			<b>500</b>		<b>\$625</b>
<b>Grand Total</b>					
			<b>1,100</b>		<b>\$38,625</b>

Map 1. Howe's Arboretum Design Layout



Map 2. Mapped Ash Trees Near Proposed Deer Exclosed Planting Area #2

