

# **Hilltop Reservation**

## **Invasive Plant Management Plan**

**Prepared for Essex County  
August 2016**

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Japanese Wisteria smothering canopy trees along the forest edge

## **Foreword**

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This report was commissioned by CME Associates on behalf of Essex County Department of Parks, Recreation and Cultural Affairs to guide invasive plant management at the Hilltop Reservation.

Special thanks are provided to Theresa Trapp, Treasurer of the Hilltop Conservancy. Ms. Trapp provided information regarding ongoing restoration and invasive species management activities at the Reservation.

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## Introductory Information

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<b>Study Area:</b>	Approximately 251 acres <u>Note:</u> the Hilltop Reservation is 284 acres in total. The 33 acres located east of Fairview Avenue in Cedar Grove were not included in this study.
<b>Municipalities/County:</b>	Cedar Grove Township, North Caldwell Borough, Verona Township / Essex County
<b>Broad Habitat Types:</b>	Upland Forest & Woodland - 203 acres (81% of Reservation) Wetland Forest & Woodland - 8 acres (3% of Reservation) Upland Shrubland - 11 acres (5% of Reservation) Wetland Shrubland - 2 acres (1% of Reservation) Upland Grassland/Meadow - 17 acres (7% of Reservation) Wetland Meadow - 4 acres (2% of Reservation) Open Water - 1 acre (< 1% of Reservation) All Natural Cover Types - 245 acres (98% of Reservation)
<b>Invasive Plant Species List:</b>	<p>Each invasive plant species was assigned an ‘Action Code’ based upon observations of current extent of infestations on the Property and within New Jersey. Codes include: “1” = species requires immediate implementation of an eradication program, “2” = species requires a long-term control program and “3” = species should be watched for spread and controlled if necessary in the future (several species on this list should be controlled in particular high conservation value areas). See report for additional information on distribution, infestation severity and control recommendations.</p> <p><b><i>Total Number of Mapped Invasive Species: 36</i></b></p> <p><b><u>Action Code = 1 (12 species)</u></b> Porcelain-berry, Five-leaf Aralia, Wintercreeper, English Ivy, Japanese Hop, Japanese Crabapple, Chinese Silvergrass, Boston Ivy, Weeping Higan Cherry, Jetbead, Linden Viburnum, Siebold’s Viburnum</p> <p><b><u>Action Code = 2 (14 species)</u></b> Tree-of-Heaven, Japanese Aralia, Mugwort, Catalpa, Oriental Bittersweet, Canada Thistle, Winged Burning Bush, Japanese Knotweed, Glossy Buckthorn, Border Privet, Japanese Honeysuckle, Common Reed, Black Locust, Japanese Wisteria</p> <p><b><u>Action Code = 3 (10 species)</u></b> Norway Maple, Garlic Mustard, Japanese Barberry, Amur Honeysuckle, Japanese Stiltgrass, Mile-a-Minute, Sweet Cherry, Multiflora Rose, Wineberry, Crown Vetch</p>

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- Appendix A. Emerging Invasive Species Points
- Appendix B. Species Prioritization Table
- Appendix C. NJISST Species Treatment Guide
- Appendix D. NJISST Herbicide Mixing Guide
- Appendix E. Western Route Project Schedule
- Appendix F. Western Route Invasive Species Control Options
- Appendix G. 10-Year Implementation Plan

## Section I. Evaluation of Invasive Plants

### Mapping Protocols

The methods used to map invasive plant species at the Reservation involved the delineation of mapping areas. The mapping area technique is a coarse method to broadly define the extent and intensity of invasive species infestations. The ultimate goal was to obtain results that identify and prioritize control activities over the next 10 years.

Mapping areas were delineated as locations containing relatively uniform ground cover for each invasive species present within the defined area or 'patch'. Within each patch, all invasive plants were assigned a cover class scores. Cover class scores included: "0": absent, "Trace" or < 1% cover, "1": 1-10% ground cover, "2": 11-25% ground cover, "3": 26-50% ground cover, "4": 51-75%, and "5": 76-100% ground cover.

### Overall Scope

A total of 132 unique mapped patches totaling 251 acres were recorded (Table 1). There were 91 acres (approximately 36% of the Reservation) where invasive species were only present at trace levels. Approximately 55% of the Reservation is considered severely infested, while approximately 6% had low to moderate infestation. Figure 1 and 2 depict the total number of invasive species and cumulative infestation scores by mapped patches, respectively.

**Table 1. Summary of Invasive Species Infestations by Mapped Patch**

Number of Species Per Patch	Total Acreage	Percentage of Reservation	Combined Infestation Score per Patch	Combined Infestation Score Category	Total Acreage	Percentage of Reservation
Non-habitat	6.6	2.6	Non-habitat	N/A	6.6	2.6
0	0	0.0	0*	"Clean"	91.3	36.3
1	5.9	2.4	1	Low	4.5	1.8
2	16.2	6.5	2	Low	1.3	0.5
3	31.5	12.5	3	Moderate	8.5	3.4
4	53.3	21.2	4	High	13.0	5.2
5	20.8	8.3	5	High	14.3	5.7
6	42.2	16.8	6	Very High	17.7	7.0
7	29.3	11.7	7	Very High	11.4	4.5
8	20.9	8.3	8	Very High	18.6	7.4
9	13.9	5.5	9	Very High	15.0	6.0
10	2.1	0.8	10	Very High	6.8	2.7
11	5.2	2.1	11	Very High	18.1	7.2
12	3.1	1.2	12	Very High	14.2	5.6
Totals	251	100	13	Very High	3.3	1.3
			14	Very High	3.7	1.5
			15	Very High	2.6	1.0
			16	Very High	0.0	0.0
			17	Very High	0.0	0.0
			18	Very High	0.5	0.2
			Totals		251	100

\*May contain one or more species at "Trace" amount

Figure 1. Number of Species per Mapped Area (map file also provided separately for easier viewing)

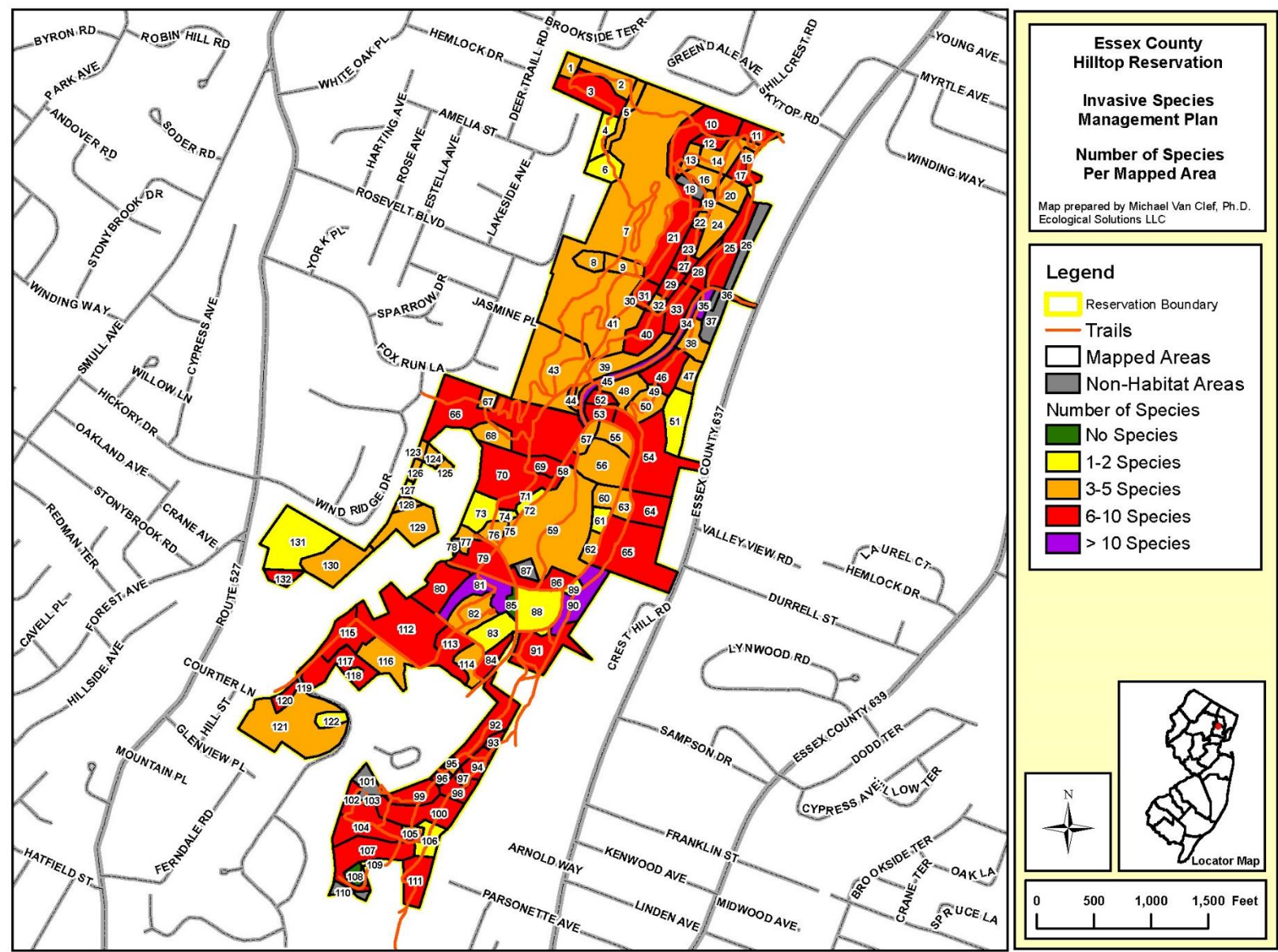
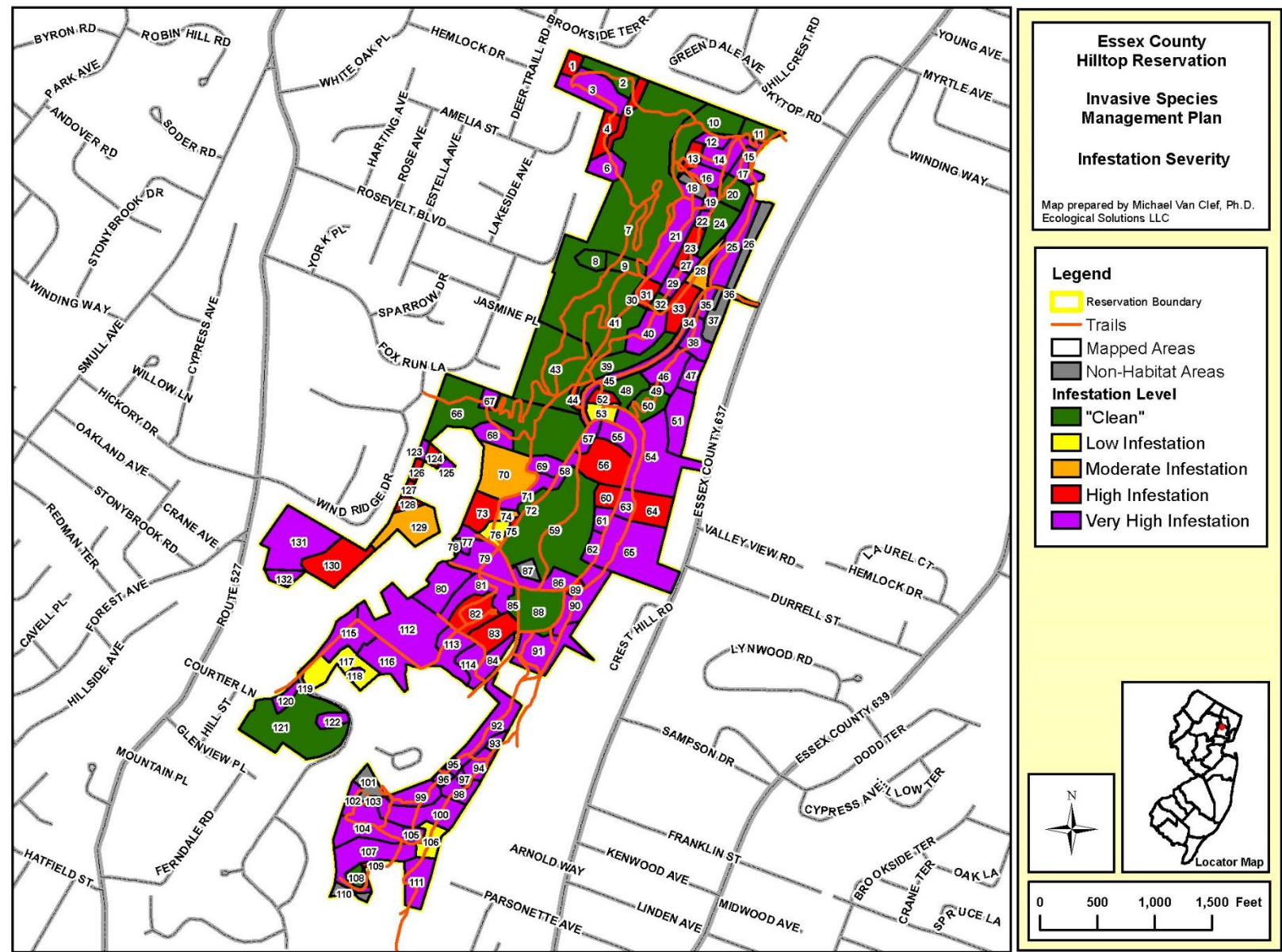




Figure 2. Infestation Severity (map file also provided separately for easier viewing)

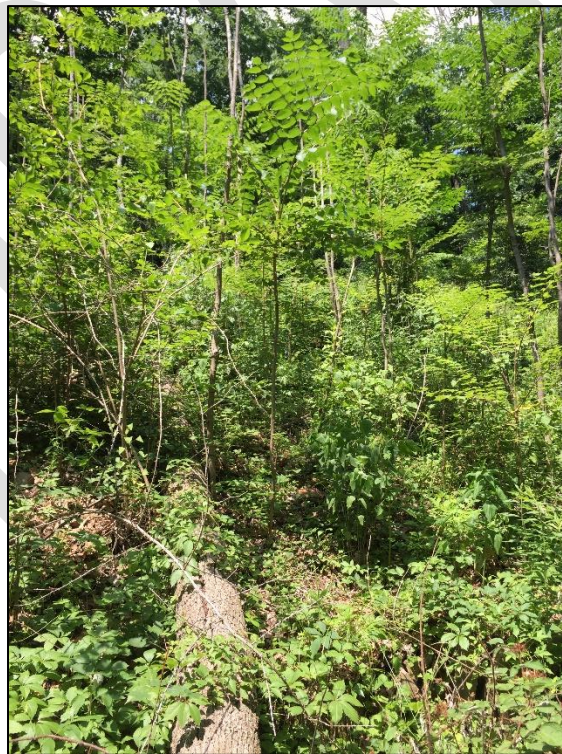


## Species Patterns

Table 2 contains data for each of 36 invasive species mapped at the Reservation (See individual Species Maps depicting distribution and intensity of infestations for each species). Table 2 also contains the “Relative Infestation Index Category.” This index provides a coarse characterization of both distribution and intensity of infested acreage at the Reservation. It is intended to provide a rapid assessment of species that currently have the greatest impacts. Values include ‘High’, ‘Medium’, and ‘Low’, which correspond to ranges of Infestation Index Scores derived by multiplying the number of acres where a species was present by its cover class score within mapped patches. Species labeled as ‘High’ are those with widespread distributions and/or consist of dense stands. Conversely, ‘Low’ species have limited distribution across the Reservation and/or primarily occur at low cover classes.

The most abundant species included Wineberry, Multiflora Rose, and Garlic Mustard. While very common, these species tended not to form infestations with > 75% cover over large areas of the Reservation. Species such as Norway Maple, Border Privet, Amur Honeysuckle, Japanese Stiltgrass and Japanese Aralia were common and all had areas with significant infestations. Two threatening vine species with localized impacts included Oriental Bittersweet and Japanese Honeysuckle. Localized, but very damaging infestations of Common Reed and Mugwort also occurred at the Reservation.

Nearly half of mapped species (17 of 36) were uncommon, but many of these species will cause significant future damage if left untreated and allowed to spread across the Reservation. Many of these species are considered to be emerging invasive species in New Jersey. Examples of the most highly threatening species to forest areas include Siebold’s Viburnum and Linden Viburnum. Particularly threatening meadow species include Japanese Crabapple and Chinese Silvergrass.



Canopy gap being filling with Japanese Aralia.

**Table 2. List of Invasive Species and Their Relative Infestation Levels (ordered by most common to least common species)**

Scientific Name	Common Name	Infestation Index Score <sup>1</sup>	Relative Infestation Index Category <sup>2</sup>	Percent of Acres Present	Acreage by Percent Ground Cover Categories						
					Category 0: 0%	Category Trace: < 1%	Category 1: 1-10%	Category 2: 10-25%	Category 3: 25-50%	Category 4: 50-75%	Category 5: 75-100%
Rubus phoenicolasius	wine raspberry	176.3	High	71.2	72.2	88.4	37.0	38.6	5.9	8.9	0.0
Rosa multiflora	multiflora rose	171.4	High	46.9	133.4	19.1	49.2	36.1	5.4	7.1	0.7
Alliaria petiolata	garlic mustard	101.8	High	37.5	156.9	29.5	39.4	17.1	7.2	0.9	0.0
Celastrus orbiculatus	Oriental bittersweet	101.2	High	36.6	159.2	14.6	54.7	22.5	0.0	0.0	0.0
Microstegium vimineum	Japanese stiltgrass	99.3	Medium	47.8	131.1	68.8	28.6	13.7	1.4	4.8	2.6
Aralia elata	Japanese angelica tree	86.3	Medium	50.3	124.8	76.1	22.3	27.0	0.8	0.0	0.0
Lonicera maackii	Amur honeysuckle	74.9	Medium	20.6	199.2	5.4	28.6	9.6	6.2	2.0	0.0
Acer platanoides	Norway maple	70.4	Medium	17.3	207.6	0.0	16.8	26.4	0.0	0.2	0.0
Phragmites australis	common reed	61.8	Medium	7.1	233.1	0.0	4.1	3.7	0.0	0.2	9.9
Lonicera japonica	Japanese honeysuckle	52.7	Medium	12.0	221.0	0.0	7.3	22.7	0.0	0.0	0.0
Ligustrum obtusifolium	border privet	51.6	Medium	18.5	204.5	16.5	21.5	1.0	3.6	3.9	0.0
Berberis thunbergii	Japanese barberry	48.8	Medium	40.2	150.2	68.1	25.6	6.0	0.0	1.1	0.0
Artemisia vulgaris	mugwort	41.6	Medium	21.1	198.1	34.8	10.3	2.3	1.8	0.7	3.0
Wisteria floribunda	Japanese wisteria	36.7	Medium	4.5	239.6	1.1	2.1	0.0	2.2	2.1	3.9
Ailanthus altissima	tree-of-heaven	21.5	Medium	8.6	229.5	6.4	12.2	0.0	2.9	0.0	0.0
Frangula alnus	glossy buckthorn	21.1	Medium	14.8	213.8	30.0	2.7	1.3	0.0	3.2	0.0
Fallopia japonica	Japanese knotweed	15.7	Medium	4.3	240.3	2.5	4.6	0.0	3.6	0.0	0.0
Robinia pseudoacacia	black locust	9.5	Low	4.2	240.4	2.8	7.1	0.0	0.7	0.0	0.0

**Table 2. List of Invasive Species and Their Relative Infestation Levels (continued)**

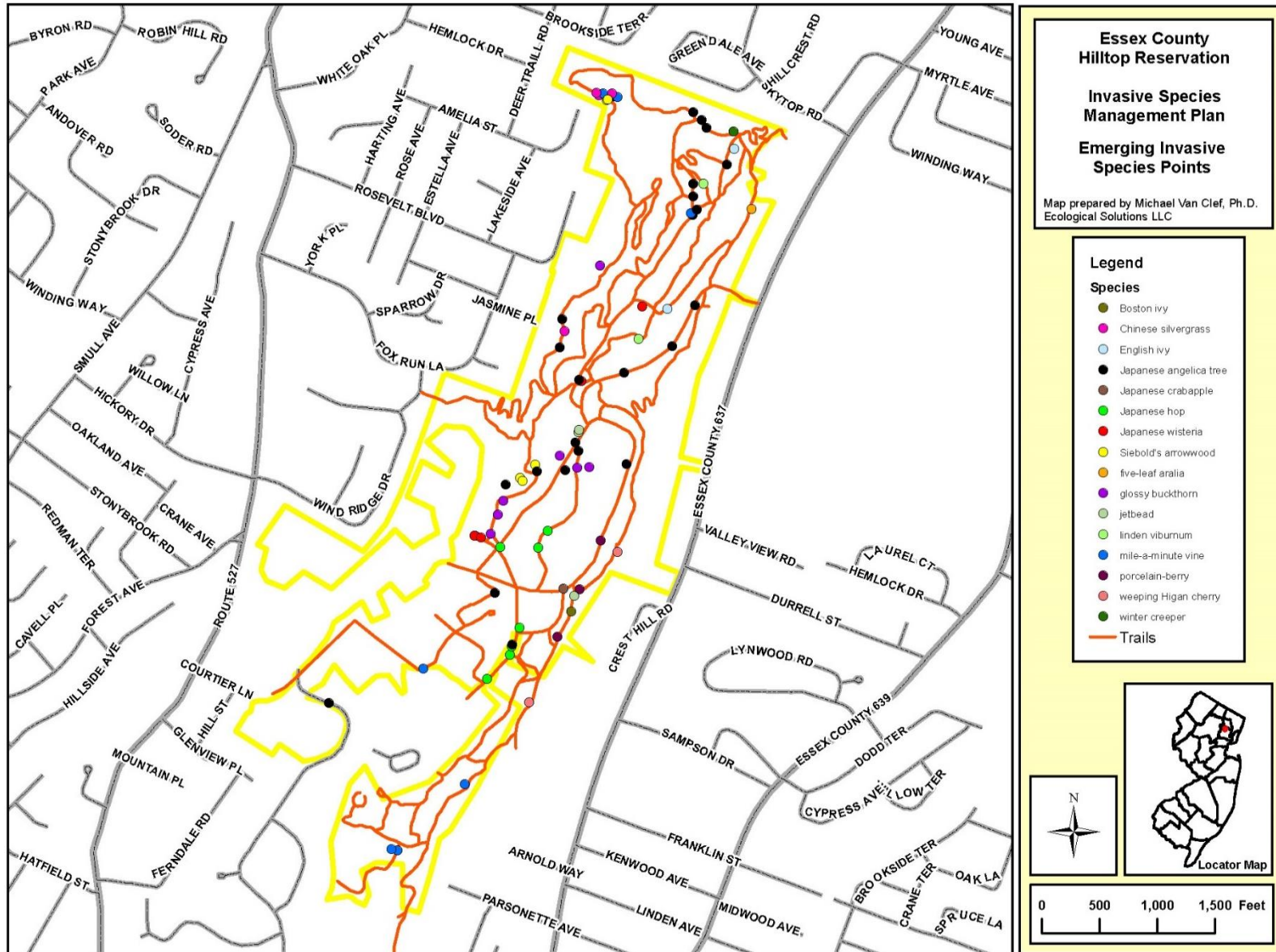
Scientific Name	Common Name	Infestation Index Score <sup>1</sup>	Relative Infestation Index Category <sup>2</sup>	Percent of Acres Present	Acreage by Percent Ground Cover Categories						
					Category 0: 0%	Category Trace: < 1%	Category 1: 1-10%	Category 2: 10-25%	Category 3: 25-50%	Category 4: 50-75%	Category 5: 75-100%
<i>Euonymus alatus</i>	winged burning bush	7.2	Low	15.9	211.2	36.7	3.0	0.0	0.0	0.0	0.1
<i>Humulus japonicus</i>	Japanese hop	4.8	Low	7.1	233.2	14.4	3.4	0.0	0.0	0.0	0.0
<i>Catalpa bignonioides</i>	Catalpa	3.8	Low	2.4	244.9	2.6	3.5	0.0	0.0	0.0	0.0
<i>Persicaria perfoliata</i>	mile-a-minute vine	2.1	Low	5.3	237.8	12.6	0.4	0.2	0.0	0.0	0.0
<i>Prunus avium</i>	Sweet Cherry	1.6	Low	0.9	248.8	0.7	1.5	0.0	0.0	0.0	0.0
<i>Rhodotypos scandens</i>	jetbead	1.4	Low	5.4	237.4	13.6	0.0	0.0	0.0	0.0	0.0
<i>Securigera varia</i>	crow n vetch	1.2	Low	0.2	250.4	0.0	0.0	0.6	0.0	0.0	0.0
<i>Cirsium arvense</i>	Canada thistle	1.2	Low	4.7	239.3	11.7	0.0	0.0	0.0	0.0	0.0
<i>Hedera helix</i>	English ivy	1.2	Low	2.8	244.0	6.5	0.5	0.0	0.0	0.0	0.0
<i>Viburnum sieboldii</i>	Siebold's arrow wood	0.8	Low	3.3	242.8	8.2	0.0	0.0	0.0	0.0	0.0
<i>Euonymus fortunei</i>	wintercreeper	0.8	Low	3.1	243.2	7.8	0.0	0.0	0.0	0.0	0.0
<i>Prunus subhirtella</i> var. <i>pendula</i>	weeping Higan cherry	0.7	Low	2.6	244.4	6.6	0.0	0.0	0.0	0.0	0.0
<i>Miscanthus sinensis</i>	Chinese silvergrass	0.4	Low	1.5	247.3	3.7	0.0	0.0	0.0	0.0	0.0
<i>Ampelopsis brevipedunculata</i>	pocelain-berry	0.4	Low	1.4	247.4	3.6	0.0	0.0	0.0	0.0	0.0
<i>Eleutherococcus sieboldianus</i>	five-leaf aralia	0.3	Low	1.2	247.9	3.1	0.0	0.0	0.0	0.0	0.0
<i>Viburnum dilatatum</i>	linden viburnum	0.3	Low	1.1	248.3	2.7	0.0	0.0	0.0	0.0	0.0
<i>Parthenocissus tricuspidata</i>	Boston ivy	0.3	Low	1.0	248.5	2.5	0.0	0.0	0.0	0.0	0.0
<i>Malus toringo</i>	Japanese crabapple	0.2	Low	0.6	249.5	1.5	0.0	0.0	0.0	0.0	0.0

<sup>1</sup> The Infestation Index Score combines the extent of acreage infested and the intensity of the infestation. It was derived by multiplying the cover class number by the number of acres within each cover class.

<sup>2</sup> The Relative Infestation Index Categories include Low, Medium and High to represent Infestation Index Scores of < 10, 10-100 and > 100, respectively.



Figure 3. Emerging Invasive Species Populations (map file also provided separately for easier viewing)



## Spatial Patterns

The western portions of the Reservation and restored meadow areas were relatively free of infestations (See Figure 2) – due to their relatively pristine condition, these areas should be considered to have the greatest conservation value for future efforts (See Section II). But even within these areas, canopy gaps were usually moderately to severely infested (this is likely a reaction to greater light resources), control efforts are particularly important in these canopy gaps to preserve the overall condition of the surrounding forest. Over 55% of the Reservation contains severe infestations consisting of multiple invasive plant species. These infested areas tended to occur in the former agricultural or other intensive human use areas at the Reservation. Control efforts in these areas should be limited to eradication or control of species that threaten higher conservation value areas.

## Species Action Codes

Each invasive species was assigned an ‘Action Code’ based upon its threat level to conservation values, current extent of infestation at the Reservation and known invasive status in New Jersey (Table 2). Specific management recommendations for particular species and areas at the Reservation are presented in Section II. Appendix B lists all invasive species and their associated action codes.

**Table 3. Action Code Summary for Invasive Plant Species**

<b>Action Code</b>	<b>Action Code Explanation</b>	<b>Treatment Recommendations</b>	<b>Number of Species</b>
1	Species has limited distribution (but is highly threatening) within the Reservation	Eradicate	12
2	Species has widespread distribution within the Reservation and is considered highly threatening	Strategic Control	14
3	Species has limited distribution and/or is not considered to be highly threatening and/or control is not feasible within the Reservation. Selected species should be controlled in high conservation value areas.	Watch for Spread, Treat as necessary in the future	10
<b>TOTAL</b>			<b>36</b>

## Section II. Stewardship Recommendations

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### Introduction

A significant and persistent effort will be required to reduce the impacts of invasive species at the Reservation. Recommendations for particular invasive species and mapped patches were prioritized relative to their location (e.g., distance to restoration areas) and threats posed to mature forest and meadow habitats (See Appendix G). An annotated species treatment prioritization table is provided in Appendix B and control treatment recommendations are provided in Appendix C. Appendix D is a companion to Appendix C and provides an herbicide mixing guide for listed techniques.

A summary of recommended goals listing target species and their locations along with suggested completion timeframes and estimated contractor cost and/or staff/volunteer level-of-effort are summarized in Appendix G.

The primary focus of invasive species control efforts hinges on the utilization of seasonal interns. While contractors with specialized equipment will be important to eliminate large/dense infestations, it is even more critical that hand control of many currently smaller infestations be tamped down before they become much more expensive contractor performed tasks. Seasonal interns, supervised by Essex County and Hilltop Conservancy, should be considered an absolutely essential means to improve ecological health at the Reservation.

It is recommended that two seasonal interns be hired for 10 weeks each summer during the 10-year plan implementation period. A reasonable salary for invasive plant control work is \$15/hour. Assuming required tax payments of 10% of hourly wages, the effective cost would be \$16.50/hour. Therefore, the total cost per year of hiring two seasonal interns would be \$13,200 (80 hours/week x 10 weeks x \$16.50/hour). The cost of seasonal interns over the 10-year implementation period would be \$132,000.

Special Note: It is absolutely essential that the current Deer Management Program be maintained in perpetuity at the Reservation. This could ultimately allow ecological control of invasive species via dense native plant growth (once freed from excessive deer browse), leading to significantly reduced need for ongoing chemical control. Invasive species are likely to be present in perpetuity, but they are much less likely to form dense infestations with an effective Deer Management Program.

### Annotated List of Goals

The following annotated recommendations are provided in Appendix G along with cost estimates and timeframes (many goals are further delineated into sub-goals within Appendix G). The total estimated cost (exclusive of the Western Route Project) over the 10-year implementation period is \$197,350. Prices for each goal and sub-goal are provided below, which provides the option to tailor projects to expected budget expenditures at the Hilltop Reservation.

#### **Goal #1: Eradicate Selected Species**

- Emerging invasive species should be the highest priority for control efforts because they threaten the Reservation and the region with future ecological degradation. This strategy, known as Early Detection & Rapid Response, represents an efficient and effective strategy to prevent damage (and minimize future stewardship costs).
- A total of twelve highly threatening emerging invasive species have been prioritized at the Reservation (See Appendix G). The estimated cost for this eradication work would be under \$5,000, which provides an excellent ‘bang for the buck’. If left untreated, these species could spread rapidly and become significantly more costly to eliminate in the future. See costs of Goal #2 for comparison.
- Total Estimated Cost for Goal #1 = \$4,725

#### **Goal #2: Forest Stewardship**

- A large portion of the Reservation (36%) was considered “Clean” (i.e., only trace levels of invasive species). Maintaining this through selective control of the small amounts of invasive species present, especially in canopy gaps, will prevent future degradation of ecological health. This preventative approach should be given very high priority. The estimated cost for this portion of the goal is \$20,800.
- The selective control of eight particular invasive species will be essential to protect and improve forest health at the Reservation. These species include Tree-of-Heaven, Japanese Aralia, Oriental Bittersweet, Winged Burning Bush, Japanese Knotweed, Glossy Buckthorn, Japanese Honeysuckle and Japanese Wisteria. Appendices B, C, D and G provide guidance on strategies and locations to guide control efforts. Contracted control work is recommended for approximately 8 acres of Japanese Wisteria, but the remaining invasive control work would most efficiently be conducted by seasonal interns supervised by Essex County and Hilltop Conservancy. The estimated cost for this portion of the goal is \$120,475 (includes \$37,750 for Japanese Wisteria control).
- Canopy replenishment is recommended for approximately 11 acres at the Reservation. These areas have lost canopy trees due to storms and disease with the result of fostering the dense growth of invasive species such as Wineberry and Common Reed. Ultimately, these invasive species can be controlled through shading of new canopy trees, but current deer densities do not allow native trees to grow tall enough to get into the forest canopy. It is recommended that larger trees (> 6” tall) be planted at a density of 35 trees per acre. Installation will be preceded by very local invasive species control (ca. 5 foot diameter areas). Deer ‘buck rub guards’ should be installed on each planted tree. The estimated cost for this portion of the goal is \$32,375.
- Total Estimated Cost for Goal #2 = \$173,650



### **Goal #3: Meadow Stewardship Control Efforts**

Theresa Trapp of the Hilltop Conservancy has been stewarding the large meadow restorations at the Reservation. She has been controlling a variety of invasive species and the meadow exhibits excellent ecological health. Current efforts to expand meadow habitat are also underway and will require similar activities in coming years. Required ongoing efforts for all restored meadows should include:

- Selective control of Mugwort. There are small patches and one large patch requiring control efforts. The estimated cost for this portion of the goal is \$1,825.
- Selective control of Canada Thistle. There are small patches or individual plants in various locations in the meadow restoration area. The estimated cost for this portion of the goal is \$1,075.
- Selective control of all woody plants. The establishment of trees and shrubs has been performed through hand control efforts and this effort must be continued. The estimated cost for this portion of the goal is \$1,075.
- The control of woody plants should be facilitated through regular prescribed burns to reduce establishment of woody seedlings. The New Jersey Forest Fire Service has visited the site and declared it “easily burned” and submitted a formal burn plan to Essex County. There is no cost associated with this goal.
- Total Estimated Cost for Goal #2 = \$3,975

### **Goal #4: Western Route Project**

- This project will be initiated in 2016 and finalized in 2017.
- The project includes multiple aspects including trail improvements, debris removal, trailside native species plantings and nearly nine acres of meadow restorations (wetland and upland). Restoration projects will be performed within the existing US Fish & Wildlife Service Partners for Fish and Wildlife agreement being administered by Essex County and the Hilltop Conservancy. Due to the complexity of the task and requirements to bid significant portions to contractors, tasks have been summarized in Appendix E for clarity and ease of incorporation into bid specifications. In addition, Appendix F contains a list of invasive species present in the project area along with possible control techniques. These techniques should be considered provisional as contractors working on the ground may decide on different methodologies. Ultimately, the goal is to eliminate invasive species to allow the establishment of native species plantings and seeding.
- Total Estimated Cost for Goal #3 = TBD (See Appendix E)