TREE & WOODLAND MANAGEMENT PLAN

Mount Hope Cemetery SOUTH SECTION

Rochester, New York
Fall 2016

Prepared for:
Mount Hope Cemetery, City of Rochester New York,
Department of Environmental Services
The Friends of Mount Hope Cemetery, Rochester, New York

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INTRODUCTION

Mount Hope Cemetery is a priceless historic asset and landmark within the City of Rochester, New York. Comprising 196 acres, the cemetery is a highly-valued public landscape featuring an iconic tree population. Mount Hope Cemetery's trees are a cultural asset, but are also considered *quantifiable infrastructure* valued at over $14 million (replacement value[1]). The cemetery's trees provide environmental, economic, and social services to Rochester's citizens. Per the citywide 2012 Urban Forest Master Plan (UFMP), the City of Rochester believes that a healthy urban forest is an integral part of the city infrastructure and is essential for the well-being of all area residents.

In recent decades, there are historic and mature trees in Mount Hope Cemetery that have not received the level of maintenance needed to keep them vital, which is a citywide challenge prevalent at varying levels and locations. In Rochester, there are currently more trees being removed than trees being planted. A management plan for Mount Hope Cemetery has been cited as a critical step in reversing this decline (Rochester 2012). This point was reiterated in the recent Mount Hope Cemetery Master Plan (MHC-MP), which cited that the preservation and care of Rochester's trees are paramount to maintaining the integrity of the cemetery and surrounding communities.

This plan is a direct response to these calls for effective and efficient management of this important city asset. The Mount Hope Cemetery Tree and Woodland Management Plan Task Force worked with Davey Resource Group to utilize the existing cemetery tree inventory in developing a tree and woodland management plan for Mount Hope Cemetery.

This management plan contains a brief analysis of existing conditions and challenges facing the trees of Mount Hope Cemetery, along with specific recommendations for ongoing proactive management, including a required budget and prioritized list of next steps. The report is divided into four sections:

- **The State of Mount Hope Cemetery Forest:** a brief summary of the condition of Mount Hope Cemetery trees
- **Reasons to Invest:** clarification of this asset, the return on investment, and its place within the city's overall plans
- **Goals:** clarification of the cemetery's goals and how to gauge success
- **The Way Forward:** a compilation of recommendations and next steps to reach goals

[1] Based on incorporation of city tree inventory data into i-Tree Eco modeling software.

THE CURRENT AND FUTURE STATE OF MOUNT HOPE CEMETERY'S URBAN FOREST

Unlike other municipal assets in Rochester, the urban forest/tree population is a public infrastructure component that is alive and growing. The city's urban forest is a dynamic ecosystem that can thrive if proper, timely, and effective management is provided. If neglected, the tree population could decline from both human and natural pressures. To provide context and a frame of reference for the analysis and recommendations in this plan, the current and future states of the cemetery's urban forest are discussed in this section.

The Current State of the Forest

The most current inventory data were analyzed and professional judgment was applied to make generalizations about the state of the inventoried tree population. Recognizing trends in the data can help guide short-term and long-term management planning. In this plan, the following criteria and indicators of the inventoried tree population were assessed:

- *Species Diversity*, the variety of species in a specific population, affects the population's ability to withstand threats from invasive pests and diseases. Species diversity also impacts tree maintenance needs and costs, tree planting goals, and canopy continuity.
- *Diameter Size Class Distribution Data*, the statistical distribution of a given tree population's trunk-size class, is used to indicate the relative age of a tree population. The diameter size class distribution affects the amount and value of tree-related benefits as well as the projection of maintenance needs and costs, planting goals, and canopy continuity.
- *Condition*, the general health of a tree population, indicates how well trees are performing given their site-specific conditions. General health affects both short-term and long-term maintenance needs and costs as well as canopy continuity.

Species Diversity

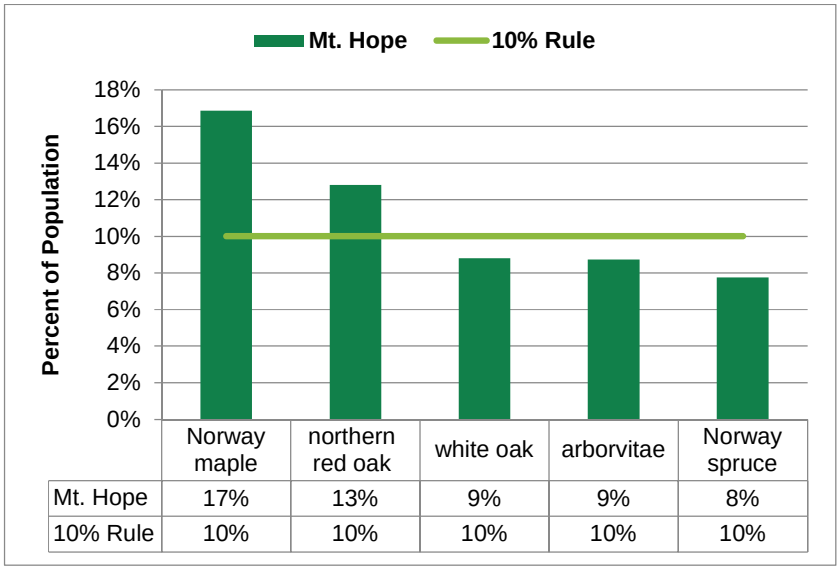
Species diversity affects maintenance costs, planting goals, canopy continuity, and the forestry program's ability to respond to threats from invasive pests or diseases. Low species diversity (large number of trees of the same species) can lead to severe losses in the event of species-specific epidemics such as the devastating results of Dutch elm disease and emerald ash borer.

The composition of a tree population should follow the 10-20-30 Rule for species diversity: a single species should represent no more than 10% of the urban forest, a single genus no more than 20%, and a single family no more than 30%.

Findings

Analysis of Mount Hope's tree inventory data indicated that the tree population has relatively good overall diversity, with at least 46 genera and 78 species represented. However, 5 species exceed industry standards and best practices for tree population diversity and, in fact, comprise nearly 60% of Mount Hope's tree population.

Figure 1 uses the 10% Rule to compare the percentages of the most common species identified from the inventory. Norway maple and northern red oak exceed the recommended 10% maximum for a single species in a population, comprising 17% and 13% of the inventoried tree population, respectively. White oak, arborvitae (species), and Norway spruce are approaching the 10% threshold.



	Norway maple	northern red oak	white oak	arborvitae	Norway spruce
Mt. Hope	17%	13%	9%	9%	8%
10% Rule	10%	10%	10%	10%	10%

Figure 1. Five most abundant species of the inventoried population compared to the 10% Rule.

Norway maple and northern red oak dominate the cemetery's landscape in both the maintained and woodland areas. Future plantings will need to be planned to limit planting these species and expand the overall diversity of the tree population to ensure Mount Hope's urban forest is sustainable and resilient to future invasive pest infestations.

Diameter Size Class Distribution

Analyzing the diameter size class distribution provides an estimate of the relative age of a tree population and offers insight into maintenance practices and needs.

The inventoried trees were categorized into the following diameter size classes: young trees (0–8 inches DBH), established (9–17 inches DBH), maturing (18–24 inches DBH), and mature trees (greater than 24 inches DBH). These categories were chosen so that the population could be analyzed according to Richards' ideal distribution (1983).

Richards proposed an ideal diameter size class distribution for landscape and street trees based on observations of well-adapted trees in Syracuse, New York. Richards' ideal distribution suggests that the largest fraction of trees (approximately 40% of the population) should be young (less than 8 inches DBH), while a smaller fraction (approximately 10%) should be in the large-diameter size class (greater than 24 inches DBH). A tree population with an ideal distribution would have an abundance of newly-planted and young trees, and lower numbers of established, maturing, and mature trees.

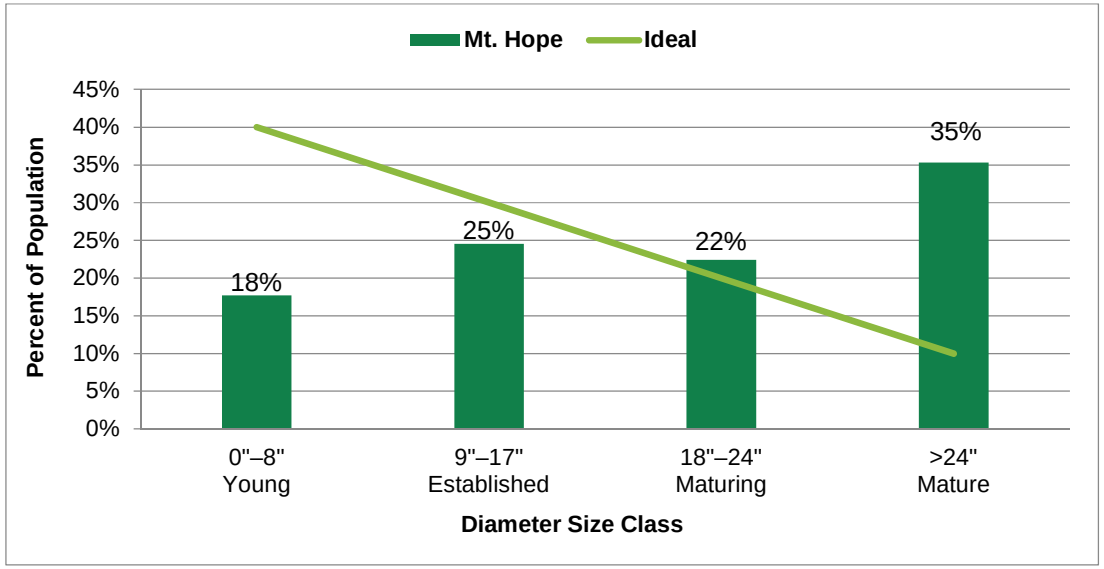


Figure 2. Comparison of diameter size class distribution for inventoried trees to the ideal distribution.

Findings

Figure 2 compares Mount Hope Cemetery's diameter size class distribution of the inventoried tree population to the ideal proposed by Richards (1983). As expected due to the historic nature of the cemetery, the distribution trends away from the ideal; young trees are under the ideal by over 22%, while larger diameter size classes exceed the ideal by 25%. Outside of the historic tree population, an objective for Mount Hope Cemetery should be to have an uneven-aged distribution of the remaining landscape trees. Currently the number of trees in the Young, Established, and Maturing categories are almost equal. For Mount Hope Cemetery to remain a forested cultural landmark and be sustainable, Mount Hope Cemetery should have a thoughtful successional planting program to ensure that young, healthy trees are in place to replace older declining trees.

Condition

The inventory classifies tree condition in the cemetery based on methods defined by International Society of Arboriculture (ISA). The condition of each inventoried tree was rated Excellent, Very Good, Good, Fair, Poor, Critical, or Dead. Figures 3 illustrates the general health and distribution of all inventoried trees.

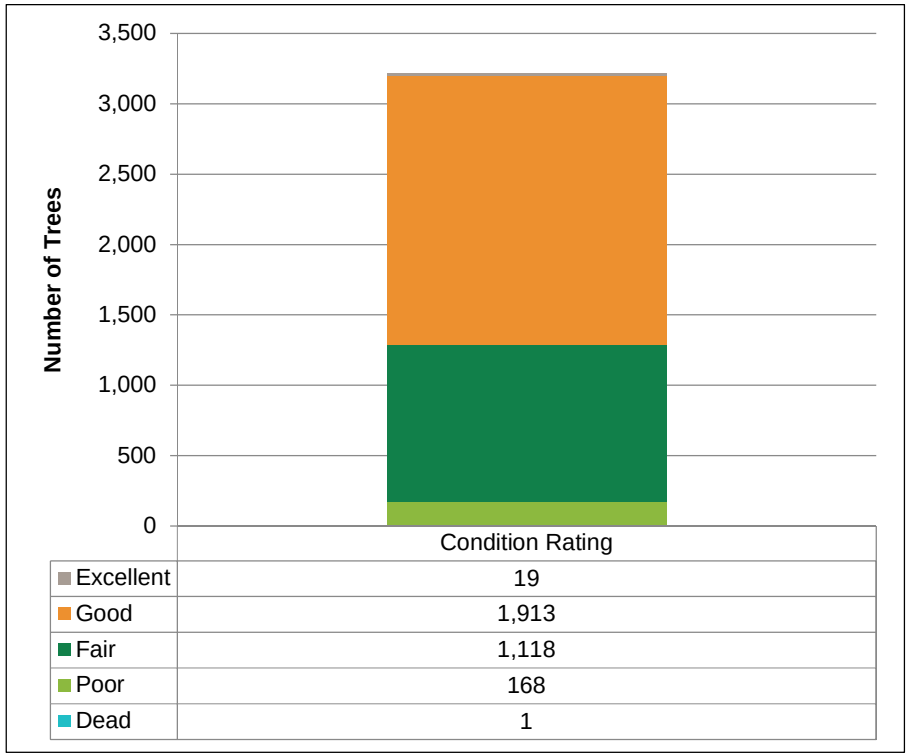


Figure 3. Conditions of inventoried trees.

Findings

Based on the most current inventory data, most of the trees were recorded to be in Good or Fair condition. When the data are taken as a whole, it can be stated that generally 60% of Mount Hope's urban forest in in Good condition or better, 35% is in Fair condition, and only 5% is in Poor or worse condition.

Current Tree Management Practices

The trees in Mount Hope Cemetery do receive maintenance and trees are planted on the grounds. The following summarizes current processes and activities in the cemetery:

1. The majority of trees are inspected annually by the city. This inspection is conducted during a one-day walk-through of the grounds, and is considered a "Limited Visual Assessment (Level 1)" by International Society of Arboriculture Standards.
2. Trees that need to be removed or pruned are noted during the inspection and are included in the citywide maintenance task list. The work is performed that year as funds are available and if other public urban forest issues do not take priority.
3. Stumps are typically not ground.
4. Select trees are being monitored and treated for insect and disease threats. Beech trees are treated for beech bark borer; treatment for hemlock wooly adelgid is being tested; and ash trees are removed except for trees that are being treated for emerald ash borer.
5. Tree planting is minimal. On average five trees per year are planted, but 10 to 15 have been planted when funds are available and/or when there is a special project.

Current Trends and Conditions of Concern

The cemetery features a significant tree canopy comprised of both landscape and woodland specimens. The inventory analysis reveals there is good species diversity and that the trees are generally in good condition. This vital resource, however, is currently threatened by a number of factors:

- *Aging Historic Trees.* Although lengthy in human perspectives, trees still have a limited lifespan. Additionally, trees growing in an active cemetery in an urbanized area and subject to land development and frequent human use have even shorter lifespans. Without ongoing proactive maintenance (and remedial care after damage), historic and mature (over 10" DBH) trees, which make up more that 75% of the tree population at Mount Hope Cemetery, could decline, become more subject to insect and disease threats, and/or become risks.

- *Insufficient New Tree Planting*. Like a native woodland, an urban forest can only be sustainable if there is a good distribution of age classes. Without planned successional tree planting, the tree canopy will decline over time. Currently, an average of 10 to15 trees are planted at Mount Hope Cemetery each year, mostly as a part of one-time project-based plantings or when funds are available. That averages to only about 1 new tree per every 20 acres planted each year. And given the lack of young trees to sustain (much less to enlarge) the existing canopy in the future, more young trees should be planted.
- *Pests and Diseases Pressures.* Exotic and native insects and diseases pose serious threats to tree health and longevity and could accelerate the decline of Mount Hope Cemetery's tree canopy. The susceptibility of Mount Hope Cemetery's urban forest (particularly the historic tree population) to insect and disease infestations is significant given the less than desirable level of overall species diversity. Specifically, the cemetery is susceptible to threats from existing forest pests and diseases (i.e., beech canker disease, hemlock wooly adelgid, and emerald ash borer), and the potential threats of Cytospora canker of spruce, and oak wilt, a devastating disease that has been found in other areas of upstate New York. Oak wilt could potentially destroy almost 25% of the cemetery's urban forest (MHC-MP Chapter 7).
- *Human Activities.* Human actions in the cemetery are an obstacle to new tree establishment and mature tree longevity. Root disturbance and tree injuries result from burials, road construction, and utility repair and maintenance. Using de-icing salts in the winter, along with lawn and weed chemicals in the spring and summer, will also induce stress in trees. Furthermore, unfortunate acts of vandalism, not uncommon for a location next to a major university, can kill or seriously impair any age tree.
- *Erosion.* Soil loss on hillsides affects root health and the ability to reforest if left unaddressed.
- *Invasive Plants.* Mount Hope Cemetery contains invasive trees and plants in the landscape, most notably a large population of Norway maple, as well as colonies of Japanese knotweed and other perennial invasives. If left unchecked, these non-native plants may outcompete the native plants in the woodland areas and even landscape trees.

What Could the Future Look Like?

Given the pressures and threats to Mount Hope Cemetery's trees, proactive management and additional tree planting is critical to preserve and grow a healthy, safe urban forest. Using the Mount Hope Cemetery inventory data and the i-Tree modeling tool Eco Forecast, a set of events or conditions were applied to forecast the urban forest over the next 30 years. This model helps quantify and visualize the impacts from natural mortality, potential threats (pests, storms), and planting activities under various scenarios of varying levels of tree maintenance and planting. The following figure illustrates the anticipated tree population numbers and benefits if tree management in the cemetery continues reactive care and plants no trees (factors also defined).

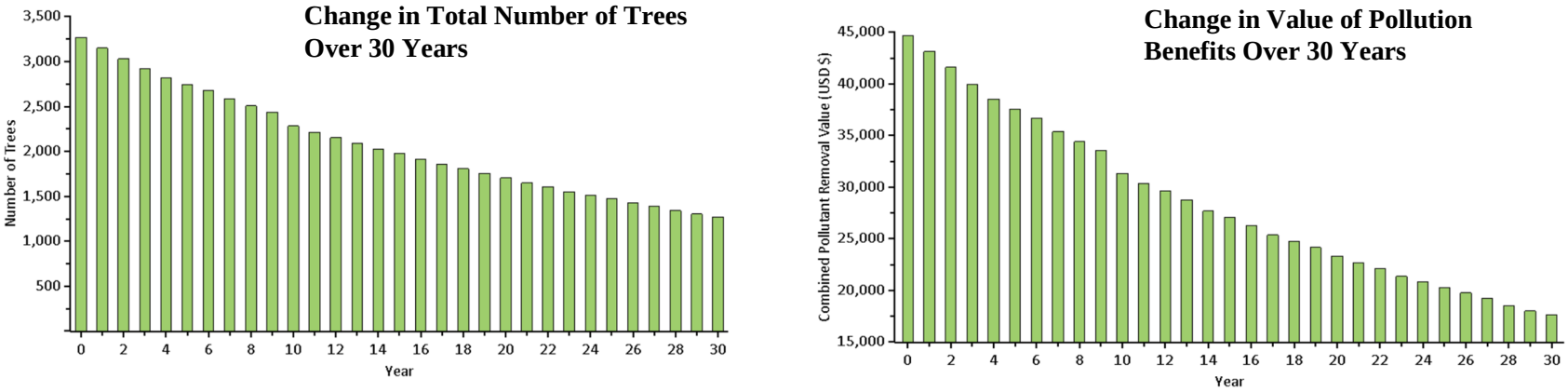


Figure 4. 30-year projection of Mount Hope Cemetery trees using a "Reactive Care/No Tree Planting Scenario".

i-Tree Eco Forecast Modeling Scenario: Reactive Care/No Planting Scenario

Timeframe: 30 years. *Annual Mortality:* i-Tree's standard rates of 3% for healthy trees, 13.1% for sick trees, 50% for dying trees. *Disease/Pests:* Registered activity of beech bark disease, hemlock woolly adelgid, and emerald ash borer, although with low mortality rates (0.5–1% per year) due to current proactive management. *Storms:* One storm (ice storm or summer storm) taking place in Year 10 that results in a 3% mortality rate. *Plantings:* None.

Full methodology, details, and assumptions made related to all i-Tree Eco modeling in this report can be found in the appendix.

As shown in Figure 1, without proactive care and tree planting, the total number of trees could drop by 60% in 30 years, from over 3,200 trees today to approximately 1,200 trees in 2046. The second chart shows the corresponding resulting drop in environmental benefits from that loss. With combined air pollutant removal, an example of one of the many benefits, the value provided by trees for this service would decrease by 60%, from almost $45,000 of annual air pollution control benefits provided today to approximately $17,000 in 2046.

To offset the likelihood of this decline, proactive mature tree care should be implemented. Proactive care leads to lower mortality rates (discussed further *Recommendation #1: Enhance and Continue Cyclical Tree Care*). The impact of tree planting on these models, also part of the solution, is explored in *Recommendation #6: Implement a Tree Succession Strategy*.

Construction is another factor that could further affect the forest. As changes recommended in the MHC-MP (road work, wall installation, erosion control) are implemented, the overall health of the urban forest is subject to potential adverse impacts.

Resources for Tree Care are Inadequate

Funding and other resources for proactive care and planting are currently at inadequate levels. The lack of funding prohibits proactive tree care, which has resulted in significant tree health decline. This management plan, combined with sufficient funding to implement the plan, is essential to reversing this trend (2012 Urban Forest Master Plan).

Over the last six years, the City of Rochester has spent approximately $460,000 in tree management at Mount Hope Cemetery. That equates to an average of approximately $76,000 per year. The budget needed for tree maintenance recommended in this plan is estimated between at least $140,000 and up to $250,000 each year, identifying a needs gap of approximately $94,000–$204,000 annually. The recommended budget for proactive tree care at Mount Hope Cemetery is presented in detail in *The Way Forward: Budget Requirements* section of this plan (Page 13).

On the positive side, there are many entities and advocates for the cemetery's trees that can potentially provide and/or support the need for additional resources. These key stakeholders include the city council, forestry staff, cemetery staff, Friends of Mount Hope Cemetery, and even the citizens of Rochester. This broad support base has a variety of expertise and resources to collectively draw upon and support the cemetery's urban forest management goals. However, these stakeholder groups also have other missions and priorities, which may complicate gaining consensus and coordinated action.

REASONS TO INVEST IN MOUNT HOPE'S URBAN FOREST

In a world characterized by tight city budgets, aging infrastructure, and fierce competition for city resources, community leaders often ask why we should invest in trees. Investment in Mount Hope Cemetery's trees is important for many reasons.

Mount Hope Trees Provide Important Benefits and Services to the City

Quality Landscape Equates to Higher Cemetery Revenues. Mount Hope Cemetery is an active cemetery that brings in revenue used to support its operations. Landscape is directly connected to the monetary value of burial sites; a high-quality landscape greatly contributes to higher revenues and a positive bottom line. Cemetery Manager Jeff Simmons considers the trees on the property to be "one of our biggest selling points and a direct correlation to the cemetery's bottom line." Preservation of cemetery trees is, therefore, a high priority for cemetery operations (MHC-MP Chapter 7).

> Managers in historic cemeteries in New York agree, and state that cemeteries have instituted proactive and comprehensive care of their grounds and have done so because they recognize the impact of trees and the landscape on cemetery revenues."

Annual Benefits. Every year, trees in Mount Hope Cemetery provide a range of benefits to the City of Rochester, ranging from quantifiable benefits like the interception of stormwater runoff and removal of air pollutants to the less quantifiable aesthetics and beauty provided to the surrounding communities. Each year, Mount Hope Cemetery trees provide approximately $60,000 in benefits to the city.

Table 1. Economic Value of the Environmental Benefits Provided by Mount Hope Cemetery Trees (i-Tree eco)

Annual Benefits from Mount Hope Cemetery Trees (from 2016 Tree Inventory Data)							
Benefit		**North Section**		**South Section**		**Entire Property**	
	Unit	Qty	Value	Qty	Value	Qty	Value
Stormwater runoff intercepted	gal.	655,516	$5,858	457,051	$4,084	1,112,567	$9,942
Gross carbon sequestered	lbs.	60,320	$3,620	30,380	$2,414	90,700	$6,034
Air Pollution Removed: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and dust, soot, other particles (PM_{10}) removed	lbs.	2,300	$26,303	1,600	$18,340	3,900	$44,643
Total Annual Benefits		$35,783		$24,838		$60,619	
There are many more benefits that urban trees provide although are not as easily quantifiable. They are listed here so as to not be neglected in the valuation of an urban forest: heat stress alleviation, improved public health, increases in nearby property values, successful business districts, safer more walkable streets, essential wildlife habitat, stronger and more vibrant communities, crime prevention, and noise buffers.							

Mount Hope is a Community Asset

Mount Hope is a city asset, but also a community asset serving as an historic anchor to the surrounding neighborhoods, valued at over $14 million (Table 2). Much of the cemetery is part of the Mount Hope-Highland Historic District and hosts walkers, runners, nature enthusiasts, and history buffs on a daily basis. Without its majestic trees, the cemetery and, thus, the surrounding neighborhoods would be a very different place. Increased investment in Mount Hope's trees would allow for the diligent work needed to care for, maintain, and preserve the trees for future generations, while maintaining the integrity of the surrounding neighborhoods and expressing respect for those buried in the cemetery.

Table 2. Replacement Value of Mount Hope Trees

Area of Cemetery	Replacement Value	
	All Trees	Historic Trees Only (479)
North Section	$9,205,938	$3,811,301
South Section	$5,018,044	$327,668
Total	**$14,223,982**	**$4,138,969**

The historic trees of Mount Hope Cemetery are unique cultural assets of the city. The attention and investment needed to extend their service lives are well deserved. Today, the historic trees in Mount Hope, found primarily in the northern sections, are valued at over $4 million. Once a venerable tree is lost, an important part of the city's history is gone, and any replacement tree will require 50 to 100 years to offset that loss. As shown in Table 2, the cemetery's designated 479 historic trees represent approximately 15% of the entire tree population and 30% of the total asset value.

Preservation and Care Align with the City's Larger Plan

Investing additional resources in Mount Hope Cemetery's urban forest is an investment in the city's existing short-term and long-term plans. This work to preserve and care for the trees directly supports multiple existing city initiatives and goals.

Rochester's last comprehensive plan, *Rochester 2010: The Renaissance Plan,* called for environmental stewardship, citing the need to:

- Conserve and protect the natural resources so that future generations can enjoy those same resources, standard of living, and quality of life.
- Reduce the amounts and toxicity of the various forms of pollution entering the environment and the public health threats from all forms of environmental pollution and contaminants.
- Preserve and enhance waterways, parks, urban forests, recreation, and open space areas in Rochester through a regional "no-net-loss" approach and maximized environmental benefits derived from those resources and assets.

The city's 2012 *Urban Forest Master Plan (UFMP)* also calls for investment in Mount Hope Cemetery, stating the following:

- The City of Rochester believes a healthy urban forest is an integral part of city infrastructure and essential to the health and welfare of all citizens, calling for management plans to be developed for both Mount Hope and Riverside cemeteries.
- Steps should be taken to stabilize the tree population in parks so that decline is avoided. A planting strategy is essential for parks and cemeteries to ensure that work is purposeful and well planned.

Recently, the 2016 *Mount Hope Cemetery Master Plan (MHC-MP)* project was initiated to identify guiding principles for current and future decisions affecting Mount Hope, identify short- and long-term needs for the cemetery, specify overall strategy and goals, and optimize land utilization, while at the same time improving the overall aesthetics of Mount Hope, among other objectives. The following statements and recommendations were made related to tree care:

- The existing mature tree canopy was noted as "vital for the spirit of place at Mount Hope" and was touted as one of the cemetery's most precious features.
- A management plan is critical to the success and longevity of the cemetery. It should identify priorities, set short- and long-term goals, and lay out a strategy for implementation, considering personnel, volunteers, and other resources.
- There should be sufficient annual funding for proactive maintenance and young tree care.
- Maintenance should follow current industry standards, including preservation and remediation techniques for mature trees impacted by construction.
- Insect and disease monitoring and control programs should be in place.
- Establish and follow a system for evaluating tree removal.
- Update the inventory with all pertinent data.

GOALS

The goal of this document is to provide a detailed roadmap for effective and efficient management of the cemetery's urban forest, including individual trees and woodland areas, by employing best practices and technical standards that reflect the latest advancements in the field. Achieving this goal will require active and consistent monitoring of trees, proactive care to extend the life of trees, and thoughtful planning for successional tree planting work.

Simply, success can be measured when the following conditions are found in Mount Hope Cemetery:

- All trees and landscape features are in good condition and are well maintained.
- Historic trees are preserved and reasonable plans are in place for successional planting.
- There are little to no invasive plants on the property.
- Woodland stewardship programs are in place.

THE WAY FORWARD

Mount Hope Cemetery is a unique cultural resource in Rochester and for the region. However, its tree resource and the management needed to preserve and sustain it are not unique. Cemeteries and cities across the state and the country have similar natural resource assets --- landscape trees, historic trees, woodlands, streams and ponds --- and the progressive managers of these assets perform their duties using proven best practices and special programs.

Best Management Practices in Precedent Landscapes

Many cemeteries place a high value on their landscape trees. They understand that this asset creates the peaceful, contemplative, and attractive setting befitting of the land use. They also realize that the mature trees support their business, provide environmental services, and increase their exposure to the public.

As stewards of this natural resource, grounds managers implement a number of proactive, best management practices related to their urban forest. The following activities have been shared by cemeteries, or are known by Davey Resource Group, as examples of what current tree management activities and programs are in place in other cemeteries.

- *Historic/Venerable Tree Care* – Historic cemeteries provide routine and specialized maintenance whenever needed, and almost at any cost, to extend the service lives of especially old and significant trees. Almost all cemeteries have tags, plaques, brochures, tours, and other programs to identify these trees for visitors.
- *Landscape Tree Care* – Notable cemeteries have a tree inventory and perform cyclical maintenance on their landscape trees with the goals of keeping them safe, vital, and attractive.
- *Insect and Disease Monitoring and Treatment* – Preventing widespread infestation and damage is key to prolonging the service lives of trees, especially mature and historic trees. Knowing that it's easier and less expansive to control a small outbreak, proactive cemeteries have implemented an insect and disease monitoring program for their landscape plants, trees, and turf.
- *Successional Tree Planting* – Proactive cemeteries have tree planting programs in place with the goals of individual tree and/or canopy replacement, species diversity, to create an arboretum setting for the enjoyment of the public.
- *Trained Staff* – While some have a dedicated cemetery arborist, most have horticultural staff who are ISA Certified Arborists, and/or provide regular tree care and planting training to their grounds staff.
- *Volunteer Programs* – Many successful cemeteries have programs for the public to become involved with and support the cemetery, such as "Tree Tenders/Stewards" who assist with young tree care.
- *Public Engagement Programs* – Notable cemeteries are recognized and valued by the public, locally and regionally, because they have long-standing and innovative public engagement programs in place, such as driving and walking tours of the grounds, special events, educational programs, etc.

(These best practices and programs were reported anonymously through interviews to Davey Resource Group by cemetery managers in New York and in the Northeast and Midwest United States. Some are known by Davey from our planning work with national and local cemeteries.)

Using the inventory data, City of Rochester and Mount Hope Cemetery planning documents, current arboricultural and natural resource management best practices and standards, and the examples set by and guidance from the managers of precedent cemetery landscapes, overall recommendations for effective management of the trees at Mount Hope Cemetery have been developed. Each recommendation is described further and prioritized and categorized in this plan, and focus topically on:

1. Enhancement of recently initiated eight-year cyclical tree care
2. Coordination of cyclical care with new tree planting, care, and inventory updates
3. Enhancement of annual inspections of historic trees
4. Creation of a dedicated arborist position
5. Development of a decision structure for care versus removal of trees
6. Implementation of a tree succession strategy
7. Reinvigoration of the historic tree program
8. Engagement of the public
9. Incorporation of Mount Hope Cemetery's needs into the city's comprehensive plan
10. Prioritization and enforcement of tree protection during construction
11. Development of a volunteer young tree care program
12. Definition of partnership roles
13. Woodland restoration and management
14. Further evaluation of erosion solutions
15. Implementation of continual training program for staff, contractors, and volunteers
16. Clarification of needs for future funding

Recommendation #1. Enhance and Continue Cyclical Tree Care Program

Currently, the cemetery tree population receives a cursory annual visual inspection. This approach can address the most urgent and obvious tree maintenance needs, but does not assess emerging issues that could be addressed quickly and more cost-effectively. This approach also does not comprehensively evaluate the conditions and needs of the historic trees.

A proactive, cyclical mature tree care program decreases risk and improves the condition of the tree population. It also increases the environmental and economic benefits of trees, results in more predictable budgets and workloads, and reduces long-term tree maintenance costs.

As a result of additional capital funding secured in 2016, the city will initiate an eight-year rotational tree care (pruning and removal) program as recommended by the MHC-MP (see map inset for the management areas). Eight years is a desirable care cycle to keep trees vital and safe, as proven by Miller's research shown in Figure 2. This is a proactive and efficient program that should be funded annually without fail.

Beyond tree pruning and required removals, the cyclical tree maintenance program could incorporate additional landscape management needs as identified in the MHC-MP. Additional tasks, such as the need for specific vista pruning, removal of invasive plants, and specific monument clearance can be addressed on the same rotation during the preventive tree maintenance operations. Plant health care checks and special care could also be addressed at this time, including tasks such as fertilization, cabling and bracing, core aeration, and insect and disease control applications.

Advance planning for this work may also provide community partners opportunities to apply for supplemental funding if needed, or to engage with the surrounding community for assistance.

This additional work identified both in the master plan and through Davey Resource Group's fieldwork in each of the eight management areas has been summarized in the appendix for easy future reference.

As shown in Figure 6, proactive tree care can potentially lower the tree mortality rates by improving overall tree condition. This has a significant impact on the future of Mount Hope Cemetery, as shown in the table and the following charts, comparing future canopy projections with standard mortality rates to those with lower mortality rates. As shown in Table 3, w*ith proactive care, the loss of mature trees can be reduced by 20% over 30 years.*

Funding Required: *Additional staff time from grounds staff, potentially more for contractors.*

Why Prune Trees on a Cycle?

Miller and Sylvester (1981) examined the frequency of pruning for 40,000 street and boulevard trees in Milwaukee, Wisconsin. They documented a decline in tree health as the length of the pruning cycle increased. When pruning was not completed for more than 10 years, the average tree condition was rated 10% lower than when trees had been pruned within the last several years. Miller and Sylvester suggested that a pruning cycle of five years is optimal for urban trees.

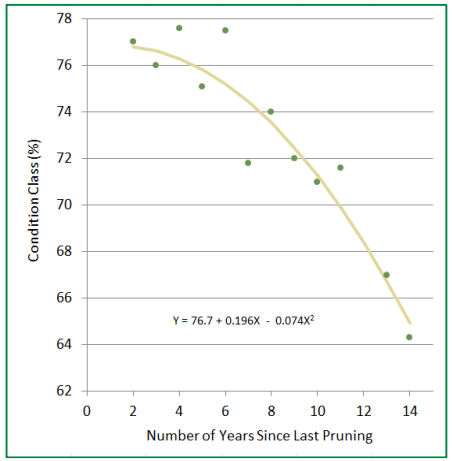


Figure 5. Relationship between average tree condition class and number of years since last pruning (adapted from Miller and Sylvester 1981).

Preventive Care Saves Money & Irreplaceable Loss

It is very easy to defer maintenance on trees; however, the consequences can be severe.

In New York one storm event ten years ago destroyed 700 trees in one night, causing over $1.2 million in damages. Ten years later, the cemetery is still paying off the loan that was acquired to cover the storm recovery efforts. Managers stated that had they had a preventative maintenance program in place prior to that event they would have had up to 40% less in damages.

Another New York cemetery lost 100 trees in just a few days from Hurricane Sandy. According to managers there it was very easy for them to defer maintenance on trees over the years, however, the consequences proved to be severe. The lesson they learned was that proper maintenance reduces storm damage to trees and consequently to the monuments below when limbs are falling and trees are toppling. Now, they have adopted a management approach to tree maintenance where they are always thinking of and working toward the health of the cemetery 100 years from now.

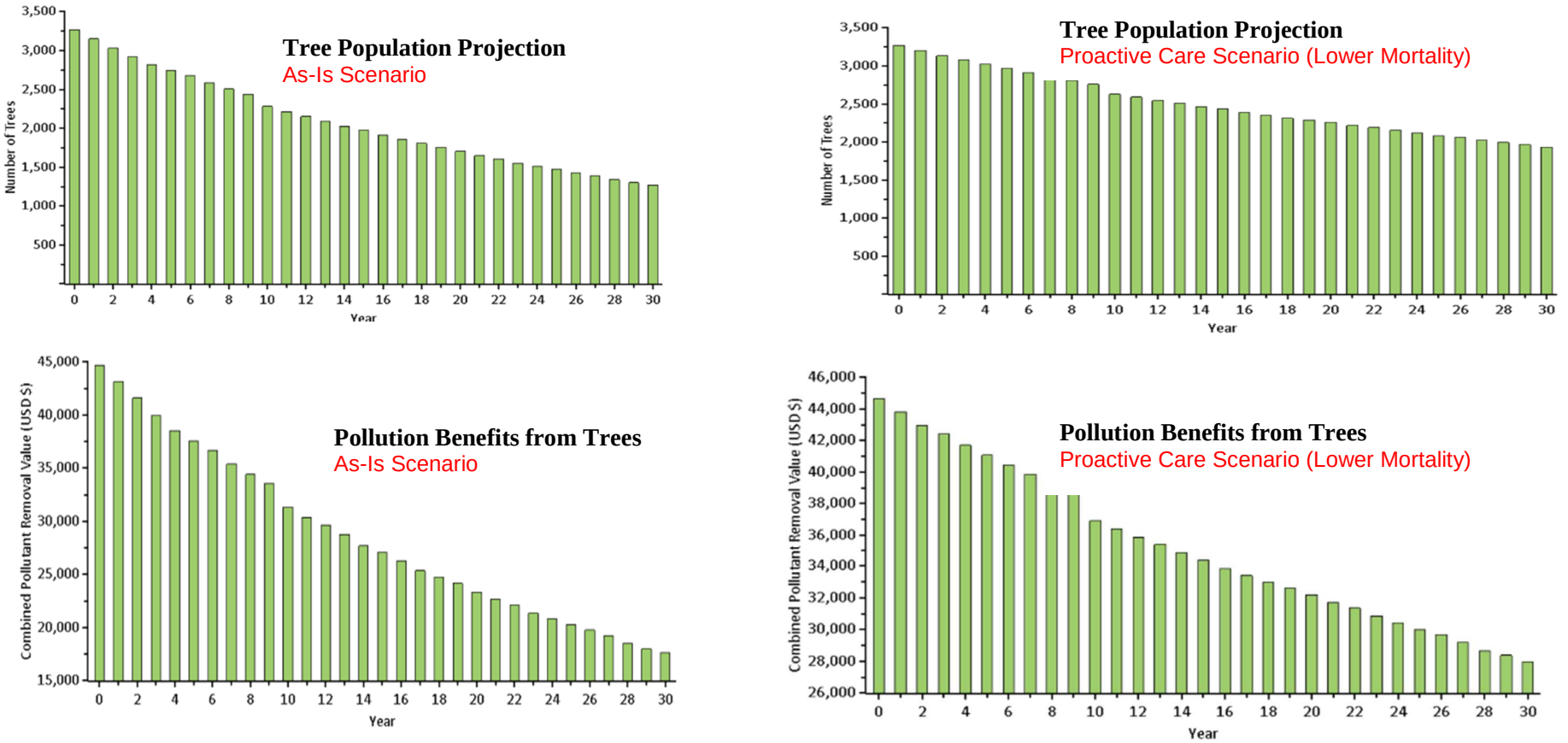


Figure 6. 30-year projections of trees at Mount Hope Cemetery – comparison of outcomes based on care levels.

Table 3. Comparison of the Effect of Care on Mount Hope Cemetery Trees

	Today at Mount Hope	In 30 Years at Mount Hope - "As-Is" Scenario -	In 30 Years at Mount Hope - "Proactive Care" Scenario -
Total Number of Trees	3,269	1,273	1,933
Change in Quantity		-61%	-41%
Air Pollution Removal Benefits Value	$44,643	$17,620	$27,979
Change in Value		-61%	-37%

i-Tree Eco Forecast Modeling Scenarios

As-Is Scenario: *Timeframe:* 30 years. *Annual Mortality:* i-Tree's standard rates of 3% for healthy trees, 13.1% for sick trees, 50% for dying trees. *Disease/Pests:* Registered activity of beech bark disease, hemlock woolly adelgid, and emerald ash borer. Low mortality rates (0.5-1% per year) due to current proactive management. *Storms:* One storm (ice storm or summer storm) taking place in Year 10 that results in a 3% mortality rate. *Plantings:* None.

Proactive Care Scenario: Same as above except for annual mortality rates. These rates were lowered as a result of proactive care: 1.5% for healthy trees, 10% for sick trees, 40% for dying trees.

Recommendation #2. Coordinate Cyclical Tree Care with New Tree Planting/Care and Inventory Updates

To facilitate coordination between many players and supporters of Mount Hope Cemetery, and to ensure effective systematic care of the landscape, an eight-year plan in line with the city arborist's work plan is recommended. Methodical coordination of work includes pruning or removing trees, grinding stumps, and clearing invasive species, followed by a planting effort the following year with a subsequent three-year young tree care program for those newly-planted trees. As work is accomplished, record tree planting in the inventory database.

In its most basic form, the annual plan under a nine-year cycle would consist of these activities:

Year One - SOUTH
Area 1 Cyclical Care (enhanced)
Area 2 Inventory Update (includes adding potential planting sites)

Year Two - SOUTH
Area 1 Succession Planting
Area 2 Cyclical Care (enhanced)
Area 3 Inventory Update (includes adding potential planting sites)

Year Three – SOUTH & NORTH
Area 2 Succession Planting
Area 3 Cyclical Care (enhanced)
Area 4 Inventory Update (includes adding potential planting sites)
Volunteer Young Tree Care Program - Areas 1 & 2

Year Four – SOUTH & NORTH
Area 3 Succession Planting
Area 4 Cyclical Care (enhanced)
Area 5 Inventory Update (includes adding potential planting sites)
Volunteer Young Tree Care Program - Areas 1, 2, & 3

Year Five –NORTH
Area 4 Succession Planting
Area 5 Cyclical Care (enhanced)
Area 6 Inventory Update (includes adding potential planting sites)
Volunteer Young Tree Care Program - Areas 1, 2, 3 & 4

Year Six – NORTH
Area 5 Succession Planting
Area 6 Cyclical Care (enhanced)
Area 7 Inventory Update (includes adding potential planting sites)
Volunteer Young Tree Care Program - Areas 2, 3, 4, & 5

Year Seven – NORTH
Area 6 Succession Planting
Area 7 Cyclical Care (enhanced)
Area 8 Inventory Update (includes adding potential planting sites)
Volunteer Young Tree Care Program - Areas 3, 4, 5, & 6

Year Eight – NORTH
Area 7 Succession Planting
Area 8 Cyclical Care (enhanced)
Area 1 Inventory Update (includes adding potential planting sites)
Volunteer Young Tree Care Program - Areas 4, 5, 6, & 7

Year Nine – NORTH & SOUTH
Area 8 Succession Planting
Area 1 Cyclical Care Program - this starts the second round again
Area 2 Inventory Update (includes adding potential planting sites)
Volunteer Young Tree Care Program - Areas 5, 6, 7, & 8

Funding Required: *None for coordination work. Actual cyclical care work is listed in the Budget Requirements section.*

Recommendation #3. Enhance Annual Inspections of Historic Trees

Proactive inspections are essential to revealing potential problems with any tree, and are critical for high-value trees like the designated historic trees at Mount Hope Cemetery. They can uncover issues early, which can lead to cost-effective actions that increase tree longevity and, in the case of issues of disease or pests, address the problem before reaching a point beyond remedy. This is especially important, as historic trees are tied to the financial stability of the business, as mentioned earlier.

Because they are of such high value, enhancing the care of historic trees through the following activities is recommended:

- Currently, city arborists inspect all trees using the International Society of Arboriculture's *Best Management Practices: Tree Risk Assessment* protocols by performing a Limited Visual Assessment (Level 1) inspection each year. Increase this inspection to a Basic Assessment (Level 2), and to an Advanced Assessment (Level 3) if indicated by the Level 2 findings, on historic trees during the scheduled inspections. Additionally, make the effort to perform Level 3 risk assessments of historic trees after severe weather events.
- Concurrent with the annual risk assessments, inspect historic trees to determine the need for other advanced maintenance tasks, including insect and disease monitoring, soil testing, foliar nutrient testing, and other special needs such as cabling, lightning protection, and plant health care.
- Adjust the existing inventory to 1) note any additional high-value trees identified (as per the definitions in the MHC-MP) and 2) create an additional data field to record findings and indicate any special maintenance needs revealed from the annual Level 2 or 3 inspection (historic trees identified in the CLR have already been noted in the inventory).
- Identify the 50 most valuable trees on the property (those that are of the utmost value to the cemetery and community) and note this status in the inventory.
- Earmark a portion of funding to historic tree care each year to be able to immediately address priority needs and findings from the historic tree inspections without needing to find funding sources mid-year.

Funding Required: *Additional staff time to perform Level 3 inspections on the 476 historic trees each year is estimated at $12,000 per year. See page 51 for more detail.*

Historic Tree Designation

Historic trees were described in the 2008 MHC Cultural Landscape Report (MHC-CLR, Chapter 4) as ones that "existed in the Mount Hope Cemetery landscape during the period of significance, with several trees that likely pre-date the founding of the cemetery." There are 476 historic trees at Mount Hope based on this definition (10% of all cemetery trees), all of which are in the northern section of the cemetery and have been noted/recorded in the city inventory system.

In the more recent MHC-MP (Pg. 61), the introduced concept of "high-value trees" expanded this category to include trees that are:

- Unique, as a specimen (i.e., not present in great numbers).
- Important as a scenic or character-giving feature (as a single specimen, as part of a vegetation pattern, or typical for its landscape character zone).
- In Excellent or Good condition (eg., newly-planted memorial trees).

If accepted, this potentially doubles the current amount to 897 historic/high value trees: 496 in the north sections and 401 in the south sections (approximately 25% of the entire tree population).

This decision will substantially affect the level of management and, thus, the level of annual funding needed.

Recommendation #4. Create a Position for a Dedicated Cemetery Arborist

Despite the city's annual walk-through inspection, cemetery trees effectively receive an in-depth professional evaluation by the city arborist once every eight years and perhaps after storm events. Proactive landscape tree management, especially for mature and historic trees, requires that an experienced certified arborist be more readily available to perform tree condition monitoring, and to complete other tasks critical to the success of Mount Hope Cemetery's urban forest management plan.

Additionally, there is additional work (many tasks of which are identified in these recommendations) that could also be assumed by a dedicated staff person. This position could conduct annual plant health care, risk, and post-storm event inspections on all historic/high-value trees, conduct the annual cyclical maintenance inspections and inventory updates, and report findings to the city arborist; perform ongoing minor tree work such as new and small tree care, tree planting, minor pruning for monument clearance; and plan and conduct invasive plant removal and habitat restoration projects. The "Cemetery Arborist" could also direct, monitor, and help perform landscape work when needed to assist the cemetery grounds staff, since an ideal candidate for this position would have horticultural expertise to carry out some of the landscape recommendations from the MHC-MP. A staff member with the ability to carry out work from both this plan and the MHC-MP would be ideal.

This role, if dedicated and full-time, could also assume and assist with administrative and public relations tasks, such as keeping the tree inventory database current, managing applications for local, state, or national champion tree status, conducting outreach programs, coordinating landscape volunteers, developing a historic tree walk to support a smartphone app, assisting with grant applications, and helping to manage volunteers and potential interns.

Whether full-time or part-time, a "cemetery arborist" position creates a structure that will result in more frequent and dedicated professional expertise on the grounds at Mount Hope Cemetery. This position could potentially perform Level 2 inspections more frequently along the high-trafficked (and thus potentially high-risk) areas, and along the woodlines where mowing occurs and people may congregate The MHC-MP also called for a significant amount of landscaping improvements, which could also fall under the purview of this position.

Possible Scenarios and Related Funding Required:

- Full-Time Arborist, shared between Mount Hope Cemetery and Riverside Cemetery. This role would likely entail 100% arboriculture work dedicated to these two properties, although the position could provide supplemental assistance to the city's street tree efforts. *Estimate Funding Needed: Salary plus benefits: approximately $52,500 per year.*
- If hiring processes and funding for personnel are such that the city cannot accomplish this, the cemetery arborist role could be filled through a qualified urban forestry consultant on an as-needed basis. *Estimate Funding Needed: Estimated 60 hours per month at $75 per hour = $4,500 per month or $54,000 per year.*
- Identify one or more cemetery staff for ISA certification, ideally one also with landscape/horticulture skills to help implement the other non-tree landscape initiatives described in the MP. *Estimate Funding Needed: ISA-Certified Arborist testing for an existing staff person would cost $1,000–$1,500 (includes study materials, classes, application, and testing) + current salary.*

Recommendation #5. Create a Structure to Evaluate Decision to Care vs. Remove

The decision to remove a mature tree or invest more maintenance funds is a difficult one for any landscape manager. Ultimately, said decision boils down to answering one question: does the benefit of having the tree outweigh the cost of managing the tree? The City of Rochester's policy on public tree removal states that a city tree will only be removed for reasons of:

- Public safety (defined as a hazard, constituting removal of more than 50% of the live crown, or when the structural integrity of the tree is undermined to the point that it is susceptible to windfall).
- Forest health (defined as when tree disease significantly threatens the health of other city trees).
- Fiscal management (defined as when alternative tree management practices exceed the value of the tree or will not prolong the tree's life beyond five years) (Rochester 2016).

It is recommended that Mount Hope Cemetery consider the following additional factors that may singularly or collectively affect the decision to remove, or invest in, mature trees:

- Risk to surrounding monuments.
- Location (highly visible or not).
- Function (framing a view, shading a building, specimen, etc.) .
- Benefits provided.
- Invasive status.
- Designation as an historic or high-value tree; high value trees were identified in the MHC-MP as vital elements of the visual integrity of the cemetery and, thus, warrant great efforts for preservation.

When considering these variables, a "cost-benefit" analysis can be performed, and the resulting decision would be reasonable, rational, and defensible.

When extensive damage from insects, diseases, or storms have occurred and/or expensive maintenance is required for an individual tree, ask the following questions:

Question 1: Is the tree an historic/high value tree?

If yes… go to Question 3. Local opinion and national practices recommend that significant steps should be taken to save or sustain the tree at almost any cost. Particularly when dealing with a historic tree, explore all options for addressing risk and/or performing plant health care measures to make every reasonable effort to treat or stabilize a historic tree before taking the most irreversible course of removal.

If no…go to Question 2.

Question 2: Is this tree a Norway maple, other invasive species, or otherwise undesirable species?

If yes…remove the tree (or girdle if in a wooded setting away from public access) as part of the effort to steadily eradicate this invasive species in the cemetery. Replace with another species if the space is available.

If no…go to Question 3.

Question 3: Has a TRAQ Basic Tree Risk Assessment been performed to identify all defects and possible targets, and determine an overall risk rating?

If yes…go to Question 4.

If no…This must be done before any future decisions are made or actions taken.

Question 4: Based on the city's acceptable risk threshold, does the tree's overall rating exceed this level?

If yes…then remove the tree. If the tree is an historic tree, or a unique species, try to salvage and reuse the wood in creative ways that honor the historic and special value of the tree. Replace with a similar species if appropriate.

If no…go to Question 5.

Historic Tree Care Guidelines for Austin, TX Cemeteries

The City of Austin, TX defines the level of appropriate care for historic trees in all five of their cemeteries as follows:

"Work to maintain historic trees unless they are dead, dying, diseased, and untreatable, or pose a high risk to people and infrastructure. When dealing with an historic tree, explore all options for addressing risk before taking the most radical course.

Make every reasonable effort to first treat or stabilize an historic tree that is diseased or damaged prior to considering removal when appropriate, and if allocation of resources permits such a course of action. Stabilization can include simple solutions such as propping up a low-hanging limb or anchoring it in place with cables. Removing large, dead branches and cabling weak branch attachments may adequately reduce the risk of falling limbs. Installing a lightning protection system may prevent a large tree from being struck and damaged"

Question 5: Does the tree perform a valuable function in a cemetery setting (such as framing views); is it in a highly visible location, and/or does it provide significant benefits (determined by using i-Tree applications)?

If yes…go to Question 6.

If no...then prune or remove the tree according to the cyclical maintenance program schedule.

Question 6: Based on past work records (if available), have consecutive maintenance expenditures (over an eight-year period) increased by more than 50% each year, and/or exceeded a reasonable level of investment (as determined by the city)?

If yes…then remove the tree according to the cyclical maintenance program schedule.

If no…go to Question 7.

Question 7: Has a Certified Arborist determined an estimated service life for the tree with and without routine or specialized maintenance?

If yes…and its projected life span is less than 3 years despite any level of maintenance given, then consider removing the tree (or at least not investing more in its care).

If yes…and its projected life span is greater than 3 years, then consider performing the recommended routine or specialized maintenance.

If no…then perform a basic vitality assessment upon which to make reasonable decisions and gauge future actions.

Funding Required: *None*

Recommendation #6. Implement Tree Succession Strategy

In an active cemetery landscape, tree succession will only happen with purposeful planning and planting. According to the city's 2012 Urban Forest Master Plan, more trees are currently being removed than are being planted. Steps have been called to "stabilize the tree population in city parks to a 0% decline," citing this need specifically at Mount Hope and Riverside cemeteries.

Considering the age of many of MHC's trees, storm events, climate change, and future development and improvements, tree loss is inevitable. As shown in the earlier section *What Does the Future Look Like?*, a tree succession strategy of planting at least 50 trees each year for the next few decades is necessary to maintain a strong tree population and retain the many benefits trees provide.

i-Tree Eco Forecast Modeling Scenarios

Scenario 1: 20 Trees/Year: *Timeframe:* 30 years. *Annual Mortality:* Low rates annual mortality from proactive tree care: 1.5% for healthy trees, 10% for sick trees, 40% for dying trees. *Disease/Pests:* Registered activity of beech bark disease, hemlock woolly adelgid, and emerald ash borer. Low mortality rates (0.5–1% per year) due to current proactive management. *Storms:* One storm (ice storm or summer storm) taking place in Year 10 that results in a 3% mortality rate. *Plantings:* Install 20, two-inch caliper trees every year.

Scenario 2: 100 Trees/Year: Same as above, except annual planting is increased to installation of 100, two-inch trees every year.

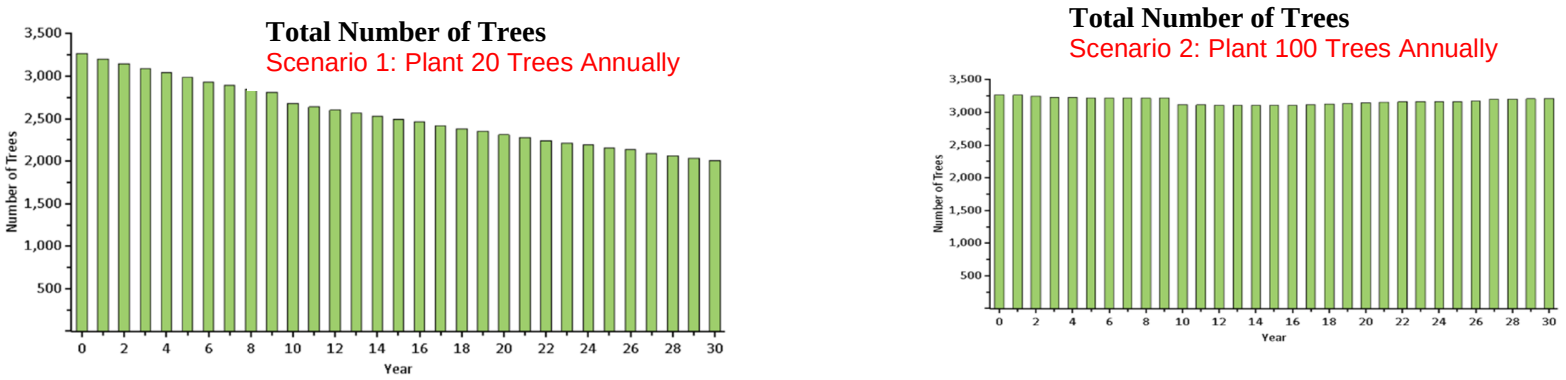


Figure 7. Comparison of planting impacts over 30 years – quantity of trees.

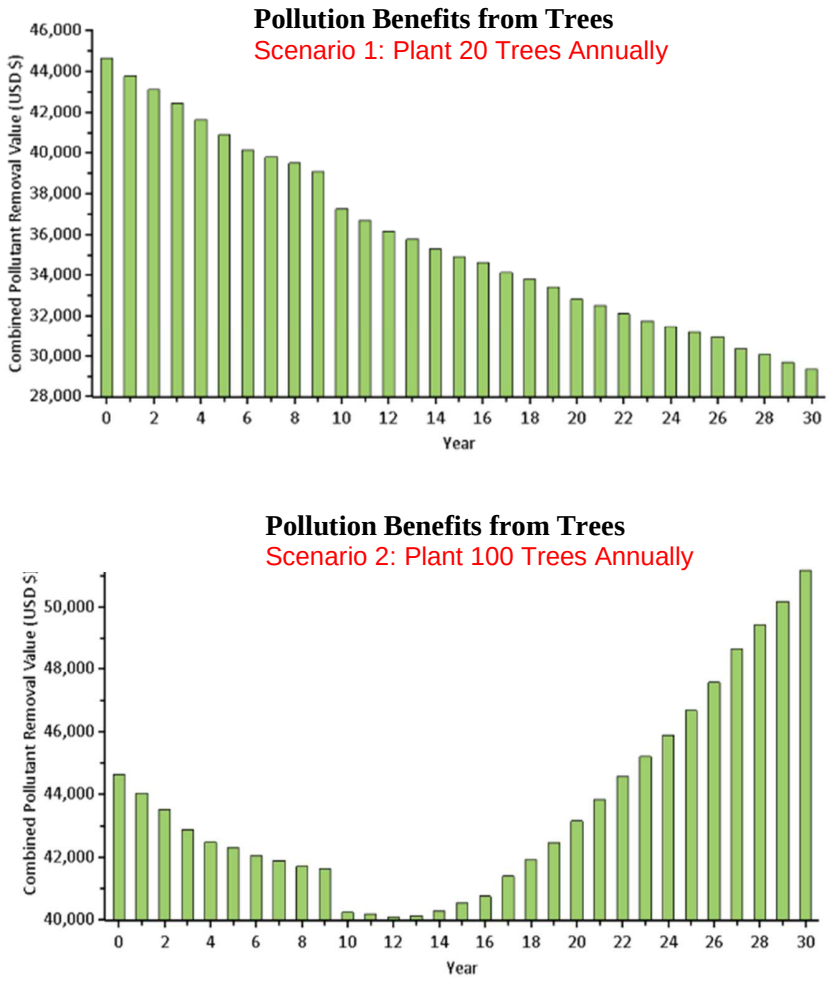


Figure 8. Comparison of planting impacts over 30 years – tree benefits.

Tree Succession Strategies

Cemeteries and arboreta have differing approaches to tree succession strategies, as shown below. The one thing they all have in common, however, is the need and drive for continuous planting.

- To support its origins, a historic cemetery in New York is focusing on tree planting based on the original plans of the cemetery. This has been spelled out in a recently commissioned "comprehensive landscape renovation" plan. Using recommendations made in this plan, they have created a 12-year planting plan based on the original plans of the cemetery, although work has not yet started because of lack of funding.

- To gain species diversity, another cemetery in New York focuses heavily on increasing species diversity into their succession planting efforts. Additionally, they try to introduce rare and lesser-known species or cultivars whenever possible.

- Using prioritized planting zones, a cemetery in Missouri is focused on methodical planting by zone (geographic area). Each zone has a priority – some may be focused on reforestation, screening, and always includes an effort to boost species diversity. Zonal planting also makes young tree care much more manageable logistically for watering, pruning, mulching, and other needs. They are also proactively planting in those areas suffering from sudden oak death as they know the loss of oaks in the future is inevitable.

According to the model, Figure 3 illustrates that anything less than planting 100 trees a year for 30 years could result in a loss of total trees. However, it is important to also note that this model does not take into account natural regeneration in woodland areas, so planting levels to retain a "no net loss" inventory level could be less than 100 per year.

It is recommended to include successional planting with the cyclical pruning/removal care program and focus the planting in one management area per year. See Recommendation #2 for the timeline example. Planting in one geographic area also makes watering and young tree care much more manageable.

In addition to purposeful planting by management area, note and anticipate historic tree decline, and try to plant new replacement trees before historic tree removals occur. Create a field in the current tree inventory (or some other kind of trigger) for trees that have been identified as having less than 10 years' life expectancy left. Making a concerted effort to determine potential new tree planting sites is encouraged. Selecting species within the recommended guidelines specified in the MHC-MP's Landscape Character Zones to install new trees in advance of mature tree removal can also be initiated.

The dedicated arborist position (see Recommendation #4) can be constantly adding potential and available planting sites and information to the inventory as part of the annual care cycle. This way, when annual tree planting projects are approaching, sites and species have already been identified.

When choosing tree species to plant, there are two basic guidelines:

- Add species not yet in Mount Hope Cemetery. Increasing the overall diversity within the tree population will help guard against great losses from insects, disease, and climate change, and will help the cemetery reach Arboretum Level II status. There are currently 87 species at Mount Hope. To meet the next level of arboretum status, 100 species are required.
- Adhere to the guidelines/suggestions provided in each description of the Landscape Character Zones of the MHC-MP when planning any installations.

Funding Required: *50 trees per year, installed by a contractor at $560 per tree = $28,000 per year.*

Recommendation #7. Reinvigorate the Mount Hope Cemetery Historic Tree Program

The historic trees are as intrinsically linked to Mount Hope's past and future as are the monuments and the people laid to rest. Without these venerable trees, this city icon would be an entirely different place. A program directed towards the promotion (and preservation) of these trees is highly recommended. The city's Urban Forest Master Plan recognized that the environmental, economic, and social value of the city's urban forest have not yet been quantified and utilized in a promotional program. Ideas included using this data in self-guided tours of city-owned trees, a cataloging of champion trees among others.

Recommended steps include:

- Recreating the brochure with current photographs and information about the 50 most well-known and interesting historic trees.
- Investigating if any historic trees qualify for state or national champion status.
- Creating an app that brings together the locations, photographs, species facts, and historic descriptions for visitors to use when touring Mount Hope. An "Historic Tree Trail" for walking or driving can also be created and made part of the app. This could potentially be branded as a part of the Reforest Mount Hope campaign.
- Updating and completing plaques for historic trees.
- Involving local historical groups, such as the Rochester Historical Society, Rochester-Avon Historical Society, Landmark Society of Western New York, among others, in developing and advertising the Historic Tree Program.
- Inviting local businesses (particularly businesses established in Rochester over 100 years ago, such as Rochester Scale Works, Burke Forging & Heat Treating, Xpedex, etc)., or other donors to "adopt" an historic tree to help fund its preservation, or be a "Canopy Sponsor", whereby their significant donation (of $5,000 or more for example) is used for "future historic tree" planting and care, and is publicly acknowledged in an appropriate manner.
- Considering this program as a potential activity of the Reforest Mount Hope campaign.

Historic Tree Programs

Green-Wood Cemetery has plaques installed on many of its historic trees. Each plaque includes genus, species, common name, native range, and family. Green-Wood has also recently launched an interpretive program, which will be placing signage in the field that will describe landscape features in order to further engage visitors (Charap 2016).

Bellefontaine Cemetery has plaques installed on all historic trees. Each plaque includes the species (common and botanical names), one informational sentence about the species, and one "fun fact" as well.

Funding Required: *App development cost, plaques cost, staff time to manage and organize tasks, printing costs for brochure, etc. With student assistance on the app development, an estimated budget of $5,000–$10,000 should cover all other costs.*

Recommendation #8. Engage the Public to Support Tree Care and Planting

Citizens vote, talk directly to elected officials, have money and resources, and benefit from the trees and landscape. Mount Hope Cemetery must actively engage the citizens of Rochester and Monroe County in support of the future of the urban forest. Programs that educate residents and promote community involvement would be useful ways to engage the public. Consider the following activity options:

- Plan a robust media campaign that focuses on the value of MHC trees and the need for community support.
- Find a local celebrity to champion MHC and be the "spokesperson for the trees."
- Provide a variety of volunteer opportunities beyond tasks that involve hard labor. Providing volunteer services, no matter the type or the duration of service, leads to a sense of ownership and responsibility in the individual, which in turns cultivates more champions for the cemetery and more tree preservation and planting initiatives.
- Promote MHC's arboretum status, and focus on its value as a place for students and homeowners to learn about trees.
- Expand the tree and horticultural related educational opportunities in MHC. Beyond historic tree walks and other tours, provide demonstrations of invasive control, woodland management, proper planting, building bird boxes, etc., and host special lecture series featuring arborists, foresters, historians, and local authors.
- Conduct festivals and special events to generate interest in and enthusiasm for MHC. Plan annual seasonal events such as spring "Cemetery in Bloom" or a fall foliage festival. Have a summer concert series set beneath the cemetery trees. Begin planning now for the 200-year anniversary and other historic milestone dates. Allow neighborhood associations and other public organizations to use the grounds for mutually beneficial and appropriate events.
- Create and improve walking trails through woodlands and among the historic trees to encourage more passive use of MHC, potentially engaging local hiking groups to work on trail building.
- Reach out to the University of Rochester and other area schools (any level) to engage them in a service learning campaign/project at MHC. Potential programs to pursue could include landscape architecture, GIS, horticulture, arboriculture, environmental studies, and education.
- Leverage the city's Sister City program to establish relationships with cemeteries in other cities to generate enthusiasm for tree care in Mount Hope.
- Work with local schools to create a writing project or contest that focuses on the historic trees and the events they have witnessed in their lives.
- Consider this program as a potential activity of the Reforest Mount Hope campaign.

Funding Required: *Staff time to manage and organize volunteer efforts, trail work if contracted out. Promotion. Not possible to estimate.*

Recommendation #9. Include the Value and Needs of Mount Hope's Trees into the City Comprehensive Plan

Rochester 2010: The Renaissance Plan, the city's long-range strategic plan completed and adopted in 1999, cited the urban forest as an integral part of Rochester 2010: The Renaissance Plan as it impacts 7 of the 11 campaigns within the plan. Rochester 2010 highlighted the city's belief in a healthy urban forest as an integral part of the city infrastructure and is essential for citizens' well-being.

This plan is currently being updated. With the update process underway, now is the time to ensure that Mount Hope Cemetery, its urban forest, and the urban forest within the city are adequately recognized in the city's comprehensive plan. This is important because city comprehensive plans are required by New York State law (28-A) to "serve as a basis for land use regulation, infrastructure development, and public and private investment."

The updated plan, *"Rochester 4.0 - Our Neighborhoods, Our Future,"* seeks to establish a cohesive vision that will serve as the roadmap to guide the city for the next 10 years. Every effort should be made to share key information about tree benefits and tree management at public meetings, as Rochester 4.0 will be a primary tool used to inform policy decisions and prioritize city investments (Rochester 1999).

Given the history and longevity of trees, the cemetery's urban forest is at the forefront of the Rochester 4.0 slogan: "Our future is as bright as our past." Before the completion of the comprehensive plan, the city should provide city planners and leaders with scientific data and context on the benefits of trees, and specifically the benefits of Mount Hope's trees.

Funding Required: *None.*

Recommendation #10. Enforce Tree Preservation and Protection During Construction

The MHC-MP recommends multiple infrastructure improvements such as road reconstruction, installation of steps on slopes, and new walkways. Additionally, there may also be future utility repair or improvement, ADA compliance, and other hardscape projects within the grounds. All of this work creates a real possibility of damage to trees from construction. Beyond providing timely maintenance and plant health care, one of the most critical actions an urban forest manager can take to preserve trees is to prevent them from being damaged by construction.

The Urban Forest Master Plan highly recommends tree protection for all public trees that are facing potential injury during construction projects. The city's current tree protection code and related guidelines are generally based on current best management practices, but as with many city code issues, enforcement and staying current with industry standards can be challenging. The city's plan acknowledges these challenges when it stated: "Construction practices and utility improvements are killing many trees and increasing the potential for tree failure due to root and trunk damage. Current ordinances and fines are not sufficient to prevent construction practices that destroy city trees and deter offenders. Reducing the number of trees removed because of construction or utility installation damage to equal the annual city attrition rates would be a significant accomplishment."

These recommendations are based on the Urban Forest Master Plan, the city's current code of ordinances, and are considered current arboricultural industry standards:

- For any construction project within the grounds, be proactive and have the Forestry Division in attendance at construction planning meetings to provide input, communicate contract specifications, invoke penalties for tree protection violations, and suggest remediation techniques per industry standards.
- The arborist and/or the city's contracted representative should be on site to monitor adherence to tree protection standards during active construction.
- Enforce the requirement that fences to be erected to protect the critical root zone of any tree within the construction limits, and prohibit encroachment into this area. Protect cemetery trees through on-site control measures, utilizing alternative construction practices, and assessing high monetary fines for violations, as defined and allowed for in the Code of the City of Rochester, New York.

- Suitable tree protection specifications, enforcement, and training for city staff and contractors should be developed and provided to enhance damage prevention, and to serve as the basis for competing operational tasks.
- The Department of Environmental Services and the Division of Forestry should continue to ensure that current tree protection standards are included in every appropriate construction contract; compliance with protection specification by contractors is achieved; and that stop-work orders are issues, payments are withheld, and fines are levied when contractors fail to abide with contract specifications related to tree protection.
- Cemetery grounds staff should be trained on tree protection basics and should be provided construction project updates to watch for instances of damage to trees.

Funding Required: *Staff time to manage and enforce.*

Recommendation #11. Institute a Young Tree Care Volunteer Program

The young tree population in MHC is expected to grow given the renewed emphasis on successional tree planting (see Recommendation #6), the expectations of receiving public and private grants for planting, and the success of the Reforest Mount Hope campaign. Getting trees purchased and planted is the "easy" part; keeping them well tended until they are established is the challenge. Professional, proactive cemetery grounds managers will not allow additional tree planting unless there is a sufficient amount of funding for maintenance and a detailed program for what and when maintenance will occur and who will do the work.

Consider implementing a young tree care volunteer program, often called "tree stewards," to assist with new tree care such as watering, mulching, and pruning. This activity provides yet another engagement opportunity and encourages partnership opportunities with youth groups (scout troops, church affiliated groups, high school community service programs), youth job corps programs, or garden clubs to accomplish young tree care tasks.

Such a program involves initial and continuing training, frequent mentoring, and overall coordination of the process and volunteers. While staff time is needed to sustain such a program, a dedicated cemetery arborist could spearhead these tasks (see Recommendation #4).

Trees to include in a "Young Tree Care" cycle are generally less than 8 inches in caliper. These younger trees sometimes have branch structures that can lead to potential problems as the tree ages, such as codominant leaders, multiple limbs attaching at the same point on the trunk, or crossing/interfering limbs. If these problems are not corrected, they may worsen as the tree grows, which increases risk and creates potential liability. Beyond pruning, young trees need consistent watering and mulching to become established, and may require fertilization and other PHC treatments until they reach maturity.

This program can create "tree stewards" for MHC and be modelled after similar and successful programs like those found in Buffalo, New York City, and Onondaga County, and "cemetery stewards" programs like the program in Huntington, New York.

Funding Required: *Staff time, volunteer time along with materials for supplies (gator bags, pruners, and other tools, etc.). Variable.*

Recommendation #12. Perform Woodland Restoration and Management

The woodland massings are part of the ecological and cultural history of the cemetery. As original features and assets of the grounds, the remnant forested areas need to be preserved and maintained.

A hallmark of the rural cemetery movement was that cemeteries like Mount Hope served as an oasis within the expanding urban and industrial landscape of the country, and were consciously designed to provide sanctuary, solitude, quiet, and beauty. Mount Hope's forested hillsides offered sanctuary and beauty in the 1800s as they still do today. The woodlands on the grounds deserve thoughtful management, as they provide many ecological benefits, but also are a large part of the development history and design heritage of the city.

To improve the quality of the woodlands and native forest ecosystem, the following tasks are recommended:

- Utilize traditional forest management techniques, like "timber stand improvement" to restore the vitality of the woodlands. Forest stand improvement activities include removal of invasive trees and plants, selective removal of poor-quality trees to reduce crown competition, and allow desirable trees to thrive, and removal of vines.
- Specifically, consider using trunk girdling (with or without basal herbicide injections) to kill medium to large Norway maple in woodland areas.
- In areas that don't present a safety risk, leave tall trunks of dead trees, creating habitat trees, to improve the habitat for birds and small mammals.
- Plant understory trees and shrubs to recreate the native, natural oak/hickory forest ecosystem.
- Create trails throughout the woodlands to encourage people to use and enjoy all areas of MHC.
- Through woodland and natural areas management, become an Audubon Certified Sanctuary. The Audubon Cooperative Sanctuary Program is an education and certification program that helps organizations and businesses protect the environment, while enhancing their bottom line. The program offers information and guidance to implement an environmental management plan that improves efficiency, conserves resources, and promotes conservation efforts. Audubon International awards certification to publicly recognize and reward environmental achievements and leadership. White Haven Memorial Park in Pittsford, Spring Grove Cemetery and Arboretum in Cincinnati, and other cemeteries across the country have already achieved this distinction. For more information: http://www.audubonintemational.org/acsp.
- Secure the services of a professional forester to assess the woodlands and provide a work plan to improve forest sustainability.

Funding Required: *Staff time, hired professionals to handle removals, chemical treatments, and more. Estimated at $5,000/year.*

Norway Maple Management

Norway maple is a non-native, invasive tree species that poses a threat to biological diversity in upstate New York. They reproduce by seed (winged fruits spread by the wind), which each tree produces in large amounts. They germinate readily in many environments and grow quickly when young. Once established, they create dense shade, preventing regeneration of native seedlings. "Although thought to have allelopathic properties (meaning that the plant releases toxins that inhibit or prevent the growth of other plants), research has not been able to confirm this." (NPS 2016)

There is no magic bullet to eradicate Norway maples. Until seed-producing trees are eliminated, annual long-term maintenance will be required to constantly maintain control of seedling populations in desired areas.

City contractors or other local tree removal experts should be used for larger Norway maple tree removals, and cut stumps should be treated with an herbicide in larger colonies under approved conditions and by a licensed applicator recognized by the State of New York.

Recommendation #13. Evaluate Both Structural and Vegetative Solutions to Erosion.

As the name implies, Mount Hope Cemetery is built on a topography subject to erosion. While vegetation is usually an effective natural solution to prevent erosion on steep slopes, there are areas where invasive plants are allowing erosion to occur, and where the natural topography, rainfall, turf maintenance practices, and human use have created erosion issues over time. The planting and/or removal of specific trees in certain areas may help improve erosion problems at Mount Hope, but that determination (and recommendations related to that determination) requires further exploration by structural engineers and agronomists.

Mount Hope Cemetery has an overabundance of Norway maple which are known to contribute to erosion by displacing other tree and groundcover species by producing abundant seedlings that create dense shade. The resulting bare ground can lead to problems such as soil erosion and soil compaction. However, the eradication of Norway maple should be approached with a post-removal, ground stabilization plan that is ready and funded.

Native grasses and herbaceous plants should be used to revegetate sloped areas after removing Norway maple or any other invasive plant. A good source of recommended species for New York can be found on the Ladybird Johnson Wildflower Center's website at www.Wildflower.org/Collections.

Additionally, these recommendations are provided to address the concerns about erosion:

- Consult with structural and soil engineers to determine what structural or vegetative solutions, or a combination of both, are most suitable for Mount Hope and will be most effective and long-lasting.
- Re-evaluate lawn mowing and weed trimming practices to ensure they do not create or contribute to erosion.
- For temporary cover, use mulch from tree care operations over wide areas of erosion, particularly near steps and walkways.

Funding Required: *Depends on whether a city engineer is available (no cost) or if consultant costs are used (variable).*

Recommendation #14. Create a Training Program for Staff, Contractors, and Volunteers

The work involved in tree care, tree planting, invasive plant control, and habitat restoration has to be performed by trained, knowledgeable persons. MHC should have a comprehensive, ongoing, and consistent training program for staff, contractors, and volunteers. A quality training program is integral to keeping workers on the grounds safe, efficient in their work, and motivated about learning new skills. Training does more than just educate. Training supports professional development and job advancement of the staff, provides contractors clear direction and expected performance outcomes, and positively influences the engagement levels, productivity, and attitudes and behaviors of volunteers.

Recommendations for Mount Hope's training program are as follows:

- Create a training program for MHC's grounds staff that focuses on new and young tree care, proper pruning, fertilization, and mowing techniques to prevent injury to trees.
- Create a training program for volunteers that gives them basic knowledge of tree planting, new tree care, and habitat restoration, as well as construction aftercare with extra watering, fertilization, or other treatments, in cases where digging for an interment is necessary within the root zone of an existing tree. See Recommendation #10.
- Request local tree service companies, landscapers, Cornell Cooperative Extension, and other local and regional professional organizations to provide free training for staff and volunteers on appropriate topics.
- Provide current or future city staff the opportunity to become International Society of Arboriculture Certified Tree Workers, Certified Arborists, and/or obtain the Tree Risk Assessment Qualification.
- Train existing staff on the city's tree protection care code, especially during construction projects, to enhance monitoring and support enforcement of regulations to protect and preserve trees.
- Train staff, volunteers, etc. on the identification of invasive plants, so they can be constantly monitoring and working to remove the plants to eradicate populations or keep populations low.
- Before allowing professional landscape and/or tree services companies, or any other contractor, to perform work within the cemetery, conduct an orientation session with crews to emphasize the exact expectations of tree protection (no string trimmer or mower contact with trunks; no parking within the Critical Roots Zone; etc.).

Funding Required: *Costs for establishing a training program may vary widely, depending on who performs the training, what materials are required, how often it is done. Variable.*

Staff Training at National Cemeteries

The U.S. Department of Veterans Affairs' National Cemetery Administration (NCA) manages and maintains 135 national cemeteries in 39 states, many of which have mature trees and are historic, such as Bath, Woodlawn, and Long Island National Cemeteries in New York.

Most VA cemeteries have proactive tree care programs but do not have certified arborists on staff. They accomplish much of the young tree care, routine maintenance, and tree protection with their grounds and landscape staff, and get good quality work results by conducting regular training programs. The NCA's tree care training programs include topics such as: general tree biology, appropriate pruning methods, planting techniques (site evaluation, appropriate selection of tree species, etc.), site preparation, root care and inspection, fertilization, mulching and staking, and post-planting care.

With limited funding for advanced tree care operations, properly training grounds staff to address routine tree maintenance and planting tasks (and to "do no harm" when they are mowing or applying herbicides) is an efficient use of public funds and uncertain annual budgets.

Recommendation #15. Make the Case for Additional Funding Needs

Both the city and FOMHC recognize a significant need for more dedicated, steady, and reliable tree management funding for Mount Hope Cemetery. Beyond the "catch-up" projects that require funding to proceed, there are ambitious plans for restoring the landscape, as indicated in both the MHC-CLR and MHC-MP.

To implement the recommendations for tree maintenance, tree planting, habitat enhancement, increased staffing, and public engagement projects, additional funding will be required by the city at very high levels. The funding will likely need to come from multiple sources, including city funds, state federal grant programs, private grants, and philanthropy.

Staffing, tree maintenance, and mature tree care can best be accomplished with city funding. State and federal agencies have grant programs that are best and more appropriate for the cemetery's sustainability and outreach projects, such as tree planting, historic preservation, invasive insect and disease management, and volunteer training and development. There are private foundations that may provide funding for Mount Hope Cemetery to support historic tree and site preservation, native habitat conservation, community involvement, and other projects. Grants and philanthropic funding should be carefully coordinated with city funding, and should follow policies and procedures already in place. It is critical that private funding *supplement* the city's public funding rather than replace it.

Additionally, while staff and supporters recognize the critical lack of funding, others in the community may not. Mount Hope Cemetery needs to analyze the budget shortfalls, justify the need for funding as described in this plan and the MHC-MP, set program priorities, and effectively communicate the items, first internally and then externally, to a wide, regional, and even national audience.

Potential options include:

- Use the current annual benefits provided by Mount Hope Cemetery's trees to educate the surrounding neighborhoods and inform the city at-large of their value. This information should be widely promoted to both raise awareness and gain support of elected officials and citizens. As noted in the Urban Forest Master Plan, "the scope and magnitude of the environmental, economic, and social value of the city's urban tree population have not been adequately quantified and need further recognition by the public, and city government."
- Represent Mount Hope Cemetery's trees as a unique and valuable city-owned resources; and then present the funding needs to city leaders and others as an equal public infrastructure, cultural, and ecological asset worthy of equal consideration of greater funding. The financial support of Mount Hope Cemetery's urban forest is consistent with the goals of the city's Urban Forest Master Plan and its Comprehensive Plan.
- Continue to utilize FOMHC's status and influence as a 501(c)3 organization and arboretum to secure increased funding from grants and donations. Consider grants focused on the benefits trees provide, not just forestry-related grants (i.e., grants with an air quality focus, watershed-based funding).

- Continue and strengthen the Reforest Mount Hope tree planting campaign. Consider redefining how funds raised through this program can be used. For instance, monies raised by ReForest Mount Hope might best be used for tree purchases, installation, mulch, and plant health care for three years until the trees are well established.
- Initiate a formal relationship with the hospital. Trees provide many health benefits, hospital staff and visitors regularly visit Mount Hope Cemetery, and the hospital is a direct corporate neighbor. With a formal relationship, applying for health care grants with an environmental focus would be feasible.
- Continue to explore potential partnerships that can result in obtaining resources needed for tree management. Include potential partners beyond the boundaries of the city to the county and region. Support can come in the form of cash and non-cash resources such as expertise, volunteer labor, and supplies.
- Expand and leverage the existing social media presence. Increase the use of all social networking platforms and crowd-funding sites to clearly express the Mount Hope Cemetery case for philanthropic support to any and all interested groups or persons.
- Team up with a regular mailer. Consider partnering with companies or government agencies (such as was done with water bill inserts in the past) that still use the mail to reach the public (i.e., banks, utilities, retailers, other city agencies) and seek their help in distributing Mount Hope Cemetery messages by enclosing inserts in the envelopes.
- Engage the local green industry in supporting Mount Hope Cemetery. Build upon the giving legacy of the original nursery that donated trees to help create Mount Hope Cemetery by engaging with local nurseries and garden stores to donate trees, shrubs, plants, and supplies to the city, and/or offer discounts to FOMHC members to encourage and grow the membership base. Provide a training ground for ISA-based courses or other pruning classes.
- Approach Mount Hope Cemetery management or other financial experts to explore planned giving opportunities that will support the arboretum. Once a program is designed, people can be invited to remember the FOMHC and the arboretum in their estate plans with a bequest or other form of a planned gift. FOMHC can then create a “Mount Hope Cemetery Arboretum Legacy Society” to recognize donors.
- Create an ongoing annual fund appeal. FOMHC should regularly reach out to the public with giving opportunities (tree planting, historic tree care, woodland restoration projects). FOMHC, as a trusted expert, can send seasonal mailings or e-newsletters with tips for tree care, announcements for tours, and other timely information.
- When historic or rare trees must be removed from the grounds, temporarily store the wood and offer it for sale to local artisans to craft furniture, pens, and art pieces. Partnerships can be forged where the artisan would donate a portion of the proceeds of the sales, and/or could donate back hand-crafted items for sale or auction by the FOMHC.

Funding Required: *Staff time.*

Prioritization of Work, Next Steps

Like the responsibility for street and park trees, tree management in Mount Hope Cemetery is a multi-faceted program with many tasks. The recommendations made in this plan are offered to guide the city in its effort to sustain the cemetery's unique urban forest. The table presented in this section list and prioritizes the many tasks made throughout these recommendations for the city's consideration. Many of the recommendations are immediately actionable and/or require little or no direct outlay of public funding.

Mount Hope Cemetery Tree Management Recommendations

Recommendation	Priority
All trees should be on an 8-year proactive maintenance cycle	High
Update the inventory as work is accomplished	High
Increase annual historic tree assessments to a Level 2 or 3	High
Perform a Level 3 assessment on historic trees after storm events	High
Inspect historic trees to determine need for advanced maintenance tasks	High
Identify the 50 most valuable trees and note status in inventory	High
Create a process/policy for care vs. removal decisions	High
Implement a tree succession strategy	High
Evaluate the entire grounds to identify planting areas and record these in the inventory database	High
Select replacement species using the guidelines of the MHC MP	High
Promote MHC's arboretum status	High
Include the value and needs of MHC trees in the current and future Comprehensive Plans	High
Provide City Planners and leaders with data on the value of MHC's trees	High
Enforce tree preservation/protection standards in MHC during all construction projects	High
Have Forestry Division staff at all project planning and pre-construction meetings	High
Have a Certified Arborist on site to monitor construction projects	High
Enforce the requirement for tree protection fencing	High
Protect MHC trees during construction by using alternative construction practices	High
Assess high monetary fines for violations	High
Provide enhanced training for staff about tree preservation techniques and enforcement	High
Ensure the all current tree protection standards are included in all construction project contracts and documents	High

Recommendation	Priority
Train cemetery grounds staff about the basics of tree protection	High
Implement a volunteer program for young tree maintenance ("tree steward program")	High
Create a training program for MHC grounds staff that focuses on young tree care	High
Provide current and future city staff the opportunity to achieve the variety of ISA certifications	High
Train existing city staff on tree care protection to enhance monitoring	High
Represent MHC trees as a valuable and unique resource worthy of additional funding per the goals of the UFMP and the Comprehensive Plan	High
Continue to use and leverage the FOMHC's status as a 501(c)3 to secure additional funding	High
Continue and strengthen the Reforest Mount Hope campaign	High
Engage the local green industry (particularly nurseries) to donate plant materials	High
Include plant health care, invasives control, and landscape management needs identified in the MHC-MP	Medium
Tree planting should be coordinated with the cyclical care program	Medium
Create a young tree care program	Medium
Create additional data field(s) in the inventory database for historic tree assessments and special maintenance	Medium
Earmark annual funding for historic tree care	Medium
Create a cemetery arborist position	Medium
Create a field in the inventory database to indicate a tree with less than 10 years of service life (to trigger replacement planting)	Medium
Create a smartphone app that guides visitors on an "historic tree trail"	Medium
Update and complete plaques for historic trees	Medium
Invite local businesses to "adopt" historic trees and/or support the MHC tree program	Medium
Plan a multi-faceted media campaign about MHC trees and the need for community support	Medium
Create and improve walking trails in the cemetery	Medium
Engage local schools to perform service learning projects	Medium
Use traditional forest management techniques to improve the vitality of the woodlands	Medium
Consider trunk girdling to remove Norway maple in woodlands	Medium
Leave tall trunks of dead trees in woodlands for wildlife habitat (where no safety risk exists)	Medium
Plant understory trees and shrubs to restore the native woodland ecosystem	Medium
Explore MHC becoming an "Audubon Certified Sanctuary"	Medium
Consult with structural and soil engineers to develop erosion control strategies	Medium

Recommendation	Priority
Review lawn mowing and weed trimming practices to ensure they do not create or contribute to erosion	Medium
Use wood chip mulch for temporary control of erosion	Medium
Create a training program for volunteers for basic knowledge of young tree care and habitat enhancement	Medium
Request local tree service companies, landscapers, extension offices, etc. to provide free training	Medium
Train staff and volunteers on identification of invasive plants	Medium
Provide orientation sessions on tree protection for all contractors performing work in MHC	Medium
Use the benefit information and historic character of MHC trees to increase support for tree management	Medium
Expand MHC's social media presence	Medium
Use mailer inserts to raise awareness and funds for MHC trees	Medium
Create an on-going funding appeal	Medium
Identify one cemetery staff for ISA certification	Low
Update the MHC brochure with information on the historic trees	Low
Investigate if any historic tree qualifies for state or national champion status	Low
Involve local historical organizations in promoting the historic tree program	Low
Find a local celebrity to be a champion and spokesperson for MHC trees	Low
Provide a variety of volunteer opportunities	Low
Expand tree and horticultural related educational opportunities for the public at MHC	Low
Conduct festivals or other special events for fund-raising and public awareness	Low
Leverage the City's Sister City program to enhance interest in MHC	Low
Work with schools to create a writing project/contest about MHC's historic trees	Low
Secure the services of a professional forester to assess the woodlands	Low
Apply for health care/environmental grants with local hospitals	Low
Explore new partnership in and outside of the city to obtain additional donated funding, labor, and supplies	Low
Explore planned giving programs to support tree management efforts	Low
Offer the wood from historic trees that are removed to artisans for fund-raising	Low

To ensure the success of this plan for Mount Hope Cemetery tree care and planting, and to promote communication and collaboration, an annual meeting of partners (city staff, cemetery staff, FOMHC, volunteers, community stakeholders, etc.) should be considered as well. The following tasks could be discussed or accomplished during this meeting:

- Annual Meeting Discussion/Action Item Suggestions:
  - Review accomplishments/create an annual report.
  - Adopt or make adjustments to this management plan (goals, recommendations, agreed upon benchmarks to measure future progress, etc.)
  - Discuss the current year's planned tree maintenance and new tree plantings.
  - Identify funding needed and sources of supplemental funding if needed.
  - Discuss strategies to address invasives (see Choosing a Strategy to Deal with Norway maple in the appendix).
  - Look at the long-term work plan to identify who can do what, what funding is needed, what should be pursued via grants, etc.

Five-Year Re-evaluation. In every fifth year, **t**he annual meetings should include a more in-depth evaluation to measure the effectiveness of the cemetery's tree management program. Benchmarks to measure this success can be developed based on plan goals. See Table 4 below as an example of how to translate goals into benchmarks.

Table 4. Translating Goals into Benchmarks to Measure Future Progress

If cemetery goal is:	Potential benchmark could then be:
All trees and landscape features are in good condition and well maintained.	70% of all trees are in Good or Excellent condition
Historic trees are preserved.	60% of historic trees are in Fair to Good condition.
Invasive plants are controlled on the property.	Presence of invasives on property, measured by number of areas or percent of affected of property.
Woodland stewardship programs are in place.	Compliance with the recommendations of a Certified Forester's report assessing the quantity and quality of current woodland management efforts.
A beautiful place and cultural asset has been restored and is appreciated and valued by the public.	Quantify public engagement numbers – number of volunteers, tour participants, interns, community projects, and partnerships in place.

Budget Requirements

Based on the recommendations above, the following budget (Table 5) was compiled to provide a sense of the resources required to proactively and comprehensively manage the trees of Mount Hope Cemetery. Note that the first year of work requires $50,000 more than the following seven years due to the number of priority pruning and removals identified in the inventory data.

Utilizing data from the city's inventory of Mount Hope Cemetery's trees, an annual maintenance schedule was developed that details the number and type of tasks recommended for completion each year. Davey Resource Group made budget projections using industry knowledge and public bid tabulations. Actual per item costs, along with a complete table of work for an eight-year tree management program, are presented in the appendix.

Following an eight-year tree management schedule can help tree care activities evolve from an on-demand system to a more proactive tree care program. If routing efficiencies and/or contract specifications allow for the accomplishment of more tree work, or if the schedule requires modification to meet budgetary or other needs, then the schedule should be modified accordingly. Unforeseen situations, such as severe weather events, may arise and change the maintenance needs of trees. Should conditions or maintenance needs change, budgets and equipment will need to be adjusted to meet the new demands.

Table 5. Estimate Budget Requirements for Mount Hope Cemetery (8-Year Cycle)

ESTIMATED BUDGET REQUIRED (rounded figures) Full detailed budget table is in the appendix.		**Year 1 (2017)**	**Year 2 (2018)**	**Year 3 (2018)**	**Year 4 (2019)**	**Year 5 (2020)**	**Year 6 (2021)**	**Year 7 (2022)**	**Year 8 (2023)**
Yearly Assessment	**Annual Inspection** (cemetery-wide Level 1 inspection on all trees except historic)	$640	$640	$640	$640	$640	$640	$640	$640
	Historic Inspection (cemetery-wide Level 2-3 inspection on historic trees)	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000
	Re-Inventory (one management area per year)	$960	$960	$960	$960	$960	$960	$960	$960
Cyclical Pruning	**Routine**	$78,000	$78,000	$78,000	$78,000	$78,000	$78,000	$78,000	$78,000
	Priority/Safety or Storm Response	$56,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Removals	**Removals**	$17,500	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000
	Stump Removal	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600
Tree Succession	**Planting** (50 trees per year)	$28,000	$28,000	$28,000	$28,000	$28,000	$28,000	$28,000	$28,000
	Young Tree Training *($0 if done by volunteers)*	$0	$0	$0	$0	$0	$0	$0	$0
Woodland Management	**Woodland Management**	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
	Subtotal	**$201,700**	**$145,200**	**$145,200**	**$145,200**	**$145,200**	**$145,200**	**$145,200**	**$145,200**
Dedicated Arborist Staff Addition (choice of one)	Scenario 1 (FT arborist city employee)	$52,500	$52,500	$52,500	$52,500	$52,500	$52,500	$52,500	$52,500
	Scenario 2 (consultant)	$54,000	$54,000	$54,000	$54,000	$54,000	$54,000	$54,000	$54,000
	Scenario 3 (train existing grounds staff)	$1,500	$0	$0	$0	$0	$0	$0	$0
	YEARLY TOTAL *(using staff scenario 1)*	**$254,200**	**$197,700**	**$197,700**	**$197,700**	**$197,700**	**$197,700**	**$197,700**	**$197,700**

Budget Table Notes:

Annual Inspection: Level 1 inspection on all trees. Two full days for staff arborist @ $40/hour = $640.

Historic Inspection: Level 2-3 inspection on 497 historic trees. 25 trees/day require 20 days @ $75/hour for contractor = $12,000.

Re-Inventory of One Management Area: Two full days for staff arborist @ $40/hour = $960.

Priority/Safety or Storm Response: Year 1 is higher to address the 141 trees identified in the city tree inventory as requiring priority pruning. Funding for subsequent years are slated for storm funds. If storm funds are not used, they are banked in a storm response or emergency fund.

Removals: Year 1 is based on actual removals needed, as specified in inventory. Years 2-8 are based on city arborist estimate for 12 removals per year @$1,000/removal average cost.

Stump Removal: Currently 240 stumps require removal based on city inventory data. This work is divided up equally over the eight-year cycle. After the 8th year, there may be no existing stumps.

Woodland Management: Estimated budget to perform timber stand improvement projects.

Additional Project-Based (non-annual) Work and Associated Costs:

Evaluation Structure for Decision Making:	Staff Time
Historic Tree Program with Student Assistance:	$5,000–$10,000
Engage Public:	Variable
Include Mount Hope's Need into City Comp. Plan:	Staff/Volunteer Time
Enforce Tree Protection During Construction:	Staff Time
Young Tree Care Volunteer Program:	Staff/Volunteer Time + Materials
Evaluate Erosion Issues with Engineer:	Variable
Training Program:	Variable
Make Case for Additional Funding:	Staff/Volunteer Time

Positive strides are being made with the implementation of a cyclical tree care program, and the involvement of the Friends of Mount

CONCLUSION

Managing trees and in landscaped areas is often complicated, even more so in an historic cemetery. Navigating the recommendations of experts, the wishes of staff, elected officials, the needs of neighboring communities and visitors, the concerns for liability issues, the physical aspects of trees, the forces of nature and severe weather events, and the desires for all of these factors to be met all at once is daunting to say the least.

Positive strides are being made with the implementation of a cyclical tree care program, and the involvement of the Friends of Mount Hope Cemetery in securing the funding for this master plan. Progress can be accelerated through partnerships that have a shared vision and implementation *team.* Annual team meetings between forestry staff, cemetery staff, and the FOMHC are critical to ensure Mount Hope Cemetery's urban forest is receiving holistic and proactive care.

Previous tree management in Mount Hope was a limiting factor in the preservation of the cemetery's urban forest as it was more reactive in nature, and did not consistently implement current industry standards for risk assessment and plant health care needs. The historic budget allocations were insufficient to maintain the trees to an acceptable standard. Tree planting to replace or expand the tree canopy has been inconsistent to date. Many opportunities to engage the public and community to support Mount Hope Cemetery have not been taken advantage of by the city.

In summary, these tasks are identified as the highest priority and all effort should be made to implement these recommendations:

1. Commit to a proactive tree management approach by dedicating the resources needed to provide cyclical, preventive tree maintenance for all landscape trees. Historic trees should receive an advanced level of inspection and care due to their tangible and intangible value in the Mount Hope landscape.
2. Through civil service hiring, contractual agreement, or even on a volunteer basis, secure the services of a Certified Arborist to provide more consistently available expertise for tree inspection, insect and disease monitoring, tree preservation monitoring during construction projects, tree planting, and engaging with the public.
3. Develop a tree planting succession strategy/program that increases overall species diversity for landscape trees, supports elevating the current arboretum status, and includes native tree planting in the cemetery's woodlands.

This plan was developed through stakeholder input, city data, case study research, and expertise provided by Davey Resource Group. The plan, however, is meant to provide a starting point for the city and Friends of Mount Hope Cemetery to head down a path of proactive management. Work plans and recommendations are expected to be altered and tweaked to reflect obstacles and opportunities not yet found.

The Friends and community partners have a wealth of current information about the cemetery's urban forest condition and benefits. Through this project and other efforts, much has been learned and seeds have been planted. With diligence and dedication, the ideas and relationships gained through this process simply need to be cultivated to take root and grow.

GLOSSARY

arboriculture: The art, science, technology, and business of commercial, public, and utility tree care.

canopy cover: As seen from above, it is the area of land surface that is covered by tree canopy.

canopy: Branches and foliage that make up a tree's crown.

community forest: see **urban forest**.

cycle: Planned length of time between vegetation maintenance activities.

defect: See **structural defect**.

diameter: See **tree size**.

diameter at breast height (DBH): See **tree size**.

further inspection (data field): Notes that a specific tree may require an annual inspection for several years to make certain of its maintenance needs. A healthy tree obviously impacted by recent construction serves as a prime example. This tree will need annual evaluations to assess the impact of construction on its root system. Another example would be an historic tree determined as high value to the owner or community.

invasive, exotic tree: A tree species that is out of its original biological community. Its introduction into an area causes or is likely to cause economic or environmental harm, or harm to human health. An invasive, exotic tree has the ability to thrive and spread aggressively outside its natural range. An invasive species that colonizes a new area may gain an ecological edge since the insects, diseases, and foraging animals that naturally keep its growth in check in its native range are not present in its new habitat.

inventory: See **tree inventory**.

monoculture: A population dominated by one single species or very few species.

pruning: The selective removal of plant parts to meet specific goals and objectives.

replacement value: The replacement (also called structural) value of the trees in iTree Eco (Nowak et al. 2002a) is based on methods from the Council of Tree and Landscape Appraisers (CTLA 1992). Compensatory value is based on four tree/site characteristics: trunk area (cross-sectional area at dbh), species, condition, and location. Trunk area and species are used to determine the basic value, which is then multiplied by condition and location ratings (0 to 1) to determine the final tree compensatory value. Local species factors, average replacement cost, and transplantable size and replacement prices are obtained from ISA publications. If no species data are available for the state, data from the nearest state are used. Condition factors are based on percent crown dieback. Available data required using location factors based on land use type (International Society of Arboriculture 1988): golf course 0.8; commercial/industrial, cemetery, and institutional 0.75; parks and residential 0.6; transportation and forest 0.5; agriculture 0.4; vacant 0.2; wetland 0.1

risk: Combination of the probability of an event occurring and its consequence.

species: Fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding.

stem: A woody structure bearing buds and foliage, and giving rise to other stems.

stems (data field): Identifies the number of stems or trunks splitting less than 1 foot above ground

street tree: A street tree is defined as a tree within the right-of-way.

structural defect: A feature, condition, or deformity of a tree or tree part that indicates weak structure and contributes to the likelihood of failure.

structural value: See **replacement value**.

topping: Topping, reducing tree size using internodal cuts without regard to tree health or structural integrity, is not an acceptable pruning practice.

tree: A perennial, woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow as multi-stemmed forms.

tree benefit: An economic, environmental, or social improvement that benefits the community and results mainly from the presence of a tree. The benefit received has real or intrinsic value associated with it.

tree inventory: Comprehensive database containing information or records about individual trees typically collected by an arborist.

tree ordinance: Tree ordinances are policy tools used by communities striving to attain a healthy, vigorous, and well-managed urban forest. Tree ordinances simply provide the authorization and standards for management activities.

urban forest: All of the trees within a municipality or community. This can include the trees along streets or rights-of-way; in forests, greenspaces, and parks; and on private property.

vista prune: Pruning to enhance a specific view without jeopardizing the health of the tree.

young tree training: Pruning of young trees to correct or eliminate weak, interfering, or objectionable branches to improve structure. These trees, up to 20 feet in height, can be worked with a pole pruner by a person standing on the ground.

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APPENDIX

Detailed Pruning/Removal Task Budget Table

The detailed pruning and removal task budget table below (Table 6) was created from the Mount Hope Cemetery tree inventory data provided by the city, and cost per service a result of estimate of aggregated costs derived from national average used by Davey local offices. The cost per service were increased 25% to account for the added difficultly/care needed (and thus more time required) to work in an historic cemetery. These numbers were combined and rounded in the summary table on page 45 for ease of consumption.

Table 6. Detailed Budget Table for Estimated Pruning/Removal Tasks

Estimated Costs for Each Activity			2017		2018		2019		2020		2021		2022		2023		2024		8-Year Cost
Activity	DBH	Cost / Tree	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	
Contract Removals	1–3"	$35	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4–6"	$135	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7–12"	$275	1	$275	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$275
	13–18"	$445	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	19–24"	$660	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	25–30"	$1,060	1	$1,060	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$1,060
	31–36"	$1,425	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	37–42"	$1,840	1	$1,840	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$1,840
	43"+	$2,315	1	$2,315	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$2,315
Removal Totals			4	$5,490	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$5,490
Stump Removals	1–3"	$35	1	$35	1	$35	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$70
	4–6"	$35	1	$35	1	$35	1	$35	1	$35	1	$35	1	$35	1	$35	1	$35	$280
	7–12"	$35	5	$175	5	$175	5	$175	4	$140	4	$140	4	$140	4	$140	4	$140	$1,225
	13–18"	$50	3	$150	3	$150	3	$150	3	$150	3	$150	3	$150	3	$150	2	$100	$1,150
	19–24"	$75	5	$375	5	$375	5	$375	5	$375	5	$375	5	$375	4	$300	4	$300	$2,850
	25–30"	$110	6	$660	5	$550	5	$550	5	$550	5	$550	5	$550	5	$550	5	$550	$4,510
	31–36"	$140	5	$700	5	$700	5	$700	5	$700	4	$560	4	$560	4	$560	4	$560	$5,040
	37–42"	$165	3	$495	3	$495	3	$495	3	$495	3	$495	3	$495	3	$495	3	$495	$3,960
	43"+	$200	5	$1,000	5	$1,000	5	$1,000	5	$1,000	4	$800	4	$800	4	$800	4	$800	$7,200
Stump Removal Totals			34	$3,625	33	$3,515	32	$3,480	31	$3,445	29	$3,105	29	$3,105	28	$3,030	27	$2,980	$26,285
Priority 1 Prune (C3PP)	1–3"	$25	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4–6"	$40	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7–12"	$95	4	$380	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$380
	13–18"	$150	6	$900	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$900
	19–24"	$215	7	$1,505	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$1,505
	25–30"	$285	19	$5,415	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$5,415
	31–36"	$385	20	$7,700	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$7,700
	37–42"	$475	9	$4,275	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$4,275
	43"+	$740	17	$12,580	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$12,580

Estimated Costs for Each Activity			2017		2018		2019		2020		2021		2022		2023		2024		8-Year Cost
Activity	DBH	Cost / Tree	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	
Priority 1 Prune Totals			82	$32,755	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$32,755
Priority 2 Prune (C3 Safety Prune)	1–3"	$25	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4–6"	$40	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7–12"	$95	1	$95	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$95
	13–18"	$150	3	$450	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$450
	19–24"	$215	7	$1,505	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$1,505
	25–30"	$285	11	$3,135	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$3,135
	31–36"	$385	18	$6,930	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$6,930
	37–42"	$475	10	$4,750	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$4,750
	43"+	$740	9	$6,660	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$6,660
Priority 2 Prune Totals			59	$23,525	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$23,525
Routine Pruning	1–3"	$25	7	$175	7	$175	7	$175	7	$175	7	$175	7	$175	7	$175	6	$150	$1,375
	4–6"	$40	33	$1,320	33	$1,320	33	$1,320	33	$1,320	33	$1,320	33	$1,320	33	$1,320	32	$1,280	$10,520
	7–12"	$95	78	$7,410	78	$7,410	78	$7,410	78	$7,410	78	$7,410	78	$7,410	78	$7,410	78	$7,410	$59,280
	13–18"	$150	63	$9,450	62	$9,300	62	$9,300	62	$9,300	62	$9,300	62	$9,300	62	$9,300	62	$9,300	$74,550
	19–24"	$215	67	$14,405	67	$14,405	67	$14,405	67	$14,405	67	$14,405	67	$14,405	67	$14,405	66	$14,190	$115,025
	25–30"	$285	55	$15,675	55	$15,675	55	$15,675	55	$15,675	55	$15,675	55	$15,675	55	$15,675	55	$15,675	$125,400
	31–36"	$385	34	$13,090	34	$13,090	34	$13,090	34	$13,090	34	$13,090	33	$12,705	33	$12,705	33	$12,705	$103,565
	37–42"	$475	15	$7,125	15	$7,125	15	$7,125	14	$6,650	14	$6,650	14	$6,650	14	$6,650	14	$6,650	$54,625
	43"+	$740	13	$9,620	13	$9,620	13	$9,620	13	$9,620	12	$8,880	12	$8,880	12	$8,880	12	$8,880	$74,000
Routine Prune Totals			365	$78,270	364	$78,120	364	$78,120	363	$77,645	362	$76,905	361	$76,520	361	$76,520	358	$76,240	$618,340
Tree Planting	Purchase	$200	50	$10,000	50	$10,000	50	$10,000	50	$10,000	50	$10,000	50	$10,000	50	$10,000	50	$10,000	$80,000
	Planting	$360	50	$18,000	50	$18,000	50	$18,000	50	$18,000	50	$18,000	50	$18,000	50	$18,000	50	$18,000	$144,000
Tree Planting Totals			100	$28,000	100	$28,000	100	$28,000	100	$28,000	100	$28,000	100	$28,000	100	$28,000	100	$28,000	$112,000
Activity Grand Total			644		497		496		494		491		490		489		485		4,086
Cost Grand Total				$171,665		$109,635		$109,600		$109,090		$108,010		$107,625		$107,550		$107,220	$818,395

Specifications of Work by Management Area

This list of work and considerations for each management area (shown at right) comes from a combination of recommendations from the following sources:

- Mount Hope Cemetery Master Plan (2016)
- Davey field observations and expertise (2016)
- MHC Cultural Landscape Report (2008)

Management Area 1 (SOUTH)

Landscape Character Zones:
Landscape Lawn (includes Elmwood Avenue Entrance & Frontage design)
Uniform Memorial Plots

Total Trees: 479
Historic Trees: 0 (from original list of 479)

Issues to Note:
The MHC-MP highlighted multiple needs beyond regular tree care, including that of screening views of/from traffic and opening views to University of Rochester cupola (vista pruning). This can be included in the cyclical tree care work (typically done by a hired contractor). In this area, there are many Norway maple, most of which are solitary and large. Removal of these trees depends on invasives strategy. Field observations also noted poison ivy on trees that should be removed and multiple instances for need of clearance for pedestrian movement.

Invasive Eradication:
Over 160 trees in Area 1 are Norway maple (invasive), which represent a sizable portion (35%) of the population in Area 1. Invasive removal work here would take the form of large tree removals in open areas. Action taken will depend on the managing team's strategy (see *Appendix – Choosing a Strategy to Address Norway maple*).

Succession Planting Opportunities:
There are several opportunities for planting in Area 1. The MP highlighted the need for installation of a grand allée (tall shade trees) along Adlington Avenue, as well as any efforts to reinforce any *existing* allées. Additionally, the street frontage of this Area will benefit from buffer/screening plantings (MHC-MP, Pg. 100). A mix of species is recommended throughout the site, including large-scale trees (both deciduous and evergreen), as well as ornamental trees, although the MP called for the use of evergreens groupings in screening and creating a gradual change from city street to open lawn. Continue to add new species not yet planted in the cemetery to work towards achieving Level II Arboretum status (MHC-MP, Pg. 135–136). Planting opportunities will also come directly from the Elmwood Avenue Entrance & Frontage Schematic Design.

Opportunities/Points to Note: The Uniform Memorial Plots in this area may provide an opportunity to reach out to related groups to encourage involvement (veterans, religious order, group homes, etc.) Additionally, this is one of the area's most visible and closest to the hospital, which can provide an outreach opportunity as well to let the "neighbors" know (via signage on the cemetery wall or posted notifications at the hospital) that a new plan to restore Mount Hope Cemetery has begun with a call for them to get involved.

Management Area 2 (SOUTH)

Landscape Character Zones:
Landscape Lawn (includes Elmwood Avenue Entrance & Frontage design)

Total Trees: 366
Historic Trees: 0

Issues to Note (from Master Plan and our observations):
Issues and priorities are the same as Area 1 (above).

Invasive Eradication:
Almost 28% (101 of 366) of trees in this section are invasive (Norway maple). Invasive removal work would take the form of large tree removals in open areas. Action taken here will depend on how aggressive of a strategy is chosen by the managing team (see *Appendix – Choosing a Strategy to Address Norway Maples*).

Succession Planting Opportunities:
Planting opportunities and priorities are the same as Area 1 (above).

Other Opportunities: N/A

Management Area 3 (SOUTH)

Landscape Character Zones:
Landscape Lawn (includes Serenity Garden area)
Open Lawn (10d – south Mount Hope Avenue entrance)
Street Frontage & Interface

Total Trees: 424
Historic Trees: 24 historic trees are primarily in a section that begins the transition into the older, northern, more rural sections of the cemetery. There are two trees specifically cited in the Master Plan as specimen trees to be preserved (a 14" beech at the Serenity Garden and a 44" gingko at the 1912 Chapel). These should be added to the extra care (historic) tree list, especially before any construction projects get underway. **7 historic oaks need priority pruning.

Issues to Note: The MHC-MP highlighted a priority for plantings to improve first impressions for visitors at the south Mount Hope Cemetery entrance and to create a buffer along Mount Hope Avenue. A significant amount of construction was recommended in the MCH-MP, which will require vigilant care to protect trees during this work once scheduled. Field observations also noted multiple instances for need of pedestrian clearance.

Invasive Eradication: There are 53 Norway maple, mostly located along edges of Elmwood and Mount Hope Avenue in this area. Invasive removal work would take the form of large tree removals in open areas. Action taken will depend on how aggressive of a strategy is chosen by the managing team (see *Appendix – Choosing a Strategy to Address Norway Maples*). However, if removals become necessary during construction for access or any reason, opt for removal of Norway maple and work to save other species.

Succession Planting Opportunities: A significant amount of new planting could happen in conjunction with the recommended road closures and construction recommended in the Master Plan. However, depending on the timeline of work, planting should be held off until after construction is completed (if that is planned anytime soon). Opportunities to install small flowering trees will come as part of the design schematics for the Serenity Garden and the South Mount Hope Entrance. Another large allée of large deciduous shade trees along 5th Avenue and buffer plantings along Mount Hope Avenue (a mix of evergreen and deciduous) will allow for additional tree installations. And yet another opportunity will come upon the closure of one segment of Woodland Avenue.

Other Opportunities: This area constitutes the busiest and most trafficked sections of the cemetery (both from within and outside), thanks to the intersections of Mount Hope Avenue and Elmwood and the location of the cemetery's business offices here. This is also the area with the least dense canopy and significant building plans proposed in the Master Plan, and could then be said to have the most planting opportunity. This area is also part of the Mount Hope/Highland Preservation District and an intersection point between the residents of the historic district across Mount Hope Avenue; therefore, the area can be considered a position of potential community engagement as needed.

Management Area 4 (NORTH)

Landscape Character Zones:
Spruce Lawn
Public Grounds
Rural Cemetery (small portion)
West Edge (small portion)

Total Trees: 403
Historic Trees: 152. According to the tree inventory, two trees are slated for removal (40" silver maple, 60" cottonwood), and five trees require priority pruning.

Issues to Note: The priorities in Area 4 include opening up views and coordination with the University of Rochester on joint work in the installation of buffer plantings and removal of invasives along the property borders (MHC-MP, Pgs. 134–137). This area was also cited as housing the oldest and most run down portions of the cemetery (due to the invasives, erosion, and student vandalism). Field observations also noted poison ivy to be removed from trees (see Photograph 1).

Invasive Eradication: Presence of invasives in this section include the 52 Norway maple (13% of all trees here) as well as knotweed and other undesirable vegetation on both sides of the property border shared with the University of Rochester. This work will entail a partnership with the university to prevent the potential spread of Japanese knotweed and other invasives onto the cemetery.

Photograph 1. Poison ivy climbing a spruce in area 4.

Succession Planting Opportunities: There are multiple planting opportunities in Area 4. The Spruce Lawn zone will benefit from a variety of new young conifers under existing trees to continue/preserve character while improving species diversity (MHC-MP, Pg. 134). Other planting work needed in this area includes restoration (replacement of missing trees) of the allée along Grove Avenue (note MHC-MP Schematics, Pg. 106) with large deciduous shade trees, installation of evergreens and large woodland trees to screen undesirable views in West Edge (residence halls), and ongoing installation in the rural cemetery areas of understory trees (a missing layer of vegetation per MHC-MP, Pg. 42).

Other Opportunities: This area will require partnership and dialogue with the University of Rochester and, thus, will be an ideal time to explore potential partnerships. Engagement could take the form of offering students work study, internship or service-learning opportunities, and engaging faculty both personally and professionally through providing service learning opportunities for students. Keep in mind that expertise beyond arboriculture/horticulture by university partners is also extremely valuable. The university can get involved in many ways beyond work "in the field," including assistance in business management, marketing, environmental studies, public administration, communications, technology, and more.

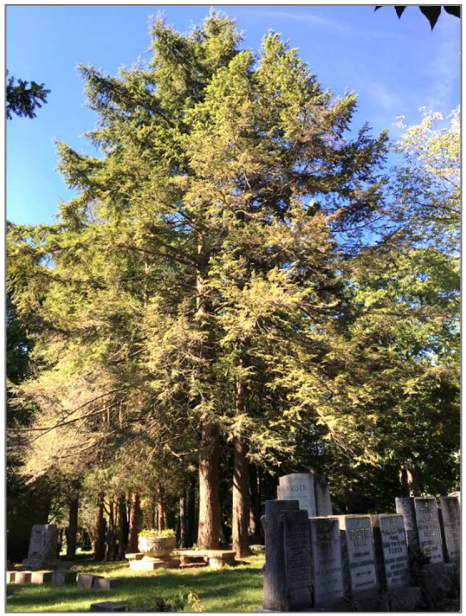
Management Area 5 (NORTH)

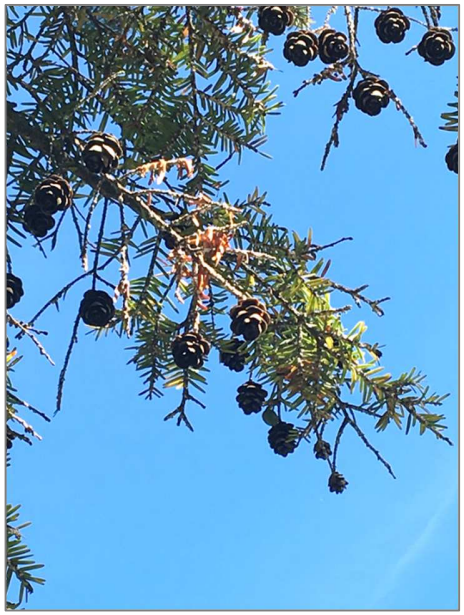
Landscape Character Zones:
Rural Cemetery
Gardenesque

Total Trees: 429 points - 13 of which are stumps, 165 oaks (38%)

Historic Trees: 89 historic trees, 10 of which need priority pruning

Issues to Note: Some erosion issues exist in sections M and MM, especially on the steep slopes along Indian Trail. The majority of this area is rural cemetery, thus more woodland management work is appropriate/needed. Field observations also noted instances of pest issues, including bleeding canker and hemlock woolly adelgid that should be addressed (Photograph 3 and 4).





Photographs 2 and 3. Effects of woolly adelgid in area 5.

Invasive Eradication: There are 55 Norway maple in Area 5, many of which are concentrated close to the proposed Section MM Corner schematic design area (MHC-MP, Pg 108). The reworking of this corner may provide an opportunity to remove some of these invasives. Section M, especially along Indian Trail, is experiencing erosion because of poor groundcover – grass is sparse due to high shade/competition with trees (MHC-MP, Pg. 36). Any removal of invasives in these areas will require immediate additional work to plan for erosion control.

Succession Planting Opportunities: There are not a large number of options for planting in the Rural Cemetery areas due to lack of space, although if options do become available, limiting plantings to native species is recommended. Include understory trees, as this layer of vegetation has been cited as missing throughout the Rural Cemetery areas (MHC-MP, Pg. 42). The Gardenesque zone calls for medium to large scale trees and shrubs using the Ellwanger & Barry Nursery planting pallet circa 1840-1918. There are recommended plans for reworking the Section MM Corner (see schematic design), which may call for additional planting.

Other Opportunities: N/A.

Management Area 6 (NORTH)

Landscape Character Zones:
Rural Cemetery
Gardenesque
Open Lawn 10b
Entrance

Total Trees: 405 trees, 5 stumps

Historic Trees: 57 historic trees (35 are oak, 15 spruce), 8 of which currently call for priority pruning. Historic trees around the North Mount Hope Avenue entrance are considered to be extremely valuable, particularly the 66" European beech.

Issues to Note:
This includes a prominent arrival area and, thus, should be well maintained. Multiple instances for need of clearance for pedestrian movement and building clearance are required (Photograph 4). Pruning is also needed to restore views from upper areas. This includes the Sylvan Waters area and steep slopes along the ravine. Field observations also noted instances of bleeding canker (Photograph 6).

Photographs 4 & 5. Low clearance and blocked views in area 6.

Invasive Eradication:
There are 27 mature Norway maple in this area. Removal of saplings has been identified as a strong focus along Ravine Avenue, although must be done in tandem with replacement planting of groundcovers, ferns, shrubs, etc.

Succession Planting Opportunities:
As with Area 5, there are not many options for planting in the Rural Cemetery areas due to lack of space, although if options do become available, limiting plantings to native species is recommended. Include understory trees, as this layer of vegetation has been cited as missing throughout the Rural Cemetery areas (MHC-MP, Pg. 42). The Gardenesque zone calls for medium- to large-scale trees and shrubs using the Ellwanger & Barry Nursery planting pallet circa 1840-1918. A replanting as part of the revitalization of Sylvan Waters (see schematic design, MHC-MP, Pg. 96) will provide additional opportunities to add trees.

Other Opportunities: N/A.

Photograph 6. Bleeding canker in area 6.

Management Area 7 (NORTH)

Landscape Character Zones:
Street Frontage Interface
Rural Cemetery
Gardenesque

Total Trees: 386, 12 stumps (144 are oak)

Historic Trees: 85, 6 requiring priority pruning. Note high value 50" weeping white mulberry in Gardenesque area 3c.

Issues to Note: This is a well-trafficked area of the cemetery – both from outside as drivers move up Mount Hope Avenue and inside the cemetery walls thanks to the grave location of one of the cemetery's most famous residents: Frederick Douglass. Field observations also noted instances of pest issues, including hemlock wooly adelgid. Pest issues should be addressed if they have not already been addressed.

Invasive Eradication: There are currently 60 adult Norway maple.

Succession Planting Opportunities: Planting should focus on large-scale deciduous species, primarily native species that will provide a large-scale canopy and link with the historic neighborhood across Mount Hope Avenue. Additionally, planting should reinforce the Ellwanger & Barry Nursery pallet circa 1840-1918. However, because there is already such a high percentage of oak (almost 40%), refrain from planting any additional oak species in this area. The missing understory trees are good options for Area 7 as well.

Other Opportunities: Like Area 3, this is a point of intersection between the residents of the historic district across Mount Hope Avenue. Area 3 can, therefore, be considered a position of potential community engagement when needed.

Management Area 8 (NORTH)

Landscape Character Zones:
Gardenesque
Landscape Lawn
Entrance
Open Lawn
(Susan B Anthony grave here)

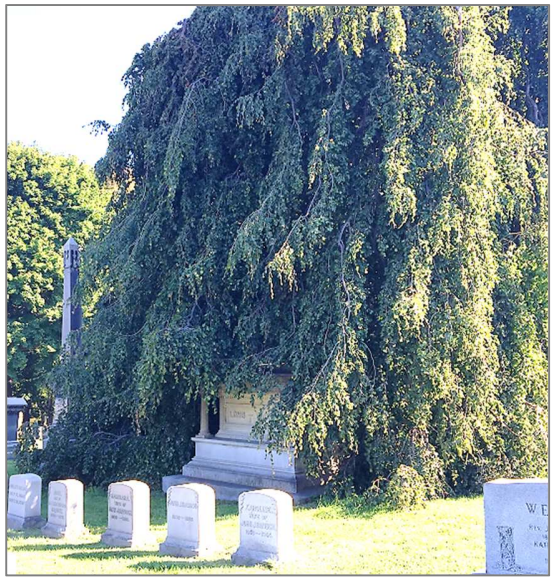
Total Trees: 415, 5 stumps

Historic Trees: 64 historic trees, 8 of which require priority pruning. This area contains multiple high-value trees that require close annual inspection and care.

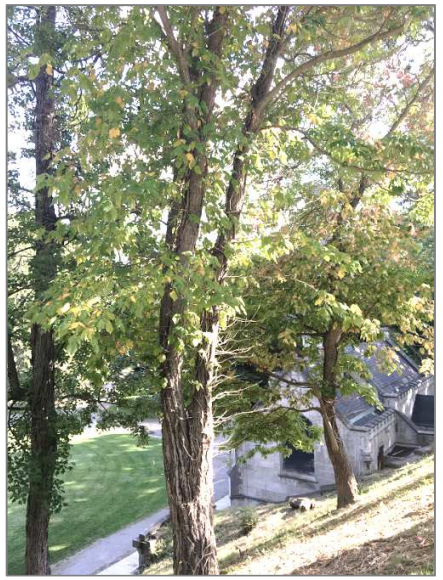
Issues to Note (from Master Plan and our observations): Field observations also noted poison ivy on trees (see Photograph 10) that should be removed, erosion control issues (Photograph 7), and multiple instances for need of clearance for pedestrian movement, building clearance, and views of monuments (see Photograph 9). Pest/disease issues were also found, including instances of bleeding beech canker and hemlock woolly adelgid.

Photograph 7. Erosion issues in area 8.

Photograph 8. Stumps requiring removal to open vacant planting sites.



Photograph 9. Clearance issues with trees and monuments.



Photograph 10. Poison ivy climbing tree.

Invasive Eradication: There are 54 Norway maple in this area, the majority of which can be found along the steep slope just west of Indian Trail Avenue.

Succession Planting Opportunities: In the entrance area, utilize medium to large trees and shrubs, maintaining the open park-like setting, while ensuring a mix of tree sizes (ages). There are potentially plant shrubs and understory trees along steep slope at 1862 Chapel. Additionally, install a planted buffer (potentially evergreen) to block the view of the service yard. Rural areas of cemetery are good places for understory trees as well. Field observations noted potential vacant planting areas (Photograph 8 – on Linden).

Opportunities/Points to Note: N/A.

About i-Tree Eco/Methodology

Eco v6 is a modeling tool that is part of the i-Tree peer-reviewed software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment. The Eco tool uses tree measurements and other data to estimate ecosystem services and structural characteristics of the urban or rural forest. It also has a forecasting component to help gauge future conditions based on user-entered data.

How Does Eco Work? Tree measurements and field data are entered into the Eco application either by web form or by manual data entry. They are merged with local pre-processed hourly weather and air pollution concentration data. These data make it possible for the model to calculate structural and functional information using a series of scientific equations or algorithms. More detailed methodology of i-Tree Eco Version 6 can be found at https://www.itreetools.org/resources/archives.php

About the Eco Forecast Modeling. Eco's new Forecast module can be run after Eco results (discussed above) are generated. Forecast uses structural estimates, environmental and location variables, species characteristics, and growth and mortality rates to forecast future tree DBH and crown size. Forecasted benefits such as pollution removal, carbon storage, and carbon sequestration are then estimated based on the projected tree growth and leaf area. Tree planting inputs, pest and disease impacts, and storm effects can also be modeled.

Data Used. Cemetery tree inventory provided by the City of Rochester was used as the primary data source for this modeling work.

Note: At this time, the Eco forecast model is not able to take into account any influence from natural regeneration in woodland areas.

Forecast Scenario Factors: Four scenarios were used in the Eco Forecast models for this report. Details on each scenario are as follows:

REACTIVE CARE/NO PLANTING
Annual Mortality Rates: i-Tree's standard rates of 3% for healthy trees, 13.1% for sick trees, 50% for dying trees.
Disease/Pest Activity: Activity in beech bark disease, hemlock woolly adelgid, and emerald ash borer were registered, although with low mortality rates (0.5–1% per year) because they are currently being actively managed.
Storms: One storm (ice storm or summer storm) was used, taking place in Year 10; the storm results in a 3% mortality rate.
Plantings: No tree plantings.

PROACTIVE CARE/NO PLANTING
Annual Mortality Rates: Lower mortality rates than i-Tree's standard rates of 3% for healthy trees, 13.1% for sick trees, 50% for dying trees. Rates used: 1.5% for healthy trees, 10% for sick trees, 40% for dying trees.
Disease/Pest Activity: Activity in beech bark disease, hemlock woolly adelgid, and emerald ash borer were registered, although with low mortality rates (0.5–1% per year) because they are currently being actively managed.
Storms: One storm (ice storm or summer storm) was used, taking place in year 10 that results in a 3% mortality rate.
Plantings: No tree plantings.

20 TREES PLANTED PER YEAR & PROACTIVE CARE
Annual Mortality Rates: Lower mortality rates than i-Tree's standard rates of 3% for healthy trees, 13.1% for sick trees, 50% for dying trees. Rates used: 1.5% for healthy trees, 10% for sick trees, 40% for dying trees.
Disease/Pest Activity: Activity in beech bark disease, hemlock woolly adelgid, and emerald ash borer were registered, although with low mortality rates (0.5–1% per year) because they are currently being actively managed.
Storms: One storm (ice storm or summer storm) was used, taking place in year 10 that results in a 3% mortality rate.
Plantings: Plant 20, two-inch trees each year.

100 TREES PLANTED PER YEAR AND PROACTIVE CARE
Annual Mortality Rates: Lower mortality rates than i-Tree's standard rates of 3% for healthy trees, 13.1% for sick trees, 50% for dying trees. Rates used: 1.5% for healthy trees, 10% for sick trees, 40% for dying trees.
Disease/Pest Activity: Activity in beech bark disease, hemlock woolly adelgid, and emerald ash borer were registered, although with low mortality rates (0.5–1% per year) because they are currently being actively managed.
Storms: One storm (ice storm or summer storm) was used, taking place in year 10 that results in a 3% mortality rate.
Plantings: Plant 100, two-inch trees each year.

Choosing a Strategy to Address Norway Maple

Norway maple is a non-native, invasive tree species that poses a threat to biological diversity in upstate New York. There are currently 567 Norway maple within the tree inventory for Mount Hope Cemetery, ranging in size from 4" DBH to 58" DBH.

There is no fast solution to the eradication of Norway maple. Additionally, it is the city's policy to refrain from removing any healthy tree unless it poses a threat to the public, to nearby trees, or is financially unfeasible to maintain. Level of aggressiveness in this work is a matter of management choice. A land management team must agree on an overall strategy. Management of invasives can be considered a two-part effort – removal of seed source and removal of saplings.

1. **Remove Seed Source.** The amount of work to manage this invasive is largely dependent on the existence and quantity of mature trees, also known as seed sources. There are currently 567 Norway maple within the tree inventory for Mount Hope Cemetery, ranging in size from 4" DBH to 58" DBH. Three potential options are as follows:

    a. *Option 1: Natural Phasing Out.* No new Norway maple will be planted; they will be removed as they age, become diseased, or experience significant storm damage. Additionally, no funds will be spent to save or restore any Norway maple.

b. *Option 2: Natural Phasing Out + Woodland Removal.* Same as above, with the addition of killing select mature Norway in woodland areas via girdling/chemical treatment. This option will accelerate their overall removal without causing large, jarring specimen tree removals in well-trafficked cemetery grounds.
c. *Option 3: Natural Phasing Out + Woodland Removal + Yearly Removals.* Same as above, with the addition of the removal of 1-2 Norway on cemetery grounds (non-woodland) each year. This is, however, a more aggressive approach that will not make a significant dent in the Norway population for decades, goes against city policy not to remove any healthy trees, and will accelerate the loss of large trees overall.

2. **Removal Saplings.** Until seed-producing trees are eliminated, annual long-term maintenance will be required to constantly maintain control of seedling populations in desired areas. In some areas, proliferation of saplings may be the cause of some erosion problems, but as described in the MHC-MP (Pg. 131), removal of saplings may cause more erosion in the short term. For this reason, sapling removal will likely require immediate subsequent soil stabilization techniques, planting of woodland groundcovers (ferns, etc.), or other erosion control methods. Even if all Norway maple were removed from cemetery grounds, there are still many outside the property. This work will be an ongoing annual effort.

Removal Methods. Smaller seedlings can be hand-pulled or treated with a foliar application of glyphosate (herbicide). Trees up to 4 inches in diameter can be controlled by applying triclopyr mixed with a horticultural oil to the bark, a foot from the base of the trunk. This can be done in early spring or from June 1 to September 30. The cut stump method may also be used—cut the tree and immediately apply the herbicide around the outer ring of the stump. Cut down large trees and grind out the stump, or clip off re-growth. Girdle the tree by cutting through the bark and growing layer (cambium) all around the trunk. Girdling is most effective in spring.